



5819

# 5819 MULTIPLIER PHOTOTUBE

10-STAGE, HEAD-ON TYPE WITH  
1-1/2" SEMI-TRANSPARENT CATHODE AND S-9 RESPONSE

## DATA

### General:

Spectral Response . . . . .	S-9
Wave Length of Maximum Response . . . . .	4800 ± 500 angstroms
Cathode, Semi-Transparent:	
Shape . . . . .	Circular
Window Area . . . . .	1.8 sq.in
Minimum Diameter of Window. . . . .	1.5 sq.in
Direct Interelectrode Capacitances:	
Anode to Dynode No.10 . . . . .	4.2 μuf
Anode to All Electrodes . . . . .	6.5 μuf
Overall Length . . . . .	5-5/8" ± 3/16" ←
Seated Length . . . . .	4-7/8" ± 3/16" ←
Maximum Diameter. . . . .	2-1/4"
Bulb. . . . .	T-16
Mounting Position . . . . .	Any
Base. . . . .	Medium-Shell Diheptal 14-Pin, Non-Hygroscopic

Basing Designation for BOTTOM VIEW. . . . . 14M<sub>1</sub> ←

Pin 1 - Dynode No.1		Pin 10 - Dynode No.10
Pin 2 - Dynode No.2		Pin 11 - Anode
Pin 3 - Dynode No.3		Pin 12 - No
Pin 4 - Dynode No.4		Pin 13 - Internal Con.
Pin 5 - Dynode No.5		Do Not Use
Pin 6 - Dynode No.6		Pin 14 - Cathode
Pin 7 - Dynode No.7		
Pin 8 - Dynode No.8		
Pin 9 - Dynode No.9		

### Maximum Ratings, Absolute Values:

ANODE-SUPPLY VOLTAGE (DC or Peak AC) <sup>□</sup> . . .	1250 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.10 and ANODE (DC or Peak AC). . .	150 max.	volts
PEAK ANODE CURRENT. . . . .	7.5 max.	ma
AVERAGE ANODE CURRENT <sup>○</sup> . . . . .	0.75 max.	ma
AMBIENT TEMPERATURE . . . . .	75 max.	°C

### Characteristics:

With 90 volts per dynode stage and  
90 volts between dynode No.10 and anode

	<u>Min.</u>	<u>Av.</u>	<u>Max.</u>	
DC Anode Dark Current <sup>#</sup> • . . . . .	-	-	0.05	μamp

□ Referred to cathode.

○ Averaged over any interval of 30 seconds maximum.

# Dark current due to thermionic emission and ion feedback may be reduced by the use of refrigerants.

• For maximum signal-to-noise ratio, operation below 1000 volts is recommended.

← Indicates a change.

JULY 3, 1950

TUBE DEPARTMENT

TENTATIVE DATA

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY



## MULTIPLIER PHOTOTUBE

	<u>Min.</u>	<u>Au.</u>	<u>Max.</u>	
→ Sensitivity:				
At 4800 Angstroms. . . . .	-	14900	-	$\mu\text{amp}/\mu\text{watt}$
Luminous:				
Cathode <sup>§</sup> . . . . .	-	40	-	$\mu\text{amp}/\text{lumen}$
Anode: <sup>▲</sup>				
At 0 cps . . . . .	10	24	-	amp/lumen
At 100 Mc. . . . .	-	21	-	amp/lumen
Current Amplification <sup>■</sup> . . . . .	-	600000	-	
→ Equivalent Noise Input <sup>*</sup> . . . . .	-	$2 \times 10^{-11}$	-	lumen

## → Characteristics:

*With 75 volts per dynode stage and  
50 volts between dynode No. 10 and anode*

Au.

Sensitivity:				
At 4800 Angstroms. . . . .		3720		$\mu\text{amp}/\mu\text{watt}$
Luminous:				
Cathode <sup>§</sup> . . . . .		40		$\mu\text{amp}/\text{lumen}$
Anode, <sup>▲</sup> at 0 cps. . . . .		6		amp/lumen
Current Amplification <sup>■</sup> . . . . .		150000		

▲ For conditions where a tungsten lamp operated at a filament color temperature of 2870°K is used as a light source. A light flux of 10 microlumens from a rectangular aperture approximately 0.8" long and 0.2" wide is projected normal to the center of the cathode. The load resistor has a value of 0.01 megohm. The applied voltages are as indicated.

■ Ratio of anode sensitivity to cathode sensitivity.

\* Defined as the value where the rms output current is equal to the rms noise current determined under the following conditions: 90 volts per stage, 25°C tube temperature, ac-amplifier bandwidth of 1 cycle per second, tungsten light source at 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.

§ For conditions the same as shown under Anode Luminous Sensitivity except that the value of light flux is 0.01 lumen and that 90 volts are applied between cathode and all other electrodes connected together as an anode.

## OPERATING NOTES

Performance of the 5819 is affected by magnetic fields. It will be observed with certain orientations of the 5819 that the earth's magnetic field is sufficient to cause a noticeable decrease in the response of the tube. Therefore, it may be desirable to provide magnetic shielding for the 5819, particularly when it is to be used in a strong magnetic field.

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

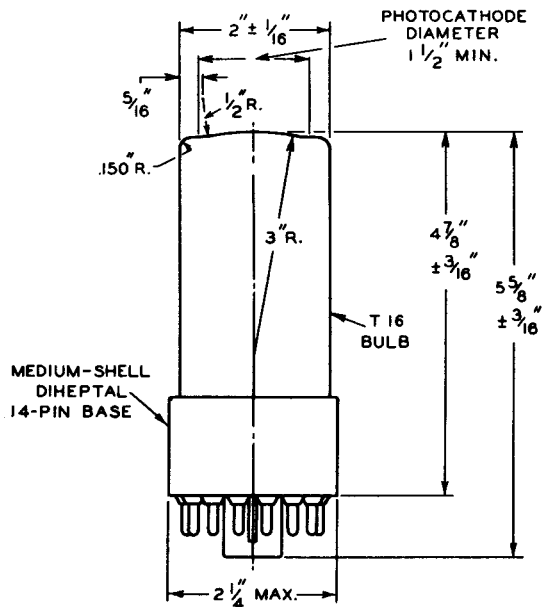
→ Indicates a change.



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## MULTIPLIER PHOTOTUBE



☉ OF BULB WILL NOT DEVIATE MORE THAN  $2^\circ$  IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

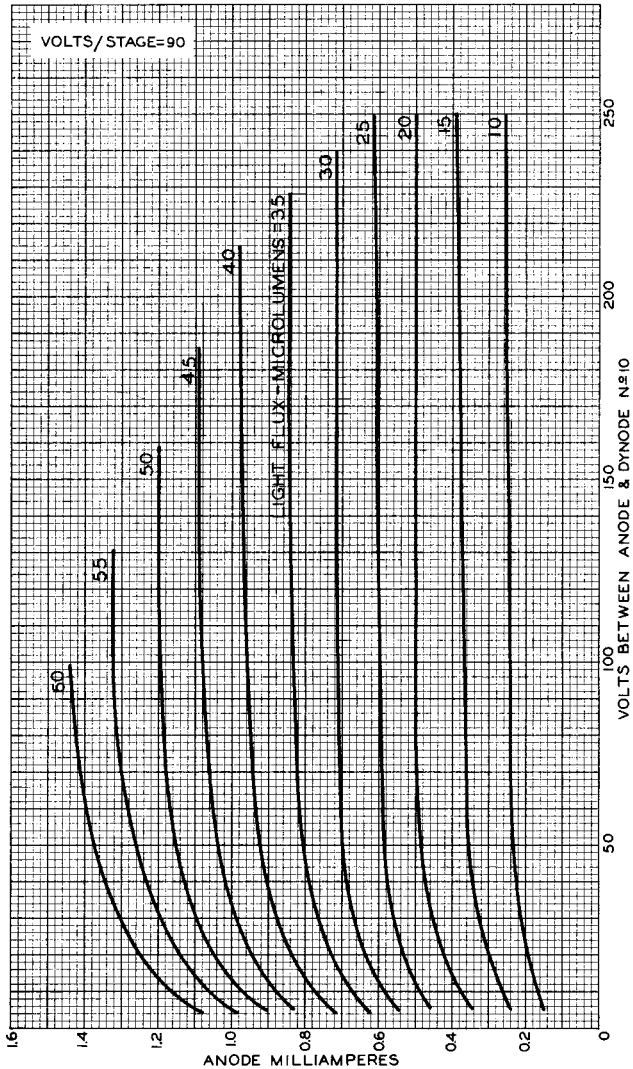
92CS-7232R1

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## AVERAGE ANODE CHARACTERISTICS



MAY 16, 1950

TUBE DEPARTMENT  
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

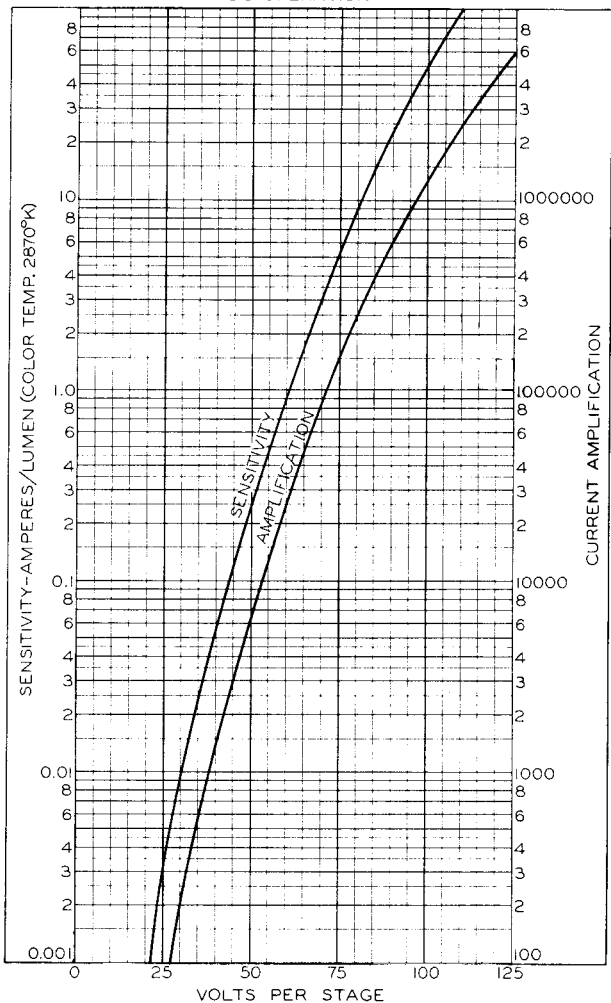
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AVERAGE CHARACTERISTICS  
DC OPERATION



MAY 15, 1950

TUBE DEPARTMENT  
RCA CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CL - 7258R2

# 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 in <sup>2</sup> (14.1 cm <sup>2</sup> )
Minimum diameter	1.69 in (4.3 cm)
Window	Corning <sup>a</sup> 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 <sup>b</sup> No.9709-7, or equivalent
Magnetic Shield	JAN <sup>c</sup> 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 <sup>e</sup>	0.75 max. mA
Ambient Temperature <sup>f</sup>	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)

	Min.	Typical	Max.	
<b>Anode Sensitivity:</b>				
Radiant <sup>g</sup> at 4400 angstroms . . . . .	—	$8 \times 10^4$	—	A/W
Luminous <sup>h</sup> (2870° K)	10	100	300	A/lm
<b>Cathode Sensitivity:</b>				
Radiant <sup>i</sup> at 4400 angstroms . . . . .	—	0.040	—	A/W
Luminous <sup>k</sup> (2870° K)	$4 \times 10^{-5}$	$5 \times 10^{-5}$	—	A/lm
Current with blue light source <sup>m</sup> (2870° K + C.S. No.5-58) . . . . .	$4 \times 10^{-8}$	—	—	A
Quantum Efficiency at 4200 angstroms .	—	11.5	—	%
Current Amplification	—	$2 \times 10^6$	—	
Anode Dark Current <sup>n</sup>	—	$6 \times 10^{-9}$	$4 \times 10^{-8}$	A
Equivalent Anode Dark Current Input <sup>n</sup> . . . . .	{	$3 \times 10^{-10}$	$2 \times 10^{-9}$	lm
		$3.7 \times 10^{-13p}$	$2.5 \times 10^{-12p}$	W
Equivalent Noise Input <sup>q</sup> . . . . .	{	$1.7 \times 10^{-12}$	—	lm
		$2 \times 10^{-15r}$	—	W

<sup>a</sup> Made by Corning Glass Works, Corning, NY 14830.

<sup>b</sup> Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia, PA 19144.

<sup>c</sup> Made by JAN Hardware Mfg. Co., Inc., 47-27 36th Street, Long Island City, NY 11101.

<sup>e</sup> Averaged over any interval of 30 seconds maximum.

<sup>f</sup> Tube operation at room temperature or below is recommended.

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

<sup>h</sup> 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  $2870^{\circ}$  K and a light input of 10 microlumens is used.

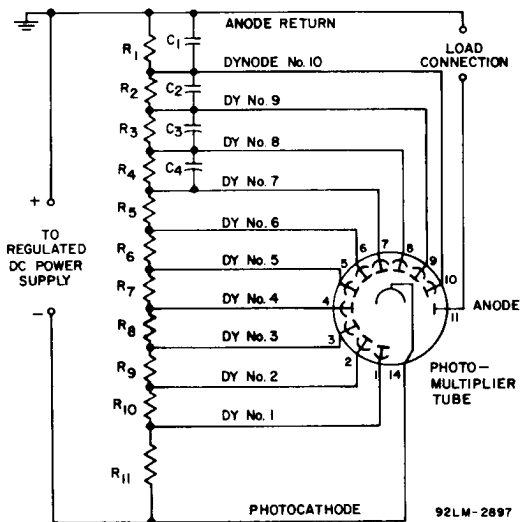
- i This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 804 lumens per watt.
- k Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of  $2870^{\circ}$  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, 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  $2870^{\circ}$  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.
- n At a tube temperature of  $22^{\circ}$  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.
- p At 4400 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 804 lumens per watt.
- q Under the following conditions: Tube temperature  $22^{\circ}$  C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of  $2870^{\circ}$  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 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

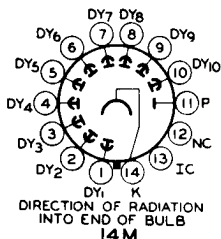


- $C_1$ : 0.05  $\mu\text{F}$ , 20%, 500 volts (dc working), ceramic disc
- $C_2$ : 0.02  $\mu\text{F}$ , 20%, 500 volts (dc working), ceramic disc
- $C_3$ : 0.01  $\mu\text{F}$ , 20%, 500 volts (dc working), ceramic disc
- $C_4$ : 0.005  $\mu\text{F}$ , 20%, 500 volts (dc working), ceramic disc
- $R_1$  through  $R_{10}$ : 390,000 ohms, 5%, 1/2 watt
- $R_{11}$ : 910,000 ohms, 5%, 1/2 watt

- 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.

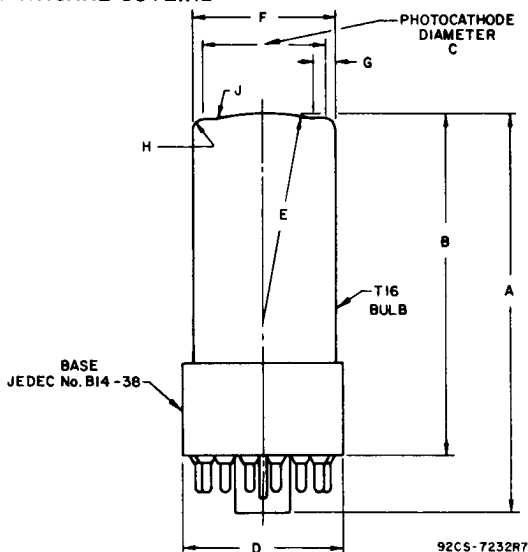
## TERMINAL DIAGRAM (Bottom View)

- 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

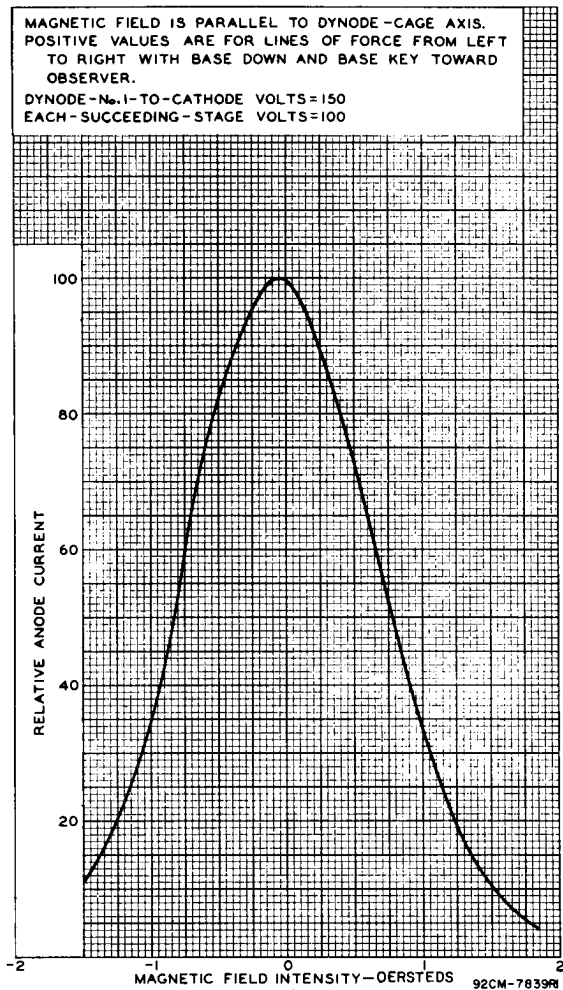
## DIMENSIONAL OUTLINE



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

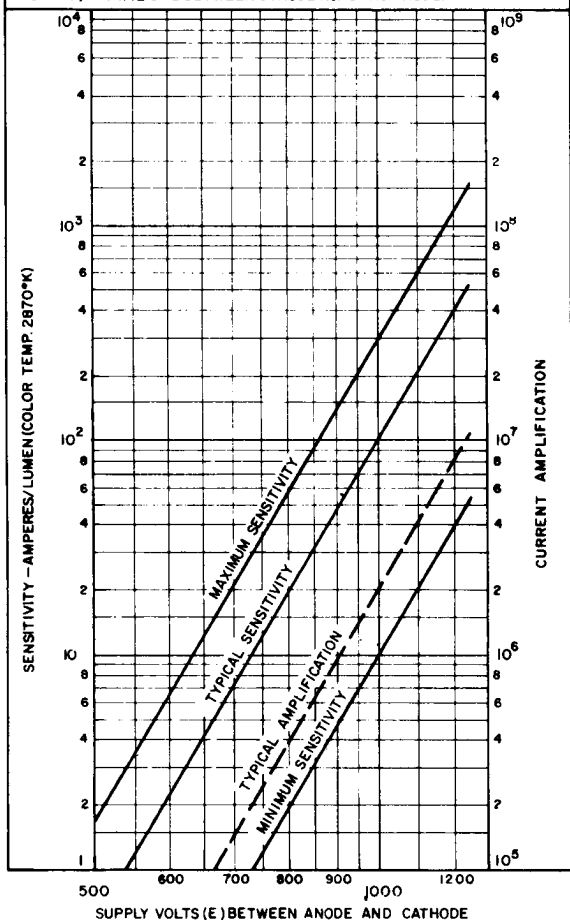
The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

Dimensions	Inches	mm
A	5.81 max.	147.6 max.
B	$4.88 \pm .19$	$123.9 \pm 4.7$
C	1.69 min. dia.	42.9 min. dia.
D	2.31 max. dia.	58.7 max. dia.
E	$3.00 \pm 1.00$ R.	$76.2 \pm 25.4$ R.
F	$2.00 \pm .06$ dia.	$50.8 \pm 1.5$ dia.
G	.312	7.92
H	$.15 \pm .05$ R.	$3.8 \pm 1.2$ R.
J	.50 R.	12.7 R.

TYPICAL EFFECT OF MAGNETIC FIELD  
ON ANODE CURRENT

## TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

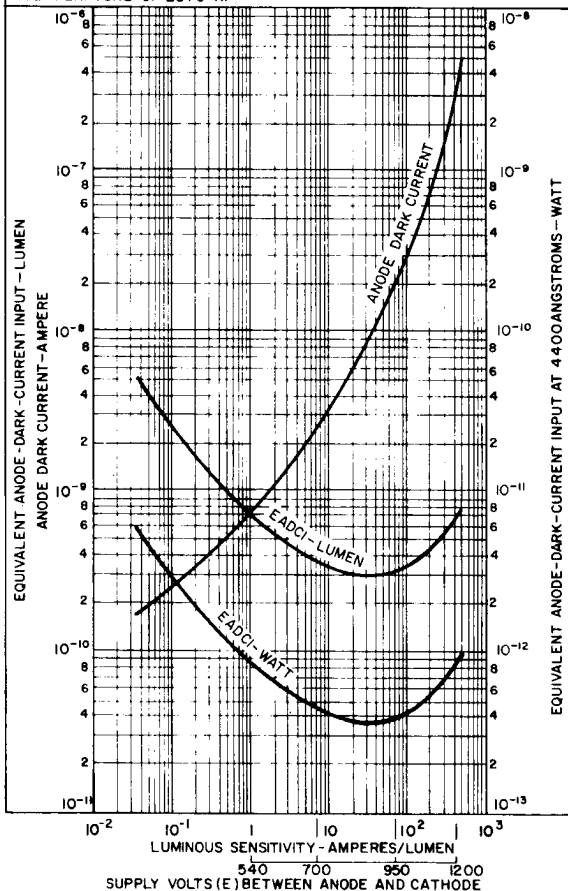
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No. 1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No. 10 AND ANODE.



92LM-2894

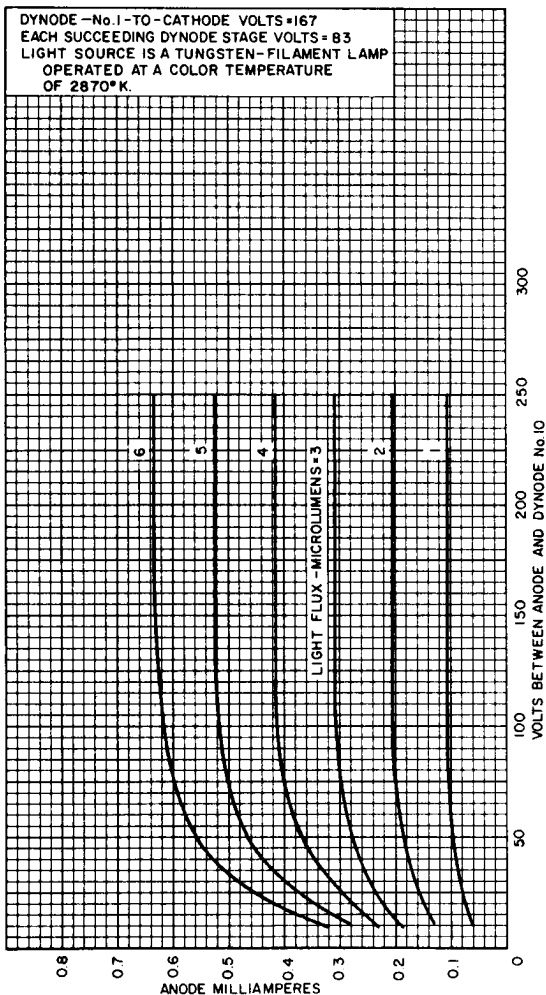
## TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

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.



92LM-289I

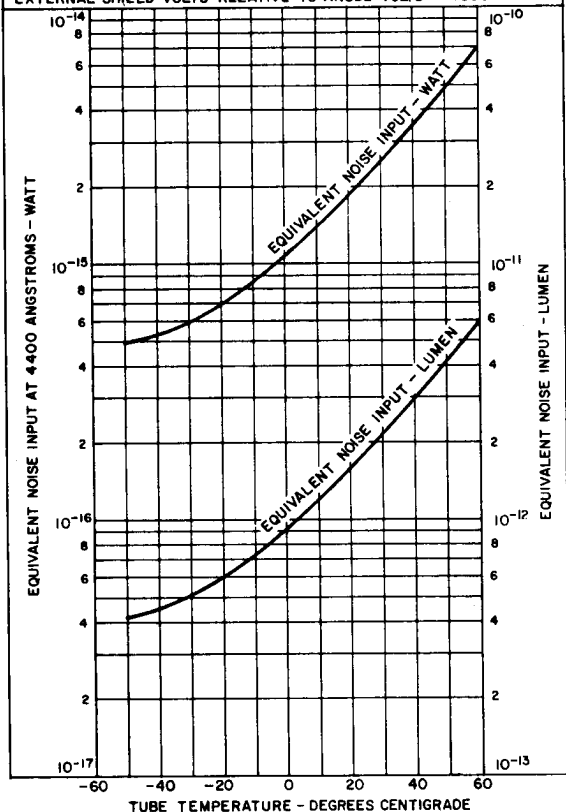
## TYPICAL ANODE CHARACTERISTICS



92LM-2895

## 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



92LM-2893