TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).

1. DYNODE No.1-TO-CATHODE VOLTS = 1/6 E
2. EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
3. 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

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

TYPICAL TIME RESOLUTION CHARACTERISTICS

1. DYNODE No.1-TO-CATHODE VOLTS = 1/6 E
2. EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
3. 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.

PHOTOCATHODE IS FULLY ILLUMINATED.
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-No.5 VOLTS

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.

ANODE CURRENT

DYNODE No.5 VOLTS (REFERRED TO ANODE)
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

- Dynode No. 1-to-cathode volts as indicated each succeeding dynode-stage volts = 125
- Anode-to-dynode No. 10 volts = 125
- 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.
- 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.

Graph showing the relationship between dynode No. 1-to-cathode volts and magnetic field intensity.
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

DYNODE No.1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
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.
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.
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 Visible Well into 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: 15.1 sq.in.
Minimum diameter: 4.38 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: 7.69" ± 0.19"
Seated Length: 6.75"
Maximum Diameter: 5.31"
Operating Position: Any
Weight (Approx.): 1 lb 7 oz
Bulb: Cinch No.3M14, or equivalent

Direction of Light: Into End of Bulb

Basing Designation for BOTTOM VIEW: 14AM

**Pin Assignments:**

- 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 dynode No.10 and anode. 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>1.1 x 10^4</td>
<td>-</td>
<td>a/w</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms</td>
<td>6.8 x 10^-2</td>
<td>-</td>
<td>a/w</td>
</tr>
<tr>
<td>Luminous, at 0 cps</td>
<td>12</td>
<td>25</td>
<td>240 a/lm</td>
</tr>
<tr>
<td>Cathode luminous: With tungsten light source</td>
<td>1.2 x 10^-4</td>
<td>1.6 x 10^-4</td>
<td>-</td>
</tr>
<tr>
<td>With blue light source ( b )</td>
<td>5 x 10^-8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>With red light source ( r )</td>
<td>3 x 10^-7</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Current Amplification: Equivalent Anode-Dark-Current Input at a luminous sensitivity of 12 a/lm</td>
<td>4 x 10^-10</td>
<td>1 x 10^-9</td>
<td>lm</td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>-</td>
<td>3.8 x 10^-12</td>
<td>lm</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time ( t_p )</td>
<td>1.65 x 10^-8</td>
<td>-</td>
<td>sec</td>
</tr>
<tr>
<td>Electron Transit Time ( t_e )</td>
<td>9.3 x 10^-8</td>
<td>-</td>
<td>sec</td>
</tr>
</tbody>
</table>

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>2.1 x 10^3</td>
<td>-</td>
<td>a/w</td>
</tr>
<tr>
<td>Cathode radiant, at 4200 angstroms</td>
<td>6.8 x 10^-2</td>
<td>-</td>
<td>a/w</td>
</tr>
<tr>
<td>Luminous, at 0 cps</td>
<td>-</td>
<td>5</td>
<td>a/lm</td>
</tr>
</tbody>
</table>
Cathode luminous:

- With tungsten light source: 1.2 x 10^{-4} \text{ a/Im}
- With blue light source: 1.6 x 10^{-4} \text{ a/Im}
- With red light source: 9 x 10^{-7} \text{ a/Im}

Current Amplification:
- Equivalent Anode-Dark Current Input at a luminous sensitivity of 12 a/Im: 4 x 10^{-10} \text{ lm}

- Corning No. 0080 made by Corning Glass Works, Corning, New York, or equivalent.
- Made by Cinch Manufacturing Company, 1026 South Worman Avenue, Chicago 24, Illinois.
- Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Nica Company, 1322 North Ellston, 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 input 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 rise time. This anode-pulse rise time is primarily a function of transit-time variation and is measured under conditions with the incident light fully illuminating the photocathode.

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

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

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT shown under Type 4463 also applies to Type 4465.
**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 4.38" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.
TYPICAL ANODE CHARACTERISTICS

DYNODE No.1-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.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.
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.

RADIO CORPORATION OF AMERICA
Electronic Components and Devices  Harrison, N. J.
TYPICAL OUTPUT CURRENT AS A FUNCTION OF DYNODE-No.5 VOLTS 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.

![Diagram of TYPICAL OUTPUT CURRENT AS A FUNCTION OF DYNODE-No.5 VOLTS CHARACTERISTIC](92CM-11078RI)

RADIO CORPORATION OF AMERICA
Electronic Components and Devices       Harrison, N. J.
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
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LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.

TUBE TEMPERATURE = 25° C

TYPICAL TIME RESOLUTION CHARACTERISTICS

DYNOIDE 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.

PHOTOCATHODE IS FULLY ILLUMINATED.
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT CHARACTERISTIC

DYNOE No.1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
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.
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

<table>
<thead>
<tr>
<th>RELATIVE ANODE CURRENT</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAGNETIC FIELD INTENSITY—GAUSS</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DYNOE No.1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
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.
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

<table>
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<th>12</th>
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</tr>
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<tr>
<td>MAGNETIC FIELD INTENSITY—GAUSS</td>
<td>0</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Photomultiplier Tubes

9-STAGE, SIDE-ON TYPES

CONTROLLED SENSITIVITY ABOVE WAVELENGTH OF 5800Å

The 4471 and 4472 are the same as the 931A except for the following items:

Characteristics Range Values:

With \( E = 1000 \) volts

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Luminous, at \( 0 \) cps\(^b\) | 10   | 100  | 600  | a/lnm
| "Red-to-White" Ratio: |      |      |      |
| 4471             | 5    | -    | -    | %    |
| 4472             | 7    | -    | -    | %    |

\(^a\) Alternate designation for Multiplier Phototube.

\(^b\) 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 \( 2870^0K \) and a light input of 10 microlumens is used.

OPERATING CONSIDERATIONS

The luminous-sensitivity ratings of the 4471 and 4472 are higher, and their sensitivities above the wavelength of 5800 angstroms are 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 the phototube. The "red-to-white" ratio is greater than 5% for the 4471, and greater than 7% for the 4472.

The anode current comprising the "white" portion of this ratio is measured with a light input of 10 micromalens. The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of \( 2870^0K \).

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 micromalens 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.
Photomultiplier Tube

9-STAGE, SIDE-ON TYPE
S-4 RESPONSE
CONTROLLED SENSITIVITY ABOVE WAVELENGTH OF 5800Å

The 4473 is the same as the IP21 except for the following items:

Characteristics Range Values:

\[ E = 1000 \text{ volts} \]

<table>
<thead>
<tr>
<th></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>Luminous, at 0 cps(^b)</td>
<td>40</td>
<td>160</td>
<td>800</td>
</tr>
<tr>
<td>&quot;Red-to-White&quot; Ratio</td>
<td>7</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^a\) Alternate designation for Multiplier Phototube.
\(^b\) 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.

OPERATING CONSIDERATIONS

Sensitivity of the 4473 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 "red-to-white" ratio is greater than 7% for the 4473.

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.
Image Orthicon

Magnetic Focus 4-1/2-Inch Dia. Magnetic Deflection

For use in the luminance channel of suitably designed
4-tube color TV cameras in studio or outdoor service

GENERAL

Heater, for Unipotential Cathode:
Voltage (AC or DC) 6.3 ± 10% V
Current at 6.3 volts 0.6 A

Direct Interelectrode Capacitance:
Anode to all other electrodes 12 pF
Target-to-Mesh Spacing 0.002 in
Spectral Response S-10
Wavelength of Maximum Response 4500 ± 200 angstroms

Photocathode, Semitransparent:
Rectangular image (4 x 3 aspect ratio):
Useful size of 1.6 in max. Diagonal
Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.
Orientation of... Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the center of the faceplate and the grid-No.6 terminal. The horizontal and vertical scan should start at the corner of the picture between the grid No.6 and the photocathode terminals.

Focusing Method: Magnetic Deflection Method: Magnetic
Overall Length 19.375 in ± 0.310 in
Greatest Diameter of Bulb 4.500 in ± 0.094 in
Envelope Terminals 5
End Base Small-Shell Diheptal 14-Pin Base
(SJEDEC Group 5, No.B14-45)

Socket Cinch Part No.3M14, or equivalent
Operating Position The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.

Weight (Approx.) 2.3 lb
Minimum Deflecting-Coil Inside Diameter 3.2 in
Deflecting-Coil Length 7 in
Focusing-Coil Length 15 in
Alignment Coil:
Position on neck Centerline of magnetic field should be located 9.25" from the flat area of the shoulder.

MAXIMUM AND MINIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

Photocathode:
Voltage -700 max. V
Illumination 50 max. fc

RCA Electronic Components
Operating Temperature:
Any part of bulb ........................................ 65 max. °C
Of bulb at large end of tube (Image section) .......... 85 min. °C

Temperature Difference:
Between image section and any part
of bulb hotter than image section .............. 5 max. °C

Grid-No.6 Voltage ........................................ -700 max. V
Target Voltage:
Positive value ........................................ 10 max. V
Negative value .......................................... 10 max. V
Field-Mesh Voltage .................................... 30 max. V
Grid-No.5 Voltage ...................................... 300 max. V
Grid-No.4 Voltage ...................................... 350 max. V
Grid-No.3 Voltage ...................................... 400 max. V
Grid-No.2 & Dynode-No.1 Voltage .................... 350 max. V
Grid-No.1 Voltage: Negative bias value ............. 125 max. V
Positive bias value ...................................... 0 max. V
Voltage Per Multiplier Stage ......................... 350 max. V
Anode-Supply Voltage ................................. 1650 max. V

TYPICAL OPERATING VALUES
Photocathode Voltage .................................... -600 V
Grid-No.6 Voltage (Image Focus)
Approx. 70% of Photocathode Voltage ............ -370 to -470 V
Target Voltage Above Cutoff .......................... 2.3 V
Field-Mesh Voltage ..................................... 15 to 25 V
Grid-No.5 Voltage (Decelerator) ..................... 40 V
Grid-No.4 Voltage (Beam Focus) ..................... 70 to 90 V
Grid-No.3 Voltage ...................................... 250 to 275 V
Grid-No.2 & Dynode-No.1 Voltage .................... 280 V
Grid-No.1 Voltage for Picture Cutoff ............... -45 to -115 V
Dynode-No.2 Voltage .................................. 600 V
Dynode-No.3 Voltage .................................. 800 V
Dynode-No.4 Voltage .................................. 1000 V
Dynode-No.5 Voltage .................................. 1200 V
Anode Voltage .......................................... 1250 V
Recommended Target Temperature Range .......... 35 to 45 °C
Minimum Peak-to-Peak Blanking Voltage ........... 5 V
Field Strength of Focusing Coil: 1
At center of scanning section (Approx.) .......... 60 G
In plane of photocathode (Approx.) ............... 120 G
Field Strength of Alignment Coil .................... 0 to 3 G

PERFORMANCE DATA
With conditions shown under Typical Operating Values
including Recommended Target Temperature Range;
target voltage adjusted to 2.3 volts above cutoff; with
camera lens set to bring picture highlights a maximum
of one stop over the knee of the light transfer charac-
4492

4 teristic; and operation in a 525-line 60-cycle TV system.

Signal-Output Current (Peak to Peak) .......................... 20 \( \mu A \)
Ratio of Peak-to-Peak Highlight
Video-Signal Current to RMS Noise
Current for Bandwidth of 4.5 MHz \(^k\) .................. 89:1 \(^k\)
Photocathode Illumination at 2870°C Required
to bring Picture Highlights to the "Knee"
of Light Transfer Characteristic .................. 0.02 \( ^o \)
Amplitude Response at 400 TV Lines
per Picture Height (Per cent of large-area
black to large-area white) \(^m\) ............... 75 \( ^o \)
Highlight Signal Variation
(Per cent of peak signal) .................. 15 \( ^o \)
Background Signal Variation
(Per cent of peak signal) .................. 7.5 \( ^o \)

b Operation outside of the Recommended Target Temperature Range shown under Typical Operating Values will not damage the 4492 provided the Maximum Temperature Ratings of the tube are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the Recommended Target Temperature Range.

c With respect to grid No.4.

d Dynode-voltage values are shown under Typical Operating Values.

• With 4492 operated in RCA TK-42 camera at fixed photocathode voltage.

f Adjust for optimum focus.

i The target supply voltage should be adjustable from -5 to +5 volts.

j Adjust to give the most uniformly shaded picture near maximum signal.

k Direction of current 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.

l Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level. Two common test conditions and resultant difference in signal-to-noise ratio are shown on reverse side.

<table>
<thead>
<tr>
<th>Method A</th>
<th>Method B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth</td>
<td>4.5 MHz</td>
</tr>
<tr>
<td>Scan Line Number</td>
<td>525</td>
</tr>
<tr>
<td>Field Rate</td>
<td>60</td>
</tr>
<tr>
<td>Black Level</td>
<td>Picture BLACK</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>2.3 V</td>
</tr>
<tr>
<td>Signal-to-Noise Ratio</td>
<td>59:1</td>
</tr>
</tbody>
</table>

\( ^m \) Measured with amplifier having flat frequency response.

RCA Electronic Components

DATA 2 5-70
TERMINAL DIAGRAM (Bottom View)

DIRECTION OF LIGHT: PERPENDICULAR TO LARGE END OF TUBE

ENVELOPE TERMINALS
Terminal Over Pin 2 - Field Mesh
Terminal Over Pin 4 - Photocathode
Terminal On Side Of Envelope
Opposite Base Key - Grid No.6
Terminal Over Pin 9 - Grid No.5
Terminal Over Pin 11 - Target

DIMENSIONAL OUTLINE

VIBRATION-ABSORBING TIPS DO NOT REMOVE

VIBRATION-ABSORBING TAPE DO NOT REMOVE

LIGHT SHIELD COATING

SMALL-SHELL DIHEPTAL 14-PIN BASE
Pin 1 - Heater
Pin 2 - Grid No.4
Pin 3 - Grid No.3
Pin 4 - Internal Connection—Do Not Use
Pin 5 - Dynode No.2
Pin 6 - Dynode No.4
Pin 7 - Anode
Pin 8 - Dynode No.5
Pin 9 - Dynode No.3
Pin 10 - Dynode No.1, Grid No.2
Pin 11 - Internal Connection—Do Not Use
Pin 12 - Grid No.1
Pin 13 - Cathode
Pin 14 - Heater

Dimensions in Inches
VIBRATION-ABSORBING TAPE DO NOT REMOVE

LIGHT SHIELD COATING

VIBRATION-ABSORBING TIPS DO NOT REMOVE

SMALL-SHELL DIHEPTAL 14-PIN BASE JEDEC GROUP 5, No 814-45

Dimensions in Inches
Vidicons

1-Inch Diameter

Electrostatic Focus
Magnetic Deflection

For use in the chroma channels of suitably designed color TV cameras in live pickup service

GENERAL

Overall Length ......................... 6.25 in ±0.10 in
Greatest Diameter ..................... 1.125 in ±0.010 in
Bulb Diameter ......................... 1.025 in ±0.003 in
Faceplate Thickness .................... 0.094 in ±0.012 in

Direct Inter-electrode Capacitance: a
Target to all other electrodes ........ 5.0 pF
Focusing Method ....................... Electrostatic
Deflection Method ...................... Magnetic
Heater Power ......................... 0.6 W

Photoconductive Layer:
Maximum useful picture size .......... 0.192 in x 0.256 in
Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin.

Base ........ Small-Button Ditetra 8-Pin, (JEDEC No. E8-11)
Socket ........ Cinch No. 133-98-11-015, or equivalent
Weight .................. 2.8 oz
Operating Position .................. Any

ABSOLUTE MAXIMUM RATINGS

Grid-No. 6 & Grid-No. 3 Voltage c ........ 1200 max. V
Grid-No. 5 Voltage ........................ 750 max. V
Grid-No. 4 Voltage ................... 400 max. V
Grid-No. 2 Voltage ..................... 850 max. V

Grid-No. 1 Voltage:
Negative bias value ................... 300 max. V
Positive bias value ................... 0 max. V

Peak Heater-Cathode Voltage:
Heater negative with respect to cathode .......... 125 max. V
Heater positive with respect to cathode .......... 10 max. V

Heater Voltage ..................... 7 max. V
Target Voltage ....................... 100 max. V
Target Dark Current .................. 0.05 max. µA
Peak Target Current ........................ 0.4 max. µA

Faceplate:
Illumination ................... 1000 max. fc
Temperature .................. 71 max. °C

RCA Electronic Components
TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 0.192 in x 0.256 in
Faceplate Temperature of 250 to 300°C

For All Types

<table>
<thead>
<tr>
<th>Grid-No. 6 (Decelerator) &amp; Grid-No.3 Voltage</th>
<th>Grid-No.5 Voltage</th>
<th>Grid-No.4 (Beam-Focus Electrode) Voltage</th>
<th>Grid-No.2 (Accelerator) Voltage</th>
<th>Grid-No.1 Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>750 V</td>
<td>250 to 315 V</td>
<td>100 to 125 V</td>
<td>100 to 300 V</td>
<td>-20 V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4493 (Red)</th>
<th>4494 (Green)</th>
<th>4495 (Blue)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illumination</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Signal Output Current</td>
<td>0.060</td>
<td>0.060</td>
</tr>
<tr>
<td>Signal-to-Dark Current Ratio</td>
<td>6:1</td>
<td>6.1</td>
</tr>
<tr>
<td>Typical Resolution:</td>
<td>Center</td>
<td>500</td>
</tr>
<tr>
<td>Corner</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Amplitude Response to a 125 TV Line Square-Wave Test Pattern at Center of Picture</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Average “Gamma” of Transfer Characteristic</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td>Lag - Per Cent of Initial Value of Signal-Output Current 1/20 Second after Illumination is Removed</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

- This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting-yoke assembly. The resistive component of the output impedance is in order of 100 megohms.
- The maximum voltage difference between grids No.6 & 3 and No.5 should not exceed 750 volts.
- Video amplifiers must be designed properly to handle peak target currents of this magnitude to avoid amplifier overload or picture distortion.
- 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 3100°K. These illumination values are incident on the filters shown in (f) which are interposed between the light source and tube faceplate.
These characteristics are measured using the following standard optical filters, or equivalent:

For type 4493 (Red) - Wratten No.25 (A) with 2 Fish-Shurman No. IR650

For type 4494 (Green) - Wratten No.58 with 1 Fish-Shurman No. IR650

For type 4495 (Blue) - Wratten No.47 with 1 Fish-Shurman No. IR650

---

**BASING DIAGRAM (Bottom View)**

- Pin 1 - Heater
- Pin 2 - Grid No.1
- Pin 3 - Grid No.4
- Pin 4 - Grids No.3 & No.6
- Pin 5 - Grid No.2
- Pin 6 - Grid No.5
- Pin 7 - Cathode
- Pin 8 - Heater
- Flange - Target
- Short Index Pin -
  - Internal Connection—
  - Make No Connection

**TARGET**

**SHORT PIN IC**

**DIRECTION OF LIGHT: INTO FACE END OF TUBE**

**8LN**
Note 1: Straight Sides Of Masked Portions Are Parallel To The Plane Passing Through Tube Axis And Short Index Pin.

Note 2: Within This Distance, Diameter Of Bulb Is $1.025'' + 0.003'' - 0.030''$. 
For Use in Applications Where Scene Motion is Limited and for Slow-Scan TV Pickup Service

**GENERAL**

**Heater, for Unipotential Cathode**
- Voltage (AC or DC) \(6.3 \pm 10\% \text{ V}\)
- Current at 6.3 V \(0.6 \text{ A}\)

**Direct Inter-electrode Capacitance**
- Target to all other electrodes \(4.6 \text{ pF}\)
- Maximum useful diagonal of rectangle image \((4 \times 3 \text{ aspect ratio})^b\)

**Focusing Method**
- Magnetic

**Deflection Method**
- Magnetic

**Overall Length**
- \(6.25 \pm 0.25 \text{ inch}\)

**Greatest Diameter**
- \(1.125 \pm 0.010 \text{ inch}\)

**Operating Position**
- Any

**Weight (Approx.)**
- 2 oz

**Bulb**
- T8

**Focusing Coils**
- Cleveland Electronics\(^c,d\) No. VF-115-5, or equivalent

**Deflecting Yoke**
- Cleveland Electronics\(^c,d\) No. VY-III-3, or equivalent

**Alignment Coil**
- Cleveland Electronics\(^c,d\) No. VA-118, or equivalent

**Socket**
- Cinch\(^a\) No. 54A18088, or equivalent

**Base**
- Small-Button Ditettrar 8-Pin, (JEDEC No.E8-II)

**BASING DIAGRAM (Bottom View)**

1. Pin 1 - Heater
2. Pin 2 - Grid No.1
3. Pin 3 - Internal Connection - Do Not Use
4. Pin 4 - Internal Connection - Do Not Use
5. Pin 5 - Grid No.2
6. Pin 6 - Grids No.3 and No.4
7. Pin 7 - Cathode
8. Pin 8 - Heater
9. Flange - Target
10. Short Index Pin - Internal Connection - Make no Connection

**Direction of Light:**
- Into Face End of Tube

---

\(^a\) Photoconductive Layer

\(^b\) Maximum useful diagonal of rectangle image

\(^c\) Cleveland Electronics

\(^d\) Cinch
ABSOLUTE-MAXIMUM VALUES

For scanned area of 1/2 x 3/8 inch

<table>
<thead>
<tr>
<th>Component</th>
<th>Low Voltage</th>
<th>High Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No. 3 &amp; Grid-No. 4 Voltage</td>
<td>1000 V</td>
<td></td>
</tr>
<tr>
<td>Grid-No. 2 Voltage</td>
<td>750 V</td>
<td></td>
</tr>
<tr>
<td>Grid-No. 1 Voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative bias value</td>
<td>300 V</td>
<td></td>
</tr>
<tr>
<td>Positive bias value</td>
<td>0 V</td>
<td></td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>125 V</td>
<td></td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>10 V</td>
<td></td>
</tr>
<tr>
<td>Target Voltage</td>
<td>60 V</td>
<td></td>
</tr>
<tr>
<td>Dark Current</td>
<td>0.1 μA</td>
<td></td>
</tr>
<tr>
<td>Peak Target Current</td>
<td>0.6 μA</td>
<td></td>
</tr>
<tr>
<td>Faceplate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illumination</td>
<td>1000 fc</td>
<td></td>
</tr>
<tr>
<td>Temperature Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>-20 to 70 °C</td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>-10 to 55 °C</td>
<td></td>
</tr>
</tbody>
</table>

TYPICAL OPERATION AND PERFORMANCE DATA

For Standard TV Scan Rates

For scanned area of 1/2 x 3/8 inch. Faceplate temperature of 30°C.

<table>
<thead>
<tr>
<th>Component</th>
<th>Low-Voltage Operation</th>
<th>High-Voltage Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No. 4 (Decelerator) &amp; Grid-No. 3 (Beam-Focus Electrode) Voltage</td>
<td>250 h to 300 V</td>
<td>750 V</td>
</tr>
<tr>
<td>Grid-No. 2 (Accelerator) Voltage</td>
<td>300 V</td>
<td>300 V</td>
</tr>
<tr>
<td>Grid-No. 1 Voltage for Picture Cutoff</td>
<td>-45 to -100 V</td>
<td>-45 to -100 V</td>
</tr>
<tr>
<td>Average &quot;Gamma&quot; of Transfer Characteristic</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>Signal-output current between 0.02 μA &amp; 0.2 μA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual Equivalent Signal-to-Noise Ratio (Approx.)</td>
<td>300:1</td>
<td>300:1</td>
</tr>
<tr>
<td>Lag m</td>
<td>Typical value</td>
<td>55</td>
</tr>
<tr>
<td>Minimum Peak-to-Peak Blanking Voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>When applied to grid No. 1</td>
<td>75 V</td>
<td>75 V</td>
</tr>
<tr>
<td>When applied to cathode</td>
<td>20 V</td>
<td>20 V</td>
</tr>
<tr>
<td>Limiting Resolution at Center of Picture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical value</td>
<td>600 TV Lines</td>
<td>700 TV Lines</td>
</tr>
<tr>
<td>Amplitude Response to a 400 TV Line Square-Wave Test Pattern</td>
<td>20 %</td>
<td>30 %</td>
</tr>
<tr>
<td>Field Strength at Center of Focusing Coil n</td>
<td>40 G</td>
<td>60 G</td>
</tr>
</tbody>
</table>
## Typical Operation and Performance Data

### For Slow-Scan Applications

<table>
<thead>
<tr>
<th>Low-Voltage Operation</th>
<th>High-Voltage Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Deflecting-Coil Current</td>
<td>Field Strength of Adjustable Alignment Coil</td>
</tr>
<tr>
<td>Horizontal</td>
<td>185 mA</td>
</tr>
<tr>
<td>Vertical</td>
<td>25 mA</td>
</tr>
<tr>
<td>0 to 4</td>
<td>0 to 4 8</td>
</tr>
</tbody>
</table>

### Average-Light-Level Operation—1.0 Footcandle on Faceplate

<table>
<thead>
<tr>
<th>Target Voltage P, q,</th>
<th>Dark Current T,</th>
<th>Signal-Output Current $s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 to 25 V</td>
<td>0.005 µA</td>
<td>0.4 µA</td>
</tr>
</tbody>
</table>

### Low-Light-Level Operation—0.1 Footcandle on Faceplate

<table>
<thead>
<tr>
<th>Target Voltage P, q,</th>
<th>Dark Current T,</th>
<th>Signal-Output Current $s$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 fc</td>
<td>0.02 µA</td>
<td>0.16 µA</td>
</tr>
</tbody>
</table>

### TYPICAL OPERATION AND PERFORMANCE DATA

#### Typical Target Voltage
- 30 V

#### Typical Dark Current
- 8 nA

#### Typical Exposure
- 0.25 footcandle-seconds

#### Typical Signal Output

<table>
<thead>
<tr>
<th>Frame Time of</th>
<th>Low Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 second</td>
<td>160 nA</td>
</tr>
<tr>
<td>2 seconds</td>
<td>70 nA</td>
</tr>
<tr>
<td>4 seconds</td>
<td>30 nA</td>
</tr>
<tr>
<td>6 seconds</td>
<td>19 nA</td>
</tr>
<tr>
<td>10 seconds</td>
<td>10 nA</td>
</tr>
</tbody>
</table>

#### Lag or Residual Signal—Time to Reach 5 percent Level
- 5 to 10 frames

#### Amplitude Response to 400 TV Lines
- 50 %

#### Signal Storage—Time to Decay to 50 percent Level
- 80 seconds

---

a This capacitance which effectively is the output impedance of the 4500, 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.

b Orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

c Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland Ohio.

d These components are chosen to provide tube operation with minimum beam-lagging error.

e Made by Cinch Manufacturing Corporation, 1026 S. Homan Ave., Chicago 24, Illinois.

f 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.

Definition, focus uniformity, and picture quality decrease with decreasing grid-No. 4 and grid-No. 3 voltage. In general, grid-No. 4 and grid-No. 3 should be operated above 250 volts.

With no blanking voltage on grid No. 1.

Measured with high gain, low-noise, cascade-input-type amplifier having bandwidth of 5 Mc/s and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

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 target voltage for each 4500 must be adjusted to the value which gives the desired operating signal current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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

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

**OPERATING CONSIDERATIONS**

Target connection may be made by a suitable spring-finger contact bearing against the edge of the metal ring at the face end of the tube.

Faceplate temperature should not exceed 55°C (131°F), either during operation or storage of the 4500. Operation at a faceplate temperature of about 30°C (86°F) is recommended. The 4500 should be operated at a steady temperature to maintain dark current at a preselected level and thereby insure optimum and stable day-to-day operation. If temperature control cannot be made in the camera installation, changes in target voltage may be required from time to time. The range of target voltage for various dark current levels is shown in Range of Dark Current. Individual 4500's will have substantially identical performance characteristics when operated with an identical value of dark current.

Operation at higher electrode voltages may introduce additional beam-landing errors that may be partially compensated for by repositioning the deflecting components. Full compensation may require the application of a modulating voltage of suitable waveform, at both horizontal and vertical scan rates, to the cathode, grid-No. 1, and grid-No. 2 of the 4500.

**Dos and Don'ts on Use of RCA-4500**

**Dos**

1. Adjust camera scanning to utilize maximum useful area of photoconductive layer.

2. Orient the vidicon so that horizontal scan is essentially parallel to the plane passing through tube axis and short index pin.

DATA 2

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N.J.
Dos and Don'ts on Use of RCA-4500

Dos

3. Align electron beam.
4. With lens capped, adjust target voltage for each individual vidicon to the highest value that will still give uniform background.
5. Match any visible raster pattern on photoconductive layer with new scan by reorienting the vidicon as required.
6. Use only sufficient beam current to bring out picture highlights.
7. Open lens iris or increase the scene illumination to obtain the "snappiest" picture without noticeable smear from moving objects. Target voltage should be reduced if light on the tube and/or resultant signal is excessive.
8. Always cap lens when transporting camera (see "Don'ts" 5).

Don'ts

1. Don't underscan the photoconductive layer.
2. Don't change camera size and centering controls once the scanned area of photoconductive layer has been properly positioned.
3. Don't rotate vidicon from its original operating position in deflecting yoke.
4. Don't turn beam of vidicon on without normal scanning or remove scanning before beam of vidicon is turned off.
5. DON'T ALLOW IMAGE OF THE SUN OR OTHER VERY INTENSE SOURCE OF ILLUMINATION TO BE FOCUSED ON PHOTOCONDUCTIVE LAYER AT ANY TIME.
Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short pin.
Note 2: Faceplate glass is Corning No. 7056 having a thickness of 0.094 ± 0.012 inch.
Range of Dark Current

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2'' x 3/8''
FACEPLATE TEMPERATURE = 30°C APPROX.
STANDARD TV SCAN RATE

Signal Output as a Function of Scan Speed for Several Values of Illumination

TARGET VOLTS = 30
TEMPERATURE = 30°C
SHUTTER SPEED = 100 mS
SLOW SCAN RATES

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

DATA 4
12-66
ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
STANDARD TV SCAN RATE
Typical Persistence Characteristics

INITIAL HIGHLIGHT SIGNAL—OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
STANDARD TV SCAN RATE

SIGNAL-OUTPUT CURRENT—PER CENT OF INITIAL VALUE

TIME AFTER ILLUMINATION IS REMOVED — MILLISECONDS

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
DATA 5 12-66
Uncompensated Horizontal Square-Wave Response

HIGHLIGHT TARGET MICROAMPERES = 0.30
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SQUARE-WAVE RESOLUTION WEDGE
STANDARD TV SCAN RATE

CURVE A: GRID - No. 4 & GRID - No. 3 VOLTS = 750
CURVE B: GRID - No. 4 & GRID - No. 3 VOLTS = 300
Typical Persistence Characteristics

TARGET VOLTS = 30
SLOW SCAN RATES

NUMBER OF FRAMES AFTER EXPOSURE

RESIDUAL SIGNAL — PER CENT OF INITIAL SIGNAL

EXPOSURE (FCS) = 1.0

0.04
0.08 - 0.25

92LM-1537

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
DATA 6
12-66
Typical Response to 400 TV Line Information

TARGET VOLTS = 30
400 TV LINES
SLOW SCAN RATES

RESOLUTION - AMPLITUDE RESPONSE

FRAME TIME - SECONDS

EXPOSURE (FCS) = 0.25
0.08
1.0
0.04

Typical Storage Characteristics

FRAME TIME = 2 SECONDS
TARGET VOLTS = 30
SLOW SCAN RATES

STORED SIGNAL - PER CENT OF STEADY STATE SIGNAL

STORAGE TIME AFTER EXPOSURE - SECONDS

EXPOSURE (FCS) = 0.25
0.08
0.04

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.
Ruggedized, Magnetic-Focus, Magnetic-Deflection Type Having Separate-Mesh Connection for Compact TV Cameras Where Severe Shock and Vibration Conditions Exist

GENERAL
Heater, for Unipotential Cathode:
Voltage (AC or DC) .................................. 6.3 ± 10% V
Current at 6.3 volts .................................. 0.3 A
Direct Interelectrode Capacitance:
Target to all other electrodes .................. 4.6 pF
Spectral Response .......................... See RCA Type II Spectral Response at front of this section

Photoconductive Layer:
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) .................................. 0.62 in
Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method .................................. Magnetic
Deflection Method .................................. Magnetic
Overall Length .................................. 5.12" ± 0.13"-0.06"
Greatest Diameter .................................. 1.125" ± 0.010"
Bulb .................................. T8
Bulb Diameter .................................. 1.025" ± 0.003"
Base .................................. Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket .................................. Cinch\(^b\) No.54A18088, or equivalent
Deflecting Yoke-Focusing Coil-Alignment-Coil Assembly .......................... Cleveland Electronics\(^c,d\) VYFA-355-2, or equivalent
Operating Position .......................... Any
Weight (Approx.) .................................. 2 oz

ABSOLUTE MAXIMUM RATINGS
For scanned area of 1/2" x 3/8"
Grid-No.4 Voltage\(^f\) .................................. 1000 max. V
Grid-No.3 Voltage\(^f\) .................................. 1000 max. V
Grid-No.2 Voltage .................................. 350 max. V
Grid-No.1 Voltage:
   Negative bias value .......................... 150 max. V
   Positive bias value ......................... 0 max. V
Peak Heater-Cathode Voltage:
   Heater negative with respect to cathode .......... 125 max. V
   Heater positive with respect to cathode ........ 10 max. V
Target Voltage .................................. 100 max. V
Dark Current ................................... 0.25 max. µA
Peak Target Current\(^g\) ....................... 0.75 max. µA
Faceplate:
   Illumination\(^h\) ............................... 5000 max. fc
   Temperature .................................. 71 max. °C

**TYPICAL OPERATION AND PERFORMANCE DATA**

*For scanned area of 1/2" x 3/8"*

*Face plate Temperature of 30° to 35° C and Standard TV Scanning Rate*

<table>
<thead>
<tr>
<th></th>
<th>Low-Voltage Mode</th>
<th>High-Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) Voltage(^f)</td>
<td>500</td>
<td>900</td>
</tr>
<tr>
<td>Grid-No.3 (Beam-Focus Electrode) Voltage(^f)</td>
<td>300</td>
<td>540</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff(^f)</td>
<td>-65 to-100</td>
<td>-65 to-100</td>
</tr>
</tbody>
</table>

Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 µA and 0.2 µA .................................................. 0.65

Visual Equivalent Signal-to-Noise Ratio (Approx.)\(^k\) .... 300:1

Lag-Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed \(^m\) ................. 20

Minimum Peak-to-Peak Blanking Voltage:
   When applied to grid No.1 ........... 75
   When applied to cathode ............. 20

\(^f\) When applied to grid No.1
\(^g\) When applied to grid No.1
\(^h\) When applied to grid No.1
\(^k\) When applied to grid No.1
\(^m\) When applied to grid No.1
**Limiting Resolution:**
- At center of picture: 1000 TV lines
- At corner of picture: 600 TV lines

**Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture:**
- 50%

**Field Strength at Center of Focusing Coil**
- Horizontal: 40 ± 4 G
- Vertical: 58 ± 4 G

**Peak Deflecting-Coil Current:**
- Horizontal: 350 mA
- Vertical: 20 mA

**Field Strength of Adjustable Alignment Coil**
- 0 to 4 G

---

**High-Sensitivity Operation—0.1 Footcandle on Faceplate**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>0.1 fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage $q_{t}$</td>
<td>30 to 60 V</td>
</tr>
<tr>
<td>Dark Current $s$</td>
<td>0.1 μA</td>
</tr>
<tr>
<td>Signal-Output Current $t$</td>
<td>Typical: 0.1 μA</td>
</tr>
</tbody>
</table>

**Average-Sensitivity Operation—1.0 Footcandle on Faceplate**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>1.0 fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage $q_{r}$</td>
<td>20 to 40 V</td>
</tr>
<tr>
<td>Dark Current $s$</td>
<td>0.02 μA</td>
</tr>
<tr>
<td>Signal-Output Current $t$</td>
<td>Typical: 0.20 μA</td>
</tr>
</tbody>
</table>

**High-Light Level Operation—10 Footcandles on Faceplate**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>10 fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage $q_{r}$</td>
<td>10 to 22 V</td>
</tr>
<tr>
<td>Dark Current $s$</td>
<td>0.005 μA</td>
</tr>
<tr>
<td>Signal-Output Current $t$</td>
<td>Typical: 0.3 μA</td>
</tr>
</tbody>
</table>

---

**Environmental Performance Data**

The 4503A is designed to withstand the following operational and non-operational environmental tests.

Rejection Criteria: After completion of all tests, the tube will meet the performance characteristics specified under Typical Operation and Performance Data. However, the number of spots specified under the Spurious Signal.
Test may increase slightly if the tube is subjected to the maximum shock and vibration levels specified below. During the vibration test the tube is positioned so that its major axis is parallel to the surface of the earth.

**Operational Tests.** The tube is operated as shown under the Typical Low-Voltage Mode in the tabulated data.

1. **Low-Frequency Sinusoidal Vibration.** The tube is subjected to 10 g peak sinusoidal vibration, 5 to 500 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve C of Figure 514-1. The vidicon will show no loss in resolution and the amplitude of any generated spurious signals will not exceed 20 per cent of the maximum white-signal level.

2. **High-Frequency Sinusoidal Vibration.** The tube is subjected to 10 g peak sinusoidal vibration, 5 to 2000 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve C of Figure 514-3. The vidicon will maintain a minimum resolution of 500 TV lines throughout this test. The amplitude of any generated spurious signals will not exceed 75 per cent of the maximum white-signal level.

3. **Random Vibration.** The tube is subjected to 12 g, RMS, 20 to 2000 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve D of Figure 514-4. The vidicon will show no loss in resolution and the amplitude of any generated spurious signals will not exceed 50 per cent of the maximum white-signal level.

**Non-Operational Tests**

1. **Shock.** The tube is subjected per MIL-STD-810A, method 516.1, Figure 516-1, procedure V, to a 100 g, 6 millisecond terminal peak sawtooth shock pulse in each of three orthogonal axes, one of which is parallel to the major axis of the tube. A total of 18 impact shocks are applied.

2. **Vibration**
   a. **Sinusoidal** — The tube is subjected to 15 g peak
sinusoidal vibration, 5 to 2000 Hz per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve D on Figure 514-3.

b. Random – The tube is subjected to 25 g, RMS, 20 to 2000 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve G on Figure 514-4.

3. Temperature-Pressure (Altitude) Tests. The vidicon and associated components are subjected, per MIL-E-5400A* par.3.2.20, 3.2.20.1, and 3.2.20.1.1, to the separate and combined effects of varying temperature of 0° to +55° C and to varying barometric pressure of 30" to 3.4" of mercury. The pressure corresponds to sea level and to an altitude of 50,000 feet, respectively.

4. Temperature-Humidity Tests. The vidicon is subjected, per MIL-E-5400A* par.3.2.30.2B, to relative humidities up to and including 95 per cent at temperatures up to and including +50° C.

* 1 January 1956

b 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.

b Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, Ill. 60007.

c Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

d This component is chosen to provide tube operation with minimum beam-landing error and is used to evaluate tube performance data. The Environmental Performance Data are obtained using a Cleveland Electronics assembly No.VYFA-164-2, or equivalent. When the tube is to be operated in severe environments, this or other suitably ruggedized components should be used to take full advantage of the environmental capabilities of the tube.

d 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 to
5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

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.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

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 3-11/16 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.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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

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.

Defined as the component of the highlight target current after the dark-current component has been subtracted.
This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in Figure 1. The 4503A is operated under the conditions specified under Typical Operation and Performance Data with the lens adjusted to provide a target current of 0.3 microampere. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.

Table 1  For scanned area of 1/2" x 3/8"

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 but not including 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3 but not including 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1 or less</td>
<td>■</td>
<td>■</td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.*
TERMINAL DIAGRAM (Bottom View)

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode

Pin 8: Heater Flange: Target
Short Index Pin: Internal Connection — Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

DIMENSIONAL OUTLINE - Dimensions in Inches (mm)

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.
Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To Obtain Minimum Beam-Landing Error

Note: Cross-hatching indicates wound portion of focusing coil.

RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
LIGHT TRANSFER CHARACTERISTICS

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

Faceplate Temperature = 30°C approx.

Signal Output — Microamperes

Tungsten Illumination on Tube Face — Footcandles

Dark Current (Microamperes) × 0.1
TYPICAL PERSISTENCE CHARACTERISTICS

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

SIGNAL-OUTPUT CURRENT - PER CENT OF INITIAL VALUE

TIME AFTER ILLUMINATION IS REMOVED - MILLISECONDS

RCA Electronic Components

DATA 6 12-68
**Amplitude response** measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.
Photomultiplier Tube

2" Diameter, 12-Stage, Head-On Type
Having a Bialkali Photocathode

General Data
Spectral Response .................................. See Figure 1
Wavelength of Maximum Response .............. 385 ± 50 nm
Cathode, Semitransparent ... Cesium-Potassium-Antimony (Bialkali)
Minimum projected area .................. 2.54 sq in (16.4 cm²)
Minimum diameter ................... 1.80 in (4.57 cm)
Window ................................ Pyrex Corning® No.7740, or equivalent
Shape .................................. Spherical Segment
Index of refraction at 589.3 nanometers ....... 1.47

Dynodes:
Substrate ........................................ Copper-Beryllium
Secondary-emitting surface ................. Beryllium-Oxide
Structure .................................. In-Line Electrostatic Focus Type

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.12 ..................... 5 pF
Anode to all other electrodes .......... 6 pF

Maximum Overall Length .................. 5.71 in (14.5 cm)
Seated Length .................... 4.9B ± 0.08 in (12.6 ± 0.2 cm)
Maximum Diameter ...................... 2.10 in (5.3 cm)
Bulb .................................. T16
Base .................................. RCA 21-Pin (See Base Drawing)
Socket ......................... RCA-AJ2144, AJ2145, or AJ2180b
Magnetic Shield .............. Perfection Mica® Part No.22P50, or equivalent
Operating Position .................. Any
Weight (Approx.) .......................... 6 oz

Maximum and Minimum Ratings,
Absolute-Maximum Values:

DC Supply Voltage:
Between anode and cathode ................ 2500 max. V
Between anode and dynode No.12 .......... 300 max. V
Between consecutive dynodes .......... 300 max. V
Between dynode No.1 and cathode ....... 600 max. V
Between focusing electrode and cathode .. 600 max. V
**Average Anode Current** \(^{\text{a}}\) .................. 0.2 max. mA

**Ambient-Temperature Range** \(^{\text{f}}\) ........... –80 to +85 \(^{\circ}\)C

---

**Characteristics Range Values for Equipment Design:**

Under conditions with a dc supply voltage \((E)\) across a voltage divider providing electrode voltages shown in Table I, and at a temperature of 22\(^{\circ}\) C, except as noted.

With \(E = 1500\) volts (Except as noted).

<table>
<thead>
<tr>
<th>Equipment Design:</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(^{\text{d}}), at 385 nm</td>
<td>–</td>
<td>1.8x10(^{5})</td>
<td>–</td>
</tr>
<tr>
<td>Luminous* ((2870,^\circ) K)</td>
<td>20</td>
<td>160</td>
<td>750</td>
</tr>
<tr>
<td>With blue light source</td>
<td>2.6</td>
<td>21</td>
<td>97</td>
</tr>
</tbody>
</table>

| **Cathode Sensitivity:** | | | |
| Radiant\(^{\text{k}}\), at 385 nm | – | 0.097 | – | A/W |
| Luminous* \((2870\,^\circ\) K) | 7.3x10\(^{-5}\) | 8.5x10\(^{-5}\) | – | A/Im |
| With blue light source | 9.5x10\(^{-6}\) | 1.1x10\(^{-5}\) | – | A/incident Im |

| **Quantum efficiency at 385 nm** | – | 31 | – | % |

| **Current Amplification** | – | 1.9x10\(^{6}\) | – |

| **Anode Dark Current** \(^{\text{p}}\) at 50 A/Im | – | 2x10\(^{-10}\) | 2x10\(^{-9}\) | A |

| **Equivalent Anode Dark Current Input** at 50 A/Im | – | 4x10\(^{-12}\)q | 4x10\(^{-11}\)q | Im |
| | – | 3.5x10\(^{-15}\)r | 3.5x10\(^{-14}\)r | W |

| **Equivalent Noise Input** \(^{\text{s}}\) | – | 4.0x10\(^{-13}\) | – | Im |
| | – | 3.5x10\(^{-16}\)t | – | W |

| **Anode Pulse Rise Time** \(^{\text{t}}\) at 2500 V | – | 2.4x10\(^{-9}\) | – | s |

| **Electron Transit Time** \(^{\text{v}}\), at 2500 V | – | 3.4x10\(^{-8}\) | – | s |
The AJ2145 is designed specifically for chassis mounting. The AJ2180 is similar to the AJ2145, but is light-tight. The AJ2144 is designed for use in any desired mounting arrangement. It is supplied with an unattached clamp ring which fits to either the top or bottom of its socket body to permit chassis mounting. The ring is not normally required for other mounting arrangements and can be discarded to make such arrangements more compact.

The 4507 is supplied without a socket. The AJ2144, AJ2145, or the AJ2180 may be ordered from your nearest RCA Field Sales Office.

These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/Im)} = \frac{\text{Anode blue sensitivity (A/Im)}}{0.13}$$

The value of 0.13 is the average value of the ratio of the anode current measured under the conditions specified in footnote (j) to the anode current measured under the same conditions but with the blue filter removed.

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 $1 \times 10^{-7}$ lumen.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

These values are calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/Im)} = \frac{\text{Cathode blue sensitivity (A/Im)}}{0.13}$$

The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote...
Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 1 x 10^-4 lumen and 500 volts are applied between cathode and all other electrodes connected as anode.

Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 1 x 10^-7 lumen. The supply voltage E is adjusted to obtain an anode current of 0.65 microamperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 50 amperes per lumen. Dark current is measured with incident light removed.

Equivalent Anode Dark Current Input is the quotient of anode dark current at a given anode luminous sensitivity by the anode luminous sensitivity.

At 385 nanometers. These values are calculated from the EADCI values in lumens using a conversion factor of 1140 lumens per watt.

Under the following conditions: An equivalent bandwidth of 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 385 nanometers. This value is calculated from the ENI value in lumens using a conversion factor of 1140 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.

Operating Considerations

Anode-Dark Current

The 4507 is intended for use in systems requiring very low
dark current. Accordingly, the base of the tube and its socket should never be allowed to become contaminated by handling. Such contamination produces leakage and dark current. It is recommended that if the tube base or its socket is handled that it be washed with a solution of alkaline soap cleaner such as Alconox®, or equivalent, and de-ionized or distilled water having a temperature not exceeding 60° C. Careful scrubbing between pins or socket contacts is useful, but not usually required. The base of socket should then be rinsed in de-ionized or distilled water (60°) for several minutes and then air-blown dry.

A temporary increase in anode dark current by as much as 3 orders of magnitude may occur if the tube is exposed momentarily to high-intensity ultraviolet radiation from sources such as fluorescent room lighting even though voltage is not applied to the tube. The increase in dark current may persist for a period up to 48 hours following such irradiation.

Cathode Current
A peak cathode current of $5 \times 10^{-9}$ ampere at a tube temperature of 22° C or $1 \times 10^{-11}$ ampere at -80° C should not be exceeded. Because of the resistivity of the photocathode, the voltage drop caused by higher peak cathode currents may produce radial electric fields on the photocathode which can result in poor photoelectron collection by the first dynode. Photocathode resistivity increases with decreasing temperature.

Leakage Current
The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding the tube at the photocathode end 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. In addition to increasing dark current and noise output because of voltage gradients developed across the bulb wall, such high voltage may produce minute leakage current to
the cathode, through the tube envelope and insulating materials, which can permanently damage the tube.


Ambient Atmosphere
Operation or storage of this tube in environments where helium is present should be avoided. Helium may permeate through the tube envelope and may lead to eventual tube destruction.

| Table I |
|-----------------|-----------------|
| Voltages To Be Provided by Divider | 6.94% of Supply Voltage (E) Multiplied By |
| Between the Following Electrodes | K – Dy1 | 2.0 |
| Cathode (K), Dynode (Dy), and Anode (P) | Dy1 – Dy2 | 1.0 |
| | Dy2 – Dy3 | 1.4 |
| | Dy3 – Dy4 | 1.0 |
| | Dy4 – Dy5 | 1.0 |
| | Dy5 – Dy6 | 1.0 |
| | Dy6 – Dy7 | 1.0 |
| | Dy7 – Dy8 | 1.0 |
| | Dy8 – Dy9 | 1.0 |
| | Dy9 – Dy10 | 1.0 |
| | Dy10 – Dy11 | 1.0 |
| | Dy11 – Dy12 | 1.0 |
| | Dy12 – P | 1.0 |
| | K – P | 14.4 |

Focusing Electrode (Pin 17) is connected to dynode No.1 potential.

Electron Multiplier Shield (Pin 10) is connected to dynode No.5 potential.
TYPICAL CIRCUIT ARRANGEMENT

C1: 0.005 μF, 20%, Ceramic Disc, 500 V dc
C2: 0.01 μF, 20%, Ceramic Disc, 500 V dc
C3: 0.02 μF, 20%, Ceramic Disc, 500 V dc
C4: 0.05 μF, 20%, Ceramic Disc, 500 V dc
R1: 200 kΩ (2-100 kΩ, 5%, 1/2 W in series)
R2: 100 kΩ, 5%, 1/2 W
R3: 130 kΩ, 5%, 1 W
R4 through R13: 100 kΩ, 5%, 1/2 W
Dimensions in Inches

Note: Caution must be employed when handling this tube because of the thinness (approx. 0.02 inch thick) of the entrance window.

The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm).

<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>.003</td>
<td>.08</td>
<td>.05</td>
<td>1.3</td>
<td>1.375</td>
<td>34.93</td>
</tr>
<tr>
<td>.010</td>
<td>.25</td>
<td>.064</td>
<td>1.63</td>
<td>1.80</td>
<td>45.7</td>
</tr>
<tr>
<td>.02</td>
<td>.5</td>
<td>.08</td>
<td>2.0</td>
<td>1.93</td>
<td>49.0</td>
</tr>
<tr>
<td>.04</td>
<td>1.0</td>
<td>.30</td>
<td>7.6</td>
<td>2.10</td>
<td>53.3</td>
</tr>
<tr>
<td>.045</td>
<td>1.14</td>
<td>.65</td>
<td>16.5</td>
<td>4.98</td>
<td>126.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.71</td>
<td>145.0</td>
</tr>
</tbody>
</table>
DETAIL OF BASE ARRANGEMENT

- 2.10 MAX. DIA.
- LIGHT SHIELD
- .65 MAX.
- .02-.05
- .045 MAX. DIA.
- .30 MAX. DIA.
- .064 ± .003 DIA.
- PIN CONTOUR
- OPTIONAL

Dimensions in Inches

RCA Electronic Components

DATA 5
10-71
TERMINAL DIAGRAM (Bottom View)

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: Dynode No.11
Pin 7: Anode
Pin 8: Dynode No.12
Pin 9: Internal Connection, Do not use
Pin 10: Electron Multiplier Shield
Pin 11: Internal Connection, Do not use
Pin 12: Dynode No.10
Pin 13: Dynode No.8
Pin 14: Dynode No.6
Pin 15: Dynode No.4
Pin 16: Dynode No.2
Pin 17: Focusing Electrode
Pin 18: Internal Connection, Do not use
Pin 19: Internal Connection, Do not use
Pin 20: Internal Connection, Do not use
Pin 21: Photocathode

DIRECTION OF RADIATION:
INTO END OF BULB

92.5 - 3012

RCA Electronic Components
TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

Figure 1
**TYPICAL DYNODE MODULATION CHARACTERISTIC**

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

<table>
<thead>
<tr>
<th>Between</th>
<th>( 0.94% ) of ( E ) multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and DYNODE No. 1</td>
<td>2.0</td>
</tr>
<tr>
<td>DYNODE No. 1 and DYNODE No. 2</td>
<td>1.0</td>
</tr>
<tr>
<td>DYNODE No. 2 and DYNODE No. 3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding DYNODE stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to DYNODE-No. 1 potential, electron multiplier shield is connected to DYNODE-No. 5 potential, cathode is at ground potential.

![Graph of typical dynode modulation characteristic](image-url)
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>6.94% of E multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding Dynode stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to Dynode No.1 potential. Electron multiplier shield is connected to Dynode No.5 potential. Photocathode is fully illuminated.

![Graph showing sensitivity and current amplification characteristics](image-url)
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>6.94% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding Dynode Stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Electron multiplier shield is connected to Dynode No.5 potential. Focusing electrode is connected to Dynode No.1 potential. Light source is a tungsten-filament lamp operated at a color temperature of 2870°K. Tube temperature = 220°C.

![Graph showing Luminous Sensitivity](image-url)
TYPICAL ANODE DARK CURRENT AS A FUNCTION OF TEMPERATURE

WITH SUPPLY VOLTAGE ADJUSTED TO PROVIDE AN ANODE LUMINOUS SENSITIVITY OF 50 AMPERES PER LUMEN.

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

<table>
<thead>
<tr>
<th>BETWEEN</th>
<th>6.94% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND DYNODE No.1</td>
<td>2.0</td>
</tr>
<tr>
<td>DYNODE No.1 AND DYNODE No.2</td>
<td>1.0</td>
</tr>
<tr>
<td>DYNODE No.2 AND DYNODE No.3</td>
<td>1.4</td>
</tr>
<tr>
<td>EACH SUCCEEDING DYNODE STAGE</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE AND CATHODE</td>
<td>14.4</td>
</tr>
</tbody>
</table>

FOCUSING ELECTRODE IS CONNECTED TO DYNODE No.1 POTENTIAL. ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE No.5 POTENTIAL. PHOTOCATHODE IS FULLY ILLUMINATED.

![Graph showing TYPICAL ANODE DARK CURRENT AS A FUNCTION OF TEMPERATURE]
**TYPICAL TIME-RESOLUTION CHARACTERISTICS**

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

<table>
<thead>
<tr>
<th>BETWEEN</th>
<th>6.94% of ( E ) MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No. 1</td>
<td>2.0</td>
</tr>
<tr>
<td>Dynode No. 1 and Dynode No. 2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No. 2 and Dynode No. 3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding Dynode stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to Dynode No. 1 potential. Electron multiplier shield is connected to Dynode No. 5 potential. Photocathode is fully illuminated.

![Graph showing transit time and rise time vs. supply volts](chart.png)
**TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT**

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

<table>
<thead>
<tr>
<th>Between</th>
<th>6.94% of $E$ multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding dynode stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and cathode</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to dynode-No.1 potential. Electron multiplier shield is connected to dynode-No.5 potential. Photocathode is fully illuminated.

Positive value of $H$ in direction shown:

\[ (1) \uparrow \text{ or (3)} \]

Direction (1) is out of paper.

![Diagram](image)

**Supply Voltage $(E)$** 2000 V

**Relative anode current**

<table>
<thead>
<tr>
<th>Magnetic field intensity (Oersteds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5</td>
</tr>
<tr>
<td>-4</td>
</tr>
<tr>
<td>-3</td>
</tr>
<tr>
<td>-2</td>
</tr>
<tr>
<td>-1</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>+1</td>
</tr>
<tr>
<td>+2</td>
</tr>
<tr>
<td>+3</td>
</tr>
<tr>
<td>+4</td>
</tr>
<tr>
<td>+5</td>
</tr>
</tbody>
</table>

**DATA 9**

Electronic Components

10-71
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)

(2) SUPPLY VOLTAGE (E) = 2000V

(3) SUPPLY VOLTAGE (E) = 2000V

RELATIVE ANODE CURRENT

MAGNETIC FIELD INTENSITY - OERSTEDS

92LM-3779
Photomultiplier Tube

3/4-INCH DIAMETER, 10-STAGE, HEAD-ON TYPE
BIALKALI PHOTOCATHODE OF HIGH QUANTUM EFFICIENCY
IN-LINE ELECTROSTATICALLY-FOCUSED DYNODE STRUCTURE

For Use in Pulse-Counting and Other Low-Light Level Detection
and Measurement Systems

GENERAL

Spectral Response ............................................ See accompanying Spectral Response Characteristics

Wavelength of Maximum Response .................. 4000 ± 500 Angstroms

Cathode, Semitransparent ....................... Cesium-Potassium-Antimony (Bialkali)

Shape .............................................................. Spherical Section

Minimum projected area ...................... 0.2 sq. in

Minimum diameter .............................................. 0.5 in

Window .............................................................. Coming® No.0080, or equivalent

Shape .............................................................. Plano-Concave

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

Dynodes

Substrate ............................................................. Copper-Beryllium

Secondary-Emitting Surface ....................... Beryllium-Oxide

Structure ............................................................. In-Line, Electrostatic-Focus Type

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) ................. 3.94 in

Maximum Diameter ............................................. 0.78 in

Envelope .............................................................. T-6

Magnetic Shield ..................................................... See footnote (b)

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

Weight (Approx.) ..................................................... 0.9 oz

Base (Approx.) ..................................................... Small-Button Thirteen« 12-Semiflexible Leads

(JEDEC No.E12-72)

TERMINAL DIAGRAM (Bottom View)

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

DIRECTION OF RADIATION INTO END OF BULB
12BG
## ABSOLUTE-MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>DC Supply Voltage</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between anode and cathode</td>
<td>1800</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Between anode and dynode No.10</td>
<td>300</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Between consecutive dynodes</td>
<td>300</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Between dynode No.1 and cathode</td>
<td>300</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Average Anode Current</td>
<td>0.5</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Ambient-Temperature Range</td>
<td>-100 to +85</td>
<td>°C</td>
<td></td>
</tr>
</tbody>
</table>

## CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage \( (E) \) across a voltage divider providing electrode voltages shown in Table 1, except as noted.

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 4000 angstroms</td>
<td>-</td>
<td>3.2 ( \times ) 10(^{-4} )</td>
<td>-</td>
</tr>
<tr>
<td>Cathode Radiant at 4000 angstroms</td>
<td>-</td>
<td>0.079</td>
<td>-</td>
</tr>
<tr>
<td>Luminous: With tungsten light source</td>
<td>10</td>
<td>27</td>
<td>173</td>
</tr>
<tr>
<td>With blue light source</td>
<td>1.5 ( \times ) 10(^{-5} )</td>
<td>4 ( \times ) 10(^{-6} )</td>
<td>2.6 ( \times ) 10(^{-5} )</td>
</tr>
<tr>
<td>Cathode Luminous: With tungsten light source</td>
<td>6.7 ( \times ) 10(^{-5} )</td>
<td>-</td>
<td>A/Im</td>
</tr>
<tr>
<td>With blue light source</td>
<td>7 ( \times ) 10(^{-9} )</td>
<td>1 ( \times ) 10(^{-8} )</td>
<td>-</td>
</tr>
<tr>
<td>Quantum Efficiency at 4000 angstroms</td>
<td>-</td>
<td>24</td>
<td>-</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>4 ( \times ) 10(^{-5} )</td>
<td>-</td>
</tr>
<tr>
<td>Anode Dark Current</td>
<td>-</td>
<td>2 ( \times ) 10(^{-10} )</td>
<td>6 ( \times ) 10(^{-10} )</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input</td>
<td>-</td>
<td>2.9 ( \times ) 10(^{-11} )</td>
<td>6 ( \times ) 10(^{-11} )</td>
</tr>
<tr>
<td>Dark-Pulse Spectrum</td>
<td>-</td>
<td>2.4 ( \times ) 10(^{-14} )</td>
<td>-</td>
</tr>
<tr>
<td>Pulse-Height Spectrum with Fe 55 Source</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pulse-Height Resolution</td>
<td>-</td>
<td>8.5</td>
<td>-</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time</td>
<td>1.8 ( \times ) 10(^{-9} )</td>
<td>-</td>
<td>s</td>
</tr>
<tr>
<td>Electron Transit Time</td>
<td>2 ( \times ) 10(^{-8} )</td>
<td>-</td>
<td>s</td>
</tr>
</tbody>
</table>

- Made by Corning Glass Works, Corning, New York 14830.
- Magnetic shielding in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston, Chicago, Illinois 60622, or equivalent.
- Averaged over any interval of 30 seconds maximum.
- Tube operation at room temperature or below is recommended.
- This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1190 lumens per watt.
- This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1190 lumens per watt.
- These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/Im)} = \frac{\text{Anode Current (with blue light source)} \times A}{0.15 \times \text{Light Flux of } 1 \times 10^{-8} \text{ (Im)}}
\]

The value of 0.15 is the average value of the ratio of the anode current measured under the conditions specified in footnote (h) to the anode current measured under the same conditions but with the blue filter removed.

**DATA 1**

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.
The value of 10 is the average value of the ratio of the cathode current measured under conditions with the blue line removed to the blue line removal. Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C. S. No. 568, polished to 0.160 stock thickness). The supply voltage (E) is adjusted to give an equivalent luminous sensitivity of 7 emperas per lumens. With supply voltage (E) adjusted to give an equivalent luminous sensitivity of 7 emperas per lumens. Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C. S. No. 568, polished to 0.160 stock thickness).
Operating Considerations

The semiflexible leads of the 4516 may be soldered into the associated circuit. If desired, the leads may be trimmed to within 1/4 inch of the protective plastic shell. When leads of reduced length are soldered, care must be taken to conduct excessive heat away from the lead seals. Otherwise, the heat of the soldering operation may crack the glass seals of the leads and damage the tube.

The operating stability of the 4516 is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 0.5 milliamperes is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of 1 microampere or less is recommended.

Electrostatic and magnetic shielding of the 4516 is ordinarily required. When a shield is used, it must be at cathode potential.

The high voltages at which the 4516 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.

Accompanying Typical Voltage-Divider Arrangements are recommended for use with the 4516. Recommended resistance values for the voltage dividers range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for any 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 power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode. The use of high resistance values per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 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 tube socket terminals 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 nonlinearity and pulse-limiting effects, the use of resistance values exceeding 1 megohm per stage make the 4516 more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
WHICH PERMITS DIRECT COUPLING TO THE ANODE

R1 and R2: 560,000 ohms, 1/2 watt
R3: 820,000 ohms, 1/2 watt
R4 through R11: 470,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 500 and 1800 volts dc.
Note 2: Component values are dependent upon nature of application and output signal desired.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS

ANODE RETURN

R11

C1

R10

C2

R9

C3

R8

C4

R7

C5

R6

R5

R4

R3

R2

R1

PHOTOCATHODE

C6

TO REGULATED DC POWER SUPPLY
(SEE NOTE 1)

+ -

OUTPUT

PHOTOMULTIPLIER TUBE

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)
C5 and C6: 0.005 μF, 3000 volts (dc working)
R1: 680,000 ohms, 1/2 watt
R2 and R3: 510,000 ohms, 1/2 watt
R4 through R11: 390,000 ohms, 1/2 watt
R12: 1 megohm, 1/2 watt
R13: 100,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 500 and 1800 volts dc.

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

Note 3: Component values are dependent upon nature of application and output signal desired.

DATA 3

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

BASE
JEDEC No. E12-72
AND
PROTECTIVE PLASTIC
SHELL

T6 BULB

PHOTOCATHODE

FACEPLATE
(NOTE 3)

.755
MAX. DIA.

.5
MIN. DIA.

3.94
MAX

3.50
+.06
-.12

.30
MAX.

.75
MIN.

.78
MAX. DIA.

.016 ± .004 DIA.
(NOTE 2)

12 SEMIFLEXIBLE LEADS

DIMENSIONS IN INCHES

Note 1: Within this length, maximum diameter of tube is 0.78".

Note 2: The semiflexible leads of the 4516 may be soldered or welded into the associated circuit. If desired, the leads may be trimmed to within 1/4 inch of the protective shell. Care must be exercised when making such connections to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the protective shell is recommended. Excessive bending of the leads is to be avoided.

Note 3: Deviation from flatness within the 0.5" diameter area will not exceed 0.006" from peak to valley.
### TABLE I

<table>
<thead>
<tr>
<th>Potential Distribution</th>
<th>8.25% of Supply Voltage ($E$) multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.7</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>12.1</td>
</tr>
</tbody>
</table>

### 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.
Typical Spectral Response Characteristics

![Graph showing typical spectral response characteristics with labels: Relative Sensitivity, Absolute Sensitivity, Quantum Efficiency.](image-url)
The supply voltage \((E)\) is across a voltage divider which provides voltages as follows:

<table>
<thead>
<tr>
<th>Stage Description</th>
<th>Multiplied By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Each succeeding dynode-stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>12.1</td>
</tr>
</tbody>
</table>

**Graph:**
- **Sensitivity (Amperes/Lumen at 2870°K):**
- **Current Amplification:**
- **Supply Volts \((E)\) between Anode and Cathode:**
  - Minimum Sensitivity
  - Typical Sensitivity
  - Maximum Sensitivity
  - Typical Amplification

**Data:**
- **Radio Corporation of America**
- **Electronic Components and Devices**
- **Harrison, N. J.**
- **Data 6**
- **9-62**
Typical Dark-Pulse Spectrum

<table>
<thead>
<tr>
<th>CATHODE-TO-DYNOE-No. 1 VOLTS</th>
<th>149</th>
</tr>
</thead>
<tbody>
<tr>
<td>OYNOE-No. 1-TO-DYNOE-No. 2 VOLTS</td>
<td>149</td>
</tr>
<tr>
<td>OYNOE-No. 2-TO-DYNOE-No. 3 VOLTS</td>
<td>210</td>
</tr>
<tr>
<td>EACH SUCCESSIVE OYNOE-STAGE VOLTS</td>
<td>124</td>
</tr>
<tr>
<td>ANODE-TO-CATHODE VOLTS</td>
<td>1500</td>
</tr>
</tbody>
</table>

DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE IS NORMALIZED TO COINCIDE WITH SINGLE PHOTOELECTRON PEAK OF DARK PULSE SPECTRUM AND IS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES ARE SUBTRACTED.

SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.

TUBE TEMPERATURE = 220°C.

ONE PHOTOELECTRON PULSE HEIGHT = 4 COUNTING CHANNELS.

INTEGRATING TIME CONSTANT = 30 μSEC. (R_L = 300 kΩ, C = 100 pF).

\[ \sum_{1 \text{ photoelectron}}^{32} \approx 2.4 \times 10^4 \text{ cpm} \]

\[ \sum_{4 \text{ photoelectrons}}^{32} \approx 4 \times 10^2 \text{ cpm} \]
Differential Fe$^{55}$ Spectrum

Fe$^{55}$ source, in contact with scintillator, activity 1 μcurie
Scintillator: Harshaw, type HG, 0.005" beryllium window,
NoI(TI), 7/8" diameter, 0.040" thick
Cathode-to-dynode-No. 1 volts = 149
Dynode-No. 1-to-dynode-No. 2 volts = 149
Dynode-No. 2-to-dynode-No. 3 volts = 210
Each succeeding dynode-stage volts = 124
Anode-to-cathode volts = 1500

Counts-rate—events per minute

Pulse height—keV

Valley
Peak
Peak/Valley $\approx 30$
Typical Dark Current and EADIC 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>8.25% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND DYNODE No. 1</td>
<td>1.2</td>
</tr>
<tr>
<td>DYNODE No. 1 AND DYNODE No. 2</td>
<td>1.2</td>
</tr>
<tr>
<td>DYNODE No. 2 AND DYNODE No. 3</td>
<td>1.7</td>
</tr>
<tr>
<td>EACH SUCCEEDING DYNODE-STAGE</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE AND CATHODE</td>
<td>12.1</td>
</tr>
</tbody>
</table>

TUBE TEMPERATURE IS 22°C.
Typical Effect of Indicated Magnetic Field on Anode Current

Supply voltage $E$ is 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.

Photocathode is fully illuminated.
Tube is oriented in magnetic field as shown below:

Positive values of magnetic field intensity ($H$) are for lines of flux out of the paper.

![Graph showing the typical effect of indicated magnetic field on anode current.](image-url)
Typical Effect of Indicated Magnetic Field on Anode Current

Supply voltage $E$ is 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.

Photocathode is fully illuminated.

Tube is oriented in magnetic field as shown below:

Positive values of magnetic field intensity ($H$) are for lines of flux in indicated direction.

Supply voltage $E$ is 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.

Photocathode is fully illuminated.

Tube is oriented in magnetic field as shown below:

Positive values of magnetic field intensity ($H$) are for lines of flux in indicated direction.

$E = 600$ Volts

$E = 1500$ Volts

Magnetic field intensity ($H$) - Oersteds

Relative anode current - per cent

-15  -10  -5   0   +5  +10  +15

-15  -10  -5   0   +5  +10  +15

RCA

Radio Corporation of America

Electronic Components and Devices

Harrison, N. J.
Typical Effect of Indicated Magnetic Field on Anode Current

Supply voltage $E$ is across a voltage divider providing 1/5 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.

Photocathode is fully illuminated.
Tube is oriented in magnetic field as shown below:

Positive values of magnetic field intensity ($H$) are for lines of flux in indicated direction.

Supply voltage $E = 1500$ volts

Supply voltage $E = 600$ volts

Magnetic field intensity ($H$) - Oersteds

Relative anode current - per cent
Photomultiplier Tube

1-1/2-INCH DIAMETER, 10-STAGE, HEAD-ON TYPE
BIALKALI PHOTOCATHODE OF HIGH QUANTUM EFFICIENCY
CIRCULAR-CAGE ELECTROSTATICALLY-FOCUSED DYNODE STRUCTURE

For Use in Pulse-Counting and Other Low-Light Level Detection and Measurement Systems

GENERAL

Spectral Response. See accompanying Spectral Response Characteristics

Wavelength of Maximum Response. 4000 ± 500 angstroms

Cathode, Semitransparent. Cesium-Potassium-Antimony (Bialkali)

Shape. Flat, Circular

Minimum area. 1.2 sq. in

Minimum diameter. 1.24 in

Window. Coming® 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 Inter electrode Capacitances (Approx.)

Anode to dynode No. 10. 4 pF

Anode to all other electrodes. 7 pF

Maximum Overall Length. 4.57 in

Seated Length. 3.88 in ± 0.19 in

Maximum Diameter. 1.56 in

Envelope. T-12

Socket. Eby® No. 9058, or equivalent

Magnetic Shield. Millen® No. 80802C, or equivalent

Operating Position. Any

Weight (Approx.). 2 oz

Base. Small-Shell Duodecal 12-Pin (JEDEC No. B12-43), Non-hygroscopic

TERMINAL DIAGRAM (Bottom View)

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

DIRECTION OF RADIATION: INTO END OF BULB
ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage
Between anode and cathode ........................................ 1800 V
Between anode and dynode No.10 .................................. 250 V
Between consecutive dynodes ...................................... 300 V
Between dynode No.1 and cathode ................................ 400 V
Average Anode Current ............................................. 0.5 mA
Ambient-Temperature Range ........................................ -100 to +85 °C

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 = 1500 volts except as noted

<table>
<thead>
<tr>
<th>Characteristic</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 4000 angstroms</td>
<td></td>
<td>3.9 x 10⁴</td>
<td></td>
</tr>
<tr>
<td>Cathode Radiant at 4000 angstroms</td>
<td></td>
<td>0.079</td>
<td></td>
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<tr>
<td>Luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source</td>
<td></td>
<td>10</td>
<td>33</td>
</tr>
<tr>
<td>With blue light source</td>
<td></td>
<td>0.15 x 10⁻⁵</td>
<td>2.2 x 10⁻⁴</td>
</tr>
<tr>
<td>Cathode Luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source</td>
<td></td>
<td>6.7 x 10⁻⁵</td>
<td></td>
</tr>
<tr>
<td>With blue light source</td>
<td></td>
<td>1 x 10⁻⁹</td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 4000 angstroms</td>
<td></td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td></td>
<td>5 x 10⁻⁵</td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current</td>
<td></td>
<td>3 x 10⁻⁴</td>
<td>7 x 10⁻¹⁰</td>
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<tr>
<td>Equivalent Anode-Dark Current Input</td>
<td></td>
<td>4.3 x 10⁻¹¹</td>
<td>1 x 10⁻¹⁰</td>
</tr>
<tr>
<td>Dark-Pulse Spectrum</td>
<td></td>
<td>3.6 x 10⁻¹⁴</td>
<td></td>
</tr>
<tr>
<td>Pulse-Height Spectrum with Fe⁵⁵ Source</td>
<td></td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>Pulse-Height Resolution</td>
<td></td>
<td>2.3 x 10⁻⁹</td>
<td></td>
</tr>
<tr>
<td>Anode-Pulse Rise Time</td>
<td></td>
<td>2.7 x 10⁻⁹</td>
<td></td>
</tr>
<tr>
<td>Electron Transit Time</td>
<td></td>
<td>2.7 x 10⁻⁸</td>
<td></td>
</tr>
</tbody>
</table>

a Made by Corning Glass Works, Corning, New York 14890.
b Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia, Pa. 19144.
c Made by James Millen Mfg. Co., Inc., 150 Exchange St., Massachusetts 02148.
d Averaged over any interval of 30 seconds maximum.
e Tube operation at room temperature or below is recommended.
f This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1190 lumens per watt.
g This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1180 lumens per watt.
h These values are calculated as shown below:

Luminous Sensitivity (A/Im) = \[
\frac{0.15 \times \text{Light Flux of } 1 \times 10^{-5} \text{ lm}}{
\text{Anode Current (with blue light source) (A)}
\]
i The value of 0.15 is the average value of the ratio of the anode current measured under the conditions specified in footnote (i) to the anode current measured under the same conditions but with the blue filter removed.

DATA 1

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C. S. No.5-56, 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 $1 \times 10^4$ lumens.

This value is calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/Im)} = \frac{0.15 \times \text{Light Flux of } 1 \times 10^4 \text{ (Im)}}{\text{Current Obtained, Pulser-Height Dow light, Measured}}$$

The value of 0.15 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C. S. No.5-56, 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 $1 \times 10^4$ lumens and 200 volts are applied between cathode and all other electrodes connected as anode.

At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C. S. No.5-56, polished to 1/2 stock thickness). The light flux incident on the filter is 10 micromicrons. The supply voltage (E) is adjusted to obtain an anode current of 10 microamperes. Sensitivity of the 4517 under these conditions is approximately equivalent to 7 amperes per lumen. Dark current is measured with no light incident on the tube.

With supply voltage (E) adjusted to give an equivalent luminous sensitivity of 7 amperes per lumen.

At 4000 angstroms. This value is calculated from the EADC1 value in lumens using a conversion factor of 1190 lumens per watt.

Measured under the following conditions: A Nuclear Data Model No.ND-180 Multichannel Pulse-Height Analyzer is used. The single-photon-electron pulse height is established by fully illuminating the photocathode with a weak light source, such as a tungsten-filament lamp operated at a low color temperature, to assure the high probability of single photon-electron emission from the photocathode of the 4517. The intensity of the light source is adjusted for approximately 50 percent counting loss. The dark-pulse spectrum is then obtained, using the same gain setting of the Multichannel Pulse-Height Analyzer, with the light source removed.

See accompanying Typical Dark-Pulse Spectrum.

Measured using a Harshaw Type HG 0.005" beryllium window NaI(Tl) scintillator, 0.04" thick and 7/8" in diameter and an isotope of iron having an atomic mass of 56 (Fe56) and an activity rate of one microcurie. The Fe56 source is in direct contact with the scintillator.

See accompanying Differental Fe55 Spectrum.

Pulse-height resolution is defined as the quotient of the full width of the photopeak at half height by the pulse height at maximum count rate under the following conditions: The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs137) and a cylindrical 1 - 1/2" x 1 - 1/2" thallium-activated sodium-iodide scintillator [NaI(Tl)-Type 6D6] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio, and is rated by the manufacturer as having a resolution capability of 8.5%. The Cs137 source is in direct contact with the metal end of the scintillator. The faceplates end of the crystal is coupled to the 4517 by a coupling fluid such as Dow Corning Corp., Type DC 200 (viscosity of 60,000 centistokes)— Manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

Under conditions with dc supply voltage (E) across a voltage divider providing 1/9 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 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

The operating stability of the 4517 is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of 1 microampere or less is recommended.

Electrostatic and magnetic shielding of the 4517 is ordinarily required. When a shield is used, it must be at cathode potential.

The high voltages at which the 4517 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.

Accompanying Typical Voltage-Divider Arrangements are recommended for use with the 4516. Recommended resistance values for the voltage dividers range from 10,000 ohms per stage to 1 megohm per stage. The choice of resistance values for any 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 power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode. The use of high resistance values per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 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 tube socket terminals 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 10 megohms per stage make the 4517 more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT WHICH PERMITS DIRECT COUPLING TO THE ANODE

\[ R_1: 680,000 \text{ ohms, 1/2 watt} \]
\[ R_2 \text{ and } R_3: 510,000 \text{ ohms, 1/2 watt} \]
\[ R_4 \text{ through } R_{11}: 360,000 \text{ ohms, 1/2 watt} \]

**Note 1:** Adjustable between approximately 500 and 1800 volts dc.

**Note 2:** Component values are dependent upon nature of application and output signal desired.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS

ANODE RETURN

TO REGULATED DC POWER SUPPLY (SEE NOTE 1)

PHOTOCATHODE

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)
C5 and C6: 0.005 μF, 3000 volts (dc working)
R1 and R2: 560,000 ohms, 1/2 watt
R3: 820,000 ohms, 1/2 watt
R4 through R11: 470,000 ohms, 1/2 watt
R12: 1 megohm, 1/2 watt
R13: 100,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 500 and 1800 volts dc.

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

Note 3: Component values are dependent upon nature of application and output signal desired.
TABLE I

TYPICAL POTENTIAL DISTRIBUTION

<table>
<thead>
<tr>
<th>Between</th>
<th>8.15% 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>

PHOTOCATHODE DIAMETER
1.24 MIN.
(SEE NOTE)

DIMENSIONAL OUTLINE

PHOTOCATHODE DIA.
1.56 MAX.

FACEPLATE

T12 BULB

BASE
JEDEC No.B12-43

DIMENSIONS IN INCHES

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

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 Spectral Response Characteristics

- Relative Sensitivity
- Absolute Sensitivity
- Quantum Efficiency

Wavelength (Angstroms):
- 2000
- 3000
- 4000
- 5000
- 6000
- 7000
Typical Anode Characteristics

CATHODE-TO-DYNOE-No. 1 Volts = 208
DYNOE-No. 1-TO-DYNOE-No. 2 VOLTS = 158
DYNOE-No. 2-TO-DYNOE-No. 3 VOLTS = 158
EACH SUCCEEDING DYNOE-STAGE VOLTS = 122
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED
AT COLOR TEMPERATURE OF 2870° K.
Typical Sensitivity and Current Amplification Characteristics

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

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<td>EACH SUCCEEDING DYNOE-STAGE</td>
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<td>12.3</td>
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</tbody>
</table>

SENSITIVITY - AMPERES/LUMEN

CURRENT AMPLIFICATION

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

DATA 5

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Dark-Pulse Spectrum

CATHODE-TO-DYNOE-NO. 1 VOLTS = 208
DYNOE-No. 1-TO-DYNOE-No. 2 VOLTS = 158
DYNOE-No. 2-TO-DYNOE-No. 3 VOLTS = 158
EACH SUCCEEDING DYNOE-STAGE VOLTS = 122
ANODE-TO-CATHODE VOLTS = 1500

DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE IS NORMALIZED TO COINCIDE WITH SINGLE PHOTOELECTRON PEAK OF DARK-PULSE SPECTRUM AND IS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES ARE SUBTRACTED.

SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22°C.

ONE-PHOTOELECTRON PULSE HEIGHT = 4 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 30 μSEC. (RL = 300 kΩ, C = 100 pF).

DATA 6 9-67
Differential Fe$^{55}$ Spectrum

Fe$^{55}$ source, in contact with scintillator, activity 1,000 curie.
Scintillator: Harshaw, Type HG, 0.005" beryllium window,
No.1(Ti), 7/8" diameter, 0.040" thick.

Cathode-to-dynode-No. 1 Volts = 149
Dynode-No. 1-to-dynode-No. 2 Volts = 149
Dynode-No. 2-to-dynode-No. 3 Volts = 210
Each succeeding dynode-stage Volts = 124
Anode-to-cathode Volts = 1500

Counting rate—events per minute

Pulse height—keV

Valley  Peak  Peak
Valley $\approx$ 30

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

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<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>12.3</td>
</tr>
</tbody>
</table>

TUBE TEMPERATURE: 22° C

<table>
<thead>
<tr>
<th>LUMINOUS SENSITIVITY - AMPERES/LUMEN</th>
<th>EADCI - LUMEN</th>
<th>EADCI - WATT</th>
</tr>
</thead>
<tbody>
<tr>
<td>680</td>
<td>10^11</td>
<td>10^13</td>
</tr>
<tr>
<td>900</td>
<td>10^10</td>
<td>10^12</td>
</tr>
<tr>
<td>1270</td>
<td>10^9</td>
<td>10^11</td>
</tr>
<tr>
<td>1780</td>
<td>10^8</td>
<td>10^10</td>
</tr>
</tbody>
</table>

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

DATA 7
9-67
Typical Effect of Indicated Magnetic Field on Anode Current

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No.1; 1/12 OF E FOR EACH SUCCESSING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No.10 AND ANODE.

PHOTOCATHODE IS FULLY ILLUMINATED.

POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX OUT OF PAPER.

DATA 7
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Effect of Indicated Magnetic Field on Anode Current

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. PHOTOCATHODE IS FULLY ILLUMINATED.

POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION.

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5
MAGNETIC FIELD INTENSITY—OERSTEDS

100 90 80 70 60 50 40 30 20 10
RELATIVE ANODE CURRENT—PER CENT

E = 1500 V
E = 600 V

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

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. PHOTOCATHODE IS FULLY ILLUMINATED.

POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION.

MAGNETIC FIELD INTENSITY - OERSTEDS

DATA 8
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
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.

TRANSIT TIME

RISE TIME

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

92L5-1945
Photomultiplier Tube

2-Inch Diameter, 10-Stage, Head-On Type
Bialkali Photocathode of High Quantum Efficiency
Circular-Cage Electrostatically-Focused Dynode Structure
For use in pulse counting and other low light level detection and measurement systems

GENERAL
Spectral Response. See accompanying Spectral Response Characteristics
Wavelength of Maximum Response. 4000 ± 500 angstroms
Cathode, Semitransparent. Cesium-Potassium-Antimony (Bialkali)
Shape. Spherical Section
Minimum projected area. 2.2 in²
Minimum diameter. 1.68 in.
Window. Corning® No.0080, or equivalent
Shape. Plano-Concave
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 pF
Maximum Overall Length. 5.81 in.
Seated Length. 4.87 in. ± 0.19 in.
Maximum Diameter. 2.31 in.
Bulb. T-16
Socket. Cinch-Jones® No.3M14, or equivalent
Magnetic Shield. Millen® No.80802B, or equivalent
Operating Position. Any
Weight (Approx.). 5.2 oz
Base. Medium-Shell Diheptal 14-Pin (JEDEC No.B14-38), Non-hygroscopic

ABSOLUTE-MAXIMUM RATINGS
DC Voltage:
Between anode and cathode. 2000 max. V
Between anode and dynode No.10. 250 max. V
Between consecutive dynodes. 400 max. V
Between dynode No.1 and cathode. 300 max. V
Between focusing electrode and cathode. 400 max. V
Average Anode Current. 0.5 max. mA
Ambient-Temperature Range. -100 to +85 °C
CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing voltages as shown in Table 1, except as noted.

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 4000 angstroms</td>
<td>$3.9 \times 10^4$</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Cathode Radiant at 4000 angstroms</td>
<td>0.079</td>
<td>-</td>
<td>A/W</td>
</tr>
</tbody>
</table>

Luminous:

| With tungsten light source   | 13          | 33    | 200   |
| With blue light source       | $2 \times 10^{-5}$ | $5 \times 10^{-5}$ | $3 \times 10^{-4}$ A |

Cathode Luminous:

| With tungsten light source   | $6.7 \times 10^{-5}$ | -     | A/Im  |
| With blue light source       | $8 \times 10^{-10}$  | $1 \times 10^{-9}$ | -     |

Quantum Efficiency

| at 4000 angstroms            | 24          | -     | %     |
| Current Amplification        | $5 \times 10^5$ | -     |       |
| Anode Dark Current           | $2.4 \times 10^{-10}$ | $5 \times 10^{-10}$ | A     |
| Equivalent Anode-Dark-Current Input | $3 \times 10^{-11}$ | -     | lm    |
| Dark-Pulse Spectrum          | (x)         | -     |       |
| Pulse-Height Resolution      | 9           | -     | %     |
| Anode-Pulse Rise Time        | $2.3 \times 10^{-9}$ | -     | s     |
| Electron Transit Time        | $2.7 \times 10^{-8}$ | -     |       |

Made by Corning Glass Works, Corning, New York 14830.
Made by Cinch Manufacturing Co., 1026 S. Homan Ave., Chicago, Ill. 60624
Made by James Millen Manufacturing Co., 150 Exchange St., Malden, Mass. 02148

*Averaged over any interval of 30 seconds maximum.
*Tube operation at room temperature or below is recommended.
*This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1190 lumens per watt.
This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1190 lumens per watt.

These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/1m)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.15 \times \text{Light Flux of 1 x 10}^{-5} \text{(1m)}}
\]

The value of 0.15 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions but with the blue filter removed.

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 10 microlumens.

This value is calculated as shown below:

\[
\text{Cathode Luminous Sensitivity (A/1m)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.15 \times \text{Light Flux of 1 x 10}^{-4} \text{(1m)}}
\]

The value of 0.15 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

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) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 100 microlumens and 200 volts are applied between cathode and all other electrodes connected as anode.

At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C. S. No.5-58, polished to 1/2 stock thickness). The light flux incident on...
the filter is 10 microlumens. The supply voltage \((E)\) is adjusted to obtain an anode current of 10 microamperes. Sensitivity of the 4518 under these conditions is approximately equivalent to 7 amperes per lumen. Dark current is measured with no light incident on the tube.

With supply voltage \((E)\) adjusted to give an equivalent luminous sensitivity of 7 amperes per lumen.

At 4000 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 1190 lumen per watt.

Measured under the following conditions: A Nuclear Data Model No. ND-180 Multichannel Pulse-Height Analyzer is used. The single-photoelectron pulse height is established by fully illuminating the photocathode with a weak light source, such as a tungsten-filament lamp operated at a low color temperature, to assure the high probability of single photoelectron emission from the photocathode of the 4518. The intensity of the light source is adjusted for approximately 50 per cent counting loss. The dark-pulse spectrum is then obtained, using the same gain setting of the Multichannel Pulse-Height Analyzer, with the light source removed.

Pulse-height resolution is defined as the quotient of the full width of the photopeak at half height by the pulse height at maximum count rate under the following conditions: The 662 keV photon from an isotope of cesium having an atomic mass of 137 \((\text{Cs}^{137})\) and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator \([\text{NaI}(\text{Tl})-\text{type 8D8}]\) are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio, and is rated by the manufacturer as having a resolution capability of 7.5%. The \text{Cs}^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 4518 by a coupling fluid such as Dow Corning Corp., Type DC200 (viscosity of 60,000 centistokes) — Manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

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 potential is adjusted as shown in Table 1.

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.

See accompanying Typical Dark-Pulse Spectrum.

<table>
<thead>
<tr>
<th>TABLE I</th>
</tr>
</thead>
</table>

**TYPICAL POTENTIAL DISTRIBUTION**

<table>
<thead>
<tr>
<th>Between:</th>
<th>7.75% of Supply Voltage (E) Multiplied by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.8</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>1.6</td>
</tr>
<tr>
<td>Dynode No.3 and Dynode No.4</td>
<td>1.2</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>12.9</td>
</tr>
</tbody>
</table>

Focusing Electrode is connected to arm of potentiometer between cathode and dynode No.1. The focusing-electrode voltage is varied between 10% and 60% of dynode No.1 potential (referred to cathode) to give maximum anode current.

**OPERATING CONSIDERATIONS**

The base pins of the 4518 fit a diheptal 14-contact socket, such as Cinch-Jones No.3M14 or equivalent. The socket should be made of high-grade, low-leakage material, and should be installed so that incident light falls on the face end of the tube.

The operating stability of the 4518 is dependent on the magnitude of the anode current. The use of an...
average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of microampere or less is recommended.

*Electrostatic and magnetic shielding* of the 4518 is ordinarily required. When a shield is used, it must be at cathode potential.

The *high voltages* at which the 4518 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.

*Accompanying typical voltage-divider arrangements* are recommended for use with the 4518. The resistance values for the voltage dividers range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for any 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 power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode.

The use of high resistance values per stage may cause deviation from linearity if the voltage-divide current is not maintained at a value of at least 10 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 tube socket terminals 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 resis-
tance values exceeding 10 megohms per stage make the
4518 more susceptible to leakage effects between ter-
mins with possible resulting deviation in interstage
voltage leading to a loss of current amplification.

**TYPICAL VOLTAGE-DIVIDER ARRANGEMENT**

**WHICH PERMITS DIRECT COUPLING TO THE ANODE**

![Circuit Diagram]

R₁ through R₇: 390,000 ohms, 1/2 watt
R₈: 470,000 ohms, 1/2 watt
R₉: 620,000 ohms, 1/2 watt
R₁₀: 560,000 ohms, 1/2 watt
R₁₁: 720,000 ohms, 1/2 watt
R₁₂: 5 megohms, 1/2 watt, adjustable

**Note 1:** Adjustable between approximately 500 and 2000 volts dc.

**Note 2:** Component values are dependent upon nature of appli-
cation and output signal desired.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS

Note 1: Adjustable between approximately 500 and 2000 volts dc.

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

Note 3: Component values are dependent upon nature of application and output signal desired.
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

DIMENSIONAL OUTLINE

DIMENSIONS IN INCHES

The dimensions 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.
### Sensitivity and Current-Amplification Characteristics

The supply voltage \( E \) is across a voltage-divider which distributes the voltage as follows:

<table>
<thead>
<tr>
<th>Between:</th>
<th>7.75% of ( E ) Multiplied by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode and Cathode</td>
<td>12.9</td>
</tr>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.8</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>1.5</td>
</tr>
<tr>
<td>Dynode No.3 and Dynode No.4</td>
<td>1.2</td>
</tr>
<tr>
<td>Each succeeding dynode stage</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**Focusing Electrode Voltage** is adjusted for maximum anode current.

The focusing electrode voltage is adjusted for maximum anode current. Each succeeding dynode stage is divided by 1.5. The supply voltage \( E \) between anode and cathode is shown in the diagram.

![Diagram showing sensitivity and current-amplification characteristics](image)

**RCA Electronic Components**

**DATA 6**

5-68
TYPICAL DARK-PULSE SPECTRUM

CATHODE-TO-DYNODE No.1 VOLTAGE = 280
DYNODE No.1-TO-DYNODE No.2 VOLTAGE = 220
DYNODE No.2-TO-DYNODE No.3 VOLTAGE = 230
DYNODE No.3-TO-DYNODE No.4 VOLTAGE = 185
EACH SUCCEEDING DYNODE-STAGE VOLTAGE = 155
ANODE-TO-CATHODE VOLTAGE = 2000
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO GIVE MAXIMUM ANODE CURRENT
DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE IS NORMALIZED TO COINCIDE WITH SINGLE PHOTOELECTRON PEAK OF DARK PULSE SPECTRUM AND IS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE.
DARK PULSES ARE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22°C.
ONE PHOTOELECTRON PULSE HEIGHT = 4 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 30 s, SEC. (R_L = 300 k, C = 100 pF).

\[ \sum_{1 \text{ photon}} \approx 7.7 \times 10^4 \text{ cpm} \]

\[ \sum_{4 \text{ photons}} \approx 7.7 \times 10^2 \text{ cpm} \]
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

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

<table>
<thead>
<tr>
<th>BETWEEN:</th>
<th>7.75% OF ( E ) MULTIPLIED BY:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND DYNODE No.1</td>
<td>1.8</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>1.5</td>
</tr>
<tr>
<td>DYNODE No.3 AND DYNODE No.4</td>
<td>1.2</td>
</tr>
<tr>
<td>EACH SUCCEEDING DYNODE STAGE</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE AND CATHODE</td>
<td>12.9</td>
</tr>
</tbody>
</table>

FOCUSING ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM ANODE CURRENT

TUBE TEMPERATURE = 22° C
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNOE No.1, 1/12 OF E FOR EACH SUCCESSING DYNOE STAGE; AND 1/12 OF E BETWEEN DYNOE No.10 AND ANODE. FOCUSING ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.

THE PHOTOCATHODE IS FULLY ILLUMINATED.

POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX OUT OF PAPER

RELATIVE ANODE CURRENT — PER CENT

MAGNETIC FIELD INTENSITY — OERSTEDS
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNOE No.1; 1/12 OF E FOR EACH SUCCESSING DYNOE STAGE; AND 1/12 OF E BETWEEN DYNOE No.10 AND ANODE. FOCUSING-ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.

THE PHOTOCATHODE IS FULLY ILLUMINATED.

POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION.

E=1500V

600V

MAGNETIC FIELD INTENSITY - OERSTEDS

RELATIVE ANODE CURRENT - PER CENT

RCA Electronic Components
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

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. Focusing-electrode voltage adjusted to give maximum anode current.

The photocathode is fully illuminated.

Positive values of magnetic field intensity (H) are for lines of flux in indicated direction.

Focusign-electrode voltage adjusted to give maximum anode current.

The photocathode is fully illuminated.

Positive values of magnetic field intensity (H) are for lines of flux in indicated direction.

Relative anode current - percent

-5 -4 -3 -2 -1 0 +1 +2 +3 +4 +5

Magnetic field intensity - oersteds

E = 1500V

E = 600V

Data 8

RCA Electronic Components

Electronic Components
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.

- **Time-Second**
- **Supply Volts (E) Between Anode and Cathode**

**Graph Details:**
- **Transit Time**
- **Rise Time**

**Graph Scale:**
- Supply Volts (E) range from 700 to 2000
- Time-Second range from 10^-8 to 4
Photomultiplier Tube

3"-Diameter, 10-Stage, Venetian-Blind Type Having a Bialkali Photocathode and Aluminum-Oxide Window

GENERAL

Spectral Response 

See Accompanying Typical Spectral Response Characteristics

Wavelength of Maximum Response: 4000 ± 500 Å

Cathode, Semitransparent: Potassium-Cesium-Antimony (Bialkali)

Minimum area: 5.27 in² (34.1 cm²)

Minimum diameter: 2.59 in (6.6 cm)

Window: Aluminum Oxide

Shape: Plano-Plano

Index of refraction at 4100 angstroms: 1.78

Dynodes:

Substrate: Copper-Beryllium

Secondary-Emitting Surface: Beryllium-Oxide

Structure: Venetian-Blind

Direct Interelectrode Capacitances (Approx.):

Anode to dynode No.10: 3.3 pF

Anode to all other electrodes: 8.9 pF

Maximum Overall Length: 5.86 in (14.8 cm)

Maximum Diameter: 3.065 in (7.75 cm)

Bulb: See Dimensional Outline

Base (Temporary): Small-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-45)

Socket: Cinch® No.3M14, or equivalent

Magnetic Shield: See Footnote b

Operating Position: Any

Weight (Approx.): 10.6 oz (300 g)

MAXIMUM RATINGS, Absolute-Maximum Values:

DC Supply Voltage:

Between anode and cathode: 2000 max. V

Between anode and dynode No.10: 300 max. V

Between consecutive dynodes: 250 max. V

Between dynode No.1 and cathode: 600 max. V

Between focusing electrode and cathode: 600 max. V

Average Anode Current: 0.5 max. mA

Ambient-Temperature Range: -100 to +85 °C
CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing the electrode voltages shown in Table I, except as noted, and at a temperature of 22°C.

With E = 1500 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^f at 4000 angstroms</td>
<td>–</td>
<td>1.9x10^4</td>
<td>–</td>
</tr>
<tr>
<td>Luminous^g (2870° K)</td>
<td>7.5</td>
<td>18</td>
<td>166</td>
</tr>
<tr>
<td>Current with blue light source^h (2870° K + C.S. No.5-58)</td>
<td>9x10^-6</td>
<td>2.2x10^-5</td>
<td>2x10^-4</td>
</tr>
<tr>
<td><strong>Cathode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant^i at 4000 angstroms</td>
<td>–</td>
<td>0.087</td>
<td>–</td>
</tr>
<tr>
<td>Luminous^j (2870° K)</td>
<td>6.7x10^-5</td>
<td>8.3x10^-5</td>
<td>–</td>
</tr>
<tr>
<td>Current with blue light source^k (2870° K + C.S. No.5-58)</td>
<td>8x10^-10</td>
<td>1x10^-9</td>
<td>–</td>
</tr>
<tr>
<td>Quantum Efficiency at 4000 angstroms</td>
<td>–</td>
<td>27</td>
<td>–</td>
</tr>
<tr>
<td><strong>Current Amplification:</strong></td>
<td>–</td>
<td>2.2x10^5</td>
<td>–</td>
</tr>
<tr>
<td><strong>Anode Dark Current^l</strong></td>
<td>–</td>
<td>2x10^-9</td>
<td>6x10^-9</td>
</tr>
<tr>
<td><strong>Equivalent Anode Dark Current Input^m</strong></td>
<td>–</td>
<td>2.7x10^-10</td>
<td>8x10^-10</td>
</tr>
<tr>
<td><strong>Equivalent Noise Input^n</strong></td>
<td>–</td>
<td>2.6x10^-13</td>
<td>7.7x10^-13</td>
</tr>
<tr>
<td><strong>Pulse Height Resolution^p</strong></td>
<td>–</td>
<td>1.8x10^-12</td>
<td>1.7x10^-15</td>
</tr>
<tr>
<td><strong>Mean Gain Deviation:</strong></td>
<td>–</td>
<td>7.5</td>
<td>–</td>
</tr>
<tr>
<td>With count rate change of 10,000 to 1,000cps^q</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>For period of 16 hours at a count rate of 10,000 cps^r</td>
<td>–</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td><strong>Anode-Pulse Rise Time^s,x</strong></td>
<td>–</td>
<td>1.3x10^-8</td>
<td>–</td>
</tr>
<tr>
<td>at 2000 V</td>
<td>–</td>
<td>5.8x10^-8</td>
<td>–</td>
</tr>
</tbody>
</table>

Electronic Components
Made by Cinch Manufacturing Company, 1501 Morse Avenue, Elk Grove Village, IL 60007.

Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago, IL, 60622, or equivalent.

Averaged over any interval of 30 seconds maximum.

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 1040 lumens per watt.

These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/Im) =} \quad \frac{\text{Anode Current with blue light source (A)}}{0.12 \times \text{Light Flux of} \ 1 \times 10^{-5} \text{ (Im)}}
\]

The value of 0.12 is the average value of the ratio of the anode current measured under the conditions specified in footnote (h) to the anode current measured with the blue filter removed.

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) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 10 microlumens.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1040 lumens per watt.

This value is calculated as shown below:

\[
\text{Cathode Luminous Sensitivity (A/Im) =} \quad \frac{\text{Cathode Current (with blue light source) (A)}}{0.12 \times \text{Light Flux of} \ 1 \times 10^{-4} \text{ (Im)}}
\]

The value of 0.12 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

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) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 1 x 10^{-4} lumen and 300 volts are applied between cathode and all other electrodes connected as anode.
Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 10 microlumens. The supply voltage \( E \) is adjusted to obtain an anode current of 9 microamperes. Sensitivity of the 4521 under these conditions is approximately equivalent to 7.5 amperes per lumen. Dark current is measured with no light incident on the tube.

At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1040 lumens per watt.

With a supply voltage \( E \) of 1100 volts. Anode load is a 100-kilohm resistor in parallel with a total capacitance of 100 pF. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photon from an isotope of cesium having an atomic mass of 137 (\( \text{Cs}^{137} \)) and a cylindrical 3" x 3" thallium-activated sodium-iodide scintillator [NaI (TI)-type 12A12, Serial No.DH184 or equivalent] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, OH. The \( \text{Cs}^{137} \) source is in direct contact with the metal end of the scintillator. The face-plate end of the crystal is coupled to the tube by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 60,000 centistokes) — Manufactured by the Dow Corning Corp., Midland, MI, or equivalent. Pulse-height resolution in per cent is defined at 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height \( A \) to the pulse height at maximum photopeak count rate \( B \).
At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1040 lumens per watt.

Under the following conditions: External shield connected to cathode, an equivalent bandwidth of 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.

Mean gain deviation is defined as follows:

\[ \text{Mean Gain Deviation (MGD)} = \frac{1}{n} \sum_{i=1}^{n} \frac{p_i}{\bar{p}} \times 100 \]

Where:

- \( \bar{p} \) = mean pulse height
- \( p_i \) = pulse height at the \( i^{th} \) reading
- \( n \) = total number of readings

Under the following conditions: The scintillator and Cs\(^{137} \) radiation source(s) are employed. The radiation source is initially centered, on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 10,000 cps. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 1,000 cps. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. Mean gain deviation is defined as shown in (t).

Under the same conditions as shown in (u) except the tube is operated for a period of 1/2 hour with the radiation source located at the point providing a pulse count rate of 10,000 cps. Following this time interval, the pulse height is sampled, at this count rate, at 1-hour intervals for a period of 16 hours. Mean gain deviation is defined as shown in (t).

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.
OPERATING CONSIDERATIONS

Terminal Connections

The 4521 is supplied with a small-shell diheptal base attached to semiflexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the 4521 in a given system.

SHIELDING

Electrostatic and magnetic shielding of the 4521 is usually required. When a shield is used it must be at cathode potential.

OPERATING VOLTAGES

The high voltages at which the 4521 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.

For additional information on this type write to RCA Commercial Engineering, Harrison, N.J. 07029 for technical bulletin.

<table>
<thead>
<tr>
<th>Voltage To Be Provided By Divider</th>
<th>7.7% of Supply Voltage (E) Multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between</td>
<td></td>
</tr>
<tr>
<td>Cathode and Dynode No.1</td>
<td>3</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1</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 Anode</td>
<td>1</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>13</td>
</tr>
</tbody>
</table>

The focus voltage shall be adjusted to the potential which gives maximum anode current and is between 70 and 100 per cent of dynode No.1 potential (referred to cathode).
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR GENERAL PHOTOMETRIC APPLICATIONS

R1 through R13: 470 kΩ, 5%, 1/2 W
R14: 5 MΩ, 20%, 1/2 W, (Adjustable)

Note 1: Adjustable between approximately 800 and 2000 volts dc.
Note 2: Component values are dependent upon nature of application and output signal desired.

BASE ARRANGEMENT
BOTTOM VIEW

Note 1: Lead is cut off near glass button for indexing.
Note 2: Leads 4, 8, 10, 14, 16, and 18 are cutoff near button.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR SCINTILLATION-COUNTING APPLICATIONS

C1: 0.05 µF, 500 volts
C2: 0.02 µF, 500 volts
C3: 0.01 µF, 500 volts
C4: 0.006 µF, 500 volts
C5 and C6: 0.005 µF, 3000 volts
R1 through R13: 470 kΩ, 5%, 1/2 W
R14: 5 MΩ, 20%, 1/2 W, (Adjustable)
R15: 1 MΩ, 5%, 1/2 W
RL: 100 kΩ, 5%, 1/2 W

Note 1: Adjustable between approximately 800 and 2000 volts dc.
Note 2: Capacitors C1 through C6 should be connected at tube socket for optimum high-frequency performance.
Note 3: The value of the load elements, RL and CL, depend on the application. For most applications, \( RL \times CL = 10 \) microseconds.
It is to be noted that R15 is in parallel with RL and must be considered when selecting the RL value.
Note 4: Component values are dependent upon nature of application and output signal desired.
LEAD CONNECTIONS
BOTTOM VIEW (WITH BASE REMOVED)

Lead 1: Photocathode
Lead 2: Dynode No.1
Lead 3: Dynode No.2
Lead 5: Dynode No.3
Lead 6: Dynode No.4
Lead 7: Dynode No.5
Lead 9: Dynode No.6

Lead 11: Dynode No.7
Lead 12: Dynode No.8
Lead 13: Dynode No.9
Lead 15: Dynode No.10

BASING DIAGRAM
BOTTOM VIEW (WITH TEMPORARY BASE)

DIRECTION OF RADIATION:
INTO END OF BULB

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

RCA
Electronic Components

DATA 5 2-70
Dimensions are in inches unless otherwise stated.

<table>
<thead>
<tr>
<th>Inch</th>
<th>mm</th>
<th>Inch</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>.006</td>
<td>.127</td>
<td>2.34</td>
<td>59.4</td>
</tr>
<tr>
<td>.025</td>
<td>.63</td>
<td>2.40</td>
<td>60.9</td>
</tr>
<tr>
<td>.030</td>
<td>.76</td>
<td>2.5</td>
<td>63.5</td>
</tr>
<tr>
<td>.08</td>
<td>2.0</td>
<td>2.59</td>
<td>66</td>
</tr>
<tr>
<td>.25</td>
<td>6.3</td>
<td>3.03</td>
<td>76.9</td>
</tr>
<tr>
<td>.75</td>
<td>19.1</td>
<td>4.86</td>
<td>123.4</td>
</tr>
<tr>
<td>2.0</td>
<td>50.8</td>
<td>5.86</td>
<td>148.8</td>
</tr>
</tbody>
</table>
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

DYNODE No. 1 - TO - CATHODE VOLTS = 3/13 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/13 E
ANODE - TO - DYNODE No. 10 VOLTS = 1/13 E
FOCUSING ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 70 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.

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

CURRENT AMPLIFICATION

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

800 1000 1500 2000 2500

92LM-3281

Electronic Components

DATA 6
2-70
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

SUPPLY VOLTAGE \( E \) ACROSS VOLTAGE DIVIDER PROVIDING 3/13 OF \( E \) BETWEEN CATHODE AND DYNODE NO.1; 1/13 OF \( E \) FOR EACH SUCCEEDING DYNODE STAGE; AND 1/13 OF \( E \) BETWEEN DYNODE NO.10 AND ANODE.

FOCUSING ELECTRODE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT. PHOTOCATHODE IS FULLY ILLUMINATED. TUBE IS ORIENTED IN MAGNETIC FIELD AS SHOWN BELOW:

Positive values of magnetic field intensity \( H \) are for lines of flux in indicated direction.

<table>
<thead>
<tr>
<th>MAGNETIC FIELD INTENSITY (H) OERSTEDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(-40)</td>
</tr>
<tr>
<td>(E = 750) VOLTS</td>
</tr>
<tr>
<td>(0)</td>
</tr>
</tbody>
</table>

Electronic Components

DATA 6
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).

DYNOKE No.1 - TO-CATHODE VOLTS = 3/13 E
EACH SUCCEEDING DYNOKE-STAGE VOLTS = 1/13 E

FOCUSING ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 70 PER CENT AND 100 PER CENT OF DYNOKE 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.
TYPICAL ANODE CHARACTERISTICS

DYNODE No 1 - TO - CATHODE VOLTS = 345
EACH SUCCEEDING DYNODE-STAGE VOLTS = 115
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE
BETWEEN 70 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.
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

WAVELENGTH — ANGSTROMS

1000 2000 3000 4000 5000 6000 7000

RELATIVE SENSITIVITY — PER CENT
ABSOLUTE SENSITIVITY — MILLI-WATT PER CENT
QUANTUM EFFICIENCY — PER CENT

RCA Electronic Components
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.
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-NO.5 VOLTS

DYNODE—No.1-TO—CATHODE VOLTS=200 VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE—NO.5 STAGE=100 FOCUSING—ELECTRODE VOLTAGE ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION. ANODE IS AT GROUND POTENTIAL.

RELATIVE ANODE CURRENT

DYNODE No.5 VOLTS (REFERRED TO ANODE)

92CM-11078R1

Electronic Components
TYPICAL TIME RESOLUTION CHARACTERISTICS

<table>
<thead>
<tr>
<th>DYNODE No.1-TO-CATHODE VOLTS</th>
<th>1/6 E</th>
</tr>
</thead>
<tbody>
<tr>
<td>EACH SUCCEEDING DYNODE-STAGE VOLTS</td>
<td>1/12 E</td>
</tr>
<tr>
<td>ANODE-TO-DYNODE No.10 VOLTS</td>
<td>1/2 E</td>
</tr>
</tbody>
</table>

FOCUSING ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 70 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.

PHOTOCATHODE IS FULLY ILLUMINATED.

TRANSIT TIME

RISE TIME

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE
Photomultiplier Tube

5-Inch Diameter, 14-Stage, Head-On Type
High Quantum Efficiency Bialkali Photocathode
In-Line Electrostatically-Focused Dynode Structure

For Use in Nuclear Physics Applications, Especially
When a High Degree of Time Definition is Required

GENERAL
Spectral Response

See accompanying Typical Spectral Response Characteristics

Wavelength of Maximum Response .... 4000 ± 500 Å
Cathode, Semitransparent ......... Cs-K-Sb (Bialkali)

Shape .......... Spherical Section
Minimum projected area .... 16 sq. in (103 sq. cm)
Minimum diameter ........ 4.5 in (11.4 cm)
Window . UV-transmitting, Corning® No. 9741, or Equivalent
Shape .......... Spherical Section
Index of refraction at 4047 angstroms .... 1.48

Dynodes:
Substrate ........ Copper-Beryllium
Secondary-Emitting Surface .... Beryllium-Oxide
Structure .......... In-Line Electrostatic-Focus

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No. 14 .... 5.5 pF
Anode to all other electrodes .... 7.0 pF

Maximum Overall Length .... 12 in (30.5 cm)
Maximum Diameter .... 5.25 in (13.3 cm)
Base .......... See Base Drawing
Socket .......... RCA-AJ2144 or AJ2145
Magnetic Shield .......... See Note (b)
Operating Position ........ Any
Weight (Approx.) .......... 21 oz (590 g)

MAXIMUM AND MINIMUM RATINGS, Absolute-Maximum Values
DC Supply Voltage:
Between anode and cathode:
With Voltage Distribution
A or B, shown in Table I .... 3000 max. V
With Voltage Distribution
C, shown in Table I .... 3500 max. V
Between anode and dynode No. 14 .... 600 max. V
Between dynode No. 14 & dynode No. 13 .... 800 max. V
Between other consecutive dynodes .... 400 max. V
Between dynode No. 1 and cathode .... \{ 800 max. V
\{ 300 min. V
Average Anode Current d .... 0.5 max. mA
Ambient-Temperature Range .... -100 to +85 °C

RCA Electronic Components

DATA 1
12-68
### CHARACTERISTICS RANGE VALUES

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>With a DC Supply Voltage (E) = 2000 volts (Except as noted)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Voltage Distribution A, Table I</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^e) at 4000 Å(^c)</td>
<td>–</td>
<td>2.6 x 10(^6)</td>
<td>– A/W</td>
</tr>
<tr>
<td>Luminous(^f) (2870°K)</td>
<td>6.5 x 10(^2)</td>
<td>2.3 x 10(^3)</td>
<td>6.5 x 10(^3) A/Im</td>
</tr>
<tr>
<td>With blue light source(^g) (2870°K + C.S. No.5-58)</td>
<td>8.5 x 10(^{-6})</td>
<td>3 x 10(^{-5})</td>
<td>8.5 x 10(^{-5}) A</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^h) at 4000 Å</td>
<td>–</td>
<td>8.8 x 10(^{-2})</td>
<td>– A/W</td>
</tr>
<tr>
<td>Luminous(^i) (2870°K)</td>
<td>–</td>
<td>7.7 x 10(^{-5})</td>
<td>– A/Im</td>
</tr>
<tr>
<td>With blue light source(^k) (2870°K + C.S. No.5-58)</td>
<td>8 x 10(^{-10})</td>
<td>1 x 10(^{-9})</td>
<td>– A</td>
</tr>
<tr>
<td>Cathode Quantum Efficiency at 3600 Å</td>
<td>–</td>
<td>29</td>
<td>– %</td>
</tr>
<tr>
<td>Current Amplification...</td>
<td>–</td>
<td>3 x 10(^{-7})</td>
<td>–</td>
</tr>
<tr>
<td>Anode Dark Current(^m)...</td>
<td>–</td>
<td>6 x 10(^{-8})</td>
<td>1 x 10(^{-8}) A</td>
</tr>
<tr>
<td>Equivalent Anode Dark Current Input...</td>
<td>–</td>
<td>3 x 10(^{-11n})</td>
<td>5 x 10(^{-10n}) Im</td>
</tr>
<tr>
<td>Dark Current Input...</td>
<td>–</td>
<td>2.6 x 10(^{-14p})</td>
<td>– W</td>
</tr>
</tbody>
</table>

With E = 2500 volts

**Voltage Distribution B, Table I**

- Pulse Height Resolution\(^q\) | – | 7.5 | – % |
- Mean Gain Deviation\(^r\)... | – | 1 | – % |
- Dark Pulse Spectrum... | See Typical Dark Pulse Spectrum |

With E = 3000 volts

**Voltage Distribution A, Table I**

- Anode-Pulse Rise Time... | – | 2.9 x 10\(^{-9}\) | – s |
- Electron Transit Time... | – | 6.6 x 10\(^{-8}\) | – s |

With E = 3000 volts

**Voltage Distribution C, Table I**

- Pulse Current:\(^u\)
  - Linear... | – | 0.13 | – A |
  - Saturated... | – | 0.32 | – A |
Magnetic shielding is available from manufacturers such as the Magnetic Shield Division, Perfection Mica Co., 1322 North Elston, Chicago 22, Illinois.

Averaged over any 500-microsecond interval.

This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/1m)} = \frac{\text{Anode Current (with blue light source)} (\text{A})}{0.13 \times \text{Light Flux of } 1 \times 10^{-7} \text{ (lm)}}
\]

The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote (k) to the cathode current measured under the same conditions but with the blue filter removed.

Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.1 microlumen.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

These values are calculated as shown below:

\[
\text{Cathode Luminous Sensitivity (A/1m)} = \frac{\text{Cathode Current (with blue light source)} (\text{A})}{0.13 \times \text{Light Flux of } 1 \times 10^{-4} \text{ (lm)}}
\]

The value of 0.13 is an average value. (See footnote f.)

Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 100 microlumens and 300 volts are applied between cathode and all other electrodes connected as anode.

At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 0.1 micromicron. The supply voltage E is adjusted to obtain an anode current of 26 microramperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 2000 amperes per lumen. Dark current is measured with incident light removed.
With supply voltage E adjusted to give a calculated value of anode luminous sensitivity of 2000 amperes per lumen.

At 4000 A. Calculated from the luminous EADCI value using a conversion factor of 1140 lumens per watt.

With a supply voltage E of 2500 volts across a voltage divider providing electrode voltages shown in Table I, Distribution B. Anode load is a 10-kilohm resistor in parallel with a total capacitance of 1000 pF. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. 662 keV photons from a one-microcurie Cs\(^{137}\) source and a cylindrical 5" dia. x 4" thallium-activated sodium-iodide scintillator NaI (TI-type Harshaw\(^*\)20A16, Serial No.CW-675 or equivalent are used. The Cs\(^{137}\) source is in direct contact with the metal end of the scintillator container. The faceplate end of the crystal is coupled to the faceplate adapter (RCA-AJ2142) by an optical coupling material such as Dow Corning\(^*\)20-057.

Under the same conditions as shown in (q) except the tube is operated for a period of 1 hour with the radiation source located at the point providing a pulse count rate of 1000 counts per second. Following this time interval, the pulse height is sampled at 1-hour intervals for a period of 24 hours.

Using a pulsed light source having a pulse duration of 0.5 microsecond and repetition rate of 30 pulses per second. The interstage voltages of the tube should not deviate more than 2 per cent from the recommended voltage distribution shown by Voltage Distribution C of Table I. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure this operating condition.

Maximum deviation from linearity is 5 per cent.

Made by Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio.

*Made by Dow Corning Corp., Midland, Michigan.

OPERATING CONSIDERATIONS
The base pins of the tube fit a 21-contact socket such as the RCA-AJ2144 and AJ2145. The 4522 can replace types 58AVP and 580VP by use of Socket Adapter, RCA-AJ2143.

The operating stability of the 4522 is dependent on the magnitude of the average anode current.

The use of an average anode current well below the
the maximum rated value of 500 microamperes is recommended when stability of operation is important. When maximum stability is required, the average anode current should not exceed 0.1 microampere.

Magnetic shielding of the tube is generally required. Magnetic shielding materials are available from manufacturers such as the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston, Chicago 22, Illinois. The curves under Typical Voltage-Divider arrangements show the effect of magnetic fields on anode current under the conditions indicated. With increase in voltage between anode and cathode, the effect of a given magnetic field will cause less decrease in anode current.

The high voltages at which the tube is operated are very dangerous. Care should be taken in the design of apparatus to prevent personnel from coming in contact with these high voltages. Precautions should include the enclosure of high-voltage 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.

Accompanying typical voltage-divider arrangements are recommended for use with the 4522. The choice of resistance values for the voltage-divider string is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the supply and the required wattage rating of the resistors increase. Phototube noise may also increase, due to heating, if the divider network is mounted near the tube. The use of high values of resistance per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum average anode current and may limit anode current response to pulsed light.

The supply voltage may be applied in 500-volt steps up to 2000 volts, and 200-volt steps from 2000 to 3000
volts and with no less than 1 minute between each step.

OPERATING VOLTAGES
Table I shows three electrode voltage distributions recommended for the 4522.
Voltage Distribution A is used to measure the tube performance values listed under Characteristic Range Values and is suggested for general purpose applications.
Voltage Distribution B is recommended where high dynode-No.1 gain is important, such as in low light level and scintillation counting applications. Voltage Distribution B maintains the cathode-to-dynode-No.1 voltage at 660 volts; it is especially useful when the supply voltage is adjusted over a wide range to achieve large changes in anode sensitivity. A suggested circuit using voltage distribution B is shown under Typical Circuit Arrangement for Scintillation-Counting Applications.
Voltage Distribution C is recommended for high peak-pulse current applications.

TYPICAL FOCUSING ELECTRODE CHARACTERISTIC
### TABLE I

<table>
<thead>
<tr>
<th>Between the following Electrodes:</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode (K), Dynode (Dy), and Anode (P)</td>
<td>5.9% of K-P Voltage (E) Multiplied by:</td>
<td>6.9% of Dy1-P Voltage (E) Multiplied by:</td>
<td>3.85% of K-P Voltage (E) Multiplied by:</td>
</tr>
<tr>
<td>K - Dy1</td>
<td>3</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Dy1 - Dy2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy2 - Dy3</td>
<td>1</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Dy3 - Dy4</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy4 - Dy5</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy5 - Dy6</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy6 - Dy7</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy7 - Dy8</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy8 - Dy9</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy9 - Dy10</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy10 - Dy11</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy11 - Dy12</td>
<td>1</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>Dy12 - Dy13</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dy13 - Dy14</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Dy14 - P</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dy1 - P</td>
<td></td>
<td>14.5</td>
<td></td>
</tr>
<tr>
<td>K - P</td>
<td>17</td>
<td></td>
<td>26</td>
</tr>
</tbody>
</table>

Focusing electrode\(^\Delta\) is connected to Dynode-No.1 voltage.

- Use distribution B for optimum pulse-height resolution performance. See Operating Voltages.
- Cathode-to-Dynode-No.1 Voltage maintained at 660 volts.
- Focusing electrode may be connected to arm of potentiometer between cathode and dynode No.1; the focusing-electrode voltage is varied to give maximum anode current.
RESPONSE AND HIGH PEAK CURRENT APPLICATIONS
PARTS LIST FOR TYPICAL CIRCUIT ARRANGEMENTS FOR SCINTILLATION COUNTING APPLICATIONS

<table>
<thead>
<tr>
<th>C</th>
<th>Value</th>
<th>DC Voltage</th>
<th>Capacitor Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁</td>
<td>0.05 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₂</td>
<td>0.02 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₃</td>
<td>0.01 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₄</td>
<td>0.005 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₅ &amp; C₆</td>
<td>0.0047 µF</td>
<td>6000 V</td>
<td>Ceramic-Disc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R₁ through R₁₂</th>
<th>Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁₂</td>
<td>51 KΩ</td>
<td>5% 1 W</td>
</tr>
<tr>
<td>R₁₃</td>
<td>75 KΩ</td>
<td>5% 1 W</td>
</tr>
<tr>
<td>R₁₄</td>
<td>51 KΩ</td>
<td>5% 1 W</td>
</tr>
<tr>
<td>R₁₅</td>
<td>100 KΩ</td>
<td>5% 1/2 W</td>
</tr>
</tbody>
</table>

Z: (2)-150 V, 1 W zener diodes, or equivalent
(2)-180 V, 1 W zener diodes, or equivalent

Note: The value of the load elements, R_L and C_L, depend on the application:
R_L * C_L = 10 microseconds for most applications

PARTS LIST FOR TYPICAL CIRCUIT ARRANGEMENT FOR FAST PULSE RESPONSE AND HIGH PEAK CURRENT APPLICATIONS

**Fast Pulse Response Applications, to 3000V**

<table>
<thead>
<tr>
<th>C</th>
<th>Value</th>
<th>DC Voltage</th>
<th>Capacitor Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁</td>
<td>0.005 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₂</td>
<td>0.01 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₃</td>
<td>0.02 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₄</td>
<td>0.05 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>R₁</td>
<td>300 KΩ</td>
<td>5% 1/2 W</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R₂ through R₁₅</th>
<th>Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁₂</td>
<td>100 KΩ</td>
<td>5% 1/2 W</td>
</tr>
</tbody>
</table>

**High Peak Current Applications, to 3500V**

<table>
<thead>
<tr>
<th>C</th>
<th>Value</th>
<th>DC Voltage</th>
<th>Capacitor Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₁</td>
<td>0.005 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₂</td>
<td>0.01 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₃</td>
<td>0.02 µF</td>
<td>1000 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>C₄</td>
<td>0.05 µF</td>
<td>500 V</td>
<td>Ceramic-Disc</td>
</tr>
<tr>
<td>R₁</td>
<td>168 KΩ</td>
<td>3-100 KΩ</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>R₂, R₄ through R₁₁</th>
<th>Value</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁₂</td>
<td>27 KΩ</td>
<td>5% 1 W</td>
</tr>
<tr>
<td>R₁₃, R₁₄</td>
<td>39 KΩ, 2 KΩ</td>
<td>5%, 2 W</td>
</tr>
<tr>
<td>R₁₅</td>
<td>54 KΩ</td>
<td>2-27 KΩ</td>
</tr>
<tr>
<td>R₁₆</td>
<td>108 KΩ</td>
<td>4-27 KΩ</td>
</tr>
</tbody>
</table>

Note: Leads to all capacitors should be as short as possible to minimize inductance effects. Location and spacing of capacitors is critical and may require adjustment for optimum results.
TYPICAL CIRCUIT ARRANGEMENT FOR FAST PULSE RESPONSE AND HIGH PEAK CURRENT APPLICATIONS

[Diagram of a circuit diagram with labels and connections.]

1000 to 3500 V REGULATED DC POWER SUPPLY

RCA Electronic Components
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)

Dimensions in Inches (mm)

SEE NOTE

PHOTOCATHODE

5.06 ± 0.02
(128.52 ± 0.51)

5.25 MAX. DIA.
(133.4)

5.10 ± 0.02R
(130 ± 0.51)

1/2

1.5

11.25 ± 0.15
(285.6 ± 3.8)

0.862
(21.9)

3.00 ± 0.16
(76.2 ± 4.1)

SEE DETAIL OF BASE

Note:
Care must be taken in mounting the tube so that the tube envelope is not subjected to excessive pressure which could strip the glass-to-metal seals. In no case should mounting supports be used in the shaded areas.

BASING DIAGRAM (Bottom View)
Pin No. 1: Internally connected - Do not use.
Pin No. 2: Internally connected - Do not use.
Pin No. 3: Dynode No. 1
Pin No. 4: Dynode No. 3
Pin No. 5: Dynode No. 5
Pin No. 6: Dynode No. 7
Pin No. 7: Dynode No. 9
Pin No. 8: Dynode No. 11
Pin No. 9: Dynode No. 13
Pin No. 10: Anode
Pin No. 11: Dynode No. 14
Pin No. 12: Dynode No. 12
Pin No. 13: Dynode No. 10
Pin No. 14: Dynode No. 8
Pin No. 15: Dynode No. 6
Pin No. 16: Dynode No. 4
Pin No. 17: Dynode No. 2
Pin No. 18: Internally connected - Do not use.
Pin No. 19: Internally connected - Do not use.
Pin No. 20: Focusing Electrode
Pin No. 21: Photocathode and Tube Envelope

DETAIL OF BASE

PLASTIC SPACER
TYPICAL TIME RESOLUTION CHARACTERISTICS

![Graph showing voltage distribution and time characteristics.]

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

![Graph showing spectral response characteristics including relative sensitivity, absolute sensitivity, and quantum efficiency.]

RCA Electronic Components

DATA 7 12-68
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

VOLTAGE DISTRIBUTION A OR B AS SHOWN ON CURVE, TABLE 1.

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

Supply Voltage (E) - Volts

Current Amplification

Electronic Components DATA 7
TYPICAL DARK-PULSE SPECTRUM

VOLTAGE DISTRIBUTION B, TABLE 1.
SUPPLY VOLTAGE (E) = 2500 VOLTS.
DASHED PORTION INDICATES LOCATION
OF SINGLE PHOTOELECTRON PEAK AND
IS NORMALIZED TO COINCIDE WITH THE
DARK PULSE SINGLE PHOTOELECTRON
PEAK.
THIS CURVE WAS MEASURED WITH A LOW
INTENSITY LIGHT SOURCE TO INSURE
LOW PROBABILITY OF COINCIDENT
PHOTOELECTRON EMISSION. DARK
PULSES WERE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-
PULSE SPECTRUM.
TUBE TEMPERATURE = 22°C
ONE-PHOTOELECTRON PULSE HEIGHT =
4 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 10 ms
(R = 10 kΩ C = 1000 pF)

\[ \sum_{i=1}^{32} = 3.0 \times 10^4 \text{ COUNTS/MIN.} \]
\[ 1 \text{ PHOTOELECTRON} \]

\[ \sum_{i=1}^{32} = 2.2 \times 10^3 \text{ COUNTS/MIN.} \]
\[ 4 \text{ PHOTOELECTRONS} \]
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

DISTRIBUTION A, TABLE 1: SUPPLY VOLTAGE (E) AS SHOWN ON CURVE. PHOTOCATHODE IS FULLY ILLUMINATED. TUBE IS ORIENTED IN MAGNETIC FIELD AS SHOWN.

POSITIVE VALUE OF H IN DIRECTION SHOWN:

* DIRECTION (1) IS OUT OF PAPER

RELATIVE ANODE CURRENT PER CENT

MAGNETIC FIELD INTENSITY (H) - OERSTEDS

E = 2500V
E = 1000V

E = 2500V
E = 1000V

E = 2500V
E = 1000V

92LL-2475RI
**Photomultiplier Tubes**

2-INCH DIAMETER—4523  
3-INCH DIAMETER—4524  
5-INCH DIAMETER—4525

**10-STAGE, HEAD-ON TYPE**  
**BIALKALI PHOTOCATHODE OF VENETIAN-BLIND DYNODE STRUCTURE**  
**HIGH QUANTUM EFFICIENCY**

*For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation*

**GENERAL**

**Spectral Response**  
See Typical Spectral Response Characteristics

**Wavelength of Maximum Response**  
4000 ± 500 angstroms

**Cathode, Semitransparent**  
Cs-K-Sb (Bialkali)

**Shape**  
Flat, Circular

**Minimum area**:
- **4523**: 2.20 sq in
- **4524**: 5.27 sq in
- **4525**: 15.1 sq in

**Minimum diameter**:
- **4523**: 1.68 in
- **4524**: 2.59 in
- **4525**: 4.38 in

**Window**  
Corning® No.0080, or equivalent

**Shape**  
Plano-Plano

**Index of refraction at 4360 angstroms**  
1.523

**Dynodes**

**Substrate**  
Cu-Be6

**Secondary-emitting surface**  
Be-0

**Structure**  
Venetian-Blind

**Direct Interelectrode Capacitances (Approx.)**

<table>
<thead>
<tr>
<th>Anode to dynode No.10</th>
<th>7 pF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode to all other electrodes</td>
<td>8.5 pF</td>
</tr>
</tbody>
</table>

**Maximum Overall Length**

<table>
<thead>
<tr>
<th>4523</th>
<th>4.87 ± 0.19 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>4524</td>
<td>5.38 ± 0.19 in</td>
</tr>
<tr>
<td>4525</td>
<td>6.75 ± 0.19 in</td>
</tr>
</tbody>
</table>

**Seated Length**

<table>
<thead>
<tr>
<th>4523</th>
<th>2.31 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>4524</td>
<td>3.06 in</td>
</tr>
<tr>
<td>4525</td>
<td>5.31 in</td>
</tr>
</tbody>
</table>

**Maximum Diameter**

<table>
<thead>
<tr>
<th>4523</th>
<th>5.81 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>4524</td>
<td>6.31 in</td>
</tr>
<tr>
<td>4525</td>
<td>7.69 in</td>
</tr>
</tbody>
</table>

**Envelope**

<table>
<thead>
<tr>
<th>4523</th>
<th>T16</th>
</tr>
</thead>
<tbody>
<tr>
<td>4524</td>
<td>J24</td>
</tr>
<tr>
<td>4525</td>
<td>J42</td>
</tr>
</tbody>
</table>

**Socket**

Cinch® No.3M14, or equivalent
Magnetic Shield

4523. ... JAN Part No. S-2004, or equivalent
4524. ... Millen Part No. 80803J, or equivalent
4525. ... Millen Part No. 80805M, or equivalent

Operating Position. ... Any

Weight (Approx.)

4523. ... 7 oz
4524. ... 9 oz
4525. ... 1 lb 7 oz

Base. ... Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No. B14-38)

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

 Unless indicated otherwise, the following ratings and characteristic range values apply to all types

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage
Between anode and cathode ... 2500 V
Between anode and dynode No. 10 ... 300 V
Between consecutive dynodes ... 300 V
Between dynode No. 1 and cathode ... 600 V
Between focusing electrode and cathode ... 600 V

Average Anode Current* ... 0.5 mA

Ambient-Temperature Range* ... -100 to +85 °C

DATA 1
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
CHARACTERISTIC 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, except as noted. 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 = 1500 volts except as noted

<table>
<thead>
<tr>
<th>Characteristic</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 4000 angstroms</td>
<td>-</td>
<td>3.2x10^3</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant at 4000 angstroms:</td>
<td>-</td>
<td>0.071</td>
<td>-</td>
</tr>
<tr>
<td>4523, 4524</td>
<td>-</td>
<td>0.08</td>
<td>-</td>
</tr>
<tr>
<td>4525</td>
<td>-</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source:</td>
<td>10</td>
<td>27</td>
<td>100</td>
</tr>
<tr>
<td>With blue light source:</td>
<td>1.5x10^-5</td>
<td>4x10^-5</td>
<td>1.5x10^-4</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source</td>
<td>-</td>
<td>6x10^-5</td>
<td>-</td>
</tr>
<tr>
<td>4523, 4524</td>
<td>-</td>
<td>6.7x10^-5</td>
<td>-</td>
</tr>
<tr>
<td>4525</td>
<td>-</td>
<td></td>
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<tr>
<td>With blue light source</td>
<td>7x10^-10</td>
<td>8x10^-9</td>
<td>-</td>
</tr>
<tr>
<td>4523, 4524</td>
<td>7x10^-10</td>
<td>1x10^-10</td>
<td>-</td>
</tr>
<tr>
<td>4525</td>
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<tr>
<td>Quantum efficiency at 4000 angstroms:</td>
<td>-</td>
<td>22</td>
<td>-</td>
</tr>
<tr>
<td>4523, 4524</td>
<td>-</td>
<td>25</td>
<td>-</td>
</tr>
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<td>4525</td>
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<tr>
<td>Current Amplification</td>
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</tr>
<tr>
<td>4523, 4524</td>
<td>-</td>
<td>4.5x10^6</td>
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</tr>
<tr>
<td>4525</td>
<td>-</td>
<td>4x10^6</td>
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</tr>
<tr>
<td>Anode Dark Current</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>4523</td>
<td>-</td>
<td>5x10^-10</td>
<td>3x10^-9</td>
</tr>
<tr>
<td>4524</td>
<td>-</td>
<td>1x10^-9</td>
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<td>Equivalent Anode—Dark—Current Input</td>
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<tr>
<td>4523</td>
<td>-</td>
<td>3.8x10^-11</td>
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<td>4524</td>
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<tr>
<td>4525</td>
<td>-</td>
<td>9.3x10^-14</td>
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<td>Dark-Pulse Spectrum</td>
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<tr>
<td>Pulse Height Resolution</td>
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<td>7.5</td>
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</tbody>
</table>

*RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N.J.*
Mean Gain Deviation* u

With count rate change
of 10,000 to 1,000 Hz.
For period of 16 hours at
a count rate of 10,000 Hz.

Anode Pulse Rise Time x

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>4523</td>
<td>1.2x10^-3</td>
<td>1.4x10^-3</td>
<td>1.8x10^-3</td>
</tr>
<tr>
<td>4524</td>
<td>5.9x10^-3</td>
<td>6.5x10^-3</td>
<td>1.1x10^-7</td>
</tr>
<tr>
<td>4525</td>
<td>5.9x10^-3</td>
<td>6.5x10^-3</td>
<td>1.1x10^-7</td>
</tr>
</tbody>
</table>

Electron Transit Time y

<table>
<thead>
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<th>Min</th>
<th>Typ</th>
<th>Max</th>
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<tbody>
<tr>
<td>4523</td>
<td>1.2x10^-3</td>
<td>1.4x10^-3</td>
<td>1.8x10^-3</td>
</tr>
<tr>
<td>4524</td>
<td>5.9x10^-3</td>
<td>6.5x10^-3</td>
<td>1.1x10^-7</td>
</tr>
<tr>
<td>4525</td>
<td>5.9x10^-3</td>
<td>6.5x10^-3</td>
<td>1.1x10^-7</td>
</tr>
</tbody>
</table>

* Made by Corning Glass Works, Corning, New York.
* Made by Cinch Manufacturing Company, 1026 South Israeli Avenue, Chicago 24, Illinois.
* Made by JAN Hardware Manufacturing Corp., 30-01, Queens Blvd., Long Island City 1, N.Y.
* Averaged over any interval of 30 seconds maximum.
* Tube operation at or below room temperature is recommended.
* This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1190 lumens per watt.
* This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1190 lumens per watt.
* These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source)}(A)}{0.15 \times \text{Light Flux of 1 x 10}^{-5} \text{ (lm)}}
\]

The value of 0.15 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions but with the blue filter removed.

(k) Under the following conditions: Light incident on the anode 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 10 micro-

\[
\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source)}(A)}{0.15 \times \text{Light Flux of 1 x 10}^{-4} \text{ (lm)}}
\]

The value of 0.15 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (n) to the cathode current measured under the same conditions but with the blue filter removed.

(n) 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 1 x 10^-4 lumen and 300 volts are applied between cathode and all other electrodes connected as anode.

(p) At a tube temperature of 22°C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 10 micro-

\[
\text{Sensitivity of these types under these conditions is approximately equivalent to 13 amperes per lumen. Dark current is measured with no light incident on the tube.}
\]
With supply voltage adjusted to give an equivalent luminous sensitivity of 13 amperes per lumen.

At 4000 angstroms. This value is calculated from the EADC1 value in lumens using a conversion factor of 1190 lumens per watt.

With the following voltage distribution: 3/13 of E between cathode and dynode No.1, 1/3 of E for each succeeding dynode stage, and 1/3 of E between dynode No.10 and anode. 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.

Pulse height resolution is defined as the quotient of the full width of the photopeak at half height by the pulse height at maximum count rate under the following conditions: The 662 kev photon from an isotope of cesium having an atomic mass of 137 (Ca137) and a cylindrical 2 inch x 2 inch (for 4523), 3 inch x 3 inch (for 4524 or 4525) thallium-activated sodium-iodide scintillator [NaI(T1)-type 808 (for 4523), 12012 (for 4524 or 4525)] are used. The scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio, and is rated by the manufacturer as having a resolution capability of 7.5%. The Ca137 source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the types 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.

Mean Gain Deviation is defined as follows:

$$\frac{1}{n} \sum_{i=1}^{n} \left( \frac{G_i}{G_{\text{avg}}} - 1 \right)$$

where $G_i$ = mean pulse height at the $i$th reading
$n$ = total number of readings

Under the following conditions: The scintillator and Ca137 radiation source of (1) are employed. The radiation source is initially centered on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 10,000 Hz. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 1,000 Hz. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. Mean gain deviation is defined as shown in (u).

Under the same conditions as shown in (v) except the tube is operated for a period of 1/2 hour with the radiation source located at the point providing pulse count rate of 10,000 Hz. Following this time interval, the pulse height is sampled at this count rate at 1-hour intervals for a period of 16 hours. Mean gain deviation is defined as shown in (w).

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**

The base pins of these types fit a diheptal 14-contact socket, such as Cinch No.3M14, or equivalent. The socket should be made of high-grade, low-leakage material, and should be installed so that incident light falls on the face end of the tube.

The operating stability of these types are dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of 1 microampere or less, commensurate with...
Electrostatic and magnetic shielding of these types may be required in some applications. When a shield is used, it must be at cathode potential.

The high voltages at which these types are 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.

Accompanying Typical Voltage-Divider Arrangements are recommended for use with these types. Recommended resistance values for the voltage dividers range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for any 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 mounted 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 of at least 10 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 tube socket terminals 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 nonlinearity and pulse-limiting effects, the use of resistance values exceeding 1 megohm per stage make these types more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR GENERAL PHOTOMETRIC APPLICATIONS

4523 4524 4525

\( R_1 \) through \( R_{12} \): 470,000 ohms, 1/2 watt
\( R_{13} \): 5 megohms, 1/2 watt, adjustable

Note 1: Adjustable between approximately 800 and 2500 volts dc.

Note 2: Component values are dependent upon nature of application and output signal desired.
Typical Voltage-Divider Arrangement for Scintillation Counter Applications

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)
C5 and C6: 0.005 μF, 3000 volts (dc working)
R1 through R10: 470,000 ohms, 1/2 watt
R11 and R12: 750,000 ohms, 1/2 watt
R13: 5 megohms, 1/2 watt, adjustable
R14: 1 megohm, 1/2 watt
R15: 100,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 800 and 2500 volts dc.
Note 2: Capacitors C1 through C5 should be connected at tube socket for optimum high-frequency performance.
Note 3: Component values are dependent upon nature of application and output signal desired.
DIMENSIONAL OUTLINE

4523

FACEPLATE
(SEE NOTE)

PHOTOCATHODE

BASE
JEDEC GROUP 5,
NaB14-38

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 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.100 inch from peak to valley.
DIMENSIONAL OUTLINE
4524

FACEPLATE
(SEE NOTE)

J24 BULB

BASE
JEDEC GROUP 5
No. 814-38

PHOTOCATHODE

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

10-Stage Dormer-Window Type Having Multialkali Photocathode Deposited on a Reflective Substrate

- Detects Low-Level Light Signals in Presence of Relatively High Background Illumination
- Highly Suitable for Star-Tracking and Laser Detection Systems to Approximately 8000 Angstroms

**General Data**

<table>
<thead>
<tr>
<th>Spectral Response</th>
<th>See Fig.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength of Maximum Response</td>
<td>5300 ± 500 Å</td>
</tr>
</tbody>
</table>

**Cathode. Semitransparent**

| Potassium-Sodium-Cesium-On Reflective Substrate Antimony (Multialkali) |
| Concave Spherical Surface |

**Minimum projected length on plane of window** 0.65 in (16.5 mm)

**Minimum projected width on plane of window** 0.50 in (12.7 mm)

**Window Shape**

| Corning® No.0080, or equivalent |
| Rectangular |

**Minimum projected length on plane of window** 0.65 in (16.5 mm)

**Minimum projected width on plane of window** 0.50 in (12.7 mm)

**Index of refraction at 5893 angstroms** 1.51

**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 pF |
| Anode to all other electrodes | 6.5 pF |

**Maximum Overall Length**

(Excluding leads and attached base) 3.01 in (76.4 mm)

**Maximum Diameter** 1.56 in (39.6 mm)

**Base (Temporary)**

| Small-Shell Duodecal 12-Pin JEDEC No.B12-43 |

**Socket**

| Eby® Part No.9058. or equivalent |

**Bulb**

| T12 with Special End Contour |

**Magnetic Shield**

| Millen® Part No.80802M, or equivalent |

**Operating Position**

| Any |

**Weight (Approx.)**

| With base attached | 3 oz (85.1 g) |
| Without base | 2 oz (56.7 g) |

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

**DC Supply Voltage:**

| Between anode and cathode | 2000 max. V |
| Between anode and dynode No.10 | 250 max. V |
| Between consecutive dynodes | 300 max. V |
| Between dynode No.1 and cathode | 400 max. V |

**Average Anode Current**

| 100 max. µA |

**Ambient Temperature**

| 85 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 = 1250 volts except as noted

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 5300 angstroms</td>
<td></td>
<td>4.4 x 10^3</td>
<td></td>
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<tr>
<td>Luminous (2870 K)</td>
<td>5</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 5300 angstroms</td>
<td></td>
<td>8.9 x 10^-2</td>
<td>5</td>
</tr>
<tr>
<td>Luminous (2870 K)</td>
<td></td>
<td>2 x 10^-4</td>
<td>3 x 10^-4</td>
</tr>
<tr>
<td>With red light (2870 K + C.S.)</td>
<td>8 x 10^-8</td>
<td>1.2 x 10^-7</td>
<td></td>
</tr>
<tr>
<td>No.2-62 filter</td>
<td>5</td>
<td>9 x 10^-9</td>
<td></td>
</tr>
<tr>
<td>With blue light (2870 K + C.S.)</td>
<td>7 x 10^-9</td>
<td>9 x 10^-9</td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 5000 angstroms</td>
<td>21</td>
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<td></td>
</tr>
<tr>
<td>Current Amplification</td>
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<td>5 x 10^4</td>
<td></td>
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<tr>
<td>Anode Dark Current</td>
<td></td>
<td>2 x 10^-9</td>
<td>1 x 10^-8</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input</td>
<td>1 x 10^-10</td>
<td>5 x 10^-10</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.4 x 10^-13</td>
<td>1.7 x 10^-12</td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>1.5 x 10^-12</td>
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<tr>
<td></td>
<td></td>
<td>5.1 x 10^-15</td>
<td></td>
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</table>

With E = 1500 volts

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Pulse Rise Time</td>
<td></td>
<td>2 x 10^-9</td>
<td></td>
</tr>
<tr>
<td>Electron Transit Time</td>
<td></td>
<td>2 x 10^-8</td>
<td></td>
</tr>
</tbody>
</table>

a Made by Corning Glass Works, Corning, New York.
b Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia 44, Pa. This socket mates with the temporary B12-43 base and is not required after initial testing of the tube.
c Made by James Millen Manufacturing Co., 150 Exchange Street, Malden 48, Mass.
d A description of the Absolute-Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes.
e Averaged over any interval of 30 seconds maximum.
f This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 295 lumens per watt.
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 and a light input of 1 microlumen is used.
This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 295 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 0.001 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 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 0.001 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 5300 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 295 lumens per watt.

Under the following conditions: Supply voltage (E) is as shown, 22° C tube temperature, 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 5300 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 295 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.
DIMENSIONAL OUTLINE

Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

### Inch Dimension Equivalents in Millimeters

<table>
<thead>
<tr>
<th>Inch</th>
<th>mm</th>
<th>Inch</th>
<th>mm</th>
<th>Inch</th>
<th>mm</th>
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</thead>
<tbody>
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<td>.005</td>
<td>.127</td>
<td>.38</td>
<td>9.65</td>
<td>1.44</td>
<td>36.5</td>
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<tr>
<td>.015</td>
<td>.38</td>
<td>.40</td>
<td>10.1</td>
<td>1.56</td>
<td>39.6</td>
</tr>
<tr>
<td>.02</td>
<td>.50</td>
<td>.50</td>
<td>12.7</td>
<td>1.80</td>
<td>45.7</td>
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<tr>
<td>.03</td>
<td>.76</td>
<td>.60</td>
<td>15.2</td>
<td>2.60</td>
<td>66.0</td>
</tr>
<tr>
<td>.04</td>
<td>1.0</td>
<td>.65</td>
<td>16.5</td>
<td>3.01</td>
<td>76.4</td>
</tr>
<tr>
<td>.10</td>
<td>2.5</td>
<td>.68</td>
<td>17.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.25</td>
<td>6.3</td>
<td>.75</td>
<td>19.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.27</td>
<td>6.8</td>
<td>1.25</td>
<td>31.7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Note 1: Projected area lies between dashed lines.

Note 2: The semiflexible leads of the 4526 may be soldered, welded, or crimp connected into the associated circuit. However, when soldering or welding is employed for making such connections, care should be exercised to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the glass-metal seals is recommended.

Note 3: Metal flange is connected internally to the photocathode.
**Note 1:** Leads 7, 14, and 15 are cut off within 0.16" (4 mm) of the glass button.

**Note 2:** Lead is cut off within 0.16" (4 mm) of the glass button for indexing.

**Basing 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
Lead Connections Bottom View (With Base Removed)

Typical Effect of Indicated Magnetic Field on Anode Current

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.

PHOTOCATHODE IS FULLY ILLUMINATED.
TUBE IS ORIENTED IN MAGNETIC FIELD AS SHOWN BELOW.

H IN DIRECTION SHOWN:
(1) ← → , OR (3) ← →

POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX (1) AND (2) IN INDICATED DIRECTION AND (3) OUT OF THE PAPER.

Figure 1

RCA Electronic Components

DATA 4
6-72
TYPICAL EFFECT OF INDICATED FIELD ON ANODE CURRENT – cont’d

Figure 2
SCHEMATIC ARRANGEMENT OF TYPE 4526

Figure 3

TYPICAL TIME-RESOLUTION CHARACTERISTICS

Figure 4
SPECTRAL RESPONSE CHARACTERISTICS

Figure 5

RELATIVE SENSITIVITY — PER CENT

ABSOLUTE SENSITIVITY — mA/WATT

QUANTUM EFFICIENCY

WAVELENGTH — ANGSTROMS

ULTRAVIOLET VIOLET BLUE GREEN YELLOW RED INfrared

RCA Electronic Components
Typical Dark Current and EADC1 Characteristics

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 dynode stage; and 1/12 of E between dynode No. 10 and anode.

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

Tube temperature = 22°C

Figure 6
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

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
TYPICAL 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.
C₁: 0.05 μF, 500 volts (dc working) ceramic-disc type
C₂: 0.02 μF, 500 volts (dc working) ceramic-disc type
C₃: 0.01 μF, 500 volts (dc working) ceramic-disc type
C₄: 0.005 μF, 500 volts (dc working) ceramic-disc type
R₁: 330 kΩ ± 5%, 1 W
R₂ through R₁₁: 160 kΩ ± 5%, 1 W

Note 1: Adjustable between approximately 500 and 2000 volts dc.

Note 2: Component values are dependent upon nature of application and output signal desired. See discussion on Typical Voltage Divider Arrangements — Page 5.

Figure 9
Silicon-Diode Array Camera Tubes for all Conventional TV Pickup Systems. Cameras Employing the 8507A or 8541A can be Readily Adapted to Use the 4532A or 4532.

- Silicon Photoconductor Having Broad Spectra Range – 380 to 1100 nm
- Extremely High Sensitivity – 4350 µA/Im
- Extremely Low Lag
- Very Low Dark Current
- Excellent Discharge Capability
- No Burn-In

ELECTRICAL

Heater Voltage:

- Operational .......................................... 6.3 V
- For standby with no other electrode voltages applied 3.0 V

AC or DC Heater Current at 6.3 Volts (nominal value) ............................................. 0.10 A

Focusing Method ..................................... Magnetic

Deflection Method .................................... Magnetic

Direct Interelectrode Capacitance: 4.6 pF

Target to all other electrodes

OPTICAL

Optical Distance ....................................... 0.113 ± 0.020 in (2.87 ± 0.51 mm)

Spectral Response .................................... RCA Type V

Target:

- Maximum useful diagonal of rectangular image ...................................................... 0.62 in (15.7 mm)

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the target.

MECHANICAL

Overall Length ........................................ 6.250 ± 0.125 in (158.7 ± 3.18 mm)

Greatest Diameter ..................................... 1.125 ± 0.010 in (28.58 ± 0.25 mm)

Bulb Diameter ......................................... 1.020 ± 0.030 + 0.035 in (25.9 ± 0.76 + 0.89 mm)
Base .......... Small-Button Ditekr 8-Pin, (JEDEC No.E8-11)
Socket .............. Cinch\textsuperscript{b} No.8VT (133-98-11-015), or equivalent

Deflecting Yoke — Focusing Coil — Alignment
Coil — Assembly ... Cleveland Electronics,\textsuperscript{c,d} No.VYLFA-959, (See Figure 2)
Penn Trans,\textsuperscript{c,d} No.1465, or equivalent

Operating Position .......... Any
Weight (approx.) .......... 2 oz

MAXIMUM AND MINIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Max.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater-Voltage Tolerance</td>
<td>+5</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Grid-No.4 Voltage\textsuperscript{f}</td>
<td>350</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Grid-No.3 Voltage\textsuperscript{f}</td>
<td>350</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>350</td>
<td>350</td>
<td></td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Heater-Cathode Voltage</td>
<td>150</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Target Voltage</td>
<td>300</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>Peak Target Current</td>
<td>750</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>Faceplate:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illumination\textsuperscript{g}</td>
<td>6x10\textsuperscript{7}</td>
<td>lm/ft\textsuperscript{2}</td>
<td></td>
</tr>
<tr>
<td>Temperature:</td>
<td>6x10\textsuperscript{8}</td>
<td>lux</td>
<td></td>
</tr>
<tr>
<td>Operating and Storage</td>
<td>90</td>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>

TYPICAL OPERATION

With tube operated in a Cleveland Electronics Assembly Type VYLFA-959, or equivalent; scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm); faceplate temperature of 30\degree ± 3\degree C; and standard CCIR "M", or EIA, TV scanning rate (525 lines, interlaced 2:1, frame time 1/30 second).

Grid-No.4 (Decelerator) Voltage\textsuperscript{f} 340 V
Grid-No.3 (Beam-Focus Electrode) Voltage\textsuperscript{f} 290 V
Grid-No.2 (Accelerator) Voltage 300 V

Peak-to-Peak Blanking Voltage:
- When applied to grid No.1 75 V
- When applied to cathode 20 V

Target Voltage\textsuperscript{h} 8 V

Focusing-Coil Current\textsuperscript{i} 43 ± 2 mA

Peak-to-Peak Deflecting-Coil Current:
- Horizontal 185 mA
- Vertical 15 mA

Field Strength of Each Adjustable Alignment Coil\textsuperscript{k} 0 to 3 G
TYPICAL PERFORMANCE DATA

Under the conditions shown under Typical Operation

- Peak Radiant Responsivity
  (At 710 nanometers) .................................. 380 mA/W

- Grid-No.1 Voltage for Picture Cutoff\(^m\) ....... -60 to -100 V

- Dark Current ........................................ 7 nA

- Average "Gamma" of Transfer Characteristic for a Signal-Output Current between 4 nA and 400 nA ................... 1

- Visual Equivalent Signal-to-Noise Ratio (Approx.)\(^n\) ....... 300:1

- Lag - Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed\(^p\) ................... 8 %

- Limiting Resolution:
  - At center of picture .................................. 700 TV lines
  - At corner of picture .................................. 600 TV lines
  - Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture\(^q\) .......... 40 %

- Sensitivity to Tungsten Light Source
  **Conditions**
  - Faceplate Illumination (Highlight) ................. 0.1 lm/ft\(^2\) (fc)

  **Performance**
  - Sensitivity ........................................ 4350 \(\mu\)A/Im
  - Typical Signal-Output Current\(^s,t\) ................. 565 nA

- Sensitivity to Visible Light
  **Conditions**
  - Illumination from 2854° K Light Source Incident on Infrared Absorbing Filter (Highlight) ............. 0.3 lm/ft\(^2\) (fc)

  **Performance**
  - Sensitivity ........................................ 910 \(\mu\)A/Im
  - Typical Signal-Output Current\(^s,t\) ................. 350 nA

- Sensitivity to Infrared Light
  **Conditions**
  - Illumination from 2854° K Light Source Incident on Visible Absorbing Filter (Highlight) ............. 1.0 lm/ft\(^2\) (fc)

  **Performance**
  - Typical Signal-Output Current\(^s,t\) ................. 540 nA
SPURIOUS SIGNAL TEST PATTERN

![Diagram of zones](image)

**FIGURE 1**

D  — Active Target Diameter  
H  — Raster Height (4 × 3 Aspect Ratio)  
Zone 1  — Diameter = H/2, Area ≈ 15%  
Zone 2  — Diameter = H, Area ≈ 45%  
Zone 3  — Peripheral Area ≈ 40%

**SPURIOUS SIGNAL TEST**

This test is performed with the tube viewing a uniformly diffused white test pattern that identifies the three zones shown in Figure 1. The tube is operated under the conditions specified under Typical Operating Values and is illuminated to provide a peak highlight signal current of 300 nanoamperes. The tube is adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table I for type 4532A and in Table II for type 4532. To be classified as a spot, the spurious signal amplitude must be at least 10% of the peak white signal under either highlight or capped conditions. Smudges, streaks, or mottled and grainy background must have a spurious signal amplitude of at least 3% to constitute a reject item.
### Table I — Type 4532A

<table>
<thead>
<tr>
<th>Blemish Size (Equivalent TV Lines)</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
<th>Zone 3 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Over 6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Over 4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Over 1</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1 or smaller</td>
<td>0</td>
<td>*</td>
<td>0</td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smeared appearance.

### Table II — Type 4532

<table>
<thead>
<tr>
<th>Blemish Size (Equivalent TV Lines)</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
<th>Zone 3 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>White</td>
<td>Black</td>
<td>White</td>
</tr>
<tr>
<td>Over 8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Over 6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Over 4</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Over 1</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>1 or smaller</td>
<td>5</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

*Spots of the size are allowed unless concentration causes a smeared appearance.

---

a 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.

b Made by Cinch Manufacturing Company, 1501 Morse Avenue, Elk Grove Village, IL 60007.
The magnetic component No. VYLFA-959 is made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087; the magnetic component No. 1465, by Penn-Tran Inc., 1155 Zion Road, Bellefonte, PA.

These components, when mounted along the tube axis as shown in Figure 2, will provide minimum beam landing error (maximum signal uniformity) at the recommended grid No. 3/grid No. 4 operating voltage ratio of 0.85. This ratio is determined by the electro-optical characteristics of the target-mesh region which are significantly different from those of the typical vidicon configuration.

Grid-No. 4 voltage must always be greater than grid-No. 3 voltage. The grid-No. 3/grid-No. 4 ratio of 0.85 provides optimum performance with regard to dark current uniformity, signal discharge uniformity and geometrical accuracy with the recommended deflection-coil assemblies. Cameras designed for the RCA vidicon types 8507A and 8541A can be modified to operate the 4532A and 4532 by providing a fixed target voltage of the proper value and the selection of suitable electrode voltages within the maximum ratings. (The 4532A and 4532 cannot be operated with conventional vidicon automatic signal control circuits operating on the target voltage.)

The tube can withstand the illumination contained in a focused image of the sun without damage.

This target voltage provides an optimum operating point consistent with maximum target discharge capability and optimizes other performance characteristics such as dark current uniformity and lag.

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 3-11/16 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.

With no blanking voltage on grid No. 1.
Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 350 nanoamperes. Because the noise in such a system is predominantly of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For an initial signal-output current of 200 nanoamperes and at recommended target voltage.

Amplitude response is the signal amplitude from a given TV line number expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

Light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854 K.

The deflecting circuits must provide extremely linear scanning for good signal reproduction. Signal current is dependent upon the scanning velocity. Any change in scanning velocity produces a signal error in proportion to the change in scanning velocity.

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

With the same light source specified in footnote (r) except an infrared absorbing filter (Schott Jenaer KG-3, 5.5 mm thick, available from Fish-Schurman Corporation, 70 Portland Road, New Rochelle, NY 10802) is interposed between the light source and the faceplate of the tube.

For sharper infrared cutoff, the Kodak Series 305 Infrared Rejection Filter may be used. This series is available from Eastman Kodak Co., Special Products Sales, Rochester, NY 14650.

With the same light source specified in footnote (r) except an infrared transmitting filter (Corning C.S. No.7-56, 2540 glass—available from the Corning Glass Works, Corning, NY 14830) is interposed between the light source and the faceplate of the tube.

Kodak filters Nos.87 or 87C may be preferred for some applications.
WARNING
Failure to observe the maximum dc electrode voltage ratings can drastically reduce the life expectancy of these tubes. When operated within ratings with the recommended deflection-focusing coil assemblies, the full performance capabilities of the silicon-diode array target will be easily realized. Normally, a tube life expectancy of many thousands of hours of useful service can be obtained when the tube is operated within the specified maximum ratings.

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS TO OBTAIN MINIMUM BEAM-LANDING ERROR

FIGURE 2
Note: Cross-hatching indicates wound portion of focusing coil.

TERMINAL DIAGRAM (Bottom View)

Pin 1— Heater
Pin 2— Grid No.1
Pin 3— Grid No.4
Pin 4— Internal Connection— Do Not Use
Pin 5— Grid No.2
Pin 6— Grid No.3
Pin 7— Cathode
Pin 8— Heater
Flange— Target
Short Index Pin — Internal Connection — Make No Connection
**Note 1** — Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

**Note 2** — Faceplate glass is Corning No. 7056 having a thickness of 0.094" + 0.012".

**Note 3** — Optical distance (from faceplate front to target plane) = 0.113" + 0.02". This distance is the nominal faceplate thickness of 0.94" divided by the index of refraction of Corning No. 7056 glass (1.487) plus the space between the inner surface of faceplate and the nominal target focal plane (0.05"").
TYPICAL LIGHT TRANSFER CHARACTERISTICS

ILLUMINATION UNIFORM OVER TARGET AREA
SCANNED AREA OF TARGET = 1/2" X 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX
TARGET VOLTAGE = 8 VOLTS

SIGNAL OUTPUT — NANOAMPERES

92LM - 2990R1
TYPICAL RCA TYPE V SPECTRAL RESPONSE CHARACTERISTICS

RESPONSITIVITY

QUANTUM EFFICIENCY

WAVELENGTH - NANOMETERS

400 500 600 700 800 900 1000 1100 1200

RCA Electronic Components

DATA 6
TYPICAL RCA TYPE V SPECTRAL RESPONSE CHARACTERISTICS AS MODIFIED BY THE FILTER CHARACTERISTICS OF FIGURES 3 AND 4

(A) TYPE V WITH KG-3 FILTER, 5.5 mm THICK
(B) TYPE V WITH CORNING C.S. No.7-56 GLASS FILTER

TYPICAL TRANSMISSION OF SCHOTT (JENAER) KG-3 INFRARED ABSORBING FILTER, THICKNESS: 5.55 MM

FIGURE 3  WAVELENGTH — NANOMETERS

DATA 7  7-71
TYPICAL PERSISTENCE (LAG) CHARACTERISTICS

SCANNED AREA OF TARGET • 1/2" x 3/8"
FACEPLATE TEMPERATURE • 30°C APPROX.
TARGET VOLTAGE = 8 VOLTS

<table>
<thead>
<tr>
<th>CURVE</th>
<th>SIGNAL CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NANOAMPERES</td>
</tr>
<tr>
<td>A</td>
<td>25</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
</tr>
<tr>
<td>D</td>
<td>200</td>
</tr>
<tr>
<td>E</td>
<td>500</td>
</tr>
</tbody>
</table>

0  50  100  150  200  250  300
TIME AFTER ILLUMINATION IS REMOVED — MILLISECONDS

RCA Electronic Components

DATA 7
TYPICAL TRANSMISSION OF CORNING C.S. NO. 7-56 (2540 GLASS) VISIBLE ABSORBING FILTER

**FIGURE 4**

<table>
<thead>
<tr>
<th>WAVELENGTH (NANOMETERS)</th>
<th>PERCENTAGE TRANSMISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>100</td>
</tr>
<tr>
<td>800</td>
<td>80</td>
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<tr>
<td>900</td>
<td>60</td>
</tr>
<tr>
<td>1000</td>
<td>40</td>
</tr>
<tr>
<td>1100</td>
<td>20</td>
</tr>
<tr>
<td>1200</td>
<td>10</td>
</tr>
<tr>
<td>1300</td>
<td>0</td>
</tr>
</tbody>
</table>

EMCBM 92L5-2395R3
DIMENSIONAL OUTLINE 4525

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 4.38-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.
Typical Time Resolution Characteristics

4523

- DYNODE No. 1-TO-CATHODE VOLTS = $\frac{1}{6}E$
- EACH SUCCEEDING DYNODE-STAGE VOLTS = $\frac{1}{12}E$
- ANODE-TO-DYNODE No. 10 VOLTS = $\frac{1}{12}E$

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.

PHOTOCATHODE IS FULLY ILLUMINATED.

![Graph for 4523](image)

Typical Time Resolution Characteristics

4524

- DYNODE No. 1-TO-CATHODE VOLTS = $\frac{1}{6}E$
- EACH SUCCEEDING DYNODE-STAGE VOLTS = $\frac{1}{12}E$
- ANODE-TO-DYNODE No. 10 VOLTS = $\frac{1}{12}E$

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.

PHOTOCATHODE IS FULLY ILLUMINATED.

![Graph for 4524](image)
Typical Time Resolution Characteristics

4525

**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.

PHOTOCATHODE IS FULLY ILLUMINATED.

**TRANSIT TIME**

**RISE TIME**

**SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE**

10

20

30

40

50

60

70

80

90

100

110

120

130

140

150

160

170

180

190

200

**Typical Characteristic of Output Current as a Function of Dynode-No.5 Volts**

4523 4524 4525

**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.
Sensitivity and Current Amplification Characteristics

DYNODE NO. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEDING 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.

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

Current Amplification

Supply Volts (E) Between Anode and Cathode

DATA 7
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.
Sensitivity and Current Amplification Characteristics

DYNODE NO. 1-TO-CATHODE VOLTS $= \frac{1}{6} E$

Each succeeding dynode stage volts $= \frac{1}{12} E$

Anode-to-dynode no. 10 volts $= \frac{1}{12} E$

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.

Supply volts (E) between anode and cathode

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical EADCI and Anode Dark Current Characteristics

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E)

DYNO DE 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=22° C.

Light Source is a Tungsten-Filament Lamp operated at a color temperature of 2870°K.
Tube temperature=22° C.
Typical EADCI and Anode Dark Current Characteristics

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
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.
Typical EADCI and Anode Dark Current Characteristics

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
FOCUSBING 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 = 22° C.

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 22° C.
CATHODE-TO-DYNODE NO. 1 VOLTS • 430
EACH SUCCEEDING DYNODE-STAGE VOLTS • 142
ANODE-TO-CATHODE VOLTS • 1850
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
DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE WAS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES WERE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM. TUBE TEMPERATURE = 22°C.
ONE-PHOTOELECTRON PULSE HEIGHT • 8 COUNTING CHANNELS INTEGRATING TIME CONSTANT • 10 μs, \((R_l = 100\, k\Omega, C = 100\, \mu F)\).

\[
\sum = 2 \times 10^4 \text{ cpm}
\]

\[
\sum = 8 \times 10^2 \text{ cpm}
\]

COUNTS PER MINUTE PER CHANNEL

PULSE HEIGHT - PHOTOELECTRONS

DATA 10

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Dark-Pulse Spectrum

CATHODE-TO-DYNOE-NO. 1 VOLTS = 430
EACH SUCCEEDING DYNODE-STAGE VOLTS = 142
ANODE-TO-CATHODE VOLTS = 1850
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.

DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE WAS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES WERE SUBTRACTED.

SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.

TUBE TEMPERATURE = 22° C

ONE-PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 10 μs, \( R_L = 100 \, \text{k} \Omega, C = 100 \, \mu\text{F} \).

\[ \sum = 5 \times 10^4 \text{ cpms} \]

\[ \sum = 2 \times 10^3 \text{ cpms} \]

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Dark-Pulse Spectrum

CATHODE-TO-DYNODE—NO. 1 VOLTS = 430
EACH SUCCEEDING DYNODE—STAGE VOLTS = 142
ANODE-TO-CATHODE VOLTS = 1850
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.

DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON
PEAK. THIS PORTION OF CURVE WAS OBTAINED WITH PHOTOCATHODE
FULLY ILLUMINATED BY A TUNGSTEN—FILAMENT LAMP OPERATED AT
A LOW COLOR TEMPERATURE. DARK PULSES WERE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22°C.
ONE-PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 10 µs. (R = 100 kΩ, C = 100 pF).

\[
\sum_{\text{1 Photoelectron}} = 1.5 \times 10^5 \text{cpm}
\]

\[
\sum_{\text{4 Photoelectrons}} = 5.8 \times 10^3 \text{cpm}
\]
Typical Effect of Magnetic Field on Anode Current

DYNODE No. 1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No. 10 VOLTS = 125
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.
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.

Typical Effect of Magnetic Field on Anode Current

DYNODE No. 1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No. 10 VOLTS = 125
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.
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

RELATIVE ANODE CURRENT

DYNODE No. 1-TO-CATHODE VOLTS = 375

250

125

MAGNETIC FIELD INTENSITY—GAUSS

RELATIVE ANODE CURRENT

DYNODE No. 1-TO-CATHODE VOLTS = 375

250

125

MAGNETIC FIELD INTENSITY—GAUSS

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

DATA 12
2-67
Typical Effect of Magnetic Field on Anode Current

4524

DYNODE No.1-TO-CATHODE VOLTS AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 150
ANODE-TO-DYNODE No.10 VOLTS = 150
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.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE
POSITIONED APPROX. I FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.

DATA 12
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Effect of Magnetic Field on Anode Current

**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 PERPENDICULAR TO MAJOR AXIS OF TUBE.

**RADIO CORPORATION OF AMERICA**
Electronic Components and Devices
Harrison, N. J.
DATA 13
2-67
Typical Effect of Magnetic Field on Anode Current

DYNODE No.1-TO-CATHODE VOLTS = AS INDICATED EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
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.
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.

Typical Effect of Magnetic Field on Anode Current

DYNODE No.1-TO-CATHODE VOLTS = AS INDICATED EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
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.
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.
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
Typical Spectral Response Characteristics

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

WAVELENGTH—ANGSTROMS

RELATIVE SENSITIVITY—PER CENT

ABSOLUTE SENSITIVITY—PER CENT

QUANTUM EFFICIENCY—PER CENT

2000 3000 4000 5000 6000 7000
Image Orthicon

4-1/2-Inch Diameter Type
For RCA TK-42 and TK-43 TV Color Cameras
Type 4536 is Unilaterally Interchangeable with Types 4492, 4492V1, and 4492V2

GENERAL
Heater, for Unipotential Cathode:
  Voltage (AC or DC) .......... 6.3 ± 10% V
  Current ...................... 0.6 A

Direct Interelectrode Capacitance:
  Anode to all other electrodes .... 12 pF
  Target-to-Mesh Spacing ........ 0.001 in
                               (0.0254 mm)

Spectral Response ................ S-10
Wavelength of Maximum Response . 4500 ± 300 angstroms

Photocathode, Semitransparent:
  Rectangular image (4 x 3 aspect ratio):
    Useful size of ............ 1.6 in (41 mm) max. Diagonal
    Note: The size of the optical image focused on the
    photocathode should be adjusted so that its maximum
    diagonal does not exceed the specified value.

Focusing Method .................. Magnetic
Deflection Method ................ Magnetic
Overall Length ................. 19.375 in (492 mm) ± 0.310 in
Greatest Diameter of Bulb .... 4.500 in (114 mm) ± 0.094 in
Envelope Terminals .............. 5
End Base ....................... Small-Shell Diheptal 14-Pin Base
                           (JEDEC Group 5, No.B14-45)
Socket ......................... Cinch Part No.3M14, or equivalent
Operating Position .......... The tube should never be operated
                            in a vertical position with the diheptal-base end up nor in
                            any other position where the axis of the tube with the base
                            up makes an angle of less than 20° with the vertical.

Weight (Approx.) ................. 2.3 lb (993 g)
Minimum Inside Diameter of
  Deflecting Coil .............. 3.2 in (81 mm)
  Deflecting-Coil Length ...... 7 in (178 mm)
  Focusing-Coil Length ...... 15 in (381 mm)

Alignment Coil:
  Position on neck .. Centerline of magnetic field should be
                            located 9.25 in (235 mm) from the flat area
                            of the shoulder
ABSOLUTE MAXIMUM AND MINIMUM RATINGS

Operating Temperature:
- Any part of bulb ............ 65 max. °C
- Of bulb at large end of tube (Image section) ............ 35 min. °C

Temperature Difference:
- Between image section and any part of bulb hotter than image section ............ 5 max. °C

Photocathode:
- Illumination .................. 50 max. lm/ft² (footcandles)–538 lux
- Voltage .................. –700 max. V
- Grid-No. 6 Voltage .......... –700 max. V

Target Voltage:
- Positive value ............ 10 max. V
- Negative value ............ 10 max. V
- Field-Mesh Voltage ........ 30 max. V
- Grid-No. 5 Voltage ........ 300 max. V
- Grid-No. 4 Voltage ........ 350 max. V
- Grid-No. 3 Voltage ........ 400 max. V
- Grid-No. 2 & Dynode-No. 1 Voltage ........ 350 max. V

Grid-No. 1 Voltage:
- Negative bias value ........ 125 max. V
- Positive bias value ........ 0 max. V

Voltage Between Consecutive Dynodes ........ 350 max. V
Anode-Supply Voltage ........ 1650 max. V

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode ........ 125 max. V
- Heater positive with respect to cathode ........ 10 max. V

TYPICAL OPERATING VALUES

Heater Voltage ............ 6.3 V
Photocathode Voltage .......... –600 V

Grid-No. 6 Voltage (Image Focus)
Approx. 70% of Photocathode Voltage ........ –370 to –470 V

Target Voltage Above Cutoff ........ Adjusted as required
Field-Mesh Voltage ........ 15 to 25 V
Grid-No. 5 Voltage (Decelerator) ........ 40 V
Grid-No. 4 Voltage (Beam Focus) ........ 70 to 90 V
Grid-No. 3 Voltage 250 to 275 V
Grid-No. 2 & Dynode-No. 1 Voltage 280 V
Grid-No. 1 Voltage for Picture Cutoff −45 to −115 V
Dynode-No. 2 Voltage 600 V
Dynode-No. 3 Voltage 800 V
Dynode-No. 4 Voltage 1000 V
Dynode-No. 5 Voltage 1200 V
Anode Voltage 1250 V
Recommended Target Temperature Range 35 to 45 °C
Peak-to-Peak Blanking Voltage 8 V

Field Strength of Focusing Coil:
At center of scanning section (Approx.) 60 G
In plane of photocathode (Approx.) 120 G
Field Strength of Alignment Coil 0 to 3 G

PERFORMANCE DATA

With conditions shown under Typical Operating Values including Recommended Target Temperature Range; target voltage adjusted to 3 volts above cutoff; and operation in a 525-line, 30-frame TV system; except as otherwise indicated.

Min. Max.

Signal-Output Current (Peak to Peak) at Maximum Multiplier Gain 15 100 μA

Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current 39.5 − dB

Photocathode Illumination at 2870 °K Required to Bring Picture Highlights to the "Knee" of Light Transfer Characteristic 0.052 lm/ft² (fc)

Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white) 45 − %

Uniformity:
Ratio of Shading (Background Signal to Highlight Signal):
Over full scanned area 0.12
Between center and peripheral areas 0.07

Variation of Highlight Signal (Per cent of maximum highlight signal over full scanned area) 20 %
b Operation outside of the Recommended Target Temperature Range shown under Typical Operating Values will not damage the 4536 provided the Maximum Temperature Ratings of the tube are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the Recommended Target Temperature Range.

c With respect to grid No.4.

d With the 4536 operated in an RCA MI-557770-A1 deflection assembly, or equivalent, and at fixed photocathode voltage.

• Adjust for optimum focus.

f The target supply voltage should be adjustable from -5 to +5 volts.

g Adjust to give the most uniformly shaded picture near maximum signal.

h The voltages shown provide maximum multiplier gain. Normally, dynode-No.3 and dynode-No.5 voltages are simultaneously adjusted to obtain the required value of signal current at the video-amplifier input.

i Direction of current 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.

k Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level. The value shown is measured under the following conditions using a Video Noise Meter, Model UPSF (North American Version), or equivalent. This meter is manufactured by Rohde and Schwarz, Munich, West Germany.

Signal: Blanked video, 0.7 V peak-to-peak including 0.07 V set-up.

Noise Meter: Gated with horizontal and vertical blanking signal of camera system. Video pass band is shaped by means of self-contained 100 kHz high-pass and 4.2 MHz low-pass filters.

Weighting filters matching the response of the human eye (CCIR Rec.421, Annex III) are not used and the color sub-carrier, 3.58 MHz, is not present during the measurement.

m Measured with amplifier having flat frequency response.
DOS and DON'TS on Use of RCA-4536

Here are the "dos" -

1. Hold temperature of the 4536 within the recommended operating range.
2. Make sure tube is properly aligned.
3. Adjust beam-focus control for best usable resolution.
4. Select target voltage according to operating needs. This freedom of operation results from use of the electronically-conducting glass target.
5. Determine proper operating point with target voltage adjusted to the desired voltage above target-cutoff.
6. Open lens before voltages are applied to the 4536.

Here are the "don'ts" -

1. Don't force the 4536 into its envelope terminal socket.
2. Don't operate the 4536 without scanning.
3. Don't use more beam current than necessary to discharge the highlights of the scene.
4. Don't turn off beam while tube is capped (and voltages applied).
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)

4.500 (114) ±.094 DIA.

.188 ±.002 .015

5.550 (141) ±.125

VIBRATION-ABSORBING TAPE DO NOT REMOVE

VIBRATION-ABSORBING TIPS DO NOT REMOVE

.175 (4.45) MIN.

.250 (6.35) ±.030

DETAILED ENVELOPE TERMINALS

.800 (20.32) ±.125

2 HOLES, 180° APART, .310 to .312 (7.87 to 7.93) DIA.

3.125 (79.4) ±.060

3.6 (91)

SMALL-SHELL DIMEPTAL 14-PIN BASE JEDEC GROUP 5, No. B14-45

32°±10°

ENLARGED BOTTOM VIEW

TERMINAL DIAGRAM (Bottom View)

DIRECTION OF LIGHT:
PERPENDICULAR TO LARGE END OF TUBE

IC 4

PC

G3 FIELD MESH

G4

H

H

1

14

13

TARGET

G1

G2

DY1

DY2

DY3

DY4

DY5

DY6

G6

7

8

9

10

11

12

IC

RCA Electronic Components
### SMALL-SHELL DIHEPTAL 14-PIN BASE

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heater</td>
</tr>
<tr>
<td>2</td>
<td>Grid No.4</td>
</tr>
<tr>
<td>3</td>
<td>Grid No.3</td>
</tr>
<tr>
<td>4</td>
<td>Internal Connection - Do Not Use</td>
</tr>
<tr>
<td>5</td>
<td>Dynode No.2</td>
</tr>
<tr>
<td>6</td>
<td>Dynode No.4</td>
</tr>
<tr>
<td>7</td>
<td>Anode</td>
</tr>
<tr>
<td>8</td>
<td>Dynode No.5</td>
</tr>
<tr>
<td>9</td>
<td>Dynode No.3</td>
</tr>
<tr>
<td>10</td>
<td>Dynode No.1, Grid No.2</td>
</tr>
<tr>
<td>11</td>
<td>Internal Connection - Do Not Use</td>
</tr>
<tr>
<td>12</td>
<td>Grid No.1</td>
</tr>
<tr>
<td>13</td>
<td>Cathode</td>
</tr>
<tr>
<td>14</td>
<td>Heater</td>
</tr>
</tbody>
</table>

### ENVELOPE TERMINALS

- Terminal over Pin 2: Field Mesh
- Terminal over Pin 4: Photocathode
- Terminal on side of envelope opposite base key: Grid No.6
- Terminal over Pin 9: Grid No.5
- Terminal over Pin 11: Target

### BASIC LIGHT TRANSFER CHARACTERISTIC

![](https://example.com/light-transfer-graph.png)

ILLUMINATION: TUNGSTEN LIGHT, DAYLIGHT, OR WHITE FLUORESCENT.
FOR SMALL-AREA HIGHLIGHTS.

**Typical Signal Output - Microamperes**

**Highlight Illumination on Photocathode - Footcandles**

92LS-2243
Typical Spectral Sensitivity Characteristic

For equal values of incident radiant power at all wavelengths.

Relative Sensitivity

Wavelength — Angstroms

ULTRAVIOLET  VIOLET  BLUE  GREEN  YELLOW  RED  INFRARED

2000  3000  4000  5000  6000  7000  8000

92LM-2574

RCA Electronic Components

Data 4
Vidicon

1"-Diameter, Magnetic Focus and Deflection
Vidicon for Signal-Storage Applications

GENERAL
Heater, for Unipotential Cathode:
Voltage (AC or DC) .................. 6.3 ± 10% V
Current at 5.3 volts ................. 0.1 A

Direct Interelectrode Capacitance:
Target to all other electrodes ........ 4.6 pF

Spectral Response .................. See RCA Type IV Spectral Response at front of this section

Photoconductive Layer:
Maximum useful diagonal of rectangular image (1 x 1 aspect ratio) ................. 0.885 in

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method .................. Magnetic
Deflection Method .................. Magnetic
Overall Length ..................... 6.250 in ± 0.125 in
Greatest Diameter .................. 1.125 in ± 0.010 in
Bulb .................. T8
Base .................. Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket .................. Cinch No.54A18088, or equivalent
Deflecting Yoke-Focusing Alignment Coil Assembly ...... Cleveland Electronics No.VYFA-355-2, or equivalent
Operating Position .................. Any
Weight (Approx.) .................. 2 oz

ABSOLUTE-MAXIMUM RATINGS
For scanned area of 5/8" x 5/8"

<table>
<thead>
<tr>
<th>Grid-No.4 Voltage</th>
<th>Grid-No.3 Voltage</th>
<th>Grid-No.2 Voltage</th>
<th>Grid-No.1 Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 max. V</td>
<td>1000 max. V</td>
<td>350 max. V</td>
<td>Negative bias value</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>150 max. V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Positive bias value</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0 max. V</td>
</tr>
</tbody>
</table>
### Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 max. V
- Heater positive with respect to cathode: 10 max. V

### Target Voltage: 100 max. V
### Dark Current: 0.25 max. µA
### Peak Target Current: 0.75 max. µA

### Faceplate:
- **Illumination:** 5000 max. fc
- **Temperature:** 71 max. °C

### TYPICAL OPERATION AND PERFORMANCE DATA

**For scanned area of 5/8" x 5/8"
Faceplate temperature of 30° to 35° C
and Standard TV Scanning Rate**

| Grid-No.4 (Decelerator) Voltage | 750 V |
| Grid-No.3 (Beam-Focus Electrode) Voltage | 450 V |
| Grid-No.2 (Accelerator) Voltage | 300 V |
| Grid-No.1 Voltage for Picture Cutoff | -45 to -100 V |

**Average "Gamma" of Transfer Characteristic for Signal-Output Current Between 0.02 µA and 0.2 µA:** 0.7

**Visual Equivalent Signal-to-Noise Ratio (Approx.):** 300:1

**Lag—Per Cent of Initial Value of Signal-Output Current:**
- 1 second after illumination is removed: 45 to 65%
- 15 seconds after illumination is removed: 10 min.
- 30 seconds after illumination is removed: 10 max.

### Minimum Peak-to-Peak Blanking Voltage:
- When applied to grid No.1: 75 V
- When applied to cathode: 20 V

### Limiting Resolution:
- At center of picture: 1000 TV Lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Strength at Center of Focusing Coil</td>
<td>52 ± 4 G</td>
</tr>
<tr>
<td>Peak Deflecting-Coil Current:</td>
<td></td>
</tr>
<tr>
<td>Horizontal</td>
<td>225 mA</td>
</tr>
<tr>
<td>Vertical</td>
<td>41 mA</td>
</tr>
<tr>
<td>Field Strength of Adjustable Alignment Coil</td>
<td>0 to 4 G</td>
</tr>
<tr>
<td>High-Sensitivity Operation - 0.1 Footcandle on Faceplate</td>
<td></td>
</tr>
<tr>
<td>Faceplate Illumination (Highlight)</td>
<td>0.1 fc</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>15 to 65 V</td>
</tr>
<tr>
<td>Dark Current</td>
<td>0.02 μA</td>
</tr>
<tr>
<td>Signal-Output Current:</td>
<td></td>
</tr>
<tr>
<td>Typical</td>
<td>0.2 μA</td>
</tr>
<tr>
<td>Minimum</td>
<td>0.15 μA</td>
</tr>
</tbody>
</table>

a 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.

b Made by Cinch Manufacturing Corporation, 1026 S. Homan Avenue, Chicago 24, Illinois.

c Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

d These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

e 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 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

f 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.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.20 microampere and a dark current of 0.02 microampere.

Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

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 3-11/16 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 target voltage for each tube must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

The deflecting circuits must provide extremely linear scanning for good signal reproduction because both dark current and signal are proportional to scanning velocity.

Defined as the component of the highlight target current after the dark-current component has been subtracted.
This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in Fig. 1. The target is adjusted to provide a dark current of 0.1 μA with no light on the vidicon faceplate. The test pattern shown in Fig. 1, is then focused on the vidicon faceplate and the iris is opened to provide a total target current of 0.4 μA (signal current of 0.3 μA). The 4542 is adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for both white and black spots. Smudges, streaks, or mottled and grainy background must have a contrast of at least 10% of a 0.3 μA peak signal amplitude to constitute a reject item.

**Table 1** For scanned area of 5/8" x 5/8"

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 4</td>
<td>0</td>
<td>Any Number Allowed</td>
</tr>
<tr>
<td>4 but not including 3</td>
<td>1</td>
<td>Under 4 TV Lines (Max.)</td>
</tr>
<tr>
<td>3 but not including 1</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1 or less</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines. Spots of this size are allowed unless concentration causes a smudged appearance.
To obtain minimum beam-landing error

Note: Cross-hatching indicates wound portion of focusing coil.

DIMENSIONAL OUTLINE-Dimensions in Inches (mm)

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".
TERMINAL DIAGRAM (Bottom View)

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater

TARGET IC G2
Flange: Target Short Index Pin — Internal Connection — Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

TYPICAL RANGE OF PERSISTENCE CHARACTERISTICS

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 5/8" x 5/8"
DARK CURRENT (MICROAMPERES) = 0.02
FACEPLATE TEMPERATURE = 30°C APPROX

TIME AFTER ILLUMINATION IS REMOVED — SECONDS

RCA Electronic Components
RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 5/8" X 5/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

LIGHT TRANSFER CHARACTERISTICS

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 5/8" X 5/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
STANDARD TV SCAN RATE

2870°K TUNGSTEN ILLUMINATION ON TUBE FACE — FOOTCANDLES
VARIATION OF TYPICAL PERSISTENCE CHARACTERISTICS
WITH CHANGES IN DARK CURRENT

INITIAL HIGHLIGHT SIGNAL-OUTPUT MICROAMPERES = 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 5/8" X 5/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

CURVE A: DARK CURRENT = 0.10 µA
CURVE B: DARK CURRENT = 0.02 µA
CURVE C: DARK CURRENT = 0.005 µA

RCA Electronic Components
DATA 5
12-68
HORIZONTAL SQUARE-WAVE RESPONSE

PEAK (HIGHLIGHT) SIGNAL MICROAMPERES = 0.40
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SLANT-LINE BURST

CURVE A: GRID-No 4 VOLTS = 750
GRID-No 3 VOLTS = 450
CURVE B: GRID-No 4 VOLTS = 500
GRID-No 3 VOLTS = 500

*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.
Image Intensifier Tube

- Variant of 8606 Having Automatic Brightness Control
- Integral Oscillator and Voltage Multiplier
- Fiber-Optic Input and Output Faceplates
- Ruggedized Construction
- ERMA Photocathode
- P20 Phosphor Screen

The 4549 is available with ERMA spectral responses to provide the minimum photocathode sensitivities specified in the table below.

<table>
<thead>
<tr>
<th>Spectral Response</th>
<th>Luminous - uA/Im</th>
<th>Radiant - mA/W</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>At 800 nm</td>
<td>At 850 nm</td>
</tr>
<tr>
<td>ERMA6-1</td>
<td>175</td>
<td>6</td>
</tr>
<tr>
<td>ERMA12-5</td>
<td>200</td>
<td>12</td>
</tr>
<tr>
<td>ERMA20-12</td>
<td>225</td>
<td>20</td>
</tr>
<tr>
<td>ERMA25-15</td>
<td>250</td>
<td>25</td>
</tr>
</tbody>
</table>

General Data

Spectral Response .......... S-20 with extended red response
Wavelength of Maximum Response .......... 500 + 140 nanometers
- 70 nanometers

Photocathode:

- Material ................. Na-K-Cs-Sb (Multialkali)
- Minimum useful area ....... 11.1 cm² (1.70 in²)
- Minimum useful diameter .... 37.5 mm (1.47 in)

Image surface:

- Shape .................. Flat, Circular
- Material ............... Fiber-Optics

Fluorescent Screen:

- Minimum useful area ....... 13.8 cm² (2.14 in²)
- Minimum useful diameter .... 42 mm (1.65 in)
- Phosphor .................. P20, Aluminized
- Fluorescence and phosphorescence .... Yellow-Green
- Persistence ............. Medium to Medium Short

Image surface:

- Shape .................. Flat, Circular
- Material ............... Fiber-Optics
- Focusing Method ........ Electrostatic
### Tube Dimensions:

- Maximum overall length: 12.028 in (302.51 mm)
- Maximum diameter: 3.747 in (95.10 mm)

### Operating Position: Any

### Weight (Approx.)

4 lbs 8 oz (2.04 kg)

### Maximum Ratings, Absolute-Maximum Values:

- **DC Input Voltage**: 7.0 max. V
- **Ambient-Temperature Range**:
  - Non-operating: $-54^\circ$ to $+68^\circ$ C
  - Operating: $-54^\circ$ to $+52^\circ$ C

### Typical Performance Characteristics

Under conditions with 6.75 volts dc applied and at an ambient temperature of $22^\circ$ C, unless otherwise noted.

<table>
<thead>
<tr>
<th>Resolution</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center$^b$</td>
<td>25</td>
<td>35</td>
<td>Line-Pairs/mm</td>
</tr>
<tr>
<td>Edge$^c$ (Peripheral)</td>
<td>23</td>
<td>30</td>
<td>Line-Pairs/mm</td>
</tr>
<tr>
<td>Maximum Screen Luminance (Brightness) See Figure 3</td>
<td>$-140$</td>
<td>$140$</td>
<td>fL</td>
</tr>
<tr>
<td>Luminance Gain:d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At $22^\circ$ C</td>
<td>$3.5 \times 10^4$</td>
<td>$8 \times 10^4$</td>
<td>fL/fc</td>
</tr>
<tr>
<td>At $-54^\circ$ C</td>
<td>$2.8 \times 10^4$</td>
<td>$-1$</td>
<td>fL/fc</td>
</tr>
<tr>
<td>Equivalent Screen Background Input:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous$^e$</td>
<td>$2 \times 10^{-11}$</td>
<td>Im/cm$^2$</td>
<td></td>
</tr>
<tr>
<td>Photocathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 470 nm$^f$</td>
<td>$-1$</td>
<td>$4.6 \times 10^{-2}$</td>
<td>A/W</td>
</tr>
<tr>
<td>At 800 nm</td>
<td>$6 \times 10^{-3}$</td>
<td>$-1$</td>
<td>A/W</td>
</tr>
<tr>
<td>At 850 nm</td>
<td>$1 \times 10^{-3}$</td>
<td>$-1$</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous$^g$</td>
<td>$1.75 \times 10^{-4}$</td>
<td>$2 \times 10^{-4}$</td>
<td>A/Im</td>
</tr>
<tr>
<td>Luminance Uniformity</td>
<td>$-1$</td>
<td>$3:1$</td>
<td></td>
</tr>
<tr>
<td>Modulation Transfer Function (MTF):i (See Figure 4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For 2.5 Line-Pairs/mm</td>
<td>$90$</td>
<td>$95$</td>
<td>%</td>
</tr>
<tr>
<td>For 7.5 Line-Pairs/mm</td>
<td>$55$</td>
<td>$60$</td>
<td>%</td>
</tr>
<tr>
<td>For 16 Line-Pairs/mm</td>
<td>$10$</td>
<td>$20$</td>
<td>%</td>
</tr>
</tbody>
</table>

---

**Notes:**
- $^a$: See Figure 3
- $^b$: Center
- $^c$: Edge
- $^d$: Luminance Gain
- $^e$: Luminous
- $^f$: Radiant
- $^g$: Luminous
- $^h$: Luminance Uniformity
- $^i$: Modulation Transfer Function

---

4549

Electronic Components
Paraxial Image Magnification \( (Cmx)^k \) \[ \begin{array}{ccc} 0.82 & - & 1.0 \\ \end{array} \]

Edge Image Magnification \( m \) \[ \begin{array}{ccc} 1.0 & - & - \\ \end{array} \]

Image Alignment \( n \) \[ \begin{array}{ccc} - & - & 0.06 \text{ in} \\ \end{array} \]

Image Stability in 30 Seconds \( p \) \[ \begin{array}{ccc} - & - & 0.006 \text{ in} \\ \end{array} \]

Distortion \( q \) \[ \begin{array}{ccc} - & - & 21 \% \\ \end{array} \]

Cathode and Screen Quality Tests

Cathode and screen quality are measured under the following conditions: The photocathode is fully illuminated with the light level adjusted to sharply define on the screen any dark spots, bright spots, streaks, or blemishes. The size and quantities of such spots, streaks, and blemishes are observed by means of a 10-power microscope fitted with a reticle and shall not exceed the size and quantities shown in Table I.

| Size of dark spots, bright spots, streaks, or blemishes observed at screen. Note 1 | Number of dark spots, bright spots, streaks, or blemishes |
|---|---|---|
| Greater than 0.015” | Area “A” Note 2 | Area “B” Note 3 | Area “C” Note 4 |
| 0.012” to and including 0.015” | 0 | 1 | 2 |
| 0.009” to less than 0.012” | 0 | 3 | 8 |
| 0.006” to less than 0.009” | 0 | 12 | 24 |
| 0.003” to less than 0.006” | 3 | 55 | Min. |
| Less than 0.003” | Min. | Min. | Min. |

**Note 1** — Two spots separated by a distance of less than the maximum dimension of either spot are considered one spot with a size equal to the sum of the maximum dimensions of the two spots plus the distance separating them.

**Note 2** — Area “A” is defined as the area within a 0.76 cm (0.30”)-diameter circle concentric with the major axis of the tube.

**Note 3** — Area “B” is defined as the area bounded by a 0.76 cm (0.30”)-diameter circle and a 3.0 cm (1.2”) -diameter circle both of which are concentric with the major axis of the tube.

**Note 4** — Area “C” is defined as the area bounded by a 3.0 cm (1.2”)-diameter circle and a 3.75 cm (1.47”)-diameter circle both of which are concentric with the major axis of the tube.
Environmental Testing
The C33088P1 is designed to withstand military environmental requirements of 75 g’s shock (peak amplitude), vibration at a frequency of 10 to 55 Hz at a double amplitude of 0.10”, and temperature extremes of -54° C to +68° C. Military environmental test procedures can be supplied on request, and customer environmental requirements may be submitted for these devices if desired. Unless requested, environmental tests will not be performed.

b The resolution, both horizontal and vertical, is determined with a test pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated a “line-pair.”

c This minimum value applies at a distance of 11 mm from the major (optical) axis of the tube.

d Luminance Gain is defined as the quotient of screen brightness in footlamberts by the photocathode illumination in footcandles provided by a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light input radiation on the photocathode image surface is in the range of $1 \times 10^{-5}$ to $3 \times 10^{-5}$ footcandle.

e Defined as the equivalent value of luminous flux from a tungsten-filament lamp operating at 2854° K that would be required to cause an increase in screen brightness equal to screen background brightness.

f For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

g Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The light spot has a minimum diameter of 1.1”.

h The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 32.5 mm in diameter centered on the image screen. No distinct line of demarcation between light and dark areas is permitted. Alternatively, tubes will conform to MIL-E-55493 (EL) Uniformity Specification dated 26 November, 1968.
A two-dimensional resolution pattern, providing constant illumination in the Y direction, and sinusoidal variation of intensity in the X direction is projected on the photocathode. Per cent image modulation M may then be defined as:

\[ M = \frac{W - B}{W + B} \times 100 \]

where \( W \) = maximum illumination in white line
\( B \) = minimum illumination in black line

Output image brightness is also a sinusoidal function of the distance across one direction of the pattern, and the output modulation is equal to or less than the input modulation. The modulation transfer function (MTF) is defined as the ratio of the output modulation to input modulation expressed as a function of the spatial frequency of the incident illumination pattern. MTF for the C33088P1 is measured using Modulation Transfer Function Analyzer Model No.K1-b, a product of Optics Technology, Inc., Belmont, CA, using the specified procedure for that instrument.

Paraxial Image Magnification (Cmx) is defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the two corresponding image points on the photocathode. The image points on the photocathode are separated by a distance of 2 mm and are located equal distances from the major axis of the tube.

Under the same conditions as shown in footnote (k) except the test points on the photocathode are separated by 32 mm.

The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will fall within a circle concentric with the optical axis of the screen having the specified diameter.

The center of the image produced on the screen of the tube as specified in footnote (n) will not shift more than the specified value during 30 seconds of operation.

A second magnification value (Emx) is obtained as stated in footnote (n) except the image points on the photocathode are separated by a distance of 32 mm. Per-cent distortion is defined by the equation

\[ \text{Per-cent Distortion} = \frac{\text{Emx-Cmx}}{\text{Cmx}} \times 100 \]
Operating Considerations

Magnetic shielding of these tubes may be required to minimize the effects of extraneous fields on tube performance. It is to be noted that 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 to insure that the case is completely demagnetized.

Response time for the automatic brightness control to adjust to incident illumination is dependent on the level of incident illumination but never exceeds a few seconds. Response time as a function of incident illumination is shown in Figure 1.

While the gain of the typical 8606 falls rapidly at input illumination levels above $10^{-3}$ footcandle and falls to unity at approximately $10^{-2}$ footcandle, the 4549 can operate at input illumination levels up to about 7 footcandles. Screen brightness as a function of incident illumination is shown in Figure 3.

The characteristic of Figure 2 shows battery current as a function of incident illumination. At normal tube operating light levels battery drain is low allowing power conservation.

DIMENSIONAL OUTLINE DETAILS

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**DETAIL "A"**

**DETAIL "B"**

FIBER-OPTIC SCREEN IMAGE SURFACE

---

Electronic Components
DIMENSIONAL OUTLINE

Note: Dimension applies within 1" of tube end.
# Dimensional Outline

## Bottom View

![Enlarged View of Reticle Pattern]

## Outline Dimensions

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Min. 11.906</td>
<td>302.512</td>
</tr>
<tr>
<td></td>
<td>Max. 12.028</td>
<td>305.511</td>
</tr>
<tr>
<td>B</td>
<td>Min. 11.025</td>
<td>280.035</td>
</tr>
<tr>
<td></td>
<td>Max. 11.115</td>
<td>282.321</td>
</tr>
<tr>
<td>C</td>
<td>Min. 2.372</td>
<td>60.249</td>
</tr>
<tr>
<td></td>
<td>Max. 2.398</td>
<td>60.909</td>
</tr>
<tr>
<td>D</td>
<td>Min. 3.742 Dia.</td>
<td>95.047 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.747 Dia.</td>
<td>95.174 Dia.</td>
</tr>
<tr>
<td>E</td>
<td>Min. 2.095 Dia.</td>
<td>53.213 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 2.105 Dia.</td>
<td>53.467 Dia.</td>
</tr>
<tr>
<td>F</td>
<td>Min. .237</td>
<td>6.020</td>
</tr>
<tr>
<td></td>
<td>Max. .243</td>
<td>6.172</td>
</tr>
<tr>
<td>G</td>
<td>Min. .082</td>
<td>2.082</td>
</tr>
<tr>
<td></td>
<td>Max. .092</td>
<td>2.336</td>
</tr>
<tr>
<td>H</td>
<td>Min. .093</td>
<td>2.362</td>
</tr>
<tr>
<td></td>
<td>Max. .113</td>
<td>2.870</td>
</tr>
<tr>
<td>I</td>
<td>Min. 3.737 Dia.</td>
<td>94.92 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.747 Dia.</td>
<td>95.10 Dia.</td>
</tr>
<tr>
<td>J</td>
<td>Min. 2.950 Dia.</td>
<td>74.93 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.050 Dia.</td>
<td>77.47 Dia.</td>
</tr>
<tr>
<td>K</td>
<td>Min. .620</td>
<td>15.74 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. .630</td>
<td>16.00 Dia.</td>
</tr>
<tr>
<td>L</td>
<td>Min. .120 Dia.</td>
<td>3.048 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. .123 Dia.</td>
<td>3.124 Dia.</td>
</tr>
<tr>
<td>M</td>
<td>Min. .208</td>
<td>5.283</td>
</tr>
<tr>
<td></td>
<td>Max. .218</td>
<td>5.537</td>
</tr>
<tr>
<td>N</td>
<td>Min. .370</td>
<td>9.398</td>
</tr>
<tr>
<td></td>
<td>Max. .380</td>
<td>9.652</td>
</tr>
<tr>
<td>O</td>
<td>Min. 2.51 Dia.</td>
<td>63.75 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 2.55 Dia.</td>
<td>64.77 Dia.</td>
</tr>
<tr>
<td>P</td>
<td>Min. 2.781 Dia.</td>
<td>70.63 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 2.791 Dia.</td>
<td>70.89 Dia.</td>
</tr>
<tr>
<td>Q</td>
<td>Min. 2.979 Dia.</td>
<td>75.66 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 2.994 Dia.</td>
<td>76.04 Dia.</td>
</tr>
<tr>
<td>R</td>
<td>Min. 3.083 Dia.</td>
<td>78.30 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.098 Dia.</td>
<td>78.68 Dia.</td>
</tr>
<tr>
<td>S</td>
<td>Min. 3.245 Dia.</td>
<td>82.42 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.260 Dia.</td>
<td>82.80 Dia.</td>
</tr>
<tr>
<td>T</td>
<td>Min. 3.297 Dia.</td>
<td>83.74 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.312 Dia.</td>
<td>84.12 Dia.</td>
</tr>
<tr>
<td>U</td>
<td>Min. 3.500 Dia.</td>
<td>88.90 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.520 Dia.</td>
<td>89.40 Dia.</td>
</tr>
<tr>
<td>V</td>
<td>Min. 3.54 Dia.</td>
<td>89.91 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 3.58 Dia.</td>
<td>90.93 Dia.</td>
</tr>
<tr>
<td>W</td>
<td>Min. .183</td>
<td>4.648</td>
</tr>
<tr>
<td></td>
<td>Max. .193</td>
<td>4.902</td>
</tr>
<tr>
<td>X</td>
<td>Min. 1.47 Dia.</td>
<td>37.5 Dia.</td>
</tr>
<tr>
<td></td>
<td>Max. 1.65 Dia.</td>
<td>42 Dia.</td>
</tr>
<tr>
<td>Y</td>
<td>Min.</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>Min.</td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td>Min.</td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>Min.</td>
<td></td>
</tr>
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</table>

The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

---

RCA Electronic Components
RESPONSE TIME FOR SCREEN LUMINANCE (BRIGHTNESS) TO ADJUST TO INCIDENT ILLUMINATION

Response time is the time for screen luminance to decrease to a minimum value and to return or exceed initial screen brightness when photocathode illumination is increased from $5 \times 10^{-4}$ footcandle to the illumination levels shown on the abscissa.

Figure 1

BATTERY CURRENT AS A FUNCTION OF INCIDENT ILLUMINATION

Figure 2
TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

![Graph showing typical photocathode spectral response characteristics for different models, including ERMA12.5, ERMA20.12, ERMA25.15, and ERMA-6-1, plotted against wavelength in nanometers and absolute sensitivity in mWatt.](image-url)
SPECTRAL ENERGY EMISSION CHARACTERISTIC (JEDEC PHOSPHOR P20)

<table>
<thead>
<tr>
<th>COLOR</th>
<th>C.I.E. COORDINATES</th>
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<tr>
<td>YELLOW-GREEN</td>
<td>0.426</td>
</tr>
<tr>
<td></td>
<td>0.546</td>
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</table>

WAVELENGTH — NANOMETERS

RELATIVE RADIANT ENERGY

RADIAL DISTANCE ON PHOTOCATHODE IMAGE SURFACE FROM CENTER TOWARD EDGE — MILLIMETERS

TYPICAL RESOLUTION CHARACTERISTICS

SAGITTAL
TANGENTIAL

Electronic Components
DATA 6
2-72
TYPICAL MODULATION TRANSFER FUNCTION VS. FREQUENCY

Figure 4

SPLTAL FREQUENCY—LINE PAIRS/MILLIMETER

DATA 7

2-72
CHARACTERISTICS

RADIAL DISTANCE ON PHOTOCATHODE IMAGE SURFACE FROM CENTER TOWARD EDGE – MILLIMETERS

MAGNIFICATION

DISTORTION – PER CENT

0.60 0.70 0.80 0.90 1.00 1.10 1.20

0 5 10 15 20

Electronic Components

RCA  DATA 7
Photomultiplier Tube
1-1/8" Diameter, Side-On Type
Having Bialkali Photocathode

GENERAL DATA
Spectral Response ............................................. See Figure 2
Wavelength of Maximum Response ......................... 400 ± 50 nm
Cathode, Opaque ................................................. Potassium-Cesium-Antimony (Bialkali)
Minimum projected lengtha .................................. 0.94 in (2.4 cm)
Minimum projected widtha ................................... 0.31 in (0.8 cm)
Window .............................................................. Lime Glass (Corningb No.0080),
or equivalent
Index of refraction at 436 nanometers ..................... 1.523
Dynôdes:
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 ..................................... 3.10 in (7.8 cm)
Seated Length ..................................................... 2.55 in (6.48 cm)
Maximum Diameter ............................................. 1.18 in (3 cm)
Bulb ................................................................. T9
Base ................................................................. 12-Pin Duodecar
Socket ............................................................. Cinch-Jonesc No.12CS-M, or equivalent
Magnetic Shield ................................................... See footnote d
Operating Position .............................................. Any
Weight (Approx.) ................................................ 1 oz

MAXIMUM RATINGS, Absolute-Maximum Values:
DC Supply Voltage:
Between anode and cathode ................................ 1250 max. V
Between anode and dynode No.9 .......................... 260 max. V
Between consecutive dynodes .............................. 250 max. V
Between dynode No.1 and cathode ......................... 250 max. V
Average Anode Currentf ..................................... 0.5 max.mA
Ambient Temperature Rangeg .............................. −80 to +85 °C

Electronics Components
DATA 1 7-71
Characteristics Range Values for Equipment Design:

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, and at a temperature of 220°C.

With E = 1000 volts (Except as noted)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
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<tr>
<td>Anode Sensitivity:</td>
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<td></td>
<td></td>
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<tr>
<td>Radiant\textsuperscript{h} at 400 nanometers</td>
<td>—</td>
<td>8.4x10\textsuperscript{4}</td>
<td>A/W</td>
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<tr>
<td>Luminous\textsuperscript{i} (2870\textdegree K)</td>
<td>10</td>
<td>100</td>
<td>1500</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant\textsuperscript{k} at 400 nanometers</td>
<td>—</td>
<td>0.054</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous\textsuperscript{m} (2870\textdegree K)</td>
<td>—</td>
<td>3.5x10\textsuperscript{-5}</td>
<td>6.5x10\textsuperscript{-5}</td>
</tr>
<tr>
<td>Quantum Efficiency at 400 nanometers</td>
<td>—</td>
<td>17</td>
<td>%</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>—</td>
<td>1.5x10\textsuperscript{6}</td>
<td>—</td>
</tr>
<tr>
<td>Anode Dark Current\textsuperscript{n} at 20 A/Im</td>
<td>—</td>
<td>8x10\textsuperscript{-10}</td>
<td>1x10\textsuperscript{-8}</td>
</tr>
<tr>
<td>Equivalent Anode Dark Current Input\textsuperscript{o}</td>
<td>—</td>
<td>4x10\textsuperscript{-11}</td>
<td>5x10\textsuperscript{-10}</td>
</tr>
<tr>
<td>Equivalent Noise Input\textsuperscript{q}</td>
<td>—</td>
<td>4.8x10\textsuperscript{-14p}</td>
<td>6x10\textsuperscript{-13p}</td>
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<tr>
<td>Anode-Pulse Rise Time\textsuperscript{s} at 1250 V</td>
<td>—</td>
<td>1.6x10\textsuperscript{-9}</td>
<td>—</td>
</tr>
<tr>
<td>Electron Transit Time\textsuperscript{t} at 1250 V</td>
<td>—</td>
<td>1.6x10\textsuperscript{-8}</td>
<td>—</td>
</tr>
</tbody>
</table>

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

\textsuperscript{b} Made by Corning Glass Works, Corning, NY 14830.

\textsuperscript{c} Made by Cinch-Jones Distributor Division, 1501 Morse Avenue, Elk Grove Village, IL 60007.

\textsuperscript{d} 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, IL 60622, or equivalent.
Averaged over any interval of 30 seconds maximum.

Tube operation at 220°C or below is recommended.

This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 837 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 837 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 220°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 400 nanometers. These values are calculated from the EADCl values in lumens using a conversion factor of 837 lumens per watt.

Under the following conditions: 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 400 nanometers. This value is calculated from the ENI value in lumens using a conversion factor of 837 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.
Operating Considerations

Operating Stability
The operating stability of the 4552 is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important. When maximum stability is required, operation at an average anode current of 1 microampere is suggested.

Ambient Atmosphere
Operation or storage of this tube in environments where helium is present should be avoided. Helium may permeate the tube envelope and may lead to eventual tube destruction.

Tube Orientation
The sensitivity of the photocathode surface varies with respect to the position of the light spot on the surface. Figure 3a shows the variation in sensitivity of the surface as the position of a 1-mm diameter light spot is moved from one end of the photocathode to the other. Similarly, the curve in Figure 3b shows how the sensitivity of the photocathode surface varies across its projected width in the plane of the grill. From these curves, the equipment designer can readily determine the optimum position of any light spot on the photocathode surface to give the highest sensitivity.

When an application involves use of light flux which covers essentially the entire cathode area, consideration should be given to the effect on luminous sensitivity caused by angular position of the cathode with respect to the direction of incident light. This effect is shown in Figure 4. As the tube is rotated from the position of maximum sensitivity (approximately +130° as shown in Figure 4), the internal structure prevents portions of a large beam of light from striking the cathode. With a light spot covering only a small portion of the cathode area, relatively minor cutoff of light occurs making the directional effect on luminous sensitivity very small.
Shielding
Electrostatic and/or magnetic shielding of the 4552 may be necessary.

An external electrostatic shield, in contact with the sides of the glass envelope and connected to a negative dc potential essentially the same as that of the photocathode, should be employed in those applications where it is desired to reduce the equivalent noise input of the 4552 to a minimum.

It is to be noted that the use of an external magnetic and/or electrostatic shield at high negative potential presents a safety hazard unless the shield is connected through a high impedance in the order of 10 megohms to the negative-potential source. If the shield is not so connected, extreme care should be observed in providing adequate safeguards to prevent personnel from coming in contact with the high potential of the shield.

Magnetic shielding of the 4552 is necessary if it is operated in the presence of strong magnetic fields. The curve in Figure 8 shows the effect on anode current of variation in magnetic field strength under the conditions indicated. With increase in supply voltage between anode and cathode, the effect of a given magnetic field will cause less decrease in anode current.

Adequate light shielding should be provided to prevent extraneous light from reaching any part of the 4552.

Dynode Modulation
Current amplification may also be controlled or the output signal may be modulated by adjustment of the voltage applied to a single or to two consecutive central dynodes with the voltages on the other stages held constant. The curve in Figure 5a shows the effect on output current as the voltage applied to dynode No.6 is varied. Similar results may be obtained by adjusting the voltage on dynodes No.2 and No. 4. Somewhat less control is obtained by adjusting the voltage on dynodes No.3, No.5, or No.7.
The curve in Figure 5b shows the effect on output current as dynodes No.5 and No.6 are modulated simultaneously but with a constant 100 volt difference maintained between these dynodes during modulation. Similar results may be obtained by simultaneous modulation of dynode No.3 and No.4 and dynode No.7 and No.8.

**Dark Current**

The use of a refrigerant, such as dry ice, to cool the 4552 is recommended in those applications where maximum current amplification with minimum dark current is required.

Typical ENI as a function of tube temperature is shown in Figure 6.

Typical anode dark current and EADCI as a function of luminous sensitivity at a temperature of +22°C is shown in Figure 7.

The resistor values of the voltage divider should be adequate to prevent variation of dynode potentials by signal current. To assure a high degree of linearity, the values of the resistors making up the voltage-divider network should be such that the current through the network, for the selected operating supply voltage, is at least 10 times greater than the maximum average anode current required. Resistor values greater than 10 megohms should not be employed between adjacent tube elements. Location of the voltage divider arrangement should be such that the power dissipated in the resistor string does not increase the temperature of the tube.

A typical voltage divider arrangement for use with the 4552 is shown in Figure 1. The choice of resistance values for the voltage divider string is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the supply and the required wattage rating of the resistors increase. Phototube noise may also increase, due to heating, if the divider is mounted near the tube. The use of
high values of resistance per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum average anode current and may limit anode current response to pulsed light.

When the ratio of peak anode current to average anode current is high, non-inductive capacitors should be employed across the latter stages of the tube. The values of these capacitors should be chosen so that sufficient charge is available to prevent a change of more than a few per cent in inter-stage voltages throughout the pulse duration.

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 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:

$$C = 100 \frac{i \cdot t}{V}$$

where

- $C$ is in farads
- $i$ is the amplitude of anode current in amperes
- $V$ is the voltage across the capacitor in volts
- $t$ 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 $(i \cdot t)$ and the following formula applies:

$$C = 100 \frac{q}{V}$$
The high voltages at which these tubes are 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.

In the use of the 4552 as with other tubes requiring high voltages, it should always be remembered that these high voltages may appear at points in the circuit which are normally at low potential because of defective circuit parts or incorrect circuit connections. Therefore, 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**

![Diagram of a voltage divider arrangement](image)

Figure 1

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.
BASING DIAGRAM, (Bottom View)

Note: The tube should be rotated about its major axis to provide maximum anode current.

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—No Internal Connection
Pin 12—Photocathode

* The socket terminal for Pin 11 may be used as a tie point for the voltage-divider resistor from dynode No.9 to the positive dc supply voltage and the load resistor from the anode to the positive dc supply voltage.

SCHEMATIC REPRESENTATION OF TUBE STRUCTURE
Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge having a thickness of 0.250" and thirteen holes with diameters of 0.0520" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1795" ± 0.0005". Gauge is also provided with a hole 0.375" + 0.005" – 0.000" diameter concentric with the pin circle.
TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

Figure 2
TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY
ALONG TUBE LENGTH

VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL
AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.

SPOT SIZE: 1 MM DIA. APPROX.

DISTANCE ALONG CATHODE FROM END
OF CATHODE NEARER BASE - MILLIMETERS

Figure 3a

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

VARIATIONS CAUSED BY INTERCEPTION OF LIGHT BY GRILL
AS WELL AS SURFACE IRREGULARITIES HAVE BEEN IGNORED.

SPOT SIZE: 1 MM DIA. APPROX.
GRILL TOWARD OBSERVER, BASE DOWN.
CATHODE WIDTH PROJECTED NORMAL TO PLANE OF GRILL.

DISTANCE ALONG PLANE OF GRILL
FROM LEFT TO RIGHT - MILLIMETERS

Figure 3b
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 CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF SIMULTANEOUS MODULATION OF DYNODES NO. 5 AND NO. 6

ANODE-TO-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.

Figure 5b
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.

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

RCA Electronic Components

DATA 8 7-71
ENI CHARACTERISTIC AS A FUNCTION OF TUBE TEMPERATURE

100 VOLTS PER STAGE
BANDWIDTH: 1 Hz
LIGHT SOURCE: TUNGSTEN, AT 2870°K INTERRUPTED AT 90 Hz TO PRODUCE PULSES ALTERNATING BETWEEN ZERO AND FLUX VALUE SHOWN FOR ANY GIVEN TUBE TEMPERATURE, "ON" PERIOD OF PULSE EQUAL TO "OFF" PERIOD: RMS SIGNAL CURRENT = RMS NOISE CURRENT.
EXTERNAL SHIELD VOLTS RELATIVE TO ANODE VOLTS = -1000

RCA Electronic Components

Figure 6
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.

Figure 7
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 SUCCEDING 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.

Figure 8

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 SUCCEDING DYNODE STAGE; AND 1/10 OF E BETWEEN DYNODE NO. 9 AND ANODE.

PHOTOCATHODE IS FULLY ILLUMINATED.
Photomultiplier Tube

1-1/8" Diameter, Side-On Type Having Bialkali Photocathode

Spectral Response ......... See accompanying Typical Photocathode Spectral Response Characteristics

Wavelength of Maximum Response ............... 400 ± 50 nm
Cathode, Opaque ............. Potassium-Cesium-Antimony (Bialkali)
Window ....................... Corning No.0080, or equivalent

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

Direct Interelectrode Capacitances:
- Anode to dynode No.9 .................... 4.4 pF
- Anode to all other electrodes ............ 6.0 pF

Socket ....................... Cinch-Jones No.12CS-M, or equivalent
Magnetic Shield ....................... See footnote a

Maximum Ratings, Absolute-Maximum Values:

DC 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 (30 seconds max. averaging time) .......... 0.5 max. mA

Ambient-Temperature Range .................. —80 to +85 °C

Characteristics Range Values for Equipment Design:

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, and at a temperature of 22°C.

With E = 1000 volts (Except as noted).

Min. Typ. Max.

Anode Sensitivity:
- Radiant, at 400 nanometers ............... 1.7x10^5 A/W

Voltage required to provide an anode current of 100 μA^b ............... 250 — 500 V
Cathode Sensitivity:
Radiant, at 400 nanometers: 0.054 A/W
With blue light source (2870° K + UG-5 and BG-12) (See Figure 2): 3.0x10^-6 A/incident
Quantum Efficiency at 400 nanometers: 17 %
Current Amplification: 3x10^6
Anode Dark Current, at 800 V: 8x10^-10 A

a 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, I.L., 60622, or equivalent.

b Under the following conditions: Light incident on the cathode is transmitted through a blue filter combination (Jena UG-5 and Jena BG-12, manufactured by Jenaer Glaswerk, Schott & Gen, Mainz, West Germany) from a tungsten-filament lamp operated at a color temperature of 2870° K. This filter combination is interposed between a 0.172” x 0.700” aperture and the tube entrance window. The light input incident on the filter combination is 1 x 10^-2 lumen. The tube is rotated about its major axis to obtain maximum output current.

c Under the same conditions as footnote (b) except 60 volts are applied between cathode and all other electrodes connected as anode.

When the ratio of peak anode current to average anode current is high, non-inductive capacitors should be employed across the latter stages of the tube. The values of these capacitors should be chosen so that sufficient charge is available to prevent a change of more than a few per cent in interstage voltages throughout the pulse duration. The capacitor values across the dynode stages 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:

\[ C = \frac{100 \cdot i \cdot t}{V} \]
where $C$ is in farads

$i$ is the amplitude of anode current in amperes

$V$ is the voltage across the capacitor in volts

$t$ 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 $(i \cdot t)$ and the following formula applies:

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

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

**TYPICAL VOLTAGE-DIVIDER ARRANGEMENT**

$R_1$ through $R_{10}$ — 5000 to 1,000,000 ohms

Note: To assure a high degree of linearity, the values of the resistors
making up the voltage-divider network should be such that the current through the network, for the selected operating supply voltage, is at least 10 times greater than the maximum average anode current required.

Note: Capacitors C1 through C3 should be connected at the tube socket for optimum high-frequency performance. Leads to all capacitors should be as short as possible to minimize inductance effects.

TYPICAL P16 SPECTRAL DISTRIBUTION CHARACTERISTIC AND THE SPECTRAL CHARACTERISTIC OF LIGHT FROM A 2870° K SOURCE AFTER PASSING THROUGH INDICATED FILTERS.

* JEDEC Publication 16A, January 1966.
** Curve B is the product of the transmission characteristics of a combination of a BG-12 filter (1 mm thick) and a UG-5 filter (1 mm thick) and the emission characteristics of a 2870° K tungsten-filament lamp. The filters are not in optical contact. The transmission characteristics of the filter combination include reflection losses at the air-glass interfaces. Some transmission occurs above 700 nanometers but is not indicated because it is beyond the spectral sensitivity range of the 4555. Information is obtained from "Color Glass Filters", Jenaer Glaswerk, Schott & Gen., 200 Park Avenue, NY 10017.
Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge having a thickness of 0.250" and thirteen holes with diameters of 0.0520" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1795" ± 0.0005". Gauge is also provided with a hole 0.375" + 0.005" - 0.000" diameter concentric with the pin circle.
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— No Internal Connection*
Pin 12— Photocathode

Note: The tube should be rotated about its major axis to provide maximum anode current.

* The socket terminal for Pin 11 may be used as a tie point for the voltage-divider resistor from dynode No.9 to the positive dc supply voltage and the load resistor from the anode to the positive dc supply voltage.

SCHEMATIC REPRESENTATION OF TUBE STRUCTURE
TYPICAL VARIATION OF PHOTOCATHODE SENSIVITY 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.

RELATIVE ANODE CURRENT

DISTANCE ALONG PLANE OF GRILL FROM LEFT TO RIGHT—MILLIMETERS

TYPICAL VARIATION OF PHOTOCATHODE SENSIVITY ALONG TUBE LENGTH

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

RELATIVE ANODE CURRENT

DISTANCE ALONG CATHODE FROM END OF CATHODE NEARER BASE—MILLIMETERS
TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

WAVELENGTH — NANOMETERS
TYPICAL CURRENT AMPLIFICATION CHARACTERISTIC

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.

CURRENT AMPLIFICATION (GAIN) vs SUPPLY VOLTAGE (E) - VOLTS.

92LM 3814
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 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.
Variant of Type 8507A Having a Fiber-Optic Faceplate

**ELECTRICAL**

Heater Voltage ........................................ 6.3 ± 10% V

Heater Current at 6.3 Volts, ac or dc .............. 0.6 nominal A

Focusing Method ........................................ Magnetic

Deflection Method ...................................... Magnetic

Direct Interelectrode Capacitance:a

Target to all other electrodes ...................... 4.6 pF

**OPTICAL**

Faceplate (Image Surface) Material ............ Dark-Clad Fiber-Optics

Flatness .................................................. Within 0.5 μm

Pitch (Center-to-center spacing) ............... 5.5 ± 1.0 μm

Maximum tilt .......................................... 2 minutes of arc

Spectral Response ................................. RCA Type II, See accompanying

Typical Spectral Sensitivity Characteristics

Photoconductor ...................................... Antimony Trisulfide

**PHOTOCONDUCTIVE LAYER**

Maximum useful diagonal of image ............... 0.625 in (16 mm)

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.

**MECHANICAL**

Overall Length ........................................ 6.250 ± 0.125 in (158.75 ± 3.19 mm)

Greatest Diameter ..................................... 1.210 ± 0.010 in (30.73 ± 0.25 mm)

Bulb Diameter .......................................... 1.025 ± 0.003 in (26.04 ± 0.08 mm)

Base ...................................................... Small-Button Ditetrar 8-Pin (JEDEC No.E8-11)

Socket .................................................... Cinchb No.8VT (133-98-11-015), or equivalent

Deflecting Yoke – Focusing Coil –

Alignment Coil – Assembly ......................... Cleveland Electronicscd No.VYFA-355-2, or-equivalent

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

Weight (Approx.) ...................................... 2 oz

**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>Grid-No.4 Voltage</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1000 V</td>
</tr>
</tbody>
</table>

**NOTES**

a Land clearance is within 0.1 μm.

d For a more thorough discussion on mechanical issues, please refer to the accompanying data.

e Grid No.4 voltage can range from 0 to 1000 V.

f For scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm).
**Typical Operation**

With tube operated in a Cleveland Electronics Assembly Type VYFA-355-2, scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm), faceplate temperature of 30 to 35°C, and standard CCIR "M", or EIA, TV scanning rate (525 lines, interlaced 2:1, frame time 1/30 second).

<table>
<thead>
<tr>
<th>Function</th>
<th>Low-Voltage Mode</th>
<th>High-Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) Voltage</td>
<td>500</td>
<td>900</td>
</tr>
<tr>
<td>Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>300</td>
<td>540</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300</td>
<td>300</td>
</tr>
</tbody>
</table>

**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**: 40 ± 4 G

**Peak-to-Peak Deflecting-Coil Current:**
- Horizontal: 350 mA
- Vertical: 28 mA
- Field Strength of Adjustable Alignment Coil: 0 to 4 G

**Faceplate:**
- Illumination: 5000 lm/ft²
- Temperature: 71°C
TYPICAL PERFORMANCE DATA

Under the conditions shown under Typical Operation

Grid-No.1 Voltage for Picture Cutoff: -65 to -100 V

Average "Gamma" of Transfer Characteristic for a Signal-Output Current Between 20 nA and 200 nA: 0.65

Lag – Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed: 20%

Limiting Resolution:
- At center of picture: 1000 TV Lines
- At corner of picture: 600 TV Lines

Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture: 45%

High-Sensitivity Operation

Conditions
- Faceplate Illumination (Highlight): 0.1 lm/ft² (fc)
- Dark Current: 0.10 μA

Performance
- Target Voltage: 30 to 60 V
- Typical Signal-Output Current:
  - For collimated light: 0.08 μA

Average-Sensitivity Operation

Conditions
- Faceplate Illumination (Highlight): 1.0 lm/ft² (fc)
- Dark Current: 0.02 μA

Performance
- Target Voltage: 20 to 40 V
- Typical Signal-Output Current:
  - For collimated light: 0.16 μA
  - For diffused light: 0.11 μA
This capacitance, which effectively is the output impedance of the 4589, 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 Company, 1501 Morse Avenue, Elk Grove, Village, IL 60007.

Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

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. When the 4589 is positioned within the magnetic assembly, the recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

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.

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 3-11/16 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.

With no blanking voltage on grid No.1.

For an initial signal-output current of 300 nanoamperes and a dark current of 20 nanoamperes. Lag will increase with a decrease in initial signal current and/or an increase in dark current.

Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

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 4589 must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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

Fiber-optic faceplates have the following transmission values:

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>To collimated light</td>
<td>68%</td>
<td>80%</td>
</tr>
<tr>
<td>To diffused light*</td>
<td>50%</td>
<td>55%</td>
</tr>
</tbody>
</table>

*Representative of light output from a phosphor screen fiber-optically coupled.

**SPURIOUS SIGNAL TEST**

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in Figure 1. To be counted as a spot, the spurious signal amplitude must be greater than 10% of a peak white signal of 300 nanoamperes under either highlight or capped conditions, and lines or streaks must be greater than 5%. Lines or streaks having an area not exceeding that of a 6-TV line round spot are counted as spots and are subject to the spot criteria shown below. Grainy or mottled background having a spurious signal amplitude greater than 3% of the peak white signal (300 nA) and block lines and multifiber shading signal amplitudes greater than 5% constitute reject items.
TABLE 1

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

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6 but not including 4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4 but not including 2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>2 but not including 1</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>1 or less</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.

Fiber-Optic Distortion Errors are normally negligible. In exceptional cases, a typical distortion of 2 TV lines may occur.

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To obtain minimum beam-landing error.

Note: Cross-hatching indicates wound portion of focusing coil.
TERMINAL DIAGRAM (Bottom View)

- Pin 1: Heater
- Pin 2: Grid No.1
- Pin 3: Grid No.4
- Pin 4: Internal Connection – Do Not Use
- Pin 5: Grid No.2
- Pin 6: Grid No.3
- Pin 7: Cathode
- Pin 8: Heater Flange: Target
  Short Index
  Pin – Internal Connection – Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

DIMENSIONAL OUTLINE - Dimensions in Inches (mm)

Note: Flatness of fiber-optic faceplate is less than 0.5 μm, corresponding to approximately 1 fringe of sodium “D” light. Maximum faceplate tilt is 2 minutes of arc.
INPUT RADIANT POWER ADJUSTED TO OBTAIN EQUAL VALUES OF SIGNAL — OUTPUT CURRENT AT ALL WAVELENGTHS.

REMARKS: MIMIC LINE BY LINE.

ULTRAVIOLET VIOLET BLUE GREEN YELLOW RED INFRARED

WAVELENGTH — NANOMETERS

300 400 500 600 700 800

RELATIVE RESPONSE — PER CENT

0 10 20 30 40 50 60 70 80 90 100

920M-1119M

RCA Electronic Components
Photomultiplier Tube

3/4"-Diameter, 12-Stage Type Having S-11 Spectral Response and Copper-Beryllium Dynodes

- Typical Current Amplification: $4 \times 10^6$
- Typical Quantum Efficiency: 17% at 440 nm
- Tube Size: 0.78" Max. Diameter, 3.8" Max. Length
- Flat Faceplate for Mounting Scintillators

General Data

Spectral Response: See Figure 1
Wavelength of Maximum Response: 440 ± 50 nm
Cathode, Semitransparent: Cesium-Antimony
  - Minimum projected area: 0.2 in² (1.26 cm²)
  - Minimum diameter: 0.5 in (1.27 cm)
Window: Borosilicate Glass (Corning® No. 7056), or equivalent
Shape: Plano-Concave
Index of refraction at 436 nanometers: 1.523

Dynodes:
- Substrate: Copper-Beryllium
- Secondary-emitting surface: Beryllium-Oxide
- Structure: In-Line, Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):
- Anode to dynode No.12: 2.4 pF
- Anode to all other electrodes: 3.2 pF

Maximum Overall Length (Excluding Semiflexible Leads): 3.8 in (96.5 mm)
Maximum Diameter: 0.78 in (19.8 mm)

Base (Temporary): Small-Shell Bidecal 20-Pin (JEDEC No.B20-102)
Socket: Cinch® No.20-PM, or equivalent
Magnetic Shield: Perfection Mica® No.10P40, or equivalent
Operating Position: Any
Weight (Approx.):
  - With temporary base removed: 1 oz

Electronic Components

DATA 1
6-72
Maximum Ratings, Absolute-Maximum Values

DC Supply Voltage:
- Between anode and cathode: 2000 max. V
- Between anode and dynode No.12: 300 max. V
- Between adjacent dynodes: 200 max. V
- Between dynode No.1 and cathode: 400 max. V
- Average Anode Current: 0.5 max. mA
- Ambient Temperature: 75 max. °C

Characteristics Range Values for Equipment Design

Under conditions with a DC supply voltage (E) across a voltage divider providing the electrode voltages as shown in Table I and at an ambient temperature of 22°C, except as noted.

With E = 1500 volts (except as noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 440 nanometers</td>
<td></td>
<td>2.4x10^5</td>
<td></td>
</tr>
<tr>
<td>Luminous (2854°K)</td>
<td>100</td>
<td>300</td>
<td>3500</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 440 nanometers</td>
<td></td>
<td>6x10^-2</td>
<td></td>
</tr>
<tr>
<td>Luminous (2854°K)</td>
<td>5x10^-5</td>
<td>7.5x10^-5</td>
<td></td>
</tr>
<tr>
<td>Blue response (2854°K + C.S. No.5-58, 1/2 stock thickness)</td>
<td>5x10^-6</td>
<td>7.5x10^-6</td>
<td></td>
</tr>
<tr>
<td>Quantum efficiency at 440 nanometers</td>
<td></td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td></td>
<td>4x10^6</td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current at 200 A/Im</td>
<td></td>
<td>5x10^-8</td>
<td>5x10^-7</td>
</tr>
<tr>
<td>Equivalent Anode Dark Current Input at 200 A/Im</td>
<td></td>
<td>2.5x10^-10</td>
<td>2.5x10^-9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.1x10^-13</td>
<td>3.1x10^-12</td>
</tr>
</tbody>
</table>

RCA Electronic Components DATA 1
<table>
<thead>
<tr>
<th>Table I</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Typical Potential Distribution</strong></td>
</tr>
<tr>
<td><strong>Between:</strong></td>
</tr>
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<td></td>
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<td></td>
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<td></td>
</tr>
</tbody>
</table>

a Made by Corning Glass Works, Corning, NY 14830.
b Made by Cinch Manufacturing Company, 1501 Morse Avenue, Elk Grove Village, IL 60007.
c Made by Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Avenue, Chicago 22, IL 60622.
d A description of the Absolute Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes.
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 anode luminous sensitivity rating using a conversion factor of 803 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 2854° K and a light input of 1 micro-lumen is used.
j This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 803 lumens per watt.
k 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 2854° K. The value of light flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
m Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, pol-
Glass Works, Corning, NY 14830) from a tungsten-filament lamp operated at a color temperature of 2854° 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.

With supply voltage adjusted to give a luminous sensitivity of 200 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

At 440 nanometers. These values are calculated from the EADCI values in lumens using a conversion factor of 803 lumens per watt.

Operating Considerations
Shielding
Electrostatic shielding of the tube 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 the tube at the photocathode end 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.

In addition to increasing dark current and noise output because of voltage gradients developed across the bulb wall, such high voltage may produce minute leakage current to the cathode, through the tube envelope and insulating materials, which can permanently damage the tube.

Ambient Atmosphere
Operation or storage of this tube in environments where helium is present should be avoided. Helium may permeate the tube envelope and may lead to eventual tube destruction.

Lead Connections
The semiflexible leads of the tube may be soldered or welded into the associated circuit. Care must be exercised when making such connections to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the protective shell is recommended. Excessive bending of the leads is to be avoided.
Basing Diagram – Bottom View (With Temporary Base)

- Pin 1: No Connection
- Pin 2: Dynode No. 1
- Pin 3: Dynode No. 3
- Pin 4: Dynode No. 5
- Pin 5: Dynode No. 7
- Pin 6: Dynode No. 9
- Pin 7: Dynode No. 11
- Pin 8: Anode
- Pin 9: No Connection
- Pin 10: No Connection
- Pin 11: No Connection
- Pin 12: Dynode No. 2
- Pin 13: Dynode No. 10
- Pin 14: Dynode No. 8
- Pin 15: Dynode No. 6
- Pin 16: Dynode No. 4
- Pin 17: Dynode No. 12
- Pin 18: No Connection
- Pin 19: No Connection
- Pin 20: Photocathode

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: Dynode No. 11
- Lead 7: Anode
- Lead 8: Dynode No. 12
- Lead 9: Dynode No. 10
- Lead 10: Dynode No. 8
- Lead 11: Dynode No. 6
- Lead 12: Dynode No. 4
- Lead 13: Photocathode
- Lead 14: Photocathode
- Lead 15: Dynode No. 2
- Lead 16: Dynode No. 4

Lead Orientation, Bottom View

- Note 1 – Lead is cut off within 0.12” of glass button for indexing.
- Note 2 – Lead Nos. 7, 9, and 17 are cut off within 0.12” of the glass button.

RCA Electronic Components

DATA 3
6-72
Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

**Note 1** — Deviation from flatness will not exceed 0.006" from peak to valley.

**Note 2** — Within this length, maximum diameter of tube is 0.78".
Typical Photocathode Spectral Response Characteristics

Figure 1
The supply voltage (E) is across a voltage divider which provides voltages as follows:

<table>
<thead>
<tr>
<th>Between</th>
<th>Multiplied by 7.1% of E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Each succeeding dynode stage</td>
<td>14.1</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2

Sensitivity and Current Amplification Characteristics
Typical EADCI and Anode Dark Current 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>7.1% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No. 1</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No. 1 and Dynode No. 2</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No. 2 and Dynode No. 3</td>
<td>1.7</td>
</tr>
<tr>
<td>Each succeeding Dynode Stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>14.1</td>
</tr>
</tbody>
</table>

Tube temperature is 220°C

Figure 3
Typical Circuit Arrangement for Scintillation Counting Applications

C1: 0.05, 500 VDC, Ceramic Disc
C2: 0.02, 500 VDC, Ceramic Disc
C3: 0.01, 500 VDC, Ceramic Disc
C4: 0.005, 500 VDC, Ceramic Disc
C5, C6: 0.005, 2500 VDC, Ceramic Disc
R1 through R10: 270 kΩ±5%, 1/2 W
R11: 470 kΩ±5%, 1/2 W
R12, R13: 330 kΩ±5%, 1/2 W
R14: 1 MΩ±5%, 1/2 W

Note 1 - The value of the load elements RL and CL, depend on the application. RL x CL = 10 microseconds for most applications.

Note 2 - Tolerance of all capacitors is ± 20%.

Figure 4
SIT Camera Tubes

Silicon-Intensifier Target (SIT), 16-Millimeter Fiber-Optic Faceplate Types

- Very High Sensitivity
- Sturdy Compact Structure
- Excellent Discharge Capability
- Low Lag
- High Resolution
- Low-Power 0.6 Watt Dark Heater

The 4804A is similar to the 4804, except that the spurious signal (spot) rejection of the 4804A is more stringent than that of the 4804 and where indicated otherwise. The 4804A/P2 and 4804/P2 are potted versions of the 4804A and 4804, respectively.

General Data

The majority of these data apply to both potted and non-potted versions. Where exceptions exist, the data are labeled appropriately.

Spectral Response ............... S-20
Wavelength of Maximum Response ............... 420 ± 50 nm

Photocathode:

Material .................. Na-K-Cs-Sb (Multialkali)

Maximum useful diagonal of rectangular image ............... 16 mm (0.625 in)

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the plane passing through the tube axis and the short index pin.

Image Surface:

Shape .................. Flat, Circular
Material .................. Dark-clad Fiber Optics

Pitch (Nominal center-to-center spacing) ............... 6 μm

Direct Interelectrode Capacitance (Approx.):

Target to all other electrodes ............... 10 pF

Maximum Overall Length:

Potted .................. 7.880 in (200 mm)
Non-potted .................. 7.500 in (190.5 mm)

Maximum Diameter:

Potted .................. 2.080 in (52.8 mm)
Non-potted ............... (See Figure 11 Note a) 1.515 in (38.5 mm)
Focusing method: Electrostatic
Configuration:
Potted: Diode-connected Triode
Non-potted: Triode
Internal Focus Bleeder (potted only): 1.00 ± 0.10 GΩ

Scanning Section:
Focusing method: Magnetic
Deflection method: Magnetic
Base: Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket: Cinch® No.8VT (133-98-11-015), or equivalent

Deflecting Yoke-Focusing Coil Alignment Coil Assembly:
Potted: Cleveland Electronics No.SVDA-2037-1 or Penn Tran No.1490-1
Non-Potted: Cleveland Electronics, No.SVDA-2037, or Penn Tran, No.1490, or equivalent

Operating Position: Any

Approximate Weight:
Potted: 9.3 oz (264 g)
Non-potted: 4.5 oz (127 g)

Maximum Ratings, Absolute-Maximum Values:

<table>
<thead>
<tr>
<th>Component</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating</td>
<td>-10</td>
<td>60 °C</td>
</tr>
<tr>
<td>Non-operating</td>
<td>-54</td>
<td>71 °C</td>
</tr>
<tr>
<td>Image Section:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photocathode voltage (negative with respect to anode):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4804A/P2, 4804A</td>
<td>-10,000 V</td>
<td></td>
</tr>
<tr>
<td>4804/P2, 4804</td>
<td>-9,000 V</td>
<td></td>
</tr>
<tr>
<td>DC photocathode current</td>
<td>350 nA</td>
<td></td>
</tr>
<tr>
<td>Focus Electrode (negative with respect to anode, non-potted):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4804A</td>
<td>-10,000 V</td>
<td></td>
</tr>
<tr>
<td>4804</td>
<td>-9,000 V</td>
<td></td>
</tr>
<tr>
<td>Anode voltage (zero with respect to thermionic cathode)</td>
<td>Ground</td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>10⁴ fc-s</td>
<td></td>
</tr>
</tbody>
</table>

RCA Electronic Components

DATA 1
### Scanning Section:

- **Heater-Voltage**: 6.0 V, 6.6 V
- **Grid-No.4 Voltage**: —, 350 V
- **Grid-No.3 Voltage**: —, 350 V
- **Grid-No.2 Voltage**: —, 350 V
- **Grid-No.2 Dissipation**: —, 1 W
- **Grid-No.1 Voltage**: —150 V, 0 V
- **Heater-Cathode Voltage**: —125 V, 10 V
- **Target Voltage**: —, 300 V
- **Peak Target Current**: —, 750 nA

### Typical Operation

With tube operated in a Cleveland Electronics Assembly Type No.SVDA-2037, or equivalent, faceplate image size 1/2" x 3/8" (12.7 mm x 9.53 mm), and standard CCIR "M", or EIA, TV scanning rate (525 lines, interlaced 2:1, frame time 1/30 second)

- **Temperature**: 25 to 31 °C

### Image Section:

- **Photocathode voltage (negative with respect to anode)**: —9000 to —2500 V
- **Focusing-grid voltage (positive with respect to photocathode)**: 1.5 ± 0.5% of photocathode voltage
- **Anode voltage (zero with respect to thermionic cathode)**: Ground

### Scanning Section:

- **Heater, for unipotential cathode:**
  - **Current**: 0.1 A
  - **Nominal voltage for current of 0.1 amperes**: 6.3 V
- **Grid-No.4 (Decelerator) Voltage**: 340 V
- **Grid-No.3 (Beam-Focus Electrode) Voltage**: 300 V
- **Grid-No.2 (Accelerator) Voltage**: 300 V
- **Peak-to-Peak Blanking Voltage**:
  - When applied to grid No.1: 75 V
  - When applied to cathode: 20 V
- **Target Current**: 300 nA
- **Target Voltage**: 8 to 10 V
- **Focusing-Coil Current** (Approx.): 40 mA
- **Peak-to-Peak Deflecting-Coil Current**:
  - **Horizontal**: 180 mA
  - **Vertical**: 20 mA

---

4804A | 4804
4804A/P2 | 4804/P2

RCA Electronic Components
Field Strength of Each Adjustable Alignment Coil:

<table>
<thead>
<tr>
<th>Coil Configuration</th>
<th>Field Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>4804A/P2, 4804A</td>
<td>0 to 3 G</td>
</tr>
<tr>
<td>4804/P2, 4804</td>
<td>0 to 4 G</td>
</tr>
</tbody>
</table>

**Performance Data**

Under conditions shown under Typical Operation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-65</td>
<td>-80</td>
<td>-120</td>
</tr>
<tr>
<td>Gain Ratio for Photocathode Voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swing from -9 to -2.5 kV</td>
<td>100</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Average &quot;Gamma&quot; of Transfer Characteristic for Signal Output Current between 1.0 nA and 700 nA (See Figure 7)</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Lag—Per Cent of Initial Signal Output Current 1/20 Second After Illumination is Removed (See Figure 3)</td>
<td>-</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Contrast Transfer (Amplitude Response) to a 400 TV Line Square-Wave Test Pattern at Center of Picture (See Figure 2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4804A/P2, 4804A</td>
<td>24</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>4804/P2, 4804</td>
<td>20</td>
<td>30</td>
<td>-</td>
</tr>
<tr>
<td>Resolution (See Figure 6)</td>
<td>600</td>
<td>700</td>
<td>TV Lines</td>
</tr>
<tr>
<td>Sensitivity (See Figure 7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>190,000</td>
<td>270,000</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Target Current Gain at 9 kV (See Figure 5):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4804A/P2, 4804A</td>
<td>1100</td>
<td>1600</td>
<td>-</td>
</tr>
<tr>
<td>4804/P2, 4804</td>
<td>-</td>
<td>1600</td>
<td>-</td>
</tr>
<tr>
<td>Dark Current for Target Voltage of 8 Volts (See Figure 4)</td>
<td>-</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Photocathode Responsivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous (28540 K Tungsten Source)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4804A/P2, 4804A</td>
<td>2.6</td>
<td>3.2</td>
<td>mA/W-</td>
</tr>
<tr>
<td>4804/P2, 4804</td>
<td>-</td>
<td>3.2</td>
<td>28540 K</td>
</tr>
<tr>
<td>Luminous (See Figure 8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4804A/P2, 4804A</td>
<td>130</td>
<td>160</td>
<td>-</td>
</tr>
<tr>
<td>4804/P2, 4804</td>
<td>-</td>
<td>160</td>
<td>-</td>
</tr>
</tbody>
</table>
Spurious Signal Test

This test is performed with the tube viewing a uniformly diffused white test pattern that identifies the three zones shown in Figure 1. The tube is operated under the conditions specified under Typical Operating Values and is illuminated to provide a peak highlight signal current of 300 nanoamperes. The tube is adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system.

4804A/P2, 4804A

Allowable spot size for each zone is shown in Table I. To be classified as a spot, the spurious signal amplitude must be at least 10% of the peak white signal under either highlight or capped conditions. Smudges, streaks, or mottled and grainy background must have a spurious signal amplitude of at least 5% to constitute a reject item.
Table I – 4804A/P2, 4804A

<table>
<thead>
<tr>
<th>Blemish Size (Equivalent Number of Raster Lines)</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
<th>Zone 3 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>over 6</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>over 4</td>
<td>3</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>over 1</td>
<td>6</td>
<td>17</td>
<td>22</td>
</tr>
<tr>
<td>1 or less</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.

4804/P2, 4804

Allowable spot size for each zone is shown in Table II. To be classified as a spot, the spurious signal amplitude must be at least 10% of the peak white signal under either highlight or capped conditions. Smudges, streaks, or mottled and grainy background (except fiber-optics block lines) must have a spurious signal amplitude of at least 10% to constitute a reject item. Fiber optics block lines under 30% amplitude are not counted.

Table II – 4804/P2, 4804

<table>
<thead>
<tr>
<th>Blemish Size (Equivalent Number of Raster Lines)</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
<th>Zone 3 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 12</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>over 8</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>over 6</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>over 4</td>
<td>3</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>over 2</td>
<td>11</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>2 or less</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Spots of this size are allowed unless concentration causes a smudged appearance.
a Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, IL 60007.

b Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087.

c Made by Penn-Tran Inc., 1155 Zion Road, Bellefonte, PA.

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

e Excessive faceplate exposure for long periods of time should be prevented whenever possible. For applications covering wide ranges of illumination, suitable combinations of lens stop, light filters and photocathode voltage should be chosen to provide close to typical signal currents.

f Grid-No.4 voltage must always be greater than grid-No.3 voltage. The recommended ratio of grid-No.3 to grid-No.4 voltage is 9/10 to 8/10. The optimum ratio is that ratio providing the most uniform center-to-edge highlight discharge.

g In normal operation, the target voltage should not exceed 15 volts.

h With respect to thermionic cathode.

i 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.

k For picture cutoff with no blanking voltage on grid No.1.

m For an initial signal output current of 300 nanoamperes.

n Measured under the following conditions. Photocathode voltage = 8.0 kV, signal current = 300 nanoamperes, and an RCA P200 slant-burst test pattern is employed.

p The unit, watts-2854°K, is used to designate the total radiated power in watts, integrated over all wavelengths, from a tungsten-filament lamp operated at a color temperature of 2854°K. This unit is directly converted into lumens by the following relationship: 1 watt-2854°K = 20 lumens. From this relationship, sensitivity can be expressed in units of either amperes/lumen or amperes/watt-2854°K.
Dimensional Outline of 4804A and 4804 (Non-potted Types)

Note a — Clearance of 1.765 in (44.8) is required to pass all protrusions.

Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension. (One inch = 25.4 mm)
Dimensional Outline of 4804A/P2 and 4804/P2 (Potted Types)

TARGET CONNECTION STUD (REMOVABLE)

RASTER SIZE = 1/2 x 3/8 (12.7 x 9.5)

1.060 DIA. (27) IMAGE SECTION FACEPLATE

1.180 ± 0.010 DIA. (29.21 ± 0.254)

0.450 MAX. (11.27)

0.150 MAX. (3.81)

0.080 ± 0.002 (1.5 ± 0.05)

4-40 ROUND HEAD SCREWS (3)

2.075 ± 0.005 DIA. (52.8 ± 0.127)

2.325 ± 0.015 (59.0 ± 0.381)

0.650 (16.51) REF.

7.730 ± 0.150 (196.3 ± 3.81)

1.815 ± 0.005 (46.0 ± 0.127)

1.0325 (26)

BASE JEDEC No. E8-11

ELECTROSTATIC SHIELD (GREY)

OUTER SHIELD-ANODE

PHOTOCATHODE LEAD 9" LONG AMP PART No. 94686-6 MATES WITH AMP RECEPTACLE No. 830290.1

Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension. (One inch = 25.4 mm).
Basing Diagram, Bottom View

Pin 1— Heater
Pin 2— Grid No.1
Pin 3— Grid No.4
Pin 4— Internal Connection —
Do not use
Pin 5— Grid No.2
Pin 6— Grid No.3
Pin 7— Cathode
Pin 8— Heater

Short Index Pin — Internal Connection—
Make no connection

Horizontal Square Wave Response  (Figure 2)

---

DC PHOTOCATHODE VOLTAGE = 8 kV
DC GRID No.4 VOLTAGE = 400 V
HIGHLIGHT TARGET CURRENT = 300 nA
TEST PATTERN: TRANSPARENT SLANT-LINE BURST*

*Contrast Transfer Function measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.
Typical Persistence Characteristics (Figure 3)

SCANNED AREA OF TARGET = 1/2" x 3/8"
TARGET SECTION TEMPERATURE = 30°C APPROX.
TARGET VOLTAGE = 8 VOLTS

<table>
<thead>
<tr>
<th>CURVE</th>
<th>SIGNAL CURRENT NANOAMPERES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>25</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
</tr>
<tr>
<td>C</td>
<td>100</td>
</tr>
<tr>
<td>D</td>
<td>200</td>
</tr>
<tr>
<td>E</td>
<td>500</td>
</tr>
</tbody>
</table>

TIME AFTER ILLUMINATION IS REMOVED — MILLISECONDS
92LM-5624
Dark Current Characteristics (Figure 4)

SCANNED AREA OF TARGET = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

Target Gain Characteristics (Figure 5)
Resolution Characteristics (Figure 6)

ILLUMINATION: 2854°K TUNGSTEN
TEST PATTERN: HIGH-CONTRAST SQUARE-WAVE RESOLUTION PATTERN
PREAMPLIFIER: RMS NOISE = 5 nA
BANDWIDTH = 10 MHz

IMAGE-SECTION GAIN SHOULD BE REDUCED BY LOWERING THE PHOTOCATHODE VOLTAGE FOR LIGHT LEVELS ABOVE 1 x 10^{-3} fc.

Transfer Characteristics (Figure 7)

FACEPLATE IMAGE SIZE = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30° C APPROX.
PHOTOCATHODE VOLTAGE = 9 kV DC

FOR HIGHER LIGHT LEVELS THAN THOSE SHOWN, IMAGE-SECTION GAIN SHOULD BE REDUCED BY LOWERING THE PHOTOCATHODE VOLTAGE.

Electronic Components
Typical Photocathode Responsivity (Figure 8)

BROADBAND SENSITIVITY
3.2 mA/WATT \cdot 2854^\circ K (160 \mu A/\text{lm})

<table>
<thead>
<tr>
<th>WAVELENGTH - NANOMETERS</th>
<th>RELATIVE RESPONSIVITY - PER CENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>100</td>
</tr>
<tr>
<td>400</td>
<td>80</td>
</tr>
<tr>
<td>500</td>
<td>60</td>
</tr>
<tr>
<td>600</td>
<td>40</td>
</tr>
<tr>
<td>700</td>
<td>20</td>
</tr>
<tr>
<td>800</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WAVELENGTH - NANOMETERS</th>
<th>ABSOLUTE RESPONSIVITY - mA / WATT</th>
</tr>
</thead>
<tbody>
<tr>
<td>300</td>
<td>1.1</td>
</tr>
<tr>
<td>400</td>
<td>0.7</td>
</tr>
<tr>
<td>500</td>
<td>0.5</td>
</tr>
<tr>
<td>600</td>
<td>0.3</td>
</tr>
<tr>
<td>700</td>
<td>0.2</td>
</tr>
<tr>
<td>800</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Image Isocon Camera Tubes

For High-Resolution, Real-Time, "Low-Light-Level" TV Systems

For High-Resolution, Real-Time, "Low-Light-Level" TV Systems

- Choice of "Flying Lead" or Permanent Base Types
- Flat Fiber-Optic Faceplate Allowing Excellent Coupling
- Extremely Simple Set-Up Procedure
- No Background Shading
- Single Non-Critical Beam-Current Adjustment
- Very High Signal-to-Noise Ratio
- Extremely High and Uniform Resolution
- Sturdy Target Highly Resistant to Intense Bursts of Light
- Low Lag
- Ruggedized
- Designed for Use With P20 Phosphor-Screen Image Intensifier
- Large Intrascene Dynamic Range Capability
- Especially useful for Coupling With an Image Intensifier
- Types 4807 and 4807A Differ Only in Certain Aspects of Performance Specifications
- Types 4807/V1 and 4807A/V1 Are Permanent Base Versions of Types 4807 and 4807A, Respectively

General Data

Direct Interelectrode Capacitance:

Anode to all other electrodes (output capacitance):

- Potted ........................................... 24 pF
- Non-Potted (including tube base) .................. 12 pF

Target-to-Mesh Spacing (Nominal) ................. 0.02 in (0.5 mm)

Spectral Response (See Figure 10) ................. Modified S-20

Photocathode, Semitransparent:

- Material ............................................ Na-K-Cs-Sb (Multialkali)

Useful Size of Image:

- Maximum target diagonal ....................... 1.4 in (35 mm)
- Maximum photocathode diagonal ............... 1.4 in (35 mm)

Note: The size of the optical image focused on the photocathode should be adjusted so its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

RCA Electronic Components

DATA 1 11/72
Orientation: Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the center of the faceplate and the index position of the shoulder base. The horizontal and vertical scan should start at the corner of the raster between the unused lead positions 2 and 3 of the shoulder base. See RCA-AJ2206 yoke assembly bulletin for proper tube-yoke orientation.

Image Surface:

- Material: Dark-Clad Fiber-Optics
- Pitch (nominal center-to-center spacing): 6 μm
- Flatness: Within 0.5 μm
- Focusing Method: Magnetic
- Deflection Method: Magnetic
- Shoulder Base: Annular 3-leads (See Dimensional Outline)
- End Base (4807, 4807A): Semiflexible leads potted in silicone rubber (See Dimensional Outline)
- Element Decoupling: See Footnote a

Associated Scanning-and Focusing-Coil Assembly: RCA Type AJ2206, or Equivalent

Operating and Storage Position: Any

Weight (Approx.): 1.5 lbs (680 kg)

Maximum and Minimum Ratings, Absolute-Maximum Values

Volatges are with respect to thermionic cathode unless otherwise specified. All ratings are maximum unless otherwise stated.

Faceplate:

- Irradiance: 26 W/m² (watts/square meter)
- Illuminance: 50 lm/ft² (fc)
- 500 lm/m² (lux)

Temperature:

- Any part of bulb: 65 °C

Temperature Difference:

- Between target section and any part of bulb hotter than target section: 5 °C

Heater, for Unipotential Thermionic Cathode:

- AC or DC current (pin No. 1 and pin No. 20 or lead No. 16 and 17): 0.63 A, 0.57 min. A
Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 V
- Heater positive with respect to cathode: 10 V

Photocathode Voltage ($E_{pc}$): $-1000$ V
Grid-No.6 Voltage ($E_{g6}$): $-750$ V

Target Voltage ($E_t$):
- Positive value: 10 V
- Negative value: 10 V

Grid-No.5 (Field-Mesh) Voltage ($E_{g5}$): 600 V
Grid-No.4 Voltage ($E_{g4}$): 600 V
Grid-No.3 Voltage ($E_{g3}$): 600 V
Grid-No.2 Voltage ($E_{g2}$): 450 V
Grid-No.1 Voltage ($E_{g1}$): $-150$ to $-40$ V

Steering-Plate Voltages:
- Plate SX1 ($E_{sx1}$): 600 V
- Plate SX2 ($E_{sx2}$): 600 V

Misalignment-Plate Voltages:
- Plate SY1 ($E_{sy1}$): 600 V
- Plate SY2 ($E_{sy2}$): 600 V

Anode Voltage ($E_b$): 1800 V

Voltage Between Adjacent Dynodes:
- Typical Operating Values:
  - 600 V

Regulation of power supply and divider network circuitry should be such that the operating values specified below are held within the limits shown.

**Heater Current**: ±5 %

Focus Coil Current (The values of currents to which this regulation requirement applies are contained in the data sheet describing the magnetic component, e.g., AJ2206): ±0.3 %

Grid-No.4 Voltage (As adjusted): ±0.2 %

Other DC Voltages (Fixed or as adjusted): ±1.0 %

Beam Blanking Pulse Voltage: { +50 %, -0 % }

Voltages are with respect to thermionic cathodes unless otherwise specified. For circuit design purposes, nominal electrode currents are 10 μA or less, including leakage, except where otherwise noted.
<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater for Unipotential Cathode</td>
<td></td>
</tr>
<tr>
<td>(Between Pins 1 and 20):</td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>0.6 A</td>
</tr>
<tr>
<td>Voltage (nominal, for current of 0.6 A)</td>
<td>6.3 V</td>
</tr>
<tr>
<td>Photocathode Voltage (Image focus)</td>
<td>-900 to -650 V</td>
</tr>
<tr>
<td>Grid-No.6 Voltage (Accelerator — approximately 63% of cathode voltage)</td>
<td>-570 to -410 V</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>3.5 V</td>
</tr>
<tr>
<td>Grid-No.5 Voltage (Field-mesh)</td>
<td>Eg4 + 12 V</td>
</tr>
<tr>
<td>Grid-No.4 Voltage</td>
<td>400 to 440 V</td>
</tr>
<tr>
<td>Grid-No.3 Voltage (Max. output)</td>
<td>Eg4 + 120 V</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>400 V</td>
</tr>
<tr>
<td>Current</td>
<td>200 μA</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-120 to -60 V</td>
</tr>
<tr>
<td>Steering Plate Difference Voltage</td>
<td>(Center voltage same value as grid No.4):</td>
</tr>
<tr>
<td></td>
<td>E\textsubscript{sx}1 — E\textsubscript{sx}2</td>
</tr>
<tr>
<td>Misalignment Plate Difference Voltage</td>
<td>(Center voltage same value as grid No.4):</td>
</tr>
<tr>
<td></td>
<td>E\textsubscript{sy}1 — E\textsubscript{sy}2</td>
</tr>
<tr>
<td>Dynode-No.1 Voltage</td>
<td>375 V</td>
</tr>
<tr>
<td>Dynode-No.2 Voltage</td>
<td>700 V</td>
</tr>
<tr>
<td>Dynode-No.3 Voltage</td>
<td>750 to 1050 V</td>
</tr>
<tr>
<td>Dynode-No.4 Voltage</td>
<td>1350 V</td>
</tr>
<tr>
<td>Dynode-No.5 Voltage</td>
<td>1650 V</td>
</tr>
<tr>
<td>Anode Voltage</td>
<td>1700 V</td>
</tr>
<tr>
<td>Current</td>
<td>25 μA</td>
</tr>
<tr>
<td>Target Temperature Range</td>
<td>30 to 50°C</td>
</tr>
<tr>
<td>Beam Blanking Voltage (Applied to grid No.1):</td>
<td>Peak-to-peak 30 V</td>
</tr>
<tr>
<td>Field Strength at Center of Focusing Coil (Approx.)</td>
<td>70 G</td>
</tr>
</tbody>
</table>
Performance Characteristics Range Values

With conditions shown under Typical Operating Values, picture highlights at $2 \times 10^{-3}$ lm/ft$^2$ at the photocathode, 525 line scanning, interlaced 2:1, frame time 1/30 second, and 1.4” photocathode diagonal with 4 x 3 aspect ratio.

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photocathode Radiant Responsivity at 440 nanometers</td>
<td>-</td>
<td>60</td>
<td>- mA/W</td>
</tr>
<tr>
<td>Photocathode Luminous Responsivity (2854° K tungsten source)$^w$</td>
<td>130</td>
<td>160</td>
<td>- µA/Im</td>
</tr>
<tr>
<td></td>
<td>2.6</td>
<td>3.2</td>
<td>- mA/W-2854° K</td>
</tr>
<tr>
<td>Signal-Output Current (Peak-to-peak)</td>
<td>3</td>
<td>5</td>
<td>- µA</td>
</tr>
<tr>
<td>Photocathode Illuminance at 2854° K Required to Reach &quot;Knee&quot; of Transfer Characteristic</td>
<td>- .001</td>
<td>.002</td>
<td>lm/ft$^2$</td>
</tr>
<tr>
<td>Photocathode Irradiance at 440 Nanometers Required to Reach &quot;Knee&quot; of Transfer Characteristic$^5$</td>
<td>-</td>
<td>5.7x10$^{-5}$</td>
<td>W/m$^2$</td>
</tr>
<tr>
<td>Signal-To-Noise Ratio: $^t$</td>
<td>Signal to noise-in-signal for highlights:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4807A, 4807A/V1</td>
<td>26</td>
<td>30</td>
<td>- dB</td>
</tr>
<tr>
<td>4807, 4807/V1</td>
<td>30</td>
<td>32</td>
<td>- dB</td>
</tr>
<tr>
<td>Highlight signal-to-dark current noise</td>
<td>40</td>
<td>46</td>
<td>- dB</td>
</tr>
<tr>
<td>Amplitude Response (Contrast transfer) at 400 TV Lines Per Picture Height (Percent of response to large-area black to large-area white transition)$^u$</td>
<td>70</td>
<td>80</td>
<td>- %</td>
</tr>
<tr>
<td>Limiting Resolution:</td>
<td>At center of picture</td>
<td>1000</td>
<td>1100</td>
</tr>
<tr>
<td></td>
<td>At corner of picture</td>
<td>850</td>
<td>900</td>
</tr>
<tr>
<td>Geometric Distortion</td>
<td>-</td>
<td>1</td>
<td>- %</td>
</tr>
<tr>
<td>Lag-Percent of Initial Signal Output Current 1/20 Second After Illuminance is Removed</td>
<td>-</td>
<td>-</td>
<td>3% at 2x10$^{-3}$ fc</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>10% at 5x10$^{-4}$ fc</td>
</tr>
</tbody>
</table>
### Shading (Uniformity): V

**Black level:**

Variation of output current with tube capped (Percent of maximum highlight signal):

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Variation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4807A, 4807A/V1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>4807, 4807/V1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

**White level:**

Variation of highlight signal (Percent of maximum highlight signal):

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>Variation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4807A, 4807A/V1</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>4807, 4807/V1</td>
<td>12</td>
<td>15</td>
</tr>
</tbody>
</table>

---

**a** See figure showing Suggested Tube End-Base Decoupling Networks.

**b** A description of the Absolute Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes.

**c** Faceplate illuminance is limited to 50 lm/ft² continuously. An exposure of $10^4$ lm/ft² for a maximum period of 5 seconds can be tolerated provided the duty cycle limits the average value to 50 lm/ft². See Figure 4 for time-illuminance relationship for continuously illuminated scenes.

**d** Operation outside of the recommended target temperature range shown under Typical Operating Values will not damage the 4807 series tubes provided the maximum temperature ratings of the tubes are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the recommended target temperature range.

**e** With respect to grid No.4. Grid-No.5 (field mesh) voltage must never be less than that of grid No.4.

**f** Dynode-voltage values are shown under Typical Operating Values.

**g** With the isocon within a RCA-AJ2206 scanning and focusing-coil assembly.

**h** Adjust for best focus. Nominal value is $-750$ V. This value is dependent upon the location of the tube within the yoke assembly with respect to the end of the focusing field.
i Nominal value is $-470\, \text{V}$. This voltage should be obtained by means of a voltage-divider network between photocathode and "ground". The resistance values should be chosen to set the grid-No.6 voltage at the recommended 63% of photocathode voltage which provides best focus.

k Normal setting of target voltage is $+3.5\, \text{volts}$ from thermionic cathode potential. Target cutoff is normally within one volt of thermionic cathode potential. The target supply voltage should be adjustable from $-3$ to $+5\, \text{volts}$. The target connection must never be interrupted while the tube is operating.

m Adjust for best focus. The focusing current of the associated assembly, e.g., AJ2206, should be adjusted to keep grid-No.4 voltage within its recommended voltage range.

n Adjust for required signal current.

p The gain of the electron multiplier may be varied to obtain the signal output current from a given tube most suitable for the associated video amplifier. Gain can be controlled by adjusting the voltage on one or two of the latter dynode stages; dynode No.3 is the preferred stage. To increase the range of gain control, the voltages on dynode Nos. 3 and 5 may be simultaneously adjusted. Overall multiplier gain varies approximately as the 3rd power of anode voltage.

q Direction of current must be such that a north-seeking pole is attracted to the image end of the focusing coil.

r Dynode-No.3 voltage is adjusted for maximum signal output (approximately 1050 volts).

s The photocathode irradiance at 440 nanometers (the peak of photocathode responsivity) is related to photocathode illumination at 2854° K by the factor $0.02865\, (1/35)$ derived as follows:

$$\frac{1\, \text{lm}}{\text{ft}^2} \times \frac{10.76\, \text{ft}^2}{\text{m}^2} \times \frac{160\, \mu\text{A}}{\text{lm}} = \frac{60\, \text{mA}}{\text{W}} = 0.02865\, \frac{\text{W}}{\text{m}^2}$$

When the photocathode is irradiated at some wavelength other than 440 nanometers, the factor will differ as the relative photocathode responsivity.
The values shown are measured under the following conditions using a Video Noise Meter, Model UPSF (North American Version), or equivalent. This meter is manufactured by Rohde and Schwarz, Munich, West Germany. Noise Meter: Video pass band is shaped by means of self-contained 100 kHz high-pass and 4.2 MHz low-pass filters. Signal to noise-in-signal for highlights is measured with lens uncapped viewing a uniform white field; highlight signal to dark current noise, with the lens capped.

Measured using an RCA test pattern style P200 with the frequency response of the video amplifier systems (essentially "flat") adjusted for uniform response to all scan-generated video frequencies. Substantially identical measurements will be obtained by using a "multi-burst" test pattern with an amplifier having flat (± 0.1 dB) frequency response to at least 14 MHz.

Variation of responses over scanned area.

The unit, watts-2854° K, is used to designate the total radiated power in watts, integrated over all wavelengths, from a tungsten-filament lamp operated at a color temperature of 2854° K. This unit is directly converted into lumens by the following relationship: 1 watt-2854° K = 20 lumens. From this relationship, responsivity can be expressed in units of either amperes/lumen or amperes/watt-2854° K.

For example, a responsivity of 160 µA/lm is equivalent to a responsivity of

\[
\frac{160 \mu A}{\text{lm}} \times \frac{20 \text{ lumens}}{\text{watt-2854° K}} = 3.2 \text{ mA/watt-2854° K}
\]

Also an illuminance of 1 lm/ft² (fc) is equivalent to an irradiance of

\[
\frac{1 \text{ lm}}{\text{ft²}} \times \frac{\text{watts-2854° K}}{20 \text{ lumens}} \times \frac{10 \text{ ft²}}{\text{M²}} = 0.5 \text{ watt-2854° K/meter}^2
\]

Therefore, all references to illuminance in lm/ft² may be converted to watts/meter²-2854° K by multiplication factor 0.5.

Amperes/watt-2854° K responsivity to the entire spectral output of a tungsten-filament lamp at a color temperature of 2854° K should not be confused with the unit of responsivity at a single wavelength, amperes/watt.

Spurious Signal (Blemish) Tests

This test is performed using a uniformly diffused white test pattern that is separated into three zones as shown in Figure 1. The tubes are operated under the conditions specified.
Set-Up Procedure

The set-up procedure described below should be followed carefully to obtain optimum performance. Before the specified voltages shown under Typical Operating Values are applied to the tube, the scanning coil, tube filament, and focusing coil should be energized. Focusing coil current, using the RCA assembly AJ2206, should be adjusted to 600 milliamperes. The following steps should then be followed sequentially.

Step 1: Light should be admitted to provide a nominal faceplate illumination of 0.01 to 0.1 lumen/ft² (footcandle). This is a very important step for all image orthicons and image isocrons. Control of target potential may be lost if the tube is started without light on the photocathode. To regain control, turn off the beam and apply light to the photocathode (all voltages applied) for 20 to 30 seconds, then resume normal operation.

Step 2: The voltage values specified under Typical Operating Values may then be applied to the tube with the exception that the steering-plate and misalignment plate differential voltages are set to the voltage values supplied with the tube or to +25 volts.

Step 3: Grid-No.1 voltage is adjusted to provide a small amount of beam current so that video information appears on the monitor.

Step 4: To center the image on the target, adjust the deflection circuits so that the beam will “overscan” the target. Note that overscanning the target results in a smaller-than-normal picture on the monitor. After centering the image, return to normal scan size.

Step 5: Grid-No.1 voltage is readjusted to fully discharge the target.

Step 6: Optical elements, photocathode voltage (image-section focus), and grid-No.4 voltage (scanning-
under Typical Operating Values. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent number of raster lines in a 525 TV line system. Allowable spots size for each zone is shown in Table I. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots.

Table 1

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
<th>Zone 3 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 6</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6 but not including 4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4 but not including 1</td>
<td>2</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>1 or less</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spurious Signal Zones

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

A – 4807, 4807A

4807A, 4807A/V1

D: Active Target Diameter
H: Raster Height (4 x 3 Aspect Ratio)
Zone 1: Diameter = H/2, Area ≈ 15%
Zone 2: Diameter = H, Area ≈ 45%
Zone 3: Area ≈ 40%

B – 4807/V1, 4807A/V1

D: Active Target Diameter
H: Raster Height (1 x 1 Aspect Ratio)
Zone 1: Diameter = .62H, Area ≈ 30%
Zone 2: Diameter = .87H, Area ≈ 30%
Zone 3: Area ≈ 40%

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section focus) are adjusted to provide best focus. The proper setting for grid No.4, about 420 volts, is that value providing best resolution regardless of picture polarity.

**Step 7:** Increase positive $E_{sx1} - E_{sx2}$ to picture cut-off and back off to best picture.

**Step 8:** Reduce target voltage to cut-off and set $E_{sx1} - E_{sx2}$ to the minimum positive value that eliminates bright edges.

**Step 9:** Increase target voltage to 3.5 volts and adjust $E_{sy1} - E_{sy2}$ for best uniformity. Use the minimum value which provides acceptable performance. Readjust beam if necessary.

**Step 10:** Reduce target voltage to determine new cut-off value. Target cut-off voltage is changed by the adjustment of $E_{sy1} - E_{sy2}$. (It should not exceed $+1.0$ volt). Set target voltage to $3.5 \pm 0.2$ volts.

**Principles of Operation**

Similar to the conventional image orthicon, the isocon has three functional sections — an image section, a scanning section, and an electron-multiplier-type signal current amplifier section — as shown in Figure 3. Operation of both the image section and the multiplier section is identical to that of the conventional image orthicon. The behavior of the scanning beam of the image isocon, however, differs from that encountered in the image orthicon.

**Scanning Operation**

The charged target is scanned by a low-velocity electron beam produced by a conventional electron gun. The primary (outbound) beam receives the required amount of transverse energy and the proper trajectory to pass through the beam-separation structure by means of transverse fields established by the electrostatic alignment plates.

The beam emerging from the beam-separation structure is focused at the target by the magnetic field of the external focusing coils, the electrostatic field of the wall electrode...
(grid No.4), and the field mesh (grid No.5). Under the influence of these fields, each electron traverses a helical path; the paths converging at the target. The fields of the steering plates are used to deflect electrons of the primary and return beams to allow control over beam trajectory. Scanning is accomplished by transverse magnetic fields produced by the external scanning coils.

By proper adjustment of electrode voltages including those of the field mesh (grid No.5) and grid No.4, the beam, regardless of its lateral deflection, is caused to approach the target at a fixed angle with zero or nearly zero velocity. The beam deposits sufficient electrons to neutralize the positive charges accumulated during the preceding frame time. Beam electrons having insufficient energy to reach the target are specularly reflected and constitute part of the return beam. Beam electrons reaching the target at positively charged areas but not captured are scattered and also become part of the return beam.

The term scattered electrons applies exclusively to the non-specularly reflected electrons obtained when the beam interacts with the surface of the target and are thus distinguished from the remainder of the returning electrons which are termed reflected electrons. The number of scattered electrons obtained is at a maximum in the lighted portions (positively charged areas) and essentially zero in the dark portions of the target. (It is to be noted that although the total return beam is a minimum in the bright areas of the target where electrons are deposited, the number of scattered electrons is a maximum). The total return beam remains under the influence of the magnetic field of the focusing coil and the electrostatic field of grid No.4. The helices described by the scattered electron portion have greater diameters than those described by the reflected electrons. The return beam now comes under the influence of the field of the steering plates and is directed toward the beam-separation edge. The beam-separation edge passes the scattered electron portion of the return beam and captures the reflected electron portion. The scattered electrons accordingly strike the first dynode of the multiplier section. As a result, secondary emission occurs. The emitted secondaries, after multiplication, are collected by the anode as the signal output current.
Camera Design Notes

1. Unless otherwise noted, the specified voltage values are referenced directly to the thermionic cathode which is grounded. No significant impedances should be introduced between the cathode and power-supply return points ("grounds"). The resistance of normal circuit conductors is deemed insignificant.

2. Designers familiar with conventional image orthicon circuitry are urged to note the following differences when designing circuits for use with the isocon:
   a. Gun (beam) blanking is used instead of target blanking.
   b. The polarity (sense) of the isocon output video signal is the inverse of that of conventional image orthicons. Maximum light produces maximum anode current.
   c. A separate connection is provided for the "persuader" multiplier focus electrode G3. Its design is such that it may be tied to G4. Maximum output may require it to be more positive than G4.
   d. The annular decelerator electrode, G5, featured in most image orthicons is not used, nor provided in the 4807 series. The designator "G5" has been reassigned to the field mesh.
   e. The insertion of shading signals is neither recommended nor necessary. This eliminates 2 or 4 controls.
   f. These tubes will NOT operate properly at any beam focus loop number other than that obtained by the application of the magnetic and electric focus fields shown under Typical Operation.
   g. Automatic beam control is not needed.

3. The gain of the electron multiplier output section is readily varied by adjustment of its operating voltages. Depending on the range of control required, the voltage on one or several dynodes may be made adjustable. The following precautions should be observed:
a. Do not vary dynode No.1 voltage for gain-control purposes.

b. Under most conditions, adjustment of only dynode No.3 voltage is the preferred gain control mode.

c. Under no circumstances should operation be attempted where the voltage on a given dynode is outside the range established by the two adjacent dynodes, i.e., \( E_{dy(n-1)} \leq E_{dy(n)} \leq E_{dy(n+1)} \).

Operation outside of these limits will not damage the tube but will result in entirely unsatisfactory multiplier action. (This requirement is not unique to these tubes — the principle applies generally to electron multiplier equipped tubes).

d. If several dynode voltages, including that of dynode No.5 are varied simultaneously, care should be taken to avoid allowing the voltage between dynode No.5 and anode to vary to the point where anode collection efficiency is reduced. A practical minimum voltage for \( E_b - E_{dyn5} \) is 35 volts.

4. "Raster Zoom", at least 4:1, can be employed without damage to the tube. Resolution degradation can be expected to the same degree as the change in scan size.

5. Raster orientation (See Data) is extremely important. Vertical scan reversal is normally not recommended and should not be used without contacting your RCA field representative for factory recommendations concerning your system.

6. Scan-failure protection. Nothing elaborate is needed as long as grid No.1 voltage does not fall to zero. In this context, note that a normal shutdown of equipment could cause damage unless the coupling time constants are such that the (negative) \( G_1 \) voltage will decay more slowly than the (positive) voltages on \( G_2 \) and/or \( G_4 \).
Schematic Arrangement of Type 4807 in AJ2206 Magnetics Assembly

- Photocathode
- Faceplate Focusing Coil
- Camera Lens
- Televised Scene
- Grid No. 6
- Target
- Focusing Coil
- Grid No. 4
- Horizontal and Vertical Deflecting Coils
- Steering and Misalignment Plates
- Potted Base
- Five-Stage Electron Multiplier
- Element Leads 17 Wires
- Field Mesh (Grid No. 5)
- Scattered Return Beam
- Reflected Return Beam
- Primary Beam
- Separation Region
- Image Section
- Scanning Section
- Multiplier Section
Suggested Tube End-Base Decoupling Networks for 4807, 4807A

Each lead is identified. Leads are approximately 9" (230 mm) long.

C1, C15: 0.1 µF
C2 through C7: 0.01 µF, 1000 V
C8, C10: 0.01 µF, 1600 V
C9: 0.01 µF, 2000 V
Suggested Tube End-Base Decoupling Networks For 4807/V1, 4807A/V1

Each Lead is identified. Leads are approximately 9" (230 mm) long.

- C11 through C14: 0.01 μF, 1000 V
- R1 through R11: 100 k, 1/4 W
- R12: 51 k, 1/4 W
- R13: 100 k, 1/4 W

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Dimensional Outline for Types 4807 and 4807A

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: Perpendicularity to fiber optic surface is 0.002" T.I.R. Centering is determined by holding and rotating at positions X-X1 above.
### Enlarged Bottom View, Types 4807 And 4807A

#### Target (Yellow)

#### Grid No.8

#### Grid No.6

#### External Factory-Installed Connection

#### Photocathode Lead (Violet)

#### NOTE

1. INDEX

#### Base

<table>
<thead>
<tr>
<th>Lead</th>
<th>Description</th>
<th>Body</th>
<th>Stripe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grid No.1</td>
<td>Brown</td>
<td>1 Green</td>
</tr>
<tr>
<td>2</td>
<td>Steering Plate SX1 (+)</td>
<td>Blue</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Grid No.4</td>
<td>Brown</td>
<td>1 Red</td>
</tr>
<tr>
<td>4</td>
<td>Grid No.3</td>
<td>Brown</td>
<td>1 Orange</td>
</tr>
<tr>
<td>5</td>
<td>Misalignment Plate SY2 (−)</td>
<td>Orange</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Dynode No.2</td>
<td>Brown</td>
<td>2 Green</td>
</tr>
<tr>
<td>7</td>
<td>Dynode No.4</td>
<td>Brown</td>
<td>2 Orange</td>
</tr>
<tr>
<td>8</td>
<td>Dynode No.5</td>
<td>Brown</td>
<td>2 Red</td>
</tr>
<tr>
<td>9</td>
<td>Anode</td>
<td>Red</td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>Dynode No.3</td>
<td>Brown</td>
<td>2 Yellow</td>
</tr>
<tr>
<td>11</td>
<td>Steering Plate SX2 (−)</td>
<td>Green</td>
<td>—</td>
</tr>
<tr>
<td>12</td>
<td>Dynode No.1</td>
<td>Brown</td>
<td>2 Blue</td>
</tr>
<tr>
<td>13</td>
<td>Grid No.2</td>
<td>Brown</td>
<td>1 Yellow</td>
</tr>
<tr>
<td>14</td>
<td>Misalignment Plate SY1 (+)</td>
<td>Yellow</td>
<td>—</td>
</tr>
<tr>
<td>15</td>
<td>Cathode</td>
<td>Brown</td>
<td>1 Blue</td>
</tr>
<tr>
<td>16</td>
<td>Heater</td>
<td>Brown</td>
<td>—</td>
</tr>
<tr>
<td>17</td>
<td>Heater</td>
<td>Brown</td>
<td>—</td>
</tr>
</tbody>
</table>

#### Note —
Scribe marks on base for alignment in RCA-AJ2206 yoke assembly. Refer to bulletin AJ2206 for alignment procedure.
Dimensional Outline For Types 4807/V1 And 4807A/V1

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: Perpendicularity to fiber optic surface is 0.002" T.I.R. Centering is determined by holding and rotating at positions X-X₁ above.
### Base Pin Description

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heater</td>
</tr>
<tr>
<td>2</td>
<td>Grid No.1</td>
</tr>
<tr>
<td>3</td>
<td>Internal Connection — Do Not Use</td>
</tr>
<tr>
<td>4</td>
<td>Steering Plate SX₁</td>
</tr>
<tr>
<td>5</td>
<td>Grid No.4</td>
</tr>
<tr>
<td>6</td>
<td>Grid No.3</td>
</tr>
<tr>
<td>7</td>
<td>Internal Connection — Do Not Use</td>
</tr>
<tr>
<td>8</td>
<td>Misalignment Plate SY₂</td>
</tr>
<tr>
<td>9</td>
<td>Dynode No.2</td>
</tr>
<tr>
<td>10</td>
<td>Dynode No.4</td>
</tr>
<tr>
<td>11</td>
<td>Dynode No.5</td>
</tr>
<tr>
<td>12</td>
<td>Anode</td>
</tr>
<tr>
<td>13</td>
<td>Dynode No.3</td>
</tr>
<tr>
<td>14</td>
<td>Steering Plate SX₂</td>
</tr>
<tr>
<td>15</td>
<td>Internal Connection — Do Not Use</td>
</tr>
<tr>
<td>16</td>
<td>Dynode No.1</td>
</tr>
<tr>
<td>17</td>
<td>Grid No.2</td>
</tr>
<tr>
<td>18</td>
<td>Misalignment Plate SY₁</td>
</tr>
<tr>
<td>19</td>
<td>Cathode</td>
</tr>
<tr>
<td>20</td>
<td>Heater</td>
</tr>
</tbody>
</table>

**Note:** Align between "H-H" scribe marks on base of RCA-AJ2206 yoke assembly. Refer to bulletin AJ2206 for alignment procedure.
Faceplate Exposure Limit

Typical Dynamic Limiting Resolution

SAFE OPERATING REGION

BANDWIDTH = 12 MHz
100% CONTRAST FOR ILLUMINANCE UNITS CONVERSION REFER TO NOTE W. PAGE 8

2854° K FACEPLATE ILLUMINANCE – LUMENS/FOOT² (FC)

Electronic Components

DATA 12 11/72
Typical Transfer Characteristic

FOR ILLUMINANCE UNITS CONVERSION REFER TO NOTE w. PAGE 6

Typical Signal to Noise-In-Signal Ratio As A Function of Faceplate Illuminance or Irradiance From Flux Levels Within A Given Scene. (Beam Adjustment Fixed At 2 x Knee Setting)
Typical S-20 Spectral Response

Residual Signal (Lag) Characteristic

FOR ILLUMINANCE UNITS CONVERSION REFER TO NOTE W, PAGE 6
Photomultiplier

Variant of 1P28 Having a Bialkali Photocathode

- Spectral Response Range — 200 to 650 nm
- Anode Current Drift — ± 1.5% maximum for an initial anode current of 3 µA
- High Current Amplification — $5 \times 10^6$ at 1000 volts
- Fast Time Resolution Characteristics — Anode Pulse Rise Time, $1.6 \times 10^{-9}$ s at 1250 volts
  Electron Transit Time, $1.6 \times 10^{-8}$ s at 1250 volts

General Data

Spectral Response ........................................ See Figure 1
Wavelength of Maximum Response ............... 400 ± 50 nm
Cathode, Opaque ....... Potassium-Cesium-Antimony (Bialkali)
  Minimum projected length ...................... 0.94 in (2.4 cm)
  Minimum projected width ...................... 0.31 in (0.8 cm)
Window ........................................ Ultraviolet-Transmitting Glass (Corning® No. 9741), or equivalent
  Index of refraction at 589.3 nanometers ....... 1.47
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)
Maximum Seated Length ....................... 3.12 in (7.9 cm)
Maximum Diameter ............................ 1.31 in (3.3 cm)
Base ........................................ Small-Shell Submagni! 11-Pin, (JEDEC Group 2, No.B11-88) DAP (Di-Allyl Phthalate) Non-Hygroscopic Material
Socket ........................ Amphenol® No.78S11T, or equivalent
Magnetic Shield ......................... Millen® No.80801B, or equivalent
Operating Position ....................... Any
Weight (Approx.) ......................... 1.6 oz

RCA Electronic Components

DATA 1 11/72
Maximum Ratings, Absolute-Maximum Values

DC Supply Voltage:
- Between anode and cathode: 1250 max. V
- Between dynode No.9 and anode: 250 max. V
- Between consecutive dynodes: 250 max. V
- Between dynode No.1 and cathode: 250 max. V

Average Anode Current: 0.5 max. mA
Ambient Temperature: 85 °C

Characteristics Range Values for Equipment Design

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, and at a temperature of 220 °C.

With E = 1000 volts (Except as noted)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 400 nm</td>
<td>2.7x10^5</td>
<td></td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2854K)</td>
<td>100</td>
<td>300</td>
<td>1200 A/Im</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 400 nm</td>
<td>5.4x10^-2</td>
<td></td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2854K)</td>
<td>2.5x10^-5</td>
<td>6x10^-5</td>
<td>A/Im</td>
</tr>
<tr>
<td>Quantum efficiency at 400 nm</td>
<td>16.5</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Anode-Current Drift:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For an initial anode current (Ib) of 3 µA</td>
<td>±1.5</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>5x10^6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current at 1000 Volts</td>
<td>2x10^-9</td>
<td>1.5x10^-8</td>
<td>A</td>
</tr>
<tr>
<td>Equivalent Anode Dark Current Input at 1000 Volts</td>
<td>6.6x10^-12</td>
<td></td>
<td>Im</td>
</tr>
<tr>
<td>Anode Pulse Rise Time, at 1250 Volts</td>
<td>1.6x10^-9</td>
<td></td>
<td>s</td>
</tr>
<tr>
<td>Electron Transit Time, at 1250 Volts</td>
<td>1.6x10^-8</td>
<td></td>
<td>s</td>
</tr>
</tbody>
</table>

a Made by Corning Glass Works, Corning, NY 14830.
b Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 50, IL 60650.
A description of the Absolute-Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes. Averaged over any interval of 30 seconds maximum.

This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 900 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 2854° K and a light input of 1 microlumen is used.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 900 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 2854° K. The value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected as anode.

Anode Current Drift is measured under the following conditions: The tube is operated at a supply voltage of 1000 volts for 30 minutes with the incident light level adjusted initially to provide an anode current (I_B) of 3 microamperes. The change in anode current for the next 12 minutes is continuously recorded and must not vary more than ±1.5%. Anode current drift is defined as follows:

\[
\text{Anode Current Drift} = \frac{\Delta I_B \text{ (30 to 42 minutes)}}{I_B \text{ (at 30 minutes)}}
\]

where \(\Delta I_B\) = the incremental change in anode current

This test is performed on an active sampling basis (10% of the total product).

Equivalent Anode Dark Current Input is the quotient of anode dark current at a given anode luminous sensitivity by the anode luminous sensitivity.

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 Consideration

Operating Stability

The operating stability of the tube is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important. When maximum stability is required, operation at an average anode current of 1 microampere is suggested.

Typical Voltage-Divider Arrangement

**Typical Voltage-Divider Arrangement**

![Diagram of voltage divider arrangement](image)

- **R1** through **R10**: 20,000 to 1,000,000 ohms
- **C1**: 0.05 μF, 500 volts (DC working)
- **C2**: 0.02 μF, 500 volts (DC working)
- **C3**: 0.01 μF, 500 volts (DC working)

**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.
Schematic Arrangement of Structure

Basing Diagram — Bottom View

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.

- 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
Dimensional Outline

BULB T9
PHOTO-
CATHODE

DIMENSIONAL OUTLINE

PHOTO-
CATHODE

BASE
JEDEC NO. B11-80

DIRECTION OF
INCIDENT
RADIATION

PIN No. 1
PHOTO-
CATHODE (SEE
DETAIL A)

92CM-62644R0

If of bulb will not deviate more than 20° in any direction from the perpendicular erected at center of bottom of base.

Detail A — Top View

DY3
DY7
DY6
DY4
DY2
DY1
DY9
ANODE

PHOTO-
CATHODE
REGION OF
BEST COLLECTION

2°
SHIELD

48° 26
GRILL

190 - 250

DIRECTION OF
INCIDENT
RADIATION

DATA 3

Electronic
Components
Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

<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>

Typical Photocathode Spectral Response Characteristics

![Graph showing photocathode spectral response characteristics]
Typical Variation of Photocathode Sensitivity Along Tube Length

<table>
<thead>
<tr>
<th>Distance along cathode from end of cathode nearer base — millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Relative anode current</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Distance along plane of grill from left to right — millimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Relative anode current</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

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 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.

Supply Voltage (E) between anode and cathode

Electronic Components

DATA 5
11/72
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 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 = (+)
**Spectral Response:**
- Wavelength of Maximum Response: 4000 ± 500 angstroms

**Cathode:**
- Shape: Semicylindrical
- Minimum projected length: 13/16" (3/4"
- Minimum projected width: 5/8"
- Direct Interelectrode Capacitance (Approx.): 2.6 μuf
- Maximum Overall Length: 3-1/16" (2-1/2"
- 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 (Approx.): Cinch No.8JM-1, or equivalent
- Base: Intermediate-Shell Octal 5-Pin Arrangement 1, (JEDEC No.B5-10)

**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>Parameter</th>
<th>Rating 1</th>
<th>Rating 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANODE-SUPPLY VOLTAGE</strong></td>
<td>80 max.</td>
<td>100 max.</td>
</tr>
<tr>
<td>(DC or Peak AC)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AVERAGE CATHODE-CURRENT DENSITY</strong></td>
<td>60 max.</td>
<td>30 max.</td>
</tr>
<tr>
<td><strong>AVERAGE CATHODE CURRENT</strong></td>
<td>6 max.</td>
<td>3 max.</td>
</tr>
<tr>
<td><strong>AMBIENT TEMPERATURE</strong></td>
<td>75 max.</td>
<td>75 max.</td>
</tr>
</tbody>
</table>

**Characteristics:**

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

<table>
<thead>
<tr>
<th>Parameter</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 4000 angstroms</td>
<td>0.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous:*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 0 cps</td>
<td>75</td>
<td>135</td>
<td>205</td>
</tr>
<tr>
<td>At 5000 cps.</td>
<td>-</td>
<td>124</td>
<td>-</td>
</tr>
<tr>
<td>At 10000 cps.</td>
<td>-</td>
<td>108</td>
<td>-</td>
</tr>
</tbody>
</table>

*indicates a change*
Gas Amplification Factor: 5.5
Anode Dark Current: 0.05 μA

Minimum Circuit Values:
With an anode-supply voltage of 80 or less, 100 volts
DC Load Resistance:
For dc currents above 3 μA, 0.1 min. — megohms
For dc currents below 3 μA, 0 min. — megohms
For dc currents above 1 μA, 2.5 min. megohms
For dc currents below 1 μA, 0.1 min. megohms

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

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

#### General:
- **Spectral Response:** S-4
- **Wavelength of Maximum Response:** 4000 ± 500 angstroms

#### Cathode:
- **Shape:** Semicylindrical
- **Minimum projected length:** 5/8"
- **Minimum projected width:** 1/2"
- **Direct Interelectrode Capacitance:** 1 µf
- **Overall Length:** 1-21/32" ± 1/16" ±
- **Seated Length:** 1-13/32" ± 1/32"
- **Length from Center of Usable 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):** 100 max. volts
- **AVERAGE CATHODE-CURRENT DENSITY:** 20 max. µamp/sq.in.
- **AVERAGE CATHODE CURRENT:** 2 max. µamp
- **AMBIENT TEMPERATURE:** 75 max. °C

#### Characteristics, At 90 Volts on Anode:

**Min. Median Max.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
</tr>
<tr>
<td>Radiant, at 4000 angstroms</td>
<td>- 0.12 µamp/µwatt</td>
</tr>
<tr>
<td>Luminous:</td>
<td></td>
</tr>
<tr>
<td>At 0 cps</td>
<td>80 µamp/lumen</td>
</tr>
<tr>
<td>At 5000 cps</td>
<td>120 µamp/lumen</td>
</tr>
<tr>
<td>At 10000 cps</td>
<td>175 µamp/lumen</td>
</tr>
<tr>
<td>Gas Amplification Factor</td>
<td>5.5 µamp/lumen</td>
</tr>
<tr>
<td>Anode Dark Current, at 25°C</td>
<td>96 µamp/lumen</td>
</tr>
</tbody>
</table>

*Indicates a change.*

---

**TUBE DIVISION**

Radio Corporation of America, Harrison, New Jersey
GAS PHOTOTUBE

Minimum Circuit Values:

With anode-supply voltage of 80 or less 100 volts

DC Load Resistance:

For dc currents above
3 µamp . . . . . . . . . . . . . . 0.1 min. — megohms

For dc currents below
3 µamp . . . . . . . . . . . . . . 0 min. — megohms

For dc currents above
1 µamp . . . . . . . . . . . . . . . — 2.5 min. megohms

For dc currents below
1 µamp . . . . . . . . . . . . . . . — 0.1 min. megohms

Averaged over any interval of 30 seconds maximum. This value may be doubled when anode-supply voltage is limited to 80 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-4 Response

and

FREQUENCY-RESPONSE CHARACTERISTICS of Gas Phototubes

are shown at the front of this Section.
### Spectral Response
S-4

### Wavelength of Maximum Response
4000 ± 500 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:** Amphenol No. 78S3S-T, or equivalent
- **Socket:** Small-Shell Peewee 3-Pin (JEDEC No. A3-1)
- **Basing Designation for BOTTOM VIEW:** 2F

### Pin Connections
- **Pin 1:** No Connection
- **Pin 2:** Anode
- **Pin 3:** Photocathode

### Maximum Ratings, Absolute-Maximum Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating I</th>
<th>Rating II</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ANODE-SUPPLY VOLTAGE</strong> (DC or Peak AC)</td>
<td>80 max.</td>
<td>100 max.</td>
</tr>
<tr>
<td><strong>AVERAGE CATHODE-CURRENT DENSITY</strong></td>
<td>40 max.</td>
<td>20 max.</td>
</tr>
<tr>
<td><strong>AVERAGE CATHODE CURRENT</strong></td>
<td>4 max.</td>
<td>2 max.</td>
</tr>
<tr>
<td><strong>AMBIENT TEMPERATURE</strong></td>
<td>75 max.</td>
<td>75 max.</td>
</tr>
</tbody>
</table>

### Characteristics:

- **Sensitivity:**
  - Radiant, at 4000 angstroms: 0.13 amp/watt
  - Luminous:
    - At 0 cps: 75 µa/lumen
    - At 5000 cps: 124 µa/lumen
    - At 10000 cps: 108 µa/lumen

*Indicates a change.*
Gas Amplification Factor $d$.

Anode Dark Current at 25° C.

Minimum Circuit Values:

With an anode-supply voltage of

DC Load Resistance:

For dc currents above

3 $\mu$A ............  0.1 min.  -  megohm

For dc currents below

3 $\mu$A ................  0 min.  -  megohms

For dc currents above

1 $\mu$A .............  -  2.5 min.  megohms

For dc currents below

1 $\mu$A .............  -  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-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 5681

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

COMPOSITE-ANODE-CATHODE, SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:
Spectral Response .................................. S-4
Wavelength of Maximum Response. ............ 4000 ± 500 angstroms

Cathode:
Shape .............................................. Flat
Minimum projected length* ....................... 19/32"
Minimum projected width* ....................... 1/4"

Direct Interelectrode Capacitances (Approx.):
Between base pins 4 and 8 (C1) ............... 1 µuf
Balancing capacitance (C2) .................... 1 µuf
Capacitance Difference between C1 and C2. 0.3 max. µuf

Maximum Overall Length ......................... 2-7/8"
Maximum Seated Length ......................... 2-5/16"
Seated Length to Center of Cathode ........... 1-5/8" ± 3/32"
Maximum Diameter ................................ 1-9/32"
Operating Position ................................ Any
Weight (Approx.) .................................. 1 oz –
Bulb .................................................. T9
Socket ............................................... Cinch No. BJM-1, or equivalent
Base ................................................ Intermediate-Shell Octal 5-Pin, Arrangement 1

Basing Designation for BOTTOM VIEW. ....... 2AB

Direction of Light:
Pin 1 - No Internal Connection
Pin 2 - Balancing Capacitance
Pin 4 - Anode or Photocathode
Pin 6 - No Internal Connection
Pin 8 - Anode or Photocathode

Maximum Ratings, Absolute-Maximum Values:
ANODE-SUPPLY VOLTAGE (DC or Peak AC) .... 250 max. volts
AVERAGE CATHODE-CURRENT DENSITYc ....... 30 max. µa/sq.in.
AVERAGE CATHODE CURRENTc ................. 4 max. µa
AMBIENT TEMPERATURE ......................... 75 max. °C

Characteristics:
With an anode-supply voltage of 250 volts
Min. Median Max.

Sensitivity:
Radiant, at 4400 angstroms. ................. 0.044 – amp/watt
Luminousd ........................................... 19 45 70 µa/lumen

Ratio of Cathode Luminous Sensitivities .......... 0.42 1.0 2.4
Anode Dark Current at 25° C ................. – 0.01 µa

Indicates a change.

RADIO CORPORATION OF AMERICA
DATA
Electron Tube Division
Harrison, N. J.
On plane perpendicular to indicated direction of incident light.

Measured between pins 2 and 4.

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 0.02 lumen are used.

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

TYPICAL CIRCUIT
Typical Operation Characteristics

With AC Voltage Applied Between the Two Electrodes

OBTAINED SIMILARLY CURVES A & B. OTHER OPERATION CURVES ELECTRODE WITH 0 LUMEN
DASHED CURVE STATIC CHARACTERISTIC FOR OTHER
DASHED CURVE STATIC CHARACTERISTIC FOR ONE
LOAD RESISTANCE : ZERO
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP
OPERATED AT A COLOR TEMPERATURE OF 2870° K.
**Vacuum Phototube**

**SIDE-ON TYPE HAVING S-4 RESPONSE**

**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: .................. Cinch No. BJM-1, or equivalent
Socket: .................. Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No. B5-10)

Basing Designation for BOTTOM VIEW: .. 3J

**DIRECTION OF LIGHT**

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

**MAXIMUM RATINGs, ABSOLUTE-MAXIMUM VALUES:**

- **Anode-Supply Voltage**
  - (DC or Peak AC): 250 max. volts
- **Average Cathode-Current 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
  - Min. Median Max.

- **Sensitivity:**
  - Radiant, at 4000 angstroms: 0.044 amp/watt
  - Luminous: 20 45 100 μA/lumen
  - Anode Dark Current at 25° C: 0.25 μA

←indicates a change.
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 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 front of this section

DIMENSIONAL OUTLINE
shown under Type 5581 also applies to the 5653

AVERAGE-ANODE-CHARACTERISTICS CURVE
shown under Type 929 also applies to the 5653
Photomultiplier Tube

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

For use in the detection and measurement of nuclear radiation and other applications involving low-level light sources

GENERAL

Spectral Response .................. S-11
Wavelength of Maximum Response .................. 4400 ± 500 Å
Cathode, Semitransparent .................. Cesium-Antimony
    Minimum projected area .................. 2.2 in² (14.1 cm²)
    Minimum diameter .................. 1.69 in (4.3 cm)
Window .................. Corning® No.0080, or equivalent
Shape .................. Convexo-Concave
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 .................. 4.2 pF
    Anode to all other electrodes .................. 6.5 pF
Maximum Overall Length .................. 5.81 in (14.8 cm)
Seated Length .................. 4.88 ± 0.19 in (12.4 ± 0.5 cm)
Maximum Diameter .................. 2.31 in (5.9 cm)
Bulb .................. T16
Base .................. Medium-Shell Diheptal 14-pin
    (JEDEC No.B14-38) Non-hygroscopic
Socket .................. Eby® No.9709-7, or equivalent
Magnetic Shield .................. JAN® No.S-2004, or equivalent
Operating Position .................. Any
Weight (Approx.) .................. 5.2 oz (174 g)

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 .................. 250 max. V
    Between dynode No.1 and cathode .................. 300 max. V
Average Anode Current* .................. 0.75 max. mA
Ambient Temperature† .................. 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.

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>Anode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^{g}) at 4400</td>
<td>–</td>
<td>8x10(^4)</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous(^{h}) (2870(^0)K)</td>
<td>10</td>
<td>100</td>
<td>300 A/lm</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^{l}) at 4400</td>
<td>–</td>
<td>0.040</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous(^{k}) (2870(^0)K)</td>
<td>4x10(^{-5})</td>
<td>5x10(^{-5})</td>
<td>A/lm</td>
</tr>
<tr>
<td>Current with blue light source(^{m}) ((2870(^0)K+C.S. No.5-58))</td>
<td>4x10(^{-8})</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Quantum Efficiency</td>
<td>–</td>
<td>11.5</td>
<td>%</td>
</tr>
<tr>
<td>at 4200 angstroms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td>–</td>
<td>2x10(^6)</td>
<td>–</td>
</tr>
<tr>
<td>Anode Dark Current(^{n})</td>
<td></td>
<td>6x10(^{-9})</td>
<td>4x10(^{-8})</td>
</tr>
<tr>
<td>Equivalent Anode</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Current(^{o}) Input(^{n})</td>
<td>–</td>
<td>3x10(^{-10})</td>
<td>2x10(^{-9})</td>
</tr>
<tr>
<td>Equivalent Noise(^{p}) Input(^{q})</td>
<td>–</td>
<td>3.7x10(^{-13})</td>
<td>2.5x10(^{-12})</td>
</tr>
<tr>
<td>–</td>
<td></td>
<td>1.7x10(^{-12})</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td></td>
<td>2x10(^{-15})</td>
<td>–</td>
</tr>
</tbody>
</table>

\(^{a}\) Made by Corning Glass Works, Corning, NY 14830.
\(^{b}\) Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia, PA 19144.
\(^{c}\) Made by JAN Hardware Mfg. Co., Inc., 47-27 36th Street, Long Island City, NY 11101.
\(^{d}\) 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 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.

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, 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.

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

**TERMINAL CONNECTIONS**

The base pins of the 5819 fit a diheptal 14-contact socket, such as Eby No.9709-7, or equivalent. The socket should be made of high-grade, low-leakage material.
Typical Voltage-Divider Arrangement

C1: 0.05 μF, 20%, 500 volts (dc working), ceramic disc
C2: 0.02 μF, 20%, 500 volts (dc working), ceramic disc
C3: 0.01 μF, 20%, 500 volts (dc working), ceramic disc
C4: 0.005 μF, 20%, 500 volts (dc working), ceramic disc
R1 through R10: 390,000 ohms, 5%, 1/2 watt
R11: 910,000 ohms, 5%, 1/2 watt

Leads to all capacitors should be as short as possible to minimize inductance effects. The location and spacing of capacitors is critical and may require adjustment for optimum results.

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: No Connection
Pin 13: Internal Connection-Do Not Use
Pin 14: Cathode

Data 2
The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

<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>147.6 max.</td>
</tr>
<tr>
<td>B</td>
<td>4.88 ± .19</td>
<td>123.9 ± 4.7</td>
</tr>
<tr>
<td>C</td>
<td>1.69 min. dia.</td>
<td>42.9 min. dia.</td>
</tr>
<tr>
<td>D</td>
<td>2.31 max. dia.</td>
<td>58.7 max. dia.</td>
</tr>
<tr>
<td>E</td>
<td>3.00 ± 1.00 R.</td>
<td>76.2 ± 25.4 R.</td>
</tr>
<tr>
<td>F</td>
<td>2.00 ± .06 dia.</td>
<td>50.8 ± 1.5 dia.</td>
</tr>
<tr>
<td>G</td>
<td>.312</td>
<td>7.92</td>
</tr>
<tr>
<td>H</td>
<td>.15 ± .05 R.</td>
<td>3.8 ± 1.2 R.</td>
</tr>
<tr>
<td>J</td>
<td>.50 R.</td>
<td>12.7 R.</td>
</tr>
</tbody>
</table>
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-N°1-TO-CATHODE VOLTS=150
EACH-SUCCEEDING-STAGE VOLTS=100

RELATIVE ANODE CURRENT

MAGNETIC FIELD INTENSITY—OERSTEDS

RCA Electronic Components DATA 3
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION 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.

Supply volts (E) between anode and cathode

Sensitivity - Amperes/million (Color Temp. 2870°K)

Current Amplification

Data 4
11-69
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

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 dynode stage; and 1/12 of E between dynode No. 10 and anode. Tube temperature = 22°C. Light source is a tungsten-filament lamp operated at a color temperature of 2870°K.

<table>
<thead>
<tr>
<th>Luminous Sensitivity - Amperes/Lumen</th>
<th>Equivalent Anode-Dark-CURRENT Input - Lumen</th>
<th>Equivalent Anode-Dark-CURRENT Input - Ampere</th>
<th>Equivalent Anode-Dark-CURRENT Input - Watt</th>
</tr>
</thead>
<tbody>
<tr>
<td>540</td>
<td>10^-12</td>
<td>10^-11</td>
<td>10^-10</td>
</tr>
<tr>
<td>700</td>
<td>10^-10</td>
<td>10^-9</td>
<td>10^-8</td>
</tr>
<tr>
<td>950</td>
<td>10^-8</td>
<td>10^-7</td>
<td>10^-6</td>
</tr>
<tr>
<td>1200</td>
<td>10^-6</td>
<td>10^-5</td>
<td>10^-4</td>
</tr>
</tbody>
</table>

Supply volts (E) between anode and cathode.
Light source is a tungsten-filament lamp operated at a color temperature of 2870°K. Each succeeding dynode stage has a voltage of 83. Light source is a tungsten-filament lamp operated at a color temperature of 2870°K.
TYPICAL ENI CHARACTERISTICS

DYNODE - No. 1 - TO - CATHODE VOLTS = 167
EACH - SUCCEEDING - DYNODE - STAGE VOLTS = 83
BANDWIDTH: 1 Hz
LIGHT SOURCE: TUNGSTEN AT 2870°K INTERRUPTED AT 90 Hz TO
PRODUCE PULSES ALTERNATING BETWEEN ZERO AND FLUX
VALUE SHOWN FOR ANY GIVEN TUBE TEMPERATURE; "ON" PERIOD
OF PULSE EQUAL TO "OFF" PERIOD: RMS SIGNAL CURRENT = RMS
NOISE CURRENT.
EXTERNAL SHIELD VOLTS RELATIVE TO ANODE VOLTS = -1000
Image Orthicon

LONG-LIFE NON-DETERIORATING TARGET

MAGNETIC FOCUS

For Outdoor and Studio Pickup with Black-and-White TV Cameras. The 5820A/L is Directly Interchangeable with the 5820 and 5820A in All Cameras.

The 5820A/L is the same as the 5820 except it utilizes a longer-life non-deteriorating glass target.

The sturdy, long-life, non-deteriorating, glass target of type 5820A/L is characterized by high gain, resistance to "burn-in", and the absence of any granular structure. Because charge transportation through this target material is electronic rather than ionic as in ordinary glass targets, the electrical characteristics of the target, such as secondary emission and resistivity, are essentially constant and sensitivity of the 5820A/L is stable throughout life.

Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster "burn-in" due to underscanning are significantly reduced. The resistance of the 5820A/L to image "burn-in" provides a highly desirable operational feature because it is not necessary to use an orbiter or continually move the camera when focused on a stationary scene.

OPERATING CONSIDERATIONS

Dos and Don'ts on Use of RCA-5820A/L

Dos

1. Allow the 5820A/L to warm up prior to operation.
2. Hold temperature of the 5820A/L within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 5820A/L's by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to exactly 2 volts above target cutoff.
7. Cap lens during standby operation.

Don'ts

1. Don't force the 5820A/L into its shoulder socket.
2. Don't operate the 5820A/L without scanning.
3. Don't operate a 5820A/L having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warm-up or standby operation.
Image Orthicon

**MAGNETIC FOCUS**

For Outdoor and Studio Pickup. The 5820A is Unilaterally Interchangeable with Type 5820.

**DATA**

**General:**

Heater, for Unipotential Cathode:
- Voltage (AC or DC).................. $6.3 \pm 10\%$ volts
- Current at 6.3 volts.................. 0.6 amp

Direct Interelectrode Capacitance:
- Anode to all other electrodes........ 12 $\mu$F

Spectral Response...................... S-10

Wavelength of Maximum Response........ 4500 ± 300 angstroms

Photocathode, Semitransparent:
- Rectangular image (4 x 3 aspect ratio):
  - Useful size of.................... 1.8" max. diagonal

Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

Orientation of. Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of face-plate and pin 7 of the shoulder base.

Focusing Method....................... Magnetic
Deflection Method...................... Magnetic

Overall Length....................... 15.20" ± 0.25"

Greatest Diameter of Bulb........... 3.00" ± 0.06"

Deflecting-Coil Inside Diameter.... 2-3/8"

Deflecting-Coil Length.............. 5"

Focusing-Coil Length................ 10"

Alignment-Coil Length................ 15/16"

Photocathode Distance Inside End of Focusing Coil... 1/2"

Operating Position. The tube should never be operated in a vertical position with the Diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.

Weight (Approx.)....................... 1 lb 6 oz

Shoulder Base......................... Keyed Jumbo Annular 7-Pin

**BOTTOM VIEW**

Pin 1 - Grid No.6
Pin 2 - Photocathode
Pin 3 - Internal Connection—Do Not Use
Pin 4 - Internal Connection—Do Not Use

Pin 5 - Grid No.5
Pin 6 - Target
Pin 7 - Internal Connection—Do Not Use

* See basing diagram on next page.
Maximum and Minimum Ratings, Absolute-Maximum Values:

PHOTOCATHODE:
- Voltage: -550 max. volts
- Illumination: 50 max. fc

OPERATING TEMPERATURE:
- Of any part of bulb: 50 max. °C
- Of bulb at large end of tube (Target section): 35 min. °C

TEMPERATURE DIFFERENCE:
- Between target section and any part of bulb hotter than target section: 5 max. °C

GRID-No.6 VOLTAGE: -550 max. volts

TARGET VOLTAGE:
- Positive value: 10 max. volts
- Negative value: 10 max. volts

GRID-No.5 VOLTAGE: 150 max. volts
GRID-No.4 VOLTAGE: 300 max. volts
GRID-No.3 VOLTAGE: 400 max. volts
GRID-No.2 & DYNODE-No.1 VOLTAGE: 350 max. volts
GRID-No.1 VOLTAGE:
- Negative-bias value: 125 max. volts
- Positive-bias value: 0 max. volts

PEAK HEATER-CATHODE VOLTAGE:
- Heater negative with respect to cathode: 125 max. volts
- Heater positive with respect to cathode: 10 max. volts

ANODE SUPPLY VOLTAGE:
- 1350 max. volts

VOLTAGE PER MULTIPLIER STAGE:
- 350 max. volts

Typical Operation:
- Photocathode Voltage (Image Focus): -400 to -540 volts
- Grid-No.6 Voltage (Accelerator) — Approx. 75% of photocathode voltage: -300 to -405 volts
Target-Cutoff Voltage\(^c\)  
Grid-No.5 Voltage (Decelerator)  
Grid-No.4 Voltage (Beam Focus)  
Grid-No.3 Voltage\(^d\)  
Grid-No.2 & Dynode-No.1 Voltage  
Grid-No.1 Voltage for Picture Cutoff  
Dynode-No.2 Voltage  
Dynode-No.3 Voltage  
Dynode-No.4 Voltage  
Dynode-No.5 Voltage  
Anode Voltage  
Minimum Peak-to-Peak Blanking Voltage  
Field Strength at Center of Focusing Coil\(^g\)  
Field Strength of Alignment Coil

Grid-No.1 Voltage for Picture Cutoff  
Dynode-No.2 Voltage  
Dynode-No.3 Voltage  
Dynode-No.4 Voltage  
Dynode-No.5 Voltage  
Anode Voltage  
Minimum Peak-to-Peak Blanking Voltage

**Performance Data:**

*With conditions shown under Typical Operation and with camera lens set to bring the picture highlights one stop above the "knee" of the light transfer characteristic.*

<table>
<thead>
<tr>
<th>Min.</th>
<th>Average</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode Radiant Sensitivity at 4500 angstroms</td>
<td>0.03 µa/µw</td>
<td></td>
</tr>
<tr>
<td>Luminous Sensitivity</td>
<td>30 µa/lumen</td>
<td>30 µa</td>
</tr>
<tr>
<td>Anode Current (DC)</td>
<td>3 µa</td>
<td>8 µa 24 µa</td>
</tr>
<tr>
<td>Signal-Output Current (Peak-to-peak)</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc</td>
<td>35:1</td>
<td>45:1</td>
</tr>
<tr>
<td>Photocathode Illumination at 2870°K Required to Bring Picture Highlights One Stop Above &quot;Knee&quot; of Light Transfer Characteristic</td>
<td>0.02 fc</td>
<td>0.04 fc</td>
</tr>
<tr>
<td>Peak-to-Peak Response to Square-Wave Test Pattern at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)(^g)</td>
<td>35</td>
<td>60</td>
</tr>
<tr>
<td>Uniformity: Ratio of Shading (Background) Signal to Highlight Signal</td>
<td>0.12</td>
<td>0.15</td>
</tr>
<tr>
<td>Variation of Highlight Signal (Per cent of maximum highlight signal)(^h)</td>
<td>20</td>
<td>25</td>
</tr>
</tbody>
</table>

\(^b\) Dynode-voltage values are shown under Typical Operation.

\(^c\) Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 to +5 volts.

\(^d\) Adjust to give the most uniformly shaded picture near maximum signal.

\(^g\) Indicates a change.
Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coll, with the indicator located outside of and at the image end of the focusing coll. 

f With 5820A operated in properly adjusted RCA TX-31 camera. 

g Measured with amplifier having flat frequency response. 

h Variation of response over scanned area.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-10 RESPONSE is shown at front of this Section.
**ANNULAR-BASE GAUGE**

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

- **a.** Six holes having diameter of 0.065" ± 0.001" and one hole having diameter of 0.150" ± 0.001". All holes have depth of 0.265" ± 0.001". The six 0.065" holes are enlarged by 45° taper to depth of 0.047". All holes are spaced at angles of 51°26′ ± 5′ on circle diameter of 2.500" ± 0.001".

- **b.** Seven stops having height of 0.187" ± 0.001", centered between pin holes to bear against flat areas of base.

- **c.** Rim extending out a minimum of 0.125" from 2.812" diameter and having height of 0.126" ± 0.001".

- **d.** Neck-cylinder clearance hole having diameter of 2.200" ± 0.001".

**NOTE 1:** Dotted area is flat or extends toward diheptal-base end of tube by 0.060" max.
BASIC LIGHT-TRANSFER CHARACTERISTIC

ILLUMINATION: TUNGSTEN LIGHT, DAY-LIGHT, OR WHITE FLUORESCENT. FOR SMALL-AREA HIGHLIGHTS.

TYPICAL SIGNAL OUTPUT - MICROAMPERES

HIGHLIGHT ILLUMINATION ON PHOTOCATHODE - FOOTCANDLES

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
The 6198-A is an improved version of the 6198 and is unilaterally interchangeable with it.

**DATA**

**General:**

Heater, for Unipotential Cathode:
- Voltage: $6.3 \pm 10\%$ ac or dc volts
- Current: 0.6 amp

Direct Interelectrode Capacitance:
- Signal electrode to all other electrodes: 4.5 µF

Spectral Response: See Curves

**Photoconductive Layer:**
- Maximum useful diagonal of rectangular image (4 x 3 aspect ratio): 0.62"
- Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the face-plate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

**Focusing Method:** Magnetic

**Deflection Method:** Magnetic

**Overall Length:** 6-1/4" ± 1/4"

**Greatest Diameter:** 1.125" ± 0.010"

**Weight (Approx.):** 2 oz

**Operating Position:** Approx. horizontal, or faceplate up

**Bulb:** T8

**Base Connector:** Cinch No. 54A18088, or equivalent

**Base:** Small-Button Ditetrar 8-Pin (JETEC No. E8-11)

**Basing Designation for BOTTOM VIEW:** 8HM

---

**Maximum Ratings, Absolute Values:**

- **SIGNAL-ELECTRODE VOLTAGE:** 100 max. volts
- **GRID-No. 4 & GRID-No. 3 VOLTAGE:** 350 max. volts
- **GRID-No. 2 VOLTAGE:** 350 max. volts

*This capacitance, which effectively is the output impedance of the 6198-A, is increased by about 3 µF 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.*

---

**ELECTRON TUBE DIVISION**

**TENTATIVE DATA**

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
<table>
<thead>
<tr>
<th>GRID-No.1 VOLTAGE:</th>
<th>125 max. volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Negative bias value</td>
<td>125 max. volts</td>
</tr>
<tr>
<td>Positive bias value</td>
<td>0 max. volts</td>
</tr>
</tbody>
</table>

**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 125 max. volts
- Heater positive with respect to cathode: 10 max. volts

**FACEPLATE:**
- Illumination (Highlight): 1000 max. ft-c
- Temperature: 60 max. °C

**Typical Operation and Characteristics:**

*For scanned area of 1/2" x 3/8"*

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>10 to 20 ft-c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal-Electrode Voltage</td>
<td>10 to 70 volts</td>
</tr>
<tr>
<td>Grid-No.4 (Decelerator) &amp; Grid-No.3 (Beam Focus) Voltage</td>
<td>250** to 300 volts</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for picture cutoff</td>
<td>-45 to -100 volts</td>
</tr>
<tr>
<td>Highlight Signal-Output Current</td>
<td>0.1 to 0.2 µa</td>
</tr>
<tr>
<td>Maximum Dark Current</td>
<td>0.02 µa</td>
</tr>
<tr>
<td>Uniform 2870° K Tungsten Illumination on Tube Face</td>
<td>3 to 10 ft-c</td>
</tr>
<tr>
<td>to Produce Signal-Output Current of 0.1 to 0.2 µa</td>
<td>0.65</td>
</tr>
<tr>
<td>Average &quot;Gamma&quot; of Transfer Characteristic for Signal-Output Current between 0.02 and 0.2 µa</td>
<td>300:1</td>
</tr>
<tr>
<td>Visual Equivalent Signal-to-Noise Ratio (Approx.)*</td>
<td>300:1</td>
</tr>
<tr>
<td>Minimum Peak-to-Peak Blanking Voltage:</td>
<td></td>
</tr>
<tr>
<td>When applied to grid No.1</td>
<td>40 volts</td>
</tr>
<tr>
<td>When applied to cathode</td>
<td>10 volts</td>
</tr>
<tr>
<td>Field Strength at Center of Focusing Device</td>
<td>40 gaussies</td>
</tr>
<tr>
<td>Field Strength of Adjustable Alignment Coil</td>
<td>0 to 4 gaussies</td>
</tr>
</tbody>
</table>

*Definition, focus uniformity, and picture quality decrease with decreasing grid-No.3 and grid-No.4 voltage. In general, grid No.3 and grid No.4 should not be operated below 250 volts.

*With no blanking voltage on grid No.1.*

*Measured with a high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 Mc and determined primarily by the signal-output level of the vidicon and the noise generated in the input amplifier. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.*
NOTE: STRAIGHT SIDES OF MASKED PORTIONS ARE PARALLEL TO THE PLANE PASSING THROUGH TUBE AXIS AND SHORT INDEX PIN.
TYPICAL LIGHT-TRANSFER CHARACTERISTICS

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/8 x 3/8".

Em = SIGNAL-ELECTRODE VOLTS TO GIVE MAXIMUM SENSITIVITY AT MAXIMUM DARK CURRENT OF 0.02 MICROAMPERE

2870°K TUNGSTEN ILLUMINATION ON TUBE FACE—FOOT-CANDLES

PERSISTENCE CHARACTERISTIC

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2 x 3/8"
INITIAL VALUE = 0.2 MICROAMPERE

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

ELECTRON TUBE DIVISION

CE-9086
-7819TV
SPECTRAL SENSITIVITY CHARACTERISTICS

CURVE A: FOR EQUAL VALUES OF SIGNAL-OUTPUT CURRENT AT ALL WAVELENGTHS. SIGNAL-OUTPUT MICROAMPERES FROM SCANNED AREA OF \( \frac{1}{2}'' \times \frac{3}{8}'' = 0.02 \)

CURVE B: SPECTRAL CHARACTERISTIC OF AVERAGE HUMAN EYE.

CURVE C: FOR EQUAL VALUES OF SIGNAL-OUTPUT CURRENT WITH RADIANT FLUX FROM TUNGSTEN SOURCE AT 2870° K.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
CURVE A: WITH 8 FT-C OF 2870°K TUNGSTEN ILLUMINATION INCIDENT ON TUBE FACE.
CURVE B: WITH NO ILLUMINATION INCIDENT ON TUBE FACE.
CURVE C = CURVE A MINUS CURVE B
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = $\frac{1}{2}'' \times \frac{3}{8}''$
Photomultiplier Tube

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

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

GENERAL

Spectral Response .................................................. S-11
Wavelength of Maximum Response .......................... 4400 ± 500 angstroms
Cathode, Semitransparent ............................................. Cs-Sb
Shape .......................................................... Flat, Circular
Minimum area ................................................... 1.2 sq in
Minimum diameter .............................................. 1.24 in
Window ........................................................ Lime Glass, Corning® No.0080, or equivalent
Shape ........................................................... Plano-Plano
Index of refraction at 5893 angstroms ...................... 1.51

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

Direct Interelectrode Capacitances (Approx.)
Anode to dynode No.10 .............................................. 4.0 pF
Anode to all other electrodes ................................. 7.0 pF
Maximum Overall Length ...................................... 4.57 in
Seated Length ...................................................... 3.88 ± 0.19 in
Maximum Diameter ............................................... 1.56 in
Operating Position ................................................ Any
Weight (Approx.) .................................................... 2.2 oz
Envelope ........................................................... JEDEC T12
Base .............................................................. Small-Shell Duodecal 12-Pin, (JEDEC No.B12-43), Non-hygrosopic
Socket ............................................................. Eby® No.9058, or equivalent
Magnetic Shield ................................................... Millen® Part No.80802C, or equivalent

TERMINAL DIAGRAM (Bottom View)

<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.3</td>
</tr>
<tr>
<td>3</td>
<td>Dynode No.5</td>
</tr>
<tr>
<td>4</td>
<td>Dynode No.7</td>
</tr>
<tr>
<td>5</td>
<td>Dynode No.9</td>
</tr>
<tr>
<td>6</td>
<td>Anode</td>
</tr>
<tr>
<td>7</td>
<td>Dynode No.10</td>
</tr>
<tr>
<td>8</td>
<td>Dynode No.8</td>
</tr>
<tr>
<td>9</td>
<td>Dynode No.6</td>
</tr>
<tr>
<td>10</td>
<td>Dynode No.4</td>
</tr>
<tr>
<td>11</td>
<td>Dynode No.2</td>
</tr>
<tr>
<td>12</td>
<td>Photocathode</td>
</tr>
</tbody>
</table>

DIRECTION OF RADIATION: INTO END OF BULB

12AE

Indicates a change.
ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage
- Between anode and cathode: 1250 V
- Between dynode No.10 and anode: 250 V
- Between consecutive dynodes: 200 V
- Between dynode No.1 and cathode: 300 V
- Average Anode Current: 0.75 mA
- Ambient Temperature: 75 °C

CHARACTERISTICS RANGE VALUES

Under conditions with 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.

With \( E = 1000 \) V (Except as noted)

<table>
<thead>
<tr>
<th>Characteristic</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>( 3.6 \times 10^4 ) A/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode radiant at 4400 angstroms</td>
<td>( 0.036 ) A/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous</td>
<td>( 10 )</td>
<td>45</td>
<td>300 A/Im</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source</td>
<td>( 3 \times 10^{-5} )</td>
<td>( 4.5 \times 10^{-5} ) A/Im</td>
<td></td>
</tr>
<tr>
<td>With blue light source</td>
<td>( 2.8 \times 10^{-8} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 4200 angstroms</td>
<td>( 1 \times 10^6 ) A/Im</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td>( 2.3 \times 10^{-10} ) 1m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input</td>
<td>( 2.8 \times 10^{-13} ) 3.1 \times 10^{-12} W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current</td>
<td>( 4.5 \times 10^{-9} ) A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Current to Any Electrode Except Anode (at 22°C)</td>
<td>( 7.5 \times 10^{-7} ) A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>( 4 \times 10^{-12} ) 1.7 \times 10^{-11} 1m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode-Pulse Rise Time</td>
<td>( 2.8 \times 10^{-9} ) s</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electron-Transit Time</td>
<td>( 3.3 \times 10^{-8} ) s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\( a \) Made by Corning Glass Works, Corning, New York.
\( b \) Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia 44, Pennsylvania.
\( c \) Made by James Millen Manufacturing Company, 150 Exchange Street, Walden 48, Massachusetts.
\( d \) Averaged over any interval of 30 seconds maximum.
\( e \) Tube operation at room temperature or below is recommended.
\( f \) This value is calculated from the typical value for luminous sensitivity using a conversion factor of 804 lumens per watt.
\( g \) This value is calculated from the typical value for cathode luminous sensitivity using a conversion factor of 804 lumens per watt.

Indicates a change.
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.

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 167 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, 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 167 volts are applied between cathode and all other electrodes connected as anode.

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

n Measured with supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current is measured with no incident light on tube.

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

q Under the following conditions: Supply voltage (E) is as shown, 22°C tube temperature, 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.

r 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.

s 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 Effect of Magnetic Field on Anode Current

UNIFORM 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. VOLTS PER STAGE = 100

![Diagram of Magnetic Field Effect on Anode Current]
TYPICAL VOLTAGE DIVIDER ARRANGEMENT

Note: Adjustable between approximately 500 and 1250 volts dc.

$C_1, C_2$: 0.01 $\mu$F, non-inductive type, 400 volts (dc working) — Values dependent on amplitude and duration of pulse.

$R_1$: 91,000 ohms, 2 watts
$R_2$ through $R_{11}$: 47,000 ohms, 1 watt
PHOTOCATHODE DIAMETER
1.24 MIN.
(SEE NOTE)

FACEPLATE

T12 BULB

BASE
JEDEC No.B12-43

DIMENSIONS IN INCHES

Note: Deviation from flatness within the 1.24-inch diameter area will not exceed 0.010 inch from peak to valley. 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 Sensitivity and Current Amplification 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.

DATA 3
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Dark Current and Luminous Sensitivity Characteristics

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 DYNODE STAGE; AND 1/2 OF E BETWEEN DYNODE NO. 10 AND ANODE.
TUBE TEMPERATURE: 22°C
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870 K.

DATA 4
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N.J.
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. Photocathode is fully illuminated.

Typical ENI Characteristics

Dynode No. 1 to cathode volts = 167
Each succeeding dynode-stage volts = 83
Bandwidth: 1 Hz
Light source: Tungsten at 2870°K interrupted at 90 Hz to produce pulses alternating between zero and flux value shown for any given tube temperature: "on" period of pulse equal to "off" period; RMS signal current = RMS noise current.
External shield volts relative to anode volts = -1000
Spectral Energy Distribution of 2870°K Light Source After Passing Through Blue 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.
Photomultiplier Tube

10-STAGE, CURVED-FACEPLATE TYPE HAVING S-10 RESPONSE
1-11/16 INCH MINIMUM DIAMETER CURVED PHOTOCATHODE

GENERAL

<table>
<thead>
<tr>
<th>Spectral Response</th>
<th>S-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength of Maximum Response</td>
<td>4500 ± 300 angstroms</td>
</tr>
<tr>
<td>Cathode, Semitransparent</td>
<td>Ag-Bi-O-Cs</td>
</tr>
<tr>
<td>Shape</td>
<td>Curved, Circular</td>
</tr>
<tr>
<td>Minimum area</td>
<td>2.2 sq in</td>
</tr>
<tr>
<td>Minimum diameter</td>
<td>1-11/16 in</td>
</tr>
<tr>
<td>Window</td>
<td>Lime Glass (Corning® No.0080), or equivalent</td>
</tr>
</tbody>
</table>

| Dyode Material | Cs-Sb |
| Direct Interelectrode Capacitances (Approx.) |
| Anode to dynode No.10 | 4.2 pF |
| Anode to all other electrodes | 6.5 pF |
| Maximum Overall Length | 5.81 in |
| Seated Length | 4.87 ± 0.19 in |
| Maximum Diameter | 2.91 in |
| Operating Position | Any |
| Weight (Approx.) | 5.2 oz |
| Envelope | JEDEC Ti6 |
| Base | Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-36), Non-hygrosopic |
| Socket | Eby® No.9709-7, or equivalent |
| Magnetic Shield | JAN® No.S-2004, or equivalent |

ABSOLUTE-MAXIMUM RATINGS

<table>
<thead>
<tr>
<th>DC or Peak AC Supply Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between anode and cathode</td>
</tr>
<tr>
<td>Between dynode No.10 and anode</td>
</tr>
<tr>
<td>Between dynode No.1 and cathode</td>
</tr>
<tr>
<td>Average Anode Current</td>
</tr>
<tr>
<td>Ambient Temperature</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 = No Connection
Pin 13 = Do Not Use
Pin 14 = Photocathode

▲ Indicates a change.
Under conditions with dc supply voltage (1) 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 \( E = 1000 \) V (Except as noted)

<table>
<thead>
<tr>
<th>Characteristic</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 4500 angstroms</td>
<td>-</td>
<td>5.1x10^4</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4500 angstroms</td>
<td>-</td>
<td>0.02</td>
<td>-</td>
</tr>
<tr>
<td>Luminous, at 0 c/s^e</td>
<td>10</td>
<td>100</td>
<td>300</td>
</tr>
<tr>
<td>Cathode luminous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light sourcef</td>
<td>2x10^-5</td>
<td>4x10^-5</td>
<td>-</td>
</tr>
<tr>
<td>With red-infrared light sourceg</td>
<td>5x10^-8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>2.5x10^-6</td>
<td>-</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input^h.</td>
<td>-</td>
<td>1.4x10^-9</td>
<td>2.5x10^-8</td>
</tr>
<tr>
<td>Equivalent Noise Input^j</td>
<td>-</td>
<td>4x10^-11</td>
<td>1.7x10^-10</td>
</tr>
<tr>
<td>Dark Current</td>
<td>-</td>
<td>7.5x10^-7</td>
<td>-</td>
</tr>
</tbody>
</table>

With \( E = 750 \) V (Except as noted)

<table>
<thead>
<tr>
<th>Characteristic</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 4500 angstroms</td>
<td>-</td>
<td>5.1x10^3</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4500 angstroms</td>
<td>-</td>
<td>0.02</td>
<td>-</td>
</tr>
<tr>
<td>Luminous, at 0 c/s^e</td>
<td>-</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>Cathode luminous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light sourcef</td>
<td>2x10^-5</td>
<td>4x10^-5</td>
<td>-</td>
</tr>
<tr>
<td>With red-infrared light sourceg</td>
<td>5x10^-5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>2.5x10^-6</td>
<td>-</td>
</tr>
</tbody>
</table>

* Made by Corning Glass Works, Corning, New York.
* Made by JAN Hardware Manufacturing Company, 38-01 Queens Blvd., Long Island City 1, New York.
* Averaged over any interval of 30 seconds maximum. For best stability, the average anode current value should not exceed 100 microamperes.
* 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 2870K and a light input of 10 microlumens 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 2870K. The value of light flux is 0.01 lumen and 167 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 red-infrared filter (Combination of Corning C.S. Nos. 3-67 and 7-59, Glass Code No. 3482 and 5850, respectively—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870K. The value of light flux is 0.02 lumen and 167 volts are applied between cathode and all other electrodes connected as anode.

---

**Notes:**
- Indicates a change.
- DATA 1
- RADIO CORPORATION OF AMERICA
- Electronic Components and Devices
- Harrison, N.J.
incident on the filter is 0.01 lumen and 167 volts are applied between cathode and all other electrodes connected at anode.

h At a tube temperature of 25°C. Prior to measurement, tube is stored in dark for a period of 30 minutes. Dark current may be reduced by use of a refrigerant.

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.

**DIMENSIONAL OUTLINE**

PHOTOCATHODE DIAMETER 11/16 MIN.

1.50 ± 0.050 R.

3 ± 1 R.

4.87 ± 0.19

5.6 MAX.

T 16 BULB

BASE

JEDEC No. B14-38

DIMENSIONS IN INCHES

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

**SPECTRAL-SENSITIVITY CHARACTERISTIC**

of Phototube having S-10 Response is shown at the front of this Section

**TYPICAL ANODE CHARACTERISTICS**

are the same as those shown for Type 6199

---

RADIO CORPORATION OF AMERICA

Electronic Components and Devices

Harrison, N. J.

DATA 2

2-66
Typical Sensitivity and Current Amplification 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

TYPICAL SENSITIVITY

MAXIMUM SENSITIVITY

TYPICAL AMPLIFICATION

MINIMUM SENSITIVITY

Current Amplification

Supply volts (E) between anode and cathode

92CM-377B
Photomultiplier Tube

9-STAGE, SIDE-ON TYPE HAVING S-4 RESPONSE
For AC-Operated Control Applications Such as Automobile-Headlight Control

GENERAL
Spectral Response.
Wavelength of Maximum Response.
Cathode, Opaque.
Minimum projected length
Minimum projected width.
Window.
Dyne Material.
Direct Interelectrode Capacitances (Approx.)
Anode to dynode No.9
Anode to all other electrodes.
Maximum Overall Length
Maximum Seated Length.
Length.

From base seat to center of useful cathode area
Maximum Diameter
Operating Position
Weight (Approx.)
Envelope
Base.
Socket.

ABSOLUTE-MAXIMUM RATINGS
Peak AC Supply Voltage
Between anode and cathode.
Between dynode No.9 and anode.
Between consecutive dynodes.
Between dynode No.1 and cathode.
Average Anode Current
Ambient-Temperature.

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.
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 \( E = 1000 \) V dc

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4000 angstroms</td>
<td>3.4x10^4</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous, at 0 c/s², ...</td>
<td>35</td>
<td>-</td>
<td>A/1m</td>
</tr>
</tbody>
</table>

Dark Current to Any Electrode

At \( 25^\circ C \)

- 7.5x10^-7 A

With \( E = \) Adjustable 60 c/s ac Voltage

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode-to-Cathode Voltage (^g)</td>
<td>525</td>
<td>750</td>
<td>980  V</td>
</tr>
<tr>
<td>RMS values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current (^h)</td>
<td>-</td>
<td>1x10^-7</td>
<td>A</td>
</tr>
</tbody>
</table>

- Indicates a change.

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, New York.
c Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 54, Illinois.
d Made by James Millen Manufacturing Company, 150 Exchange St., Malden 48, Massachusetts.
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 microlumens is used.
g Under the following conditions: Light incident on the cathode is transmitted through a filter (Corning C.S. No. 62, Glass Code No. 2418 which has an effective transmission of luminous flux of 5%—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 10 microlumens. Supply voltage (E) is adjusted to give an anode current of 8 microamperes.
h For conditions same as (g) except no radiant flux on photocathode.
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: The maximum angular variation between the planes through pins 1 and 11 and the plane of the grill will not exceed 6°.
DETAIL A

PHOTO-CATHODE
REGION OF BEST COLLECTION

DIRECTION OF INCIDENT RADIATION

ANODE

.SHIELD

BULB

DY9

DY5

DY7

DY6

DY8

DY4

DY2

DY1

GRILL

.270

.402

.190 - .250

.48 .26

RADIO CORPORATION OF AMERICA
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RECOMMENDED VOLTAGE-DIVIDER NETWORK FOR USE WITH TYPE 6328 IN HEADLIGHT-CONTROL SERVICE

R1, R2, R3, R4, R5
R6, R7, R8, R9, R10: 1 megohm, 1/2 watt
R11: 2 megohms, 1/2 watt
R12: 5.1 megohms, 1/2 watt
R13, R14, R15, R16
R17, R18, R19, R20: 8.2 megohms, 1/2 watt
R21: 820,000 ohms, 1/2 watt
Typical Anode Characteristics

VOLTS/STAGE = 100
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2670° K.

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

AC SINE-WAVE 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.

[Graph showing sensitivity characteristics with peaks at different voltages.]

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

DATA 4 12-65
Variation in Photocathode Sensitivity Along Its Length

Spot size: 1mm dia., approx.
Variations caused by interception of light by grill as well as surface irregularities have been ignored.

Variation in Photocathode Sensitivity Across Its 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.
Multiplier Phototube

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

DATA

General:
Spectral Response. ... S-11
Wavelength of Maximum Response. ... 4400 ± 500 angstroms
Cathode, Semitransparent. ... Cesium-Antimony
Shape. ... Curved, Circular
Minimum area. ... 2.2 sq. in.
Minimum diameter. ... 1.68 in.
Window. ... Lime Glass (Corning® No.0080), or equivalent

Index of refraction. ... 1.51
Dy三代 Material. ... Copper-Beryllium

Direct Inter electrode Capacitances (Approx.):
Anode to dynode No.10. ... 4.4 pf
Anode to all other electrodes. ... 7.0 pf

Maximum Overall Length. ... 5.81" ± 0.19"
Seated Length. ... 4.87"
Maximum Diameter. ... 2.31"
Operating Position. ... Any
Weight (Approx.). ... 5.2 oz

Bulb. ... T16
Socket. ... Loranger® No.2274, or equivalent
Magnetic Shield. ... Millen® No.80802B, or equivalent
Base. ... Medium-Shell Diheptal 14-Pin, (JEDEC Group 5, No.814-38), Non-hygroscopic

Basing Designation for BOTTOM VIEW. ... 14AA

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

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

- **SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC or Peak AC)**: 1500 max. volts
- **SUPPLY VOLTAGE BETWEEN DYNOE No. 10 AND ANODE (DC or Peak AC)**: 250 max. volts
- **SUPPLY VOLTAGE BETWEEN DYNOE No. 1 AND CATHODE (DC or Peak AC)**: 400 max. volts
- **SUPPLY VOLTAGE BETWEEN FOCUSING ELECTRODE AND CATHODE (DC or Peak AC)**: 400 max. volts
- **AVERAGE ANODE CURRENT**: 2 max. ma
- **AMBIENT TEMPERATURE**: 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>Sensitivity:</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4400 angstroms</td>
<td>-</td>
<td>( 2.5 \times 10^4 )</td>
<td>a/w</td>
</tr>
<tr>
<td>Cathode radiant at 4400 angstroms</td>
<td>-</td>
<td>0.064</td>
<td>a/w</td>
</tr>
<tr>
<td>Luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 0 cps</td>
<td>15</td>
<td>31</td>
<td>200 a/lm</td>
</tr>
<tr>
<td>With dynode No. 10 as output electrode</td>
<td>-</td>
<td>22</td>
<td>a/lm</td>
</tr>
<tr>
<td>Cathode Luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source</td>
<td>( 5 \times 10^{-5} )</td>
<td>( 8 \times 10^{-5} )</td>
<td>a/lm</td>
</tr>
<tr>
<td>With blue light source</td>
<td>( 5 \times 10^{-8} )</td>
<td>-</td>
<td>a</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>3.9 \times 10^5</td>
<td>-</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input</td>
<td>-</td>
<td>( 2 \times 10^{-10^k} )</td>
<td>1m</td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>-</td>
<td>( 2.5 \times 10^{-13^m} )</td>
<td>( 2.5 \times 10^{-12^m} ) w</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time</td>
<td>-</td>
<td>( 7 \times 10^{-12} )</td>
<td>( 1.7 \times 10^{-11} )</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>( 8.7 \times 10^{-15^p} )</td>
<td>( 2.1 \times 10^{-14^p} ) w</td>
</tr>
</tbody>
</table>

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 —

+ Indicates a change.
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-II RESPONSE
is shown at the front of this Section.
FACEPLATE (SEE NOTE)

PHOTOCATHODE

BASE
JEDEC GROUP 5,
No.B14-38

2.00 ±.06
DIA.

1.68 MIN.
DIA.

4.67
±.19

5.81
MAX.

2.31 MAX.
DIA.

92C3-B108R6

ALL 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 1.68" DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.010" FROM PEAK TO VALLEY.
CHARACTERISTICS

<table>
<thead>
<tr>
<th>SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/8 OF E BETWEEN CATHODE AND DYNOKE No. 1, 1/12 OF E FOR EACH SUCCEEDING DYNOKE STAGE, AND 1/12 OF E BETWEEN DYNOKE No. 10 AND ANODE. FOCUSING—ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE</th>
<th>SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td>1000</td>
<td>1500</td>
</tr>
</tbody>
</table>

Sensitivity — Amperes/Lumen (Color Temperature 2870 K)

- Typical Amplification
- Maximum Sensitivity
- Typical Sensitivity
- Minimum Sensitivity

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Electronic Components and Devices
Harrison, N. J.
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES $\frac{1}{6}$ OF E BETWEEN CATHODE AND DYNOE N2; $\frac{1}{12}$ OF E FOR EACH SUCCEEDING STAGE; AND $\frac{1}{12}$ OF E BETWEEN DYNOE N10 AND ANODE. FOCUSING-ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.

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

**SIDE-ON TYPE**

For Industrial Applications Critical as to Microphonics and Sensitivity Gradient

**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.)** .... 2.6 pf

**Maximum Overall Length.** .... 4-7/16"

**Maximum Seated Length** ........ 3-13/16"

**Seated Length to Center of Cathode.** 2-1/8" ± 3/32"

**Maximum Diameter.** .......... 1-1/8"

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

**Weight (Approx.).** .......... 1.3 oz

**Bulb.** .......... T8

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

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

**Non-hygroscopic**

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

---

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

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

**Characteristics:**

*With an anode-supply voltage of 50 volts unless otherwise specified*

**Sensitivity:**

Radiant, at 8000 angstroms. .......... 0.0033 a/w→

→ indicates a change.
**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.
Photomultiplier Tube

**FLEXIBLE LEADS**

S-4 RESPONSE

For AC- or DC-Operated Control Applications Which Require High Luminous Sensitivity

**GENERAL**

Spectral Response ........................................... S-4
Wavelength of Maximum Response ......................... 4000 ± 500 angstroms
Cathode, Opaque ........................................... Cs-Sb
Minimum projected length\(^a\) .............................. 15/16 in
Minimum projected width\(^a\) ............................... 5/16 in
Window ..................................................... Lime Glass, (Corning\(^b\) No.0080), or equivalent
Dynode Material ........................................... Cs-Sb
Direct Interelectrode Capacitances (Approx.)
Anode-to-dynode No.9 ....................................... 3.8 pF
Anode to all other electrodes .............................. 4.8 pF
Maximum Overall Length ................................. 2-3/4 in
Excluding semiflexible leads
Maximum Envelope Length ............................... 2-1/4 in
Excluding tip
Length ................................................... 1-1/4 ± 3/32 in
From envelope seal to center of useful cathode area
Maximum Diameter ......................................... 1-3/16 in
Operating Position ........................................ Any
Weight (Approx.) ........................................... 2 oz
Envelope ..................................................... JEDEC T9
Magnetic Shield ........................................... Perfection Mica Co.,\(^c\) No.P-107, or equivalent

**TERMINAL DIAGRAM** (Bottom View)

**ABSOLUTE-MAXIMUM RATINGS**

**DC or Peak AC Supply Voltage**
Between anode and cathode ............................... 1250 V
Between anode and dynode No.9 ......................... 250 V
Between consecutive dynodes ........................... 250 V
Between dynode No.1 and cathode ..................... 250 V
Average Anode Current\(^d\) ............................... 0.1 mA
Ambient Temperature ....................................... 75 °C

\(^a\) Indicates a change.

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

DATA I 12-65
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 V dc

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4000 angstroms</td>
<td>3.4x10^4</td>
<td></td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous, at 0 c/s</td>
<td>5</td>
<td>35</td>
<td>250</td>
</tr>
</tbody>
</table>

Dark Current to any Electrode:

<table>
<thead>
<tr>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7.5x10^-7</td>
</tr>
</tbody>
</table>

At 25°C

With E = Adjustable 60 c/s ac voltage

<table>
<thead>
<tr>
<th>Anode-to-Cathode Voltage^f</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS Values</td>
<td>535</td>
<td>775</td>
<td>1000</td>
</tr>
</tbody>
</table>

Anode Dark Current^g

<table>
<thead>
<tr>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2.5x10^-7</td>
</tr>
</tbody>
</table>

At 25°C

^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, New York.

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

^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 micromens 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 and a light input of 1 micromen is used. Supply Voltage (E) is adjusted to give an anode current of 7.5 microamperes.

^g For conditions same as (f) except no radiant flux on photocathode.

Indicates a change.
DIMENSIONAL OUTLINE

The angular variation between the plane through Lead No. 1 and tube axis and the plane perpendicular to the plane of the grill will not exceed 20°.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-4 Response is shown at front of this section.
RECOMMENDED VOLTAGE-DIVIDER NETWORK FOR USE WITH TYPE 6472 IN HEADLIGHT-DIMMING SERVICE

AC OR DC POWER SUPPLY (SEE NOTE)

R1 R2 R3 R4 R5
R4 R5 R6 R7 R8 R9 R10: 1 megohm, 1/2 watt
R11: 2 megohms, 1/2 watt
R12: 5.1 megohms, 1/2 watt
R13 R14 R15 R16
R17 R18 R19 R20: 8.2 megohms, 1/2 watt
R21: 820,000 ohms, 1/2 watt

Note: Adjustable between approximately 500 and 1000 volts dc or peak ac.
Typical Anode Characteristics

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

- DC
- PEAK AC

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

DC or Peak Sine-Wave AC Volts Per Stage

Maximum

Minimum

Typical

DATA 3

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Variation in Photocathode Sensitivity Along Its Length

Variation in Photocathode Sensitivity Across Its Projected Width in Plane of Grill
**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: 3 µf
- Overall Length: 4-5/16" ± 1/8" 
- Seated Length to Center of Cathode: 2-1/8" ± 3/32" 
- Maximum Diameter: 1-1/8" 
- Mounting Position: Any
- Weight (Approx.): 1.9 oz 
- Bulb: Dwarf-Shell Small 4-Pin (JETEC No. A4-26)

**Maximum Ratings, Absolute Values:**
- **Anode—Supply Voltage:** (DC or Peak AC) 500 max. volts 
- **Average Cathode—Current Density°:** 25 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></th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 8000 angstroms</td>
<td>0.0027</td>
<td>0.0030</td>
<td>0.0040 µamp/µwatt</td>
</tr>
<tr>
<td>Luminous°</td>
<td>20</td>
<td>30</td>
<td>40   µamp/lumen</td>
</tr>
<tr>
<td>Sensitivity Difference Between Highest Value and Lowest Value Along Cathode Length°</td>
<td>-</td>
<td>4.5</td>
<td>µamp/lumen</td>
</tr>
<tr>
<td>Anode Dark Current at 25°C.</td>
<td>-</td>
<td>0.013</td>
<td>µamp</td>
</tr>
</tbody>
</table>

* 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. 
* Measured under the same conditions as indicated under (#) with light input of 0.1 lumen and a light spot 1/2 inch in diameter.
SPECTRAL-SENSIVITY CHARACTERISTIC of Phototube having S-1 Response is shown at the front of this Section.

AA' IS PLANE PASSING THROUGH CENTER OF BOTTOM OF BASE PARALLEL TO PLANE THROUGH PINS 1 & 4.

PLANE PASSING THROUGH SIDE RODS OF CATHODE WILL NOT DEVIATE FROM PLANE AA' BY MORE THAN 12°.
Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-II 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.

Spectral Response

S-Il

Wavelength of Maximum Response

4400 ± 500 angstroms

Cathode, Semitransparent

Cs-Sb

Shape

Curved, Circular

Minimum projected area

2.2 sq in

Minimum diameter

1.68 in

Window

Lime Glass, Corning® No.0080, or equivalent

Shape

Plano-Concave

Index of refraction at 5893 angstroms

1.51

Dynesides

Substrate

Ni

Secondary-Emitting Surface

Cs-Sb

Structure

Circular-Cage

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

Seated Length

4.87 ± 0.19 in

Maximum Diameter

2.31 in

Operating Position

Any

Weight (Approx.)

5.2 oz

Envelope

JEDEC T16

Base

Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.8114-38), Non-hygroscopic

Socket

Loranger® No.2274, or equivalent

Magnetic Shield

Millen® Part No.808028, or equivalent

TERMINAL DIAGRAM (Bottom View)

RADIO CORPORATION OF AMERICA
Harrison, N.J.

DATA 10-66
### Absolute-Maximum Ratings

<table>
<thead>
<tr>
<th>DC 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.10 and anode</td>
<td>250 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between consecutive dynodes</td>
<td>200 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between dynode No.1 and cathode</td>
<td>300 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between focusing electrode and cathode</td>
<td>300 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Anode Current</td>
<td>0.75 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 1/6 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 50 per cent of dynode No.1 potential (referred to cathode) which provides maximum anode current.

With E = 1000 V dc (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, f at 4400 angstroms</td>
<td>9.6x10^4 A/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode radiant, g at 4400 angstroms</td>
<td>0.061 A/W</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous, h</td>
<td>10</td>
<td>120</td>
<td>300 A/1m</td>
</tr>
<tr>
<td>Cathode luminous: with tungsten light source</td>
<td>4x10^-5</td>
<td>7.6x10^-5 A/1m</td>
<td></td>
</tr>
<tr>
<td>With blue light source</td>
<td>4x10^-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 4200 Angstroms</td>
<td>17</td>
<td></td>
<td>%</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>1.6x10^6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input</td>
<td>3x10^-10</td>
<td>2x10^-9</td>
<td>1m</td>
</tr>
<tr>
<td>Anode Dark Current</td>
<td>6x10^-9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>8x10^-13</td>
<td>2.7x10^-11</td>
<td>1m</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time</td>
<td>3.4x10^-9</td>
<td></td>
<td>s</td>
</tr>
<tr>
<td>Electron Transit Time</td>
<td>3.4x10^-8</td>
<td></td>
<td>s</td>
</tr>
</tbody>
</table>

a Made by Corning Glass Works, Corning, New York.
b Made by Loranger Manufacturing Corp., 36 Clark St., Warren, Pa.
c Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts.
d Averaged over any interval of 30 seconds maximum.
f This value is calculated from the typical value for luminous sensitivity using a conversion factor of 804 lumens per watt.
g This value is calculated from the typical value for cathode luminous sensitivity 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 2870K and a light input of 10 microlumens is used.

Indicates a change.

---

**Data 1**

**RADIO CORPORATION OF AMERICA**

Electronic Components and Devices

Harrison, N. 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.

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.

- Measured at a tube temperature of 22°C. Dark current may be reduced by use of a refrigerant.
- Measured with supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current is measured with no incident light on tube.
- At 4400 angstroms. This value is calculated from the rating in lumens using a conversion factor of 804 lumens per watt.
- Under the following conditions: Supply voltage (E) is as shown, 22°C tube temperature, 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.
- 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.
$C_1, C_2$: 0.01 $\mu$F non-inductive type, 400 volts (dc working). Values dependent on amplitude and duration of pulse.

$R_1$ through $R_{12}$: 33,000 ohms, 2 watts.

$R_{13}$: 2.5 megohms, 2 watts, adjustable.

Note 1: Adjustable between approximately 500 and 1250 volts dc.
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 inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.
Typical Sensitivity and Current Amplification Characteristics

SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE NO.1, 1/12 OF E FOR EACH SUCCESSING 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.
Typical Anode Characteristics

DYNO DE NO. 1-TO-CATHODE VOLTS 167
EACH SUCCEEDING DYNO DE STAGE VOLTS 83
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED
AT COLOR TEMPERATURE OF 2870°K

VOLTS BETWEEN ANODE AND DYNO DE NO. 10

ANODE CURRENT—MILLIAMPERES

LIGHT FLUX—MICROMEN = 10

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS A 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 IS ADJUSTED TO THAT VALUE BETWEEN 10 AND 60 PER CENT OF DYNOE 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.
Spectral Energy Distribution of 2870°K Light Source after Passing Through Blue 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.
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.
FOCUSING ELECTRODE IS CONNECTED TO DYNODE NO.1 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

<table>
<thead>
<tr>
<th>TIME - SECOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>10^-7</td>
</tr>
<tr>
<td>10^-8</td>
</tr>
<tr>
<td>10^-9</td>
</tr>
<tr>
<td>500</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>1000</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>500</td>
</tr>
<tr>
<td>SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE</td>
</tr>
</tbody>
</table>

DATA 5
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Photomultiplier Tube

2"-Diameter, 14-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
Minimum projected area .................. 2.2 in² (14.2 cm²)
Minimum diameter .................. 1.68 in (4.2 cm)
Window ............................................. Corning® No.0080, or equivalent
Shape ............................................. Plano-Concave
Index of refraction at 4360 angstroms ........ 1.523

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

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.14 .................. 2.8 pF
Anode to all other electrodes .......... 6 pF
Dynode No.14 to all other electrodes ..... 7.5 pF
Maximum Overall Length .................. 7.5 in (19 cm)
Seated Length .................. 6.69 in (17 cm) ± 0.19 in
Maximum Diameter .................. 2.38 in (6 cm)

Bulb ........................................ T16
Base .................................... Small-Shell Bidecal 20-Pin, JEDEC No.B20-102
Socket ................................... Alden® Part 220FTC, or equivalent
Magnetic Shield .................. Millen® No.80802E, or equivalent
Operating Position .................. Any
Weight (Approx.) .................. 8 oz (226 g)

MAXIMUM RATINGS, Absolute-Maximum Values:
DC Supply Voltage:
Between anode and cathode .................. 2400 max. V
Between anode and dynode No.14 .......... 400 max. V
Between consecutive dynodes ........... 500 max. V
Between accelerating electrode and
grid No.13 ................................ ±500 max. V
Between dynode No. 1 and cathode... 400 max. V
Between focusing electrode and cathode... 400 max. V
Average Anode Current... 2 max. mA
Ambient Temperature... 75 max. °C

CHARACTERISTICS RANGE VALUES

Voltage Distribution, Table 1
With E = 2000 volts (Except as noted)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 4400 angstroms... 3 x 10^6</td>
<td>... A/W</td>
<td></td>
</tr>
<tr>
<td>Luminous (2870° K)... 4.8 x 10^2 3.8 x 10^3</td>
<td>2 x 10^4</td>
<td>A/Im</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 4400 angstroms... 0.056</td>
<td>... A/W</td>
<td></td>
</tr>
<tr>
<td>Luminous (2870° K)... 5 x 10^-5 7 x 10^-5</td>
<td>... A/Im</td>
<td></td>
</tr>
<tr>
<td>Current with blue light source (2870° K + C.S. No. 5-58)... 5 x 10^-8 7 x 10^-8</td>
<td>... A</td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 4200 angstroms... 16</td>
<td>... %</td>
<td></td>
</tr>
<tr>
<td>Current Amplification... 5.4 x 10^7</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current... 1 x 10^-6 3 x 10^-6</td>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Equivalent Anode Dark Current Input... 5 x 10^-10 1.5 x 10^-9</td>
<td>... lm</td>
<td></td>
</tr>
<tr>
<td>Equivalent Noise Input... 6.2 x 10^-13p 1.8 x 10^-12p</td>
<td>... W</td>
<td></td>
</tr>
<tr>
<td>Anode-Pulse Rise Time at 2400 V... 3.1 x 10^-9</td>
<td>... s</td>
<td></td>
</tr>
<tr>
<td>Electron Transit Time at 2400 V... 4.4 x 10^-8</td>
<td>... s</td>
<td></td>
</tr>
</tbody>
</table>

o Made by Corning Glass Works, Corning, NY 14830.
b Made by Alden Products Co., 262 N. Main Street, Brockton, MA 02403.

Indicates a change or addition.
Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.

Averaged over any interval of 30 seconds maximum.

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 803 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 0.1 microlumen is used.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 803 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, NY) 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 2000 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant. Dark current is measured with incident light removed.

At 4400 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 803 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 4400 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 803 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.

**TERMINAL DIAGRAM (Bottom View)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No 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>Dynode No.13</td>
</tr>
<tr>
<td>9</td>
<td>Grid No.2 (Accelerating Electrode)</td>
</tr>
<tr>
<td>10</td>
<td>Anode</td>
</tr>
<tr>
<td>11</td>
<td>Dynode No.14</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>
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<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>No Connection</td>
</tr>
<tr>
<td>19</td>
<td>Grid No.1 (Focusing Electrode)</td>
</tr>
<tr>
<td>20</td>
<td>Photocathode</td>
</tr>
</tbody>
</table>

Metal Collar: No Connection

Note — If used, connect only to photocathode.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (dc working), ceramic disc
R_1: 24000 ohms, 5%, 1 watt
R_2: 22000 ohms, 5%, 1 watt
R_3: 1 megohm, 20%, 2 watts, adjustable
R_4 through R_13: 22000 ohms, 5%, 1 watt
R_14: 27000 ohms, 5%, 2 watts
R_15: 33000 ohms, 5%, 2 watts
R_16: 22000 ohms, 5%, 2 watts
R_17: 18000 ohms, 5%, 2 watts
R_18: 22000 ohms, 5%, 2 watts
R_19: 22000 ohms, 5%, 2 watts
R_20: 10 megohms, 2 watts, adjustable
R_L: Value will depend on magnitude of peak pulse voltage desired. For a peak pulse amplitude of 100 volts, the value is approximately 300 ohms.

Note 1: Adjustable between approximately 800 and 2400 volts dc.
Note 2: Component values are dependent upon nature of application and output signal desired.
Voltage between Cathode and Dynode No. 1

C1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C6: 100 pF, 20%, 1000 volts (dc working), ceramic disc
R1: 5 megohms, 20%, 1/2 watt, adjustable
R2 through R11: 2200 ohms, 5%, 1 watt
R12: 27000 ohms, 5%, 2 watts
R13: 33000 ohms, 5%, 2 watts
R14: 22000 ohms, 5%, 2 watts
R15: 18000 ohms, 5%, 2 watts
R16: 22000 ohms, 5%, 2 watts
R17: 22000 ohms, 5%, 2 watts
R18: 10 megohms, 2 watts, adjustable
R_L: Value will depend on magnitude of peak pulse voltage desired. For a peak pulse amplitude of 100 volts, the value is approximately 300 ohms.

Z: (2) - 180 V, 2 W zener diodes, or equivalent

Note 1: Adjustable between approximately 800 and 2400 volts dc.
Note 2: Component values are dependent upon nature of application and output signal desired.

RCA Electronic Components
DIMENSIONAL OUTLINE

FACEPLATE - (SEE NOTE)

PHOTOCATHODE

T16 BULB

METAL COLLAR

SMALL-SHELL BIDECAI 20-PIN BASE JEDEC No. B20-102

2.00 ± 0.06 DIA.

1.68 MIN. DIA.

6.69 ± 0.19

5.40 1.12

7.5 MAX.

2.36 MAX.

92CS-8802R3

$\theta$ of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

Note: Deviation from flatness of external surface of faceplate will not exceed 0.005" from peak to valley.

Dimensions are in inches unless otherwise stated.

INCH DIMENSION EQUIVALENTS 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>0.06</td>
<td>1.5</td>
<td>0.09</td>
<td>2.30</td>
<td>0.50</td>
<td>12.7</td>
</tr>
<tr>
<td>0.12</td>
<td>3.0</td>
<td>0.18</td>
<td>4.60</td>
<td>0.70</td>
<td>17.8</td>
</tr>
<tr>
<td>0.19</td>
<td>4.8</td>
<td>0.23</td>
<td>5.80</td>
<td>0.75</td>
<td>19.0</td>
</tr>
</tbody>
</table>

RCA Electronic Components

DATA 4
11-69
### Table 1

<table>
<thead>
<tr>
<th>Electrode Pairs</th>
<th>Between the following Electrodes:</th>
<th>Voltage Distribution</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cathode (K), Dynode (Dy), and Anode (P)</td>
<td>5.4% of Supply Voltage (E) multiplied by</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K - Dy1</td>
<td></td>
<td>2</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy1 - Dy2</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy2 - Dy3</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy3 - Dy4</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy4 - Dy5</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy5 - Dy6</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy6 - Dy7</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy7 - Dy8</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy8 - Dy9</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy9 - Dy10</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy10 - Dy11</td>
<td></td>
<td>1</td>
<td>6.06% of Supply Voltage (E) multiplied by</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy11 - Dy12</td>
<td></td>
<td>1.25</td>
<td>1.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy12 - Dy13</td>
<td></td>
<td>1.5</td>
<td>1.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy13 - Dy14</td>
<td></td>
<td>1.75</td>
<td>1.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy14 - P</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dy1 - P</td>
<td></td>
<td>18.5</td>
<td>—</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K - P</td>
<td></td>
<td>—</td>
<td>—</td>
<td></td>
<td></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.

Cathode-to-dynode No.1 voltage is maintained at 360 volts.

### Typical Time-Resolution Characteristics

- **VOLTAGE DISTRIBUTION A, TABLE I**
- **TRANSIT TIME**
- **RISE TIME**

![Graphical Representation of Voltage Distribution](image-url)
TYPICAL FOCUSING ELECTRODE CHARACTERISTIC

TYPICAL ANODE CHARACTERISTICS

CATHODE-TO-FOCUSING ELECTRODE VOLTS = 173
CATHODE-TO-DYNOODE No.1 (DY1) VOLTS = 216
DY1-TO-DY2 VOLTS = 135
DY2-TO-DY3 VOLTS = 160
ETC. TO
DY10-TO-DY11

GRID No.2 VOLTS ADJUSTED TO GIVE MAX. ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.

RCA Electronic Components

DATA 5
11-69
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

VOLTAGE DISTRIBUTION A OR B AS SHOWN ON CURVE, TABLE 1.

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

CURRENT AMPLIFICATION

SUPPLY VOLTAGE (E) VOLTS
TYPICAL EADC1 AND ANODE DARK CURRENT CHARACTERISTICS

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>5.4% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND FOCUSING ELECTRODE</td>
<td>1.6</td>
</tr>
<tr>
<td>CATHODE AND DYNODE No.1 (DY1)</td>
<td>2</td>
</tr>
<tr>
<td>DY1 &amp; DY2</td>
<td>1</td>
</tr>
<tr>
<td>DY2 &amp; DY3</td>
<td>1</td>
</tr>
<tr>
<td>DY3 &amp; DY4</td>
<td>1</td>
</tr>
<tr>
<td>DY4 &amp; DY5</td>
<td>1</td>
</tr>
<tr>
<td>DY5 &amp; DY6</td>
<td>1</td>
</tr>
<tr>
<td>DY6 &amp; DY7</td>
<td>1</td>
</tr>
<tr>
<td>DY7 &amp; DY8</td>
<td>1</td>
</tr>
<tr>
<td>DY8 &amp; DY9</td>
<td>1</td>
</tr>
<tr>
<td>DY9 &amp; DY10</td>
<td>1</td>
</tr>
<tr>
<td>DY10 &amp; DY11</td>
<td>1.25</td>
</tr>
<tr>
<td>DY11 &amp; DY12</td>
<td>1.5</td>
</tr>
<tr>
<td>DY12 &amp; DY13</td>
<td>1.75</td>
</tr>
<tr>
<td>DY13 &amp; DY14</td>
<td>2</td>
</tr>
<tr>
<td>ANODE &amp; CATHODE</td>
<td>18.5</td>
</tr>
</tbody>
</table>

..GRID—No. 2 VOLTS ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN—FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE • 22°C
# Photomultiplier Tube

**S-13 Response**

**Electrostatically Focused**

**Dynode Stages**

For Detection and Measurement of Ultraviolet Radiation and Other Low-Level Radiation Sources

## General

<table>
<thead>
<tr>
<th>Spectral Response</th>
<th>S-13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength of Maximum Response</td>
<td>4400 ± 500 angstroms</td>
</tr>
<tr>
<td>Cathode, Semitransparent</td>
<td>Cesium-Antimony</td>
</tr>
<tr>
<td>Shape</td>
<td>Flat, Circular</td>
</tr>
<tr>
<td>Minimum area</td>
<td>2 sq in</td>
</tr>
<tr>
<td>Minimum diameter</td>
<td>1-5/8 in</td>
</tr>
<tr>
<td>Window</td>
<td>Fused Silica</td>
</tr>
<tr>
<td>Maximum thickness</td>
<td>0.150 in</td>
</tr>
<tr>
<td>Index of refraction at 2000 angstroms</td>
<td>1.51</td>
</tr>
<tr>
<td>Dynode Material</td>
<td>Cesium-Antimony</td>
</tr>
</tbody>
</table>

## Direct Inter-electrode Capacitances (Approx.)

- Anode to dynode No. 10: 4.4 pF
- Anode to all other electrodes: 7.0 pF

## Maximum Overall Length

- 6-9/16 in

## Seated Length

- 5-5/8 ± 3/16 in

## Maximum Diameter

- 2-5/16 in

## Operating Position

- Any

## Weight (Approx.)

- 5.8 oz

## Bulb

- T16

## Socket

- Amphenol b No. 59-417, or equivalent

## Magnetic Shield

- Perfection Mica Co. c, No. P-108, or equivalent

## Base

- Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No. B14-38), Non-hygroscopic

## Basing Designation for BOTTOM VIEW

- 14AA

## Pin Numbers

- 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

---

b: Amphenol

c: Perfection Mica Co.
MAXIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

DC or Peak AC Supply Voltage

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between anode and cathode</td>
<td>1250 V</td>
</tr>
<tr>
<td>Between dynode No.10 and anode</td>
<td>250 V</td>
</tr>
<tr>
<td>Between dynode No.1 and cathode</td>
<td>300 V</td>
</tr>
<tr>
<td>Between focusing electrode and cathode</td>
<td>300 V</td>
</tr>
<tr>
<td>Average Anode Current</td>
<td>0.75 mA</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>75 °C</td>
</tr>
</tbody>
</table>

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 percent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

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>-</td>
<td>7.2x10^4</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>-</td>
<td>0.047</td>
<td>-</td>
</tr>
<tr>
<td>Luminous: At 0 c/s</td>
<td>10</td>
<td>90</td>
<td>300 A/1m</td>
</tr>
<tr>
<td>With dynode No.10 as output electrode</td>
<td>-</td>
<td>52</td>
<td>-</td>
</tr>
<tr>
<td>Cathode luminous: With tungsten light source</td>
<td>4x10^-5</td>
<td>6x10^-5</td>
<td>-</td>
</tr>
<tr>
<td>With blue light source</td>
<td>4x10^-8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>1.5x10^6</td>
<td>-</td>
</tr>
<tr>
<td>Equivalent Anode-Dark Current Input</td>
<td>5x10^-10</td>
<td>2x10^-8</td>
<td>1m</td>
</tr>
<tr>
<td>Equivalent Noise Input Luminous</td>
<td>6.3x10^-12</td>
<td>2.5x10^-12</td>
<td>W</td>
</tr>
<tr>
<td>Radiant P</td>
<td>6.7x10^-12</td>
<td>2.7x10^-11</td>
<td>1m</td>
</tr>
<tr>
<td>Dark Current to any Electrode Except Anode at 25°C</td>
<td>-</td>
<td>7.5x10^-7</td>
<td>A</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>-</td>
<td>6.3x10^3</td>
<td>-</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>-</td>
<td>0.047</td>
<td>-</td>
</tr>
</tbody>
</table>

- Indicates a change.
### Luminous:

<table>
<thead>
<tr>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 0 c/(s^2)</td>
<td>-</td>
<td>7.9</td>
</tr>
<tr>
<td>With dynode No.10 as output electrode</td>
<td>-</td>
<td>4.6</td>
</tr>
</tbody>
</table>

#### Cathode Luminous:

- With tungsten light source\(d\): \(4 \times 10^{-5}\) \(6 \times 10^{-6}\) \(A/1m\)
- With blue light source\(h\): \(4 \times 10^{-6}\) \(A\)

#### Current Amplification:

- \(1.3 \times 10^5\)

---

**SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSensitive DEVICE HAVING S-I3 RESPONSE**

Is shown at the front of this section.
DIMENSIONAL OUTLINE

PHOTOCATHODE DIAMETER
1 5/8 MIN.
(SEE NOTE)

BASE
JEDEC GROUP 5
No. BI4 - 3B

DIMENSIONS IN INCHES

Center line of bulb will not deviate more than 3° in any direction from the perpendicular erected at the center of bottom of the base.

Note: Within minimum diameter, deviation from flatness will not exceed 0.010" from peak to valley.
Typical Anode Characteristics

Operated at color temperature of 2870°K.

Light source is a Tungsten-Filament lamp.

Each succeeding dynode voltage = 83.

Dynode No. 1 - 70 - Cathode voltage = 167.
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES \( \frac{1}{6} \) OF E BETWEEN CATHODE AND DYNOE No.1; \( \frac{1}{12} \) OF E FOR EACH SUCCEEDING STAGE; AND \( \frac{1}{12} \) OF E BETWEEN DYNOE No.10 AND ANODE.

FOCUSING-ELECTRODE VOLTAGE ADJUSTED TO PROVIDE MAXIMUM ANODE CURRENT.

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

DASHED PORTION INDICATES INSTABILITY.

TUBE TEMPERATURE = 25°C
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. FOCUSING- ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.

SENSITIVITY - AMPERES/LUMEN (COLOR TEMPERATURE 2870° K)

CURRENT AMPLIFICATION

MAXIMUM SENSITIVITY

TYPICAL AMPLIFICATION

TYPICAL SENSITIVITY

MINIMUM SENSITIVITY

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

500 6 7 8 9 1000 1250

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

DATA 4
7-63
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.

RELATIVE ANODE CURRENT

MAGNETIC FIELD INTENSITY - GAUSSES

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

Monovoltage Types Having S-1 Spectral Response

GENERAL
For Both Types
Spectral Response
Wavelength of Maximum Response
Photocathode:
Material
Minimum useful diameter
Image surface:
Shape
Window
Index of refraction at 589.3 nm
Fluorescent Screen:
Minimum useful diameter
Phosphor
Fluorescence and phosphorescence
Persistence
Image surface:
Shape
Window
Index of refraction at 589.3 nm
Focusing Method
Tube Dimensions:
Overall length
Maximum diameter
Operating Position
Weight
MAXIMUM RATINGS, Absolute-Maximum Values for altitude up to 10,000 feet
For Both Types
Anode Voltage:
Average (DC)
Peak Instantaneous
Average Photocathode Current
(Continuous operation)
Peak Photocathode Current
Ambient-Temperature Range

800 ± 100 nm
Ag-O-Cs
26 mm (1.000 in)
Convex
1.48
P20, Aluminized
Yellow-Green
Medium to Medium Short
Flat
1.48
Electrostatic
2.925 in ± 0.050 in
1.880 in ± 0.025 in
Any
3 oz
16000 max. V
17000 max. V
0.35 max. µA
3.5 max. µA
-54 to +68 °C
### Characteristics at Ambient Temperature of 22°C

<table>
<thead>
<tr>
<th></th>
<th>Type 6914</th>
<th>Type 6914A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Anode Voltage (DC)</strong></td>
<td>16000</td>
<td>16000</td>
</tr>
<tr>
<td><strong>Typical Paraxial Magnification Factor</strong></td>
<td>0.76</td>
<td>0.76</td>
</tr>
<tr>
<td><strong>Minimum Conversion Index</strong></td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td><strong>Minimum Resolution</strong></td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td><strong>Maximum Quotient of Screen Background by Conversion Index</strong></td>
<td>$2.5 \times 10^{-7}$</td>
<td>$2.5 \times 10^{-7}$</td>
</tr>
<tr>
<td><strong>Maximum Luminous Equivalent of Infrared Radiation for Threshold Visibility</strong></td>
<td>–</td>
<td>$4.1 \times 10^{-11}$</td>
</tr>
</tbody>
</table>

#### Photocathode Sensitivity:

<table>
<thead>
<tr>
<th></th>
<th>Type 6914</th>
<th>Type 6914A</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Radiant</strong></td>
<td>2.3</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>Luminous</strong></td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

**b** Referred to photocathode.

**c** Averaged over any interval of 10 seconds maximum.

**d** The 6914 and the 6914A should not be subjected to this peak photocathode current value more than 10 times during the useful life of the tubes. No single time period during which this current is drawn should exceed 2 minutes.

**a** Defined as the ratio of the linear size of the image on the fluorescent screen to the linear size of the image on the photocathode. The image on the photocathode consists of two parallel lines 0.08" long, each located 0.10" from the tube axis. Size of the image on the fluorescent screen is determined by measuring the spacing between the two parallel lines.

**f** Ratio of luminous flux from fluorescent screen to the product of the luminous flux incident on Corning No.2540 infrared filter (Melt No.1613, 2.61 mm thick) or equivalent, and the filter factor of 10.8 per cent. The light source is a tungsten-filament lamp operated at a color temperature of 28540 K.

**g** The resolution, both horizontally and vertically in a 0.24-inch-diameter circle centered on the photocathode, is determined with a pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated as a "line-pair".

---

Indicates a change or addition
The value of this quotient for any individual tube multiplied by the square of the magnification factor of the tube gives that value of the incident illumination from 2854 °K source required to produce an increase in screen brightness equal to the screen background.

Radiation from a tungsten lamp operating at a color temperature of 2854 °K is passed through a Corning No.2540 infrared filter and focused to a point on the photocathode. The resulting image on the fluorescent screen is viewed by a dark-adapted eye through a 10-power ocular. The amount of infrared radiation for threshold visibility is determined by reducing the incident radiation until the image on the screen can just be discerned. The luminous equivalent of this amount of infrared radiation is the product of the unfiltered luminous flux from the 2854 °K source and the filter factor of the Corning No.2540 infrared filter.

For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854 °K. The value of light flux is $1 \times 10^{-2}$ lumen and 200 volts are applied between the photocathode and anode.

**SAFETY PRECAUTIONS**

**X-Radiation Warning**

This tube in operation produces X-rays which can constitute a health hazard unless the tube is adequately shielded. Make sure the shielding provides the required protection against personal injury.

**High Voltage**

The high voltage at which the tube 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.

**Operating Considerations**

Handling. The tubes should be handled by the metal terminals. Fingerprints on the glass should be avoided since they cause leakage current, corona, and higher screen background. To minimize the possibility of leakage current and corona, the external surface of the glass side wall is coated with a transparent, non-hygroscopic film. This film should
be cleaned only with a soft dry cloth.

Subjecting the tubes to intense incident-radiation levels may temporarily decrease the tube's sensitivity even though there is no voltage applied. The magnitude and duration of this decrease depend on the length of exposure. Permanent damage to the tube may result if it is exposed to radiant energy so great as to cause excessive heating of the photocathode.

Connections to the two terminals of the tube, indicated on the Dimensional Outline, should not be soldered to the terminals. They may be made by spring fingers engaging the rim or the straight side of each terminal.

Magnetic shielding of these image tubes is required to minimize the effects of extraneous fields on tube performance. It is to be noted that 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.

**TYPICAL CHARACTERISTIC**

<table>
<thead>
<tr>
<th>LIGHT OUTPUT - ARBITRARY UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ANODE KILOVOLTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>6</td>
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<tr>
<td>8</td>
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<td>10</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>14</td>
</tr>
<tr>
<td>16</td>
</tr>
</tbody>
</table>

LIGHT INPUT OF 0.1 LUMEN FROM 2854° K TUNGSTEN SOURCE INCIDENT ON CORNING NO. 2540 INFRARED FILTER. IRRADIATED PHOTOCATHODE AREA HAS DIAMETER OF 3/4 INCH.
DIMENSIONAL OUTLINE

**USEFUL PHOTOCATHODE 1.000 MIN. DIA.**

**PHOTOCATHODE TERMINAL**

**ANODE TERMINAL**

**NOTE 1**

**NOTE 2**

**NOTE 3**

**NOTE 4**

**NOTE 5**

Dimensions in Inches

**USEFUL SCREEN .860 MIN. DIA.**

**RCA**

Electronic Components

DATA 3

8-70
DIMENSIONAL OUTLINE NOTES

Note 1: Radius of curvature of faceplate is 2.38" ± 0.05". Faceplate thickness at center is 0.065" ± 0.004".

Note 2: Three insulated lead tips will not extend beyond maximum O.D. of tube. Leads are used only during tube manufacture.

Note 3: Depth is measured to tangent of the two radii.

Note 4: Diameter is measured to tangent of the two radii.

Note 5: The exhaust tip will not extend beyond max. dia. of tube.

TYPICAL MOUNTING ARRANGEMENT

TERMINAL CONNECTIONS

CL: Collector
G1: Grid No.1
   (Focusing Electrode)
G2: Grid No.2
   (Focusing & Accelerating Electrode)
K: Photocathode
Direction of incident radiation:
Perpendicular to photocathode end of tube
TYPICAL CHARACTERISTICS

PINCUSHION DISTORTION (PER CENT) = \( \left( \frac{M_x}{M_c} - 1 \right) \times 100 \)

WHERE:
- \( M_x \) = MAGNIFICATION AT DISTANCE "x" FROM CENTER OF PHOTO Cathode
- \( M_c \) = MAGNIFICATION AT CENTER OF PHOTO Cathode

\[ \text{RESOLUTION} = \text{LINE-PAIRS PER MM} \]

\[ \text{RADIAL DISTANCE ON PHOTO Cathode FROM CENTER TOWARD EDGE INCHES} \]

Electronic Components

DATA 4
8-70
The dashed portion shown in the above curve of the spectral response is not controlled.
Image Converter Tube

Monovoltage Type Having S-1 Spectral Response

GENERAL
Spectral Response ........................................... S-1
Wavelength of Maximum Response ...................... 800 ± 100 nm
Photocathode:
Material .................................................. Ag-O-Cs
Minimum useful diameter .............................. 19.05 mm (0.750 in)
Image surface:
Shape ..................................................... Convex
Window
   Index of refraction at 589.3 nm .................... 1.48
Fluorescent Screen:
Minimum useful diameter .............................. 14.48 mm (0.570 in)
Phosphor ................................................ P20, Aluminized
Fluorescence and phosphorescence ................. Yellow-Green
Persistence .............................................. Medium to Medium Short
Image surface:
Shape ..................................................... Flat
Window
   Index of refraction at 589.3 nm .................... 1.48
Focusing Method ........................................... Electrostatic
Tube Dimensions:
Overall length ........................................ 2.285 in ± 0.050 in
Maximum diameter ..................................... 1.350 in ± 0.025 in
Operating Position .................................... Any
Weight ...................................................... 1.5 oz

MAXIMUM RATINGS, Absolute-Maximum Values

Anode Voltage:\nb
Average (DC) ............................................ 12500 max. V
Peak Instantaneous ..................................... 13000 max. V
Average Photocathode Current
(Continuous operation)\nc .......................... 0.35 max. \(\mu A\)
Peak Photocathode Current\nd .............................................. 3.5 max. \(\mu A\)
Ambient Temperature .................................. 75 max. °C

RCA Electronic Components
Anode Voltage (DC) \(12000\) V

Typical Paraxial Magnification Factor \(0.75\)

Minimum Conversion Index \(15\)

Minimum Resolution \(50\) line-pairs/mm

Maximum Quotient \(3.3 \times 10^{-7}\) of Screen Background by Conversion Index

Sensitivity:

- Radiant \(2.3\) mA/W
- Luminous \(25\) µA/Im

\(b\) Referred to photocathode.

\(c\) Averaged over any interval of 10 seconds maximum.

\(d\) The 6929 should not be subjected to this peak photocathode current value more than 10 times during the useful life of the tube. No single time period during which this current is drawn should exceed 2 minutes.

\(e\) Defined as the ratio of the linear size of the image on the fluorescent screen to the linear size of the image on the photocathode. The image on the photocathode consists of two parallel lines 0.08" long, each located 0.08" from the tube axis. Size of the image on the fluorescent screen is determined by measuring the spacing between the two parallel lines.

\(f\) Ratio of luminous flux from fluorescent screen to the product of the luminous flux incident on Corning No.2540 infrared filter (Melt No.1613, 2.61 mm thick) or equivalent, and the filter factor of 10.8 per cent. The light source is a tungsten-filament lamp operated at a color temperature of 28540 K.

\(g\) The resolution, both horizontally and vertically in a 0.15-inch-diameter circle centered on the photocathode, is determined with a pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated as a "line-pair".

\(h\) The value of this quotient for any individual tube multiplied by the square of the magnification factor of the tube gives that value of the incident illumination from 28540 K source required to produce an increase in screen brightness equal to the screen background.

---

Indicates a change

RCA Electronic Components

DATA 1
For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light flux is 0.01 lumen and 200 volts are applied between anode and cathode.

SAFETY PRECAUTIONS

X-Radiation Warning
This tube in operation produces X-rays which can constitute a health hazard unless the tube is adequately shielded. Make sure the shielding provides the required protection against personal injury.

High Voltage
The high voltage at which the tube 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.

Operating Considerations

HANDLING The tubes should be handled by the metal terminals. Fingerprints on the glass should be avoided since they cause leakage current, corona, and higher screen background. To minimize the possibility of leakage current and corona, the external surface of the glass side wall is coated with a transparent, non-hygroscopic film. This film should be cleaned only with a soft dry cloth.

Subjecting the tube to intense incident-radiation levels may temporarily decrease the tube's sensitivity even though there is no voltage applied. The magnitude and duration of this decrease depend on the length of exposure. Permanent damage to the tube may result if it is exposed to radiant energy so great as to cause excessive heating of the photocathode.

Connections to the two terminals of the tube, indicated on the Dimensional Outline, should not be soldered to the terminals. They may be made by spring fingers engaging the
rim or the straight side of each terminal.

Magnetic shielding of this image tube is required to minimize the effects of extraneous fields on tube performance. It is to be noted that 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.

**TYPICAL CHARACTERISTICS**

![Graph showing light input and output vs. anode kilovolts]

**DIMENSIONAL OUTLINE DETAILS**

![Dimensional diagrams with measurements]

**RCA Electronic Components**
DIMENSIONAL OUTLINE

USEFUL PHOTOCATHODE .750 MIN. DIA.

NOTE 1: Radius of curvature of faceplate is 1.230" ± 0.005"; faceplate thickness at center is 0.060" ± 0.004".

NOTE 2: Three insulated lead tips will not extend beyond maximum O.D. of tube. Leads are used only during tube manufacture.

NOTE 3: Depth is measured to tangent of the two radii.

NOTE 4: Tip will not extend beyond maximum O.D. of tube.
TYPICAL MOUNTING ARRANGEMENT

TERMINAL CONNECTIONS

C_G: Collector
G1: Grid No.1
   (Focusing Electrode)
G2: Grid No.2
   (Focusing & Accelerating Electrode)
K: Photocathode

Direction of incident radiation:
Perpendicular to photocathode end of tube
PINCUSHION DISTORTION (PER CENT) = \(\frac{M_x - 1}{M_c} \times 100\) WHERE:

- \(M_x\): Magnification at distance "x" from center of photocathode
- \(M_c\): Magnification at center of photocathode

TYPICAL CHARACTERISTICS

![Graph showing typical characteristics of a photocathode with curves for magnification, resolution, and distortion vs. radial distance.]

RADIAL DISTANCE ON PHOTOCATHODE FROM CENTER TOWARD EDGE - INCHES

RCA Electronic Components

DATA 4

8-70
The dashed portion shown in the above curve of the spectral response is not controlled.
Gas Phototube

SIDE-ON TYPE HAVING UNOBSTRUCTED PHOTOCATHODE AREA AND S-1 RESPONSE

DATA

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

Cathode:
Shape: Semicylindrical
Minimum unobstructed projected length: 23/32"
Minimum unobstructed projected width: 9/16" Direct Interelectrode Capacitance (Approx.): 3 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: Cinch No. 8JM-1, or equivalent

Base: Intermediate-Shell Octal 5-Pin Arrangement 1, (JEDEC No. B5-10)

Basing Designation for BOTTOM VIEW: 3J

DIRECTION OF RADIATION

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 1</th>
<th>Rating 2</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>μa/sq. in.</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>°C</td>
</tr>
</tbody>
</table>

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

Sensitivity:
Radiant, at 8000 angstroms: 0.019 amp/watt

Indicates a change.
### Luminous:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 0 cps.</td>
<td>140</td>
<td>200</td>
<td>330</td>
</tr>
<tr>
<td>At 5000 cps.</td>
<td></td>
<td>165</td>
<td></td>
</tr>
<tr>
<td>At 10000 cps.</td>
<td></td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Gas Amplification Factor</td>
<td></td>
<td>-10</td>
<td></td>
</tr>
</tbody>
</table>

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

### Minimum Circuit Values:

**With an anode-supply voltage of**
- 70 or less volts
- 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.
UNOBRUCTIONED PHOTOCATHODE AREA

INTERMEDIATE-SHELL OCTAL 5-PIN BASE ARRANGEMENT I, JEDEC No. B5-10

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

For Live and Film Pickup With Color or Black-and-White TV Cameras

General:
Heater, for Unipotential Cathode:
Voltage (AC or DC) ...................................................... 6.3 ± 10% volts
Current at heater volts = 6.3 ........................................ 0.6 amp
Direct Interelectrode Capacitance: .................................. 4.6 pf
Target to all other electrodes ........................................ 4.6 pf
Spectral Response ......................................................... See Accompanying Curves
Photoconductive Layer:
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) ........................................ 0.62"

Focusing Method ......................................................... Magnetic
Deflection Method ......................................................... Magnetic
Overall Length .......................................................... 6.25" ± 0.25"
Greatest Diameter ....................................................... 1.125" ± 0.010"
Operating Position ....................................................... Any
Weight (Approx.) .......................................................... 2 oz
Bulb ................................................................. T8
Focusing Coil ......................................................... Cleveland Electronics c, d No.VF-115-5,
or equivalent
Deflecting Yoke ...................................................... Cleveland Electronics c, d No.VY-111-3,
or equivalent
Alignment Coil ...................................................... Cleveland Electronics c, d No.VA-118,
or equivalent
Socket .............................................................. Cinch® No.54A18088, or equivalent
Base ................................................................. Small-Button Ditettr B-Pin (JEDEC No.E8-11)
Basing Designation for BOTTOM VIEW ................................ 8HM

Pin 1-Heater
Pin 2-Grid No.1
Pin 3-Do Not Use
Pin 4-Do Not Use
Pin 5-Grid No.2
Pin 6-Grid No.3 & No.4
Pin 7-Cathode
Pin 8-Heater
Flange-Target
Short Pin-Do Not Use

Maximum Ratings, Absolute-Maximum Values:
For scanned area of 1/2" x 3/8"

Grid-No.3 & Grid-No.4 Voltage .................................... 750 max. volts
Grid-No.2 Voltage ..................................................... 750 max. volts
Grid-No.1 Voltage:
Negative-bias value ............................................... 300 max. volts
Positive-bias value .................................................. 0 max. volts

Direction of Light: Into Face End of Tube

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J. 2-65

DATA 1
Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 max. volts
- Heater positive with respect to cathode: 10 max. volts

Dark Current: 0.25 max. \( \mu \)A
Peak Target Current: 0.55 max. \( \mu \)A
Faceplate:
- Illumination: 1000 max. \( fc \)
- Temperature: 71 max. °C

**Typical Operation:**

For scanned area of 1/2" x 3/8" and faceplate temperature of 30°C to 35°C

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) &amp; Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>250 to 300 volts</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for picture cutoff</td>
<td>(-45 ) to (-100 ) volts</td>
</tr>
<tr>
<td>Average &quot;Gamma&quot; of Transfer Characteristic for signal-output current between 0.02 ( \mu )A and 0.2 ( \mu )A</td>
<td>0.65</td>
</tr>
<tr>
<td>Visual Equivalent Signal-to-Noise Ratio (Approx.)</td>
<td>300:1</td>
</tr>
<tr>
<td>Minimum Peak-to-Peak Blanking Voltage: When applied to grid No.1</td>
<td>75 volts</td>
</tr>
<tr>
<td>When applied to cathode</td>
<td>20 volts</td>
</tr>
<tr>
<td>Field Strength at Center of Focusing Coil (Approx.)</td>
<td>40 gauss</td>
</tr>
<tr>
<td>Field Strength of Adjustable Alignment Coil</td>
<td>0 to 4 gauss</td>
</tr>
</tbody>
</table>

**Maximum-Sensitivity Operation for Live-Scene Pickup**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faceplate Illumination (Highlight)</td>
<td>2 ( fc )</td>
</tr>
<tr>
<td>Maximum Target Voltage required to produce dark current of 0.2 ( \mu )A in any tube</td>
<td>110 volts</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>60 to 100 volts</td>
</tr>
<tr>
<td>Dark Current</td>
<td>0.2 ( \mu )A</td>
</tr>
<tr>
<td>Target Current (Highlight)</td>
<td>0.4 to 0.5 ( \mu )A</td>
</tr>
<tr>
<td>Signal-Output Current: Peak</td>
<td>0.2 to 0.3 ( \mu )A</td>
</tr>
<tr>
<td>Average</td>
<td>0.08 to 0.1 ( \mu )A</td>
</tr>
</tbody>
</table>

**Average-Sensitivity Operation for Live-Scene Pickup**

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faceplate Illumination (Highlight)</td>
<td>15 ( fc )</td>
</tr>
<tr>
<td>Maximum Target Voltage required to produce dark current of 0.02 ( \mu )A in any tube</td>
<td>60 volts</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>30 to 50 volts</td>
</tr>
<tr>
<td>Dark Current</td>
<td>0.02 ( \mu )A</td>
</tr>
<tr>
<td>Target Current (Highlight)</td>
<td>0.3 to 0.4 ( \mu )A</td>
</tr>
<tr>
<td>Signal-Output Current: Peak</td>
<td>0.3 to 0.4 ( \mu )A</td>
</tr>
<tr>
<td>Average</td>
<td>0.1 to 0.2 ( \mu )A</td>
</tr>
</tbody>
</table>

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1. Indicates a change.
Minimum-Log Operation for Film Pickup

Faceplate Illumination (Highlight) ... 100 fc

Maximum Target Voltage required to produce dark current of 0.004 µa in any tube ... 30 volts

Target Voltage ... 15 to 25 volts

Dark Current ... 0.004 µa

Target Current (Highlight) ... 0.3 to 0.4 µa

Signal-Output Current:

Peak ... 0.3 to 0.4 µa

Average ... 0.1 to 0.2 µa

This capacitance, which effectively is the output impedance of the 7038, 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.

Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin. The masking is for orientation only and does not define the proper scanned area of photoconductive layer.

These components are chosen to provide tube operation with minimum beam-landing error.

Beam focus is obtained by combined effect of grid-No.3 voltage which should be adjustable over indicated range, and a focusing coil having an average field strength of 40 gauss.

Definition, focus uniformity, and picture quality decrease with decreasing grid-No.4 and grid-No.3 voltage. In general, grid No.4 and grid No.3 should be operated above 250 volts.

With no blanking voltage on grid No.1.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 Mc. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of highlight video-signal current to rms noise current, multiplied by a factor of 3.

The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 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 target voltage for each 7038 must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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.

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

Defined as the component of the target current after the dark-current component has been subtracted.
Note: Straight sides of masked portions are parallel to the plate passing through tube axis and short pin.
Alignment of the beam is accomplished by a transverse magnetic field produced by external coils located at the base end of the focusing coil.

Deflection of the beam is accomplished by transverse magnetic fields produced by external deflecting coils.

**RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS**

*For Minimum Beam-Landing Error*

**DIMENSIONS IN INCHES**

The deflecting yoke and focusing coil used with the 7038 are designed to cause the scanning beam to land perpendicularly to the target at all points of the scanned area with minimum beam-landing error and resultant superior uniformity of sensitivity and focus over the scanned area.
SQUARE-WAVE RESPONSE - ARBITRARY UNITS

HORIZONTAL & EQUIVALENT SQUARE-WAVE RESPONSE CHARACTERISTICS

1MC = 60 TV LINES (APPROX.)
WAVE RESOLUTION WINDOW
TEST PATTERN: TRANSPARENT SQUARE
DARK CURRENT (MICROAMPERES) = 0.02
HIGHLIGHT TARGET MICROAMPERES = 0.35

4.5 kc BROADCAST BANDWIDTH
TYPICAL LIGHT-TRANSFER CHARACTERISTICS

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

TYPICAL PERSISTENCE CHARACTERISTIC

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.2,
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
TYPICAL PERSISTENCE CHARACTERISTICS

INITIAL HIGHLIGHT SIGNAL-OUTPUT MICROAMPERES = 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30° C APPROX.

TIME AFTER ILLUMINATION IS REMOVED — MILLISECONDS

SIGNAL-OUTPUT CURRENT — PERCENT OF INITIAL VALUE

DARK CURRENT — MICROAMPERES = 0.05

0 50 100 150 200 250 300

92CM-9505RI

RADIO CORPORATION OF AMERICA
Electronic Components and Devices  Harrison, N. J.
SPECTRAL-SENSITIVITY CHARACTERISTICS

CURVE A: 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
CURVE B: SPECTRAL CHARACTERISTIC OF AVERAGE HUMAN EYE.
CURVE C: FOR EQUAL VALUES OF SIGNAL-OUTPUT CURRENT WITH RADIANT FLUX FROM TUNGSTEN SOURCE AT 2870° K.

WAVELENGTH—ANGSTROMS
MICROAMPERES/MICROWATT OF RADIANT ENERGY (CURVE A)

RANGE OF MAX VALUE

 ULTRA VIOLET VIOLET BLUE GREEN YELLOW RED INFRA RED

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

92CM-7783R2
HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.2
DARK CURRENT (MICROAMPERES) = 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = \(\frac{1}{2}'' \times \frac{3}{8}''\)

CURVE A: RELATIVE TARGET VOLTAGE REQUIRED TO MAINTAIN DARK CURRENT OF 0.2 \(\mu\)A.

CURVE B: 2870 K INCANDESCENT ILLUMINATION REQUIRED TO PRODUCE SIGNAL - OUTPUT CURRENT OF 0.2 \(\mu\)A.

CURVE C: PERSISTENCE (LAG) CHARACTERISTIC FOR AN INITIAL SIGNAL-OUTPUT CURRENT OF 0.2 \(\mu\)A.
DARK-CURRENT RANGE

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30° C APPROX.
TYPICAL CHARACTERISTIC

ILLUMINATION: 2870° K INCANDESCENT.
HIGHLIGHT SIGNAL-OUTPUT MICRO-AMPÈRES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2 x 3/8
FACEPLATE TEMPERATURE = 30° C APPROX.
Photomultiplier Tube

10-Stage, Head-On Type Having S-1 Spectral Response

For the detection and measurement of low-level radiation extending from the visible to near-infrared region of the spectrum.

**GENERAL**
Spectral Response ............................................. S-1
Wavelength of Maximum Response .............. $8000 \pm 1000$ Å
Cathode, Semitransparent ....................... Silver-Oxygen-Cesium
Minimum area .............................................. $1.2 \text{ in}^2$ (7.7 cm$^2$)
Minimum diameter ...................................... $1.24 \text{ in}$ (3.1 cm)
Window ......................................................... Lime Glass (Corning® No.0080) or equivalent
Shape .......................................................... Plano-Plano
Index of refraction at 5893 angstroms ........... 1.512

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 pF
Anode to all other electrodes ...................... 7 pF
Maximum Overall Length ......................... 4.57 in (11.6 cm)
Seated Length .............................................. $3.88 \pm 0.19$ in (9.8 ± 0.48 cm)
Maximum Diameter ..................................... 1.56 in
Bulb .......................................................... T12
Base .......................................................... Small-Shell Duodecal 12-Pin (JEDEC B12-43), Non-hygroscopic
Socket ......................................................... Eby No.9058, or equivalent
Magnetic Shield ......................................... Millen® No.80802C, or equivalent
Operating Position ..................................... Any
Weight (Approx.) ........................................... 2.2 oz (60 g)

**MAXIMUM RATINGS, Absolute-Maximum Values**

DC Supply Voltage:
- Between anode and cathode ...................... 1500 max. V
- Between anode and dynode No.10 .................... 250 max. V
- Between consecutive dynodes ...................... 200 max. V
- Between dynode No.1 and cathode ................. 400 max. V
- Average Anode Current............................. 10 max. µA
- Ambient Temperature......................... 75 max. °C
CHARACTERISTICS RANGE VALUES

Under conditions with 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.

With E = 1250 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 (8000 angstroms)</td>
<td>6.6x10²</td>
<td>—</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2870°K)</td>
<td>1</td>
<td>7</td>
<td>30 A/Im</td>
</tr>
<tr>
<td><strong>Cathode Sensitivity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant (8000 angstroms)</td>
<td>2.8x10⁻³</td>
<td>—</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2870°K)</td>
<td>1x10⁻⁵</td>
<td>3x10⁻⁵</td>
<td>A/Im</td>
</tr>
<tr>
<td>Current with infrared light source (2870°K + C.S. No.7-56)</td>
<td>1.2x10⁻³</td>
<td>4x10⁻⁵</td>
<td>A</td>
</tr>
<tr>
<td>Quantum Efficiency at 7800 angstroms</td>
<td>—</td>
<td>0.43</td>
<td>%</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>2.3x10⁵</td>
<td>—</td>
<td>%</td>
</tr>
<tr>
<td>Anode Dark Current</td>
<td>1.9x10⁻⁶</td>
<td>6x10⁻⁶</td>
<td>A</td>
</tr>
<tr>
<td>Equivalent Anode Dark Current Input</td>
<td>4.8x10⁻⁷</td>
<td>1.5x10⁻⁷</td>
<td>A/Im</td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td>5.1x10⁻⁹</td>
<td>1.6x10⁻⁸</td>
<td>W</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time at 1500 V</td>
<td>2.2x10⁻⁹</td>
<td>—</td>
<td>s</td>
</tr>
<tr>
<td>Electron Transit Time at 1500 V</td>
<td>2.8x10⁻⁸</td>
<td>—</td>
<td>s</td>
</tr>
</tbody>
</table>

- Made by Corning Glass Works, Corning, NY 14830.
- Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia, PA 19144.
- Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.
- Averaged over any interval of 30 seconds maximum. When stability of operation is important, the use of an average anode current well below the maximum rated value of 10 microamperes is recommended. This maximum rating should never be exceeded because operation at higher average output currents may cause a permanent decrease in infrared sensitivity and a consequent decrease in the tube life.
- Tube operation at room temperature or below is recommended.

Indicates a change or addition.
This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 94 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 micro-lumens is used.

This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 94 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 250 volts are applied between cathode and all other electrodes connected as anode.

Under the following conditions: Light incident on the cathode is transmitted through an infrared filter (C.S. No.7-56, manufactured by 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 250 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 4 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

At 8000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 94 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 8000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 94 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.

TERMINAL CONNECTIONS

The base pins of the 7102 fit a duodecal 12-contact socket, such as Eby No.9058, or equivalent. The basing arrangement is such that the voltage between anode pin and adjacent pins is not more than twice the voltage per stage. As a result, external leakage between anode pin and adjacent pins is kept low.

ANODE CURRENT

The operating stability of the 7102 is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 10 microamperes is recommended when stability of operation is important. This maximum rating should never be exceeded because operation at higher average output currents may cause a permanent decrease in infrared sensitivity and a consequent decrease in the tube life.

SHIELDING

Electrostatic and/or magnetic shielding of the 7102 may be necessary.

SCHEMATIC ARRANGEMENT OF STRUCTURE
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

ANODE RETURN

R₁₁ DYNODE No.10
R₁₀ DYNODE No.9
R₉ DYNODE No.8
R₈ DYNODE No.7
R₇ DYNODE No.6
R₆ DYNODE No.5
R₅ DYNODE No.4
R₄ DYNODE No.3
R₃ DYNODE No.2
R₂ DYNODE No.1
R₁ PHOTOCATHODE

LOAD CONNECTION

+ TO REGULATED DC POWER SUPPLY (SEE NOTE 1)

−

C₁: 0.02 µF, 20%, 500 volts (dc working), ceramic disc
C₂: 0.01 µF, 20%, 500 volts (dc working), ceramic disc
R₁: 910,000 ohms, 2 watts
R₂ through R₁₁: 470,000 ohms, 1 watt

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

Note 2: Capacitors C₁ and C₂ should be connected at tube socket for optimum high-frequency performance.

Note 3: Component values are dependent upon nature of application and output signal desired.
TERMINAL DIAGRAM (Bottom View)

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

DIRECTION OF RADIATION:
INTO END OF BULB
12AE

DIMENSIONAL OUTLINE

Note: Deviation from flatness will not exceed 0.010" from peak to valley.

C of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.57 max.</td>
<td>116.1 max.</td>
</tr>
<tr>
<td>B</td>
<td>3.88 ± 0.19</td>
<td>98.5 ± 4.8</td>
</tr>
<tr>
<td>C</td>
<td>1.24 min. dia.</td>
<td>31.4 min. dia.</td>
</tr>
<tr>
<td>D</td>
<td>1.56 max. dia.</td>
<td>39.6 max. dia.</td>
</tr>
</tbody>
</table>
TYPICAL TIME RESOLUTION CHARACTERISTICS

DYNODE No. 1-TO-CATHODE VOLTS $= \frac{1}{6} E$
EACH SUCCEEDING DYNODE-STAGE VOLTS $= \frac{1}{12} E$
ANODE-TO-DYNODE No. 10 VOLTS $= \frac{1}{12} E$
PHOTOCATHODE IS FULLY ILLUMINATED.

SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870°K LIGHT SOURCE AFTER PASSING THROUGH INFRARED FILTER (CORNING C.S. NO. 7-56)
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

MAGNETIC FIELD IS PARALLEL TO DYNOE—CAGE AXIS. POSITIVE VALUES ARE FOR LINES OF FORCE FROM LEFT TO RIGHT WITH BASE DOWN AND BASE KEY TOWARD OBSERVER. VOLTS PER STAGE = 100
TYPICAL ANODE CHARACTERISTICS

VOLTS BETWEEN ANODE & CATHODE NO. 10

10 - 150

ANODE MICROAMPERES

250 200 150 100 50

TYPICAL ANODE CHARACTERISTICS

DYNODE NO. 1 TO - CATHODE VOLTS = 208 ELECTRON CONDIT = 250 COLLECT CART.
LIGHT SOURCE - 1000 LUMINOUS ACHROMATIC LAMP
OPERATED AT COLOR TEMPERATURE OF 2870°K

LIGHT FLUX - MICROLUMENS = 10
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

DYNODE No.1-TO-CATHODE VOLTS = 1/6E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E

SENSITIVITY - AMPERES/LUMEN (COLOR TEMPERATURE 2870° K)

CURRENT AMPLIFICATION

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE
The dashed portion shown in the above curve of the spectral response is not controlled.
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
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22°C.
Photomultiplier Tube

9-STAGE, SIDE-ON TYPE HAVING S-4 RESPONSE
For DC-Operated Control Applications Such as Automobile-Headlight Control

GENERAL

Spectral Response... S-4
Wavelength of Maximum Response... 4000 ± 500 angstroms

Cathode, Opaque... Cs-Sb
Minimum projected length...
Minimum projected width...
Window... Lime Glass, (Corning® No.0080), or equivalent

Dynode Material... Cs-Sb

Direct Interelectrode Capacitances (Approx.)
Anode to dynode No.9... 4.2 pF
Anode to all other electrodes... 5.5 pF

Maximum Overall Length... 3.12 in
Maximum Seated Length... 2.69 in
Length... 1.56 ± 0.09 in
From base seat to center of useful cathode area

Maximum Diameter... 1.31 in
Operating Position... Any
Weight (Approx.)... 1.6 oz

Envelope... JEDEC T9
Base... Small-Shell Neosubmagnal 11-Pin (JEDEC No.B11-104), Non-hygroscopic

Socket... Amphenol® No.78S11T, or equivalent
Magnetic Shield... Millen® No.8080IB, or equivalent

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage
Between anode and cathode... 1250 V
Between dynode No.9 and anode... 250 V
Between consecutive dynodes... 250 V
Between dynode No.1 and cathode... 250 V

Average Anode Current... 0.1 mA
Ambient Temperature... 75 °C

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.
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 $E = 1000$ V (except as noted)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>3.4x10^4 A/W</td>
<td>34 A/lm</td>
<td></td>
</tr>
<tr>
<td>Electrode Dark Current</td>
<td>(1 \times 10^{-7}) A</td>
<td>(7.5 \times 10^{-7}) A</td>
<td></td>
</tr>
</tbody>
</table>

With $E = \text{Adjustable dc voltage}$

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode-to-Cathode Voltage</td>
<td>630</td>
<td>900</td>
<td>1100 V</td>
</tr>
</tbody>
</table>

DC values

$\text{a}$ On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

$\text{b}$ Made by Corning Glass Works, Corning, New York.

$\text{c}$ Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 54, Illinois.

$\text{d}$ Made by James Millen Manufacturing Company, 150 Exchange Street, Welden 48, Massachusetts.

$\text{e}$ Averaged over any interval of 30 seconds maximum.

$\text{f}$ 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 2870K and a light input of 10 microlumens is used.

$\text{g}$ Under the following conditions: Light incident on the cathode is transmitted through a filter (Corning C.S. No.3-67, Glass Code No.3482—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870K. The value of light flux incident on the filter is 10 microlumens. Supply voltage (E) is adjusted to give an anode current of 50 microamperes.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-4 Response is shown at the front of this Section

DIMENSIONAL OUTLINE and AVERAGE-ANODE-CHARACTERISTICS and VARIATION-IN-SENSITIVITY-OF-PHOTOCATHODE Curves shown under Type 6328 also apply to the 7117

--- Indicates a change.
RECOMMENDED VOLTAGE-DIVIDER NETWORK FOR USE WITH TYPE 7117 IN HEADLIGHT-CONTROL SERVICE

R1 R2 R3 R4 R5
R6 R7 R8 R9 R10: 1 megohm, 1/2 watt
R11: 2 megohms, 1/2 watt
R12: 5.1 megohms, 1/2 watt
R13 R14 R15 R16
R17 R18 R19 R20: 8.2 megohms, 1/2 watt
R21: 820,000 ohms, 1/2 watt

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Sensitivity Characteristics

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

SENSITIVITY - AMPERES/LUMEN COLOR TEMPERATURE 2/170° K

ANODE-TO-CATHODE SUPPLY VOLTS (E)

DATA 2
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
MULTIPLIER PHOTOTUBE
9-STAGE TYPE HAVING S-19 RESPONSE
For detection and measurement of ultraviolet radiation

General:
Spectral Response. S-19
Wavelength of Maximum Response. 3300 ± 500 angstroms
Cathode:
Minimum projected length. 0.94"
Minimum projected width. 0.31"
Direct Interelectrode Capacitances (Approx.):
Anode to dynode No. 9. 4.4 μf
Anode to all other electrodes. 6 μf
Maximum Overall Length. 5.69"
Maximum Seated Length. 5.12"
Length from Base Seat to Center of Usefull Cathode Area. 3.94" ± 0.09"
Maximum Diameter. 1.31"
Weight (Approx.). 1.8 oz
Operating Position. Any
Bulb. Fused-Silica Section with Graded Seal Socket. Amphenol Part No. 78RS-11T, or equivalent
Base. Small-Shell Submagnal 11-Pin (JETEC No. B11-88), Non-hygroscopic

Basing Designation for BOTTOM VIEW. 11K

Maximum Ratings, Absolute Values:
SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC or Peak AC). 1250 max. volts
SUPPLY VOLTAGE BETWEEN ANODE AND DYNOE No. 9 (DC or Peak AC). 250 max. volts
AVERAGE ANODE CURRENT. 0.5 max. ma
AMBIENT-TEMPERATURE RANGE. -80 to +75°C

*: See next page.
Characteristics:

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 dc (except as noted)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
</table>

**Sensitivity:**
- Radiant, at 3300 angstroms.
- Cathode radiant, at 3300 angstroms.
- Luminous:
  - At 0 cps.
  - Cathode luminous

**Current Amplification**
- Equivalent Anode—Dark—Current Input
- Equivalent Noise

**Input:**
- Luminous:
- Ultraviolet:

**Output:**
- On plane perpendicular to the 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 light input of 10 micro-lumens is used. The load resistor has a value of 0.01 megohm.
- For conditions the same as shown under (†) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.
- Supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission and ion feed-back may be reduced by the use of a refrigerant.
- For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.
- Under the following conditions: Supply voltage (E) is 1000 volts, external shield operated at −1000 volts with respect to anode, 25°C tube temperature, ac-amplifier bandwidth of 1 cycle per second, tungsten light source at 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.
- Determined under the same conditions as shown under (†). except that use is made of monochromatic source having radiation of 2537 angstroms.

---

**Radiation Cosbaration of America 7-58**

7000 ELECTRON TUBE DIVISION TENTATIVE DATA 1

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
7200
MULTIPLIER PHOTOTUBE

OPERATING CONSIDERATIONS

The use of an average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important.

Electrostatic and/or magnetic shielding of the 7200 may be necessary.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-19 Response is shown at the front of this Section

PHOTOCATHODE

1.25" MAX. DIA.

5.12" MAX.

3.94" MAX.

5.69" MAX.

SMALL-SHELL SUBMAGNAL 11-PIN BASE JETEC NR BII-88

DIRECTION OF LIGHT

PIN #1

PHOTOCATHODE (SEE DETAIL A)

92CS-9881

7-58
ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

TENTATIVE DATA 2
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.

AVERAGE ANODE CHARACTERISTICS

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

Supply Voltage (E) across voltage divider providing \( \frac{1}{10} \) of E between cathode and dynode No 1; \( \frac{1}{10} \) of E for each succeeding dynode stage; and \( \frac{1}{10} \) of E between dynode No 9 and anode.
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE \( E \) ACROSS VOLTAGE DIVIDER WHICH PROVIDES \( \frac{1}{10} \) OF \( E \) 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

LUMINOUS SENSITIVITY—AMPERES/LUMEN

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

Short, Sturdy, 1-Inch Diameter Type

Magnetic Focus

Magnetic Deflection

Low Heater Power – 0.6 watt

1000 TV Line Resolution

For Compact, Low-Power Transistorized TV Cameras

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC) ................ 6.3 ± 10% V

Current at 6.3 volts ................ 0.095 A

Direct Interelectrode Capacitance:

Target to all other electrodes ....... 4.6 pF

Spectral Response: See Typical Spectral Sensitivity Characteristic

Photoconductive Layer:

Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) ............... 0.62 inch

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method .................... Magnetic

Deflection Method .................. Magnetic

Overall Length ..................... 5.12" ± 0.06"

Greatest Diameter .................. 1.125" ± 0.010"

Bulb ................................ T8

Base ................................ Small-Button Ditettrar 8-Pin, (JEDEC No.E8-11)

Socket .......................... Cinch® No.54A18088, or equivalent

Focusing Coil-Deflecting Yoke-Alignment Coil Assembly ........ Cleveland Electronics® No. VYFA-355-1, or equivalent

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

Weight (Approx.) ................... 2 oz.

ABSOLUTE MAXIMUM RATINGS

For scanned area of 1/2" x 3/8"

Grid-No.3 & Grid-No. 4 Voltage .... 1000 max. volts

Grid-No. 2 Voltage .................. 1000 max. volts

Grid-No. 1 Voltage:

Negative bias value ................. 300 max. volts

Positive bias value .................. 0 max. volts
### Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 max. volts
- Heater positive with respect to cathode: 10 max. volts
- Target Voltage: 100 max. volts
- Dark Current: 0.25 max. µA
- Peak Target Current: 0.55 max. µA

### Faceplate:
- Illumination: 5000 max. ft
- Temperature: 71 max. °C

### TYPICAL OPERATION AND PERFORMANCE DATA

<table>
<thead>
<tr>
<th>Low-Voltage Operation</th>
<th>High-Voltage Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>For scanned area of 1/2&quot; x 3/8&quot; Faceplate temperature of 30°C to 35°C</td>
<td></td>
</tr>
<tr>
<td>Grid-No.4 (Decelerator) &amp; Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>250 to 300</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-45 to -100</td>
</tr>
<tr>
<td>Average &quot;Gamma&quot; of Transfer Characteristic for Signal-Output Current between 0.02µA and 0.2µA</td>
<td>0.65</td>
</tr>
<tr>
<td>Visual Equivalent Signal-to-Noise Ratio (Approx.)</td>
<td>300:1</td>
</tr>
<tr>
<td>Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed:</td>
<td></td>
</tr>
<tr>
<td>Maximum value</td>
<td>28</td>
</tr>
<tr>
<td>Typical value</td>
<td>22</td>
</tr>
</tbody>
</table>

### Minimum Peak-to-Peak Blanking Voltage:
- When applied to grid No.1: 75 | 75 volts
- When applied to cathode: 20 | 20 volts

### Limiting Resolution:
- At center of picture—Typical value: 750 | 900 TV lines

### Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture:
- 30 | 45 %
Field Strength at Center of Focusing Coil

<table>
<thead>
<tr>
<th></th>
<th>40</th>
<th>60</th>
</tr>
</thead>
<tbody>
<tr>
<td>gauss</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Peak Deflecting-Coil Current:

<table>
<thead>
<tr>
<th>Direction</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>340</td>
</tr>
<tr>
<td>Vertical</td>
<td>20</td>
</tr>
<tr>
<td>mA</td>
<td>520</td>
</tr>
<tr>
<td>mA</td>
<td>32</td>
</tr>
</tbody>
</table>

Field Strength of Adjustable Alignment Coil

<table>
<thead>
<tr>
<th></th>
<th>0 to 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>gauss</td>
<td></td>
</tr>
</tbody>
</table>

High-Sensitivity Operation—0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight)

<table>
<thead>
<tr>
<th>Value</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

Target Voltage

<table>
<thead>
<tr>
<th>Value</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>to 60</td>
</tr>
</tbody>
</table>

Dark Current

<table>
<thead>
<tr>
<th>Value</th>
<th>µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td></td>
</tr>
</tbody>
</table>

Signal-Output Current:

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
<td>0.11</td>
<td></td>
</tr>
</tbody>
</table>

Average-Sensitivity Operation—1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight)

<table>
<thead>
<tr>
<th>Value</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td></td>
</tr>
</tbody>
</table>

Target Voltage

<table>
<thead>
<tr>
<th>Value</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>to 40</td>
</tr>
</tbody>
</table>

Dark Current

<table>
<thead>
<tr>
<th>Value</th>
<th>µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.02</td>
<td></td>
</tr>
</tbody>
</table>

Signal-Output Current:

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

High Light Level Operation—10 Footcandles on Faceplate

Faceplate Illumination (Highlight)

<table>
<thead>
<tr>
<th>Value</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

Target Voltage

<table>
<thead>
<tr>
<th>Value</th>
<th>volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>to 22</td>
</tr>
</tbody>
</table>

Dark Current

<table>
<thead>
<tr>
<th>Value</th>
<th>µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.005</td>
<td></td>
</tr>
</tbody>
</table>

Signal-Output Current:

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>µA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>

This capacitance, which effectively is the output impedance, 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, 1026 S. Homan Ave., Chicago 24, Illinois.

Made by Cleveland Electronics, Inc., 2000 Highland Road, Twinsburg, Ohio. Components are also available from companies such as Syntronic Instruments, Inc., 100 Industrial Road, Addison, Illinois and Celco-Constantine Engineering Laboratories Co., 70 Constantine Drive, Mahwah, New Jersey.

These components are chosen to provide tube operation with minimum beam-landing error.
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.

Definition, focus uniformity, and picture quality decrease with decreasing grid-No. 4 and grid-No. 3 voltage. In general, grid No. 4 and grid No. 3 should be operated above 250 volts.

With no blanking voltage on grid No. 1.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.3 microampere and a dark current of 0.025 microampere.

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 target voltage for each 7262A must be adjusted to that value which gives the desired operating signal current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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.

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

OPERATING CONSIDERATIONS

When operated at maximum voltage, the 7262A has a typical center resolution of 1000 TV lines and a typical corner resolution of 600 TV lines. At low operating voltage with minimum deflection and focus power employed, its center resolution will ordinarily be in excess of 650 TV lines and 350 TV lines in the corner.
BASING DIAGRAM (Bottom View)

FLANGE TARGET

IC

4

5

G2

IC

4

3

G3

G4

G1

2

1

H

SHORT PIN
IC

K

H

DIRECTION OF LIGHT:
INTO FACE END OF TUBE

8HM

Pin 1: Heater
Pin 2: Grid No. 1
Pin 3: Internal Connection — Do Not Use
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No. 2
Pin 6: Grids No. 3 and No. 4
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection — Make No Connection

Spurious Signal Test

ZONE 1

ZONE 2

Fig. 1
This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in Fig. 1. The 7262A is operated under the conditions specified under Typical Operation and Performance Data with the lens adjusted to provide a target current of 0.3 microampere. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.

### Table 1

For scanned area of 1/2" x 3/8"

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 but not including 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3 but not including 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1 or less</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.
Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No. 7056 having a thickness of 0.094" ± 0.012".
Recommended Location and Length of Deflecting, Focusing, and Alignment Components to obtain Minimum Beam-Landing Error.

**RANGE OF DARK CURRENT**

- Scanned Area of Photoconductive Layer: 1/2" x 3/8"
- Faceplate Temperature: 30°C Approx.

![Graph showing the range of dark current](image)

- Vertical Axis: Dark Current (Microamperes)
- Horizontal Axis: Target Volts

NOTE: CROSS-HATCHING INDICATES WOUND PORTION OF FOCUSING COIL.
LIGHT TRANSFER CHARACTERISTICS

ILLUMINATION UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

DARK CURRENT (MICROAMPERES) - 0.10

SIGNAL OUTPUT - MICROAMPERES

2870°K TUNGSTEN ILLUMINATION ON TUBE FACE - FOOTCANDLES

DATA 5
1-68
TYPICAL PERSISTENCE CHARACTERISTIC

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30° C APPROX.

RCA Electronic Components

DATA 5
UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE

HIGHLIGHT TARGET MICROAMPERES = 0.35
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SQUARE-WAVE RESOLUTION WEDGE.
TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC

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

0.110
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000

MICROAMPERES/MICROWATT OF RADIANT ENERGY

WAVELENGTH—ANGSTROMS

ULTRA VIOLET
BLUE
GREEN
YELLOW
RED
INFRA RED

3000 4000 5000 6000 7000 8000

92CM-11619

E l e c t r o n i c C o m p o n e n t s
Short, Ruggedized, 1-Inch Diameter Type

Magnetic Focus
Low-Power 0.6 W Heater

Magnetic Deflection
1000 TV Line Resolution

For Compact, Low-Power Transistorized TV Cameras Where Severe Shock and Vibration Conditions Exist

The 7263A is the same as the 7262A except for the following:

SPECIAL PERFORMANCE DATA

In connection with the following tests, sample 7263A's will maintain resolution as determined with a RETMA Resolution Chart, or equivalent, and will faithfully reproduce all resolution wedges and grey scales of the chart.

Vibration Tests These tests are performed under conditions for Average-Sensitivity Operation on a sample lot of tubes from each production run. Tubes and their associated components§ are vibrated on apparatus providing dynamic conditions similar to those described in MIL-E-5272B*, par. 4.7.1. Resonance. Tubes and associated components§ are vibrated (per the method of MIL-E-5272B*, par. 4.7.1.1) for 1 hour at +25°C, for 15 minutes at 0°C, and for 15 minutes at +55°C.

Cycling. Tubes and associated components§ are vibrated (per the method of MIL-E-5272B*, par. 4.7.1.2 pertaining to specimen without vibration isolators) for 1 hour at +25°C, for 15 minutes at 0°C, and for 15 minutes at +55°C.

Temperature-Pressure (Altitude) Tests. Tubes and associated components§ are subjected (per the method of MIL-E-5400* par. 3.2.20, 3.2.20.1, and 3.2.20.1.1) to the separate and combined effects of varying temperature 0°C to +55°C and varying barometric pressure 30" to 3.4" of mercury. The pressures correspond to sea level and to an altitude of 50,000 feet, respectively.
Shock Tests. These tests are performed with no voltages applied on a sample lot of tubes from each production run. Tubes are subjected in these tests (per MIL-E-5400*, par.3.2.21.2.1) to 18 impact shocks of 15g consisting of 3 shocks in opposite directions along each of three mutually perpendicular axes of the tube. Each shock impulse has a duration of $11 \pm 1$ milliseconds with a maximum impact acceleration occurring at approximately 5.5 milliseconds. Tube mounting accessories assure the rigid fastening of the tube to the shock test apparatus.

Temperature-Humidity Tests. These tests are performed with no voltages applied to the 7263A. The 7263A is subjected (per the method of MIL-E-5400*, par. 3.2.20.2B) to relative humidities up to and including 95 per cent at temperatures up to and including $+50^\circ C$.

§ Tube socket such as Cinch No.54A18088 and RCA Assembly No.200SDU501, or equivalent, which consists of the deflecting coils, focusing coil, alignment coil, shield, and target connector.

* 5 June 1957, Procedure 1 of Military Specification.

Typical Component Assembly for Tube Operation Under Severe Environmental Conditions

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RCA Electronic Components DATA
MULTIPLIER PHOTOTUBE
14-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE WITH 1.68"-DIA., SPHERICAL, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE. VERY SHORT TIME-RESOLUTION CAPABILITY.

**DATA**

**General:**
- Spectral Response: S-11
- Wavelength of Maximum Response: 4400 ± 500 angstroms

**Cathode, Semitransparent:**
- Shape: Spherical
- Window:
  - Area: 2.2 sq. in.
  - Minimum diameter: 1.68 in.
  - Index of refraction: 1.51
- Direct Interelectrode Capacitances (Approx.):
  - Anode to dynode No.14: 2.4 μμf
  - Anode to all other electrodes: 5.5 μμf
  - Dynode No.14 to all other electrodes: 7.5 μμf
- Maximum Overall Length: 7.5" ± 0.19"
- Seated Length: 6.69" ± 0.19"
- Maximum Diameter: 2.38"
- Operating Position: Any
- Weight (Approx.): 8 oz
- Bulb: T16
- Socket: Alden No.220FT with 20 contacts, or equivalent
- Base: Small-Shell Bidecal 20-Pin (JETEC No.B20-102)

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

**Pin Connections:**
- Pin 1 - No Connection
- Pin 2 - Dynode No.1
- Pin 3 - Dynode No.3
- Pin 4 - Dynode No.5
- Pin 5 - Dynode No.7
- Pin 6 - Dynode No.9
- Pin 7 - Dynode No.11
- Pin 8 - Dynode No.13
- Pin 9 - Grid No.2 (Accelerating Electrode)
- Pin 10 - Anode
- Pin 11 - Dynode No.14
- Pin 12 - Dynode No.12
- Pin 13 - Dynode No.10
- Pin 14 - Dynode No.8
- Pin 15 - Dynode No.6
- Pin 16 - Dynode No.4
- Pin 17 - Dynode No.2
- Pin 18 - No Connection
- Pin 19 - Grid No.1 (Focusing Electrode)
- Pin 20 - Photocathode
- Pin 21 - Photocathode Metal Collar - No Connection (If used, connect only to photocathode)

**ELECTRON TUBE DIVISION**
**TENTATIVE DATA 1**
MULTIPLIER PHOTOTUBE

VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

With supply voltage \( E \) across voltage divider providing electrode voltages shown in Table I—Column A

Maximum Ratings, Absolute Values:

- Supply voltage between anode and cathode (DC) \( 2400 \) max. volts
- Supply voltage between dynode No. 14 and anode (DC) \( 400 \) max. volts
- Supply voltage between consecutive dynodes (DC) \( 500 \) max. volts
- Supply voltage between accelerating electrode and dynode No. 13 (DC) \( \pm 500 \) max. volts
- Dynode No. 1 supply voltage (DC) \( 400 \) max. volts
- Focusing-electrode supply voltage (DC) \( 400 \) max. volts
- Average anode current \( 2 \) max. ma
- Ambient temperature \( 75 \) max. °C

Characteristics Range Values for Equipment Design:

With \( E = 2000 \) volts (except as noted) and focusing-electrode as well as accelerating-electrode voltage adjusted to give maximum gain

<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 4400 angstroms</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>0.056</td>
<td></td>
</tr>
<tr>
<td>Luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 0 cps.</td>
<td>120</td>
<td>875</td>
</tr>
<tr>
<td>With dynode No. 14 as output electrode</td>
<td>612</td>
<td></td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>With blue light source</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td>12.5 ( \times ) 10^6</td>
<td></td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input</td>
<td>5 ( \times ) 10^{-10}</td>
<td>2 ( \times ) 10^{-9}</td>
</tr>
<tr>
<td>Equivalent Noise Input:*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At +250 °C</td>
<td>3.3 ( \times ) 10^{-12}</td>
<td>1.5 ( \times ) 10^{-11}</td>
</tr>
<tr>
<td>At -50 °C</td>
<td>9 ( \times ) 10^{-13}</td>
<td></td>
</tr>
<tr>
<td>Anode-Pulse Rise Time</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

* See next page.
MULTIPLIER PHOTOTUBE

Greatest Delay Between Anode Pulses:
Due to position from which electrons are simultaneously released within a circle centered on tube face and having a diameter of:

- 1.12" : 0.5\textsuperscript{\dagger} \text{ millisecond}
- 1.5": 1\textsuperscript{\dagger} \text{ millisecond}

HIGH-OUTPUT-PULSE SERVICE

With supply voltage (E) across voltage divider providing electrode voltages shown in Table I—Column B

Maximum Ratings, Absolute Values:

- SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC) : 2800 \text{ max. volts}
- SUPPLY VOLTAGE BETWEEN DYNODE No. 14 AND ANODE (DC) : 400 \text{ max. volts}
- SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC) : 500 \text{ max. volts}
- SUPPLY VOLTAGE BETWEEN ACCELERATING ELECTRODE AND DYNODE No. 13 (DC) : ±500 \text{ max. volts}
- DYNODE-No.1 SUPPLY VOLTAGE (DC) : 400 \text{ max. volts}
- FOCUSING-ELECTRODE SUPPLY VOLTAGE (DC) : 400 \text{ max. volts}
- AVERAGE ANODE CURRENT : 2 \text{ max. ma}
- AMBIENT TEMPERATURE : 75 \text{ max. °C}

Characteristics Range Values for Equipment Design:

With \( E = 2400 \text{ volts} \) (except as noted) and focusing-electrode as well as accelerating-electrode voltage adjusted to give maximum gain

Sensitivity:
Radiant, at 4400 angstroms : 0.7 \text{ amp/\mu W}
Cathode radiant, at 4400 angstroms : 0.056 \text{ \mu A/\mu W}
Luminous:
At 0 cps : 875 \text{ amp/lumen}
With dynode No. 14 as output electrode : 612 \text{ amp/lumen}
Cathode luminous:
With tungsten light source : 50 \text{ \mu W/lumen}
With blue light source : 0.05 \text{ \mu W/lumen}

\text{\dagger}: \text{See next page.}

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

Current Amplification... - 12.5 x 10^6 -
Equivalent Anode-Dark-
Current Input* - 1.1 x 10^-9 - lumen
Equivalent Noise Input:
At +250 C. ............. - 4.6 x 10^-12 - lumen
At -500 C. ............. - 1.2 x 10^-12 - lumen

Averaged over any interval of 30 seconds maximum.
* Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 0.1 microlumen is used. The load resistor has a value of 0.01 megohm.

An output current of opposite polarity to that obtained at the anode may be provided by using dynode No.1 as the output electrode. With this arrangement, the load is connected in the dynode-No.1 circuit and the anode serves only as a collector.

For spectral characteristic of this source, see sheet 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.

Measured at a tube temperature of 25° C and with the supply voltage (E) adjusted to give a luminous sensitivity of 2000 amperes per lumen. Dark current caused by thermionic emission may be reduced by the use of a refrigerant.

For maximum signal-to-noise ratio, operation with a supply voltage (E) below 2000 volts is recommended.

Under the following conditions: Supply voltage (E) is 2000 volts, 25°-C tube temperature, external-shield potential of -2000 volts, ac-amplifier bandwidth of 1 cycle per second, tungsten light source 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is determined primarily by transit-time variations in the multiplier stages and with an incident-light spot approximately 1 millimeter in diameter centered on 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.

For maximum signal-to-noise ratio, operation with a supply voltage (E) below 2300 volts is recommended.

Same as (*) except the supply voltage (E) is 2400 volts, and the external-shield potential is -2400 volts.
## Table I

**Voltage to be Provided by Divider**

<table>
<thead>
<tr>
<th>Between</th>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.4% of Supply Voltage (E) multiplied by</td>
<td>2.75% of Supply Voltage (E) multiplied by</td>
</tr>
<tr>
<td>Cathode and Focusing Electrode</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Cathode and Dynode No.1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.3 and Dynode No.4</td>
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<td>1</td>
</tr>
<tr>
<td>Dynode No.4 and Dynode No.5</td>
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<td>1</td>
</tr>
<tr>
<td>Dynode No.5 and Dynode No.6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.6 and Dynode No.7</td>
<td>1</td>
<td>1.2</td>
</tr>
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<td>Dynode No.7 and Dynode No.8</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>Dynode No.8 and Dynode No.9</td>
<td>1</td>
<td>1.9</td>
</tr>
<tr>
<td>Dynode No.9 and Dynode No.10</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Dynode No.10 and Dynode No.11</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Dynode No.11 and Dynode No.12</td>
<td>1.25</td>
<td>3.8</td>
</tr>
<tr>
<td>Dynode No.12 and Dynode No.13</td>
<td>1.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Dynode No.13 and Dynode No.14</td>
<td>1.75</td>
<td>6</td>
</tr>
<tr>
<td>Dynode No.14 and Anode</td>
<td>2</td>
<td>4.8</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>18.5</td>
<td>36.4</td>
</tr>
</tbody>
</table>

*Focusing electrode is connected to arm of potentiometer between cathode and dynode No.1. Focusing-electrode voltage is adjusted to give maximum gain.*
MULTIPLIER PHOTOTUBE

OPERATING CONSIDERATIONS

Exposure of the 7264 to strong ultraviolet radiation may cause an increase in anode dark current. After cessation of such irradiation, the dark current drops rapidly.

The operating stability of the 7264 depends on the magnitude and duration of the anode current. When the 7264 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 7264 usually recovers a substantial percentage of such loss in sensitivity.

Operation at an average anode current well below the maximum rated value of 2 milliamperes is recommended when stability is important. When maximum stability is required, the anode current should not exceed 250 microamperes.

Electrostatic and/or magnetic shielding of the 7264 may be necessary. It is to be noted that the use of an external magnetic and/or electrostatic shield at high negative potential is a safety hazard unless the shield is connected to the potential source through an impedance in the order of 10 megohms. If the shield is not so connected, extreme care should be observed in providing adequate safeguards to prevent personnel from coming in contact with the high potential of the shield.

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

COPY OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF THE BOTTOM OF THE BASE.
TYPICAL ANODE CHARACTERISTICS

VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

CATHODE - TO - GRID - N°1 VOLTS = 108
GRID - N°1 - TO - DYNODE - N°1 (DY1) VOLTS = 108
DY1 - TO - DY2
DY2 - TO - DY3
ETC. TO
DY10 - TO - DY11

VOLTS = 108

DY11 - TO - DY12 VOLTS = 135
DY12 - TO - DY13 VOLTS = 160
DY13 - TO - DY14 VOLTS = 189
GRID - N°2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.

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

ANODE MILLIAMPERES
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9684
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC
VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

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>5.4% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE &amp; GRID #1</td>
<td></td>
</tr>
<tr>
<td>GRID #1 &amp; DYNOE #1 (DY1)</td>
<td></td>
</tr>
<tr>
<td>DY1 &amp; DY2</td>
<td></td>
</tr>
<tr>
<td>DY2 &amp; DY3</td>
<td></td>
</tr>
<tr>
<td>DY3 &amp; DY4</td>
<td></td>
</tr>
<tr>
<td>DY4 &amp; DY5</td>
<td></td>
</tr>
<tr>
<td>DY5 &amp; DY6</td>
<td></td>
</tr>
<tr>
<td>DY6 &amp; DY7</td>
<td></td>
</tr>
<tr>
<td>DY7 &amp; DY8</td>
<td></td>
</tr>
<tr>
<td>DY8 &amp; DY9</td>
<td></td>
</tr>
<tr>
<td>DY9 &amp; DY10</td>
<td>1.25</td>
</tr>
<tr>
<td>DY10 &amp; DY11</td>
<td>1.8</td>
</tr>
<tr>
<td>DY11 &amp; DY12</td>
<td>1.75</td>
</tr>
<tr>
<td>DY12 &amp; DY13</td>
<td>2.</td>
</tr>
<tr>
<td>DY13 &amp; DY14</td>
<td>18.5</td>
</tr>
<tr>
<td>DY14 &amp; ANODE</td>
<td></td>
</tr>
<tr>
<td>ANODE &amp; CATHODE</td>
<td>18.5</td>
</tr>
</tbody>
</table>

GRID-#2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP
OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C
DASHED PORTION INDICATES INSTABILITY.
CHARACTERISTICS
VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

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

<table>
<thead>
<tr>
<th>BETWEEN</th>
<th>5.4% OF ( E ) MULT. BY</th>
<th>BETWEEN</th>
<th>5.4% OF ( E ) MULT. BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE &amp; GRID NO. 1</td>
<td>I</td>
<td>DY(<em>{11}) &amp; DY(</em>{12})</td>
<td>1.25</td>
</tr>
<tr>
<td>GRID NO. 1 &amp; DYNODE NO. 1</td>
<td>I</td>
<td>DY(<em>{13}) &amp; DY(</em>{14})</td>
<td>1.75</td>
</tr>
<tr>
<td>DYNODE NO. 1(DY(<em>{1}) &amp; DY(</em>{2}))</td>
<td>I</td>
<td>DY(_{14}) &amp; ANODE</td>
<td>2</td>
</tr>
<tr>
<td>ETC. THRU DY(<em>{10}) &amp; DY(</em>{11})</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GRID-NO. 2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.
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>2.75% OF E</th>
</tr>
</thead>
<tbody>
<tr>
<td>cathode &amp; grid N1</td>
<td>1</td>
</tr>
<tr>
<td>grid N1 &amp; dynode N1 (DY1)</td>
<td>1</td>
</tr>
<tr>
<td>DY1 &amp; DY2</td>
<td>1</td>
</tr>
<tr>
<td>DY2 &amp; DY3</td>
<td>1</td>
</tr>
<tr>
<td>DY3 &amp; DY4</td>
<td>1</td>
</tr>
<tr>
<td>DY4 &amp; DY5</td>
<td>1</td>
</tr>
<tr>
<td>DY5 &amp; DY6</td>
<td>1</td>
</tr>
<tr>
<td>DY6 &amp; DY7</td>
<td>1</td>
</tr>
<tr>
<td>DY7 &amp; DY8</td>
<td>1</td>
</tr>
<tr>
<td>DY8 &amp; DY9</td>
<td>1.9</td>
</tr>
<tr>
<td>DY9 &amp; DY10</td>
<td>2.4</td>
</tr>
<tr>
<td>DY10 &amp; DY11</td>
<td>3</td>
</tr>
<tr>
<td>DY11 &amp; DY12</td>
<td>3.8</td>
</tr>
<tr>
<td>DY12 &amp; DY13</td>
<td>4.8</td>
</tr>
<tr>
<td>DY13 &amp; DY14</td>
<td>6</td>
</tr>
<tr>
<td>DY14 &amp; anode</td>
<td>4.8</td>
</tr>
<tr>
<td>anode &amp; cathode</td>
<td>36.4</td>
</tr>
</tbody>
</table>

GRID-N2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED
AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C
DASHED PORTION INDICATES INSTABILITY.
### CHARACTERISTICS

**HIGH-OUTPUT-PULSE SERVICE**

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

<table>
<thead>
<tr>
<th>BETWEEN</th>
<th>2.75% OF E MULT. BY</th>
<th>BETWEEN</th>
<th>2.75% OF E MULT. BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE &amp; GRID NO.1</td>
<td>1</td>
<td>DY8 &amp; DY9</td>
<td>1.9</td>
</tr>
<tr>
<td>GRID NO.1 &amp; DYNODE NO.2(DY)</td>
<td>1</td>
<td>DY9 &amp; DY10</td>
<td>2.4</td>
</tr>
<tr>
<td>DY1 &amp; DY2 ETC. THRU</td>
<td>1</td>
<td>DY10 &amp; DY11</td>
<td>3</td>
</tr>
<tr>
<td>DY6 &amp; DY6</td>
<td>1.2</td>
<td>DY11 &amp; DY12</td>
<td>3.8</td>
</tr>
<tr>
<td>DY6 &amp; DY7</td>
<td>1.5</td>
<td>DY12 &amp; DY13</td>
<td>4.8</td>
</tr>
<tr>
<td>DY7 &amp; DY8</td>
<td></td>
<td>DY13 &amp; DY14</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DY14 &amp; ANODE</td>
<td>4.8</td>
</tr>
</tbody>
</table>

GRID-N0.2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.

**GRID-NO.2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.**

**Sensitivity**
- Electron Tube Division
- Radio Corporation of America, Harrison, New Jersey

**Supply Volts (E) Between Anode & Cathode**

**92CM-9685**
Photomultiplier Tube

14-Stage, Head-On Type
Having S-20 Spectral Response

GENERAL
Spectral Response ........................................... S-20
Wavelength of Maximum Response ......................... 4200 ± 500 Å
Cathode, Semitransparent ................................. Potassium-Sodium
                                            Cesium-Antimony (Multialkali)
Minimum projected area ................................. 2.2 in² (14.2 cm²)
Minimum diameter ........................................ 1.68 in (4.2 cm)
Window .................................................. Corning® No.0080, or equivalent
Shape .................................................. Plano-Concave
Index of refraction at 5898 angstroms .............. 1.512

Dynodes:
Substrate ............................................. Copper-Beryllium
Secondary-Emitting Surface ............................. Beryllium Oxide
Structure .............................................. In-Line Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.14 ................................ 2.8 pF
Anode to all other electrodes ......................... 6 pF
Dynode No.14 to all other electrodes .............. 7.5 pF

Maximum Overall Length ................................. 7.5 in (19 cm)
Seated Length ......................................... 6.69 in (17 cm) ± 0.19 in
Maximum Diameter ..................................... 2.38 in (6 cm)

Bulb .................................................. T16
Base .................................................. Small-Shell Bidecal 20-Pin, JEDEC No.B20-102
Socket ................................................ Alden® Part 220FTC, or equivalent
Magnetic Shield ....................................... Millen® No.80802E, or equivalent
Operating Position .................................... Any
Weight (Approx.) ..................................... 8 oz (226 g)

ABSOLUTE-MAXIMUM RATINGS
DC Supply Voltage:
Between Anode and Cathode .......................... 3000 max. V
Between Anode and Dynode No.14 ................. 500 max. V
Between Consecutive Dynodes ...................... 600 max. V
Between Accelerating Electrode
and Dynode No.13 ..................................... ±600 max. V
Between Dynode No.1 and Cathode ................. 500 max. V
Between Focusing-Electrode
and Cathode ........................................... 500 max. V
Average Anode Current ............................... 1 max. mA
Ambient Temperature ................................. 85 max. °C
Voltage Distribution A (See Table)

<table>
<thead>
<tr>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^g) at 4200 angstroms . . .</td>
<td>(3 \times 10^6)</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous(^h) . . .</td>
<td>(7.2 \times 10^3)</td>
<td>(3.3 \times 10^4)</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant(^i) at 4200 angstroms . . .</td>
<td>(0.064)</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous . . .</td>
<td>(1 \times 10^{-4})</td>
<td>(1.5 \times 10^{-4})</td>
</tr>
<tr>
<td>With red light(^m) . . .</td>
<td>(3 \times 10^{-7})</td>
<td></td>
</tr>
<tr>
<td>With blue light(^n) . . .</td>
<td>(5 \times 10^{-8})</td>
<td></td>
</tr>
<tr>
<td>Cathode Quantum Efficiency at 4000 angstroms</td>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Current Amplification . . . . .</td>
<td>(4.8 \times 10^7)</td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current(^p)</td>
<td>(5 \times 10^{-8})</td>
<td>(8 \times 10^{-7})</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input(^p)</td>
<td>(5 \times 10^{-11})</td>
<td>(8 \times 10^{-10})</td>
</tr>
<tr>
<td>Equivalent Noise Input(^f)</td>
<td>(1.2 \times 10^{-13})</td>
<td>(1.9 \times 10^{-12})</td>
</tr>
<tr>
<td>Anode Pulse Rise Time at 3000 V(^f)</td>
<td>(2.7 \times 10^{-9})</td>
<td></td>
</tr>
<tr>
<td>Electron Transit Time at 3000 V(^d)</td>
<td>(4 \times 10^{-8})</td>
<td></td>
</tr>
</tbody>
</table>

\(a\) Made by Corning Glass Works, Corning, New York.
\(b\) Made by Alden Products Co., 262 N. Main St., Brockton, Mass. 02403.
\(c\) Made by James Millen Manufacturing Co., 150 Exchange Street, Malden 48, Mass.
\(d\) Averaged over any interval of 30 seconds maximum.
\(e\) Tube operation at room temperature or below is recommended.
\(f\) This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 428 lumens per watt.
\(g\) 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 and a light input of 0.1 microlumen is used.
This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 428 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 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.

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 1000 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant. Dark current is measured with incident light removed.

At 4200 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 428 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 4200 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 428 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.

### Voltage Distribution

<table>
<thead>
<tr>
<th>Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>K - Dy1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Dy1 - Dy2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy2 - Dy3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy3 - Dy4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy4 - Dy5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy5 - Dy6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy6 - Dy7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy7 - Dy8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy8 - Dy9</td>
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<td></td>
</tr>
<tr>
<td>Dy9 - Dy10</td>
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<td></td>
</tr>
<tr>
<td>Dy10 - Dy11</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Dy11 - Dy12</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>Dy12 - Dy13</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Dy13 - Dy14</td>
<td>1.75</td>
<td></td>
</tr>
<tr>
<td>Dy14 - P</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Dy1 - P</td>
<td></td>
<td>16.5</td>
</tr>
<tr>
<td>K - P</td>
<td>18.5</td>
<td></td>
</tr>
</tbody>
</table>

Focus electrode is connected to arm of potentiometer between cathode and dynode No.1; the focusing electrode voltage is varied to give maximum anode current.

The metal collar (See Dimensional Outline) is connected internally to the focusing electrode. Extreme care should be taken in the design of apparatus to prevent operating personnel from coming in contact with the collar when the circuit application is such that the collar is at high potential.

Cathode-to-dynode No.1 voltage is maintained at 330 volts.
OPERATING CONSIDERATIONS

The base pins of the 7265 fit a bidecal 20-contact socket, such as Alden No.220FTC or equivalent. The socket should be made of high-grade, low-leakage material.

The operating stability of the 7265 is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 1 milliampere is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of 1 microampere or less, commensurate with satisfactory output signal, is recommended.

Electrostatic shielding of the tube 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 the tube at the photocathode end 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.

Accompanying voltage-divider arrangements are recommended for use with the 7265. Recommended resistance values for the voltage divider range from 10 kilohms per stage to 10 megohms per stage. The choice of resistance values for any 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 power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode. The use of high resistance values per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum value of average anode current, and may limit anode-current response to pulsed light. The latter effect may be reduced by con-
necting capacitors between the tube socket terminals for dynodes No.11 and No.12, dynodes No.12 and No.13, dynodes No.13 and No.14, and between dynode No.14 and anode return.

In addition to nonlinearity and pulse-limiting effects, the use of resistance values exceeding 10 megohms per stage make the 7265 more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.

Voltage Distribution B is recommended where high dynode-No.1 gain is important, such as low light level and scintillation counting applications. Voltage Distribution B maintains the cathode to dynode-No.1 voltage constant at 330 volts; it is especially useful when the supply voltage is adjusted over a wide range to achieve large changes in anode sensitivity.

The high voltages at which the 7265 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.

In the use of the 7265 as with other tubes requiring high voltages, it should always be remembered that these high voltages may appear at points in the circuit which are normally at low potential, because of defective circuit parts or incorrect circuit connections.

Therefore, 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
PHOTOCATHODE

C1: 25 pF, 20%, 600 volts  
( dc working), ceramic disc  
C2: 50 pF, 20%, 600 volts  
( dc working), ceramic disc  
C3: 100 pF, 20%, 600 volts  
( dc working), ceramic disc  
C4: 250 pF, 20%, 600 volts  
( dc working), ceramic disc  
C5: 500 pF, 20%, 600 volts  
( dc working), ceramic disc  
C6: 100 pF, 20%, 1000 volts  
( dc working), ceramic disc  

R1: 24000 ohms, 5%, 1 watt  
R2: 22000 ohms, 5%, 1 watt  
R3: 1 megohm, 20%, 2 watts,  
adjustable  
R4 through R13: 22000 ohms,  
5%, 1 watt  
R14: 27000 ohms, 5%, 2 watts  
R15: 33000 ohms, 5%, 2 watts  
R16: 22000 ohms, 5%, 2 watts  
R17: 18000 ohms, 5%, 2 watts  
R18: 22000 ohms, 5%, 2 watts  
R19: 22000 ohms, 5%, 2 watts  
R20: 10 megohms, 2 watts,  
adjustable  

R_L: Value will depend on magnitude of peak pulse voltage  
desired. For a peak pulse amplitude of 100 volts, the  
value is approximately 300 ohms.  

Note 1: Adjustable between approximately 800 and 3000 V dc.  
Note 2: Component values are dependent upon nature of appli-
cation and output signal desired.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR CONSTANT VOLTAGE BETWEEN CATHODE AND DYNOSE No.1

PHOTOCATHODE

FOCUSING ELECTRODE

DYNOSE N°1

DYNOSE N°2

DYNOSE N°3

DYNOSE N°4

DYNOSE N°5

DYNOSE N°6

DYNOSE N°7

DYNOSE N°8

DYNOSE N°9

DYNOSE N°10

DYNOSE N°11

DYNOSE N°12

DYNOSE N°13

DYNOSE N°14

ACCELERATING ELECTRODE

C1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C6: 100 pF, 20%, 1000 volts (dc working), ceramic disc
R1: 5 megohms, 20%, 1/2 watt, adjustable
R2 through R11: 22000 ohms, 5%, 1 watt

R12: 27000 ohms, 5%, 2 watts
R13: 33000 ohms, 5%, 2 watts
R14: 22000 ohms, 5%, 2 watts
R15: 18000 ohms, 5%, 2 watts
R16: 22000 ohms, 5%, 2 watts
R17: 22000 ohms, 5%, 2 watts
R18: 10 megohms, 2 watts, adjustable
R_L: Value will depend on magnitude of peak pulse voltage desired. For a peak pulse amplitude of 100 volts, the value is approximately 300 ohms.
Z: (1) - 150 V, 1 W zener diode, or equivalent
(1) - 180 V, 1 W zener diode, or equivalent

Note 1: Adjustable between approximately 800 and 3000 V dc.
Note 2: Component values are dependent upon nature of application and output signal desired.
DIMENSIONAL OUTLINE - Dimensions In Inches

- FACEPLATE
- PHOTOCATHODE
- BULB
- METAL COLLAR
- BASE JEDEC N# B20-102

**Note:** Within 1.68" diameter, deviation from flatness of external surface of faceplate will not exceed 0.005" from peak to valley.

\( \theta \) of bulb will not deviate more than 2\(^\circ\) in any direction from the perpendicular erected at the center of bottom of the base.

Inch Dimension Equivalents 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>0.06</td>
<td>1.5</td>
<td>1.68</td>
<td>42.6</td>
<td>5.40</td>
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<tr>
<td>0.12</td>
<td>3.0</td>
<td>2.00</td>
<td>50.8</td>
<td>6.69</td>
<td>169.9</td>
</tr>
<tr>
<td>0.19</td>
<td>4.8</td>
<td>2.38</td>
<td>60.4</td>
<td>7.5</td>
<td>190.5</td>
</tr>
</tbody>
</table>
TERMINAL DIAGRAM (Bottom View)

Pin 1: No Connection
Pin 2: Dynode No.1
Pin 3: Dynode No.3
Pin 4: Dynode No.5
Pin 5: Dynode No.7
Pin 6: Dynode No.9
Pin 7: Dynode No.11
Pin 8: Dynode No.13
Pin 9: Grid No.2 (Accelerating Electrode)
Pin 10: Anode
Pin 11: Dynode No.14
Pin 12: Dynode No.12
Pin 13: Dynode No.10
Pin 14: Dynode No.8
Pin 15: Dynode No.6
Pin 16: Dynode No.4
Pin 17: Dynode No.2
Pin 18: No Connection
Pin 19: Grid No.1 (Focusing Electrode)
Pin 20: Photocathode

TYPICAL FOCUSING ELECTRODE CHARACTERISTIC

Metal Collar: Connected Internally to Focusing Electrode — Do Not Make Electrical Connection to Collar.

Note: The Metal Collar May be at High Potential Depending on the Circuit Application and Should be Insulated Accordingly.
TYPICAL TIME-RESOLUTION CHARACTERISTICS

VOLTAGE DISTRIBUTION A, TABLE I

SUPPLY VOLTAGE (E) VOLTS

1000 1.2 1.4 1.6 1.8 2.0 2.2 2.4 2.6 3.0

TRANSIT TIME

RISE TIME

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

WAVELENGTH-ANGSTROMS

RELATIVE SENSITIVITY- PER CENT

ABSOLUTE SENSITIVITY- MA/WATT

QUANTUM EFFICIENCY- PER CENT

RANGE OF MAXIMUM VALUE

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

WAVELENGTH-ANGSTROMS

RCA Electronic Components
TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS

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>5.4% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>cathode &amp; focusing electrode</td>
<td>1.6</td>
</tr>
<tr>
<td>cathode &amp; dynode No.1 (Dyi)</td>
<td>2</td>
</tr>
<tr>
<td>Dy1 &amp; Dy2</td>
<td>1</td>
</tr>
<tr>
<td>Dy2 &amp; Dy3</td>
<td>1</td>
</tr>
<tr>
<td>Dy3 &amp; Dy4</td>
<td>1</td>
</tr>
<tr>
<td>Dy4 &amp; Dy5</td>
<td>1</td>
</tr>
<tr>
<td>Dy5 &amp; Dy6</td>
<td>1</td>
</tr>
<tr>
<td>Dy6 &amp; Dy7</td>
<td>1</td>
</tr>
<tr>
<td>Dy7 &amp; Dy8</td>
<td>1</td>
</tr>
<tr>
<td>Dy8 &amp; Dy9</td>
<td>1</td>
</tr>
<tr>
<td>Dy9 &amp; Dy10</td>
<td>1.25</td>
</tr>
<tr>
<td>Dy10 &amp; Dy11</td>
<td>1.5</td>
</tr>
<tr>
<td>Dy11 &amp; Dy12</td>
<td>1.75</td>
</tr>
<tr>
<td>Dy12 &amp; Dy13</td>
<td>2</td>
</tr>
<tr>
<td>Dy13 &amp; Dy14</td>
<td>2</td>
</tr>
<tr>
<td>Dy14 &amp; anode</td>
<td>2</td>
</tr>
<tr>
<td>anode &amp; cathode</td>
<td>18.5</td>
</tr>
</tbody>
</table>

GRID-No.2 VOLTS ADJUSTED TO GIVE 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

CATHODE-TO-FOCUSING-ELECTRODE VOLTS = 208
CATHODE-TO-DYNOE - No.1 (DY) VOLTS = 260
DY1-TO-DY2
DY2-TO-DY3
ETC. TO
DY10-TO-DY11

VOLTS=130

DY11-TO-DY12 VOLTS = 161
DY12-TO-DY13 VOLTS = 193
DY13-TO-DY14 VOLTS = 226
GRID-No.2 VOLTS ADJUSTED TO GIVE MAX. ANODE CURRENT

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

LIGHT FLUX/MICROMEN'S-005
ANODE MILLIAMPERES
0.01
0.02
0.03
0.04

VOLTS BETWEEN ANODE AND DYNOE No.14

RCA Electronic Components
Image Orthicon

For Outdoor and Studio Pickup with High-Quality Black-and-White TV Cameras. The 7295B is Unilaterally Interchangeable with Types 7295 and 7295A.

**DATA**

**General:**
- Heater, for Unipotential Cathode:
  - Voltage (AC or DC): \(6.3 \pm 10\%\) volts
  - Current at 6.3 volts: 0.6 amp
- Direct Interelectrode Capacitance:
  - Anode to all other electrodes: 12 pf
- Target-to-Mesh Spacing: 0.002 inch
- Spectral Response: S-10
- Wavelength of Maximum Response: 4500 ± 300 angstroms

**Rectangular image (4 x 3 aspect ratio):**
- Useful size: 1.6” max. diagonal

**Note:** The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

**Orientation:** Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of the faceplate and the grid-No.6 envelope terminal. The horizontal and vertical scan should start at the corner of the picture between the grid-No.6 and the photocathode envelope terminals.

**Focusing Method:** Magnetic
**Deflection Method:** Magnetic
**Overall Length:** 19.375” ± 0.310”
**Greatest Diameter of Bulb:** 4.500” ± 0.094”
**Minimum Deflecting-Coil Inside Diameter:** 3.2”
**Deflecting-Coil Length:** 7”
**Focusing-Coil Length:** 15”
**Alignment-Coil:** Position on neck. Centerline of magnetic field should be located 9.25” from the flat area of the shoulder.

**Operating Position:** See Operating Considerations
**Weight (Approx.):** 2.3 lbs
**Socket:** Cinch Part No.3M14, or equivalent
**Envelope Terminals:** 5

**BOTTOM VIEW**
- Terminal Over Pin 2 - Field Mesh
- Terminal Over Pin 4 - Photocathode (PC)
- Terminal On Side of Envelope
  - Opposite Base Key: Grid No.6 (G6)

▲ See basing diagram on next page.
Terminal Over Pin 9 - Grid No.5 (G5)
Terminal Over Pin 11 - Target

End Base. Small-Shell Diheptal 14-Pin
(JEDEC Group 5, No. 814-45)

Bottom View

Direction of light:
Perpendicular to
Large end of tube

Pin 1 - Heater
Pin 2 - Grid No.4
Pin 3 - Grid No.3
Pin 4 - Do Not Use
Pin 5 - Dynode No.2
Pin 6 - Dynode No.4
Pin 7 - Anode
Pin 8 - Dynode No.5
Pin 9 - Dynode No.3
Pin 10 - Dynode No.1, Grid No.2
Pin 11 - Do Not Use
Pin 12 - Grid No.1
Pin 13 - Cathode
Pin 14 - Heater

Maximum and Minimum Ratings, Absolute - Maximum Values:

Photocathode:
Voltage .................................................. -700 max. volts
Illumination ............................................. 50 max. fc

Operating Temperature:
Any part of bulb ........................................ 65 max. °C
Of bulb at large end of tube
(Image section) ........................................ 35 min. °C

Temperature Difference:
Between image section and any part
of bulb hotter than image section .................. 5 max. °C

Grid-No.6 Voltage........................................... -700 max. volts

Target Voltage:
Positive value .......................................... 10 max. volts
Negative value .......................................... 10 max. volts

Field-Mesh Voltage........................................ 30 max. volts

Grid-No.5 Voltage ......................................... 300 max. volts
Grid-No.4 Voltage ......................................... 350 max. volts
Grid-No.3 Voltage ......................................... 400 max. volts
Grid-No.2 & Dynode-No.1 Voltage ................. 350 max. volts

Grid-No.1 Voltage:
Negative-bias value ................................. 125 max. volts
Positive-bias value ................................. 0 max. volts

Voltage Per Multiplier Stage ......................... 350 max. volts

Anode Supply Voltage ................................... 1650 max. volts

Peak Heater-Cathode Voltage:
Heater negative with respect to cathode . 125 max. volts
Heater positive with respect to cathode . 10 max. volts
Typical Operating Values:

Photocathode Voltage...... -600 volts
Grid-No.6 Voltage (Image Focus) Approx. -250 to -350 volts
50% of photocathode voltage?
Target Voltage Above Cutoff 2.3 volts
Field-Mesh Voltage c 15 to 25 volts
Grid-No.5 Voltage (Decelerator) 40 volts
Grid-No.4 Voltage (Beam Focus) 70 to 90 volts
Grid-No.3 Voltage k 250 to 275 volts
Grid-No.2 & Dynode-No.1 Voltage 280 volts
Grid-No.1 Voltage for picture cutoff -45 to -115 volts
Dynode-No.2 Voltage 600 volts
Dynode-No.3 Voltage 800 volts
Dynode-No.4 Voltage 1000 volts
Dynode-No.5 Voltage 1200 volts
Anode Voltage 1250 volts
Recommended Target-Temperature Range b 35 to 45 °C
Minimum Peak-to-Peak Blanking Voltage 5 volts
Field Strength of Focusing Coil (Approx.):
At center of scanning section 60 gausses
In plane of photocathode 120 gausses
Field Strength of Alignment Coil 0 to 3 gausses

Performance Data:

With conditions shown under Typical Operating Values including Recommended Target-Temperature Range, target voltage adjusted to 2.3 volts above cutoff, and with the camera lens set to bring picture highlights one stop above the "knee" of the accompanying Basic Light-Transfer-Characteristic curve.

<table>
<thead>
<tr>
<th>Min.</th>
<th>Average</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode Radiant Sensitivity at 4500 angstroms</td>
<td>-</td>
<td>0.030 a/w</td>
</tr>
<tr>
<td>Luminous Sensitivity</td>
<td>30</td>
<td>60 μa/lm</td>
</tr>
<tr>
<td>Signal-Output Current (Peak to Peak)</td>
<td>10</td>
<td>40 μa</td>
</tr>
<tr>
<td>Ratio of Peak-to-Peak Highlight Video Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc</td>
<td>60.1</td>
<td>75.1</td>
</tr>
<tr>
<td>Photocathode Illumination at 2870°K Required to bring Picture Highlights One Stop above &quot;Knee&quot; of Light-Transfer Characteristic</td>
<td>-</td>
<td>0.110 fc</td>
</tr>
<tr>
<td>Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)</td>
<td>60</td>
<td>75</td>
</tr>
<tr>
<td>Uniformity: Ratio of Shading (Background) Signal to Highlight Signal</td>
<td>-</td>
<td>0.10</td>
</tr>
</tbody>
</table>
Decrease from Peak Highlight Signal Level of Signal from any Point on Scanned Area of Target.  

\[ \begin{array}{ccc} 
\text{Min.} & \text{Average} & \text{Max.} \\
- & 12 & 25 \%
\end{array} \]

a Clinch Manufacturing Corporation, 1026 South Homan Avenue, Chicago 24, Illinois.
b Operating outside the Recommended Target-Temperature Range shown under Typical Operating Values will not damage the 72958 provided the Maximum Temperature Ratings of the tube are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the Recommended Target-Temperature Range.
c With respect to grid No. 3.
d Dynode-voltage values are shown under Typical Operating Values.
e With 72958 operated in RCA TK-60 camera at fixed photocathode voltage.
f Adjust for optimum focus.
g The target supply voltage should be adjustable from -5 to 5 volts.
h Adjust to give the most uniformly shaded picture near maximum signal.
i Direction of current 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.
j Measured with amplifier having flat frequency response.
k With uniform illumination on photocathode.

**OPERATING CONSIDERATIONS**

The tube should never be operated in a vertical position with the Diheptal/base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

**SPECTRAL-SENSITIVITY CHARACTERISTIC**

of Photosensitive Device having S-10 Response

is shown at the front of this Section
Details of envelope terminals

All dimensions in inches

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

7295B

7295B

DETIAL OF ENVELOPE TERMINALS

ENLARGED BOTTOM VIEW

SMALL-SHELL DHNEPTAL 14-PIN BASE JEDEC GROUP 5, NS B14-45

RCA
ILLUMINATION: TUNGSTEN LIGHT, DAYLIGHT, OR WHITE FLUORESCENT. FOR SMALL-AREA HIGHLIGHTS.

HIGHLIGHT ILLUMINATION ON PHOTOCATHODE—FOOTCANDLES

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

LONG-LIFE TARGET
MAGNETIC FOCUS

FIELD-MESH TYPE
MAGNETIC DEFLECTION

For High-Quality Black-and-White TV Pickup in Studio or Outdoor Service. The 7295C is Directly Interchangeable with the 7295, 7295A, and 7295B in all Cameras.

The 7295C is the same as the 7295B except utilizes a stable, long-life target.

The stable, long-life, glass target of type 7295C is characterized by high gain, resistance to "burn-in", and the absence of any granular structure. Because charge transportation through this target material is electronic rather than ionic as in ordinary glass targets, the electrical characteristics of the target, such as secondary emission and resistivity, are essentially constant and sensitivity of the 7295C is stable throughout life.

Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster "burn-in" due to underscanning are significantly reduced. The resistance of the 7295C to image "burn-in" provides a highly desirable operational feature because it is not necessary to use an orbiter or continually move the camera when focused on a stationary scene.

OPERATING CONSIDERATIONS

Dos and Don’ts on Use of RCA-7295C

Dos
1. Allow the 7295C to warm up prior to operation.
2. Hold temperature of the 7295C within operation range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 7295C’s by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to the desired voltage above target cutoff.
7. Uncap lens before voltages are applied to the 7295C.

Don’ts
1. Don’t force the 7295C into its shoulder socket.
2. Don’t operate the 7295C without scanning.
3. Don’t operate a 7295C having an ion spot.
4. Don’t use more beam current than necessary to discharge the highlights of the scene.
5. Don’t turn off beam while voltages are applied to photocathode, grid No. 6, target, dynodes, and anode during warm-up or standby operation.
# Multiplier Phototube

## General:

### Spectral Response
- S-20

### Wavelength of Maximum Response
- 4200 ± 500 angstroms

### Cathode, Semitransparent:
- **Shape:** Curved Circular
- **Window:**
  - **Area:** 2.2 sq. in.
  - **Minimum Diameter:** 1.68 in.
  - **Index of Refraction:** 1.51

### Direct Interelectrode Capacitances (Approx.):
- Anode to dynode No. 10: 2.4 μf
- Anode to all other electrodes: 5.5 μf
- Dynode No. 10 to all other electrodes: 6.5 μf

### Maximum Overall Length
- 6.78" ± 0.19"

### Seated Length
- 5.84" ± 0.19"

### Maximum Diameter
- 2.38" ± 0.19"

### Operating Position
- Any

### Weight (Approx.)
- 6 oz

### Bulb
- Medium-Shelf Diheptal 14-Pin (JEDEC Group 5, No.B14-38), Non-hygroscopic

### Basing Designation for Bottom View
- 14AM

## Pinout and Connection:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
<th>Direction of Light</th>
<th>Internal Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dynode No. 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Dynode No. 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Dynode No. 3</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>Dynode No. 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Dynode No. 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Dynode No. 6</td>
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</tr>
<tr>
<td>7</td>
<td>Dynode No. 7</td>
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<tr>
<td>8</td>
<td>Dynode No. 8</td>
<td></td>
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</tr>
<tr>
<td>9</td>
<td>Dynode No. 9</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>Dynode No. 10</td>
<td></td>
<td></td>
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<tr>
<td>11</td>
<td>Anode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Internal Connection</td>
<td></td>
<td>Do Not Use</td>
</tr>
<tr>
<td>13</td>
<td>Focusing Electrode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Photo-cathode Metal Collar</td>
<td></td>
<td>No Connection</td>
</tr>
</tbody>
</table>

## Maximum Ratings, Absolute Values:

- **Supply Voltage Between Anode and Cathode (DC):** 2400 max. volts
- **Supply Voltage Between Dynode No. 10 and Anode (DC):** 500 max. volts
- **Supply Voltage Between Consecutive Dynodes (DC):**
  - Dynode No. 1 Supply Voltage (DC): 600 max. volts
  - Focusing-Electrode Supply Voltage (DC): 500 max. volts
  - Average Anode Current: 1 max. mA
  - Ambient Temperature: 85 max. °C

*See next page.*
MULTIPLIER PHOTOTUBE

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; 1/8 of E between cathode and focusing electrode; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No. 10 and anode

With \( E = 1800 \) volts (Except as noted)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>9600</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cathode radiant, at 4200 angstroms.</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>0.064</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Luminous: Cathode luminous: With tungsten light source*</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>120</td>
<td>150</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Luminous: Cathode luminous: With blue light source**</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>0.05</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Luminous: Cathode luminous: With red light source***</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>0.3</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Amplification.</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>1.5 \times 10^5</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equivalent Anode-Dark-Current Input*:</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>3 \times 10^{-10}</td>
<td>1.4 \times 10^{-9}</td>
<td>lumen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equivalent Noise Input:</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>At +25°C</td>
<td>1.9 \times 10^{-12}</td>
<td>4.3 \times 10^{-12}</td>
<td>lumen</td>
</tr>
<tr>
<td>At -80°C</td>
<td>3 \times 10^{-13}</td>
<td>6 \times 10^{-13}</td>
<td>lumen</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Anode-Pulse Rise Time*:</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>2.5</td>
<td>-</td>
<td>milliμsec</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Greatest Delay Between Anode Pulses:</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Due to position from which electrons are simultaneously released within a circle centered on tube face and having a diameter of—</td>
<td>1.12&quot;</td>
<td>1.56&quot;</td>
<td>milliμsec</td>
</tr>
</tbody>
</table>

* Averaged over any interval of 30 seconds maximum.

See next page.
**MULTIPLIER PHOTOTUBE**

Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 0.1 microlumen is used. The load resistor has a value of 0.01 megohm.

Under the following conditions: The light source is a tungsten-filament lamp 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 together as anode. The load resistor has a value of 0.01 megohm.

Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning, Glass Code No. 5115 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm and 200 volts are applied between cathode and all other electrodes connected together as anode.

For spectral characteristic of this source, see sheet 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, Glass Code No. 2418, or equivalent) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm and 200 volts are applied between cathode and all other electrodes connected together as anode.

For spectral characteristic of this source, see sheet 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.

Measured at a tube temperature of 25° C and with the supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by the use of a refrigerant.

For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1800 volts is recommended.

Under the following conditions: Supply voltage (E) is 1800 volts, external-shield potential of -1800 volts, ac-amplifier bandwidth of 1 cycle per second, tungsten light source 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is determined primarily by transit time variations in the multiplier stages and with an incident-light spot approximately 1 millimeter in diameter centered on 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.

**OPERATING CONSIDERATIONS**

Operation at an average anode current well below the maximum rated value of 1 milliampere is recommended when stability is important.

Electrostatic and/or magnetic shielding of the 7326 may be necessary.

**SPECTRAL-SENSITIVITY CHARACTERISTIC**

of Phototube having S-20 Response is shown at front of this Section
MULTIPLIER PHOTOTUBE

FACEPLATE
(SEE NOTE)

PHOTOCATHODE

T 16 BULB

METAL COLLAR

MEDIUM-SHELL DIHEPTAL
14-PIN BASE
JEDEC GROUP 5,
NBR14-38

2.00" ± 0.06"
DIA.

1.60" MIN.
DIA.

2.38" MAX.
DIA.

4.63" ± 0.12"

5.84" ± 0.19"

6.78" MAX.

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 0.005" FROM PEAK TO VALLEY.
TYPICAL ANODE CHARACTERISTICS

- Dynode - No. 1 to Cathode Volts = 300
- Each succeeding dynode stage Volts = 150
- Focusing electrode to cathode Volts = 240
- Light source is a tungsten-filament lamp operated at color temperature of 2870° K.

![Graph showing typical anode characteristics](image-url)
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE NO. 1; 1/8 OF E BETWEEN CATHODE AND FOCUSING ELECTRODE; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE NO. 10 AND ANODE.
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

Supply voltage $E$ across voltage divider providing $\frac{1}{6}$ of $E$ between cathode and dynode No. 1; $\frac{1}{8}$ of $E$ between cathode and focusing electrode; $\frac{1}{12}$ of $E$ for each succeeding dynode stage; and $\frac{1}{12}$ 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 instability.

Tube temperature = 25°C.

Electron Tube Division
Radio Corporation of America, Harrison, New Jersey
"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS

FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

MAGNETIC FOCUS

For High-Quality Black-and-White Studio TV Cameras, Live Pickup, and Magnetic Tape Recording Requiring High-Signal-to-Noise Ratio. The 7389B is Unilaterally Interchangeable with the 7389 and 7389A.

General:

Heater, for Unipotential Cathode:

- Voltage (AC or DC) .... 6.3 ± 10% volts
- Current at 6.3 volts .... 0.6 amp

Direct Inter-electrode Capacitance:

- Anode to all other electrodes .... 12 pf
- Target-to-Mesh Spacing .... 0.001 inch
- Spectral Response .... S-10
- Wavelength of Maximum Response .... 4500 ± 300 angstroms

Photocathode, Semitransparent:

- Rectangular image (4 x 3 aspect ratio): Useful size of .... 1.6" max. diagonal

Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

Orientation of: Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and the grid-No.6 envelope terminal. The horizontal and vertical scan should start at the corner of the picture between the grid-No.6 and the photocathode envelope terminals.

Focusing Method: Magnetic

Deflection Method: Magnetic

Overall Length .... 19.375" ± 0.310"

Greatest Diameter of Bulb .... 4.500" ± 0.094"

Minimum Deflecting-Coil Inside Diameter .... 3.2"

Deflecting-Coil Length .... 7"

Focusing-Coil Length .... 15"

Alignment-Coil: Position on neck .... Centerline of magnetic field should be located 9.25" from the flat area of the shoulder.

Operating Position: See Operating Considerations

Weight (Approx.) .... 2.3 lbs

Socket .... Cincl® Part No.3M14, or equivalent

DATA I 2-64

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

**BOTTOM VIEW**
- Terminal Over Pin 2 - Field Mesh
- Terminal Over Pin 4 - Photocathode (PC)
- Terminal On Side Of Envelope
- Opposite Base Key - Grid No.6 (G6)
- Terminal Over Pin 9 - Grid No.5 (G5)
- Terminal Over Pin 11 - Target

**End Base.**
Small-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-45)

**DIRECTION OF LIGHT:** PERPENDICULAR TO LARGE END OF TUBE

---

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

- **Photocathode:**
  - Voltage: \(-700\) max. volts
  - Illumination: \(50\) max. fc

- **Operating Temperature:**
  - Any part of bulb: \(65\) max. °C
  - Of bulb at large end of tube (Image section): \(35\) min. °C

- **Temperature Difference:**
  - Between image section and any part of bulb hotter than image section: \(5\) max. °C

- **Grid-No.6 Voltage:** \(-700\) max. volts

- **Target Voltage:**
  - Positive value: \(10\) max. volts
  - Negative value: \(-10\) max. volts
  - Field-Mesh Voltage: \(30\) max. volts
  - Grid-No.5 Voltage: \(300\) max. volts
  - Grid-No.4 Voltage: \(350\) max. volts
  - Grid-No.3 Voltage: \(400\) max. volts
  - Grid-No.2 & Dynode-No.1 Voltage: \(350\) max. volts
  - Grid-No.1 Voltage:
    - Negative-bias value: \(-125\) max. volts
    - Positive-bias value: \(10\) max. volts

- **Peak Heater-Cathode Voltage:**
  - Heater negative with respect to cathode: \(-125\) max. volts
  - Heater positive with respect to cathode: \(10\) max. volts

---

**RADIO CORPORATION OF AMERICA**
Electronic Components and Devices
Harrison, N. J.
### Anode-Supply Voltage
- Value: 1650 max. volts

### Voltage Per Multiplier Stage
- Value: 350 max. volts

### Typical Operating Values:

<table>
<thead>
<tr>
<th>Voltage Type</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photocathode Voltage</td>
<td>-600</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.6 Voltage (Image focus) Approx. 70% of photocathode voltage</td>
<td>-370 to -470</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Target Voltage Above Cutoff</td>
<td>2.3</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Field-Mesh Voltage</td>
<td>15 to 25</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.5 Voltage (Decelerator)</td>
<td>40</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.4 Voltage (Beam Focus)</td>
<td>70 to 90</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
<td>250 to 275</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.2 &amp; Dynode-No.1 Voltage</td>
<td>280</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-45 to -115</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Dynode-No.2 Voltage</td>
<td>600</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Dynode-No.3 Voltage</td>
<td>800</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Dynode-No.4 Voltage</td>
<td>1000</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Dynode-No.5 Voltage</td>
<td>1200</td>
<td></td>
<td>volts</td>
</tr>
<tr>
<td>Anode Voltage</td>
<td>1250</td>
<td></td>
<td>volts</td>
</tr>
</tbody>
</table>

### Recommended-Target-Temperature Range:
- Value: 35 to 45 °C

### Minimum Peak-to-Peak Blanking Voltage
- Value: 5 volts

### Field Strength of Focusing Coil (Approx.)
- At center of scanning section: 60 gauss
- In plane of photocathode: 120 gauss

### Performance Data:

With conditions shown under Typical Operating Values including Recommended Target-Temperature Range, target voltage adjusted to 2.3 volts above cutoff, and with the camera lens set to bring the picture highlights 1/2 stop above the "knee" of the accompanying Basic Light-Transfer-Characteristic Curve.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode Radiant Sensitivity at 4500 angstroms</td>
<td>0.030</td>
<td>a/w</td>
<td></td>
</tr>
<tr>
<td>Luminous Sensitivity</td>
<td>60</td>
<td>μa/Im</td>
<td></td>
</tr>
<tr>
<td>Anode Current (DC)</td>
<td>30</td>
<td>μa</td>
<td></td>
</tr>
<tr>
<td>Signal-Output Current (Peak to Peak)</td>
<td>40</td>
<td>μa</td>
<td></td>
</tr>
<tr>
<td>Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc</td>
<td>85:1</td>
<td>95:1</td>
<td></td>
</tr>
<tr>
<td>Photocathode Illumination at 2870°K Required to bring Picture Highlights 1/2 Stop above &quot;Knee&quot; of Light Transfer Characteristic</td>
<td>0.070</td>
<td>0.130</td>
<td>fc</td>
</tr>
<tr>
<td>Amplitude Response at 400 TV Lines per Picture Height (Percent of large-area black to large-area white)</td>
<td>60</td>
<td>75</td>
<td>%</td>
</tr>
</tbody>
</table>
Uniformity:

<table>
<thead>
<tr>
<th>Ratio of Shading (Background) Signal to Highlight Signal</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.10</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Decrease from Peak Highlight Signal Level of Signal from any Point on Scanned Area of Target</td>
<td></td>
<td></td>
<td>12</td>
</tr>
</tbody>
</table>

a Cinch Manufacturing Corporation, 1026 South Homan Avenue, Chicago 24, Illinois.

b Operating outside the Recommended Target-Temperature Range shown under Typical Operating Values will not damage the 7389B provided the Maximum Temperature Ratings of the tube are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the Recommended Target-Temperature Range.

c With respect to grid No. 4.
d Dynode-voltage values are shown under Typical Operating Values.
e With 7389B operated in RCA TK-60 camera at fixed photocathode voltage.
f Adjust for optimum focus.
g The target supply voltage should be adjustable from -5 to 5 volts.
h Adjust to give the most uniformly shaded picture near maximum signal.
i Direction of current 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.
j Measured with amplifier having flat frequency response.
k With uniform illumination on photocathode.

OPERATING CONSIDERATIONS

The tube should never be operated in a vertical position with the Diheptal/base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

SPECTRAL-SENSITIVITY CHARACTERISTIC

of Photosensitive Device having S-10 Response

is shown at the front of this Section

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
BASIC LIGHT-TRANSFER CHARACTERISTIC

ILLUMINATION: TUNGSTEN LIGHT, DAYLIGHT, OR WHITE FLUORESCENT. FOR SMALL-AREA HIGHLIGHTS.

TYPICAL SIGNAL OUTPUT—MICROAMPERES

HIGHLIGHT ILLUMINATION ON PHOTOCATHODE—FOOTCANDLES

92CS-10690
Image Orthicon

"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS
FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

LONG-LIFE TARGET
FIELD-MESH TYPE
MAGNETIC FOCUS
MAGNETIC DEFLECTION

For Extremely High-Quality Performance in Black-and-White Studio TV Cameras and Television Tape-Recording Operations. The 7389C is Directly Interchangeable with the 7389, 7389A, and 7389B in all Cameras.

The 7389C is the same as the 7389B except utilizes a stable, long-life glass target.

The stable, long-life, glass target of type 7389C is characterized by high gain, resistance to "burn-in", and the absence of any granular structure. Because charge transportation through this target material is electronic rather than ionic as in ordinary glass targets, the electrical characteristics of the target, such as secondary emission and resistivity, are essentially constant and sensitivity of the 7389C is stable throughout life.

Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster "burn-in" due to underscanning are significantly reduced. The resistance of the 7389C to image "burn-in" provides a highly desirable operational feature because it is not necessary to use an orbiter or continually move the camera when focused on a stationary scene.

OPERATING CONSIDERATIONS

Dos and Don'ts on Use of RCA-7389C

Dos
1. Allow the 7389C to warm-up prior to operation.
2. Hold temperature of the 7389C within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control to best usable resolution.
5. Condition spare 7389C's by operating several hours once each month.
6. Determine proper operation point with target voltage adjusted to the desired voltage above target cutoff.
7. Uncap lens before voltage are applied to the 7389C.

Don'ts
1. Don't force the 7389C into its shoulder socket.
2. Don't operate the 7389C without scanning.
3. Don't operate a 7389C having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid-No.6, target, dynodes, and anode during warm-up or standby operation.
PHOTOCONDUCTIVE CELL
CADMIUM-SULFIDE, HEAD-ON TYPE

<table>
<thead>
<tr>
<th>General:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectral Response.</td>
</tr>
<tr>
<td>Wavelength of Maximum Response</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensitive Surface:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape.</td>
</tr>
<tr>
<td>Length (Minimum)</td>
</tr>
<tr>
<td>Width (Minimum)</td>
</tr>
<tr>
<td>Area (Minimum)</td>
</tr>
<tr>
<td>Maximum Length (Excluding flexible leads)</td>
</tr>
<tr>
<td>Diameter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leads, Flexible.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum length</td>
</tr>
<tr>
<td>Diameter</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating Position</th>
<th>Any</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (Approx.)</td>
<td>0.06 oz</td>
</tr>
</tbody>
</table>

λ indicates that the primary characteristic of the element within the envelope symbol is designed to vary under the influence of light.

Maximum Ratings, Absolute-Maximum Values:

| VOLTAGE BETWEEN TERMINALS (DC or Peak AC) | 200 max. volts |
| PHOTOCURRENT | 1000 max. μA |
| POWER DISSIPATION. | 50 max. mw |
| AMBIENT TEMPERATURE. | 60 max. °C |

Characteristics:

With dc voltage of 12 volts between terminals and an ambient temperature of 25°C Min. Median Max.

<table>
<thead>
<tr>
<th>Sensitivity:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant*, at 5800 angstroms</td>
</tr>
<tr>
<td>Luminous*</td>
</tr>
<tr>
<td>Illumination*</td>
</tr>
<tr>
<td>Photocurrent*</td>
</tr>
<tr>
<td>Rise</td>
</tr>
<tr>
<td>Decay</td>
</tr>
</tbody>
</table>

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

For conditions where the incident power is $2 \times 10^{-9}$ watt.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K.

Incident illumination on the sensitive surface is 0.01 footcandle.

Measured approximately 20 seconds after removal of incident-illumination level of 0.01 footcandle.

OPERATING CONSIDERATIONS

The flexible leads of the 7412 are usually soldered to the circuit elements. Soldering of the leads may be made close to the seals provided care is taken to conduct excessive heat away from the seals. Otherwise, the heat of soldering will break the seals and damage the cell.

A clamp around the glass envelope may be used to hold the cell in position. However, care must be taken in clamping to avoid cracking the glass envelope or introducing strains in the envelope which could lead to eventual breakage.

The voltage between terminals of the 7412 may be applied without regard to polarity.

The angle of view of the 7412 may be narrowed by the use of a hood of the desired length placed in front of the cell.

If the source of radiation is some distance from the cell, the use of a lens system may be desirable to utilize more effectively the available radiation. However, the radiation should not be focused onto such a small area that localised overheating of the sensitive surface may result with consequent adverse affects on its characteristics. Exposure of the 7412 to radiation (even without voltage applied) so intense as to cause excessive heating of the cell may permanently damage it.

For a given illumination, the output current will have its highest value when the incident illumination is normal (angle of incidence is 90°) to the face of the cell. For smaller angles of incidence, the output current decreases. The decrease depends upon several factors including the angle of incidence of the illumination, the amount of illumination, and the area of sensitive surface illuminated.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Photoconductive Cell having S-15 Response is shown at the front of this Section.
NOTE: THE SPECIFIED LEAD DIAMETER IS MAINTAINED ONLY WITHIN THE UNTINNED LENGTH.
AVERAGE CHARACTERISTICS

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K. AMBIENT TEMPERATURE = 25° C

MAXIMUM POWER DISSIPATION

ILLUMINATION—FOOTCANDLES = 0.1

PHOTOCURRENT—MICROAMPERES

DC VOLTS BETWEEN TERMINALS

ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
TYPICAL RISE CHARACTERISTICS

CURVES ARE INDEPENDENT OF VOLTAGE.
AMBIENT TEMPERATURE = 25°C

<table>
<thead>
<tr>
<th>CURVE</th>
<th>ILLUMINATION—FOOTCANDLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>0.1</td>
</tr>
<tr>
<td>D</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*COLOR TEMPERATURE 2870°K.*

5-SECOND STORAGE IN DARK PRIOR TO EXCITATION.
5-MINUTE STORAGE IN DARK PRIOR TO EXCITATION.

TYPICAL DECAY CHARACTERISTICS

CURVES ARE INDEPENDENT OF VOLTAGE.
AMBIENT TEMPERATURE = 25°C

<table>
<thead>
<tr>
<th>CURVE</th>
<th>ILLUMINATION—FOOTCANDLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>0.1</td>
</tr>
<tr>
<td>D</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*COLOR TEMPERATURE 2870°K.*

TIME AFTER EXCITATION IS APPLIED—SECONDS

TIME AFTER EXCITATION IS REMOVED—SECONDS

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

CURVES ARE INDEPENDENT OF VOLTAGE.

<table>
<thead>
<tr>
<th>CURVE</th>
<th>ILLUMINATION—FOOTCANDLES *</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
</tr>
<tr>
<td>C</td>
<td>0.1</td>
</tr>
<tr>
<td>D</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* COLOR TEMPERATURE 2870° K.

RELATIVE SENSITIVITY

AMBIENT TEMPERATURE—°C
RESPONSE CHARACTERISTICS

CURVES ARE INDEPENDENT OF VOLTAGE.
AMBIENT TEMPERATURE = 25°C

<table>
<thead>
<tr>
<th>CURVE</th>
<th>ILLUMINATION—FOOTCANDLES *</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.01</td>
</tr>
<tr>
<td>B</td>
<td>0.1</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
</tr>
<tr>
<td>E</td>
<td>100</td>
</tr>
</tbody>
</table>

* COLOR TEMPERATURE 2870° K.

LIGHT PULSES PER SECOND—"ON" TIME EQUALS "OFF" TIME
Image Orthicon

SEMICONDUCTIVE TARGET, S-10 RESPONSE

VERY HIGH SENSITIVITY
HIGH RESOLUTION
MAGNETIC FOCUS
MAGNETIC DEFLECTION

For Studio and Remote Low-Light Level Color and Black-and-White TV Pickup. Sensitivity Equivalent to Film having ASA Exposure Index of 20,000.

DATA

General:
Heater, for Unipotential Cathode:
Voltage (AC or DC) .............. 6.3 ± 10% volts
Current at 6.3 volts .......... 0.6 amp

Direct Interelectrode Capacitance:
Anode to all other electrodes .... 12 pf

Spectral Response ................ S-10
Wavelength of Maximum Response ... 4500 ± 300 angstroms
Photocathode, Semitransparent:
Rectangular image (4 x 3 aspect ratio):
Useful size of ...................... 1.8” max. diagonal

Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

Orientation of.. Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base.

Focusing Method ................. Magnetic
Deflection Method ................. Magnetic

Overall Length ...................... 15.20” ± 0.25”
Greatest Diameter of Bulb ........ 3.00” ± 0.06”
Minimum Deflecting-Coil Inside Diameter ........ 2-3/8”
Deflecting Coil ................. Cleveland Electronics, Part No.OY-1a, or equivalent
Deflecting-Coil Length ............ 5”
Focusing Coil ..................... Cleveland Electronics, Part No.OF-2a, or equivalent
Focusing-Coil Length ............. 10”
Alignment Coil .................... Cleveland Electronics, Part No.OA-3a, or equivalent
Alignment-Coil Length ........... 15/16”
Photocathode Distance Inside End of Focusing Coil . 1/2”
Socket .......................... Cinch Part No.3M14b, or equivalent
Operating Position ................ The tube should never be operated in a vertical position with the diheptal—base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.

Weight (Approx.) ................. 1 lb 6 oz

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

DATA I
9-63
Shoulder Base . . . . . . . . . . . . Keyed Jumbo Annular 7-Pin

**BOTTOM VIEW**

- Pin 1 - Grid No. 6
- Pin 2 - Photocathode
- Pin 3 - Do Not Use
- Pin 4 - Do Not Use

End Base . . . Small-Shell Diheptal 14-Pin (JEDEC No. B14-45)

**BOTTOM VIEW**

- Pin 1 - Heater
- Pin 2 - Grid No. 4
- Pin 3 - Grid No. 3
- Pin 4 - Do Not Use
- Pin 5 - Dynode No. 2
- Pin 6 - Dynode No. 4
- Pin 7 - Anode
- Pin 8 - Dynode No. 5
- Pin 9 - Dynode No. 3
- Pin 10 - Dynode No. 1, Grid No. 2
- Pin 11 - Do Not Use
- Pin 12 - Grid No. 1
- Pin 13 - Cathode
- Pin 14 - Heater

---

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

**PHOTOCATHODE:**
- Voltage: \(-550\) max. volts
- Illumination: \(50\) max. fc

**OPERATING TEMPERATURE:**
- Of any part of bulb: \(55\) max. °C
- Of bulb at large end of tube (Target section): \(0\) min. °C

**TEMPERATURE DIFFERENCE:**
- Between target section and any part of bulb hotter than target section: \(5\) max. °C
- GRID-No. 6 VOLTAGE: \(-550\) max. volts
- TARGET VOLTAGE:
  - Positive value: \(10\) max. volts
  - Negative value: \(10\) max. volts
- GRID-No. 5 VOLTAGE: \(150\) max. volts
- GRID-No. 4 VOLTAGE: \(300\) max. volts
- GRID-No. 3 VOLTAGE: \(400\) max. volts
- GRID-No. 2 & DYNODE-No. 1 VOLTAGE: \(350\) max. volts
- GRID-No. 1 VOLTAGE:
  - Negative-bias value: \(125\) max. volts
  - Positive-bias value: \(0\) max. volts
- VOLTAGE PER MULTIPLIER STAGE: \(350\) max. volts
- ANODE-SUPPLY VOLTAGE: \(1350\) max. volts
- PEAK HEATER-CATHODE VOLTAGE:
  - Heater negative with respect to cathode: \(125\) max. volts
  - Heater positive with respect to cathode: \(10\) max. volts

---

**RADIO CORPORATION OF AMERICA**

Electronic Components and Devices Harrison, N. J.
**Typical Operating Values:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photocathode Voltage</td>
<td>-400</td>
<td></td>
<td>-540</td>
</tr>
<tr>
<td>Grid-No.6 Voltage (Image Focus)</td>
<td>-300</td>
<td></td>
<td>-405</td>
</tr>
<tr>
<td>(Accelerator)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target-Cutoff Voltage</td>
<td>-3</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Grid-No.5 Voltage (Decelerator)</td>
<td>0</td>
<td></td>
<td>125</td>
</tr>
<tr>
<td>Grid-No.4 Voltage (Beam Focus)</td>
<td>140</td>
<td></td>
<td>180</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
<td>225</td>
<td></td>
<td>330</td>
</tr>
<tr>
<td>Grid-No.2 &amp; Dynode-No.1 Voltage</td>
<td>300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-45</td>
<td></td>
<td>-115</td>
</tr>
<tr>
<td>Dynode-No.2 Voltage</td>
<td>600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynode-No.3 Voltage</td>
<td>800</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynode-No.4 Voltage</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynode-No.5 Voltage</td>
<td>1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Voltage</td>
<td>1250</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Peak-to-Peak Blanking Voltage</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Field Strength at Center of Focusing Coil</td>
<td></td>
<td>75</td>
<td></td>
</tr>
<tr>
<td>Field Strength of Alignment Coil</td>
<td></td>
<td>0 to 3</td>
<td></td>
</tr>
</tbody>
</table>

**Performance Data:**

- With conditions shown under Typical Operating Values and with camera lens set to bring the picture highlights one stop above the "knee" of the accompanying Basic Light-Transfer-Characteristic Curve.
- Cathode Radiant Sensitivity at 4500 angstroms: 0.033 a/w
- Luminous Sensitivity: 65 µa/ lm
- Anode Current (DC): 30 µa
- Signal-Output Current (Peak to Peak): 6 µa
- Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc.: 32:1
- Photocathode Illumination at 2870° K Required to bring Picture Highlights One Stop above "Knee" of Light Transfer Characteristic: 0.007 fc
- Peak-to-Peak Response to Square-Wave Test Pattern of 400 TV Lines Per Picture Height (Per cent of large-area black to large-area white): 65 %
a Made by Cleveland Electronics Inc., 1974 East 61st Street, Cleveland, Ohio.
b Made by Cinch Manufacturing Company, 1026 South Roman Avenue, Chicago 24, Illinois.
c Dynode voltage values are shown under Typical Operating Values.
d With 7629A operated in properly adjusted RCA TK-31 camera.
e Adjust for best focus.
f Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 to 5 volts.
g Adjust to give the most uniformly shaded picture near maximum signal.
h Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with indicator located outside of and at the image end of the focusing coil.
i Measured with amplifier having flat frequency response.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-10 RESPONSE
is shown at front of this Section
NOTE 1: DOTTED AREA IS FLAT OR EXTENDS TOWARD 01HEPTAL-BASE END OF TUBE BY 0.060" MAX.

ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

a. Six holes having diameter of 0.065" ± 0.001" and one hole having diameter of 0.150" ± 0.001". All holes have depth of 0.265" ± 0.001". The six 0.065" holes are enlarged by 45° taper to depth of 0.047". All holes are spaced at angles of 51°26' ± 5' on circle diameter of 2.500" ± 0.001".

b. Seven stops having height of 0.187" ± 0.001", centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125" from 2.812" diameter and having height of 0.126" ± 0.001".

d. Neck-cylinder clearance hole having diameter of 2.200" ± 0.001".
BASIC LIGHT-TRANSFER CHARACTERISTIC

ILLUMINATION: TUNGSTEN LIGHT, DAYLIGHT, OR WHITE FLUORESCENT. FOR SMALL-AREA HIGHLIGHTS.

HIGHLIGHT ILLUMINATION ON PHOTOCATHODE—FOOTCANDLES

TYPICAL SIGNAL OUTPUT—MICROAMPERES

0.00001 0.0001 0.001 0.01 0.1

0.1 2 4 6 8

0.00001 0.0001 0.001 0.01 0.1

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Magnetic Focus 1"-Diameter  Magnetic Deflection
For Non-Critical Industrial and Consumer
Product Closed-Circuit TV

The 7735A and 7735 are the same as the 7735B except for
the following items:

TYPICAL OPERATION AND PERFORMANCE DATA

Low-Voltage Operation

<table>
<thead>
<tr>
<th></th>
<th>7735A</th>
<th>7735</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No.1 Voltage for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Picture Cutoff</td>
<td>-45 to -100</td>
<td>-45 to -100</td>
</tr>
<tr>
<td>Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Value</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Limiting Resolution:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At center of picture—Typical Value</td>
<td>700</td>
<td>700</td>
</tr>
</tbody>
</table>

AVERAGE SENSITIVITY OPERATION

Faceplate Illumination (Highlight) 1 fc

Target Voltage 20 to 40 V

Dark Current 0.02 μA

Minimum Signal-Output Current 0.15 μA

a With no blanking voltage on grid No.1.

b For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

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

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

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

SPURIOUS SIGNAL TEST

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 but not including 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3 but not including 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1 or less</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.
Vidicon

Magnetic Focus 1"-Diameter Magnetic Deflection

For Live-Scene Pickup with Color or Black-and-White TV Cameras in Broadcast, Industrial, and Closed-Circuit Systems. The 7735B is Unilaterally Interchangeable with Types 7735 & 7735A.

GENERAL
Heater, for Unipotential Cathode:
Voltage (AC or DC) ............... 6.3 ± 10% volts
Current at 6.3 volts .............. 0.6 A

Direct Interelectrode Capacitance:
Target to all other electrodes .... 4.6 pF

Spectral Response: See Type II Spectral Response at front of this section

Photoconductive Layer:
Maximum useful diagonal of rectangular image (4 x 3 [aspect ratio]) 0.62 inch

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method .......... Magnetic
Deflection Method .......... Magnetic
Overall Length .......... 6.25" ± 0.25"
Greatest Diameter .......... 1.125" ± 0.010"
Bulb .......... T8

Base .......... Small-Button Ditetar 8-Pin, (JEDEC No.E8-11)
Socket .......... Cinch® No.54A18088, or equivalent

Cleveland Electronics

Focusing Coil .......... No. VF-115-5, or equivalent
Deflecting Yoke .......... No. VY-111-3, or equivalent
Alignment Coil .......... No. VA-118, or equivalent

Operating Position .......... Any
Weight (Approx.) .......... 2 oz

ABSOLUTE-MAXIMUM RATINGS
For scanned area of 1/2" x 3/8"

Grid—No. 3 & Grid—No. 4 Voltage .......... 1000 max. volts
Grid—No. 2 Voltage .......... 1000 max. volts
Grid—No. 1 Voltage:
Negative bias value .......... 300 max. volts
Positive bias value .......... 0 max. volts
Peak Heater-Cathode Voltage:
Heater negative with respect to cathode .......... 125 max. volts
### Heater positive with respect to cathode
- Target Voltage: 10 max. volts
- Dark Current: 0.25 max. μA
- Peak Target Current: 0.55 max. μA
- Faceplate:
  - Illumination: 1000 max. fc
  - Temperature: 71 max. °C

### TYPICAL OPERATION AND PERFORMANCE

**For scanned area of 1/2" x 3/8" - Faceplate temperature of 30° to 35°C**

<table>
<thead>
<tr>
<th>Grid-No. 4 (Decelerator) &amp; Grid-No. 3 (Beam-Focus Electrode) Voltage</th>
<th>Low-Voltage Operation</th>
<th>High-Voltage Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>250 to 300 volts</td>
<td>750 volts</td>
</tr>
<tr>
<td>Grid-No. 2 (Accelerator) Voltage</td>
<td>300 volts</td>
<td>300 volts</td>
</tr>
</tbody>
</table>

**Grid-No. 1 Voltage for Picture Cutoff**
- -45 to -100 volts

**Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 μA and 0.2 μA**
- 0.65

**Visual Equivalent Signal-to-Noise Ratio (Approx.)**
- 300:1

**Leg**
- Maximum value: 28 %
- Typical value: 23 %

**Minimum Peak-to-Peak Blanking Voltage:**
- When applied to grid No. 1: 75 volts
- When applied to cathode: 20 volts

**Limiting Resolution:**
- At center of picture:
  - Typical value: 750 TV lines
  - Minimum value: 700 TV lines

**Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture**
- Field Strength at Center of Focusing Coil:
  - Horizontal: 40 gauss
  - Vertical: 25 gauss

**Peak Deflecting-Coil Current:**
- Horizontal: 185 mA
- Vertical: 25 mA

**Field Strength of Adjustable Alignment Coil**
- 0 to 4 gauss

---

*Indicates a change.*
**High-sensitivity operation—0.5 footcandle on faceplate**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>0.5</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage&lt;sup&gt;n&lt;/sup&gt;.P.</td>
<td>30 to 60</td>
<td>V</td>
</tr>
<tr>
<td>Dark Current&lt;sup&gt;y&lt;/sup&gt;.</td>
<td>0.10</td>
<td>µA</td>
</tr>
<tr>
<td>Signal-Output Current&lt;sup&gt;r&lt;/sup&gt;</td>
<td>Typical</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>0.265</td>
</tr>
</tbody>
</table>

**Average-sensitivity operation—1.0 footcandle on faceplate**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>1.0</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage&lt;sup&gt;n&lt;/sup&gt;.P.</td>
<td>20 to 40</td>
<td>V</td>
</tr>
<tr>
<td>Dark Current&lt;sup&gt;y&lt;/sup&gt;.</td>
<td>0.025</td>
<td>µA</td>
</tr>
<tr>
<td>Signal-Output Current&lt;sup&gt;r&lt;/sup&gt;</td>
<td>Typical</td>
<td>0.275</td>
</tr>
<tr>
<td></td>
<td>Minimum</td>
<td>0.265</td>
</tr>
</tbody>
</table>

**High-Light Level Operation—40 footcandles on faceplate**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>10</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage&lt;sup&gt;n&lt;/sup&gt;.P.</td>
<td>10 to 22</td>
<td>V</td>
</tr>
<tr>
<td>Dark Current&lt;sup&gt;y&lt;/sup&gt;.</td>
<td>0.005</td>
<td>µA</td>
</tr>
<tr>
<td>Signal-Output Current&lt;sup&gt;r&lt;/sup&gt;</td>
<td>Typical</td>
<td>0.3</td>
</tr>
</tbody>
</table>

---

**Notes:**

a. This capacitance, which effectively is the output impedance of the 7735B, 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.

b. Orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

c. Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

d. These components are chosen to provide tube operation with minimum beam-loading error.

e. Made by Cinch Manufacturing Corporation, 1026 S. Homan Ave., Chicago 24, Illinois.

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

g. Definition, focus uniformity, and picture quality decreases with decreasing grid-No. 4 and grid-No. 3 voltage. In general, grid-No. 4 and grid-No. 3 should be operated above 250 volts.

h. With no blanking voltage on grid No. 1.

i. Measured with high-gain, low-noise, cascade-input-type amplifier having bandwidth of 5 Mc/s and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominantly of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

j. Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.3 microampere and a dark current of 0.025 microampere.

k. 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.

l. The target voltage for each 7735B must be adjusted to the value which gives the desired operating signal current.

m. Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.
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.

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

**OPERATING CONSIDERATIONS**

Target connection is made by a suitable spring contact bearing against the edge of the metal ring at the face end of the tube.

**Faceplate-temperature** should not exceed 71°C (160°F), either during operation or storage of the 7735B. Operation with a faceplate temperature in the range from about 25°C to 35°C (77°F to 95°F) is recommended.

Provisions should also be made in the camera installation to hold the faceplate temperature of the 7735B at a steady value within the recommended range. Dark current increases with increasing temperature. It is highly desirable to operate the 7735B at a steady temperature to maintain dark current at a preselected value. This mode of operation ensures both optimum and stable day-to-day performance. If such provisions cannot be made, changes in target voltage may be required from time to time to maintain the desired picture quality.

As shown under *Uncompensated Horizontal Square-Wave Response*, a substantial increase in both limiting resolution and amplitude response of the 7735B may be obtained by increasing the operating voltages on grid No. 4 and grid No. 3. The focusing-coil field strength must be increased and more deflecting power is required at higher electrode voltages as indicated under *Typical Operation and Performance Data*.

Operation at higher electrode voltages may introduce additional beam-landing errors that may be partially compensated for by repositioning the deflecting components. Full compensation may require the application of a modulating voltage of suitable waveform, at both horizontal and vertical scan rates, to the cathode, grid No. 1, and grid No. 2 of the 7735B.

**Dos and Don’ts on Use of RCA-7735B**

**Dos**

1. Adjust camera scanning to utilize maximum useful area of photoconductive layer.
2. Orient the vidicon so that horizontal scan is essentially parallel to the plane passing through tube axis and short pin.
3. Align electron beam.
4. With lens capped, adjust target voltage for each individual vidicon to the highest value that will still give uniform background.
5. Match any visible raster pattern of photoconductive layer with new scan by reorienting the vidicon as required.
6. Use only sufficient beam current to bring out picture highlights.
7. Open lens iris or increase the scene illumination to obtain the "snappiest" picture without noticeable smear from moving objects. Target voltage should be reduced if light on the tube and/or resultant signal is excessive.

8. Always cap lens when transporting camera (see "Don'ts" 5).

Don'ts
1. Don't underscan the photoconductive layer.
2. Don't change camera size and centering controls once the scanned area of photoconductive layer has been properly positioned.
3. Don't rotate vidicon from its original operating position in deflecting yoke.
4. Don't turn beam of vidicon on without normal scanning or remove scanning before beam of vidicon is turned off.
5. DON'T ALLOW IMAGE OF THE SUN OR OTHER VERY INTENSE SOURCE OF ILLUMINATION TO BE FOCUSED ON PHOTOCONDUCTIVE LAYER AT ANY TIME.

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown above. The 7735B is operated under the conditions specified under Typical Operation and Performance Data with the lens adjusted to provide a target current of 0.3 microampere. The 7735B is adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.
TABLE I (For scanned area of 1/2" x 3/8")

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>ZONE 1 Allowed Spots</th>
<th>ZONE 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3 but not including 1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1 or less</td>
<td>footnote s</td>
<td>footnote s</td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

Spots of this size are allowed unless concentration causes a smudged appearance.

DIMENSIONAL OUTLINE

Note: Straight sides of masked portions are parallel to the plane passing through tube axis and short pin.
ADDITIONAL DIMENSIONAL OUTLINE NOTE:
Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

TERMINAL DIAGRAM (Bottom View)
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Internal Connection — Do Not Use
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No. 2
Pin 6: Grids No.2 and No.4
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection — Make No Connection

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS
To obtain minimum beam-landing error

Note: Cross-hatching indicates wound position of focusing coil.
RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30° C APPROX.

TARGET VOLTS

DARK CURRENT - MICROAMPERES

UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE

HIGHLIGHT TARGET MICROAMPERES = 0.35
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SQUARE-WAVE RESOLUTION WEDGE.

CURVE A: GRID - No. 4 & GRID - No. 3 VOLTS = 750
CURVE B: GRID - No. 4 & GRID - No. 3 VOLTS = 300

UNCOMPENSATED HORIZONTAL PEAK-TO-PEAK SQUARE-WAVE RESPONSE AT CENTER OF PICTURE PER CENT

TV LINE NUMBER

RCA Electronic Components
ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROXIMATE.

DARK CURRENT (MICROAMPERES) = 0.025

SIGNAL OUTPUT - MICROAMPERES

0.002 0.01 0.1 1.0

0.005 0.01 0.1 1.0

2870°K TUNGSTEN ILLUMINATION ON TUBE FACE - FOOTCANDLES

0.01 2 4 6 8 10 12 14

FACEPLATE TEMPERATURE • 30°C APPROXIMATE.
TYPICAL PERSISTENCE CHARACTERISTIC

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" X 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
FACEPLATE ILLUMINATION = 1 FOOTCANDLE

SIGNAL - OUTPUT CURRENT - PER CENT OF INITIAL VALUE

TIME AFTER ILLUMINATION IS REMOVED - MILLISECONDS
Multiplier Phototube

10-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE HAVING ENCLOSED, IN-LINE DYNOE STRUCTURE, 1.68"-DIAMETER, SPHERICAL, SEMITRANSPARENT PHOTOCATHODE, S-11 RESPONSE, AND VERY SHORT TIME-RESOLUTION CAPABILITY

DATA

General:
Spectral Response: S-11
Wavelength of Maximum Response: 4400 ± 500 angstroms
Cathode, Semitransparent:
Shape: Spherical
Window:
Area (Projected): 2.2 sq.in.
Minimum diameter: 1.68 in.
Index of refraction: 1.51
Direct Interelectrode Capacitances (Approx.):
Anode to dynode No. 10: 3.8 μf
Anode to all other electrodes: 5 μf
Dynode No. 10 to all other electrodes: 6.5 μf
Maximum Overall Length: 6.12"
Seated Length: 5.18" ± 0.19"
Maximum Diameter: 2.31"
Operating Position: Any
Weight (Approx.): 6 oz
Bulb: Cinch No. 3M14, or equivalent
Base: Medium-Shell Dihedral 14-Pin (JEDEC Group 5, No. B14-38)

Basing Designation (Bottom View): 14AV

Maximum Ratings, Absolute-Maximum Values:
SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC): 2500 max. volts
### Characteristics Range Values for Equipment Design:

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table 1

*With E = 2000 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification*

#### Sensitivity:

<table>
<thead>
<tr>
<th>Radiant, at 4400 angstroms</th>
<th>9.6 x 10^5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>0.056</td>
</tr>
<tr>
<td>Luminous, at 0 cps</td>
<td>200 1200 6000</td>
</tr>
</tbody>
</table>

#### Equivalent Anode-Dark-Current Input

- at luminous sensitivity of 230 amperes/lumen: 9 x 10^{-10} 3.5 x 10^{-9} lumen
- at capacitive sensitivity of 40 amperes/lumen: 1.7 x 10^{-7} lumen

#### Equivalent Noise Input

- Anode-Pulse Rise Time: 2 x 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} sec
- 1.6" = 5 x 10^{-10} sec

*With E = 1500 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification*
### Cathode luminous:
- With tungsten light source: 
  - Min. 50 µa/lumen
  - Median 70 µa/lumen
  - Max. µa/lumen

### Current Amplification:
- Equivalent Anode-Dark-Current Input at luminous sensitivity of 20 amperes/lumen: 
  - Min. \(-8 \times 10^{-10}\)
  - Median \(2.5 \times 10^{-9}\)
  - Max. \(1 \times 10^{-11}\) lumen

### Equivalent Noise Input:
- Min. \(-8.5\)
- Median \(9\)
- Max. %

### Pulse Height Resolution:
- Min. \(-10\)
- Median \(-12\)
- Max. -

### With E = 1000 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification:

<table>
<thead>
<tr>
<th>Sensitivity:</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4400 angstroms</td>
<td>(-4.8 \times 10^3)</td>
<td>(-)</td>
<td>(-) amp/watt</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>(-0.056)</td>
<td>(-)</td>
<td>(-) amp/watt</td>
</tr>
<tr>
<td>Luminous, at 0 cps</td>
<td>1</td>
<td>6</td>
<td>30 amp/lumen</td>
</tr>
<tr>
<td>Cathode luminous: With tungsten light source</td>
<td>50 µa/lumen</td>
<td>70 µa/lumen</td>
<td></td>
</tr>
</tbody>
</table>

### Current Amplification:
- Equivalent Anode-Dark-Current Input at luminous sensitivity of 6 amperes/lumen: 
  - Min. \(-5 \times 10^{-10}\)
  - Median -
  - Max. - lumen

### Equivalent Noise Input:
- Min. \(-5 \times 10^{-12}\)
- Median -
- Max. - lumen

### Notes:
- Averaged over any interval of 30 seconds maximum.
- Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 0.1 microlumen is used.
- Under the following conditions: The light source is a tungsten-filament lamp 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 together as anode.
- Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning No.C.S. 5-58, Glass Code No.5113 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux is 0.01 lumen. A voltage of 200 volts is applied between cathode and all other electrodes connected together as anode.
- For spectral characteristic of this source, see sheet 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.
- Measured at a tube temperature of 28° C. Dark current may be reduced by the use of a refrigerant.
- Under the following conditions: Supply voltage (E) is as shown, 25°C—C tube temperature, external shield is connected to cathode, bandwidth 1 cycle per second, tungsten light source of 2870° K interrupted at a 1 MHz 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.
- Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is primarily a function of transition time in the multiplier stages and is measured under conditions with an incident-light spot approximately 1 millimeter in diameter centered on the photocathode.

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**RADIO CORPORATION OF AMERICA**  
Electron Tube Division  
Harrison, N.J.  
DATA 2  
3-61
These values 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.

Measured with supply voltage \( E \) = 1200 to 1300 volts; radiation source, an isotope of cesium having an atomic mass of 137 \(^{137}\)Cs; scintillation counter crystal, acylindrical \( 2^* \times 2^* \) thallium-activated sodium-iodide type \( \text{NaI(Tl)} \) — type 808550, Serial No AL281 manufactured by Harshaw Chemical Co., 1945 E. 97 Street, Cleveland 6, Ohio.

<table>
<thead>
<tr>
<th>TABLE I</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Voltage to be Provided by Divider</th>
<th>8.06% 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 Anode</td>
<td>12.4</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td></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 current amplification.

Operating Considerations

The operating stability of the 7746 is dependent on the magnitude of the anode current and its duration. When the 7746 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 7746 usually recovers a substantial percentage of such loss in sensitivity.

The use of an average anode current well below the maximum-rated value of 2 milliamperes is recommended 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 7746 may be necessary.

Adequate light shielding should be provided to prevent extraneous light from reaching any part of the 7746.

RADIO CORPORATION OF AMERICA
Electron Tube Division Harrison, N. J.
The high voltages at which the 7746 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 Phototube having S-II Response is shown at 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.
**CHARACTERISTICS**

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

<table>
<thead>
<tr>
<th>Between</th>
<th>8.06% of ( E ) multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode &amp; ( \text{DY1} )</td>
<td>2</td>
</tr>
<tr>
<td>( \text{DY1} ) &amp; ( \text{DY2} )</td>
<td>1.4</td>
</tr>
<tr>
<td>( \text{DY2} ) &amp; ( \text{DY3} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY3} ) &amp; ( \text{DY4} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY4} ) &amp; ( \text{DY5} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY5} ) &amp; ( \text{DY6} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY6} ) &amp; ( \text{DY7} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY7} ) &amp; ( \text{DY8} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY8} ) &amp; ( \text{DY9} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY9} ) &amp; ( \text{DY10} )</td>
<td></td>
</tr>
<tr>
<td>( \text{DY10} ) &amp; Anode</td>
<td></td>
</tr>
<tr>
<td>Anode &amp; Cathode</td>
<td>12.4</td>
</tr>
</tbody>
</table>

Focusing-electrode voltage is adjusted for maximum current amplification.

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**Graph**

- **Sensitivity—Amperes/Lumen (Color Temp. 2870°K)**
  - **Maximum Sensitivity**
  - **Median Sensitivity**
  - **Minimum Sensitivity**

- **Supply Volts \( (E) \) Between Anode and Cathode**
  - 500, 1000, 1500, 2000, 2500 Volts
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>8.06% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE &amp; D1</td>
<td>2</td>
</tr>
<tr>
<td>D2 &amp; D3</td>
<td>1.4</td>
</tr>
<tr>
<td>D4 &amp; D5</td>
<td>1</td>
</tr>
<tr>
<td>D6 &amp; D7</td>
<td>1</td>
</tr>
<tr>
<td>D8 &amp; D9</td>
<td>1</td>
</tr>
<tr>
<td>D10</td>
<td>1</td>
</tr>
<tr>
<td>D11 &amp; ANODE</td>
<td>1</td>
</tr>
<tr>
<td>ANODE &amp; CATHODE</td>
<td>12.4</td>
</tr>
</tbody>
</table>

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.

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

TUBE TEMPERATURE = 25° C
FOCUSING-ELECTRODE VOLTAGE IS VARIED BY ADJUSTMENT OF POTENIOMETER CONNECTED BETWEEN DYNOE NO. 1 AND CATHODE.
TYPICAL ANODE-CURRENT CHARACTERISTIC

DYNODE-N°1-TO-CATHODE VOLTS = 200
DYNODE-N°1-TO-DYNODE-N°2 VOLTS = 140
VOLTS PER SUCCEEDING DYNODE STAGE
EXCEPT FOR DYNODE-N°5 STAGE = 100
FOCUSING-ELECTRODE VOLTAGE ADJUSTED
FOR MAXIMUM CURRENT AMPLIFICATION.
ANODE IS AT GROUND POTENTIAL.
Multiplier Phototube

6-STAGE, HEAD-ON, FLAT-FACEPLATE, COMPACT TYPE HAVING IN-LINE DYNOE STRUCTURE, 0.5"-DIAMETER CURVED, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-II RESPONSE

DATA

General:

Spectral Response .............................................. S-11
Wavelength of Maximum Response .......................... 4400 ± 500 angstroms

Cathode, Semitransparent:

Shape ......................................................... Curved Circular
Window:

Area .................................................................. 0.2 sq. in.
Minimum diameter ............................................ 0.5 in.
Index of refraction ........................................... 1.51

Direct Interelectrode Capacitances (Approx.):

Anode to dynode No. 6 ........................................... 1.8 μf
Anode to all other electrodes ................................. 2.8 μf

Maximum Overall Length ...................................... 2.75"
Seated Length .................................................... 2.18" ± 0.06"
Maximum Diameter ............................................. 0.78"
Operating Position ............................................. Any
Weight (Approx.) ................................................ 0.6 oz

Bulb .................................................................. T6
Socket ................................................................ Cinch No. 121-11-10-134, or equivalent
Base .................................................................. Small-Button Ninar 9-Pin (JEDEC No. E9-37)
Basing Designation for BOTTOM VIEW ................... 9NG

Pin 1 - Dynode No. 1
Pin 2 - Dynode No. 3
Pin 3 - Dynode No. 5
Pin 4 - Anode
Pin 5 - Dynode No. 6
Pin 6 - Dynode No. 4

Pin 7 - Internal Connection – Do Not Use
Pin 8 - Dynode No. 2
Pin 9 - Photocathode

Maximum Ratings, Absolute-Maximum Values:

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC or Peak AC) .................. 1500 max. volts
SUPPLY VOLTAGE BETWEEN DYNOE No. 6 AND ANODE (DC or Peak AC) ............... 300 max. volts
SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNOES (DC or Peak AC) ............... 200 max. volts
SUPPLY VOLTAGE BETWEEN DYNOE No. 1 AND CATHODE (DC or Peak AC) ....... 400 max. volts
AVERAGE ANODE CURRENT .................................. 0.5 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 \( 1/4 \) of \( E \) between cathode and dynode No.1; \( 1/8 \) of \( E \) for each succeeding stage; and \( 1/8 \) of \( E \) between dynode No.6 and anode

With \( E = 1200 \) volts (Except as noted)

<table>
<thead>
<tr>
<th>Sensitivity:</th>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiant, at 4400 angstroms.</td>
<td>0.00024</td>
<td>–</td>
<td>( \text{amp}/\mu\text{w} )</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td>0.048</td>
<td>–</td>
<td>( \text{amp}/\text{watt} )</td>
</tr>
<tr>
<td>Luminous, at 0 cps.</td>
<td>0.1</td>
<td>0.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source*</td>
<td>40</td>
<td>60</td>
<td>–</td>
</tr>
<tr>
<td>With blue light source†</td>
<td>–</td>
<td>0.06</td>
<td>–</td>
</tr>
<tr>
<td>Equivalent Amplification.</td>
<td>–</td>
<td>( 5 \times 10^{-3} )</td>
<td>–</td>
</tr>
<tr>
<td>Equivalent Anode-Dark Current Input.</td>
<td>–</td>
<td>( 1 \times 10^{-8} )</td>
<td>( 3 \times 10^{-8} )</td>
</tr>
<tr>
<td>Equivalent Noise Input.</td>
<td>–</td>
<td>( 3 \times 10^{-10} )</td>
<td>( 1 \times 10^{-9} )</td>
</tr>
</tbody>
</table>

* Averaged over any interval of 30 seconds maximum.
† Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.
‡ Under the following conditions: The light source is a tungsten-filament lamp 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 together as anode.
§ For spectral characteristic of this source, see sheet 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.

Measured at a tube temperature of 25° C and with the supply voltage \( (E) \) adjusted to give a luminous sensitivity of 0.3 ampere per lumen. Dark current may be reduced by the use of a refrigerator.

Under the following conditions: Supply voltage \( (E) \) is as shown, 25°-C tube temperature, external shield is connected to cathode, bandwidth 1 cycle per second, tungsten light source 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 pulses is equal to the "off" period. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

OPERATING CONSIDERATIONS

The use of an average anode current will below the maximum-rated value of 0.5 milliampere is recommended when stability of operation is important.
Electrostatic and/or magnetic shielding of the 7764 may be necessary.

The high voltages at which the 7764 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.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-II Response is shown at front of this Section
AVERAGE ANODE CHARACTERISTICS

DYNODE NO. 1-TO-CATHODE VOLTS=300
EACH SUCCEEDING-DYNOE-STAGE VOLTS=150
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT
COLOR TEMPERATURE OF 2870° K.
CHARACTERISTICS

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/4 OF E BETWEEN CATHODE AND DYNODE #1; 1/8 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/8 OF E BETWEEN DYNODE #6 AND ANODE.
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/4 OF E BETWEEN CATHODE AND DYNOIDE N81; 1/8 OF E FOR EACH SUCCEEDING STAGE; AND 1/6 OF E BETWEEN DYNOIDE N86 AND ANODE.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE=25° C.

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

Small, 3/4"-Diameter, 10-Stage, Head-On Type
Having S-11 Spectral Response

For Use in Compact Scintillation Counting Systems and
In Other Applications Involving The Detection and Measure-
ment Of Low-Level Light Sources

GENERAL
Spectral Response ......................................... S-11
Wavelength of Maximum Response .................. 4400 ± 500 Å
Cathode, Semitransparent ......................... Cesium-Antimony
Minimum projected area ......................... 0.2 in² (1.26 cm²)
Minimum diameter ................................. 0.5 in (1.27 cm)
Window .... Lime Glass (Corning® No.0080), or equivalent
Shape ......................................................... Plano-Concave
Index of refraction at 4360 angstroms ........... 1.523

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

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) ............... 3.94 in (10 cm)
Maximum Diameter ........................... 0.78 in (2 cm)
Bulb ......................................................... T6

Base ................................................ See Dimensional Outline
Magnetic Shield ... Millen® Part No.80801N, or equivalent
Operating Position .................. Any
Weight (Approx.) ...................................... 0.9 oz (25.5 g)

MAXIMUM RATINGS, Absolute-Maximum Values
DC Supply voltage:
Between anode and cathode .................. 1500 max. V
Between anode and dynode No.10 ........... 300 max. V
Between consecutive dynodes .................. 200 max. V
Between dynode No.1 and cathode ........... 400 max. V
Average Anode Current .......................... 0.5 max. mA
Ambient Temperature .......................... 75 max. °C

RCA Electronic Components

DATA 1
11-69
CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

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

With E = 1250 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 at 4400 angstroms</td>
<td>-</td>
<td>1.3 x 10^4</td>
<td>- A/W</td>
</tr>
<tr>
<td>Luminous (2870° K)</td>
<td>7</td>
<td>16</td>
<td>60 A/Im</td>
</tr>
<tr>
<td><strong>Cathode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 4400 angstroms</td>
<td>-</td>
<td>0.048</td>
<td>- A/W</td>
</tr>
<tr>
<td>Luminous (2870° K)</td>
<td>4 x 10^{-5}</td>
<td>6 x 10^{-5}</td>
<td>- A/Im</td>
</tr>
<tr>
<td>Current with blue light source</td>
<td>4 x 10^{-8}</td>
<td>6 x 10^{-8}</td>
<td>- A</td>
</tr>
<tr>
<td>Quantum Efficiency at 4200 angstroms</td>
<td>-</td>
<td>14</td>
<td>- %</td>
</tr>
<tr>
<td><strong>Current Amplification:</strong></td>
<td>-</td>
<td>2.7 x 10^5</td>
<td>-</td>
</tr>
<tr>
<td><strong>Anode Dark Current:</strong></td>
<td>-</td>
<td>4 x 10^{-9}</td>
<td>4 x 10^{-8} A</td>
</tr>
<tr>
<td><strong>Equivalent Anode Dark Current Input:</strong></td>
<td>-</td>
<td>5 x 10^{-10}</td>
<td>5 x 10^{-9} lm</td>
</tr>
<tr>
<td><strong>Equivalent Noise Input:</strong></td>
<td>-</td>
<td>3.2 x 10^{-12}</td>
<td>- lm</td>
</tr>
<tr>
<td><strong>Anode-Pulse Rise Timer,</strong> at 1500 V</td>
<td>-</td>
<td>1.8 x 10^{-9}</td>
<td>- s</td>
</tr>
<tr>
<td><strong>Electron Transit Timer,</strong> at 1500 V</td>
<td>-</td>
<td>2 x 10^{-8}</td>
<td>-</td>
</tr>
</tbody>
</table>

* Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.
* Averaged over any interval of 30 seconds maximum.
* 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 803 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.

--- Indicates a change or addition.
This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 803 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, 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.

At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 7.5 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

At 4400 angstroms. These values are calculated from the EADCi values in lumens using a conversion factor of 803 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 4400 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 803 lumens per watt.

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.

**DIMENSIONAL OUTLINE**

![Diagram of the tube's dimensions](image)

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.94 max.</td>
<td>100.0 max.</td>
</tr>
<tr>
<td>B</td>
<td>3.50 + .06</td>
<td>88.9 + 1.5</td>
</tr>
<tr>
<td>C</td>
<td>.5 min. dia.</td>
<td>12.7 min. dia.</td>
</tr>
<tr>
<td>D</td>
<td>.78 max. dia.</td>
<td>19.8 max. dia.</td>
</tr>
<tr>
<td>E</td>
<td>.755 max. dia.</td>
<td>19.18 max. dia.</td>
</tr>
<tr>
<td>F</td>
<td>.38 max.</td>
<td>9.7 max.</td>
</tr>
<tr>
<td>G</td>
<td>.47 ± .01 dia.</td>
<td>11.9 ± .25 dia.</td>
</tr>
<tr>
<td>H</td>
<td>.75 min.</td>
<td>19.0 min.</td>
</tr>
<tr>
<td>P</td>
<td>.30 max.</td>
<td>7.6 max.</td>
</tr>
<tr>
<td>R</td>
<td>1.0 max.</td>
<td>25 max.</td>
</tr>
</tbody>
</table>
**DIMENSIONAL OUTLINE NOTES**

**Note 1:** Within this length, maximum diameter of tube is 0.78".

**Note 2:** The semiflexible leads of the tube may be soldered or welded into the associated circuit. If desired, the leads may be trimmed to within 1/4 inch of the protective shell. Care must be exercised when making such connections to prevent tube destruction due to thermal stress of the glass–metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the protective shell is recommended. Excessive bending of the leads is to be avoided.

**Note 3:** Deviation from flatness will not exceed 0.006" from peak to valley.

**LEAD CONNECTIONS (BOTTOM VIEW)**

- 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

**LEAD ORIENTATION (BOTTOM VIEW)**

- 12 SEMIFLEXIBLE DUMET LEADS 0.016±0.004 DIA

**INDEX**

- **NOTE 1**
- **NOTE 2**
LEAD ORIENTATION NOTES

Note 1: Lead No. 14 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 VOLTAGE-DIVIDER ARRANGEMENT WHICH PERMITS DIRECT COUPLING TO THE ANODE

R₁ and R₂: 560,000 ohms, 1/2 watt
R₃: 820,000 ohms, 1/2 watt
R₄ through R₁₁: 470,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 500 and 1500 volts dc.
Note 2: Component values are dependent upon nature of application and output signal desired.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS

---

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)
C5 and C6: 0.005 μF, 3000 volts (dc working)
R1 and R2: 560,000 ohms, 1/2 watt
R3: 820,000 ohms, 1/2 watt
R4 through R11: 470,000 ohms, 1/2 watt
R12: 1 megohm, 1/2 watt
R13: 100,000 ohms, 1/2 watt

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

(Continued on next page)
Note 2: Capacitors $C_1$ through $C_6$ should be connected at tube socket for optimum high-frequency performance.

Note 3: Component values are dependent upon nature of application and output signal desired.

**TABLE I

**

**TYPICAL POTENTIAL DISTRIBUTION**

<table>
<thead>
<tr>
<th>Between:</th>
<th>8.25% of Supply Voltage (E) Multiplied by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.7</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>12.1</td>
</tr>
</tbody>
</table>

**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](image-url)
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

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

<table>
<thead>
<tr>
<th>BETWEEN</th>
<th>8.25% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND DYNOKE No.1</td>
<td>1.2</td>
</tr>
<tr>
<td>DYNOKE No. 1 AND DYNOKE No. 2</td>
<td>1.2</td>
</tr>
<tr>
<td>DYNOKE No. 2 AND DYNOKE No. 3</td>
<td>1.7</td>
</tr>
<tr>
<td>EACH SUCCEEDING DYNOKE-STAGE</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE AND CATHODE</td>
<td>12.1</td>
</tr>
</tbody>
</table>

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

CURRENT AMPLIFICATION

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

92CM-10657R2
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.
TYPICAL ANODE 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>8.25 % OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND DYNOE No.1</td>
<td>1.2</td>
</tr>
<tr>
<td>DYNOE No.1 AND DYNOE No.2</td>
<td>1.2</td>
</tr>
<tr>
<td>DYNOE No.2 AND DYNOE No.3</td>
<td>1.7</td>
</tr>
<tr>
<td>EACH SUCCEEDING DYNOE - STAGE</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE AND CATHODE</td>
<td>12.1</td>
</tr>
</tbody>
</table>

TUBE TEMPERATURE IS 22°C.

Electronic Components

DATA 6
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

Supply voltage E is 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. Photocathode is fully illuminated. Tube is oriented in magnetic field as shown below:

- Positive value of H in direction shown:
  1. Direction (1) is out of paper
  2. Direction (2) is into paper
  3. Direction (3) is out of paper

Electronics Components

DATA 7
11-69
Multiplier Phototube

12-Stage, Head-On, Spherical-Faceplate Type Having Enclosed, In-Line Dynode Structure, 1.68"-Diameter, Spherical, Semitransparent Photocathode, S-11 Response, High Current Amplification, and Extremely Short Rise Time

**Data**

**General:**

- Spectral Response: S-11
- Wavelength of Maximum Response: 4400 ± 500 angstroms

**Cathode, Semitransparent:**

- Shape: Spherical
- Window:
  - Area (Projected): 2.2 sq. in.
  - Minimum diameter: 1.68 in.
  - Index of refraction: 1.51

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

- Anode to dynode No.12: 3.8 μf
- Anode to all other electrodes: 5.7 μf
- Dynode No.12 to all other electrodes: 6.8 μf

**Maximum Overall Length:** 6.31"

**Seated Length:** 5.50" ± 0.19"

**Maximum Diameter:** 2.06"

**Operating Position:** Any

**Weight (Approx.):** 7 oz

**Bulb:** T16

**Socket:** Cinch No.CX-875A, or equivalent

**Base:** Small-Shell Bidecal 20-Pin (JEDEC No.B20-102)

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

**Pin 1** – No Connection

**Pin 2** – Dynode No.1

**Pin 3** – Dynode No.3

**Pin 4** – Dynode No.5

**Pin 5** – Dynode No.7

**Pin 6** – Dynode No.9

**Pin 7** – Dynode No.11

**Pin 8** – Anode

**Pin 9** – No Connection

**Pin 10** – No Connection

**Pin 11** – No Connection

**Pin 12** – Dynode No.12

**Pin 13** – Dynode No.10

**Pin 14** – Dynode No.8

**Pin 15** – Dynode No.6

**Pin 16** – Dynode No.4

**Pin 17** – Dynode No.2

**Pin 18** – No Connection

**Pin 19** – Grid No.1
  (Focusing Electrode)

**Pin 20** – Photocathode

*RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.*
**Maximum Ratings, Absolute-Maximum Values:**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC)</td>
<td>2600 max. volts</td>
</tr>
<tr>
<td>SUPPLY VOLTAGE BETWEEN DYNODE No.12 AND ANODE (DC)</td>
<td>400 max. volts</td>
</tr>
<tr>
<td>SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC)</td>
<td>300 max. volts</td>
</tr>
<tr>
<td>SUPPLY VOLTAGE BETWEEN DYNODE No.1 AND CATHODE (DC)</td>
<td>600 max. volts</td>
</tr>
<tr>
<td>SUPPLY VOLTAGE BETWEEN FOCUSING ELECTRODE AND CATHODE (DC)</td>
<td>600 max. volts</td>
</tr>
<tr>
<td>AVERAGE ANODE CURRENT</td>
<td>2 max. ma</td>
</tr>
<tr>
<td>AMBIENT TEMPERATURE</td>
<td>75 max. °C</td>
</tr>
</tbody>
</table>

**Characteristics Range Values for Equipment Design:**

Under conditions with dc supply voltage \(E\) across a voltage divider providing electrode voltages shown in Table I

With \(E = 2300\) volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

<table>
<thead>
<tr>
<th>Min.</th>
<th>Median</th>
<th>Max.</th>
</tr>
</thead>
</table>

**Sensitivity:**

- Radiant, at 4400 angstroms: \(4.8 \times 10^6\) a/w
- Cathode radiant, at 4400 angstroms: \(0.056\) a/w
- Luminous, at 0 cps: \(1.4 \times 10^3\) a/w

**Cathode luminous:**

- With tungsten light source: 50 μa/μm
- With blue light source: 0.05 μa/μm

**Current Amplification:**

- Equivalent Anode-Dark Current Input at luminous sensitivity of 6000 a/μm: \(4 \times 10^{-10}\) lm
- Equivalent Noise Input: \(3 \times 10^{-12}\) 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:

- \(1.4''\): \(3 \times 10^{-10}\) sec
- \(1.6''\): \(5 \times 10^{-10}\) sec
With $E = 1800$ volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

<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 4400 angstroms.</td>
<td>$5.1 \times 10^5$</td>
<td>$\mu$a/lm</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms.</td>
<td>$0.056$</td>
<td>$\mu$a/lm</td>
</tr>
<tr>
<td>Luminous, at 0 cps$^c$</td>
<td>$640$</td>
<td>$\mu$a/lm</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source$^d$.</td>
<td>$50$</td>
<td>$70$</td>
</tr>
<tr>
<td>Current Amplification.</td>
<td>$9.1 \times 10^6$</td>
<td>$\mu$a/lm</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input$^g$ at luminous sensitivity of 160 a/lm.</td>
<td>$4 \times 10^{-10}$</td>
<td>$1$</td>
</tr>
<tr>
<td>Equivalent Noise Input$^h$.</td>
<td>$2.4 \times 10^{-12}$</td>
<td>$1$</td>
</tr>
</tbody>
</table>

With $E = 1300$ volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

<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 4400 angstroms.</td>
<td>$2.9 \times 10^4$</td>
<td>$\mu$a/lm</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms.</td>
<td>$0.056$</td>
<td>$\mu$a/lm</td>
</tr>
<tr>
<td>Luminous, at 0 cps$^c$</td>
<td>8</td>
<td>36</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source$^d$.</td>
<td>$50$</td>
<td>$70$</td>
</tr>
<tr>
<td>Current Amplification.</td>
<td>$5 \times 10^5$</td>
<td>$\mu$a/lm</td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input$^g$ at luminous sensitivity of 9 a/lm.</td>
<td>$5 \times 10^{-10}$</td>
<td>$2 \times 10^{-9}$</td>
</tr>
<tr>
<td>Equivalent Noise Input$^h$.</td>
<td>$3 \times 10^{-12}$</td>
<td>$1$</td>
</tr>
<tr>
<td>Pulse Height Resolution$^i$.</td>
<td>8.5</td>
<td></td>
</tr>
</tbody>
</table>

* Made by Cinch Manufacturing Corporation, 1026 South Wabash Avenue, Chicago 24, Illinois.

* Averaged over any interval of 30 seconds maximum.

* Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2970$^0$ K. A light input of 0.1 microlumen is used.

* Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2970$^0$ K. The value of input flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected together as anode.

* Under the following conditions: The 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) from a tungsten-filament lamp operated at a color temperature of 2970$^0$ K. The value of light flux on the filter is 0.01 lumen.

* For spectral characteristic of this source see sheet SPECTRAL CHARACTERISTIC OF 2970$^0$ K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2970$^0$ K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER at front of this section.

---

RADIO CORPORATION OF AMERICA Electron Tube Division

DATA 2

Harrison, N. J.

5-61
Measured at a tube temperature of 25°C. Dark current may be reduced by the use of a refrigerant.

Under the following conditions: Supply voltage (E) is as shown, 25°C tube temperature, external shield is connected to cathode, bandwidth 1 cycle per second, tungsten light source of 2870°C 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

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 variations in the multiplier stages and is measured under conditions with an incident light spot approximately 1 millimeter in diameter centered on the photocathode.

These values 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.

Measured with supply voltage (E) = 1100 to 1400 volts: radiation source, an isotope of cesium having an atomic mass of 137 (Cs137); scintillation-counter crystal, a cylindrical 2" x 2" thallium-activated sodium-iodide type NaI(Tl) — type 88350, Serial No. AL281, manufactured by Harshaw Chemical Company, 1945 East 97 Street, Cleveland 6, Ohio.

### TABLE I

<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>
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<tr>
<td>Dynode No.7 and Dynode No.8</td>
<td>1</td>
</tr>
<tr>
<td>Dynode No.8 and Dynode No.9</td>
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<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 current amplification.
OPERATING CONSIDERATIONS

The operating stability of the 7850 is dependent on the magnitude of the anode current and its duration. When the 7850 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 7850 usually recovers a substantial percentage of such loss in sensitivity.

The use of an average anode current well below the maximum-rated value of 2 milliamperes is recommended 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 7850 may be necessary.

Adequate light shielding should be provided to prevent extraneous light from reaching any part of the 7850.

The high voltages at which the 7850 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 Phototube having S-II 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.
TYPICAL ANODE CHARACTERISTICS

DYNODE—No.1—TO—CATHODE VOLTS = 250
DYNODE—No.1—TO—DYNODE—No.2 VOLTS = 175
EACH SUCCEEDING—DYNODE—STAGE VOLTS = 125
FOCUSING—ELECTRODE VOLTAGE ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.
LIGHT SOURCE IS A TUNGSTEN—FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.

FOCUSING—ELECTRODE VOLTAGE ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.
LIGHT SOURCE IS A TUNGSTEN—FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
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</td>
</tr>
<tr>
<td>DY1 &amp; DY2</td>
<td>4</td>
</tr>
<tr>
<td>DY2 &amp; DY3</td>
<td>1</td>
</tr>
<tr>
<td>DY3 &amp; DY4</td>
<td>1</td>
</tr>
<tr>
<td>DY4 &amp; DY5</td>
<td>1</td>
</tr>
<tr>
<td>DY5 &amp; DY6</td>
<td>1</td>
</tr>
<tr>
<td>DY6 &amp; DY7</td>
<td>1</td>
</tr>
<tr>
<td>DY7 &amp; DY8</td>
<td>1</td>
</tr>
<tr>
<td>DY8 &amp; DY9</td>
<td>1</td>
</tr>
<tr>
<td>DY9 &amp; DY10</td>
<td>1</td>
</tr>
<tr>
<td>DY10 &amp; DY11</td>
<td>1</td>
</tr>
<tr>
<td>DY11 &amp; DY12</td>
<td>1</td>
</tr>
<tr>
<td>DY12 &amp; ANODE</td>
<td>1</td>
</tr>
<tr>
<td>ANODE &amp; CATHODE</td>
<td>14.4</td>
</tr>
</tbody>
</table>

FOCUSING—ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.
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</td>
</tr>
<tr>
<td>DY₁ &amp; DY₂</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₂ &amp; DY₃</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₃ &amp; DY₄</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₄ &amp; DY₅</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₅ &amp; DY₆</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₆ &amp; DY₇</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₇ &amp; DY₈</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₈ &amp; DY₉</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₉ &amp; DY₁₀</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₁₀ &amp; DY₁₁</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₁₁ &amp; DY₁₂</td>
<td>1.4</td>
</tr>
<tr>
<td>DY₁₂ &amp; ANODE</td>
<td>14.4</td>
</tr>
<tr>
<td>ANODE &amp; CATHODE</td>
<td>14.4</td>
</tr>
</tbody>
</table>

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 25°C

---

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
FOCUSING-ELECTRODE VOLTAGE IS VARIED BY ADJUSTMENT OF POTENTIOMETER CONNECTED BETWEEN DYNODE AND CATHODE.

RELATIVE ANODE CURRENT—PER CENT

FOCUSING-ELECTRODE VOLTAGE—PER CENT OF DYNODE NR1-TO-CATHODE VOLTS

92CM-10590

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
TYPICAL ANODE-CURRENT CHARACTERISTIC

DYNODE-N° 1-TO-CATHODE VOLTS = 200
DYNODE-N° 1-TO-DYNODE-N° 2 VOLTS = 140
VOLTS PER SUCCEEDING DYNODE STAGE
EXCEPT FOR DYNODE-N° 5 STAGE = 100
FOCUSING-ELECTRODE VOLTAGE ADJUSTED
FOR MAXIMUM CURRENT AMPLIFICATION.
ANODE IS AT GROUND POTENTIAL.

RELATIVE ANODE CURRENT

DYNODE-N° 5 VOLTS (REFERRED TO ANODE)

92CM-10959
For Broadcast Film-Pickup or Data Transmission with Color or Black-and-White TV Cameras Requiring Resolutions of more than 1200 TV Lines

General:
Heater, for Unipotential Cathode:
Voltage (AC or DC) .......... 6.3 ± 10% volts
Current at 6.3 volts ......... 0.6 amp
Direct Interelectrode Capacitance:
Target to all other electrodes ........ 8.0 pf
Spectral Response ............. S-18
Wavelength of Maximum Response 4500 +500 -300 angstroms
Photoconductive Layer:
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) 1" 
Focusing Method ................. Magnetic
Deflection Method ................. Magnetic
Overall Length ................. 7.75" ± 0.25"
Greatest Diameter ................. 1.59" ± 0.01"
Bulb Diameter ................. 1.50" ± 0.01"
Operating Position ............ Any
Weight (Approx.) .............. 5.25 oz
Bulb ................................ T12
Focusing-Alignment Assembly ........ Cleveland Electronics®
No.15-VFA-259, or equivalent
Deflecting Yoke .................. Cleveland Electronics®
No.15-VY-258, or equivalent
Socket .................. Alden® No.208-SBSDC, or equivalent
Base ... Small-Button Super-Ditetra 8-Pin (JEDEC No.E8-78)
Basing Designation for BOTTOM VIEW .... BLB

Pin 1—Heater
Pin 2—Grid No. 1
Pin 3—Do Not Use
Pin 4—Grid No.4
Pin 5—Grid No.2
Pin 6—Grid No.3
Pin 7—Cathode
Pin 8—Heater
Flange—Target
Short Pin—Do Not Use

Maximum Ratings, Absolute—Maximum Values:
For scanned area of 0.6" x 0.8" 
Grid-No.4 Voltage ............. 1500 volts
Grid-No.3 Voltage ............. 1500 volts

⇒ Indicates a change.
### Grid-No.2 Voltage
550 volts

### Grid-No.1 Voltage:
- Negative-bias value: 300 volts
- Positive-bias value: 0 volts

### Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 volts
- Heater positive with respect to cathode: 10 volts

### Target Voltage
- Negative-bias value: 300 volts
- Positive-bias value: 0 volts

### Peak Target Current:
- 0.60 μA

### Faceplate:
- Illumination: 1000 fc
- Temperature: 72°C

#### Typical Operation

For scanned area of 0.6" x 0.8" and faceplate temperature of 30° to 35°C

- **Grid-No.4 (Accelerator) Voltage**: 1400 volts
- **Grid-No.3 (Beam-Focus Electrode) Voltage**: 800 to 1000 volts
- **Grid-No.2 (Accelerator) Voltage**: 300 volts
- **Grid-No.1 Voltage for picture cutoff**: -45 to -100 volts

### Average "Gamma" of Transfer Characteristic
For signal-output current between 0.02 μA and 0.6 μA.
- Minimum: 0.65

### Minimum Peak-to-Peak Blanking Voltage:
- When applied to grid No.1: 75 volts
- When applied to cathode: 20 volts

### Lag:
- Maximum value: 33%
- Typical value: 25%

### Limiting Resolution:
- At center of picture:
  - Typical value: 1500 TV lines
  - Minimum value: 1200 TV lines
- At corners of picture:
  - Typical value: 900 TV lines

### Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture:
- Minimum value: 60%

### Field Strength at Center of Focusing Coil (Approx.)
- 46 gauss

### Field Strength of Adjustable Alignment Coil
- 0 to 4 gauss

### Peak Deflecting-Coil Current for Specified Deflecting Yoke:
- Horizontal: 240 ma
- Vertical: 50 ma

### Average-Sensitivity Operation
- **Faceplate Illumination (Highlight)**: 10 fc
- **Target Voltage**: 20 to 50 volts
- **Dark Current**: 0.02 μA
- **Signal-Output Current** (Typical): 0.5 μA

---

*Indicates a change.*
Minimum-Lag Operation

Faceplate Illumination (Highlight) .................. 50 fc
Target Voltage* ........................................ 10 to 30 volts
Dark Current .......................................... 0.005 μA
Signal-Output Current† (Typical) .................. 0.5 μA

a. This capacitance, which effectively is the output impedance of the 8051, is increased when the tube is mounted in the deflecting-yoke and focusing-alignment assembly. The resistive component of the output impedance is in the order of 100 megohms.
b. Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the plane passing through the axis and short indexpin. The masking is for orientation only and does not define the proper scanned area of photoconductive layer. Final orientation should be such that the image also fits inside of any internal mask of the mesh assembly.
c. Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.
d. For minimum geometric distortion, the deflecting yoke should be located in its proper axial position 3/4-inch from the face of the tube.
e. Alden Products Co., 9140 North Main Street, Brockton 64, Mass.
f. Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.
g. Grid-No.4 voltage must always be greater than grid-No.3 voltage. For minimum "marginal" effect, grid-No.4 voltage should be adjusted to approximately 1.6 times the grid-No.3 voltage value, and the focusing-alignment assembly and deflecting yoke positioned as shown in accompanying diagram.
h. Beam focus is obtained by the combined effect of grid-No.3 voltage, which should be adjustable over indicated range, and a focusing coil having an average field strength of 45 gauss.
i. With no blanking voltage on grid No.1.
j. Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.2 microampere and a dark current of 0.02 microamperes.
k. The alignment coil should be located on the tube so that its center is at a distance of 6 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.
l. Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.
m. The target voltage for each 8051 must be adjusted to that value which gives the desired operating dark current.

Operating Considerations

The target connection is made by a suitable spring contact bearing against the edge of the metal ring at the face end of the tube.

Spectral-Sensitivity Characteristic

Of photosensitive device having 5-18 response

is shown at front of this section
DIMENSIONAL OUTLINE

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Within this area the minimum bulb diameter dimension does not apply.

Note 3: Faceplate thickness is 0.135" ± 0.005".

DIMENSIONS IN INCHES

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

FOCUSING COIL

ALIGNMENT COIL

END OF ELECTRON GUN

HORIZONTAL AND VERTICAL DEFLECTING COILS

DIMENSIONS IN INCHES

RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.6" x 0.8"
FACEPLATE TEMPERATURE = 30°C APPROX.

TARGET VOLTS

DARK CURRENT — MICROAMPERES

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

DATA 3
4-65
ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.6" x 0.8"
FACEPLATE TEMPERATURE = 30° C APPROX.

SIGNAL OUTPUT — MICROAMPERES

DARK CURRENT (MICROAMPERE) = 0.05

2870°K TUNGSTEN ILLUMINATION ON TUBE FACE — FOOTCANDLES

DATA 3
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
TYPICAL PERSISTENCE CHARACTERISTICS

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES ≈ 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER ≈ 0.6" X 0.8"
FACEPLATE TEMPERATURE ≈ 30°C APPROX.

---

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES ≈ 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER ≈ 0.6" X 0.8"
FACEPLATE TEMPERATURE ≈ 30°C APPROX.

---

DATA 4
Electronic Components and Devices  Harrison, N. J.
RADIO CORPORATION OF AMERICA
UNCOMPENSATED HORIZONTAL RESPONSE TO A SQUARE-WAVE TEST PATTERN

HIGHLIGHT TARGET MICROAMPERES = 0.3
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SQUARE-WAVE RESOLUTION WEDGE.
GRID—No. 4 VOLTS = 1400
GRID—No. 3 VOLTS = 850
GRID—No. 2 VOLTS = 300

DATA 4
RADIO CORPORATION OF AMERICA
Electronic Components and Devices  Harrison, N. J.
Photomultiplier Tubes

**2-INCH DIAMETER—8053**

**3-INCH DIAMETER—8054**

**5-INCH DIAMETER—8055**

## S-11 RESPONSE

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-INCH</td>
<td>8053</td>
</tr>
<tr>
<td>3-INCH</td>
<td>8054</td>
</tr>
<tr>
<td>5-INCH</td>
<td>8055</td>
</tr>
</tbody>
</table>

**VENETIAN-BLIND**

**DYNOKE STRUCTURE**

For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation

### GENERAL

#### Spectral Response

<table>
<thead>
<tr>
<th>Time</th>
<th>8053</th>
<th>8054</th>
<th>8055</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>5.27 sq.in</td>
<td>15.0 sq.in</td>
<td></td>
</tr>
</tbody>
</table>

#### Wavelength of Maximum Response

<table>
<thead>
<tr>
<th>Time</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>4400 ± 500 angstroms</td>
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</tbody>
</table>

#### Cathode, Semitransparent

<table>
<thead>
<tr>
<th>Time</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>Cesium-Antimony</td>
</tr>
</tbody>
</table>

#### Shape

<table>
<thead>
<tr>
<th>Time</th>
<th>Flat, Circular</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td></td>
</tr>
</tbody>
</table>

#### Minimum area

<table>
<thead>
<tr>
<th>Time</th>
<th>8053</th>
<th>8054</th>
<th>8055</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>2.20 sq.in</td>
<td>5.27 sq.in</td>
<td>15.0 sq.in</td>
</tr>
</tbody>
</table>

#### Minimum diameter

<table>
<thead>
<tr>
<th>Time</th>
<th>8053</th>
<th>8054</th>
<th>8055</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>1.68 in</td>
<td>2.59 in</td>
<td>4.38 in</td>
</tr>
</tbody>
</table>

#### Window

<table>
<thead>
<tr>
<th>Time</th>
<th>Lime glass, Corning® No.0080, or equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>Plano-Plano</td>
</tr>
</tbody>
</table>

#### Index of refraction at 4360 angstroms

<table>
<thead>
<tr>
<th>Time</th>
<th>1.523</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td></td>
</tr>
</tbody>
</table>

#### Dynodes

<table>
<thead>
<tr>
<th>Time</th>
<th>Substrate</th>
<th>Secondary-Emitting Surface</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>Copper-Beryllium</td>
<td>Beryllium-Oxide</td>
<td>Venetian-Blind</td>
</tr>
</tbody>
</table>

#### Direct interelectrode Capacitances (Approx.)

<table>
<thead>
<tr>
<th>Time</th>
<th>Anode to dynode No.10</th>
<th>Anode to all other electrodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>7 pF</td>
<td>8.5 pF</td>
</tr>
</tbody>
</table>

#### Maximum Overall Length

<table>
<thead>
<tr>
<th>Tube</th>
<th>8053</th>
<th>8054</th>
<th>8055</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>5.81 in</td>
<td>6.31 in</td>
<td>7.69 in</td>
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#### Seated Length

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<th>8055</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>4.87 ± 0.19 in</td>
<td>5.38 ± 0.18 in</td>
<td>6.75 ± 0.19 in</td>
</tr>
</tbody>
</table>

#### Maximum Diameter

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>2.31 in</td>
<td>3.06 in</td>
<td>5.31 in</td>
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</table>

#### Envelope

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td>T16</td>
<td>J24</td>
<td>J42</td>
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</tbody>
</table>

#### Socket

<table>
<thead>
<tr>
<th>Time</th>
<th>Cinch® No.3M14, or equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-9 sec</td>
<td></td>
</tr>
</tbody>
</table>

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

DATA 1
4-67
Magnetic Shield
8053  
8054  
8055  
JAN No.S-2004, or equivalent  
JAN No.3W14, or equivalent  
See footnote (d)  
Operating Position  
Any  
Weight (Approx.)  
8053  7 oz  
8054  9 oz  
8055  1 lb 7 oz  
Base  
Medium-Shell Diheptal 14-Pin  
(JEDEC Group 5, No.814-38)

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

Unless indicated otherwise, the following ratings and characteristic range values apply to all types

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage  
Between anode and cathode  
Between anode and dynode No.10  
Between consecutive dynodes  
Between dynode No.1 and cathode  
Between focusing electrode and cathode  
Average Anode Current  
Ambient Temperature

2000 V  
300 V  
250 V  
600 V  
600 V  
2 mA  
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, except as noted. 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 \( E = 1500 \) 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 4400 angstroms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8053</td>
<td>-</td>
<td>3.4x10^4</td>
<td>-</td>
</tr>
<tr>
<td>8054, 8055</td>
<td>-</td>
<td>3.5x10^4</td>
<td>-</td>
</tr>
<tr>
<td>Cathode Radiant at 4400 angstroms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8053</td>
<td>-</td>
<td>0.056</td>
<td>-</td>
</tr>
<tr>
<td>8054</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>8055</td>
<td>-</td>
<td>0.088</td>
<td>-</td>
</tr>
<tr>
<td>Luminous:  With tungsten light source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8053</td>
<td>9</td>
<td>42</td>
<td>220</td>
</tr>
<tr>
<td>8054</td>
<td>9</td>
<td>43</td>
<td>220</td>
</tr>
<tr>
<td>8055</td>
<td>9</td>
<td>44</td>
<td>220</td>
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<tr>
<td>With blue light source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8053</td>
<td>9x10^-6</td>
<td>4.2x10^-5</td>
<td>2.2x10^-4</td>
</tr>
<tr>
<td>8054</td>
<td>9x10^-6</td>
<td>4.3x10^-5</td>
<td>2.2x10^-4</td>
</tr>
<tr>
<td>8055</td>
<td>9x10^-6</td>
<td>4.4x10^-5</td>
<td>2.2x10^-4</td>
</tr>
<tr>
<td>Cathode Luminous: With tungsten light source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8053</td>
<td>-</td>
<td>7x10^-5</td>
<td>-</td>
</tr>
<tr>
<td>8054</td>
<td>-</td>
<td>8x10^-5</td>
<td>-</td>
</tr>
<tr>
<td>8055</td>
<td>-</td>
<td>1.1x10^-4</td>
<td>-</td>
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<tr>
<td>With blue light source</td>
<td></td>
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</tr>
<tr>
<td>8053</td>
<td>6x10^-6</td>
<td>7x10^-6</td>
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<td>8054</td>
<td>6x10^-6</td>
<td>8x10^-6</td>
<td>-</td>
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<tr>
<td>8055</td>
<td>6x10^-6</td>
<td>1.1x10^-7</td>
<td>-</td>
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<tr>
<td>Cathode Quantum Efficiency at 4400 angstroms:</td>
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<td></td>
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<tr>
<td>8053</td>
<td>-</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>8054</td>
<td>-</td>
<td>18</td>
<td>-</td>
</tr>
<tr>
<td>8055</td>
<td>-</td>
<td>25</td>
<td>-</td>
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<tr>
<td>Current Amplification</td>
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<td></td>
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</tr>
<tr>
<td>8053</td>
<td>-</td>
<td>6x10^5</td>
<td>-</td>
</tr>
<tr>
<td>8054</td>
<td>-</td>
<td>5.4x10^5</td>
<td>-</td>
</tr>
<tr>
<td>8055</td>
<td>-</td>
<td>4x10^5</td>
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<tr>
<td>Anode Dark Current</td>
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<td></td>
</tr>
<tr>
<td>8053</td>
<td>-</td>
<td>4x10^-9</td>
<td>7x10^-8</td>
</tr>
</tbody>
</table>
8053, 8054, 8055

Equivalent Anode-Dark Current Input
- 4.4x10⁻⁴ 7.8x10⁻⁴
Max

Equivalent Noise Input
- 5.5x10⁻¹³ 9.7x10⁻¹³

Pulse-Height Resolution
- 8053
- 1.2x10⁻⁸

- 8054, 8055
- 1.4x10⁻⁸

Electron Transit Time
- 8053
- 5.9x10⁻⁸

- 8054, 8055
- 6.5x10⁻⁸

a Made by Corning Glass Works, Corning, New York. 14830
b Made by Cinch Manufacturing Company, 1026 South llano Avenue, Chicago, Illinois. 60624
c Made by JAN Hardware Manufacturing Corp., 38-01, Queens Blvd., Long Island City 1, N. Y.
d Magnetic shielding material in the form of foil or tape as available from Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Ave., Chicago 22, Ill., 60622, or equivalent.
e Averaged over any interval of 30 seconds maximum.
f Tube operation at or below room temperature is recommended.
g This value is calculated from the typical luminous sensitivity rating using a conversion factor of 804 lumens per watt.
h This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

These values are calculated as shown below:

Luminous Sensitivity (A/lm) = Anode Current (with blue light source) (A)

0.10 x Light Flux of 1 x 10⁻⁵ (lm)
The value of 0.10 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions, but with the blue filter removed.
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) from a tungsten-filament lamp having a lime-glass envelope. The lamp is 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.

Cathode Current (with blue light source) (A)

0.10 x Light Flux of 0.01 (lm)
The value of 0.10 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (n) to the cathode current measured under the same conditions but with the blue filter removed.

n 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) from a tungsten-filament lamp having a lime-glass envelope. The lamp is 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 220°C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No. S-58, polished to 1/2 stock thickness) from a blue-glass envelope, tungsten-filament lamp, operating at 2870K. The light flux incident on the filter is 10 microlumens. The supply voltage E is adjusted to obtain an anode current of 9 microamperes. Sensitivity of these types under these conditions is approximately equivalent to 9 microamperes per lumen. Dark current is measured with no light incident on the tube.

With supply voltage E adjusted to give an equivalent luminous sensitivity of 9 microamperes per lumen.

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

At 4400 angstroms. The following conditions: Supply voltage (E) is as shown, 220°C tube temperature, external shield is connected to one electrode, with 1 Hz, light source as shown under (k) incident at a low audio frequency to produce incident radiation pulses alternately between zero and the value stated. The on period of the pulse is equal to the off period. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

With the following voltage distribution: 3/13 of E between cathode and dynode No.1, 1/15 of E for each succeeding dynode stage, and 1/13 of E between dynode No.10 and anode. 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.

Pulse height resolution is defined as the quotient of the full width of the photopeak at half height by the pulse height at maximum count rate under the following conditions: The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Ca37) and a sub-400 cm length x 14 mch thallium-activated sodium iodide scintillator (NaI(Tl) - type 12012) are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio, and is rated by the manufacturer as having a half peak of 7.5%. The Ca37 source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the type by a coupling fluid such as Dow Corning Corp., Type DC200 (viscosity of 60,000 centistokes) - manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

Mean Gain Deviation is defined as follows:  
\[
\text{MGD} = \frac{1}{n} \sum_{i=1}^{n} \frac{p_i - \bar{p}}{\bar{p}} \times 100
\]

where:  
- \(p_i\) = pulse height at the \(i\)th reading  
- \(\bar{p}\) = total number of readings

Under the following conditions: The scintillator and Ca37 radiation source of (x) are employed. The radiation source is initially centered on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 10,000 Hz. The pulse height of the photopeak is measured under this condition. Next the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 1,000 Hz. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. Mean gain deviation is defined as shown in (w).

Under the same conditions as shown in (x) except the tube is operated for a period of 1/2 hour with the radiation source located at the point providing a pulse count rate of 10,000 Hz. Following this time interval, the pulse height is sampled at this count rate at 1-hour intervals for a period of 16 hours. Mean gain deviation is defined as shown in (t).

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 and is measured under conditions with the incident light fully illuminating the phototube.

The electron transit time in 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 phototube.
OPERATING CONSIDERATIONS

The base pins of these types fit a diheptal 14-contact socket, such as Cinch No. 3M14, or equivalent. The socket should be made of high-grade, low-leakage material, and should be installed so that incident light falls on the face end of the tube.

The operating stability of these types are dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 2 milliamperes is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of 10 microamperes or less, commensurate with satisfactory output signal, is recommended.

Electrostatic and magnetic shielding of these types may be required in some applications. When a shield is used, it must be at cathode potential.

The high voltages at which these types are 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.

Accompanying Typical Voltage-Divider Arrangements are recommended for use with these types. Recommended resistance values for the voltage dividers range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for any 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 power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted 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 of at least 10 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 tube socket terminals for dynodes No. 7 and No. 8, dynodes No. 8 and No. 9, dynode No. 9 and No. 10, and between dynode No. 10 and anode return. In addition to nonlinearity and pulse-limiting effects, the use of resistance values exceeding 1 megohm per stage make these types more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
FOR GENERAL PHOTOMETRIC APPLICATIONS
8053  8054  8055

R1 through R12: 470,000 ohms, 1/2 watt
R13: 5 megohms, 1/2 watt, adjustable

Note 1: Supply voltage should be adjustable between approximately 800 and 2000 volts dc.

Note 2: Component values are dependent upon nature of application and output signal desired.
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
FOR SCINTILLATION-COUNTING APPLICATIONS
8053 8054 8055

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)
C5 and C6: 0.005 µF, 3000 volts (dc working)
R1 through R10: 470,000 ohms, 1/2 watt
R11 and R12: 750,000 ohms, 1/2 watt
R13: 5 megohms, 1/2 watt, adjustable
R14: 1 megohm, 1/2 watt
R15: 100,000 ohms, 1/2 watt

Note 1: Supply voltage should be adjustable between approximately 800 and 2000 volts dc.
Note 2: Capacitors C1 through C5 should be connected at tube socket for optimum high-frequency performance.
Note 3: Component values are dependent upon nature of application and output signal desired.
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-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010-inch from peak to valley.
DIMENSIONAL OUTLINE

8054

3.00 ±.06 DIA.

2.59 MIN. DIA.

FACEPLATE (SEE NOTE)

PHOTOCATHODE

.25 R. MAX.

.75 R.

1.09

.75 R.

2.00 ±.06 DIA.

2.31 MAX. DIA.

5.38 ±.18

6.31 MAX.

BASE

JEDEC GROUP 5
No. 814-38

J24
BULB

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-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.
DIMENSIONAL OUTLINE

8055

FACEPLATE (SEE NOTE)

3.50 ± .19

1.97

J42 BULB

2.00 ± .06 DIA.

BASE
JEDEC No. B14-38

PHOTO-CATHODE

6.75 ± .19

3°

.75 R.

D

7.69 MAX.

5.25 ± .06 DIA.

4.38 MIN. DIA.

2.31 MAX. DIA.

3.75

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 4.38-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.
Typical Time Resolution Characteristics

8053

- 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.
- PHOTOCATHODE IS FULLY ILLUMINATED.

![Graph](image1)

8054

- 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.
- PHOTOCATHODE IS FULLY ILLUMINATED.

![Graph](image2)
**Typical Time Resolution Characteristics**

8055

<table>
<thead>
<tr>
<th>DYNODE NO.1 TO CATHODE VOLTS</th>
<th>( \frac{1}{6} E )</th>
</tr>
</thead>
<tbody>
<tr>
<td>EACH SUCCEEDING DYNODE STAGE VOLTS</td>
<td>( \frac{1}{12} E )</td>
</tr>
<tr>
<td>ANODE TO DYNODE NO.10 VOLTS</td>
<td>( \frac{1}{12} E )</td>
</tr>
</tbody>
</table>

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.

PHOTOCATHODE IS FULLY ILLUMINATED.

---

**Typical Characteristic of Output Current As a Function of Dynode-No.5 Volts**

8053 8054 8055

<table>
<thead>
<tr>
<th>DYNODE No.1 TO CATHODE VOLTS</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE-No.5 STAGE</td>
<td>100</td>
</tr>
<tr>
<td>ANODE TO DYNODE No.10 VOLTS</td>
<td>100</td>
</tr>
</tbody>
</table>

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 Sensitivity and Current Amplification Characteristics

THE DC SUPPLY VOLTAGE (E) IS ACROSS A 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 ANODE AND DYNOE NO. 10. 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.

[Graphical representation of sensitivity and current amplification characteristics for 8053, 8054, and 8055 tubes, with axes labeled as follows:
- Sensitivity: Amperes/Lumen (color temp. = 2870°K)
- Current Amplification
- Supply Volts (E) between Anode and Cathode (800 to 2000)]

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Sensitivity and Current Amplification Characteristics

THE DC SUPPLY VOLTAGE (E) IS 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.
Typical Sensitivity and Current Amplification Characteristics

THE DC SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE NO.1; 1/2 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.
Typical Anode Characteristics

8053

DYNODE NO. 1-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.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.
Typical Anode Characteristics

Anode Current - Milliamperes

Volts Between Anode and Dynode No. 10

Light Source is a Tungsten-Platinum Lamp

Operated at a Color Temperature of 2870°K.

Provides Maximum Anode Current

No. 1 Potential (Referenced to Cathode) Which Value Between 90 and 100 Per Cent of Dynode-

Focus Ionic-Electrode Voltage is Adjusted to That Each succeeding Dynode Voltage Volt = 250

Dynode No. 1 - To Cathode Volt = 250

8054, 8053, 8055, 8055
Typical Dark Current and EADCI Characteristics

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).

DYNOE NO. I-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.

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

TUBE TEMPERATURE = 22° C.

DATA 10
RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Effect of Magnetic Field on Anode Current

8053

**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.**

---

**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 PERPENDICULAR TO MAJOR AXIS OF TUBE.**

---

**Data Sheet: 92CS-112301M**
**Radio Corporation of America**
**Electronic Components and Devices**
**Harrison, N.J.**
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.

8054

MAGNETIC FIELD INTENSITY- GAUSS

RELATIVE ANODE CURRENT

0 5 10 15

DYNOE No.1 -TO-CATHODE VOLTS = 500 400 300 200

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.

8054

MAGNETIC FIELD INTENSITY- GAUSS

RELATIVE ANODE CURRENT

0 5 10 15

DYNOE No.1-TO-CATHODE VOLTS = 500 400 300 200

DATA 11

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

8055

DYNODE No.1-TO-CATHODE VOLTS AS INDICATED EACH SUCCEEDING DYNODE-STAGE VOLTS =125
ANODE-TO-DYNODE-No.10 VOLTS =125
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.
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.

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.
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
Typical Spectral Response Characteristics

8053

Wavelength (Angstroms)

Quantum Efficiency — Per Cent

Relative Sensitivity — Per Cent

Absolute Sensitivity — Milliamperes/Milliwatt

Relative Sensitivity

Absolute Sensitivity

Quantum Efficiency

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

3000 4000 5000 6000 7000

92LM-153I
Typical Spectral Response Characteristics

8054

WAVELENGTH—ANGSTROMS

QUANTUM EFFICIENCY—PER CENT

RELATIVE SENSITIVITY—PER CENT

ABSOLUTE SENSITIVITY—MILLIAMPÈRES/WATT

92LS -1542
Typical Spectral Response Characteristics

8055

WAVELENGTH—ANGSTROMS

QUANTUM EFFICIENCY—PER CENT RELATIVE SENSITIVITY—PER CENT ABSOLUTE SENSITIVITY—MILLIAMPERES/WATT

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

3000 4000 5000 6000 7000
Image Orthicon

FIELD MESH SEMICONDUCTIVE TARGET MAGNETIC FOCUS
MAGNETIC DEFLECTION

For Low-Light-Level Studio and Remote Color (Scene illumination—40 fc or less) and Black-and-White (Scene illumination—as low as 1 fc) TV Pickup Service

DATA

General:
- Heater, for Unipotential Cathode:
  - Voltage (AC or DC) ............. 6.3 ± 10% volts
  - Current at 6.3 volts ........... 0.6 amp
- Direct Interelectrode Capacitance:
  - Anode to all other electrodes .... 12 pf
- Spectral Response ............... 4500 ± 300 angstroms
- Photocathode, Semitransparent:
  - Rectangular image (4 x 3 aspect ratio):
    - Useful size of .............. 1.8" max. diagonal
  - Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.
  - Orientation of: Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base.

Focusing Method ............. Magnetic
Deflection Method ............. Magnetic
Overall Length ............... 15.20" ± 0.25"
Greatest Diameter of Bulb .... 3.00" ± 0.06"
Minimum Deflecting-Coil Inside Diameter .... 2-3/8"
Deflecting Coil .............. Cleveland Electronics, Part No.OY-1a, or equivalent
Deflecting Coil Length ........ 5"
Focusing Coil .............. Cleveland Electronics, Part No.OF-2a, or equivalent
Focusing Coil Length ........ 10"
Alignment Coil .............. Cleveland Electronics, Part No.OA-3a, or equivalent
Alignment-Coil Length .......... 15/16"
Photocathode Distance Inside End of Focusing Coil .... 1/2"
Operating Position: The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.

Weight (Approx.) .......... 11 lb 6 oz
Socket .............. Cinch Part No.3M14b, or equivalent

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

DATA 9-63
Shoulder Base. Keyed Jumbo Annular 7-Pin

**Pin 1** - Grid No.6
**Pin 2** - Photocathode
**Pin 3** - Do Not Use
**Pin 4** - Do Not Use

**End Base**. Small-Shell Diheptal 14-Pin

**Pin 1** - Heater
**Pin 2** - Grid No.4 & Field Mesh
**Pin 3** - Grid No.3
**Pin 4** - Do Not Use
**Pin 5** - Dynode No.2
**Pin 6** - Dynode No.4
**Pin 7** - Anode
**Pin 8** - Dynode No.5
**Pin 9** - Dynode No.3
**Pin 10** - Dynode No.1, Grid No.2
**Pin 11** - Do Not Use
**Pin 12** - Grid No.1
**Pin 13** - Cathode & Suppressor
**Pin 14** - Heater

Maximum and Minimum Ratings, Absolute-Maximum Values:

**PHOTOCATHODE**:
- Voltage: -550 max. volts
- Illumination: 50 max. fc

**OPERATING TEMPERATURE**:
- Of any part of bulb: 55 max. °C
- Of bulb at large end of tube (Target section): 0 min. °C

**TEMPERATURE DIFFERENCE**:
- Between target section and any part of bulb hotter than target section: 5 max. °C

**GRID-No.6 VOLTAGE**: -550 max. volts

**TARGET VOLTAGE**:
- Positive value: 10 max. volts
- Negative value: 10 max. volts

**GRID-No.5 VOLTAGE**: 150 max. volts
**GRID-No.4 VOLTAGE**: 300 max. volts
**GRID-No.3 VOLTAGE**: 400 max. volts
**GRID-No.2 & DYNODE No.1 VOLTAGE**: 350 max. volts

**GRID-No.1 VOLTAGE**:
- Negative bias value: 125 max. volts
- Positive bias value: 0 max. volts

**VOLTAGE PER MULTIPLIER STAGE**: 350 max. volts
**ANODE-SUPPLY VOLTAGE**: 1350 max. volts

---

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
### PEAK HEATER-CATHODE VOLTAGE:
- Heater negative with respect to cathode: 125 max. volts
- Heater positive with respect to cathode: 10 max. volts

### Typical Operating Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Typical Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photocathode Voltage</td>
<td>Image Focus</td>
</tr>
<tr>
<td>Grid-No.6 Voltage (Accelerator)</td>
<td>Approx. 75% photocathode voltage</td>
</tr>
<tr>
<td>Target-Cutoff Voltage</td>
<td>-3 to 1 volts</td>
</tr>
<tr>
<td>Grid-No.5 Voltage (Decelerator)</td>
<td>0 to 125 volts</td>
</tr>
<tr>
<td>Grid-No.4 Voltage (Beam Focus)</td>
<td>140 to 180 volts</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
<td>225 to 330 volts</td>
</tr>
<tr>
<td>Grid-No.2 &amp; Dynode-No.1 Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-45 to -115 volts</td>
</tr>
<tr>
<td>Dynode-No.2 Voltage</td>
<td>600 volts</td>
</tr>
<tr>
<td>Dynode-No.3 Voltage</td>
<td>800 volts</td>
</tr>
<tr>
<td>Dynode-No.4 Voltage</td>
<td>1000 volts</td>
</tr>
<tr>
<td>Dynode-No.5 Voltage</td>
<td>1200 volts</td>
</tr>
<tr>
<td>Anode Voltage</td>
<td>1250 volts</td>
</tr>
<tr>
<td>Minimum Peak-to-Peak Blanking Voltage</td>
<td>5 volts</td>
</tr>
<tr>
<td>Field Strength at Center of Focusing Coil</td>
<td>75 gausses</td>
</tr>
<tr>
<td>Field Strength of Alignment Coil</td>
<td>0 to 3 gausses</td>
</tr>
</tbody>
</table>

### Performance Data:

- Cathode Radiant Sensitivity at 4500 angstroms: 0.033 a/w
- Luminous Sensitivity: 65 µa/Im
- Anode Current (DC): 30 µa
- Signal-Output Current (Peak to Peak): 5 µa
- Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc: 37:1
- Photocathode Illumination at 2870° K Required to bring Picture High- lights one stop above the "Knee" of Light Transfer Characteristic: 0.007 fc

---

**RADIO CORPORATION OF AMERICA**

Electronic Components and Devices

Harrison, N. J.

DATA 2 9-63
Peak-to-Peak Response to Square-Wave Test Pattern at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white) \( k \) 65 %

a Made by Cleveland Electronics Inc., 1974 East 61st Street, Cleveland, Ohio.
b Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.
c The suppressor grid connected to the cathode and the field-mesh grid connected to grid No. 4 are not given as numbered grids in order to conform with industry practice of associating functional camera control knobs with specific grid numbers. For example, beam-focus control is generally associated with knob identified as No. 4 (grid No. 4), regardless of its position with respect to the cathode.
d Dynode-voltage values are shown under Typical Operating Values.
e With 8092A operated in RCA-TK-11 or -TK-31 camera. Other cameras may require slightly different voltage ranges.
f Adjust for best focus.
g Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 to 5 volts.
h Adjust to give the most uniformly shaded picture near maximum signal.
i Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with indicator located outside of and at the image end of the focusing coil.
j Measured with amplifier having flat frequency response.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-I0 RESPONSE is shown at front of this Section
ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

a. Six holes having diameter of 0.065" ± 0.001" and one hole having diameter of 0.150" ± 0.001". All holes have depth of 0.265" ± 0.001". The six 0.065" holes are enlarged by 45° taper to depth of 0.047". All holes are spaced at angles of 51° 26' ± 5' on circle diameter of 2.500" ± 0.001".

b. Seven stops having height of 0.187" ± 0.001", centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125" from 2.812" diameter and having height of 0.126" ± 0.001".

d. Neck-cylinder clearance hole having diameter of 2.200" ± 0.001".

NOTE 1: DOTTED AREA IS FLAT OR EXTENDS TOWARD DIHEPTAL-BASE END OF TUBE BY 0.060" MAX.

DIMENSIONS IN INCHES

SEE NOTE 1

.5 MIN.

1.315 R. MIN.

1.185 R. MAX.

25° 43'

JUMBO ANNULAR 7-PIN BASE

BASE JEDEC GROUP 5 NA B14-45

ENLARGED BOTTOM VIEW

DIMENSIONS IN INCHES

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

DATA 3
9-63
BASIC LIGHT-TRANSFER CHARACTERISTIC

ILLUMINATION: TUNGSTEN LIGHT, DAYLIGHT, OR WHITE FLUORESCENT. FOR SMALL-AREA HIGHLIGHTS.

TYPICAL SIGNAL OUTPUT—MICROAMPERES

HIGHLIGHT ILLUMINATION ON PHOTOCATHODE—FOOTCANDLES

92C5-12066
Vidicon

For Color Television Film Pickup Service
- Electrostatic-Focus, Magnetic-Deflection
- Low-Power "Dark Heater" — 0.6 Watt
- Separate Mesh Connection
- Precision Outer-Diameter Glass Bulb
- Tested to Stringent Signal Uniformity Specifications

General Data
Dimensions See Dimensional Outline
Direct Interelectrode Capacitance:  
Target to all other electrodes 5 pF
Focusing Method Electrostatic
Deflection Method Magnetic
Heater Power 0.6 W
Maximum Useful 0.375 x 0.5 in
Picture Size (12.70 x 9.52 mm)
Orientation of Quality Rectangle:  
Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tubes and short axis index pin.

Base Small-Button Ditetrar 8-Pin (JEDEC No. E8-11)
Socket Cinchb' No. 133-98-11-015, or equivalent
Weight 2.8 (79.5 g) oz
Operating Position Any
Deflection Alignment Assembly Cleveland Electronics No. VYA-300, or equivalent

RCA Electronic Components
DATA 1
6-72
Maximum Ratings, Absolute-Maximum Values:

Grid-No.6 & 3 Voltage\( \ldots \) 1350 V
Grid-No.5 Voltage \( \ldots \) 1000 V
Grid-No.4 Voltage \( \ldots \) 400 V
Grid-No.2 Voltage\( f \) \( \ldots \) 850 V
Grid-No.1 Voltage:
  Negative bias value \( \ldots \) 300 V
  Positive bias value \( \ldots \) 0 V
Peak Heater-Cathode Voltage:
  Heater negative with respect to cathode \( \ldots \) 125 V
  Heater positive with respect to cathode \( \ldots \) 10 V
Heater Voltage \( \ldots \) 6.3 ± 5% V
Target Voltage \( \ldots \) 125 V
Target Dark Current \( \ldots \) 0.20 µA
Peak Target Current\( g \) \( \ldots \) 0.60 µA
Faceplate:
  Illumination\( h \) \( \ldots \) 5000 fc
  Temperature \( \ldots \) 71 °C

Typical Operation and Performance Data

Grid-No.6 (Decelerator)
  & 3 Voltage\( e \) \( \ldots \) 750 V
Grid-No.5 Voltage\( e \) \( \ldots \) 325 to 450 V
Grid-No.4 (Beam-Focus Electrode) Voltage \( \ldots \) 90 to 150 V
Grid-No.2 (Accelerator)
  Voltage\( f \) \( \ldots \) 300 V
Grid-No.1 Voltage
  (For Picture Cutoff)\( i \) \( \ldots \) −45 to −100 V
Signal-To-Noise Ratio (Approximate)\( m \) \( \ldots \) 300:1
Typical Resolution:
  Center \( \ldots \) 700 TV Lines
### Limiting Resolution:
- Center horizontal: 500 (min.) TV Lines
- Center vertical: 400 (min.) TV Lines

### Amplitude Response to 400 TV Line Square-Wave Test
- Pattern at Center of Picture: 30%

### Average “Gamma” of Transfer Characteristic
- 0.65

### Lag-Per Cent of Initial Value of Signal-Output Current
- 20%

### Typical Sensitivity
- **Faceplate Illumination**: 4 fc
- **Target Voltage**: 15 to 30 V
- **Dark Current**: 0.010 µA
- **Signal Output Current** (Typical): 0.30 µA

### Notes
- This capacitance, which effectively is the output impedance of the vidicon, is increased when the tube is mounted in the deflecting-yoke assembly. The resistive component of the output impedance is in order of 100 megohms.
- Made by Alden Products Co., 9140 North Main St., Brockton 64, Massachusetts.
- Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.
- Grid-No.6 & 3 voltage must always be greater than grid-No.5 voltage. The maximum voltage difference between these electrodes, however, should not exceed 800 volts. The recommended ratio of grid-No.5 to grid-No.6 & 3 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.
The power dissipation at grid No.2 should not exceed one watt, a condition normally met when the tube is operated at the specified maximum grid-No.2 rating and when the specified peak target current rating is not exceeded. However, if the vidicon is operated continuously with grid-No.1 voltage near or approaching zero bias, grid-No.2 voltage should not exceed 350 volts dc maximum.

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

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

With no blanking voltage on grid No.1.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.2 microampere and a dark current of 0.02 microampere.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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

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.

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

This typical capability may be limited by conditions external to the tube such as test pattern material, optics and/or yoke.
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Grids No.3 & No.6
Pin 5: Grid No.2
Pin 6: Grid No.5
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin:
  Internal Connection —
  Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE
8LN
Dimensional Outline

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 — Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2 — Within this distance, diameter of bulb is 1.025" ± 0.003" – 0.030". Tube is acceptable regarding camber when it can be inserted into a 1"-long cylinder gauge which has an inner diameter of 1.0280" ± 0.0011" – 0.0000". The gauge must pass along the tube length from the base to the metal target flange.

Note 3 — Faceplate is Corning No.7056 glass having a thickness of 0.094" ± 0.012".
Recommended Location of Deflecting Yoke and Alignment Coil to Obtain Optimum Geometry and Optimum Output Signal Uniformity

HORIZONTAL AND VERTICAL DEFLECTING COILS

TWO CONCENTRIC MAGNETIC SHIELDS

ALIGNMENT COIL

END OF ELECTRON GUN

Typical Range of Dark Current

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.375 x 0.5
FACEPLATE TEMPERATURE = 30°C APPROX.
Typical Persistence Characteristics

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.375 x 0.5
FACEPLATE TEMPERATURE = 30°C APPROX.
| ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER. | SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.375 x 0.5 |
| FACEPLATE TEMPERATURE = 30° C APPROX. | |

<table>
<thead>
<tr>
<th>SIGNAL OUTPUT - MICROAMPERES</th>
<th>DARK CURRENT MICROAMPERES</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.01</td>
</tr>
<tr>
<td>0.2</td>
<td>0.02</td>
</tr>
<tr>
<td>0.3</td>
<td>0.03</td>
</tr>
<tr>
<td>0.4</td>
<td>0.04</td>
</tr>
<tr>
<td>0.5</td>
<td>0.05</td>
</tr>
</tbody>
</table>

2870 P X TUNGSTEN ILLUMINATION ON TUBE FACE - FOOTCANDLES
Relative Response - Percent

ULTRA VIOLET
VIOLET
BLUE
GREEN
YELLOW
RED
INFRA RED

Wavellengt - Nanometers

300 400 500 600 700 800

Input Radiant Power Adjusted to Obtain Equal Values of Signal - Output Current at All Wavelengths.
For Color Television Film Pickup Service

- Electrostatic-Focus, Magnetic-Deflection
- Low-Power “Dark Heater” — 0.6 Watt
- Separate Mesh Connection
- Precision Outer-Diameter Glass Bulb
- Tested to Stringent Signal Uniformity Specifications

General Data

Dimensions ........................................ See Dimensional Outline
Direct Interelectrode Capacitance$^a$
  Target to all other electrodes ................. 11 pF
Focusing Method ................................. Electrostatic
Deflection Method ............................... Magnetic
Heater Power ...................................... 0.6 W
Maximum Useful Picture Size ................. 0.6x0.8
  (15.24 x 20.32 mm) in

Orientation of Quality Rectangle:
Proper orientation is obtained when
the horizontal scan is essentially
parallel to the straight sides of the
masked portions of the faceplate.
The straight sides are parallel to the
plane passing through the tube axis
and short index pin.

Base ................................................ Small-Button Super
  Ditetar 8-Pin (JEDEC
  No. E8-78)
  Alden$^b$ No.208-SPEC.
  or equivalent
  11 (312.4 g) oz

Socket ............................................ Any

Weight ............................................. Cleveland Electronics
  No.15VYA-333, or
equivalent

Operating Position .............................

Deflection Alignment Assembly$^c$ ..........
Maximum Ratings, Absolute-Maximum Values:

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.6 &amp; 3 Voltage(^a)</td>
<td>1500 V</td>
</tr>
<tr>
<td>Grid-No.5 Voltage</td>
<td>1500 V</td>
</tr>
<tr>
<td>Grid-No.4 Voltage</td>
<td>500 V</td>
</tr>
<tr>
<td>Grid-No.2 Voltage(^f)</td>
<td>750 V</td>
</tr>
<tr>
<td>Grid-No.1 Voltage:</td>
<td></td>
</tr>
<tr>
<td>Negative bias value</td>
<td>300 V</td>
</tr>
<tr>
<td>Positive bias value</td>
<td>0 V</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>125 V</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>10 V</td>
</tr>
<tr>
<td>Heater Voltage</td>
<td>6.3 ± 5% V</td>
</tr>
<tr>
<td>Target Voltage</td>
<td>125 V</td>
</tr>
<tr>
<td>Target Dark Current</td>
<td>0.25 μA</td>
</tr>
<tr>
<td>Peak Target Current(^g)</td>
<td>0.60 μA</td>
</tr>
<tr>
<td>Faceplate:</td>
<td></td>
</tr>
<tr>
<td>Illumination(^h)</td>
<td>5000 fc</td>
</tr>
<tr>
<td>Temperature</td>
<td>71 °C</td>
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</tbody>
</table>

Typical Operation and Performance Data

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.6 (Decelerator) &amp; 3 Voltage(^a)</td>
<td>1400 V</td>
</tr>
<tr>
<td>Grid-No.5 Voltage(^e)</td>
<td>700 to 840 V</td>
</tr>
<tr>
<td>Grid-No.4 (Beam-Focus Electrode) Voltage(^e)</td>
<td>230 to 260 V</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage(^f)</td>
<td>300 V</td>
</tr>
<tr>
<td>Grid-No.1 Voltage (For Picture Cutoff)(^i)</td>
<td>–45 to –100 V</td>
</tr>
<tr>
<td>Signal-To-Noise Ratio (Approximate)(^m)</td>
<td>300:1</td>
</tr>
</tbody>
</table>

Typical Resolution:

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center</td>
<td>1400/1200 TV Lines</td>
</tr>
<tr>
<td>Corner</td>
<td>1000</td>
</tr>
</tbody>
</table>
Amplitude Response to 400 TV Line Square-Wave Test Pattern at Center of Picture 60/55 %

Average "Gamma" of Transfer Characteristic 0.65

Lag Per Cent of Initial Value of Signal-Output Current 1/20 Second after Illumination is Removed 25 %

Typical Sensitivity

Faceplate Illumination 10 fc

Target Voltage P.Q 15 to 45 V

Dark Current P.Q, 0.010 µA

Signal Output Current (Typical) 0.30 µA

Notes

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

b Made by Alden Products Co., 9140 North Main St., Brockton 64, Massachusetts.

b' Made by Cinch Manufacturing Co., 1026 S. Homan Ave., Chicago 24, Illinois.

c Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

e Grid-No.6 & 3 voltage must always be greater than grid-No.5 voltage. The maximum voltage difference between these electrodes, however, should not exceed 800 volts. The recommended ratio of grid-No.5 to grid-No.6 & 3 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

f The power dissipation at grid No.2 should not exceed one watt, a condition normally met when the tube is operated at the specified maximum grid-No.2 rating and when the specified peak target current rating is not exceeded. However, if the vidicon is operated continuously with grid-No.1 voltage near or approaching zero bias, grid-No.2 voltage should not exceed 350 volts dc maximum.
Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

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

With no blanking voltage on grid No.1.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.2 microampere and a dark current of 0.02 microampere.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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

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.

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

This typical capability may be limited by conditions external to the tube such as test pattern material, optics and/or yoke.
Basing Diagram (Bottom View)

DIRECTION OF LIGHT:
INTO FACE END OF TUBE

8MD

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Grids No.3 & No.6
Pin 5: Grid No.5
Pin 6: Grid No.2
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin:
  Internal Connection —
  Make No Connection
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 — Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2 — Within this area the minimum bulb diameter dimension does not apply.

Note 3 — Faceplate thickness is 0.135" ± 0.005".
Recommended Location of Deflecting Yoke and Alignment Coil to obtain Optimum Geometry and Optimum Output Signal Uniformity

Typical Range of Dark Current

SCANNED AREA OF PHOTOCO nductive LAY E 0.6" x 0.8" FACEPLATE TEMPERATURE = 30°C APPROX.
Typical Persistence Characteristics

INITIAL HIGHLIGHT SIGNAL-OUTPUT MICROAMPERES = 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.6" x 0.8"
FACEPLATE TEMPERATURE = 30°C APPROX.

DEMOGRAPHIC DATA

- Dark Current (MICROAMPERES) = 0.05, 0.02, 0.005
- Signal-Output Current — Per Cent of Initial Value
- Time After Illumination Is Removed — Milliseconds

RCA Electronic Components
Light Transfer Characteristics

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.6" x 0.8"
FACEPLATE TEMPERATURE = 30° C APPROX.

ILLUMINATION ON TUBE FACE - FOOTCANDLES

DARK CURRENT (MICROAMPERES) = 0.05

SIGNAL OUTPUT — MICROAMPERES
Typical RCA Type I Spectral Response

Wave length - nanometers

Relative sensitivity

Range of maximum value

RCA Components
8507A Vidicon

1-Inch Diameter

Magnetic Focus
Magnetic Deflection

High-Resolution Type Having High Sensitivity and Low Lag
For Live Scene and Film Pickup in Black-and-White
and Color TV Cameras

The 8507A is unilaterally interchangeable with the 8507

GENERAL

Heater, for Unipotential Cathode:
Voltage (AC or DC) .............. 6.3 ± 10% V
Current at 6.3 volts ............ 0.6 A

Direct Interelectrode Capacitance: a
Target to all other electrodes .......... 4.6 pF

Spectral Response ........ See Typical Spectral Sensitivity Characteristic

Photoconductive Layer:
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) .............. 0.62 in

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method ........ Magnetic
Deflection Method ........ Magnetic

Overall Length .............. 6.250" ± 0.125"
Greatest Diameter .......... 1.125" ± 0.010"

Bulb .................. T8

Base .................. Small-Button Ditetrar 8-Pin, (JEDEC No. E8-11)

Socket .................. Cinch No. 54A18088, or equivalent

Deflecting Yoke-Focusing Coil-Alignment Coil Assembly ........ Cleveland Electronics No. VYFA-355-2, or equivalent

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

Weight (Approx.) ............ 2 oz

ABSOLUTE-MAXIMUM RATINGS

For scanned area of 1/2" x 3/8"

Grid-No.4 Voltage ................ 1000 max. V
Grid-No.3 Voltage ................ 1000 max. V
Grid-No.2 Voltage ................ 350 max. V
Grid-No.1 Voltage:
Negative bias value ............. 150 max. V
Positive bias value ............. 0 max. V
**Peak Heater-Cathode Voltage:**

- Heater negative with respect to cathode: 125 max. V
- Heater positive with respect to cathode: 10 max. V

**Target Voltage:** 100 max. V

**Dark Current:** 0.25 max. µA

**Peak Target Current:** 0.75 max. µA

**Faceplate:**
- Illumination: 5000 max. fc
- Temperature: 71 max. °C

**TYPICAL OPERATION AND PERFORMANCE DATA**

For scanned area of 1/2" x 3/8" —
Faceplate temperature of 30° to 35° C

and Standard TV Scanning Rate

<table>
<thead>
<tr>
<th>Mode</th>
<th>Low-Voltage</th>
<th>High-Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) Voltage</td>
<td>500 V</td>
<td>900 V</td>
</tr>
<tr>
<td>Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>300 V</td>
<td>540 V</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300 V</td>
<td>300 V</td>
</tr>
</tbody>
</table>

Grid-No.1 Voltage for Picture Cutoff: -65 to -100 V

-65 to -100 V

Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 µA and 0.2 µA: 0.65

Visual Equivalent Signal-to-Noise Ratio (Approx.): 300:1

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

**Minimum Peak-to-Peak Blanking Voltage:**
- When applied to grid No.1: 75 V
- When applied to cathode: 20 V
Limiting Resolution:
- At center of picture: 1000 TV lines
- At corner of picture: 600 TV lines

Amplitude Response to
- a 400 TV Line Square Wave Test Pattern at Center of Picture:
  - Center: %

Field Strength at Center of Focusing Coil:
- Horizontal: 40 ± 4 G
- Vertical: 58 ± 4 G

Peak Deflecting-Coil Current:
- Horizontal: 180 mA
- Vertical: 250 mA

Field Strength of Adjustable Alignment Coil:
- 0 to 4 G

**High-Sensitivity Operation**
- 0.1 Footcandle on Faceplate

<table>
<thead>
<tr>
<th>Faceplate Illumination</th>
<th>(Highlight)</th>
<th>0.1</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage</td>
<td>30 to 60 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Current</td>
<td>0.10 µA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal-Output Current:</td>
<td>Typical</td>
<td>0.1 µA</td>
<td></td>
</tr>
</tbody>
</table>

**Average-Sensitivity Operation**
- 1.0 Footcandle on Faceplate

<table>
<thead>
<tr>
<th>Faceplate Illumination</th>
<th>(Highlight)</th>
<th>1.0</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage</td>
<td>20 to 40 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Current</td>
<td>0.02 µA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal-Output Current:</td>
<td>Typical</td>
<td>0.2 µA</td>
<td></td>
</tr>
</tbody>
</table>

**High-Light Level Operation**
- 10 Footcandles on Faceplate

<table>
<thead>
<tr>
<th>Faceplate Illumination</th>
<th>(Highlight)</th>
<th>10</th>
<th>fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage</td>
<td>10 to 22 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Current</td>
<td>0.005 µA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Signal-Output Current:</td>
<td>Typical</td>
<td>0.3 µA</td>
<td></td>
</tr>
</tbody>
</table>
This capacitance, which effectively is the output impedance of the 8507A, 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, 1026 S. Homan Avenue, Chicago 24, Illinois.

Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087

These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

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 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

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.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a percent of the signal amplitude from a very-low-frequency (large-
area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

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 3-11/16 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 target voltage for each 8507A must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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.

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

**BASING DIAGRAM (Bottom View)**

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin — Internal Connection — Make No Connection
This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in Fig.1. The 8507A is operated under the conditions specified under Typical Operation and Performance Data with the lens adjusted to provide a target current of 0.3 microampere. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.

Table 1
For scanned area of 1/2" x 3/8"

<table>
<thead>
<tr>
<th>Equivalent Number of Raster Lines</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4 but not including 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>3 but not including 1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1 or less</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.
Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To obtain minimum beam-landing error

Dimensions in Inches

Note: Cross-hatching indicates wound portion of focusing coil.

RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.
TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC

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

WAVELENGTH (ANGSTROMS)
TYPICAL PERSISTENCE CHARACTERISTICS

INITIAL HIGHLIGHT SIGNAL - OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" X 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

<table>
<thead>
<tr>
<th>SIGNAL-OUTPUT CURRENT - PER CENT OF INITIAL VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

DARK CURRENT (MICROAMPERES) = 0.1

0.02

TIME AFTER ILLUMINATION IS REMOVED - MILLISECONDS
Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.
Vidicon

MAGNETIC FOCUS  1-1/2" Diameter  MAGNETIC DEFLECTION

For Black-and-White Pickup in Industrial Closed-Circuit TV Systems Requiring Limiting Resolutions of more than 1200 TV Lines

General:
Heater, for Unipotential Cathode:
  Voltage (AC or DC).................................................. 6.3 ± 10% volts
  Current at heater volts = 6.3................................. 0.6 amp
Direct Interelectrode Capacitance:
  Target to all other electrodes........................................ 8.0 pf
Spectral Response.................................................. See Accompanying Curve

Photoconductive Layer:
  Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)b.......................... 1"

Focusing Method.................................................. Magnetic
Deflection Method.................................................. Magnetic

Overall Length.................................................. 7.75" ± 0.25"
Greatest Diameter.................................................. 1.59" ± 0.01"
Bulb Diameter.................................................. 1.50" ± 0.01"
Operating Position.................................................. Any
Weight (Approx.).................................................. 5.25 oz
Bulb............................................................. T12

[Diagram]

Maximum Ratings, Absolute-Maximum Values:
For scanned area of 0.6" x 0.8"

Grid-No.4 Voltage.................................................. 1500 max. volts
Grid-No.3 Voltage.................................................. 1500 max. volts
Grid-No.2 Voltage.................................................. 550 max. volts
Grid-No.1 Voltage:
Negative-bias value: 300 max. volts
Positive-bias value: 0 max. volts

Peak Heater-Cathode Voltage:
Heater negative with respect to cathode: 125 max. volts
Heater positive with respect to cathode: 10 max. volts

Target Voltage: 100 max. volts

Dark-CURRENT:
Target Value: 0.25 max. μa
Peak Target Current: 0.60 max. μa

Faceplate:
Illumination: 1000 max. fc
Temperature: 71 max. °C

Typical Operation:
For scanned area of 0.6" x 0.8" and faceplate temperature of 28° to 34° C

Grid-No.4 (Decelerator) Voltage: 1400 volts
Grid-No.3 (Beam-Focus Electrode) Voltage: 800 to 1000 volts
Grid-No.2 (Accelerator) Voltage: 300 volts
Grid-No.1 Voltage for picture cutoff: -45 to -100 volts

Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 μa and 0.6 μa: 0.65

Minimum Peak-to-Peak Blanking Voltage:
When applied to grid No.1: 75 volts
When applied to cathode: 20 volts

Lag—Percent of Initial Value of Signal-Output Current 1/20 Second after Illumination is Removed:
Maximum value: 45 %
Typical value: 30 %

Limiting Resolution:
At center of picture:
Typical value: 1500 TV lines
Minimum value: 1200 TV lines
At corners of picture:
Typical value: 900 TV lines

Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture:
Minimum value: 60 %
Field Strength at Center of Focusing Coil (Approx.): 46 gauss
Field Strength of Adjustable Alignment Coil: 0 to 4 gauss
Peak Deflecting-Coil Current for Specified Deflecting Yoke:
Horizontal: 240 ma
Vertical: 50 ma

Maximum—Sensitivity Operation—0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight): 0.1 fc

RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.
### Signal-Output Current

**Typical**

- **Target Voltage**
  - p

- **Dark Current**

- **Faceplate Illumination (Highlight)**

- **Target Voltage**

- **Dark Current**

- **Signal-Output Current**
  - Typical

### Average-Sensitivity Operation

- **1.0 Footcandle on Faceplate**

- **Faceplate Illumination (Highlight)**

- **Target Voltage**

- **Dark Current**

- **Signal-Output Current**
  - Typical

- **Minimum**

### High-Light Level Operation

- **10 Footcandles on Faceplate**

- **Faceplate Illumination (Highlight)**

- **Target Voltage**

- **Dark Current**

- **Signal-Output Current**
  - Typical

---

- **Target Voltage**
  - p

- **Dark Current**

- **Signal-Output Current**
  - Typical

- **Average-Sensitivity Operation**

#### 1.0 Footcandle on Faceplate

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>Target Voltage</th>
<th>Dark Current</th>
<th>Signal-Output Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Image]</td>
<td>1.0 fc</td>
<td>17 to 35 volts</td>
<td>0.02 µA</td>
</tr>
<tr>
<td>[Image]</td>
<td>10 fc</td>
<td>10 to 20 volts</td>
<td>0.005 µA</td>
</tr>
</tbody>
</table>

### High-Light Level Operation

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>Target Voltage</th>
<th>Dark Current</th>
<th>Signal-Output Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Image]</td>
<td>1.0 fc</td>
<td>17 to 35 volts</td>
<td>0.20 µA</td>
</tr>
<tr>
<td>[Image]</td>
<td>10 fc</td>
<td>10 to 20 volts</td>
<td>0.15 µA</td>
</tr>
</tbody>
</table>

---

- **This capacitance, which effectively is the output impedance of the 8521, is increased when the tube is mounted in the deflecting-yoke and focusing-alignment assembly. The resistive component of the output impedance is in the order of 100 megohms.**

- **Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the plane passing through the axis and short index pin. The masking is for orientation only and does not define the proper scanned area of photoconductive layer.** Final orientation should be such that the image also fits inside of any internal mask of the mesh assembly.

- **Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.**

- **For minimum geometric distortion, the deflecting yoke should be located in its proper axial position 9/4-inch from the face of the tube.**

- **Alden Products Co., 9140 North Main Street, Brockton 64, Mass.**

- **Video amplifiers must be designed properly to handle target currents of the magneto to avoid amplifier overload or picture distortion.**

- **Grid-No.4 voltage must always be greater than grid-No.3 voltage.** For minimum "porthole" effect, grid-No.4 voltage should be adjusted to approximately 1.6 times the grid-No.3 voltage value, and the focusing-alignment assembly and deflecting yoke positioned as shown in accompanying diagram.

- **Beam focus is obtained by the combined effect of grid-No.3 voltage, which should be adjustable over indicated range, and a focusing coil having an average field strength of 40 gauss.**

- **With no blanking voltage on grid No.1.**

- **Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the plane passing through the axis and short index pin.**

- **Alignment coil should be located on the tube so that its center is at a distance of 6 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.**

- **Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.**

- **The target voltage for each 8521 must be adjusted to that value which gives the desired operating dark current.**

- **The deflecting circuits must provide extremely linear scanning for good black-level reproduction.** Dark-current signal is proportional to the scanning velocity. A change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity. Defined as the component of the highlight target current after the dark-current component has been subtracted.
DIMENSIONS IN INCHES

**Note 1:** Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

**Note 2:** Within this area the minimum bulb diameter dimension does not apply.

**Note 3:** Faceplate thickness is 0.135" ± 0.005".
COMPONENT LOCATIONS

FOCUSING COIL

ALIGNMENT COIL

END OF ELECTRON GUN

HORIZONTAL AND VERTICAL DEFLECTING COILS

DIMENSIONS IN INCHES

RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCONDUCTIVE LAYER=0.6" X 0.8"
FACEPLATE TEMPERATURE=30° C APPROX.

TARGET VOLTS

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

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.6" X 0.8"
FACEPLATE TEMPERATURE = 30° C APPROX.
TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC

FOR EQUAL VALUES OF SIGNAL-OUTPUT CURRENT AT ALL WAVELENGTHS.

SIGNAL-OUTPUT MICROAMPERES FROM SCANNED AREA OF $1/2'' \times 3/8'' = 0.02$

DARK CURRENT (MICROAMPERES) = 0.02

WAVELENGTH—ANGSTROMS

ULTRA VIOLET  BLUE  GREEN  YELLOW  RED  INFRARED

MICROAMPERES/MICROWATT OF RADIANT ENERGY

0.110
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000

3000  4000  5000  6000  7000  8000

92CM-11619

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

INITIAL HIGHLIGHT SIGNAL-OUTPUT MICROAMPERES = 0.2
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.6" x 0.8"
FACEPLATE TEMPERATURE = 30°C APPROX.
UNCOMPENSATED HORIZONTAL RESPONSE TO A SQUARE-WAVE TEST PATTERN

HIGHLIGHT TARGET MICROAMPERES = 0.3
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SQUARE-WAVE RESOLUTION WEDGE,
GRID-No. 4 VOLTS = 1400
GRID-No. 3 VOLTS = 850
GRID-No. 2 VOLTS = 300

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N.J.
8541, 8541A

Vidicons

- High Resolution — 1100 TV Lines (Typical at 900 Volts)
- High Amplitude Response — 60% (Typical at 900 Volts)
- Separate Mesh Connection
- High Signal Output — 200 Nanoamperes 1 Footcandle on Tube Face and Target Voltage of 30 Volts (Typical)
- Low Lag — 20% of Initial Signal Output After 50 Milliseconds
- 0.6 Watt "Dark Heater"

General Data
Heater, for Unipotential Cathode:

Voltage (AC or DC) ................. 6.3 ± 10% V
Current at 6.3 volts ................ 0.1 A

Direct Inter-electrode Capacitance:
Target to all other electrodes .... 4.6 pF

Spectral Response .................. See Figure 5

Photoconductive Layer:
Maximum useful diagonal of rectangular image .......... 0.63 in (16 mm)
Orientation of quality rectangle — Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method .................... Magnetic
Deflection Method .................. Magnetic
Dimensions .......................... See Dimensional Outline
Bulb ................................. T8
Base ................................. Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket ............................... Cinch² 8VT (133-98-11-015), or equivalent
Deflecting Yoke-Focusing Coil .. Cleveland Electronics⁵,⁶
Alignment Coil Assembly .......... No.VYFA-355-2, or equivalent
Operating Position ................. Any
Weight (Approx.) .................... 2 oz (56.6 g)
### Maximum Ratings, Absolute-Maximum Values

For scanned area of 1/2" x 3/8" (12.8 x 9.6 mm²)

<table>
<thead>
<tr>
<th>Component</th>
<th>Low Voltage Mode</th>
<th>High Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 Voltage</td>
<td>500 V</td>
<td>900 V</td>
</tr>
<tr>
<td>Grid-No.3 Voltage</td>
<td>300 V</td>
<td>540 V</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>300 V</td>
<td>300 V</td>
</tr>
<tr>
<td>Grid-No.2 Dissipation</td>
<td></td>
<td>1 W</td>
</tr>
<tr>
<td>Grid-No.1 Voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative bias value</td>
<td>300 V</td>
<td></td>
</tr>
<tr>
<td>Positive bias value</td>
<td>0 V</td>
<td></td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heater negative w.r.t. cathode</td>
<td>125 V</td>
<td></td>
</tr>
<tr>
<td>Heater positive w.r.t. cathode</td>
<td>10 V</td>
<td></td>
</tr>
<tr>
<td>Target Voltage</td>
<td>100 V</td>
<td></td>
</tr>
<tr>
<td>Dark Current</td>
<td>250 nA</td>
<td></td>
</tr>
<tr>
<td>Peak Target Current</td>
<td>750 nA</td>
<td></td>
</tr>
<tr>
<td>Faceplate:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illumination</td>
<td>50,000 lx</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>5000 fc</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>71°C</td>
<td></td>
</tr>
</tbody>
</table>

### Typical Operation and Performance Data

For scanned area of 1/2" x 3/8" (12.8 x 9.6 mm²)

Faceplate temperature of 30°C to 35°C and Standard TV Scanning Rate in VYFA-355-2 Coil Assembly

<table>
<thead>
<tr>
<th>Component</th>
<th>Low Voltage Mode</th>
<th>High Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) Voltage</td>
<td>350 mA</td>
<td>480 mA</td>
</tr>
<tr>
<td>Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>20 mA</td>
<td>28 mA</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>40±4 G</td>
<td>58±4 G</td>
</tr>
</tbody>
</table>
### Field Strength of Adjustable Alignment Coil

<table>
<thead>
<tr>
<th>Voltage Mode</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Voltage Mode</td>
<td>0 to 4</td>
<td>0 to 4</td>
</tr>
<tr>
<td>High Voltage Mode</td>
<td>G</td>
<td>G</td>
</tr>
</tbody>
</table>

### Minimum Peak-to-Peak Blanking Voltage:

- When applied to grid No.1: 75 V
- When applied to cathode: 20 V

### Grid-No.1 Voltage for Picture Cutoff:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>8541A</td>
<td>-65 to</td>
<td>-65 to</td>
</tr>
<tr>
<td>8541</td>
<td>-40 to</td>
<td>-40 to</td>
</tr>
</tbody>
</table>

### Average "Gamma" of Transfer Characteristic for Signal-Output Current Between 20 nA and 200 nA

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>8541A</td>
<td>-100</td>
<td>-100</td>
</tr>
<tr>
<td>8541</td>
<td>-100</td>
<td>-100</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Maximum</td>
<td>8541A</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>8541</td>
<td>30</td>
</tr>
</tbody>
</table>

### Limiting Resolution:

- At center of picture (Typ.): 1000 TV lines
- At center of picture (Min.): 950 TV lines
- At corner of picture (Typ.): 600 TV lines

### Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Minimum</td>
<td>8541A</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>8541</td>
<td>35</td>
</tr>
</tbody>
</table>
8541, 8541A

Sensitivity:
See "Light Transfer Characteristics" (Figure 7)

Performance Tests:

Test conditions: \{ 1.0 fc on Faceplate \\
20 nA Dark Current \}

Limit values:

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target voltage:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8541A</td>
<td>20</td>
<td>40</td>
</tr>
<tr>
<td>8541</td>
<td>10</td>
<td>70</td>
</tr>
<tr>
<td>Signal current:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8541A</td>
<td>150</td>
<td>5nA</td>
</tr>
<tr>
<td>8541</td>
<td>120</td>
<td>5nA</td>
</tr>
</tbody>
</table>

a) 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.

b) Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, IL 60007.

c) Made by Cleveland Electronics Inc., 14500 Darley Rd., Cleveland, OH 44110.

d) These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis as shown in Figure 2.

e) A description of the Absolute-Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes.

f) 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 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

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

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

i) With no blanking voltage on grid No.1.
For initial signal-output current of 300 nanoamperes and a dark current of 20 nanoamperes.

Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

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 3-11/16 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 target voltage for each tube must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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.

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

**Spurious Signal**

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in Figure 1. The tubes are operated under the conditions specified under Typical Operation and Performance Data and the lens adjusted to provide a target current of 300 nanoamperes. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system.
Allowable spot size for each zone is shown in Table I for the 8541A and Table II for the 8541. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item. Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

<table>
<thead>
<tr>
<th>Blemish Size (Equivalent Number of Raster Lines)</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>over 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>over 1</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>over 1/2</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

Table II — 8541
For scanned area of 1/2" x 3/8" (12.8 mm x 9.6 mm)

<table>
<thead>
<tr>
<th>Blemish Size (Equivalent Number of Raster Lines)</th>
<th>Zone 1 Allowed Spots</th>
<th>Zone 2 Allowed Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>over 6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>over 4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>over 1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>over 1/2</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

* Spots of this size are allowed unless concentration causes a smudged appearance.
Operating Considerations
The target connection is made by a suitable spring contact bearing against the edge of the metal ring at the face end of the tube.

The temperature of the faceplate should not exceed 71° C (160° F), either during operation or storage of these tubes. Operation with a faceplate temperature in the range from about 25° to 35° C (77° to 95° F) is recommended.

Figure 2 — Recommended Location and Length of Deflecting, Focusing, and Alignment Components to Obtain Minimum Beam-Landing Error

Note: Cross-hatching indicates wound portion of focusing coil.

Provisions should also be made in the camera installation to hold the faceplate temperature at a steady value within the recommended range. Dark current increases with increasing temperature. It is highly desirable to operate the tube at a steady temperature to maintain dark current at a preselected value. This mode of operation insures both optimum and stable day-to-day performance. If such provisions cannot be made, changes in target voltage may be required from time to time to maintain the desired picture quality.
As target voltage is increased, dark current also increases. The range of target voltage for various dark current levels of different tubes is shown in Figure 3. It should be noted that the range of target voltage to produce a given dark current, and therefore a given sensitivity is very narrow for these tubes. Individual tubes will therefore have substantially identical performance characteristics when operated with an identical value of dark current. For proper adjustment of the target voltage on each tube see Set-Up Procedure.

Persistence or lag of the photoconductive layer is given in Figure 4 for two values of dark current. Each curve shows the decay in signal-output current from an initial value of 300 nanoamperes after the illumination is cut off.

The spectral response of the 8541 and 8541A is shown in Figure 5.

As shown in Figure 6, a substantial increase in both limiting resolution and amplitude response of the tubes may be obtained by increasing the operating voltages of grid No.4 and grid No.3. The focusing-coil field strength must be increased and more deflecting power is required at higher electrode voltages as indicated under Typical Operation and Performance Data. Very little additional beam-landing error is introduced at the higher voltages provided the recommended operating voltages are used and the associated components are positioned as shown in Figure 2.

The power dissipation at grid No.2 should not exceed one watt, a condition normally met when the tube is operated at the specified maximum grid-No.2 rating and when the specified peak target current rating is not exceeded. However, if the tubes are operated continuously with grid-No.1 voltage near or approaching zero bias, grid-No.2 voltage should not exceed 350 volts dc maximum.

Signal-Output and Light Transfer Characteristics
Typical signal output as a function of uniform 28540 K tungsten illumination on the photoconductive layer for different values of dark current is shown in Figure 7.
The average "gamma", or slope, of the light transfer characteristic curves shown in Figure 7 is approximately 0.65. This value is relatively constant over an adjustment range of 4 to 1 in target voltage, or 50 to 1 in dark current, for a signal-output current range between 10 and 300 nanoampere.

Uniformity of the photoconductive layer of the tubes is excellent. When operated with the recommended focus and deflection components, signal output over the entire picture area is also very uniform. When other components are employed, beam-landing errors at the target may contribute to poor signal uniformity or "shading" characteristics in the generated picture. In such instances, compensation for the beam-landing errors to achieve uniform sensitivity can be obtained by supplying a modulating voltage of a suitable waveform to the cathode of the 8541 and 8541A. The desired waveform is parabolic in shape and of such a polarity that the cathode voltage is lowered as the beam approaches the edges of the scanned area.

Proper-size scanning of the photoconductive target area should always be used. Both overscanning and underscanning impair performance.

Figure 3 — Range of Dark Current

![Figure 3](image-url)
Failure of scanning even for a few seconds may permanently damage the photoconductive layer. The damaged area shows up as a spot or line in the picture during subsequent operation. To avoid damage during scanning failure, it is necessary to prevent the scanning beam from reaching the layer.

The scanning beam can conveniently be prevented from reaching the layer by increasing the grid-No.1 voltage to cutoff, biasing the target negatively, or removing grid-No.4, grid-No.3, and grid-No.2 electrode voltages.

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:** Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

**Note 2:** Faceplate glass is Corning No.7056 having a thickness of 0.094 ± 0.012 in (2.4 ± 0.3).
Basing Diagram — Bottom View

TARGET

IC

G1

G2

G3

G4

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use

Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection — Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

SHORT PIN IC

Figure 4 — Typical Persistence Characteristics

<table>
<thead>
<tr>
<th>SIGNAL-OUTPUT CURRENT — PERCENT OF INITIAL VALUE</th>
<th>INITIAL HIGHLIGHT SIGNAL-OUTPUT = 300 NANOAMPERES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FACEPLATE TEMPERATURE = 300°C APPROX.</td>
<td>DARK CURRENT = 20 NANOAMPERES</td>
</tr>
<tr>
<td>SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.5&quot; X 0.375&quot;</td>
<td>(12.8 mm X 9.6 mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TIME AFTER ILLUMINATION IS REMOVED — MILLISECONDS</th>
<th>0</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGNAL-OUTPUT CURRENT — PERCENT OF INITIAL VALUE</td>
<td>90</td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>20</td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

92LM-2174R2

RCA Electronic Components

DATA 6

11-72
Figure 5 — Typical Spectral Response

FOR EQUAL VALUES OF SIGNAL-OUTPUT CURRENT AT ALL WAVELENGTHS
SCANNED AREA OF 0.5" X 0.375" (12.8 mm X 9.6 mm)

RELATIVE RESPONSE - %

WAVELENGTH - NANOMETERS

RCA Electronic Components
Figure 6 — Horizontal Square-Wave Response

PEAK (HIGHLIGHT) SIGNAL NANOAMPERES = 400
DARK CURRENT NANOAMPERES = 20
TEST PATTERN: TRANSPARENT SLANT-LINE BURST*

CURVE A: GRID-No. 4 VOLTS = 900;
GRID-No. 3 VOLTS = 540
CURVE B: GRID-No. 4 VOLTS = 500;
GRID-No. 3 VOLTS = 300

*Amplitude response measured using the RCA-P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.
Figure 7 – Light Transfer Characteristics

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.5" X 0.375" (12.8 mm X 9.6 mm)
FACEPLATE TEMPERATURE = 30°C APPROX.

DARK CURRENT (NANOMETERS X 100)

SIGNAL OUTPUT – NANOAMPERES

285°F K TUNGSTEN ILLUMINATION ON TUBE FACE – FOOTCANDLES (LUMENS PER SQUARE FOOT)
## Vidicon

**LOW-POWER (0.6-WATT) "DARK HEATER" 1" DIAMETER PRECISION BULB**

**ELECTROSTATIC FOCUS RUGGEDIZED MAGNETIC DEFORMATION**

For Compact, Lightweight, Transistorized TV Cameras in Industrial and Other Closed-Circuit TV Systems Where Severe Environmental Conditions May Be Encountered

### General:

Heater, for Unipotential Cathode:

- Voltage (AC or DC) .................. 6.3 ± 10% volts
- Current at 6.3 volts ................ 0.095 amp

Direct Inter-electrode Capacitance:

- Target to all other electrodes. . . . 5.0 pf

Spectral Response. . . . See Typical Spectral-Sensitivity Characteristic, shown under Type 8134

### Photoconductive Layer:

- Maximum useful diagonal of rectangular image
  
  \[(4 \times 3 \text{ aspect ratio})\] \(= 0.62"\)

Focusing Method. .................. Electrostatic

Deflection Method. ............... Magnetic

Overall Length .................... 6.25" ± 0.10"

Greatest Diameter. ............... 1.125" ± 0.010"

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

Weight (Approx.) ................ 2.8 oz

Bulb ................................ T8

Bulb Diameter ..................... 1.025" ± 0.003"

Deflecting-Alignment Assembly . Cleveland Electronics\(^d\)

Socket ................... Cinch\(^e\) No. 133-98-11-015, or equivalent

Base .................. Small-Button Ditetra 8-Pin (JEDEC No.E8-11)

Basing Designation for BOTTOM VIEW .... 8LN

### Pin Configuration:

<table>
<thead>
<tr>
<th>Pin</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Heater</td>
</tr>
<tr>
<td>2</td>
<td>Grid No.1</td>
</tr>
<tr>
<td>3</td>
<td>Grid No.4</td>
</tr>
<tr>
<td>4</td>
<td>Grid No.3</td>
</tr>
<tr>
<td>5</td>
<td>Grid No.2</td>
</tr>
<tr>
<td>6</td>
<td>Grid No.5</td>
</tr>
<tr>
<td>7</td>
<td>Cathode</td>
</tr>
<tr>
<td>8</td>
<td>Heater</td>
</tr>
<tr>
<td>Flange-Target</td>
<td></td>
</tr>
<tr>
<td>Short Pin</td>
<td>Do Not Use</td>
</tr>
</tbody>
</table>

### Maximum Ratings, Absolute-Maximum Values:

For scanned area of \(1/2" \times 3/8"\)

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Voltage</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 &amp; 3</td>
<td>Voltage</td>
<td>1000</td>
</tr>
<tr>
<td>5</td>
<td>Voltage</td>
<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>Voltage</td>
<td>300</td>
</tr>
<tr>
<td>2</td>
<td>Voltage</td>
<td>750</td>
</tr>
</tbody>
</table>

---

\(^d\) Cleveland Electronics, No.VYA-300, or equivalent

\(^e\) Cinch, No. 133-98-11-015, or equivalent

\(^f\) Grid-No.6 & Grid-No.3

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RADIO CORPORATION OF AMERICA

Electronic Components and Devices

Harrison, N. J.

DATA 1 4-65
Grid-No.1 Voltage:
- Negative-bias value: 300 volts
- Positive-bias value: 0 volts

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 volts
- Heater positive with respect to cathode: 10 volts

Target Voltage: 100 volts
Dark Current: 0.2 µa
Peak Target Current: 0.6 µa

Faceplate:
- Illumination: 1000 fc
- Temperature: 71 °C

Typical Operation and Performance Data:
For scanned area of 1/2" x 3/8" and faceplate temperature of 30° to 35° C and standard TV scanning rate

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Low-Voltage</th>
<th>Intermediate-Voltage</th>
<th>High-Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.6 (Decelerator) &amp; Grid-No.3 Voltage</td>
<td>300</td>
<td>500</td>
<td>750</td>
</tr>
<tr>
<td>Grid-No.5 Voltage</td>
<td>180</td>
<td>300</td>
<td>450</td>
</tr>
<tr>
<td>Grid-No.4 (Beam-Focus Electrode) Voltage</td>
<td>20 to 60</td>
<td>50 to 100</td>
<td>90 to 150</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300</td>
<td>500</td>
<td>300</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for picture cutoff</td>
<td>-45 to -100</td>
<td>-45 to -100</td>
<td>-45 to -100</td>
</tr>
</tbody>
</table>

Typical Electrode Currents:
- Grid No.6 & 3: 1.7, 2.5, 3 µa
- Grid No.5: 0.05, 0.2, 0.3 µa
- Grid No.4: 0.0015, 0.006, 0.008 µa
- Grid No.2: 375, 450, 500 µa

Lag:
- Maximum value: 20, 20, 20 %
- Typical value: 15, 15, 15 %

Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 & 0.2 µa: 0.65 %

Minimum Peak-to-Peak Blanking Voltage:
- Applied to grid-No.1: 75 volts
- Applied to cathode: 20 volts

Limiting Resolution at picture center: 600 TV lines

Amplitude Response to a 400 TV Line Square Wave Test Pattern at picture center:
- 20, 25, 30 %

Field Strength of Adjustable Alignment Coil:
- 0 to 1 gauss
### Average-Sensitivity Operation

**Under typical operating conditions specified for either low- or high-voltage operation**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>1 fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage(^\text{a},\text{b})</td>
<td>20 to 40 volts</td>
</tr>
<tr>
<td>Dark Current(^\text{c})</td>
<td>0.02 (\mu)amp</td>
</tr>
<tr>
<td>Signal-Output Current(^\text{d})</td>
<td>0.2 (\mu)amp</td>
</tr>
</tbody>
</table>

### High-Sensitivity Operation

**Under typical operating conditions specified for either low- or high-voltage operation**

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>0.1 fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage(^\text{a},\text{b})</td>
<td>30 to 60 volts</td>
</tr>
<tr>
<td>Dark Current(^\text{c})</td>
<td>0.10 (\mu)amp</td>
</tr>
<tr>
<td>Signal-Output Current(^\text{d})</td>
<td>0.10 (\mu)amp</td>
</tr>
</tbody>
</table>

\(\text{a}\) The precision outer-diameter bulb permits the use of low-power, close-fitting deflecting yokes of small size and low impedance.

\(\text{b}\) This capacitance, which effectively is the output impedance of the 8567, is increased when the tube is mounted in the deflecting-yoke assembly. The resistive component of the output impedance is in order of 100 megohms.

\(\text{c}\) Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin.

\(\text{d}\) Cleveland Electronics Incorporated, 1974 East 61st Street, Cleveland, Ohio. This component is not designed to withstand severe environmental conditions. It is recommended that custom components be used in such service.

\(\text{e}\) Cinch Manufacturing Corporation, 1026 South Homan Avenue, Chicago 24, Illinois.

\(\text{f}\) The maximum voltage difference between grids No. 6 & 9 and No. 5 should not exceed 500 volts.

\(\text{g}\) Video amplifiers must be designed properly to handle peak target currents of this magnitude to avoid amplifier overload or picture distortion.

\(\text{h}\) With no blanking voltage on grid No. 1.

\(\text{i}\) Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.2 microampere and a dark current of 0.02 microampere.

\(\text{j}\) The alignment coil should be located on the tube so that its center is at a distance of 4-15/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube and the deflecting yoke.

\(\text{k}\) Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

\(\text{l}\) The target voltage for each 8567 must be adjusted to that value which gives the desired operating dark current.

\(\text{m}\) 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.

\(\text{n}\) Defined as the component of the highlight target current after the dark-current component has been subtracted.

\(\text{o}\) Operation at this higher sensitivity level will result in a decrease in the resolution capability of the 8567.

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**ENVIRONMENTAL TESTS**

The 8567 is designed to withstand the following operational and non-operational environmental tests.

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**RADIO CORPORATION OF AMERICA**

Electronic Components and Devices

Harrison, N. J.

DATA 2

4-65
OPERATIONAL TESTS

Rejection Criteria

Tubes are operated as specified under Typical Operation, Low-Voltage Operation. Throughout these tests, the amplitude of any generated spurious signals must not exceed 80 per cent of the maximum white-signal value and the tube must provide a resolution of at least 200 TV lines.

Sinusoidal Vibration

These tests are performed on apparatus which applies variable-sinusoidal frequency vibration to the tube. The tube is vibrated in each of three orthogonal axes, one axis being parallel to the major axis of the tube, according to the schedule specified below. A vibration cycle has a duration of 4.5 minutes per axis in which time the frequency is varied from 20 to 1000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period is 13.5 minutes.

<table>
<thead>
<tr>
<th>Double Amplitude inches</th>
<th>Peak Acceleration g's</th>
<th>Sweep Frequencies cps</th>
<th>Sweep Cycle Duration per Axis minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.250</td>
<td>-</td>
<td>20 to 40</td>
<td>40 to 400</td>
</tr>
<tr>
<td>-</td>
<td>20</td>
<td>400 to 1000</td>
<td>1000 to 400</td>
</tr>
<tr>
<td>-</td>
<td>Decreased linearly from 20 to 3</td>
<td>3 to 20</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>Increased linearly from 20 to 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.250</td>
<td>-</td>
<td>400 to 40</td>
<td>40 to 20</td>
</tr>
</tbody>
</table>

Random Vibration

The 8567 is also subjected to random vibration having a spectral density of 0.1 g²/cps in a bandwidth of 20 to 1000 cycles per second (10 g's — rms value) for a period of 3 minutes in each of the three orthogonal axes specified above. The total test period for each tube is 9 minutes.

NON-OPERATIONAL TESTS

Rejection Criteria

After completion of these tests, tubes will meet the performance characteristics specified under Typical Operation.

Shock

These tests are performed on apparatus which provides half-wave sinusoidal shock pulses. The 8567 is subjected to three impact shocks in each direction of the three orthogonal axes specified above. The peak acceleration of the impact shock is 30 g's and the time duration is 11 milliseconds. Each tube is subjected to a total of 18 impact shocks.
Sinusoidal Vibration

These tests are performed on apparatus which applies variable sinusoidal frequency vibration to the tube. The tube is vibrated in each of the three orthogonal axes previously specified. A vibration cycle has a duration of 30 minutes per axis in which time the frequency is varied from 5 to 2000 and back to 5 cycles per second. One vibration cycle is performed for each axis and the total test period is 90 minutes.

<table>
<thead>
<tr>
<th>Double Amplitude</th>
<th>Peak Acceleration</th>
<th>Sweep Frequencies</th>
<th>Sweep 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>0.250</td>
<td></td>
<td>5 to 20</td>
<td>30</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>20 to 2000</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>2000 to 20</td>
<td></td>
</tr>
<tr>
<td>0.250</td>
<td></td>
<td>20 to 5</td>
<td></td>
</tr>
</tbody>
</table>

Random Vibration

The 8567 is also subjected to random vibration having a spectral density of 0.05 g²/cps in a bandwidth of 20 to 2000 cycles per second (10 g's — rms value) for a period of 10 minutes in each of the three orthogonal axes specified above. The total test period for each tube is 30 minutes.

Acoustical Noise

The 8567 is subjected to an overall external noise of 140 db for a period of 5 minutes.

Static Acceleration

The 8567 is subjected to a static acceleration of 20 g's in each of the three orthogonal axes specified above for a period of 5 minutes. The total test period for each tube is 15 minutes.

DIMENSIONAL OUTLINE,
RECOMMENDED LOCATION OF DEFLECTING YOKE AND ALIGNMENT COIL,
DARK-CURRENT RANGE,
TYPICAL LIGHT-TRANSFER CHARACTERISTICS,
TYPICAL SPECTRAL-SENSITIVITY CHARACTERISTIC,
TYPICAL PERSISTENCE CHARACTERISTICS,
and
TYPICAL HORIZONTAL-DEFLECTION-CURRENT-CHARACTERISTIC
shown under Type 8134 also apply to the 8567
UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE

HIGHLIGHT TARGET MICROAMPERES = 0.3
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SQUARE-WAVE RESOLUTION WEDGE.

CURVE A: GRID - No. 6 & 3 VOLTS = 750,
GRID - No. 5 VOLTS = 450
CURVE B: GRID - No. 6 & 3 VOLTS = 500,
GRID - No. 5 VOLTS = 300
CURVE C: GRID - No. 6 & 3 VOLTS = 300,
GRID - No. 5 VOLTS = 180

DATA 3
RADIO CORPORATION OF AMERICA
Electronic Components and Devices  Harrison, N. J.
Photomultiplier Tube

S-4 RESPONSE

VERY SMALL, RUGGEDIZED, SIDE-ON, 9-STAGE TYPE
TESTED FOR SHOCK, VIBRATION, CONSTANT ACCELERATION,
AND TEMPERATURE CYCLING

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

GENERAL

Spectral Response... S-4
Wavelength of Maximum Response ... 4000 ± 500 angstroms
Cathode... Cesium-Antimony
Minimum projected length... 0.375 in
Minimum projected width... 0.06 in
Minimum projected area... 0.023 sq. in
Secondary-Emitting Surface... Cesium-Antimony
Window... Lime Glass, (Corning No. 0080), or equivalent
Direct interelectrode Capacitances (Approx.):
Anode-to-dynode No. 9... 2.5 pF
Anode to all other electrodes... 3.0 pF
Maximum Overall Length... 1.37 in
Excluding semiflexible leads
Length... 0.48 ± 0.03 in
Bulb top to useful center cathode area
Maximum Diameter... 0.53 in
Operating Position... Any
Weight (Approx.)... 0.17 oz
Bulb... T-4
Magnetic Shield... See footnote (d)
Base... See Dimensional Outline and Base Drawing
Basing Designation for BOTTOM VIEW... I2FZ

DIRECTION OF INCIDENT RADIATION
±20° ±20°

MAXIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

DC Supply Voltage
Between anode and cathode... 1250 V
Between anode and dynode No. 9... 250 V
Between consecutive dynodes... 250 V
Between dynode No.1 and cathode... 250 V
Average Anode Current
Ambient Temperature
Lead Temperature

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

CHARACTERISTICS RANGE VALUES

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

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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity Radiant, at 4000 angstroms</td>
<td>$7.3 \times 10^4$</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Cathode Radiant, at 4000 angstroms</td>
<td>-</td>
<td>-</td>
<td>$0.034$</td>
</tr>
<tr>
<td>Luminous, at 0 c/s$^a$</td>
<td>20</td>
<td>75</td>
<td>300</td>
</tr>
<tr>
<td>Cathode Luminous$^b$</td>
<td>$2 \times 10^{-5}$</td>
<td>$3.5 \times 10^{-5}$</td>
<td>-</td>
</tr>
<tr>
<td>Cathode Quantum Efficiency at 3800 Angstroms (Approx.)</td>
<td>-</td>
<td>-</td>
<td>1.05</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>-</td>
<td>$2.1 \times 10^6$</td>
</tr>
<tr>
<td>Equivalent Anode-Dark Current Input$^j$</td>
<td>-</td>
<td>-</td>
<td>$1 \times 10^{-10} \text{k}$</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time$^n$</td>
<td>-</td>
<td>-</td>
<td>$1.4 \times 10^{-9}$</td>
</tr>
<tr>
<td>Electron Transit Time$^p$</td>
<td>-</td>
<td>-</td>
<td>$6 \times 10^{-9}$</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity Radiant, at 4000 angstroms</td>
<td>$1 \times 10^4$</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Cathode Radiant, at 4000 angstroms</td>
<td>-</td>
<td>-</td>
<td>$0.034$</td>
</tr>
<tr>
<td>Luminous, at 0 c/s$^a$</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>Cathode Luminous$^b$</td>
<td>$2 \times 10^{-6}$</td>
<td>$3.5 \times 10^{-5}$</td>
<td>-</td>
</tr>
<tr>
<td>Cathode Quantum Efficiency at 3800 Angstroms (Approx.)</td>
<td>-</td>
<td>-</td>
<td>10.5</td>
</tr>
<tr>
<td>Current Amplification</td>
<td>-</td>
<td>-</td>
<td>$3 \times 10^5$</td>
</tr>
<tr>
<td>Equivalent Anode-Dark Current Input$^j$</td>
<td>-</td>
<td>-</td>
<td>$1 \times 10^{-10} \text{k}$</td>
</tr>
<tr>
<td>Anode-Pulse Rise Time$^n$</td>
<td>-</td>
<td>-</td>
<td>$1.8 \times 10^{-9}$</td>
</tr>
<tr>
<td>Electron Transit Time$^p$</td>
<td>-</td>
<td>-</td>
<td>$7.4 \times 10^{-9}$</td>
</tr>
</tbody>
</table>

$^a$ Alternate designation is Multiplier Phototube.

$^b$ On a plane parallel to the grill wires. See Schematic Arrangement of Structure.

$^c$ Made by Corning Glass Works, Corning, N.Y.

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

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

$^f$ Averaged over any interval of 30 seconds maximum.

DATA 1

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. 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. A light input of 1 microlumen is used and the approximate spot size of the beam incident on the tube envelope is 0.35 inch by 0.05 inch. The tube is rotated to provide maximum anode output current.

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

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

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

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

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

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

ENVIRONMENTAL TESTS

The 8571 is designed to withstand the following environmental tests:

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

Vibration. With no voltage applied, the 8571 is vibrated, in each of the three orthogonal axes and as specified below, on apparatus which applies variable-sinusoidal frequency vibration to the tube. A vibration sweep has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 5 to 2000 and back to 5 cycles per second. Six vibration sweeps are performed for each axis and the total test period is 1-1/2 hours.
### Constant Acceleration

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

### Temperature Cycling

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

### Schematic Arrangement of Structure

(Top View)

<table>
<thead>
<tr>
<th>Double Amplitude Inches</th>
<th>Acceleration g’s</th>
<th>Frequency c/s</th>
<th>Total Sweep Duration Per Axis minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.45</td>
<td>-</td>
<td>5-30</td>
<td>30</td>
</tr>
<tr>
<td>-</td>
<td>20</td>
<td>30-2000</td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>20</td>
<td>2000-30</td>
<td></td>
</tr>
<tr>
<td>0.45</td>
<td>-</td>
<td>30-5</td>
<td></td>
</tr>
</tbody>
</table>

0 = PHOTOCATHODE  
10 = ANODE  
1-9 = DYNODES  
GRILL  
NORMAL DIRECTION OF INCIDENT RADIATION  
SHIELD
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

LOAD CONNECTION
TO REGULATED DC POWER SUPPLY (SEE NOTE 1)

R1 through R10 = 20,000 to 5,000,000 ohms.

NOTE 1: Adjustable between approximately 500 and 1250 volts.
NOTE 2: Capacitors C1 through C3 should be connected near tube base for optimum high-frequency performance.

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

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

DATA 3
7-65
NOTE: Lead is cut off within 0.10 inch of the glass button for indexing.

Typical Time Resolution Characteristics

<table>
<thead>
<tr>
<th>SUPPLY VOLTAGE (E)</th>
<th>ACROSS VOLTAGE DIVIDER PROVIDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>PHOTOCATHODE FULLY ILLUMINATED.</td>
<td></td>
</tr>
</tbody>
</table>

Graph:
- **Transit Time**: 700 to 2125 with a slope of -0.5
- **Rise Time**: 700 to 2125 with a slope of -0.5

**Schematic Diagram**
- 27° angles marked throughout the diagram.
- 27° SEMIFLEXIBLE LEADS .016 ± .004 DIA.
- INDEX SEE NOTE
- BASE DRAWING (Bottom View)

**Data 3**
- RADIO CORPORATION OF AMERICA
- Electronic Components and Devices
- Harrison, N. J.
Average Anode Characteristics

DYNOE—No.1-TO-CATHODE VOLTS = 100
EACH SUCCEEDING-DYNOE-STAGE VOLTS = 100
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP
OPERATED AT COLOR TEMPERATURE OF 2870° K.

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

92CM-12763
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 Anode-Dark-Current Characteristic

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
Typical Anode Current
Modulation Characteristic

ANODE SUPPLY VOLTS (E) = 1000
VOLTS PER STAGE EXCEPT FOR DYNOE-NO. 6 STAGE = 100

RELATIVE ANODE CURRENT

DYNOE-NO. 6 VOLTS (REFERRED TO ANODE)

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
Typical Effect of Magnetic Field on Anode Current
**MAGNETIC FOCUS**

For High-Resolution Film Pickup with Black-and-White or Color Cameras. Grid No.3 and Grid No.4 Have Separate Base Terminals.

**General:**
Heater, for Unipotential Cathode:

- Voltage (AC or DC) .................. $6.3\pm10\%$ volts
- Current at 6.3 volts .................. 0.6 amp
- Direct Interelectrode Capacitance: Target to all other electrodes .................. 4.6 pf
- Spectral Response .................. See accompanying Typical Spectral Sensitivity Characteristic Curves

**Photoconductive Layer:**

- Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) .................. 0.62"

**Focusing Method** .................. Magnetic Deflection Method .................. Magnetic

**Overall Length** .................. 6.250" ± 0.125"
**Greatest Diameter** .................. 1.125" ± 0.010"

**Operating Position** .................. Any
**Weight (Approx.)** .................. 2 oz
**Bulb** .................. T8
**Focusing Coil** .................. Cleveland Electronics\(^c,d\) No.VF-115-12, or equivalent

**Deflecting Yoke** .................. Cleveland Electronics\(^c,d\) No.VY-111-3, or equivalent
**Alignment Coil** .................. Cleveland Electronics\(^c,d\) No.VA-118, or equivalent

**Socket** .................. Cinch\(^e\) No.54A18088, or equivalent
**Base** .................. Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)

Basing Designation for BOTTOM VIEW .................. 8ME

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

For scanned area of $1/2" \times 3/8"

- Grid-No.4 Voltage .................. 1000 volts
- Grid-No.3 Voltage .................. 1000 volts
- Grid-No.2 Voltage .................. 750 volts

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\(^a\) See accompanying Typical Spectral Sensitivity Characteristic Curves

\(^b\) Image size varies with area scanned

\(^c\) Cleveland Electronics

\(^d\) Cleveland Electronics

\(^e\) Cinch
### Typical Operation and Performance Data:

For scanned area of 1/2" x 3/8" and faceplate temperature of 30°C to 35°C

<table>
<thead>
<tr>
<th>Low Voltage</th>
<th>High Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) Voltage</td>
<td>500 volts</td>
</tr>
<tr>
<td>Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300 volts</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-45 to -100</td>
</tr>
</tbody>
</table>

- **Average "Gamma" of Transfer Characteristic**: for signal-output current between 0.02 μA and 0.2 μA. 0.65
- **Visual Equivalent Signal-to-Noise Ratio (Approx.)**: 300:1
- **Lag (Typical Value for minimum lag operation)**: 1.5

**Minimum Peak-to-Peak Blanking Voltage**:
- When applied to grid No.1: 75 volts
- When applied to cathode: 20 volts

**Limiting Resolution**:
- At center of picture: 900 TV lines
- At corner of picture: 600 TV lines

**Field Strength at Center of Focusing Coil**:
- 41 ± 4 Gauss

**Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture**:
- 35%

**Peak Deflecting-Coil Current**:
- Horizontal: 180 mA
- Vertical: 33 mA

**Field Strength of Adjustable Alignment Coil**:
- 0 to 4 Gauss

---

DATA 1

RADIO CORPORATION OF AMERICA

Electronic Components and Devices

Harrison, N. J
### Average-Sensitivity Operation for Live-Scene Pickup 10 Footcandles on Faceplate

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>10 fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage*&lt;sup&gt;p,q&lt;/sup&gt;</td>
<td>25 to 60 volts</td>
</tr>
<tr>
<td>Dark Current*</td>
<td>0.02 μA</td>
</tr>
<tr>
<td>Signal-Output Current* (Typical)</td>
<td>0.3 μA</td>
</tr>
</tbody>
</table>

### Minimum-Lag Operation for Film Pickup 100 Footcandles on Faceplate

<table>
<thead>
<tr>
<th>Faceplate Illumination (Highlight)</th>
<th>100 fc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Voltage*&lt;sup&gt;p,q&lt;/sup&gt;</td>
<td>12 to 30 volts</td>
</tr>
<tr>
<td>Dark Current*</td>
<td>0.004 μA</td>
</tr>
<tr>
<td>Signal-Output Current* (Typical)</td>
<td>0.3 μA</td>
</tr>
</tbody>
</table>

---

This capacitance, which effectively is the output impedance of the 8572 is increased when the tube is mounted in the deflecting-yoke and focusing-alignment assembly. The resistive component of the output impedance is in the order of 100 megohms.

Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the plane passing through the axis and short pin. The masking is for orientation only and does not define the proper scanned area of photoconductive layer. Final orientation should be such that the image also fits inside of any internal mask of the mesh assembly.

Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

Cinch Manufacturing Corporation, 1026 S. Homan Avenue, Chicago 24, Illinois.

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

Beam focus is usually attained by varying the focus-coil current to obtain a field-strength value within the range shown under Typical Operation and Performance Data. If the field-strength of the focus coil is fixed, beam focus is obtained within ±10 percent range of the grid-No.4 and grid-No.3 voltages. However, the recommended ratio of 0.6 between grid No.3 and grid No.4 must be maintained as these voltages are varied.

In general, grid No.3 should be operated above 250 volts and be 0.6 of grid-No.4 voltage.

With no blanking voltage on grid No.1.

Measured with high-gain, low-noise, cascade-input-type amplifier having bandwidth of 5 Mc and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.3 microampere and a dark current of 0.004 microampere.

The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 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 target voltage for each 8572 must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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.

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

The target connection is made by a suitable spring contact bearing against the edge of the metal ring at the face end of the tube. This spring contact may conveniently be provided as part of the focusing-coil design.

COMPONENT LOCATIONS

Recommended Location and Length of Deflecting, Focusing, and Alignment Components to obtain Minimum Beam-Landing Error

![Diagram of component locations with dimensions in inches.]

Note: Cross-hatching indicates wound portion of focusing coil.

DIMENSIONS IN INCHES

DATA 2

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

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate thickness is 0.094" ± 0.012".
**RANGE OF DARK CURRENT**

Scanned area of photoconductive layer = 1/2" x 3/8"
Faceplate temperature = 30° C approx.

**LIGHT TRANSFER CHARACTERISTICS**

Illumination: Uniform over photoconductive layer,
Scanned area of photoconductive layer = 1/2" x 3/8"
Faceplate temperature = 30° C approx.

2870° K tungsten illumination on tube face — Foot — Candles
92CS-9495
TYPICAL PERSISTENCE CHARACTERISTICS

INITIAL HIGHLIGHT SIGNAL-OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

[Graph showing signal-output decay over time after illumination is removed.]

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

DATA 4
4-65
TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC

CURVE A: FOR EQUAL VALUES OF SIGNAL—OUTPUT CURRENT AT ALL WAVELENGTHS.
SIGNAL—OUTPUT MICROAMPERES FROM SCANNED AREA OF $\frac{1}{2} \times \frac{3}{2} = 0.02$
DARK CURRENT (MICROAMPERES) = 0.02

CURVE B: SPECTRAL CHARACTERISTIC OF AVERAGE HUMAN EYE.

CURVE C: FOR EQUAL VALUES OF SIGNAL—OUTPUT CURRENT WITH RADIANT FLUX FROM TUNGSTEN SOURCE AT 2870° K.
UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE

HIGHLIGHT TARGET MICROAMPERES = 0.35
DARK CURRENT (MICROAMPERES) = 0.02
TEST PATTERN: TRANSPARENT SQUARE-WAVE RESOLUTION WEDGE.

CURVE A: GRID-No. 4 VOLTS = 750;
GRID-No. 3 VOLTS = 450
CURVE B: GRID-No. 4 VOLTS = 500;
GRID-No. 3 VOLTS = 300

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
DATA 5
4-65
TYPICAL CHARACTERISTIC

ILLUMINATION: 2870° K INCANDESCENT.
HIGHLIGHT SIGNAL—OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = \( \frac{1}{2}'' \times \frac{3}{8}'' \)
FACEPLATE TEMPERATURE = 30° C APPROX.
Vidicon

High-Resolution Type for Film Pickup
With Color or Black-and-White TV Cameras

GENERAL
Heater, for Unipotential Cathode:
Voltage (AC or DC) ....................  6.3 ± 10% V
Current at 6.3 volts .................  0.6 A

Direct Interelectrode Capacitance:
Target to all other electrodes ........  4.6 pF
Spectral Response ........... See accompanying Typical RCA Type I Spectral Response

Photoconductive Layer:
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) ........ 0.62 in
Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method .................. Magnetic
Deflection Method ................. Magnetic
Overall Length .................. 6.250 in ± 0.125 in
Greatest Diameter ................. 1.125 in ± 0.010 in
Bulb .................. T8
Base .................. Small-Button Ditetra 8-Pin, (JEDEC No.E8-11)
Socket .................. Cinch No.54A18088, or equivalent
Deflecting Yoke-Focusing Coil-
Alignment Coil Assembly ........ Cleveland Electronics No.VYFA-355-2, or equivalent
Operating Position ............. Any
Weight (Approx.) .............. 2 oz

ABSOLUTE-MAXIMUM RATINGS
For scanned area of 1/2" x 3/8"

Grid-No.4 Voltage .................. 1000 max. V
Grid-No.3 Voltage .................. 1000 max. V
Grid-No.2 Voltage .................. 750 max. V
Grid-No.1 Voltage:
Negative bias value ............. 300 max. V
Positive bias value ............  0 max. V
### TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 1/2" x 3/8"  
Faceplate temperature of 30° to 35° C and Standard TV Scanning Rate

<table>
<thead>
<tr>
<th>Component</th>
<th>Low-Voltage Mode</th>
<th>High-Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.4 (Decelerator) Voltage</td>
<td>500</td>
<td>900</td>
</tr>
<tr>
<td>Grid-No.3 (Beam-Focus Electrode) Voltage</td>
<td>300</td>
<td>540</td>
</tr>
<tr>
<td>Grid-No.2 (Accelerator) Voltage</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Grid-No.1 Voltage for Picture Cutoff</td>
<td>-65 to -100</td>
<td>-65 to -100</td>
</tr>
</tbody>
</table>

Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 µA and 0.2 µA | 0.65 | 0.65 |

Visual Equivalent Signal-to-Noise Ratio (Approx.) | 300:1 | 300:1 |

Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed:  
Typical value for minimum lag operation | 7.5 | 7.5 |

Minimum Peak-to-Peak Blanking Voltage:  
When applied to grid No.1 | 75 | 75 |
When applied to cathode | 20 | 20 |

Limiting Resolution:  
At center of picture | 1000 | 1100 | TV lines  
At corner of picture | 600 | 700 | TV lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture

Field Strength at Center of Focusing Coil

Peak Deflecting-Coil Current:

- Horizontal: 350 mA
- Vertical: 20 mA

Field Strength of Adjustable Alignment Coil

Average-Sensitivity Operation (Live-Scene Pickup)

- Faceplate Illumination (Highlight): 10 fc
- Target Voltage: 25 to 60 V
- Dark Current: 0.02 µA
- Signal-Output Current: 0.3 µA

Minimum-Lag Operation (Film Pickup)

- Faceplate Illumination (Highlight): 100 fc
- Target Voltage: 12 to 30 V
- Dark Current: 0.004 µA
- Signal-Output Current: 0.3 µA

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, IL 60007.

Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087.

These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

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 to 5/10; best geometry being provided when the ratio
is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

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.

Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.3 microampere and a dark current of 0.004 microampere.

Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

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 3-11/16 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 target voltage for each 8572A must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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.

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

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS TO OBTAIN MINIMUM BEAM-LANDING ERROR

Dimensions in Inches
Note: Cross-hatching indicates wound portion of focusing coil.

TERMINAL DIAGRAM (Bottom View)

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin — Internal Connection — Make No Connection
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)

1.125 ± .010
(28.58 ± .25)
DIA.

.855 ± .035
(21.71 ± .89)

MASKED PORTION
OF FACE
(NOTE 1)

0.050
(1.27)
FACEPLATE
(NOTE 2)

1.020 ± .035
(25.91 ± .89)
DIA.

BASE
JEDEC
NO.EB-11

6.250 ± .125
(158.75 ± 3.18)

1.75
(4.45)

METAL
TARGET
FLANGE

92CS-12251R

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No. 7056 having a thickness of 0.094" ± 0.012".

RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX

TARGET VOLTS

DARK CURRENT - MICROAMPERES

0.001 2 4 6 8 10 2 4 6 8 1000

92CS-12575

Electronic Components

DATA 3
LIGHT TRANSFER CHARACTERISTICS

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
ESCANNED AREA OF PHOTOCONDUCTIVE LAYER = $\frac{1}{2} \times \frac{3}{8}$
FACEPLATE TEMPERATURE = 30°C APPROX.

2870°K TUNGSTEN ILLUMINATION ON TUBE FACE — FOOT — CANDLES
92CS-9495

TYPICAL CHARACTERISTIC

ILLUMINATION: 2870°K INCANDESCENT.
HIGHLIGHT SIGNAL-OUTPUT MICROAMPERES = 0.3
ESCANNED AREA OF PHOTOCONDUCTIVE LAYER = $\frac{1}{2} \times \frac{3}{8}$
FACEPLATE TEMPERATURE = 30°C APPROX.
TYPICAL PERSISTENCE CHARACTERISTICS

INITIAL HIGHLIGHT SIGNAL-OUTPUT MICROAMPERES = 0.3
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30°C APPROX.

<table>
<thead>
<tr>
<th>SIGNAL-OUTPUT CURRENT - PER CENT OF INITIAL VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>80</td>
</tr>
<tr>
<td>70</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>50</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>20</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DARK CURRENT (MICROAMPERES) [µA]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
</tr>
<tr>
<td>0.02</td>
</tr>
<tr>
<td>0.004</td>
</tr>
</tbody>
</table>

TIME AFTER ILLUMINATION IS REMOVED — MILLISECONDS

0 50 100 150 200 250 300

Electronic Components
TYPICAL RCA TYPE I 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

[Graph showing spectral response with wavelength on the x-axis and microamperes on the y-axis.]
**HORIZONTAL SQUARE-WAVE RESPONSE**

- **Peak (Highlight) Signal (Microamperes):** 0.40
- **Dark Current (Microamperes):** 0.02
- **Test Pattern:** Transparent Slant-Line Burst

---

*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.*
Short, High-Resolution Type Having High Sensitivity and Low Lag for Live Scene Pickup in Transistorized Black-and-White and Color TV Cameras in Industrial and Other Closed-Circuit TV Systems.

**GENERAL**

Heater, for Unipotential Cathode:
- Voltage (AC or DC) ............................................. 6.3 ± 10% V
- Current at 6.3 volts ........................................... 0.1 A

Direct Interelectrode Capacitance:
- Target to all other electrodes ................................ 4.6 pF

Spectral Response .............................................. See RCA Type II Spectral

Photoconductive Layer: ........................................... See RCA Type II Spectral

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method ............................................... Magnetic

Deflection Method ............................................... Magnetic

Overall Length .................................................. 5.12" ± 0.06"

Greatest Diameter ................................................ 1.125" ± 0.010"

Bulb ................................................................. T8

Base ................................................................. Small-Button Ditetra 8-Pin, (JEDEC No.E8-11)

Socket ............................................................. Cinch b No.54A18088, or equivalent

Deflecting Yoke-Focusing Coil-Alignment Coil Assembly .............................................. Cleveland Electronicsc,d No.VYFA-355-2, or equivalent

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

Weight (Approx.) .................................................. 2 oz

**MAXIMUM RATINGS, Absolute-Maximum Values:**

For scanned area of 1/2" x 3/8"

<table>
<thead>
<tr>
<th>Grid-No.</th>
<th>Voltage</th>
<th>Maximum Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.4</td>
<td></td>
<td>1000 max. V</td>
</tr>
<tr>
<td>No.3</td>
<td></td>
<td>1000 max. V</td>
</tr>
<tr>
<td>No.2</td>
<td></td>
<td>750 max. V</td>
</tr>
</tbody>
</table>

---

b: Cinch

c: Cleveland Electronics

d: Cleveland Electronics

RCA Electronic Components

DATA 1

2-70
Grid-No.1 Voltage:
- Negative bias value: 300 max. V
- Positive bias value: 0 max. V

Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 max. V
- Heater positive with respect to cathode: 10 max. V

Target Voltage: 100 max. V

Dark Current: 0.25 max. µA

Peak Target Current: 0.75 max. µA

Faceplate:
- Illumination: 5000 max. fc
- Temperature: 71 max. °C

**TYPICAL OPERATION AND PERFORMANCE DATA**

*For scanned area of 1/2" x 3/8"
Faceplate temperature of 30° to 35° C and Standard TV Scanning Rate*

<table>
<thead>
<tr>
<th>Grid-No.4 (Decelerator)</th>
<th>Low-Voltage Mode</th>
<th>High-Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>500 V</td>
<td>900 V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grid-No.3 (Beam-Focus Electrode)</th>
<th>Voltage</th>
<th>Low-Voltage Mode</th>
<th>High-Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>300 V</td>
<td>540 V</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grid-No.2 (Accelerator)</th>
<th>Voltage</th>
<th>Low-Voltage Mode</th>
<th>High-Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>300 V</td>
<td>300 V</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grid-No.1 Voltage for Picture Cutoff</th>
<th>Voltage</th>
<th>Low-Voltage Mode</th>
<th>High-Voltage Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Cutoff</td>
<td>-65 V</td>
<td>-65 V</td>
<td>-100 V</td>
</tr>
</tbody>
</table>

Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 µA and 0.2 µA:
- 0.65

Visual Equivalent Signal-to-Noise Ratio (Approx.):
- 300:1

**RCA Electronic Components**
### Lag-Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed

<table>
<thead>
<tr>
<th></th>
<th>20</th>
<th>20</th>
<th>%</th>
</tr>
</thead>
</table>

### Minimum Peak-to-Peak Blanking Voltage:
- When applied to grid No.1: 75 V
- When applied to cathode: 20 V

### Limiting Resolution:
- At center of picture: 1000 TV lines
- At corner of picture: 600 TV lines

### Amplitude Response to a 400 TV line Square-Wave Test Pattern at Center of Picture

<table>
<thead>
<tr>
<th></th>
<th>50</th>
<th>60</th>
<th>%</th>
</tr>
</thead>
</table>

### Field Strength at Center of Focusing Coil

<table>
<thead>
<tr>
<th></th>
<th>40 ± 4</th>
<th>58 ± 4</th>
<th>G</th>
</tr>
</thead>
</table>

### Peak Deflecting-Coil Current:
- Horizontal: 350 mA
- Vertical: 20 mA

### Field Strength of Adjustable Alignment Coils

<table>
<thead>
<tr>
<th></th>
<th>0 to 4</th>
<th>0 to 4</th>
<th>G</th>
</tr>
</thead>
</table>

### Maximum-Sensitivity Operation — 0.1 Footcandle on Faceplate
- Faceplate Illumination (Highlight): 0.1 fc
- Target Voltage: 35 to 70 V
- Dark Current: 0.2 μA
- Signal-Output Current:
  - Typical: 0.14 μA

### Intermediate-Sensitivity Operation — 0.5 Footcandle on Faceplate
- Faceplate Illumination (Highlight): 0.5 fc
- Target Voltage: 30 to 60 V
- Dark Current: 0.10 μA
- Signal-Output Current:
  - Typical: 0.27 μA
Average-Sensitivity Operation — 1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight) ... 1.0 fc
Target Voltage* ... 20 to 40 V
Dark Current† ... 0.02 μA
Signal-Output Current:‡
   Typical ... 0.20 μA

High-Light Level Operation — 10 Footcandles on Faceplate

Faceplate Illumination (Highlight) ... 10 fc
Target Voltage* ... 10 to 22 V
Dark Current† ... 0.005 μA
Signal-Output Current:‡
   Typical ... 0.3 μA

a This capacitance, which effectively is the output impedance of the 8573A, 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.
b Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, IL 60007.
c Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087.
d These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.
f 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 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.
g Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.
h For conditions where "white light" is uniformly diffused overentire tube face.
i With no blanking voltage on grid No.1.
Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

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 3-11/16 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 target voltage for each 8573A must be adjusted to that value which gives the desired operating dark current.

Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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.

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

Note: Cross-hatching indicates wound portion of focusing coil.

DIMENSIONAL OUTLINE
NOTES FOR DIMENSIONAL OUTLINE

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

TERMINAL DIAGRAM (Bottom View)

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin — Internal Connection — Make No Connection

RANGE OF DARK CURRENT

SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30° C APPROX.
LIGHT TRANSFER CHARACTERISTICS

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER: 1/2" x 3/8"
FACEPLATE TEMPERATURE: 30°C APPROX.

---

Graph showing relationship between illumination and signal output.

---

RCA Electronic Components
HORIZONTAL SQUARE-WAVE RESPONSE

PEAK (HIGHLIGHT) SIGNAL MICROAMPERES • 0.40
DARK CURRENT (MICROAMPERES) • 0.02
TEST PATTERN: TRANSPARENT SLANT-LINE BURST*

CURVE A: GRID-No. 4 VOLTS • 900;
GRID-No. 3 VOLTS • 540
CURVE B: GRID-No. 4 VOLTS • 500;
GRID-No. 3 VOLTS • 300

*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.
Photomultiplier Tube

2"-Diameter, 12-Stage, Head-On Type Having Bialkali Photocathode and In-Line Electrostatically-Focused Dynode Structure

GENERAL

Spectral Response ........................................ See accompanying Typical Photocathode Spectral Response Characteristics

Wavelength of Maximum Response ..................... 3850 ± 500 angstroms

Cathode, Semitransparent ............................... Cesium-Potassium-Antimony (Bialkali)

Minimum projected area .................................. 2.54 sq. in

Minimum diameter ............................................. 1.80 in

Window ......................................................... Pyrex, Corning® No.7740, or equivalent

Shape ......................................................... Plano-Concave

Index of refraction at 5893 angstroms ............... 1.47

Dynodes:

Substrate ....................................................... Copper-Beryllium

Secondary-Emitting Surface .............................. Beryllium-Oxide

Structure ..................................................... In-Line Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):

Anode to dynode No.12 ..................................... 5 pF

Anode to all other electrodes ............................ 6 pF

Maximum Overall Length .................................. 5.71 in

Seated Length ............................................... 4.98 ± 0.08 in

Maximum Diameter ......................................... 2.10 in

Bulb ............................................................. T16

Base ............................................................. See Base Drawing

Socket ........................................................... RCA AJ2144 or AJ2145b

Magnetic Shield ............................................. See footnote (c)

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

Weight (Approx.) ............................................. 6 oz

MAXIMUM AND MINIMUM RATINGS, Absolute-Maximum Values:

DC Supply Voltage:

Between anode and cathode:

With Voltage Distribution A shown in Table I ................................. \[ \begin{align*}
&3000 \text{ max. V} \\
&800 \text{ min. V} \\
&1300 \text{ min. V}
\end{align*} \]
With Voltage Distribution C shown in Table I

<table>
<thead>
<tr>
<th>Voltage Distribution</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode and dynode No.12</td>
<td>3500 max. V</td>
<td>800 min. V</td>
<td></td>
</tr>
<tr>
<td>Between dynode No.12 and dynode No.11</td>
<td>800 max. V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between dynode No.1 and cathode</td>
<td>1000 max. V</td>
<td>300 min. V</td>
<td></td>
</tr>
<tr>
<td>Between focusing electrode and cathode</td>
<td>1000 max. V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Anode Current</td>
<td>0.2 max. mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I, and at a temperature of 22°C.

With E = 2000 volts (Except as noted)

Voltage Distribution A, Table I

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 3850 angstroms</td>
<td></td>
<td>9.7x10^{-5}</td>
<td></td>
</tr>
<tr>
<td>Luminous (2870° K)</td>
<td>100</td>
<td>850</td>
<td>3000</td>
</tr>
<tr>
<td>Current with blue light source (2870° K + C.S. No.5-58)</td>
<td>1.3x10^{-6}</td>
<td>1.1x10^{-5}</td>
<td>4x10^{-5}</td>
</tr>
<tr>
<td>Cathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 3850 angstroms</td>
<td></td>
<td>0.087</td>
<td></td>
</tr>
<tr>
<td>Luminous (2870° K)</td>
<td>6.2x10^{-5}</td>
<td>8.5x10^{-5}</td>
<td></td>
</tr>
<tr>
<td>Current with blue light source (2870° K + C.S. No.5-58)</td>
<td>8x10^{-10}</td>
<td>1.1x10^{-9}</td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 3850 angstroms</td>
<td></td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Current Amplification</td>
<td></td>
<td>1x10^{-7}</td>
<td></td>
</tr>
<tr>
<td>Anode Dark Current</td>
<td></td>
<td>1x10^{-9}</td>
<td>4x10^{-9}</td>
</tr>
</tbody>
</table>

* Indicates a change or addition.
### Equivalent Anode Dark Current Input

<table>
<thead>
<tr>
<th></th>
<th>5x10^{-12}</th>
<th>2x10^{-11}</th>
<th>Im</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.4x10^{-15}</td>
<td>1.8x10^{-14}</td>
<td>W</td>
</tr>
</tbody>
</table>

### Equivalent Noise Input

<table>
<thead>
<tr>
<th></th>
<th>1.8x10^{-13}</th>
<th>-</th>
<th>Im</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.6x10^{-16}</td>
<td>-</td>
<td>W</td>
</tr>
</tbody>
</table>

### Dark Pulse Summation

- 1/8 photoelectron to 16 photoelectrons
- See Typical Dark-Pulse Spectrum

### Pulse Heights

<table>
<thead>
<tr>
<th>Pulse Height Resolution</th>
<th>7.5</th>
<th>8</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulse Height Y</td>
<td>4.9x10^{-12}</td>
<td>1.5x10^{-11}</td>
<td>1.5x10^{-10}</td>
</tr>
</tbody>
</table>

### Peak-to-Valley Ratio of Pulse Height Spectrum with Fe^{55} Source

|               | 38 | - |

### Mean Gain Deviation

With count rate change of 1000 to 10000 cps
For a period of 16 hours at a count rate of 1000 cps

|               | 1 | - | % |

### Pulse Current

- Linear:
  - 0.15 | A |
- Space-charge limited (saturated):
  - 0.60 | A |

### Voltage Distribution

See Table I

### Notes

- Except as noted
- With E = 3000 volts
- With E = 3000 volts
- With E = 1100 volts
- Pulse Height Ratio of Pulse Height Spectrum with Fe^{55} Source
- Mean Gain Deviation
- Pulse Current:
- Linear
- Space-charge limited (saturated)
- Equivalent Anode Dark Current Input
- Equivalent Noise Input
- Dark Pulse Summation
- Pulse Height Resolution
- Peak-to-Valley Ratio of Pulse Height Spectrum with Fe^{55} Source
- Mean Gain Deviation
- Pulse Current:
- Linear
- Space-charge limited (saturated)
a Made by Corning Glass, Corning, NY 14830.

b The AJ2145 is ordinarily supplied with the tube and is designed specifically for chassis mounting. The AJ2144 may be supplied as an alternate socket if requested by the user. The AJ2144 is designed for use in any desired mounting arrangement. It is supplied with an unattached clamp ring which fits to either the top or bottom of its socket body to permit chassis mounting. The ring is not normally required for other mounting arrangements and can be discarded to make such arrangements more compact.

c Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago, IL, 60622, or equivalent.

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 anode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

h These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/Im)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-7} \text{ (Im)}}
\]

The value of 0.13 is the average value of the ratio of the anode current measured under the conditions specified in footnote (j) to the anode current measured under the same conditions but with the blue filter removed.

j 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 \(1 \times 10^{-7}\) lumen.

k This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

m These values are calculated as shown below:

\[
\text{Cathode Luminous Sensitivity (A/Im)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-4} \text{ (Im)}}
\]
The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote (n) to the cathode current measured under the same conditions but with the blue filter removed.

Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 100 microlumens and 500 volts are applied between cathode and all other electrodes connected as anode.

* Calculated from the cathode current measured with blue light source.

Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 0.1 microlumen. The supply voltage $E$ is adjusted to obtain an anode current of 2.6 microamperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 200 amperes per lumen. Dark current is measured with incident light removed.

At 3850 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1140 lumens per watt.

Under the following conditions: External shield connected to cathode, an equivalent bandwidth of 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 3850 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1140 lumens per watt.

Measured as shown under (q) and with the tube in complete darkness. The pulse height for the single photoelectron equivalent is determined by using a light source operated at a low color temperature to assure the high probability of single photoelectron emission from the photocathode of the tube. The intensity of the light source is adjusted for approximately $10^4$ photons per second. This light is removed before the dark pulse summation is measured.

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.

Anode load is a 100 kilohm resistor with a total capacitance of 100 ± 3% pF in parallel. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photon from a 1 microcurie Cs$^{137}$ source and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator [NaI(Tl)]-type 8D8S50, Serial No.BR772, or equivalent] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, OH, and is rated by the manufacturer as having a resolving capability of 8.2 per cent to 8.3 per cent. The Cs$^{137}$ source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the tube by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 60,000 centistokes)—Manufactured by the Dow Corning Corp., Midland, MI, or equivalent. Pulse height resolution in per cent is defined as 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height (A) to the pulse height at maximum photopeak count rate (B).
Pulse height is defined as the average charge collected at the anode from a pulse caused by the photoelectric absorption of a 662 keV photon from Cs$^{137}$ in a thallium-activated sodium-iodide scintillator, NaI(Tl).

Measured using a Harshaw Type HG 0.005” beryllium window NaI(Tl) scintillator, 0.04” thick and 7/8” in diameter and an isotope of iron having an atomic mass of 55 (Fe$^{55}$) and an effective activity at the scintillator of one microcurie.

Mean gain deviation is defined as follows:

$$MGD = \frac{100}{\bar{p}} \sum_{i=1}^{n} \left| \bar{p} - p_i \right|$$

where: $\bar{p}$ = mean pulse height  
$p_i$ = pulse height at the $i^{th}$ reading  
$n$ = total number of readings

Under the following conditions: The scintillator and Cs$^{137}$ radiation source of (x) are employed. The radiation source is initially centered, on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 1000 cps. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 10,000 cps. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. The difference in pulse height between these two measurements is typically 1 per cent.

Under the same conditions as (bb) except the count rate position of 1,000 cps is maintained for 16 hours and the pulse height is sampled at 1 hour intervals.

The interstage voltages of the tube should not deviate more than 2 per cent from the specified voltage distribution. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure this operating condition.

Maximum deviation from linearity is 2 per cent.
### Table 1

<table>
<thead>
<tr>
<th>Between the Following Electrodes:</th>
<th>Column A</th>
<th>Column B</th>
<th>Column C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode (K), Dynode (Dy), and Anode (P)</td>
<td>6.1% of Supply Voltage (E) multiplied by</td>
<td>8.06% of Dy1 – P Voltage (E) multiplied by</td>
<td>4.6% of Supply Voltage (E) multiplied by</td>
</tr>
<tr>
<td>K – Dy1</td>
<td>4.0</td>
<td></td>
<td>4.0</td>
</tr>
<tr>
<td>Dy1 – Dy2</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dy2 – Dy3</td>
<td>1.4</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Dy3 – Dy4</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dy4 – Dy5</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dy5 – Dy6</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dy6 – Dy7</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dy7 – Dy8</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dy8 – Dy9</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Dy9 – Dy10</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Dy10 – Dy11</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Dy11 – Dy12</td>
<td>1.0</td>
<td>1.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Dy12 – P</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
</tr>
<tr>
<td>Dy1 – P</td>
<td></td>
<td>12.4</td>
<td></td>
</tr>
<tr>
<td>K – P</td>
<td>16.4</td>
<td></td>
<td>21.9</td>
</tr>
</tbody>
</table>

Focusing Electrode (Pin 17) connected to dynode No.1 potential.
Electron Multiplier Shield (Pin 10) connected to dynode No.5 potential.
Co Cathode-to-Dynode-No.1 Voltage maintained at 660 volts.

### TERMINAL CONNECTIONS

The base pins of the tube fit a 21-contact socket such as the RCA-AJ2144 and the AJ2145.

### BASING DIAGRAM (BOTTOM VIEW)

[Drawing of the tube base connections]

**Direction of Radiation:** INTO END OF BULB

---

**RCA Electronic Components**

DATA 4
Dimensions in Inches

Note: Deviation from Flatness of External Surface of Faceplate will not exceed 0.010" from Peak to Valley.

The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm).

<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>.003</td>
<td>.08</td>
<td>.05</td>
<td>1.3</td>
<td>1.375</td>
<td>34.93</td>
</tr>
<tr>
<td>.010</td>
<td>.25</td>
<td>.064</td>
<td>1.63</td>
<td>1.80</td>
<td>45.7</td>
</tr>
<tr>
<td>.02</td>
<td>.5</td>
<td>.08</td>
<td>2.0</td>
<td>1.91</td>
<td>48.5</td>
</tr>
<tr>
<td>.04</td>
<td>1.0</td>
<td>.30</td>
<td>7.6</td>
<td>2.10</td>
<td>53.3</td>
</tr>
<tr>
<td>.045</td>
<td>1.14</td>
<td>.65</td>
<td>16.5</td>
<td>4.98</td>
<td>126.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.71</td>
<td>145.0</td>
</tr>
</tbody>
</table>
DETAILED BASE ARRANGEMENT

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: Dynode No.11
Pin 7: Anode
Pin 8: Dynode No.12
Pin 9: Internal Connection, Do not use
Pin 10: Electron Multiplier Shield
Pin 11: Internal Connection, Do not use
Pin 12: Dynode No.10
Pin 13: Dynode No.8
Pin 14: Dynode No.6
Pin 15: Dynode No.4
Pin 16: Dynode No.2
Pin 17: Focusing Electrode
Pin 18: Internal Connection, Do not use
Pin 19: Internal Connection, Do not use
Pin 20: Internal Connection, Do not use
Pin 21: Photocathode
TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

RELATIVE SENSITIVITY — PER CENT

ABSOLUTE SENSITIVITY — mA/WATT

QUANTUM EFFICIENCY — PER CENT

WAVELENGTH — ANGSTROMS

2000 3000 4000 5000 6000 7000

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

RCA Electronic Components

DATA 6

2-70
The supply voltage (E) is across a voltage divider which provides voltages as follows:

<table>
<thead>
<tr>
<th>Between</th>
<th>6.1% of E multiplies by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No. 1</td>
<td>4.0</td>
</tr>
<tr>
<td>Dynode No. 1 and Dynode No. 2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No. 2 and Dynode No. 3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding dynode-stage volts</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>16.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to dynode-No. 1 potential. Electron multiplier shield is connected to dynode-No. 5 potential. Photocathode is fully illuminated.

Rise time (seconds): 5
Transit time (seconds): 4

Supply volts (E) between anode and cathode

Rise time — seconds

Transit time — seconds

Supply volts (E) between anode and cathode

92EM-13042

RCA Electronic Components   DATA 6
TYPICAL ANODE 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>6.1% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND DYNOE No.1</td>
<td>4.0</td>
</tr>
<tr>
<td>DYNOE No.1 AND DYNOE No.2</td>
<td>1.0</td>
</tr>
<tr>
<td>DYNOE No.2 AND DYNOE No.3</td>
<td>1.4</td>
</tr>
<tr>
<td>EACH SUCCEEDING DYNOE-STAGE VOLTS</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE AND CATHODE</td>
<td>16.4</td>
</tr>
</tbody>
</table>

ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNOE No.5 POTENTIAL.
FOCUSING ELECTRODE IS CONNECTED TO DYNOE No.1 POTENTIAL.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22 °C
TYPICAL DARK-PULSE SPECTRUM

MEASURED UNDER THE FOLLOWING CONDITIONS: LIGHT ON CATHODE IS TRANSMITTED THROUGH A BLUE FILTER (CORNING CS No. 5-58, POLISHED TO 1/2 STOCK THICKNESS). LIGHT ON FILTER IS 0.1 MICROLUMEN. VOLTAGE DISTRIBUTION(A) IS USED AND SUPPLY VOLTAGE ADJUSTED TO OBTAIN AN ANODE CURRENT OF 2.6 MICROAMPERES. LIGHT IS EXCLUDED DURING MEASUREMENT.

FOCUSING ELECTRODE IS CONNECTED TO DYNODE No. 1 POTENTIAL ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE - No. 5 POTENTIAL TUBE TEMPERATURE = 22°C

ONE PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS
INTEGRATING TIME CONSTANT = 10 us (R=100kΩ, C=100pF)

16 PHOTOELECTRONS
\[ \sum = 40,000 \text{ COUNTS PER MINUTE (660 cps)} \]
1/8 PHOTOELECTRON

PULSE HEIGHT - PHOTOELECTRON EQUIVALENTS
DIFFERENTIAL Fe^{55} SPECTRUM

Fe^{55} SOURCE, ACTIVITY 1 µ CURIE
SCINTILLATOR: HARSHAW, TYPE HG 0.005" BERYLLIUM WINDOW,
NaI(Tl), 7/8" DIAMETER, 0.040" THICK
CATHODE-TO-DYNOE-NO. 1 VOLTS • 420
DYNOE-NO. 1-TO-DYNOE-NO. 2 VOLTS • 105
DYNOE-NO. 2-TO-DYNOE-NO. 3 VOLTS • 155
EACH SUCCEEDING DYNOE-STAGE VOLTS • 105
ANODE-TO-CATHODE VOLTS • 1700
FOCUSING ELECTRODE IS CONNECTED TO DYNOE-NO. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNOE-NO. 5
POTENTIAL.

COUNTING RATE—EVENTS PER MINUTE

PULSE HEIGHT—Kev

VALLEY

PEAK

PEAK VALLEY ≈ 38
TYPICAL DYNODE MODULATION CHARACTERISTIC

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

<table>
<thead>
<tr>
<th>Between</th>
<th>6.1% of E Multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and DYNODE No. 1</td>
<td>4.0</td>
</tr>
<tr>
<td>DYNODE No. 1 and DYNODE No. 2</td>
<td>1.0</td>
</tr>
<tr>
<td>DYNODE No. 2 and DYNODE No. 3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding DYNODE-stage Volts</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>16.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to DYNODE-No.1 potential. Electron multiplier shield is connected to DYNODE-No. 5 potential. Cathode is at ground potential.
TYPICAL ANODE CHARACTERISTICS

CATHODE TO DYNODE - No.1 VOLTS = 488
DYNODE - No.1 TO DYNODE - No.2 VOLTS = 122
DYNODE - No.2 TO DYNODE - No.3 VOLTS = 175
EACH SUCCEEDING DYNODE-STAGE VOLTS = 122
ANODE TO CATHODE VOLTS = 2000

FOCUSING ELECTRODE IS CONNECTED TO DYNODE - No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE - No. 5 POTENTIAL.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

VOLTAGE DISTRIBUTION (A) OR (B) AS SHOWN ON CURVE, TABLE 1.
FOCUSING ELECTRODE IS CONNECTED TO DYNODE - No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE - No. 5 POTENTIAL.

![Graph showing voltage distribution and current amplification characteristics.]

SENSITIVITY - AMPERES / LUMEN (COLOR TEMP. 2870°K)
CURRENT AMPLIFICATION (A)
CURRENT AMPLIFICATION (B)
MINIMUM SENSIVITY (A)
TYPICAL SENSITIVITY (A)
TYPICAL SENSITIVITY (B)

SUPPLY VOLS (E) BETWEEN ANODE AND CATHODE

1000 1500 2000 2500 3000 3500

10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5} 10^{6} 10^{7} 10^{8} 10^{9}

10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5} 10^{6} 10^{7} 10^{8} 10^{9}

RCA Electronic Components
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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

<table>
<thead>
<tr>
<th>BETWEEN:</th>
<th>6.1% of ( E ) MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No.1</td>
<td>4.0</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding Dynode stage</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>16.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to Dynode-No.1 potential. Electron multiplier shield is connected to Dynode-No.5 potential. Photocathode is fully illuminated.

Positive value of \( H \) in direction shown:

\( (1)^\uparrow, (2)^\uparrow, (3) \rightarrow \)

Direction (1) is out of paper.

\[ \text{SUPPLY VOLTAGE}\ (E) = 3000\text{V} \]

\[ \text{SUPPLY VOLTAGE}\ (E) = 3000\text{V} \]

\[ \text{MAGNETIC FIELD INTENSITY - OERSTEDS} \]
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)

**TYPICAL FOCUSING-ELECTRODE CHARACTERISTIC**

FOCUSING-ELECTRODE VOLTAGE IS VARIED BY ADJUSTMENT OF POTENTIOMETER CONNECTED BETWEEN DYNODE No.1 AND CATHODE.
Image Intensifier Tubes

- Fiber-Optic Input and Output Faceplates
- Integrated Voltage Multiplier Incorporated in 8606
- Ruggedized Construction
- S-20 Spectral Response with Extended Red Sensitivity
- P20 Phosphor Screen

**GENERAL**

Each Type

Spectral Response ............... S-20 with extended red response

Wavelength of Maximum Response . 4700 +1000 Å - 500 Å

Photocathode:

Material ....................... Na-K-Cs-Sb (Multialkali)

Minimum useful area

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum useful area</th>
</tr>
</thead>
<tbody>
<tr>
<td>8606</td>
<td>11.1 cm² (1.70 in²)</td>
</tr>
<tr>
<td>Types 8605/V1, 8605/V2</td>
<td>12.6 cm² (1.96 in²)</td>
</tr>
</tbody>
</table>

Minimum useful diameter

<table>
<thead>
<tr>
<th>Type</th>
<th>Minimum useful diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>8606</td>
<td>37.5 mm (1.47 in)</td>
</tr>
<tr>
<td>Types 8605/V1, 8605/V2</td>
<td>40 mm (1.58 in)</td>
</tr>
</tbody>
</table>

Image surface:

Shape ......................... Flat, Circular

Material ..................... Fiber-Optics

Fluorescent Screen:

Minimum useful area ......... 13.8 cm² (2.14 in²)

Minimum useful diameter .... 42 mm (1.65 in)

Phosphor ...................... P20, Aluminized

Fluorescence and phosphorescence Yellow-Green

Persistence .................. Medium to Medium Short

Image surface:

Shape ......................... Flat, Circular

Material ..................... Fiber-Optics

Focusing Method ............... Electrostatic

*Note: The 8605/V1 is equivalent to the image intensifier designated 8605-1 by the military and the 8605/V2 is equivalent to the image intensifiers designated 8605-2 and 8605-3.*
Tube Dimensions:

Maximum overall length

Type 8606 ........................................... 12.028 in (302.51 mm)
Types 8605/V1, 8605/V2 ................... 3.705 in (94.2 mm)

Maximum diameter

Type 8606 ........................................... 3.737 in (95.10 mm)
Types 8605/V1, 8605/V2 ................... 3.05* in (77.5 mm)

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

Weight (Approx.)

Type 8606 ........................................... 4 lbs 8 oz (2.04 kg)
Types 8605/V1, 8605/V2 ................... 14 oz (0.396 kg)

MAXIMUM RATINGS, Absolute-Maximum Values

Peak-to-Peak AC Input Voltage

Type 8606 ........................................... 2.8 kV, 1200 to 2000 Hz

DC Anode-to-Cathode Voltage

Types 8605/V1, 8605/V2 ................... 16 kV

Screen Luminance (Brightness)

Types 8605/V1, 8605/V2 ................... 125 fL

Each Type

Ambient-Temperature Range:

Non-operating ................................... -54° to +68° C
Operating ........................................ -54° to +52° C

ELECTRICAL CHARACTERISTICS, Type 8606 Only

<table>
<thead>
<tr>
<th>Input Capacity</th>
<th>Min.</th>
<th>Typical</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>22</td>
<td></td>
<td>55</td>
</tr>
</tbody>
</table>

*Excluding exhaust tubulation cap.
**TYPICAL PERFORMANCE CHARACTERISTICS**

<p>| Characteristic | Type 8606 | | | Type 8605/V1 | | | Type 8605/V2 | | |
|----------------|-----------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | Under conditions with 2.7 ± 0.05 kV 1500 Hz applied and at an ambient temperature of 22°C, unless otherwise noted. | Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted. | Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted. |
| Resolution:     | Min. | Typical | Max. | Min. | Typical | Max. | Min. | Typical | Max. | Units |
| Center          | 25   | 35       | -    | 57   | 70       | -    | 57   | 70       | -    | Line-Pairs/mm |
| Edges (Peripheral) | 23   | 30       | -    | 45   | -        | -    | 45   | -        | -    | Line-Pairs/mm |
| Screen Luminance (Brightness) | - | -     | 120^f | - | - | - | - | - | fl |
| Luminance Gain: | At 22°C | 3.5 x 10^4 | - | 65^h | - | - | - | - | fl/fe |
|                  | At -54°C | 2.8 x 10^4 | - | - | - | - | - | - | fl/fe |
| With green light source | - | - | - | - | - | - | - | - | fl/fe |</p>
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Type 8606 Under conditions with 2.7 ± .05 kV 1500 Hz applied and at an ambient temperature of 22°C, unless otherwise noted.</th>
<th>Type 8605/V1 Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.</th>
<th>Type 8605/V2 Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equivalent Screen Background Input:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photocathode Sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 4700 Å</td>
<td>2 x 10^{-11}</td>
<td>2 x 10^{-11}</td>
<td>2 x 10^{-10}</td>
</tr>
<tr>
<td>At 8000 Å</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 8500 Å</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminance Uniformity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modulation Transfer Function (MTF):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(See next page)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Type 8606 Under conditions with 2.7 ± .05 kV 1500 Hz applied and at an ambient temperature of 22° C, unless otherwise noted.</th>
<th>Type 8605/V1 Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22° C, unless otherwise noted.</th>
<th>Type 8605/V2 Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22° C, unless otherwise noted.</th>
</tr>
</thead>
<tbody>
<tr>
<td>For 2.5 Line-Pairs/mm</td>
<td>90</td>
<td>95</td>
<td>-</td>
</tr>
<tr>
<td>For 7.5 Line-Pairs/mm</td>
<td>55</td>
<td>60</td>
<td>-</td>
</tr>
<tr>
<td>For 16 Line-Pairs/mm</td>
<td>10</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>Paraxial Image Magnification (Cmx)</td>
<td>0.82</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>Edge Image Magnification (Cmx)</td>
<td>1.0</td>
<td>-</td>
<td>1.06</td>
</tr>
<tr>
<td>Image Alignment (0.06)</td>
<td>-</td>
<td>-</td>
<td>0.06</td>
</tr>
<tr>
<td>Image Stabilily in 30 seconds (0.005)</td>
<td>-</td>
<td>-</td>
<td>0.005</td>
</tr>
<tr>
<td>Distortion (25)</td>
<td>-</td>
<td>-</td>
<td>25</td>
</tr>
</tbody>
</table>
Suitable oscillators providing this input voltage are available from the Microsemiconductor Corporation, Culver City, CA; Varo, Inc., Plano, TX 75074; or Venus Scientific Inc., 25 Bloomingdale Road, Hicksville, NY 11801.

At the maximum rated peak-to-peak ac input voltage of 2.8 kV, 1200 to 2000 Hz, the maximum dc charging current will not exceed 200 microamperes. Charging current is defined as the peak value of the rectified charging current after the sinusoidal component has been subtracted. See waveshape below. Input capacity is measured at a temperature of +52°C, with operating voltage applied, no light incident on the photocathode, and the tube shielded in a close-fitting, grounded metallic cylinder.

The resolution, both horizontal and vertical, is determined with a test pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated a "line-pair."

This minimum value applies at a distance of 11 mm from the major (optical) axis of the tube.

With $1 \times 10^{-3}$ foot-candle or greater on the photocathode. The 8606 must be protected from overload by the use of a low power output oscillator when exposed to illumination levels above the specified value. Oscillators meeting the Military Specification 052374 are satisfactory. Vendors see footnote (b).
Luminance Gain is defined as the quotient of screen brightness in footlamberts by the photocathode illumination in footcandles provided by a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light input radiation on the photocathode image surface is in the range of $1 \times 10^{-5}$ to $3 \times 10^{-5}$ footcandle.

Under the same conditions of footnote (g) except input radiation on photocathode is $5 \times 10^{-2}$ footcandle. Anode voltage is 15 kV.

Under the same conditions of footnote (g) except that a light input of $5 \times 10^{-2}$ footcandle is incident on Corning C.S. No.3-71 and C.S. No.4-67 interposed between the light source and the tube. Anode voltage is 15 kV. Use of these filters in conjunction with the 2854° K source closely approximates the P20 spectral distribution.

Defined as the equivalent value of luminous flux from a tungsten-filament lamp operating at 2854° K that would be required to cause an increase in screen brightness equal to screen background brightness.

For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The light spot has a minimum diameter of 1.1".

The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 32.5 mm in diameter centered on the image screen. No distinct line of demarcation between light and dark areas is permitted. Alternatively, tubes will conform to MIL-I-55493 (EL) Uniformity Specification dated 26 November, 1968.

The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 38 mm in diameter centered on the image screen. No distinct line of demarcation between light and dark areas is permitted.

Under the same conditions as shown in footnote (q) except that Corning C.S. No.3-71 and C.S. No.4-67 filters are interposed between the light source and the tube.
A two-dimensional resolution pattern, providing constant illumination in the Y direction, and sinusoidal variation of intensity in the X direction is projected on the photocathode. Per cent image modulation $M$ may then be defined as:

$$M = \frac{W - B}{W + B} \times 100$$

where $W =$ maximum illumination in white line
$B =$ minimum illumination in black line

Output image brightness is also a sinusoidal function of the distance across one direction of the pattern, and the output modulation is equal to or less than the input modulation. The modulation transfer function (MTF) is defined as the ratio of the output modulation to input modulation expressed as a function of the spatial frequency of the incident illumination pattern. MTF for type 8606 is measured using Modulation Transfer Function Analyzer Model No.K1-b, a product of Optics Technology, Inc., Belmont, CA, using the specified procedure for that instrument.

Paraxial Image Magnification (Cmx) is defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the two corresponding image points on the photocathode. The image points on the photocathode are separated by a distance of 2 mm and are located equal distances from the major axis of the tube.

Under the same conditions as shown in footnote (t) except the test points on the photocathode are separated by 32 mm.

The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will fall within a circle concentric with the optical axis of the screen having the specified diameter.

The center of the image produced on the screen of the tube as specified in footnote (v) will not shift more than the specified value during 30 seconds of operation.

A second magnification value (Emx) is obtained as stated in footnote (v) except the image points on the photocathode are separated by a distance of 32 mm. Per-cent distortion is defined by the equation

$$\text{Per-cent Distortion} = \frac{\text{Emx} - \text{Cmx}}{\text{Cmx}} \times 100$$
OPERATING CONSIDERATIONS

Magnetic Shielding
Magnetic shielding of these tubes may be required to minimize the effects of extraneous fields on tube performance. It is to be noted that 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 to insure that the case is completely demagnetized.

High Humidity for Types 8605/V1 and 8605/V2
To avoid possible corona effects, it is recommended that these tubes not be operated under conditions of high humidity unless potted in silicone rubber, or equivalent, and that sharp bends in terminal connection leads be avoided.

DC Power Supply for Types 8605/V1 and 8605/V2
The dc supply voltage for these tubes may be obtained from a suitable high-voltage power-supply unit. Such units are offered commercially by several manufacturers listed in buyers’ guides.

DIMENSIONAL OUTLINE
TYPE 8606

DETAIL "A"

Spherical R.

0.040±0.005 DIA.

0.093±0.005
Note: Dimension applies with 1" of tube end.
## DIMENSIONAL OUTLINE

### TYPE 8606

![Diagram of 8606 Type](image)

### FIBER-OPTIC SCREEN IMAGE SURFACE

### DETAILS "B"

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>A</td>
<td>11.906</td>
<td>12.028</td>
</tr>
<tr>
<td>B</td>
<td>11.025</td>
<td>11.115</td>
</tr>
<tr>
<td>C</td>
<td>2.372</td>
<td>2.398</td>
</tr>
<tr>
<td>D</td>
<td>3.742 Dia.</td>
<td>3.747 Dia.</td>
</tr>
<tr>
<td>E</td>
<td>2.905 Dia.</td>
<td>2.105 Dia.</td>
</tr>
<tr>
<td>F</td>
<td>.237</td>
<td>.243</td>
</tr>
<tr>
<td>G</td>
<td>.082</td>
<td>.092</td>
</tr>
<tr>
<td>J</td>
<td>.093</td>
<td>.113</td>
</tr>
<tr>
<td>K</td>
<td>3.737 Dia.</td>
<td>3.747 Dia.</td>
</tr>
<tr>
<td>M</td>
<td>2.950 Dia.</td>
<td>3.050 Dia.</td>
</tr>
<tr>
<td>N</td>
<td>.620 Dia.</td>
<td>.630 Dia.</td>
</tr>
<tr>
<td>O</td>
<td>.120 Dia.</td>
<td>.123 Dia.</td>
</tr>
<tr>
<td>P</td>
<td>.208</td>
<td>.218</td>
</tr>
<tr>
<td>Q</td>
<td>.370</td>
<td>.380</td>
</tr>
<tr>
<td>R</td>
<td>2.51 Dia.</td>
<td>2.55 Dia.</td>
</tr>
<tr>
<td>S</td>
<td>2.781 Dia.</td>
<td>2.791 Dia.</td>
</tr>
<tr>
<td>T</td>
<td>2.979 Dia.</td>
<td>2.994 Dia.</td>
</tr>
<tr>
<td>U</td>
<td>3.083 Dia.</td>
<td>3.098 Dia.</td>
</tr>
<tr>
<td>V</td>
<td>3.245 Dia.</td>
<td>3.260 Dia.</td>
</tr>
<tr>
<td>W</td>
<td>3.297 Dia.</td>
<td>3.312 Dia.</td>
</tr>
<tr>
<td>X</td>
<td>3.500 Dia.</td>
<td>3.520 Dia.</td>
</tr>
<tr>
<td>Y</td>
<td>3.54 Dia.</td>
<td>3.58 Dia.</td>
</tr>
<tr>
<td>Z</td>
<td>.183</td>
<td>.193</td>
</tr>
</tbody>
</table>

The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm).
### DIMENSIONAL OUTLINE

**TYPES 8605/V1 AND 8605/V2**

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3.690 ± .015</td>
<td>93.7 ± .4</td>
</tr>
<tr>
<td>B</td>
<td>3.337</td>
<td>84.8</td>
</tr>
<tr>
<td>C</td>
<td>2.600 ± .015 Dia.</td>
<td>66 ± .4 Dia.</td>
</tr>
<tr>
<td>D</td>
<td>3.00 ± .05 Dia.</td>
<td>76.2 ± 1.3 Dia.</td>
</tr>
<tr>
<td>E</td>
<td>1.15</td>
<td>29.2</td>
</tr>
<tr>
<td>F</td>
<td>.320 ± .020</td>
<td>8.13 ± .51</td>
</tr>
<tr>
<td>G</td>
<td>.042 ± .02</td>
<td>1.1 ± .5</td>
</tr>
<tr>
<td>H</td>
<td>.70</td>
<td>17.8</td>
</tr>
<tr>
<td>J</td>
<td>.77 ± .03</td>
<td>19.6 ± .8</td>
</tr>
<tr>
<td>K</td>
<td>2.100 ± .005 Dia.</td>
<td>53.3 ± .13 Dia.</td>
</tr>
<tr>
<td>L</td>
<td>2.50 Dia.</td>
<td>63.5 Dia.</td>
</tr>
<tr>
<td>M</td>
<td>1.575 Min. Dia.</td>
<td>40 Min. Dia.</td>
</tr>
<tr>
<td>N</td>
<td>1.70 Max. R.</td>
<td>43.2 Max. R.</td>
</tr>
<tr>
<td>P</td>
<td>.55 Dia.</td>
<td>14 Dia.</td>
</tr>
</tbody>
</table>

The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm).
TYPICAL RESOLUTION CHARACTERISTICS FOR ALL TYPES

![Graph showing resolution characteristics for 8605/V1, 8605/V2, and 8606.]

TYPICAL RESOLUTION CHARACTERISTICS FOR TYPES 8605/V1 AND 8605/V2

![Graph showing center resolution versus DC anode voltage for 8605/V1 and 8605/V2.]

RCA Electronic Components

DATA 7
LUMINANCE GAIN AS A FUNCTION OF VOLTAGE FOR TYPE 8606

Light source is a tungsten-filament lamp operated at a color temperature of 2854°K. Light input on photocathode image surface is 1x10^-5 to 3x10^-4 footcandle. Tube temperature = 22°C.

RELATIVE LIGHT OUTPUT CHARACTERISTIC FOR TYPES 8605/V1 AND 8605/V2

Light source is a tungsten-filament lamp operated at a color temperature of 2854°K.
TYPICAL SPECTRAL RESPONSE CHARACTERISTIC FOR ALL TYPES

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

WAVELENGTH (ANGSTROMS)

2500 3500 4500 5500 6500 7500 8500 9500

RELATIVE SENSITIVITY - PER CENT
ABSOLUTE SENSITIVITY - mA/WATT

2 4 6 8 10

100 80 60 40 20 10 2

10

MEDÍJ Electronic Components DATA 8
# Spectral Energy Emission Characteristics

(JEDED Phosphor P20) for all types

<table>
<thead>
<tr>
<th>Color</th>
<th>C.I.E. Coordinates</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow-Green</td>
<td></td>
<td>0.426</td>
<td>0.546</td>
</tr>
</tbody>
</table>

![Graph](image_url)
TYPICAL MODULATION TRANSFER FUNCTION VERSUS FREQUENCY FOR TYPE 8606
TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPE 8606

RADIAL DISTANCE ON PHOTOCATHODE IMAGE SURFACE FROM CENTER TOWARD EDGE – MILLIMETERS
CONTRAST TRANSFER CHARACTERISTICS FOR TYPES 8605/V1 AND 8605/V2

CONTRAST TRANSFER CORRESPONDS TO MODULATION TRANSFER FUNCTION (MTF) EXCEPT THE RESOLUTION PATTERN EMPLOYED HAS A SQUARE WAVE VARIATION OF INTENSITY IN THE X DIRECTION. CONTRAST TRANSFER IS SLIGHTLY HIGHER THAN MTF. SEE REFERENCE BELOW FOR METHOD OF CONVERTING ONE CHARACTERISTIC TO THE OTHER.
Photomultiplier Tubes

3/4 Inch Diameter, 10-Stage, Head-On Types
Multialkali Photocathode of High Quantum Efficiency
In-Line Electrostatically-Focused Dynode Structure

For miniaturized low-level light detection and measurement systems and laser detection equipment to approximately 8000 angstroms. Typical quantum efficiency of these tubes at 6943 angstroms, is 2.5 per cent.

GENERAL
Spectral Response .............................................. S-20
Wavelength of Maximum Response... 4200 ± 500 angstroms
Cathode, Semitransparent ....... Potassium-Sodium-Cesium-
Antimony (Multialkali)
Shape .............................................. Sperical Section
Minimum area ..................................... 0.2 sq.in (129 sq.mm)
Minimum diameter .................................. 0.5 in. (12.7 mm)
Window ............................................. Boroilicate, Corning° No.7056,
or equivalent
Shape ............................................. Plano-Concave
Index of refraction at 5893 angstroms .............. 1.49

Dynodes:
Substrate .................................. Copper-Beryllium
Secondary-Emitting Surface ......... Beryllium-Oxide
Structure .................................. In-Line Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.10 .................. 2.4 pF
Anode to all other electrodes ......... 3.6 pF

Maximum Overall Length (Excluding leads):
8644 .................................. 3.9 in (99 mm)
8645 .................................. 4.55 in (115.6 mm)

Maximum Diameter:
8644 .................................. 0.78 in (19.8 mm)
8645 .................................. 0.95 in (24.1 mm)

Bulb .............................................. T6

Lead Connections ........................................................................
Temporary Base ................. Small-Shell Duodecal, JEDEC B12-43
Magnetic Shield .................... See footnote (b)
Operating Position .................. Any

Weight (Approx.):
8644 .................. With temporary base .............. 1.7 oz (48.2 g)
.......................... Without temporary base .......... 0.9 oz (25.5 g)
8645 .................................. 4.5 oz (127.6 g)

Indicates a change.
### ABSOLUTE-MAXIMUM RATINGS

<table>
<thead>
<tr>
<th></th>
<th>8644</th>
<th>8645</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage (DC or Peak AC):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Anode and Cathode</td>
<td>2100 max.</td>
<td>1800 max.</td>
</tr>
<tr>
<td>Between Anode and Dynode No.10</td>
<td>300 max.</td>
<td>300 max.</td>
</tr>
<tr>
<td>Between Consecutive Dynodes</td>
<td>200 max.</td>
<td></td>
</tr>
<tr>
<td>Between Dynode No.1 and Cathode</td>
<td>400 max.</td>
<td></td>
</tr>
<tr>
<td>Average Anode Current</td>
<td>0.5 max.</td>
<td>0.1 max. mA</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>85 max.</td>
<td>55 max. °C</td>
</tr>
</tbody>
</table>

### CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage \((E)\) across a voltage divider as shown in Table I. This voltage distribution is provided by the integral voltage-divider network of type 8645. With \(E = 1500\) volts dc (Except as noted)

For Both Types: Min. Typ. Max.

**Sensitivity:**
- Radiant, at 4200 angstroms: \(-\) 5.1 x 10^3 \(\text{A/W}\)
- Cathode radiant, at 4200 angstroms: \(-\) 0.064 \(\text{A/W}\)
- Luminous\(^f\): 4 12 60 \(\text{A/\text{lm}}\)
- Cathode luminous:
  - With tungsten light source\(^g\): \(\ldots\) \(1.2 \times 10^{-4}\) \(1.5 \times 10^{-4}\) \(\text{A/\text{lm}}\)
  - With blue light source\(^h\): \(\ldots\) \(5.5 \times 10^{-8}\) \(8.5 \times 10^{-8}\) \(\text{A}\)
  - With red light source\(^i\): \(\ldots\) \(4 \times 10^{-7}\) \(5.2 \times 10^{-7}\) \(\text{A}\)

**Current Amplification:** \(-\) 8 x 10^4 \(-\)

**Equivalent Anode-Dark Current**\(^{k,m}\): \(-\) 4 x 10^{-11} \(6 \times 10^{-10}\) \(\text{lm}\)

**Equivalent Noise Input**\(^{p}\): \(-\) 2.5 x 10^{-12} \(6 \times 10^{-15}\) \(\text{W}\)

**Anode-Pulse Rise Time**\(^q\): \(-\) 1.8 x 10^{-9} \(-\) \(\text{s}\)

**Electron Transit Time**\(^r\): \(-\) 2 x 10^{-8} \(-\) \(\text{s}\)

With \(E = 2000\) volts dc (Except as noted)

For Type 8644 Only: Min. Typ. Max.

**Sensitivity:**
- Radiant, at 4200 angstroms: \(-\) 4.7 x 10^4 \(\text{A/W}\)

Indicates a change.
Cathode radiant, at 4200 angstroms... 0.004 A/W
Luminous... 110 A/Im
Cathode luminous:
With tungsten light source... 1.2 x 10^{-4} 1.5 x 10^{-4} A/Im
With blue light source... 5.5 x 10^{-8} 6.5 x 10^{-8} A
With red light source... 4 x 10^{-7} 5.2 x 10^{-7} A
Current Amplification... 7.3 x 10^{5}
Equivalent Anode-Dark-Current Input... 4 x 10^{-11} 6 x 10^{-10} Im
Anode Dark Current... 9.4 x 10^{-14} 1.4 x 10^{-12} W
Anode-Pulse Rise Time... 5 x 10^{-9} s
Electron Transit Time... 1.7 x 10^{-8} s

a Made by Corning Glass Works, Corning, New York.
b Magnetic shielding material, for type 8644, in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston, Chicago 24, Illinois, or equivalent. Type 8645 has an integral magnetic shield.
c Averaged over any interval of 30 seconds maximum.
d Tube operation at room temperature or below is recommended.
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 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. This characteristic can not be measured after type 8645 is encapsulated in its potting compound.
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 incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode. This characteristic can not be measured after type 8645 is encapsulated in its potting compound.
h 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. This characteristic can not be measured after type 8645 is encapsulated in its potting compound.
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. This characteristic can not be measured after type 8645 is encapsulated in its potting compound.

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

With supply voltage (E) adjusted to give a luminous sensitivity of 30 amperes per lumen.

At 4200 angstroms. This value is calculated using a conversion factor of 428 lumens per 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.

OPERATING CONSIDERATIONS
Terminal Connections and Mounting Considerations:
Type 8644

The 8644 is supplied with a small-shell duodecal base attached to semiflexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the 8644 in a given system.

The semiflexible leads of the 8644 may be soldered or welded into the associated circuit. However, extreme caution must be exercised when making such connections to the leads to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the glass button is recommended.
Excessive bending of the leads—especially in the region close to the glass button—must be avoided.

Direct clamping to the bulb for mounting purposes is not recommended. It is suggested that a resilient material, such as Silastic* RTV 881, RTV 882, or equivalent, be used between the bulb and clamp.

The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding the 8644 at the photocathode end of the tube 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. In addition to increasing dark current and noise output because of voltage gradients developed across the bulb wall, such high voltage may produce minute leakage current to the cathode through the tube envelope and insulating materials which can permanently damage the tube.

Type 8645

Support for the 8645 may be effected by clamping directly to the magnetic shield. However, only that amount of uniformly distributed pressure necessary to hold the tube firmly in position should be employed.

Shielding:

Type 8644

Electrostatic and magnetic shielding of the 8644 is usually required. When a shield is used it must be at cathode potential.

See accompanying curves which show the effect of magnetic fields on anode current of the 8644 under the conditions indicated. The effects of hysteresis due to residual magnetism of the materials used in the tube structure have been neglected.

Type 8645

The 8645 is encapsulated with an insulating plastic potting compound in a magnetic shield and has

* Trademark of Dow Corning Corporation, Midland, Michigan.
an integral voltage-divider network. The magnetic shield is electrically connected to the photocathode.

See accompanying curve which shows the effect of magnetic fields on anode current of the 8645 under the conditions indicated. The effects of hysteresis due to residual magnetism of the materials used in the tube have been neglected.

See accompanying voltage-divider network and supply voltage connections for the 8645.

Dark Current:

A very small anode dark current is observed when voltage is applied to the electrodes of these tubes in complete darkness. Among the components contributing to dark current are ohmic leakage between the anode and adjacent elements and pulses produced by electrons thermionically released from the cathode, secondary electrons released by ionic bombardment of the dynodes, support rods, or cathode, and by cold emission from the electrodes.

Typical anode dark current as a function of luminous sensitivity at a temperature of \(+22^\circ\) C is shown in accompanying Typical-Dark Current and EADC1 Characteristics.

A temporary increase in anode dark current by as much as 3 orders of magnitude may occur if these tubes are exposed momentarily to high-intensity ultraviolet radiation from sources such as fluorescent room lighting even though voltage is not applied to the tubes. The increase in dark current may persist for a period of 24 to 48 hours following such irradiation.

For optimum tube performance it is also recommended that the 8644 and 8645 be operated at or below room temperature. Dark current may be reduced by use of a refrigerant such as dry ice.

Operating Stability:

The operating stability of the 8644 and the 8645 is dependent on the magnitude of the anode current.
The use of an average anode current well below the maximum rated value of 0.5 milliampere is recommended when stability of operation is important. When maximum stability is required, operation at an average anode current of 0.5 microampere is recommended.

Operating Voltages:

The 8645 is supplied with an integral voltage-divider network. The following considerations, accordingly, apply only to type 8644.

The voltage applied between cathode and dynode No.1 should be nearly constant and have a value of at least 150 volts to insure high conversion efficiency, i.e., high photon quantum efficiency, high collection efficiency, and high first dynode gain. Zener diodes, or other constant voltage sources, may be employed across these elements to provide constant voltage in applications where tube sensitivity is varied by adjusting the supply voltage.

The operating voltage between dynode No.10 and anode should be kept as low as will permit operation over the knee of the accompanying anode characteristic curves. With low operating voltage between dynode No.10 and anode, the ohmic leakage current to the anode is reduced. Operation over the knee occurs in the approximate range of 100 to 150 volts for the light level range shown. Under high pulse current conditions, saturation due to space-charge limitations will occur and higher voltage will be required. To obtain the suggested operating voltage between dynode No.10 and anode, it is necessary to increase the supply voltage between these electrodes by an amount equal to the voltage drop across a particular output load.

The operating voltages for the 8644 can be supplied by spaced taps on a voltage divider across a regulated dc power supply. The current through the voltage divider will depend on the applied voltage and the
linearity required by the application. In general, the current in the divider should be at least 5 times greater than the maximum average value of anode current. The resistance value of the voltage divider should be adequate to prevent variation of dynode potentials by signal current. Resistance values greater than 10 meg-ohms should not be employed between adjacent tube elements. Location of the voltage-divider arrangement should be such that the power dissipated in the resistor string does not increase the temperature of the tube. In pulse applications requiring low-noise operation, it is recommended that the negative high-voltage terminal be grounded.

See Typical voltage-divider arrangement for use with the 8644. The choice of resistance values for the voltage-divider string is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the supply and the required wattage rating of the resistors increase. Phototube noise may also increase, due to heating, if the divider network is mounted near the tube. The use of high values of resistance per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 5 times that of the maximum average anode current and may limit anode current response to pulsed light.

When the ratio of peak anode current to average anode current is high, non-inductive high-quality capacitors should be employed across the latter stages of the tube. The values of these capacitors should be chosen so that sufficient charge is available to prevent a change of more than a few per cent in the interstage voltages throughout the pulse duration.

Damping resistors in series with each of the dynode leads of the latter stages of the tube may be used to suppress spurious oscillations under high peak current conditions. Typical values for these resistors are in
the range of 5 to 50 ohms. These values are chosen to provide sufficient damping while minimizing the voltage drop across the resistors.

The high voltages at which these tubes are 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.

In the use of the 8644 and the 8645, as with other tubes requiring high voltages, it should always be remembered that these high voltages may appear at points in the circuit which are normally at low potential, because of defective circuit parts or incorrect circuit connections. Therefore, before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors grounded.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>TYPICAL VOLTAGE DISTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between:</td>
<td>8.33% of Supply Voltage (E) Multiplied by:</td>
</tr>
<tr>
<td>Cathode and Dynode No.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Dynode No.1 and Dynode No.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Dynode No.2 and Dynode No.3</td>
<td>1.7</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>12.0</td>
</tr>
</tbody>
</table>
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR TYPE 8644

NOTE: Adjustable between approximately 500 and 2100 volts dc.

C₁, C₂: 0.01 µF, non-inductive type, 400 volts (dc working)

R₁: 51 kilohms, 5%, 1 watt
R₂: 56 kilohms, 5%, 1 watt
R₃: 82 kilohms, 5%, 2 watt
R₄ through R₁₁: 47 kilohms, 5%, 1 watt
R₁₂, R₁₃: 10 to 50 ohms, 10%, 1/2 watt

(See Damping resistors under Operating Considerations, Operating Voltages)
INTEGRAL VOLTAGE-DIVIDER NETWORK OF TYPE 8645

"C" LEAD (BLACK) TO REGULATED POWER SUPPLY

"B" LEAD (RED)

PHOTO-CATHODE

MAGNETIC SHIELD (CONNECTED TO PHOTO-CATHODE)

R1: 220 kilohms, 5%, 1/4 watt
R2: 240 kilohms, 5%, 1/4 watt
R3: 330 kilohms, 5%, 1/4 watt
R4 to R11: 200 kilohms, 5%, 1/4 watt

C1: 68 pF ± 10%, 500 volts (dc working)
C2: 270 pF ± 10%, 500 volts (dc working)

R1: 220 kilohms, 5%, 1/4 watt
R2: 240 kilohms, 5%, 1/4 watt
R3: 330 kilohms, 5%, 1/4 watt
R4 to R11: 200 kilohms, 5%, 1/4 watt

INTEGRAL VOLTAGE-DIVIDER NETWORK OF TYPE 8645

"C" LEAD (BLACK) TO REGULATED POWER SUPPLY

"B" LEAD (RED)

PHOTO-CATHODE

MAGNETIC SHIELD (CONNECTED TO PHOTO-CATHODE)

R1: 220 kilohms, 5%, 1/4 watt
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R3: 330 kilohms, 5%, 1/4 watt
R4 to R11: 200 kilohms, 5%, 1/4 watt

C1: 68 pF ± 10%, 500 volts (dc working)
C2: 270 pF ± 10%, 500 volts (dc working)
DIMENSIONAL OUTLINE (TYPE 8644)

PHOTOCATHODY

0.685 ± 0.035
(17.3 ± 0.89) I.R.

T6 BULB

0.28(7.1)
MAX.

0.30(7.6) MAX.

1.5 (38.1)
MIN.

12 SEMIFLEXIBLE
GOLD PLATED
0.028 ± 0.004
(0.7 ± 0.1) DIA.

FACEPLATE
NOTE 3

0.755
(19.2)
MAX. DIA.

0.5
(12.7)
MIN. DIA.

3.26 ± 0.15
(82.8 ± 3.8)

3.9
(96.5)
MAX.

0.5
(12.7)
NOTE 2

0.78 (19.8)
MAX. DIA.
NOTE 2

.16 (.4)
MAX. DIA.

TEMPORARY
BASE
JEDEC No. B12-43

NOTE 2

0.30 (7.6) MAX.

NOTE 3

92LM-1178R
NOTE 1: Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters.

NOTE 2: Wall thickness of magnetic shield is 0.020" (0.5 mm) Netic* and 0.014" (0.355) Conetic*.

* Made by Magnetic Shield Division, Perfection Mica Company, 1322 North Elston, Chicago 24, Illinois, or equivalent material.
**LEAD ORIENTATION (Bottom View)**

![LEAD ORIENTATION Diagram](https://example.com/lead_orientation_diagram.png)

**NOTE 1:** Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters.

**NOTE 2:** Within this length, maximum diameter of tube is 0.78 inch (19.8 mm).

**NOTE 3:** Deviation from flatness within a concentric circle, 0.55 inch (14 mm) diameter will not exceed 0.006 inches (0.15 mm) peak to valley.

**NOTE 4:** Lead is cut off within 0.06 inch (1.5 mm) of glass button for indexing.

**NOTE 5:** Leads 6, 7, 15, 16, and 17 are cut off within 0.06 inch (1.5 mm) of glass button.

**TERMINAL DIAGRAM With Temporary Base, JEDEC B12-43, Bottom View**

<table>
<thead>
<tr>
<th>Pin 1: Dynode No.1</th>
<th>Pin 9: Dynode No.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 2: Dynode No.3</td>
<td>Pin 10: Dynode No.4</td>
</tr>
<tr>
<td>Pin 3: Dynode No.5</td>
<td>Pin 11: Dynode No.2</td>
</tr>
<tr>
<td>Pin 4: Dynode No.7</td>
<td>Pin 12: Photocathode</td>
</tr>
<tr>
<td>Pin 5: Dynode No.9</td>
<td></td>
</tr>
<tr>
<td>Pin 6: Anode</td>
<td></td>
</tr>
<tr>
<td>Pin 7: Dynode No.10</td>
<td></td>
</tr>
<tr>
<td>Pin 8: Dynode No.8</td>
<td></td>
</tr>
</tbody>
</table>

**LEAD TERMINAL CONNECTIONS (Bottom View)**

<table>
<thead>
<tr>
<th>Lead 1: Dynode No.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead 2: Dynode No.3</td>
</tr>
<tr>
<td>Lead 3: Dynode No.5</td>
</tr>
<tr>
<td>Lead 4: Dynode No.7</td>
</tr>
<tr>
<td>Lead 5: Dynode No.9</td>
</tr>
<tr>
<td>Lead 8: Anode</td>
</tr>
<tr>
<td>Lead 9: Dynode No.10</td>
</tr>
<tr>
<td>Lead 10: Dynode No.8</td>
</tr>
<tr>
<td>Lead 11: Dynode No.6</td>
</tr>
<tr>
<td>Lead 12: Dynode No.4</td>
</tr>
<tr>
<td>Lead 13: Dynode No.2</td>
</tr>
<tr>
<td>Lead 14: Photocathode</td>
</tr>
</tbody>
</table>
SPECTRAL RESPONSE CHARACTERISTICS

RANGE OF MAXIMUM VALUE

RELATIVE SENSITIVITY

ABSOLUTE SENSITIVITY

QUANTUM EFFICIENCY

RELATIVE SENSITIVITY - PER CENT

ABSOLUTE SENSITIVITY - MAX/WATT

QUANTUM EFFICIENCY - PER CENT

WAVELENGTH - ANGSTROMS

2500 3500 4500 5500 6500 7500 8500

RCA Electronic Components
TYPICAL TIME-RESOLUTION CHARACTERISTICS

SEE TABLE I FOR VOLTAGE DISTRIBUTION. PHOTOCATHODE IS FULLY ILLUMINATED.

AVERAGE ANODE CHARACTERISTICS FOR TYPE 8644

DYNODE No.1-TO-CATHODE VOLTS = 138
DYNODE No.1-TO-DYNODE No.2 VOLTS = 150
DYNODE No.2-TO-DYNODE No.3 VOLTS = 213
EACH SUCCEEDING DYNODE STAGE VOLTS = 125
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT COLOR TEMPERATURE OF 2870° K.

RCA Electronic Components
Photomultiplier Tube

Ruggedized, 2"-Diameter, 10-Stage Type

GENERAL

Spectral Response .................. See accompanying Spectral Response Characteristics

Wavelength of Maximum Response ........ 4000 ± 500 Å

Cathode, Semitransparent .......... Cesium-Potassium-Antimony (Bialkali)

Minimum area ......................... 2.54 in² (16.4 cm²)

Minimum diameter .................... 1.8 in (4.6 cm)

Window .......................... UV-Grade Sapphire

Shape .................................. Plano-Plano

Index of refraction ................. See Table I

Dynodes

Substrate .......................... Copper-Beryllium

Secondary-Emitting Surface .......... Beryllium-Oxide

Structure .......................... Venetian-Blind

Direct Interelectrode Capacitances (Approx.):

Anode to dynode No.10 and guard ring .................. 9.5 pF

Anode to all other electrodes .......... 9.5 pF

Maximum Overall Length ................. 4.00 in (10.2 cm)

Maximum Diameter .................. 2.06 in (5.2 cm)

Magnetic Shield ...................... See footnote a

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

Weight (Approx.) .................. 7 oz (190 g)

MAXIMUM RATINGS, Absolute-Maximum Values:

DC Supply Voltage:

Between anode and cathode ............... 2000 max. V

Between anode and dynode No.10 ........ 300 max. V

Between anode and guard ring ........... 300 max. V

Between consecutive dynodes ........... 250 max. V

Between dynode No.1 and cathode ........ 600 max. V

Average Anode Current ............... 2 max. mA

Ambient-Temperature Range .......... -100 to + 75 max. °C
Under conditions with dc supply voltage (E) across a voltage divider providing 3/13 of E between cathode and dynode No.1; 1/13 of E for each succeeding dynode stage; and 1/13 of E between dynode No.10 and anode. The guard ring is operated at or near anode potential.

With \( E = 1500 \text{ Volts} \) (Except as noted)

<table>
<thead>
<tr>
<th>Parameter</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 at 4000 angstroms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous ((2870^\circ\text{K}))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current with blue light source ((2870^\circ\text{K} + \text{C.S. No. 5-58}))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cathode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 4000 angstroms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous ((2870^\circ\text{K}))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current with blue light source ((2870^\circ\text{K} + \text{C.S. No. 5-58}))</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 3750 angstroms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Current Amplification</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equivalent Dark Current</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dark Current Input</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Equivalent Noise Input</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peak-to-Valley Ratio of Pulse Height Spectrum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dark Pulse Spectrum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode-Pulse Rise Time (\text{at } 2000 \text{ V})</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electron Transit Time (\text{at } 2000 \text{ V})</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Electronic Components DATA 1
With \( E = 1100 \) Volts

| Pulse Height Resolution \( \cdots \) | 7.7 | 8 | \% |
| Pulse Height \( \cdots \) | \( 6 \times 10^{-12} \) | – | – | coulombs |

Under conditions with dc supply voltage \( (E) \) across a voltage divider providing the following cathode-to-anode voltage distribution: 2, 1, 1, 1, 1, 1, 4, 3.5, 4, and 4.8. The guard ring is connected at or near anode potential.

With \( E = 2000 \) Volts

| Min. | Typical | Max. |
| Pulse Current: | | |
| Space-Charge Limited (Saturated) \( \cdots \) | – | 0.5 | – | A |
| Linear \( ^{2} \cdots \) | – | 0.033 | – | A |

---

- 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.
- The guard ring is an electrode located between dynode No. 10 and anode. Its function is to minimize leakage current flowing to the anode.
- Averaged over any interval of 30 seconds maximum. When stability of operation is important, the use of an average anode current well below the maximum rated value is recommended.
- 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 1030 lumens per watt.
- These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.12 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}
\]
The value of 0.12 is the average value of the ratio of the anode current measured under the conditions specified in footnote (h) to the anode current measured under the same conditions but with the blue filter removed.

h 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 1 x 10^-5 lumen.

i This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1030 lumens per watt.

j These values are calculated as shown below:

\[
\text{Cathode Luminous Sensitivity (A/Im)} = \frac{0.12 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (Im)}}{\text{Cathode Current (with blue light source) (A)}}
\]

The value of 0.12 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

m 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 1 x 10^-5 lumen and 250 volts are applied between cathode and all other electrodes connected as anode.

n Calculated from the typical cathode radiant sensitivity value.

p At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 10 microlumens. The supply voltage (E) is adjusted to obtain an anode current of 9 microamperes. Sensitivity of the 8664 under these conditions is approximately equivalent to 7.5 amperes per lumen. Dark current is measured with no light incident on the tube.
At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1030 lumens per watt.

Under the following conditions: Supply voltage (E) is as shown, 22° C tube temperature, 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 1030 lumens per watt.

Light incident on the photocathode is obtained from a Harshaw Type HG 0.005″ beryllium window NaI(T1) scintillator, 0.04″ thick and 7/8″ in diameter (or equivalent) and an isotope of iron having an atomic mass of 55 (Fe55) and an effective activity of 1 µcurie.

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.

With a supply voltage E of 1100 volts. Anode load is a 100-kilohm resistor in parallel with a total capacitance of 100 pF. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photons from a one-microcurie Cs137 source and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator NaI(T1)-type Harshaw Type 8D8S50, Serial No. CJ-156, or equivalent, are used. The Cs137 source is in direct contact with the metal end of the scintillator container. The faceplate end of the crystal is coupled to the faceplate of the tube using a coupling fluid such as Nujol mineral oil, or equivalent. Pulse-height resolution in per cent is de-
fined at 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height (A) to the pulse height at maximum photopeak count rate (B).

Pulse height is defined as the average charge collected at the anode from a pulse caused by the photoelectric absorption of a 662 keV photon from Cs$^{137}$ in a thallium-activated sodium-iodide scintillator, NaI(Tl).

The interstage voltages of the 8664 should not deviate more than 2 per cent from the recommended voltage distribution. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure the operating condition.

Maximum deviation from linearity is 5 per cent.

**TABLE 1**

<table>
<thead>
<tr>
<th>Wavelength (\AA)</th>
<th>1830</th>
<th>2652</th>
<th>3021</th>
<th>4046</th>
<th>5461</th>
<th>6438</th>
<th>7065</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index of Refraction for Sapphire Window</td>
<td>3.0</td>
<td>1.83</td>
<td>1.81</td>
<td>1.79</td>
<td>1.77</td>
<td>1.77</td>
<td>1.76</td>
</tr>
</tbody>
</table>

For additional information on this type write for Technical Bulletin to RCA Commercial Engineering, Harrison, N. J. 07029
TYPICAL ELECTRON TRANSIT TIME DIFFERENCE AS A FUNCTION OF SPOT POSITION OF INCIDENT RADIATION ON TUBE FACEPLATE

PARTS LIST FOR TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

C₁: 0.005 µF, 20%, 1000 V dc, ceramic disc
C₂: 0.01 µF, 20%, 1000 V dc, ceramic disc
C₃, C₄: 0.01 µF, 20%, 3000 V dc, ceramic disc
R₁: 10 MΩ, 5%, 1/2 Watt
R₂ through R₁₁: 3.3 MΩ, 5%, 1/2 Watt
R₁₂: 1 MΩ, 5%, 1/2 Watt

Note: The value of the load elements, Rₗ and Cₗ, depend on the application:

RₗCₗ = 10 microseconds for most applications
The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

**Note 1:** Deviation from flatness of external surface of faceplate will not exceed 0.005" from peak to valley.

**Note 2:** The maximum dimension of both exhaust tip covers will not extend beyond the maximum diameter of the tube. Care should be exercised not to subject these covers to any stress or strain.

**Note 3:** Minimum useful photocathode diameter.
## OUTLINE DIMENSIONS

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.00 Max.</td>
<td>101.6 Max.</td>
</tr>
<tr>
<td>B</td>
<td>1.45</td>
<td>36.8</td>
</tr>
<tr>
<td>C</td>
<td>.73</td>
<td>18.5</td>
</tr>
<tr>
<td>D</td>
<td>2.06 Max. Dia.</td>
<td>52.3 Max. Dia.</td>
</tr>
<tr>
<td>E</td>
<td>2.00 Dia.</td>
<td>50.8 Dia.</td>
</tr>
<tr>
<td>F</td>
<td>1.80 Max. Dia.</td>
<td>45.7 Max. Dia.</td>
</tr>
<tr>
<td>G</td>
<td>1.80 Max. Dia.</td>
<td>45.7 Max. Dia.</td>
</tr>
<tr>
<td>H</td>
<td>.02</td>
<td>.5</td>
</tr>
<tr>
<td>J</td>
<td>.03</td>
<td>.8</td>
</tr>
<tr>
<td>L</td>
<td>.08</td>
<td>1.5</td>
</tr>
<tr>
<td>M</td>
<td>.18</td>
<td>4.6</td>
</tr>
<tr>
<td>N</td>
<td>1.37 Dia.</td>
<td>34.8 Dia.</td>
</tr>
<tr>
<td>P</td>
<td>1.075</td>
<td>27.3</td>
</tr>
</tbody>
</table>

## TYPICAL TIME-RESOLUTION CHARACTERISTICS

<table>
<thead>
<tr>
<th>DYNODE No. 1—TO-CATHODE VOLTS = 3/13 E</th>
<th>EACH SUCCEEDING DYNODE—STAGE VOLTS = 1/13 E</th>
<th>ANODE—TO-DYNODE No. 10 VOLTS = 1/13 E</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUARD RING OPERATED AT OR NEAR ANODE POTENTIAL,</td>
<td>PHOTOCATHODE IS FULLY ILLUMINATED.</td>
<td></td>
</tr>
</tbody>
</table>

**Graph:**

- **Transit Time**
- **Rise Time**

**Axes:**
- Supply Volts (E) between Anode and Cathode
- Time in Seconds

**Data:**

- Supply Volts (E): 500 to 3000
- Time: 10^-9 to 10^-6 seconds
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

UNDER CONDITIONS WITH DC SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER PROVIDING 3/13 OF E BETWEEN CATHODE AND DYNODE No.1; 1/13 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/13 OF E BETWEEN DYNODE No.10 AND ANODE. THE GUARD RING IS OPERATED AT OR NEAR ANODE POTENTIAL.

SEN SITIVITY — AMPERES/LUMEN (2870*E)

CURRENT AMPLIFICATION

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE
TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES 3/13 OF E BETWEEN CATHODE AND DYNODE NO. 1; 1/13 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/13 OF E BETWEEN DYNODE NO. 10 AND ANODE. THE GUARD RING IS OPERATED AT OR NEAR ANODE POTENTIAL.

TUBE TEMPERATURE = 22 °C
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870 °K.

EQUIVALENT ANODE-DARK-CURRENT INPUT - AMPERE

EQUVALENT ANODE-DARK-CURRENT INPUT AT 1000 ANGSTROMS - WATT

EADCI - LUMEN

EADCI - WATT

LUMINOUS SENSITIVITY - AMPERES/LUMEN

SUPPLY VOLTAGE (E) - VOLTS

92LM - 2982
TYPICAL DARK PULSE SPECTRUM

CATHODE - TO - DYNOE No. 1 VOLS = 346
EACH SUCCEEDING DYNOE - STAGE VOLS = 115
DYNOE No. 10 - TO - ANODE = 115
GUARD RING OPERATED AT ANODE POTENTIAL.
ANODE - TO - CATHODE VOLS = 1500
TUBE TEMPERATURE = 22 °C
ONE PHOTOELECTRON PULSE HEIGHT = 4 COUNTING CHANNELS
INTEGRATING TIME CONSTANT = 10 μs
(R = 100 kΩ, C = 100 pF)

\[ \sum \approx 2.5 \times 10^4 \text{ COUNTS PER MINUTE} \]

1/4 PHOTOELECTRON
Differential $^{55}$Fe Spectrum

$^{55}$Fe SOURCE, ACTIVITY 1 µCURI
SCINTILLATOR: HARSHAW, TYPE HG 0.005" BERYLLIUM WINDOW,
No1(T1), 7/8" DIAMETER, 0.040" THICK.
CATHODE-TO-DYNODE No. 1 VOLTS = 346
EACH SUCCEEDING DYNODE - STAGE VOLTS = 15
DYNODE No.10 - TO - ANODE VOLTS = 115
GUARD RING OPERATED AT ANODE POTENTIAL.
ANODE - TO - CATHODE VOLTS = 1500

COUNTING RATE - EVENTS PER MINUTE

PULSE HEIGHT - keV

92LM - 2986

RCA Electronic Components
TYPICAL ANODE CHARACTERISTICS

DYNODE No.1 TO CATHODE VOLTS = 346
EACH SUCCEEDING DYNODE-STAGE VOLTS = 115
ANODE-TO-DYNOE No.10 VOLTS = 115
GUARD RING OPERATED AT OR NEAR ANODE POTENTIAL
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED
AT COLOR TEMPERATURE OF 2970°K.

[Graph depicting typical anode characteristics with axes labeled for volts and anode microamperes.]
RCA-8664/VI is a variant of type 8664 incorporating in its design a scintillation-crystal holder and a voltage-divider network. Ratings and characteristics for the 8664/VI are the same as shown for type 8664.
DIMENSIONAL OUTLINE (Bottom View)

BLUE LEAD
BLACK LEAD
RED LEAD

DETAIL "A"

E
F
H
G

J
K
L
M

RCA Electronic Components
### OUTLINE DIMENSIONS

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Inches</th>
<th>mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6.99 Max.</td>
<td>177.5 Max.</td>
</tr>
<tr>
<td>B</td>
<td>2.352 ± .005</td>
<td>59.740 ± .127</td>
</tr>
<tr>
<td>C</td>
<td>4.00 Max.</td>
<td>102 Max.</td>
</tr>
<tr>
<td>D</td>
<td>2.250 ± .010 Dia.</td>
<td>57.15 ± .25 Dia.</td>
</tr>
<tr>
<td>E</td>
<td>2.210 ± .005 Dia.</td>
<td>56.134 ± .127 Dia.</td>
</tr>
<tr>
<td>F</td>
<td>2.150 ± .005 Dia.</td>
<td>54.610 ± .127 Dia.</td>
</tr>
<tr>
<td>G</td>
<td>2.190 ± .005 Dia.</td>
<td>55.626 ± .127 Dia.</td>
</tr>
<tr>
<td>H</td>
<td>2.120 Dia.</td>
<td>53.85 Dia.</td>
</tr>
<tr>
<td>J</td>
<td>.098 ± .005</td>
<td>2.499 ± .127</td>
</tr>
<tr>
<td>K</td>
<td>.188 ± .005</td>
<td>4.775 ± .127</td>
</tr>
<tr>
<td>L</td>
<td>.280 ± .005</td>
<td>7.112 ± .127</td>
</tr>
<tr>
<td>M</td>
<td>{.406 + .030 - .000}</td>
<td>{10.31 + .76 - .00}</td>
</tr>
</tbody>
</table>

### PARTS LIST FOR ACCOMPANYING TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

- **C₁**: 0.005 μF, 20%, 1000 V dc, ceramic disc
- **C₂**: 0.01 μF, 20%, 1000 V dc, ceramic disc
- **C₃, C₄**: 0.01 μF, 20%, 3000 V dc, ceramic disc

- **R₁**: 22 MΩ, 5%, 1/2 Watt
- **R₂** through **R₁₀**: 8.2 MΩ, 5%, 1/2 Watt
- **R₁₁**: 2.4 MΩ, 5%, 1/2 Watt
- **R₁₂**: 1 MΩ, 5%, 1/2 Watt
- **R₁₃**: 1.1 MΩ, 5%, 1/2 Watt
- **R₁₄**: 10 MΩ, 5%, 1/2 Watt
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

- **GND** (BLACK LEAD)
- **SIG. OUT** (BLUE LEAD)
- **+ HV** (RED LEAD)

Components:
- R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13
- C1, C2, C3, C4
- **GUARD RING**
- **P**

Electronic Components DATA 2
12CT3

Half-Wave Vacuum Rectifier

9-Pin Miniature Type

The 12CT3 is the same as the 6CT3 except for:

Heater Characteristics and Ratings

- Current: 0.600 ± 0.040 A
- Voltage (ac or dc) at 0.600 A: 12.6 V
- Warm-up time (Average): 11 s

12CU5/12C5

Beam Power Tube

7-Pin Miniature Type

The 12CU5/12C5 is the same as the 6CU5 except for:

Heater Characteristics and Ratings

- Current: 0.600 ± 0.040 A
- Voltage (ac or dc) at 0.600 A: 12.6 V
- Warm-up time (Average): 11 s
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) AS ShOWN IN TABLE I.

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°C, TUBE TEMPERATURE = 22°C.

<table>
<thead>
<tr>
<th>SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE</th>
<th>LUMINOUS SENSITIVITY — AMPERES / LUMEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100</td>
<td>1</td>
</tr>
<tr>
<td>1300</td>
<td>2</td>
</tr>
<tr>
<td>1470</td>
<td>4</td>
</tr>
<tr>
<td>1600</td>
<td>6</td>
</tr>
<tr>
<td>1760</td>
<td>8</td>
</tr>
<tr>
<td>1990</td>
<td>10</td>
</tr>
</tbody>
</table>

ANODE DARK CURRENT — AMPERES

EQUIVALENT ANODE — DARK — CURRENT INPUT — LUMENS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) AS SHOWN IN TABLE I.
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS SHOWN IN TABLE 1.

SENSITIVITY—AMPERES/LUMEN (COLOR TEMPERATURE 2870°K)

CURRENT AMPLIFICATION

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS SHOWN IN TABLE 1.
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT FOR TYPE 8644

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS SHOWN IN TABLE I.

E = 1000 VOLTS

- MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.
- MAGNETIC FIELD PERPENDICULAR TO DYNODES.
- MAGNETIC FIELD PARALLEL TO DYNODES.

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT FOR TYPE 8645

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS SHOWN IN TABLE I.

E = 1000 VOLTS

MAGNETIC FIELD PARALLEL AND PERPENDICULAR TO MAJOR AXIS OF TUBE.

Indicates a change

RCA Electronic Components
SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH RED FILTER

SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH RED FILTER (CORNING C.S No. 2-62)

MAXIMUM FILTER TRANSMISSION OCCURS AT WAVELENGTH > 6500 ANGSTROMS AND IS APPROXIMATELY 87 PER CENT.
Image Orthicon

3-INCH DIAMETER  LONG-LIFE TYPE
MAGNETIC FOCUS    MAGNETIC DEFLECTION

For Exceptionally High-Quality Performance in Color and Black-
and-White Studio Television

The 8673 is designed to replace types 4513, 7513, 7513/L, 8093,
8093A, and 8093A/L

GENERAL

Heater, for Unipotential Cathode
Voltage (AC or DC) 6.3 ± 10% V
Current at 6.3 V 0.600 A

Direct Inter-electrode Capacitance
Anode to all other electrodes 12 pF

Target-to-Mesh Spacing 0.001 (0.0254 mm) in

Spectral Response. See Typical Spectral Sensitivity Characteristic
Window Material. Corning® No.7056, or equivalent
Photocathode Material. Bialkali (Cs-K-Sb)

Photocathode Semitransparent
Rectangular image (4 x 3 aspect ratio): 1.8-inch max. diagonal

Useful Size

Focusing Method. Magnetic
Deflection Method. Magnetic

Overall Length 15.2 in (386 mm) ± 0.25 in
Greatest Diameter of Bulb 3.00 in (76.2 mm) ± 0.06 in
Minimum Deflecting Coil Inside Diameter 2-3/8 in
Deflecting Coil. Cleveland Electronics, OV-Series,
or equivalent

Deflecting-Coil Length 5 in
Focusing Coil. Cleveland Electronics, OF-Series,
or equivalent

Focusing-Coil Length 10 in
Alignment Coil. Cleveland Electronics, OA-Series,
or equivalent

Length 15/16 in
Location Axially centered 11 inches to rear of tube faceplace

Photocathode Distance Inside End of Focusing Coil. 1/2 in
Operating Position. The tube should never be operated in a
vertical position with the diheptal-base end up nor in any
other position where the axis of the tube with base up makes
an angle of less than 20° with the vertical.

Socket Cinch Part No.3M14, or equivalent
Weight (Approx.) 1 lb 6 oz (600 g)
TERMINAL DIAGRAM (Bottom View)

Shoulder Base: Keyed Jumbo Annular 7-Pin

DIRECTION OF LIGHT:
PERPENDICULAR TO
LARGE END OF TUBE

WHITE INDEX LINE
ON FACE

End Base: Small-Shell Diheptal 14-Pin (JEDEC No. B14-45)

Note: In the tube symbol, the suppressor grid connected to the cathode, and the field-mesh grid connected to grid No. 4, are intentionally without numbers to avoid upsetting industry practice of associating functional camera control knobs with specific grid numbers. For example, beam-focus control is generally associated with knob identified as G4 (grid No. 4).

ABSOLUTE-MAXIMUM RATINGS

Volatages are with respect to thermionic cathode unless otherwise specified.

Photocathode
Voltage: ........................................... -600 V
Illumination: ................................... 50 fc (538 lux)

Operating Temperature
Of any part of bulb: ..................... 50 °C
Of bulb at large end of tube (target section): 35 min °C
Temperature Difference: .............. 5 °C
Between target section and any part of bulb hotter than target section

Grid-No. 6 Voltage: ....................... -550 V
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Target Voltage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive value</td>
<td>10 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative value</td>
<td>10 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 5 Voltage</strong></td>
<td>200 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 4 Voltage</strong></td>
<td>300 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 3 Voltage</strong></td>
<td>400 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 2 &amp; Dynode-No. 1 Voltage</strong></td>
<td>350 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 1 Voltage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative-bias value</td>
<td>125 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive-bias value</td>
<td>0 V</td>
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<tr>
<td><strong>Peak Heater-Cathode Voltage</strong></td>
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<tr>
<td>Heater negative with respect to cathode</td>
<td>125 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>10 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anode-Supply Voltage</strong></td>
<td>1350 V</td>
<td></td>
<td>400 V</td>
</tr>
<tr>
<td><strong>Voltage Between Consecutive Dynodes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Typical Operating Values</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photocathode Voltage (Image focus)</td>
<td>-400 to -540 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No. 6 Voltage (Accelerator)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approx. 59% to 60% of photocathode voltage</td>
<td>-235 to -325 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Target Voltage Above Cutoff</strong></td>
<td>2 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 5 Voltage (Decelarator)</strong></td>
<td>0 to 150 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 4 Voltage (Beam focus)</strong></td>
<td>140 to 180 V</td>
<td></td>
<td></td>
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<tr>
<td><strong>Grid-No. 3 Voltage</strong></td>
<td>260 to 300 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 2 &amp; Dynode-No. 1 Voltage</strong></td>
<td>300 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid-No. 1 Voltage for Picture Cutoff</strong></td>
<td>-45 to -115 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dynode-No. 2 Voltage</strong></td>
<td>600 V</td>
<td></td>
<td></td>
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<tr>
<td><strong>Dynode-No. 3 Voltage</strong></td>
<td>800 V</td>
<td></td>
<td></td>
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<tr>
<td><strong>Dynode-No. 4 Voltage</strong></td>
<td>1000 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dynode-No. 5 Voltage</strong></td>
<td>1200 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Anode Voltage</strong></td>
<td>1250 V</td>
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<td></td>
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<tr>
<td><strong>Target-Temperature Range</strong></td>
<td>35 to 45 °C</td>
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<td></td>
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<tr>
<td><strong>Peak-to-Peak Target Blanking Voltage</strong></td>
<td>6 V</td>
<td></td>
<td></td>
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<tr>
<td><strong>Field Strength at Center of Focusing Coil (Approx.)</strong></td>
<td>75 G</td>
<td></td>
<td></td>
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<tr>
<td><strong>Field Strength of Alignment Coil (Approx.)</strong></td>
<td>0 to 3 G</td>
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</tr>
</tbody>
</table>

**Performance Data**

With conditions shown under Typical Operating Values, picture highlights at the "knee" of the light-transfer characteristic, 525-line scanning, interlaced 2:1, frame time of 1/30 second, and 1.8-inch picture diagonal with 4x3 aspect ratio. Characteristics are measured in an RCA Model TK-31A camera, or equivalent.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cathode Radiant Sensitivity at 4000 angstroms.</strong></td>
<td>-</td>
<td>0.08 μA</td>
<td>μA/μW</td>
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<tr>
<td><strong>Cathode Luminous Sensitivity</strong></td>
<td>60 μA</td>
<td>100 μA</td>
<td>μA</td>
</tr>
<tr>
<td><strong>Signal-Output Current (Peak to Peak)</strong></td>
<td>5 μA</td>
<td>32 μA</td>
<td></td>
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<tr>
<td><strong>Signal-to-Noise Ratio</strong></td>
<td>38:1 (31.6 dB)</td>
<td>45:1 (33.1 dB)</td>
<td></td>
</tr>
</tbody>
</table>
Photocathode Illumination at 2870°K Required to Reach "Knee" of Light-Transfer Characteristic

<table>
<thead>
<tr>
<th>Amplitude Response at 400 TV Lines per Picture Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Per cent of large-area black to large-area white)</td>
</tr>
<tr>
<td>Uniformity</td>
</tr>
</tbody>
</table>

| Ratio of Shading (Background) Signal to Highlight Signal | - | 0.15 |
| Variation of Highlight Signal (Per cent of maximum highlight signal) | - | 25 | % |

a Made by Corning Glass Works, Corning, New York.
b Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 1 of the shoulder base. The horizontal and vertical scan should preferably start at the corner of the raster nearest pin 6 of the shoulder base.
c The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring; a condition that may be achieved in some camera designs with a 1.6 inch diagonal image on the photocathode.
d Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.
e Made by Cinch Manufacturing Company, 1026 South Homer Ave., Chicago 24, Ill.
f Adjust for best focus.
g For minimum highlight flare of "ghost" the grid-No. 6 voltage should be 59% of the photocathode voltage.
h Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 volts to +5 volts.
i Adjust to give the most uniformly shaded picture near maximum signal.
j Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of end at the image end of the focusing coil.
k 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 1 x 10^-4 lumen and -90 to -175 volts are applied between photocathode and grounded grid No. 6 and target.
l With a noise equivalent bandwidth of 4.5 MHz. Peak signal output is measured with respect to "picture" black. Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level.
m Measured with amplifier having flat frequency responses.
q Variation of response over scanned area.

**OPERATING TECHNIQUES**

With lens uncapped and lens iris opened, proper voltages should be applied to the 8673, and the grid-No. 1 voltage should immediately be adjusted to produce a small amount of beam current. This prevents the mesh from being electrostatically pulled into contact with the glass disc. Adjust the deflection circuits so that the beam "overscans" the target, i.e., so that the area of the target scanned is greater than its sensitive area. Note that overscanning the target results in a smaller-than-normal picture on the monitor. The lens should
be capped and the tube should be allowed to warm up for 10 minutes before used or before adjustments are made.

Care should be taken to avoid operating the camera with the lens turret removed, or swinging the tube and focusing coil away from the optical system of a color camera, when voltages are applied to the tube. Excessive illumination for short periods of time under these conditions may damage the photocathode of the 8673.

Next, uncap the lens and partially open the lens iris. Increase the target voltage until information appears on the monitor. Then adjust beam focus, image focus, and optical focus until detail can be discerned in the picture. Adjust alignment-coil current controls until picture response is maximum. If picture appears in negative contrast, increase the beam current. Further adjust the alignment-coil current so that the center of the picture does not move when the beam-focus control (grid No.4) is varied, but simply goes in and out of focus. During alignment of the beam, and also during operating of the tube, always keep the beam current as low as possible to give the best picture quality and also to prevent excessive noise.

Next, focus the camera on a test pattern. The camera-to-test pattern distance should be set so that the corners of the test-pattern image just touch the inside of the target ring. The deflection circuits are next adjusted so that the entire test pattern just fills the TV raster. The target voltage is then advanced or reduced to the point where a reproduction of the test pattern is just discernible on the monitor. This value of target voltage is known as the "target-cutoff voltage". The target voltage should then be raised exactly two volts above the cutoff-voltage value, and the beam-current control adjusted to give just sufficient beam current to discharge the highlights.

Then adjust the lens to produce best optical focus, and the voltage on the photocathode as well as the voltage on grid No.4 to produce the sharpest picture. Grid No.4 should be adjustable in the range of 140 to 180 volts. There are several voltage values outside of this range which will provide beam focus. However, such focus modes are not recommended.

Proper adjustment for suppression of highlight flare or "ghost" and proper geometry is obtained when the grid-No.6 voltage is accurately set at 59 per cent of the photocathode voltage. This adjustment may be effected by positioning a small bright spot of light on the edge of the field to be viewed and then adjusting the grid-No.6 voltage so that the "ghost" that appears on the viewing monitor disappears as the image section is brought into sharpest focus. Improper adjustment is evident when a light spot that is observed on the right edge of the viewing monitor produces a "ghost" that appears above the spot and when a light spot observed on the left edge of the viewing monitor produces a "ghost" that appears below the spot.

Grid No.5 should then be adjusted to produce best uniformity of signal, i.e., the absence of dark corners. Such uniformity is best obtained while viewing a uniform white card, or test
with the picture monitor adjusted for low brightness.

After adjustment of the image section voltages, grid-No.3 voltage should be set for maximum signal output. The deflecting yoke and 8673 should be rotated, if necessary, so that the horizontal scanning of the camera is parallel to the horizontal plane of the scene.

Finally, readjust the target voltage so that it is accurately set to 2 volts above target cutoff. In black-and-white service, the lens iris should be opened to 1/2 or 1 lens stop beyond the point where the highlights of the scene reach the knee of the light transfer characteristic. In color camera service, each tube should be operated with white-scene highlights at the knee.

Do and Don'ts on Use of RCA-8673

Dos
1. Allow the 8673 to warm up prior to operation.
2. Hold temperature of the 8673 within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 8673's by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to exactly 2 volts above target cutoff.
7. Uncap lens before voltages are applied to the 8673.
8. Turn off the camera or the image-section highvoltage supply if the lens turret or the yoke and 8673 must be "wung out" to clean the lens of the tube faceplate.

Don'ts
1. Don't force the 8673 into its shoulder socket.
2. Don't operate the 8673 without scanning.
3. Don't operate an 8673 having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warmup or standby operation.
6. Don't remove the lens turret or lens when the camera is turned on, or when voltages are applied to the image section of the 8673, unless the light level incident on the tube can be reduced below 50 footcandles.
**DIMENSIONAL OUTLINE**

**JUMBO ANNULAR 7-PIN BASE**

**BASE JEDEC GROUP 5, NF B14-45**

**DETAIL OF BOTTOM VIEW OF JUMBO ANNULAR BASE**

**CROSS-HATCHED AREA IS FLAT**

**SEE NOTE .5" MIN.**

**92CM-10154R3**

**Note:** Dotted area is flat or extends toward diheptal-base end of tube by 0.060 inch max.

**ANNULAR BASE GAUGE**

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

a. Six holes having diameter of 0.065 ± 0.001 inch and one hole having diameter of 0.150 ± 0.001 inch. All holes have depth of 0.265 inch ± 0.001 inch. The six 0.065 inch holes are enlarged by 45° taper to depth of 0.047 inch. All holes are spaced at angles of 51° 26' ± 5' on circle diameter of 2.500 ± 0.001 inches.

b. Seven stops having height of 0.187 ± 0.001 inch, centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125 inch from 2.812 inch diameter and having height of 0.126 ± 0.001 inch.

d. Neck-cylinder clearance hole having diameter of 2.200 ± 0.001 inches.
Typical Spectral Sensitivity Characteristic

WAVELENGTH-ANGSTROMS

RELATIVE SENSITIVITY

ULTRA VIOLET
VIOLET
BLUE
GREEN
YELLOW
RED
INFRARED

DATA 5
12-66
Image Orthicon

3-INCH DIAMETER  LONG-LIFE, HIGH-SENSITIVITY TYPE
MAGNETIC FOCUS  MAGNETIC DEFLECTION

For Superior Studio or Remote TV Pickup at Light
Levels Available in Black-and-White TV Studios

The 8674 is designed to replace types 4415, 4416, 7293, 7293A, and 7293A/L.

GENERAL

Heater, for Unipotential Cathode
Voltage (AC or DC) .................................. 6.3 ± 10% V
Current at 6.3 V ..................................... 0.600 A

Direct Interelectrode Capacitance
Anode to all other electrodes ...................... 12 pF
Target-to-Mesh Spacing .............................. 0.002 in (0.051 mm)

Spectral Response ................................... See Typical Spectral Sensitivity Characteristic

Window Material ..................................... Corning® No. 7056, or equivalent
Photocathode Material ............................... Bialkali (Cs-K-Sb)

Photocathode Semitransparent
Rectangular image (4 x 3 aspect ratio):b
Useful Sizec ........................................ 1.8-inch max. diagonal

Focusing Method ..................................... Magnetic
Deflection Method ................................... Magnetic

Overall Length ...................................... 15.2 in (386 mm) ± 0.25 in
Greatest Diameter of Bulb ......................... 3.00 in (76.2 mm) ± 0.06 in
Minimum Defiecting-Coil Inside Diameter ....... 2-3/8 in
Defecting Coil ...................................... Cleveland Electronics, OV-Series, or equivalent

Deflecting-Coil Length ............................. 5 in
Focusing Coil ........................................ Cleveland Electronics, OF-Series, or equivalent

Focusing-Coil Length ............................... 10 in
Alignment Coil ...................................... Cleveland Electronics, OA-Series, or equivalent

Length ................................................ 15/16 in
Location .............................................. Axially centered 11 inches to rear of tube faceplate

Photocathode Distance Inside End of Focusing Coil .... 1/2 in
Operating Position ................................. The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

Socket ............................................... Cinch Part No. 3M14, or equivalent
Weight (Approx.) .................................... 1 lb 6 oz (600 g)
TERMINAL DIAGRAM (Bottom View)

Shoulder Base: Keyed Jumbo Annular 7-Pin

Pin 1 - Grid No. 6
Pin 2 - Photocathode
Pin 3 - Do Not Use
Pin 4 - Do Not Use
Pin 5 - Grid No. 5
Pin 6 - Target
Pin 7 - Do Not Use

DIRECTION OF LIGHT: PERPENDICULAR TO LARGE END OF TUBE

End Base: Small-Shell Diheptal 14-Pin (JEDEC No. B14-45)

Pin 1 - Heater
Pin 2 - Grid No. 4 & Field Mesh
Pin 3 - Grid No. 3
Pin 4 - Do Not Use
Pin 5 - Dynode No. 2
Pin 6 - Dynode No. 4
Pin 7 - Anode
Pin 8 - Dynode No. 5
Pin 9 - Dynode No. 3
Pin 10 - Dynode No. 1, Grid No. 2
Pin 11 - Do Not Use
Pin 12 - Grid No. 1
Pin 13 - Cathode & Suppressor Grid
Pin 14 - Heater

NOTE: In the tube symbol, the suppressor grid connected to the cathode, and the field-mesh grid connected to grid No. 4, are intentionally without numbers to avoid upsetting industry practice of associating functional camera control knobs with specific grid numbers. For example, beam-focus control is generally associated with knob identified as G4 (grid No. 4).

ABSOLUTE-MAXIMUM RATINGS

Photocathode
Voltage ............................................. -600 V
Illumination ................................ 50 fc (538 lux)

Operating Temperature
Of any part of bulb .......................... 50 °C
Of bulb at large end of tube (Target section) 35 min. °C

Temperature Difference ............ 5 °C

Between target section and any part of bulb hotter than target section

Grid-No. 6 Voltage ...................... -550 V

DATA 1

RADIO CORPORATION OF AMERICA
Electronic Components and Devices
Harrison, N. J.
**Target Voltage**
- Positive value: 10 V
- Negative value: 10 V

**Grid-No.5 Voltage**
- 200 V

**Grid-No.4 Voltage**
- 300 V

**Grid-No.3 Voltage**
- 400 V

**Grid-No.2 & Dynode-No.1 Voltage**
- 350 V

**Grid-No.1 Voltage**
- Negative-bias value: 125 V
- Positive-bias value: 0 V

**Peak Heater-Cathode Voltage**
- Heater negative with respect to cathode: 125 V
- Heater positive with respect to cathode: 0 V

**Anode-Supply Voltage**
- 1350 V

**Voltage Between Consecutive Dynodes**
- 400 V

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**TYPICAL OPERATING VALUES**

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<tr>
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<tr>
<td>Target Voltage above Cutoff</td>
<td>2 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No.5 Voltage (Decelerator)</td>
<td>0 to 150 V</td>
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</tr>
<tr>
<td>Grid-No.4 Voltage (Beam focus)</td>
<td>140 to 180 V</td>
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<tr>
<td>Target-Temperature Range</td>
<td>35 to 45 °C</td>
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<td>6 V</td>
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</tr>
<tr>
<td>Field Strength at Center of Focusing Coil</td>
<td>75 G</td>
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<td></td>
</tr>
<tr>
<td>(Approx.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Strength of Alignment Coil (Approx.)</td>
<td>0 to 3 G</td>
<td></td>
<td></td>
</tr>
</tbody>
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**PERFORMANCE DATA**

With conditions shown under Typical Operating Values, picture highlights at the "knee" of the light-transfer characteristic, 525-line scanning, interlaced 2:1, frame time of 1/30 second, and 1.8-inch picture diagonal with 4x3 aspect ratio. Characteristics are measured in an RCA Model TK-31A camera, or equivalent.

**Cathode Radiant Sensitivity**
- at 4000 angstroms: -

**Cathode Luminous Sensitivity**
- 60

**Signal-Output Current**
- (Peak to Peak)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode Radiant Sensitivity</td>
<td>-</td>
<td>0.08</td>
<td>-</td>
</tr>
<tr>
<td>Cathode Luminous Sensitivity</td>
<td>60</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>Signal-Output Current (Peak to Peak)</td>
<td>5</td>
<td>-</td>
<td>32</td>
</tr>
<tr>
<td>Signal-to-Noise Ratio&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Min</td>
<td>Typ</td>
<td>Max</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td></td>
<td>35:1</td>
<td>40:1</td>
<td></td>
</tr>
<tr>
<td>(31 dB) (32 dB)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Photocathode Illumination at 2870°K Required to Reach "Knee" of Light-Transfer Characteristic**

- - 0.022 fc(1m/ft<sup>2</sup>)

**Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)**

<table>
<thead>
<tr>
<th>Ratio of Shading (Background) Signal to Highlight Signal&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Variation of Highlight Signal (Per cent of maximum highlight signal)<sup>c</sup>**

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>25</td>
</tr>
</tbody>
</table>

<sup>a</sup> Made by Corning Glass Works, Corning, New York.

<sup>b</sup> Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base. The horizontal and vertical scan should preferably start at the corner of the raster nearest pin 6 of the shoulder base.

<sup>c</sup> The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have size such that the corners of the rectangle just touch the target ring; a condition that may be achieved in some camera designs with a 1.6-inch diagonal image on the photocathode.

<sup>d</sup> Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

<sup>e</sup> Made by Ciuch Manufacturing Company, 1026 South Human Ave., Chicago 24, Ill.

<sup>f</sup> Adjust for best focus.

<sup>g</sup> For minimum highlight flare or "ghost" the grid-No.6 voltage should be 59% of the photocathode voltage.

<sup>h</sup> Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 volts to +5 volts.

<sup>i</sup> Adjust to give the most uniformly shaded picture near maximum signal.

<sup>j</sup> Direction of current 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.

<sup>k</sup> Under the following conditions: The light source is a tungsten-filament lamp having a line-glass envelope. It is operated at a color temperature of 2870°K. The value of light flux is 1 x 10<sup>6</sup> lumen and -90 to -175 volts are applied between photocathode and grounded grid No.6 and target.

<sup>m</sup> With a noise equivalent bandwidth of 4.5 MHz. Peak signal output is measured with respect to "picture" block. Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level.

<sup>n</sup> Measured with amplifier having flat frequency responses.

<sup>o</sup> Variation of response over scanned area.

---

**DATA 2**

**RADIO CORPORATION OF AMERICA**

Electronic Components and Devices  Harrison, N. J.
OPERATING TECHNIQUES

With lens uncapped and lens iris opened, proper voltages should be applied to the 8674, and the grid-No.1 voltage should immediately be adjusted to produce a small amount of beam current. Adjust the deflection circuits so that the beam "overscans" the target, i.e., so that the area of the target scanned is greater than its sensitive area. The lens should be capped and the tube should be allowed to warm up for 10 minutes before use or before adjustments are made.

Care should be taken to avoid operating the camera with the lens turret removed, or swinging the tube and focusing coil away from the optical system of a color camera, when voltages are applied to the tube. Excessive illumination for short periods of time under these conditions may damage the photocathode of the 8674.

Next, uncap the lens and partially open the lens iris. Increase the target voltage until information appears on the monitor. Then adjust beam focus, image focus, and optical focus until detail can be discerned in the picture. Adjust alignment-coil-current controls until picture response is maximum. If picture appears in negative contrast, increase the beam current. Further adjust the alignment-coil current so that the center of the picture does not move when the beam-focus control (grid No.4) is varied, but simply goes in and out of focus. During alignment of the beam, and also during operation of the tube, always keep the beam current as low as possible to give the best picture quality and also to prevent excessive noise.

Next, focus the camera on a test pattern. The camerato-test pattern distance should be set so that the corners of the test-pattern image just touch the inside of the target ring. The deflection circuits are next adjusted so that the entire test pattern just fills the TV raster. The target voltage is then advanced or reduced to the point where a reproduction of the test pattern is just discernible on the monitor. This value of target voltage is known as the "target-cutoff voltage". The target voltage should then be raised exactly two volts above the cutoff-voltage value, and the beam-current control adjusted to give just sufficient beam current to discharge the highlights.

Then adjust the lens to produce best optical focus, and the voltage on the photocathode as well as the voltage on grid No.4 to produce the sharpest picture. Grid No.4 should be adjustable in the range of 140 to 180 volts. There are several voltage values outside of this range which will provide beam focus. However, such focus modes are not recommended.

Proper adjustment for suppression of highlight flare or "ghost" and proper geometry is obtained when the grid-No.6 voltage is accurately set at 59 per cent of the photocathode voltage. This adjustment may be effected by positioning a small bright spot of light on the edge of the field to be viewed and then adjusting the grid-No.6 voltage so that the "ghost" that appears on the viewing monitor disappears as the image section is brought into sharpest focus. Improper
adjustment is evident when a light spot that is observed on
the right edge of the viewing monitor produces a "ghost" that
appears above the spot and when a light spot observed on the
left edge of the viewing monitor produces a "ghost" that
appears below the spot.

Grid No.5 should then be adjusted to produce best uni-
formity of signal, i.e., the absence of dark corners. Such
uniformity is best obtained while viewing a uniform white
card, or test pattern, with the exposure on the tube well
above the knee and with the picture monitor adjusted for low
brightness.

After adjustment of the image section voltages, grid-No.3
voltage should be set for maximum signal output. The de-
fecting yoke and the 8674 should be rotated, if necessary,
so that the horizontal scanning of the camera is parallel to
the horizontal plane of the scene.

Finally, readjust the target voltage so that it is accur-
ately set to 2 volts above target cut-off. In black-and-
white service, the lens iris should be opened to 1/2 or 1 lens
stop beyond the point where the highlights of the scene reach
the knee of the light transfer characteristic. In color
camera service, each tube should be operated with white-scene
highlights at the knee.

Dos and Don'ts on Use of RCA-8674

Dos
1. Allow the 8674 to warm up prior to operation.
2. Hold temperature of the 8674 within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 8674's by operating several hours once
each month.
6. Determine proper operating point with target voltage ad-
justed to exactly 2 volts above target cutoff.
7. Uncap lens before voltages are applied to the 8674.
8. Turn off the camera or the image-section high voltage
supply if the lens turret or the yoke and 8674 must be
"swung out" to clean the lens of the tube faceplate.

Don'ts
1. Don't force the 8674 into its shoulder socket.
2. Don't operate the 8674 without scanning.
3. Don't operate the 8674 having an ion spot.
4. Don't use more beam current than necessary to discharge
the highlights of the scene.
5. Don't turn off beam while voltages are applied to photo-
cathode, grid No.6, target, dynodes, and anode during
warmup or standby operation.
6. Don't remove the lens turret or lens when the camera is turned on, or when voltages are applied to the image section of the 8674, unless the light level incident on the tube can be reduced below 50 footcandles.

DETAIL OF BOTTOM VIEW OF JUMBO ANNULAR BASE

CROSS-HATCHED AREA IS FLAT

1.315" R. MIN.

1.185" R. MAX.

25° 43'

25° 43'

SEE NOTE 1

0.5" MIN.

0.5" MIN.

Note 1: Dotted area is flat or extends toward diheptal-base end of tube by 0.060 inch max.

ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flatplate gauge with:

a. Six holes having diameter of 0.065 ± 0.001 inch and one hole having diameter of 0.150 ± 0.001 inch. All holes have depth of 0.265 ± 0.001 inch. The six holes are enlarged by 45° taper to depth of 0.047 inch. All holes are spaced at angles of 51° 26' ± 5' on circle diameter of 2.500 ± 0.001 inches.

b. Seven stops having height of 0.187 ± 0.001 inch, centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125 inch from 2.812 inch diameter and having height of 0.126 ± 0.001 inch.

d. Neck-cylinder clearance hole having diameter of 2.200 ± 0.001 inches
Typical Spectral Sensitivity Characteristic
"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS
FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

LONG-LIFE ELECTRONICALLY-
CONDUCTING GLASS TARGET

MAGNETIC FOCUS
MAGNETIC DEFLECTION

For Extremely High-Quality Performance in Black-and-White
Studio and Television Tape-Recording Operations. The 8748
is Directly Interchangeable with the 7389, 7389A, 7389B,
and 7389C.

The 8748 is the same as the 7389B except for the following
paragraph, Performance Data, and Typical Spectral Sensitivity
Characteristic.

Compatibility of the bialkali photocathode and the glass
target of the 8748 results in constant high-resolution through-
out tube life. The glass target is characterized by stable
long-life, resistance to "burn-in", and the absence of granular
structure. Charge transport through this target is electronic
rather than ionic. Tube life is therefore extended and stable
sensitivity is achieved. Other important advantages of this
target are that the undesirable characteristics of scene re-
tention or "sticking picture" and raster burn-in are signifi-
cantly reduced. As a result, the need for an orbiter, or the
necessity of continually moving the camera when focused on a
stationary scene, is eliminated.

PERFORMANCE DATA

<table>
<thead>
<tr>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode Radiant Sensitivity at 4000 angstroms</td>
<td>0.08</td>
<td>A/W</td>
</tr>
<tr>
<td>Cathode Luminous Sensitivity (2870°K)</td>
<td>85</td>
<td>μA/1m</td>
</tr>
</tbody>
</table>
Typical Spectral Sensitivity Characteristic

For equal values of incident radiant power at all wavelengths.

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

"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS
FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

LONG-LIFE ELECTRONICALLY-
CONDUCTIVE GLASS TARGET
MAGNETIC FOCUS

For Very High-Quality Performance in Black-and-White Studio or
Remote TV Cameras. The 8749 is Directly Interchangeable with
the 7295, 7295A, 7295B, and 7295C.

The 8749 is the same as the 7295B except for the following para-
graph, Performance Data, and Typical Spectral Sensitivity Charac-
teristic.

Compatibility of the bialkali photocathode and the glass target
of the 8749 results in constant high resolution throughout tube
life. The glass target is characterized by stable long-life, re-
sistance to "burn-in", and the absence of granular structure. Charge
transport through this target is electronic rather than ionic. Tube
life is therefore extended and stable sensitivity is achieved. Other
important advantages of this target are that the undesirable char-
acteristics of scene retention or "sticking picture" and raster
burn-in are significantly reduced. As a result, the need for an
orbiter, or the necessity of continually moving the camera when
focused on a stationary scene, is eliminated.

PERFORMANCE DATA

<table>
<thead>
<tr>
<th>Cathode Radiant Sensitivity at 4000 angstroms</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Luminous Sensitivity (2870°K)</td>
<td>36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>μA/1m</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Typical Spectral Sensitivity Characteristic

For equal values of incident radiant power at all wavelengths.
Image Orthicon

3-Inch Diameter, Bialkali Photocathode Long-Life Type
For Remote and Studio Television Service

Types 8775 is designed to replace types 5820, 5820A, 5820A/L, and 5830B

GENERAL

Direct Interelectrode Capacitance:
  Anode to all other electrodes ................... 12 pF

Target-to-Mesh:
  Spacing .......................... 0.0022 in (0.056 mm)
  Capacitance ......................... 100 pF

Photocathode, Semitransparent:
  Spectral Response .......................... See Typical Bialkali Spectral Sensitivity Characteristic

Window material ........................ Corning® No.7056, or equivalent
Photocathode material ........................ Bialkali (Cesium-Potassium-Antimony)

Rectangular image (4 x 3 aspect ratio):
  Useful size of .................. 1.8 in (46 mm) max. diagonal
  Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

Orientation of .................. Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base. The horizontal and vertical scan should preferably start at the corner of the raster nearest pin 6 of the shoulder base.

Focusing Method ....................... Magnetic
Deflection Method ...................... Magnetic
Overall Length ......................... 15.20 in (386 mm) ± 0.25 in
Greatest Diameter of Bulb ........... 3.00 in (76.2 mm) ± 0.06 in
Shoulder Base ........................ Keyed Jumbo Annular 7-Pin
End Base ............................. Small-Shell Diheptal 14-Pin
JEDEC Group 5, No.B14-45

Socket ............................. Cinch Part No.3M14, or equivalent
Operating Position .................. The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.
Weight (Approx.) ..................... 1 lb 6 oz (600g)

8775

RCA Electronic Components

DATA 1

5-68
Minimum Deflecting-Coil
  Inside Diameter .................. 2-3/8 in (61.3 mm)
  Deflecting Coil ................ Cleveland Electronics, OY-Series®, or equivalent
  Deflecting-Coil Length .............. 5 in (127 mm)
  Focusing Coil ................ Cleveland Electronics, OF-Series®, or equivalent
  Focusing-Coil Length ............... 10 in (254 mm)
  Alignment Coil ................ Cleveland Electronics, OA-Series®, or equivalent
  Alignment-Coil Length ............. 15/16 in (23.8 mm)
  Alignment-Coil Location. Axially centered 11 inches to rear of tube faceplate

Photocathode Distance Inside
  End of Focusing Coil ............... 1/2 in (12.7 mm)

**ABSOLUTE MAXIMUM AND MINIMUM RATINGS**

  Voltages are with respect to thermionic cathode unless otherwise specified.

  **Heater, for Unipotential Cathode:**
  Voltage (AC or DC) applied between end base pin No.1 and pin No.14 .......... 6.3 ± 10% V
  Current ................................ 0.6 A

  **Operating Temperature:**
  Of any part of bulb ..................... 50 max. °C
  Of bulb at large end of tube (Target section) ..................... 35 min. °C

  **Temperature Difference:**
  Between target section and any part of bulb hotter than target section ..................... 5 max. °C

  **Photocathode:**
  Voltage ................................ -550 max. V
  Illumination ............................ 50 max. lm/ft² (fc)
                                    ...................... 538 lux

  **Grid-No.6 Voltage** ................. -550 max. V

  **Target Voltage:**
  Positive value .......................... 10 max. V
  Negative value .......................... 10 max. V

  **Grid-No.5 Voltage** ................. 150 max. V
  **Grid-No.4 Voltage** ................. 300 max. V
  **Grid-No.3 Voltage** ................. 400 max. V
  **Grid-No.2 & Dynode No.1 Voltage** ...... 350 max. V

  **Grid-No.1 Voltage:**
  Negative bias value ........................ 125 max. V
  Positive bias value ........................ 0 max. V
### Peak Heater-Cathode Voltage:
- Heater negative with respect to cathode: 125 max. V
- Heater positive with respect to cathode: 10 max. V
- Anode-Supply Voltage: 1350 max. V
- Voltage Between Consecutive Dynodes: 350 max. V

### TYPICAL OPERATING VALUES

#### Heater Voltage, for Unipotential Cathode:
- Cathode: 6.3 V

#### Photocathode Voltage (Image Focus):
- Approximately 75% of photocathode voltage: -300 to 405 V

#### Grid-No.6 Voltage (Accelerator):
- Approx. 75% of photocathode voltage: -300 to 405 V

#### Target Voltage Above Cutoff:
- 2 V

#### Grid-No.5 Voltage (Decelerator):
- 0 to 125 V

#### Grid-No.4 Voltage (Beam Focus):
- 140 to 180 V

#### Grid-No.3 Voltage:
- 225 to 330 V

#### Grid-No.2 & Dynode-No.1 Voltage:
- 300 V

#### Grid-No.1 Voltage for Picture Cutoff:
- -45 to -115 V

#### Dynode-No.2 Voltage:
- 600 V

#### Dynode-No.3 Voltage:
- 800 V

#### Dynode-No.4 Voltage:
- 1000 V

#### Dynode-No.5 Voltage:
- 1200 V

#### Anode Voltage:
- 1250 V

#### Target Temperature Range:
- 35 to 45 °C

#### Target Blanking Voltage (Peak to Peak):
- 5 V

#### Field Strength at Center of Focusing Coil (Approx.):
- 75 G

#### Field Strength of Alignment Coil:
- 0 to 3 G

### PERFORMANCE CHARACTERISTICS RANGE VALUES

With conditions shown under Typical Operating Values, picture highlights at the "knee" of the light transfer characteristic, 525 line scanning, interlaced 2:1, frame time of 1/30 second, and 1.8" picture diagonal with 4 x 3 aspect ratio. Characteristics are measured in an RCA Model TK-31A camera, or equivalent.

#### Min. Typ. Max.

- Cathode Radiant Sensitivity at 4000 angstroms: 0.072 A/W
### Cathode Luminous Sensitivity

<table>
<thead>
<tr>
<th>Signal-Output Current (Peak-to-Peak)</th>
<th>3</th>
<th>12</th>
<th>30</th>
<th>$\mu$A/Im</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal-to-Noise Ratio</td>
<td>32</td>
<td>34</td>
<td>-</td>
<td>$\mu$A</td>
</tr>
</tbody>
</table>

### Photocathode Illumination

- **2870°K Required to Reach “Knee” of Light Transfer Characteristic**
- **Amplitude Response at 400 TV Lines per Picture**
- **Height (per cent of large area black to large-area white)**

| Uniformity: | 35 | 50 | - | % |

#### Electronic DATA

- **Components**

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*a* Made by Corning Glass Works, Corning, New York.

*b* Made by Cinch Manufacturing Company, 1026 South Homan Ave., Chicago 24, Ill.

*c* Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

*d* Adjust for best focus.

*e* For minimum highlight flare or “ghost” the grid-No.6 voltage should be 75% of the photocathode voltage.

*f* Test setting of target voltage is +2 volts from target-cut-off. The target supply voltage should be adjustable from -3 to +5 volts to allow user choice of operating target voltage.

*g* Adjust to give the most uniformly shaded picture near maximum signal.

*h* Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with indicator located outside of and at the image end of the focusing coil.
k 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 1 x 10^-4 lumen and -90 to -175 volts are applied between photocathode and grounded grid No.6 and target.

m Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level. The value shown is measured under the following conditions using a Video Noise Meter, Model UPSF (North American Version), or equivalent. This meter is manufactured by Rohde and Schwarz, Munich, West Germany.

Signal: Blanked video, 0.7 V peak-to-peak including 0.07 V set-up.

Noise Meter: Gated with horizontal and vertical blanking signal of camera system. Video pass band is shaped by means of self-contained 100 kHz high-pass and 4.2 MHz low-pass filters.

Weighting filters matching the response of the human eye (CCIR Rec.421, Annex III) are not used and the color sub-carrier, 3.58 MHz, is not present during the measurement.

n Measured with amplifier having flat frequency response.

P Variation of response over scanned area.

DOS and DON'TS On Use of RCA-8775

Here are the "dos"

1. Allow the 8775 to warm up prior to operation.
2. Hold temperature of the 8775 within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Select target voltage according to operating needs. This freedom of operation results from use of the electronically-conducting glass target.
6. Uncap lens before voltages are applied to the 8775.
Here are the "don'ts"

1. Don't force the 8775 into its shoulder socket.
2. Don't operate the 8775 without scanning.
3. Don't operate an 8775 having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warmup or standby operation.
6. Don't remove the lens turret or lens when the camera is turned on, or when voltages are applied to the image section of the 8775, unless the light level incident on the tube can be reduced below 50 foot-candles.

TERMINAL DIAGRAM (Bottom View)
SMALL-SHELL DIHEPTAL 14-PIN BASE

- Pin 1: Heater
- Pin 2: Grid No.4
- Pin 3: Grid No.3
- Pin 4: Internal Connection — Do not use
- Pin 5: Dynode No.2
- Pin 6: Dynode No.4
- Pin 7: Anode
- Pin 8: Dynode No.5
- Pin 9: Dynode No.3
- Pin 10: Dynode No.1, Grid No.2
- Pin 11: Internal Connection — Do not use
- Pin 12: Grid No.1
- Pin 13: Cathode
- Pin 14: Heater

KEYED JUMBO ANNULAR 7-PIN BASE

- Pin 1: Grid No.6
- Pin 2: Photocathode
- Pin 3: Internal Connection — Do not use
- Pin 4: Internal Connection — Do not use
- Pin 5: Grid No.5
- Pin 6: Target
- Pin 7: Internal Connection — Do not use

ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

a. Six holes having diameter of $0.065'' \pm 0.001''$ and one hole having diameter of $0.150'' \pm 0.001''$. All holes have depth of $0.265'' \pm 0.001''$. The six $0.065''$ holes are enlarged by 45° taper to depth of $0.047''$. All holes are spaced at angles of $51^\circ 26' \pm 5'$ on circle diameter of $2.500'' \pm 0.001$.

b. Seven stops having height of $0.187'' \pm 0.001''$, centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of $0.125''$ from $2.812''$ diameter and having height of $0.126'' \pm 0.001''$.

d. Neck-cylinder clearance hole having diameter of $2.200'' \pm 0.001''$. 
Note 1: Dotted area is flat or extends toward diheptal-base end of tube by 0.060" max.
TYPICAL BIALKALI SPECTRAL SENSITIVITY CHARACTERISTIC

For equal values of incident radiant power at all wavelengths.

Relative Sensitivity

Wavelength-Angstroms

Ultra violet

Violet

Blue

Green

Yellow

Red

Infra-red

3000

4000

5000

6000

7000
BASIC LIGHT TRANSFER CHARACTERISTIC

ILLUMINATION: TUNGSTEN LIGHT, DAYLIGHT, OR WHITE FLUORESCENT, FOR SMALL-AREA HIGHLIGHTS.

TYPICAL SIGNAL OUTPUT—MICROAMPERES

HIGHLIGHT ILLUMINATION ON PHOTOCATHODE—FOOTCANDLES

0.0001 0.001 0.01 0.1

0.1

2 4 6 8 2 4 6 8 2 4 6 8

92CS-7296R2
Photomultiplier Tube

2"-Diameter Type

RCA-8850 is a 12-stage, head-on QUANTACON® Type Having Extremely High-Gain Gallium-Phosphide First Dynode and High Quantum Efficiency Bialkali Photocathode

GENERAL

Spectral Response: See accompanying Spectral Response Characteristics

Wavelength of Maximum Response: 3850 ± 500 Å

Cathode, Semitransparent: Potassium-Cesium-Antimony (Bialkali)

Minimum projected area: 2.54 sq in

Minimum diameter: 1.80 in

Window: Pyrex, Corning® No. 7740, or equivalent

Shape: Plano-Concave

Index of refraction at 5893 angstroms: 1.47

Dynode No. 1:

Secondary Emitting Surface: Gallium-Phosphide, GaP

Dynode No. 2 through 12:

Secondary Emitting Surface: Beryllium-Oxide

Dynode Structure: In-Line Electrostatic Focus-Type

Direct Inter-electrode Capacitances (Approx.):

- Anode to dynode No. 12: 5 pF
- Anode to all other electrodes: 6 pF

Maximum Overall Length: 5.71 in

Seated Length: 4.88 ± 0.08 in

Maximum Diameter: 2.10 in

Bulb: T16

Base: See Base Drawing

Socket: RCA AJ2144 or AJ2145®

Magnetic Shield: See footnote (c)

Operating Position: Any

Weight (Approx.): 6 oz

MAXIMUM AND MINIMUM RATINGS, Absolute-Maximum Values

DC Supply Voltage:

- Between anode and cathode:
  - With Voltage Distribution A shown in Table I: {3000 max. V, 1300 min. V}
  - With Voltage Distribution B shown in Table I: {3000 max. V, 1800 min. V}
<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 at 3850 angstroms</td>
<td>7.1 x 10^5</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2870°K)</td>
<td>46</td>
<td>620</td>
<td>1500</td>
</tr>
<tr>
<td>Current with blue light source</td>
<td>6 x 10^-7</td>
<td>8 x 10^-6</td>
<td>- A</td>
</tr>
<tr>
<td>(2870°K + C.S. No.5-58)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cathode Sensitivity:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiant at 3850 angstroms</td>
<td>0.097</td>
<td>-</td>
<td>A/W</td>
</tr>
<tr>
<td>Luminous (2870°K)</td>
<td>7.7 x 10^-5</td>
<td>8.5 x 10^-5</td>
<td>- A/1m</td>
</tr>
<tr>
<td>Current with blue light source</td>
<td>1 x 10^-8</td>
<td>1.1 x 10^-8</td>
<td>- A</td>
</tr>
<tr>
<td>(2870°K + C.S. No.5-58)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantum Efficiency at 3850 angstroms</td>
<td>28</td>
<td>31</td>
<td>- %</td>
</tr>
<tr>
<td><strong>Current Amplification:</strong></td>
<td></td>
<td>7.3 x 10^8</td>
<td>-</td>
</tr>
<tr>
<td><strong>Anode Dark Current</strong></td>
<td>6 x 10^-10</td>
<td>4 x 10^-9</td>
<td>A</td>
</tr>
<tr>
<td><strong>Equivalent-Anode-Dark Current</strong></td>
<td>3 x 10^-12</td>
<td>2 x 10^-11</td>
<td>1m</td>
</tr>
<tr>
<td><strong>Input</strong></td>
<td>2.6 x 10^-15</td>
<td>1.8 x 10^-14</td>
<td>W</td>
</tr>
<tr>
<td><strong>Single Photoelectron Pulse Height Resolution at Full-Width-Half-Maximum Point</strong></td>
<td>40</td>
<td>-</td>
<td>%</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Min.</td>
<td>Typical</td>
<td>Max.</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>--------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>Peak-to-Valley Ratio Between Single and Double PE</td>
<td>1.4</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>Peak-to-Valley Ratio of Pulse Height Spectrum with Fe55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark Pulse Summation v</td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>1 to 128 channels</td>
<td></td>
<td>150</td>
<td>680</td>
</tr>
</tbody>
</table>

(See Typical Dark-Pulse Spectrum)

Pulse Height Resolution:

Cs137 source, NaI(Tl) scintillator ... – 7.5 8.0 %

The following characteristics were measured with an anode-to-cathode voltage distribution of 4, 1, 1.4, 1, 1, 1, 1, 1, 1, 1, 1, 1, and 1. They are included for guidance purposes only.

With $E = 1100$ volts (Except as noted)

Pulse Height $^{w,x}$

Cs137 source, NaI(Tl) scintillator ... – 0.15 – V

Mean Gain Deviation $^{y}$

With count rate change of 1000 to 10000 cps ... – 1.5 x 10^{-11} – coulombs

For a period of 16 hours at a count rate of 1000 cps ... – 1 – %

Anode-Pulse Rise Time $^{bb}$ at 3000 Volts ... – 2.1 x 10^{-9} – s

Electron Transit Time $^{cc}$ at 3000 Volts ... – 3.1 x 10^{-8} – s

The following characteristics were measured with anode-to-cathode voltage distribution of 4, 1, 1.4, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 4, and 2. They are included for guidance purposes only.

With $E = 3000$ volts (Except as noted)

Pulse Current $^{dd}$

Linear $^{ee}$ ... – 0.25 – A

Saturated ... – 0.75 – A
Table I

<table>
<thead>
<tr>
<th>Voltage Distribution</th>
<th>Column A</th>
<th>Column B*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between the following Electrodes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode (K), Dynode (Dy), and Anode (P)</td>
<td>8.06% of Dy1-P Voltage (E) Multiplied By:</td>
<td>5.45% of K-P Voltage (E) Multiplied By:</td>
</tr>
<tr>
<td>K - Dy1</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Dy1 - Dy2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy2 - Dy3</td>
<td>1.4</td>
<td>1.4</td>
</tr>
<tr>
<td>Dy3 - Dy4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy4 - Dy5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy5 - Dy6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy6 - Dy7</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy7 - Dy8</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy8 - Dy9</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy9 - Dy10</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy10 - Dy11</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy11 - Dy12</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy12 - P</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Dy1 - P</td>
<td>12.4</td>
<td>18.4</td>
</tr>
<tr>
<td>K - P</td>
<td>-</td>
<td>-</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. Multiplier shield is operated at Dynode-No.5 potential.

Cathode-to-Dynode-No.1 Voltage maintained at 660 volts.

To take full advantage of the operating capabilities of the 8850 it is required that the cathode-to-dynode No.1 voltage be a minimum of 600 volts.

PHOTOELECTRON PULSE HEIGHT SPECTRUM

---

**RCA Electronic Components**

DATA 2
QUANTACON is the RCA designation for photomultiplier tubes employing group III/V compounds as secondary emitters and/or photocathodes. A typical compound is gallium-phosphide.

Made by Corning Glass Works, Corning, NY 14830.

The AJ2145 is ordinarily supplied with the tube and is designed specifically for chassis mounting. The AJ2144 may be supplied as an alternate socket if requested by the user. The AJ2144 is designed for use in any desired mounting arrangement. It is supplied with an unattached clamp ring which fits to either the top or bottom of its socket body to permit chassis mounting. The ring is not normally required for other mounting arrangements and can be discarded to make such arrangements more compact.

Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago, IL, 60622, or equivalent.

To take full advantage of the performance capability of the 8850, tube operation at voltage values below these minimum specified values is not recommended.

Averaged over any interval of 30 seconds maximum.

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 1140 lumens per watt.

These values are calculated as shown below:

\[
\text{Luminous Sensitivity (A/Im)} = \frac{0.13 \times \text{Light Flux of}}{1 \times 10^{-4} \text{ (Im)}}
\]

The value of 0.13 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions but with the blue filter removed.

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 \(1 \times 10^{-7}\) lumen.
This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

These values are calculated as shown below:

Cathode Luminous Sensitivity (A/1m) =
Cathode Current (with blue light source) (A)

\[
0.13 \times \text{Light Flux of } 1 \times 10^{-4} \text{ (lm)}
\]

The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote (p) to the cathode current measured under the same conditions but with the blue filter removed.

Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 100 microlumens and 660 volts are applied between cathode and all other electrodes connected as anode.

Calculated from the cathode current measured with blue light source.

At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 0.1 microlumen. The supply voltage \( E \) is adjusted to obtain an anode current of 2.6 microamperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 200 amperes per lumen. Dark current is measured with incident light removed.

At 3850 angstroms. These values are calculated from the EADC1 values in lumens using a conversion factor of 1140 lumens per watt.

Measured under the following conditions: Dark noise is eliminated by use of a coincidence circuit. As a result, most of the low energy pulses below one photoelectron are not counted. The light source is a gallium-phosphide light-emitting diode having peak output at a wavelength of approximately 5600 angstroms. The diode is pulsed at a rate of 30,000 pps; pulse duration is approximately 0.4 \( \mu s \); anode circuit integrating time is approximately 10 \( \mu s \). The light intensity from the diode is adjusted to obtain greater or fewer registered counts in a given multielectron peak to obtain an approximately equal number of counts in the first and second photoelectron peaks. A Multichannel Pulse-Height Analyzer having 256 channels is employed.
Measured using a Harshaw Type HG 0.005" beryllium window NaI(Tl) scintillator, 0.04" thick and 7/8" in diameter and an isotope of iron having an atomic mass of 55 (Fe\textsuperscript{55}) and an effective activity at the scintillator of one microcurie.

Measured under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a low color temperature to assure the high probability of single photoelectron emission from the photocathode of the tube. The intensity of the light source is adjusted for approximately $10^4$ photons per second.

Pulse-height resolution in per cent is defined as 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height to the pulse height at maximum photopeak count rate under the conditions of (x).

Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 kilohm resistor and a total capacitance of $100 \pm 3\% \text{ pF}$ in parallel. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs\textsuperscript{137}) and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator (NaI(Tl)-type 3D8850, Serial No.AJ651, or equivalent) are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, OH, and is rated by the manufacturer as having a resolving capability of 8.2 per cent to 8.3 per cent. The Cs\textsuperscript{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the tube by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 60,000 centistokes)—Manufactured by the Dow Corning Corp., Midland, MI, or equivalent.

Mean gain deviation is defined as the percentage change, regardless of sign, from the average pulse height for a given radiation source and scintillator over a specified time or count rate interval.

Under the following conditions: The scintillator and Cs\textsuperscript{137} radiation source of (x) are employed. The radiation source
is initially centered, on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 1000 cps. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 10,000 cps. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. The difference in pulse height between these two measurements is typically 1 per cent.

Under the same conditions as (z) except the count rate position of 1,000 cps is maintained for 16 hours and the pulse height is sampled at 1 hour intervals.

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.

The interstage voltages of the tube should not deviate more than 2 per cent from the specified voltage distribution. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure this operating condition.

Maximum deviation from linearity is 2 per cent.

**TERMINAL DIAGRAM (Bottom View)**

*Note: The diagram includes pin numbers and descriptions of the connections and components.*
Dimensions in Inches

Note: Deviation from Flatness of External Surface of Faceplate will not exceed 0.010" from Peak to Valley.

The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

<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>.003</td>
<td>.08</td>
<td>.05</td>
<td>1.3</td>
<td>1.375</td>
<td>34.93</td>
</tr>
<tr>
<td>.010</td>
<td>.25</td>
<td>.064</td>
<td>1.63</td>
<td>1.80</td>
<td>45.7</td>
</tr>
<tr>
<td>.02</td>
<td>.5</td>
<td>.08</td>
<td>2.0</td>
<td>1.91</td>
<td>48.5</td>
</tr>
<tr>
<td>.04</td>
<td>1.0</td>
<td>.30</td>
<td>7.6</td>
<td>2.10</td>
<td>53.3</td>
</tr>
<tr>
<td>.045</td>
<td>1.14</td>
<td>.65</td>
<td>16.5</td>
<td>4.98</td>
<td>126.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.71</td>
<td>145.0</td>
</tr>
</tbody>
</table>
DETAILED OF BASE ARRANGEMENT

- MAX. DIA. 2.10
- MAX. DIA. 0.65
- MAX. DIA. 0.02-.06
- MAX. DIA. 0.045
- MIN. DIA. 0.064 ± 0.003
- MIN. DIA. 0.30 ± 0.04
- MIN. DIA. 3.26°
- MIN. DIA. 1.375 ± 0.00
TYPICAL TIME-RESOLUTION CHARACTERISTICS

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

<table>
<thead>
<tr>
<th></th>
<th>6.1% of E multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and Dynode No. 1</td>
<td>4.0</td>
</tr>
<tr>
<td>Dynode No. 1 and Dynode No. 2</td>
<td>1.0</td>
</tr>
<tr>
<td>Dynode No. 2 and Dynode No. 3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding dynode-stage volts</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>16.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to Dynode-No. 1 potential. Electron multiplier shield is connected to Dynode-No. 5 potential. Photocathode is fully illuminated.

Rise time—seconds

Transit time—seconds

 Supply volts (E) between anode and cathode
TYPICAL ANODE DARK CURRENT AND EADCi CHARACTERISTICS

SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGE DISTRIBUTION OF COLUMN A, TABLE I.

ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNOE-NO. 5 POTENTIAL.
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22° C.

EQUIVALENT ANODE - DARK CURRENT - LUMEN

EQUIVALENT ANODE - DARK CURRENT - AMPERE

EQUIVALENT ANODE - DARK CURRENT INPUT AT 3850 ANGSTROMS - WATT

EQUIVALENT ANODE - DARK CURRENT INPUT - LUMEN

EQUIVALENT ANODE - DARK CURRENT - AMPERE

LUMINOUS SENSITIVITY - AMPERES/LUMEN

SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE
TYPICAL SECONDARY-EMISSION RATIO OF FIRST DYNODE AS A FUNCTION OF CATHODE-TO-DYNODE NO. 1 VOLTAGE

TYPICAL DARK-PULSE SPECTRUM

VOLTAGE DISTRIBUTION, TABLE 1, COLUMN A
SUPPLY VOLTAGE = 2500 VOLTS
TUBE TEMPERATURE = 22°C
ONE PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS
INTEGRATING TIME CONSTANT = 10 µs
(R = 100 kΩ, C = 100 pF)
MEASURED AFTER 24 HOUR OPERATION OF TUBE IN DARKNESS.
Differential Fe$^{55}$ Spectrum

Fe$^{55}$ SOURCE, ACTIVITY 1 $\mu$ CURIE
SCINTILLATOR: HARSHAW, TYPE HG 0.005" BERYLLIUM WINDOW,
No1(Tf), 7/8" DIAMETER, 0.040" THICK
CATHODE - TO - DYNODE No.1 VOLTS = 660
DYNODE No.1 - TO - DYNODE No.2 VOLTS = 108
DYNODE No.2 - TO - DYNODE No.3 VOLTS = 151
EACH SUCCEEDING DYNODE - STAGE VOLTS = 108
ANODE - TO - CATHODE VOLTS = 2000
FOCUSING ELECTRODE IS CONNECTED TO DYNODE No.1 POTENTIAL
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE No.5 POTENTIAL

COUNTING RATE — EVENTS PER MINUTE

PULSE HEIGHT — Kev

RCA Electronic Components
**TYPICAL DYNODE MODULATION CHARACTERISTIC**

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

<table>
<thead>
<tr>
<th>Between</th>
<th>6.1% of ( E ) multiplied by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cathode and DYNODE No. 1</td>
<td>4.0</td>
</tr>
<tr>
<td>DYNODE No. 1 and DYNODE No. 2</td>
<td>1.0</td>
</tr>
<tr>
<td>DYNODE No. 2 and DYNODE No. 3</td>
<td>1.4</td>
</tr>
<tr>
<td>Each succeeding DYNODE-stage volts</td>
<td>1.0</td>
</tr>
<tr>
<td>Anode and Cathode</td>
<td>16.4</td>
</tr>
</tbody>
</table>

Focusing electrode is connected to DYNODE-No. 1 potential. Electron multiplier shield is connected to DYNODE-No. 5 potential. Cathode is at ground potential.

---

![Graph showing typical dynode modulation characteristic](graph.png)

**Graph**

Relative anode current versus dynode-No. 5 volts (referred to anode).
TYPICAL ANODE CHARACTERISTICS

CATHODE—TO—DYNODE—No. 1 VOLTS = 660
DYNODE—No. 1—TO—DYNODE—No. 2 VOLTS = 108
DYNODE—No. 2—TO—DYNODE—No. 3 VOLTS = 151
EACH SUCCEEDING DYNODE—STAGE VOLTS = 108
ANODE—TO—CATHODE VOLTS = 2000

FOCUSING ELECTRODE IS CONNECTED TO DYNODE—No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE—No. 5 POTENTIAL.
LIGHT SOURCE IS A TUNGSTEN—FILAMENT LAMP OPERATED AT A
COLOR TEMPERATURE OF 2870° K.

ANODE MICROAMPERES

VOLTS BETWEEN ANODE AND DYNODE No. 12

LIGHT FLUX: LUMENS = \( \times 10^4 \)

Electron Multiplier Shield
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

VOLTAGE DISTRIBUTION, TABLE I, COLUMN A
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM ANODE CURRENT.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.

[Graph showing sensitivity and current amplification characteristics]
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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

<table>
<thead>
<tr>
<th>BETWEEN:</th>
<th>6.1% OF E MULTIPLIED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AND DYNODE No.1</td>
<td>4.0</td>
</tr>
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<td>DYNODE No.1 AND DYNODE No. 2</td>
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<td>1.4</td>
</tr>
<tr>
<td>EACH SUCCEEDING DYNODE STAGE</td>
<td>1.0</td>
</tr>
<tr>
<td>ANODE AND CATHODE</td>
<td>16.4</td>
</tr>
</tbody>
</table>

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No.5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

SUPPLY VOLTAGE (E) = 3000 V

RELATIVE ANODE CURRENT

MAGNETIC FIELD INTENSITY - OERSTEDS

(1) DIRECTION (1) IS OUT OF PAPER

(2) DIRECTION (2) OR (3)

SUPPLY VOLTAGE (E) = 3000 V

RELATIVE ANODE CURRENT

MAGNETIC FIELD INTENSITY - OERSTEDS
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)

![Graph showing the typical effect of magnetic field on anode current. The graph plots relative anode current against magnetic field intensity in oersteds for supply voltages of 1000V, 2000V, and 3000V.]

TYPICAL FOCUSING-ELECTRODE CHARACTERISTIC

![Graph showing the typical focusing-electrode characteristic. The graph plots focusing-electrode voltage against relative anode current for Dynode No.1-to-cathode voltage.]
Photomultiplier Tube

2"-Diameter Type

RCA-8851 is a 2"-diameter, 12-stage, head-on QUANTACON* photomultiplier tube having a bialkali photocathode and a pyrex entrance window. It is identical in all respects to type 8850, except for the shape of its window which is a spherical segment.

*QUANTACON is the RCA designation for photomultiplier tubes employing group III/V compounds as secondary emitters and/or photocathodes. A typical compound is gallium-phosphide.

See Dimensional Outline on Reverse Side.
**DIMENSIONAL OUTLINE**

**Note:** Caution must be employed when handling this tube because of the thinness of the entrance window.

The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm).

<table>
<thead>
<tr>
<th>Inch</th>
<th>mm</th>
<th>Inch</th>
<th>mm</th>
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<tr>
<td>.003</td>
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<td>1.3</td>
<td>1.375</td>
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</tr>
<tr>
<td>.010</td>
<td>.25</td>
<td>.064</td>
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<tr>
<td>.02</td>
<td>.5</td>
<td>.08</td>
<td>2.0</td>
<td>1.93</td>
<td>49.0</td>
</tr>
<tr>
<td>.04</td>
<td>1.0</td>
<td>.30</td>
<td>7.6</td>
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<td>.045</td>
<td>1.14</td>
<td>.65</td>
<td>16.5</td>
<td>4.98</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.71</td>
<td>145.0</td>
</tr>
</tbody>
</table>
8857/V1,V2, 8858

Image Intensifier Tubes
18-mm Types Having Fiber-Optic Input and Output Faceplates

GENERAL
All Types
Spectral Response: S-20 with extended red response
Wavelength of Maximum Response: 4700 ± 1000 Å

Photocathode:
- Material: Na-K-Cs-Sb (MultikaI)
- Minimum useful area: 2.5 cm² (0.4 in²)
- Minimum useful diameter: 18 mm (0.71 in)

Image surface:
- Shape: Flat, Circular
- Material: Fiber-Optics

Fluorescent Screen:
- Minimum useful area: 2.5 cm² (0.4 in²)
- Minimum useful diameter: 18 mm (0.71 in)
- Phosphor: P20, Aluminized
- Fluorescence and phosphorescence: Yellow-Green
- Persistence: Medium to Medium Short

Image surface:
- Shape: Flat, Circular
- Material: Fiber-Optics

Focusing Method: Electrostatic

Tube Dimensions:
- Maximum overall length:
  - Type 8858: 5.93 in
  - Types 8857/V1, 8857/V2: 1.926 in
- Maximum diameter:
  - Type 8858: 2.08 in
  - Types 8857/V1, V2: 1.480 in
- Operating Position: Any

Weight (Approx.):
- Type 8858: 1 lb
- Types 8857/V1, V2: 3 oz
## Typical Performance Characteristics

### Type 8858

Under conditions with 2.65 Vdc applied, and an ambient temperature of 22°C, unless otherwise noted.

<table>
<thead>
<tr>
<th>Description</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
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</thead>
<tbody>
<tr>
<td>Resolution:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Center</td>
<td>32</td>
<td>36</td>
<td>-</td>
</tr>
<tr>
<td>Edge (Peripheral)</td>
<td>30</td>
<td>36</td>
<td>-</td>
</tr>
<tr>
<td>Screen Luminance (Brightness)</td>
<td></td>
<td>1</td>
<td>125</td>
</tr>
<tr>
<td>Luminance Gain:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 22°C</td>
<td>$3 \times 10^4$</td>
<td>$5 \times 10^4$</td>
<td>-</td>
</tr>
<tr>
<td>With green light source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Screen Background Input:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous</td>
<td></td>
<td>$5 \times 10^{-12}$</td>
<td>$2 \times 10^{-11}$</td>
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### Type 8857/V1

Under conditions with a dc anode voltage of 12 kV, and an ambient temperature of 22°C, unless otherwise noted.

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<tr>
<td>Center</td>
<td>64</td>
<td>73</td>
<td>-</td>
</tr>
<tr>
<td>Edge (Peripheral)</td>
<td>64</td>
<td>73</td>
<td>-</td>
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<tr>
<td>Screen Luminance (Brightness)</td>
<td>65h</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Luminance Gain:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>At 22°C</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>With green light source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Screen Background Input:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous</td>
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### Type 8857/V2

Under conditions with a dc anode voltage of 12 kV, and an ambient temperature of 22°C, unless otherwise noted.

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<th>Max.</th>
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</thead>
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<td>Resolution:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Center</td>
<td>64</td>
<td>73</td>
<td>-</td>
</tr>
<tr>
<td>Edge (Peripheral)</td>
<td>64</td>
<td>73</td>
<td>-</td>
</tr>
<tr>
<td>Screen Luminance (Brightness)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Luminance Gain:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 22°C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With green light source</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equivalent Screen Background Input:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luminous</td>
<td></td>
<td></td>
<td></td>
</tr>
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### Units

- Line-Pairs/mm
- Line-Pairs/mm
- fL
- fL/ fc
- fL/ fc
- lm/cm²
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<tr>
<th>Photocathode Sensitivity:</th>
<th>Type 8858</th>
<th>Type 8857/V1</th>
<th>Type 8857/V2</th>
<th>Units</th>
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<tr>
<td>At 4700 Å</td>
<td>-</td>
<td>4.6x10^-2</td>
<td>-</td>
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</tr>
<tr>
<td>At 8000 Å</td>
<td>1x10^-2</td>
<td>1.3x10^-2</td>
<td>-</td>
<td>1x10^-2</td>
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<tr>
<td>At 8500 Å</td>
<td>3x10^-3</td>
<td>7x10^-3</td>
<td>-</td>
<td>3x10^-3</td>
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<tr>
<td>Luminous^</td>
<td>1.75x10^-4</td>
<td>2.1x10^-4</td>
<td>-</td>
<td>1.75x10^-4</td>
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<tr>
<td>Luminance Uniformity</td>
<td>-</td>
<td>3:1P</td>
<td>4:1P</td>
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<td>Modulation Transfer Function (MTF):^5 (See Figures 3 and 7)</td>
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<td></td>
<td></td>
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<tr>
<td>For 2.5 Line-Pairs/mm</td>
<td>93</td>
<td>95</td>
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<td>-</td>
</tr>
<tr>
<td>For 7.5 Line-Pairs/mm</td>
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<td>73</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>For 16 Line-Pairs/mm</td>
<td>25</td>
<td>31</td>
<td>-</td>
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<tr>
<td>Paraxial Image Magnification (Cmx)^1</td>
<td>0.82</td>
<td>0.84</td>
<td>1.0</td>
<td>0.94</td>
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<td>Image Alignment^u</td>
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<td>0.06</td>
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<tr>
<td>Image Stability in 30 Seconds^v</td>
<td>-</td>
<td>-</td>
<td>0.005</td>
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<tr>
<td>Distortion^w</td>
<td>-</td>
<td>12</td>
<td>20</td>
<td>-</td>
</tr>
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</table>
MAXIMUM RATINGS, Absolute-Maximum Values

DC Input Voltage
Type 8858 ........................................ 3.0 V

DC Voltage:
Anode with respect to photocathode
Types 8857/V1,V2 .............................. 13 max. kV

Average Photocathode Current (Continuous operation)
Types 8857/V1,V2 .............................. 0.25 max. \( \mu A \)

Ambient-Temperature Range:
Non-operating ................................ -54 to +68\(^\circ\) C
Operating ....................................... -54 to +52\(^\circ\) C

---

a Excluding exhaust tip.

c The specified value is the maximum permitted average anode current with the photocathode uniformly illuminated. This value is averaged over any interval of 10 seconds maximum.

d The resolution, both horizontal and vertical, is determined with a test pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated a "line pair."

e This minimum value applies at a distance of 7 mm from the major (optical) axis of the tube.

f Maximum screen luminance (brightness) is limited automatically by the oscillator power supply and occurs when the input illumination is equal to or greater than 10\(^{-3}\) footcandle. Typical values are measured at 2 \times 10^{-5} footcandle using a 2854\(^{0}\) K tungsten lamp.

g Luminance Gain is defined as the quotient of screen brightness in footlamberts by the photocathode illumination in footcandles provided by a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854\(^{0}\) K. The value of light input radiation on the photocathode image surface is in the range of 1 \times 10^{-5} to 3 \times 10^{-5} footcandle and illuminates uniformly a 0.5"-diameter spot on the photocathode. The output is measured with a photometer centered on a 10-mm diameter spot on the screen.

h Under same conditions of footnote (g) except input radiation on photocathode is 5 \times 10^{-2} footcandle. Anode voltage is 15 kV.

j Under the same conditions of footnote (g) except that a light input of 5 \times 10^{-2} footcandle is incident on Corning C.S. No.3-71 and C.S. No.4-67 interposed between the light source and the tube. Anode voltage is 12 kV. Use of these filters in conjunction with the 2854\(^{0}\) K source closely approximates the P20 spectral distribution.
Defined as the equivalent value of luminous flux from a tungsten-filament lamp operating at 2854° K that would be required to cause an increase in screen brightness equal to screen background brightness.

For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light flux is 0.03 lumen. The light spot has a nominal diameter of 0.5", and 300 volts are applied between anode and photocathode.

The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 17 mm in diameter centered on the image screen when the photocathode is illuminated uniformly with $1 \times 10^{-5}$ to $3 \times 10^{-5}$ footcandle and the output is scanned with a 1 millimeter aperture in a spiral pattern.

The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 17 mm in diameter centered on the image screen.

Under the same conditions as shown in footnote (q) except that Corning C.S. No.3-71 and C.S. No.4-67 filters are interposed between the light source and the tube.

A two-dimensional resolution pattern, providing constant illumination in the Y direction, and sinusoidal variation of intensity in the X direction is projected on the photocathode. Per cent image modulation $M$ may then be defined as:

$$M = \frac{W - B}{W + B} \times 100$$

where $W$ = maximum illumination in white line
$B$ = minimum illumination in black line

Output image brightness is also a sinusoidal function of the distance across one direction of the pattern, and the output modulation is equal to or less than the input modulation. The modulation transfer function (MTF) is defined as the ratio of the output modulation to input modulation expressed as a function of the spatial frequency of the incident illumination pattern. MTF for the tubes is measured using Modulation Transfer Function Analyzer Model No.K1-b, a product of Optics Technology, Inc., Belmont, CA, using the specified procedure for that instrument.
Modulation is recorded with a square-wave resolution pattern for types 8857/V1 and 8857/V2.

In this case, modulation is expressed as a function of line frequency and is called "contrast transfer characteristic". MTF is calculated from the contrast transfer data using the following relationship.

\[
M(N) = \frac{\pi}{4} \left[ C(N) + \frac{C(3N)}{3} - \frac{C(5N)}{5} + \frac{C(7N)}{7} \right]
\]

where \( M(N) \) is the MTF value at line frequency \( N \) and \( C(N) \) is the contrast transfer value at line frequency \( N \).

Paraxial Image Magnification (Cmx) is defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the two corresponding image points on the photocathode. The image points on the photocathode are separated by a distance of 1 mm and are located equal distances from the major axis of the tube.

The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will fall within a circle concentric with the optical axis of the screen having the specified diameter.

The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will not shift more than the specified value during 30 seconds of operation.

A second magnification value (Emx) is obtained as stated in footnote (m) except the image points on the photocathode are separated by a distance of 14 mm. Per-cent distortion is defined by the equation.

\[
\text{Per-Cent Distortion} = \frac{\text{Emx} - \text{Cmx}}{\text{Cmx}} \times 100\%
\]
DIMENSIONAL OUTLINE FOR TYPE 8858

FIBER-OPTIC PHOTO CathODE
IMAGE SURFACE
USEFUL DIA. = 18mm

2.075 ± 0.005 DIA.

1.050 ± 0.004 DIA.

0.06 ± 0.01

5.815 ± 0.115

Note: This distance is measured with a depth microscope.

Dimensions in Inches

RCA Electronic Components

DATA 42-71
8857/V1, V2, 8858

DIMENSIONAL OUTLINE FOR TYPE 8858

CATHODE GROUND (NEGATIVE) AND ALIGNMENT PIN .060 DIA.

9 HOLES .250 MIN DIA. .100 MIN. DEPTH

DIMENSIONAL OUTLINE FOR TYPES 8857/V1, 8857/V2

FIBER-OPTIC PHOTOCATHODE IMAGE SURFACE USEFUL DIA. .710 MIN. PHOTOCATHODE TERMINAL 2.00 ± .100

EXHAUST TUBULATION CAP .910 MAX R.

FIBER-OPTIC SCREEN IMAGE SURFACE USEFUL DIA. .795 MIN.

ANODE TERMINAL .070 ± .010

Dimensions in Inches
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS
FOR ALL TYPES

RELATIVE SENSITIVITY — PER CENT
ABSOLUTE SENSITIVITY — mA/WATT

WAVELENGTH — ANGSTROMS

RCA Electronic Components
DATA 5 2-71
TYPICAL RESOLUTION AS A FUNCTION OF RADIAL DISTANCE ON PHOTOCATHODE FOR TYPE 8858

TYPICAL RESOLUTION AS A FUNCTION OF RADIAL DISTANCE ON PHOTOCATHODE FOR TYPES 8857/V1, 8857/V2
TYPICAL RESOLUTION AS A FUNCTION OF ANODE VOLTAGE FOR TYPES 8857/V1, 8857/V2

TYPICAL MODULATION TRANSFER FUNCTION AND CONTRAST TRANSFER CHARACTERISTICS FOR TYPES 8857/V1, 8857/V2
TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPE 8858

RADIAL DISTANCE ON PHOTOCATHODE IMAGE SURFACE FROM CENTER TOWARD EDGE—MILLIMETERS

TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPES 8857/V1, 8857/V2

RADIAL DISTANCE ON PHOTOCATHODE IMAGE SURFACE FROM CENTER TOWARD EDGE—INCHES
TYPICAL MODULATION TRANSFER FUNCTION FOR TYPE 8858

Spatial Frequency - Line Pairs/Millimeter

Modulation Transfer Function - Per Cent

0 20 40 60 80 100
1 2 3 4 5 6 7 8 9 10

RCA Electronic Components

DATA 7 2-71
JEDEC PHOSPHOR P20 FOR ALL TYPES

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<th>COLOR</th>
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<td>YELLOW-GREEN</td>
<td>X</td>
<td>Y</td>
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<tr>
<td></td>
<td>0.426</td>
<td>0.546</td>
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WAVELENGTH — ANGSTROMS

RELATIVE RADIANT ENERGY

592CM-11263

DATA 7
RELATIVE LIGHT OUTPUT CHARACTERISTIC FOR TYPES 8857/V1, 8857/V2

LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2854°K.

RELATIVE LIGHT OUTPUT - PER CENT

DC ANODE VOLTAGE - KILOVOLTS

0 2 4 6 8 10 12

RCA Electronic Components
This Section contains data on thyratrons, ignitrons, and glow-discharge (cold-cathode) tubes used for voltage-regulator, relay, and voltage-reference applications.

For further Technical Information, write to Commercial Engineering, Tube Division, Radio Corporation of America, Harrison, N. J.
### THYRATRONS

#### Triodes

<table>
<thead>
<tr>
<th>Anode Current</th>
<th>Temperature Range °C</th>
<th>Peak Inverse Anode Volts</th>
<th>Filament-F</th>
<th>RCA Type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mercury-Vapor Types</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>0.5</td>
<td>2</td>
<td>40 to 80</td>
<td>5000</td>
<td>2.5 F</td>
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<td>4</td>
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<td>40</td>
<td>40 to 80</td>
<td>2500</td>
<td>5.0 H</td>
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<td>2.5 F</td>
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<td>77</td>
<td>-40 to 80</td>
<td>1500</td>
<td>2.5 F</td>
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#### Tetrodes

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<th>Temperature Range °C</th>
<th>Peak Inverse Anode Volts</th>
<th>Filament-F</th>
<th>RCA Type</th>
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<td><strong>Mercury-Vapor Types</strong></td>
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<tr>
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<td>40 to 80</td>
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<td>5 H</td>
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<td>40 to 80</td>
<td>1250</td>
<td>5 H</td>
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<td>1500</td>
<td>5 H</td>
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<td>40 to 80</td>
<td>2500</td>
<td>5 H</td>
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<tr>
<td>6.4</td>
<td>40</td>
<td>40 to 80</td>
<td>2500</td>
<td>5 H</td>
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<td>500</td>
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<tr>
<td>0.1</td>
<td>0.5</td>
<td>-75 to +150</td>
<td>1300</td>
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</tr>
<tr>
<td>0.1</td>
<td>1</td>
<td>-55 to 90</td>
<td>1300</td>
<td>6.3 H</td>
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</table>
Tetrodes (Cont'd)

<table>
<thead>
<tr>
<th>RCA Type</th>
<th>Gas Types (Cont'd)</th>
<th>Tetrodes (Cont'd)</th>
<th>Gas Types (Cont'd)</th>
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<tbody>
<tr>
<td>Anode Current</td>
<td>Temperature Range</td>
<td>Peak Inverse Anode Volts</td>
<td>Filament-F or Heater-H</td>
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<tr>
<td>Av Amp</td>
<td>Peak Amp</td>
<td>°C</td>
<td>Volts</td>
</tr>
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<td>---------</td>
<td>---------</td>
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<td>1</td>
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<td>1</td>
<td>0.3</td>
<td>1300</td>
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<td>0.5</td>
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<td>1300</td>
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<tr>
<td>0.8</td>
<td>8</td>
<td>0.3</td>
<td>1500</td>
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GLOW-DISCHARGE TUBES

<table>
<thead>
<tr>
<th>Voltage-Regulator Types</th>
<th>DC Operating Current Range</th>
<th>Average DC Operating Currents</th>
<th>RCA Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage-Reference Types</td>
<td>Average DC Starting Volts</td>
<td>RCA Type</td>
<td></td>
</tr>
<tr>
<td>Relay Types</td>
<td>Maximum Cathode Milliamperes</td>
<td>RCA Type</td>
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<table>
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<th>Voltage-Regulator Types</th>
<th>DC Operating Current Range</th>
<th>Average DC Operating Currents</th>
<th>RCA Type</th>
</tr>
</thead>
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<tr>
<td>Voltage-Reference Types</td>
<td>Average DC Starting Volts</td>
<td>RCA Type</td>
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<tr>
<td>Relay Types</td>
<td>Maximum Cathode Milliamperes</td>
<td>RCA Type</td>
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<th>Voltage-Regulator Types</th>
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<th>Average DC Operating Currents</th>
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</thead>
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<td>Voltage-Reference Types</td>
<td>Average DC Starting Volts</td>
<td>RCA Type</td>
<td></td>
</tr>
<tr>
<td>Relay Types</td>
<td>Maximum Cathode Milliamperes</td>
<td>RCA Type</td>
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IGNITRONS

MAXIMUM RATINGS

For power-supply frequencies of 25 to 60 Hz

<table>
<thead>
<tr>
<th>Anode Current</th>
<th>Time Intervals</th>
<th>Demand Power</th>
<th>RMS Supply</th>
<th>Peak Anode Inverse or Forward Volts</th>
<th>RCA Type</th>
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</thead>
<tbody>
<tr>
<td>Amp</td>
<td>Sec</td>
<td>Amp</td>
<td>KVA</td>
<td>Volts</td>
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<table>
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<tr>
<th>Resistance-Welding Control Service</th>
<th>4.86</th>
<th>27.8</th>
<th>846</th>
<th>150</th>
<th>250</th>
<th>5550</th>
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<tr>
<td>Power Supply Frequencies of 25 to 60 Hz</td>
<td>4.86</td>
<td>11.6</td>
<td>354</td>
<td>150</td>
<td>600</td>
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<tr>
<td>Anode Current</td>
<td>12.1</td>
<td>22</td>
<td>1692</td>
<td>300</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Time Intervals</td>
<td>12.1</td>
<td>9.2</td>
<td>708</td>
<td>300</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Peak Power</td>
<td>30.2</td>
<td>18</td>
<td>3400</td>
<td>600</td>
<td>250</td>
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</tr>
<tr>
<td>Supply</td>
<td>30.2</td>
<td>7.5</td>
<td>1410</td>
<td>600</td>
<td>600</td>
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<tr>
<td>Anode Current</td>
<td>56</td>
<td>18</td>
<td>1130</td>
<td>200</td>
<td>250</td>
<td></td>
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<tr>
<td>Time Intervals</td>
<td>56</td>
<td>7.5</td>
<td>466</td>
<td>200</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Peak Power</td>
<td>75.6</td>
<td>14</td>
<td>6800</td>
<td>1200</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Supply</td>
<td>75.6</td>
<td>5.8</td>
<td>2830</td>
<td>1200</td>
<td>600</td>
<td></td>
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<tr>
<td>Anode Current</td>
<td>140</td>
<td>14</td>
<td>2260</td>
<td>400</td>
<td>250</td>
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<tr>
<td>Time Intervals</td>
<td>140</td>
<td>5.8</td>
<td>945</td>
<td>400</td>
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<table>
<thead>
<tr>
<th>Interimmitent Rectifier Service and Frequency-Changer Welder Service</th>
<th>4</th>
<th>10</th>
<th>480</th>
<th></th>
<th></th>
<th>5551A</th>
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<tbody>
<tr>
<td>Power Supply Frequencies of 25 to 60 Hz</td>
<td>5</td>
<td>10</td>
<td>600</td>
<td></td>
<td></td>
<td>1200</td>
</tr>
<tr>
<td>Anode Current</td>
<td>40</td>
<td>6</td>
<td>700</td>
<td></td>
<td></td>
<td>500</td>
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<tr>
<td>Time Intervals</td>
<td>100</td>
<td>6</td>
<td>1600</td>
<td></td>
<td></td>
<td>500</td>
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<table>
<thead>
<tr>
<th>Resistance-Welding-Capacitor Discharge Service</th>
<th>3.25</th>
<th>500</th>
<th>60 dischgs/sec</th>
<th>5550</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Supply Frequencies of 25 to 60 Hz</td>
<td>0.66</td>
<td>500</td>
<td>60 dischgs/sec</td>
<td>3000</td>
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VACUUM-GAUGE TUBES

<table>
<thead>
<tr>
<th>Gas Pressure Range</th>
<th>in mm of Hg (Torr)</th>
<th>in microns</th>
<th>Gauge Type</th>
<th>RCA Type</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>1 to 0.0001</td>
<td>1000 to 0.1</td>
<td>Thermo-couple</td>
<td>1946</td>
</tr>
<tr>
<td></td>
<td>1 to 0.001</td>
<td>1000 to 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.5 to below 0.01</td>
<td>1500 to below 10</td>
<td>Pirani</td>
<td>1947</td>
</tr>
<tr>
<td></td>
<td>0.5 to 0.01</td>
<td>500 to 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.001 to below</td>
<td>1 to below 0.1</td>
<td>Ionization (Hard Glass)</td>
<td>1949</td>
</tr>
<tr>
<td></td>
<td>0.0001</td>
<td>0.1 and below</td>
<td></td>
<td></td>
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</table>

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

THY, GLOW-DIS, IGN, & VAC-GA TUBE GUIDE 2
7-67
b "Premium" version of OB2 intended for applications critical to shock and vibration.

c "Premium" version of OA2 intended for applications critical to shock and vibration.

d Like the 5651 but has greater voltage stability.

f For operation from a dc supply.

h For operation from an ac supply.

i Per tube.

j Two tubes in inverse-parallel circuit.

k Intermittent Rectifier Service only.

l Range of greatest sensitivity.
**GRID-CONTROLLED RECTIFIER CIRCUITS**

Numerical Relationships Among Electrical Quantities

<table>
<thead>
<tr>
<th>E = Trans. Sec. Voltage (RMS)</th>
<th>E&lt;sub&gt;av&lt;/sub&gt; = Average DC Output Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>E&lt;sub&gt;av&lt;/sub&gt; = Average DC Output Voltage</td>
<td>I&lt;sub&gt;av&lt;/sub&gt; = Average Anode Current</td>
</tr>
<tr>
<td>E&lt;sub&gt;pm&lt;/sub&gt; = Peak Inverse Anode Voltage</td>
<td>I&lt;sub&gt;p&lt;/sub&gt; = Anode Current (RMS)</td>
</tr>
<tr>
<td>E&lt;sub&gt;a&lt;/sub&gt; = Major Ripple Voltage (RMS)</td>
<td>I&lt;sub&gt;pm&lt;/sub&gt; = Peak Anode Current</td>
</tr>
<tr>
<td>f = Supply Frequency</td>
<td>I&lt;sub&gt;p&lt;/sub&gt; = Trans. Pri. Volt-Amperes</td>
</tr>
<tr>
<td>f&lt;sub&gt;r&lt;/sub&gt; = Major Ripple Frequency</td>
<td>I&lt;sub&gt;pm&lt;/sub&gt; = Trans. Sec. Volt-Amperes</td>
</tr>
</tbody>
</table>

\[ Pe = \text{DC Power} \ (E<sub>av</sub> \times I<sub>av</sub>) \]

**Note:** Conditions assumed involve sine-wave supply; zero voltage drop in tubes; no losses in transformer and circuit; no back emf in the load circuit; and no phase-back.

### Voltage Ratios

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Fig. 1</th>
<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
<th>Fig. 5</th>
<th>Fig. 6</th>
<th>Fig. 7</th>
<th>Fig. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>E/E&lt;sub&gt;av&lt;/sub&gt;</td>
<td>2.22</td>
<td>1.11</td>
<td>1.11</td>
<td>0.854</td>
<td>0.854</td>
<td>0.427</td>
<td>0.785</td>
<td>0.74</td>
</tr>
<tr>
<td>E&lt;sub&gt;bm&lt;/sub&gt;/E</td>
<td>1.41</td>
<td>2.83</td>
<td>1.41</td>
<td>2.45</td>
<td>2.45</td>
<td>2.45</td>
<td>2.83</td>
<td>2.83</td>
</tr>
<tr>
<td>E&lt;sub&gt;bm&lt;/sub&gt;/E&lt;sub&gt;av&lt;/sub&gt;</td>
<td>3.14</td>
<td>3.14</td>
<td>1.57</td>
<td>2.09</td>
<td>2.09</td>
<td>1.05</td>
<td>2.22</td>
<td>2.09</td>
</tr>
<tr>
<td>E&lt;sub&gt;a&lt;/sub&gt;/E&lt;sub&gt;av&lt;/sub&gt;</td>
<td>3.14</td>
<td>1.57</td>
<td>1.57</td>
<td>1.21</td>
<td>1.05</td>
<td>1.05</td>
<td>1.11</td>
<td>1.05</td>
</tr>
<tr>
<td>E/E&lt;sub&gt;av&lt;/sub&gt;</td>
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<td>0.472</td>
<td>0.177</td>
<td>0.04</td>
<td>0.04</td>
<td>0.106</td>
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### Frequency Ratio

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<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
<th>Fig. 5</th>
<th>Fig. 6</th>
<th>Fig. 7</th>
<th>Fig. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>f/f&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>6</td>
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### Current Ratios

<table>
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<tr>
<th>Ratio</th>
<th>Fig. 1</th>
<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
<th>Fig. 5</th>
<th>Fig. 6</th>
<th>Fig. 7</th>
<th>Fig. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;p&lt;/sub&gt;/I&lt;sub&gt;av&lt;/sub&gt;</td>
<td>1.57</td>
<td>0.785</td>
<td>0.785</td>
<td>0.578</td>
<td>0.289</td>
<td>0.578</td>
<td>0.5</td>
<td>0.408</td>
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<tr>
<td>I&lt;sub&gt;b&lt;/sub&gt;/I&lt;sub&gt;av&lt;/sub&gt;</td>
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<td>0.5</td>
<td>0.5</td>
<td>0.53</td>
<td>0.167</td>
<td>0.33</td>
<td>0.25</td>
<td>0.167</td>
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</table>

### Resistive Load

<table>
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<tr>
<th>Ratio</th>
<th>Fig. 1</th>
<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
<th>Fig. 5</th>
<th>Fig. 6</th>
<th>Fig. 7</th>
<th>Fig. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;p&lt;/sub&gt;/I&lt;sub&gt;b&lt;/sub&gt;</td>
<td>3.14</td>
<td>1.57</td>
<td>1.57</td>
<td>1.21</td>
<td>0.52</td>
<td>1.05</td>
<td>1.11</td>
<td>1.05</td>
</tr>
<tr>
<td>I&lt;sub&gt;p&lt;/sub&gt;/I&lt;sub&gt;b&lt;/sub&gt;</td>
<td>5.14</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
<td>4.5</td>
<td>6.5</td>
</tr>
<tr>
<td>I&lt;sub&gt;p&lt;/sub&gt;/I&lt;sub&gt;b&lt;/sub&gt;</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>0.5</td>
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### Inductive Load

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<th>Fig. 1</th>
<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
<th>Fig. 5</th>
<th>Fig. 6</th>
<th>Fig. 7</th>
<th>Fig. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;p&lt;/sub&gt;/I&lt;sub&gt;b&lt;/sub&gt;</td>
<td>3.49</td>
<td>1.74</td>
<td>1.24</td>
<td>1.11</td>
<td>1.11</td>
<td>1.11</td>
<td>1.11</td>
<td>1.11</td>
</tr>
<tr>
<td>I&lt;sub&gt;p&lt;/sub&gt;/I&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2.09</td>
<td>1.23</td>
<td>1.24</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
</tr>
<tr>
<td>I&lt;sub&gt;p&lt;/sub&gt;/I&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2.09</td>
<td>1.23</td>
<td>1.24</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
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### Power Ratios

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Fig. 1</th>
<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
<th>Fig. 5</th>
<th>Fig. 6</th>
<th>Fig. 7</th>
<th>Fig. 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>P&lt;sub&gt;a&lt;/sub&gt;/P&lt;sub&gt;dc&lt;/sub&gt;</td>
<td>3.49</td>
<td>1.74</td>
<td>1.24</td>
<td>1.11</td>
<td>1.11</td>
<td>1.11</td>
<td>1.11</td>
<td>1.11</td>
</tr>
<tr>
<td>P&lt;sub&gt;a&lt;/sub&gt;/P&lt;sub&gt;dc&lt;/sub&gt;</td>
<td>2.09</td>
<td>1.23</td>
<td>1.24</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
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<tr>
<td>P&lt;sub&gt;a&lt;/sub&gt;/P&lt;sub&gt;dc&lt;/sub&gt;</td>
<td>2.09</td>
<td>1.23</td>
<td>1.24</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
<td>1.21</td>
</tr>
</tbody>
</table>

* Bleeder current of 2% full-load current will provide exciting current for balance coil and thus avoid poor regulation at light loading.
* The use of a large filter-input choke is assumed.
GRID-CONTROLLED RECTIFIER CIRCUITS

FIG. 1 HALF-WAVE SINGLE-PHASE

FIG. 2 FULL-WAVE SINGLE-PHASE

FIG. 3 SERIES SINGLE-PHASE

FIG. 4 HALF-WAVE THREE-PHASE

FIG. 5 PARALLEL THREE-PHASE (QUADRATURE OPERATION)

Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.
GRID-CONTROLLED RECTIFIER CIRCUITS

FIG. 6 SERIES THREE-PHASE (QUADRATURE OPERATION)

FIG. 7 HALF-WAVE FOUR-PHASE (QUADRATURE OPERATION)

FIG. 8 HALF-WAVE SIX-PHASE (QUADRATURE OPERATION)

NOTE
T=PEAKING TRANSFORMER

4-57 TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
RECTIFIER CIRCUITS 2
VOLTAGE REGULATOR
MINIATURE GLOW—DISCHARGE TYPE

GENERAL DATA

Electrical:
Cathode .................................................. Cold

Mechanical:
Mounting Position .................................. Any
Maximum Overall Length ...................... 2-5/8"
Maximum Seated Length ............. 2-3/8"
Length, Base Seat to Bulb Top (Excluding tip) .... 2" ± 3/32"
Maximum Diameter ....................... 3/4"
Weight (Approx.) ......................... 0.3 oz
Bulb ........................................ T-5-1/2
Base ........................................ Small-Button Miniature 7-Pin (JETEC No.E7-1)
Basing Designation for BOTTOM VIEW .... 5BO

Pin 1 - Anode
Pin 2 - Cathode
Pin 3 - Internal Connection—
Do Not Use
Pin 4 - Cathode
Pin 5 - Anode
Pin 6 - Internal Connection—
Do Not Use
Pin 7 - Cathode

Maximum and Minimum Ratings, Absolute Values:
AVERAGE STARTING CURRENT* ........ 75 max. ma
DC CATHODE CURRENT .......... { 30 max. ma
5 min. ma
FREQUENCY, .......................... 0 max. cps
AMBIENT-TEMPERATURE RANGE .......... -55 to +90 °C

Circuit Values:
Shunt Capacitor ......................... 0.1 max. µf
Series Resistor ......................... See Operating Considerations

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode-Supply Voltage</td>
<td>185°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Breakdown Voltage</td>
<td>156</td>
<td>185°</td>
<td></td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td>140°</td>
<td>151</td>
<td>168°</td>
</tr>
<tr>
<td>Regulation (5 to 30 ma)</td>
<td></td>
<td>2</td>
<td>6°</td>
</tr>
</tbody>
</table>

* Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

- Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.
- Maximum individual tube value during useful life.
- Minimum individual tube value during useful life.

Indicates a change.

NOV. 5, 1954
Sufficient resistance must always be used in series with the OA2 to limit the current through the tube. The value for the series resistor is dependent on the maximum anode-supply voltage and the ratio of the current through the load to the operating current of the OA2, and should be chosen to limit the operating current through the tube to 30 milliamperes at all times after the starting period.

The maximum load current that can be regulated by the OA2 is determined by the minimum and maximum values of the supply voltage. After the value of series resistor for the maximum supply voltage has been calculated as indicated above, it is then in order to determine if this value will permit adequate starting voltage when the supply voltage falls to its minimum value. If adequate starting voltage is not obtained, a new load current of lower value must be used and the calculations repeated. It will be apparent from such calculations that the higher the minimum supply voltage and the smaller the difference between its minimum and maximum values, the higher will be the load current that can be regulated.

When equipment utilizing the OA2 is "turned on", a starting current in excess of the average operating current is permissible as indicated under Maximum Ratings. When the tube is subjected to such high starting currents, the regulated voltage may require up to 20 minutes to drop to its normal operating value. This performance is characteristic of voltage-regulator tubes of the glow-discharge type. Similarly, the regulation is affected by changes in current within the operating current range. For example, the regulation of a tube operated for a protracted period at 5 milliamperes and then changed to 25 milliamperes, may be somewhat different from the value that will be obtained after a long period of operation at 25 milliamperes. Likewise, the regulation may change somewhat after a long idle period.

In order to handle more load current, two or more OA2's may be operated in parallel, but such parallel operation requires that a resistance of approximately 100 ohms be used in series with each OA2 in order to equalize division of the current between the paralleled tubes. The disadvantage of this method, of course, is that the use of resistors impairs the regulation which can be obtained.

If the associated circuit has a capacitor in shunt with the OA2, the capacitor should be limited in value to 0.1 μf. A larger value may cause the OA2 to oscillate and thus give unstable regulation performance.

NOV. 5, 1954

RADIO CORPORATION OF AMERICA, HAVERSTON, NEW JERSEY
Typical circuit to provide regulated supply voltage of approximately 150 or 108 volts to load. Removal of tube from socket removes voltage from load.

Typical circuit using two OA2's or two OB2's to provide regulated supply voltages of approximately 300 or 216 volts and 150 or 108 volts to load. Socket connections are so made that voltage on load is removed when either tube is taken from its socket.

CIRCUIT FOR BIAS-SUPPLY REGULATION IS SHOWN ON NEXT PAGE.

Many of the devices and arrangements shown or described herein use inventions of patents owned by RCA or others. Information contained herein is furnished without assuming any responsibility for its use.

DEC. 30, 1947
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
VOLTAGE REGULATOR
GLOW-DISCHARGE TYPE

GENERAL DATA

Electrical:
Cathode ........................................... Cold

Mechanical:
Mounting Position .................................. Any
Maximum Overall Length .......................... 4-1/8" ± 3/16"
Seated Length ...................................... 3-3/8" ± 3/16"
Maximum Diameter .................................. 1-9/16"
Dimensional Outline ............................... See General Section
Weight (Approx.) ................................... 1.3 oz
Base ................................................. Small-Shell Octal 6-Pin (JETEC No. B6-3)
Basing Designation for BOTTOM VIEW ........... 4AJ

Pin 1 — No Connection
Pin 2 — Cathode
Pin 3 — Jumper
Pin 5 — Anode
Pin 7 — Jumper
Pin 8 — No Connection

Maximum and Minimum Ratings, Absolute Values:
AVERAGE STARTING CURRENT* ................... 100 max. ma
DC CATHODE CURRENT ................................ 40 max. ma
FREQUENCY .......................................... 5 min. ma
AMBIENT-TEMPERATURE RANGE ................. -55 to +90 °C

Circuit Values:
Shunt Capacitor ................................... 0.1 max. μf
Series Resistor ..................................... See Operating Considerations

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode-Supply Voltage</td>
<td>105°</td>
<td>100</td>
<td>105°</td>
<td>volts</td>
</tr>
<tr>
<td>Anode Breakdown Voltage</td>
<td>66°</td>
<td>75</td>
<td>85°</td>
<td>volts</td>
</tr>
<tr>
<td>Anode Voltage Drop ..........</td>
<td>5</td>
<td>5</td>
<td>6.5°</td>
<td>volts</td>
</tr>
</tbody>
</table>

*With suitable socket connections, jumper within base acts as a switch to open power-supply circuit when voltage regulator tube is removed from socket.

*Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

*Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

*Maximum individual tube value during useful life.

*Minimum individual tube value during useful life.

Indicates a change.
OPERATING CONSIDERATIONS

Sufficient resistance must always be used in series with the OA3 to limit the current through the tube. The value for the series resistor is dependent on the maximum anode-supply voltage and the ratio of the current through the load to the operating current of the OA3, and should be chosen to limit the operating current through the tube to 40 milliamperes at all times after the starting period.

The maximum load current that can be regulated by the OA3 is determined by the minimum and maximum values of the supply voltage. After the value of series resistor for the maximum supply voltage has been calculated as indicated above, it is then in order to determine if this value will permit adequate starting voltage when the supply voltage falls to its minimum value. If adequate starting voltage is not obtained, a new load current of lower value must be used and the calculations repeated. It will be apparent from such calculations that the higher the minimum supply voltage and the smaller the difference between its minimum and maximum values, the higher will be the load current that can be regulated.

When equipment utilizing the OA3 is "turned on", a starting current in excess of the average operating current is permissible as indicated under Maximum Ratings. When the tube is subjected to such high starting currents, the regulated voltage may require up to 20 minutes to drop to its normal operating value. This performance is characteristic of voltage-regulator tubes of the glow-discharge type. Similarly, the regulation is affected by changes in current within the operating-current range. For example, the regulation of a tube operated for a protracted period at 5 milliamperes and then changed to 35 milliamperes, may be somewhat different from the value that will be obtained after a long period of operation at 35 milliamperes. Likewise, the regulation may change somewhat after a long idle period.

In order to handle more load current, two or more OA3's may be operated in parallel, but such parallel operation requires that a resistance of approximately 100 ohms be used in series with each OA3 in order to equalize division of the current between the paralleled tubes. The disadvantage of this method, of course, is that the use of resistors impairs the regulation which can be obtained.

If the associated circuit has a capacitor in shunt with the OA3, the capacitor should be limited in value to 0.1 μF. A larger value may cause the OA3 to oscillate and thus give unstable regulation performance.

→ Indicates a change.
VOLTAGE REGULATOR

Typical circuit to provide regulated supply voltage of approximately 75, 105, or 150 volts to load. Removal of tube from socket removes voltage from load.

Typical circuit using two OA3's, two OC3's, or two OD3's to provide regulated supply voltages of approximately 150, 210, or 300 volts and 75, 105, or 150 volts to load. Socket connections are so made that voltage on load is removed when either tube is taken from its socket.

Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.
GLOW-DISCHARGE TYPE

For Applications Requiring a Relatively Constant DC Output Voltage, Independent of Load and Supply-Voltage Variations

Mechanical:

Operating Position: Any
Type of Cathode: Cold
Maximum Overall Length: 3-1/16"
Maximum Seated Length: 2-1/2"
Maximum Diameter: 1-9/32"
Dimensional Outline: See General Section

Bulb: Intermediate-Shelf Octal 6-Pin, Arrangement 1 (JEDEC Group 1, No. B6-8)

Basing Designation for BOTTOM VIEW: 4AJ

Pin 1 - No Internal Connection
Pin 2 - Cathode
Pin 3 - Jumper
Pin 5 - Anode
Pin 7 - Jumper
Pin 8 - No Internal Connection

VOLTAGE REGULATOR

Maximum and Minimum Ratings, Absolute-Maximum Values:

Average Cathode Starting Current: 100 max. ma
DC Cathode Current: 40 max. ma
DC or AC Jumper Current: 5 min. ma
Ambient-Temperature Range: -55 to +90°C

Circuit Values:

Shunt Capacitor: 0.1 max. μF
Series Resistor: See Operating Considerations

With suitable socket connections, the jumper within the tube base (between pins 3 and 7) provides for opening the power-supply circuit to protect circuit components when the voltage-regulator tube is removed from its socket.

Averaged over starting period not exceeding 10 seconds. When starting currents greatly in excess of the maximum dc-cathode-current rating of 40 milliamperes are encountered, it may be necessary to operate these tubes as much as 20 minutes under steady-state conditions to assure stable operation.
# CHARACTERISTICS RANGE VALUES

Values are initial unless otherwise specified

<table>
<thead>
<tr>
<th>DC Anode Supply Voltage</th>
<th>Note Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode Starting Voltage in:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total darkness</td>
<td></td>
<td></td>
<td>160</td>
</tr>
<tr>
<td>Normal ambient light</td>
<td></td>
<td>100</td>
<td>105</td>
</tr>
<tr>
<td>(5 to 50 footcandles)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for dc cathode current of:</td>
<td></td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>5 ma.</td>
<td></td>
<td>70</td>
<td>76</td>
</tr>
<tr>
<td>30 ma.</td>
<td></td>
<td>70</td>
<td>79</td>
</tr>
<tr>
<td>40 ma.</td>
<td></td>
<td>70</td>
<td>81</td>
</tr>
<tr>
<td>Regulation for dc-cathode- current range of:</td>
<td></td>
<td>3</td>
<td>4.5</td>
</tr>
<tr>
<td>5 to 30 ma.</td>
<td></td>
<td>5</td>
<td>6.5</td>
</tr>
<tr>
<td>5 to 40 ma.</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Tube Noise for dc cathode current of:</td>
<td></td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>40 ma.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Leakage Current</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>for dc anode supply voltage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of 50 volts and anode resistor of 3000 ohms</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Note 1: The minimum value to insure starting throughout useful tube life must be equal to the dc anode starting voltage plus the voltage drop across the series resistor at the maximum value of the load current. |

| Note 2: The maximum values for the specified regulation range apply throughout useful tube life. |

# OPERATING CONSIDERATIONS

In any given application, the following two considerations must be met to assure safe and reliable operation:

1. The dc cathode current must be kept within the minimum (I_{k_{min}}) and maximum (I_{k_{max}}) ratings.

2. The dc anode starting voltage, E_{b_{(stg)}}, must be available under the worst probable conditions.

Instantaneous cathode starting currents in excess of the maximum dc-cathode-current rating (40 milliamperes) are permissible as indicated under Maximum and Minimum Ratings. When the tubes are subjected to such high starting currents, as much as 20 minutes may be required for the regulated dc voltage to reach its normal operating value. The regulated dc voltage may also change after long idle periods. To assure a constant regulated voltage a single value of operating current should be maintained.

Another effect associated with VR tubes is "spot jump", sometimes referred to as "jitter". This phenomenon is an instantaneous shift of the glow on the surface of the cathode and is responsible for small instantaneous changes in anode voltage drop. These changes can be minimized by operating the voltage-regulator tubes at dc cathode currents sufficiently above the minimum dc-cathode-current rating (5 milliamperes).
to assure that the glow covers a substantial portion of the cathode surface.

The level of ambient radiation directly affects the dc anode starting voltage of VR tubes. The maximum values required to start any tube under normal ambient-light conditions and in total darkness are given under Characteristics Range Values. Shielding should be considered when VR tubes are operated in the presence of strong, varying, magnetic, or nuclear-radiation fields to assure proper performance.

Ambient temperature should be kept relatively constant to minimize voltage drift.

Coupling effects can be minimized by shunting the VR tube with a capacitor not larger than 0.1 µf.

Series connection of VR tubes may be employed to obtain dc regulated voltages greater than those obtainable from a single tube. Different types may be used provided the series current is kept within the maximum dc-cathode-current rating of the lowest-rated tube.

Parallel connection of VR tubes may be employed where it is necessary to obtain dc load currents greater than those obtainable from a single tube but at a loss in regulation. This loss in regulation results from the requirement that a resistor be used in series with each VR tube when in parallel operation.

Combinations of regulated dc voltages may also be obtained by series connection of VR tubes with tapped output as shown in Typical Circuit 1.

To determine the value of the series resistor for small load currents in a circuit of this type, disconnect the loads and adjust the series resistor for a tube current of not more than 40 milliamperes.

Regulated bias voltages may also be obtained as shown in Typical Circuit 2. In this circuit, a single OA3A can supply a regulated dc voltage of -75 volts.

The jumper between pins 3 and 7 inside the base makes it possible with suitable socket connections, to open power-supply circuits to protect circuit components when one of the VR tubes is removed from its socket.
TYPICAL CIRCUIT 2

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**OA4-G**

**GAS-TRIODE**

**COLD-CATHODE STARTER-ANODE TYPE**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Overall Length</td>
<td>4-1/8&quot;</td>
</tr>
<tr>
<td>Maximum Diameter</td>
<td>1-9/16&quot;</td>
</tr>
<tr>
<td>Bulb</td>
<td>ST-12</td>
</tr>
<tr>
<td>Small Shell Octal 6-Pin</td>
<td></td>
</tr>
<tr>
<td>Pin 1 — No Connection</td>
<td></td>
</tr>
<tr>
<td>Pin 2 — Cathode</td>
<td></td>
</tr>
<tr>
<td>Pin 3 — No Connection</td>
<td></td>
</tr>
<tr>
<td>Bottom View</td>
<td></td>
</tr>
</tbody>
</table>

**CHARACTERISTICS**

- **Peak Anode Breakdown Voltage (Starter anode tied to cathode):** 225 min. volts
- **Peak Positive Starter-Anode Breakdown Voltage:** 70 min. volts
- **Starter-Anode Current (For transition of discharge to anode at 140 volts peak):** 190 max. volts
- **Starter-Anode Drop:** 100 max. max.
- **Anode Drop:** 60 approx. volts
- **Anode Drop:** 70 approx. volts

**MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS**

**Relay Service**

- **Peak Cathode Current:** 100 max. ma.
- **D-C Cathode Current:** 25 max. ma.
- **Typical Operation with A-C Supply:**
  - Anode-Supply Voltage (RMS): 105-130 volts
  - A-C Starter-Anode Voltage (peak): 70 max. volts
  - R-F Starter-Anode Voltage (peak): 55 min. volts
  - Sum of A-C and R-F Starter-Anode Voltages (peak): 110 min. volts

**SCHEMATIC RELAY CIRCUIT USING TYPE OA4-G**

**A-C OPERATION**

- **L = HIGH-Q TUNED CIRCUIT FOR R-F SIGNAL**
- **R1 = 15000 OHMS (1/2 WATT)**
- **R2 = 10000 OHMS (1/2 WATT)**
- **S = RELAY — CHOSEN FOR DESIGN REQUIREMENTS**

The license extended to the purchaser of tubes appears in the License Notice accompanying them. Information contained herein is furnished without assuming any obligations.

**APRIL 20, 1938**

**RCA RADIOTRON DIVISION**

**TENTATIVE DATA**
TYPICAL BREAKDOWN CHARACTERISTICS
FOR DIFFERENT ELECTRODE POLARITIES

GAS-TRIODE

AVERAGE TRANSITION CHARACTERISTIC

AVERAGE ANODE-DROP CHARACTERISTIC

April 20, 1938

RCA Radiotron Division
RCA Manufacturing Company, Inc.
VOLTAGE REGULATOR
MINIATURE GLOW-DISCHARGE TYPE

GENERAL DATA

Electrical:
Cathode. ............................................ Cold

Mechanical:
Mounting Position. ................................ Any
Maximum Overall Length. ....................... 2-5/8"
Maximum Seated Length. ....................... 2-3/8"
Length, Base Seat to Bulb Top (Excluding tip). 2" ± 3/32"
Maximum Diameter. ................................ 3/4"
Weight (Approx.). .................................. 0.3 oz
Bulb ................................................. T-5-1/2
Base ................................................ Small-Button Miniature 7-Pin (JETEC No. E7-1)
Basing Designation for BOTTOM VIEW .............. 580

Pin 1 - Anode
Pin 2 - Cathode
Pin 3 - Internal Connection—Do Not Use
Pin 4 - Cathode

Pin 5 - Anode
Pin 6 - Internal Connection—Do Not Use
Pin 7 - Cathode

Maximum and Minimum Ratings, Absolute Values:
AVERAGE STARTING CURRENT.................. 75 max. ma
DC CATHODE CURRENT ......................... { 30 max. ma
FREQUENCY. ......................................... 0 max. cps
AMBIENT-TEMPERATURE RANGE ................. -55 to +90 °C

Circuit Values:
Shunt Capacitor. ..................................... 0.1 max. µF
Series Resistor. ..................................... See note below

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode—Supply Voltage.</td>
<td>133°</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anode Breakdown Voltage.</td>
<td>-</td>
<td>115</td>
<td>133°</td>
</tr>
<tr>
<td>Anode Voltage Drop.</td>
<td>101°</td>
<td>108</td>
<td>114°</td>
</tr>
<tr>
<td>Regulation (5 to 30 ma.)</td>
<td>-</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

* Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition or at least 20 minutes, or tube performance will be impaired.

* Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

* Maximum individual tube value during useful life.

* Minimum individual tube value during useful life.

The operating considerations and circuit information shown under Type OA2 also apply to Type OB2

JAN. 3, 1955
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

indicates a change.
GENERAL DATA

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td>Measured with NO load</td>
</tr>
<tr>
<td>-</td>
<td>Reduced due to refraction</td>
</tr>
</tbody>
</table>

Mechanical:

- Measured with NO load
- Reduced due to refraction

Maximum and Minimum Ranges:

- AVS: 10, 20...50
- AVS: 0, 20...50

Circuit Values:

- 0.6
- 1.0

CHARACTERISTIC RANGES FOR EQUIPMENT DESIGN

- DC source (24V) ±1% ±3% ±5%
- AC source (24V) ±1% ±3% ±5%
- Alternating Current: 20...50 V
- DC power: 20...50 V

The fundamental constants and characteristics are shown in the figure above.

Type: Type 124 also applies to Type 123

- Printed by a machine
VOLTAGE REGULATOR
7-PIN MINIATURE, 75-VOLT, GLOW-DISCHARGE TYPE

GENERAL DATA

Electrical:
Cathode. .................................................. Cold

Mechanical:
Operating Position ................................... Any
Maximum Overall Length ........................... 2.63"
Maximum Seated Length ............................ 2.38"
Length, Base Seat to Bulb Top (Excluding tip) 2.00" ± 0.09"
Maximum Diameter .................................. 0.75"
Dimensional Outline ................................. See General Section
Bulb ...................................................... T5-1/2
Base ....................................................... Small-Button Miniature 7-Pin (JETEC No.E7-1)
Basing Designation for BOTTOM VIEW. ........ SBO

Pin 1—Anode .............................. Pin 5—Anode
Pin 2—Cathode .............................. Pin 6—Internal Connection—Do Not Use
Pin 3—Internal Connection—Do Not Use  Pin 7—Cathode

Maximum and Minimum Ratings, Absolute Values:
AVERAGE STARTING CURRENT: .............................. 75 max. ma
DC CATHODE CURRENT: ................................. 30 max. ma
FREQUENCY: .................................................. 0 max. cps
AMBIENT—TEMPERATURE RANGE: ..................... -55 to +90 °C

Maximum Circuit Values:
Shunt Capacitance: ......................................... 0.1 max. µf

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode—Supply Voltage.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Breakdown Voltage:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under total darkness</td>
<td></td>
<td></td>
<td>145**</td>
</tr>
<tr>
<td>Under normal ambient light conditions</td>
<td>105</td>
<td>115**</td>
<td></td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td>68*</td>
<td>75</td>
<td>83</td>
</tr>
<tr>
<td>Regulation (5 to 30 ma.)</td>
<td>3</td>
<td>4.5</td>
<td></td>
</tr>
</tbody>
</table>

* Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

** The minimum value to insure "starting" throughout tube life must be equal to the anode breakdown voltage plus the voltage drop across the series resistor at the maximum value of the load current.

Minimum individual tube value during useful life.

Minimum individual tube value during useful life.
VOLTAGE REGULATOR

OPERATING CONSIDERATIONS

Sufficient resistance must always be used in series with the OC2 to limit the current through the tube.

The value for the series resistor is dependent on the dc supply voltage, anode voltage drop, load current, and cathode current and should be chosen to limit the operating current through the tube to 30 milliamperes at all times after the starting period.
**VOLTAGE REGULATOR**

**GLOW-DISCHARGE TYPE**

**GENERAL DATA**

### Electrical:
- Cathode: Cold

### Mechanical:
- Mounting Position: Any
- Maximum Overall Length: 4-1/8" ± 3/16"
- Seated Length: 3-3/8" ± 3/16"
- Maximum Diameter: 1-9/16"
- Weight (Approx.): 1.3 oz

**Bulb**:
- Small-Shell Octal 6-Pin (JETEC No.B6-3)

**Basing Designation for BOTTOM VIEW**:
- Pin 1—No Connection
- Pin 2—Cathode
- Pin 3—Jumper
- Pin 5—Anode
- Pin 7—Jumper
- Pin 8—No Connection

**Characteristics Range Values for Equipment Design**

<table>
<thead>
<tr>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode-Supply Voltage</td>
<td>135°</td>
<td></td>
</tr>
<tr>
<td>Anode Breakdown Voltage</td>
<td>115</td>
<td>133°</td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td>103°</td>
<td>108</td>
</tr>
<tr>
<td>Regulation (5 to 40 ma)</td>
<td>2</td>
<td>4°</td>
</tr>
</tbody>
</table>

*With suitable socket connections, jumper within base acts as a switch to open power-supply circuit when voltage regulator tube is removed from socket.

*Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

*Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

*Maximum individual tube value during useful life.

*Minimum individual tube value during useful life.

The operating considerations and circuit information shown under Type 0A3 also apply to Type OC3

---

**Tube Division**

**Corporation of America, Harrison, New Jersey**
## GENERAL DATA

### Electrical:
- **Cathode**: Cold

### Mechanical:
- **Mounting Position**: Any
- **Maximum Overall Length**: 4-1/8"
- **Seated Length**: 3-3/8" ± 3/16"
- **Maximum Diameter**: 1-9/16"
- **Dimensional Outline**: See General Section
- **Weight (Approx.)**: 1.3 oz
- **Bulb**: ST-12

### Base
- **Small-Shell Octal 6-Pin**: [JETEC No. B6-3)

### Basing Designation for BOTTOM VIEW
- **Pin 1 - No Connection**
- **Pin 2 - Cathode**
- **Pin 3 - Jumper**
- **Pin 5 - Anode**
- **Pin 7 - Jumper**
- **Pin 8 - No Connection**

### Pin Layout Diagram

#### Maximum and Minimum Ratings, Absolute Values:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AVERAGE STARTING CURRENT</strong></td>
<td>100 max.</td>
<td>ma</td>
<td></td>
</tr>
<tr>
<td><strong>DC CATHODE CURRENT</strong></td>
<td>40 max.</td>
<td>ma</td>
<td>5 min.</td>
</tr>
<tr>
<td><strong>FREQUENCY</strong></td>
<td>0 max.</td>
<td>cps</td>
<td></td>
</tr>
<tr>
<td><strong>AMBIENT-TEMPERATURE RANGE</strong></td>
<td>-55 to +90°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Circuit Values:
- **Shunt Capacitor**: 0.1 max. μf
- **Series Resistor**: See note below

### CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode-Supply Voltage</td>
<td>185 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Breakdown Voltage</td>
<td>160 to 185 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td>142 volts</td>
<td>153</td>
<td>165 volts</td>
</tr>
<tr>
<td>Regulation (5 to 40 ma)</td>
<td>4</td>
<td>5.5 volts</td>
<td></td>
</tr>
</tbody>
</table>

*With suitable socket connections, jumper within base acts as a switch to open power-supply circuit when voltage regulator tube is removed from socket.*

Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady state operating condition of at least 20 minutes, or tube performance will be impaired.

- *Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.*
- *Maximum individual tube value during useful life.*
- *Minimum individual tube value during useful life.*

The operating considerations and circuit information shown under Type 0A3 also apply to Type 0D3

[Indicates a change.]

---

4-56 TUBE DIVISION
MAMO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
Voltage-Regulator

GLOW-DISCHARGE TYPE  105 VOLTS

For Applications Requiring a Relatively Constant DC Output Voltage, Independent of Load and Supply-Voltage Variations

Mechanical:
- Operating Position: Any
- Type of Cathode: Cold
- Maximum Overall Length: 3-1/16"
- Maximum Seated Length: 2-1/2"
- Maximum Diameter: 1-9/32"
- Dimensional Outline: See General Section
- Bulb: Intermediate-Shell Octal 6-Pin, Arrangement 1 (JEDEC Group 1, No.B6-8)
- Base: Intermediate-Shell Octal 6-Pin, Arrangement 1

Basing Designation for BOTTOM VIEW: 4AJ

Pin 1 - No Internal Connection
Pin 2 - Cathode
Pin 3 - Jumper
Pin 5 - Anode
Pin 7 - Jumper
Pin 8 - No Internal Connection

VOLTAGE REGULATOR

Maximum and Minimum Ratings, Absolute-Maximum Values:
- Average Cathode Starting Current \( \geq 100 \text{ max. ma} \)
- DC Cathode Current: \( \leq 40 \text{ max. ma} \)
- DC or AC Jumper Current: \( \leq 2 \text{ max. amp} \)
- Ambient-Temperature Range: \(-55 \text{ to } +90 ^\circ C\)

Circuit Values:
- Shunt Capacitor: \(0.1 \text{ max. } \mu F\)
- Series Resistor: See Operating Considerations

With suitable socket connections, the jumper within the tube base (between pins 3 and 7) provides for opening the power-supply circuit to protect circuit components when the voltage-regulator tube is removed from its socket.

Averaged over starting period not exceeding 10 seconds. When starting currents greatly in excess of the maximum dc-cathode-current rating of 40 milliamperes are encountered, it may be necessary to operate these tubes as much as 20 minutes under steady-state conditions to assure stable operation.
### DC Anode Supply Voltage

<table>
<thead>
<tr>
<th>Note</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See Note 1

### DC Anode Starting Voltage in:

- **Total darkness**  
  -  210 volts
- **Normal ambient light**  
  - (5 to 50 footcandles)  
  -  115 127 volts

### Anode Voltage Drop

- for dc cathode current of:
  -  5 ma.  
    -  105 volts
  -  30 ma.  
    -  105 109 111 volts
  -  40 ma.  
    -  105 110 112 volts

### Regulation for dc-cathode-current range of:

-  5 to 30 ma.  
  -  105 2 volts
-  5 to 40 ma.  
  -  105 4 volts

### Tube Noise for dc cathode current of:

-  40 ma.  
  -  15 rms mv

### DC Leakage Current

- for dc anode supply voltage of 50 volts and anode resistor of 3000 ohms  
  -  10 µa

---

**Note 1:** The minimum value to insure starting throughout useful tube life must be equal to the dc anode starting voltage plus the voltage drop across the series resistor at the maximum value of the load current.

**Note 2:** The maximum values for the specified regulation range apply throughout useful tube life.

**OPERATING CONSIDERATIONS**

- **shown under Type OA3A also apply to the OC3A**
Voltage-Regulator

GLOW-DISCHARGE TYPE

For Applications Requiring a Relatively Constant DC Output Voltage, Independent of Load and Supply-Voltage Variations

Mechanical:

Operating Position ....................................... Any
Type of Cathode ............................................. Cold
Maximum Overall Length .................................. 3-1/16"
Maximum Seated Length ................................. 2-1/2"
Maximum Diameter ................................. 1-9/32"
Dimensional Outline .............................. See General Section
Bulb .................................................. Intermediate-Shell Octal 6-Pin, Arrangement 1
Base ....................................... Intermediate-Shell Octal 6-Pin, Arrangement 1

Basing Designation for BOTTOM VIEW. ................. 4AJ

Pin 1—No Internal Connection
Pin 2—Cathode
Pin 3—Jumper
Pin 5—Anode
Pin 7—Jumper
Pin 8—No Internal Connection

VOLTAGE REGULATOR

Maximum and Minimum Ratings, Absolute-Maximum Values:

Average Cathode Starting Current \( b \) ........... 100 max. \( \text{ma} \)
DC Cathode Current .................................. \{ 40 max. \( \text{ma} \)
\{ 5 min. \( \text{ma} \)
DC or AC Jumper Current ............................... 2 max. \( \text{amp} \)
Ambient-Temperature Current Range ................ -55 to +90 \( \degree \text{C} \)

Circuit Values:

Shunt Capacitor ....................................... 0.1 max. \( \mu \text{f} \)
Series Resistor ......................................... See Operating Considerations

\( a \) With suitable socket connections, the jumper within the tube base (between pins 3 and 7) provides for opening the power-supply circuit to protect circuit components when the voltage-regulator tube is removed from its socket.

\( b \) Averaged over starting period not exceeding 10 seconds. When starting currents greatly in excess of the maximum dc-cathode-current rating of 40 milliamperes are encountered, it may be necessary to operate these tubes as much as 20 minutes under steady-state conditions to assure stable operation.

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

DATA 10-63
<table>
<thead>
<tr>
<th></th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DC Anode Supply Voltage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total darkness</strong></td>
<td></td>
<td>-</td>
<td>225</td>
</tr>
<tr>
<td><strong>Normal ambient light</strong></td>
<td></td>
<td>-</td>
<td>160</td>
</tr>
<tr>
<td><strong>(5 to 50 footcandles)</strong></td>
<td></td>
<td>-</td>
<td>180</td>
</tr>
<tr>
<td><strong>Anode Voltage Drop</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>for dc cathode current of:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 ma.</td>
<td>145</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>30 ma.</td>
<td>145</td>
<td>149</td>
<td>160</td>
</tr>
<tr>
<td>40 ma.</td>
<td>145</td>
<td>150</td>
<td>162</td>
</tr>
<tr>
<td><strong>Regulation for dc-cathode-current range of:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 to 30 ma.</td>
<td>2</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>5 to 40 ma.</td>
<td>2</td>
<td>-</td>
<td>5.5</td>
</tr>
<tr>
<td><strong>Tube Noise for dc cathode current of:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40 ma.</td>
<td>-</td>
<td>-</td>
<td>15</td>
</tr>
<tr>
<td><strong>DC Leakage Current</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>for dc anode supply voltage</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of 50 volts and anode resistor of 3000 ohms</td>
<td>-</td>
<td>-</td>
<td>10</td>
</tr>
</tbody>
</table>

**Note 1:** The minimum value to ensure starting throughout useful tube life must be equal to the dc anode starting voltage plus the voltage drop across the series resistor at the maximum value of the load current.

**Note 2:** The maximum values for the specified regulation range apply throughout useful tube life.

**OPERATING CONSIDERATIONS** shown under Type OA3A also apply to the OD3A.
IC21
GAS-TRIODE
COLD-CATHODE GLOW-DISCHARGE TYPE

Maximum Overall Length  2-5/8"
Maximum Seated Height   2-1/16"
Maximum Diameter        1-5/16"
Bulb                    T-9
Base                    Intermediate Sh. Octal 6-Pin
Pin 1-No Connection    Pin 7-Grid
Pin 2-Cathode          Pin 8-No Connection
Pin 3-No Connection    • Gas Tube Type
Pin 5-Anode
Mounting Position      BOTTOM VIEW (G-4V)

Any

CHARACTERISTICS

Peak Anode Breakdown Voltage (Grid tied to cathode)  180 min. volts
Peak Positive Grid Breakdown Voltage                 66 min. volts
D-C Anode Extinction Voltage                         80 max. volts
Grid Current (For transition of discharge to anode at 100 volts peak) 25 av. approx. volts
Anode Voltage-Drop                                     50 max. μamp.
Grid Voltage-Drop                                      73 approx. volts
                                   55 approx. volts

Maximum Ratings Are Design-Center Values

MAXIMUM RATINGS

Peak Cathode Current                                  100 max. ma.
D-C Cathode Current                                    25 max. ma.
Typical Operation as Relay Tube:
D-C Anode-Supply Voltage                               125 - 145 volts
Peak Positive Grid-Bias Voltage                        66 max. volts
Peak Grid-Signal Voltage                               40 min. volts
Sum of Grid-Bias and Grid-Signal Voltages (Peak)      100 min. volts
D-C Grid Current                                       100 μamp.

Dec. 1, 1942  RCA RADIOFROTON DIVISION
              RCA MANUFACTURING COMPANY, INC.

TENTATIVE DATA
GAS-TRIODE

AVERAGE TRANSITION CHARACTERISTIC

TYPE IC21

GRID MICROAMPERES (D-C)

ANODE VOLTS (D-C)

200
200
150
100
50

20 40 60 80 100

ANODE MILLIAMPERES (INSTANTANEOUS)

92C-6419RI

ANODE VOLTS (INSTANTANEOUS)

+100
+20 +40 +60 +80

-40 -20

-100

-200

Dec. 1, 1942

RCA RADIOTRON DIVISION

RCA MANUFACTURING COMPANY, INC.
2D22
THYRATRON
GAS TETRODE, MINIATURE TYPE

GENERAL DATA

**Electrical:**

- Heaters, for Unipotential Cathode: Min. 5.7, Avg. 6.3, Max. 6.9 volts
- Voltage (AC or DC): Current, with heater volts = 6.3 0.54, 0.60, 0.66 amp

**Cathode:**

- Heating Time, prior to tube conduction: 10 sec

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

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Value (μf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid No. 1 to Anode</td>
<td>0.026</td>
</tr>
<tr>
<td>Input</td>
<td>2.4</td>
</tr>
<tr>
<td>Output</td>
<td>1.6</td>
</tr>
</tbody>
</table>

**Ionization Time (Approx.):**

- For conditions: dc anode volts = 100; grid-No. 1 square-pulse volts = 50; peak anode amp. during conduction = 0.5

**Deionization Time (Approx.):**

- For conditions: dc anode volts = 125; grid-No. 1 volts = -100, grid-No. 1 resistor (ohms) = 1000; dc anode amp. = 0.1
- For conditions: dc anode volts = 125; grid-No. 1 volts = -10; grid-No. 1 resistor (ohms) = 1000; dc anode amp. = 0.1

**Maximum Critical Grid Current, with ac anode-supply volts (rms) = 460, and average anode amp. = 0.1**

**Anode Voltage Drop (Approx.):**

- 8 volts

**Grid-No. 1 Control Ratio (Approx.):**

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>with grid-No. 1 resistor (megohms) = 0; grid-No. 2 volts = 0</td>
<td>250</td>
</tr>
<tr>
<td>with grid-No. 1 resistor (megohms) = 0; grid-No. 2 resistor (megohms) = 0; grid-No. 1 volts = 0</td>
<td>1000</td>
</tr>
</tbody>
</table>

**Mechanical:**

- Mounting Position: Any
- Maximum Overall Length: 2-1/8"
- Maximum Seated Length: 1-7/8"
- Length, Base Seat to Bulb Top (excluding tip): 1-1/2" ± 3/32"
- Maximum Diameter: 3/4"
- Bulb: T-5-1/2
- Base: Small-Button Miniature 7-Pin

**Basing Designation for BOTTOM VIEW:** 7BN

**Pin Assignments:**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grid No. 1</td>
</tr>
<tr>
<td>2</td>
<td>Cathode</td>
</tr>
<tr>
<td>3</td>
<td>Heater</td>
</tr>
<tr>
<td>4</td>
<td>Pin 5</td>
</tr>
<tr>
<td>5</td>
<td>Anode</td>
</tr>
<tr>
<td>6</td>
<td>Pin 7</td>
</tr>
</tbody>
</table>

*Without external shield.*

---

JUNE 15, 1948

TUBE DEPARTMENT

Data page includes a change.
### Maximum Ratings, Absolute Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Anode Voltage:</td>
<td></td>
</tr>
<tr>
<td>Forward</td>
<td>650 max. volts</td>
</tr>
<tr>
<td>Inverse</td>
<td>1300 max. volts</td>
</tr>
<tr>
<td>Grid-No.2 (Shield-Grid) Voltage:</td>
<td></td>
</tr>
<tr>
<td>Peak, before anode conduction</td>
<td>-100 max. volts</td>
</tr>
<tr>
<td>Average, during anode conduction</td>
<td>-10 max. volts</td>
</tr>
<tr>
<td>Grid-No.1 (Control-Grid) Voltage:</td>
<td></td>
</tr>
<tr>
<td>Peak, before anode conduction</td>
<td>-100 max. volts</td>
</tr>
<tr>
<td>Average, during anode conduction</td>
<td>-10 max. volts</td>
</tr>
<tr>
<td>Cathode Current:</td>
<td></td>
</tr>
<tr>
<td>Peak</td>
<td>0.5 max. amp</td>
</tr>
<tr>
<td>Average</td>
<td>0.1 max. amp</td>
</tr>
<tr>
<td>Surge, for duration of 0.1 sec. max.</td>
<td>10 max. amp</td>
</tr>
<tr>
<td>Grid-No.2 Current:</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>+0.01 max. amp</td>
</tr>
<tr>
<td>Grid-No.1 Current:</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>+0.01 max. amp</td>
</tr>
<tr>
<td>Peak Heater-Cathode Voltage:</td>
<td></td>
</tr>
<tr>
<td>Heater negative with respect to cathode</td>
<td>100 max. volts</td>
</tr>
<tr>
<td>Heater positive with respect to cathode</td>
<td>25 max. volts</td>
</tr>
<tr>
<td>Ambient Temperature Range:</td>
<td>-75 to -90 °C</td>
</tr>
</tbody>
</table>

### Typical Operating Conditions for Relay Service:

<table>
<thead>
<tr>
<th>Voltage Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS Anode Voltage</td>
<td>117 400 volts</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>0 0 volts</td>
</tr>
<tr>
<td>RMS Grid-No.1 Bias Voltage</td>
<td>5 - volts</td>
</tr>
<tr>
<td>DC Grid-No.1 Bias Voltage</td>
<td>- -6 volts</td>
</tr>
<tr>
<td>Peak Grid-No.1 Signal Voltage</td>
<td>5 6 volts</td>
</tr>
<tr>
<td>Grid-No.1-Circuit Resistance</td>
<td>1.0 1.0 megohm</td>
</tr>
<tr>
<td>Anode-Circuit Resistance</td>
<td>1200 2000 ohms</td>
</tr>
</tbody>
</table>

### Maximum Circuit Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid-No.1-Circuit Resistance</td>
<td>10 max. megohms</td>
</tr>
</tbody>
</table>

- *Averaged over any interval of 30 sec. max.*
- *Approximately 180° out of phase with the anode voltage.*
- *Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.*
- *Indicates a change.*
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

TYPE 2D21 SHIELD-GRID VOLTS=0
RANGES SHOWN ARE FOR TWO VALUES OF GRID RESISTOR - 0.1 MEG. AND 10 MEG. - AND TAKE INTO ACCOUNT INITIAL DIFFERENCES BETWEEN INDIVIDUAL TUBES & SUBSEQUENT DIFFERENCES DURING TUBE LIFE, FOR A HEATER-VOLTAGE RANGE OF 5.7 TO 6.9 VOLTS

Range for 10 Megohms
Range for 0.1 Megohm

AC ANODE VOLTS (RMS-60°)

DC GRID-N°1 SUPPLY VOLTS

92CM-6534T2
AVERAGE GRID CHARACTERISTICS
BEFORE ANODE CONDUCTION

Type 2D21

$E_f = 6.3$ VOLTS

SHIELD-GRID VOLTS = 0

$g = \text{CONDUCTION STARTS}$

D-C ANODE VOLTS = 25

D-C CONTROL-GRID VOLTS

AVERAGE GRID CHARACTERISTICS
DURING ANODE CONDUCTION

Type 2D21

$E_f = 6.3$ VOLTS

SHIELD-GRID VOLTS = 0

D-C ANODE MA. = 25

D-C CONTROL-GRID MILLIAMPERES

APRIL 1, 1944

RCA VICTOR DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
# GAS-AND-MERCURY-VAPOR THYRATRON
## NEGATIVE-CONTROL TRIODE TYPE

### GENERAL DATA

#### Electrical:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament, Coated</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>$2.5 \pm 5%$ ac or dc volts</td>
</tr>
<tr>
<td>Current at 2.5 volts</td>
<td>7 amp</td>
</tr>
<tr>
<td>Minimum heating time prior to tube conduction</td>
<td>15 sec</td>
</tr>
<tr>
<td>Direct Inter-electrode Capacitance (Approx.)</td>
<td>1.8 μF</td>
</tr>
<tr>
<td>Ionization Time (Approx.)</td>
<td></td>
</tr>
<tr>
<td>For conditions: dc anode volts = 100, peak grid volts = +30, and peak anode amperes = 6</td>
<td>3 μsec</td>
</tr>
<tr>
<td>Deionization Time (Approx.)</td>
<td></td>
</tr>
<tr>
<td>For conditions: dc anode volts = 120, dc grid-supply volts = -20, grid resistor (ohms) = 10000, and dc anode amperes = 1.5</td>
<td>360 μsec</td>
</tr>
<tr>
<td>Anode Voltage Drop (Approx.)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15 volts</td>
</tr>
</tbody>
</table>

#### Mechanical:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting Position</td>
<td>Vertical, base down</td>
</tr>
<tr>
<td>Maximum Overall Length</td>
<td>6-1/8&quot;</td>
</tr>
<tr>
<td>Seated Length</td>
<td>5-1/4&quot; ± 1/4&quot;</td>
</tr>
<tr>
<td>Maximum Diameter</td>
<td>2-1/16&quot;</td>
</tr>
<tr>
<td>Cooling</td>
<td>Natural circulation of air around tube</td>
</tr>
<tr>
<td>Weight (Approx.)</td>
<td>3 oz</td>
</tr>
<tr>
<td>Bulb.</td>
<td>ST-16</td>
</tr>
<tr>
<td>Cap.</td>
<td>Medium (JETEC No.C1-5)</td>
</tr>
<tr>
<td>Base.</td>
<td>Medium-Shell Small 4-Pin with Bayonet (JETEC No.A4-10)</td>
</tr>
<tr>
<td>Basing Designation for BOTTOM VIEW</td>
<td>3G</td>
</tr>
</tbody>
</table>

#### Control Service

- Maximum Ratings, Absolute Values: For supply frequency up to 400 c/s
  - Operating Condensed-Mercury Temperature Range
    - $-40^\circ$ to $+100^\circ$C
    - $-40^\circ$ to $+80^\circ$C
- PEAK ANODE VOLTAGE:
  - Forward: 200 max. 1250 max. volts
  - Inverse: 200 max. 1250 max. volts

*without external shield.*

---

**Notes:**
- Indicates a change.
- Pin 1: Filament
- Pin 2: No Connection
- Pin 3: Grid
- Pin 4: Filament Cap-Anode

---

**TUBE DIVISION**

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
GRID VOLTAGE:
Peak or DC, before tube conduction ... -500 max. -500 max. volts
Average*, during tube conduction ... -10 max. -20 max. volts

ANODE CURRENT:
Peak ... 6 max. 6 max. amp
Average* ... 1.5 max. 1.5 max. amp
Fault, for duration of 0.1 second max. ... 120 max. 120 max. amp

GRID CURRENT:
Average* ... +0.01 max. +0.01 max. amp

* Averaged over one conducting period.
* Averaged over any interval of 5 seconds maximum.
* Averaged over period of grid conduction.

Operating Condensed-Mercury Temperature Range
-40° to +100°C -40° to +80°C
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE:  
\( E_f = 2.5 \text{ VOLTS AC} \pm 5\% \)  CIRCUIT RETURNS TO CENTER TAP OF FILAMENT TRANSFORMER. THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES. GRID RESITOR = 0 TO 100000 OHMS. CONDENSED-MERCURY TEMPERATURE = -40°C TO +80°C.

CONDUCTING

CRITICAL

NON-CONDUCTING

DC GRID-SUPPLY VOLTS

92CS-6703T2
HYDROGEN THYRATRON
POSITIVE-CONTROL, TRIODE TYPE

GENERAL DATA

Electrical:
Heater, for Unipotential Cathode:
Voltage ................. 6.3 +5% -10% ac or dc volts
Current at 6.3 volts:
  Minimum ............... 2.0 amp
  Average ............... 2.3 amp
  Maximum ............... 2.5 amp
Minimum Heating Time .... 2 minutes
Direct Interelectrode Capacitances (Approx.):
  Grid to Anode .......... 3.9 µf
  Grid to Cathode ......... 8.6 µf
Ionization Time (Approx.) .... 0.6 µsec
Deionization Time (Approx.) .... 25 µsec
Anode-Cathode Voltage Drop (Approx.):
  At middle of pulse duration .... 150 volts
Maximum Variation in Firing Time (Jitter) .... 0.06 µsec

Mechanical:
Operating Position ....... Any
Overall Length ............ 4-3/4" ± 1/4"
Seated Length ............. 4-1/8" ± 1/4"
Maximum Diameter ........ 1-9/16"
Bulb ....................... T-12
Cap ........................ Small (JETEC No.C1-1)
Base ...................... Medium-Shell Small 4-Pin, Micanol (JETEC No.A4-9)

Cooling .................... Natural

PULSE MODULATOR SERVICE

Maximum and Minimum CCS® Ratings, Absolute Values:
DC ANODE-SUPPLY VOLTAGE ........ 800 min. volts

Defined as the time interval between the point on the rising portion of the grid pulse which is 26% of the peak unloaded pulse amplitude and the point on the anode-current pulse which is 26% of its peak amplitude. The anode-current pulse has a time rise of 0.05 microsecond maximum. The grid pulse has a peak amplitude of 130 volts minimum, has a rise time of 0.5 microsecond maximum, and is supplied by a driver having 1500 ohms maximum internal impedance.

Continuous Commercial Service.

SEPT. 1, 1952
TUBE DEPARTMENT
TENTATIVE DATA 1
RCA CORPORATION OF AMERICA, MATERION, NEW JERSEY
PEAK ANODE VOLTAGE:

Forward (Emf)* .................................. 3000 max. volts
Inverse ........................................... 5% of Emf min. volts

After anode—current pulse:
During first 25 µsec ................................ 1500 max. volts
After first 25 µsec ................................ 3000 max. volts

GRID VOLTAGE:

Negative (DC or Peak), before conduction ......... 200 max. volts
Peak Positive Pulse .................................. 175 min. volts

ANODE CURRENT:

Peak .................................................. 35 max. amp
Average* ........................................... 0.045 max. amp
Rate of Rise ........................................ 750 max. amp/µsec

OPERATION FACTOR* ................................ 3 x 10^6 max.

PULSE DURATION* ................................... 6 max. µsec

AMBIENT TEMPERATURE ................................ -50 to +90 °C

**Typical Operation at 2000 pps in Circuit of Fig.1:**

Pulse Duration
of 0.5 µsec

DC Anode—Supply Voltage ......................... 1250 volts
Peak Anode Voltage:
Forward ............................................. 3000 volts
Inverse: Immediately after anode—
current pulse ...................................... 530 volts

Grid Voltage:

Negative, before conduction ...................... 0 volts
Peak Positive Pulse (Unloaded) .................... 175 volts

Effective Grid—Circuit Resistance .............. 1000 ohms

Anode Current:

Peak .................................................. 35 amp
Average* ........................................... 0.035 amp

Operation Factor* ................................ 2.1 x 10^8

Peak Power Output to Pulse Transformer (T) .... 43000 watts

Maximum Circuit Values:

Effective Grid—Circuit Resistance .............. 1500 max. ohms

* In applications where the anode voltage is applied instantaneously, the
power-supply filter should be designed so that the peak forward anode
voltage is applied at a rate not to exceed 75000 volts per second.

† Exclusive of spike not having more than 0.05 microsecond duration.

‡ Operation with a bulb temperature within the approximate range of 60°
to 90°C measured on the bulb directly opposite the anode is recommended
for longest life. To attain this temperature under operating conditions
involving low ambient temperature, the use of a heat-conserving enclo-
sure for the tube may be necessary.

* Averaged over any cycle.

SEP. 1, 1952 TENTATIVE DATA 1
HYDROGEN THYRATRON

† Defined as Peak Forward Anode Volts x Pulse Repetition Rate (pps) x Peak Anode Amperes (excluding spike).

Pulse duration is defined as the time interval between points on the pulse envelope at which instantaneous amplitudes are equal to 70.7% of the maximum amplitude excluding spike.

OPERATING CONSIDERATIONS

The ambient-temperature operating range for the 3C45 extends from -50°C to +90°C (-58°F to +194°F). Within this range, there is no appreciable effect on the electrical characteristics of the tube. However, for longest life, it is recommended that the tube be operated with a bulb temperature within the approximate range of 60°C to 90°C (140°F to 194°F). Under no circumstances should a stream of cooling air be applied to the glass envelope.

The Connector for the anode cap should be of the heat-radiating type and should have ample current-carrying capability for the operating requirements.

**Fig. 1 - Typical Pulse-Modulator Circuit**

Operating at 2000 pps.

![Schematic Diagram]

- C: Blocking Capacitor, 0.001 μF
- Cg: Pulse Generator supplying peak positive pulse grid voltage of 175 volts (unloaded)
- L: Charging Choke, 5 henries
- PFN: Pulse-Forming Network with iterative impedance of 50 ohms, and a two-way transmission time of 0.5 microsecond
- R1: Grid Resistor, 30000 ohms
- R2: Effective Resistance of grid circuit, 1000 ohms
- RL: Load Resistance, value reflected into primary of transformer (T) is 35 ohms.

SEPT. 1, 1952

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.

SEPT. 1, 1952  TUBE DEPARTMENT  CE-7757
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
**XENON THYRATRON**

**NEGATIVE-CONTROL TRIODE TYPE**

### GENERAL DATA

#### Electrical:

<table>
<thead>
<tr>
<th>Property</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament, Coated:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>2.4</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Current at 2.5 volts</td>
<td>5.5</td>
<td>6.3</td>
<td>7.1</td>
</tr>
<tr>
<td>Minimum heating time prior to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tube conduction</td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitances (Approx.):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid to anode</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Grid to cathode</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Maximum Deionization Time</td>
<td></td>
<td></td>
<td>500</td>
</tr>
<tr>
<td>Maximum Critical Grid Current</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum, at end of life</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Maximum, at end of life</td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Maximum Commutation Factor,</td>
<td></td>
<td></td>
<td>0.15</td>
</tr>
<tr>
<td>averaged over first 500 volts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>of inverse anode voltage rise</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid Control Ratio (Approx.):</td>
<td></td>
<td></td>
<td>230</td>
</tr>
</tbody>
</table>

#### Mechanical:

- Mounting Position: Any
- Maximum Overall Length: 4-1/4" (107.2 mm)
- Maximum Diameter: 1-9/16" (41.8 mm)
- Weight (Approx.): 3 oz
- Bulb: Medium-Metal-Shelf Small 4-Pin with Bayonet (JETEC No. A4-89)
- Basing Designation for BOTTOM VIEW: 4D

**GRID-CONTROLLED RECTIFIER SERVICE**

**Maximum Ratings, Absolute Values:**

- **PEAK ANODE VOLTAGE:**
  - Forward: 1000 max. volts
  - Inverse: 1250 max. volts
- **GRID VOLTAGE:**
  - Peak, before tube conduction: \(-100\) max. volts

*Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.*
### ANODE CURRENT:

<table>
<thead>
<tr>
<th>Peak</th>
<th>8 max. amp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>1 max. amp</td>
</tr>
</tbody>
</table>

Overload*, for duration of

| 0.56 sec. | 8 max. amp |
| 1 sec.    | 4.5 max. amp |
| 2 sec.    | 2.25 max. amp |
| 3 sec.    | 1.5 max. amp |
| 4 sec.    | 1.13 max. amp |

Fault, for duration of 0.1 second maximum...

| 77 max. amp |

AMBIENT-TEMPERATURE RANGE...

-55 to +75 °C

* Averaged over any period of 4.5 seconds.

* Averaged for duration of overload occurring no more than once in any period of 4.5 seconds.

### OPERATING CONSIDERATIONS

Circuit returns may be made to either side of filament or to transformer center-tap.

The anode of the C1K/6014 may show a red color when the tube is operated at full load.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE:
E_f = 2.5 VOLTS AC ± 5%; CIRCUIT RETURNS TO FILAMENT TRANSFORMER CENTER-TAP. THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES, GRID RESISTOR = 0 TO 10000 OHMS. AMBIENT-TEMPERATURE RANGE = -55 TO +75°C.
**GENERAL DATA**

**Electrical:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament, Coated and Mid-tapped:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage between pins 1 and 4</td>
<td>2.4</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Current at 2.5 volts</td>
<td>7</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>Minimum heating time prior to tube conduction</td>
<td>30 sec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Interelectrode Capacitances (Approx.):</td>
<td>2 µf</td>
<td>14 µf</td>
<td></td>
</tr>
<tr>
<td>Maximum Deionization Time</td>
<td>1000 µsec</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Critical Grid Current</td>
<td>10 µamp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Voltage Drop:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average, at beginning of life</td>
<td>10 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum, at end of life</td>
<td>14 volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Commutation Factor, averaged over first 350 volts of inverse anode voltage rise</td>
<td>0.66 va/µs²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid Control Ratio (Approx.):</td>
<td>200</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Mechanical:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting Position</td>
<td>Any</td>
</tr>
<tr>
<td>Maximum Overall Length</td>
<td>6&quot;</td>
</tr>
<tr>
<td>Maximum Diameter</td>
<td>1-9/16&quot;</td>
</tr>
<tr>
<td>Weight (Approx.)</td>
<td>3 oz</td>
</tr>
<tr>
<td>Cap</td>
<td>Medium (JETEC No.C1-5)</td>
</tr>
<tr>
<td>Bulb</td>
<td>T-12</td>
</tr>
<tr>
<td>Base</td>
<td>Medium-Metal-Shell Small 4-Pin with Bayonet (JETEC No.A4-89)</td>
</tr>
</tbody>
</table>

**Basing Designation for BOTTOM VIEW:**

- Pin 1 - Filament
- Pin 2 - Filament Mid-Tap & Circuit Returns
- Pin 3 - Grid Cap-Anode
- Pin 4 - Filament Cap - Anode

**GRID-CONTROLLED RECTIFIER SERVICE**

**Maximum Ratings, Absolute Values:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK ANODE VOLTAGE:</td>
<td></td>
</tr>
<tr>
<td>Forward</td>
<td>900 max. volts</td>
</tr>
<tr>
<td>Inverse</td>
<td>1250 max. volts</td>
</tr>
</tbody>
</table>

*Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.*
GRID VOLTAGE:
  Peak, before tube conduction... -100 max. volts
ANODE CURRENT:
  Peak... 30 max. amp
  Average... 2.5 max. amp
Overload:
  Rating I*, for duration of...
      0.37 sec... 30 max. amp
      0.50 sec... 22.5 max. amp
  Rating II**, for duration of...
      1 sec... 11.25 max. amp
      2 sec... 5.63 max. amp
      3 sec... 3.75 max. amp
      4 sec... 2.82 max. amp
      3 sec... 3.75 max. amp
      4 sec... 3.40 max. amp
      4.5 sec... 3.30 max. amp
Fault, for duration of 0.1 second maximum... 300 max. amp
AMBIENT-TEMPERATURE RANGE... -55 to +75 °C

* Averaged over any period of 4.5 seconds.
** Averaged over duration of overload occurring no more than once in any period of 30 seconds.

OPERATING CONSIDERATIONS

Circuit returns should be connected to filament mid-tap (pin 2).
The anode of the C37/5632 may show a red color when the tube is operated at full load.
Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.
**XENON THYRATRON**

**OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE**

RANGE IS FOR CONDITIONS WHERE:
- $E_p = 2.5\text{ VOLTS} \pm 5\%$; CIRCUIT RETURNS AND PIN 2 CONNECTED TO FILAMENT TRANSFORMER CENTER-TAP.
- THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES, GRID RESISTOR = 0 TO 10000 OHMS. AMBIENT-TEMPERATURE RANGE = -55 TO 75°C.

**Diagram**

- Conducting
- Non-conducting

<table>
<thead>
<tr>
<th>DC Grid Supply Volts</th>
<th>DC Anode Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>-12</td>
<td>100</td>
</tr>
<tr>
<td>-6</td>
<td>200</td>
</tr>
<tr>
<td>0</td>
<td>300</td>
</tr>
<tr>
<td>+6</td>
<td>400</td>
</tr>
<tr>
<td>100</td>
<td>500</td>
</tr>
<tr>
<td>200</td>
<td>600</td>
</tr>
<tr>
<td>300</td>
<td>700</td>
</tr>
<tr>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>500</td>
<td>900</td>
</tr>
</tbody>
</table>

TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
C3J-A/5684
XENON THYRATRON
NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:
Filament, Coated and
Mid-tapped:
Voltage between pins 1 and 4 .......... 2.4 2.5 2.6 ac or dc volts
Current at 2.5 volts .......... 7 9 11 amp
Minimum heating time prior to tube conduction .......... 30 sec
Direct Inter-electrode Capacitances (Approx.):
Grid to anode .......... 2 µf
Grid to cathode .......... 14 µf
Maximum Deionization Time .......... 1000 µsec
Maximum Critical Grid Current .......... 10 µamp
Anode Voltage Drop:
Average, at beginning of life .......... 10 volts
Maximum, at end of life .......... 14 volts
Maximum Commutation Factor:
averaged over first 350 volts of inverse anode voltage rise .......... 0.66 va/µs²
Grid Control Ratio (Approx.):
For conditions: 10000-ohm grid resistor, circuit returns to filament mid-tap, dc anode voltage, and dc grid voltage .......... 200

Mechanical:
Mounting Position .......... Any
Maximum Overall Length .......... 6"
Maximum Diameter .......... 1-9/16"
Weight (Approx.) .......... Medium (JETEC No.C1-5)
Bulb .......... Medium-Metal-Shell Small 4-Pin with Bayonet (JETEC No.A4-89)
Base .......... 4CF

Basing Designation for BOTTOM VIEW .......... 4CF

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, Absolute Values:
PEAK ANODE VOLTAGE:
Forward .......... 1000 max. volts
Inverse .......... 1250 max. volts
\[\text{defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.}\]
**GRID VOLTAGE:**
Peak, before tube conduction ....... -100 max. volts

**ANODE CURRENT:**
Peak .................................. 30 max. amp
Average* ........................... 2.5 max. amp

**Overload:**

<table>
<thead>
<tr>
<th>Rating I*, for duration of</th>
<th>0.37 sec</th>
<th>0.50 sec</th>
<th>1 sec</th>
<th>2 sec</th>
<th>3 sec</th>
<th>4 sec</th>
<th>3 sec</th>
<th>4 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 max. amp</td>
<td>22.5 max. amp</td>
<td>11.25 max. amp</td>
<td>5.63 max. amp</td>
<td>3.75 max. amp</td>
<td>2.82 max. amp</td>
<td>3.75 max. amp</td>
<td>3.40 max. amp</td>
</tr>
</tbody>
</table>

**Rating II**, for duration of

<table>
<thead>
<tr>
<th>Rating II**</th>
<th>3 sec</th>
<th>4 sec</th>
<th>4.5 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 sec</td>
<td>3.75 max. amp</td>
<td>3.40 max. amp</td>
<td>3.30 max. amp</td>
</tr>
<tr>
<td>4 sec</td>
<td>3.75 max. amp</td>
<td>3.40 max. amp</td>
<td>3.30 max. amp</td>
</tr>
<tr>
<td>4.5 sec</td>
<td>3.75 max. amp</td>
<td>3.40 max. amp</td>
<td>3.30 max. amp</td>
</tr>
</tbody>
</table>

**Fault, for duration of 0.1 second maximum** ....... 300 max. amp

**AMBIENT-TEMPERATURE RANGE** .................. -55 to +75 °C

* Averaged over any period of 4.5 seconds.
** Averaged over duration of overload occurring no more than once in any period of 30 seconds.

**OPERATING CONSIDERATIONS**

Circuit returns should be connected to filament mid-tap (pin 2).

The anode of the C3J-A/5684 may show a red color when the tube is operated at full load.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE:

- $E_F = 2.5 \text{ VOLTS} \pm 5\%$
- CIRCUIT RETURN AND PIN 2 CONNECTED TO FILAMENT TRANSFORMER CENTER-TAP.
- THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES.

GRID RESISTOR = 0 TO 10000 OHMS.
AMBIENT-TEMPERATURE RANGE = -55 TO 75°C.

DC GRID SUPPLY VOLTAGE
92C5-9112T

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
Xenon Thyratron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

<table>
<thead>
<tr>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filament, Coated and Mid-Tapped: Voltage (AC or DC) between pins 2 and 3.</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>Current</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Minimum heating time prior to tube conduction</td>
<td>30 sec</td>
<td></td>
</tr>
</tbody>
</table>

Direct Interelectrode Capacitances (Approx.):

Grid to anode | 2 μf |
Ionization Time (Approx.) | 10 μsec |
Deionization Time (Approx.) | 1000 μsec |
Maximum Critical Grid Current | 10 μa |
Anode Voltage Drop at peak anode amperes = 10. | 10 volts |
Maximum Commutation Factor averaged over first 350 volts of inverse anode-voltage rise | 0.66 va/μsec² |

Mechanical:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Position</td>
<td>Any</td>
<td></td>
</tr>
<tr>
<td>Maximum Overall Length</td>
<td>6-3/4&quot;</td>
<td></td>
</tr>
<tr>
<td>Maximum Seated Length</td>
<td>6&quot;</td>
<td></td>
</tr>
<tr>
<td>Maximum Diameter</td>
<td>2-3/16&quot;</td>
<td></td>
</tr>
<tr>
<td>Weight (Approx.)</td>
<td>Medium (JEDEC No.C1-5)</td>
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</tr>
<tr>
<td>Base</td>
<td>Special Metal Shell</td>
<td></td>
</tr>
</tbody>
</table>

Terminal Diagram:

Pin 1 - Grid
Pin 2 - Filament Tap & Circuit Returns
Pin 3 - Filament
Pin 4 - Filament Cap - Anode

GRID-CONTROLLED-RECTIFIER SERVICE

Maximum and Minimum Ratings, Absolute-Maximum Values:

For anode supply frequency of 60 cps

PEAK ANODE VOLTAGE:

Forward | 900 max. volts |
Inverse | 1250 max. volts |

PEAK NEGATIVE GRID VOLTAGE:

Before tube conduction | 100 max. volts |
During tube conduction | 10 max. volts |
Average ........................................ 2.5 max. amp
Fault ........................................... 300 max. amp

AMBIENT-TEMPERATURE RANGE during operation: -55 to +75 °C

a Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse-voltage rise in volts per microsecond following current conduction.
b Averaged over any period of 4.5 seconds.

OPERATING CONSIDERATIONS

Circuit returns should be connected to filament mid-tap (Pin 4).

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the maximum current ratings of the tube.

OPERATIONAL RANGE
OF CRITICAL GRID VOLTAGE

Ef = 2.5±5% VOLTS

AMBIENT-TEMPERATURE RANGE (°C) = -55 to +75
CIRCUIT RETURNS AND PIN 4 CONNECTED TO FILAMENT-TRANSFORMER CENTER-TAP.
RANGE SHOWN TAKES INTO ACCOUNT INITIAL DIFFERENCES BETWEEN INDIVIDUAL TUBES AND SUBSEQUENT DIFFERENCES DURING TUBE LIFE.
C6J/5C21

XENON THYRATRON
NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

Filament, Coated:
Voltage .................. 2.4 2.5 2.6 ac or dc volts
Current at 2.5 volts. .... 19 21 23 amp
Minimum heating time prior to tube conduction. ..... 60 sec
Direct Interelectrode Capacitances (Approx.):
Grid to anode ................ 4 μF
Grid to cathode ............... 21 μF
Maximum Deionization Time .... 1000 μsec
Maximum Critical Grid Current ... 10 μAmp
Anode Voltage Drop:
Average, at beginning of life .... 9 volts
Maximum, at end of life ....... 12 volts
Maximum Commutation Factor, averaged over first 350 volts of inverse anode voltage rise........... 0.66 va/μs²
Grid Control Ratio (Approx.):
For conditions: 10000-ohm grid resistor, circuit returns to filament transformer center-tap, filament pin 2 negative with respect to filament pin 3 when anode is positive, dc anode voltage, and dc grid voltage ... 210

Mechanical:
Mounting Position .............. Vertical, base down
Maximum Overall Length ........ 9-1/2"
Maximum Diameter ............. 2-1/32"
Weight (Approx.) .............. 7 oz
Cap. ................................ Medium (JETEC No.C1-5)
Bulb. ................................ Medium-Metal-Shell Super-Jumbo 4-Pin (JETEC No.A4-81)
Base. ................................ T-16

Basing Designation for BOTTOM VIEW. .......... 4BZ

Pin 1 - Grid
Pin 2 - Filament
Pin 3 - Filament
Pin 4 - No Connection
Cap - Anode

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, Absolute Values:

PEAK ANODE VOLTAGE:
Forward ..................... 750 max. volts
Inverse ...................... 1250 max. volts

TENTATIVE DATA
C6J/5C21
XENON THYRATRON

<table>
<thead>
<tr>
<th>GRID VOLTAGE:</th>
<th>ANODE CURRENT:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak, before tube conduction.</td>
<td>Peak, before tube conduction.</td>
</tr>
<tr>
<td></td>
<td>-100 max. volts</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>77 max. amp</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6.4 max. amp</td>
</tr>
</tbody>
</table>

Fault, for duration of 0.1 second
maximum 770 max. amp

AMBIENT-TEMPERATURE RANGE -55 to +75 °C

---

**OPERATING CONSIDERATIONS**

The anode of the C6J/5C21 will show a red color when the tube is operated at full load.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

<table>
<thead>
<tr>
<th>Rating I*</th>
<th>Rating II**</th>
</tr>
</thead>
<tbody>
<tr>
<td>duration of</td>
<td>duration of</td>
</tr>
<tr>
<td>0.5 sec.</td>
<td>3 sec.</td>
</tr>
<tr>
<td>1 sec.</td>
<td>4 sec.</td>
</tr>
<tr>
<td>2 sec.</td>
<td>5 sec.</td>
</tr>
<tr>
<td>3 sec.</td>
<td>6 sec.</td>
</tr>
<tr>
<td>4 sec.</td>
<td></td>
</tr>
<tr>
<td>5 sec.</td>
<td></td>
</tr>
</tbody>
</table>

- *Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.
- Averaged over any period of 6 seconds.
- Averaged over duration of overload occurring no more than once in any period of 6 seconds.
- **Averaged over duration of overload occurring no more than once in any period of 30 seconds.
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE: EF = 2.5 VOLTS ± 5%; CIRCUIT RETURNS TO CENTER-TAP OF FILAMENT TRANSFORMER. FILAMENT VOLTAGE AT PIN 2 IS (-) WHEN ANODE VOLTAGE IS (+). THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES. GRID RESISTOR = 0 TO 10000 OHMS. AMBIENT TEMPERATURE = -55 TO +75°C.
C6J-A/5685
XENON THYRATRON
NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:
Filament, Coated:
Voltage.............. 2.4 2.5 2.6 ac or dc volts
Current at 2.5 volts... 19 21 23 amp
Minimum heating time prior to
tube conduction.......... 60 sec
Direct Interelectrode Capacitances (Approx.):
Grid to anode........... 4 μf
Grid to cathode.......... 21 μf
Maximum Deionization Time........ 1000 μsec
Maximum Critical Grid Current........ 10 μamp
Anode Voltage Drop:
Average, at beginning of life........ 9 volts
Maximum, at end of life........ 12 volts
Maximum Commutation Factor (approx.),
averaged over first 350 volts of
inverse anode voltage rise........ 0.66 va/μs²

Grid Control Ratio (Approx.):
For conditions: 10000-ohm grid re-
sistor, circuit returns to filament
transformer center-tap, filament
pin 2 negative with respect to filament pin 3 when anode is posi-
tive, dc anode voltage, and dc
gird voltage........ 210

Mechanical:
Mounting Position........ Vertical, base down
Maximum Overall Length........ 9-1/2"
Maximum Diameter........ 2-1/32"
Weight (Approx.)........ 7 oz
Cap. (Approx.)........ Medium (JETEC No.C1-5)
Bulb........ Medium-Metal-Shell Super-Jumbo 4-Pin
Base........ (JETEC No.A4-81) 4BZ

Basing Designation for BOTTOM VIEW........ TENTATIVE DATA
Pin 1-Grid
Pin 2-Filament
Pin 3-Filament
Pin 4-No Connection
Cap-Anode

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, Absolute Values:
PEAK ANODE VOLTAGE:
Forward.................. 1000 max. volts
Inverse.................. 1250 max. volts

*: see next page.
GRID VOLTAGE:
Peak, before tube conduction ........ -100 max. volts

ANODE CURRENT:
Peak ........................................ 77 max. amp
Average* ................................... 6.4 max. amp
Overload:

<table>
<thead>
<tr>
<th>Rating I*, for duration of</th>
<th>0.5 sec</th>
<th>1 sec</th>
<th>2 sec</th>
<th>3 sec</th>
<th>4 sec</th>
<th>5 sec</th>
<th>6 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>77 max. amp</td>
<td>38.5 max. amp</td>
<td>19.2 max. amp</td>
<td>12.8 max. amp</td>
<td>9.6 max. amp</td>
<td>7.7 max. amp</td>
<td>9.6 max. amp</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rating II**, for duration of</th>
<th>3 sec</th>
<th>4 sec</th>
<th>5 sec</th>
<th>6 sec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12.8 max. amp</td>
<td>11.2 max. amp</td>
<td>10.3 max. amp</td>
<td>9.6 max. amp</td>
</tr>
</tbody>
</table>

Fault, for duration of 0.1 second maximum. ............ 770 max. amp

AMBIENT-TEMPERATURE RANGE. .................. -55 to +75 °C

1. Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.
2. Averaged over any period of 6 seconds.
3. Averaged over duration of overload occurring no more than once in any period of 6 seconds.
4. Averaged over duration of overload occurring no more than once in any period of 30 seconds.

OPERATING CONSIDERATIONS

The anode of the C6J-A/5685 will show a red color when the tube is operated at full load.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.
XENON THYRATRON

MEDIUM CAP
JETEC N4C1-5

T16 BULB

MEDIUM-
METAL-SHELL
SUPER-JUMBO
4-PIN BASE
JETEC N4A4-81

2\(\frac{1}{32}\)" MAX.

9\(\frac{1}{2}\)" MAX.

RCA

C6J-A/5685

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

TUBE DIVISION

CE-9161

12-56
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

Range is for conditions where: Ef = 2.5 volts ± 5%; circuit returns to center-tap of filament transformer. Filament voltage at pin 2 is (-) when anode voltage is (+). The range includes initial and life variations of individual tubes. Grid resistor = 0 to 10000 ohms. Ambient temperature = -55 to +75°C.

- Critical
- Conducting
- Non-conducting

DC grid supply volts: -12 to +6
### GENERAL DATA

**Electrical:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
<th>ac or dc volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament, Coated Voltage</td>
<td>2.4</td>
<td>2.5</td>
<td>2.6</td>
<td>amp</td>
</tr>
<tr>
<td>Current at 2.5 volts</td>
<td>28</td>
<td>31</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Minimum heating time prior to tube conduction</td>
<td>60</td>
<td></td>
<td></td>
<td>sec</td>
</tr>
</tbody>
</table>

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

- Grid to anode: 8 µuf
- Grid to cathode: 29 µuf

**Maximum Deionization Time:** 1000 µsec

**Maximum Critical Grid Current:** 10 µamp

**Anode Voltage Drop:**
- Average, at beginning of life: 11 volts
- Maximum, at end of life: 14 volts

**Maximum Commutation Factor,** averaged over first 330 volts of inverse anode voltage rise: 0.66 volt/µs²

**Grid Control Ratio (Approx.):**

For conditions: 10000-ohm grid resistor, circuit returns to filament transformer center-tap, filament lead F- negative with respect to filament lead F+ during conduction period, dc anode voltage and dc grid voltage: 270

**Mechanical:**

- Mounting Position: Vertical, base down
- Tube and Base Bracket Dimensions: See Dimensional Outline
- Weight (Approx.): 14 oz
- Bulb: T-20
- Terminal Connections: See Dimensional Outline

### BOTTOM VIEW

- F- Filament Lead
- F+ Filament Lead
- G- Grid Lead
- P- Anode Lead (On end opposite bracket)

**GRID-CONTROLLED RECTIFIER SERVICE**

**Maximum Ratings, Absolute Values:**

**PEAK ANODE VOLTAGE:**
- Forward: 1000 max. volts
- Inverse: 1250 max. volts

*Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.*

12-56

**TENTATIVE DATA**

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
GRID VOLTAGE:
Peak, before tube conduction .......... -100 max. -100 max. volts

ANODE CURRENT:
Peak .................................. 160 max. 100 max. amp
Average* .............................. 16 max. 18 max. amp
Overload:
Rating I*, for duration of ...
1 sec. 72 max. 81 max. amp
2 sec. 36 max. 40.5 max. amp
3 sec. 24 max. 27 max. amp
3.5 sec. 21 max. 22.8 max. amp
4 sec. 18 max. 20.3 max. amp
Rating II**, for duration of ...
3 sec. 24 max. - amp
3.5 sec. 23 max. 22.8 max. amp
4 sec. 22 max. 22.5 max. amp
4.5 sec. 21.3 max. 22 max. amp
Fault, for duration of
0.1 second maximum ........... 1000 max. 1000 max. amp

AMBIENT-TEMPERATURE RANGE ... -55 to +75 -55 to +75

* Averaged over any period of 4.5 seconds.
** Averaged over duration of overload occurring no more than once in any period of 4.5 seconds.

OPERATING CONSIDERATIONS

The anode of the C16J/5665 will show a red color when the tube is operated at full load.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE:
\[ E_f = 2.5 \text{ VOLTS} \pm 5\% \]; CIRCUIT RETURNS TO FILAMENT TRANSFORMER CENTER-TAP; FILAMENT LEAD \( F^- \) NEGATIVE WITH RESPECT TO FILAMENT LEAD \( F^+ \) DURING CONDUCTION PERIOD. THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES, GRID RESISTOR = 0 TO 10000 OHMS, AMBIENT TEMPERATURE RANGE -55 TO +75°C.

CONDUCTING

NON-CONDUCTING

DC ANODE VOLTS

DC GRID SUPPLY VOLTS

92CS-9120T
### GENERAL DATA

#### Electrical:

**Heater, for Unipotential Cathode:**

<table>
<thead>
<tr>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
<th>ac or dc volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.7</td>
<td>6.3</td>
<td>6.9</td>
<td></td>
</tr>
</tbody>
</table>

**Current at 6.3 volts:**

- 2.6 amp
- 2.85 amp

**Cathode:**

- Minimum heating time prior to tube conduction: 30 sec
- Maximum outage time without reheating: 3 sec

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

- Grid No. 1 to anode*: 0.1 µf
- Grid No. 1 to cathode, grid No. 2, base shell, and heater: 8.5 µf
- Anode to cathode, grid No. 2, base shell, and heater: 4.6 µf

** Ionization Time (Approx.):**

For conditions: dc anode volts = 100, grid-No.1 square-pulse volts = +100, and peak anode amperes during conduction = 8

- 0.5 µsec

**Deionization Time (Approx.):**

For conditions: dc anode volts = 125, dc grid-No.1 volts = -200, grid-No.1 resistor (ohms) = 1000, and dc anode amperes = 0.8

- 150 µsec

For conditions: ac anode volts = 125, dc grid-No.1 volts = -14.8, grid-No.1 resistor (ohms) = 1000, and dc anode amperes = 0.8

- 400 µsec

**Maximum Critical Grid-No.1 Current:**

For conditions: ac anode-supply volts = 460 (rms), and average anode amperes = 0.8

- 0.8 µamp

**Anode Voltage Drop (Approx.):**

- 10 volts

**Grid-No.1 Control Ratio (Approx.):**

For conditions: grid-No.1 resistor (megohms) = 0 to 0.1, grid-No.2 resistor (megohms) = 0, and grid-No.2 volts = 0

- 150

**Grid-No.2 Control Ratio (Approx.):**

For conditions: grid-No.1 resistor (megohms) = 0, grid-No.2 resistor (megohms) = 0 to 0.1, and grid-No.1 volts = -3

- 650

* Without external shield.

* With all other electrodes and base shell connected to ground.
Mechanical:
Mounting Position: Any
Maximum Overall Length: 4-5/8"
Maximum Seated Length: 4"
Maximum Diameter: 2-3/8"
Weight (Approx.): 5 oz
Bulb: Medium-Metal-Shell Giant 7-Pin with Bayonet (JETEC No. A7-17)
Base: 7-BV

Basing Designation for BOTTOM VIEW: 7BV

Pin 1 - Heater
Pin 2 - Grid No.2
Pin 3 - Cathode
Pin 4 - Grid No.1
Pin 5 - Grid No.2
Pin 6 - Anode
Pin 7 - Heater

AX = PLANE OF ELECTRODES

RELAY AND GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, Absolute Values:

PEAK ANODE VOLTAGE:
Forward: 650 max. volts
Inverse: 1500 max. volts

GRID-No.2 (SHIELD-GRID) VOLTAGE:
Peak, before tube conduction: -100 max. volts
Average#, during tube conduction: -10 max. volts

GRID-No.1 (CONTROL-GRID) VOLTAGE:
Peak or DC, before tube conduction: -200 max. volts
Average#, during tube conduction: -10 max. volts

CATHODE CURRENT:
Peak: 8 max. amp
Average#: 0.8 max. amp
Fault, for duration of 0.1 second max.: 30 max. amp
AVERAGE GRID-No.2 CURRENT# +0.1 max. amp
AVERAGE GRID-No.1 CURRENT# +0.05 max. amp

PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode: 100 max. volts
Heater positive with respect to cathode: 25 max. volts

AMBIENT-TEMPERATURE RANGE: -75 to +90 °C

Maximum Circuit Values:
Grid-No.1-Circuit Resistance: 2 max. megohms

# Averaged over any interval of 30 seconds maximum.
GAS THYRATRON

SPECIAL PERFORMANCE TESTS

Made in conformance with indicated sections of MIL-E-18 Specifications dated 2 May 1952

4.9.19.2 (F-66) High-Frequency Vibration:
The tube is rigidly mounted on a table vibrating with simple harmonic motion at a frequency of 50 ± 2 cps with a fixed amplitude of 0.040" ± 0.0025" (total excursion is double the amplitude). Maximum acceleration is 10g. No voltage is applied during vibration. Tube is vibrated for 10 minutes in such manner that table motion is along shortest line between anode and cathode. This test will not cause tube to be inoperative.

4.10.19 (F-64) Thyatron High-Voltage Operation:

<table>
<thead>
<tr>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.4</td>
<td>-9.2</td>
</tr>
</tbody>
</table>

Grid-No.1 Supply Voltage (1) ....... 
This test is made after two light taps with a felt hammer (similar to type used for noise tests) in direction from cathode to anode under the following conditions: heater voltage of 6.3 volts rms, anode supply voltage of 500 volts rms, grid No.2 tied to cathode, load resistance of 2000 ohms, and grid-No.1 circuit-resistance of 2 megohms. Tube conduction is indicated by an oscilloscope connected between anode and cathode and ceases when the grid-No.1 supply voltage is increased negatively within indicated range.

Grid-No.1 Supply Voltage (2) ....... 
This test is made as for Grid-No.1 Supply Voltage (1), except that the taps are made in direction from anode to cathode.

Voltage Difference ............... -1 volt
The difference between the value of grid-No.1 supply voltage in the first and second grid-No.1 supply voltage tests will not exceed the specified value.

OPERATING CONSIDERATIONS

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.
DC Voltage Control

PHASE SHIFTER

FIG. 1 HALF-WAVE SINGLE-PHASE PHASE SHIFTER

FIG. 2 FULL-WAVE SINGLE-PHASE PHASE SHIFTER

FIG. 3 SERIES SINGLE-PHASE

AC Voltage Control

PHASE SHIFTER

FIG. 4 FULL-WAVE SINGLE-PHASE

NOTES

T = PEAKING TRANSFORMER

IN FIG. 3, THE RECTIFIER TUBES MAY BE 3D22-A's USED AS DIODES. THE 3D22-A IS USED AS A DIODE BY CONNECTING GRIDS #2 AND #1 TO CATHODE (PIN 3)

Devices and arrangements shown or described herein may use patents of RCA or others. Information contained herein is furnished without responsibility by RCA for its use and without prejudice to RCA's patent rights.

JULY 1, 1955

DATA 2
GRID - CONTROLLED RECTIFIER CIRCUITS

Numerical Relationships Among Electrical Quantities

<table>
<thead>
<tr>
<th>E = Trans. Sec. Voltage (RMS)</th>
<th>E_{av} = Average DC Output Voltage</th>
<th>E_{bmf} = Peak Forward Anode Voltage</th>
<th>E_{bmi} = Peak Inverse Anode Voltage</th>
<th>E_{m} = Peak DC Output Voltage</th>
<th>E_{r} = Major Ripple Voltage (RMS)</th>
<th>f = Supply Frequency</th>
<th>f_{r} = Major Ripple Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>l_{av} = Average DC Output Current</td>
<td>l_{b} = Average Anode Current</td>
<td>l_{p} = Anode Current (RMS)</td>
<td>l_{pm} = Peak Anode Current</td>
<td>l_{pm} (Res) = Peak Anode Current</td>
<td>l_{pm} (Load) = Load Volt-Amperes</td>
<td>l_{pm} = Line Volt-Amperes</td>
<td>l_{pm} = Trans. Pri. Volt-Amperes</td>
</tr>
<tr>
<td>P_{ac} = Load Volt-Amperes</td>
<td>P_{pm} = Trans. Sec. Volt-Amperes</td>
<td>P_{dc} = DC Power (E_{av} \times l_{av})</td>
<td>P_{dc} = DC Power</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Conditions assumed involve sine-wave supply; zero voltage drop in tubes; no losses in transformer and circuit; no back emf in the load circuit; and no phase-back.

### Voltage Ratios

<table>
<thead>
<tr>
<th>Voltage Ratios</th>
<th>Fig. 1</th>
<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>E/E_{av}</td>
<td>2.22</td>
<td>1.11</td>
<td>1.41</td>
<td></td>
</tr>
<tr>
<td>E_{bmf}/E</td>
<td>1.41</td>
<td>2.83</td>
<td>1.41</td>
<td>1.41</td>
</tr>
<tr>
<td>E_{bmf}/E_{av}</td>
<td>3.14</td>
<td>3.14</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>E_{m}/E_{av}</td>
<td>3.14</td>
<td>1.57</td>
<td>1.57</td>
<td></td>
</tr>
<tr>
<td>E_{r}/E_{av}</td>
<td>1.11</td>
<td>0.472</td>
<td>0.472</td>
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</tr>
<tr>
<td>E_{bmf}/E_{m}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistive Load</td>
<td>1.41</td>
<td>1.41</td>
<td>1.41</td>
<td>1.41</td>
</tr>
<tr>
<td>Inductive Load</td>
<td>1.41</td>
<td>2.83</td>
<td>1.41</td>
<td>1.41</td>
</tr>
</tbody>
</table>

### Frequency Ratio

<table>
<thead>
<tr>
<th>Frequency Ratio f/f</th>
<th>1</th>
<th>2</th>
<th>2</th>
<th>2</th>
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### Current Ratios

<table>
<thead>
<tr>
<th>Current Ratios</th>
<th>1</th>
<th>2</th>
<th>2</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_p/l_{av}</td>
<td>1.57</td>
<td>0.785</td>
<td>0.785</td>
<td>1.41</td>
</tr>
<tr>
<td>I_b/l_{av}</td>
<td>1</td>
<td>0.5</td>
<td>0.5</td>
<td>1.41</td>
</tr>
<tr>
<td>Resistive Load</td>
<td>1.41</td>
<td>1.57</td>
<td>1.57</td>
<td>1.57</td>
</tr>
<tr>
<td>I_pm/l_{av}</td>
<td>3.14</td>
<td>1.57</td>
<td>1.57</td>
<td>1.57</td>
</tr>
<tr>
<td>I_pm/l_{b}</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
<td>3.14</td>
</tr>
<tr>
<td>Inductive Load</td>
<td>1.41</td>
<td>2.83</td>
<td>1.41</td>
<td>1.41</td>
</tr>
<tr>
<td>I_pm/l_{av}</td>
<td>---</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### Power Ratios

<table>
<thead>
<tr>
<th>Power Ratios</th>
<th>1.41</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_{ac}/l_{b}E_{bmf}</td>
<td>---</td>
</tr>
<tr>
<td>Resistive Load</td>
<td>3.49</td>
</tr>
<tr>
<td>P_{as}/P_{dc}</td>
<td>2.69</td>
</tr>
<tr>
<td>P_{pm}/P_{dc}</td>
<td>2.69</td>
</tr>
</tbody>
</table>

*: see next page.
### Power Ratios (Cont'd)

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Fig. 1</th>
<th>Fig. 2</th>
<th>Fig. 3</th>
<th>Fig. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inductive Load</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$P_{a}/P_{dc}$</td>
<td>-</td>
<td>1.57</td>
<td>1.11</td>
<td>-</td>
</tr>
<tr>
<td>$P_{ap}/P_{dc}$</td>
<td>-</td>
<td>1.14</td>
<td>1.11</td>
<td>-</td>
</tr>
<tr>
<td>$P_{ai}/P_{dc}$</td>
<td>-</td>
<td>1.11</td>
<td>1.11</td>
<td>-</td>
</tr>
</tbody>
</table>

*The use of a large filter-input choke is assumed, except for the circuit in Fig. 4.*

<table>
<thead>
<tr>
<th>Circuit Single-Phase</th>
<th>MAX. TRANS. SEC. VOLTS (RMS)</th>
<th>APPROX. DC OUTPUT VOLTS TO FILTER $E_{av}$</th>
<th>MAX. DC OUTPUT AMPERES $I_{av}$</th>
<th>MAX. DC OUTPUT WATTS $P_{dc}$</th>
<th>MAX. AC OUTPUT VOLT-AMPERES $P_{ac}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig. 1 Half-Wave</td>
<td>460</td>
<td>205</td>
<td>0.8</td>
<td>165</td>
<td>-</td>
</tr>
<tr>
<td>Fig. 2 Full-Wave:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistive Load</td>
<td>460</td>
<td>410</td>
<td>1.6</td>
<td>660</td>
<td>-</td>
</tr>
<tr>
<td>Inductive Load</td>
<td>230</td>
<td>205</td>
<td>1.6</td>
<td>330</td>
<td>-</td>
</tr>
<tr>
<td>Fig. 3 Series</td>
<td>460</td>
<td>410</td>
<td>1.6</td>
<td>660</td>
<td>-</td>
</tr>
<tr>
<td>Fig. 4 Full-Wave</td>
<td>460</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>800</td>
</tr>
</tbody>
</table>

**Diagram:**

- **T16 Bulb:**
  - $2\frac{3}{8}''$ Max.
  - $4\frac{3}{8}''$ Max.

- **Medium-Metal Shell Giant 7-Pin Bayonet Base Jetec No. A7-17**

**TUBE DIVISION**

**Radio Corporation of America, Harrison, New Jersey**

**Date:** JULY 1, 1955
OPERATIONAL RANGE OF CRITICAL GRID-N21 VOLTAGE

GRID N22 (SHIELD) CONNECTED TO CATHODE. RANGES SHOWN ARE FOR TWO VALUES OF GRID-N21 RESISTOR, 01 MEG AND 2 MEG, AND TAKE INTO ACCOUNT INITIAL DIFFERENCES BETWEEN INDIVIDUAL TUBES AND SUBSEQUENT DIFFERENCES DURING TUBE LIFE, FOR HEATER-VOLTAGE RANGE OF 5.7 TO 6.9 VOLTS, AND FOR AN AMBIENT TEMPERATURE RANGE OF -40 TO +90°C.

Range for 2 Megohms
Range for 0.1 Megohm

AC ANODE VOLTS (RMS -60°C)

DC GRID-N21 SUPPLY VOLTS 92CM-6483T3

JULY 1, 1955
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
AVERAGE CONTROL CHARACTERISTICS

$E_F = 6.3$ VOLTS
GRID-N$\#2$ RESISTOR = 0 OHMS
GRID-N$\#1$ RESISTOR = 0 OHMS

DC ANODE VOLTS

TUBE DIVISION

JAN. 22, 1947

RADIO CORPORATION OF AMERICA, MARISSON, NEW JERSEY
CHARACTERISTIC CURVES

AVERAGE GRID-N#1 CHARACTERISTICS BEFORE TUBE CONDUCTION

- \( E_f = 6.3 \) VOLTS
- GRID N#2 (SHIELD) CONNECTED TO CATHODE
- GRID-N#1 RESISTOR (OHMS) = 0
- CONDUCTION STARTS

DC ANODE VOLTS = 600

AVERAGE GRID-N#1 CHARACTERISTICS DURING TUBE CONDUCTION

- \( E_f = 6.3 \) VOLTS
- GRID N#2 (SHIELD) CONNECTED TO CATHODE
- GRID-N#2 RESISTOR (OHMS) = 0
- GRID-N#1 RESISTOR (OHMS) = 0

DC ANODE VOLTS

JULY 1, 1955
TUBE DIVISION
BRIDG CO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
### Electrical Data

<table>
<thead>
<tr>
<th>Description</th>
<th>Continuous Service</th>
<th>Intermittent Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater, for Unipotential Cathode:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage*</td>
<td>5.0</td>
<td>5.5</td>
</tr>
<tr>
<td>Current</td>
<td>10.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitance:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grid-No.1 to Anode (Approx.)</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Peak Voltage Drop (Approx.)</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Approx. Control Characteristics:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Voltage</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Grid-No.2 Voltage</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Grid-No.1 Voltage</td>
<td>+1</td>
<td>-9</td>
</tr>
<tr>
<td>Ionization Time (Approx.)</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Deionization Time (Approx.)</td>
<td>1000</td>
<td>1000</td>
</tr>
</tbody>
</table>

### Mechanical

- Mounting Position: Vertical, Base Down
- Overall Length: 11" ± 1/4"
- Seated Length: 10-1/4" ± 1/4"
- Greatest Radius: 2-13/16"
- Bulb: ST-30
- Caps: No. 3917
- Base: Super-Jumbo 4-Pin, with Bayonet

### Maximum Ratings, Absolute Values

<table>
<thead>
<tr>
<th>Description</th>
<th>Continuous Service</th>
<th>Intermittent Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK FORWARD ANODE VOLT.</td>
<td>2500</td>
<td>750</td>
</tr>
<tr>
<td>PEAK INVERSE ANODE VOLT.</td>
<td>2500</td>
<td>750</td>
</tr>
<tr>
<td>GRID-No.1 (CONT.GRID) VOLT.:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before Conduction</td>
<td>-1000</td>
<td>-1000</td>
</tr>
<tr>
<td>During Conduction</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>GRID-No.2 (SH'LD GRID) VOLT.:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before Conduction</td>
<td>-500</td>
<td>-500</td>
</tr>
<tr>
<td>During Conduction</td>
<td>-10</td>
<td>-10</td>
</tr>
<tr>
<td>INSTANTANEOUS ANODE CUR.:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below 25 Cycles</td>
<td>12.8</td>
<td>5.0</td>
</tr>
<tr>
<td>25 Cycles and Higher</td>
<td>40</td>
<td>77</td>
</tr>
<tr>
<td>AVERAGE ANODE CURRENT.</td>
<td>6.4</td>
<td>2.5</td>
</tr>
<tr>
<td>SURGE ANODE CUR., for 0.1 sec., max.</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>INSTANTANEOUS GRID-No.1 CUR.</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>AVERAGE GRID-No.1 CUR.</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>INSTANTANEOUS GRID-No.2 CUR.</td>
<td>2.0</td>
<td>2.0</td>
</tr>
<tr>
<td>AVERAGE GRID-No.2 CUR.</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>TIME OF AVERAGING CURRENT</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>COND.-MERCURY TEMP. RANGE*</td>
<td>40-80</td>
<td>30-95</td>
</tr>
</tbody>
</table>

* Must be applied 5 minutes before anode voltage is applied.

**Recommended condensed-mercury temperature = 40°C.**

MAY 1, 1946

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

TENTATIVE DATA
# THYRATRON
**MERCURY-VAPOR TRIODE**

## Electrical:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filament Voltage*</td>
<td>2.5 volts</td>
</tr>
<tr>
<td>Current</td>
<td>6.0 amp</td>
</tr>
<tr>
<td>Direct Interelectrode Capacitance: Anode to Grid (Approx.)</td>
<td>2.5 µf</td>
</tr>
<tr>
<td>Peak Voltage Drop</td>
<td>12 volts</td>
</tr>
<tr>
<td>Control Characteristic Negative</td>
<td></td>
</tr>
<tr>
<td>Ionization Time (Approx.)</td>
<td>10 µseconds</td>
</tr>
<tr>
<td>Deionization Time (Approx.)</td>
<td>1000 µseconds</td>
</tr>
</tbody>
</table>

## Mechanical:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting Position</td>
<td>Vertical, Base Down</td>
</tr>
<tr>
<td>Overall Length</td>
<td>6-3/8&quot; ± 1/4&quot;</td>
</tr>
<tr>
<td>Seated Length</td>
<td>6&quot; ± 1/4&quot;</td>
</tr>
<tr>
<td>Maximum Diameter</td>
<td>2-1/16&quot;</td>
</tr>
<tr>
<td>Bulb</td>
<td>S-19</td>
</tr>
<tr>
<td>Cap.</td>
<td>Medium Metal</td>
</tr>
<tr>
<td>Base</td>
<td>Small Shell Super-Jumbo 4-Pin</td>
</tr>
</tbody>
</table>

## Maximum Ratings, Absolute Values:

For frequencies up to 150 cycles

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK FORWARD ANODE VOLTAGE</td>
<td>1250 max. volts</td>
</tr>
<tr>
<td>PEAK INVERSE ANODE VOLTAGE</td>
<td>2500 max. volts</td>
</tr>
<tr>
<td>PEAK GRID VOLT. (Before Conduction)</td>
<td>-500 max. volts</td>
</tr>
<tr>
<td>PEAK ANODE CURRENT</td>
<td>2.5 max. amp</td>
</tr>
<tr>
<td>AVERAGE ANODE CURRENT**</td>
<td>0.64 max. amp</td>
</tr>
<tr>
<td>SURGE ANODE CURRENT for 0.1 sec. max.</td>
<td>25 max. amp</td>
</tr>
<tr>
<td>GRID CURRENT, Before Conduction (Grid Neg.)</td>
<td>4 max. µamp</td>
</tr>
<tr>
<td>PEAK GRID CURRENT</td>
<td>0.25 max. amp</td>
</tr>
<tr>
<td>AVERAGE GRID CURRENT**</td>
<td>0.06 max. amp</td>
</tr>
<tr>
<td>COND.-MERCURY TEMPERATURE RANGE^</td>
<td>25-70 °C</td>
</tr>
</tbody>
</table>

* Filament voltage must be applied at least 10 seconds before start of tube conduction.

** Averaged over any 30-second interval.

^ Recommended Condensed-Mercury Temperature 40 to 45°C.
THYRATRON

- **TYPE**
  - Ef = 2.5 Volts

- **Small Shell Super-Jumbo 4-Pin Base**

- **Operational Region of Critical Grid Voltage**
  - **Type 627**
  - Ef = 2.5 Volts

- **DC Grid Volts**
- **AC Anode Volts (Peak)**

- **MAY 1, 1946**
- **TUBE DIVISION**
- **BENDO CORPORATION OF AMERICA, HARRISON, NEW JERSEY**

- **92CS-8738**
MERCURY-VAPOR THYRATRON
NEGATIVE-CONTROL TETRODE TYPE

GENERAL DATA

Electrical:
Heater, for Unipotential Cathode:
  Voltage: 5V ac or dc volts
  Current: 5 amp
Cathode:
  Minimum heating time prior to tube conduction: 5 minutes
Direct Interelectrode Capacitances (Approx.):
  Grid No.1 to anode: 0.04 μf
  Grid No.2 to anode: 3 μf
Ionization Time (Approx.): 10 μsec
Deionization Time (Approx.): 1000 μsec
Maximum Critical Grid-No.1 Current: 2 μamp
Anode Voltage Drop (Approx.): 12 volts

Mechanical:
Mounting Position: Vertical, base down
Max. Overall Length: 8-5/16" ± 1/4"
Seated Length: 7-1/2" ± 1/4"
Max. Radius (including side cap): 1-3/4"
Weight (Approx.): 9 oz
Bulb: T-18
Top Cap: Skirted Medium (JETEC No.C1-29)
Side Cap: Saddle Medium
Base: Skirted-Medium-Shell Small 4-Pin with Bayonet (JETEC No.A4-71)
Basing Designation for BOTTOM VIEW: 4CD
Pin 1-Heater
Pin 2-Cathode, Circuit Returns
Pin 3-Grid No.2
Pin 4-Heater, Cathode Top Cap-Anode Side Cap-Grid No.1

Temperature Control:
Heating—When the ambient temperature is so low that the normal rise of condensed-mercury temperature above the ambient temperature will not bring the condensed-mercury temperature up to the minimum value of the operating range specified under Maximum Ratings, some form of heat-conserving enclosure or auxiliary heater will be required.

Cooling—When the operating conditions are such that the maximum value of the operating condensed-mercury temperature is exceeded, provision should be made for forced-air cooling sufficient to prevent exceeding the maximum value.

Under operating conditions where the average anode current does not exceed 0.5 ampere, the heater voltage may be increased to 5.5 volts.
IGNITOR-FIRING AND GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, Absolute Values:

For anode-supply frequency of 60 cps

**Operating Condensed-Mercury Temperature Range**

40° to 80°C

**PEAK ANODE VOLTAGE:**
- Forward: 1500 max. volts
- Inverse: 1500 max. volts

**GRID-No.2 (SHIELD-GRID) VOLTAGE:**
- Peak, before tube conduction: -300 max. volts

**GRID-No.1 (CONTROL-GRID) VOLTAGE:**
- Peak, before tube conduction: -1000 max. volts

**CATHODE CURRENT:**
- Peak: 30 max. amp
- Average: 2.5 max. amp
- Fault, for duration of 0.1 second max.: 150 max. amp

**AVERAGE GRID-No.2 CURRENT**
- +0.25 max. amp

**AVERAGE GRID-No.1 CURRENT**
- +0.25 max. amp

Recommended temperature range of condensed mercury is 45° to 50°C. Averaged over any interval of 30 seconds maximum.

---

**ZONE WHERE CONDENSED-MERCURY TEMPERATURE SHOULD BE MEASURED**

**SKIRTED MEDIUM CAP**
JETEC No C1-29

**SKIRTED-MEDIUM-SHELL SMALL 4-PIN BASE WITH BAYONET**
JETEC No A4-7
632-B
MERCURY-VAPOR THYRATRON

OPERATIONAL RANGES
OF CRITICAL GRID-N21 VOLTAGE

Ef = 5 VOLTS
GRID-N2 (SHIELD) VOLTS = 0
RANGE SHOWN TAKES INTO AC-
COUNT INITIAL DIFFERENCES
BETWEEN INDIVIDUAL TUBES
AND SUBSEQUENT DIFFER-
ENCES DURING TUBE LIFE.
GRID RESISTOR = 0 OHMS
CONDENSED-MERCURY TEMPE-
RATURE = 40° TO 80° C

CRITICAL
CONDUCTING
NON-CONDUCTING

DC GRID-N21 SUPPLY VOLTS

92CS-9008T

Ef = 5 VOLTS
GRID-N2 (SHIELD) VOLTS = 10
RANGE SHOWN TAKES INTO AC-
COUNT INITIAL DIFFERENCES
BETWEEN INDIVIDUAL TUBES
AND SUBSEQUENT DIFFER-
ENCES DURING TUBE LIFE.
GRID RESISTOR = 0 OHMS
CONDENSED-MERCURY TEMPE-
RATURE RANGE = 40° TO 80° C

CRITICAL
CONDUCTING
NON-CONDUCTING

DC GRID-N21 SUPPLY VOLTS

92CS-9007T

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

CE-9008T
9007T
THYRATRON
MERCURY-VAPOR TETRODE
Supersedes Type 672

GENERAL DATA

Electrical:
Heater, for Unipotential Cathode:
  Voltage: 5 ac or dc volts
  Current: 5 amp

Cathode:
  Min. Heating Time, prior to tube conduction: 5 minutes

Direct Inter-electrode Capacitances:
  Grid No.1 to Anode: 0.04 μf
  Grid No.2 to Anode: 3 μf

Ionization Time (Approx.): 10 μsec
Deionization Time (Approx.): 1000 μsec

Maximum Critical Grid Current: 2 μamp
Anode Voltage Drop (Approx.): 12 volts

Mechanical:
Mounting Position: Vertical, Base Down
Overall Length: 7-7/8" ± 1/4"
Seated Length: 7-1/8" ± 1/4"
Maximum Diameter: 2-5/16"
Bulb: T-18
Cap.: Skirted Medium
Base: Large-Shell Super-Jumbo 4-Pin, Bayonet

Basing Designation for BOTTOM VIEW: 4CE

Pin 1 - Grid No.1
Pin 2 - Heater, Cathode
Pin 3 - Heater
Pin 4 - Grid No.2
Cap. - Anode

GRID-CONTROLLED RECTIFIER SERVICE
For frequencies up to 150 cycles

Maximum Ratings, Absolute Values:

PEAK ANODE VOLTAGE:
  Forward: 2500 max. volts
  Inverse: 2500 max. volts

GRID-NO.2 (SHIELD-GRID) VOLTAGE:
  Peak, before anode conduction: -300 max. volts

GRID-NO.1 (CONTROL-GRID) VOLTAGE:
  Peak, before anode conduction: -1000 max. volts

CATHODE CURRENT:
  Peak: 40 max. amp
  Average: 3.2 max. amp
  Surge, for duration of 0.1 sec. max.: 150 max. amp

See next page.

(continued on next page)
GRID-No.2 CURRENT:
Peak: 1 max. amp
Average: 0.25 max. amp

GRID-No.1 CURRENT:
Peak: 1 max. amp
Average: 0.25 max. amp

COND.-MERCURY TEMPERATURE RANGE: 40 to 80 °C

* Averaged over any interval of 15 sec. max.
* Recommended condensed-mercury temperature is between 45° and 50°C.
**General Data**

**Electrical:**
- Heater, for Unipotential Cathode:
  - Voltage: 5 ac or dc volts
  - Current: 5 amp
- Cathode:
  - Min. Heating Time, prior to tube conduction: 5 minutes
- Direct Interelectrode Capacitances:
  - Grid No.1 to Anode: 0.04 μf
  - Grid No.2 to Anode: 3 μf
- Ionization Time (Approx.): 10 μsec
- Deionization Time (Approx.): 1000 μsec
- Maximum Critical Grid Current: 2 μamp
- Anode Voltage Drop (Approx.): 12 volts

**Mechanical:**
- Mounting Position: Vertical, Base Down
- Overall Length: 7-7/8" ± 1/4"
- Seated Length: 7-1/8" ± 1/4"
- Maximum Diameter: 2-5/16"
- Bulb: T-18
- Cap.: Skirted Medium
- Base: Large-Shell Super-Jumbo 4-Pin, Bayonet
- Basing Designation for BOTTOM VIEW: 4CE

**Grid-Controlled Rectifier Service**

*For frequencies up to 150 cycles*

**Maximum Ratings, Absolute Values:**

**Peak Anode Voltage:**
- Forward: 2500 max. volts
- Inverse: 2500 max. volts

**Grid-No.2 (Shield-Grid) Voltage:**
- Peak, before anode conduction: -300 max. volts

**Grid-No.1 (Control-Grid) Voltage:**
- Peak, before anode conduction: -1000 max. volts

**Cathode Current:**
- Peak: 40 max. amp
- Average: 3.2 max. amp
- Surge, for duration of 0.1 sec. max.: 150 max. amp

See next page.

(continued on next page)
GRID-No.2 CURRENT:
Peak ........................................ 1 max. amp
Average* .................................... 0.25 max. amp

GRID-No.1 CURRENT:
Peak ........................................ 1 max. amp
Average* .................................... 0.25 max. amp

COND.-MERCURY TEMPERATURE RANGE* ........ 40 to 80 °C

* Averaged over any interval of 15 sec. max.

* Recommended condensed-mercury temperature is between 45° and 50°C.

SKIRTED MEDIUM CAP
No 39002

2 3/16" MAX.

ANODE TERMINAL

18 BULB

LARGE-SHELL SUPER-JUMBO 4-PIN BAYONET BASE

7 1/8" ± 1/4"

7 7/8" ± 1/4"

BOTTOM VIEW OF BASE

92CS-6735R1

SEPT. 30, 1948

TUBE DEPARTMENT

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
OPERATIONAL RANGES OF CRITICAL GRID-NO.1 VOLTAGE

TYPE 672-A
E_F = 5.0 VOLTS
GRID-NO.2 (SHEILD) VOLTS = 0

CRITICAL
CONDUCTING

NON-CONDUCTING

AC ANODE VOLTS (PEAK)

DC GRID-NO.1 VOLTS
-40
-20
0
+20
92CM-6734T1

TYPE 672-A
E_F = 5.0 VOLTS
GRID-NO.2 (SHEILD) VOLTS = 10

CRITICAL
CONDUCTING

NON-CONDUCTING

AC ANODE VOLTS (PEAK)

DC GRID-NO.1 VOLTS
-40
-20
0
+20
92CM-6929T

SEPT. 30, 1948
TUBE DEPARTMENT
CE-6734T1-6929T
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
### Electrical:

**Heater, for Unipotential Cathode:**
- Voltage*: 5 volts
- Current: 10 amp

**Direct Interelectrode Capacitance:**
- Grid to Anode (Approx.): 5 μf
- Peak Voltage Drop: 12 volts

**Control Characteristic:**
- Negative Ionization Time (Approx.): 10 μseconds
- Deionization Time (Approx.): 1000 μseconds

### Mechanical:

**Mounting Position:** Vertical, Base Down

**Overall Length:** 11-1/4" ± 1/2"

**Maximum Diameter:** 3-13/16"

**Bulb:** ST-30

**Cap:** No.3985

**Base:** Large Shell Super-Jumbo 4-Pin

### Maximum Ratings, Absolute Values:

For frequencies up to 150 cycles:

<table>
<thead>
<tr>
<th>Service</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welder-</td>
<td>Service</td>
</tr>
<tr>
<td>Service</td>
<td>Service</td>
</tr>
</tbody>
</table>

| PEAK FORWARD ANODE VOLTAGE | 2500 max. | 750 max. |
| PEAK INVERSE ANODE VOLTAGE | 2500 max. | 750 max. |
| PEAK GRID VOLTAGE: Before Conduction | -500 max. | -500 max. |
| PEAK ANODE CURRENT: | 40 max. | 77 max. |
| AVERAGE ANODE CURRENT: | 6.4 max. | 2.5 max. |
| SURGE ANODE CURRENT for 0.1 sec. max. | 200 max. | 200 max. |
| GRID CURRENT: Before conduction (Grid Negative) | 5 max. | 5 max. |
| PEAK GRID CURRENT: | 1 max. | 1 max. |
| AVERAGE GRID CURRENT: | 0.25 max. | 0.25 max. |
| TIME OF AVERAGING CURRENTS: | 15 max. | 5 max. |
| COND.-MERCURY TEMP. RANGE*: | 40 - 80 | 40 - 90 °C |

*Heater voltage must be applied for at least 5 minutes before anode voltage is applied.

Recommended condensed-mercury temperature range, 45 - 55°C.
THYRATRON
MERCURY-VAPOR TRIODE

**DATA**

**Electrical:**
- Heater, for Unipotential Cathode:
  - Voltage*: 5 volts
  - Current: 10 amp
- Direct Interelectrode Capacitance:
  - Grid to Anode (Approx.): 5 µf
- Peak Voltage Drop: 12 volts
- Control Characteristic: Negative
- Ionization Time (Approx.): 10 µseconds
- Deionization Time (Approx.): 1000 µseconds

**Mechanical:**
- Mounting Position: Vertical, Base Down
- Overall Length: 11 1/4" ± 1/2"
- Maximum Diameter: 3-13/16"
- Bulb: ST-30
- Cap: No. 3985
- Base: Large Shell Super-Jumbo 4-Pin

**Maximum Ratings, Absolute Values:**

For frequencies up to 150 cycles:
- **Peak Forward Anode Voltage:** 10000 max. volts
- **Peak Inverse Anode Voltage:** 10000 max. volts
- **Peak Grid Voltage:**
  - Before Conduction: -500 max. volts
  - Anode Negative: 10 max. volts
- **Peak Anode Current:** 15 max. amp
- **Average Anode Current**: 4 max. amp
- **Surge Anode Current** for 0.1 sec., max.: 16 max. amp
- **Grid Current:** Before Conduction (Grid Neg.): 5 max. µamp
- **Peak Grid Current:** 1 max. µamp
- **Average Grid Current**: 0.25 max. amp
- **Cond.-Mercury Temperature Range**: 30 - 50 °C

# Heater voltage must be applied for at least 5 minutes before anode voltage is applied.

**Averaged over any 15-second interval.**

*Recommended condensed-mercury temp. range, 35 - 45°C.*
THYRATRON

LARGE SHELL
SUPER-JUMBO
4-PIN BASE

OPERATIONAL REGION
OF CRITICAL GRID VOLTAGE

TYPE 677
E_f = 5.0 VOLTS

CONDUCTING

NON-CONDUCTING

DC GRID VOLTS

MAY 1, 1946
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
Gas and Mercury-Vapor Thyatron
NEGATIVE-CONTROL TRIODE TYPE

**GENERAL DATA**

### Electrical:
- **Filament, Coated:**
  - Voltage (AC or DC) between pins 1 and 4: 2.5 volts
  - Current at 2.5 volts: 9 ± 2 amp
  - Minimum heating time prior to tube conduction: 20 sec
- **Direct Interelectrode Capacitances (Approx.):**
  - Grid to anode: 2 µf
  - Grid to cathode: 12 µf
- **Ionization Time (Approx.):** 10 µsec
- **Deionization Time (Approx.):** 1000 µsec
- **Peak Tube Voltage Drop at anode:** amperes = 8, 10 volts

### Mechanical:
- **Operating Position:** Vertical, base down
- **Maximum Overall Length:** 6-1/4"
- **Maximum Diameter:** 1-5/8"
- **Weight (Approx.):** 4 oz
- **Bulb Cap.:** Medium (JEDEC No.C1-5)
- **Socket Base:** Small 4-Contact, Medium-Shell Small 4-Pin with Bayonet (JEDEC No.A4-10)

### Thermal:
- **Type of Cooling:** Convection
- **Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.):**
  - No load: 25 °C
  - Full load: 30 °C

**GRID-CONTROLLED-RECTIFIER SERVICE**

**Maximum and Minimum Ratings, Absolute-Maximum Values:**
For anode-supply frequency of 60 cps

**PEAK ANODE VOLTAGE:**
- **Forward:** 1500 max. volts
- **Inverse:** 1500 max. volts
During tube conduction: .................................. 10 max. volts
CATHODE CURRENT:
Peak ..................................................... 30 max. amp
Average\(^b\) .............................................. 2.5 max. amp
Fault ..................................................... 250 max. amp
CONDENSED-MERCURY TEMPERATURE RANGE (Operating)\(^c\) .......... -40 to +80°C

\(^a\) Without external shield.
\(^b\) Averaged over any interval of 5 seconds maximum.
\(^c\) For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40°C and +80°C which corresponds approximately to +10°C to +50°C ambient.
Gas and Mercury-Vapor Thyatron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

Filament, Coated:
Voltage (AC or DC)......... 2.5 volts
Current at 2.5 volts........ 5.0 ± 0.5 amp
Minimum heating time prior to tube conduction... 6 sec

Direct Interelectrode Capacitance (Approx.): b
Grid to anode............. 2 µf
Ionization Time (Approx.).. 10 µsec
Deionization Time (Approx.).. 1000 µsec
Maximum Critical Grid Current.... 5 µa
Peak Tube Voltage Drop at anode amperes = 3...... 15 volts

Mechanical:

Operating Position........ Vertical, base down
Maximum Overall Length..... 6-1/8"
Maximum Diameter........... 2-1/16"
Weight (Approx.)........... 3 oz
Bulb.......................... ST16
Cap......................... Medium (JEDEC No.C1-5)
Socket...................... Small 4-Contact
Base.......................... Medium-Shield Small 4-Pin with Bayonet (JEDEC No.A4-10)

Basing Designation for BOTTOM VIEW: 3G

Pin 1 - Filament
Pin 2 - No Internal Connection
Pin 3 - Grid
Pin 4 - Filament Cap - Anode

Thermal:

Type of Cooling................ Convection
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.)... 15°C

GRID-CONTROLLED-RECTIFIER SERVICE

Maximum and Minimum Ratings, Absolute-Maximum Values:

For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:
Forward....................... 1250 max. volts
Inverse....................... 1250 max. volts

PEAK NEGATIVE GRID VOLTAGE:
Before tube conduction........... 500 max. volts
During tube conduction........... 10 max. volts

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

DATA 5-62
AVeTage

Fault

CONDENSED-MERCURY TEMPERATURE
RANGE (Operating)\(d\), ............... -40 to +80 \(^\circ\)C

\(a\) With circuit returns to filament-transformer center-tap.
\(b\) Without external shield.
\(c\) Averaged over any interval of 5 seconds maximum.
\(d\) For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40\(^\circ\) and +80\(^\circ\) C which corresponds approximately to +100 to +50\(^\circ\) C ambient.
**Gas and Mercury-Vapor Thyratron**

**NEGATIVE-CONTROL TRIODE TYPE**

**GENERAL DATA**

**Electrical:**

- **Filament, Coated:**
  - Voltage (AC or DC)........ 2.5 volts
  - Current at 2.5 volts........ 6.3 ± 0.8 amp
  - Minimum heating time prior to tube conduction........ 15 sec

- **Direct Interelectrode Capacitance (Approx.):**
  - Grid to anode........ 3 μf
  - Ionization Time (Approx.)........ 10 μsec
  - Deionization Time (Approx.)........ 1000 μsec

- **Maximum Critical Grid Current**........ 10 μa

- **Peak Tube Voltage Drop at anode**
  - amperes........ 8 volts

**Mechanical:**

- **Operating Position**........ Vertical, base down

- **Maximum Overall Length**........ 4-3/8" to 1.562"

- **Weight (Approx.)**........ 3 oz

- **Bulb**........ T12

- **Socket**........ Medium-Shell Small 4-Pin with Bayonet (JEDEC No.A4-10)

**Basing Designation for BOTTOM VIEW**........ 4D

- **Pin 1 - Filament**
- **Pin 2 - Anode**
- **Pin 3 - Grid**
- **Pin 4 - Filament**

**Thermal:**

- **Type of Cooling**........ Convection

- **Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.)**........ 30 °C

**GRID-CONTROLLED-RECTIFIER SERVICE**

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

For anode-supply frequency of 60 cps

- **PEAK ANODE VOLTAGE:**
  - Forward........ 1250 max. volts
  - Inverse........ 1250 max. volts

- **PEAK NEGATIVE GRID VOLTAGE:**
  - Before tube conduction........ 500 max. volts
  - During tube conduction........ 10 max. volts
With circuit returns to filament-transformer center-tap.

Without external shield.

Averaged over any interval of 5 seconds maximum.

For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40° and +80° C which corresponds approximately to +10° to +50° C ambient.
Gas and Mercury-Vapor Thyratron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

Filament, Coated:
- Voltage (AC or DC): 2.5 volts
- Current at 2.5 volts: 21 ± 2 amp
- Minimum heating time prior to tube conduction: 60 sec
- Direct Interelectrode Capacitance (Approx.):
  - Grid to anode: 4 μF
  - Ionization Time (Approx.): 10 μsec
  - Deionization Time (Approx.): 1000 μsec
- Maximum Critical Grid Current: 10 μA
- Peak Tube Voltage Drop at anode: 12 volts

Mechanical:

Operating Position: Vertical, base down
- Maximum Overall Length: 9-1/2"
- Maximum Diameter: 2-9/16"
- Weight (Approx.): 9 oz
- Cap: Medium (JEDEC No.C1-5)
- Socket: Super-Jumbo 4-Contact
- Base: Large-Metal-Shell Super-Jumbo 4-Pin with Bayonet (JEDEC No.A4-18)

Basing Designation for BOTTOM VIEW: 4BZ

Thermal:

Type of Cooling: Convection
- Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.): 30°C

GRID-CONTROLLED-RECTIFIER SERVICE

Maximum and Minimum Ratings, Absolute-Maximum Values:
For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:
- Forward: 1500 max. volts
- Inverse: 1500 max. volts

PEAK NEGATIVE GRID VOLTAGE:
- Before tube conduction: 500 max. volts
- During tube conduction: 10 max. volts

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

DATA 5-62
Average \( \text{max.} \) amp = 6.4 max. amp
Fault \( \text{max.} \) amp = 770 max. amp

**CONDENSED-MERCURY TEMPERATURE RANGE**

(Operating) \( \text{d.} \) \( -40 \) to \( +80 \) \(^\circ\text{C}\)

- With circuit returns to filament-transformer center-tap.
- Without external shield.
- Averaged over any interval of 15 seconds maximum.
- For longest life, the operating condensed-mercury temperature range after warm-up should be kept between \( +40\) and \( +80\) \(^\circ\text{C}\) which corresponds approximately to \( +10\) to \( +50\) \(^\circ\text{C}\) ambient.
## GENERAL DATA

### Electrical:

<table>
<thead>
<tr>
<th></th>
<th>Type 884</th>
<th>Type 885</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater</td>
<td>Coated Unpotential Cathode</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>6.3 ±10%</td>
<td>2.5 ±10%</td>
</tr>
<tr>
<td>Current</td>
<td>0.6</td>
<td>1.5</td>
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</table>

### Direct Interelectrode Capacitances:

<table>
<thead>
<tr>
<th>Electrodes</th>
<th>Type 884</th>
<th>Type 885</th>
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</thead>
<tbody>
<tr>
<td>Grid to Anode</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Grid to Cathode</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Anode to Cathode</td>
<td>0.6</td>
<td>0.6</td>
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</table>

### Tube Voltage Drop

<table>
<thead>
<tr>
<th>Type 884</th>
<th>Type 885</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

### Physical:

<table>
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<tr>
<th>Mounting Position</th>
<th>Any</th>
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<tbody>
<tr>
<td>Maximum Overall Length</td>
<td>4-1/8</td>
</tr>
<tr>
<td>Maximum Seated Length</td>
<td>3-9/16</td>
</tr>
<tr>
<td>Maximum Diameter</td>
<td>1-9/16</td>
</tr>
<tr>
<td>Bulb</td>
<td>ST-12</td>
</tr>
<tr>
<td>Base</td>
<td>Small Shell</td>
</tr>
<tr>
<td>Basing Designation</td>
<td>G-602</td>
</tr>
<tr>
<td>Pin 1 - No Connection</td>
<td>Pin 1 - Heater</td>
</tr>
<tr>
<td>Pin 2 - Heater</td>
<td>Pin 2 - Anode</td>
</tr>
<tr>
<td>Pin 3 - Anode</td>
<td>Pin 3 - Grid</td>
</tr>
<tr>
<td>Pin 5 - Grid</td>
<td>Pin 4 - Cathode</td>
</tr>
<tr>
<td>Pin 7 - Heater</td>
<td>Pin 5 - Heater</td>
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</table>

### Tube Designation

<table>
<thead>
<tr>
<th>Pin 1</th>
<th>Pin 2</th>
<th>Pin 3</th>
<th>Pin 4</th>
<th>Pin 5</th>
<th>Pin 6</th>
<th>Pin 7</th>
<th>Pin 8</th>
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</thead>
<tbody>
<tr>
<td>No Connection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

### Bottom Views

#### RELAXATION OSCILLATOR — Sweep-Circuit Service

Maximum Ratings, Absolute Values:

- PEAK ANODE VOLTAGE: 300 max. volts
- PEAK CATHODE CURRENT: 300 max. ma.
- PEAK GRID CURRENT: 1 max. ma.
- PEAK VOLTAGE BETWEEN ANY TWO ELECTRODES OR BETWEEN ANY ELECTRODE AND HEATER: 350 max. volts
- D-C HEATER-CATHODE POTENTIAL: -100 to +25 volts
- AMBIENT TEMPERATURE RANGE: -75 to +90 °C

For best life results, it is desirable to delay tube conduction for about 10 seconds after applying heater voltage in order to allow the cathode to reach normal operating temperature.

In sweep circuits designed so that the peak cathode current of 300 milliamperes will not be exceeded during condenser discharge, the resultant average cathode current is so small in comparison with the average-current capability of the cathode that a maximum rating for average cathode current is omitted because it has no practical significance.

The resistance of the grid resistor should be not less than 1000 ohms per maximum instantaneous volt applied to the grid. Resistance values in excess of 500000 ohms may cause circuit instability.

--- Indicates a change.

DEC. 15, 1944  RCA VICTOR DIVISION  DATA 1
THYRATRONS

(continued from preceding page)

RELAY & GRID-CONTROLLED RECTIFIER SERVICE

At Frequencies Below 75 Cycles per Second

Maximum Ratings, Absolute Values:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEAK ANODE VOLTAGE</td>
<td>350 max. volts</td>
</tr>
<tr>
<td>PEAK CATHODE CURRENT</td>
<td>300 max. ma.</td>
</tr>
<tr>
<td>AVERAGE CATHODE CURRENT</td>
<td>75 max. ma.</td>
</tr>
<tr>
<td>PEAK VOLTAGE BETWEEN ANY TWO ELECTRODES OR BETWEEN ANY ELECTRODE AND HEATER</td>
<td>350 max. volts</td>
</tr>
<tr>
<td>D-C HEATER-CATHODE POTENTIAL</td>
<td>-100 to +25 volts</td>
</tr>
<tr>
<td>AMBIENT TEMPERATURE RANGE</td>
<td>-75 to +90 °C</td>
</tr>
</tbody>
</table>

The heater voltage should be applied for 10 seconds before tube conduction occurs.

* For an averaging period of 30 seconds.

---

Indicates a change.

DEC. 15, 1944

RCA VICTOR DIVISION

RADIO CORPORATION OF AMERICA, HAIGHTON, NEW JERSEY

DATA 1
884

LINEAR SWEEP-CIRCUIT
OSCILLATOR AND AMPLIFIER

**Approximate Frequency Range (Cycles/Sec.)**

<table>
<thead>
<tr>
<th>SWITCH ($s_1$) ON</th>
<th>$C_2$</th>
<th>$C_3$</th>
<th>$C_4$</th>
<th>$C_5$</th>
<th>$C_6$</th>
<th>$C_7$</th>
<th>$C_8$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_6$ at MAX.</td>
<td>20</td>
<td>40</td>
<td>110</td>
<td>280</td>
<td>670</td>
<td>1500</td>
<td>3600</td>
</tr>
<tr>
<td>$R_6$ at MIN.</td>
<td>60</td>
<td>130</td>
<td>340</td>
<td>880</td>
<td>2200</td>
<td>8900</td>
<td>11400</td>
</tr>
</tbody>
</table>

The license extended to the purchaser of tubes appears in the License Notice accompanying them. Information contained herein is furnished without assuming any obligations. Indicates a change.

DEC, 15, 1944

RCA VICTOR DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
AVERAGE CONTROL CHARACTERISTIC

$E_p = 6.3 \text{ VOLTS}$
VOLTAGE REGULATOR

Type                      Glow Discharge
Maximum Overall Length    1-9/16"     991
Maximum Diameter          5/8"
Bulb                      T-4-1/2
Base                      Bayonet Candelabra, Double Contact

Operating Conditions:
Starting-Supply Voltage (D.C.) 87 min. volts
Peak Current"               3 max. ma.
Continuous Current (D.C.)**  2 max. ma.
Operating VoltageΔ          67 max. volts
                           48 min. volts

* If the 991 is used with a pulsating or alternating supply voltage, the peak current should be limited to 3 ma.
** Sufficient resistance must always be used in series with this tube to limit its d-c current to 2 ma.
Δ For d-c operating current between 0.4 and 2 ma.

TUBE MOUNTING POSITION
VERTICAL OR HORIZONTAL

REGULATION CHARACTERISTIC

STARTING 1 VOLTAGE

OPERATION NOT RECOMMENDED

DEC. 1, 1939
RCA RADIotron DIVISION
RCA MANUFACTURING COMPANY INC.
1946 VACUUM-GAUGE TUBE
THERMOCOUPLE TYPE

DATA

General:
Heater, for Thermocouple:
  Voltage (Approx.) ... 1 ac or dc volts
  Current ... 0.070 amp
Resistance of Thermocouple ... 5 approx. ohms
Maximum Overall Length (with tubulation) ... 6-1/4" in
Maximum Diameter ... 1-11/16"
Bulb ... T-12
Tubulation ... 3/8" Diameter Hard Glass, Corning Code 772 Nonex

Mounting Position ... Any
Terminal Arrangement ... See Outline Drawing
Terminal Connections:

H - Heater
TC - Thermocouple

Calibration:
See next page.

"MEASURED FROM BULB END TO BULB-TOP LINE AS DETERMINED BY RING GAUGE OF 1/2" I.D.
**BROWN HEATER LEAD SHOULD BE CONNECTED TO POSITIVE TERMINAL OF DC HEATER SUPPLY. 92C3-8815
1947 VACUUM-GAUGE TUBE

PIRANI TYPE

DATA

General:
Filament, Platinum Iridium:
Voltage (Approx.): 10 dc volts
Current (Varies with Gas Pressure): 70 - 100 ma.
Resistance between base pins No.1 & No.2 under vacuum better than 3 x 10⁻⁵ mm of mercury: 135.8 ohms
Maximum Overall Length (including tubulation): 7-9/16"
Maximum Diameter: 1-3/16"
Bulb: T-9
Tubulation: 7/32" Diameter Soft Glass, Corning Code 001 Lead
Mounting Position: Any
Base: Small-Shell Small 4-Pin

Pin 1 - Filament
Pin 2 - Filament
Pin 3 - No Connection
Pin 4 - Internal Connection - Do Not Use

Maximum Ratings, Absolute Values:
FILAMENT VOLTAGE: 16 max. volts

Calibration for 1947 in Accompanying Circuit:
See curve on following sheet.

PIRANI GAUGE BRIDGE CIRCUIT

R1: 50 ohms  R3 + METER: 15 ohms  R6: 120.7 ohms
R2: 25 ohms  R4 R5: 10 ohms each  R7: 135.8 ohms
STEP 1: With switch S in position 2, adjust R2 so that meter reads 2.5 milliamperes.
STEP 2: With switch S in position 1, and with dry air at atmospheric pressure in the 1947, adjust R1 so that meter reads 5.0 milliamperes.
STEP 3: With no further adjustments and with switch S in position 1, proceed to use gauge.

JUNE 20, 1947
TUBE DEPARTMENT
TENTATIVE DATA
RADIO CORPORATION OF AMERICA, HARISON, NEW JERSEY
SOFT GLASS
CORNING CODE
001 LEAD

1 3/16 MAX.
TO BULB

SMALL-SHELL
SMALL 4-PIN
BASE

\frac{7}{32}" APPROX.

7 \frac{9}{16}" MAX.

\frac{3}{16}" APPROX.

MEASURED FROM END OF BASE PINS TO BULB-TOP LINE AS DETERMINED BY RING GAUGE OF \frac{1}{2}" I.D.

92CS-6816
CALIBRATION CURVE
FOR USE WITH CIRCUIT ON DATA PAGE

GAS = DRY AIR
TO CONVERT MM TO MICRONS,
MULTIPLY VALUES BY 1000.

MARCH 10, 1947
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
1949

VACUUM-GAUGE TUBE
HARD—GLASS BULB, IONIZATION TYPE

DATA

General:
Filament, Tungsten:
Voltage (Approx.) .......... 5 .... ac or dc volts
Current (Approx.) ....... 3.5 ... amp
Maximum Tube Length (Including tubulation) ...... 11-1/2"
Maximum Tube Radius ........ 2-3/16"
Maximum Bulb Length .......... 5-1/8"
Maximum Bulb Diameter ...... 2-1/16"
Bulb .................. T-16
Tubulation ................. 1/2" Diameter Hard Glass,
Corning Code 772 Nonex
Operating Position .......... Vertical with tubulation up or
donw.; Horizontal, with stem
press in vertical plane
Terminal Arrangement ......... See Outline Drawing
Terminal Lead Connections:
Lead 1—Common
Lead to Filaments
Lead 2—Filament
Lead 3—Filament( Spare)
Lead 4—Grid

Maximum Ratings, Absolute Values:
FILAMENT VOLTAGE .......... 6.5 max. volts
DC PLATE VOLTAGE DURING OPERATION ...... -100 max. volts
DC GRID VOLTAGE DURING OPERATION ....... +200 max. volts
VOLTAGE ON GRID & PLATE TIED TOGETHER DURING DEGASSING (DC OR PEAK AC) . 650 max. volts
GRID & PLATE DISSIPATION (TOTAL) DURING DEGASSING .......... 150 max. watts
AMBIENT TEMPERATURE DURING OPERATION .......... 100 max. °C
GAS PRESSURE .......... 0.001 max. mm of Hg

Typical Degassing Conditions:
Grid Connected to Plate
Filament Voltage (AC or DC) ...... 6 6 volts
Grid & Plate Voltage .......... 350 rms 500 dc volts
Grid & Plate Current (Average) ... 100 150 ma

Typical Operation:
DC Plate Voltage ........ -22.5 -22.5 -22.5 volts

* The 1949 contains two filaments, one of which is a spare. Values shown are for either filament operated alone. The filament voltage should be kept as low as possible during degassing because use of a low filament voltage materially increases filament life.

MARCH 1, 1954
TUBE DEPARTMENT
RCA CORPORATION OF AMERICA, HARRISON, NEW JERSEY
### VACUUM-GAUGE TUBE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Voltage</th>
<th>Current</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Grid Voltage</td>
<td>±80</td>
<td>±110</td>
<td>±160</td>
</tr>
<tr>
<td>Grid Current</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>
| Sensitivity             | 80      | 110     | 140         | µa/micron

**Calibration:**

See curve on following sheet.

1 micron = 0.001 mm of mercury.

---

**Diagram:**

- **PLATE**: 1 3/16 aprox.
- **7/8**: 0.050 Dia.
- **6 3/8**: Max.
- **1/2**: Dia. approx.
- **HARD GLASS CORNING CODE 772 NONEX**
- **T16 BULB**: 11 1/2 max.
- **2 3/4**: Max.
- **4 1/2**: approx.
- **GRID**: 4 1/2 aprox.
- **4 TERMINAL LEADS**: 0.050 Dia.
- **COMMON LEAD TO FILAMENTS**
- **FILAMENT (SPARE)**
- **FILAMENT**

**Code:** 92CS-6617

---

**MARCH 1, 1954**

**TUBE DEPARTMENT**

**BANDO CORPORATION OF AMERICA, MESSON, NEW JERSEY**
CALIBRATION CURVES

GAS = DRY AIR
GRID MILLIAMPERES (I_C) = 10
PLATE VOLTS (E_B) = -22.5
TO CONVERT MM TO MICRONS,
MULTIPLY VALUES BY 1000

GRID VOLTAGE (E_C) = +80
+110
+160
2050 THYRATRON GAS TETRODE

GENERAL DATA

**Electrical:**

Heater, for Unipotential Cathode:  
Voltage (AC or DC) ....... 5.7  6.3  6.9 volts  
Current, with heater volts = 6.3 .... 0.54  0.60  0.66 amp  

Cathode:  
Heating Time, prior to tube conduction ..... 10 sec  

Direct Interelectrode Capacitances (Approx.):
  Grid No.1 to Anode ....... 0.26 µµf  
  Input ................. 4.2 µµf  
  Output ............... 3.6 µµf  

Ionization Time (Approx.):  
For conditions: dc anode volts = 100; grid-No.1 square-pulse volts = 50; and peak anode amp. during conduction = 1.0 ......... 0.5 µsec  

Deionization Time (Approx.):  
For conditions: dc anode volts = 125; grid-No.1 volts = -250; grid-No.1 resistor (ohms) = 1000; dc anode amp. = 0.1 ......... 50 µsec  
For conditions: dc anode volts = 125; grid-No.1 volts = -10; grid-No.1 resistor (ohms) = 1000; dc anode amp. = 0.1 ......... 100 µsec  

Maximum Critical Grid Current, with ac anode-supply volts (rms) = 460, and average anode amp. = 0.1 .......... 0.5 µamp  

Tube Voltage Drop (Approx.) .......... 8 volts  

Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0; grid-No.2 volts = 0 ......... 250  
Grid-No.2 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0; grid-No.2 resistor (megohms) = 0; grid-No.1 volts = 0 ......... 800  

* Without external shield.

**Mechanical:**

Mounting Position ......... Any  
Maximum Overall Length ......... 4-1/8"  
Maximum Seated Length ......... 3-9/16"  
Maximum Diameter ......... 1-9/16"  
Bulb ............... ST-12  
Base ............... Small-Shell Octal 8-Pin  

Basing Designation for BOTTOM VIEW ......... 6BS  

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

Pin 5 — Grid No.1  
Pin 6 — Grid No.2  
Pin 7 — Heater  
Pin 8 — Cathode  

* Indicates a change.

JUNE 15, 1948

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
## Maximum Ratings, Absolute Values:

### PEAK ANODE VOLTAGE:
- **Forward.**
  - 180 max. 650 max. volts
- **Inverse.**
  - 360 max. 1300 max. volts

### GRID-No.2 (SHIELD-GRID) VOLTAGE:
- **Peak, before anode conduction.**
  - -100 max. -100 max. volts
- **Average, during anode conduction.**
  - -10 max. -10 max. volts

### GRID-No.1 (CONTROL-GRID) VOLTAGE:
- **Peak, before anode conduction.**
  - 250 max. 250 max. volts
- **Average, during anode conduction.**
  - -10 max. -10 max. volts

### CATHODE CURRENT:
- **Peak.**
  - 1.0 max. 1.0 max. amp
- **Average.**
  - 0.2 max. 0.1 max. amp
- **Surge, for duration of 0.1 sec. max.**
  - 10 max. 10 max. amp

### GRID-No.2 CURRENT:
- **Average.**
  - +0.01 max. +0.01 max. amp

### GRID-No.1 CURRENT:
- **Average.**
  - +0.01 max. +0.01 max. amp

### PEAK HEATER-CATHODE VOLTAGE:
- **Heater negative with respect to cathode.**
  - 100 max. 100 max. volts
- **Heater positive with respect to cathode.**
  - 25 max. 25 max. volts

### AMBIENT TEMPERATURE RANGE:
- -75 to +90 °C

## Typical Operating Conditions for Relay Service:
- **RMS Anode Voltage.**
  - 117 400 volts
- **Grid-No.2 Voltage.**
  - 0 0 volts
- **RMS Grid-No.1 Bias Voltage.**
  - 5 6 volts
- **DC Grid-No.1 Bias Voltage.**
  - -6 volts
- **Peak Grid-No.1 Signal Voltage.**
  - 6 volts
- **Grid-No.1-Circuit Resistance.**
  - 1.0 1.0 megohms
- **Anode-Circuit Resistance.**
  - 1200 2000 ohms

## Maximum Circuit Values:
- **Grid-No.1-Circuit Resistance:**
  - For average anode current below 0.1 amp. 10 max. megohms
  - For average anode current above 0.1 amp. 2 max. megohms

---

* Averaged over any interval of 30 sec. max.
* Approximately 180° out of phase with the anode voltage.
* Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.
* Indicates a change.

---

**JUNE 15, 1948**

TUBE DEPARTMENT

BHBO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

TYPE 2050  GRID-N° 2 VOLTS=0
RANGES SHOWN ARE FOR TWO VALUES OF GRID RESISTOR - 0.1 MEG. AND 10 MEG.- AND TAKE INTO ACCOUNT INITIAL DIFFERENCES BETWEEN INDIVIDUAL TUBES & SUBSEQUENT DIFFERENCES DURING TUBE LIFE, FOR A HEATER-VOLTAGE RANGE OF 5.7 TO 6.9 VOLTS.

Range for 10 Megohms  Range for 0.1 Megohm

AC ANODE VOLTS (RMS-60')

500
400
300
200
100

DC GRID-N°1 SUPPLY VOLTS

92CM-6540T1

JUNE 15, 1948  RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

TUBE DEPARTMENT  CE-6540T1
AVERAGE GRID CHARACTERISTICS DURING ANODE CONDUCTION

TYPE 2050
$E_F = 6.3$ VOLTS
SHIELD-GRID VOLTS = 0

D-C ANODE VOLTS = 25

0

D-C CONTROL-GRID VOLTS

92CM-6275T

AVERAGE GRID CHARACTERISTICS BEFORE ANODE CONDUCTION

TYPE 2050
$E_F = 6.3$ VOLTS
SHIELD-GRID VOLTS = 0

D-C ANODE VOLTS = 25

0.016

D-C CONTROL-GRID MICROAMPERES

92CM-6541T
Gas Thyratron

TETRODE TYPE
For Relay and Grid-Controlled-Rectifier Service

GENERAL DATA

Electrical:
Heater, for Unipotential Cathode:
Voltage (AC or DC).......................... 6.3 ± 10% volts
Current at 6.3 volts.......................... 0.6 amp
Cathode:
Minimum heating time prior to tube conduction........ 10 sec
Direct Interelectrode Capacitances (Approx.):^a
Grid No.1 to anode........................... 0.15 µf
Grid No.1 to cathode and grid No.2........... 2.2 µf
Ionization Time (Approx.):
For dc anode volts = 100, grid-No.1 volts (square-wave pulse) = 50, peak anode amperes during conduction = 1 .... 0.5 µsec
Deionization Time (Approx.):
With dc anode volts = 125, grid-No.1 volts = -250, grid-No.1 resistor (ohms)
= 1000, dc anode amperes = 0.1 ........ 50 µsec
With dc anode volts = 125, grid-No.1 volts = -10, grid-No.1 resistor (ohms)
= 1000, dc anode amperes = 0.1 ....... 100 µsec
Maximum Critical Grid-No.1 Current for dc anode supply volts (rms) = 460,
average anode amperes = 0.1 ........ 0.5 µa
Anode Voltage Drop (Approx.).................. 8 volts
Grid-No.1 Control Ratio (Approx.) for grid-No.1 resistor (ohms) = 0, grid No.2 connected to cathode at socket.......... 250
Grid-No.2 Control Ratio (Approx.) for grid-No.1 resistor (ohms) = 0, grid-No.2 resistor (ohms) = 0, grid No.1 connected to cathode at socket......... 800

Mechanical:
Operating Position........................... Any
Maximum Overall Length.................... 3-1/16"
Maximum Seated Length...................... 2-1/2"
Maximum Diameter........................... 1-9/32"
Dimensional Outline......................... See General Section
Bulb........................................ T9
Base......................................... Intermediate-Shell Octal 6-Pin, Arrangement 3, with External Barriers (JEDEC Group 1, B6-229)
**RELAY AND GRID-CONTROLLED-RECTIFIER SERVICE**

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

For anode supply frequency of 60 cps

**PEAK ANODE VOLTAGE:**
- **Forward:** 180 max. 650 max. volts
- **Inverse:** 360 max. 1300 max. volts

**GRID-No.2 (SHIELD-GRID) VOLTAGE:**
- Peak, before tube conduction: -100 max. -100 max. volts
- Average, during tube conduction: -10 max. -10 max. volts

**GRID-No.1 (CONTROL-GRID) VOLTAGE:**
- Peak, before tube conduction: -250 max. -250 max. volts
- Average, during tube conduction: -10 max. -10 max. volts

**CATHODE CURRENT:**
- Peak: 1 max. 1 max. amp
- Average: 0.2 max. 0.1 max. amp

**Fault, for duration of 0.1 second maximum:**
- 10 max. 10 max. amp

**GRID-No.2 CURRENT:**
- Average: +0.01 max. +0.01 max. amp

**GRID-No.1 CURRENT:**
- Average: +0.01 max. +0.01 max. amp

**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 100 max. 100 max. volts
- Heater positive with respect to cathode: 25 max. 25 max. volts

**AMBIENT-TEMPERATURE RANGE:** -75 to +90°C

**Typical Operation for Relay Service:**
- **RMS Anode Voltage:** 117 400 volts
- **Grid No.2.** Connected to cathode at socket
- **RMS Grid-No.1 Bias Voltage:** 5 volts
- **DC Grid-No.1 Bias Voltage:** -6 volts
- **Peak Grid-No.1 Signal Voltage:** 5 6 volts

**Grid-No.1-Circuit Resistance:**
- Resistance: 1 1 megohm
- Anode-Circuit Resistance: 1200 2000 ohms
Maximum Circuit Values:

Grid-No.1-Circuit Resistance:
For average anode current below
0.1 ampere. .................. 10 max. megohms
For average anode current above
0.1 ampere. .................. 2 max. megohms

a) Without external shield.
b) Averaged over any interval of 30 seconds maximum.
c) Approximately 180° out of phase with the anode voltage.
d) Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.

OPERATING CONSIDERATIONS

The heater is designed to operate on either ac or dc at 6.3 volts. Regardless of the heater-voltage supply used, the heater voltage must never be allowed to deviate from its rated range. Heater operation outside of this voltage range will impair tube performance and may cause tube failure. Low heater voltage causes low cathode temperature with resultant cathode sputtering and consequent destruction of the cathode; high heater voltage causes high cathode temperature with resultant heating of the grid and consequent grid emission which produces unpredictable shifts in the critical grid-No.1 voltage for conduction.

The cathode should be allowed to reach normal operating temperature before anode current is drawn. The delay period should not be less than 10 seconds after application of heater voltage. Unless this recommendation is followed, the cathode will be damaged.

The shield grid (grid No.2) is normally connected to the cathode at socket. It may, however, be used as a control electrode because the control characteristic of grid No.1 may be shifted by varying the potential of grid No.2. As grid No.2 is made negative, the grid-No.1 characteristic is shifted in the positive direction. The use of grid No.2 as the control electrode (with grid No.1 connected to cathode at socket) has the advantage of increased sensitivity but consideration must be given to the higher preconduction current, higher capacitance to anode, and less stability of operation.

A grid-No.1 resistor having a value as high as 10 megohms to give circuit sensitivity can be used with the 2050-A because its control-grid current is very low. However, when a high value of grid resistor is used, care should be taken to keep the tube base and socket clean and dry in order to make the effect of leakage currents between the control-grid base pin and anode base pin very small.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.
During Tube Conduction

$E_f = 6.3$ V

GRID No. 2 CONNECTED TO CATHODE AT SOCKET.

0 = CONDUCTION STARTS

DC ANODE VOLTS = 25

DC GRID - No. 1 VOLTS

RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.
OPERATIONAL RANGE OF CRITICAL GRID-No.1 VOLTAGE

\[ E_g = 6.3 \pm 10\% \text{ VOLTS} \]

GRID No.2 connected to cathode at socket.

Ambient-temperature range \( ^\circ\text{C} \) = -75 to +90

Ranges shown are for two values of GRID-No.1 resistor and take into account initial differences between individual tubes and subsequent differences during tube life.

AC ANODE VOLTS (RMS-60 CPS)

<table>
<thead>
<tr>
<th>DC GRID-No.1 SUPPLY VOLTS</th>
<th>NON-CONDUCTING</th>
<th>CRITICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>-8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ranges for 0.1 MEGOHM and 10 MEGOHMS.

92CS-6540R3

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

DATA 3 3-61
AVERAGE CONTROL CHARACTERISTICS

$E_f = 6.3$ VOLTS
GRID-N°2 RESISTOR (OHMS) = 0
GRID-N°1 RESISTOR (OHMS) = 0

DC GRID-N°1 VOLTS

DC ANODE VOLTS

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

**SEALED, CLAMP-COOLED, MERCURY-POOL-CATHODE TYPE**

For Resistance-Welding Control

**GENERAL DATA**

**Electrical:**
- Cathode Excitation: Cyclic
- Cathode-Spot Starting: By Ignitor
- Minimum Requirements for Cathode Excitation:
  - Peak ignitor voltage required to fire: 200 volts
  - Peak ignitor current required to fire: 30 amp
  - Starting time at required voltage or current: 100 µsec

**Tube Voltage Drop:**
- At peak anode current of 1697 amperes: 30 volts
- At peak anode current of 70.4 amperes: 12 volts

**Mechanical:**
- Operating Position: Vertical, flexible lead up
- Maximum Overall Length (including flexible lead): 17-5/8"
- Maximum Diameter: 2-1/2"
- Weight (Approx.): 1.5 lbs
- Terminal Diagram (See Dimensional Outline):

![Terminal Diagram](attachment:terminal_diagram.png)

- P - Anode
- K - Cathode
- I - Ignitor

**Cooling:**
- Type: Air or water-cooled clamp
- Clamp height (Approx.): 1-7/8"
- Clamp location: See Dimensional Outline

**RESISTANCE-WELDING-CONTROL SERVICE**

Two Tubes in Inverse-Parallel Circuit

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

For frequencies from 25 to 60 cps

Ratings I-A and I-B Apply to Operation with a Clamp-Temperature Range of 10° to 75° C

**RATING I-A**

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY VOLTAGE (RMS)</td>
<td>250 max.</td>
</tr>
<tr>
<td>DEMAND POWER (During-conduction)</td>
<td>50 max.</td>
</tr>
</tbody>
</table>

---

**Indicates a change.**
<table>
<thead>
<tr>
<th>Column _b</th>
<th>Column _b</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUTY_c,_d</td>
<td>10 max.</td>
</tr>
</tbody>
</table>

**ANODE CURRENT (Per tube):**

- Peak | 282 max. | 846 max. | amp |
- Demand (RMS, during conduction) | 200 max. | 600 max. | amp |
- Average (Averaged over any interval of 27.8 seconds maximum) | 9 max. | 4.86 max. | amp |
- Fault, for duration of 0.15 second maximum | 1680 max. | 1680 max. | amp |

**RATING I-B**

<table>
<thead>
<tr>
<th>Column _b</th>
<th>Column _b</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY VOLTAGE (RMS)</td>
<td>600 max.</td>
</tr>
<tr>
<td>DEMAND POWER (During conduction)</td>
<td>50 max.</td>
</tr>
<tr>
<td>DUTY_c,_d</td>
<td>24 max.</td>
</tr>
</tbody>
</table>

**ANODE CURRENT (Per tube):**

- Peak | 118 max. | 354 max. | amp |
- Demand (RMS, during conduction) | 83 max. | 250 max. | amp |
- Average (Averaged over any interval of 11.6 seconds maximum) | 9 max. | 4.86 max. | amp |
- Fault, for duration of 0.15 second maximum | 700 max. | 700 max. | amp |

Ratings II-A and II-B Apply to Operation with a Clamp-Temperature Range of 10\(^\circ\) to 50\(^\circ\) C

**RATING II-A**

<table>
<thead>
<tr>
<th>Column _b</th>
<th>Column _b</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY VOLTAGE (RMS)</td>
<td>250 max.</td>
</tr>
<tr>
<td>DEMAND POWER (During conduction)</td>
<td>100 max.</td>
</tr>
<tr>
<td>DUTY_c,_d</td>
<td>12.4 max.</td>
</tr>
</tbody>
</table>

**ANODE CURRENT (Per tube):**

- Peak | 564 max. | 1692 max. | amp |
- Demand (RMS, during conduction) | 400 max. | 1200 max. | amp |
- Average (Averaged over any interval of 2.2 seconds maximum) | 22.4 max. | 12.1 max. | amp |
- Fault, for duration of 0.15 second maximum | 3360 max. | 3360 max. | amp |

**RATING II-B**

<table>
<thead>
<tr>
<th>Column _b</th>
<th>Column _b</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY VOLTAGE (RMS)</td>
<td>600 max.</td>
</tr>
<tr>
<td>DEMAND POWER (During conduction)</td>
<td>100 max.</td>
</tr>
<tr>
<td>DUTY_c,_d</td>
<td>30 max.</td>
</tr>
<tr>
<td>Parameter</td>
<td>RATING I</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td><strong>ANODE CURRENT (Per tube)</strong></td>
<td></td>
</tr>
<tr>
<td>Peak</td>
<td>236 max.</td>
</tr>
<tr>
<td>Demand (RMS, during conduction)</td>
<td>167 max.</td>
</tr>
<tr>
<td>Average (Averaged over any interval of 9.2 seconds maximum)</td>
<td>22.4 max.</td>
</tr>
<tr>
<td>Fault, for duration of 0.15 second maximum</td>
<td>1400 max.</td>
</tr>
<tr>
<td><strong>RESISTANCE-WELDING CAPACITOR-DISCHARGE SERVICE</strong></td>
<td>Maximum Ratings, Absolute-Maximum Values:</td>
</tr>
<tr>
<td><strong>RATING I</strong></td>
<td></td>
</tr>
<tr>
<td>CLAMP TEMPERATURE</td>
<td>70 max.</td>
</tr>
<tr>
<td>NUMBER OF DISCHARGES PER SECOND</td>
<td>60 max.</td>
</tr>
<tr>
<td>PEAK ANODE VOLTAGE:</td>
<td></td>
</tr>
<tr>
<td>Forward</td>
<td>3000 max.</td>
</tr>
<tr>
<td>Inverse</td>
<td>3000 max.</td>
</tr>
<tr>
<td>ANODE CURRENT</td>
<td></td>
</tr>
<tr>
<td>Peak</td>
<td>500 max.</td>
</tr>
<tr>
<td>Average</td>
<td>3.3 max.</td>
</tr>
<tr>
<td><strong>IGNITOR</strong></td>
<td>Maximum Ratings, Absolute-Maximum Values:</td>
</tr>
<tr>
<td>PEAK IGNITOR VOLTAGE:</td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>900 max.</td>
</tr>
<tr>
<td>Negative</td>
<td>5 max.</td>
</tr>
</tbody>
</table>

*Indicates a change.*
RMS Voltage, current, and demand kVA are on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

b Column 1 represents operation at maximum average anode current; Column 2 represents operation at maximum demand power.

c Defined as \((\text{cycles} \cdot \text{on})/(\text{cycles} \cdot \text{on} + \text{cycles} \cdot \text{off})\) during the specified averaging time.

d For supply voltages between 250 volts and 600 volts, duty is proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

e For supply voltages between 250 volts and 600 volts, demand anode current and averaging time are each inversely proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

f With the use of log-log paper, straight-line interpolation between tabulated points may be used to obtain average-anode-current and maximum-averaging-time ratings at clamp temperatures between the two tabulated values.
NOTE: CATHODE TERMINAL AND CLAMP-COOLED AREA.
### Resistance-Welding-Control Service

**RATING CHART 1**

Two tubes connected in inverse parallel.

**CLAMP TEMPERATURE (°C) = 10 TO 50**

<table>
<thead>
<tr>
<th>CURVE</th>
<th>RMS ANODE SUPPLY VOLTS</th>
<th>MAXIMUM AVERAGING TIME—SECONDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250</td>
<td>22</td>
</tr>
<tr>
<td>B</td>
<td>500</td>
<td>11</td>
</tr>
<tr>
<td>C</td>
<td>600</td>
<td>9.2</td>
</tr>
</tbody>
</table>

**CONDUCTION TIME (SECONDS) = 0.5**

---

**RADIO CORPORATION OF AMERICA**
Electron Tube Division
Harrison, N. J.
RATING CHART 2
Resistance-Welding-Control Service

TWO TUBES CONNECTED IN INVERSE PARALLEL.
CLAMP TEMPERATURE (°C) = 10 TO 50
RMS ANODE SUPPLY VOLTS = 250 TO 600

AVERAGE ANODE AMPERES

DEMAND - KVA

10 20 30 40 50 60 70 80 90 100

92CS-10842RI
IGNITRON
WATER-COOLED, STEEL-JACKETED, MERCURY-POOL-CATHODE
TYPE HAVING MOUNTING PLATE FOR THERMOSTATIC CONTROL
For resistance-welding control

GENERAL DATA

Electrical:
Cathode Excitation.............................. Cyclic
Cathode-Spot Starting........................... By Ignitor
Minimum Requirements for Cathode Excitation:
  Peak ignitor voltage required to fire........... 200 volts
  Peak ignitor current required to fire........... 30 amp
  Starting time at required voltage or current.... 100 µsec
Tube Voltage Drop:
  At peak anode current of 3400 amperes........... 26 volts
  At peak anode current of 176 amperes........... 13 volts

Mechanical:
Operating Position............................. Vertical, flexible lead up
Maximum Overall Length (Including flexible lead)...... 23-1/4"
Maximum Radius (Including water connections).......... 2-7/8"
Weight........................................ 3.6 lbs

Terminal Connections (See Dimensional Outline):
P - Anode
  Terminal (Flexible lead)
K - Cathode
  Terminal (Bar opposite anode terminal)
  (Within jacket skirt at cathode end)
I - Ignitor
  Terminal (Within jacket)

Cooling:
Type........................................ Water
Minimum inlet water temperature.................. 10 °C
Maximum outlet water temperature............... 40 °C
Minimum water flow............................ 1 gpm
Maximum water-temperature rise................... 4 °C
Maximum pressure drop........................... 2.5 psi

INTERMITTENT RECTIFIER SERVICE
and FREQUENCY-CHANGER WELDER SERVICE

Maximum Ratings, Absolute-Maximum Values:
For zero phase-control angle and frequencies from 50 to 60 cps

RATING I

PEAK ANODE VOLTAGE:
  Forward..................................... 500 max. volts
  Inverse..................................... 500 max. volts
ANODE CURRENT:
- Peak: 700 max. amp
- Average (Averaged over any interval of 6 seconds maximum): 40 max. amp
- Fault, for duration of 0.15 second maximum: 8750 max. amp

RATING I

PEAK ANODE VOLTAGE:
- Forward: 1200 max. volts
- Inverse: 1200 max. volts

ANODE CURRENT:
- Peak: 135 max. 600 max. amp
- Average (Averaged over any interval of 10 seconds maximum): 22.5 max. 5 max. amp
- Fault, for duration of 0.15 second maximum: 7500 max. 7500 max. amp

RATING III

PEAK ANODE VOLTAGE:
- Forward: 1500 max. 1500 max. volts
- Inverse: 1500 max. 1500 max. volts

ANODE CURRENT:
- Peak: 108 max. 480 max. amp
- Average (Averaged over any interval of 10 seconds maximum): 18 max. 4 max. amp
- Fault, for duration of 0.15 second maximum: 6000 max. 6000 max. amp

RESISTANCE-WELDING-CONTROL SERVICE*

Two Tubes in Inverse-Parallel Circuit

Maximum Ratings, Absolute-Maximum Values:
- For frequencies from 25 to 60 cps

Ratings I-A and I-B Apply to Operation Either (1) Without Water-Saving Thermostat, or (2) With Water-Saving Thermostat Shunted by Auxiliary Contactor

RATING I-A

SUPPLY VOLTAGE (RMS) .......... 250 max. 250 max. volts
DEMAND POWER (During conduction) .. 200 max. 600 max. kva

* See next page.
<table>
<thead>
<tr>
<th><strong>IGNITRON</strong></th>
<th><strong>RATING I-B</strong></th>
<th><strong>RATING II-A</strong></th>
<th><strong>RATING II-B</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DUTY</strong></td>
<td><strong>15 max. 2.8 max.</strong></td>
<td><strong>DUTY</strong></td>
<td><strong>9.7 max. 1.9 max.</strong></td>
</tr>
<tr>
<td><strong>ANODE CURRENT (Per tube):</strong></td>
<td><strong>1130 max. 3400 max. amp</strong></td>
<td><strong>ANODE CURRENT (Per tube):</strong></td>
<td><strong>1130 max. 3400 max. amp</strong></td>
</tr>
<tr>
<td>Peak</td>
<td><strong>800 max. 2400 max. amp</strong></td>
<td>Demand (RMS, during conduction)</td>
<td><strong>800 max. 2400 max. amp</strong></td>
</tr>
<tr>
<td>Demand (RMS, during conduction)</td>
<td><strong>56 max. 30.2 max. amp</strong></td>
<td>Average (Averaged over any interval of 18 seconds maximum)</td>
<td><strong>56 max. 30.2 max. amp</strong></td>
</tr>
<tr>
<td>Fault, for duration of 0.15 second maximum</td>
<td><strong>6720 max. 6720 max. amp</strong></td>
<td>Fault, for duration of 0.15 second maximum</td>
<td><strong>6720 max. 6720 max. amp</strong></td>
</tr>
<tr>
<td>SUPPLY VOLTAGE (RMS)</td>
<td><strong>600 max. 600 max. volts</strong></td>
<td>SUPPLY VOLTAGE (RMS)</td>
<td><strong>250 max. 250 max. volts</strong></td>
</tr>
<tr>
<td>DEMAND POWER (During conduction)</td>
<td><strong>200 max. 600 max. kva</strong></td>
<td>DEMAND POWER (During conduction)</td>
<td><strong>200 max. 600 max. kva</strong></td>
</tr>
<tr>
<td>DUTY**</td>
<td><strong>37 max. 6.7 max. %</strong></td>
<td>DUTY**</td>
<td><strong>23 max. 4.7 max. %</strong></td>
</tr>
<tr>
<td>ANODE CURRENT (Per tube):</td>
<td><strong>466 max. 1410 max. amp</strong></td>
<td>ANODE CURRENT (Per tube):</td>
<td><strong>1130 max. 3400 max. amp</strong></td>
</tr>
<tr>
<td>Peak</td>
<td><strong>333 max. 1000 max. amp</strong></td>
<td>Demand (RMS, during conduction)</td>
<td><strong>800 max. 2400 max. amp</strong></td>
</tr>
<tr>
<td>Demand (RMS, during conduction)</td>
<td><strong>56 max. 30.2 max. amp</strong></td>
<td>Average (Averaged over any interval of 25.6 seconds maximum)</td>
<td><strong>36 max. 21 max. amp</strong></td>
</tr>
<tr>
<td>Fault, for duration of 0.15 second maximum</td>
<td><strong>2800 max. 2800 max. amp</strong></td>
<td>Fault, for duration of 0.15 second maximum</td>
<td><strong>6720 max. 6720 max. amp</strong></td>
</tr>
</tbody>
</table>

Ratings II-A and II-B Apply to Operation with Water-Saving Thermostat Not Shunted by Auxiliary Contactor.
ANODE CURRENT (Per tube):

- Peak: 466 max. 1410 max. amp
- Demand (RMS, during conduction): 333 max. 1000 max. amp
- Average (Averaged over any interval of 10.7 seconds maximum): 36 max. 21 max. amp
- Fault, for duration of 0.15 second maximum: 925 max. 2800 max. amp

IGNITOR

Maximum Ratings, Absolute-Maximum Values:

- PEAK IGNITOR VOLTAGE:
  - Positive: Equal to anode volts
  - Negative: 5 max. volts

- IGNITOR CURRENT:
  - Peak: 100 max. amp
  - Average (Averaged over any interval of 5 seconds maximum): 1 max. amp
  - RMS: 10 max. amp

RMS voltage, current, and demand kVA are on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

Defined as \((\text{cycles 'on'}/(\text{cycles 'on'} + \text{cycles 'off'}))\) during the specified averaging time.

For supply voltages between 250 volts and 600 volts, duty is proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

For supply voltages between 250 volts and 600 volts, demand anode current and averaging time are each inversely proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

OPERATING CONSIDERATIONS

The 5551-A is equipped for mounting a thermostatic control with a mounting plate calibrated either for controlling the flow of cooling water through the water jacket, or for protection of the ignitron against overheating.

When the cooling water is circulated successively through the water jackets of two or more ignitrons, the water-saving thermostat, if used should be mounted on the ignitron connected directly to the water supply.

The water-saving thermostat, which has normally open contacts, is calibrated to close a circuit energizing a solenoid valve in the water-supply line and thus permit water flow to start when the temperature of the thermostat mounting plate exceeds approximately 35°C. Because of the lag between the heating of the ignitron envelope and the functioning of the water-saving thermostat to start water flow through the water jackets, the ignitron may overheat before the flow of cooling water starts.
Such overheating can be prevented by the use of an auxiliary contactor shunted across the contacts of the water-saving thermostat and actuated by the welding-control switch. The contactor causes the solenoid valve in the water-supply line to open as soon as welding current flows.

If the water-saving thermostat is not shunted by an auxiliary contactor, it will be necessary to use a lower value of maximum average current than that which is specified when the auxiliary contactor is employed. The lower average current value is achieved by increasing the maximum averaging time and decreasing the maximum duty. Although the same maximum conduction time is permitted for both of these operating conditions, the use of the water-saving thermostat alone, without the auxiliary contactor requires a longer interval between successive welds than when the thermostat is shunted by the contactor.

When a protective thermostat is used, it should be mounted on an ignitron from which the cooling water discharges into the drain. The protective thermostat is calibrated to open a set of normally closed contacts at a jacket temperature of approximately 520°C. The opening of these contacts causes a protective device to function. This device may be a relay opening the ignitor firing controls, or preferably, a circuit breaker which removes power from the ignitrons.

Care must be taken to insure that the water jacket of each ignitron is completely filled before power is applied. Tube operation with a partially filled water jacket may cause abnormal heating of the tube envelope, with resultant arc-back which impairs tube life. It is also necessary to arrange the cooling system so as to prevent any draining of the water jackets when the flow of water ceases.
NOTE 1: MAY BE SLOTTED.
NOTE 2: DASHED POSITION MANUFACTURER'S OPTION.
RATING CHARTS
FREQUENCY-CHANGER-WELDER SERVICE

<table>
<thead>
<tr>
<th>CURVE</th>
<th>PEAK ANODE VOLTS FORWARD OR INVERSE</th>
<th>MAXIMUM AVERAGING TIME—SECONDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1200</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>1500</td>
<td>10</td>
</tr>
</tbody>
</table>

0.5-SECOND WELDING TIME

10-SECONDS WELDING TIME

RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
RMS ANODE-SUPPLY VOLTS = 250 TO 600
CURVE A: NO WATER-SAVING THERMOSTAT, OR WATER-SAVING THERMOSTAT SHUNTED BY AUXILIARY CONTACOR.
CURVE B: WATER-SAVING THERMOSTAT WITHOUT AUXILIARY CONTACOR.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
# Resistance-Welding-Control Service

Two tubes connected in inverse parallel, no water-saving thermostat, or water-saving thermostat shunted by auxiliary contactor. Protective thermostat optional.

<table>
<thead>
<tr>
<th>Curve</th>
<th>RMS Anode-Supply Volts</th>
<th>Maximum Averaging Time—Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250</td>
<td>18</td>
</tr>
<tr>
<td>B</td>
<td>500</td>
<td>9</td>
</tr>
<tr>
<td>C</td>
<td>600</td>
<td>7.5</td>
</tr>
</tbody>
</table>

![Graph showing conduction time and demand amperes](image)

Conduction Time = 0.5 Second

Demand Amperes (RMS) in Load

Duty — Per Cent

Electron Tube Division

Radio Corporation of America, Harrison, New Jersey

92CM-9696
RATING CHART
RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
WATER-SAVING THERMOSTAT WITHOUT AUXILIARY CONTROLLER.
PROTECTIVE THERMOSTAT OPTIONAL.

<table>
<thead>
<tr>
<th>CURVE</th>
<th>RMS ANODE-SUPPLY VOLTS</th>
<th>MAXIMUM AVERAGING TIME - SECONDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250</td>
<td>25.6</td>
</tr>
<tr>
<td>B</td>
<td>500</td>
<td>12.8</td>
</tr>
<tr>
<td>C</td>
<td>600</td>
<td>10.7</td>
</tr>
</tbody>
</table>

CONDUCTION TIME = 0.5 SECOND

DEMAND AMPERES (RMS) IN LOAD

DUTY - PER CENT

ELECTRON TUBE DIVISION
RAIDO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
5552-A
IGNITRON
WATER-COOLED, STEEL-JACKETED, MERCURY-POOL-CATHODE TYPE HAVING MOUNTING PLATE FOR THERMOSTATIC CONTROL
for resistance-welding control

GENERAL DATA

Electrical:
Cathode Excitation ........................................... Cyclic
Cathode-Spot Starting ........................................ By Ignitor
Minimum Requirements for Cathode Excitation:
Peak ignitor voltage required to fire .................. 200 volts
Peak ignitor current required to fire ................... 30 amp
Starting time at required voltage or current ........... 100 μsec
Tube Voltage Drop:
At peak anode current of 6800 amperes ............... 28 volts
At peak anode current of 440 amperes ................. 14 volts

Mechanical:
Operating Position ............................................ Vertical, flexible lead up
Maximum Overall Length (Including flexible lead) .... 27-1/4"
Maximum Radius (Including water connections) ...... 3-5/8"
Weight ......................................................... 8 lbs
Terminal Connections (See Dimensional Outline):
P - Anode
  Terminal (Flexible lead)
K - Cathode
  Terminal (Bar opposite anode terminal)
  I - Ignitor
    Terminal (Within jacket skirt at cathode end)

Cooling:
Type .............................................. Water
Minimum inlet water temperature ....................... 10 °C
Maximum outlet water temperature ..................... 40 °C
Minimum water flow ...................................... 1.5 gpm
Maximum water-temperature rise ...................... 6 °C
Maximum pressure drop .................................. 6 psi

INTERMITTENT RECTIFIER SERVICE

Maximum Ratings, Absolute-Maximum Values:
For zero phase-control angle and frequencies from 25 to 60 cps

PEAK ANODE VOLTAGE:
Forward ...................................................... 500 max. volts
Inverse ....................................................... 500 max. volts
**ANODE CURRENT:**

- Peak: 1600 max. amp
- Average (Averaged over any interval of 6 seconds maximum): 100 max. amp
- Fault, for duration of 0.15 second maximum: 6000 max. amp

**RESISTANCE-WELDING-CONTROL SERVICE**

Two Tubes in Inverse-Parallel Circuit

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

For frequencies from 25 to 60 cps

Ratings I-A and I-B Apply to Operation Either (1) Without Water-Saving Thermostat, or (2) With Water-Saving Thermostat Shunted by Auxiliary Contactor

### RATING I-A

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPLY VOLTAGE (RMS)</strong></td>
<td>250 max.</td>
</tr>
<tr>
<td><strong>DEMAND POWER (During conduction)</strong></td>
<td>400 max.</td>
</tr>
<tr>
<td><strong>DUTY</strong></td>
<td>19 max.</td>
</tr>
<tr>
<td><strong>ANODE CURRENT (Per tube):</strong> Peak</td>
<td>2260 max.</td>
</tr>
<tr>
<td>Demand (RMS, during conduction)</td>
<td>1600 max.</td>
</tr>
<tr>
<td>Average (Averaged over any interval of 14 seconds maximum)</td>
<td>140 max.</td>
</tr>
<tr>
<td>Fault, for duration of 0.15 second maximum</td>
<td>13450 max.</td>
</tr>
</tbody>
</table>

### RATING I-B

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SUPPLY VOLTAGE (RMS)</strong></td>
<td>600 max.</td>
</tr>
<tr>
<td><strong>DEMAND POWER (During conduction)</strong></td>
<td>400 max.</td>
</tr>
<tr>
<td><strong>DUTY</strong></td>
<td>47 max.</td>
</tr>
<tr>
<td><strong>ANODE CURRENT (Per tube):</strong> Peak</td>
<td>945 max.</td>
</tr>
<tr>
<td>Demand (RMS, during conduction)</td>
<td>666 max.</td>
</tr>
<tr>
<td>Average (Averaged over any interval of 5.8 seconds maximum)</td>
<td>140 max.</td>
</tr>
<tr>
<td>Fault, for duration of 0.15 second maximum</td>
<td>5600 max.</td>
</tr>
</tbody>
</table>

---

*See next page.*
Ratings II-A and II-B Apply to Operation with Water-Saving Thermostat Not Shunted by Auxiliary Contactor

<table>
<thead>
<tr>
<th></th>
<th>Column 1°</th>
<th>Column 2°</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY VOLTAGE (RMS)</td>
<td>250 max.</td>
<td>250 max.</td>
</tr>
<tr>
<td>DEMAND POWER (During conduction)</td>
<td>400 max.</td>
<td>1200 max.</td>
</tr>
<tr>
<td>DUTY*†</td>
<td>11 max.</td>
<td>2 max.</td>
</tr>
<tr>
<td>ANODE CURRENT (Per tube):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak</td>
<td>2260 max.</td>
<td>6800 max.</td>
</tr>
<tr>
<td>Demand (RMS, during conduction)#</td>
<td>1600 max.</td>
<td>4800 max.</td>
</tr>
<tr>
<td>Average (Averaged over any interval of 23.5 seconds maximum)#</td>
<td>80 max.</td>
<td>43 max.</td>
</tr>
<tr>
<td>Fault, for duration of 0.15 second maximum.</td>
<td>13450 max.</td>
<td>13450 max.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Column 1°</th>
<th>Column 2°</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLY VOLTAGE (RMS)</td>
<td>600 max.</td>
<td>600 max.</td>
</tr>
<tr>
<td>DEMAND POWER (During conduction)</td>
<td>400 max.</td>
<td>1200 max.</td>
</tr>
<tr>
<td>DUTY*†</td>
<td>26 max.</td>
<td>4.8 max.</td>
</tr>
<tr>
<td>ANODE CURRENT (Per tube):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak</td>
<td>945 max.</td>
<td>2830 max.</td>
</tr>
<tr>
<td>Demand (RMS, during conduction)#</td>
<td>666 max.</td>
<td>2000 max.</td>
</tr>
<tr>
<td>Average (Averaged over any interval of 10 seconds maximum)#</td>
<td>80 max.</td>
<td>43 max.</td>
</tr>
<tr>
<td>Fault, for duration of 0.15 second maximum.</td>
<td>5600 max.</td>
<td>5600 max.</td>
</tr>
</tbody>
</table>

IGNITOR

Maximum Ratings, Absolute-Maximum Values:

PEAK IGNITOR VOLTAGE:
- Positive: Equal to anode volts
- Negative: 5 max. volts

IGNITOR CURRENT:
- Peak: 100 max. amp
- Average (Averaged over any interval of 5 seconds maximum): 1 max. amp
- RMS: 10 max. amp

* See next page.
RMS voltage, current, and demand kva are on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

Defined as (cycles "on")/(cycles "on" + cycles "off") during the specified averaging time.

For supply voltages between 250 volts and 600 volts, duty is proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

For supply voltages between 250 volts and 600 volts, demand anode current and averaging time are each inversely proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

Column 1 represents operation at maximum average anode current; Column 2 represents operation at maximum demand current.

OPERATING CONSIDERATIONS
for the 5552-A are the same as those shown for Type 5551-A
NOTE 1: MAY BE SLOTTED.
NOTE 2: DASHED POSITION AT MANUFACTURER'S OPTION.

RATING CHART
RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
RMS ANODE-SUPPLY VOLTS = 250 TO 600

CURVE A: NO WATER-SAVING THERMOSTAT, OR
WATER-SAVING THERMOSTAT SHUNTED BY
AUXILIARY CONTACTOR.

CURVE B: WATER-SAVING THERMOSTAT,
WITHOUT AUXILIARY CONTACTOR.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
### Resistance-Welding-Control Service

Two tubes connected in inverse parallel.

No water-saving thermostat, or water-saving thermostat shunted by auxiliary contactor. Protective thermostat optional.

<table>
<thead>
<tr>
<th>Curve</th>
<th>RMS Anode-Supply Volts</th>
<th>Maximum Averaging Time—Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250</td>
<td>14</td>
</tr>
<tr>
<td>B</td>
<td>500</td>
<td>7</td>
</tr>
<tr>
<td>C</td>
<td>600</td>
<td>5.8</td>
</tr>
</tbody>
</table>

**Demand Amperes (RMS) in Load**

- Conduction time = 0.5 second

**Duty—Per Cent**

Electron Tube Division

Radio Corporation of America, Harrison, New Jersey
TWO TUBES CONNECTED IN INVERSE PARALLEL.
WATER-SAVING THERMOSTAT WITHOUT
AUXILIARY CONTADOR.
PROTECTIVE THERMOSTAT OPTIONAL.

<table>
<thead>
<tr>
<th>CURVE</th>
<th>RMS ANODE-SUPPLY VOLTS</th>
<th>MAXIMUM AVERAGING TIME—SECONDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250</td>
<td>23.5</td>
</tr>
<tr>
<td>B</td>
<td>500</td>
<td>11.8</td>
</tr>
<tr>
<td>C</td>
<td>600</td>
<td>10</td>
</tr>
</tbody>
</table>

CONDUCTION TIME = 0.5 SECOND
MERCURY-VAPOR THYRATRON
NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:
Filament, Coated:

<table>
<thead>
<tr>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>2.38</td>
<td>2.5</td>
</tr>
<tr>
<td>Current at 2.5 volts</td>
<td>5.0</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Minimum heating time prior to tube conduction: 5 sec

Direct Interelectrode Capacitances (Approx.):^0
- Grid to anode: 2.5 µµf
- Grid to cathode: 7 µµf

Ionization Time (Approx.): 10 µsec
Deionization Time (Approx.): 1000 µsec
Anode Voltage Drop (Approx.): 16 volts

Mechanical:
Operating Position: Vertical, base down
Maximum Overall Length: 6-1/8"
Seated Length: 5-1/4" ± 1/4"
Maximum Diameter: 2-1/16"
Weight (Approx.): 3 oz
Bulb: Medium (JETEC No.C1-5)
Cap.: Medium-Shell Small 4-Pin with Bayonet (JETEC No.A4-10)
Base: ST16

Basing Designation for BOTTOM VIEW: 3G

Temperature Control:
Heating—When the ambient temperature is so low that the normal rise of condensed-mercury temperature above the ambient temperature will not bring the condensed-mercury temperature up to the minimum value of the operating ranges specified under Maximum Ratings, some form of heat-conserving enclosure or auxiliary heater will be required.

Cooling—When the operating conditions are such that the maximum value of the operating condensed-mercury temperature is exceeded, provision should be made for forced-air cooling sufficient to prevent exceeding the maximum value.

Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.):^*
No load: 17.5 °C

^0 Without external shield.
^* With filament volts = 2.98 and no heat-conserving enclosure.
### CONTROL SERVICE

**Maximum Ratings, Absolute Values:**

For anode-supply frequency of 60 cps

<table>
<thead>
<tr>
<th>Operating Condensed-Mercury-</th>
<th>40° to 90° C</th>
<th>40° to 80° C</th>
<th>40° to 60° C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEAK ANODE VOLTAGE:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward.</td>
<td>1250 max.</td>
<td>2500 max.</td>
<td>5000 max.</td>
</tr>
<tr>
<td>Inverse.</td>
<td>1250 max.</td>
<td>5000 max.</td>
<td>10000 max.</td>
</tr>
<tr>
<td>GRID VOLTAGE:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak or DC, before</td>
<td>-500 max.</td>
<td>-500 max.</td>
<td>-500 max.</td>
</tr>
<tr>
<td>tube conduction.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average*, during</td>
<td>-10 max.</td>
<td>-10 max.</td>
<td>-10 max.</td>
</tr>
<tr>
<td>tube conduction.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANODE CURRENT:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak</td>
<td>3 max.</td>
<td>2 max.</td>
<td>1 max.</td>
</tr>
<tr>
<td>Average*</td>
<td>1 max.</td>
<td>0.5 max.</td>
<td>0.25 max.</td>
</tr>
<tr>
<td>Fault, for duration of 0.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>second maximum.</td>
<td>40 max.</td>
<td>40 max.</td>
<td>40 max.</td>
</tr>
<tr>
<td>GRID CURRENT:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average*, positive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>with anode positive</td>
<td>0.05 max.</td>
<td>0.05 max.</td>
<td>0.05 max.</td>
</tr>
</tbody>
</table>

* Averaged over one conducting period.
* Averaged over any interval of 15 seconds maximum.
* Averaged over period of grid conduction.

**DIMENSIONAL OUTLINE**

For Type 5557 is the same as that shown for Type 3623

---

4-58

ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
$E_p = 2.38 \text{ VOLTS}$

NO LOAD.

RATE OF RISE OF CONDENSED-MERCURY TEMPERATURE

TEMPERATURE RISE OF CONDENSED MERCURY ABOVE AMBIENT TEMPERATURE—°C

HEATING TIME—MINUTES
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE:

- $E_f = 2.5$ VOLTS AC ± 5%
- CIRCUIT RETURNS TO FILAMENT TRANSFORMER CENTER-TAP.
- FILAMENT VOLTAGE AT PIN 1 IS (+) WHEN ANODE VOLTAGE IS (+).
- THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES.
- GRID RESISTOR (OHMS) = 1000
- CONDENSED—MERCURY—TEMPERATURE RANGE = 40 TO 80°C

WHERE:

- FILAMENT PIN I
- TRANSFORMER ANODE
- LIFE VARIATIONS RANGE = 40 TO 130°C
- DC OR PEAK AC ANODE VOLTS

TUBE DIVISION
RAMO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9300T
AVERAGE GRID CHARACTERISTICS DURING TUBE CONDUCTION

$E_c = 2.5$ VOLTS AC
CIRCUIT RETURNS TO FILAMENT TRANSFORMER CENTER-TAP.
GRID RESISTOR (OHMS) = 0
CONDENSED-MERCURY TEMPERATURE ($^\circ$C) = 40

DC GRID VOLTS vs. DC GRID MILLIAMPERES

DC ANODE AMP. = 0.25

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9302T
Thyratron
Mercury-Vapor Triode

Data

Electrical:
Heater, for Unipotential Cathode:
Voltage: 5.0 volts
Current: 4.5 amp

Cathode:
Minimum Heating Time, prior to tube conduction: 5 minutes

Direct Interelectrode Capacitances (Approx.):
Grid to Anode: 2.5 µf
Grid to Cathode: 10 µf
Ionization Time (Approx.): 10 µsec
Deionization Time (Approx.): 1000 µsec
Anode Voltage Drop (Approx.): 16 volts
Grid-No. 1 Control Ratio (Approx.) resistor (megohms) = 0.22

Mechanical:
Mounting Position: Vertical, Base Down
Overall Length: 7" ± 1/4"
Seated Length: 6-3/8" ± 1/4"
Maximum Diameter: 3"
Bulb: ST-23
Cap: Medium
Base: Medium-Shell Small 4-Pin, Bayonet
Basing Designation for BOTTOM VIEW: 4BL

Maximum Ratings, Absolute Values:
PEAK ANODE VOLTAGE:
Forward: 1000 max. volts
Inverse: 1000 max. volts

GRID VOLTAGE:
Before Conduction: -500 max. volts
During Conduction: -10 max. volts

CATHODE CURRENT:
Peak: 15 max. amp
Average*: 2.5 max. amp
Fault, for 0.1 sec. maximum: 200 max. amp

GRID CURRENT:
Average**: +0.25 max. amp

COND.-MERCURY TEMPERATURE RANGE: +40 to +80 °C
OPERATING FREQUENCY: 150 max. cps

* Averaged over any interval of 15 sec. max.
** Recommended operating temperature is 50°C.

MARCH 1, 1951
TUBE DEPARTMENT
RCA CORPORATION OF AMERICA, HARRISON, NEW JERSEY

** Indicated a change.
ZONE WHERE
CONDENSED-MERCURY
TEMPERATURE SHOULD
BE MEASURED

MEDIUM-SHELL
SMALL 4-PIN
BAYONET BASE

MEDIUM CAP

ST 23 BULB

3" DIA. MAX

7" ± 1/4"

MARCH 1, 1951
TUBE DEPARTMENT
SUNOCO CORPORATION OF AMERICA, MARIKNON, NEW JERSEY

CE-6743R1
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

TYPE 5559
RANGE IS FOR CONDITIONS WHERE
E_p=5 VOLTS AC ±5%. CIRCUIT RETURNS TO PIN N.A. 2. THE RANGE INCLUDES INITIAL & LIFE VARIATIONS OF INDIVIDUAL TUBES, AS WELL AS CHANGE IN CHARACTERISTICS DUE TO HEATER PHASING.
GRID RESISTOR (OMHS) = 0
COND.-MERCURY TEMPERATURE = 40°C

AVERAGE GRID CHARACTERISTICS DURING ANODE CONDUCTION

TYPE 5559
E_p=5 VOLTS AC
CIRCUIT RETURNS TO PIN N.A. 2
GRID RESISTOR (OMHS) = 0
COND.-MERCURY TEMPERATURE = 40°C

MARCH 1, 1951
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

CE-6704T1-7562T
THYRATRON

SHIFT OF AVERAGE CONTROL CHARACTERISTIC WITH CHANGE IN HEATER PHASING

<table>
<thead>
<tr>
<th>CURVE</th>
<th>PHASE ANGLE DEGREES</th>
<th>CIRCUIT RETURN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90°</td>
<td>PIN NR2</td>
</tr>
<tr>
<td></td>
<td>0°</td>
<td>PIN NR2</td>
</tr>
</tbody>
</table>

* BETWEEN HEATER VOLTAGE AT PIN NR1 AND ANODE VOLTAGE

DC GRID VOLTS

PEAK ANODE VOLTS

TEMP-RISE CHARACTERISTIC

<table>
<thead>
<tr>
<th>TYPE 5550</th>
<th>E_F = 4.75 VOLTS AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATHODE AMPERES = 0</td>
<td></td>
</tr>
</tbody>
</table>

MARCH 1, 1951
TUBE DEPARTMENT
BRIDG CORPORATION OF AMERICA, MARGOM, NEW JERSEY
## 5560 THYRATRON
### MERCURY-VAPOR TETRODE

<table>
<thead>
<tr>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical:</strong></td>
</tr>
<tr>
<td>Heater, for Unipotential Cathode:</td>
</tr>
<tr>
<td>Voltage</td>
</tr>
<tr>
<td>Current</td>
</tr>
<tr>
<td>Cathode:</td>
</tr>
<tr>
<td>Minimum Heating Time, prior to tube conduction</td>
</tr>
</tbody>
</table>
| Direct Inter-electrode Capacitances (Approx.):
| Grid No.1 to Anode | 0.2 | μf |
| Grid No.1 to Cathode | 4.4 | μf |
| Ionization Time (Approx.) | 10 | μsec |
| Deionization Time (Approx.) | 1000 | volts |
| Anode Voltage Drop (Approx.) | 10 | volts |
| Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (ohms) = 0; grid-No.1 and grid-No.2 volts = 0 | 170 | |
| Grid-No.2 Control Ratio (Approx.) with grid-No.1 resistor (ohms) = 0; grid-No.1 and grid-No.2 volts = 0 | 300 | |
| **Mechanical:** |
| Mounting Position | Vertical, Base Down |
| Overall Length | 7-11/16" ± 1/4" |
| Seated Length | 7-1/16" ± 1/4" |
| Greatest Radius | 2-1/4" |
| Bulb | ST-23 |
| Caps (Two) | Medium-Shell |
| Base | Small 4-Pin, Bayonet |
| Basing Designation for BOTTOM VIEW | 4CD |
| Pin 1-Heater | Pin 2-Cathode; Circuit Return |
| Pin 3-Grid No.2 | Pin 4-Heater, Cathode Top Cap - Anode Side Cap - Grid No.1 |
| **Maximum Ratings, Absolute Values:** |
| PEAK ANODE VOLTAGE: |
| Forward | 1000 max. volts |
| Inverse | 1000 max. volts |
| GRID-No.2 (SHIELD-GRID) VOLTAGE: |
| Before Conduction | -300 max. volts |
| During Conduction | -5 max. volts |
| GRID-No.1 (CONTROL-GRID) VOLTAGE: |
| Before Conduction | -1000 max. volts |
| During Conduction | -10 max. volts |
| CATHODE CURRENT: |
| Peak | 30 max.° | 15 max. amp |
| Average** | 0.5 max.° | 2.5 max. amp |
| Fault, for 0.1 sec. maximum | 200 max. amp |

*indicates a change.
GRID-No. 2 CURRENT:
Average**: 0.25 max. amp

GRID No. 1 CURRENT:
Average**: 0.25 max. amp

COND.-MERCURY TEMPERATURE RANGE: +40 to +80 °C

OPERATING FREQUENCY: 150 max. cps

** Applies when this tube is used for igniter firing.

* Averaged over any interval of 15 sec. max.

Recommended operating temperature is 40°C.


TEMPERATURE-RISE CHARACTERISTIC of the 5560 is the same as that shown for Type 5559.

MARCH 1, 1951
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
OPERATIONAL RANGE
OF CRITICAL GRID VOLTAGE

TYPE 5560
RANGE IS FOR CONDITIONS WHERE:
E_F = 5 VOLTS AC 15 %; GRID-NR 2 (SHIELD)
VOLTS = 0; CIRCUIT RETURNS TO PIN NR
2. THE RANGE INCLUDES INITIAL AND
LIFE VARIATIONS OF INDIVIDUAL TUBES,
AS WELL AS CHANGE IN CHARACTERIS-
TICS DUE TO HEATER PHASING.
GRID-NR 1 RESISTOR (OHMS) = 0
COND.-MERCURY TEMPERATURE = 40°C

SHIFT OF AVERAGE
CONTROL CHARACTERISTIC
WITH CHANGE IN HEATER PHASING

TYPE 5560
E_F = 5 VOLTS AC
GRID-NR 2 (SHIELD) VOLTS 10
CONDENSED-MERCURY TEMPERATURE = 40°C
GRID-NR 1 RESISTOR (OHMS) = 0

CURVE PHASE ANGLE CIRCUIT RETURN
PHASE DEGREES
100° PIN NR 2
0° PIN NR 2

* BETWEEN HEATER VOLTAGE AT
PIN NR 1 AND ANODE VOLTAGE

MARCH 1, 1951
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
THYRATRON

AVERAGE GRID CHARACTERISTICS
BEFORE ANODE CONDUCTION

TYPE 5560
$E_d = 3$ VOLTS AC
GRID-N2 (SHIELD) VOLTS = 0
GRID-N1 RESISTOR (OHMS) = 0
CIRCUIT RETURNS TO PIN N2
COND.-MERCURY TEMPERATURE = 80°C

0 = CONDUCTION STARTS

DC ANODE VOLTS = 100
500
1000
2000

DC GRID-N1 VOLTS

-1200 -800 -400 0 +400 +800

0.8

DC GRID-N1 MICROAMPERES

92CM-7556T

AVERAGE GRID CHARACTERISTICS
DURING ANODE CONDUCTION

TYPE 5560
$E_d = 3$ VOLTS AC
GRID-N2 (SHIELD) VOLTS = 0
GRID-N1 RESISTOR (OHMS) = 0
CIRCUIT RETURNS TO PIN N2
COND.-MERCURY TEMPERATURE = 80°C

DC ANODE AMP. = 1.25

DC GRID-N1 MILLIAMPERES

-10 -8 -6 -4 -2 0 +2 +4 +6

92CM-7570T

MARCH 1, 1951

TUBE DEPARTMENT

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

CE-7556T-7570T
**MERCURY-VAPOR THYRATRON**

**NEGATIVE-CONTROL TRIODE TYPE**

**Supersedes Type 5563**

**5563-A**

**GENERAL DATA**

**Electrical:**

<table>
<thead>
<tr>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>4.75</td>
<td>5</td>
<td>5.25</td>
</tr>
<tr>
<td>Current at 5 volts</td>
<td>-</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

**Minimum Heating Time:**

- On initial installation, with no voltage on grid or anode, for redistribution of mercury to lower part of tube. **15 minutes**
- During subsequent operation, to allow filament to reach operating temperature prior to tube conduction. **1 minute**

**Direct Interelectrode Capacitances:**

- Grid to anode: **4 µf**
- Grid to cathode: **16 µf**

**Ionization Time (Approx.)**: **10 µsec**

**Deionization Time (Approx.)**: **1000 µsec**

**Maximum Critical Grid Current for instantaneous anode volts = 20000**: **50 µa**

**Anode Voltage Drop (Approx.):**

- At anode amperes = 11.5: **15 volts**
- At anode amperes = 70: **25 volts**

**Grid Control Ratio (Approx.):**

Under conditions: 10000-ohm grid resistor, circuit returns to pin 2, filament voltage at pin 4 out of phase with anode voltage by 180°, and condensed-mercury temperature of 40°C, **275**

**Mechanical:**

- Operating Position: Vertical, base down
- Overall Length: **10-3/32" ± 7/16"**
- Maximum Diameter: **2-5/8"**
- Bulb: **T20**
- Weight (Approx.): **13 oz**
- Cap: Medium with Tubular Support (JETEC No.C1-39)
- Socket: Johnson No.123-211, or equivalent
- Base: Skirted Medium-Metal-Shell Jumbo 4-Pin with Bayonet (JETEC No.A4-69)

**Basing Designation for BOTTOM VIEW**

- **Pin 1 - Grid**
- **Pin 2 - Filament, Internal Shield, Circuit Returns**
- **Pin 3 - No Connection**
- **Pin 4 - Filament Cap - Anode**

Note: Without external shield.

---

**TUBE DIVISION**

**RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY**
Temperature Control:

Heating—when the ambient temperature is so low that the normal rise of condensed-mercury temperature above the ambient temperature will not bring the condensed-mercury temperature up to the minimum value of the operating range specified under Maximum Ratings, some form of heat-conserving enclosure or auxiliary heater will be required.

Cooling—when the operating conditions are such that the maximum value of the operating condensed-mercury temperature for the applicable service rating is exceeded, provision should be made for forced-air cooling sufficient to prevent exceeding the maximum value.

Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature
(Approx.):

No load ........................................ 13 °C
Full load ........................................ 17 °C

CONTROL SERVICE—In-Phase Operation

Maximum Ratings, Absolute Values:
For supply frequency of 25 to 60 cps

Operating Condensed-Mercury-Temperature Range
25 to 55 °C  25 to 50 °C

PEAK ANODE VOLTAGE:
  Forward ...................................... 15000 max. 20000 max. volts
  Inverse ...................................... 15000 max. 20000 max. volts

GRID VOLTAGE:
  Peak or DC, before tube conduction ........ -500 max. -500 max. volts
  Average*, during tube conduction ......... -10 max. -10 max. volts

ANODE CURRENT:
  Peak .......................................... 10 max.  6.4 max. amp
  Average** .................................... 1.8 max. 1.6 max. amp
  Fault, for duration of 0.1 second maximum .. 70 max.  70 max. amp

GRID CURRENT:
  Average positive*** ......................... 100 max. 100 max. ma
  Peak positive with anode negative ........ 5 max.  5 max. ma

Maximum Circuit Values:

Grid-Circuit Resistance ................................ 0.1 max.  0.1 max. megohm

- With filament volts = 4.75 and no heat-conserving enclosure.
- Filament voltage has a phase angle of either 0° or 180° with respect to the anode voltage.

* See next page.  \( \Rightarrow \) Indicates a change.
**CONTROL SERVICE—Quadrature Operation**

**Maximum Ratings, Absolute Values:**

For supply frequency of 25 to 60 cps

Operating Condensed-Mercury-Temperature Range

<table>
<thead>
<tr>
<th>Condition</th>
<th>Temperature</th>
<th>Peak Anode Voltage</th>
<th>Grid Voltage</th>
<th>Anode Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25 to 55 °C</td>
<td>25 to 50 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Forward</strong></td>
<td></td>
<td>15000 max.</td>
<td>15000 max.</td>
<td>2.5 max.</td>
</tr>
<tr>
<td><strong>Inverse</strong></td>
<td></td>
<td>15000 max.</td>
<td>-500 max.</td>
<td>-10 max.</td>
</tr>
<tr>
<td><strong>Grid Voltage</strong></td>
<td></td>
<td>-500 max.</td>
<td>-500 max.</td>
<td></td>
</tr>
<tr>
<td><strong>Peak</strong></td>
<td></td>
<td>11.5 max.</td>
<td>11.5 max.</td>
<td></td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td>2.5 max.</td>
<td>2.5 max.</td>
<td></td>
</tr>
<tr>
<td><strong>Fault, for duration of</strong></td>
<td></td>
<td>70 max.</td>
<td>70 max.</td>
<td></td>
</tr>
<tr>
<td>0.1 second maximum</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Grid Current</strong></td>
<td></td>
<td>100 max.</td>
<td>100 max.</td>
<td>5 max.</td>
</tr>
<tr>
<td><strong>Peak positive with</strong></td>
<td></td>
<td></td>
<td></td>
<td>5 max.</td>
</tr>
<tr>
<td><strong>anode negative</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maximum Circuit Values</strong></td>
<td></td>
<td>0.1 max.</td>
<td>0.1 max.</td>
<td>0.1 max.</td>
</tr>
<tr>
<td>Grid-Circuit Resistance</td>
<td></td>
<td></td>
<td></td>
<td>megohm</td>
</tr>
</tbody>
</table>

**HIGH-SPEED LOAD-CIRCUIT PROTECTION SERVICE**

Maximum Ratings, Absolute Values:

Operating Condensed-Mercury-Temperature Range

<table>
<thead>
<tr>
<th>Condition</th>
<th>Temperature</th>
<th>Peak Anode Voltage</th>
<th>Grid Voltage</th>
<th>Anode Current</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 to 55 °C</td>
<td>20 to 50 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Forward</strong></td>
<td></td>
<td>15000 max.</td>
<td>15000 max.</td>
<td>70 max.</td>
</tr>
<tr>
<td><strong>Inverse</strong></td>
<td></td>
<td>15000 max.</td>
<td>15000 max.</td>
<td>70 max.</td>
</tr>
<tr>
<td><strong>Grid Voltage</strong></td>
<td></td>
<td>-500 max.</td>
<td>-500 max.</td>
<td>70 max.</td>
</tr>
<tr>
<td><strong>Peak</strong></td>
<td></td>
<td>100 max.</td>
<td>100 max.</td>
<td>70 max.</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td>70 max.</td>
<td>70 max.</td>
<td>70 max.</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td>1.05 max.</td>
<td>1.05 max.</td>
<td>1.05 max.</td>
</tr>
<tr>
<td><strong>Maximum Circuit Values</strong></td>
<td></td>
<td>0.1 max.</td>
<td>0.1 max.</td>
<td>0.1 max.</td>
</tr>
<tr>
<td>Grid-Circuit Resistance</td>
<td></td>
<td></td>
<td></td>
<td>megohm</td>
</tr>
</tbody>
</table>

\*\*\* See next page. \*\*\*

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**TUBE DIVISION**

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
MERCURY-VAPOR THYRATRON

Averaged over one grid-conducting period.
Averaged over any period of 20 seconds maximum.
Filament voltage is 60° to 120° out of phase (leading or lagging) with the anode voltage.
In this service, the faults may occur in quick succession or may be separated by several months.
Averaged over any period of 0.1 second maximum.
Averaged over any period of 20 seconds maximum. This average-anode-current value is specified to indicate the number of faults that are permissible within the 20-second interval. The number of faults that may occur in any 20-second interval depends on the value of anode current over the averaging period less than 0.1 second and may be determined by

\[
\text{Number of Faults} = \frac{1.05 \times 20}{\text{Average Anode Current \times Duration during fault} \times \text{of Fault}}
\]

Example:
Assume that the maximum average anode current is 70 amperes for the maximum duration of 0.1 second. On substitution of these values in the equation, the permissible number of faults is determined to be 3. If the average anode current is less than 70 amperes over an averaging period of less than 0.1 second, it will be obvious that a greater number of faults may occur.

OPERATING CONSIDERATIONS

X rays are produced when the 5563-A is operated with a peak inverse anode voltage above 16000 volts (absolute value). These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. Although relatively simple shielding should prove adequate, make sure it provides the required protection to the operator.

Shields and rf filter circuits should be provided for the 5563-A if it is subjected to extraneous high-frequency fields during operation. These fields tend to produce breakdown effects in mercury vapor and are detrimental to tube life and performance. When shields are used, special attention must be given to providing adequate ventilation and to maintaining normal condensed-mercury temperature. Radio-frequency filters are employed to prevent damage caused by rf currents which might otherwise be fed back into the 5563-A.
**MERCURY-VAPOR THYRATRON**

For Circuit Figures, see Front of this Section

<table>
<thead>
<tr>
<th>CIRCUIT</th>
<th>MAX. TRANS. SEC. VOLTS (RMS) E</th>
<th>APPROX. DC OUTPUT VOLTS TO FILTER Eavg</th>
<th>MAX. DC OUTPUT AMPERES Iavg</th>
<th>MAX. DC OUTPUT KW TO FILTER Pdc</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fig. 1</strong>&lt;br&gt;Half-Wave&lt;br&gt;Single-Phase&lt;br&gt;In-Phase Operation</td>
<td>14000&lt;sup&gt;a&lt;/sup&gt; 10500&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6300 4700</td>
<td>1.6 1.8</td>
<td>10 9.5</td>
</tr>
<tr>
<td><strong>Fig. 2</strong>&lt;br&gt;Full-Wave&lt;br&gt;Single-Phase&lt;br&gt;In-Phase Operation</td>
<td>7000&lt;sup&gt;a&lt;/sup&gt; 5300&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6300 4700</td>
<td>3.2 3.6</td>
<td>20 17</td>
</tr>
<tr>
<td><strong>Fig. 3</strong>&lt;br&gt;Series&lt;br&gt;Single-Phase&lt;br&gt;In-Phase Operation</td>
<td>14000&lt;sup&gt;a&lt;/sup&gt; 10600&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12700 9500</td>
<td>3.2 3.6</td>
<td>40 34</td>
</tr>
<tr>
<td><strong>Fig. 4</strong>&lt;br&gt;Half-Wave&lt;br&gt;Three-Phase&lt;br&gt;In-Phase Operation</td>
<td>8100&lt;sup&gt;a&lt;/sup&gt; 6100&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9500 7100</td>
<td>4.8 5.4</td>
<td>45 38</td>
</tr>
<tr>
<td><strong>Fig. 5</strong>&lt;br&gt;Parallel&lt;br&gt;Three-Phase&lt;br&gt;Quadrature Operation</td>
<td>8100&lt;sup&gt;a&lt;/sup&gt; 6100&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9500 7100</td>
<td>15.0 15.0</td>
<td>143 106</td>
</tr>
<tr>
<td><strong>Fig. 6</strong>&lt;br&gt;Series&lt;br&gt;Three-Phase&lt;br&gt;Quadrature Operation</td>
<td>8100&lt;sup&gt;a&lt;/sup&gt; 6100&lt;sup&gt;a&lt;/sup&gt;</td>
<td>19000 14200</td>
<td>7.5 7.5</td>
<td>143 106</td>
</tr>
<tr>
<td><strong>Fig. 7</strong>&lt;br&gt;Half-Wave&lt;br&gt;Four-Phase&lt;br&gt;Quadrature Operation</td>
<td>7000&lt;sup&gt;a&lt;/sup&gt; 5300&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9000 6700</td>
<td>10.0 10.0 10.0 10.0</td>
<td>90 67</td>
</tr>
<tr>
<td><strong>Fig. 8</strong>&lt;br&gt;Half-Wave&lt;br&gt;Six-Phase&lt;br&gt;Quadrature Operation</td>
<td>7000&lt;sup&gt;a&lt;/sup&gt; 5300&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9500 7100</td>
<td>11.0 11.5 11.0 11.5</td>
<td>105 78 110 81</td>
</tr>
</tbody>
</table>

For maximum peak inverse anode voltage of 20000 volts, and condensed-mercury-temperature range of 25 to 50°C.

For maximum peak inverse anode voltage of 15000 volts, and condensed-mercury-temperature range of 25 to 55°C.
MERCURY-VAPOR THYRATRON

ZONE WHERE CONDENSED-MERCURY TEMPERATURE SHOULD BE MEASURED

SKIRTED MEDIUM-METAL-SHELL JUMBO 4-PIN BAYONET BASE JETEC NO. A4-69

RATE OF RISE OF COND-MERCURY TEMPERATURE

<table>
<thead>
<tr>
<th>CURVE</th>
<th>FIL. VOLTS</th>
<th>AV. CATHODE AMP.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-----</td>
<td>4.75</td>
<td>2.5</td>
</tr>
<tr>
<td>-----</td>
<td>4.75</td>
<td>0</td>
</tr>
</tbody>
</table>

NATURAL CIRCULATION OF AIR AROUND TUBE.
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE:
E_f = 5.0 VOLTS AC ± 5%; CIRCUIT RETURNS TO PIN 2.
FILAMENT VOLTAGE AT PIN 4 IS (-) WHEN ANODE VOLTAGE IS (+).
THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES.
GRID RESISTOR = 10000 TO 100000 OHMS
CONDENSED - MERCURY TEMPERATURE RANGE = 25° TO 55°C
CHARACTERISTIC CURVES

AVERAGE GRID CHARACTERISTICS BEFORE TUBE CONDUCTION

\[ E_F = 5.0 \text{ VOLTS AC} \]
- CIRCUIT RETURNS TO PIN 2
- GRID RESISTOR = 0 OHM
- CONDENSED - MERCURY
- TEMPERATURE = 40°C
- \( o = \text{CONDUCTION STARTS} \)

CONDUCTION STARTS AT \( +6.7V, +35 \mu A \)

DC GRID VOLTS

AVERAGE GRID CHARACTERISTICS DURING TUBE CONDUCTION

\[ E_F = 5.0 \text{ VOLTS AC} \]
- CIRCUIT RETURNS TO PIN 2
- GRID RESISTOR = 0 OHM
- CONDENSED - MERCURY
- TEMPERATURE = 40°C

DC ANODE AMPERES = 0.5

DC GRID VOLTS

JAN. 3, 1955
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

CE-8313T
8315T
CHARACTERISTIC CURVES

FILAMENT REHEATING TIME
AFTER POWER SUPPLY INTERRUPTION

ANODE CURRENT = 0
FILAMENT VOLTS = 4.75
FILAMENT VOLTS = 5.0
FILAMENT VOLTS = 5.25

OUTAGE TIME - MINUTES
0 1 2 3 4 5
92C5-8300T

SHIFT OF AVERAGE
CONTROL CHARACTERISTIC
WITH CHANGE IN
CONDENSED-MERCURY TEMPERATURE

εc = 5.0 VOLS AC
GRID RESISTOR = 10000 OHMS

<table>
<thead>
<tr>
<th>CURVE</th>
<th>CONDENSED MERCURY TEMP. - °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>25</td>
</tr>
<tr>
<td>B</td>
<td>40</td>
</tr>
<tr>
<td>C</td>
<td>55</td>
</tr>
</tbody>
</table>

DC GRID SUPPLY VOLTS
-60 -60 -40 -20 0
92C5-8316T

PEAK ANODE KILOWATTS
0 5 10 15 20

JAN. 3, 1955
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
CE-8300T
-8316T
SHIFT OF AVERAGE CONTROL CHARACTERISTICS WITH CHANGE IN FILAMENT PHASING AND CIRCUIT RETURN

$E_f = 5.0$ VOLTS AC
GRID RESISTOR = 10000 OHMS
CONDENSED-MERCURY TEMPERATURE = 40°C

<table>
<thead>
<tr>
<th>CURVE</th>
<th>PHASE ANGLE</th>
<th>CIRCUIT RETURN</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0°</td>
<td>PIN 2</td>
</tr>
<tr>
<td>B</td>
<td>0°</td>
<td>CT*</td>
</tr>
<tr>
<td>C</td>
<td>0°, 180°</td>
<td>PIN 4</td>
</tr>
<tr>
<td></td>
<td>90°</td>
<td>ANY*</td>
</tr>
<tr>
<td>D</td>
<td>180°</td>
<td>CT*</td>
</tr>
<tr>
<td>E</td>
<td>180°</td>
<td>PIN 2</td>
</tr>
</tbody>
</table>

* BETWEEN FILAMENT VOLTAGE AT PIN 4 AND ANODE VOLTAGE
° CENTER TAP OF FILAMENT TRANSFORMER
* PIN 2, PIN 4, OR CT

DC GRID SUPPLY VOLTS

APRIL 12, 1954
TUBE DIVISION
82CM-8309
SHIFT OF AVERAGE CONTROL CHARACTERISTICS WITH CHANGE IN FILAMENT PHASING AND CIRCUIT RETURN AT LOW ANODE VOLTAGES

$E_f = 5.0$ VOLTS AC
GRID RESISTOR = 10000 OHMS
CONDENSED—MERCURY TEMPERATURE = 40°C

<table>
<thead>
<tr>
<th>CURVE</th>
<th>PHASE ANGLE</th>
<th>CIRCUIT RETURN</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0°</td>
<td>PIN 2</td>
</tr>
<tr>
<td>B</td>
<td>180°</td>
<td>PIN 4</td>
</tr>
<tr>
<td>C</td>
<td>0°</td>
<td>CT °</td>
</tr>
<tr>
<td>D</td>
<td>180°</td>
<td>CT °</td>
</tr>
<tr>
<td>E</td>
<td>0°</td>
<td>PIN 4</td>
</tr>
<tr>
<td>F</td>
<td>180°</td>
<td>PIN 2</td>
</tr>
</tbody>
</table>

* BETWEEN FILAMENT VOLTAGE AT PIN 4 AND ANODE VOLTAGE
° CENTER TAP OF FILAMENT TRANSFORMER

APRIL 8, 1954
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
5563-A
SHIFT OF AVERAGE CONTROL CHARACTERISTICS
WITH CHANGE IN GRID-RESISTOR VALUE

$E_T = 5.0$ VOLTS AC
CONDENSED-MERCURY TEMPERATURE = 40°C

<table>
<thead>
<tr>
<th>CURVE</th>
<th>GRID RESISTOR MEGOHMS</th>
<th>CIRCUIT RETURN</th>
<th>PHASE ANGLE *</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.01</td>
<td>PIN 2</td>
<td>180°</td>
</tr>
<tr>
<td>B</td>
<td>0.1</td>
<td>PIN 2</td>
<td>180°</td>
</tr>
<tr>
<td>C</td>
<td>1</td>
<td>PIN 2</td>
<td>180°</td>
</tr>
</tbody>
</table>

*BETWEEN FILAMENT VOLTAGE AT PIN 4 AND ANODE VOLTAGE

DC GRID SUPPLY VOLTS

PEAK ANODE KILOVOLTS

APRIL 12, 1964
TUBE DIVISION
BELL TELEPHONE LABORATORIES, INC
HARRISON, NEW JERSEY
92CM-8307
Voltage-Reference Tube

7-PIN MINIATURE, GLOW-DISCHARGE TYPE
 Especially Useful as a Voltage-Reference Tube in DC Power Supplies

DATA

General:
Cathode .................................................. Cold
Operating Position .................................. Any
Maximum Overall Length .................................. 2-1/8"
Maximum Seated Length .................................. 1-7/8"
Length, Base Seat to Bulb Top (Excluding tip) .................................. 1-1/2" ± 3/32"
Diameter .............................................. 0.650" to 0.750"
Dimensional Outline .................................. (See General Section) JEDEC No. 5-2
Bulb ......................................................... T5-1/2
Base .................................................. Small-Button Miniature 7-Pin (JEDEC No. E7-1)
Basing Designation for BOTTOM VIEW .................................. 5B0

Pin 1 – Anode
Pin 2 – Cathode
Pin 3 – Do not use
Pin 4 – Cathode
Pin 5 – Anode
Pin 6 – Do not use
Pin 7 – Cathode

Maximum and Minimum Ratings, Absolute-Maximum Values:

DC OPERATING CURRENT (Continuous) .................. 3.5 max. ma
DC OPERATING CURRENT (Continuous) .................. 1.5 max. ma
AMBIENT TEMPERATURE RANGE .................. -55 to 90 °C

Characteristics and Operation Range Values:

DC Starting Voltage .................. Min. Av. Max. 107 115a volts
DC Operating Voltage (Variation from tube to tube):
At 1.5 ma .................................. 83 85 87 volts
At 2.5 ma .................................. 83.5 85.5 87.5 volts
At 3.5 ma .................................. 84.5 86.5 88.5 volts
Regulation (1.5 ma to 3.5 ma) ............... 3 volts
Temperature Coefficient of Operating Voltage (over ambient temperature range of -55 to 90 °C) ............... -4 mv/°C
Percentage Variation of Operating Voltage:
During first 300 hours of life ............... 0.1 %
During subsequent 1000 hours of life ............... 0.1 %
Variation of Operating Voltage after first 300 hours of life


Instantaneous Voltage Fluctuation (Voltage jump)

Circuit Values:

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shunt Capacitor</td>
<td>0.02 µf</td>
</tr>
<tr>
<td>Series Resistor</td>
<td></td>
</tr>
</tbody>
</table>

a. A dc supply voltage of 115 volts minimum should be provided to insure "starting" throughout tube life.

b. DC operating current = 2.5 ma.

c. After initial 3-minute warm-up period.

d. Defined as the maximum instantaneous voltage fluctuation at any current level within the operating current range.

e. A series resistor must always be used with the 5651A. The resistance value must be chosen so that (1) the maximum current rating of 3.5 ma is not exceeded at the highest anode-supply voltage employed, and (2) the minimum current rating of 1.5 ma is always exceeded when the anode-supply voltage is at its lowest value.

SPECIAL TESTS AND PERFORMANCE DATA

Stability Life Performance:

This test is performed on a sample lot of tubes to assure that the tubes have been properly stabilized. Life testing is performed under the following conditions: DC anode-supply volts = 135, dc operating milliamperes = 2.5, anode-circuit resistance (ohms) = 20000. At the end of 300 hours of operation, tubes will not show a change in dc operating voltage greater than 0.1 per cent from the initial dc operating voltage. At the end of 1300 hours of operation, tubes will not show a change in dc operating voltage greater than 0.1 per cent from the operating voltage at 300 hours. During any 100-hour interval between 300 and 1300 hours of operation, tubes will not show a change in dc operating voltage greater than 0.05 per cent from the dc operating voltage at the start of the interval.

INSTALLATION AND APPLICATION

Make no connections to pins 3 and 6. Any potentials applied to these pins may cause erratic tube performance. The three pin terminals for the cathode (pins 2, 4, and 7) and the two for the anode (pins 1 and 5) offer the equipment designer several different possibilities for connection of the 5651A. Any pair of interconnected pins can be used as a jumper connection to a circuit common to either the cathode or to the anode. The use of such a jumper connection provides a means for opening the circuit to protect circuit components when the 5651A is removed from its socket. Under no circumstances should the current through any pair of interconnected pins exceed one ampere.
If the load for the regulated power supply is disconnected either directly or by removing the 5651A from its socket, the rectifier capacitors will charge to the rectifier peak voltage. It is important, therefore, that these capacitors be rated to withstand such voltage.

A warm-up period of 3 minutes should be allowed each time the equipment is turned on to insure minimum voltage drift of the 5651A.

When a shunt capacitor is used with the 5651A, its value should be limited to 0.02 µf. A large value of capacitance may cause the tube to oscillate and thus give unstable performance.

Shielding should be utilized for the 5651A to insure maximum stability when the tube is operated in the presence of strong rf or magnetic fields.

SERIES-TYPE STABILIZED-VOLTAGE SUPPLY-CIRCUIT

Using RCA-5651A as Voltage-Reference Tube

The voltage regulation of this supply operated at a fixed line voltage of 117 volts and an output voltage of 250 volts is less than 0.2 volt over the current range of 0 to 225 milliamperes. At full current, the regulation for a variation of ±10 per cent in line voltage is less than 0.1 volt.

![Circuit Diagram](image)

- **C1** - 0.1 µf, 400 volts
- **R1** - Plate current balancing potentiometer, 160 ohms, 10 watts
- **R2** - 12000 ohms, 2 watts
- **R3** - 470000 ohms, 1/2 watt
- **R4** - 470000 ohms, 1/2 watt
- **R5** - 12000 ohms, 2 watts
- **R6** - 68000 ohms, 1 watt
- **R7** - 1 megohm, 1/2 watt
- **R8** - 15000 ohms, 2 watts
- **R9** - Output voltage-control potentiometer, 10000 ohms

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**THYRATRON GAS-TETRODE, MINIATURE TYPE**

**GENERAL DATA**

**Electrical:**
- Heater, for Unipotential Cathode:
  - Voltage: 6.3 ac or dc volts
  - Current: 0.150 amp

- Cathode:
  - Minimum Heating Time, prior to tube conduction: 10 sec
  - Direct Interelectrode Capacitances (Approx.):
    - Grid No.1 to Anode: 0.03 μf
    - Input: 1.8 μf
    - Output: 0.54 μf

- Ionization Time (Approx.):
  - For conditions: dc anode volts = 100; grid-No.1 square-pulse volts = +50; peak cathode amperes during conduction = 0.150...
  - 0.5 μsec

- Deionization Time (Approx.):
  - For conditions: dc anode volts = 500; grid-No.1 volts = 100, grid-No.1 resistor (ohms) = 1000; dc cathode amperes = 0.025...
  - 25 μsec
  - For conditions: dc anode volts = 500; grid-No.1 volts = 13; grid-No.1 resistor (ohms) = 1000; dc cathode amperes = 0.025...
  - 40 μsec

- Maximum Critical Grid-No.1 Current, with ac anode-supply volts (rms) = 350, and average cathode amperes = 0.025...
  - 0.5 μamp

- Anode Voltage Drop (Approx.)...
  - 10 volts

- Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0; grid-No.2 volts = 0...
  - 250

- Grid-No.2 Control Ratio (Approx.) with grid-No.1 volts = 0, grid-No.2 resistor (ohms) = 0...
  - 15

*Without external shield.*

**Mechanical:**
- Mounting Position: Any
- Maximum Overall Length: 1-3/4"
- Maximum Seated Length: 1-1/2"
- Length, Base Seat to Bulb Top (excluding tip): 1-1/8" ± 3/32"
- Maximum Diameter: 3/4"
- Bulb: T-5-1/2
- Base: Small-Button Miniature 7-Pin

- Basing Designation for BOTTOM VIEW: 7BN
- Pin 1—Grid No.1
- Pin 2—Cathode
- Pin 3—Heater
- Pin 4—Heater
- Pin 5—Grid No.2
- Pin 6—Anode
- Pin 7—Grid No.2

**DEPARTMENT TENTATIVE DATA**
RELAY and GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, Absolute Values:

PEAK ANODE VOLTAGE:
- Forward: 500 max. volts
- Inverse: 500 max. volts

GRID-No. 2 (SHIELD-GRID) VOLTAGE:
- Peak, before anode conduction: -50 max. volts
- Average, during anode conduction: -10 max. volts

GRID-No. 1 (CONTROL-GRID) VOLTAGE:
- Peak, before anode conduction: -100 max. volts
- Average, during anode conduction: -10 max. volts

CATHODE CURRENT:
- Peak: 0.1 max. amp
- Average: 0.025 max. amp
- Surge, for duration of 0.1 sec. max.: 2 max. amp

GRID-No. 2 CURRENT:
- Average: 0.005 max. amp

GRID-No. 1 CURRENT:
- Average: 0.005 max. amp

PEAK HEATER-CATHODE VOLTAGE:
- Heater negative with respect to cathode: 100 max. volts
- Heater positive with respect to cathode: 25 max. volts

AMBIENT TEMPERATURE RANGE: -55 to +90 °C

Typical Operating Conditions for Relay Service:

- RMS Anode Voltage: 117 volts
- Grid No. 2: Connected to cathode at socket
- RMS Grid-No. 1 Bias Voltage: 5 volts
- Peak Grid-No. 1 Signal Voltage: 5 volts
- Grid-No. 1-Circuit Resistance: 0.1 megarms
- Anode-Circuit Resistance: 5000 ohms

Maximum Circuit Values:
- Grid-No. 1-Circuit Resistance: 10 max. megarms

- Averaged over any interval of 30 sec. max.
- Approximately 180° out of phase with the anode voltage.
- Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.
AVERAGE CONTROL CHARACTERISTICS

$E_f = 6.3$ VOLTS

GRID-MA# 2 RESISTOR (OHMS) = 0

GRID-MA# 1 RESISTOR (OHMS) = 0
THYRATRON

OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

TYPE 5696
GRID-N92 (SHIELD) VOLTS = 0
RANGES SHOWN ARE FOR TWO VALUES OF GRID RESISTOR-0.1 MEG. AND 10 MEG.-AND TAKE INTO ACCOUNT INITIAL DIFFERENCES BETWEEN INDIVIDUAL TUBES & SUBSEQUENT DIFFERENCES DURING TUBE LIFE, FOR A HEATER-VOLTAGE RANGE OF 5.7 TO 6.9 VOLTS AND FOR AN AMBIENT TEMPERATURE RANGE OF -55 TO +90°C

Range for 10 Megohms

Range for 0.1 Megohm

DC GRID-N21 SUPPLY VOLTS

AC ANODE VOLTS (RMS-60°C)

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

FEB. 1, 1949
THYRATRON

AVERAGE CHARACTERISTICS BEFORE ANODE CONDUCTION

TYPE 5696
E_f = 6.3 VOLTS
GRID-N2 (SHIELD) VOLTS = 0
GRID-N1 RESISTOR (OHMS) = 0
0 = CONDUCTION STARTS

AVERAGE CHARACTERISTICS DURING ANODE CONDUCTION

TYPE 5696
E_f = 6.3 VOLTS
GRID-N2 (SHIELD) VOLTS = 0
GRID-N1 RESISTOR (OHMS) = 0

FEB. 1, 1949 TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

CE-7047T - 7052T
<table>
<thead>
<tr>
<th>General Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical:</strong></td>
<td></td>
</tr>
<tr>
<td>Heater, for Unipotential Cathode:</td>
<td></td>
</tr>
<tr>
<td>Voltage</td>
<td>(6.3 \pm 10%) ac or dc volts</td>
</tr>
<tr>
<td>Current</td>
<td>0.6 amp</td>
</tr>
<tr>
<td><strong>Cathode:</strong></td>
<td></td>
</tr>
<tr>
<td>Minimum heating time prior to tube conduction</td>
<td>20 sec</td>
</tr>
<tr>
<td><strong>Direct Interelectrode Capacitances (Approx.):</strong></td>
<td></td>
</tr>
<tr>
<td>Grid No.1 to anode</td>
<td>0.026 (\mu \text{F})</td>
</tr>
<tr>
<td>Grid No.1 to cathode, grid No.2, and heater</td>
<td>2.4 (\mu \text{F})</td>
</tr>
<tr>
<td>Anode to cathode, grid No.2, and heater</td>
<td>1.6 (\mu \text{F})</td>
</tr>
<tr>
<td><strong>Ionization Time (Approx.):</strong></td>
<td></td>
</tr>
<tr>
<td>For dc anode volts = 100, grid-No.1 volts (square-wave pulse) = 50, peak anode amperes during conduction = 0.5</td>
<td>0.5 (\mu \text{sec})</td>
</tr>
<tr>
<td><strong>Deionization Time (Approx.):</strong></td>
<td></td>
</tr>
<tr>
<td>For dc anode volts = 125, dc anode amperes = 0.1, grid-No.1 resistor (ohms) = 1000, and grid-No.1 volts = -100</td>
<td>35 (\mu \text{sec})</td>
</tr>
<tr>
<td>For dc anode volts = 125, dc anode amperes = 0.1, grid-No.1 resistor (ohms) = 1000, and grid-No.1 volts = -10</td>
<td>75 (\mu \text{sec})</td>
</tr>
<tr>
<td><strong>Maximum Critical Grid-No.1 Current:</strong></td>
<td></td>
</tr>
<tr>
<td>For anode-supply volts (rms) = 460, and average anode amperes = 0.1</td>
<td>0.5 (\mu \text{A})</td>
</tr>
<tr>
<td><strong>Anode Voltage Drop (Approx.):</strong></td>
<td></td>
</tr>
<tr>
<td>Grid-No.1 Control Ratio</td>
<td>250</td>
</tr>
<tr>
<td>with grid-No.1 resistor (megohms) = 0, grid-No.2 volts = 0</td>
<td>250</td>
</tr>
<tr>
<td>Grid-No.2 Control Ratio</td>
<td>1000</td>
</tr>
<tr>
<td>with grid-No.1 resistor (megohms) = 0, grid-No.2 resistor (megohms) = 0, grid-No.1 volts = 0</td>
<td>1000</td>
</tr>
</tbody>
</table>

| Mechanical: |  |
| Operating Position | Any |  |
| Maximum Overall Length | 2-1/8" |  |
| Maximum Seated Length | 1-7/8" |  |
| Length, Base Seat to Bulb Top (Excluding tip) | 1-1/2" ± 3/32" |  |
| Maximum Diameter | 3/4" |  |
| Dimensional Outline | See General Section |  |
| Bulb | T5-1/2 |  |
| Base | Small-Button Miniature 7-Pin (JETEC No.E7-1) |  |

*: See next page.
GAS THYRATRON

Basing Designation for BOTTOM VIEW ............... 7BN

Pin 1—Grid No.1
Pin 2—Cathode
Pin 3—Heater
Pin 4—Heater

Pin 5—Grid No.2
Pin 6—Anode
Pin 7—Grid No.2

RELAY AND GRID-CONTROLLED RECTIFIER SERVICE

Maximum and Minimum Ratings, Absolute Values:

For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:
Forward ........................................ 650 max. volts
Inverse .......................................... 1300 max. volts

GRID-No.2 (SHIELD-GRID) VOLTAGE:
Peak, before tube conduction .................... -100 max. volts
Average*, during tube conduction ............. -10 max. volts

GRID-No.1 (CONTROL-GRID) VOLTAGE:
Peak, before tube conduction .................... -100 max. volts
Average*, during tube conduction ............. -10 max. volts

CATHODE CURRENT:
Peak .............................................. 0.5 max. amp
Average .......................................... 0.1 max. amp
Fault, for duration of 0.1 second max. ....... 10 max. amp

GRID-No.2 CURRENT:
Average* .......................................... +0.01 max. amp

GRID-No.1 CURRENT:
Average* .......................................... +0.01 max. amp

PEAK HEATER-CATHODE VOLTAGE:
Heater negative with respect to cathode ...... 100 max. volts
Heater positive with respect to cathode ...... 25 max. volts

BULB TEMPERATURE (At hottest point on bulb surface) .................................. 150 max. °C

AMBIENT TEMPERATURE ................................ -75 min. °C

Typical Operation for Relay Service:

RMS Anode Voltage ............................... 117 400 volts
Grid-No.2 Voltage ................................ 0 0 volts
RMS Grid-No.1 Bias Voltage* .................. 5 - volts
DC Grid-No.1 Bias Voltage ....................... - 6 volts
Peak Grid-No.1 Signal Voltage .................. 5 6 volts
Grid-No.1-Circuit Resistance .................... 1 1 megohm
Anode-Circuit Resistance* ...................... 1200 2000 ohms

Maximum Circuit Values:

Grid-No.1-Circuit Resistance .................... 10 max. megohms

*o,*,*,*: See next page.
GAS THYRATRON

PULSE-MODULATOR SERVICE

For rectangular-wave shapes, duty cycle of 0.001 max., pulse duration of 5 μsec. max., and pulse-repetition rate of 500 pps max.

Maximum and Minimum Ratings, Absolute Values:

**PEAK ANODE VOLTAGE:**
- Forward: 500 max. volts
- Inverse: 100 max. volts

**GRID-No.2 (SHIELD-GRID) VOLTAGE:**
- Peak, before tube conduction: -50 max. volts
- Average, during tube conduction: -10 max. volts

**GRID-No.1 (CONTROL-GRID) VOLTAGE:**
- Peak, before tube conduction: -100 max. volts
- Average, during tube conduction: -10 max. volts

**CATHODE CURRENT:**
- Peak: 10 max. amp
- Average: 0.01 max. amp
- Rate of change: 100 max. amp/μsec

**PEAK GRID-No.2 CURRENT:** 0.02 max. amp

**PEAK GRID-No.1 CURRENT:** 0.02 max. amp

**PEAK HEATER-CATHODE VOLTAGE:**
- Heater negative with respect to cathode: 0 max. volts
- Heater positive with respect to cathode: 0 max. volts

**BULB TEMPERATURE** (At hottest point on bulb surface): 150 max. °C

**AMBIENT TEMPERATURE:** -75 min. °C

Maximum and Minimum Circuit Values:

**Grid-No.1-Circuit Resistance:** 0.5 max. megohm

**Grid-No.2-Circuit Resistance:** 25000 max. ohms

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Range</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heater Current</td>
<td>1 540 660</td>
<td>ma</td>
</tr>
<tr>
<td>Grid-No.1 Supply Voltage for Tube Conduction (1)</td>
<td>1 2.9 4.5</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Supply Voltage for Tube Conduction (2)</td>
<td>1.3 -5.2</td>
<td>volts</td>
</tr>
<tr>
<td>Grid-No.1 Supply Voltage for Tube Conduction (3)</td>
<td>4.3 -6.4</td>
<td>volts</td>
</tr>
<tr>
<td>Anode-Supply Voltage for Tube Conduction (1)</td>
<td>1.5 38</td>
<td>volts</td>
</tr>
<tr>
<td>Anode-Supply Voltage for Tube Conduction (2) at 500 hours</td>
<td>1.5 50</td>
<td>volts</td>
</tr>
<tr>
<td>Anode-Supply Voltage for Tube Conduction (2)</td>
<td>6.5 50</td>
<td>volts</td>
</tr>
</tbody>
</table>

*OMF: See next page.*
### Anode-Supply Voltage for Tube Conduction (3)

<table>
<thead>
<tr>
<th>Note</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7,8</td>
<td>650</td>
<td>—</td>
</tr>
</tbody>
</table>

RMS Grid-No.2 Supply Voltage for Tube Conduction (This voltage is 180° out of phase with anode-supply voltage).

<table>
<thead>
<tr>
<th>Note</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,9</td>
<td>1,9</td>
<td>3,3</td>
</tr>
</tbody>
</table>

### Heater-Cathode Leakage Current:

- Heater 25 volts positive with respect to cathode: 1 — 15 μA
- Heater 100 volts negative with respect to cathode: 1 — 15 μA

### Leakage Resistance:

#### Grid-No.2 to anode:

- 1,40 760 — megohms
- 1,10 380 — megohms

### SPECIAL RATINGS AND PERFORMANCE DATA

#### Shock Rating:

Impact Acceleration: 750 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are held rigid and are tested in

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four different positions. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for heater–cathode leakage current, grid-No.1 supply voltage for tube conduction (I), and anode-supply voltage for tube conduction (I).

Fatigue Rating:

Vibrational Acceleration . . . . . . . 2.5 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected in each of three positions to 2.5 g vibrational acceleration at 60 cycles per second for 32 hours. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for heater–cathode leakage current, grid-No.1 supply voltage for tube conduction (I), and anode-supply voltage for tube conduction (I).

Heater-Cycling Life Performance:

Cycles of Intermittent Operation . . . . 2000 min. cycles

Under the following conditions: Heater volts = 7.5 cycled one minute on and one minute off, heater 100 volts negative with respect to cathode, and all other elements connected to ground.

Shorts and Continuity Test:

This test is performed on a sample lot of tubes from each production run. In this test a tube is considered inoperative if it shows a permanent or temporary short or open circuit.

1-Hour Stability Life Performance:

This test is performed on a sample lot of tubes from each production run to insure that tubes have been properly stabilized. Conditions of life testing are specified under 500-hour intermittent life performance, except test run at room temperature. Tubes are initially read for grid-No.1 supply voltage for tube conduction (I). At the end of 1 hour, grid-No.1 supply voltage is read. The variation in the 0-hour and 1-hour readings will not exceed 15 per cent. Tubes must also meet established limits of grid-No.1 supply voltage.

100-Hour Survival Life Performance:

This test is performed on a sample lot of tubes from each production run to insure a low percentage of early inoperatives. Conditions of life testing are specified under 500-hour intermittent life performance, except test run at room temperature. At the end of 100 hours, a tube is considered inoperative if it shows a permanent or
5727

GAS THYRATRON

temporary short or open circuit or fails to meet established limits of grid-No.1 supply voltage for tube conduction (1).  

500-Hour Intermittent Life Performance:  
This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and to guard against epidemic failures of any of the characteristics indicated below. Life testing is conducted under the following conditions: Heater volts = 6.3, anode-supply volts (rms) = 460, grid-No.2 supply volts = 0, average anode milliampere = 80, peak anode milliampere = 500, grid-No.1 resistor (ohms) = 50000, and minimum bulb temperature (°C) = 150. At the end of 500 hours, tube will not show permanent shorts or open circuits and will be criticized for the total number of defects in the sample lot and for the number of tubes failing to pass established initial limits of heater current, grid-No.1 supply voltage (1), and 500-hour limits for anode-supply voltage (1), heater-cathode leakage current, and leakage resistance shown under CHARACTERISTICS RANGE VALUES.

OPERATING CONSIDERATIONS

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

Curves shown under Type 2D21 also apply to the 5727
Electrical:

Heater, for Unipotential Cathode:

<table>
<thead>
<tr>
<th>Voltage (ac or dc volts)</th>
<th>Min</th>
<th>Av.</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage at 6.3 volts</td>
<td>5.7</td>
<td>6.3</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Cathode:

- Minimum heating time prior to tube conduction: 30 sec
- Maximum outage time without reheating: 5 sec

Direct Interelectrode Capacitances (Approx.):

- Grid No.1 to anode: 0.23 \( \mu \text{F} \)
- Grid No.1 to cathode, grid No.2, and heater: 5.8 \( \mu \text{F} \)
- Anode to cathode, grid No.2, and heater: 3.9 \( \mu \text{F} \)

Ionization Time (Approx.):

- For conditions: dc anode volts = 100, grid-\( \text{No.2} \) volts = 0, grid-\( \text{No.1} \) square-pulse volts = +50, and peak anode amperes during conduction = 5. 0.5 \( \mu \text{sec} \)

Deionization Time (Approx.): See Table 1

Maximum Critical Grid-\( \text{No.1} \) Current:

- For conditions: ac anode-supply volts = 460 (rms), and average anode amperes = 0.5. 3 \( \text{mAmp} \)

Anode Voltage Drop (Approx.): 10 volts

Grid-\( \text{No.1} \) Control Ratio (Approx.):

- For conditions: grid-\( \text{No.1} \) resistor (megohms) = 0, grid-\( \text{No.2} \) resistor (megohms) = 0, and grid-\( \text{No.2} \) volts = 0. 150

Grid-\( \text{No.2} \) Control Ratio (Approx.):

- For conditions: grid-\( \text{No.1} \) resistor (megohms) = 0, grid-\( \text{No.2} \) resistor (megohms) = 0, and grid-\( \text{No.1} \) volts = 0. 650

Mechanical:

- Mounting Position: Any
- Maximum Overall Length: 3-7/8" ➔
- Maximum Seated Length: 3-5/16" ➔
- Maximum Diameter: 1-23/32" ➔
- Bulb: Large-Wafer Octal 6-Pin ➔
- Base: with External Barriers and Sleeve (JETEC No.86-100)

Indicates a change.
RELAY AND GRID-CONTROLLED RECTIFIER SERVICE

For anode-supply frequency of 60 cps

Maximum Ratings, Absolute Values:

PEAK ANODE VOLTAGE:
- Forward: 650 max. volts
- Inverse: 1300 max. volts

GRID-No.2 (SHIELD-GRID) VOLTAGE:
- Peak, before tube conduction: -100 max. volts
- Average#, during tube conduction: -10 max. volts

GRID-No.1 (CONTROL-GRID) VOLTAGE:
- Peak, before tube conduction: -200 max. volts
- Average#, during tube conduction: -10 max. volts

CATHODE CURRENT:
- Peak: 5 max. amp
- Average#: 0.5 max. amp
- Fault, for duration of 0.1 second max. 20 max. amp

AVERAGE GRID-No.2 CURRENT#: +0.05 max. amp
AVERAGE GRID-No.1 CURRENT#: +0.05 max. amp

PEAK HEATER-CATHODE VOLTAGE:
- Heater negative with respect to cathode: 100 max. volts
- Heater positive with respect to cathode: 25 max. volts

AMBIENT-TEMPERATURE RANGE: -75 to +90 °C

Maximum Circuit Values:

Grid-No.1-Circuit Resistance: 2 max. megohms

# Averaged over any interval of 30 seconda maximum.
## TABLE I

<table>
<thead>
<tr>
<th>DC Anode Volts</th>
<th>125</th>
<th>250</th>
<th>Rg1</th>
<th>Ecc1</th>
<th>Rg2</th>
<th>Ecc2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode Amperes</td>
<td>0.5</td>
<td>1.0</td>
<td>0.5</td>
<td>1.0</td>
<td></td>
<td></td>
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<tr>
<td>175</td>
<td>225</td>
<td>250</td>
<td>275</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>350</td>
<td>375</td>
<td>450</td>
<td>475</td>
<td>0.1</td>
<td>-13</td>
<td>1000</td>
</tr>
<tr>
<td>650</td>
<td>700</td>
<td>1100</td>
<td>1200</td>
<td>2</td>
<td>-100</td>
<td>1000</td>
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<tr>
<td>100</td>
<td>125</td>
<td>100</td>
<td>125</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>150</td>
<td>150</td>
<td>175</td>
<td>0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>275</td>
<td>275</td>
<td>300</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DEIONIZATION TIME**

μsec (Approx.)

<table>
<thead>
<tr>
<th>DEIONIZATION TIME</th>
<th>DEIONIZATION TIME</th>
<th>DEIONIZATION TIME</th>
<th>DEIONIZATION TIME</th>
<th>DEIONIZATION TIME</th>
<th>DEIONIZATION TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/5</td>
<td>350</td>
<td>650</td>
<td>100</td>
<td>125</td>
<td>250</td>
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<tr>
<td>350</td>
<td>700</td>
<td>1100</td>
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<td>250</td>
</tr>
<tr>
<td>650</td>
<td>1100</td>
<td>1200</td>
<td>-100</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>125</td>
<td>125</td>
<td>0.001</td>
<td>0</td>
<td></td>
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<td>125</td>
<td>150</td>
<td>175</td>
<td>0.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>250</td>
<td>275</td>
<td>300</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Series resistor between grid No. 2 and cathode.

---

**Series resistor between grid No. 2 and cathode.**

---

**LARGE-WAFER OCTAL 6-PIN WITH EXTERNAL BARRIERS AND SLEEVE**

**JETEC No. B6-100**

**T12 BULB**

**92CS-7635RI**
OPERATIONAL RANGE OF CRITICAL GRID-N°1 VOLTAGE

GRID-N°2 (SHIELD) VOLTS=0
RANGES SHOWN ARE FOR TWO VALUES OF GRID-N°1 RESISTOR, 0.1 MEG. AND 2 MEH., AND TAKE INTO ACCOUNT INITIAL DIFFERENCES BETWEEN INDIVIDUAL TUBES AND SUBSEQUENT DIFFERENCES DURING TUBE LIFE. FOR HEATER-VOLTAGE RANGE OF 5.7 TO 6.9 VOLTS AND FOR AN AMBIENT TEMPERATURE RANGE OF FROM -75° TO +90°C.

RANGE FOR 2 MEGOHMS

RANGE FOR 0.1 MEGOHM

AC ANODE VOLTS (RMS-60°C)

DC GRID-N°1 SUPPLY VOLTS

GRID-N°1 SUPPLY VOLTS

92CS-7748T1

TUBE DIVISION

BEAUD CORPORATION OF AMERICA, HARRISON, NEW JERSEY

CE-7748T1
$E_C = 6.3$ VOLTS
GRID-N°2 RESISTOR (OHMS) = 0
GRID-N°1 RESISTOR (OHMS) = 0
AVERAGE GRID-N#1 CHARACTERISTICS BEFORE TUBE CONDUCTION

$E_f = 6.3 \text{ VOLTS}$

GRID-N#2 (SHIELD) VOLTS = 0

GRID-N# 2 RESISTOR (OHMS) = 0

GRID-N#1 RESISTOR (OHMS) = 0

$0 = \text{CONDUCTION STARTS}$

DC ANODE VOLTS = 25

DC GRID-N#1 SUPPLY VOLTS 92CM-7763T1

AVERAGE GRID-N#1 CHARACTERISTICS DURING TUBE CONDUCTION

$E_f = 6.3 \text{ VOLTS}$

GRID-N#2 (SHIELD) VOLTS = 0

GRID-N# 2 RESISTOR (OHMS) = 0

GRID-N#1 RESISTOR (OHMS) = 0

DC ANODE MA = 100

DC GRID-N#1 MILLIAMPERES

DC GRID-N#1 SUPPLY VOLTS 92CM-7764T1

TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

4-56

CE-7763T1

-7764T1
VOLTAGE REGULATOR
MINIATURE GLOW-DISCHARGE TYPE

Intended for applications where very stable characteristics and dependable performance under shock and vibration are paramount: The 6073 is a "premium" version of the 0A2.

DATA

General:
Cathode: Cold

Mechanical:
Mounting Position: Any
Maximum Overall Length: 2-5/8"
Maximum Seated Length: 2-3/8"
Length, Base Seat to Bulb Top (Excluding tip): 2" ± 3/32"
Maximum Diameter: 3/4"
Bulb: T-5-1/2
Base: Small-Button Miniature 7-Pin (JETEC No. E7-1)
Basing Designation for BOTTOM VIEW: 580

Pin 1 - Anode
Pin 2 - Cathode
Pin 3 - Internal Connection—Do Not Use
Pin 4 - Cathode
Pin 5 - Anode
Pin 6 - Internal Connection—Do Not Use
Pin 7 - Cathode

Maximum Ratings, Absolute Values:
AVERAGE STARTING CURRENT (See note below). 75 max. ma
DC CATHODE CURRENT. 30 max. ma
AMBENT TEMPERATURE RANGE -55 to +90°C
FREQUENCY. 0 max. cps

Characteristics Range Values for Equipment Design:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode-Supply Voltage</td>
<td>185</td>
<td>185</td>
<td>volts</td>
</tr>
<tr>
<td>Anode Breakdown Voltage</td>
<td>156</td>
<td>185</td>
<td>volts</td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td>140</td>
<td>151</td>
<td>168</td>
</tr>
<tr>
<td>Regulation (5 to 30 ma)</td>
<td>2</td>
<td>6</td>
<td>volts</td>
</tr>
</tbody>
</table>

Circuit Values:
Shunt Capacitor - 0.1 µf
Series Resistor - See note below

NOTE: The notes and circuit information shown under Type 0A2 are also applicable to the 6073.

* * * See next page.

MAY 1, 1952
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
Shock and Vibration Tests:
These tests are made as indicated in the JAN Specifications JAN 1-A for Electron Tubes, May, 1946 under the sections as follows:

Section F-6b (9e) Shock Test:
Instantaneous Impact Acceleration ... 900 max.

Section F-6b (9f) Vibration Test:
Vibrational Acceleration . . . . . . . . 2.5 max.

* Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.
* Maximum individual tube value during life.
* Minimum individual tube value during life.
# 6074 Voltage Regulator

**Miniature Glow-Discharge Type**

Intended for applications where very stable characteristics and dependable performance under shock and vibration are paramount. The 6074 is a "premium" version of the 082.

## DATA

### General:
- **Cathode**

### Mechanical:
- **Mounting Position**: Any
- **Maximum Overall Length**: 2-5/8"
- **Maximum Seated Length**: 2-3/8"
- **Length, Base Seat to Bulb Top (Excluding tip)**: 2" ± 3/32"
- **Maximum Diameter**: 3/4"
- **Bulb**: T-5-1/2
- **Base**: Small-Button Miniature 7-Pin (JETEC No. E7-1)
- **Basing Designation for BOTTOM VIEW**: 5BQ

### Pin Numbers:
- **Pin 1**: Anode
- **Pin 2**: Cathode
- **Pin 3**: Internal Connection—Do Not Use
- **Pin 4**: Cathode
- **Pin 5**: Anode
- **Pin 6**: Internal Connection—Do Not Use
- **Pin 7**: Cathode

### Maximum Ratings, Absolute Values:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE STARTING CURRENT (See note below)</td>
<td></td>
<td></td>
<td>75 max. ma</td>
</tr>
<tr>
<td>DC CATHODE CURRENT</td>
<td></td>
<td>30 max. ma</td>
<td>5 min. ma</td>
</tr>
<tr>
<td>AMBIENT TEMPERATURE RANGE</td>
<td></td>
<td>-55 to +90 °C</td>
<td></td>
</tr>
<tr>
<td>FREQUENCY</td>
<td></td>
<td>0 max. cps</td>
<td></td>
</tr>
</tbody>
</table>

### Characteristics Range Values for Equipment Design:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Min.</th>
<th>Av.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Anode-Supply Voltage</td>
<td>133a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anode Breakdown Voltage</td>
<td>115</td>
<td>114</td>
<td>135b</td>
</tr>
<tr>
<td>Anode Voltage Drop</td>
<td>101a</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>Regulation (5 to 30 ma)</td>
<td>1</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

### Circuit Values:
- **Shunt Capacitor**: 0.1 µf
- **Series Resistor**: See note below

**Note**: The notes and circuit information shown under Type 042 are also applicable to the 6074.

---

**MAY 1, 1952**

TUBE DEPARTMENT

TENTATIVE DATA
VOLTAGE REGULATOR

Shock and Vibration Tests:
These tests are made as indicated in the JAN Specifications JAN 1-A for Electron Tubes, May, 1946 under the sections as follows:

Section F-6b (9e) Shock Test:
Instantaneous Impact Acceleration . . . . . 900 max.

Section F-6b (9f) Vibration Test:
Vibrational Acceleration . . . . . . . . . 2.5 max.

Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

Maximum individual tube value during life.

Minimum individual tube value during life.
6130/3C45
HYDROGEN THYRATRON
POSITIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:

Voltage: 6.3 {+5% \(-10\%\) ac or dc volts

Current at 6.3 volts:

- Minimum: 2 amp
- Average: 2.3 amp
- Maximum: 2.5 amp
- Minimum heating time: 2 minutes

Direct Interelectrode Capacitances (Approx.):

- Grid to anode: 3.9 \(\mu\)f
- Grid to cathode: 8.6 \(\mu\)f

Ionization Time (Approx.):

- 0.6 \(\mu\)sec

Deionization Time (Approx.):

- 25 \(\mu\)sec

Anode-Cathode Voltage Drop (Approx.):

- at middle of pulse duration: 150 volts
- Maximum Variation in Firing Time (Jitter): 0.06 \(\mu\)sec

Mechanical:

Operating Position: Any

Maximum Overall Length: 4-9/16" ± 3/16"

Maximum Diameter: 1-9/16"

Weight (Approx.): 3 oz

Cooling: Natural

Bulb: Ti2

Cap.: Small (JEDEC No. C1-1)

Base: Medium-Shell Small 4-Pin, Micanol (JEDEC No. A4-9)

Basing Designation for BOTTOM VIEW: 4BL

Pin 1 – Heater
Pin 2 – Cathode
Pin 3 – Grid
Pin 4 – Heater, Cathode
Cap – Anode

PULSE-MODULATOR SERVICE

Maximum and Minimum CCS* Ratings, Absolute Values:

For pressures down to 70 mm of \(Hg\)

DC ANODE-SUPPLY VOLTAGE: 800 min. volts

PEAK ANODE VOLTAGE:

- Forward \((E_{bm})\): 3000 max. volts
- Inverse: 5\% of \(E_{bm}\) min. volts

After anode-current pulse:

- During first 25 \(\mu\)sec: 1500 max. volts
- After first 25 \(\mu\)sec: 3000 max. volts

See next page.

DATA 1

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

For pressures down to 70 mm of Hg

GRID VOLTAGE:
Negative (DC or Peak), before conduction... 200 max. volts
Peak positive-pulse... 175 min. volts

ANODE CURRENT:
Peak... 35 max. amp
Average... 0.045 max. amp
Rate of rise... 750 max. amp/µsec

OPERATION FACTOR:
3 x 10^8 max. µsec

AMBIENT-TEMPERATURE RANGE... -50 to +90 °C

Typical Operation:
At 2000 pps in accompanying circuit with pulse duration of 0.5 µsec

DC Anode-Supply Voltage... 1250 volts
Peak Anode Voltage:
Forward... 3000 volts
Inverse: Immediately after anode-current pulse... 530 volts

GRID VOLTAGE:
Negative, before conduction... 0 volts
Peak positive-pulse (Unloaded)... 175 volts

Effective Grid-Circuit Resistance... 1000 ohms

ANODE CURRENT:
Peak... 35 amp
Average... 0.035 amp
Operation Factor... 2.1 x 10^8

Peak Power Output to Pulse Transformer (T)... 43000 watts

Maximum Circuit Values:
Effective Grid-Circuit Resistance... 1500 max. ohms

Defined as the time interval between the point on the rising portion of the grid pulse which is 26 per cent of the peak unloaded-pulse amplitude and the point on the anode-current pulse which is 26 per cent of its peak amplitude. The anode-current pulse has a maximum rise time of 0.05 µsec. The grid pulse has a minimum peak amplitude of 130 volts, a maximum rise time of 0.5 µsec, and is supplied by a driver having a maximum internal impedance of 1500 ohms.

Continuous Commercial Service. Corresponds to altitude of about 50,000 feet.

In applications where the anode voltage is applied instantaneously, the power-supply filter should be designed so that the peak forward anode voltage is applied at a rate not to exceed 75,000 volts per second.

Exclusive of spike not having more than 0.05 µsec duration.

Averaged over any cycle.

Defined as Peak Forward Anode Volts x Pulse-Repetition Rate (pps) x Peak Anode Current (excluding spike).

Data 1

4-59 ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY
6130/3C45
HYDROGEN THYRATRON

Pulse duration is defined as the time interval between points on the pulse envelope at which instantaneous amplitudes are equal to 70.7 percent of the maximum amplitude excluding spike.

Operation with a bulb temperature within the approximate range of 60°C to 90°C measured on the bulb directly opposite the anode is recommended for longest life. To attain this temperature under operating conditions involving low ambient temperature, the use of a heat-conserving enclosure for the tube may be necessary.

OPERATING CONSIDERATIONS

The anode is brought out of the tube to a small cap. The connector for this cap should be of the heat-radiating type and the connector lead should have ample current-carrying capability for the operating requirements.

Shielding of the 6130/3C45 should be provided if it is operated in the presence of strong electric fields which will ionize the gas within the tube. Any such ionization will cause erratic performance.

Cooling of the 6130/3C45 is accomplished by natural circulation of air around it. Under no circumstances should a stream of cooling air be applied to the glass envelope.

TYPICAL PULSE-MODULATOR CIRCUIT

C: Blocking Capacitor, 0.001 μF
egg: Pulse Generator supplying peak positive-pulse grid voltage of 175 volts (unloaded)
L: Charging Choke, 5 henries
PFN: Pulse-Forming Network with iterative impedance of 50 ohms, and a two-way transmission time of 0.5 μsec
R1: Grid Resistor, 30,000 ohms
Rg: Effective Resistance of grid circuit, 1000 ohms
Rl: Load Resistance. Value reflected into primary of transformer (T) is 35 ohms.
T: Matching Pulse Transformer

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HYDROGEN THYRATRON

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[Diagram of a thyatron with dimensions and labels]

19/16" MAX. DIA.
1 15/32" MAX. DIA.

SMALL CAP JEDEC N#C1-1

INSULATOR

T12 BULB

MEDIUM-SHELL SMALL 4-PIN BASE JEDEC N#A4-9

5 3/16" MAX.

92CS-7974R1

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