

Multiplier Phototube

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

GENERAL

Spectral Response	S-11
Wavelength of Maximum Response	$4400 \pm 500 \text{ \AA}$
Cathode, Semitransparent	Cesium-Antimony with High-Conductivity Grating
Area including grating	$1.8 \text{ in}^2 (11.6 \text{ cm}^2)$
Minimum diameter	$1.5 \text{ in} (3.8 \text{ cm})$
Window	Corning ^a No.0080, or equivalent
Shape	Plano-Plano
Index of refraction at 4360 angstroms	1.523

Dynodes:

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

Direct Interelectrode Capacitances (Approx.):

Anode to dynode No.10	4.4 pF
Anode to all other electrodes	7.0 pF
Maximum Overall Length	5.81 in (14.8 cm)
Seated Length	$4.88 \pm 0.19 \text{ in} (12.4 \pm 0.48 \text{ cm})$
Maximum Diameter	2.31 in (5.9 cm)
Bulb	T-16
Base	Medium-Shell Diheptal 14-Pin (JEDEC No.B14-38), Non-hygroscopic
Socket	Eby ^b No.9709-7, or equivalent
Magnetic Shield	Millen ^c Part No.80802B, or equivalent
Operating Position	Any
Weight (Approx.)	5.2 oz (174 g)

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage:

Between anode and cathode	1500 max.	V
Between anode and dynode No.10	250 max.	V
Between consecutive dynodes	250 max.	V
Between dynode No.1 and cathode	400 max.	V

Between focusing electrode and cathode . .	400 max. V
Average Anode Current ^e	2 max. mA
Average Cathode Current ^f	5 max. μ A
Ambient Temperature ^g	75 max. $^{\circ}$ 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)

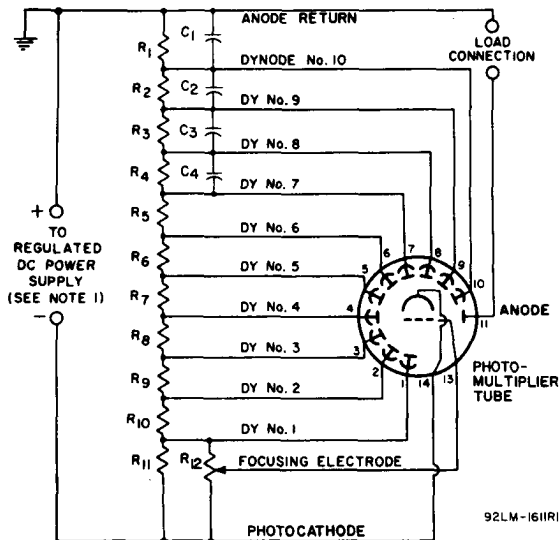
	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant ^h at				
4400 angstroms . .	—	4.8×10^3	—	A/W
Luminous				
(2870 $^{\circ}$ K) ⁱ	2.5	6	75	A/lm
Cathode Sensitivity:				
Radiant ^k at				
4400 angstroms . .	—	0.04	—	A/W
Luminous				
(2870 $^{\circ}$ K) ^m	3×10^{-5}	5×10^{-5}	—	A/lm
Current with blue				
light source				
(2870 $^{\circ}$ K + C.S.				
No.5-58) ⁿ	3×10^{-8}	5×10^{-8}	—	A
Quantum Efficiency				
at 4200				
angstroms.	—	11.5	—	%
Current Amplification	—	1.2×10^5	—	
Anode Dark Current ^p	—	4×10^{-9}	4.5×10^{-8}	A
Equivalent Anode				
Dark Current				
Input ^p	{ —	$\frac{2}{2.5} \times 10^{-10-13q}$	$\frac{2.25}{2.8} \times 10^{-9-12q}$	$\frac{1}{W}$
Equivalent Noise				
Input ^r	{ —	$\frac{5.6}{7} \times 10^{-12-15s}$	$\frac{1.9}{2.3} \times 10^{-11-14s}$	$\frac{1}{W}$

^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 James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.
- ^e Averaged over any interval of 30 seconds maximum.
- ^f Above this value of average cathode current, serious loss in linearity between light input and anode current will be caused by the resistivity of the cathode.
- ^g Tube operation at room temperature or below is recommended.
- ^h This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 804 lumens per watt.
- ⁱ Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870° K and a light input of 10 microlumens is used.
- ^k This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 804 lumens per watt.
- ^m 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.
- 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, 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.
- ^p 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.
- ^q 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. These values are calculated from the ENI values in lumens using a conversion factor of 804 lumens per watt.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

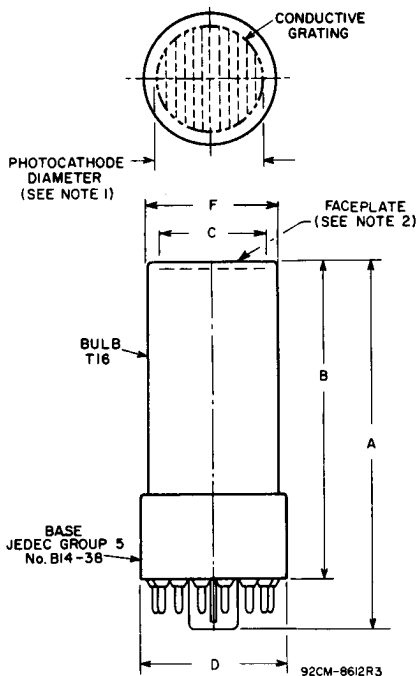


- C_1 : 0.05 μF , 20%, 500 volts (dc working), ceramic disc
 C_2 : 0.02 μF , 20%, 500 volts (dc working), ceramic disc
 C_3 : 0.01 μF , 20%, 500 volts (dc working), ceramic disc
 C_4 : 0.005 μF , 20%, 500 volts (dc working), ceramic disc
 R_1 through R_{10} : 390,000 ohms, 5%, 1/2 watt
 R_{11} : 910,000 ohms, 5%, 1/2 watt
 R_{12} : 5 megohms, 20%, 1/2 watt, adjustable

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

Note 2: Component values are dependent upon nature of application and output signal desired.

DIMENSIONAL OUTLINE



☉ of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

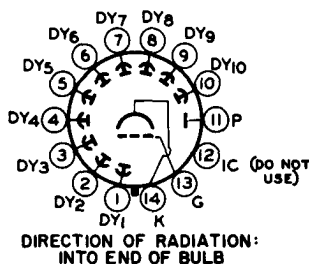
Note 1: The grating consists of 12 equally spaced conductive strips having a maximum width of 0.02" (0.5 mm).

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

OUTLINE DIMENSIONS

Dimensions	Inches	mm
A	5.81 max.	147.5 max.
B	$4.88 \pm .19$	123.9 ± 4.8
C	1.5 min. dia.	38 min. dia.
D	2.31 max. dia.	58.6 max. dia.
F	$2.00 \pm .06$ dia.	50.8 ± 1.5 dia.

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

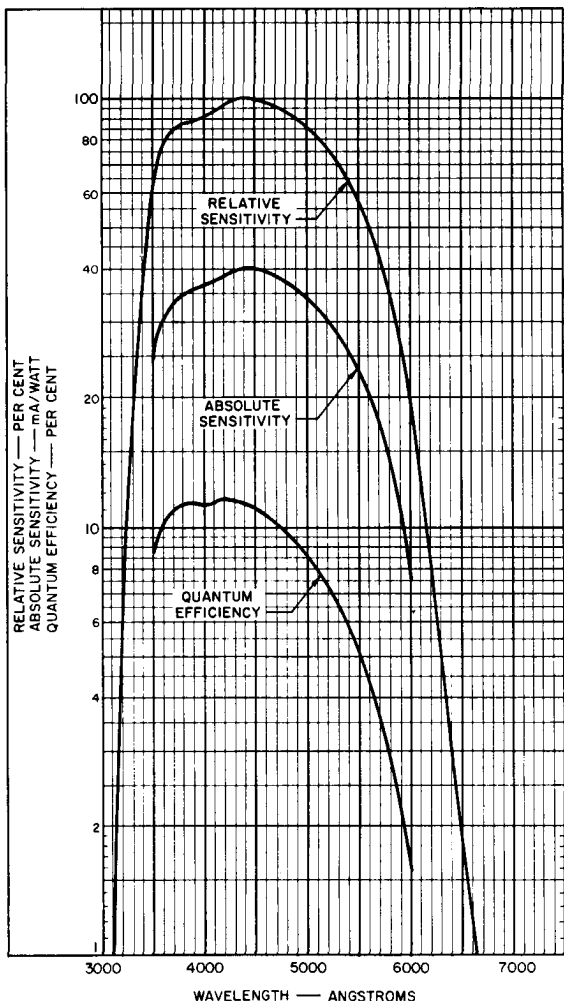
Pin 11: Anode

Pin 12: Internal connection-
Do not use

Pin 13: Focusing Electrode

Pin 14: Photocathode

Typical Spectral Response Characteristics



92LM-2843

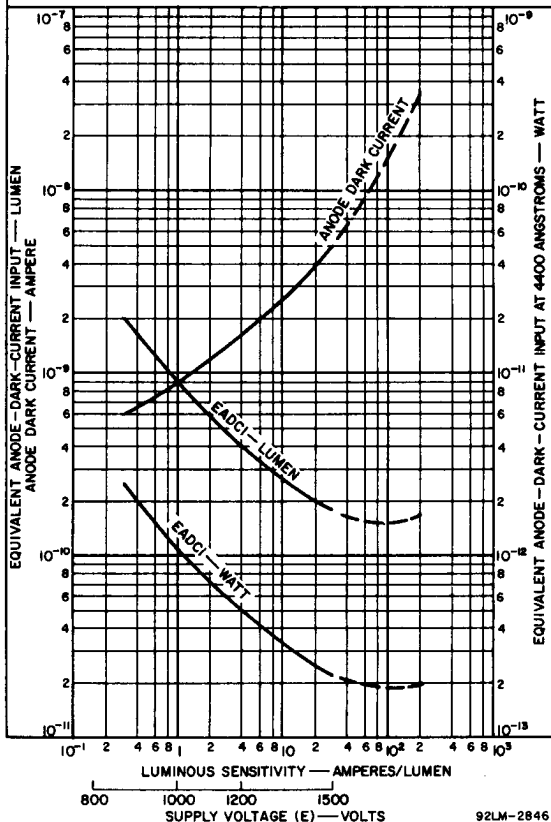
Typical EADCI and Anode Dark Current Characteristics

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

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

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

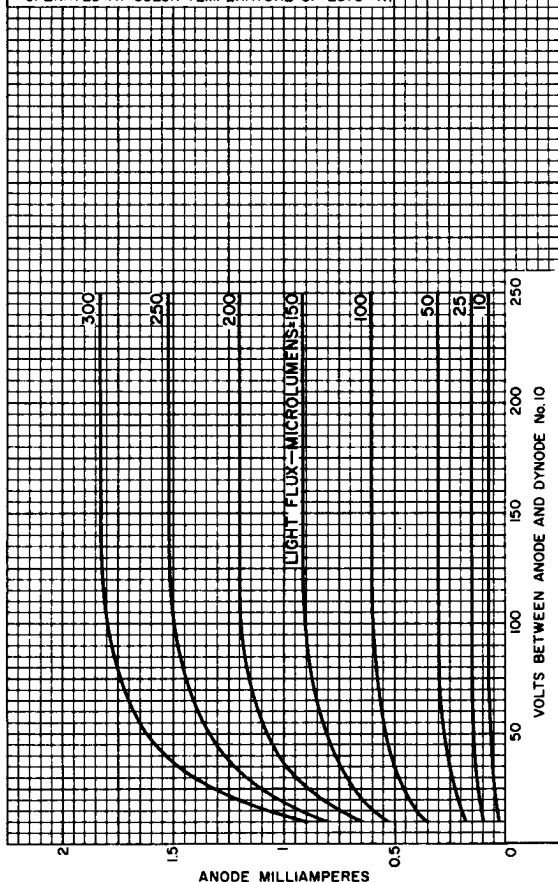
TUBE TEMPERATURE = 22°C



92LM-2846

Typical Anode Characteristics

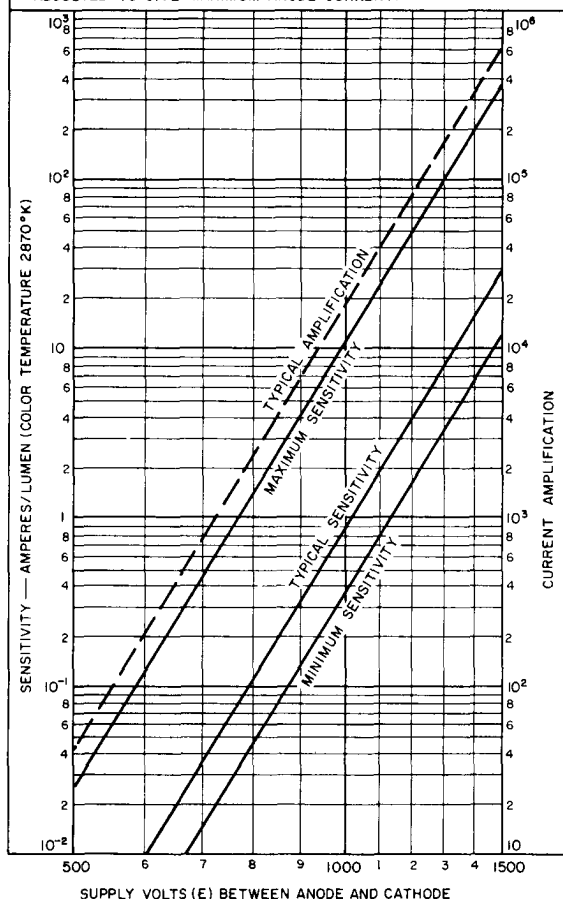
DYNODE-No.1-TO-CATHODE VOLTS=200
 EACH SUCCEEDING-DYNODE-STAGE VOLTS=100
 FOCUSING ELECTRODE ADJUSTED TO PROVIDE
 MAXIMUM ANODE CURRENT.
 LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP
 OPERATED AT COLOR TEMPERATURE OF 2870° K.



92CM-8641R2

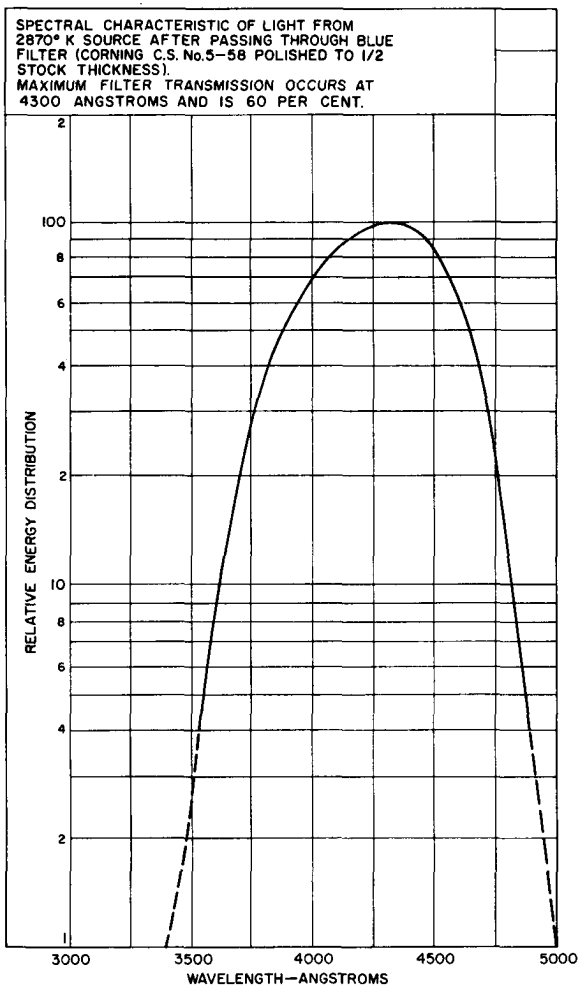
Sensitivity and Current Amplification Characteristics

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. FOCUSING-ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.



92LM-2848

Spectral Energy Distribution of 2870° K Light Source After Passing Through Indicated Filter



92CM-11081R1

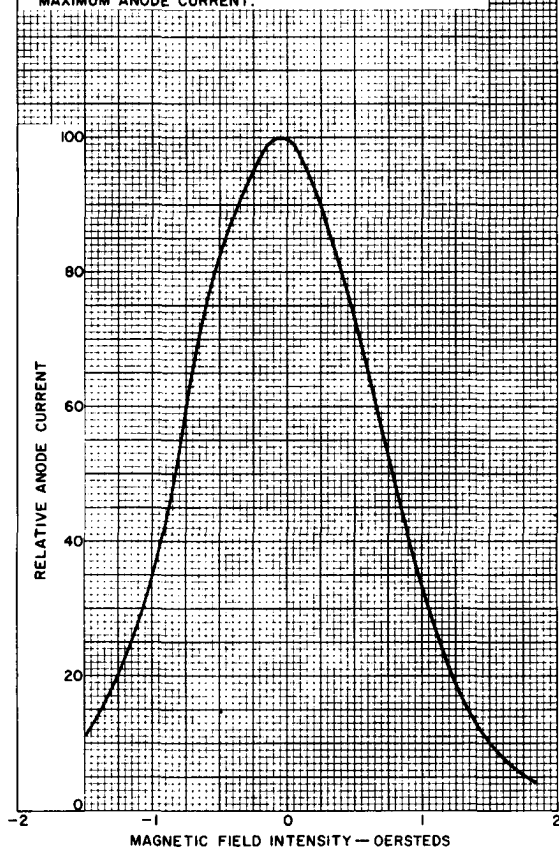
Typical Effect of Magnetic Field on Anode Current

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.



92CM-8136R3