Photomultiplier Tube

S-13 RESPONSE
10-STAGE, HEAD-ON, ELECTROSTATICALLY FOCUSED
FLAT-FACEPLATE DYNODE STAGES

For Detection and Measurement of Ultraviolet
Radiation and Other Low-Level Radiation Sources

GENERAL
Spectral Response .......................... S-13
Wavelength of Maximum Response .... 4400 ± 500 angstroms
Cathode, Semitransparent. .......... Cesium-Antimony
  Shape .................................... Flat, Circular
  Minimum area ............................ 2 sq in
  Minimum diameter ..................... 1-5/8 in
Window ................................... Fused Silica
  Maximum thickness ..................... 0.150 in
  Index of refraction at 2000 angstroms .................................. 1.51
Dynode Material ......................... Cesium-Antimony
Direct Interelectrode 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 No.59-417, or equivalent
Magnetic Shield ........................ Perfection Mica Co., 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 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

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

DATA 1
7-65
MAXIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

DC or Peak AC Supply Voltage
Between anode and cathode .................................................. 1250 V
Between dynode No.10 and anode .......................................... 250 V
Between dynode No.1 and cathode .......................................... 300 V
Between focusing electrode and cathode .................................. 300 V
Average Anode Current\(^d\) .................................................. 0.75 mA
Ambient Temperature .......................................................... 75 °C

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage \(E\) across a voltage divider providing 1/6 of \(E\) between cathode and dynode No.1; 1/12 of \(E\) for each succeeding dynode stage; and 1/12 of \(E\) between 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>Parameter</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></td>
<td>(7.2 \times 10^4)</td>
<td>(A/W)</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td></td>
<td>0.047</td>
<td>(A/W)</td>
</tr>
<tr>
<td>Luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 0 c/s(^e)</td>
<td>10</td>
<td>90</td>
<td>300</td>
</tr>
<tr>
<td>With dynode No.10 as output electrode(^f)</td>
<td></td>
<td>52</td>
<td>(A/1m)</td>
</tr>
<tr>
<td>Cathode luminous:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With tungsten light source(^g)</td>
<td>(4 \times 10^{-5})</td>
<td>(6 \times 10^{-5})</td>
<td>(A/1m)</td>
</tr>
<tr>
<td>With blue light source(^h,q)</td>
<td>(4 \times 10^{-8})</td>
<td></td>
<td>(A)</td>
</tr>
<tr>
<td>Current Amplification</td>
<td></td>
<td>1.5 \times 10^6</td>
<td></td>
</tr>
<tr>
<td>Equivalent Anode-Dark-Current Input(^g)</td>
<td>(5 \times 10^{-10})</td>
<td>(2 \times 10^{-9})</td>
<td>(1m)</td>
</tr>
<tr>
<td>Equivalent Noise Input</td>
<td></td>
<td>(6.3 \times 10^{-12})</td>
<td>(2.7 \times 10^{-11})</td>
</tr>
<tr>
<td>Dark Current to any Electrode Except Anode at 250 C.</td>
<td></td>
<td>(7.5 \times 10^{-7})</td>
<td>(A)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Parameter</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></td>
<td>(6.3 \times 10^3)</td>
<td>(A/W)</td>
</tr>
<tr>
<td>Cathode radiant, at 4400 angstroms</td>
<td></td>
<td>0.047</td>
<td>(A/W)</td>
</tr>
</tbody>
</table>

\(^a\) Indicates a change.
Luminous:
At 0 c/s

With dynode No. 10 as output electrode

Cathode luminous:
With tungsten light source

With blue light source

Current Amplification

Min  Typ  Max
-  7.9  -  A/1m
-  4.6  -  A/1m
-  4x10^{-5}  6x10^{-5}  -  A/1m
-  4x10^{-8}  -  A
-  1.3x10^{5}  -  -

a Alternate designation for Multiplier Phototube.
b Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 54, Illinois.
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^o K and a light input of 10 micromolens is used.
f An output current of opposite polarity to that obtained at the anode may be provided by using dynode No. 10 as the output electrode. With this arrangement, the load is connected in the dynode-No. 10 circuit and the anode serves only as collector. The curve shown in Typical Anode Characteristics does not apply when dynode No. 10 is used as the output electrode.
g Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870^o K. The value of light flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
h Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, Glass Code No.5113 polished to 1/2 stock thickness — Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870^o K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
i For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.
j Measured at a tube temperature of 25^o C and with supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current may be reduced by use of a refrigerant.
k Determined at 4400 angstroms.
l Under the following conditions: Supply voltage (E) is as shown, 250^o C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870^o 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.
m Under the same conditions as shown under (n) except that use is made of a monochromatic source having radiation at 2537 angstroms.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSCRIPTIVE DEVICE HAVING S-13 RESPONSE
is shown at the front of this section.
DIMENSIONAL OUTLINE

PHOTOCATHODE DIAMETER
1 \( \frac{5}{8} \) MIN. (SEE NOTE)

BASE
JEDEC GROUP 5
No. B14 -38

T 16 BULB

2 ± \( \frac{5}{32} \) DIA.

2 \( \frac{5}{16} \) MAX. DIA.

5 \( \frac{5}{8} \) ± \( \frac{3}{16} \) 6 \( \frac{9}{16} \) MAX.

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

DYNODE - No. 1 - TO - CATHODE VOLTS = 167
EACH SUCCEEDING DYNODE - STAGE VOLTS = 83
LIGHT SOURCE IS A TUNGSTEN - FILAMENT LAMP
OPERATED AT COLOR TEMPERATURE OF 2870°K.
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES $\frac{1}{8}$ 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°K.

DASHED PORTION INDICATES INSTABILITY.

TUBE TEMPERATURE = 25°C
CHARACTERISTICS

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

SENSITIVITY — AMPERES/ LUMEN (COLOR TEMPERATURE 2870° K) vs
SUPPLY VOLTS (E) BETWEEN ANODE AND CATHODE

TYPICAL SENSITIVITY
MAXIMUM SENSITIVITY
MINIMUM SENSITIVITY
TYPICAL AMPLIFICATION
CURRENT AMPLIFICATION

92CM—9033RI
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

92CM—8136R2