4818

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 x 10^6 at 1000 volts**
- **Fast Time Resolution Characteristics – Anode Pulse Rise Time, 1.6 x 10^{-9} s at 1250 volts**
  Electron Transit Time, 1.6 x 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[a] 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 Submagnal 11-Pin, (JEDEC Group 2, No.B11-88) DAP (Di-Allyl Phthalate) Non-Hygroscopic Material
Socket	Amphenol[b] No.78S11T, or equivalent
Magnetic Shield	Millen[c] No.80801B, or equivalent
Operating Position	Any
Weight (Approx.)	1.6 oz

Maximum Ratings, Absolute-Maximum Values[d]

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[e]	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 22° C.

With E = 1000 volts (Except as noted)

	Min.	Typ.	Max.	
Anode Sensitivity:				
Radiant[f] at 400 nm	–	2.7×10^{5}	–	A/W
Luminous[g] (2854° K)	100	300	1200	A/lm
Cathode Sensitivity:				
Radiant[h] at 400 nm	–	5.4×10^{-2}	–	A/W
Luminous[i] (2854° K)	2.5×10^{-5}	6×10^{-5}	–	A/lm
Quantum efficiency at 400 nm	–	16.5	–	%
Anode-Current Drift:[k]				
For an initial anode current (I_b) of 3 μA	–	–	±1.5	%
Current Amplification	–	5×10^{6}	–	
Anode Dark Current at 1000 Volts	–	2×10^{-9}	1.5×10^{-8}	A
Equivalent Anode Dark Current Input[m] at 1000 Volts	–	6.6×10^{-12}	–	lm
Anode Pulse Rise Time[n], at 1250 Volts	–	1.6×10^{-9}	–	s
Electron Transit Time[p], at 1250 Volts	–	1.6×10^{-8}	–	s

[a] Made by Corning Glass Works, Corning, NY 14830.

[b] Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 50, IL 60650.

c Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, MA 02148.

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 900 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 2854° K and a light input of 1 microlumen is used.

h This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 900 lumens per watt.

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 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.

k 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:

$$\text{Anode Current Drift} = \frac{\triangle I_b \text{ (30 to 42 minutes)}}{I_b \text{ (at 30 minutes)}}$$

where $\triangle I_b$ = the incremental change in anode current

This test is performed on an active sampling basis (10% of the total product).

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

n 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.

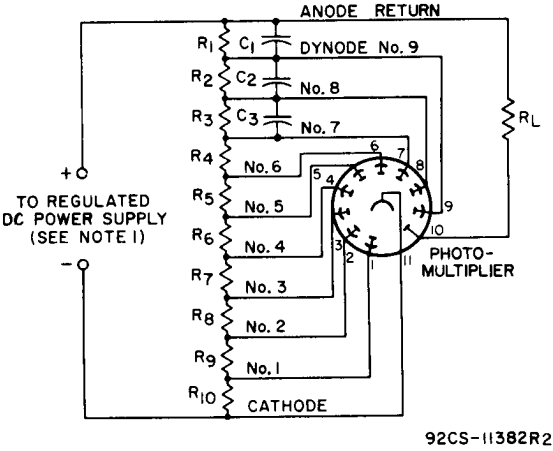
p The electron transit time is the time interval between the arrival of a delta function light pulse at the entrance window of the tube and the time at which the output pulse at the anode terminal reaches peak amplitude. The transit time is measured under conditions with the incident light fully illuminating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



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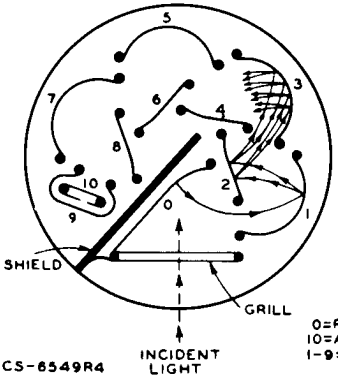
C1: 0.05 μF, 500 volts (DC working)
C2: 0.02 μF, 500 volts (DC working)
C3: 0.01 μF, 500 volts (DC working)
R1 through R10: 20,000 to 1,000,000 ohms

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.

Schematic Arrangement of Structure



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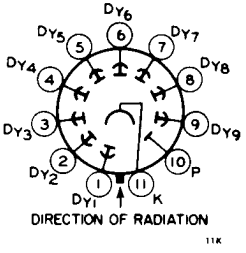
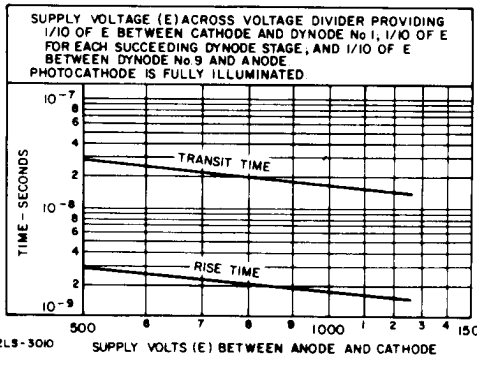
Basing Diagram — Botton View



11K

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

Typical Time-Resolution Characteristics



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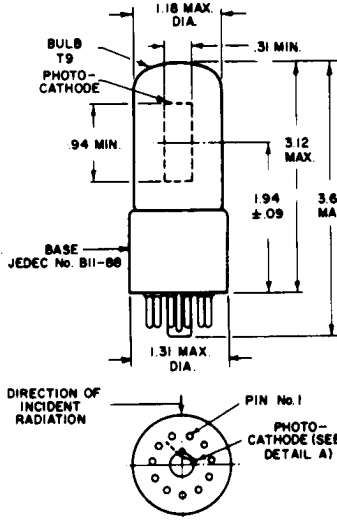
Dimensional Outline



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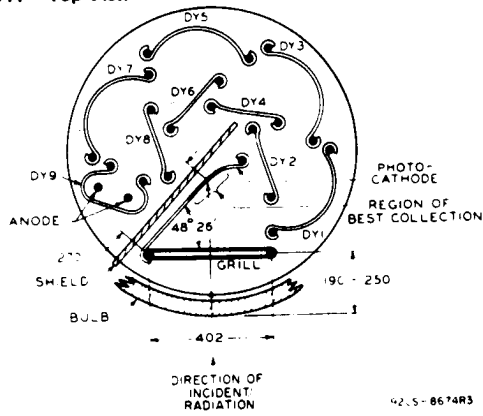
℄ of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base.

Detail A – Top View



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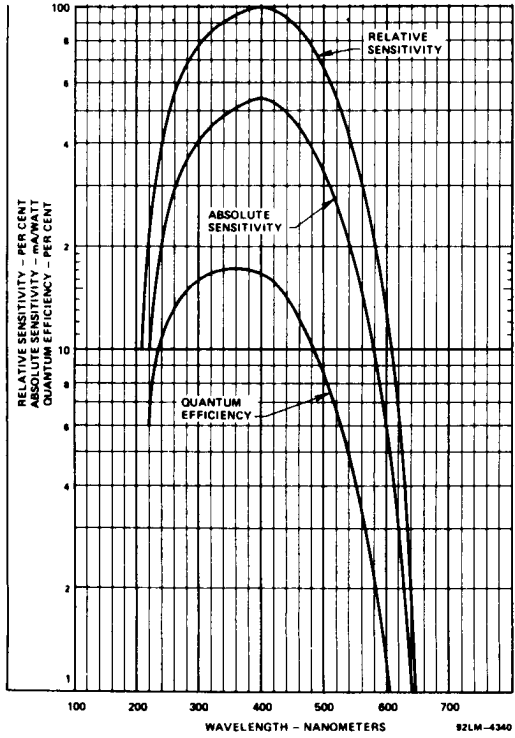
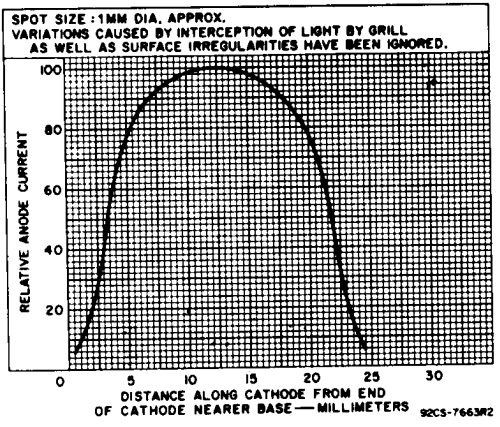
Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Inch Dimension Equivalents in Millimeters					
Inch	mm	Inch	mm	Inch	mm
.09	2.3	.31	7,9	1.31	33.2
.190	4.8	.402	10.2	1.94	49.2
.250	6.3	.94	23.8	3.12	79.2
.270	6.8	1.18	29.9	3.68	93.4

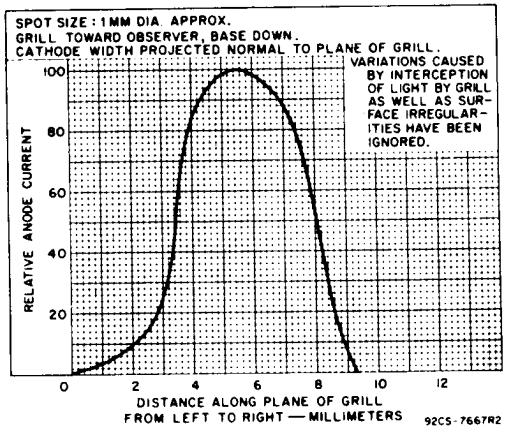
Typical Photocathode Spectral Response Characteristics



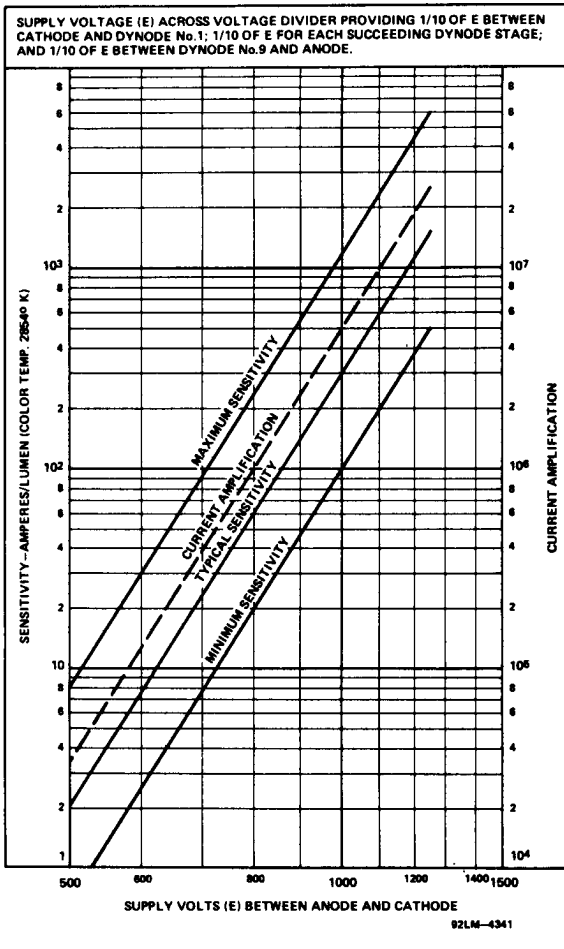
Typical Variation of Photocathode Sensitivity Along Tube Length



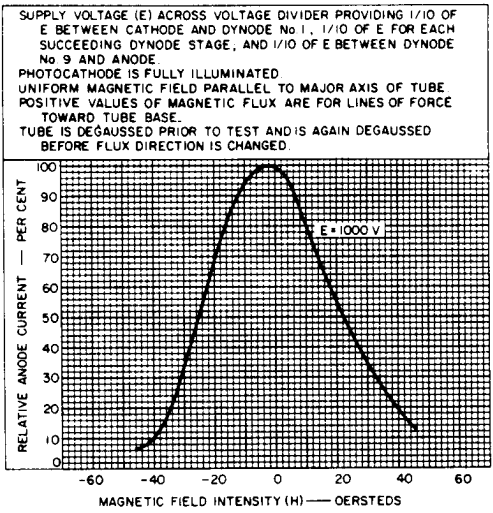
Typical Variation of Photocathode Sensitivity Across Projected Width in Plane of Grill



Typical Sensitivity and Current Amplification Characteristics



Typical Effect of Magnetic Field on Anode Current



Typical Variation of Sensitivity as Tube is Rotated with Respect to Fixed Light Beam