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 ± 1000 Å
Cathode, Semitransparent	Silver-Oxygen-Cesium
Minimum area	1.2 in^2 (7.7 cm^2)
Minimum diameter	1.24 in (3.1 cm)
Window	Lime Glass (Corning[a] 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 in ± 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[b] No.9058, or equivalent
Magnetic Shield	Millen[c] 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[e]	10	max.	μA
Ambient Temperature[f]	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)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g] at 8000 angstroms	–	6.6×10^{2}	–	A/W
Luminous[h] (2870° K)	1	7	30	A/lm
Cathode Sensitivity:				
Radiant[j] at 8000 angstroms	–	2.8×10^{-3}	–	A/W
Luminous[k] (2870°K)	1×10^{-5}	3×10^{-5}	–	A/lm
Current with infrared light source[m] (2870° K + C.S. No.7-56)	1.2×10^{-8}	4×10^{-8}	–	A
Quantum Efficiency at 7800 angstroms	–	0.43	–	%
Current Amplification	–	2.3×10^{5}	–	
Anode Dark Current[n]	–	1.9×10^{-6}	6×10^{-6}	A
Equivalent Anode Dark Current Input[n]	–	4.8×10^{-7}	1.5×10^{-6}	lm
	–	5.1×10^{-9}[p]	1.6×10^{-8}[p]	W
Equivalent Noise Input[q]	–	1.5×10^{-10}	–	lm
	–	1.6×10^{-12}[r]	–	W
Anode-Pulse Rise Time[s] at 1500 V	–	2.2×10^{-9}	–	s
Electron Transit Time[t] at 1500 V	–	2.8×10^{-8}	–	s

[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. 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.

[f] Tube operation at room temperature or below is recommended.

→ Indicates a change or addition.

[g] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 94 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.

[j] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 94 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° K. The value of light flux is 0.01 lumen and 250 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 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.

[n] 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.

[p] At 8000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 94 lumens per watt.

[q] 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.

[r] At 8000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 94 lumens per watt.

[s] 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.

[t] 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.

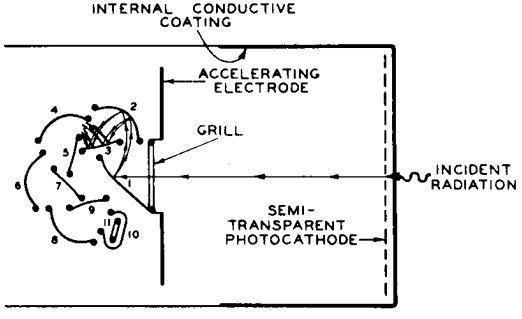
ANODE CURRENT

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.

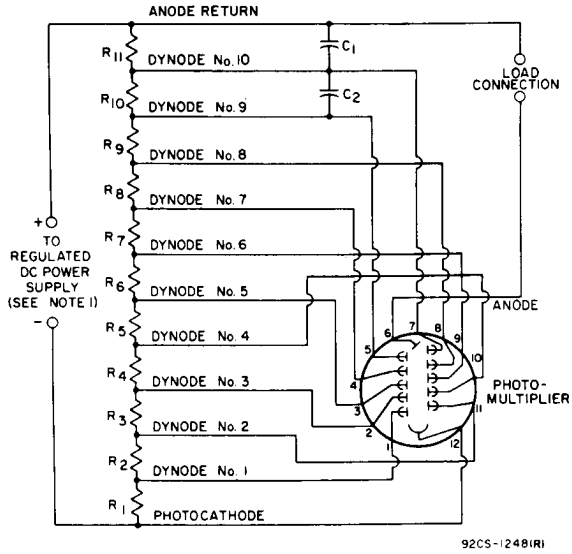
SCHEMATIC ARRANGEMENT OF STRUCTURE



I - 10: DYNODES
11: ANODE

92CS-9461RI

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



C_1: 0.02 μF, 20%, 500 volts (dc working), ceramic disc
C_2: 0.01 μF, 20%, 500 volts (dc working), ceramic disc
R_1: 910,000 ohms, 2 watts
R_2 through R_{11}: 470,000 ohms, 1 watt

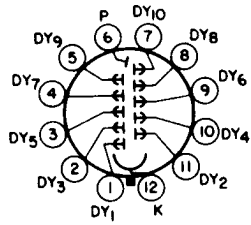
Note 1: Adjustable between approximately 500 and 1500 volts dc.

Note 2: Capacitors C_1 and C_2 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.

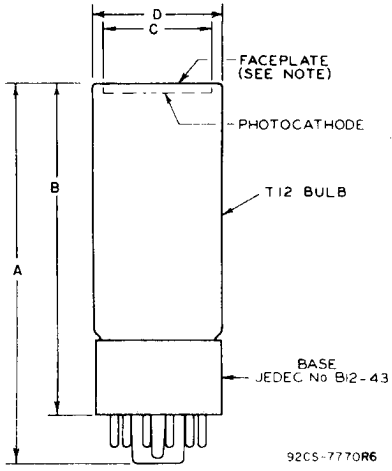
TERMINAL DIAGRAM (Bottom View)

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

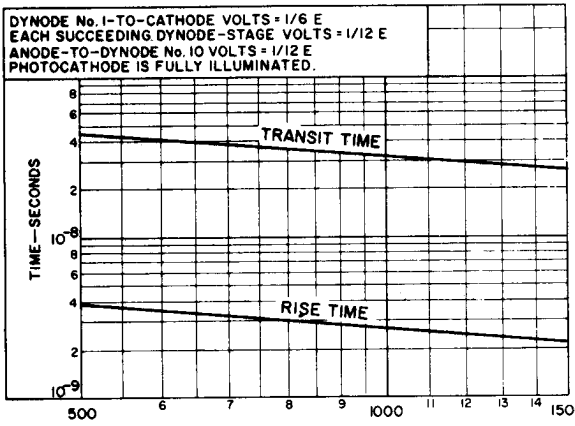


Note: Deviation from flatness will not exceed 0.010" from peak to valley.

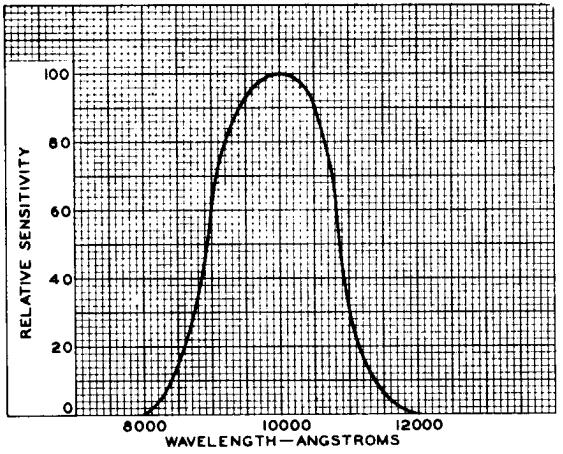
℄ of bulb will not deviate more than 2^{o} in any direction from the perpendicular erected at the center of bottom of the base.

Dimensions	Inches	mm
A	4.57 max.	116.1 max.
B	3.88 ± 0.19	98.5 ± 4.8
C	1.24 min. dia.	31.4 min. dia.
D	1.56 max. dia.	39.6 max. dia.

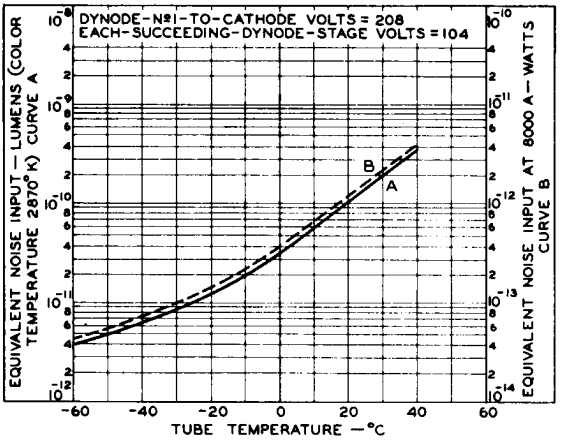
TYPICAL TIME RESOLUTION CHARACTERISTICS



SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870°K LIGHT SOURCE AFTER PASSING THROUGH INFRARED FILTER (CORNING C.S. NO. 7-56)



EQUIVALENT NOISE-INPUT CHARACTERISTICS



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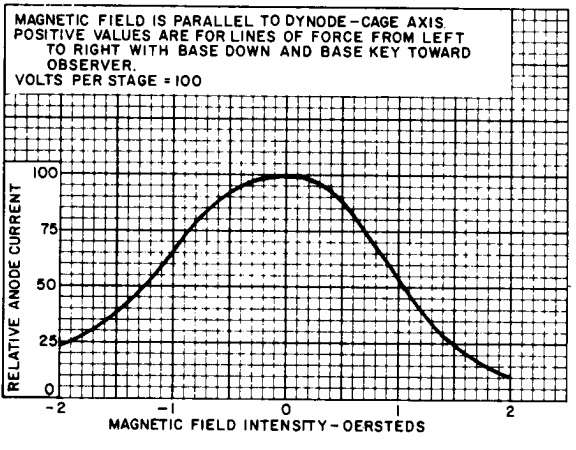
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



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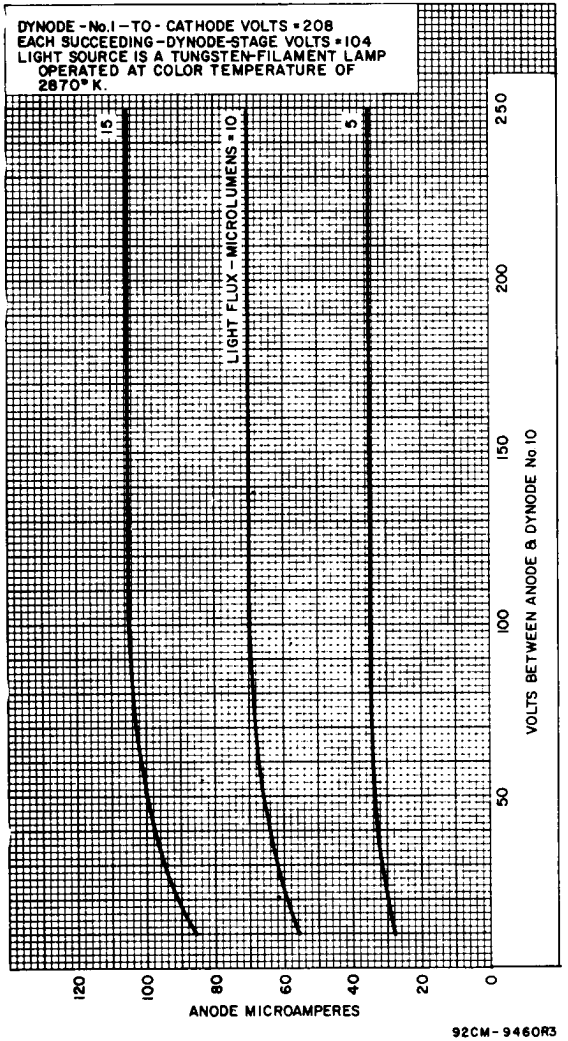
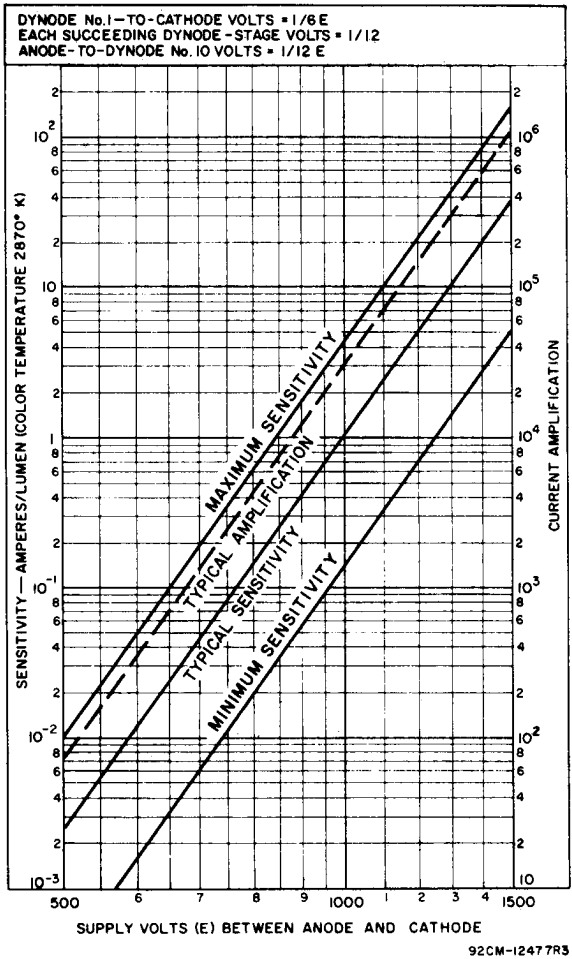
TYPICAL ANODE CHARACTERISTICS

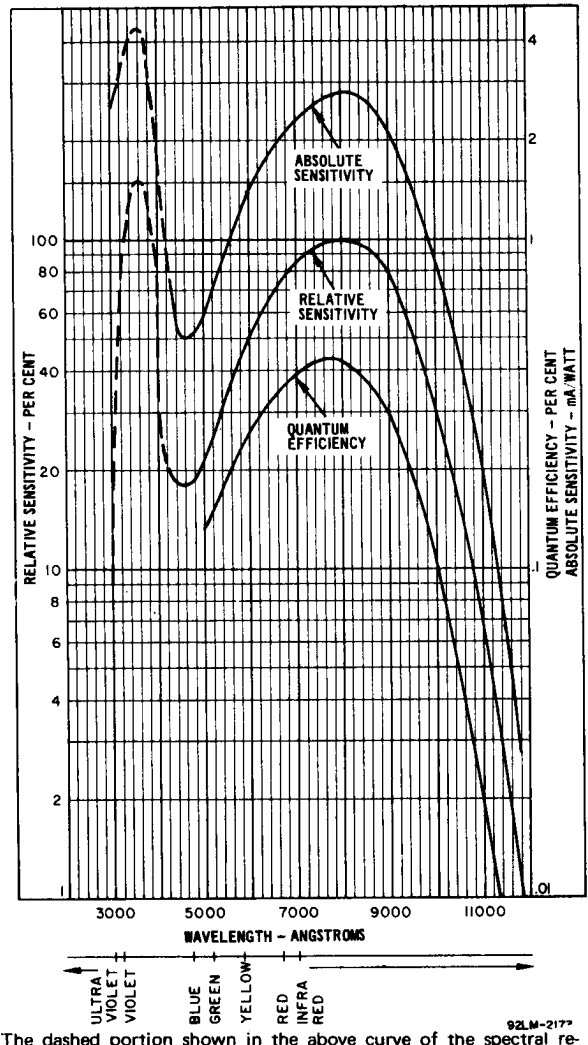


92CM-9460R3

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



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The dashed portion shown in the above curve of the spectral response is not controlled.

TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS