RCA TUBE HANDBOOK HB-3

PHOTOSENSITIVE DEVICE SECTION

This Section contains data on phototubes of the single-unit, twin-unit, and multiplier types; photocells; television camera tubes such as image orthicons, iconoscopes, and vidicons; and other devices employing photosensitive materials.

For further Technical Information, write to Commercial Engineering, Tube Division, Radio Corporation of America, Harrison, N. J.

Photosensitive Devices

DEFINITIONS

of Photosensitive-Device Terms

Radiant Sensitivity. The quotient of output current by incident radiant power of a given wavelength, at constant electrode voltages.

Radiant Intensity Sensitivity. The quotient of output current by incident radiant power per unit area, at constant electrode voltages.

Cathode Radiant Sensitivity. The quotient of current leaving the photocathode by incident radiant power of a given wavelength.

Luminous Sensitivity. The quotient of output current by incident luminous flux, at constant electrode voltages.

Luminous Intensity Sensitivity. The quotient of the output current by the incident luminous intensity, at constant electrode voltages.

Cathode Luminous Sensitivity. The quotient of current leaving the photocathode by the incident luminous flux.

Illumination Sensitivity. The quotient of output current by the incident illumination, at constant electrode voltages.

Dynamic Sensitivity. The quotient of the modulated component of the electrical output by the modulated component of the incident radiation.

Current Amplification. Ratio of the output current to the photocathode current, at constant electrode voltages.

Equivalent Anode-Dark-Current Input. The quotient of the anode dark current by the luminous sensitivity.

Equivalent Noise Input. That value of incident luminous flux which when modulated in a stated manner produces an rms output current equal to the rms noise current within a specified bandwidth.

Electrode Dark Current. The electrode current which flows when there is no radiant flux incident on the photocathode.

Transit-Time Spread. The increase in width of the output pulse over that of the input pulse. Pulse width is measured at 50 per cent of the pulse height.

Pulse Rise Time. The time required for the instantaneous amplitude of the pulse to go from 10 per cent to 90 per cent of the peak value.

Median. That value in a series such that half of the devices in the series are on one side of it, and half on the other.

PHOTOMULTIPLIER TUBES

Spectral Response	Diameter (nominal) in	No. of Stages	Secondary Emitting Surface	RCA Tube Types
S-1	1-1/2	10	Mg-O[a]	7102
S-4	1/2	9	Cs-Sb	8571
	1-1/8	9	Cs-Sb	1P21, 931A, 4471, 4472, 4473, 6328, 6472, 7117
S-5	1-1/8	9	Cs-Sb	1P28, 1P28A
S-8	1-1/8	9	Cs-Sb	1P22
S-10	2	10	Cs-Sb	6217
S-11	3/4	6	Be-O	7764
		10	Be-O	4460, 7767
	1-1/2	10	Be-O	4461
		10	Cs-Sb	2060, 2067, 4438, 4439, 4440, 4441, 4441A, 6199
	2	10	Be-O	2020, 2061, 2063, 6342A, 7746, 8053
		10	Cs-Sb	2062, 5819, 6655A
		12	Be-O	7850
		14	Be-O	6810A, 7264
	3	10	Be-O	2064, 2064B, 8054
	5	10	Be-O	2065, 8055
S-11[b]	5	14	Be-O	7046
S-13	2	10	Cs-Sb	6903
S-19	1-1/2	9	Cs-Sb	7200
S-20	3/4	10	Be-O	8644, 8645
	2	10	Be-O	4463, 7326
		12	Be-O	4459
		14	Be-O	7265
	3	10	Be-O	4464
	5	10	Be-O	4465
(c)	2	10	Be-O	4523
	3	10	Be-O	4524
	5	10	Be-O	4525
	2	12	Be-O	8575

VACUUM AND GAS PHOTODIODES

Spectral Response	Single-Unit		Twin Unit	Anode-Cathode
	Vacuum	Gas	Gas	Vacuum
S-1	917 919 922 925 6570	1P40 1P41 868 918 921 923 927 930 6405/1640 6953	920	
S-3	926	1P29		
S-4	1P39 929 934 5653 7043	1P37 4409 5581 5582 5583		5652
S-5	935			
S-9	1P42			

IMAGE-CONVERTER TUBES[d]

Spectral Response	Recommended Service	
	Infrared	Photographic Shutter
S-1	6032A 6914 6914A 6929	
S-11		4449A

CAMERA TUBES

VIDICONS[e]			
Tube Diameter inches	Recommended Service		
	Television Film Pickup	Live Television and Industrial	Space Military and Industrial
1/2			4427
1	7038 8134/V1 8572	4478 4488 4493 4494 4495 7262A 7697 7735B 8134 8507 8573	2048[b] 4482[b] 4500 4503[b] 7263A[b] 8567[b]

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

CAMERA TUBES

VIDICONS[e] (Cont'd)

Tube Diameter inches	Recommended Service		
	Television Film Pickup	Live Television and Industrial	Space Military, and Industrial
1-1/2	8051 8480 8480/V1		8480 8521

IMAGE ORTHICONS

Tube Diameter inches	Recommended Service		
	Live Television Pickup		Military and Industrial
	Color	Black and White	
3	4415, 4416 4415/S, 4416/S[g] 7513[h] 7513/S, 4513/S[g] 7513/L 8092A/S	4401V1 4401V1/L 5820A 5820A/L 7293A 7293A/L 7513 7513/L 8092A 8093A 8093A/L	4401V1 4401V1/L 7198A[b] 7629A 7967 8092A
4-1/2	4492[j]	7295B 7295C 7389B 7389C	

IMAGE-INTENSIFIER ORTHICON

Combined Image-Converter and Image Orthicon Sections	
Tube Diameter inches	Recommended Service
	Extremely Low-Light Level Television Cameras
5	4470

a This surface is being replaced gradually by Be-O.

b Has extended spectral response in the near-ultraviolet. Maximum response occurs at about 4200 angstroms. The approximate spectral range, at the 10 per cent points, is from 2500 to 6500 angstroms.

c A spectral-response S- designation has not been assigned for these bialkali photocathode types. Maximum response occurs at about 3850 angstroms for approximate spectral range, at the 10 per cent points, is from 2600 to 6000 angstroms for type 8575 and from 3100 to 6100 for types 4523, 4524, and 4525.

d These types utilize a P20 phosphor screen except type 4449A which has a P11 phosphor screen.

[e] Variants of each vidicon type having fiber-optics faceplates, reticles, and/or radiation-resistant faceplates can often be supplied to meet the needs of specific applications.

[f] Ruggedized type.

[g] Types 4415/S, 4416/S are available as a trio having matched characteristics. The 4415/S's are for use in the red and green channels and the 4416/S is for use in the blue channel. Types 7513/S, 4513/S are also available as a set of three tubes having matched characteristics. Types 7513/S are for the red and green channels and type 4513/S for the blue.

[h] A trio of these tubes having matched characteristics is available as three type 7513/S.

[j] For the luminance channel in 4-tube color cameras.

PHOTOTUBE SENSITIVITY AND SENSITIVITY MEASUREMENTS

GENERAL CONSIDERATIONS

The range of luminous-sensitivity limits given for a phototube on the data sheets of this Section is that which the tube will display when operated under low-current conditions.

If the tube is to be operated under conditions approaching its maximum-current rating, the equipment design should provide for a wider sensitivity range having a minimum value equal to one-half of that shown for low-current operation. The sensitivity of a phototube under such high-current conditions is dependent upon the tube type, as follows:

1. Single-Unit and Twin Phototubes

a. Gas Types: For high-current operation, and particularly in applications in which the type is subjected to these higher values continuously, a drop in sensitivity below the values for low-current operation may be expected, the extent of the drop being affected by the severity of the operating conditions. After a period of idleness, a gas phototube usually recovers most of its initial sensitivity.

b. Vacuum Types: Unlike gas phototubes, this class of phototubes shows negligible drop in sensitivity values for different degrees of illumination and over long periods of use. The output current of a vacuum phototube is a linear function of the exciting illumination under normal operating conditions. The frequency response is flat up to frequencies at which transit-time effects become the limiting factor.

2. Multiplier Phototubes

Although RCA Multiplier Phototubes are vacuum types, a drop in sensitivity is to be expected from this class of phototubes when operated at high anode-current values. The extent of the drop is affected by the nature and severity of the operating conditions to which the tube is subjected. After a period of idleness, the multiplier phototube usually recovers a substantial percentage of this loss of sensitivity.

Multiplier-phototube-sensitivity values are dependent on the respective amplification of each dynode stage. Hence, large variations in sensitivity can be expected between individual tubes of a given type. The overall amplification of a multiplier phototube is equal to the average amplification per stage raised to the $\underline{n}$th power, where $\underline{n}$ is the number of stages. Thus, very small variations in amplification per stage produce very large changes in overall tube amplification.

Because these overall changes are very large, it is advisable for designers to provide adequate adjustment of the supply voltage per stage so as to be able to adjust the amplification of individual tubes to the desired design value. It is suggested that an overall voltage-adjustment

(continued on next page)

range of at least 2 to 1 be provided. When the output current can be controlled by change in the illumination of the photocathode of the multiplier phototube, the required range of adjustment in the voltage per stage can be reduced.

SENSITIVITY MEASUREMENTS

The luminous-sensitivity values shown on the data pages of this Section are measured according to the following procedures:

1. Single-Unit and Twin Phototubes

a. Gas Types: The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. For the 0-cycle measurements, a light input of 0.1 lumen is used, unless otherwise specified. For the 5000- and 10000 cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean. For all measurements, a dc anode-supply voltage of 90 volts and a 1.0-megohm load resistor are employed. Under these conditions, the effect of tube capacitance is negligible.

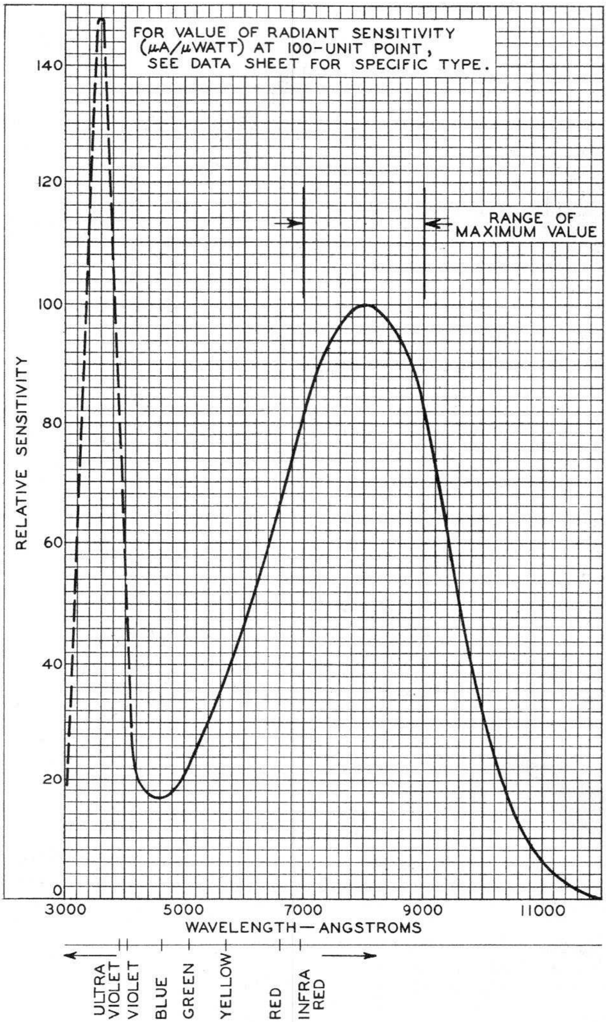
b. Vacuum Types: The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. A steady light input of 0.1 lumen is used, unless otherwise specified, together with a dc anode-supply voltage of 250 volts and a 1-megohm load resistor.

2. Multiplier Phototubes

The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. A light flux of 10 microlumens from a rectangular aperture approximately 0.8" long and 0.2" wide is projected normal to the cathode in the direction noted on the basing diagram and outline. The load resistor has a value of 0.01 megohm. The applied voltages are specified on the individual data sheets.

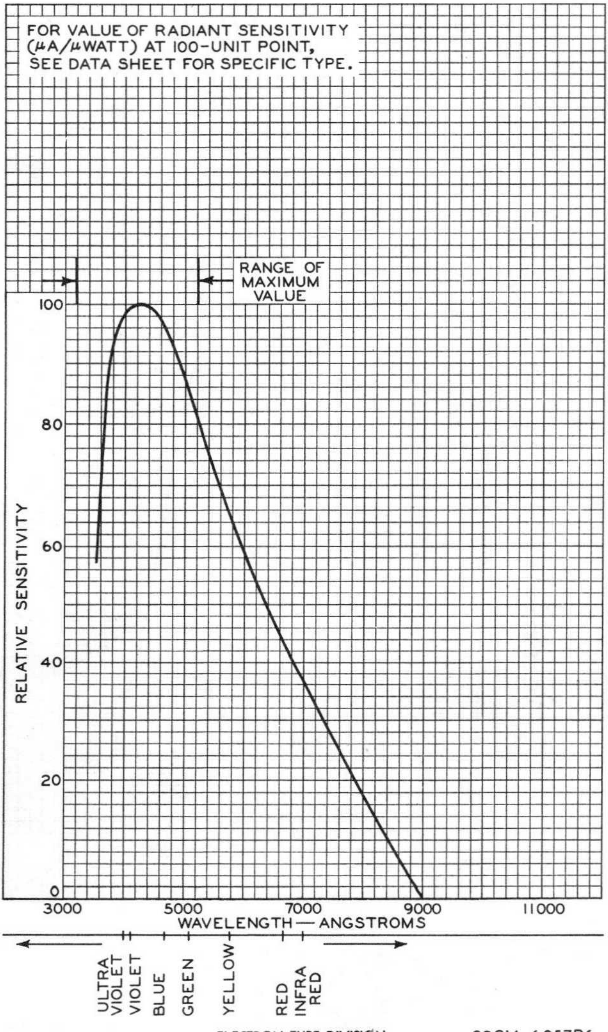
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-1 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-3 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



ELECTRON TUBE DIVISION

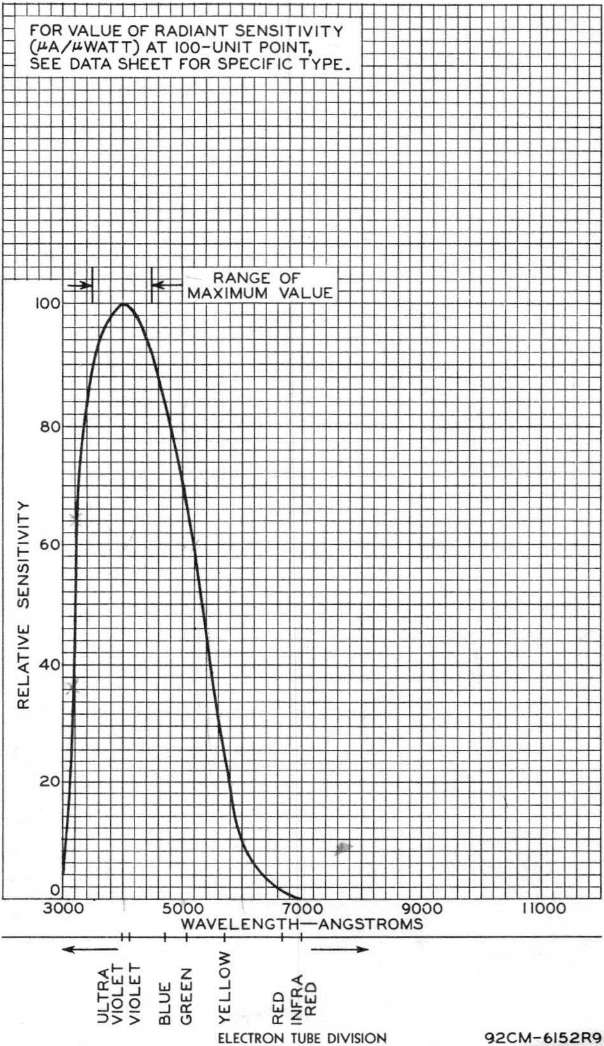
92CM-6057R6

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-4 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



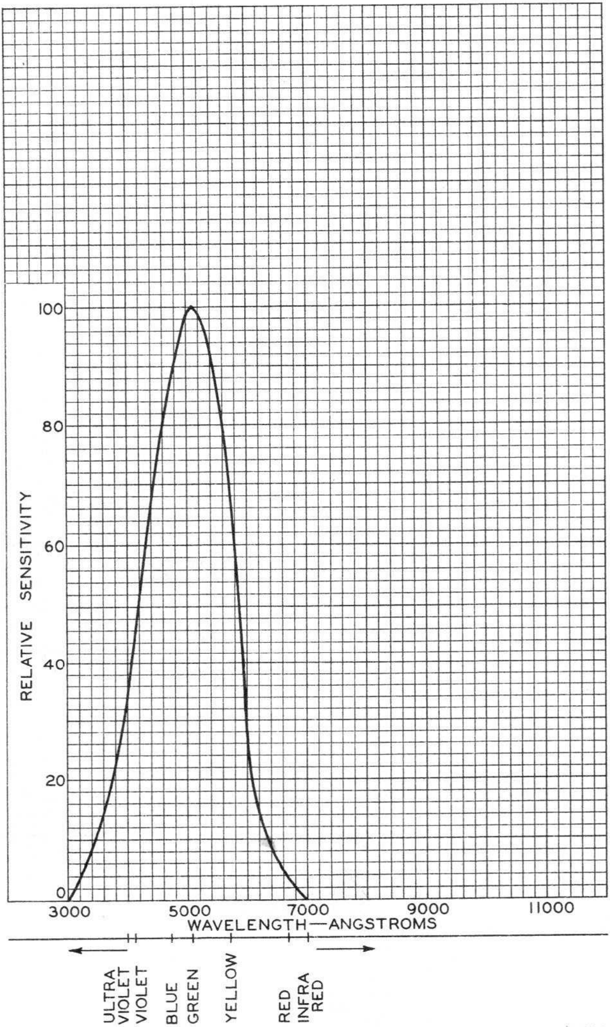
ELECTRON TUBE DIVISION

92CM-6152R9

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-4 RESPONSE

RADIANT FLUX FROM TUNGSTEN SOURCE AT 2870° K



ELECTRON TUBE DIVISION

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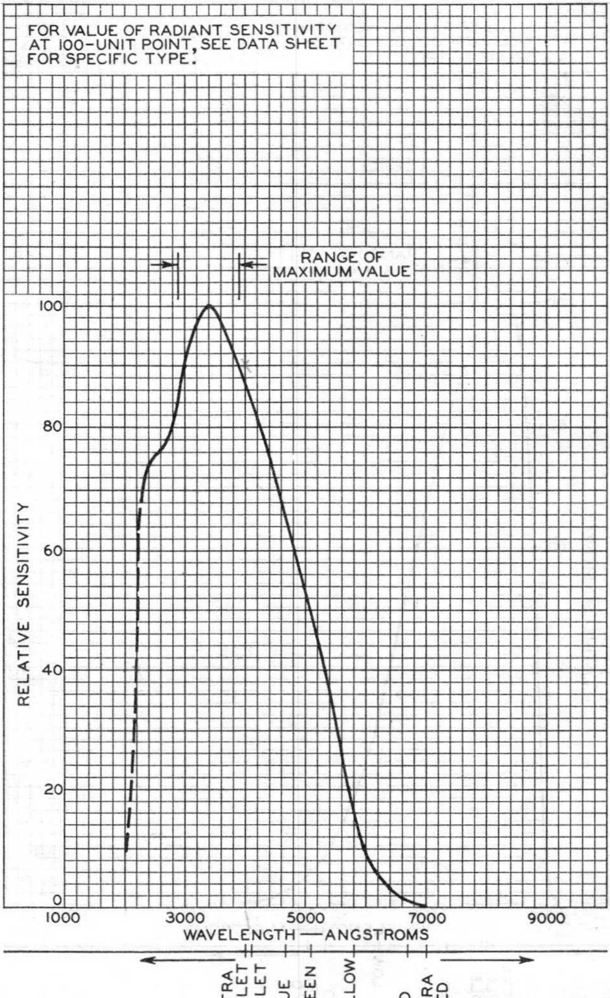
92CM-6652R3

SPECTRAL–SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-5 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



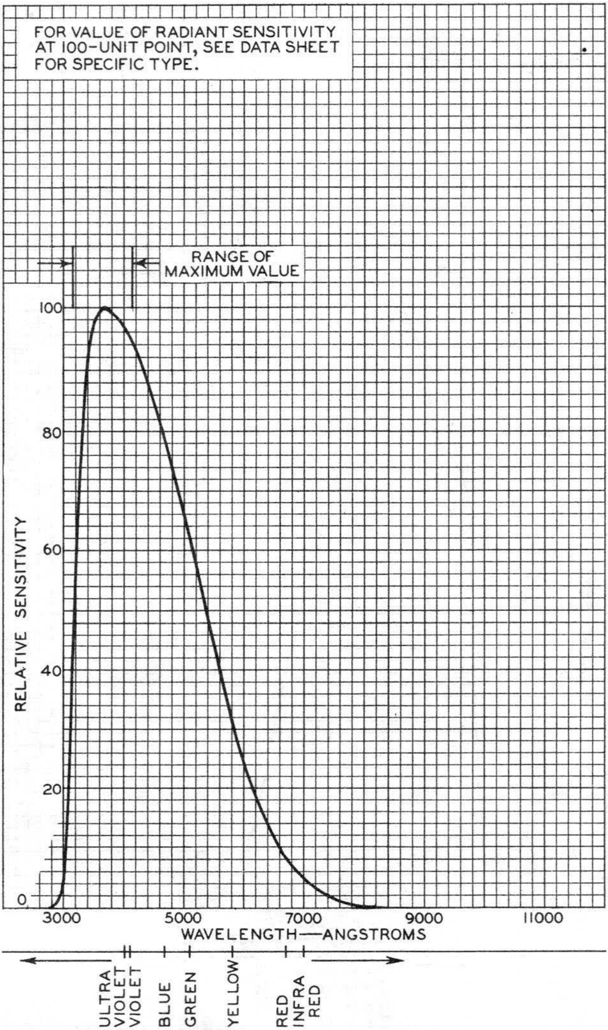
ELECTRON TUBE DIVISION

92CM-6814R2

RCA

SPECTRAL—SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-8 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



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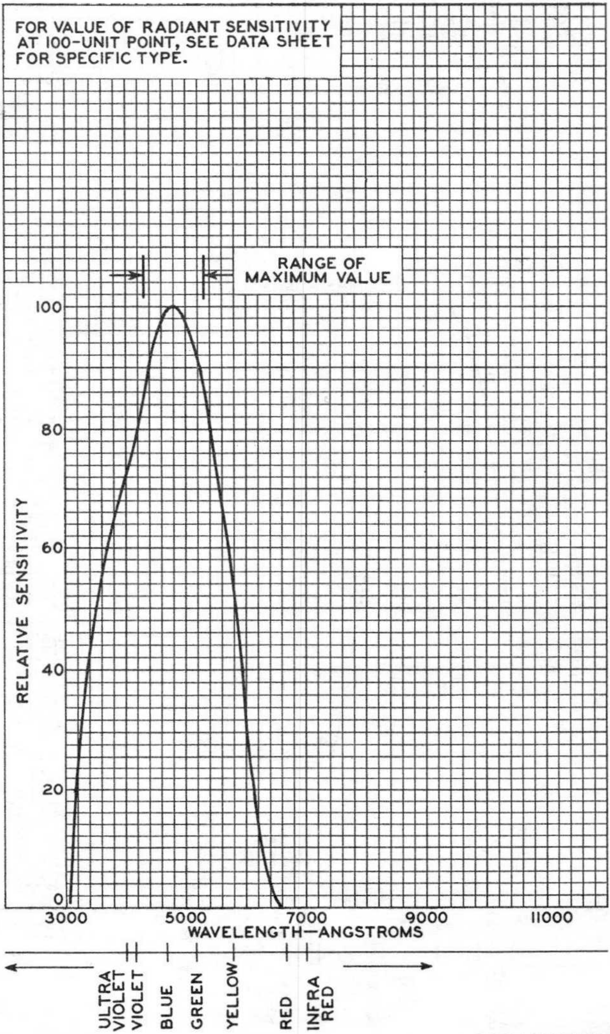
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-9 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

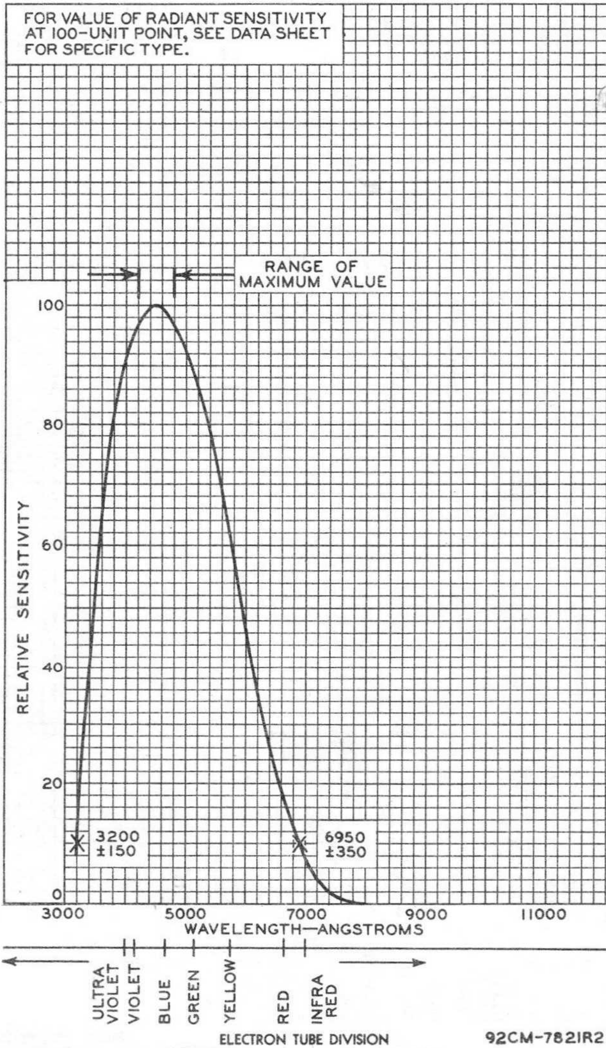


ELECTRON TUBE DIVISION 92CM-7274R2

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

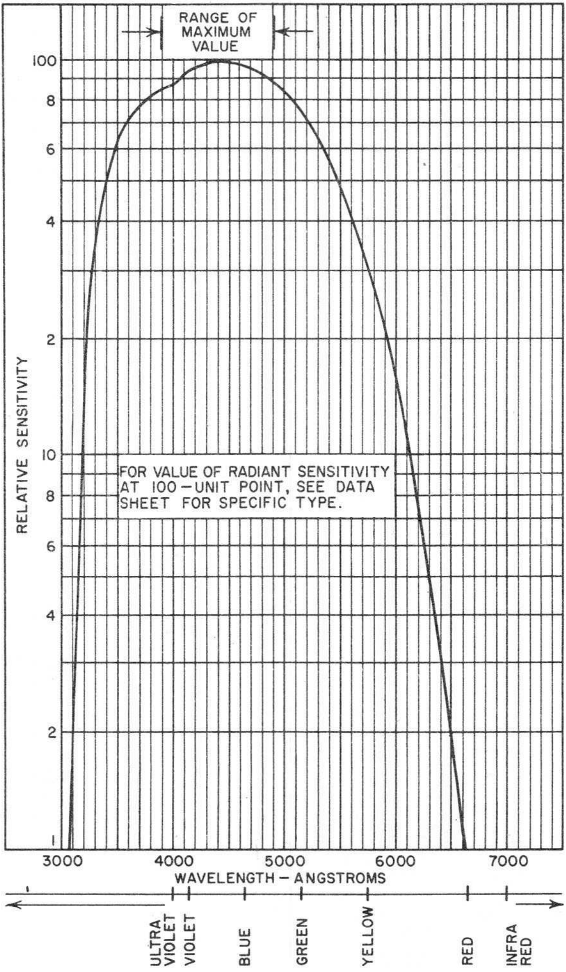
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-10 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE

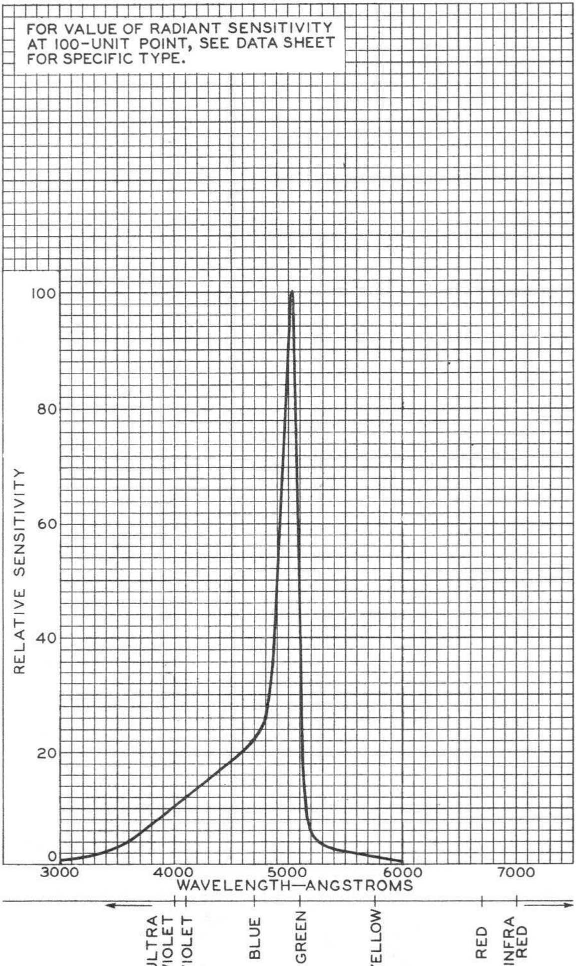
For Equal Values of Radiant Power at All Wavelengths



92CM-10662RI

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-12 RESPONSE

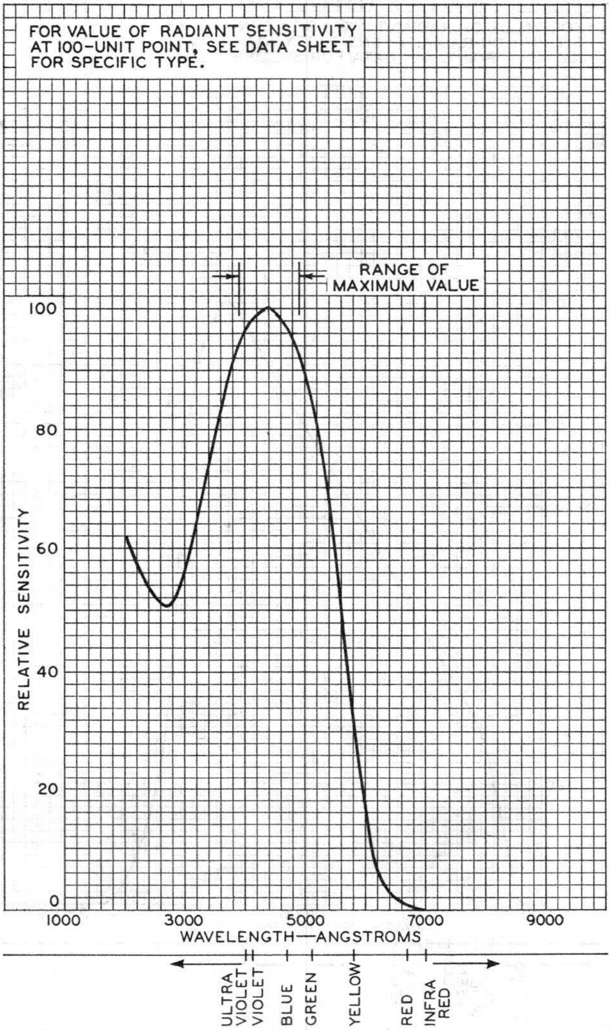
For Equal Values of Radiant Power at All Wavelengths



92CM-8569R1

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-13 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



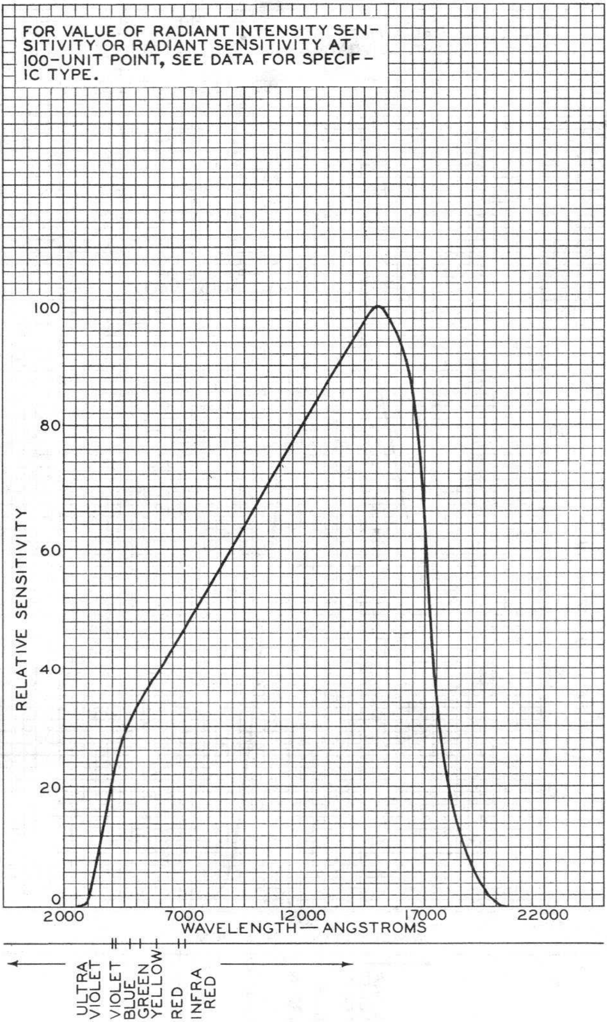
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9037RI

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOJUNCTION CELL HAVING S-14 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



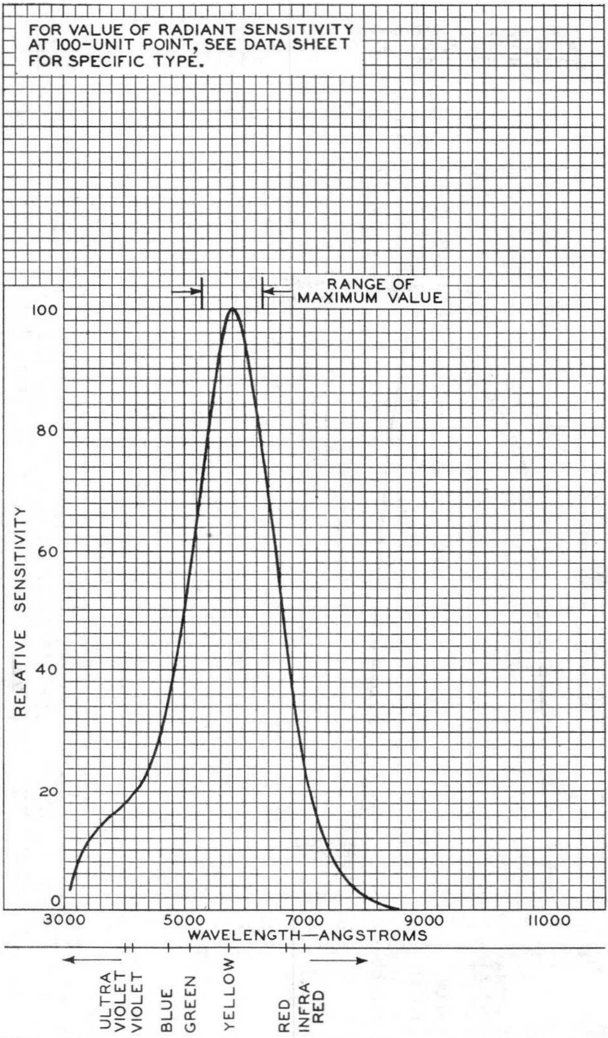
ELECTRON TUBE DIVISION

92CM-9647

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOCONDUCTIVE CELL HAVING S-15 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



ELECTRON TUBE DIVISION
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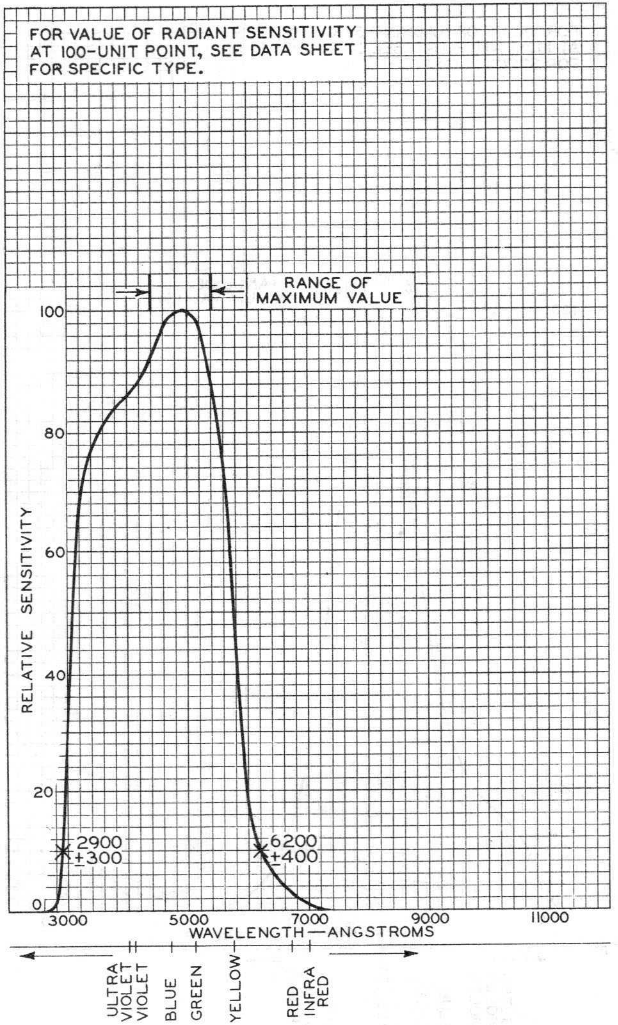
92CM-9206R1

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-17 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



ELECTRON TUBE DIVISION

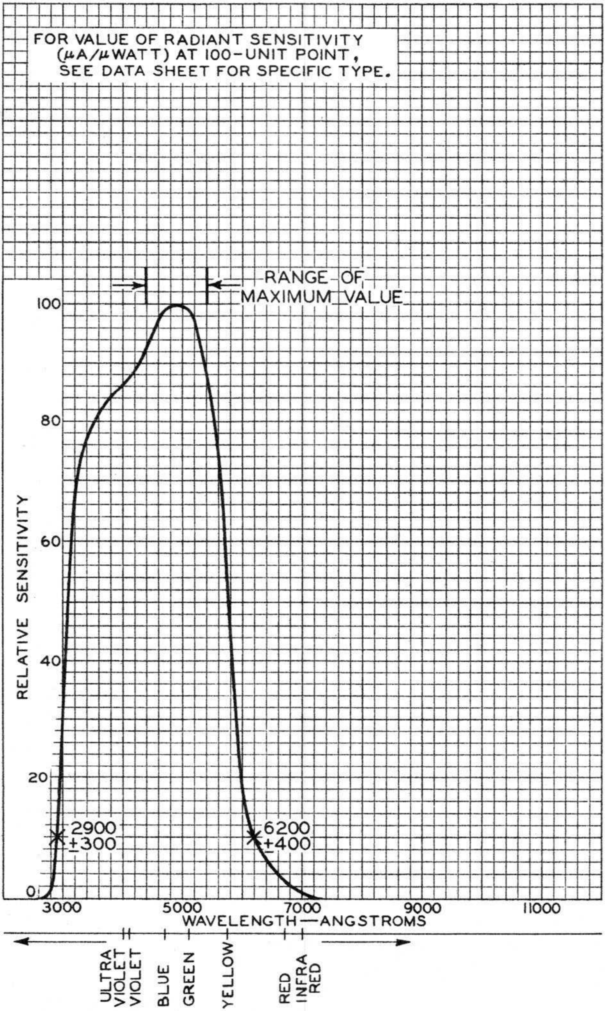
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9477RI

RCA

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-17 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



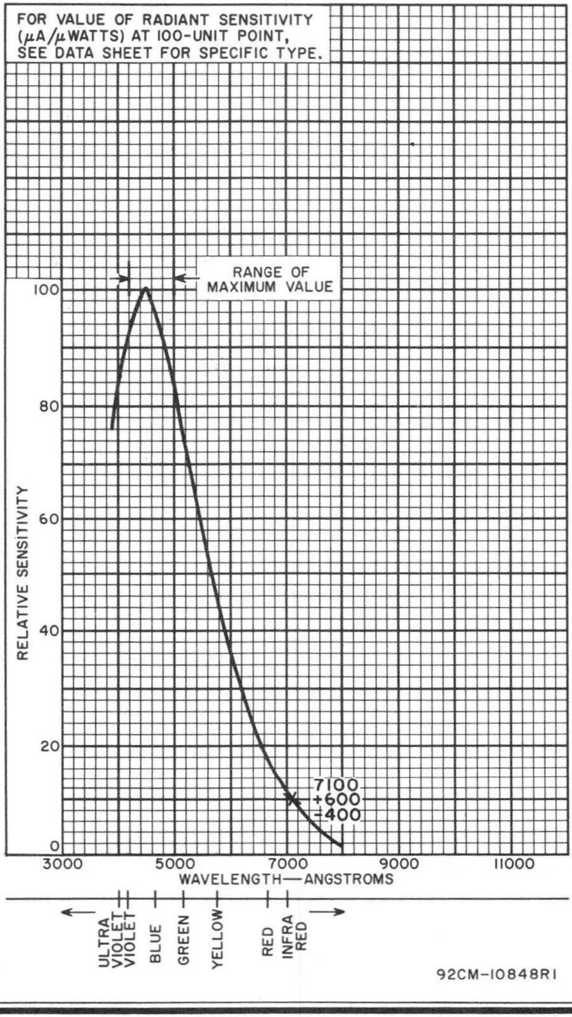
ELECTRON TUBE DIVISION

92CM-9477

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-18 RESPONSE

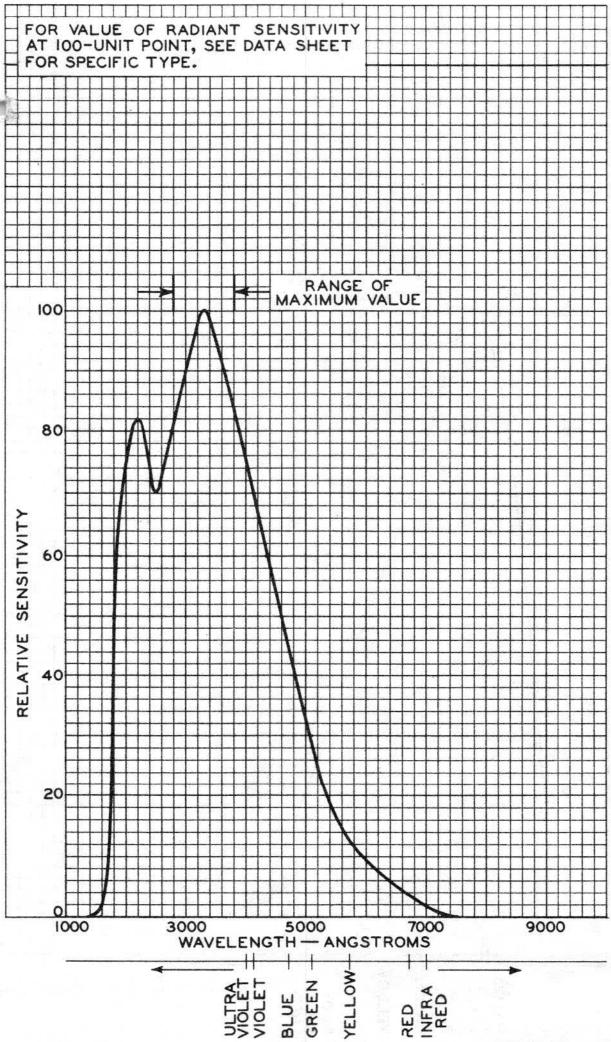
For Equal Values of Radiant Power at All Wavelengths



92CM-10848R1

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-19 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



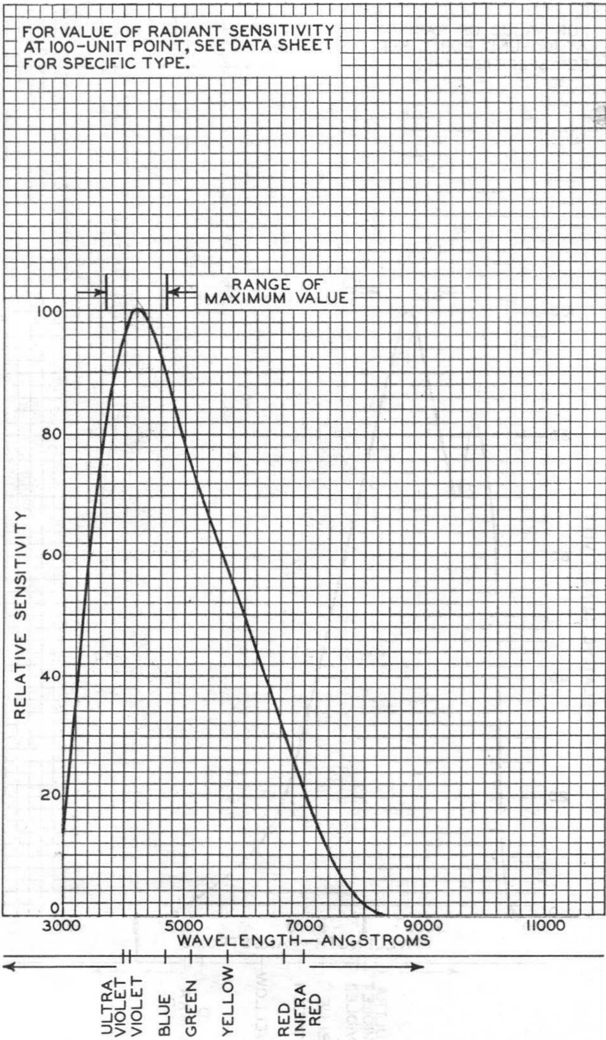
ELECTRON TUBE DIVISION

92CM-9582

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-20 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



ELECTRON TUBE DIVISION

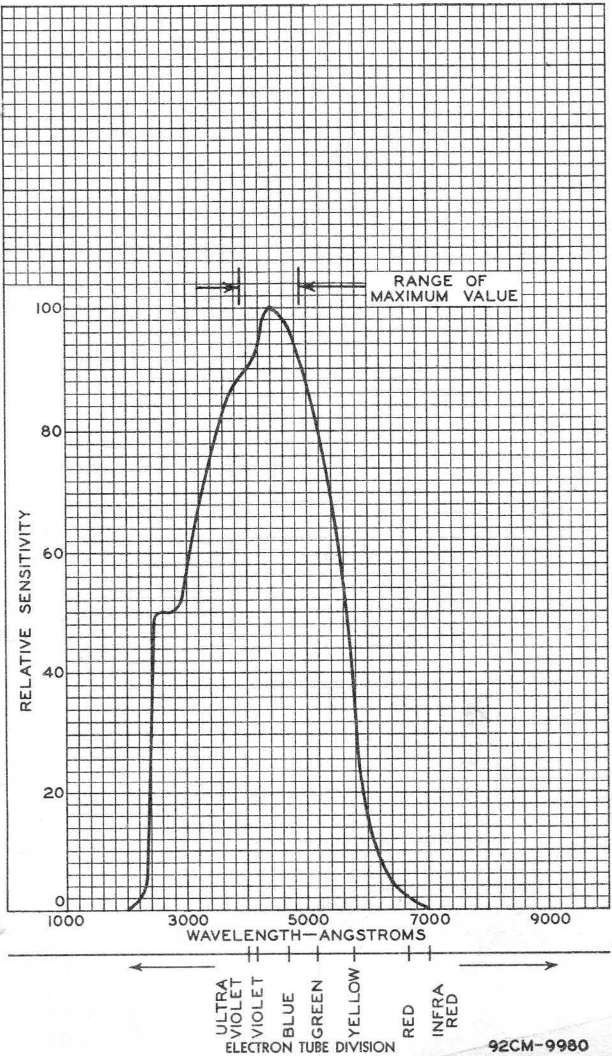
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9779

RCA

TENTATIVE SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-21 RESPONSE

FOR EQUAL VALUES OF RADIANT POWER AT ALL WAVELENGTHS



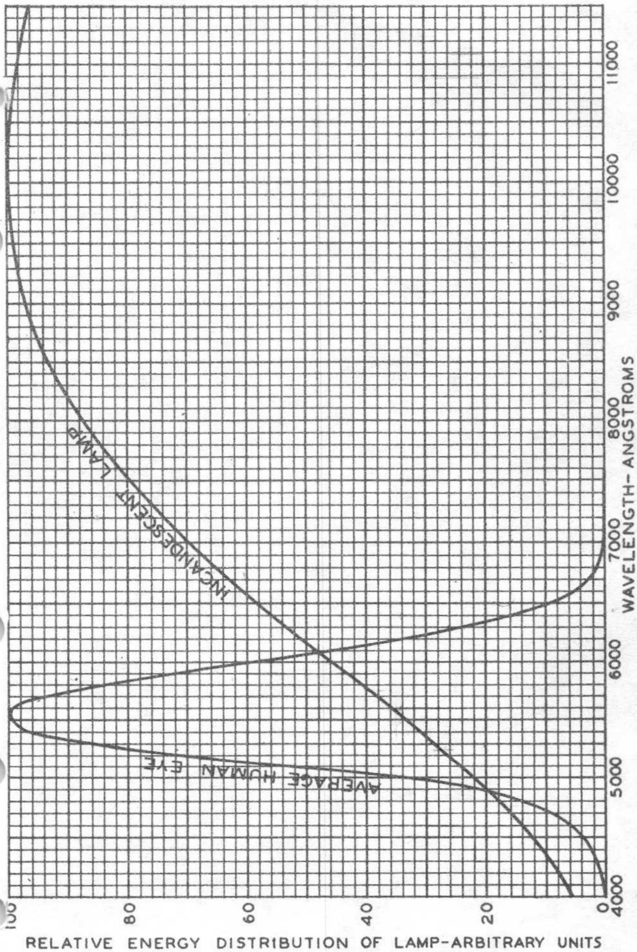
ELECTRON TUBE DIVISION

92CM-9980

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SPECTRAL CHARACTERISTIC OF HUMAN EYE & OF TUNGSTEN LAMP AT COLOR TEMPERATURE OF 2870 °K

EYE CURVE IS ON BASIS OF EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

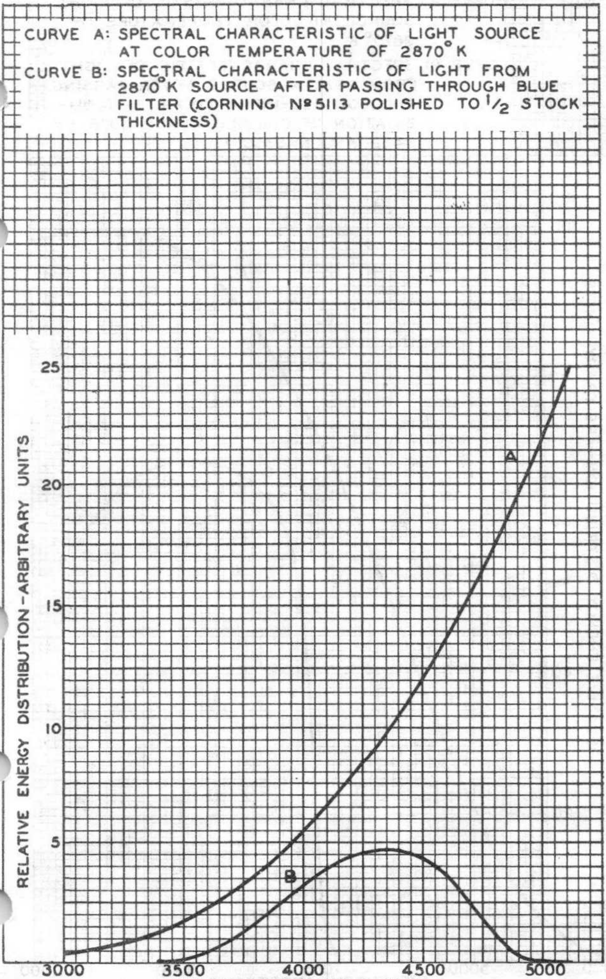


RELATIVE ENERGY DISTRIBUTION OF LAMP-ARBITRARY UNITS

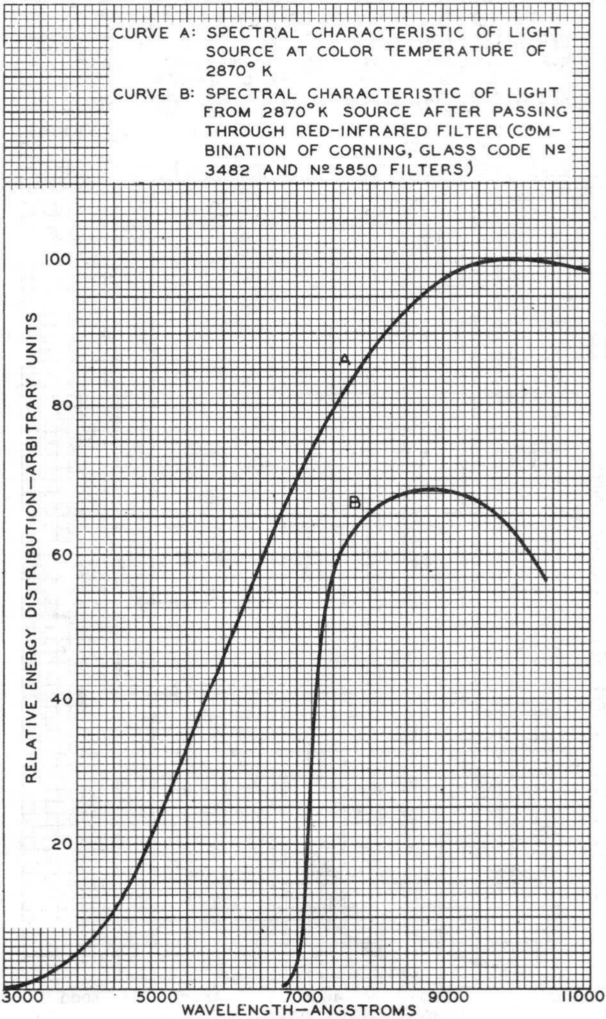
RELATIVE SENSITIVITY OF EYE-ARBITRARY UNITS

RCA

SPECTRAL CHARACTERISTIC OF 2870°K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER



SPECTRAL CHARACTERISTIC OF 2870°K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870°K SOURCE AFTER PASSING THROUGH INDICATED RED-INFRARED FILTER



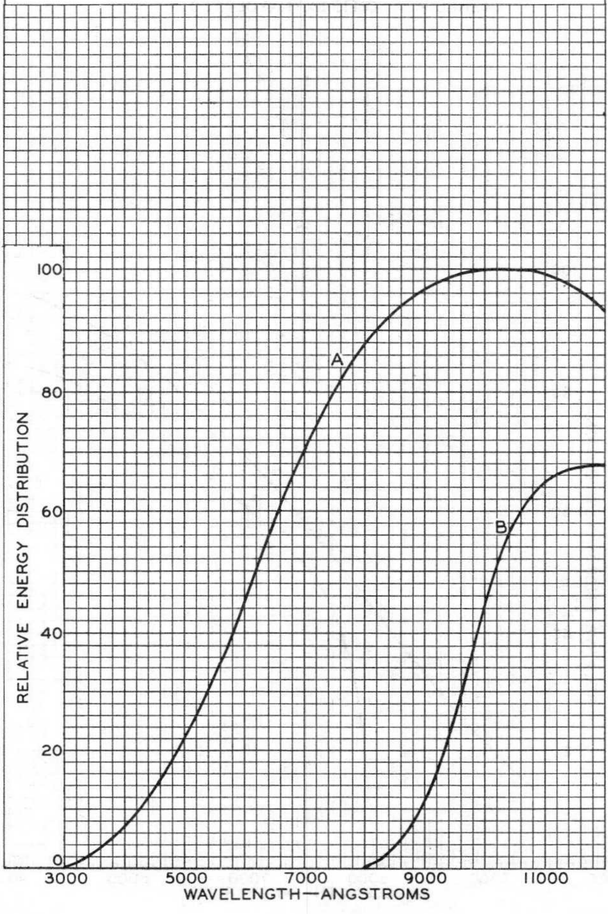
SEPT. 3, 1952

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-7838

SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED INFRARED FILTER

CURVE A: SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870° K.
CURVE B: SPECTRAL CHARACTERISTIC OF RADIATION FROM 2870° K SOURCE AFTER PASSING THROUGH INFRARED FILTER (CORNING № 2540).



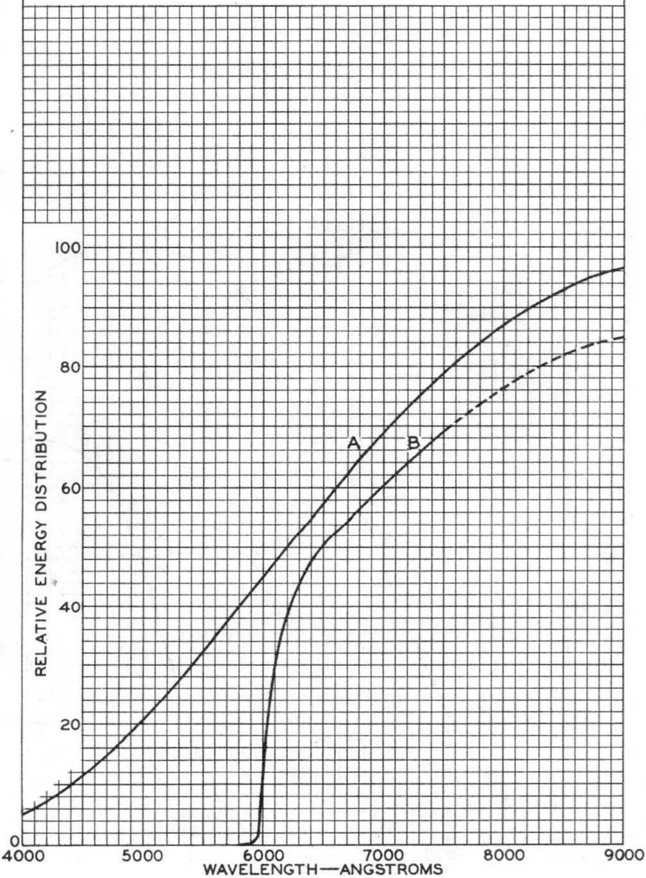
ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9454

RCA

SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED RED FILTER

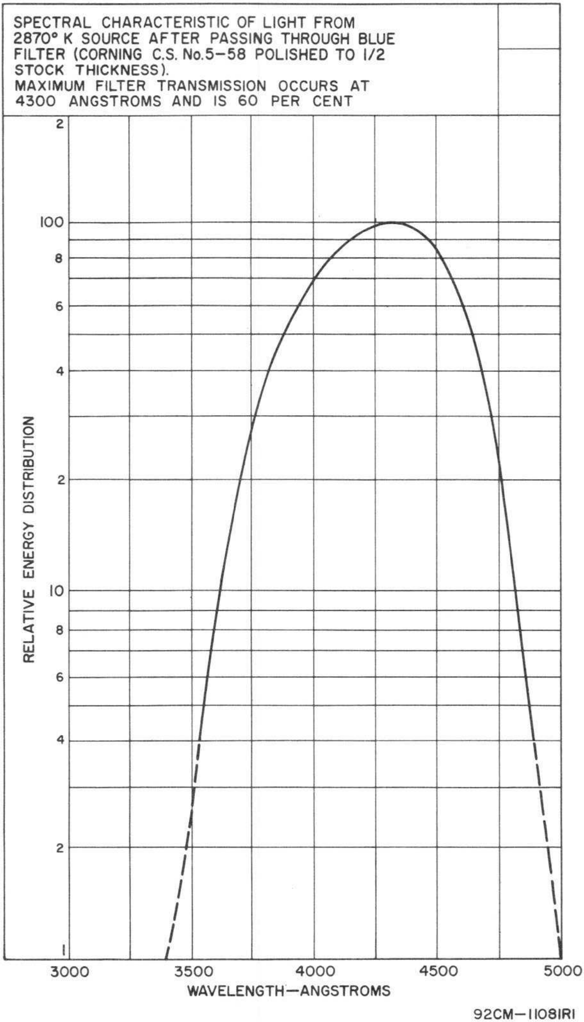
CURVE A: SPECTRAL CHARACTERISTIC OF LIGHT SOURCE AT COLOR TEMPERATURE OF 2870° K.
CURVE B: SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH RED FILTER (CORNING № 2418).
DASHED PORTION IS EXTRAPOLATED.



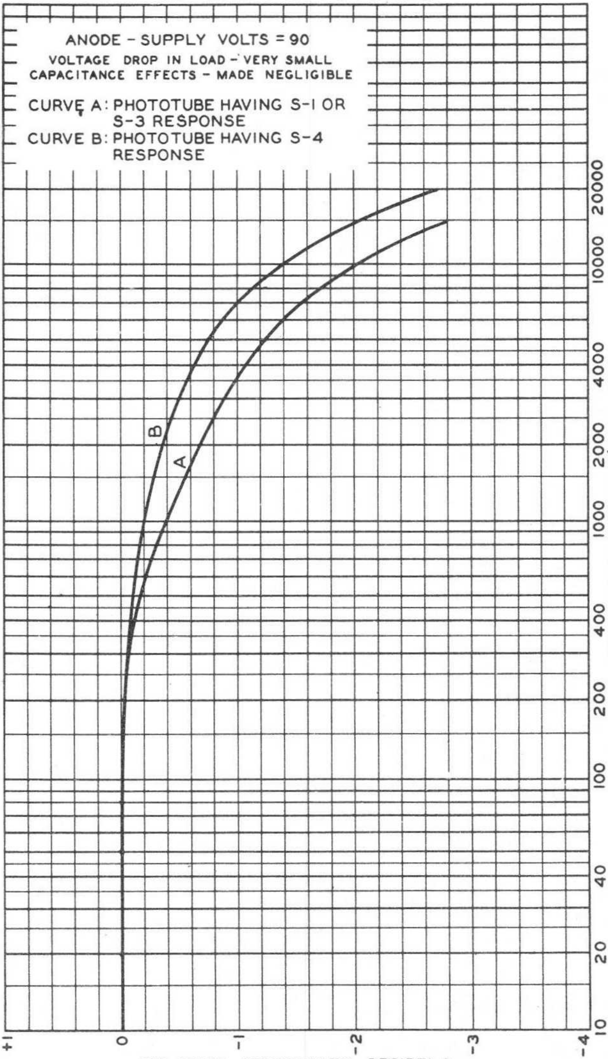
ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9883

SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT
SOURCE AFTER PASSING THROUGH INDICATED FILTER

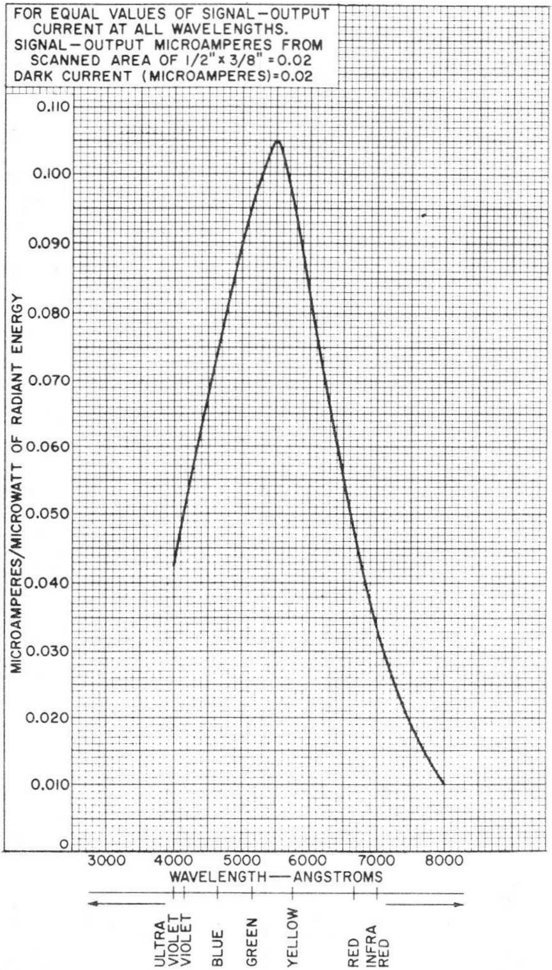


92CM—11081R1

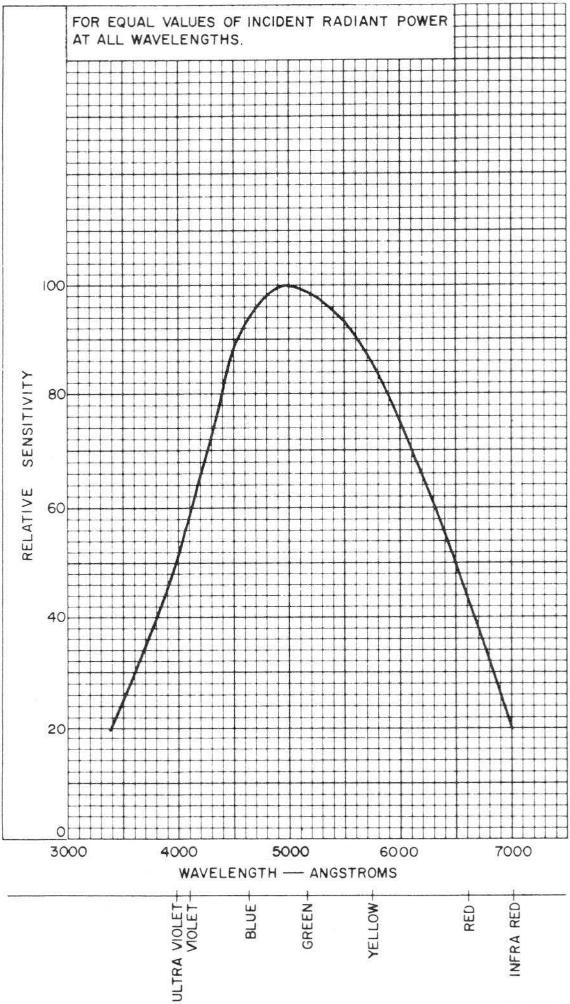


FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

RCA Type II Spectral Response



RCA Type IV Spectral Response



Photomultiplier Tube

9-Stage, Side-On Type
Having S-4 Spectral Response

GENERAL

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode, Opaque	Cesium-Antimony
Minimum projected length[a]	0.94 in (2.4 cm)
Minimum projected width[a]	0.31 in (0.8 cm)
Window	Lime Glass (Corning[b] No.0080), or equivalent
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.9	4.4 pF
Anode to all other electrodes	6.0 pF
Maximum Overall Length	3.68 in (9.3 cm)
Seated Length	3.12 in (7.9 cm)
Maximum Diameter	1.31 in (3.3 cm)
Bulb	T9
Base	Small-Shell Submagnal 11 Pin, (JEDEC Group 2, No.B11-88), Non-hygroscopic
Socket	Amphenol[c] No.78S11T, or equivalent
Magnetic Shield	Millen[d] No.80801B, or equivalent
Operating Position	Any
Weight (Approx.)	1.6 oz

ABSOLUTE-MAXIMUM RATINGS

DC or Peak AC Supply Voltage:		
Between anode and cathode	1250 max.	V
Between anode and dynode No.9	250 max.	V
Between consecutive dynodes	250 max.	V
Between dynode No.1 and cathode	250 max.	V
Average Anode Current[f]	0.1 max.	mA
Ambient Temperature[g]	+75 max.	°C

→ CHARACTERISTICS RANGE VALUES

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.

With E = 1000 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[h] at 4000 angstroms	–	1.2×10^{5}	–	A/W
Luminous[i] (2870° K)	40	120	800	A/lm
Cathode Sensitivity:				
Radiant[k] at 4000 angstroms	–	0.04	–	A/W
Luminous[m] (2870° K)	2×10^{-5}	4×10^{-5}	–	A/lm
Quantum Efficiency at 3800 angstroms	–	13	–	%
Current Amplification	–	3×10^{6}	–	
Anode Dark Current[n]	–	1×10^{-9}	1×10^{-8}	A
Equivalent Anode Dark Current Input[n]	–	5×10^{-11}	5×10^{-10}	lm
	–	4.8×10^{-14}[p]	4.8×10^{-13}[p]	W
Equivalent Noise Input[q]	–	6.7×10^{-13}	–	lm
	–	6.4×10^{-16}[r]	–	W
Anode-Pulse Rise Time[s] at 1250 V . .	–	1.6×10^{-9}	–	s
Electron Transit Time[t] at 1250 V . .	–	1.6×10^{-8}	–	s

[a] On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

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

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

[d] Made by James Millen Manufacturing Company, 150 Exchange Street. Malden, MA 02148.

[f] Averaged over any interval of 30 seconds maximum.

→ Indicates a change.

[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 1036 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 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 1036 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 100 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 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

[p] At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1036 lumens per watt.

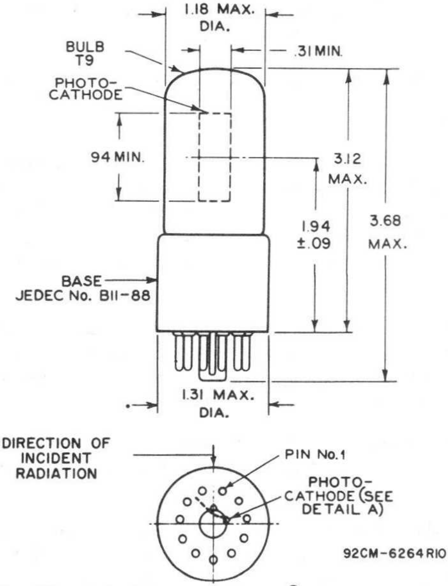
[q] Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

[r] At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1036 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.

† 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.

DIMENSIONAL OUTLINE

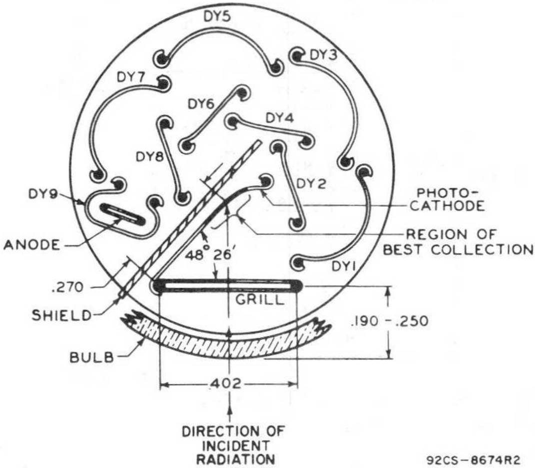


℄ of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base.

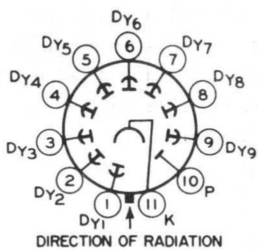
Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters.

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

DETAIL A (Top View)

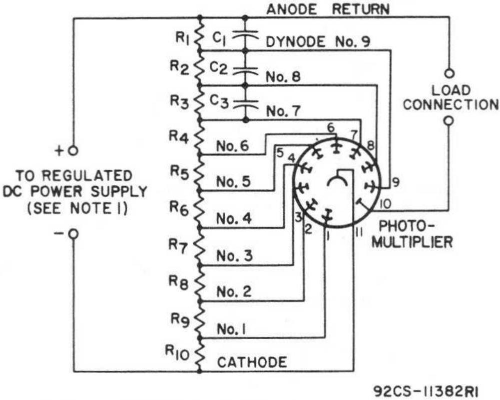


TERMINAL DIAGRAM (Bottom View)



Pin 1: Dynode No.1	Pin 7: Dynode No.7
Pin 2: Dynode No.2	Pin 8: Dynode No.8
Pin 3: Dynode No.3	Pin 9: Dynode No.9
Pin 4: Dynode No.4	Pin 10: Anode
Pin 5: Dynode No.5	Pin 11: Photocathode
Pin 6: Dynode No.6	

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



R_1 through R_{10} = 20,000 to 1,000,000 ohms

Note 1: Adjustable between approximately 500 and 1250 volts.

Note 2: Capacitors C_1♦ through C_3♦ should be connected at tube socket for optimum high-frequency performance.

♦Leads to all capacitors should be as short as possible to minimize inductance effects.

The capacitor values will depend upon the shape and the amplitude of the anode-current pulse, and the time duration of the pulse, or train of pulses. When the output pulse is assumed to be rectangular in shape, the following formula applies:

$$C = 100 \frac{i \cdot t}{V}$$

where C is in farads

i is the amplitude of anode current in amperes

V is the voltage across the capacitor in volts

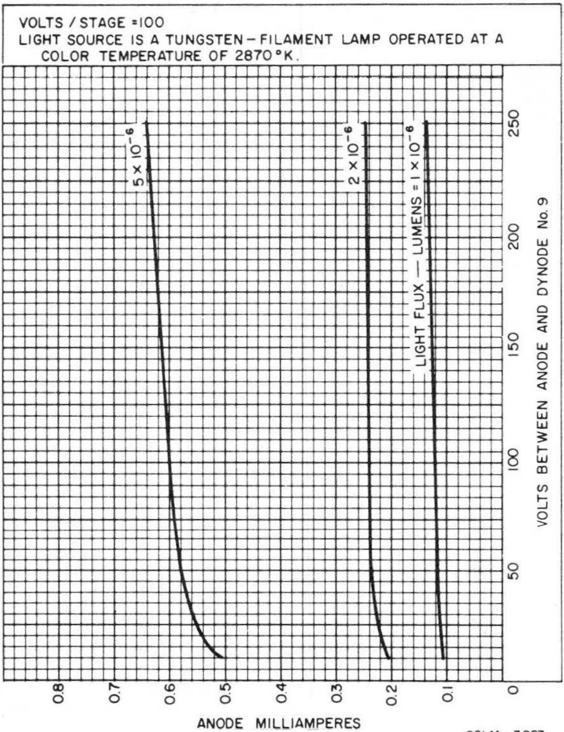
and t is the time duration of the pulse in seconds

This formula applies for the anode-to-final dynode capacitor. The factor 100 is used to limit the voltage change across the capacitor to 1% maximum during a pulse. Capacitor values for preceding stages should take into account the smaller values of dynode currents in these stages. Conservatively, a factor of approximately 2 per stage is used. Capacitors are not required across those dynode stages where the dynode current is less than 1/10 of the current through the voltage-divider network.

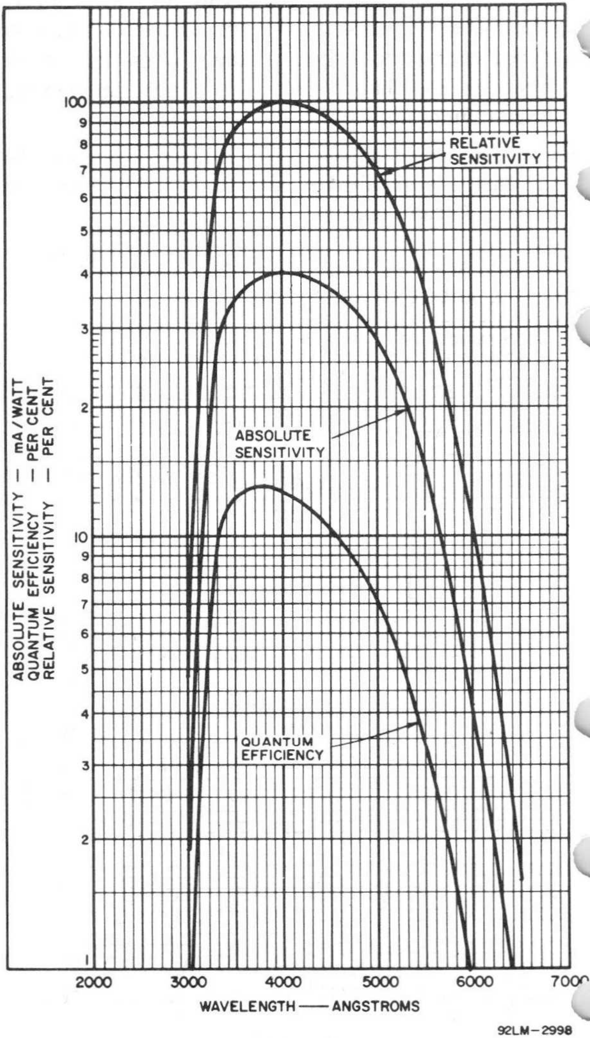
For other shaped pulses or for a train of pulses, the total charge q should be substituted for (i·t) and the following formula applies:

$$C = 100 \frac{q}{V} \qquad \text{where } q = \int i(t)\,dt \text{ coulombs}$$

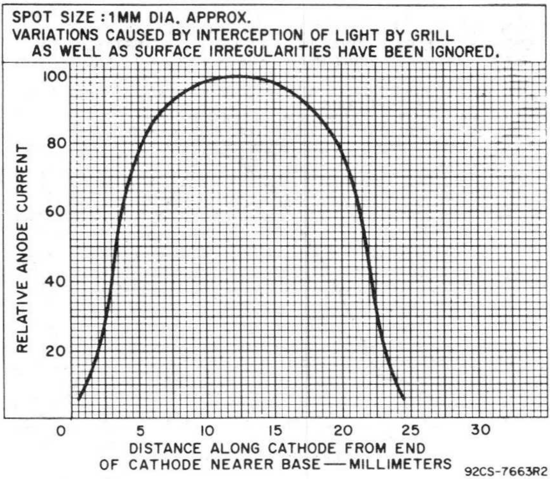
TYPICAL ANODE CHARACTERISTICS



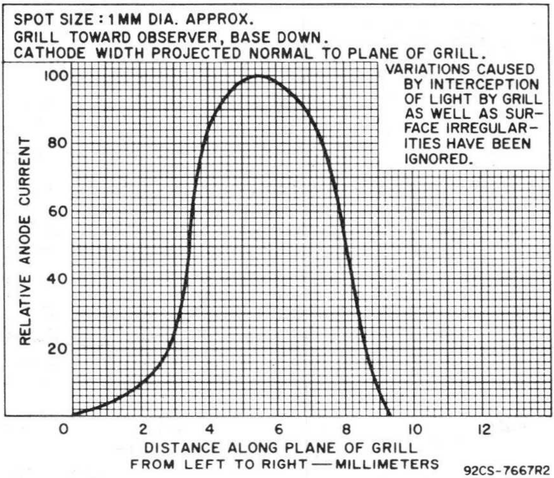
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



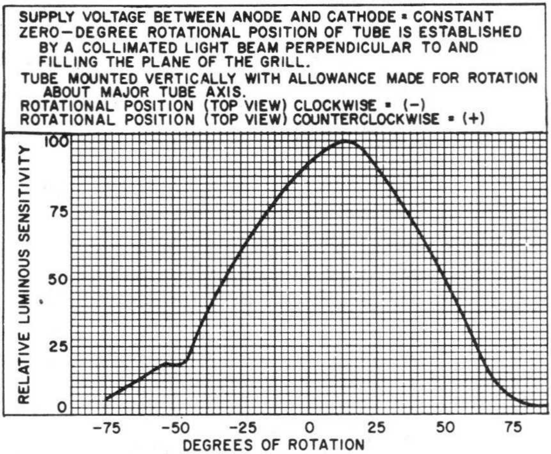
TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ALONG TUBE LENGTH



TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ACROSS PROJECTED WIDTH IN PLANE OF GRILL

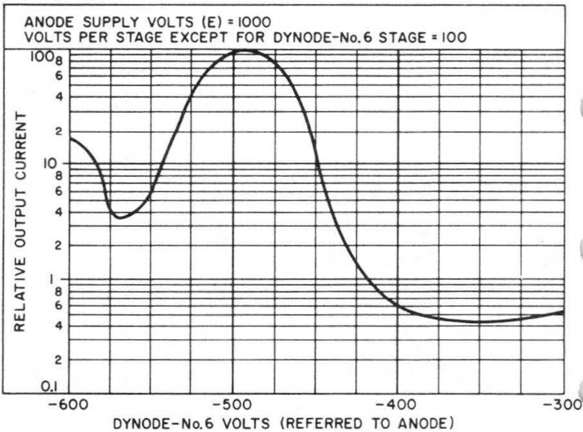


TYPICAL VARIATION OF SENSITIVITY AS TUBE IS ROTATED WITH RESPECT TO FIXED LIGHT BEAM



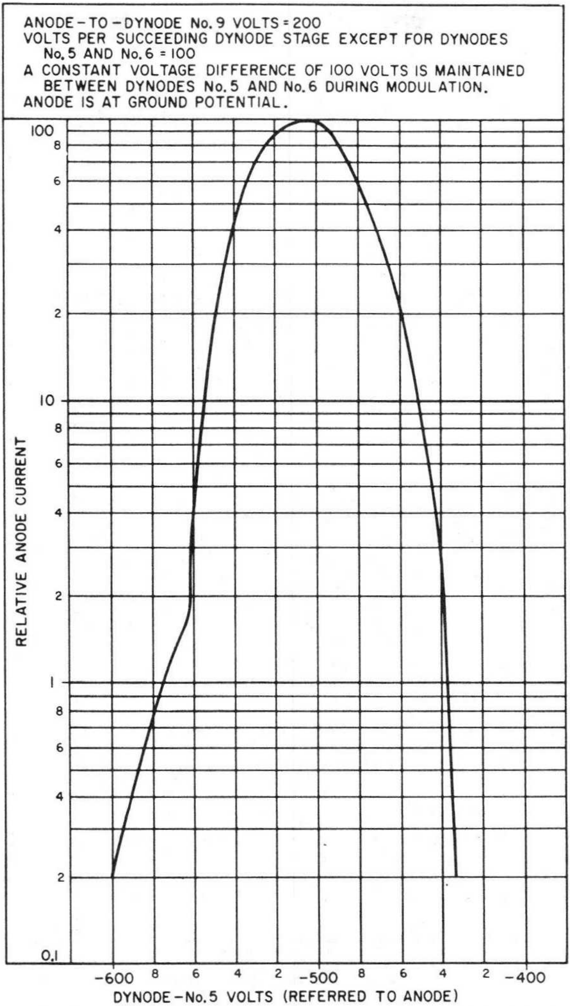
92CS−8671R2

TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-NO. 6 VOLTS

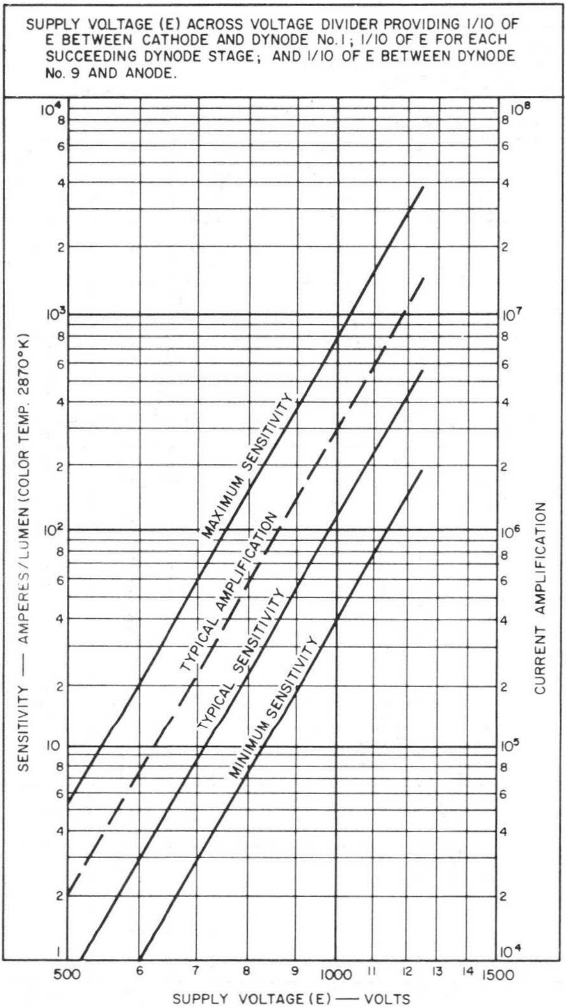


92CS−8672R1

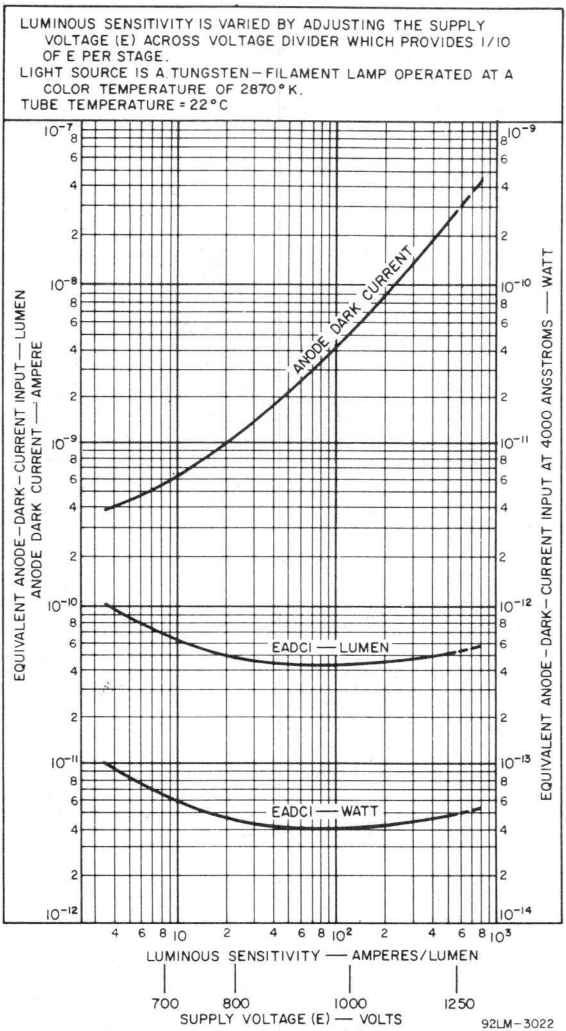
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF SIMULTANEOUS MODULATION OF DYNODES NO. 5 AND NO. 6



SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

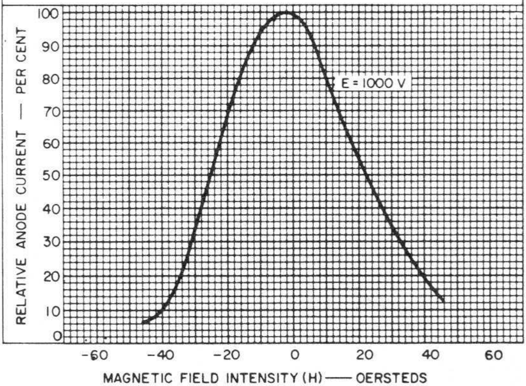


TYPICAL EADCI AND DARK CURRENT CHARACTERISTICS



TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

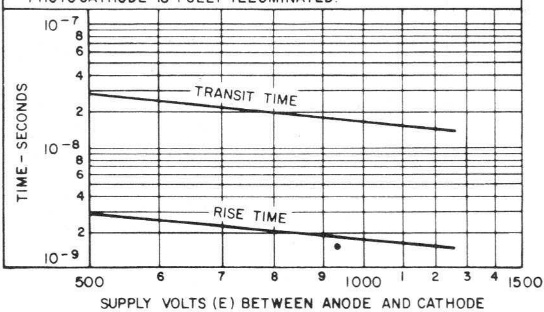
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/10 OF E BETWEEN CATHODE AND DYNODE No. 1; 1/10 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/10 OF E BETWEEN DYNODE No. 9 AND ANODE.
PHOTOCATHODE IS FULLY ILLUMINATED.
UNIFORM MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.
POSITIVE VALUES OF MAGNETIC FLUX ARE FOR LINES OF FORCE TOWARD TUBE BASE.
TUBE IS DEGAUSSED PRIOR TO TEST AND IS AGAIN DEGAUSSED BEFORE FLUX DIRECTION IS CHANGED.



92LS-3001

TYPICAL TIME-RESOLUTION CHARACTERISTICS

SUPPLY VOLTAGE (E) ACROSS 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.
PHOTOCATHODE IS FULLY ILLUMINATED.



92LS-3010

Multiplier Phototube

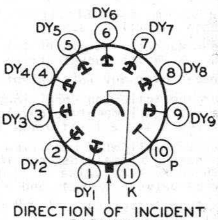
9-STAGE, SIDE-ON TYPE **S-8 RESPONSE**

Especially Useful in Colorimetric and Spectroscopic Applications. High Sensitivity to Green-and-Blue Rich Light

General:

Spectral Response	S-8
Wavelength of Maximum Response	3650 ± 500 angstroms
Cathode, Opaque	Cesium-Bismuth
Minimum projected length[a]	15/16"
Minimum projected width[a]	5/16"
Window	Lime Glass[b]
Dynode Material	Cesium-Antimony
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.9	4.4 pf
Anode to all other electrodes	6.0 pf
Maximum Overall Length	3-11/16"
Maximum Seated Length	3-1/8"
Length from Base Seat to Center of Useful Cathode Area	1-15/16" ± 3/32"
Maximum Diameter	1-5/16"
Operating Position	Any
Weight (Approx.)	1.6 oz
Bulb	T9
Socket	Amphenol[c] No.78S11T, or equivalent
Magnetic Shield	Perfection Mica Co.[d] No.P-101-2, or equivalent
Base	Small-Shell Submagnal 11-Pin (JEDEC Group 2, No.B11-88), Non-hygroscopic
Basing Designation for BOTTOM 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



Maximum Ratings, *Absolute-Maximum Values:*

Supply Voltage Between Anode and Cathode (DC or Peak AC)	1250 max.	volts
Supply Voltage Between Dynode No.9 and Anode (DC or Peak AC)	250 max.	volts
Supply Voltage Between Consecutive Dynodes (DC or Peak AC)	250 max.	volts
Supply Voltage Between Dynode No.1 and Cathode (DC or Peak AC)	250 max.	volts
Average Anode Current[e]	1 max.	ma
Ambient Temperature	50 max.	°C

← Indicates a change.

→ Characteristics Range Values:

Under conditions with 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

With E = 1000 volts (Except as noted)

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 3650 angstroms. .	–	750	–	a/w
Cathode radiant, at 3650 angstroms.	–	2.3×10^{-3}	–	a/w
Luminous, at 0 cps[f].	0.115	1	16	a/lm
Cathode luminous[g].	1.5×10^{-6}	3×10^{-6}	–	a/lm
Current Amplification.	–	3.3×10^{5}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 0.4 a/lm[h,j]	–	7.5×10^{-9}	3.75×10^{-7}	lm
Equivalent Noise Input[k]. . . .	–	7.5×10^{-12}	–	lm

With E = 750 volts (Except as noted)

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 3650 angstroms . .	–	110	–	a/w
Cathode radiant, at 3650 angstroms.	–	2.3×10^{-3}	–	a/w
Luminous, at 0 cps[f].	0.016	0.145	1.85	a/lm
Cathode luminous[g].	1.5×10^{-6}	3×10^{-6}	–	a/lm
Current Amplification.	–	4.8×10^{4}	–	

a On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

b Corning No. 0080, Corning Glass Works, Corning, New York, or equivalent.

c Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 54, Illinois.

d Made by Magnetic Shield Division, Perfection Mica Co., 1829 Civic Opera Bldg., 20 North Wacker Drive, Chicago 6, Illinois.

e Averaged over any interval of 30 seconds maximum.

f 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.

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° K. The value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected as anode.

h At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

j For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.

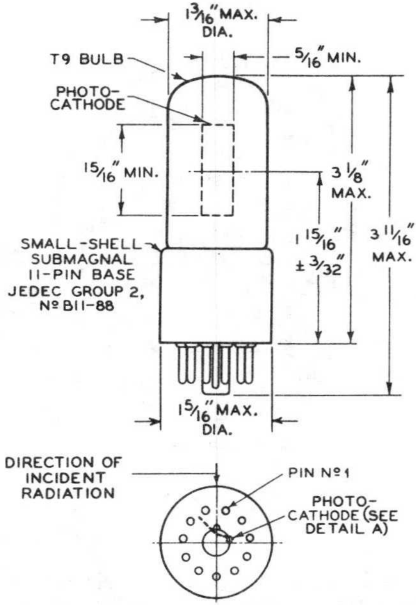
k Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

→ Indicates a change.

IP22

IP22

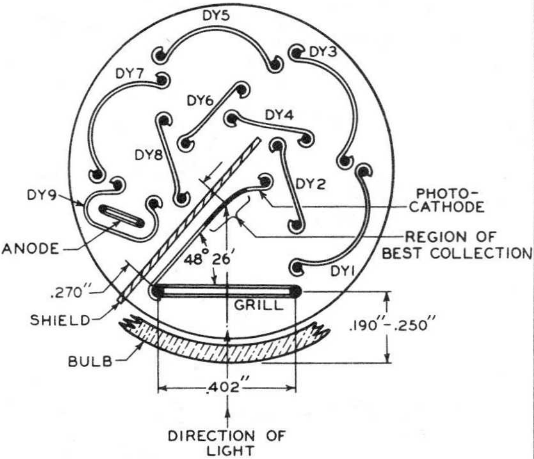
MULTIPLIER PHOTOTUBE



92CM-6264R7

1P22
MULTIPLIER PHOTOTUBE

DETAIL A

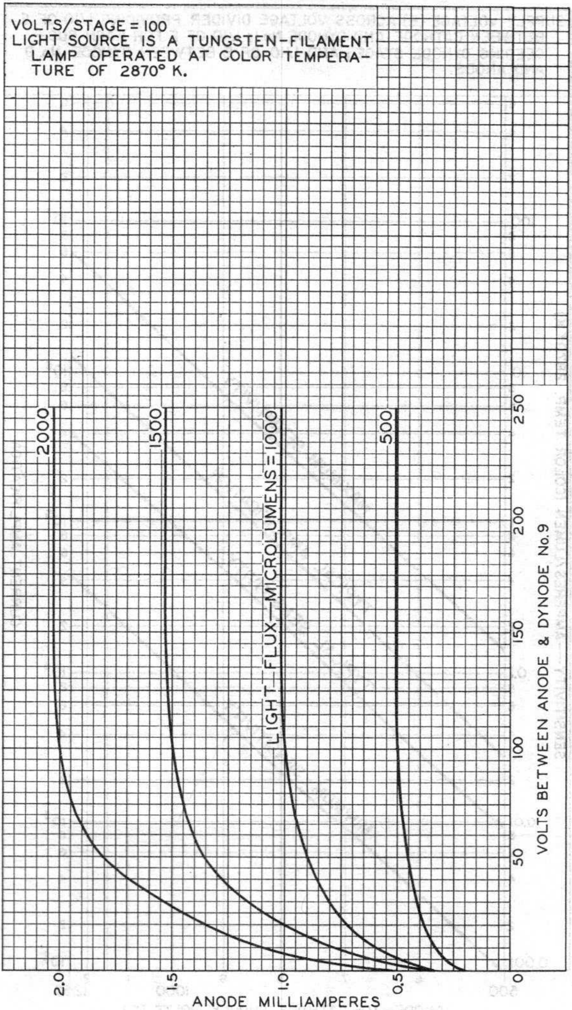


92CS-8674R1

NOTE 1: CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT CENTER OF BOTTOM OF BASE.

NOTE 2: THE MAXIMUM ANGULAR VARIATION BETWEEN THE PLANE THROUGH PINS 1 AND 11 AND THE PLANE OF THE GRILL WILL NOT EXCEED 6°.

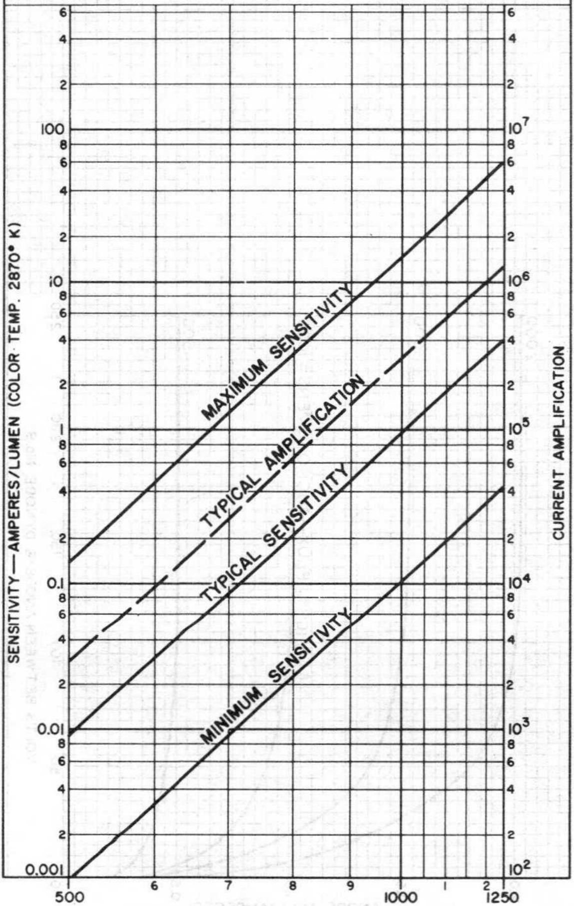
TYPICAL ANODE CHARACTERISTICS



92CM—6585R1

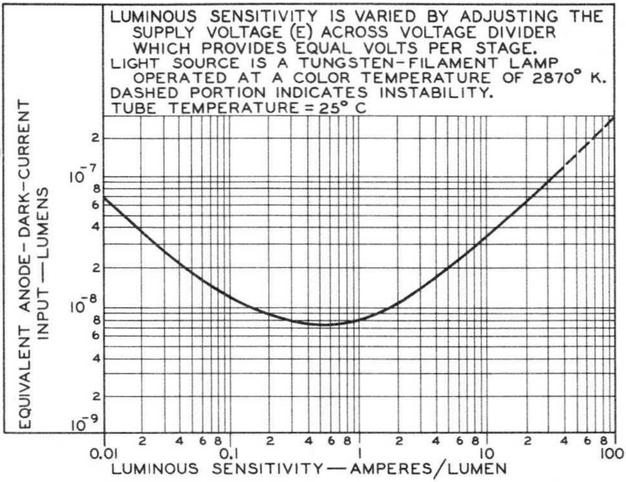
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

SUPPLY VOLTAGE (E) ACROSS 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.



92CM—9674R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



92CS-9680

Photomultiplier Tube

9-STAGE, SIDE-ON TYPE — S-5 RESPONSE

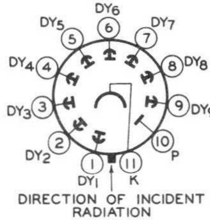
For Detection and Measurement of Ultraviolet and Visible Radiation

GENERAL

Spectral Response	S-5
Wavelength of Maximum Response	3400 ± 500 angstroms
Cathode, Opaque	Cs-Sb
Minimum projected length[a]	15/16 inch
Minimum projected width[a]	5/16 inch
Window	Ultraviolet-Transmitting Glass[b]
Index of refraction at 5893 angstroms	1.47 ←
Dynodes ←	
Substrate	Ni
Secondary-emitting surface	Cs-Sb
Structure	Circular Cage
Direct Interelectrode Capacitances (Approx.)	
Anode to dynode No.9	4.4 pF
Anode to all other electrodes	6.0 pF
Maximum Overall Length	3-11/16 inch
Maximum Seated Length	3-1/8 inch
Length from Base Seat to Center of Useful Cathode Area	1-15/16 ± 3/32 inch
Maximum Diameter	1-5/16 inch
Operating Position	Any
Weight (Approx.)	1.6 oz
Envelope	JEDEC T9
Base	Small-Shell Submagnal 11-Pin, (JEDEC Group 2, No.B11-88), Non-hygroscopic
Socket	Amphenol[c] No.78S11T, or equivalent
Magnetic Shield	Millen[d] Part No.80801B, or equivalent ←

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 – Anode
Pin 11 – Photocathode



← Indicates a change.

ABSOLUTE-MAXIMUM VALUES

DC or Peak AC Supply Voltage		
Between anode and cathode	1250	V
Between dynode No.9 and anode	250	V
Between consecutive dynodes	250	V
Between dynode No.1 and cathode	250	V
Average anode current[e]	0.5	mA
Ambient temperature[f]	75	°C

→ CHARACTERISTICS RANGE VALUES

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.

With E = 1000 V (Except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant,[g] at 3400 angstroms	-	1.2×10^5	-	A/W
Cathode radiant,[h] at 3400 angstroms	-	0.05	-	A/W
Luminous[j]	17.5	100	500	A/lm
Cathode luminous[k]	1×10^{-5}	4×10^{-5}	-	A/lm
Quantum efficiency at 3200 angstroms	-	19	-	%
Current Amplification	-	2.5×10^6	-	
Equivalent Anode-Dark-Current Input[n]	-	2.5×10^{-10} [m]	1.25×10^{-9} [m]	lm
	-	2×10^{-13} [p]	1×10^{-12} [p]	W
Anode Dark Current at 20 A/lm[m,n]	-	5×10^{-9}	2.5×10^{-8}	A
Equivalent Noise Input[q]	-	7.5×10^{-13}	-	lm
	-	6×10^{-16} [p]	-	W
Anode-Pulse Rise Time[r]	-	1.9×10^{-9}	-	s
Electron Transit Time[s]	-	1.7×10^{-8}	-	s

[a] On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

[b] Corning No.9741, Corning Glass Works, Corning, New York, or equivalent.

[c] Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 50, Illinois.

[d] Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Mass.

[e] Averaged over any interval of 30 seconds maximum.

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

[g] This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1252 lumens per watt.

[h] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1252 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 2870°K and a light input of 10 microlumens is used.

[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 100 volts are applied between cathode and all other electrodes connected as anode.

→ Indicates a change.

m At a tube temperature of 22°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.

n For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.

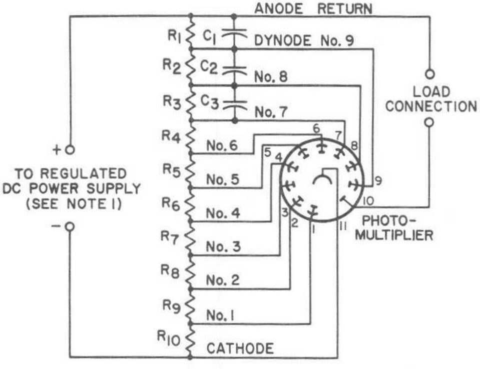
p At 3400 angstroms. This value is calculated from the rating in lumen using a conversion factor of 1252 lumens/watt.

q Under the following conditions: Supply voltage (E) is as shown, 22°C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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 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.

s 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.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



92CS-11382R1

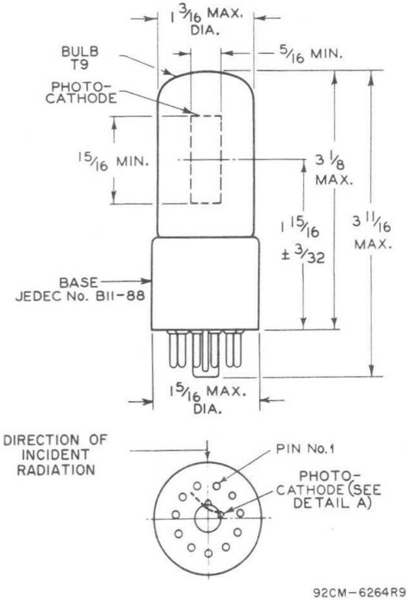
R_1 through R_{10} = 20,000 to 1,000,000 ohms

Note 1: Adjustable between approximately 500 and 1250 volts.

Note 2: Capacitors C_1 through C_3 should be connected at tube socket for optimum high-frequency performance.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-5 RESPONSE
is shown at the front of this section

DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

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

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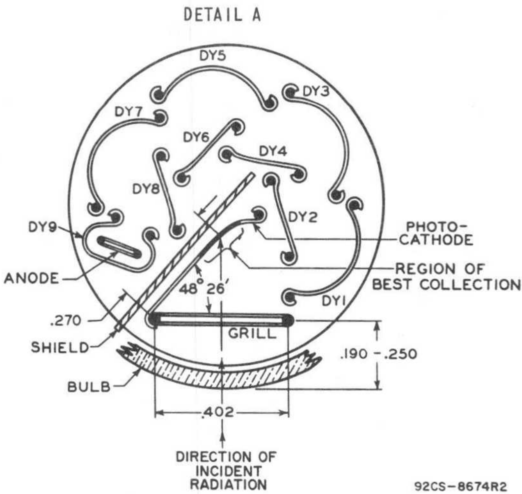
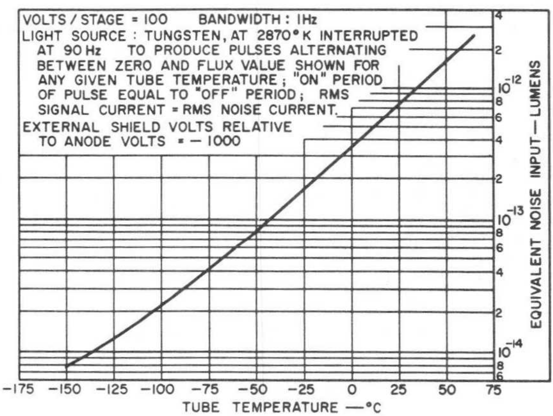
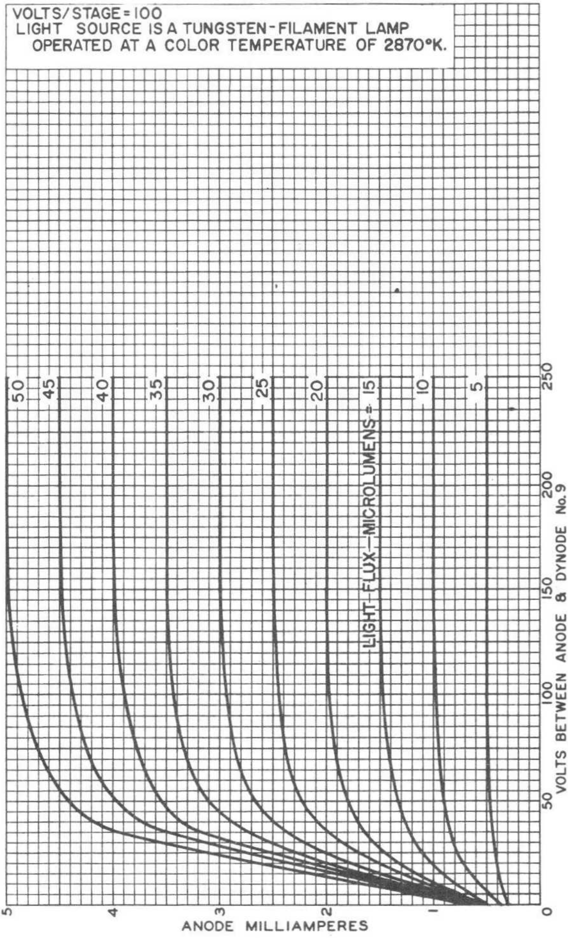
Electronic Components and Devices Harrison, N. J.



Equivalent-Noise-Input Characteristic



Typical Anode Characteristics



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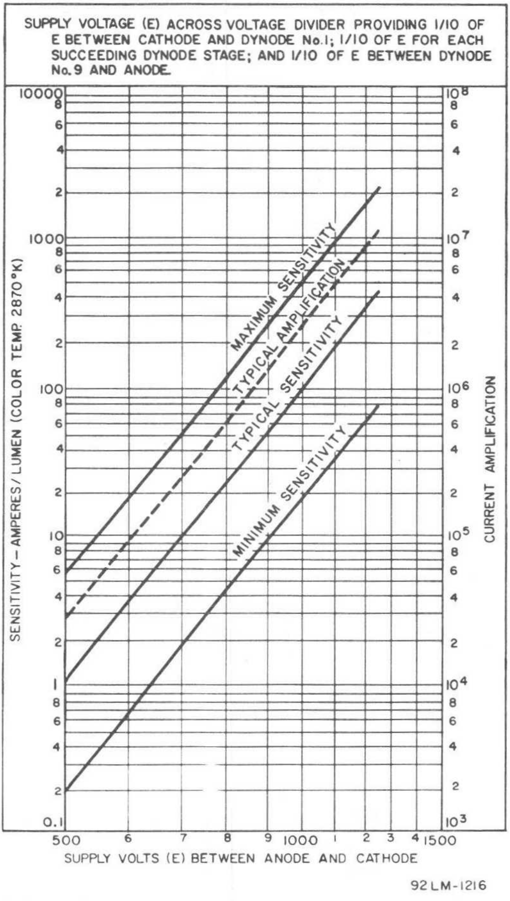
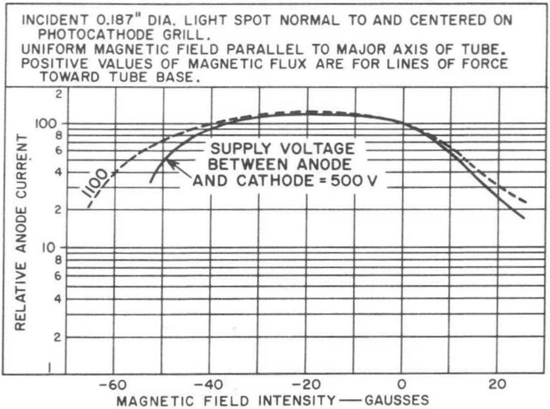
Electronic Components and Devices Harrison, N. J.

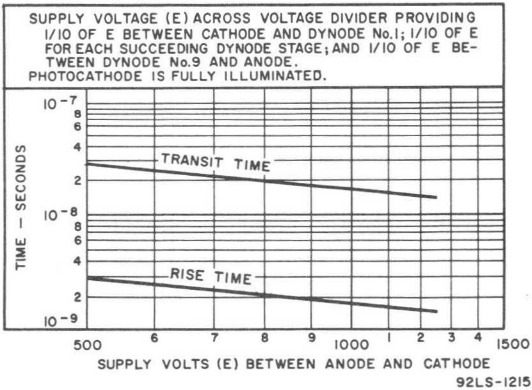
Typical Sensitivity and Current Amplification Characteristics



Typical Effect of Magnetic Field on Anode Current

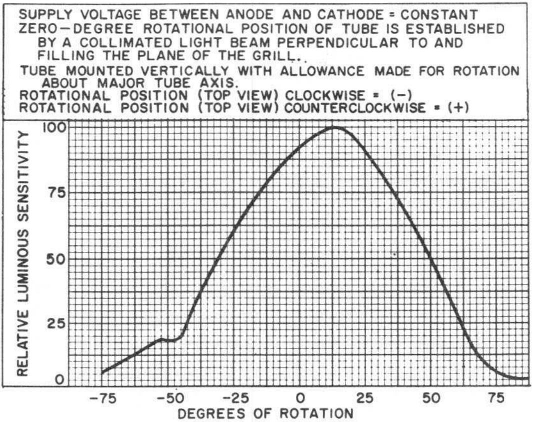


Typical Time-Resolution Characteristics



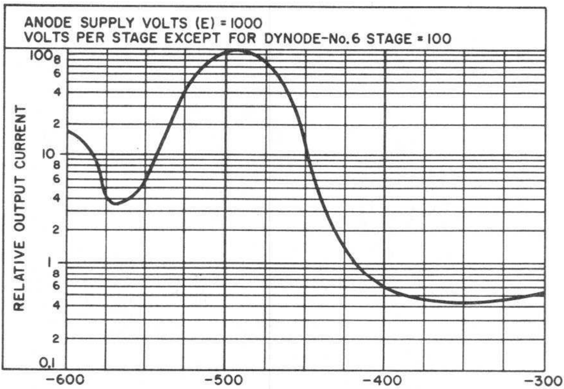
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

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



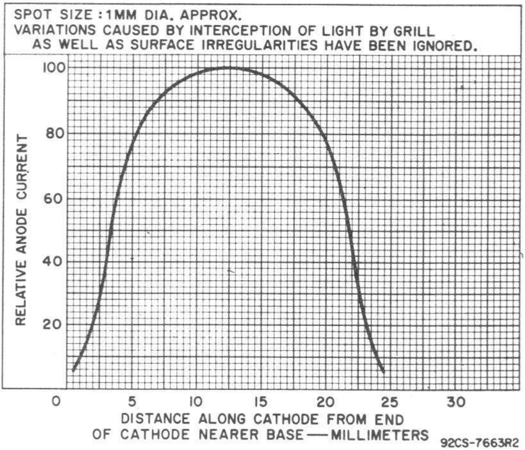
92CS–8671R2

Dynode Modulation Characteristics

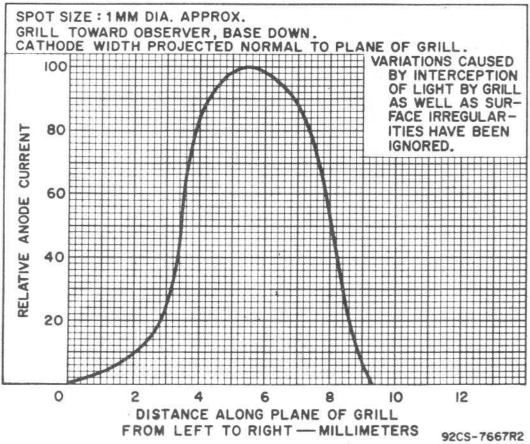


92CS–8672R1

Typical Variation of Photocathode Sensitivity Along Tube Length



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



Photomultiplier Tube

9-STAGE, SIDE-ON TYPE **S-5 RESPONSE**

For Detection and Measurement of Ultraviolet and Visible Radiation

The 1P28A is the same as the 1P28 except for the following items:

CHARACTERISTICS RANGE VALUES

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.

With E = 1000 volts

	Min	Typ	Max	
Sensitivity:				
Luminous[j]	35	200	500	A/lm
"Red-to-White" Ratio	7	-	-	%

[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 2870 °K and a light input of 10 microlumens is used.

RED-TO-WHITE RATIO

The sensitivity of the 1P28A above the wavelength of 5800 angstroms is controlled. This control is important in applications where a high-level of sensitivity in the red region of the spectral-response characteristic is required. The degree of this controlled sensitivity in the red region is specified by a "red-to-white" ratio of anode currents. Anode current is measured first using a tungsten-lamp source, and then measured with a red filter interposed between the light source and phototube.

The anode current comprising the "white" portion of this ratio is measured with a light input of 10 microlumens. The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870 °K.

The anode current comprising the "red" portion of the ratio is measured under conditions identical with the "white" measurement except that the light input of 10 microlumens is transmitted through a red filter (Corning C.S. No. 2-112-manufactured by the Corning Glass Works, Corning, N.Y., or equivalent) which has the following characteristics: the transmittance of all wavelengths from 3000 to 5790 angstroms is less than 0.5%; the 37% transmittance point lies between 6030 and 6070 angstroms; the transmittance from 6400 to 7000 angstroms is greater than 80%; and the difference between the wavelengths where transmittance is 15% and 60% is not greater than 150 angstroms.

Gas Phototube

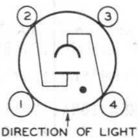
SIDE-ON TYPE HAVING S-3 RESPONSE

DATA

General:

Spectral Response	S-3
Wavelength of Maximum Response	4200 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	1-1/4"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	3 μμf
Maximum Overall Length	4-1/8"
Maximum Seated Length	3-1/2"
Seated Length to Center of Cathode	2-1/8" ± 3/32"
Maximum Diameter	1-1/8"
Operating Position	Any
Weight (Approx.)	1.1 oz ←
Bulb	T8
Socket	Amphenol No.77-MIP-4-T, or equivalent ←
Base	Dwarf-Shell Small 4-Pin (JEDEC No.A4-26) ←
Basing Designation for BOTTOM VIEW	2K

Pin 1 - No Connection
Pin 2 - Anode



Pin 3 - No Connection
Pin 4 - Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	80 max.	100 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	50 max.	25 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	10 max.	5 max.	μa
AMBIENT TEMPERATURE	100 max.	100 max.	°C

Characteristics: ←

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4200 angstroms	–	0.011	–	amp/watt
Luminous:[c]				
At 0 cps	20	40	70	μa/lumen
At 5000 cps	–	35	–	μa/lumen
At 10000 cps	–	31	–	μa/lumen
Gas Amplification Factor[d]	–	–	9	
Anode Dark Current at 25° C	–	–	0.10	μa

← Indicates a change.

Minimum Circuit Values:

With an anode-supply voltage of	*80 or less*	*100*	*volts*
DC Load Resistance:			
For dc currents above 5 μa. . .	0.1 min.	–	megohm
For dc currents below 5 μa. . .	0 min.	–	megohms
For dc currents above 3 μa. . .	–	2.5 min.	megohms
For dc currents below 3 μa. . .	–	0.1 min.	megohm

a On plane perpendicular to indicated direction of incident light.

b Averaged over any interval of 30 seconds maximum.

c For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

d The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-3 RESPONSE

and

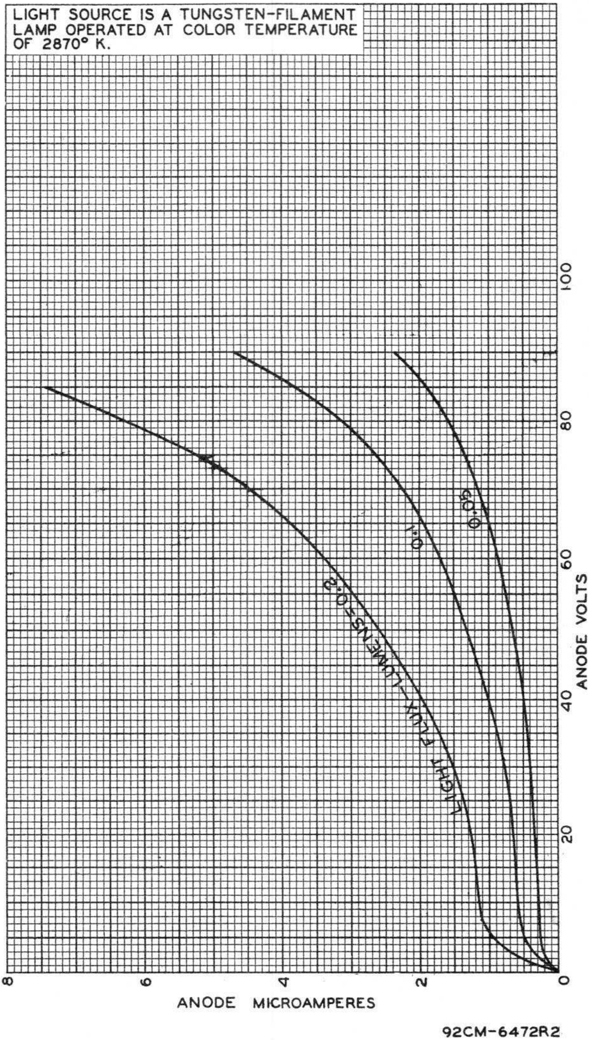
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section

DIMENSIONAL OUTLINE

shown under Type 1P37 also applies to the 1P29

AVERAGE ANODE CHARACTERISTICS



Gas Phototube

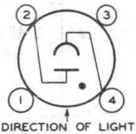
SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	1-1/4"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	3 μμf
Maximum Overall Length	4-1/8"
Maximum Seated Length	3-1/2"
Seated Length to Center of Cathode	2-1/8" ± 3/32"
Maximum Diameter	1-1/8"
Operating Position	Any
Weight (Approx.)	1.1 oz ←
Bulb	T8
Socket	Amphenol No.77-MIP-4-T, or equivalent ←
Base	Dwarf-Shell Small 4-Pin (JEDEC No.A4-26) ←
Basing Designation for BOTTOM VIEW	2K

Pin 1 - No Connection
Pin 2 - Anode



Pin 3 - No Connection
Pin 4 - Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

	Rating I	Rating II	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	80 max.	100 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	50 max.	25 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	10 max.	5 max.	μa
AMBIENT TEMPERATURE	75 max.	75 max.	°C

Characteristics: ←

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4000 angstroms	-	0.13	-	μa/μw
Luminous:[c]				
At 0 cps	75	135	205	μa/lumen
At 5000 cps	-	124	-	μa/lumen
At 10000 cps	-	108	-	μa/lumen
Gas Amplification Factor[d]	-	-	5.5	
Anode Dark Current at 25° C	-	-	0.05	μa

← Indicates a change.

Minimum Circuit Values:

With an anode-supply voltage of	*80 or less*	*100*	*volts*
DC Load Resistance:			
For dc currents above 5 μa . .	0.1 min.	–	megohm
For dc currents below 5 μa . .	0 min.	–	megohms
For dc currents above 3 μa . .	–	2.5 min.	megohms
For dc currents below 3 μa . .	–	0.1 min.	megohm

[a] On plane perpendicular to indicated direction of incident light.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

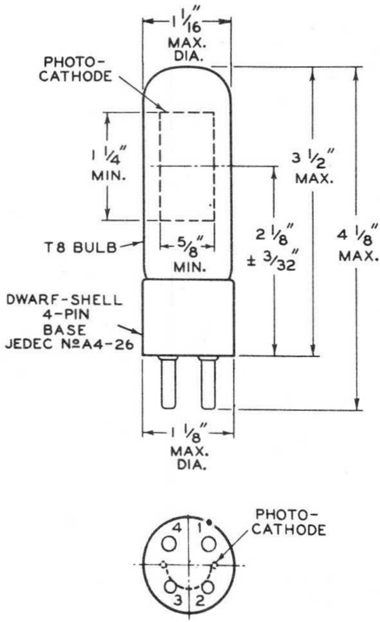
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE

and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section

AVERAGE-ANODE-CHARACTERISTICS CURVE shown under Type 5581 also applies to the 1P37


1 1/16" MAX. DIA.
PHOTO-CATHODE
1 1/4" MIN.
3 1/2" MAX.
2 1/8" ± 3/32"
4 1/8" MAX.
T8 BULB
5/8" MIN.
DWARF-SHELL 4-PIN BASE JEDEC No A4-26
1 1/8" MAX. DIA.
4
1
3
2
PHOTO-CATHODE

92CM-470R5

RCA

1P39

VACUUM PHOTOTUBE

WITH S-4 RESPONSE

For applications critical as to leakage under high-humidity conditions

The 1P39 is like the 929, except that the 1P39 has a maximum dark current of 0.005 μa at 250 volts, and has a non-hygroscopic base which insures a value of resistance between anode and cathode pins about 10 times higher than conventional bases under adverse service conditions of high humidity. ←

← Indicates a change.

RCA

1P40

GAS PHOTOTUBE

WITH S-1 RESPONSE

For applications critical as to leakage under high-humidity conditions

The 1P40 is like the 930, except that the 1P40 has a maximum dark current of 0.005 μa at 90 volts, and has a non-hygroscopic base which insures a value of resistance between anode and cathode pins about 10 times higher than conventional bases under adverse service conditions of high humidity. ←

← Indicates a change.

1P41

GAS PHOTOTUBE

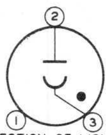
HEAD-ON TYPE WITH S-1 RESPONSE

DATA

General:

Spectral Response S-1
Wavelength of Maximum Response. . . . . 8000 ± 1000 angstroms
Cathode:
  Shape . . . . .Circular
  Minimum diameter. 9/16"
Direct Interelectrode Capacitance . . . . 1.8 μμf
Maximum Overall Length. . . . . 2-1/16"
Maximum Seated Length . . . . 1-19/32"
Axial Distance from Bulb Top to Plane through
  Periphery of Cathode Area . . . . 5/16" ± 3/32" ←
Maximum Diameter. .13/16"
Mounting Position . . . . Any
Weight (Approx.). 0.3 oz ←
Bulb. T6
Base. . . . . .Small-Shell Peewee 3-Pin (JETEC No.A3-1) ←
  Basing Designation for BOTTOM VIEW. . . . . 2AR ←

Pin 1 - No Connection



Pin 2 - Anode
Pin 3 - Cathode

DIRECTION OF LIGHT: INTO END OF BULB

Maximum Ratings, *Absolute Values:*

	Rating I	Rating II	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	70 max.	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY°.	40 max.	20 max.	μamp/sq.in. ←
AVERAGE CATHODE CURRENT°.	3 max.	1.5 max.	μamp
AMBIENT TEMPERATURE	100 max.	100 max.	°C

Characteristics, *With 90 Volts on Anode:*

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 8000 angstroms.	-	0.008	-	μamp/μwatt ←
Luminous:●				
At 0 cps.	50	90	145	μamp/lumen
At 5000 cps	-	77	-	μamp/lumen
At 10000 cps.	-	67	-	μamp/lumen
Gas Amplification Factor. .	-	-	8.5	
Anode Dark Current at 25 °C.	-	-	0.1	μamp ←

°,●: See next page. ← Indicates a change.

1P41

GAS PHOTOTUBE

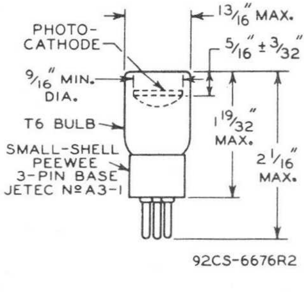
Minimum Circuit Values:

With anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 1.5 μamp.	0.1 min.	–	megohm
For dc currents below 1.5 μamp.	0 min.	–	megohm
For dc currents above 1 μamp.	–	2.5 min.	megohms
For dc currents below 1 μamp.	–	0.1 min.	megohm

° Averaged over any interval of 30 seconds maximum.

♦ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870 °K. A dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurements, a light input of 0.06 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-1 Response
and
FREQUENCY-RESPONSE CHARACTERISTICS
of Gas Phototubes
are shown at the front of this Section

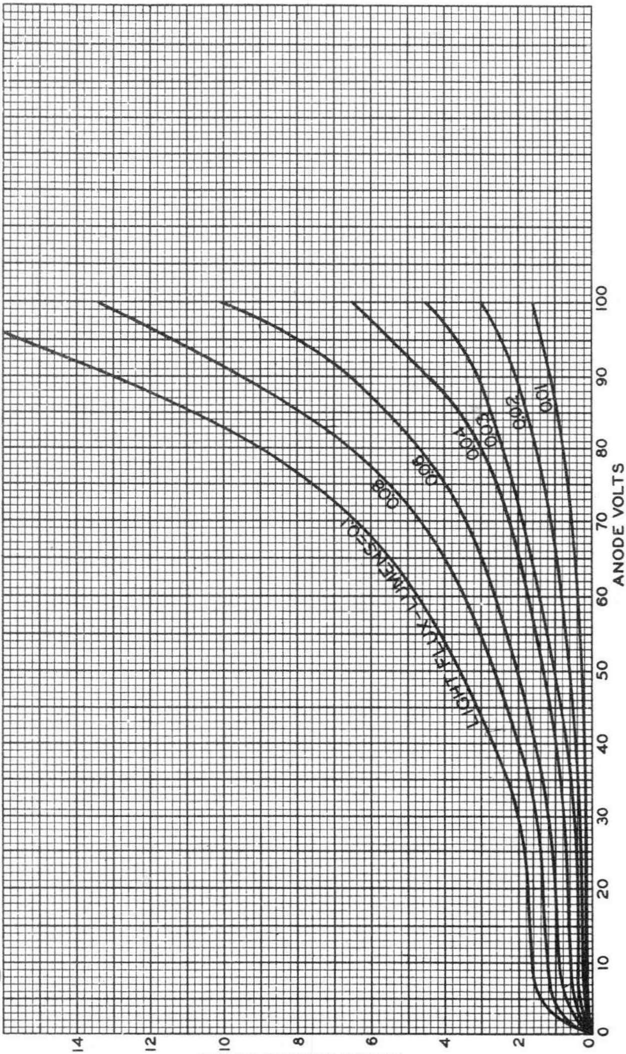


92CS-6676R2

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

IP41

AVERAGE ANODE CHARACTERISTICS



Vacuum Phototube

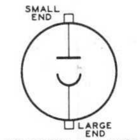
HEAD-ON TYPE WITH S-9 RESPONSE

DATA

General:

Spectral Response. S-9
Wavelength of Maximum Response . . . . . 4800 ± 500 angstroms
Cathode, Semitransparent: ←
  Shape. . . . . Circular
  Window:
    Area . . . . 0.03 sq. in.
    Minimum diameter . . . . 0.19"
Direct Interelectrode Capacitance. . . . . 1.9 $\mu\mu$f
Maximum Overall Length . . . . 1-11/32" ± 1/16"
Maximum Diameter . . . . 1/4"
Operating Position . . . . .Any
Weight (Approx.) . . . . 0.1 oz ←
Bulb T2
Terminal Diagram (See *Dimensional Outline*) . . . . .2AT ←

Small End: Anode



Large End: Cathode

DIRECTION OF LIGHT:
INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:* ←

ANODE-SUPPLY VOLTAGE (DC or PEAK AC) .	180 max.	volts
AVERAGE CATHODE-CURRENT DENSITY• . . .	25 max.	μa/sq. in.
AVERAGE CATHODE CURRENT•	0.4 max.	μa
AMBIENT TEMPERATURE.	75 max.	°C

Characteristics: ←

With an anode-supply voltage of 180 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4800 angstroms .	–	0.025	–	μa/μw
Luminous#	20	37	70	μa/lumen
Anode Dark Current at 25° C. .	–	–	0.005	μa

• Averaged over any interval of 30 seconds maximum.

For conditions where the light source is a tungsten-filament lamp operated a color temperature of 2870° K. The supply voltage is 180 volts, the load resistor is 1 megohm, and the light input is 0.015 lumen.

← Indicates a change.

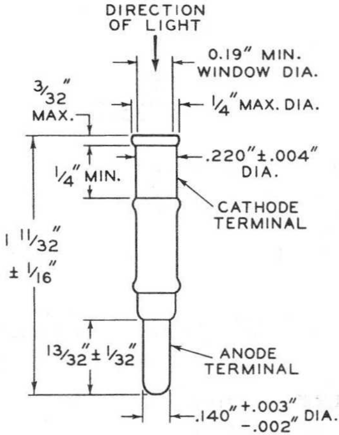
→

OPERATING CONSIDERATIONS

Exposure to intense illumination, such as direct sunlight, may decrease the sensitivity of the 1P42 even though no voltage is applied to the tube. The magnitude and duration of the decrease depend on the length of the exposure.

Shielding of the 1P42 and its leads to the amplifier is recommended when amplifier gain is high or when the phototube load resistance is high. Whenever frequency response is important in a phototube circuit, the leads from the phototube to the amplifier should be made short so as to minimize capacitance shunting of the phototube load. It is important that insulation of associated circuit parts and wiring be adequate.

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

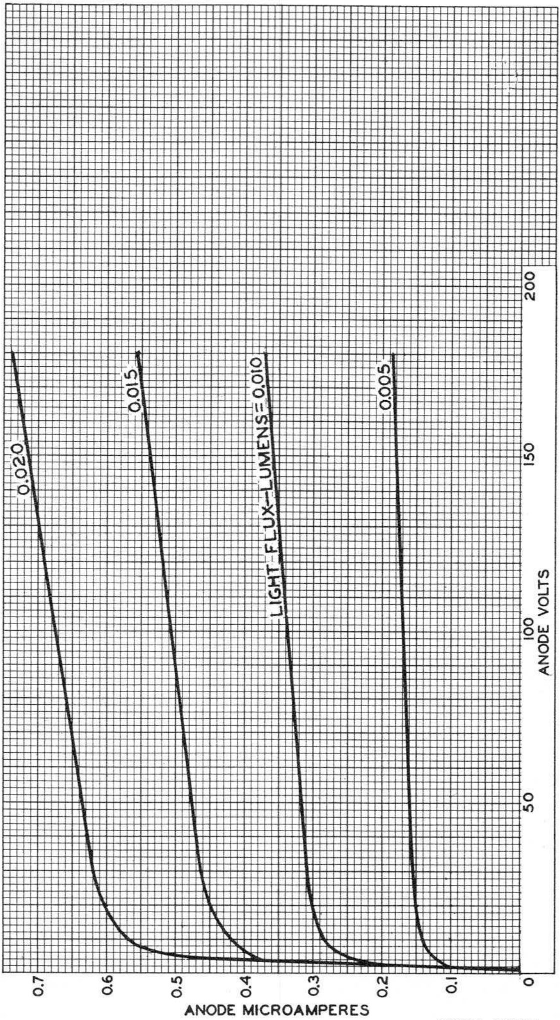


NOTE: WHEN TUBE IS ROTATED ABOUT THE LONGITUDINAL AXIS OF ITS CATHODE TERMINAL, NO PART OF THE ANODE TERMINAL WILL FALL OUTSIDE OF A 0.241"-DIAMETER CIRCLE CONCENTRIC WITH THE LONGITUDINAL AXIS OF THE CATHODE TERMINAL.

92CS-6791R2

→ Indicates a change.

AVERAGE ANODE CHARACTERISTICS



92CM-10757

Gas Phototube

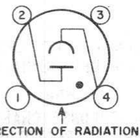
SIDE-ON TYPE HAVING S-1 RESPONSE

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	1-1/4"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	3 μμf
Maximum Overall Length	4-1/8"
Maximum Seated Length	3-1/2"
Seated Length to Center of Cathode	2-1/8" ± 3/32"
Maximum Diameter	1-1/8"
Operating Position	Any
Weight (Approx.)	1.1 oz ←
Bulb	T8
Socket	Amphenol No.77-MIP-4-T, or equivalent ←
Base	Dwarf-Shell Small 4-Pin (JEDEC No.A4-26) ←
Basing Designation for BOTTOM VIEW	2K

Pin 1 - No Connection
Pin 2 - Anode



Pin 3 - No Connection
Pin 4 - Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	80 max.	100 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	50 max.	25 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	10 max.	5 max.	μa
AMBIENT TEMPERATURE	100 max.	100 max.	°C

Characteristics: ←

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 8000 angstroms	–	0.0084	–	amp/watt
Luminous:[c]				
At 0 cps	50	90	145	μa/lumen
At 5000 cps	–	77	–	μa/lumen
At 10000 cps	–	67	–	μa/lumen
Gas Amplification Factor[d]	–	–	8	
Anode Dark Current at 25° C.	–	–	0.1	μa

← Indicates a change.

Minimum Circuit Values:

With an anode-supply voltage of	*80 or less*	*100*	*volts*
DC Load Resistance:			
For dc currents above 5 μa.	0.1 min.	–	megohm
For dc currents below 5 μa.	0 min.	–	megohms
For dc currents above 3 μa.	–	2.5 min.	megohms
For dc currents below 3 μa.	–	0.1 min.	megohm

[a] On plane perpendicular to indicated direction of incident radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE

and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section

DIMENSIONAL OUTLINE
shown under Type 1P37 also applies to the 868

AVERAGE-ANODE-CHARACTERISTICS CURVE
shown under Type 1P41 also applies to the 868

RCA

917

VACUUM PHOTOTUBE

LOW-LEAKAGE TYPE WITH ANODE-TERMINAL CAP AND S-1 RESPONSE

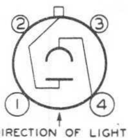
For light-measuring and relay applications

DATA

General:

Spectral Response	S-1	
Wavelength of Maximum Response	8000 ± 1000 angstroms	
Cathode:		
Shape	Semicylindrical	
Minimum projected length*	1-9/16"	
Minimum projected width*	5/8"	
Direct Interelectrode Capacitance	2.2 μμf	
Maximum Overall Length	4-7/16"	
Seated Length	3-11/16" ± 1/8"	
Seated Length to Center of Cathode	2-1/8" ± 3/32"	
Maximum Diameter	1-1/8"	
Mounting Position	Any	
Weight (Approx.)	1.1 oz	←
Bulb	T-8	
Cap	Small (JETEC No.C1-1)	←
Base	Dwarf-Shell Small 4-Pin (JETEC No.A4-26)	←
Basing Designation for BOTTOM VIEW	1A	←

Pin 1 - No Connection
Pin 2 - No Connection



Pin 3 - No Connection
Pin 4 - Cathode
Cap - Anode

Maximum Ratings, *Absolute Values:*

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	500 max.	volts	
AVERAGE CATHODE-CURRENT DENSITY°	30 max.	μamp/sq.in.	←
AVERAGE CATHODE CURRENT°	10 max.	μamp	
AMBIENT TEMPERATURE	100 max.	°C	

Characteristics, *At 250 Volts on Anode:*

	Min.	*Median*	*Max.*		
Sensitivity:					
Radiant, at 8000 angstroms	–	0.0018	–	μamp/μwatt	←
Luminous▲	12	20	40	μamp/lumen	
Anode Dark Current at 25°C	–	–	0.005	μamp	

* On plane perpendicular to indicated direction of incident light.

° Averaged over any interval of 30 seconds maximum.

▲ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 250 volts, a 1-megohm load resistor, and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-1 Response is shown at front of this Section

← Indicates a change.

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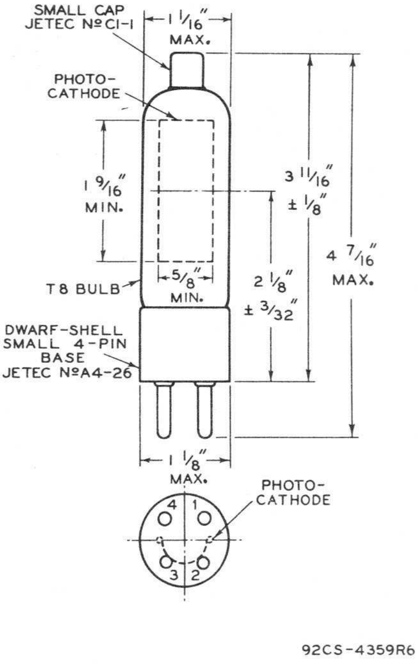
917
VACUUM PHOTOTUBE



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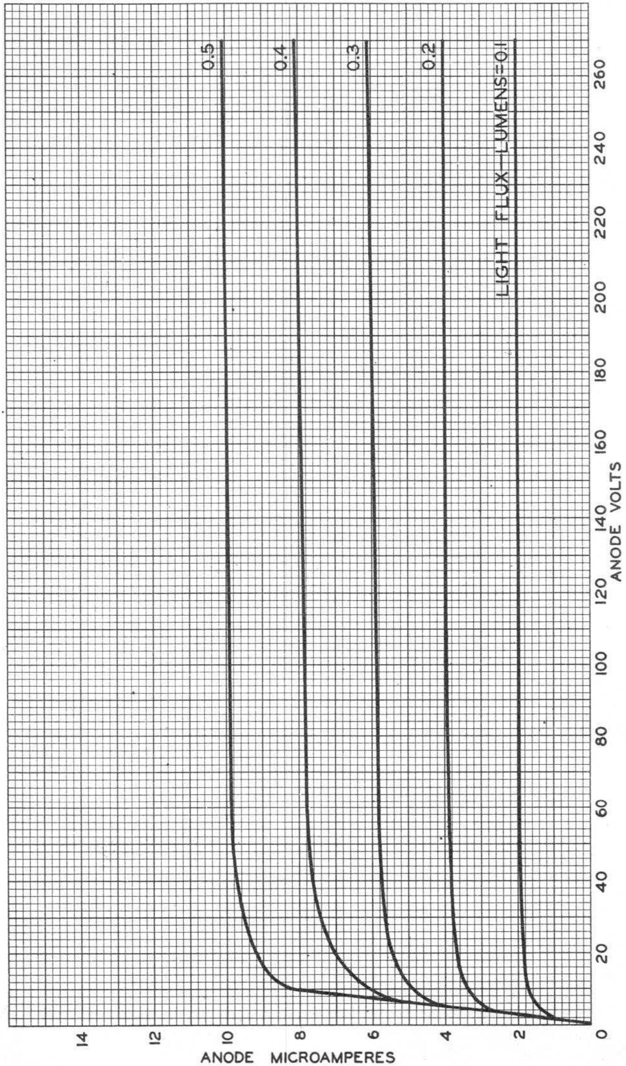
917

AVERAGE ANODE CHARACTERISTICS



Gas Phototube

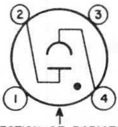
SIDE-ON TYPE HAVING S-1 RESPONSE

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	1-1/4"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	3 μμf
Maximum Overall Length	4-1/8"
Maximum Seated Length	3-1/2"
Seated Length to Center of Cathode	2-1/8" ± 3/32"
Maximum Diameter	1-1/8"
Operating Position	Any
Weight (Approx.)	1.1 oz ←
Bulb	T8
Socket	Amphenol No.77-MIP-4-T, or equivalent ←
Base	Dwarf-Shell Small 4-Pin (JEDEC No.A4-26) ←
Basing Designation for BOTTOM VIEW	2K

Pin 1 – No Connection
Pin 2 – Anode



DIRECTION OF RADIATION

Pin 3 – No Connection
Pin 4 – Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	70 max.	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	50 max.	25 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	10 max.	5 max.	μa
AMBIENT TEMPERATURE	100 max.	100 max.	°C

Characteristics: ←

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 8000 angstroms	–	0.014	–	amp/watt
Luminous:[c]				
At 0 cps	120	150	220	μa/lumen
At 5000 cps	–	120	–	μa/lumen
At 10000 cps	–	105	–	μa/lumen
Gas Amplification Factor[d]	–	–	10.5	
Anode Dark Current at 25° C.	–	–	0.1	μa

← Indicates a change.

Minimum Circuit Values:

With an anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 5 µa.	0.1 min.	–	megohm
For dc currents below 5 µa.	0 min.	–	megohms
For dc currents above 3 µa.	–	2.5 min.	megohms
For dc currents below 3 µa.	–	0.1 min.	megohm

[a] On plane perpendicular to indicated direction of incident radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE

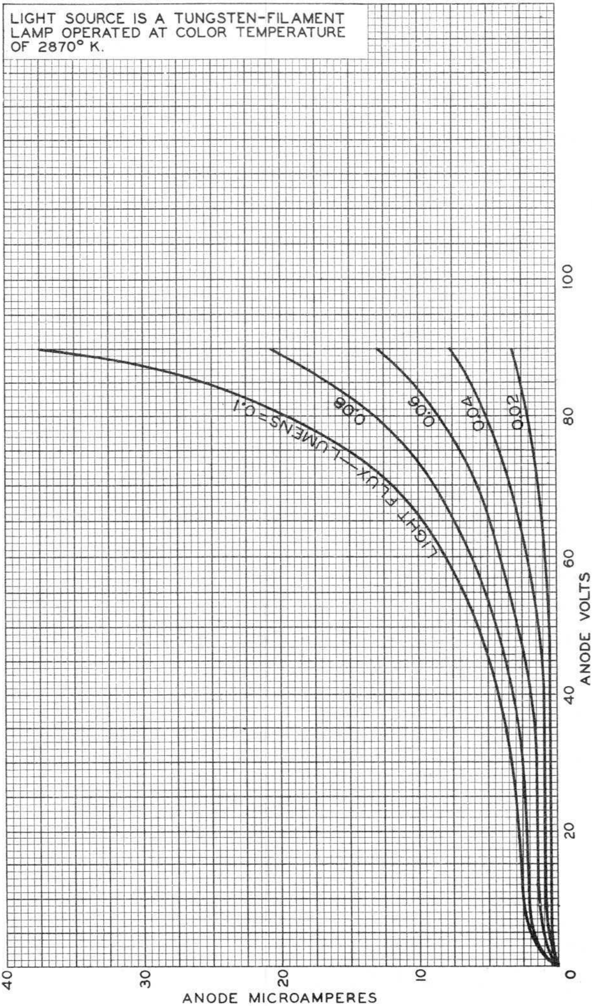
and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section

DIMENSIONAL OUTLINE
shown under Type 1P37 also applies to the 918

AVERAGE ANODE CHARACTERISTICS



92CM-4351R3

919

VACUUM PHOTOTUBE

LOW-LEAKAGE TYPE WITH CATHODE-TERMINAL CAP AND S-1 RESPONSE

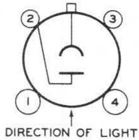
For light-measuring and relay applications

The 919 is the same as the 917 except for the following item:

General:

Base . . . . Dwarf-Shell Small 4-Pin (JETEC No.A4-26)
Basing Designation for BOTTOM VIEW 1B

Pin 1 - No Connection
Pin 2 - Anode
Pin 3 - No Connection



Pin 4 - No Connection
Cap - Cathode

Gas Phototube

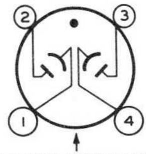
SIDE-ON, TWIN-UNIT TYPE HAVING S-1 RESPONSE

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode (Each):	
Shape	Quarter-Cylindrical
Minimum projected length[a]	1-3/16"
Minimum projected width[a]	1/4"
Direct Interelectrode Capacitances (Approx.):	
Cathode to cathode[b]	1.8 $\mu\mu$f
Cathode to anode[c]	1.6 $\mu\mu$f
Anode to anode[d]	0.4 $\mu\mu$f ←
Maximum Overall Length	4"
Maximum Seated Length	3-3/8"
Seated Length to Center of Cathodes	2-1/8" ± 3/32"
Maximum Diameter	1-3/16"
Operating Position	Any
Weight (Approx.)	1.1 oz ←
Bulb	T9
Socket	Amphenol No.77-M1P-4-T, or equivalent ←
Base	Small-Shell Small 4-Pin (JEDEC No.A4-5)
Basing Designation for BOTTOM VIEW	4BG

Pin 1 - Photocathode of Unit No.2
Pin 2 - Anode of Unit No.2



DIRECTION OF RADIATION

Pin 3 - Anode of Unit No.1
Pin 4 - Photocathode of Unit No.1

Maximum Ratings, *Absolute-Maximum Values:* ←

Values are for Each Unit

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	70 max.	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[e]	30 max.	15 max.	μa/sq.in.
AVERAGE CATHODE CURRENT[e]	4 max.	2 max.	μa
AMBIENT TEMPERATURE	100 max.	100 max.	^{o}C

← Indicates a change.

→ **Characteristics:**

Values are for each unit with an anode-supply voltage of 90 volts unless otherwise specified

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 8000 angstroms. .	–	0.0094	–	amp/watt
Luminous:[f]				
At 0 cps.	50	100	175	μa/lumen
At 5000 cps	–	85	–	μa/lumen
At 10000 cps.	–	74	–	μa/lumen
Ratio of Luminous Sensitivities (Unit No.1 to Unit No.2). . .	0.5	1.15	2.0	
Gas Amplification Factor[g] . . .	–	–	9	
Anode Dark Current at 25° C . .	–	–	0.1	μa

Minimum Circuit Values:

Values are for Each Unit

With an anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 2 μa. .	0.1 min.	–	megohm
For dc currents below 2 μa. .	0 min.	–	megohm
For dc currents above 1 μa. .	–	2.5 min.	megohms
For dc currents below 1 μa. .	–	0.1 min.	megohm

a On plane perpendicular to indicated direction of incident radiation.

b With anodes grounded.

c Each unit, with other unit grounded.

d With cathodes grounded.

e Averaged over any interval of 30 seconds maximum.

f For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.04 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

g The ratio of luminous sensitivity at an anode-supply voltage of 90 volts to luminous sensitivity at an anode-supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.04 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE

and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

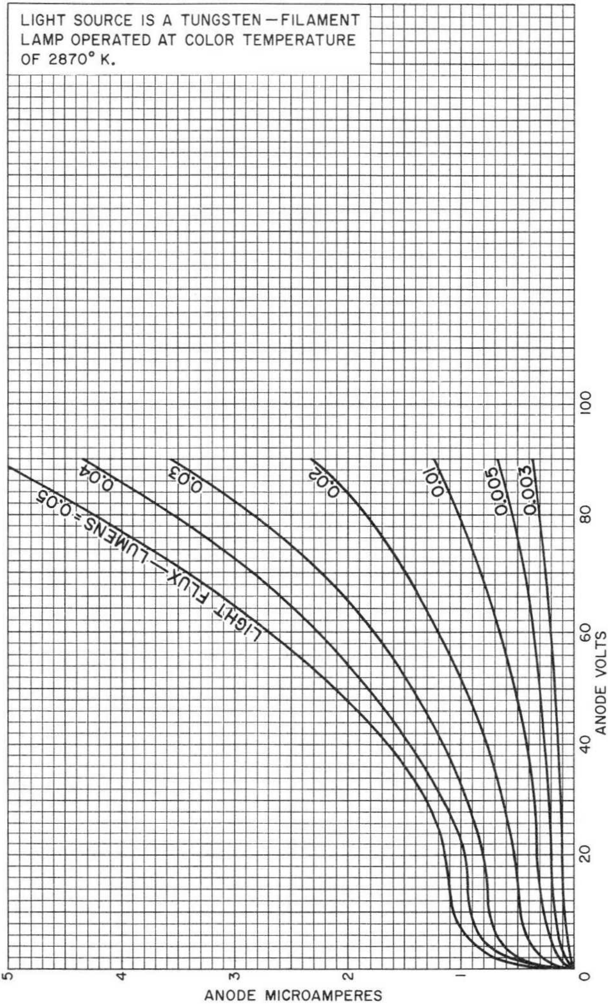
are shown at the front of this section

DIMENSIONAL OUTLINE

shown under Type 5584 also applies to the 920

→ Indicates a change.

AVERAGE ANODE CHARACTERISTICS
Each Unit



92CM—4618R4

921

GAS PHOTOTUBE

CARTRIDGE TYPE WITH S-1 RESPONSE

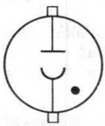
For relay applications

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length*	7/8"
Minimum projected width*	1/2"
Direct Interelectrode Capacitance	1 $\mu\mu$f
Overall Length	1-21/32" ± 1/16"
Seated Length	1-13/32" ± 1/32"
Length from Center of Useful Cathode Area to Plane A-A' *(See Dimensional Outline)*	11/16" ± 1/16"
Maximum Diameter	0.890"
Weight (Approx.)	0.4 oz ←
Mounting Position	Any
Terminals: ←	
Recessed cap	JETEC No.J1-23
Protruding cap	JETEC No.J1-24
Basing Designation	2AQ ←

Recessed Cap } Anode



Protruding Cap } Cathode

DIRECTION OF LIGHT: INTO CONCAVE SIDE OF CATHODE

Maximum Ratings, *Absolute Values:*

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY°	30 max.	μamp/sq.in. ←
AVERAGE CATHODE CURRENT°	3 max.	μamp
AMBIENT TEMPERATURE	100 max.	°C

Characteristics, *At 90 Volts on Anode:*

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 8000 angstroms	–	0.012	–	μamp/μwatt ←
Luminous:▲				
At 0 cps	75	135	205	μamp/lumen
At 5000 cps	–	119	–	μamp/lumen
At 10000 cps	–	108	–	μamp/lumen
Gas Amplification Factor	–	–	10	
Anode Dark Current at 25°C	–	–	0.01	μamp ←

* On plane perpendicular to indicated direction of incident light.

°,▲: See next page.

← Indicates a change.

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921

GAS PHOTOTUBE

Minimum Circuit Values:

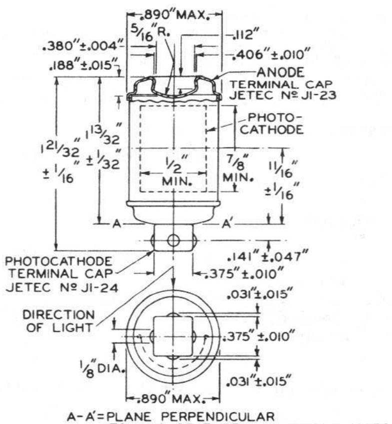
With anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 3 μamp	0.1 min.	–	megohm
For dc currents below 3 μamp	0 min.	–	megohm
For dc currents above 2 μamp	–	2.5 min.	megohms
For dc currents below 2 μamp	–	0.1 min.	megohm

○ Averaged over any interval of 30 seconds maximum. This value may be doubled when anode-supply voltage is limited to 70 volts.

▲ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurements, a light input of 0.1 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-1 Response
and
FREQUENCY-RESPONSE CHARACTERISTICS
of Gas Phototubes
are shown at the front of this Section

AVERAGE ANODE CHARACTERISTICS
for Type 921 are the same as those shown for Type 930



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922

VACUUM PHOTOTUBE

CARTRIDGE TYPE WITH S-1 RESPONSE

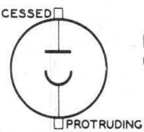
For relay applications

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length*	5/8"
Minimum projected width*	1/2"
Direct Interelectrode Capacitance	1 $\mu\mu$f
Overall Length	1-21/32" + 1/32" − 1/16" ←
Seated Length	1-13/32" ± 1/32"
Length from Center of Useful Cathode Area to Plane A-A' *(See Dimensional Outline)*	11/16" ± 1/16"
Maximum Diameter	0.890"
Mounting Position	Any
Weight (Approx.)	0.4 oz ←
Terminals: ←	
Recessed cap	JETEC No. J1-23
Protruding cap	JETEC No. J1-24
Basing Designation	2AQ ←

Recessed Cap } Anode



Protruding Cap } Cathode

DIRECTION OF LIGHT: INTO CONCAVE SIDE OF CATHODE

Maximum Ratings, ***Absolute Values:***

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	500 max.	volts
AVERAGE CATHODE-CURRENT DENSITY°	30 max.	μamp/sq. in. ←
AVERAGE CATHODE CURRENT°	5 max.	μamp
AMBIENT TEMPERATURE	100 max.	°C

Characteristics, ***At 250 Volts on Anode:***

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 8000 angstroms	–	0.0018	–	μamp/μwatt ←
Luminous▲	10	20	40	μamp/lumen
Anode Dark Current at 25°C	–	–	0.005	μamp

* On plane perpendicular to indicated direction of incident light.

° Averaged over any interval of 30 seconds maximum.

▲ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 250 volts, a 1-megohm load resistor, and a light input of 0.1 lumen are used.

← Indicates a change.

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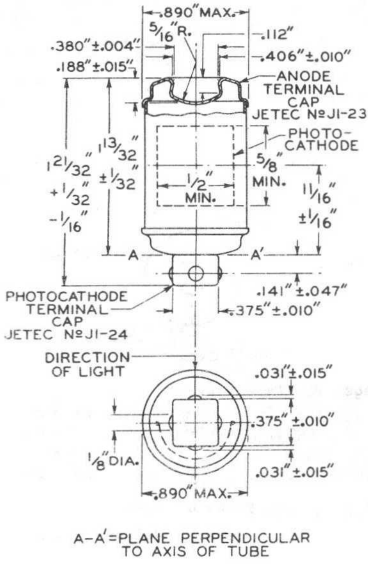
922

VACUUM PHOTOTUBE

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-1 Response
is shown at the front of this Section

AVERAGE ANODE CHARACTERISTICS
for Type 922 are the same as those shown for Type 917



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

923
GAS PHOTOTUBE

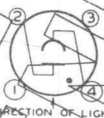
WITH S-1 RESPONSE

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 Angstroms
Cathode:	
Shape	Semi-Cylindrical
Minimum Projected Length*	13/16"
Minimum Projected Width*	5/8"
Direct Interelectrode Capacitance	2 μμf
Maximum Overall Length	3-9/16"
Maximum Seated Length	2-15/16"
Seated Length to Center of Cathode	1-31/32" ± 3/32"
Maximum Diameter	1-3/16"
Bulb	T-9
Mounting Position	Any
Base	Small-Shell Small 4-Pin
Basing Designation for BOTTOM VIEW	2K

Pin 1 – No Connection
Pin 2 – Anode



Pin 3 – No Connection
Pin 4 – Cathode

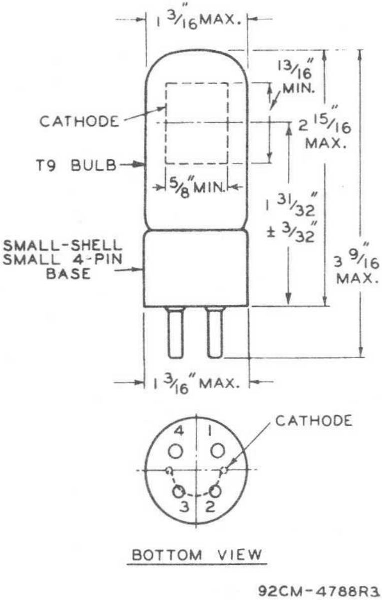
Maximum Ratings, Characteristics, and Curves
for the 923
are the same as those shown
for Type 930

* On plane perpendicular to indicated direction of incident light.

← Indicates a change.

RCA

923
GAS PHOTOTUBE



Vacuum Phototube

SIDE-ON TYPE HAVING S-1 RESPONSE

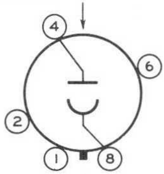
DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	13/16"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	1.6 μμf
Maximum Overall Length	2-5/8"
Maximum Seated Length	2-1/16"
Seated Length to Center of Cathode	1-13/32" ± 3/32" ←
Maximum Diameter	1-9/32"
Operating Position	Any
Weight (Approx.)	0.8 oz ←
Bulb	T9
Socket	Cinch No.8JM-1, or equivalent ←
Base	Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No.B5-10)
Basing Designation for BOTTOM VIEW	3J

DIRECTION OF RADIATION

Pin 1 – No Internal Connection
Pin 2 – No Internal Connection



Pin 4 – Anode
Pin 6 – No Internal Connection
Pin 8 – Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	250 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	30 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	5 max.	μa
AMBIENT TEMPERATURE	100 max.	°C

Characteristics: ←

With an anode-supply voltage of 250 volts

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 8000 angstroms	–	0.0019	–	amp/watt
Luminous[c]	12	20	40	μa/lumen
Anode Dark Current at 25° C.	–	–	0.0125	μa

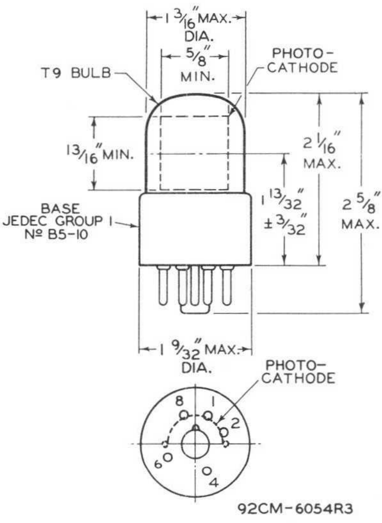
← Indicates a change.

[a] On plane perpendicular to indicated direction of radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE is shown at the front of this section



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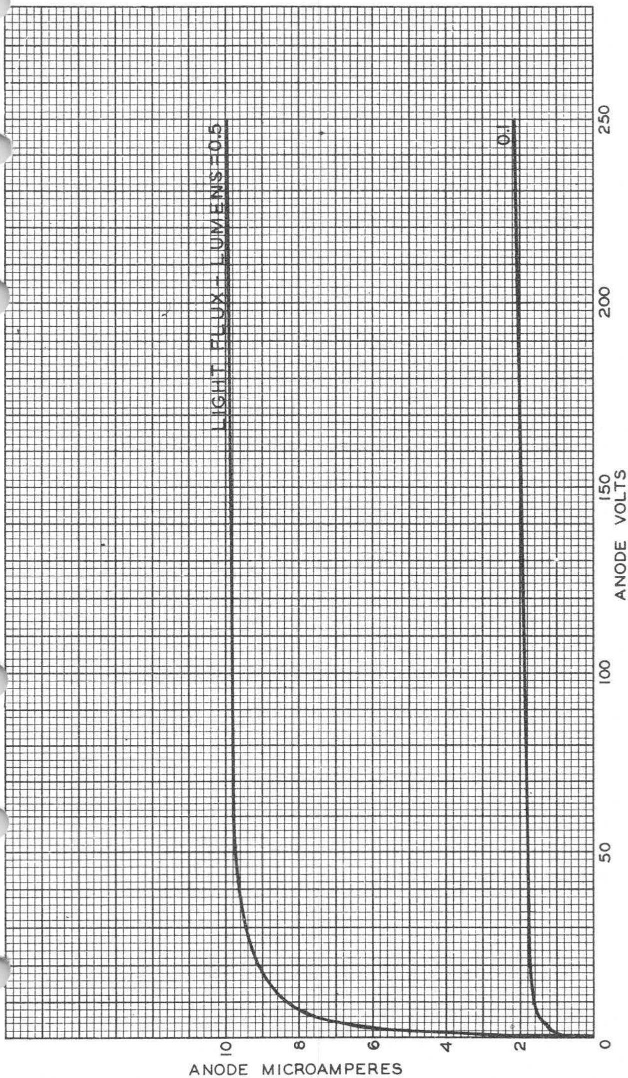
AVERAGE ANODE CHARACTERISTICS



JULY 31, 1947

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6208R1

926

926

VACUUM PHOTOTUBE

CARTRIDGE TYPE WITH S-3 RESPONSE

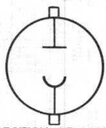
For colorimetric applications

DATA

General:

Spectral Response S-3
Wavelength of Maximum Response . . . . 4200 ± 1000 angstroms
Cathode:
  Shape . . . . Semicylindrical
  Minimum projected length* . . . . 7/8"
  Minimum projected width* . . . . 1/2"
Direct Interelectrode Capacitance . . . . 1 $\mu\mu$f
Overall Length . . . . 1-21/32" ± 1/16"
Seated Length . . . . 1-13/32" ± 1/32"
Length from Center of Useful Cathode Area
  to Plane A-A' *(See Dimensional Outline)* . . . . 11/16" ± 1/16"
Maximum Diameter . . . . 0.890"
Weight (Approx.) . . . . 0.4 oz ←
Mounting Position . . . . Any
Terminals: ←
  Recessed cap . . . . JETEC No.J1-23
  Protruding cap . . . . JETEC No.J1-24
Basing Designation . . . . 2AQ ←

Recessed Cap } Anode



Protruding Cap } Cathode

DIRECTION OF LIGHT: INTO CONCAVE SIDE OF CATHODE

Maximum Ratings, *Absolute Values:*

ANODE-SUPPLY VOLTAGE (DC or Peak AC) . .	500 max.	volts
AVERAGE CATHODE-CURRENT DENSITY°	30 max.	μamp/sq. in. ←
AVERAGE CATHODE CURRENT°	5 max.	μamp
AMBIENT TEMPERATURE	100 max.	°C

Characteristics, *At 250 Volts on Anode:*

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4200 angstroms	–	0.0018	–	μamp/μwatt ←
Luminous▲	4	6.5	15	μamp/lumen
Anode Dark Current at 25°C	–	–	0.005	μamp

* On plane perpendicular to indicated direction of incident light.

° Averaged over any interval of 30 seconds maximum.

▲ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 250 volts, a 1-megohm load resistor, and a light input of 0.1 lumen are used.

← Indicates a change.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

926

RCA

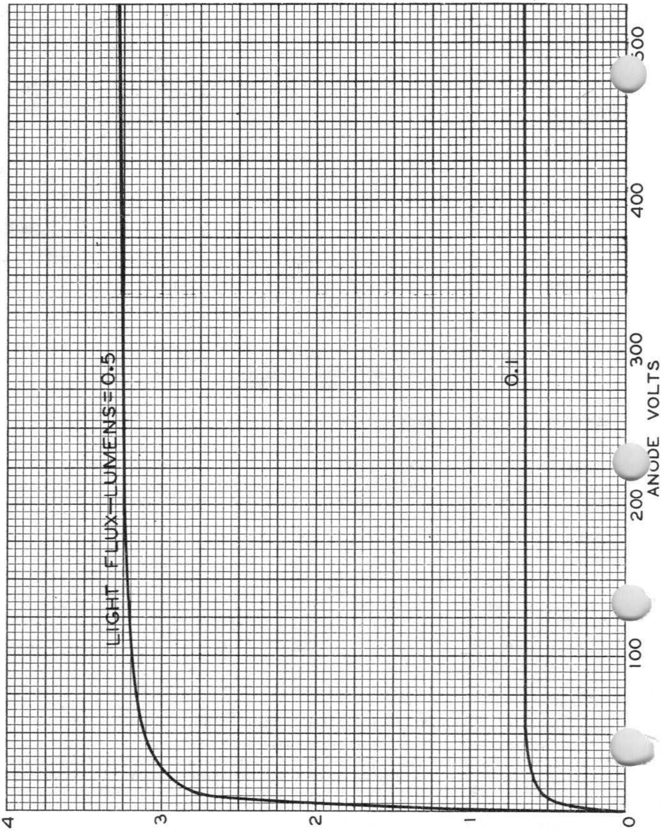
926

VACUUM PHOTOTUBE

DIMENSIONAL OUTLINE
for Type 926 is the same as that shown for Type 921

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-3 Response
is shown at the front of this Section

AVERAGE ANODE CHARACTERISTICS



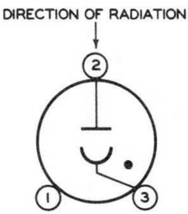
Gas Phototube

SIDE-ON TYPE HAVING S-1 RESPONSE

DATA

General:

Spectral Response S-1
Wavelength of Maximum Response. . . . . 8000 ± 1000 angstroms
Cathode:
  Shape . . . . Semicylindrical
  Minimum projected length[a] . . . . 11/16"
  Minimum projected width[a]. . . . . 7/16"
Direct Interelectrode Capacitance (Approx.) . . . . 2 $\mu\mu$f
Maximum Overall Length. . . . . 2-13/32"
Maximum Seated Length . . . . 1-15/16"
Seated Length to Center of Cathode. . . . . . 1-1/4" ± 3/32"
Maximum Diameter. . . . . 0.669"
Operating Position. . . . . Any
Weight (Approx.). . . . . 0.3 oz ←
Bulb. T5-1/4
Socket. . . . . .Amphenol No.78S3S-T, or equivalent ←
Base. . . . . .Small-Shell Peewee 3-Pin (JEDEC No.A3-1)
  Basing Designation for BOTTOM VIEW. 2F



Pin 1 - No Internal Connection

Pin 2 - Anode

Pin 3 - Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	70 max.	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b].	60 max.	30 max.	μa/sq.in.
AVERAGE CATHODE CURRENT[b]. . .	4 max.	2 max.	μa
AMBIENT TEMPERATURE	100 max.	100 max.	^{o}C

Characteristics: ←

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 8000 angstroms	–	0.012	–	amp/watt

← Indicates a change.

	Min.	Median	Max.	
Luminous:[c]				
At 0 cps.	75	125	185	μa/lumen
At 5000 cps	–	110	–	μa/lumen
At 10000 cps.	–	100	–	μa/lumen
Gas Amplification Factor[d] . .	–	–	10	
Anode Dark Current at 25° C .	–	–	0.1	μa

Minimum Circuit Values:

With an anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 2 μa.	0.1 min.	–	megohm
For dc currents below 2 μa.	0 min.	–	megohm
For dc currents above 1 μa.	–	2.5 min.	megohms
For dc currents below 1 μa.	–	0.1 min.	megohm

[a] On plane perpendicular to indicated direction of radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

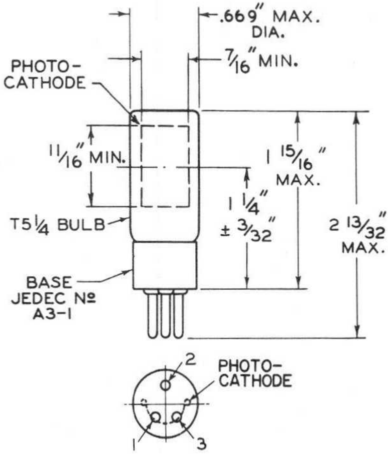
[d] The ratio of luminous sensitivity at an anode-supply voltage of 90 volts to luminous sensitivity at an anode-supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE

and

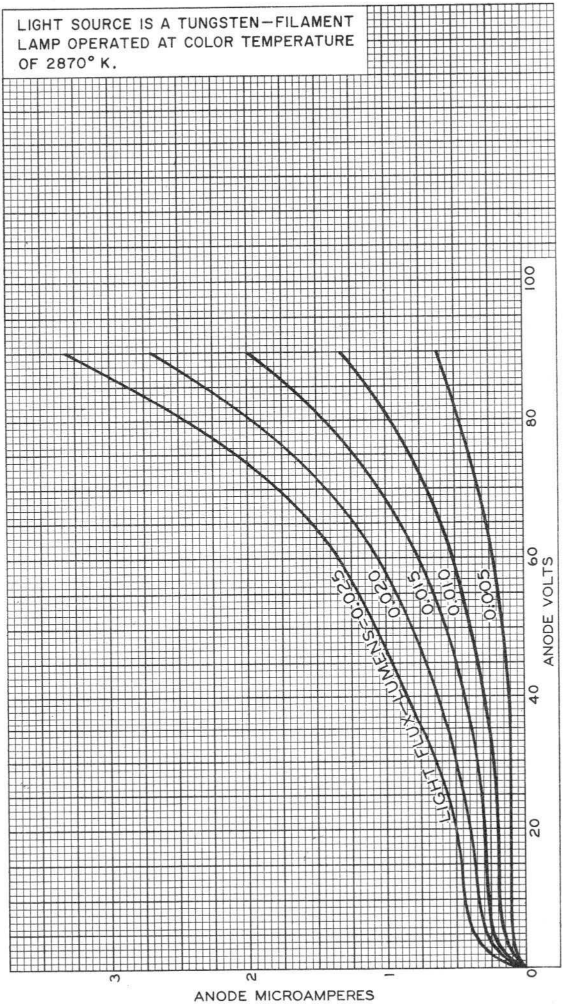
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section


.669" MAX. DIA.
7/16" MIN.
PHOTO-CATHODE
11/16" MIN.
1 15/16" MAX.
1 1/4" ± 3/32"
2 13/32" MAX.
T5 1/4 BULB
BASE JEDEC № A3-1
2
PHOTO-CATHODE
1
3

92CM-6053R5

AVERAGE ANODE CHARACTERISTICS



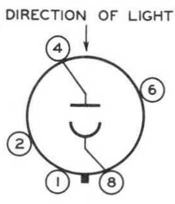
Vacuum Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	13/16"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	2.6 μμf
Maximum Overall Length	3-1/16"
Maximum Seated Length	2-1/2"
Seated Length to Center of Cathode	1-5/8" ± 3/32"
Maximum Diameter	1-9/32"
Operating Position	Any
Weight (Approx.)	0.9 oz ←
Bulb	T9
Socket	Cinch No.8 JM-1, or equivalent ←
Base	Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No.B5-10) ←
Basing Designation for BOTTOM VIEW	3J



Pin 1 – No Internal Connection
Pin 2 – No Internal Connection
Pin 4 – Anode
Pin 6 – No Internal Connection
Pin 8 – Cathode

Maximum Ratings, *Absolute-Maximum Values:* ←

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	250 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	25 max.	μa/sq.in.
AVERAGE CATHODE CURRENT[b]	5 max.	μa
AMBIENT TEMPERATURE	75 max.	°C

Characteristics: ←

With an anode-supply voltage of 250 volts

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4000 angstroms	–	0.044	–	amp/watt
Luminous[c]	25	45	70	μa/lumen
Anode Dark Current at 25° C.	–	–	0.0125	μa

← Indicates a change.

[a] On plane perpendicular to indicated direction of radiation.

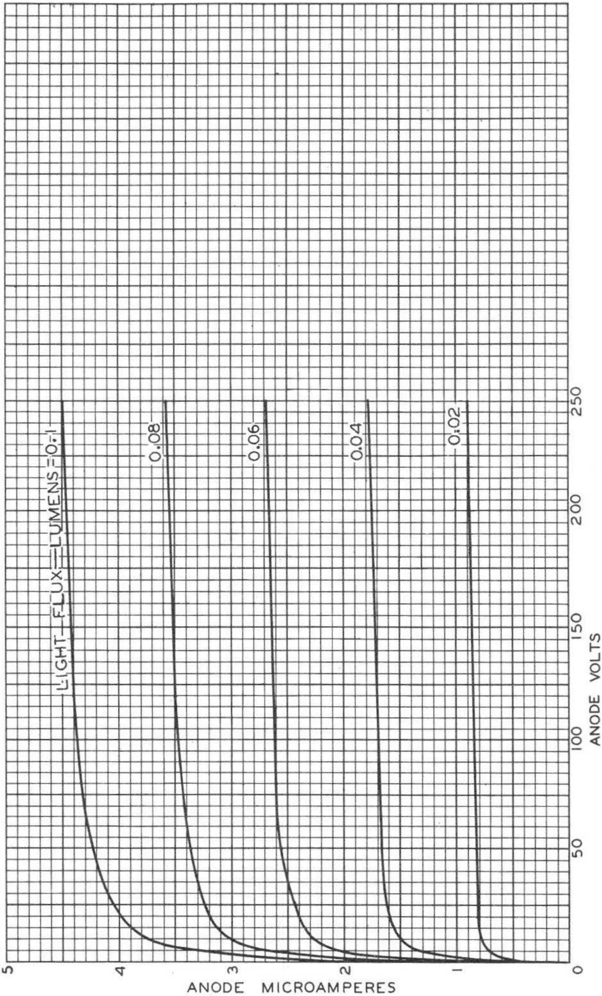
[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE
is shown at the front of this section

DIMENSIONAL OUTLINE
shown under Type 5581 also applies to the 929

AVERAGE ANODE CHARACTERISTICS



92CM–6151R1

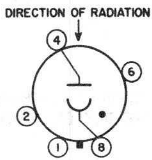
Gas Phototube

SIDE-ON TYPE HAVING S-1 RESPONSE

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	13/16"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	2.4 $\mu\mu$f
Maximum Overall Length	3-1/16"
Maximum Seated Length	2-1/2"
Seated Length to Center of Cathode	1-5/8" ± 3/32"
Maximum Diameter	1-9/32"
Operating Position	Any
Weight (Approx.)	0.9 oz
Bulb	T9
Socket	Cinch No.8JM-1, or equivalent ←
Base	Intermediate-Shell Octal 5-Pin Arrangement 1, (JEDEC No.B5-10)
Basing Designation for BOTTOM VIEW	3J



Pin 1 - No Connection
Pin 2 - No Connection
Pin 4 - Anode
Pin 6 - No Connection
Pin 8 - Photocathode

Maximum Ratings, ***Absolute-Maximum Values:***

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC)	70 max.	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	60 max.	30 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	6 max.	3 max.	μa
AMBIENT TEMPERATURE	100 max.	100 max.	^{o}C

Characteristics:

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 8000 angstroms	-	0.013	-	amp/watt ←

← Indicates a change.

	Min.	Median	Max.	
Luminous:[c]				
At 0 cps.	90	135	205	μa/lumen
At 5000 cps	–	111	–	μa/lumen
At 10000 cps.	–	101	–	μa/lumen
Gas Amplification Factor[d] . . .	–	–	10	
Anode Dark Current at 25° C . .	–	–	0.1	μa

Minimum Circuit Values:

With an anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 3 μa. .	0.1 min.	–	megohm
For dc currents below 3 μa. .	0 min.	–	megohms
For dc currents above 2 μa. .	–	2.5 min.	megohms
For dc currents below 2 μa. .	–	1 min.	megohm

[a] On plane perpendicular to indicated direction of incident radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE

and

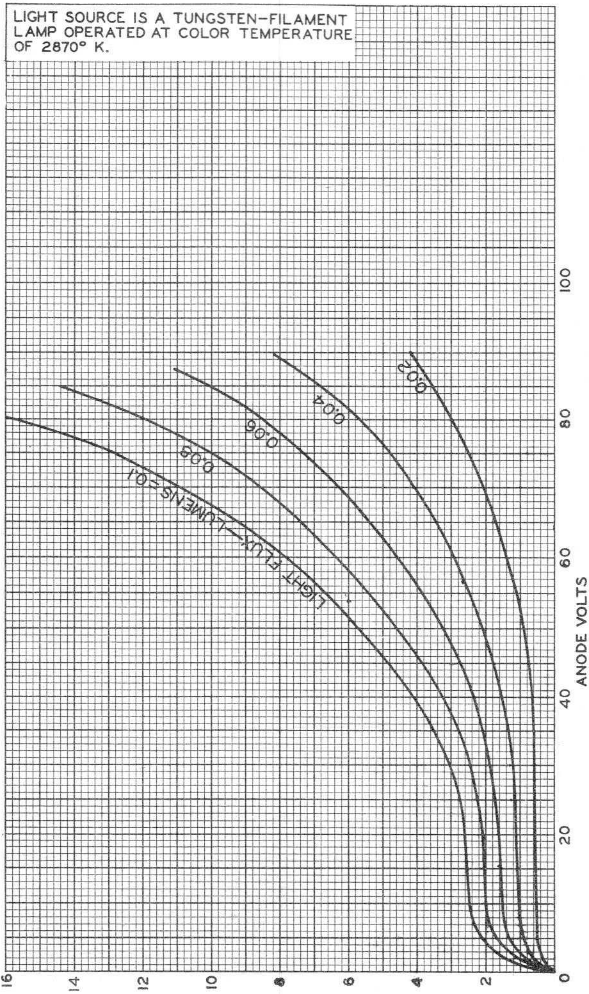
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section

DIMENSIONAL OUTLINE

shown under Type 5581 also applies to the 930

AVERAGE ANODE CHARACTERISTICS



92CM-4806R2

Photomultiplier Tube

9-Stage, Side-On Type Having S-4 Spectral Response

For general purpose applications in low-light level detection and measurement systems.

GENERAL

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode, Opaque	Cesium-Antimony
Minimum projected length[a]	0.94 in (2.4 cm)
Minimum projected width[a]	0.31 in (0.8 cm)
Window	Lime Glass (Corning[b] No. 0080), or equivalent
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.9	4.4 pF
Anode to all other electrodes	6.0 pF
Maximum Overall Length	3.68 in (9.3 cm)
Seated Length	3.12 in (7.9 cm)
Maximum Diameter	1.31 in (3.3 cm)
Bulb	T9
Base	Small-Shell Submagnal 11 Pin, (JEDEC Group 2, No. B11-88), Non-hygroscopic
Socket	Amphenol[c] No. 78S11T, or equivalent
Magnetic Shield	Millen[d] No. 80801B, or equivalent
Operating Position	Any
Weight (Approx.)	1.6 oz

MAXIMUM RATINGS, *Absolute-Maximum Values*

DC or Peak AC Supply Voltage:		
Between anode and cathode	1250 max.	V
Between anode and dynode No.9	250 max.	V
Between consecutive dynodes	250 max.	V
Between dynode No.1, and cathode	250 max.	V

Average Anode Current[f] . . . . 1.0 max. mA
Ambient Temperature[g] . . . . +75 max. °C

CHARACTERISTICS RANGE VALUES

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.

With E = 1000 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[h] at 4000 angstroms . . .	–	8.3×10^4	–	A/W
Luminous[i] (2870° K).	10	80	600	A/lm
Cathode Sensitivity:				
Radiant[k] at 4000 angstroms . . .	–	0.04	–	A/W
Luminous[m] (2870° K).	–	4×10^{-5}	–	A/lm
Quantum Efficiency at 3800 angstroms . . .	–	13	–	%
Current Amplification	–	2×10^6	–	
Anode Dark Current[n].	–	5×10^{-9}	5×10^{-8}	A
Equivalent Anode Dark Current Input[n]	–	2.5×10^{-10}	2.5×10^{-9}	lm
	–	2.4×10^{-13}[p]	2.4×10^{-12}[p]	W
Equivalent Noise Input[q]	–	3×10^{-12}	–	lm
	–	2×10^{-15}[r]	–	W
Anode-Pulse Rise Time[s] at 1250 V . .	–	1.6×10^{-9}	–	s
Electron Transit Time[t] at 1250 V.	–	1.6×10^{-8}	–	s

[a] On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

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

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

[d] Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.

[f] Averaged over any interval of 30 seconds maximum.

→ Indicates a change or addition.

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

This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1036 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 1036 lumens per watt.

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 100 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 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

[p] At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1036 lumens per watt.

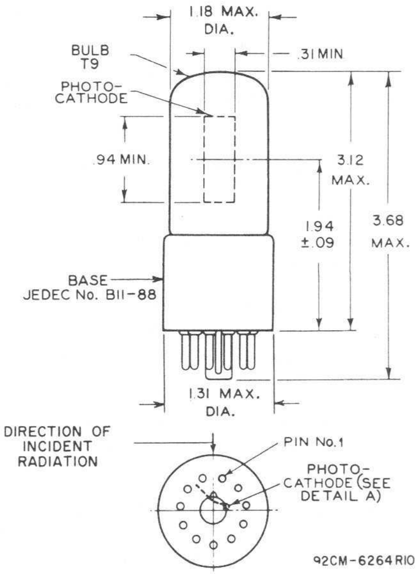
[q] Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1036 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.

† 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.

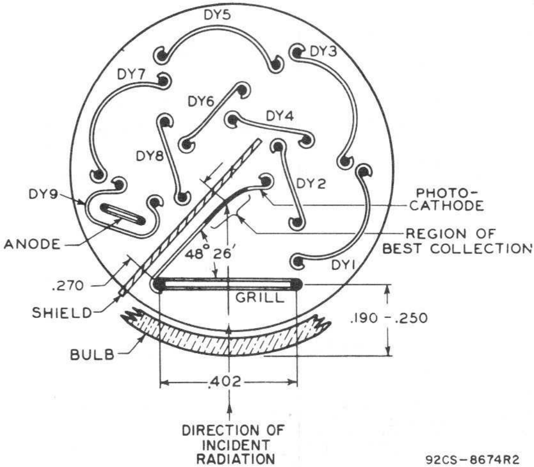
DIMENSIONAL OUTLINE



℄ of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base. Dimensions are in inches unless otherwise stated.

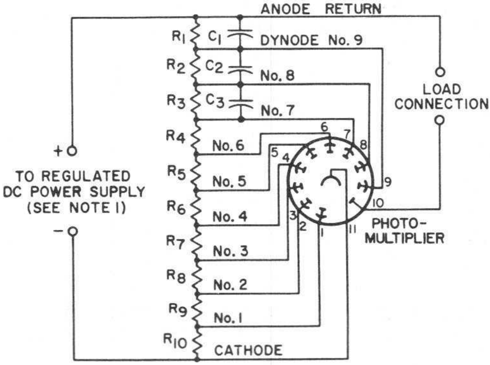
Inch Dimension Equivalents in Millimeters					
Inch	mm	Inch	mm	Inch	mm
.09	2.3	.31	7.9	1.31	33.2
.190	4.8	.402	10.2	1.94	49.2
.250	6.3	.94	23.8	3.12	79.2
.270	6.8	1.18	29.9	3.68	93.4

DETAIL A (Top View)



92CS-8674R2

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



92CS-11382R1

R_1 through R_{10} = 20,000 to 1,000,000 ohms

Note 1: Adjustable between approximately 500 and 1250 volts.

Note 2: Capacitors C_1 through C_3 should be connected at tube socket for optimum high-frequency performance.

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

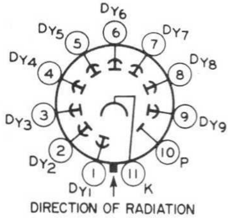
Pin 7: Dynode No.7

Pin 8: Dynode No.8

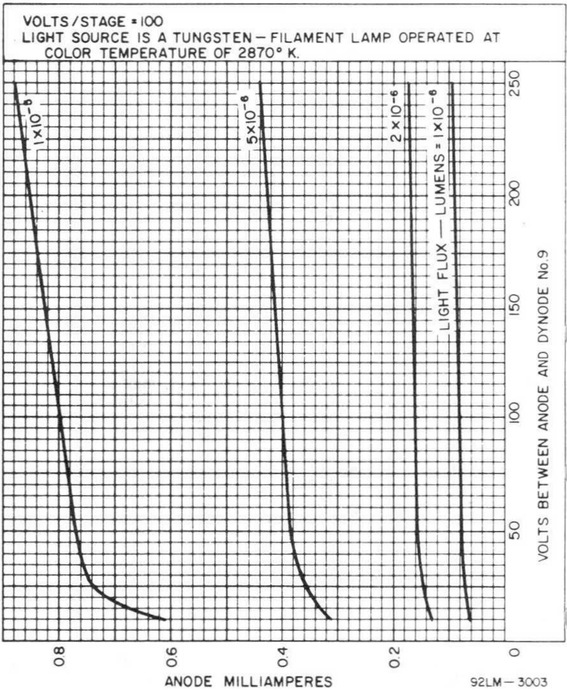
Pin 9: Dynode No.9

Pin 10: Anode

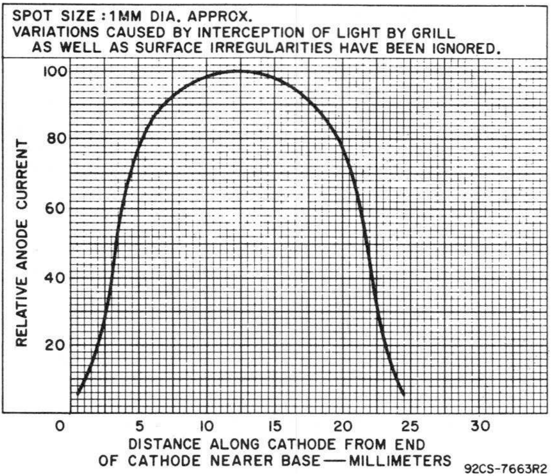
Pin 11: Photocathode



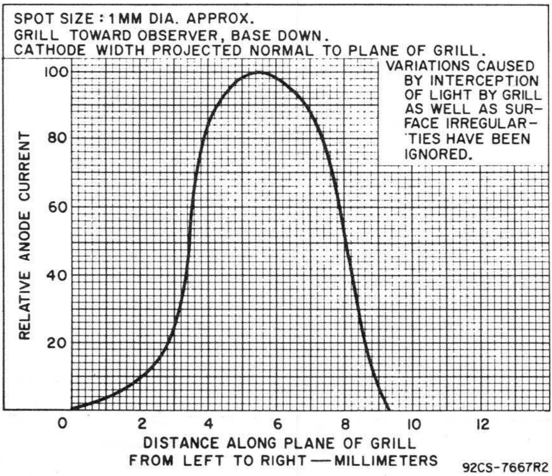
TYPICAL ANODE CHARACTERISTICS



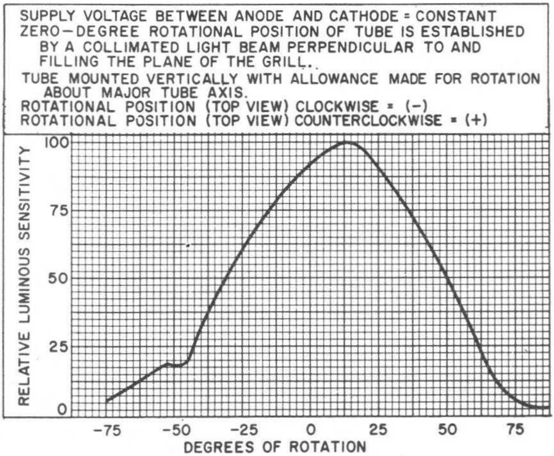
TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ALONG TUBE LENGTH



TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ACROSS PROJECTED WIDTH IN PLANE OF GRILL

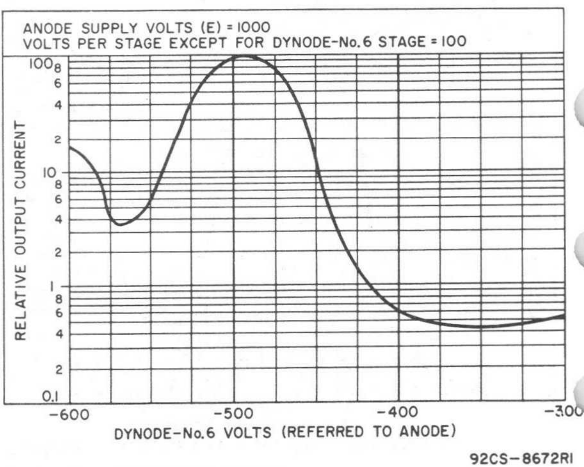


TYPICAL VARIATION OF SENSITIVITY AS TUBE IS ROTATED WITH RESPECT TO FIXED LIGHT BEAM



92CS−8671R2

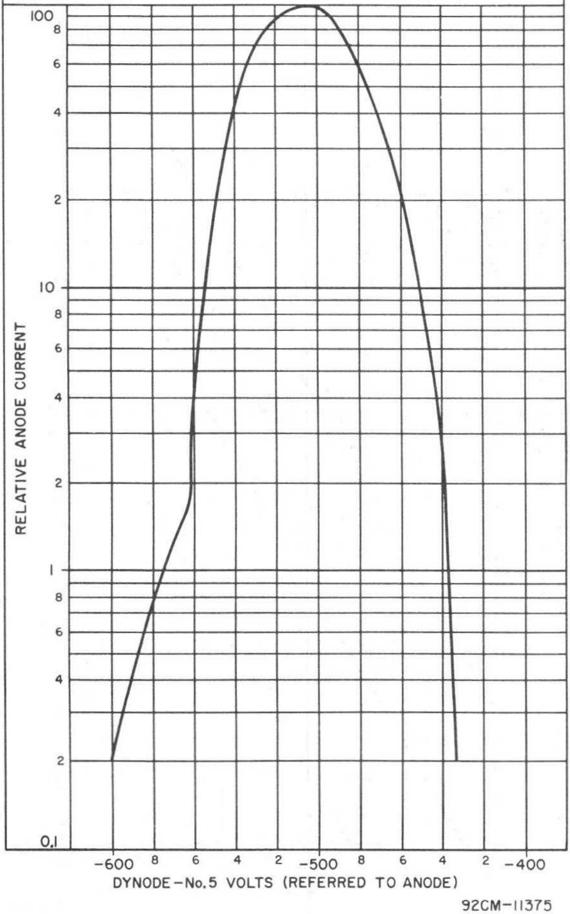
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-NO.6 VOLTS



92CS−8672R1

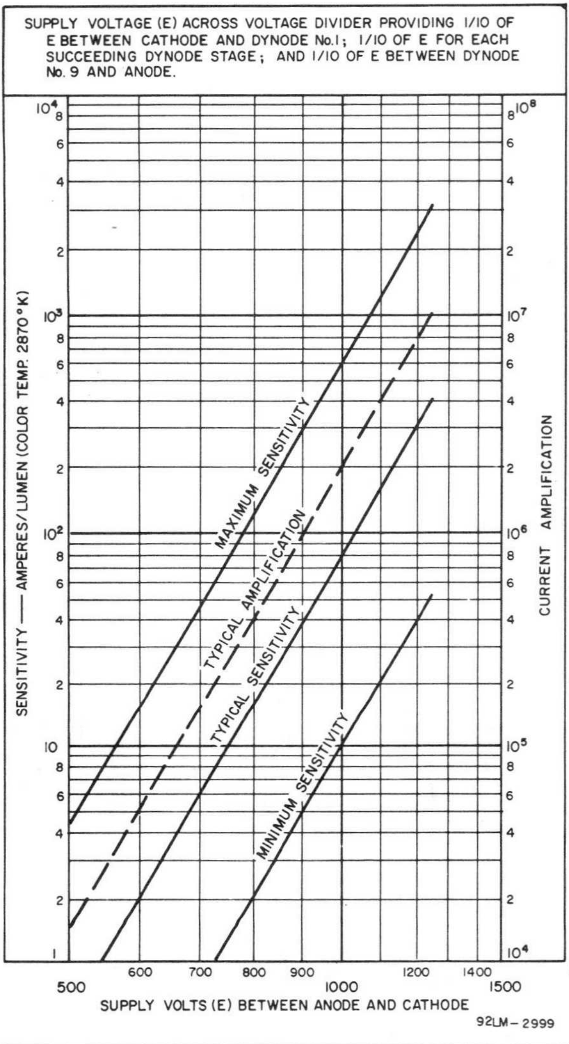
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF SIMULTANEOUS MODULATION OF DYNODES NO.5 AND NO.6

ANODE – TO – DYNODE No. 9 VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODES No. 5 AND No. 6 = 100
A CONSTANT VOLTAGE DIFFERENCE OF 100 VOLTS IS MAINTAINED BETWEEN DYNODES No. 5 AND No. 6 DURING MODULATION.
ANODE IS AT GROUND POTENTIAL.



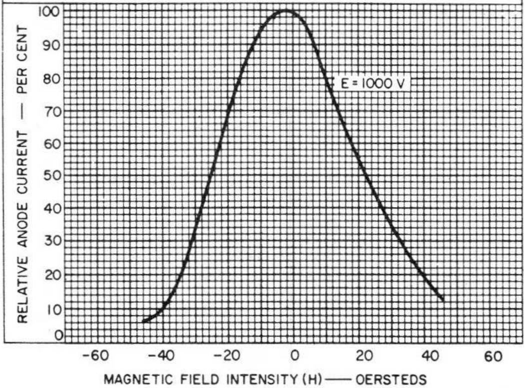
92CM–11375

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

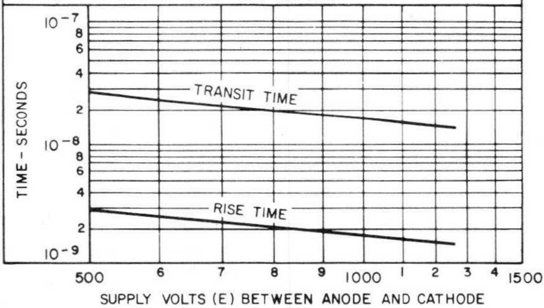
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/10 OF E BETWEEN CATHODE AND DYNODE No. 1; 1/10 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/10 OF E BETWEEN DYNODE No. 9 AND ANODE.
PHOTOCATHODE IS FULLY ILLUMINATED.
UNIFORM MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.
POSITIVE VALUES OF MAGNETIC FLUX ARE FOR LINES OF FORCE TOWARD TUBE BASE.
TUBE IS DEGAUSSED PRIOR TO TEST AND IS AGAIN DEGAUSSED BEFORE FLUX DIRECTION IS CHANGED.



92LS-3001

TYPICAL TIME-RESOLUTION CHARACTERISTICS

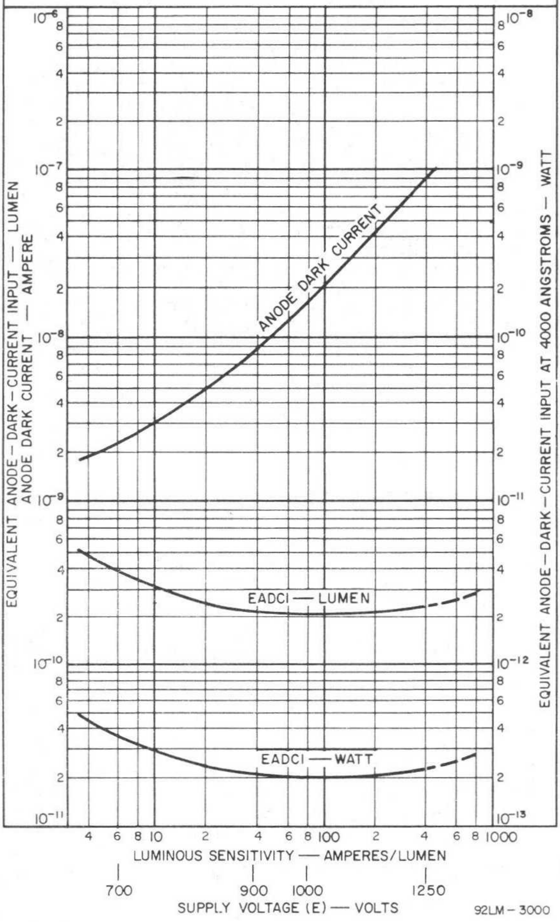
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/10 OF E BETWEEN CATHODE AND DYNODE No. 1; 1/10 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/10 OF E BETWEEN DYNODE No. 9 AND ANODE.
PHOTOCATHODE IS FULLY ILLUMINATED.



92LS-3010

TYPICAL EADCI AND DARK CURRENT CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/10 OF E PER STAGE.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870 °K.
TUBE TEMPERATURE = 22 °C



Vacuum Phototube

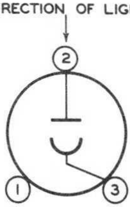
SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	11/16"
Minimum projected width[a]	7/16"
Direct Interelectrode Capacitance (Approx.)	1.5 μμf
Maximum Overall Length	2-13/32"
Maximum Seated Length	1-15/16"
Seated Length to Center of Cathode	1-1/4" ± 3/32"
Maximum Diameter	0.669"
Operating Position	Any
Weight (Approx.)	0.4 oz ←
Bulb	T5-1/4
Socket	Amphenol No.78S3S-T, or equivalent ←
Base	Small-Shell Peewee 3-Pin (JEDEC No.A3-1)
Basing Designation for BOTTOM VIEW	2F

DIRECTION OF LIGHT



Pin 1 – No Internal Connection

Pin 2 – Anode
Pin 3 – Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	250 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	30 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	4 max.	μa
AMBIENT TEMPERATURE	75 max.	°C

Characteristics: ←

With an anode-supply voltage of 250 volts

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4000 angstroms	–	0.029	–	amp/watt
Luminous[c]	19	30	75	μa/lumen
Anode Dark Current at 25° C	–	–	0.005	μa

← Indicates a change.

[a] On plane perpendicular to indicated direction of incident light.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE
is shown at the front of this section

DIMENSIONAL OUTLINE
shown under Type 927 also applies to the 934

AVERAGE ANODE CHARACTERISTICS

92CM—6479R1

Vacuum Phototube

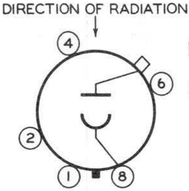
SIDE-ON TYPE HAVING S-5 RESPONSE

DATA

General:

Spectral Response	S-5
Wavelength of Maximum Response	3400 ± 500 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	1-5/16"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	0.6 $\mu\mu$f
Maximum Overall Length	4-1/4"
Seated Length	3-9/16" ± 1/8"
Seated Length to Center of Cathode	2" ± 1/16"
Maximum Diameter	1-9/32"
Operating Position	Any
Weight (Approx.)	1 oz ←
Bulb	T9
Cap	Skirted Miniature (JEDEC No.C1-3) ←
Socket	Cinch No.8JM-1, or equivalent ←
Base	Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No.B5-10) ←
Basing Designation for BOTTOM VIEW	1C

Pin 1 – No Internal Connection
Pin 2 – No Internal Connection
Pin 4 – No Internal Connection



Pin 6 – No Internal Connection
Pin 8 – Photocathode
Cap – Anode

Maximum Ratings, *Absolute-Maximum Values:* ←

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	250 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	30 max.	μa/sq.in.
AVERAGE CATHODE CURRENT[b]	10 max.	μa
AMBIENT TEMPERATURE	75 max.	^{o}C

Characteristics: ←

With an anode-supply voltage of 250 volts

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 3400 angstroms	–	0.043	–	amp/watt
Luminous[c]	18	35	70	μa/lumen
Anode Dark Current at 25° C.	–	–	0.0005	μa

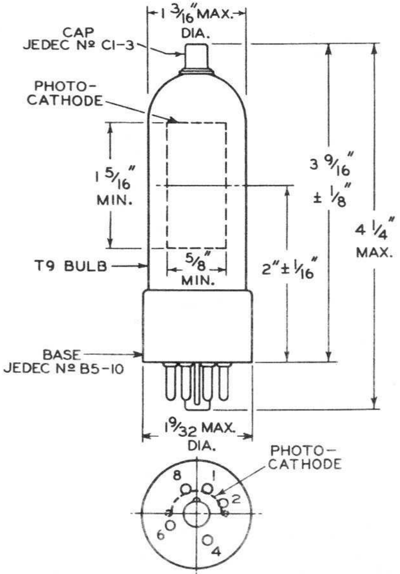
← Indicates a change.

[a] On plane perpendicular to indicated direction of radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-5 RESPONSE
is shown at the front of this section



92CM-6411R5

Multiplier Phototube

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

GENERAL

Spectral Response S-11
Wavelength of Maximum Response . . . . 4400 ± 500 Å
Cathode, Semitransparent . . . . Cesium-Antimony with High-Conductivity Grating
  Area including grating . . . . 1.8 in^2 (11.6 cm^2)
  Minimum diameter . . . . 1.5 in (3.8 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 ± 0.19 in (12.4 ± 0.48 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.	µA
Ambient Temperature[g]	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. 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° K)[i]	2.5	6	75	A/lm
Cathode Sensitivity:				
Radiant[k] at 4400 angstroms . .	–	0.04	–	A/W
Luminous (2870° K)[m]	3×10^{-5}	5×10^{-5}	–	A/lm
Current with blue light source (2870° 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]	–	2×10^{-10}	2.25×10^{-9}	lm
	–	2.5×10^{-13}[q]	2.8×10^{-12}[q]	W
Equivalent Noise Input[r]	–	5.6×10^{-12}	1.9×10^{-11}	lm
	–	7×10^{-15}[s]	2.3×10^{-14}[s]	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.

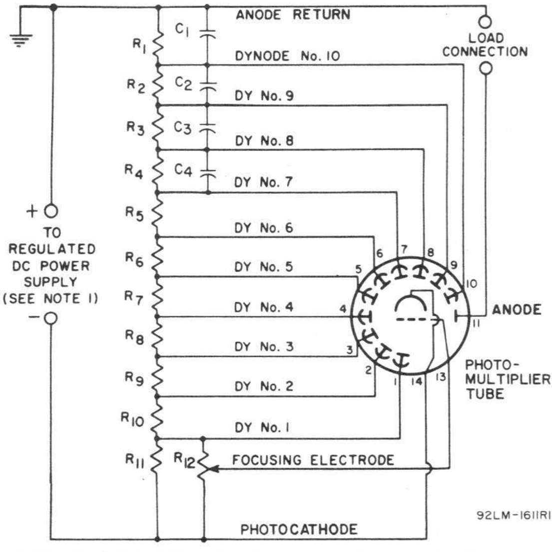
[p] At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

[q] At 4400 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 804 lumens per watt.

[r] 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.

[s] 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

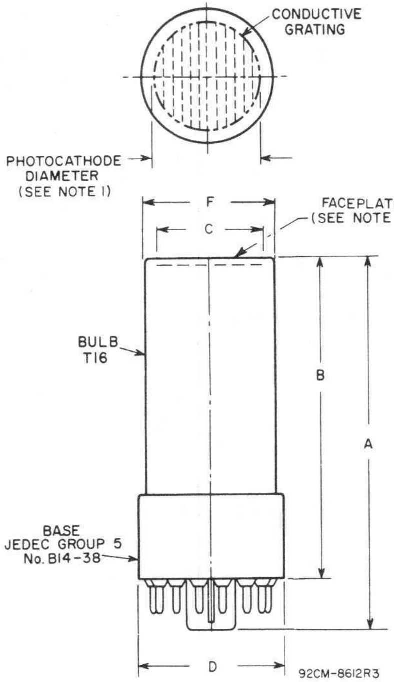


C_1: 0.05 μF, 20%, 500 volts (dc working), ceramic disc
C_2: 0.02 μF, 20%, 500 volts (dc working), ceramic disc
C_3: 0.01 μF, 20%, 500 volts (dc working), ceramic disc
C_4: 0.005 μF, 20%, 500 volts (dc working), ceramic disc
R_1 through R_{10}: 390,000 ohms, 5%, 1/2 watt
R_{11}: 910,000 ohms, 5%, 1/2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

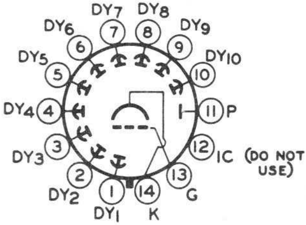
Note 1: The grating consists of 12 equally spaced conductive strips having a maximum width of 0.02" (0.5 mm).

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 ± .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 ± .06 dia.	50.8 ± 1.5 dia.

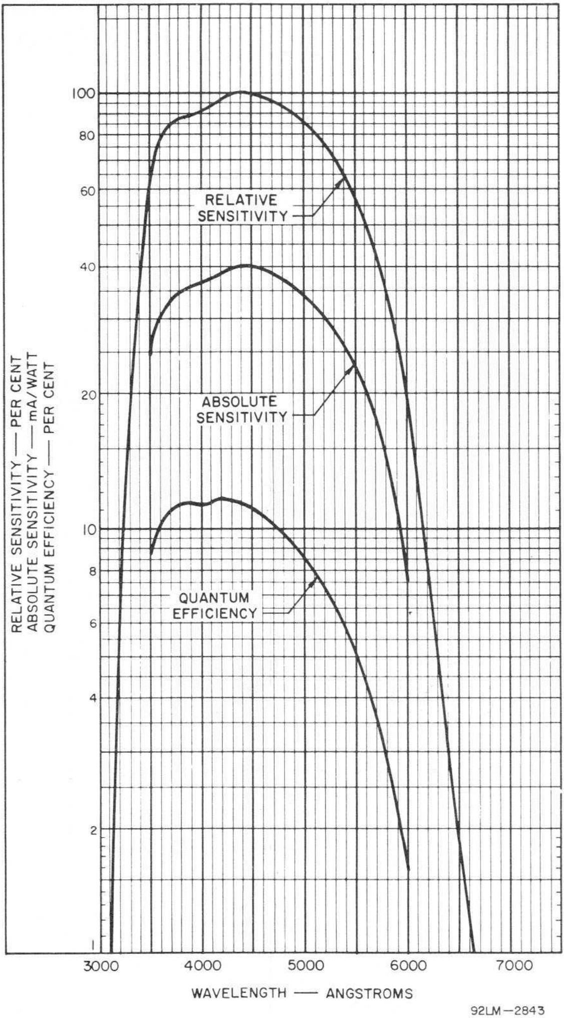
TERMINAL DIAGRAM (Bottom View)



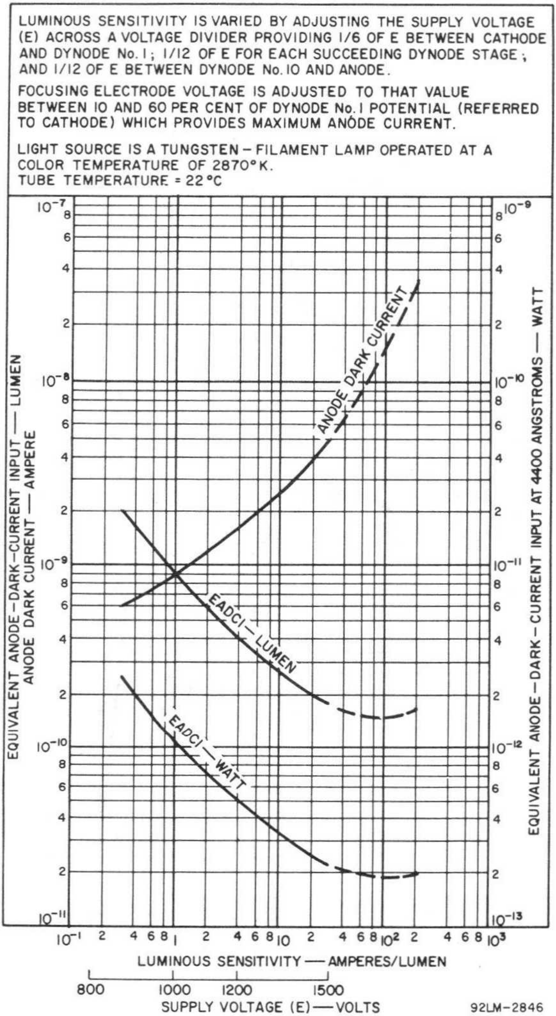
DIRECTION OF RADIATION:
INTO END OF BULB

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

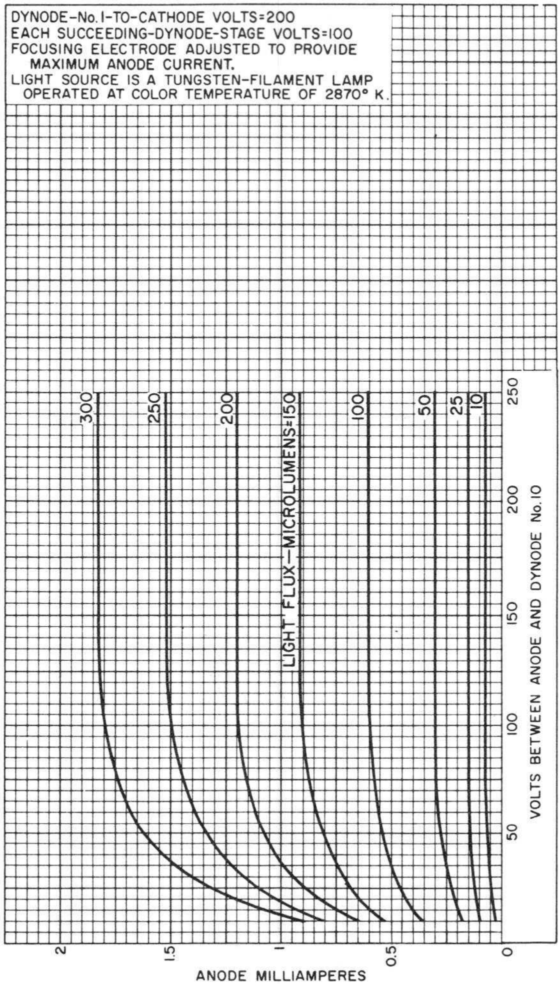
Typical Spectral Response Characteristics



Typical EADCI and Anode Dark Current Characteristics

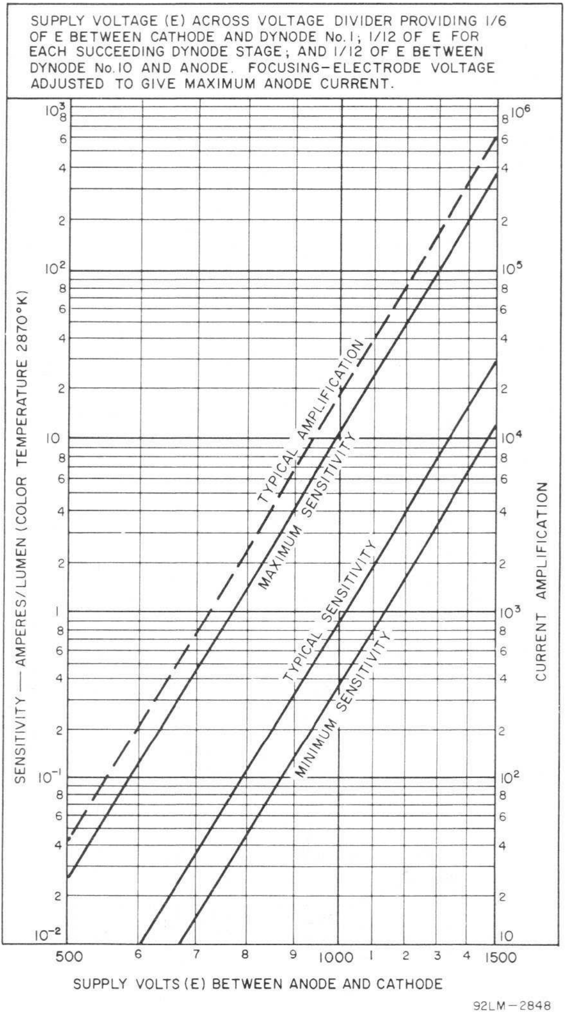


Typical Anode Characteristics

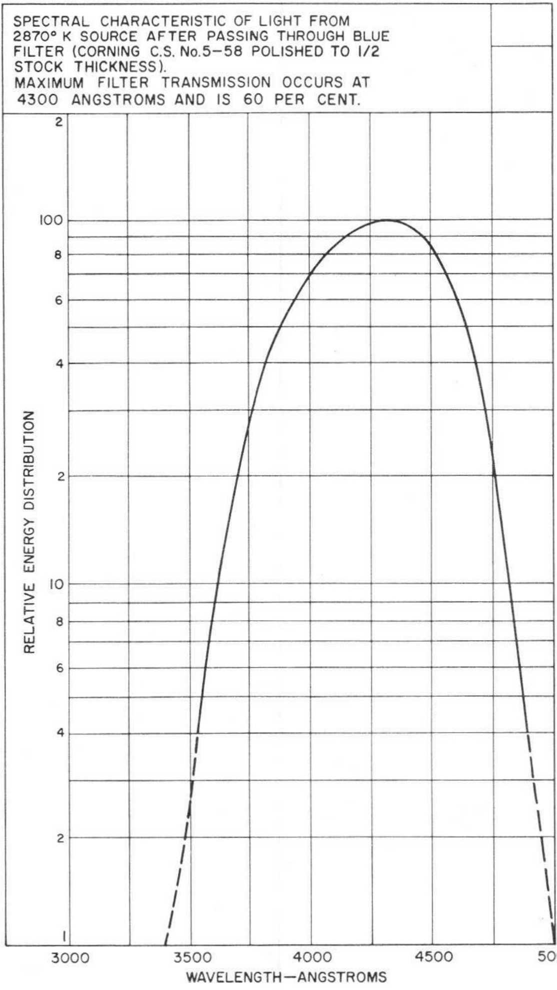


92CM-8641R2

Sensitivity and Current Amplification Characteristics

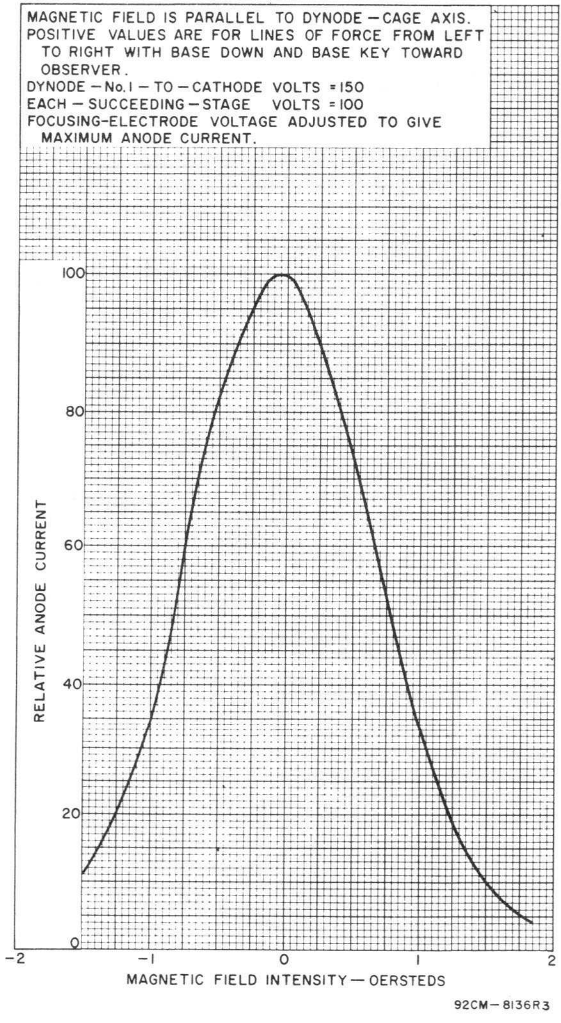


Spectral Energy Distribution of 2870° K Light Source After Passing Through Indicated Filter



92CM—11081R1

Typical Effect of Magnetic Field on Anode Current



Photomultiplier Tube

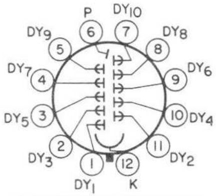
10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-11 RESPONSE
1.24 INCH MINIMUM DIAMETER FLAT PHOTOCATHODE

For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources

The 2060 *is identical to type* 6199 *in all respects except that it is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the* 2060 *in a given system.*

BASING DIAGRAM (Bottom View)
With Base Attached

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

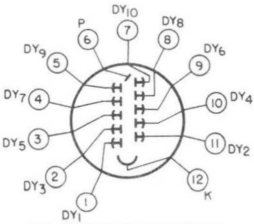


DIRECTION OF RADIATION:
INTO END OF BULB

12AE

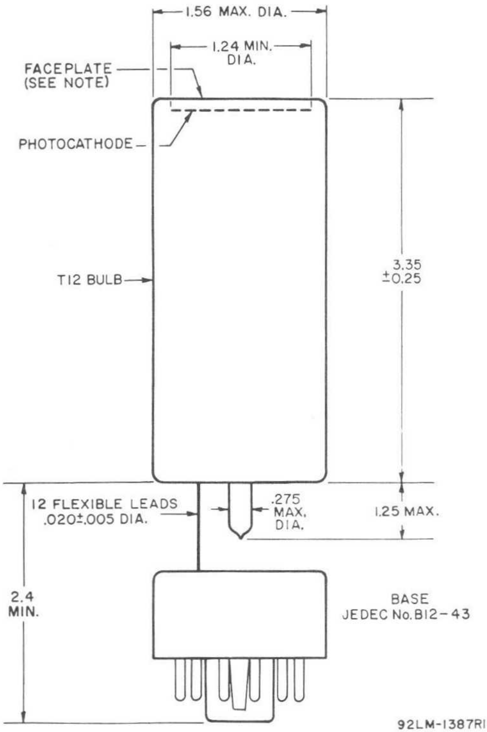
TERMINAL CONNECTIONS (Bottom View)
With Base Removed

Lead 1 – Dynode No.1
Lead 2 – Dynode No.3
Lead 3 – Dynode No.5
Lead 4 – Dynode No.7
Lead 5 – Dynode No.9
Lead 6 – Anode
Lead 7 – Dynode No.10
Lead 8 – Dynode No.8
Lead 9 – Dynode No.6
Lead 10 – Dynode No.4
Lead 11 – Dynode No.2
Lead 13 – Photocathode



DIRECTION OF RADIATION:
INTO END OF BULB

DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note: Within 1.24-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010-inch from peak to valley.

Photomultiplier Tube

S-11 RESPONSE
10-STAGE, HEAD-ON, FLAT-FACEPLATE

ELECTROSTATICALLY FOCUSED
DYNODE STAGES

For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Scintillation Counters

The **2061** *is electrically similar to type* **6342A** *except for the following performance characteristic and that the anode luminous sensitivity and equivalent noise input ratings shown for the* **6342A** *do not apply for type* **2061**.

The 2061 is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2061 should be removed prior to installing the tube in a given system.

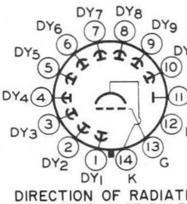
PERFORMANCE CHARACTERISTIC

Minimum Pulse Height[a]	0.13	V

[a] Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5%-kilohm resistor and a total capacitance of 92 ± 3% pF in parallel. An anode-to-cathode voltage of 1130 volts is applied across a voltage-divider network having a 1.5 ± 5% megohm resistor between cathode and dynode No. 1, 450 ± 5%—kilohm resistors between each succeeding stage including dynode No. 10 to anode. The focusing electrode is adjusted to that value between 0% and 60% of dynode No. 1 potential (referred to cathode) which will provide maximum anode current. The 662-KeV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 2 inch x 2 inch thallium-activated sodium-iodide scintillator [NaI(Tl)] type 8D8, or equivalent are used. The scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, Ohio. The Cs^{137} is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 2061 by a coupling fluid such as Dow Corning Corp., Type DC200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

BASING DIAGRAM (Bottom View)
With Base Attached

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 – Focusing Electrode
Pin 14 – Photocathode

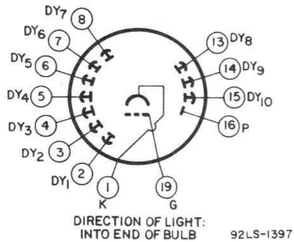


DIRECTION OF RADIATION: INTO END OF BULB

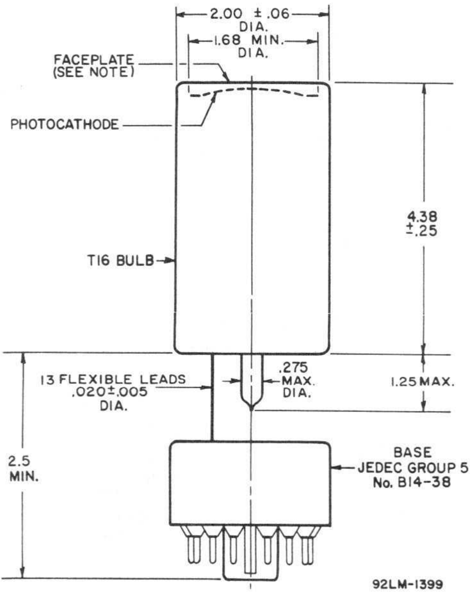
TERMINAL CONNECTIONS (Bottom View)

With Base Removed

Lead 1 – Photocathode
Lead 2 – Dynode No.1
Lead 3 – Dynode No.2
Lead 4 – Dynode No.3
Lead 5 – Dynode No.4
Lead 6 – Dynode No.5
Lead 7 – Dynode No.6
Lead 8 – Dynode No.7
Lead 13 – Dynode No.8
Lead 14 – Dynode No.9
Lead 15 – Dynode No.10
Lead 16 – Anode
Lead 19 – Focusing Electrode



DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note: Within 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

Photomultiplier Tube

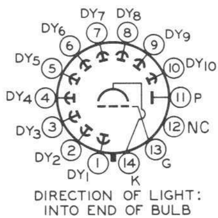
10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-11 RESPONSE
1.68 INCH MINIMUM DIAMETER CURVED PHOTOCATHODE

For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources

The 2062 *is identical to type* 6655A *in all respects except that it is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the* 2062 *in a given system.*

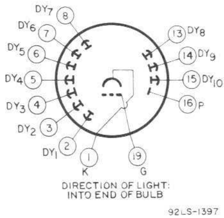
BASING DIAGRAM (Bottom View)
With Base Attached

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 – Focusing Electrode
Pin 14 – Photocathode

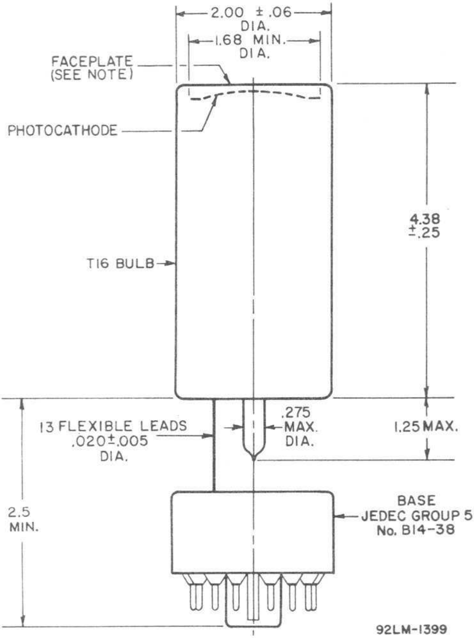


TERMINAL CONNECTIONS (Bottom View)
With Base Removed

Lead 1 – Photocathode
Lead 2 – Dynode No.1
Lead 3 – Dynode No.2
Lead 4 – Dynode No.3
Lead 5 – Dynode No.4
Lead 6 – Dynode No.5
Lead 7 – Dynode No.6
Lead 8 – Dynode No.7
Lead 13 – Dynode No.8
Lead 14 – Dynode No.9
Lead 15 – Dynode No.10
Lead 16 – Anode
Lead 19 – Focusing Electrode



DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note: Within 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010-inch from peak to valley.

Photomultiplier Tube

10-STAGE, HEAD-ON FLAT-FACEPLACE TYPE HAVING VENETIAN-BLIND-TYPE DYNODE STRUCTURE, 1.68-INCH MINIMUM-DIAMETER, FLAT, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE

For Use in Scintillation Counting Applications

The **2063** *is electrically similar to type* **8053** *except for the following performance characteristics and that the anode luminous sensitivity and equivalent noise input ratings shown for the* **8053** *do not apply for type* **2063**.

The 2063 is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2063 should be removed prior to installing the tube in a given system.

PERFORMANCE CHARACTERISTICS

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. The focusing electrode is adjusted to that value between 50% and 100% of dynode No. 1 potential (referred to cathode) which will provide maximum anode current.

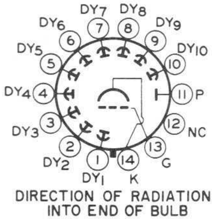
Maximum Anode Dark Current[a]	0.05	μA
Minimum Pulse Height[b]	0.13	V

[a] Measured under the following conditions: Light incident on the photocathode 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, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The light flux incident on the filter is 10 microlumens. The supply voltage is adjusted to obtain an anode current of 9 μA. Dark current is measured with the light source removed.

[b] Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5%-kilohm resistor and a total capacitance of 92 ± 3% pF in parallel. An anode-to-cathode voltage of 1130 volts is applied across a voltage divider network having a 1.5 ± 5%—megohm resistor between cathode and dynode No. 1, 450 ± 5%—kilohm resistors between each succeeding stage including dynode No. 10 to anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode No. 1 potential (referred to cathode) which will provide maximum anode current. The 662-KeV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 2 inch x 2 inch thallium-activated sodium-iodide scintillator [NaI(Tl)] type 8D8, or equivalent are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, Ohio. The Cs^{137} is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 2063 by a coupling fluid such as Dow Corning Corp., Type DC200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

BASING DIAGRAM (Bottom View) With Base Attached

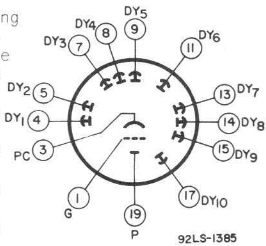
Pin 1 – Dynode No. 1
Pin 2 – Dynode No. 2
Pin 3 – Dynode No. 3
Pin 4 – Dynode No. 4
Pin 5 – Dynode No. 5
Pin 6 – Dynode No. 6
Pin 7 – Dynode No. 7



Pin 8 – Dynode No. 8
Pin 9 – Dynode No. 9
Pin 10 – Dynode No. 10
Pin 11 – Anode
Pin 12 – No Connection
Pin 13 – Focusing Electrode
Pin 14 – Photocathode

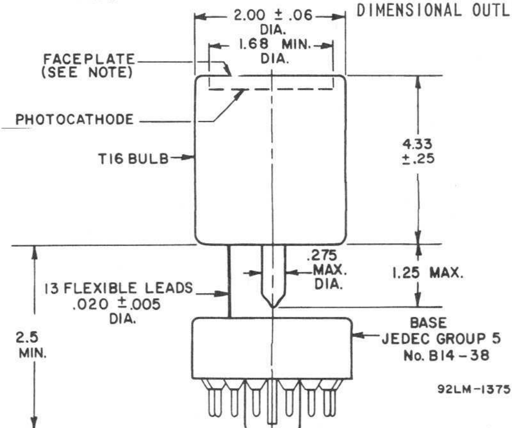
TERMINAL CONNECTIONS (Bottom View) With Base Removed

Lead 1 – Focusing
Lead 3 – Photocathode
Lead 4 – Dynode No. 1
Lead 5 – Dynode No. 2
Lead 7 – Dynode No. 3
Lead 8 – Dynode No. 4
Lead 9 – Dynode No. 5



Lead 11 – Dynode No. 6
Lead 13 – Dynode No. 7
Lead 14 – Dynode No. 8
Lead 15 – Dynode No. 9
Lead 17 – Dynode No. 10
Lead 19 – Anode

DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note: Within 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLACE TYPE HAVING VENETIAN-BLIND-TYPE DYNODE STRUCTURE, 2.59-INCH MINIMUM-DIAMETER, FLAT, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE

For Use in Scintillation Counting Applications

The **2064B** *is electrically similar to type* **8054** *except for the following performance characteristics and that the anode luminous sensitivity and equivalent noise input ratings shown for the* **8054** *do not apply for type* **2064B**.

The 2064B is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2064B should be removed prior to installing the tube in a given system.

PERFORMANCE CHARACTERISTICS

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. The focusing electrode is adjusted to that value between 50% and 100% of dynode-No. 1 potential (referred to cathode) which will provide maximum anode current.

Maximum Anode Dark Current[a]	0.05	μA
Minimum Pulse Height[b]	0.18	V

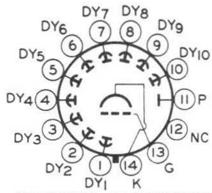
[a] Measured under the following conditions: Light incident on the photocathode is transmitted through a blue filter (Corning C.S. No. 5-58, polished to 1/2 stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The light flux incident on the filter is 10 microlumens. The supply voltage is adjusted to obtain an anode current of 9 μA. Dark current is measured with the light source removed.

[b] Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5%-kilohm resistor and a total capacitance of 92 ± 3% pF in parallel. An anode-to-cathode voltage of 1130 volts is applied across a voltage-divider network having a 1.5 ± 5%-megohm resistor between cathode and dynode No. 1, 450 ± 5%-kilohm resistors between each succeeding stage including dynode No. 10 to anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode No. 1 potential (referred to cathode) which will provide maximum anode current. The 662-KeV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 3 inch x 3 inch thallium-activated sodium-iodide scintillator [NaI(Tl)] type 12A12, or equivalent are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, Ohio. The Cs^{137} is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 2064B by a coupling fluid such as Dow Corning Corp., Type DC200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

BASING DIAGRAM (Bottom View)

With Base Attached

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 – Focusing Electrode
Pin 14 – Photocathode

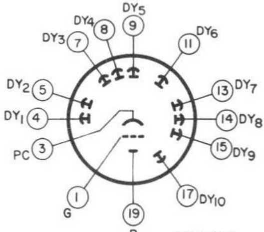


DIRECTION OF RADIATION: INTO END OF BULB

TERMINAL CONNECTIONS (Bottom View)

With base Removed

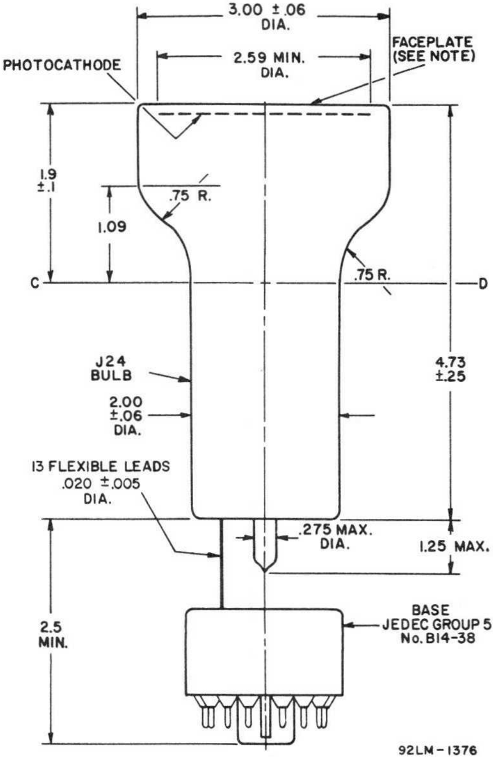
Lead 1 – Focusing Electrode
Lead 3 – Photocathode
Lead 4 – Dynode No.1
Lead 5 – Dynode No.2
Lead 7 – Dynode No.3
Lead 8 – Dynode No.4
Lead 9 – Dynode No.5
Lead 11 – Dynode No.6
Lead 13 – Dynode No.7
Lead 14 – Dynode No.8
Lead 15 – Dynode No.9
Lead 17 – Dynode No.10
Lead 19 – Anode



92LS-1385

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

DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note: Within 2.59-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING VENETIAN-BLIND-TYPE DYNODE STRUCTURE, 4.38-INCH MINIMUM DIAMETER, FLAT, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE

For Use in Scintillation Counting Applications

The **2065** *is electrically similar to type* **8055** *except for the following performance characteristics and that the anode luminous sensitivity and equivalent noise input ratings shown for the* **8055** *do not apply for type* **2065**.

The 2065 is supplied with a medium-shell diheptal base attached to flexible leads to facilitate testing. After testing, the attached base of the 2065 should be removed prior to installing the tube in a given system.

PERFORMANCE CHARACTERISTICS

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. The focusing electrode is adjusted to that value between 50% and 100% of dynode-No. 1 potential (referred to cathode) which will provide maximum anode current.

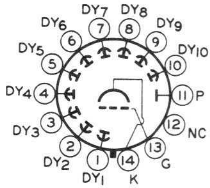
Maximum Anode Dark Current[a]	0.05	μA
Minimum Pulse Height[b]	0.13	V

[a] Measured under the following conditions: Light incident on the photocathode 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, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The light flux incident on the filter is 10 microlumens. The supply voltage is adjusted to obtain an anode current of 9 μA. Dark current is measured with the light source removed.

[b] Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 ± 5%-kilohm resistor and a total capacitance of 92 ± 3% pF in parallel. An anode-to-cathode voltage of 1130 volts is applied across a voltage-divider network having a 1.5 ± 5%-megohm resistor between cathode and dynode No. 1, 450 ± 5%-kilohm resistors between each succeeding stage including dynode No. 10 to anode. The focusing electrode is adjusted to that value between 50% and 100% of dynode No. 1 potential (referred to cathode) which will provide maximum anode current. The 662-KeV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 3 inch x 3 inch thallium-activated sodium-iodide scintillator [NaI(Tl)] type 12A12, or equivalent are used. This scintillator is manufactured by Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, Ohio. The Cs137 is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 2065 by a coupling fluid such as Dow Corning Corp., Type DC200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

BASING DIAGRAM (Bottom View)
With Base Attached

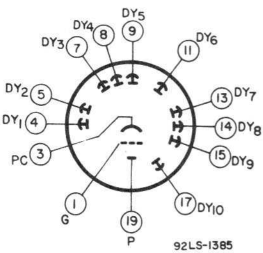
Pin 1 – Dynode No.1
Pin 2 – Dynode No.2
Pin 3 – Dynode No.3
Pin 4 – Dynode No.4
Pin 5 – Dynode No.5
Pin 6 – Dynode No.6
Pin 7 – Dynode No.7
Pin 8 – Dynode No.8
Pin 9 – Dynode No.9
Pin 10 – Dynode No.10
Pin 11 – Anode
Pin 12 – No Connection
Pin 13 – Focusing Electrode
Pin 14 – Photocathode



DIRECTION OF RADIATION:
INTO END OF BULB

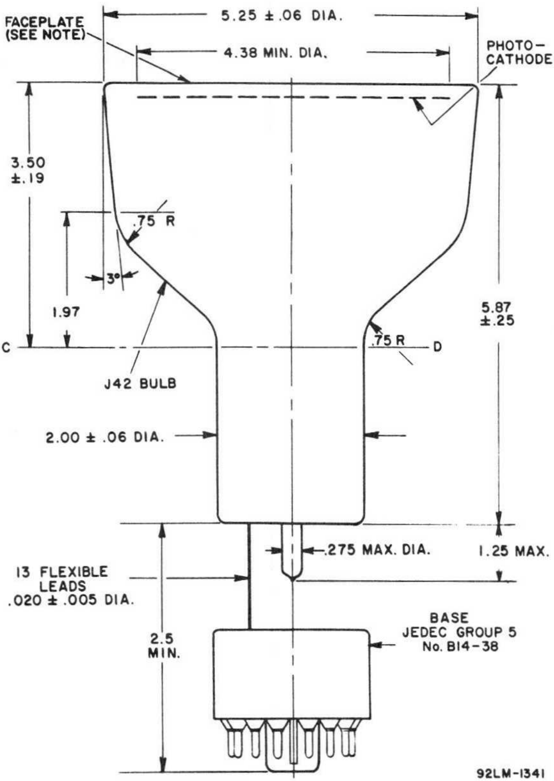
TERMINAL CONNECTIONS (Bottom View)
With Base Removed

Lead 1 – Focusing Electrode
Lead 3 – Photocathode
Lead 4 – Dynode No.1
Lead 5 – Dynode No.2
Lead 7 – Dynode No.3
Lead 8 – Dynode No.4
Lead 9 – Dynode No.5
Lead 11 – Dynode No.6
Lead 13 – Dynode No.7
Lead 14 – Dynode No.8
Lead 15 – Dynode No.9
Lead 17 – Dynode No.10
Lead 19 – Anode



92LS-1385

DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note: Within 4.38-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

Photomultiplier Tubes

Sturdy, 10-Stage, S-11, Head-On Types for Use Under Adverse Environmental Conditions

The 4439 differs from the 4438 in that it is supplied with a small-shell duodecal base attached to semi-flexible leads to facilitate testing prior to installation. After testing, the attached base should be removed.

GENERAL

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 Å
Cathode, Semitransparent	Cesium-Antimony
Minimum area	1.2 in^2 (7.7 cm^2)
Minimum diameter	1.24 in (3.1 cm)
Window	Corning[a] No.0080, or equivalent
Shape	Plane-Plano
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 pF
Anode to all other electrodes	5.5 pF
Maximum Overall Length (Excluding Semiflexible Leads)	3.91 in (9.9 cm)
Maximum Diameter	1.56 in (3.9 cm)
Bulb	T-12
Base (Temporary for 4439 only)	Small-Shell Duodecal 12-Pin (JEDEC No.B12-43), Non-hygroscopic
Socket	Eby[b] No.9058, or equivalent
Magnetic Shield	See footnote c
Operating Position	Any
Weight (Approx.)	2 oz

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	200 max.	V
Between dynode No.1 and cathode	300 max.	V

Average Anode Current[e] . . . . 0.75 max. mA

Ambient Temperature[f] . . . . 75 max. °C

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages as shown in Table I, except as noted.

With E = 1000 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g] at 4400 angstroms	–	2.2×10^{4}	–	A/W
Luminous[h]	10	27	300	A/lm
Cathode Sensitivity:				
Radiant[i] at 4400 angstroms	–	3.6×10^{-2}	–	A/W
Luminous[k]	3×10^{-5}	4.5×10^{-5}	–	A/lm
With blue light[m] . .	2.8×10^{-8}	–	–	A
Quantum Efficiency at 4200 angstroms	–	10.5	–	%
Current Amplification	–	6×10^{5}	–	
Anode Dark Current[n]	–	1.6×10^{-8}	5×10^{-8}	A
Equivalent Anode Dark Current Input[n]	–	8×10^{-10}	2.5×10^{-9}	lm
	–	1×10^{-12}[p]	–	W
Equivalent Noise Input[q]	–	6.5×10^{-12}	–	lm
Anode-Pulse Rise Time[r,s] at 1250 V.	–	2.5×10^{-9}	–	s
Electron Transit Time[r,t] at 1250 V.	–	2.9×10^{-8}	–	s

[a] Made by Corning Glass Works, Corning, New York 14830.

[b] Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia, Pa. 19144.

[c] Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Avenue, Chicago, Ill., 60622, or equivalent.

[e] Averaged over any interval of 30 seconds maximum.

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

→ *Indicates additions or changes.*

[g] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

[h] 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.

[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° 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, New York) 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.

[n] At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 20 amperes per lumen.

[p] At 4400 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 804 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] 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.

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.

Table I

Typical Potential Distribution

Between	8.13% of Supply Voltage (E) multiplied by
Cathode and Dynode No.1	1.7
Dynode No.1 and Dynode No.2	1.3
Dynode No.2 and Dynode No.3	1.3
Dynode No.3 and Dynode No.4	1.0
Dynode No.4 and Dynode No.5	1.0
Dynode No.5 and Dynode No.6	1.0
Dynode No.6 and Dynode No.7	1.0
Dynode No.7 and Dynode No.8	1.0
Dynode No.8 and Dynode No.9	1.0
Dynode No.9 and Dynode No.10	1.0
Dynode No.10 and Anode	1.0
Anode and Cathode	12.3

OPERATING CONSIDERATIONS

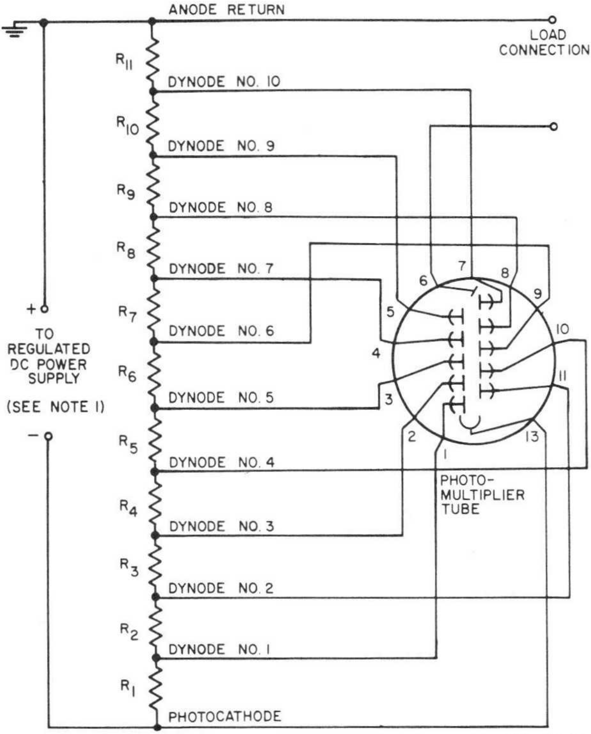
SHIELDING:

Electrostatic shielding of these tubes is ordinarily required. When a shield is used, it must be connected to the cathode terminal. The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding these tubes at the photocathode end of the tubes should not be permitted unless such materials are chosen to limit leakage current to the tube envelope to 1×10^{-12} ampere or less.

HIGH VOLTAGE WARNING:

The high voltages at which these tubes are operated are very dangerous. Before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors grounded.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT WHICH PERMITS DIRECT COUPLING TO THE ANODE



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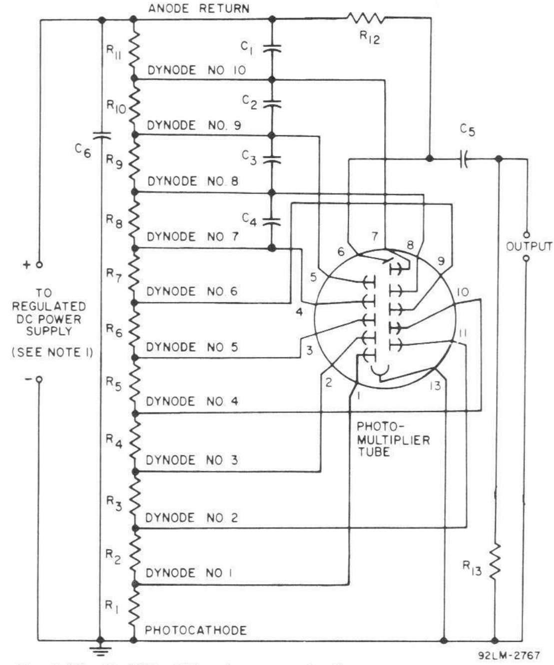
R_1: 680,000 ohms, 5%, 1/2 watt
R_2 and R_3: 510,000 ohms, 5%, 1/2 watt
R_4 through R_{11}: 390,000 ohms, 5%, 1/2 watt

Note 1: Adjustable between approximately 500 and 1250 volts dc.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS



C_1: 0.05 µF, 20%, 500 volts, ceramic disc
C_2: 0.02 µF, 20%, 500 volts, ceramic disc
C_3: 0.01 µF, 20%, 500 volts, ceramic disc
C_4: 0.005 µF, 20%, 500 volts, ceramic disc
C_5 and C_6: 0.005 µF, 20%, 3000 volts, ceramic disc
R_1: 680,000 ohms, 5%, 1/2 watt
R_2 and R_3: 510,000 ohms, 5%, 1/2 watt
R_4 through R_{11}: 390,000 ohms, 5%, 1/2 watt
R_{12}: 1 megohm, 5%, 1/2 watt
R_{13}: 100,000 ohms, 5%, 1/2 watt

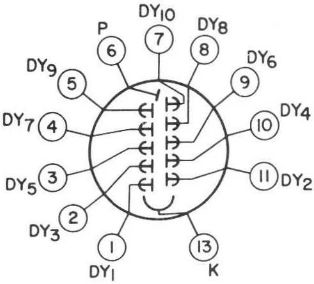
Note 1: Adjustable between approximately 500 and 1250 volts dc.

Note 2: Capacitors C_1 through C_6 should be connected at tube socket for optimum high-frequency performance.

LEAD CONNECTIONS

Bottom View

(With Base Removed)



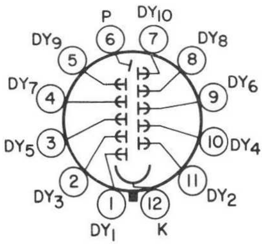
DIRECTION OF LIGHT:
INTO END OF BULB

Lead 1: Dynode No.1
Lead 2: Dynode No.3
Lead 3: Dynode No.5
Lead 4: Dynode No.7
Lead 5: Dynode No.9
Lead 6: Anode
Lead 7: Dynode No.10
Lead 8: Dynode No.8
Lead 9: Dynode No.6
Lead 10: Dynode No.4
Lead 11: Dynode No.2
Lead 13: Photocathode

TERMINAL DIAGRAM

Bottom View

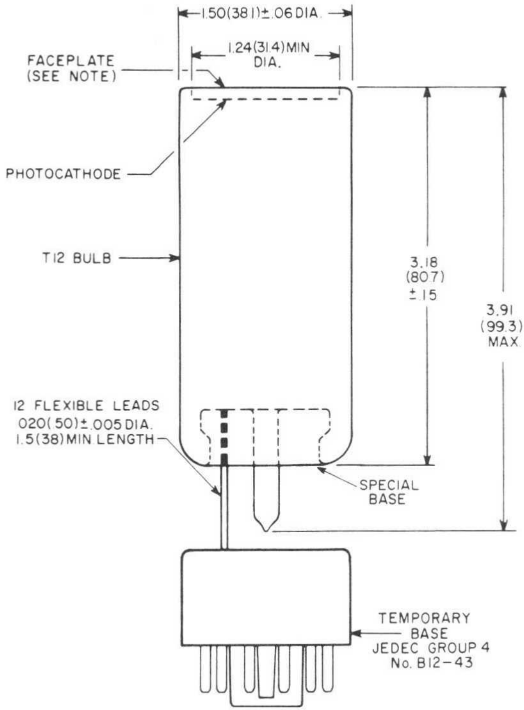
(With Temporary Base)



DIRECTION OF LIGHT:
INTO END OF BULB

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

DIMENSIONAL OUTLINE



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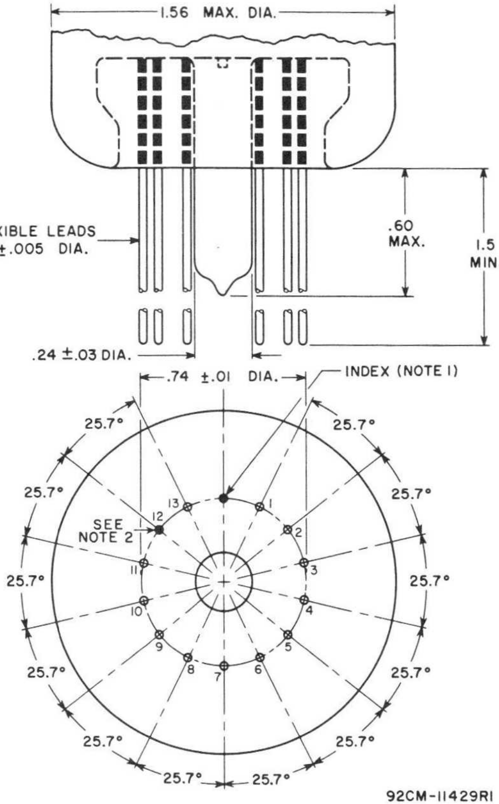
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Note: Within 1.24" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.

Note: Type 4438 is supplied without temporary B12-43 base.

DETAIL OF BASE STEM

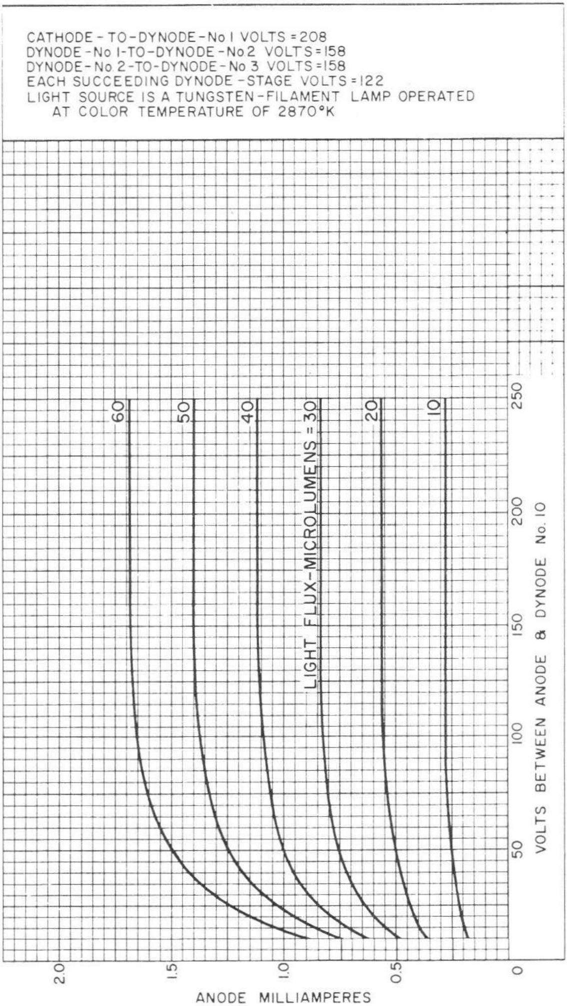


Note 1: Lead is cut off within 0.04 inch of the glass button for indexing.

Note 2: Lead No.12 is cut off within 0.04 inch of the glass button.

See Spectral Energy Distribution Curve at Front of this Section.

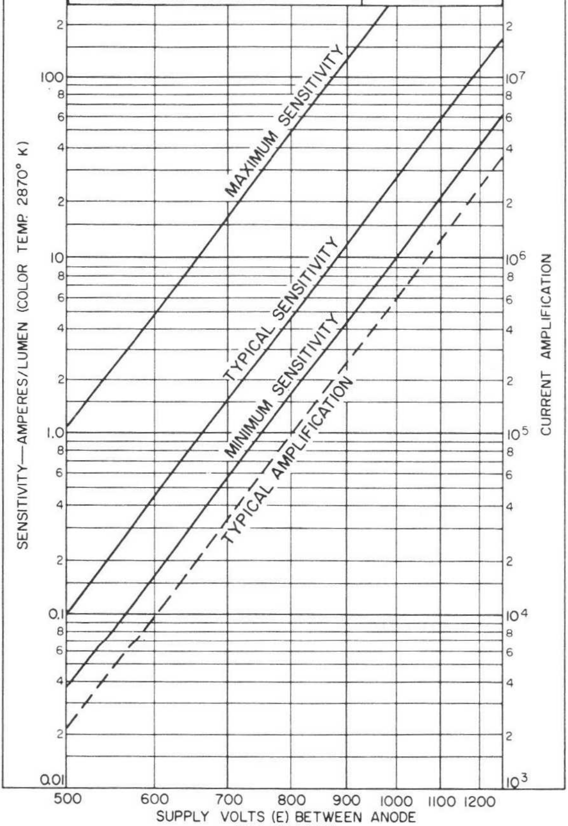
TYPICAL ANODE CHARACTERISTICS



TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN:	8.13% OF E MULTIPLIED BY:
CATHODE AND DYNODE No. 1	1.7
DYNODE No. 1 AND DYNODE No. 2	1.3
DYNODE No. 2 AND DYNODE No. 3	1.3
EACH SUCCEEDING DYNODE-STAGE	1.0
ANODE AND CATHODE	12.3



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TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

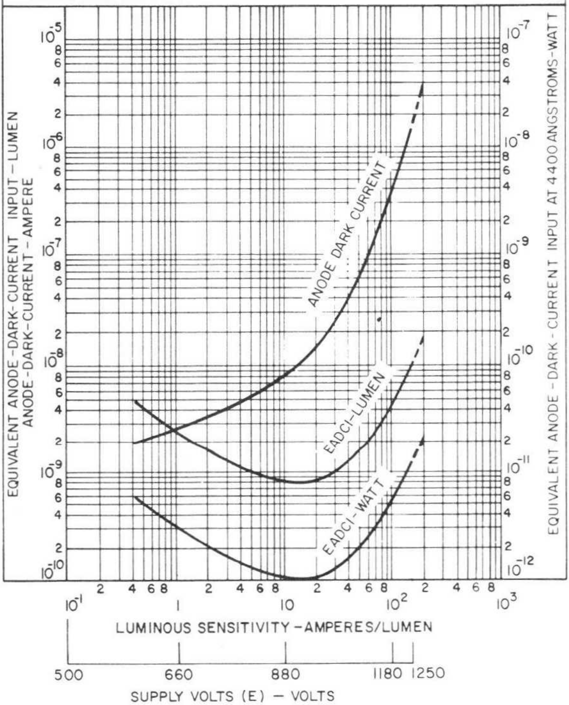
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN:	8.13% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	1.7
DYNODE No. 1 AND DYNODE No. 2	1.3
DYNODE No. 2 AND DYNODE No. 3	1.3
EACH SUCCEEDING DYNODE-STAGE	1.0
ANODE AND CATHODE	12.3

TUBE TEMPERATURE = 22°C

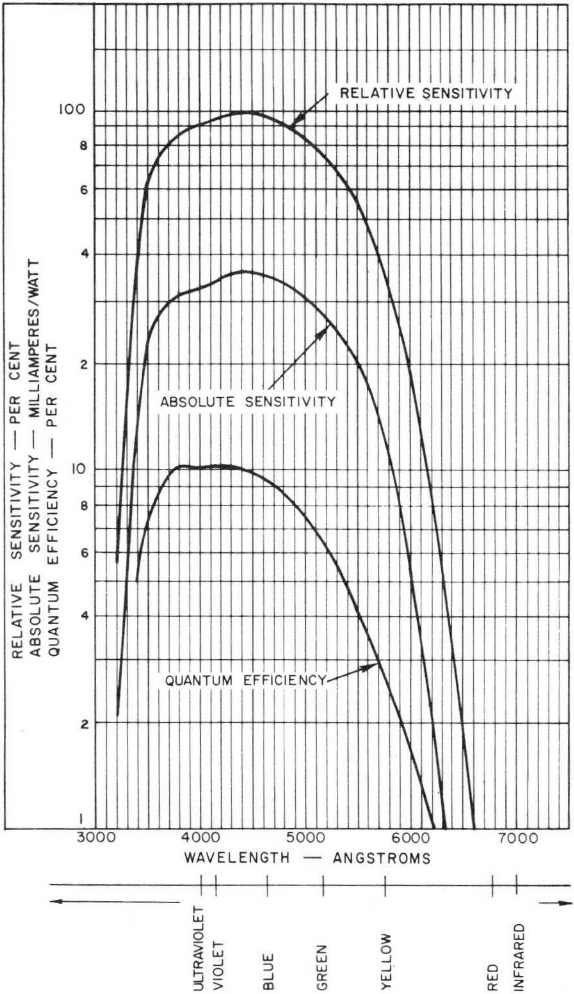
DASHED PORTION INDICATES INSTABILITY.

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



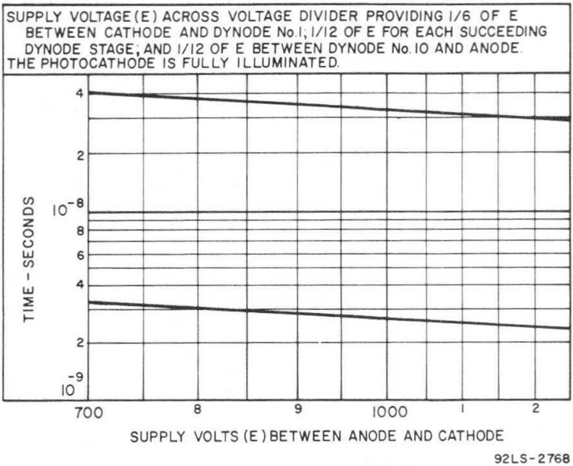
92LM-2769

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



92LM-2770

TYPICAL TIME RESOLUTION CHARACTERISTICS



Multiplier Phototube

S-11 RESPONSE

"RUGGEDIZED", 10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE

ELECTROSTATICALLY FOCUSED DYNODE STAGES

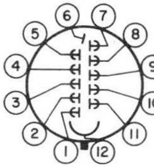
For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Industrial, Military, and Missile Applications

DATA

General:

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 angstroms
Cathode, Semitransparent	Cesium-Antimony
Shape	Flat, Circular
Minimum Area	1.2 sq. in.
Minimum diameter	1.24"
Window	Lime Glass (Corning[a] No.0080), or equivalent
Index of refraction	1.51
Dynode Material	Cesium-Antimony
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.10	4 pf
Anode to all other electrodes	7 pf
Maximum Overall Length	4.12"
Seated Length	3.50" ± 0.12"
Maximum Diameter	1.56"
Operating Position	Any
Weight (Approx.)	2.2 oz
Bulb	T12
Socket	Amphenol[b] No.59-402, or equivalent
Magnetic Shield	Millen[c] No.80802C, or equivalent
Base	Ultrashort Small-Shell Duodecal 12-Pin, (JEDEC Group 4, No.B12-186), Non-hygroscopic
Basing Designation for BOTTOM VIEW	12AE

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

Maximum Ratings, *Absolute-Maximum Values:*

DC SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 max.	volts
DC SUPPLY VOLTAGE BETWEEN DYNODE No.10 AND ANODE	250 max.	volts
DC SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES	200 max.	volts

DC SUPPLY VOLTAGE BETWEEN DYNODE No. 1 AND CATHODE	300 max.	volts
AVERAGE ANODE CURRENT[d]	0.75 max.	ma
AMBIENT TEMPERATURE	75 max.	°C

Characteristics Range Values for Equipment Design:

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.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 4400 angstroms	–	2.2×10^{4}	–	a/w
Cathode radiant, at 4400 angstroms	–	0.036	–	a/w
Luminous:				
At 0 cps[e]	10	27	300	a/lm
With dynode No. 10 as output electrode[f]	–	16	–	a/lm
Cathode luminous:				
With tungsten light source[g]	3×10^{-5}	4.5×10^{-5}	–	a/lm
With blue light source[h,n]	2.8×10^{-8}	–	–	a
Current Amplification	–	6×10^{-5}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 20 a/lm[j,k]	–	8×10^{-10}	2.5×10^{-9}	lm
Equivalent noise Input[m]	–	4×10^{-12}	1.7×10^{-11}	lm
Dark Current to Any Electrode Except Anode at 25° C	–	–	7.5×10^{-7}	a

With E = 750 volts (Except as noted)

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 4400 angstroms	–	2.2×10^{3}	–	a/w
Cathode radiant, at 4400 angstroms	–	0.036	–	a/w
Luminous:				
At 0 cps[e]	–	2.7	–	a/lm
With dynode No. 10 as output electrode[f]	–	1.6	–	a/lm

	Min.	Typ.	Max.	
Cathode luminous:				
With tungsten light source[g]. . .	3×10^{-5}	4.5×10^{-5}	–	a/lm
With blue light source[h,n].	2.8×10^{-8}	–	–	a
Current Amplification. .	–	6×10^{4}	–	

[a] Made by Corning Glass Works, Corning, New York.

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

[c] Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts.

[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° K and a light input of 10 microlumens 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 curves shown in the accompanying *Typical Anode Characteristics* curve do 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° 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° 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.

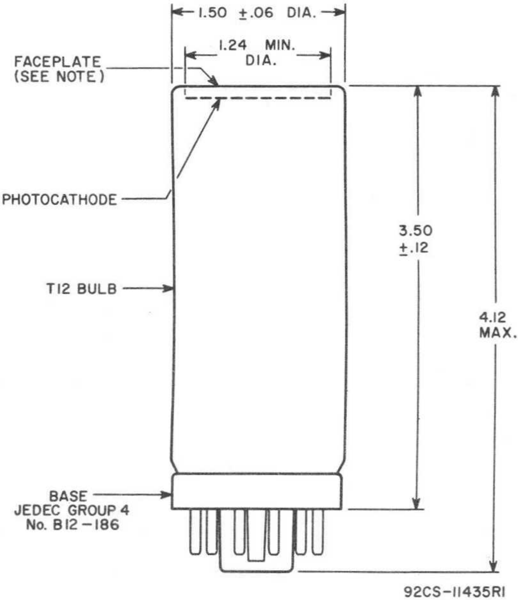
[j] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[k] For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.

[m] Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

[n] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE
is shown at the front of this Section

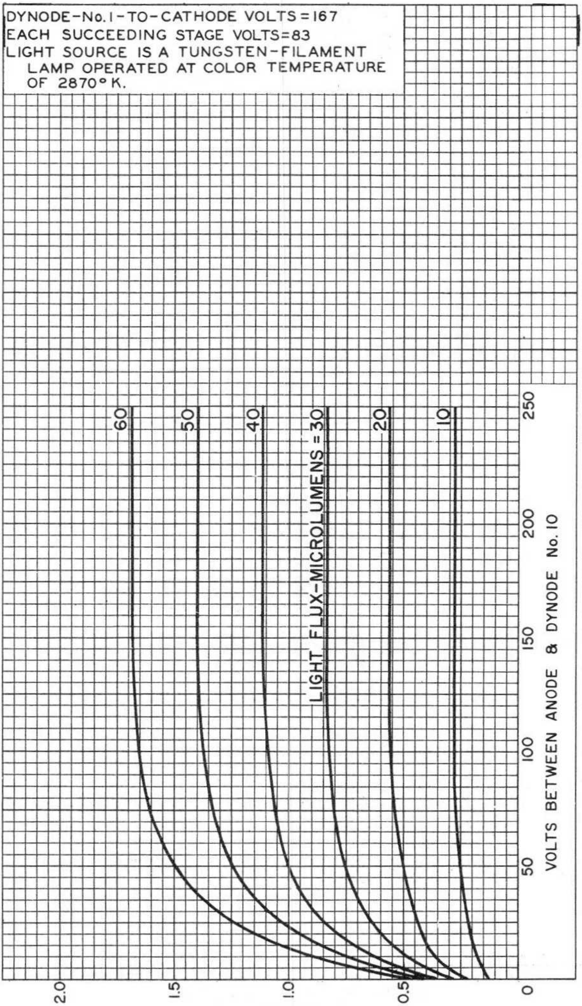


DIMENSIONS IN INCHES

CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

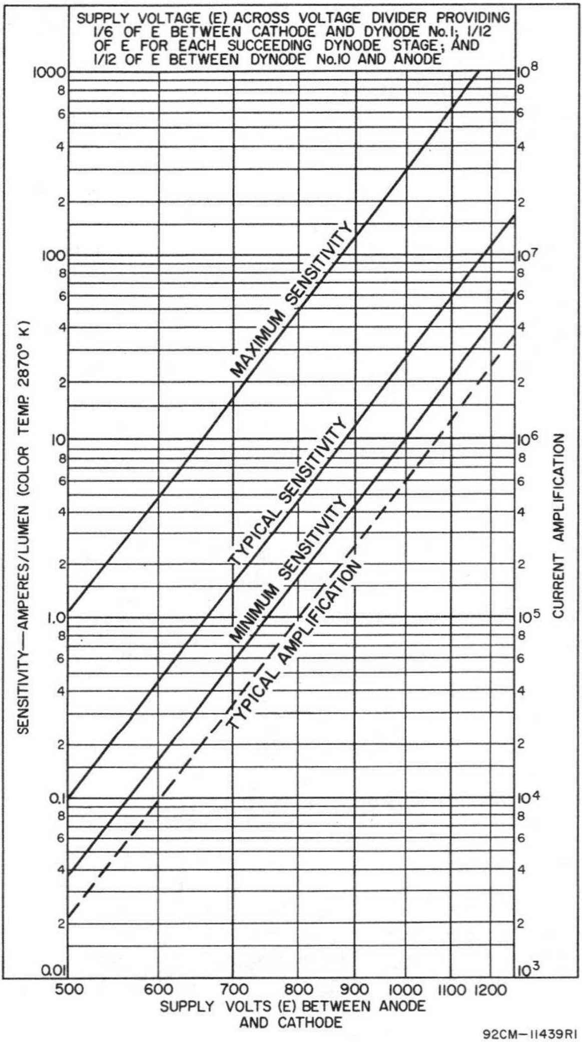
NOTE: WITHIN 1.24 INCH DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.010 INCH FROM PEAK TO VALLEY.

TYPICAL ANODE CHARACTERISTICS



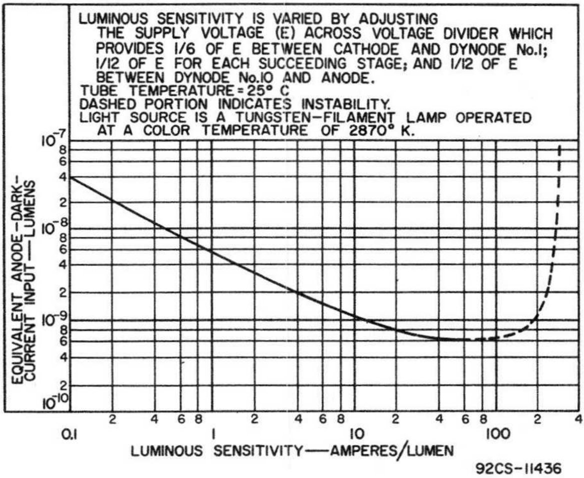
92CM-7255R6

TYPICAL CHARACTERISTICS



92CM—11439R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



Multiplier Phototube

S-11 RESPONSE

"RUGGEDIZED", 10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE

ELECTROSTATICALLY FOCUSED DYNODE STAGES

For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Industrial, Military, and Missile Applications

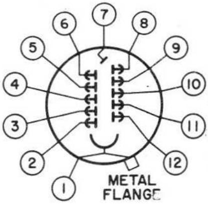
DATA

General:

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 angstroms
Cathode, Semitransparent	Cesium-Antimony
Shape	Flat, Circular
Minimum area	1.2 sq. in.
Minimum diameter	1.24"
Window	Lime Glass (Corning[a] No.0080), or equivalent
Index of refraction	1.51
Dynode Material	Cesium-Antimony
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No. 10	3.2 pf
Anode to all other electrodes	5.0 pf
Maximum Overall Length (Excluding flexible leads)	3.18"
Maximum Diameter	1.56"
Operating Position	Any
Weight (Approx.)	3 oz
Bulb	T12
Magnetic Shield	[b]
Base	Special

Terminal Diagram: BOTTOM VIEW

- Lead 1 & Metal Flange–Photocathode
- Lead 2 – Dynode No.1
- Lead 3 – Dynode No.3
- Lead 4 – Dynode No.5
- Lead 5 – Dynode No.7
- Lead 6 – Dynode No.9
- Lead 7 – Anode
- Lead 8 – Dynode No.10
- Lead 9 – Dynode No.8
- Lead 10 – Dynode No.6
- Lead 11 – Dynode No.4
- Lead 12 – Dynode No.2



DIRECTION OF RADIATION: INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:*

DC SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE	1250 max.	volts
DC SUPPLY VOLTAGE BETWEEN DYNODE No.10 AND ANODE	250 max.	volts
DC SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES	200 max.	volts

DC SUPPLY VOLTAGE BETWEEN DYNODE NO.1 AND CATHODE	300 max.	volts
AVERAGE ANODE CURRENT[c]	0.75 max.	ma.
AMBIENT TEMPERATURE	75 max.	°C

Characteristic Range Values for Equipment Design:

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.	Typ.	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	2.2×10^{4}	–	a/w
Cathode radiant, at 4400 angstroms	–	0.036	–	a/w
Luminous:				
At 0 cps[d]	10	27	300	a/lm
With dynode No.10 as output electrode[e]	–	16	–	a/lm
Cathode luminous:				
With tungsten light source[f]	3×10^{-5}	4.5×10^{-5}	–	a/lm
With blue light source[g,m]	2.8×10^{-8}	–	–	a
Current Amplification	–	6×10^{5}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 20 a/lm:[h,j]	–	8×10^{-10}	2.5×10^{-9}	lm
Equivalent Noise Input[k]	–	4×10^{-12}	1.7×10^{-11}	lm
Dark Current to Any Electrode Except Anode at 25° C.	–	–	7.5×10^{-7}	a

With E = 750 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	2.2×10^{3}	–	a/w
Cathode radiant, at 4400 angstroms	–	0.036	–	a/w
Luminous:				
At 0 cps[d]	–	2.7	–	a/lm
With dynode No.10 as output electrode[e]	–	1.6	–	a/lm
Cathode luminous:				
With tungsten light source[f]	3×10^{-5}	4.5×10^{-5}	–	a/lm
With blue light source[g,m]	2.8×10^{-8}	–	–	a
Current Amplification	–	6×10^{4}	–	

[a] Made by Corning Glass Works, Corning, New York.

[b] Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1829 Civic Opera Building, 20 North Wacker Drive, Chicago 6, Illinois, or equivalent.

[c] Averaged over any interval of 30 seconds maximum.

[d] 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.

[e] 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 curves shown in the accompanying *Typical Anode Characteristics* curve do not apply when dynode No.10 is used as the output electrode.

[f] 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.

[g] 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° 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.

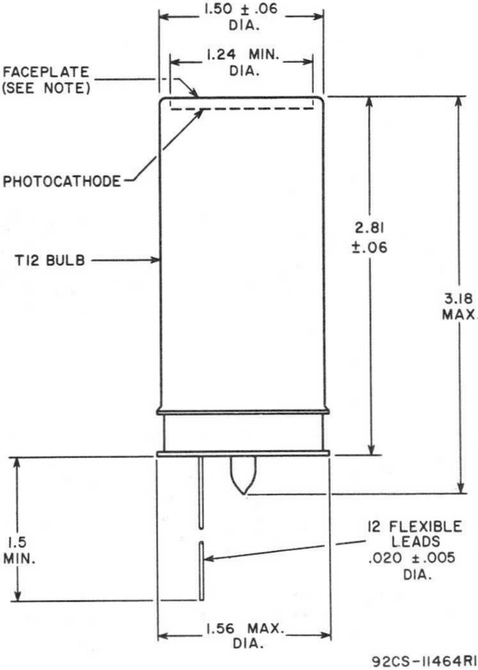
[h] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[j] For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.

[k] Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

[m] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE is shown at the front of this Section

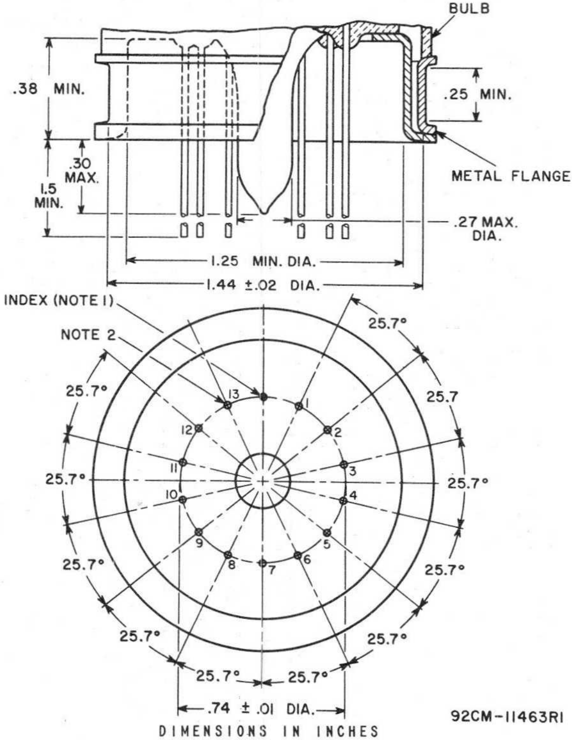


DIMENSIONS IN INCHES

CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE FLANGE.

NOTE: DEVIATION FROM FLATNESS WITHIN THE 1.24 INCH DIAMETER AREA WILL NOT EXCEED 0.010 INCH FROM PEAK TO VALLEY.

SPECIAL BASE
Pin Dimensions and Orientation and Index Guide



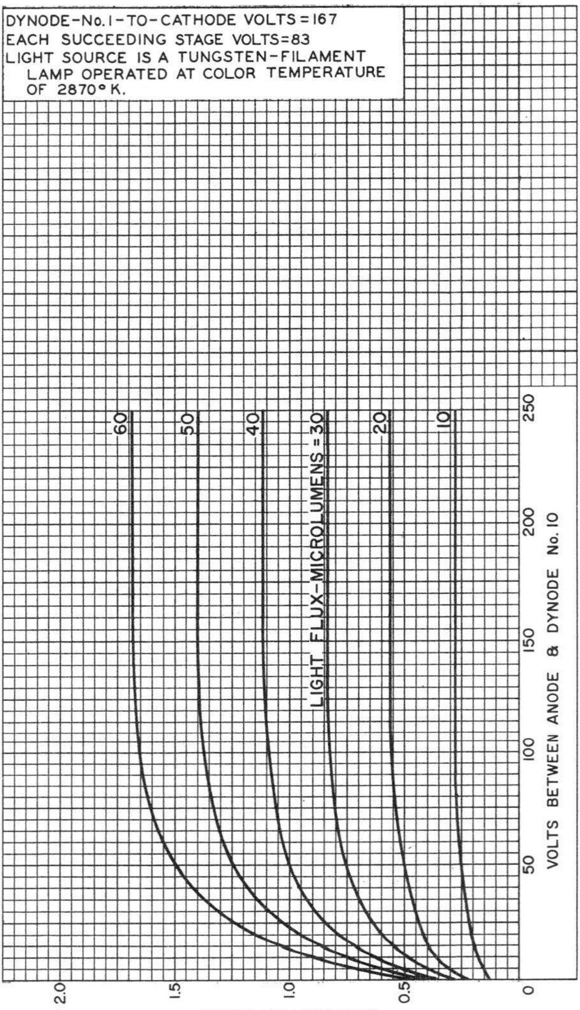
DIMENSIONS IN INCHES

12-Lead Base 1,2,3,4,5,6,7,8,9,10,11,12

NOTE 1: LEAD IS CUT OFF WITHIN 0.04 INCH OF THE GLASS BUTTON FOR INDEXING.

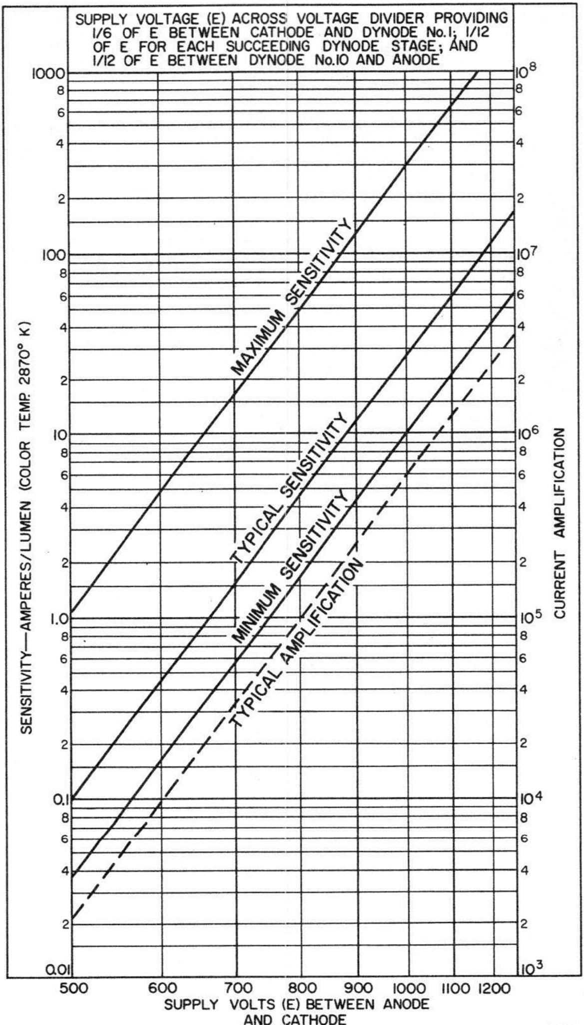
NOTE 2: LEAD NO. 13 IS CUT OFF WITHIN 0.04 INCH OF THE GLASS BUTTON.

TYPICAL ANODE CHARACTERISTICS



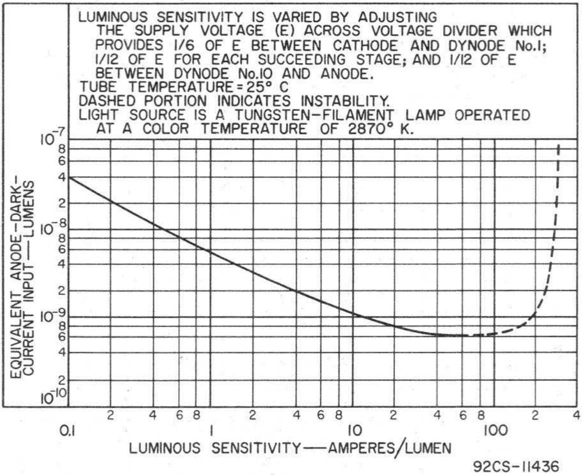
92CM-7255R6

TYPICAL CHARACTERISTICS



92CM–11439R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



Multiplier Phototube

RUGGED VIBRATION-RESISTANT STRUCTURE
S-11 RESPONSE — ELECTROSTATICALLY FOCUSED
10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE — DYNODE STAGES

For Detection and Measurement of Nuclear Radiation and other Low-Level Light Sources. Especially Useful in Missile and Rocket Service and other Industrial and Military Applications where Severe Environmental Conditions may be Encountered.

The 4441A is the same as the 4441 except for the following:

Characteristics Range Values for Equipment Design:

With E = 1000 volts

	Min.	*Typ.*	*Max.*	
Anode-Pulse Rise Time[a]	–	2.8×10^{-9}	–	sec.
With E = 750 volts				
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 20 a/lm[b,c]	–	8×10^{-10}	2.5×10^{-9}	lm

ENVIRONMENTAL TESTS:

The 4441A is designed to withstand environmental tests equivalent to those specified in MIL-E-5272C* for equipment mounted on the structures of missiles propelled or launched by high-thrust rocket engines. The accelerations specified in these tests are applied directly to the tubes.

One-Hundred Per-Cent Shock and Vibration Testing:

Shock. These tests are performed first, per method of MIL-E-5272C*, Par.4.15.5.1, Proc.V, on apparatus which provides a half-wave sinusoidal shock pulse. One-hundred percent testing of all 4441A's is performed. Each 4441A (non-operating) is subjected to three impact shocks in each direction of the three orthogonal axes. Each impact shock has a peak acceleration of 30 ± 3 g's and a time duration of 11 ± 1 milliseconds. Each tube is subjected to a total of 18 impact shocks.

Vibration. These tests are performed next, on apparatus which applies a variable-sinusoidal frequency vibration to the tube in accordance with MIL-E-5272C*, par.4.7.14 and par.4.7.14.1, except forthe cycle duration. This test is performed on all 4441A tube types. Each 4441A (Operating under the conditions specified under *Tube Rejection Criterion*) is vibrated in each of the three orthogonal axes and as specified in the following schedule. A vibration cycle has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 20 to 2000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period for each tube is 15 minutes.

Double Amplitude inches	Accelera-tion g's	Fre-quency cps	Cycle Duration Per Axis minutes
0.050 ± 0.005	–	20–87	5
–	20	87–2000	
–	20	2000–87	
0.050 ± 0.005	–	87–20	

Tube Rejection Criterion. After completion of the shock tests, tubes are operated at an anode-to-cathode voltage of 1000 volts with the light level incident on the tube adjusted to provide an anode current of 8 microamperes. Electrical and/or mechanical tube failures due to shock or vibration are observed during the vibration test when the specified anode current is monitored. Tube rejection criterion for both tests is that the anode current of 8 microamperes will not change more than ± 20 per cent at any time during the vibration test for each axis.

Design Tests:

Vibration. These tests are performed under conditions equivalent to those described in MIL-E-5272C*, par.4.7.14 and par.4.7.14.1. The vibration cycle has a duration of one hour and two cycles are performed for each of the three orthogonal axes. The total test period for each tube is six hours.

Acceleration. These tests are performed in a centrifuge providing unidirectional acceleration by a method equivalent to that specified in MIL-E-5272C*, par.4.16.3, Proc.III except that tubes are subjected for one minute to an increased acceleration test level of 100 ± 10 g's in both directions of the three orthogonal axes and the tubes are non-operating.

* Military Specification MIL-E-5272C (ASG), 13 April 1959; and Amendment 1, 5 January 1960.

Vidicon

SpectraPlex Type for Single-Tube Color Cameras

- Integral Dichroic Filter Stripes Optically Encode Color Information
- Signal Can Be NTSC (or PAL) Encoded
- Requires Only Moderate Studio Lighting—100 lumens/foot^2 (fc)
- Produces Fully Compatible Video for Black-and-White Monitors
- Familiar Vidicon Structure – Magnetic Focus and Deflection

General Data

Electrical:

Heater Voltage . . . . 6.3 ± 5% V

Heater Current at 6.3 Volts, ac or dc . . . . . . 0.6 nominal A

Focusing Method . . . . Magnetic

Deflection Method . . . . Magnetic

Direct Interelectrode Capacitance:[a]

Target to all other electrodes . . . . 4.6 pF

Optical:

Outer faceplate glass is Corning code 7056 having a thickness of 0.094" ±0.012".

Inner faceplate . . . . Dark-Clad Fiber Optics

Photoconductor . . . . Antimony Trisulfide

Orientation of quality rectangle – Proper orientation is obtained when the horizontal scan is essentially parallel to the plane passing through the tube axis and short index pin.

Maximum Useful Diagonal of Image . . . . . 0.625 in (16 mm)

Mechanical:

Maximum Length . . . . 6.475 in (164.5 mm)

Maximum Diameter . . . . 1.135 in (28.83 mm)

Bulb T8

Base . . . . . Small-Button Ditetrar 8-Pin (JEDEC No.E8-11)

Socket . . . . Cinch[b] No.8VT (133-98-11-015), or equivalent

Deflecting Yoke – Focusing Coil –
Alignment Coil – Assembly . . . . . . Cleveland Electronics[c,d] No.VDA-945, or equivalent

Operating Position . . . . Any

Weight (Approx.) . . . . 2 oz

Maximum and Minimum Ratings, Absolute-Maximum Values:[e]

For scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm)

	Min.	Max.	
Grid-No.4 Voltage[f]	–	1000	V
Grid-No.4 and Grid-No.3 Voltage Difference	–	600	V
Grid-No.3 Voltage[f]	–	1000	V
Grid-No.2 Voltage	–	350	V
Grid-No.2 Power Dissipation	–	1	W
Grid-No.1 Voltage	−150	0	V
Heater-Cathode Voltage	−125	10	V
Heater-Voltage Tolerance	–	5	%
Target Voltage	–	70	V
Dark Current	–	0.25	μA
Peak Target Current[g]	–	0.75	μA
Faceplate:			
Illumination[h]	–	1000	lm/ft²
		10,000	lux
Temperature:			
Operating and storage	–	71	°C

Typical Operation and Performance Data:

For scanned area of 1/2" x 3/8" – Faceplate temperature of 30° ± 3° C and standard TV scanning Rate

Grid-No.4 (Decelerator) Voltage[f]	900	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	540	V
Grid-No.2 (Accelerator) Voltage	300	V
Grid-No.1 Voltage for Picture Cutoff[j]	−65 to −100	V
Average "Gamma" of Transfer Characteristic for Signal-Output Current Between 30 nA and 300 nA	0.65	
Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed[k]	25	%
Peak-to-Peak Blanking Voltage:		
When applied to grid No.1	75	V
When applied to cathode	20	V

Field Strength at Center of Focusing Coil[m]	60 ± 5	G
Field Strength of Adjustable Alignment Coil[n]	0 to 4	G
Peak Deflecting-Coil Current:		
Horizontal	250	mA
Vertical	45	mA

Sensitivity

Conditions

Faceplate illumination (highlight)	6	lm/ft^2 (fc)
Dark current[p]	30	nA

Performance

Target voltage[q,r]	22 to 45	V
Signal-Output Current[s]	300	nA

a This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

b Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, ILL 60007.

c Made by Cleveland Electronics Inc., 17877 St. Clair Avenue, Cleveland, OH 44110.

d These components are chosen to maximize resolution uniformity over the useful picture area of the camera tube. Resolution uniformity is necessary for good color uniformity.

e A description of the Absolute Maximum Rating is given in the General Section titled Rating System for Electron Tubes.

f Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10.

g Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

h For conditions where "white light" is uniformly diffused over entire tube face.

j With no blanking voltage on grid No.1.

k For initial signal-output current of 300 nanoamperes and a dark current of 30 nanoamperes.

m The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

n The alignment coil should be located on the tube so that its center is at a distance of 3-3/4 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

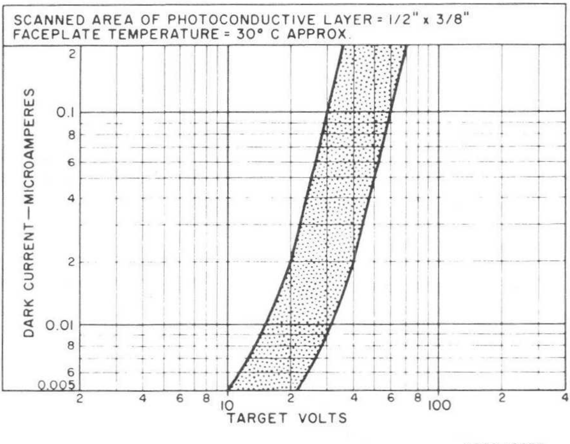
p The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

q The target voltage for each tube must be adjusted to that value which gives the desired operating dark current.

r Indicated range serves only to illustrate the operating target-voltage range normally encountered.

s Defined as the component of the highlight target current after dark-current component has been subtracted.

Typical Range of Dark Current



Spurious Signal Test

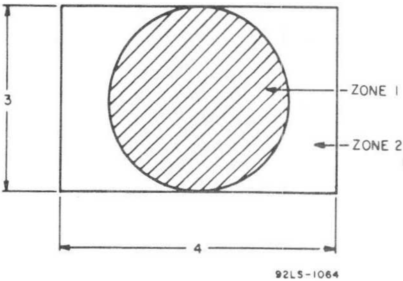


Figure 1

Spurious Signal Test Zones

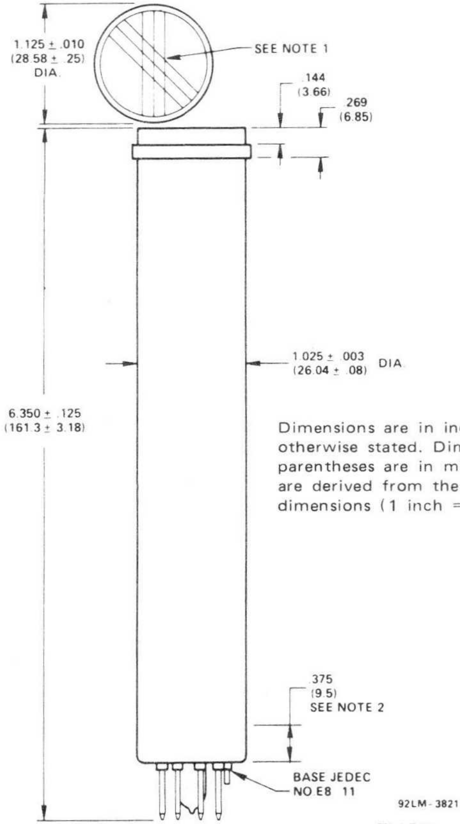
This test is performed using a uniformly illuminated test pattern containing two "zones" as shown in **Figure 1.** Illumination is for a peak signal current of 300 nanoamperes. Under these conditions, a blemish will be counted if its signal amplitude is greater than 45 nanoamperes under either illuminated or capped conditions. Some spots and fiber-optic distortion errors are more easily observed when viewing a red or a blue field. Therefore, Wratten filters numbers 25 or 47B (or equivalents) will be inserted into the light path to provide the red or blue fields. Table I shows the number of countable spots allowed. No two spots may be closer together than the distance equivalent to twenty TV lines.

Table I
For scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm)

Blemish Size (equivalent number of raster lines)	Zone 1	Zone 2
over 4	0	0
over 3	2	3
over 1	6	10
1 or less	*	*

*Spots of this size are allowed unless concentration causes a smudged appearance.

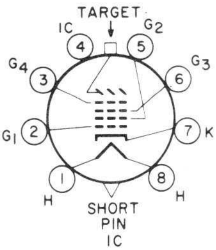
Dimensional Outline



Note 1 – Color encoding stripes, 530 line pairs/inch. The yellow (minus blue) stripes are shown vertically on the centerline, the cyan (minus red) stripes are 45° counterclockwise from the yellow stripes. The yellow stripes are perpendicular to the plane passing through tube axis and short index pin. This plane also defines the direction of horizontal scan.

Note 2 – Within this distance, diameter of bulb is 1.025″ + 0.003″ – 0.030″.

Basing Diagram

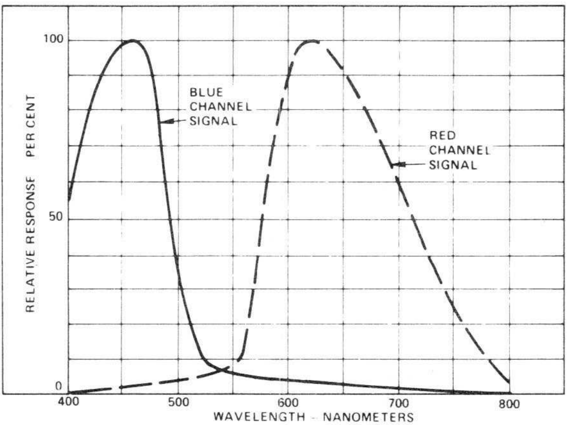


DIRECTION OF LIGHT: INTO FACE END OF TUBE

Pin 1 -- Heater
Pin 2 -- Grid No.1
Pin 3 -- Grid No.4
Pin 4 -- Internal Connection — Do Not Use
Pin 5 -- Grid No.2
Pin 6 -- Grid No.3
Pin 7 -- Cathode
Pin 8 -- Heater
Flange — Target
Short Index Pin — Internal Connection — Make No Connection

Typical System Response

(These data are obtained by "sweeping" the input of a camera system, employing a SpectraPlex vidicon type 4445 with the output of a Bausch & Lomb Monochromator Model 33-86-02.



92LS-3819

Typical Light Transfer Characteristic

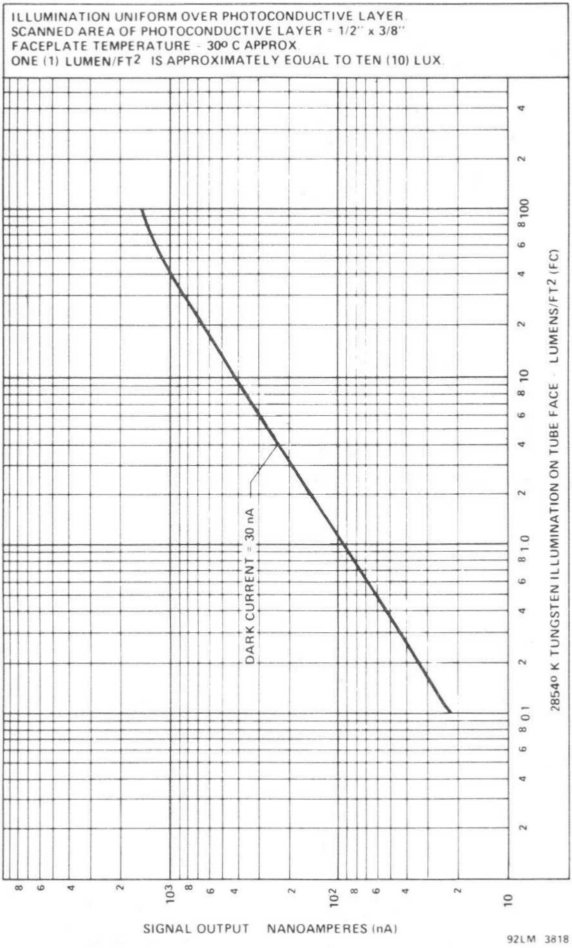


Image-Converter Tube

S-11 RESPONSE

For Use as a High-Speed Light Shutter
in Extremely-High-Speed Photography

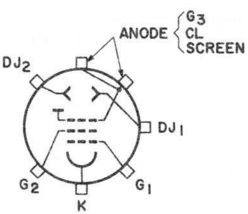
General:

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 angstroms
Photocathode, Semitransparent:	
Shape	Spherical, Circular
Window:	
Area	9.52 sq.cm (1.48 sq.in.)
Minimum diameter	3.48 cm (1.37 in.)
Index of refraction	1.48
Fluorescent Screen:	
Shape	Flat, Circular
Phosphor	P11[a], Aluminized
Fluorescence	Blue
Phosphorescence	Blue
Persistence[a]	Medium Short
Window:	
Useful deflection area (Approx.)	18 sq.cm (2.8 sq.in.)
Minimum diameter	7.1 cm (2.8 in.)
Index of refraction	1.48
Direct Interelectrode Capacitances (Approx.):	
Grid No.1 to all other electrodes	20 pf
Deflecting electrode DJ1 to deflecting electrode DJ2	1 pf
Deflecting electrode DJ1 to all other electrodes	6 pf
Deflecting electrode DJ2 to all other electrodes	6 pf
Focusing Method	Electrostatic
Deflection Method	Electrostatic
Overall Length	9.87" ± 0.06"
Diameter	3.97" ± 0.07"
Operating Position	Any
Weight (Approx.)	28 oz

Terminal Connections (See *Dimensional Outline*):

G_1 – Grid No.1
G_2 – Grid No.2
DJ1 – Deflecting Electrode No.1
K – Photocathode
DJ2 – Deflecting Electrode No.2
Anode – (Grid No.3, Collector, Screen)

DIRECTION OF LIGHT: PERPENDICULAR TO PHOTOCATHODE END OF TUBE



Maximum Ratings, *Absolute-Maximum Values:*

DC Anode Voltage[b]	15000 max.	volts
DC Grid-No.2 Voltage[b]	2200 max.	volts
Grid-No.1 Voltage[b]	190 max.	volts
Deflecting Electrode Voltage:		
DJ1 and DJ2[c]	±1500 max.	volts
Peak Photocathode Current[d]	0.02 max.	ampere
Photocathode Current Density:		
Peak[d]	0.002 max.	amp/cm^2
Average[e]	0.1 max.	μa/cm^2

Typical Operating Values:

Anode Voltage[b]	15000	volts
Grid-No.2 Voltage[b,f]	1500 to 1900	volts
Grid-No.1 Voltage:[b]		
Operating (Minimum)[f]	110 to 170	volts
Cutoff (Maximum)	-90	volts
Deflection Factor	1050 to 1250	volts/in.

Characteristics:

With conditions shown under Typical Operating Values and at an ambient temperature of 25° C

	Min.	Typical	Max.	
Photocathode Sensitivity:				
Radiant, at 4400 angstroms	–	0.04	–	amp/watt
Luminous, at 0 cps[g]	2×10^{-5}	5×10^{-5}	–	amp/lumen
Paraxial Image Magnification (Cmx)[h,j]	0.69	–	0.78	
Distortion[h,k]	–	–	0.03	
Paraxial Resolution[b,m]	25	–	–	line-pairs/mm
Edge Resolution[b,m,n]	15	–	–	line-pairs/mm
Radiant Power Gain,[p,q]	50	–	–	
Equivalent Background Screen Brightness Input[r]	–	–	5×10^{-12}	watts/sq.cm
Screen Uniformity Factor[s]	–	–	1.3	
Alignment	–	–	t	

[a] For P11 Spectral-Energy Emission Characteristic curve, see *front of Cathode-Ray Tube, Storage-Tube, & Monoscope Section.* See also accompanying *Operating Considerations.*

[b] Referred to photocathode.,

[c] Referred to anode.

[d] Over an interval not exceeding 1 microsecond.

[e] Averaged over any interval of 8 minutes maximum.

[f] Adjusted to minimize shadowing effects in the displayed image caused by the wires of grid No.1.

[g] For conditions where the light source is a tungsten-filament lamp having a lime glass envelope (Corning Glass Code No.0080, or equivalent). The lamp is operated at a color temperature of 2870° K. A light input of 0.01 lumen is used to irradiate a centered 1/2-inch diameter of the photocathode.

[h] Defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the corresponding image points on the photocathode.

j Determined as follows: The image incident on the photocathode is perpendicular to the grid-No.1 wires and consists of 2 parallel lines on a bright background approximately 0.16" in length and separated by a distance of 0.160" ± 0.002". The image on the photocathode is focused and positioned so that the separation between the image lines is an equal distance on both sides of the geometric center of the photocathode. The line spacing on the screen is measured adjacent to the faint image of the center grid-No.1 wire.

k A second magnification value (Emx) is measured under the conditions established in (**j**) except that the lines are separated by a distance of 1.00" ± 0.01". Distortion (D) is defined by the equation:

$$D = \frac{Emx}{Cmx} - 1$$

m Determined with a resolution pattern consisting of horizontal and vertical bars. The limiting resolution value is measured adjacent to the faint image of the center grid-No.1 wire and applies to both vertical and horizontal resolution.

n Measured at the edge of a 1-inch diameter circle positioned concentric with the geometric center of the photocathode under the same conditions established in (**m**).

p Under the following conditions: Light incident on the photocathode is transmitted through a blue filter (Corning C. S. No.5-58 filter from Melt No.5113 polished to 1/2 stock thickness—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2870° K. A 1/2-inch diameter of the photocathode is irradiated and the value of light flux incident on the filter is 0.1 lumen. A calibrated receiver having S-11 spectral response and masked to have a 1/2-inch-diameter aperture is positioned 12 inches from the screen of the 4449A. The output current (I_1) of the receiver is noted. The same receiver is then positioned to receive the radiant flux originally incident on the photocathode and its output current (I_2) is noted. Radiant power gain (G) is defined by the equation:

$$G = 2000 \times \frac{I_1}{I_2}$$

The coefficient 2000 is derived by assuming that the integrated light radiated by the screen is 79 per cent of that value that would be obtained if the light emitted by the screen has a cosine distribution.

q See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

r Defined as that value of incident radiation required to cause an increase in screen brightness equal to the screen background brightness.

s The ratio of the luminance values of the brightest area to the darkest area of the screen with the entire photocathode uniformly illuminated. The value of incident illumination on the photocathode is 1 footcandle and the light spot on the screen has a diameter of 0.10" ± 0.01".

t A trace produced on the screen, when the center of the photocathode is irradiated with a 0.025-inch diameter light spot and an ac voltage is applied to the deflecting electrodes, will not deviate more than 4° from the plane passing through the center of the recessed ball cap of grid No.1 and the major axis of the tube. The angle produced by the trace and the faint images of the grid wires, that are observed when the photocathode is uniformly illuminated, will be 90° ± 3°.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE is shown at front of this Section

OPERATING CONSIDERATIONS

Magnetic shielding of the 4449A is required to minimize the effects of extraneous fields on tube performance; ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken in its construction to insure that the case is completely demagnetized.

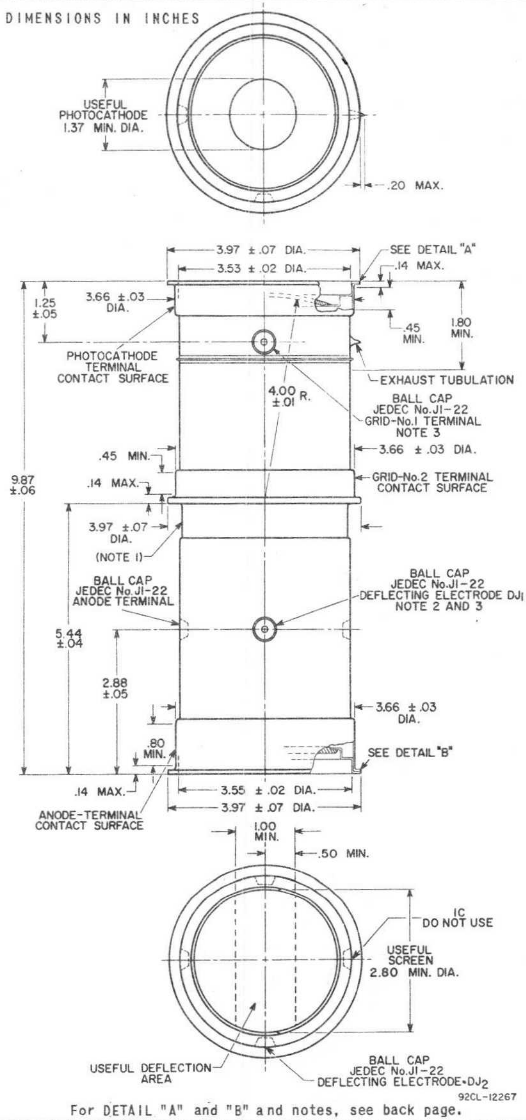
The *P-11 phosphor screen* employed by the 4449A emits high-intensity actinic blue fluorescence and has a persistence characteristic, within the range of 10 microseconds to 1 millisecond, that is dependent on the current density employed.

To *prevent degradation in the resolution of deflected images* care must be taken to assure that the deflecting voltage is free of ac ripple and that shielded semiflexible leads are used for making connection to the deflecting electrode terminals. Balanced deflection with respect to anode should be used.

Exposure Time. In practice, the shutter speeds attainable with the 4449A are limited by the ability of the external circuitry to supply to grid No. 1 good rectangular-wave pulses of sufficiently short duration. With perfect pulse-forming circuits, the minimum exposure time of the 4449A is limited by electron transit time which, for an anode voltage of 15 kilovolts, is in the order of 10^{-9} seconds. Electrons are defocused if they are not beyond the influence of the gating (control) grid when its voltage returns to cutoff value at the end of the gating pulse.

The high voltage at which the 4449A is operated may be very dangereous. Great care should be taken in the design of apparatus to prevent the user from coming in contact with the high voltage. Precautions must include safeguards which eliminate all hazards to operating personnel. In the use of high-voltage tubes, such as the 4449A, it should always be remembered that high voltage may appear at normally low-potential points in the circuit because of capacitor breakdown or incorrect circuit connections. Before any part of the circuit is touched, the voltage-supply switch should be turned off and both terminals of any capacitors grounded.

DIMENSIONS IN INCHES



For DETAIL "A" and "B" and notes, see back page.

NOTES FOR DIMENSIONAL OUTLINE

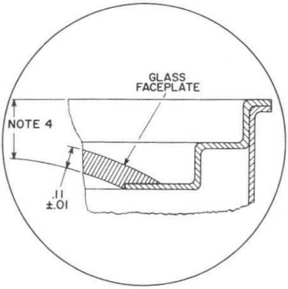
Note 1: Not to be used for mechanical support or electrical connection.

Note 2: The plane passing through the center of the recessed ball cap DJ2 and the major axis of the tube will not deviate more than 3° from the plane passing through the center of the recessed ball cap DJ1 and the major axis of the tube.

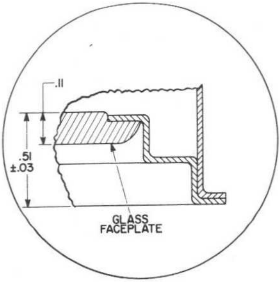
Note 3: The plane passing through the center of the recessed ball cap DJ1 and the major axis of the tube will not deviate more than 5° from the plane passing through the center of the recessed ball cap for grid No. 1 and the major axis of the tube.

Note 4: This distance on the major axis of the tube is .33 ± .03.

DETAIL "A"



DETAIL "B"



DIMENSIONS IN INCHES

Multiplier Phototube

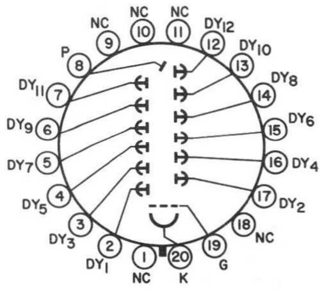
12-STAGE, HEAD-ON SPHERICAL-FACEPLATE TYPE | S-20 RESPONSE | ENCLOSED, IN-LINE DYNODE STRUCTURE
HIGH CURRENT AMPLIFICATION | EXTREMELY SHORT RISE TIME

For Near-Infrared Ruby-Laser Detector Systems, Flying-Spot Scanning, Photometry, and Scintillation Counters Requiring Low-Dark Current and High Sensitivity over the Visible and Near-Infrared Regions of the Spectrum.

General:

Spectral Response S-20
Wavelength of Maximum Response . . . . . 4200 ± 500 angstroms
Cathode, Semitransparent . . . . . . K-Na-Cs-Sb (Multialkali)
  Shape . . . . Spherical, Circular
  Minimum area . . . . 2.2 sq.in.
  Minimum diameter . . . . 1.68 in.
Window . . . . Borosilicate Glass[a]
  Index of refraction 1.48
Dynode Material . . . . Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):
  Anode to dynode No.12 . . . . 3.8 pf
  Anode to all other electrodes . . . . 5.7 pf
  Dynode No.12 to all other electrodes . . . . 6.8 pf
Maximum Overall Length . . . . 6.31"
Seated Length . . . . 5.50" ± 0.19"
Maximum Diameter . . . . 2.06"
Operating Position . . . . Any
Weight (Approx.) . . . . 7 oz
Bulb T16
Socket . . . . Cinch[b] No.20-PM, or equivalent
Magnetic Shield . . . . . . Perfection Mica Co.[c], or equivalent
Base . . . . Small-Shell Bidecal 20-Pin (JEDEC No.B20-102), Non-hygroscopic
  Basing Designation for BOTTOM VIEW 20E

Pin 1 – No Internal Connection
Pin 2 – Dynode No.1
Pin 3 – Dynode No.3
Pin 4 – Dynode No.5
Pin 5 – Dynode No.7
Pin 6 – Dynode No.9
Pin 7 – Dynode No.11
Pin 8 – Anode
Pin 9 – Same as Pin 1
Pin 10 – Same as Pin 1
Pin 11 – Same as Pin 1
Pin 12 – Dynode No.12
Pin 13 – Dynode No.10
Pin 14 – Dynode No.8
Pin 15 – Dynode No.6
Pin 16 – Dynode No.4
Pin 17 – Dynode No.2
Pin 18 – Same as Pin 1
Pin 19 – (Focusing Electrode)
Pin 20 – Photocathode



DIRECTION OF LIGHT:
INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:*

DC Supply Voltage:		
Between anode and cathode.	2800 max.	volts
Between anode and dynode No.12	400 max.	volts
Between consecutive dynodes.	400 max.	volts
Between dynode No.1 and cathode.	600 max.	volts
Between focusing electrode and cathode.	600 max.	volts
Average Anode Current[d]	1 max.	ma
Ambient-Temperature Range.	-200 to +85	°C

Characteristics Range Values:

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I. Focusing electrode is connected to arm of a potentionmeter between cathode and dynode No.1 and its voltage is adjusted to that value which provides maximum anode current.

With E = 2300 volts (Except as noted)

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 4200 angstroms . . .	–	4.3×10^{5}	–	a/w
Cathode radiant, at 4200 angstroms . . .	–	0.064	–	a/w
Luminous, at 0 cps[e] . . .	250	1000	12000	a/lm
Cathode luminous:				
With tungsten light source[f]	1.1×10^{-4}	1.5×10^{-4}	–	a/lm
With blue light source[g,h] . .	5.5×10^{-8}	–	–	a
With red light source[j,k] . .	3×10^{-7}	5×10^{-7}	–	a
Current Amplification.	–	6.6×10^{6}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 300 a/lm[m]	–	1×10^{-10}	1.3×10^{-9}	lm
Anode-Pulse Rise Time[n]	–	2×10^{-9}	–	sec
Greatest Delay Between Anode Pulses:				
Due to position from which electrons are simultaneously released within a circle centered on tube				

	Min.	Typ.	Max.	
face having a diameter of—				
1.4"	–	3×10^{-10}[p]	–	sec
1.6"	–	5×10^{-10}[p]	–	sec

With E = 1800 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4200 angstroms	–	4.3×10^{4}	–	a/w
Cathode radiant, at 4200 angstroms. .	–	0.064	–	a/w
Luminous, at 0 cps[e].	–	100	–	a/lm
Cathode luminous:				
With tungsten light source[f] .	1.1×10^{-4}	1.5×10^{-4}	–	a/lm
With blue light source[g,h] . . .	5.5×10^{-8}	–	–	a
With red light source[j,k] . . .	3×10^{-7}	5×10^{-7}	–	a
Current Amplification	–	6.6×10^{5}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 300 a/lm[m]	–	1×10^{-10}	1.3×10^{-9}	lm
Equivalent Noise Input[q].	–	1.1×10^{-12}	2.4×10^{-12}	lm

[a] Corning No. 7056, made by Corning Glass Works, Corning, New York, or equivalent.

[b] Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.

[c] Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1829 Civic Opera Bldg., 20 North Wacker Drive, Chicago 6, Illinois, or equivalent.

[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° K and a light input of 0.1 microlumen is used.

[f] 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.

[g] 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, New York) 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.

[h] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

[j] Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62--Manufactured by the Corning Glass Works, Corning, New York) 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.

k See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Red Filter* at front of this Section.

m At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

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 These values also represent the difference in time of transit between the photocathode and dynode No.1 for electrons simultaneously released from the center and from the periphery of the specified areas.

q Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

TABLE I

VOLTAGE TO BE PROVIDED BY DIVIDER	
Between	6.95% of Supply Voltage (E) multiplied by
Cathode and Dynode No.1	2
Dynode No.1 and Dynode No.2	1.4
Dynode No.2 and Dynode No.3	1
Dynode No.3 and Dynode No.4	1
Dynode No.4 and Dynode No.5	1
Dynode No.5 and Dynode No.6	1
Dynode No.6 and Dynode No.7	1
Dynode No.7 and Dynode No.8	1
Dynode No.8 and Dynode No.9	1
Dynode No.9 and Dynode No.10	1
Dynode No.10 and Dynode No.11	1
Dynode No.11 and Dynode No.12	1
Dynode No.12 and Anode	1
Anode and Cathode	14.4
Focusing electrode is connected to arm of potentiometer between cathode and dynode No.1. The focusing-electrode voltage is varied to give maximum anode current.	

OPERATING CONSIDERATIONS

The *operating stability* of the 4459 is dependent on the magnitude of the anode current and its duration. When the 4459 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends of the severity of the operating conditions. After a period of idleness, the 4459 usually recovers a substantial percentage of such loss in sensitivity.

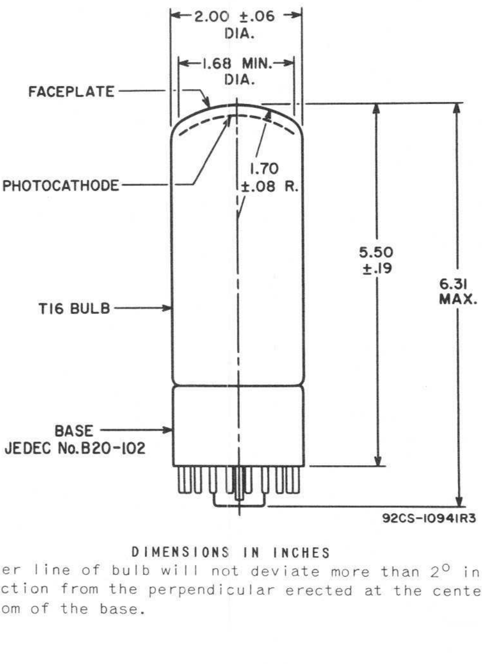
It is recommended that the average anode current be well below the maximum-rated value of 1 milliampere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Electrostatic and/or *magnetic shielding* of the 4459 may be necessary.

Adequate *light shielding* should be provided to prevent extraneous light from reaching any part of the 4459.

The *high voltages at which the 4459 is operated are very dangerous.* Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the exclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

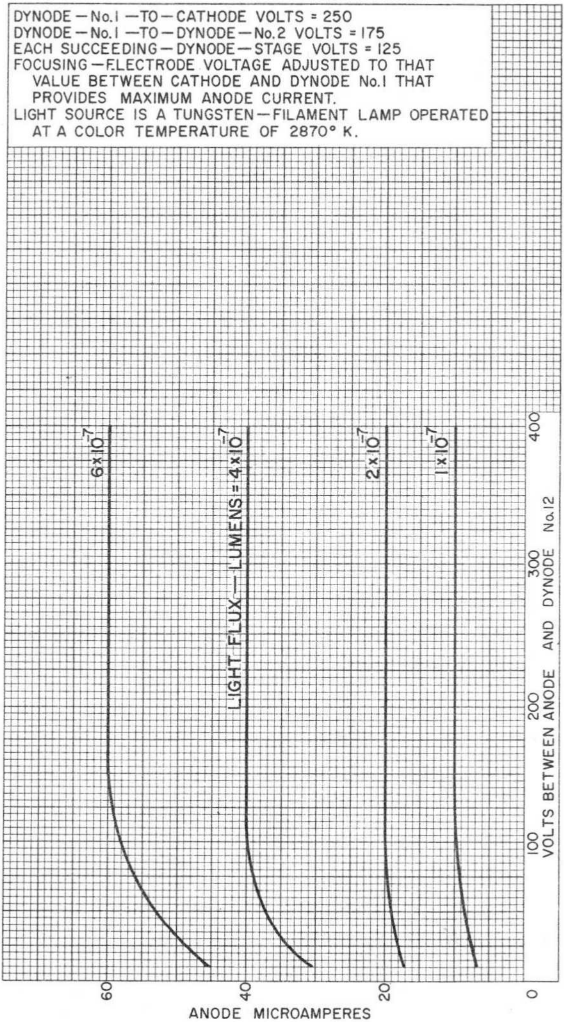
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE
is shown at the front of this Section



DIMENSIONS IN INCHES

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

TYPICAL ANODE CHARACTERISTICS



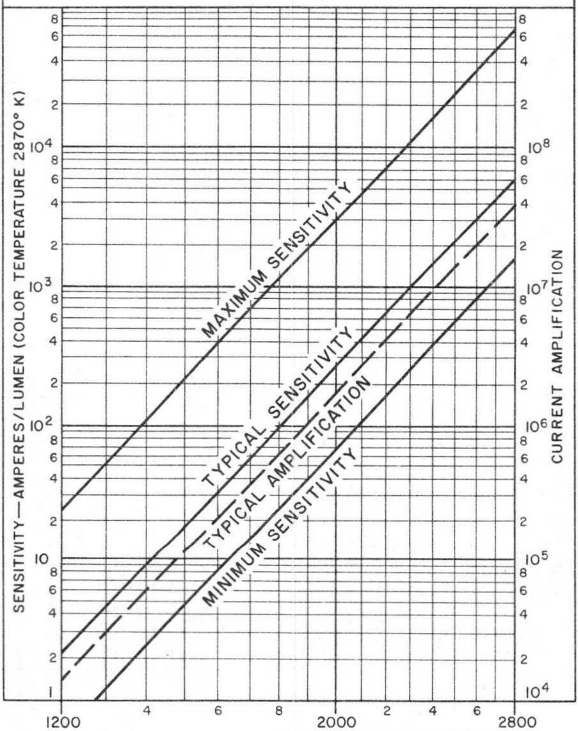
92CM—12212

SENSITIVITY AND AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.95 % OF E MULTIPLIED BY
CATHODE & DY_1	2.0
DY_1 & DY_2	1.4
DY_2 & DY_3 THROUGH DY_{12} & ANODE	1.0
ANODE & CATHODE	14.4

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN CATHODE AND DYNODE No. 1 THAT PROVIDES MAXIMUM ANODE CURRENT.



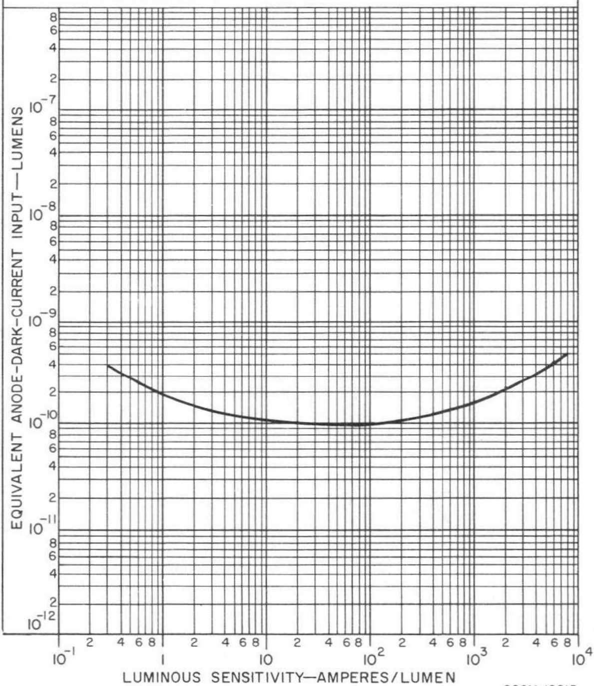
92CM-12213

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

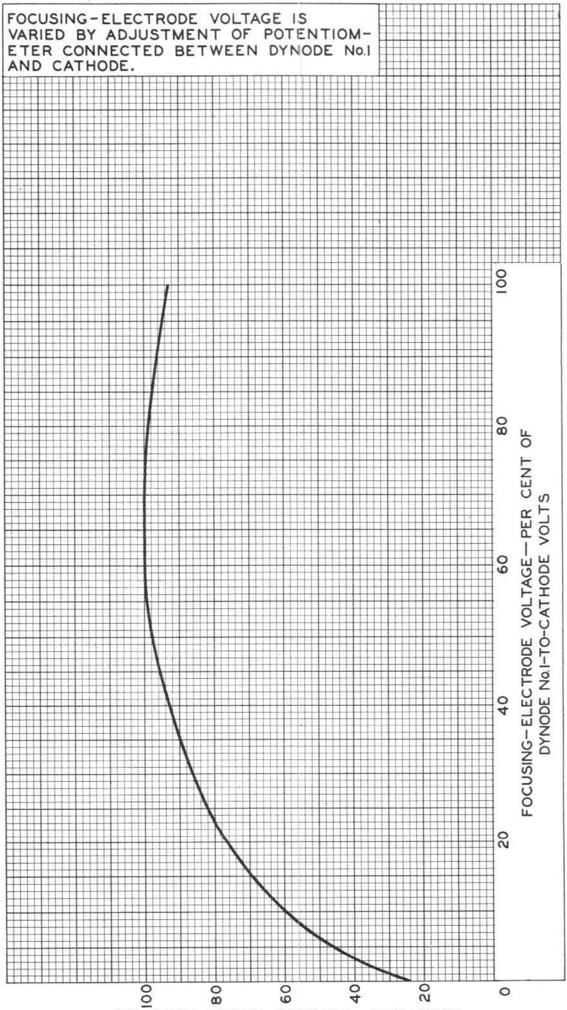
BETWEEN	6.95% OF E MULTIPLIED BY
CATHODE & DY_1	2.0
DY_1 & DY_2	1.4
DY_2 & DY_3 THROUGH DY_{12} & ANODE	1.0
ANODE & CATHODE	14.4

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN CATHODE AND DYNODE No.1 THAT PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE=25° C



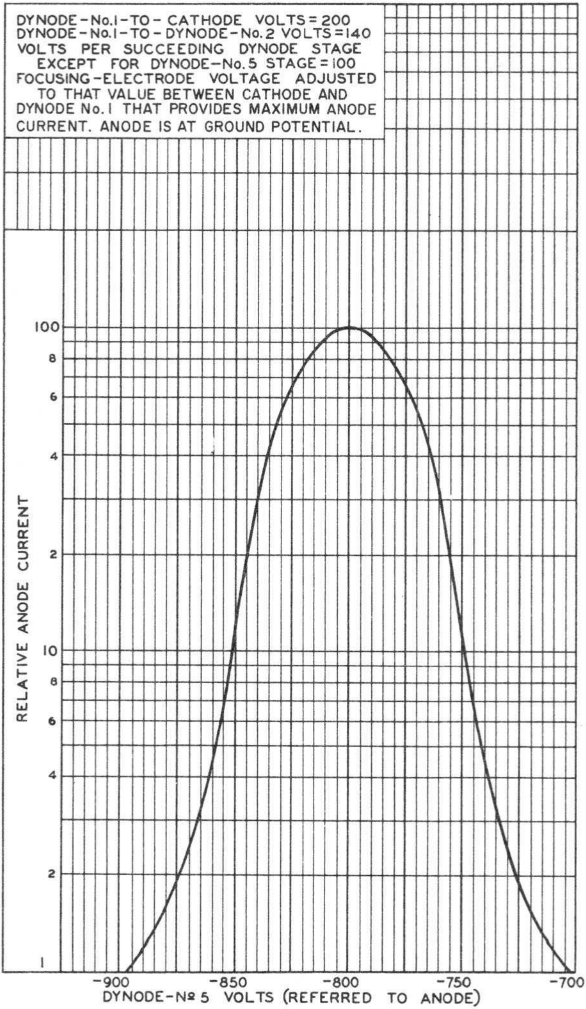
92CM-12215

AVERAGE FOCUSING-ELECTRODE-VOLTAGE CHARACTERISTIC



92CM-10590

TYPICAL ANODE-CURRENT CHARACTERISTIC



92CM-10959R1

Multiplier Phototube

S-11 RESPONSE

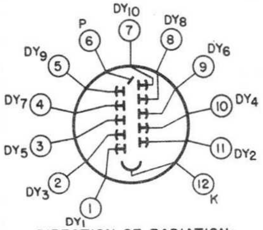
"RUGGEDIZED", 10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE — ELECTROSTATICALLY FOCUSED IN-LINE DYNODE STAGES

For Detection and Measurement of Nuclear-Radiation and Low-Level Light in Compact Industrial and Military Equipment

General:

Spectral Response. S-11
Wavelength of Maximum Response . . . . . 4400 ± 500 angstroms
Cathode, Semitransparent . . . . .Cesium-Antimony
  Minimum area . . . . 0.2 sq. in.
  Minimum diameter . . . . 0.5 in.
Window . . . . . Lime Glass (Corning[a] No.0080), or equivalent
  Shape . . . . .Plano-Concave
  Index of refraction at 5893 angstroms. 1.51
Dynode Material. . . . . Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):
  Anode to dynode No.10. . . . . 2.4 pf
  Anode to all other electrodes. . . . . 3.2 pf
Maximum Overall Length
  (Excluding semiflexible leads) . . . . 3.38"
Maximum Diameter . . . . 0.78"
Operating Position . . . . .Any
Weight (Approx.) . . . . 0.9 oz
Bulb T6
Magnetic Shield. . . . . . .Perfection Mica Co.[b], or equivalent
Base . . . . . .Small-Button Thirteenar 12-Semiflexible Lead, (JEDEC No.E12-72), and Protective Shell
  Basing Designation for BOTTOM VIEW 12BG

Lead 1 – Dynode No.1
Lead 2 – Dynode No.3
Lead 3 – Dynode No.5
Lead 4 – Dynode No.7
Lead 5 – Dynode No.9
Lead 6 – Anode
Lead 7 – Dynode No.10
Lead 8 – Dynode No.8
Lead 9 – Dynode No.6
Lead 10 – Dynode No.4
Lead 11 – Dynode No.2
Lead 12 – Photocathode



DIRECTION OF RADIATION: INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:*

Supply Voltage (DC or Peak AC):		
Between Anode and Cathode.	1500 max.	volts
Between Anode and Dynode No.10	300 max.	volts
Between Consecutive Dynodes.	250 max.	volts
Between Dynode No.1 and Cathode.	400 max.	volts
Average Anode Current[c]	0.5 max.	ma
Ambient Temperature.	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 = 1250 volts (Except as noted)

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 4400 angstroms.	–	6×10^{3}	–	a/w
Cathode radiant, at 4400 angstroms. . .	–	0.048	–	a/w
Luminous, At 0 cps[d].	3	7.5	60	a/lm
Cathode luminous:				
With tungsten light source[e].	4×10^{-5}	6×10^{-5}	–	a/lm
With blue light source[f,g].	4×10^{-8}	6×10^{-8}	–	a
Current Amplification. . .	–	1.25×10^{5}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 7.5 a/lm[h].	–	8×10^{-10}	2×10^{-9}	lm
Equivalent Noise Input[j]. .	–	3×10^{-12}	1×10^{-11}	lm
Anode-Pulse Rise Time[k] . .	–	2.1×10^{-9}	–	sec
Electron Transit Time[m] . .	–	2.3×10^{-8}	–	sec
Quantum Efficiency at 4300 angstroms	–	14	–	%

[a] Made by Corning Glass Works, Corning, New York.

[b] Magnetic shielding in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Ellston, Chicago 24, Illinois, or equivalent.

[c] Averaged over any interval of 30 seconds maximum.

[d] 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.

[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° K. The value of light flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

[f] 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, New York) 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.

[g] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

[h] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant such as dry ice.

[j] Under the following conditions: Supply voltage (E) is as shown, 25°C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

k 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.

m 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.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE
is shown at the front of this Section

ENVIRONMENTAL TESTS-

The 4460 is designed to withstand the shock, vibration, and acceleration tests shown below which are equivalent to those specified in MIL-E-5272C* for equipment mounted on the structures of missiles propelled or launched by high-thrust rocket engines. The accelerations specified in these tests are applied directly to the tubes.

One-Hundred Per-Cent Shock and Vibration Testing:

Each 4460 is subjected in sequence to shock and then to vibration as specified below with the tube non-operating.

Shock. These tests are performed first, per method of MIL-E-5272C*, Paragraph 4.15.5.1, Procedure V, on apparatus which provides a half-wave sinusoidal shock pulse. One-hundred per-cent testing of all 4460's is performed. Each 4460 is subjected to three impact shocks in each direction of the three orthogonal axes shown in the accompanying *Orthogonal Axes Used During Environmental Tests* drawing. The peak acceleration of the impact shock is 30 ± 3 g's and the time duration is 11 ± 1 milliseconds. Each tube is subjected to a total of 18 impact shocks.

Vibration. These tests are performed next, on apparatus which applies variable-sinusoidal frequency vibration to the tube, per method of MIL-E-5272C*, paragraph 4.7.14 and paragraph 4.7.14.1. One-hundred per-cent testing of all 4460's is performed. Each 4460 is vibrated in each of the three orthogonal axes shown in the accompanying *Orthogonal Axes Used During Environmental Tests* drawing and as specified in the schedule below. A vibration cycle has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 20 to 2000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period for each tube is 15 minutes.

Double Amplitude Inches	Acceleration g's	Frequency cps	Cycle Duration per axis minutes
0.050 ± 0.005	–	20 – 87	5
–	20 ± 2	87 – 2000	
–	20 ± 2	2000 – 87	
0.050 ± 0.005	–	87 – 20	

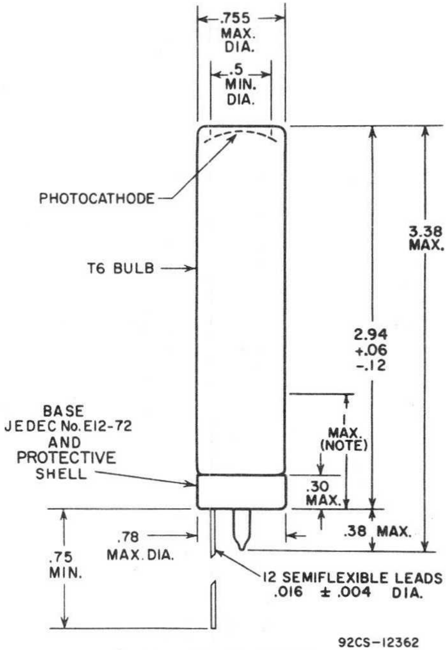
Tube Rejection Criterion. Upon completion of the *One-Hundred Per-Cent Shock and Vibration Testing* each tube is tested at a anode-to-cathode voltage of 1250 volts under the conditions shown under *Characteristics Range Values for Equipment Design* and will meet the specified values.

Design Tests:

Vibration. These tests are performed under conditions equivalent to those described in MIL-E-5272C*, paragraph 4.7.14 and paragraph 4.7.14.1. The vibration cycle has a duration of one hour and two cycles are performed for each of the three orthogonal axes shown in the accompanying *Orthogonal Axes Used During Environmental Tests* drawing. The total test period for each tube is six hours. Tubes are operating during the test.

Acceleration. These tests are performed in a centrifuge providing unidirectional acceleration by a method equivalent to that specified in MIL-E-5272C*, paragraph 4.16.3, Procedure III, except that tubes are subjected for one minute to an increased acceleration test level of 100 ± 10 g's in both directions of the three orthogonal axes shown in the accompanying *Orthogonal Axes Used During Environmental Tests* drawing and the tubes are non-operating.

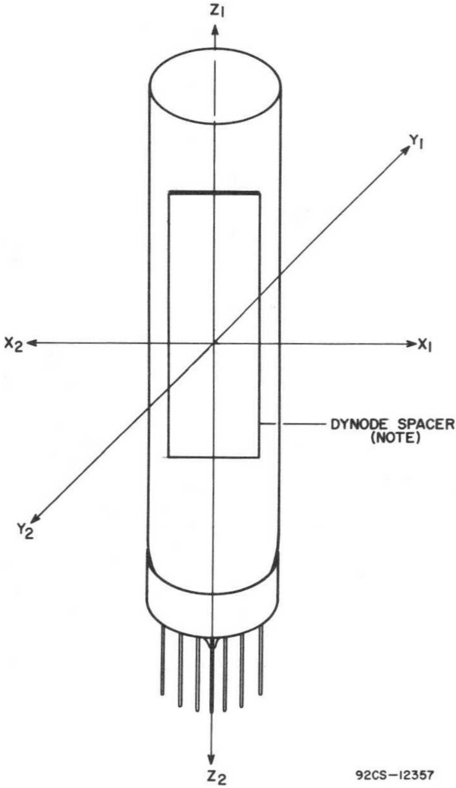
* Military Specification MIL-E-5272C (ASG), 13 April 1959; and Amendment 1, 5 January 1960.



DIMENSIONS IN INCHES

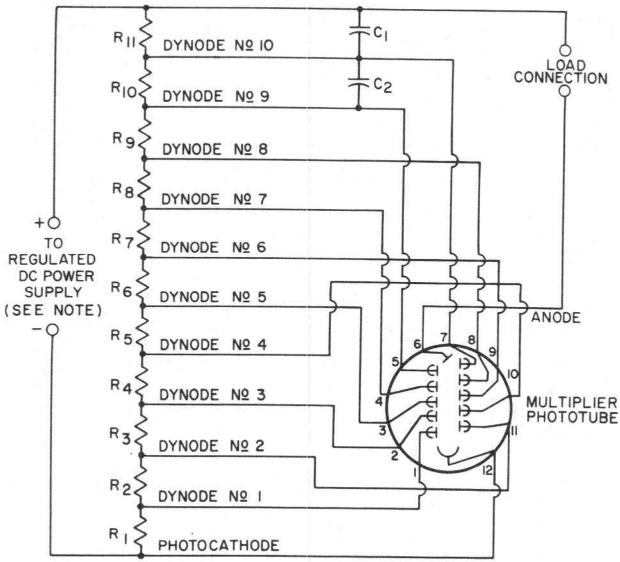
Note: Within this length, maximum diameter of tube is 0.78".

ORTHOGONAL AXES USED
DURING ENVIRONMENTAL TESTS



Note: The plane of each dynode spacer is parallel to the X-Z plane. The Z-axis is the major axis of the tube.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

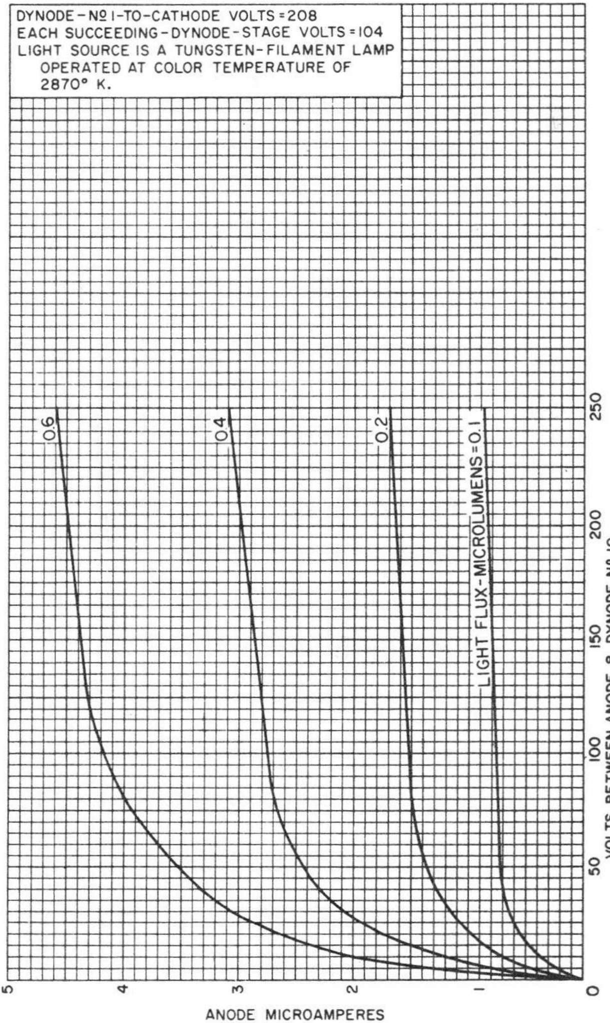


92CS—10656R1

Note: Adjustable between approximately 500 and 1500 volts DC.

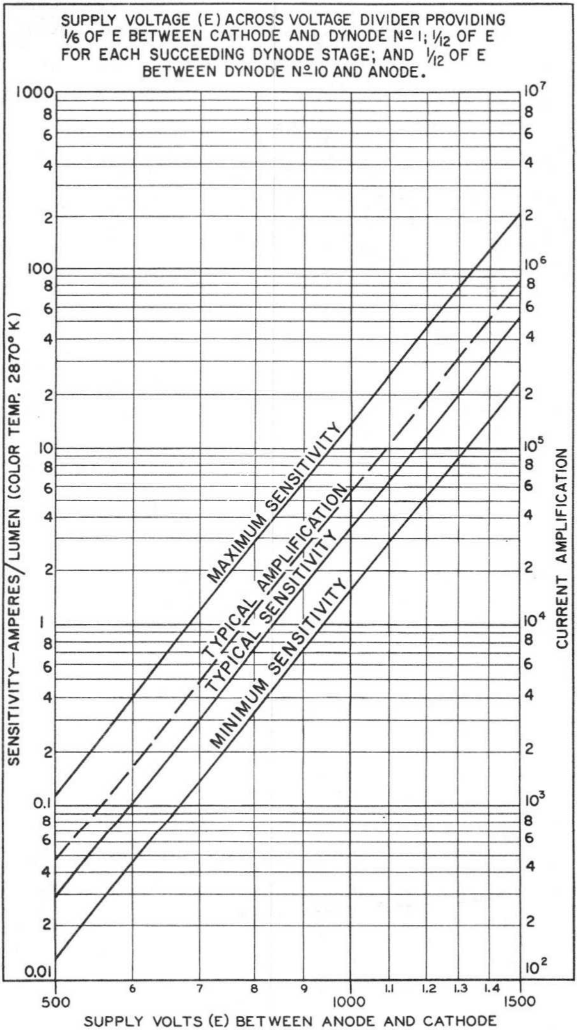
C_1, C_2: 0.01 μf, 500 volts (dc working)
R_1: 91,000 ohms, 2 watts
R_2 through R_{11}: 47,000 ohms, 1 watt

AVERAGE ANODE CHARACTERISTICS



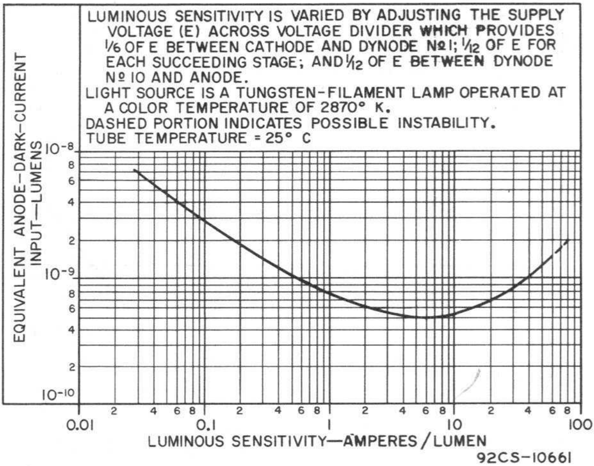
92CM-10660

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

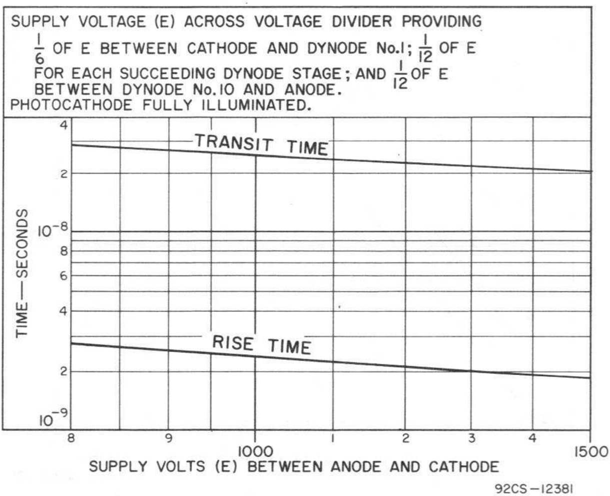


92CM-10657RI

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



TYPICAL TIME RESOLUTION CHARACTERISTICS



Photomultiplier Tube[q]

RUGGED VIBRATION-RESISTANT STRUCTURE

S-11 RESPONSE — **ELECTROSTATICALLY FOCUSED DYNODE STAGES**

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE

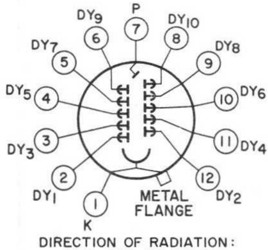
For Detection and Measurement of Nuclear Radiation and other Low-Level Light Sources. Especially Useful in Missile and Rocket Service and other Industrial and Military Applications where Severe Environmental Conditions may be Encountered.

General:

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 angstroms
Cathode, Semitransparent	Cesium-Antimony
Minimum area	1.2 sq. in.
Minimum diameter	1.24"
Window	Lime Glass (Corning[a] No.0080), or equivalent
Shape	Plano-plano
Index of refraction at 5893 angstroms	1.51
Dynode Material	Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.10	3.2 pf
Anode to all other electrodes	5.0 pf
Maximum Overall Length (Excluding semiflexible leads)	3.18"
Maximum Diameter	1.56"
Operating Position	Any
Weight (Approx.)	2.2 oz
Bulb	T12
Magnetic Shield	Millen Co.[b], or equivalent
Base	Special

Terminal Diagram: BOTTOM VIEW

Lead 1 & Metal Flange—Photocathode
Lead 2 – Dynode No.1
Lead 3 – Dynode No.3
Lead 4 – Dynode No.5
Lead 5 – Dynode No.7
Lead 6 – Dynode No.9
Lead 7 – Anode
Lead 8 – Dynode No.10
Lead 9 – Dynode No.8
Lead 10 – Dynode No.6
Lead 11 – Dynode No.4
Lead 12 – Dynode No.2



Maximum Ratings, *Absolute-Maximum Values:*

DC Supply Voltage:		
Between anode and cathode	1500	volts
Between anode and dynode No.10	250	volts
Between consecutive dynodes	200	volts
Between dynode No.1 and cathode	400	volts
Average Anode Current[c]	1	ma
Average Cathode Current[c,d]	2	μa
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 anode and dynode No. 10 and anode.

With E = 1250 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4400 angstroms		8×10^{-3}	–	a/w
Cathode radiant, at 4400 angstroms	–	0.048	–	a/w
Luminous, at 0 cps[e] . . .	3	10	90	a/lm
With dynode No. 10 as output electrode[f]. . .	–	6	–	a/lm
Cathode luminous:				
With tungsten light source[g].	4×10^{-5}	6×10^{-5}	–	a/lm
With blue light source[h].	4×10^{-8}	6×10^{-8}	–	a
Current Amplification .	–	1.7×10^{-5}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 10 a/lm[j]	–	5×10^{-10}	2×10^{-9}	lm
Equivalent Noise Input[k,m]	–	2.8×10^{-12}	1.8×10^{-11}	lm
Anode-Pulse Rise Time[n]. .	–	2.4×10^{-9}	–	sec
Electron Transit Time[p]. .	–	2.9×10^{-8}	–	sec
Quantum Efficiency at 4300 angstroms.	–	14	–	%

With E = 750 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	1.8×10^{-2}	–	a/w
Cathode radiant, at 4400 angstroms	–	0.048	–	a/w
Luminous, at 0 cps[e] . . .	–	0.22	–	a/lm
Cathode luminous:				
With tungsten light source[g].	4×10^{-5}	6×10^{-5}	–	a/lm
With blue light source[h].	4×10^{-8}	6×10^{-8}		a
Current Amplification . .	–	3.7×10^{-3}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 10 a/lm[j]	–	5×10^{-10}	2×10^{-9}	lm
Anode-Pulse Rise Time[k]. . .	–	3.1×10^{-9}	–	sec
Electron Transit Time[p] . .	–	3.8×10^{-8}	–	sec

[a] Made by Corning Glass Works, Corning, New York.

[b] Magnetic shielding in the form of foil or tape as available from the James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts, or equivalent.

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c Averaged over any interval of 30 seconds maximum.

d For a uniformly illuminated area of 0.5 square inches minimum.

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° K and at a light input of 10 microlumens.

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 a collector. The curves under *Typical Anode Characteristics* do 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° 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, 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° 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.

j At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

k For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1250 volts is recommended.

m Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

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 variations and is measured under conditions with an 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.

q Alternate designation for Multiplier Phototube.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE
is shown at the front of this Section

ENVIRONMENTAL TESTS:

The 4461 is designed to withstand the shock, vibration, and acceleration tests shown below which are equivalent to those specified in MIL-E-5272C* for equipment mounted on the structures of missiles propelled or launched by high-thrust rocket engines. The accelerations specified in these tests are applied directly to the tubes.

One-Hundred Per-Cent Shock and Vibration Testing:

Each 4461 is subjected in sequence to shock and then to vibration as specified below with the tube non-operating.

Shock. These tests are performed first, per method of MIL-E-5272C*, Paragraph 4.15-5.1, Procedure V, on apparatus which provides a half-wave sinusoidal shock pulse. One-hundred per-cent testing of all 4461's is performed. Each 4461 (non-operating) is subjected to three impact shocks in each direction of the three orthogonal axes. The peak acceleration of the impact shock is 30 ± 3 g's and the time duration is 11 ± 1 milliseconds. Each tube is subjected to a total of 18 impact shocks.

Vibration. These tests are performed next, on apparatus which applies variable-sinusoidal frequency vibration to the tube, per method of MIL-E-5272C*, paragraph 4.7.14 and paragraph 4.7.14.1. One hundred per-cent testing of all 4461's is performed. Each 4461 is vibrated in each of the three orthogonal axes as specified in the schedule below. A vibration cycle has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 20 to 2000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period for each tube is 15 minutes.

Double Amplitude Inches	Acceleration g's	Frequency cps	Cycle Duration Per Axis minutes
0.050 ± 0.005	-	20 - 87	5
-	20 ± 2	87 - 2000	
-	20 ± 2	2000 - 87	
0.050 ± 0.005	-	87 - 20	

Tube Rejection Criterion. Upon completion of the *Shock and Vibration Testing* each tube is tested at a anode-to-cathode voltage of 1250 volts with the light level incident on the tube adjusted to provide an anode current of approximately 8 microamperes. Electrical and/or mechanical tube failures due to shock or vibration will be observed during the vibration test when the specified anode current is monitored. Tube rejection criterion for both tests is that the anode current of 8 microamperes will not change more than ±20 per cent upon completion of the vibration test for each axis.

Design Tests:

Vibration. These tests are performed under conditions equivalent to those described in MIL-E-5272C*, paragraph 4.7.14 and paragraph 4.7.14.1. The vibration cycle has a duration of one hour and two cycles are performed for each of the three orthogonal axes. The total test period for each tube is six hours.

Acceleration. These tests are performed in a centrifuge providing unidirectional acceleration by a method equivalent to that specified in MIL-E-5272C*, paragraph 4.16.3, Procedure III, except that tubes are subjected for one minute to an increased acceleration test level of 100 ± 10 g's in both directions of the three orthogonal axes. The tubes are non-operating during the test.

* Military Specification MIL-E-5272C (ASG), 13 April 1959; and Amendment 1, 5 January 1960.

OPERATING CONSIDERATIONS

The *operating stability* of the 4461 is dependent on the magnitude of the anode current and its duration. When operating at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 4461 usually recovers a substantial percentage of such loss in sensitivity.

It is recommended that the average anode current be well below the maximum rated value of 1 milliampere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

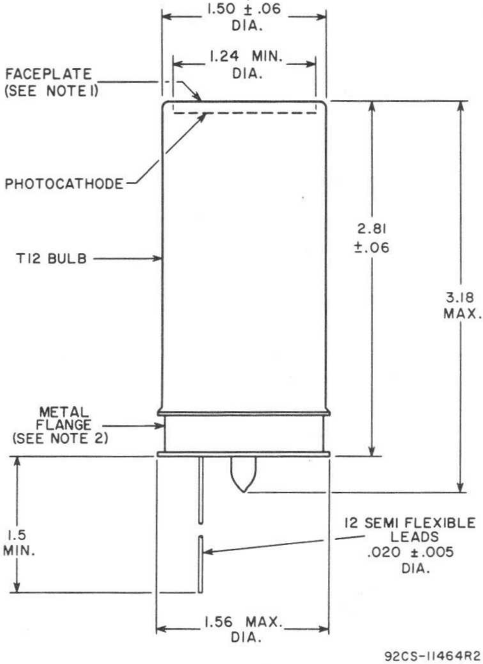
Electrostatic and/or *magnetic shielding* of the 4461 may be necessary.

Adequate *shielding* should be provided to prevent extraneous radiation from reaching any part of the 4461.

The *high voltages* at which the 4461 is operated are very dangerous. Before any part of the circuit is touched, the power supply switch should be turned off and both terminals of any capacitors grounded.

Accompanying *Typical Voltage-Divider Arrangement* is recommended for use with the 4461. *Resistance values* for the voltage-divider arrangement range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for the voltage-divider network is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the regulated power supply and the required wattage rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is near the photocathode. The use of resistance values near 1 megohm per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value several times that of the maximum value of anode current, and may limit anode-current response to pulsed light. The latter effect may be reduced by connecting capacitors between the leads for dynodes No.7 and No.8, dynodes No.8 and No.9, dynodes No.9 and No.10, and between dynode No.10 and anode return. In addition to non-linearity and pulse-limiting effects, the use of resistance values exceeding 1 megohm per stage make the 4461 more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.

DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

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

Note 1: Deviation from flatness within the 1.24 inch diameter area will not exceed 0.010 inch from peak to valley.

Note 2: The metal flange should never be employed for mechanical mounting purposes.

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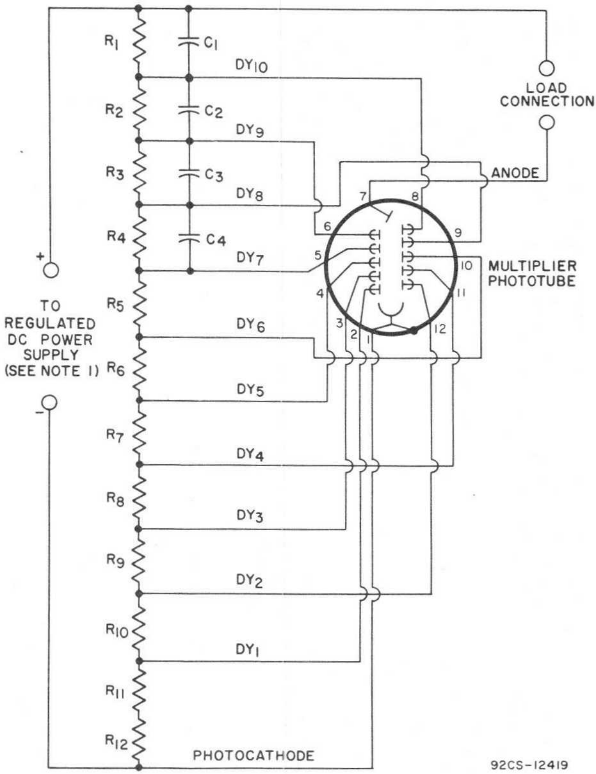
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

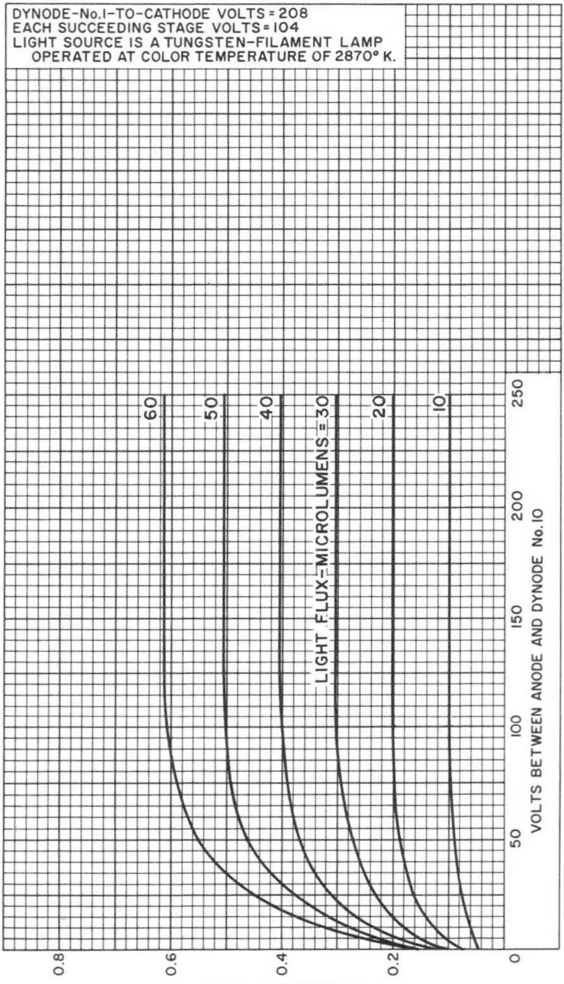


C_1: 0.05 μf, 500 volts (dc working)
C_2: 0.02 μf, 500 volts (dc working)
C_3: 0.01 μf, 500 volts (dc working)
C_4: 0.005 μf, 500 volts (dc working)
R_1 through R_{12}: 33,000 ohms, 2 watts

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

Note 2: Capacitors C_1 through C_4 should be connected at tube socket for optimum high-frequency performance.

Typical Anode Characteristics



92CM-12414

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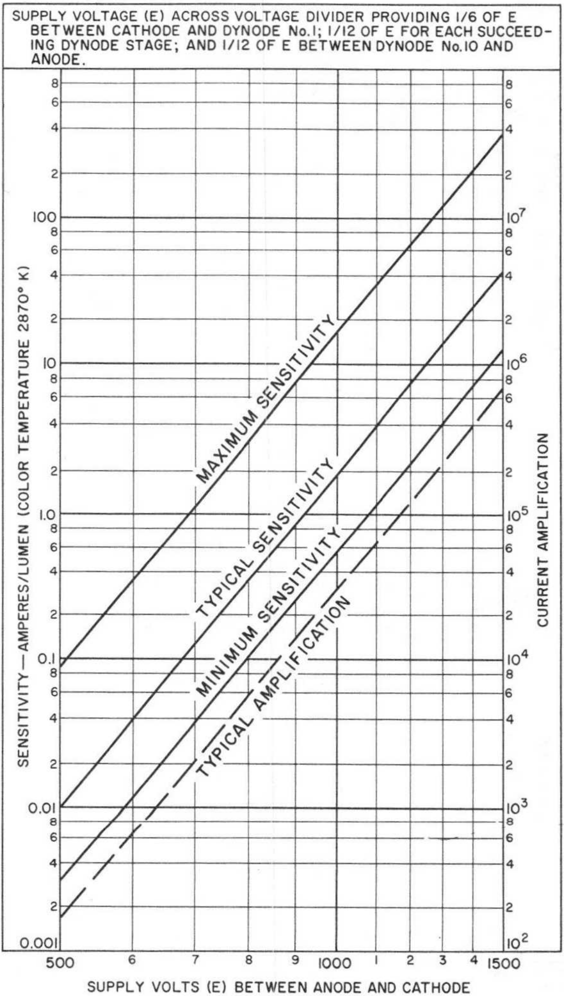
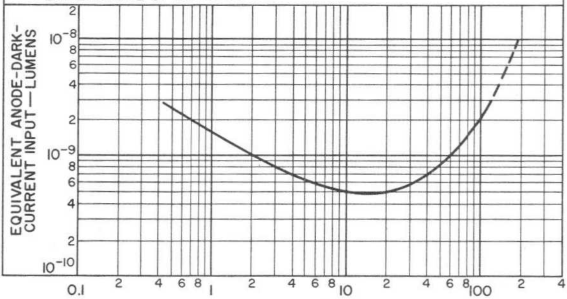
Typical Sensitivity And Current Amplification Characteristics



92CM-12412

Typical Anode-Dark-Current Characteristic

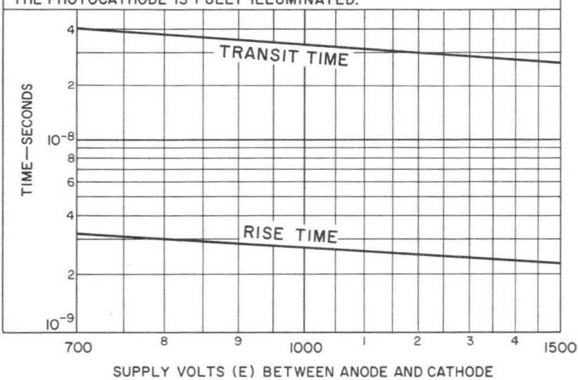
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/6 OF E BETWEEN CATHODE AND DYNODE No 1; 1/12 OF E FOR EACH SUCCEEDING STAGE; AND 1/12 OF E BETWEEN DYNODE No. 10 AND ANODE.
TUBE TEMPERATURE = 25° C
DASHED PORTION INDICATES INSTABILITY.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.



92CS-12410

Typical Time Resolution 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.
THE PHOTOCATHODE IS FULLY ILLUMINATED.



92CS-12408

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Multiplier Phototube

S-20 RESPONSE

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE

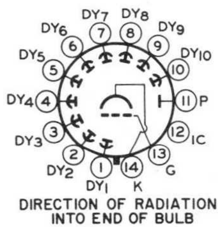
VENETIAN-BLIND-TYPE DYNODE STRUCTURE

For Photometry, Flying-Spot Scanning, and Scintillation-Counter Equipment Requiring Low-Dark Current and High Sensitivity Over a Wide Spectrum (Blue through Near-Infrared).

General:

Spectral Response S-20
Wavelength of Maximum Response . . . . 4200 ± 500 angstroms
Cathode, Semitransparent . . Potassium-Sodium-Cesium-Antimony (Multialkali)
  Shape . . . . Flat, Circular
  Minimum area . . . . 2.2 sq. in.
  Minimum diameter . . . . 1.68 in.
Window . . . . Borosilicate Glass[a]
  Index of refraction at 5893 angstroms 1.48
Dynode Material . . . . Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):
  Anode to dynode No. 10 . . . . 7 pf
  Anode to all other electrodes . . . . 8.5 pf
Maximum Overall Length . . . . 5.81"
Seated Length . . . . 4.87" ± 0.19"
Maximum Diameter . . . . 2.31"
Operating Position . . . . Any
Weight (Approx.) . . . . 7 oz
Bulb T16
Socket . . . . Cinch[b] No. 3M14, or equivalent
Magnetic Shield . . . . JAN[c] No. S-2004, 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

Maximum Ratings, *Absolute-Maximum Values:*

DC Supply Voltage:		
Between anode and cathode.	2500 max.	volts
Between anode and dynode No.10	300 max.	volts
Between consecutive dynodes.	300 max.	volts
Between dynode No.1 and cathode.	600 max.	volts
Between focusing electrode and cathode .	600 max.	volts
Average Anode Current[d]	1 max.	ma
Ambient Temperature.	85 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 anode and dynode No.10. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

With E = 2000 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4200 angstroms	–	1.1×10^4	–	a/w
Cathode radiant, at 4200 angstroms. .	–	6.8×10^{-2}	–	a/w
Luminous, at 0 cps[e]. .	12	25	240	a/lm
Cathode luminous:				
With tungsten light source[f] . .	1.2×10^{-4}	1.6×10^{-4}	–	a/lm
With blue light source[g,h]	5×10^{-8}	–	–	a
With red light source[j,k]	3×10^{-7}	–	–	a
Current Amplification .	–	1.6×10^5	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 12 a/lm[m] . .	–	4×10^{-10}	1×10^{-9}	lm
Equivalent Noise Input .	–	–	3.8×10^{-12}	lm
Anode-Pulse Rise Time[n] .	–	9.8×10^{-9}	–	sec
Electron Transit Time[p] .	–	5.2×10^{-8}	–	sec

With E = 1500 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4200 angstroms	–	2.1×10^3	–	a/w
Cathode radiant, at 4200 angstroms .	–	6.8×10^{-2}	–	a/w
Luminous, at 0 cps[e]. .	–	5	–	a/lm

	Min.	*Typ.*	*Max.*	
Cathode luminous:				
With tungsten light source[f] .	1.2×10^{-4}	1.6×10^{-4}	-	a/lm
With blue light source[g,h] . . .	5×10^{-8}	–	–	a
With red light source[j,k] . . .	3×10^{-7}	–	–	a
Current Amplification	–	3.1×10^{4}	–	
Equivalent Anode-Dark Current Input at a luminous sensitivity of 12 a/lm[m]	–	4×10^{-10}	1×10^{-9}	lm

[a] Corning No.7056 made by Corning Glass Works, Corning, New York, or equivalent.

[b] Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.

[c] Made by JAN Hardware Manufacturing Company, 38-01 Queens Blvd., Long Island City 1, New York.

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

[f] 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.

[g] 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. New York) 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.

[h] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

[j] Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62, manufactured by the Corning Glass Works, Corning, New York) 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.

[k] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Red Filter* at front of this Section.

[m] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[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 CONSIDERATIONS

The *operating stability* of the 4463 is dependent on the magnitude of the anode current and its duration. When the 4463 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 4463 usually recovers a substantial percentage of such loss in sensitivity.

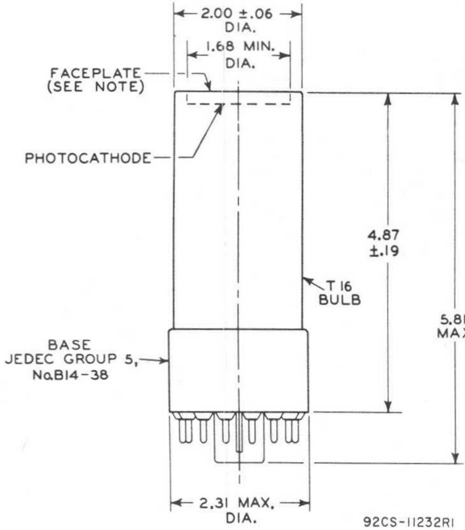
It is recommended that the average anode current be well below the maximum-rated value of 1 milliampere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Electrostatic and/or *magnetic shielding* of the 4463 may be necessary.

Adequate *shielding* should be provided to prevent extraneous radiation from reaching any part of the 4463.

The *high voltages at which the 4463 is operated are very dangerous.* Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

**SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE
is shown at the front of this Section**



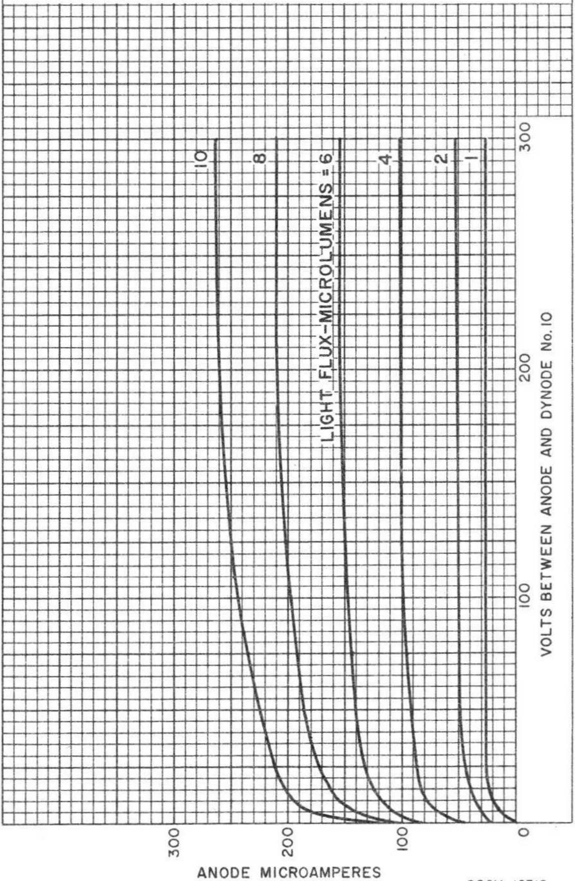
DIMENSIONS IN INCHES

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

Note: Within 1.68" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.

TYPICAL ANODE CHARACTERISTICS

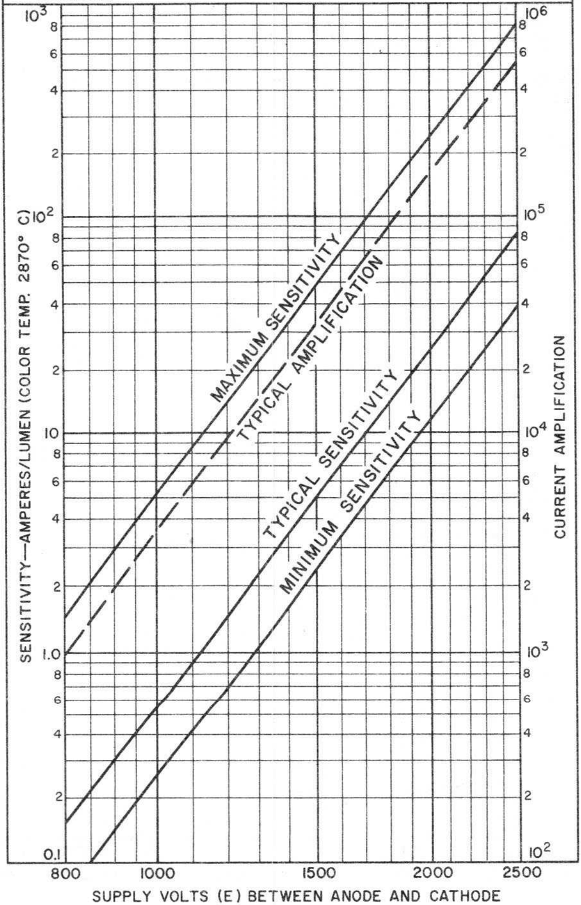
DYNODE No. I-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.



92CM-12310

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

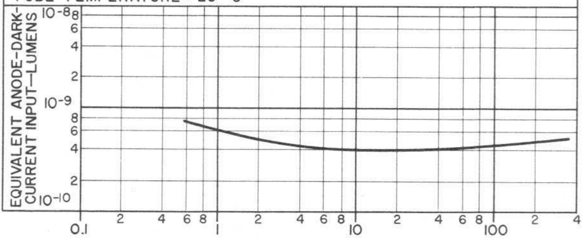
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.



92CM-12312

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

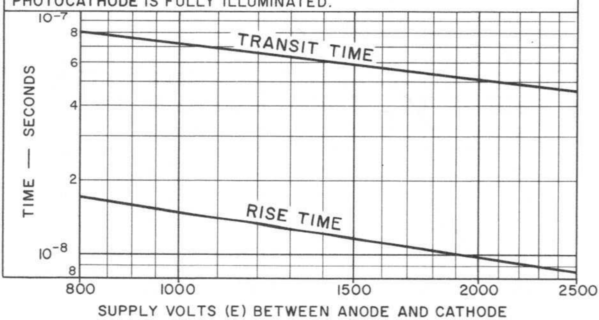
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C



92CS-12311

TYPICAL TIME RESOLUTION CHARACTERISTICS

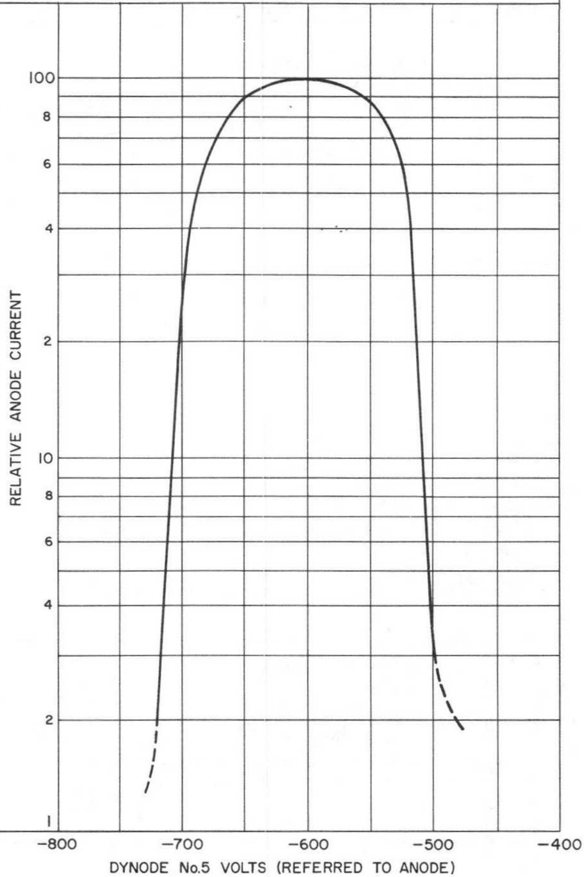
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS FULLY ILLUMINATED.



92CS-12309

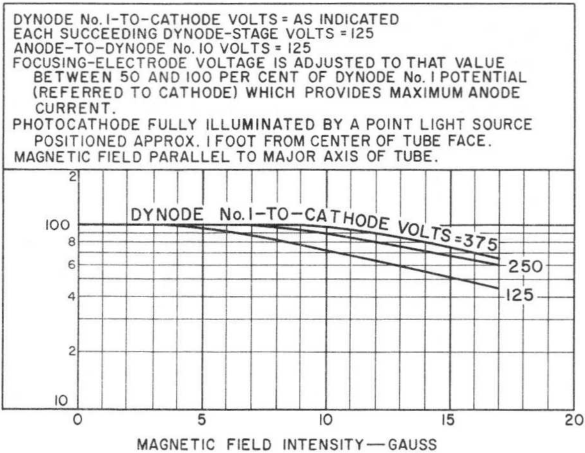
TYPICAL ANODE-CURRENT CHARACTERISTIC

DYNODE No. 1-TO-CATHODE VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE-No. 5 STAGE = 100
ANODE-TO-DYNODE No. 10 VOLTS = 100
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
ANODE IS AT GROUND POTENTIAL.

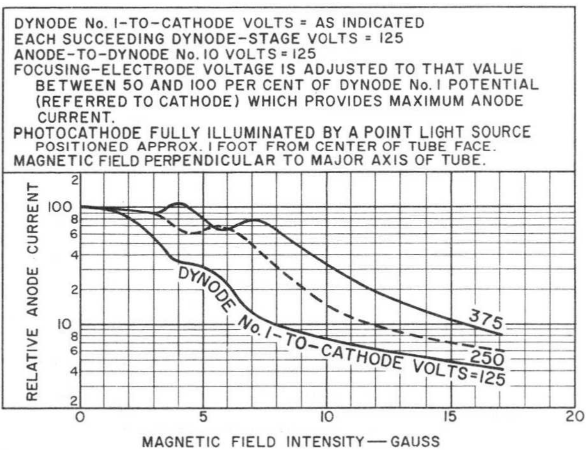


92CM-11078R1

TYPICAL ANODE-CURRENT CHARACTERISTICS



92CS-11235R2



92CS-11236R2

Multiplier Phototube

S-20 RESPONSE

10-STAGE, HEAD-ON,
FLAT-FACEPLATE TYPE

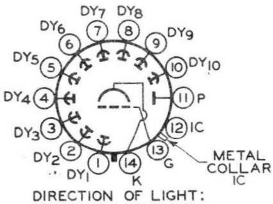
VENETIAN-BLIND-TYPE
DYNODE STRUCTURE

For Photometry, Flying-Spot Scanning, and Scintillation-Counter Equipment Requiring Low-Dark Current and High Sensitivity Over a Wide Spectrum (Blue through Near-Infrared).

General:

Spectral Response S-20
Wavelength of Maximum Response . . . . . . 4200 ± 500 angstroms
Cathode, Semitransparent . . . . K-Na-Cs-Sb (Multialkali)
  Shape . . . . Flat, Circular
  Minimum area . . . . 5.27 sq. in.
  Minimum diameter . . . . 2.59 in.
Window . . . . Lime Glass[a]
  Index of refraction at 5893 angstroms 1.51
Dynode Material . . . . Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):
  Anode to dynode No.10 . . . . 7 pf
  Anode to all other electrodes . . . . 8.5 pf
Maximum Overall Length . . . . 6.31"
Seated Length . . . . 5.38" ± 0.18"
Maximum Diameter . . . . 3.06"
Operating Position . . . . Any
Weight (Approx.) . . . . 7 oz
Bulb J24
Socket . . . . Cinch[b] No.3M14, or equivalent
Magnetic Shield . . . . . . Perfection Mica Co.[c], or equivalent
Base . . . . Medium-Shell Diheptal 14-Pin
  (JEDEC Group 5, No.B14-45) Non-hygroscopic
  Basing Designation for BOTTOM VIEW 14AM

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
Metal
  Collar - Do Not Use



DIRECTION OF LIGHT:
INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:*

DC Supply Voltage:		
Between anode and cathode	2500 max.	volts
Between anode and dynode No.10	300 max.	volts
Between consecutive dynodes	300 max.	volts
Between dynode No.1 and cathode	600 max.	volts
Between focusing electrode and cathode	600 max.	volts
Average Anode Current[d]	1 max.	ma
Ambient Temperature	85 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 anode and dynode No.10. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

With E = 2000 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4200 angstroms	–	1.1×10^4	–	a/w
Cathode radiant, at 4200 angstroms	–	6.8×10^{-2}	–	a/w
Luminous, at 0 cps[e]	12	25	240	a/lm
Cathode luminous:				
With tungsten light source[f]	1.2×10^{-4}	1.6×10^{-4}	–	a/lm
With blue light source[g,h]	5×10^{-8}	–	–	a
With red light source[j,k]	3×10^{-7}	–	–	a
Current Amplification	–	1.6×10^5	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 12 a/lm[m]	–	4×10^{-10}	1×10^{-9}	lm
Equivalent Noise Input	–	–	3.8×10^{-12}	lm
Anode-Pulse Rise Time[n]	–	1.16×10^{-8}	–	sec
Electron Transit Time[p]	–	5.8×10^{-8}	–	sec

With E = 1500 volts (Except as noted)

	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4200 angstroms	–	2.1×10^3	–	a/w
Cathode radiant, at 4200 angstroms	–	6.8×10^{-2}	–	a/w
Luminous, at 0 cps[e]	–	5	–	a/lm

	Min.	Typ.	Max.	
Cathode luminous:				
With tungsten light source[f]	1.2×10^{-4}	1.6×10^{-4}	–	a/lm
With blue light source[g,h]	5×10^{-8}	–	–	a
With red light source[j,k]	3×10^{-7}	–	–	a
Current Amplification. . .	–	3.1×10^{4}	–	
Equivalent Anode-Dark Current Input at a luminous sensitivity of 12 a/lm[m]	–	4×10^{-10}	1×10^{-9}	lm

[a] Corning No.0080 made by Corning Glass Works, Corning, New York, or equivalent.

[b] Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.

[c] Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Ellston, Chicago 24, Illinois, or equivalent.

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

[f] 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.

[g] 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, New York) 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.

[h] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

[j] Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62, manufactured by the Corning Glass Works, Corning, New York) 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.

[k] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Red Filter* at front of this Section.

[m] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[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 CONSIDERATIONS

It is recommended that the average anode current be well below the maximum-rated value of 1 milliampere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

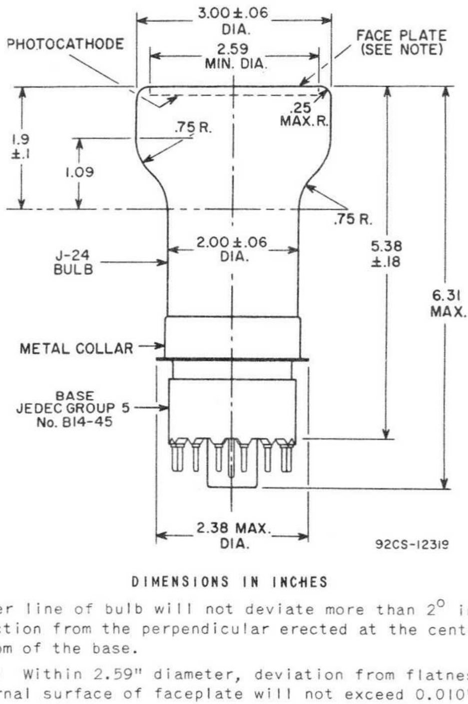
Electrostatic and/or *magnetic shielding* of the 4464 may be necessary.

Adequate *shielding* should be provided to prevent extraneous radiation from reaching any part of 4464.

The *operating stability* of the 4464 is dependent on the magnitude of the anode current and its duration. When the 4464 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 4464 usually recovers a substantial percentage of such loss in sensitivity.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE
is shown at the front of this Section

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
shown under Type 4463 also applies to Type 4464



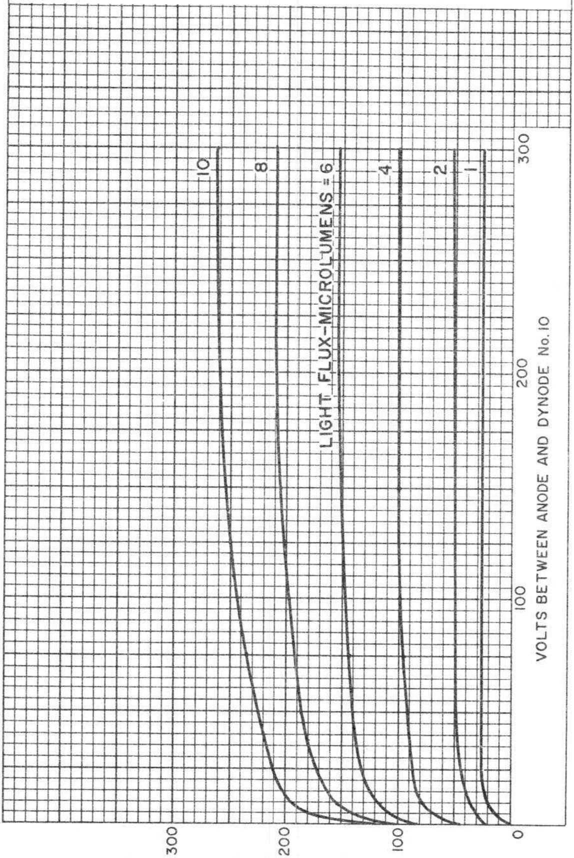
DIMENSIONS IN INCHES

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

NOTE: Within 2.59" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.

TYPICAL ANODE CHARACTERISTICS

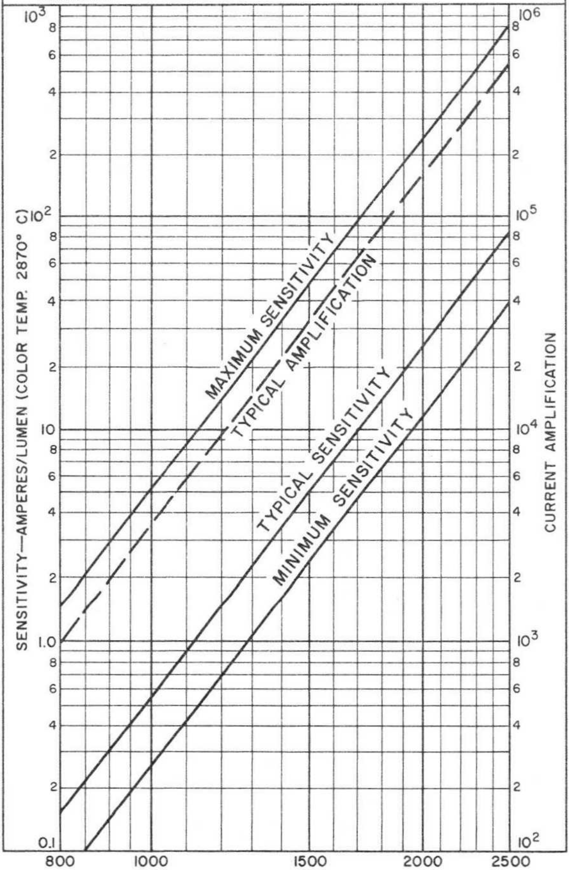
DYNODE No. I-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.



92CM-12310

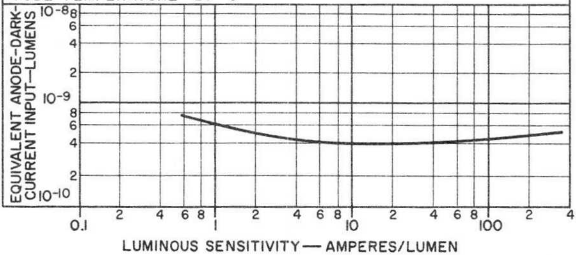
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.



TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

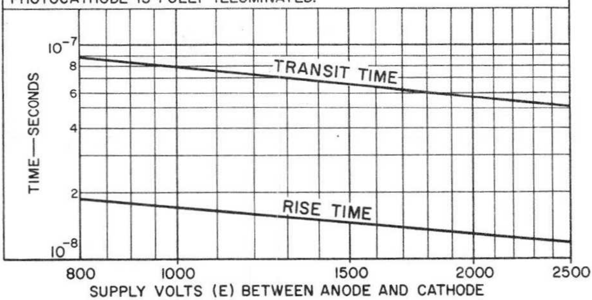
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C



92CS-12311

TYPICAL TIME RESOLUTION CHARACTERISTICS

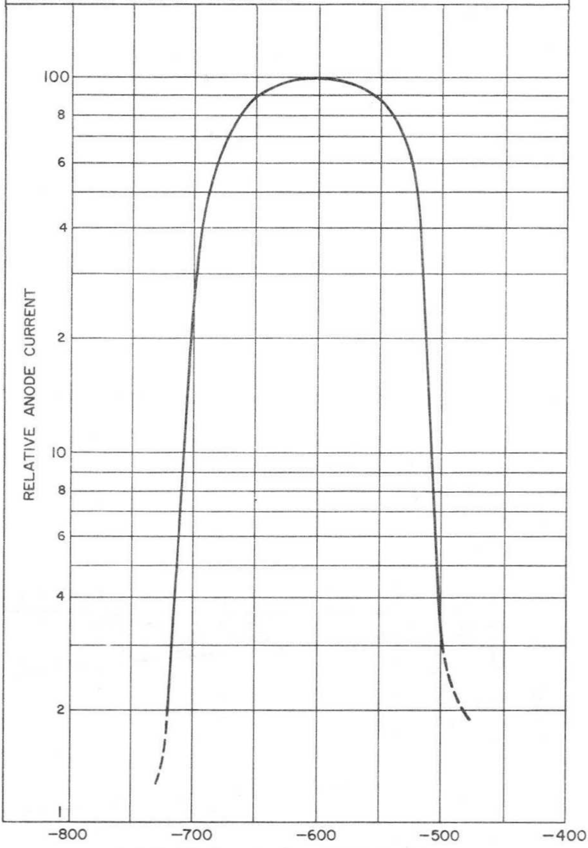
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS FULLY ILLUMINATED.



92CS-12314

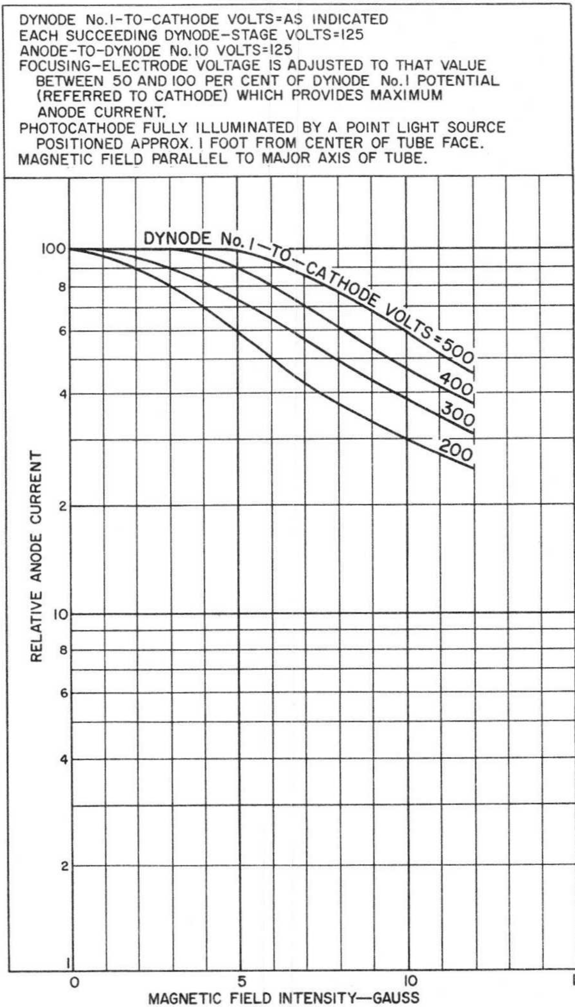
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-No.5 VOLTS

DYNODE No. 1-TO-CATHODE VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE-No. 5 STAGE = 100
ANODE-TO-DYNODE No. 10 VOLTS = 100
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
ANODE IS AT GROUND POTENTIAL.



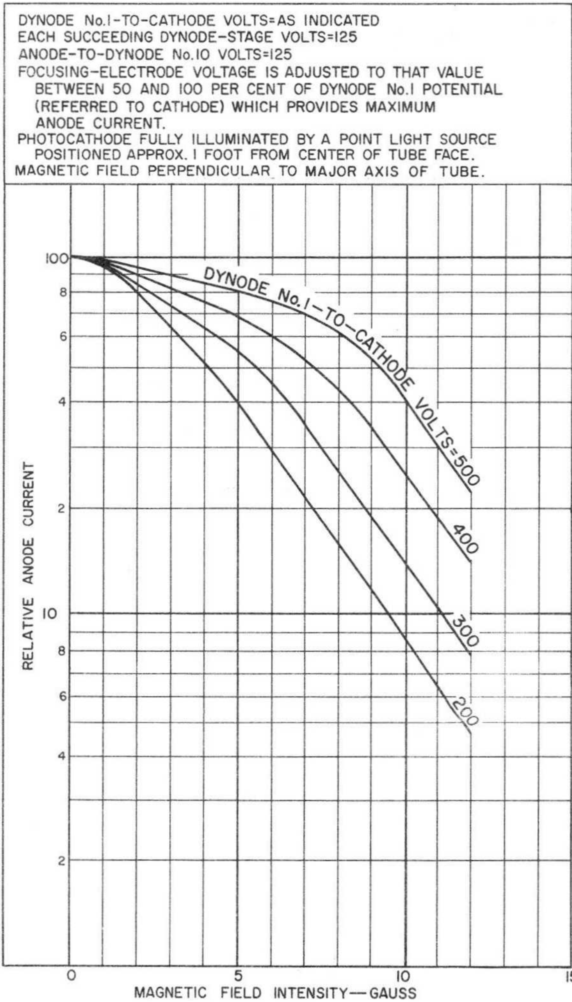
92CM-11078R1

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



92CM-11084R2

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



92CM-11085R2

Multiplier Phototube

S-20 RESPONSE

10-STAGE, HEAD-ON
FLAT-FACEPLATE TYPE

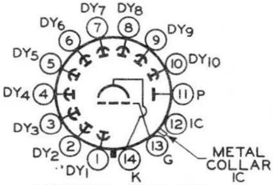
VENETIAN-BLIND-TYPE
DYNODE STRUCTURE

For Photometry, Flying-Spot Scanning, and Scintillation-Counter Equipment Requiring Low-Dark Current and High Sensitivity Over a Wide Spectrum (Blue Visible Well into Near Infrared).

General:

Spectral Response	S-20
Wavelength of Maximum Response	4200 ± 500 angstroms
Cathode, Semitransparent	K-Na-Cs-Sb (Multialkali)
Shape	Flat, Circular
Minimum area	15.1 sq.in.
Minimum diameter	4.38 in.
Window	Lime Glass[a]
Index of refraction at 5893 angstroms	1.51
Dynode Material	Copper-Beryllium
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.10	7 pf
Anode to all other electrodes	8.5 pf
Maximum Overall Length	7.69"
Seated Length	6.75" ± 0.19"
Maximum Diameter	5.31"
Operating Position	Any
Weight (Approx.)	1 lb 7 oz
Bulb	J42
Socket	Cinch[b] No.3M14, or equivalent
Magnetic Shield	Perfection Mica Co.[c], or equivalent
Base	Small-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-45), Non-hygroscopic
Basing Designation for BOTTOM VIEW	14AM

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
Metal Collar - Do Not Use



DIRECTION OF LIGHT: INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:*

DC Supply Voltage:		
Between anode and cathode.	2500 max.	volts
Between anode and dynode No.10	300 max.	volts
Between consecutive dynodes.	300 max.	volts
Between dynode No.1 and cathode.	600 max.	volts
Between focusing electrode and cathode .	600 max.	volts
Average Anode Current[d]	1 max.	ma
Ambient Temperature.	85 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. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

With E = 2000 volts (Except as noted)

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 4200 angstroms.	–	1.1×10^{4}	–	a/w
Cathode radiant, at 4200 angstroms. .	–	6.8×10^{-2}	–	a/w
Luminous, at 0 cps[e]. .	12	25	240	a/lm
Cathode luminous:				
With tungsten light source[f]. . .	1.2×10^{-4}	1.6×10^{-4}	–	a/lm
With blue light source[g,h].	5×10^{-8}	–	–	a
With red light source[j,k].	3×10^{-7}	–	–	a
Current Amplification. .	–	1.6×10^{5}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 12 a/lm[m].	–	4×10^{-10}	1×10^{-9}	lm
Equivalent Noise Input .	–	–	3.8×10^{-12}	lm
Anode-Pulse Rise Time[n] .	–	1.65×10^{-8}	–	sec
Electron Transit Time[p] .	–	9.3×10^{-8}	–	sec

With E = 1500 volts (Except as noted)

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Radiant, at 4200 angstroms.	–	2.1×10^{3}	–	a/w
Cathode radiant, at 4200 angstroms. . .	–	6.8×10^{-2}	–	a/w
Luminous, at 0 cps[e]. . .	–	5	–	a/lm

	Min.	*Typ.*	*Max.*	
Cathode luminous:				
With tungsten light source[f]	1.2×10^{-4}	1.6×10^{-4}	–	a/lm
With blue light source[g,h]	5×10^{-8}	–	–	a
With red light source[j,k]	3×10^{-7}	–	–	a
Current Amplification. . .	–	3.1×10^{4}	–	
Equivalent Anode-Dark-Current Input at a luminous sensitivity of 12 a/lm[m]	–	4×10^{-10}	1×10^{-9}	lm

[a] Corning No.0080 made by Corning Glass Works, Corning, New York, or equivalent.

[b] Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.

[c] Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Ellston, Chicago 24, Illinois, or equivalent.

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

[f] 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.

[g] 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, New York) 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.

[h] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

[j] Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62, manufactured by the Corning Glass Works, Corning, New York) 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.

[k] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after passing through Indicated Red Filter* at front of this Section.

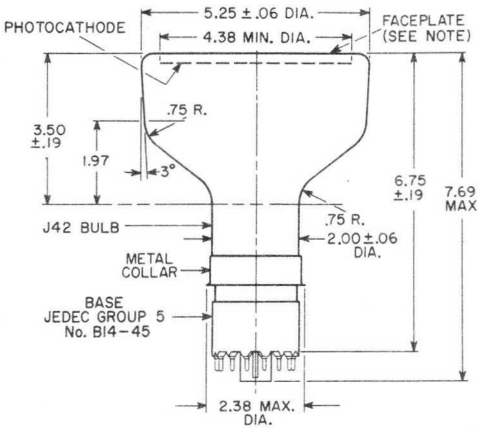
[m] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[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.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE
is shown at the front of this Section

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
shown under Type 4463 also applies to Type 4465

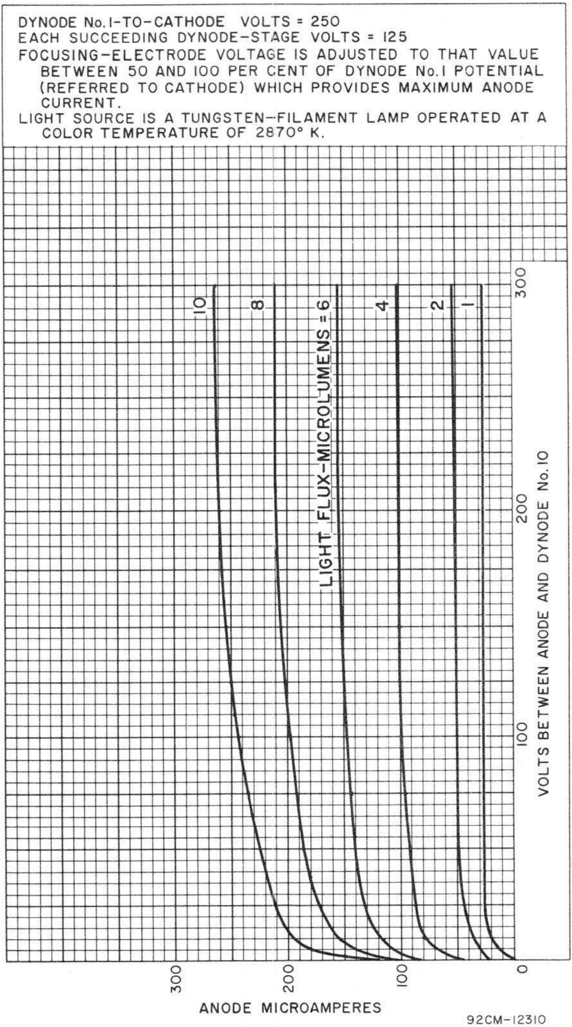


DIMENSIONS IN INCHES

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

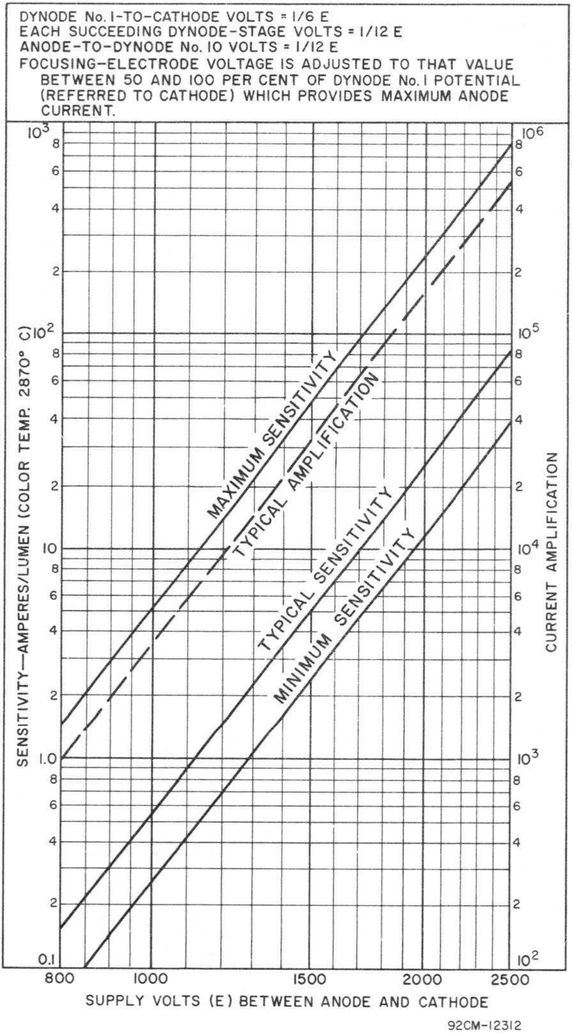
NOTE: Within 4.38" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.

TYPICAL ANODE CHARACTERISTICS



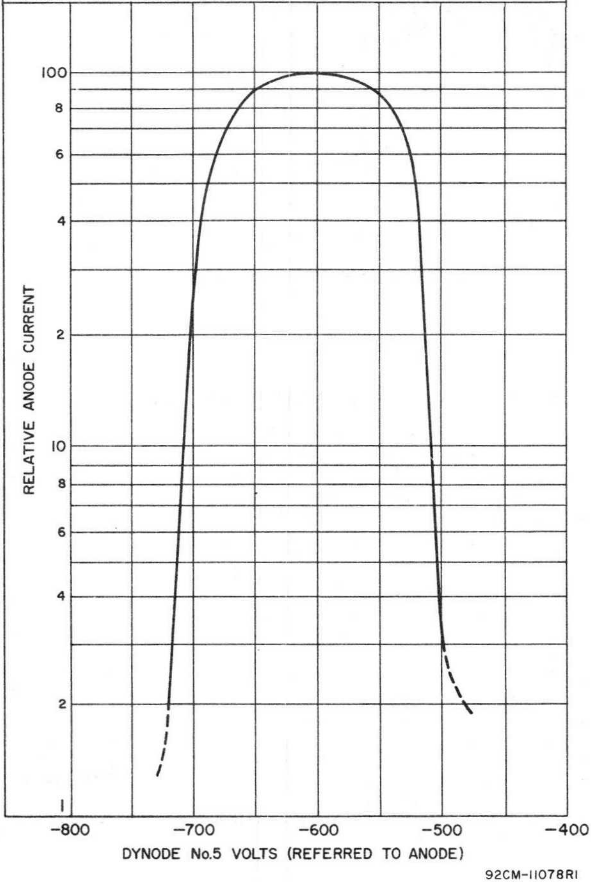
92CM-12310

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



TYPICAL OUTPUT CURRENT AS A FUNCTION OF DYNODE-No.5 VOLTS CHARACTERISTIC

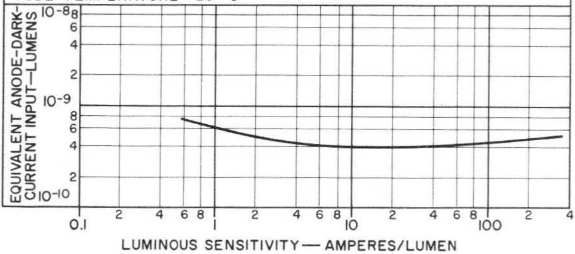
DYNODE No. 1-TO-CATHODE VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE-No. 5 STAGE = 100
ANODE-TO-DYNODE No. 10 VOLTS = 100
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
ANODE IS AT GROUND POTENTIAL.



92CM-11078R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

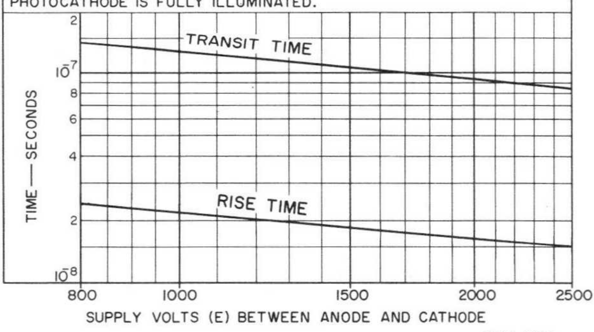
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C



92CS-12311

TYPICAL TIME RESOLUTION CHARACTERISTICS

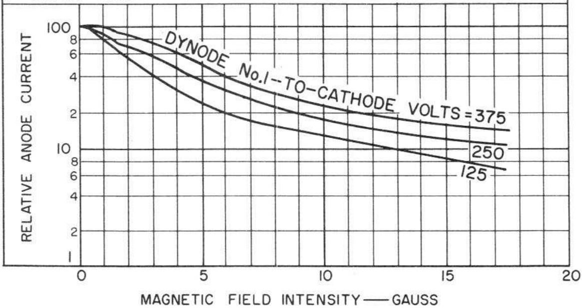
DYNODE No.1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No.10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS FULLY ILLUMINATED.



92CS-12313

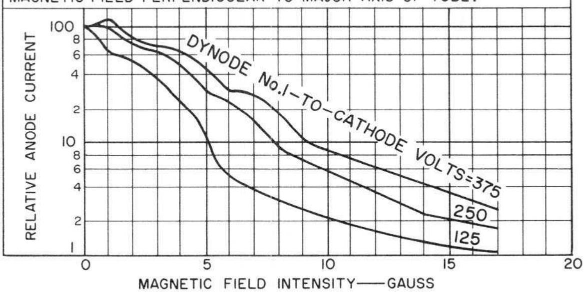
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT CHARACTERISTIC

DYNODE No.1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE POSITIONED APPROX. 1 FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.



92CS-11187R2

DYNODE No.1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFEERED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE POSITIONED APPROX. 1 FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PERPENDICULAR TO MAJOR AXIS OF TUBE.



92CS-11188R2

Photomultiplier Tubes[a]

9-STAGE, SIDE-ON TYPES **S-4 RESPONSE**

CONTROLLED SENSITIVITY ABOVE WAVELENGTH OF 5800Å

The **4471** and **4472** are the same as the **931A** except for the following items:

Characteristics Range Values:

With E = 1000 volts

	Min.	Typ.	Max.	
Sensitivity:				
Luminous, at 0 cps[b]	10	100	600	a/lm
"Red-to-White" Ratio:				
4471	5	–	–	%
4472	7	–	–	%

[a] Alternate designation for Multiplier Phototube.

[b] 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.

OPERATING CONSIDERATIONS

The luminous-sensitivity ratings of the 4471 and 4472 are higher, and their sensitivities above the wavelength of 5800 angstroms are controlled. This control is important in applications where a high level of sensitivity in the red region of the spectral-response characteristic is required. The degree of this controlled sensitivity in the red region is specified by a "red-to-white" ratio of anode currents. Anode current is measured first using a tungsten-lamp source, and then measured with a red filter interposed between the light source and the phototube. The "red-to-white" ratio is greater than 5% for the 4471, and greater than 7% for the 4472.

The anode current comprising the "white" portion of this ratio is measured with a light input of 10 microlumens. The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870° K.

The anode current comprising the "red" portion of the ratio is measured under conditions identical with the "white" measurement except that the light input of 10 microlumens is transmitted through a red filter (Corning C.S. No.2-112--manufactured by the Corning Glass Works, Corning, N.Y., or equivalent) which has the following characteristics: the transmittance of all wavelengths from 3000 to 5790 angstroms is less than 0.5%; the 37% transmittance point lies between 6030 and 6070 angstroms; the transmittance from 6400 to 7000 angstroms is greater than 80%; and the difference between the wavelengths where transmittance is 15% and 60% is not greater than 150 angstroms.

Photomultiplier Tube[a]

9-STAGE, SIDE-ON TYPE **S-4 RESPONSE**

CONTROLLED SENSITIVITY ABOVE WAVELENGTH OF 5800Å

The **4473** is the same as the **1P21** except for the following items:

Characteristics Range Values:

With E = 1000 volts

	Min.	*Typ.*	*Max.*	
Sensitivity:				
Luminous, at 0 cps[b]	40	160	800	a/lm
"Red-to-White" Ratio	7	–	–	%

[a] Alternate designation for Multiplier Phototube.

[b] 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.

OPERATING CONSIDERATIONS

Sensitivity of the 4473 above the wavelength of 5800 angstroms is controlled. This control is important in applications where a high-level of sensitivity in the red region of the spectral-response characteristic is required. The degree of this controlled sensitivity in the red region is specified by a "red-to-white" ratio of anode currents. Anode current is measured first using a tungsten-lamp source, and then measured with a red filter interposed between the light source and phototube. The "red-to-white" ratio is greater than 7% for the 4473.

The anode current comprising the "white" portion of this ratio is measured with a light input of 10 microlumens. The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870° K.

The anode current comprising the "red" portion of the ratio is measured under conditions identical with the "white" measurement except that the light input of 10 microlumens is transmitted through a red filter (Corning C.S. No.2-112--manufactured by the Corning Glass Works, Corning, N.Y., or equivalent) which has the following characteristics: the transmittance of all wavelengths from 3000 to 5790 angstroms is less than 0.5%; the 37% transmittance point lies between 6030 and 6070 angstroms; the transmittance from 6400 to 7000 angstroms is greater than 80%; and the difference between the wavelengths where transmittance is 15% and 60% is not greater than 150 angstroms.

Image Orthicon

Magnetic Focus 4-½-Inch Dia. Magnetic Deflection
For use in the luminance channel of suitably designed 4-tube color TV cameras in studio or outdoor service

GENERAL

Heater, for Unipotential Cathode:
- Voltage (AC or DC) . . . . 6.3 ± 10% V
- Current at 6.3 volts . . . . 0.6 A

Direct Interelectrode Capacitance:
- Anode to all other electrodes. . . . . . 12 pF

Target-to-Mesh Spacing . . . . 0.002 in

Spectral Response. S-10

Wavelength of Maximum Response. . . . 4500 ± 300 angstroms

Photocathode, Semitransparent:
- Rectangular image (4 x 3 aspect ratio):
  - Useful size of . . . . 1.6 in max. Diagonal

    Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.
  - Orientation of. . . . Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the center of the faceplate and the grid-No.6 terminal. The horizontal and vertical scan should start at the corner of the picture between the grid No.6 and the photocathode terminals.

Focusing Method. . . . . Magnetic

Deflection Method . . . . Magnetic

Overall Length . . . . 19.375 in ± 0.310 in

Greatest Diameter of Bulb. . . . . 4.500 in ± 0.094 in

Envelope Terminals. 5

End Base . . . . Small-Shell Diheptal 14-Pin Base (JEDEC Group 5, No.B14-45)

Socket . . . . Cinch Part No.3M14, or equivalent

Operating Position . . . The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.

Weight (Approx.). . . . . 2.3 lb

Minimum Deflecting-Coil Inside Diameter . . . . 3.2 in

Deflecting-Coil Length. . . . . 7 in

Focusing-Coil Length . . . . 15 in

Alignment Coil:
- Position on neck. . . . Centerline of magnetic field should be located 9.25" from the flat area of the shoulder.

MAXIMUM AND MINIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

Photocathode:
- Voltage. . . . . -700 max. V
- Illumination . . . . 50 max. fc

Operating Temperature:[b]		
Any part of bulb	65 max.	°C
Of bulb at large end of tube (Image section)	35 min.	°C
Temperature Difference:		
Between image section and any part of bulb hotter than image section	5 max.	°C
Grid-No.6 Voltage	-700 max.	V
Target Voltage:		
Positive value	10 max.	V
Negative value	10 max.	V
Field-Mesh Voltage[c]	30 max.	V
Grid-No.5 Voltage	300 max.	V
Grid-No.4 Voltage	350 max.	V
Grid-No.3 Voltage	400 max.	V
Grid-No.2 & Dynode-No.1 Voltage	350 max.	V
Grid-No.1 Voltage: Negative bias value	125 max.	V
Positive bias value	0 max.	V
Voltage Per Multiplier Stage	350 max.	V
Anode-Supply Voltage[d]	1650 max.	V
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	V
Heater positive with respect to cathode	10 max.	V

TYPICAL OPERATING VALUES[e]

Photocathode Voltage	-600	V
Grid-No.6 Voltage (Image Focus) Approx. 70% of Photocathode Voltage[f]	-370 to -470	V
Target Voltage Above Cutoff[g]	2.3	V
Field-Mesh Voltage[c]	15 to 25	V
Grid-No.5 Voltage (Decelerator)	40	V
Grid-No.4 Voltage (Beam Focus)	70 to 90	V
Grid-No.3 Voltage[h]	250 to 275	V
Grid-No.2 & Dynode-No.1 Voltage	280	V
Grid-No.1 Voltage for Picture Cutoff	-45 to -115	V
Dynode-No.2 Voltage	600	V
Dynode-No.3 Voltage	800	V
Dynode-No.4 Voltage	1000	V
Dynode-No.5 Voltage	1200	V
Anode Voltage	1250	V
Recommended Target Temperature Range[b]	35 to 45	°C
Minimum Peak-to-Peak Blanking Voltage	5	V
Field Strength of Focusing Coil:[i]		
At center of scanning section (Approx.)	60	G
In plane of photocathode (Approx.)	120	G
Field Strength of Alignment Coil	0 to 3	G

PERFORMANCE DATA

With conditions shown under Typical Operating Values including Recommended Target Temperature Range; target voltage adjusted to 2.3 volts above cutoff; with camera lens set to bring picture highlights a maximum of one stop over the knee of the light transfer charac-

teristic; and operation in a 525-line 60-cycle TV system.

	Typical	
Signal-Output Current (Peak to Peak)	20	μA
Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 MHz[k]	59:1[k]	
Photocathode Illumination at 2870°K Required to bring Picture Highlights to the "Knee" of Light Transfer Characteristic.	0.02	fc
Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[m].	75	%
Highlight Signal Variation (Per cent of peak signal)	15	%
Background Signal Variation (Per cent of peak signal)	7.5	%

[b] Operation outside of the *Recommended Target Temperature Range* shown under *Typical Operating Values* will not damage the 4492 provided the *Maximum Temperature Ratings* of the tube are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the *Recommended Target Temperature Range*.

[c] With respect to grid No.4.

[d] Dynode-voltage values are shown under *Typical Operating Values*.

[e] With 4492 operated in RCA TK-42 camera at fixed photocathode voltage.

[f] Adjust for optimum focus.

[g] The target supply voltage should be adjustable from -5 to +5 volts.

[h] Adjust to give the most uniformly shaded picture near maximum signal.

[i] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

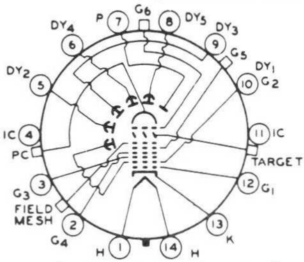
[k] Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level. Two common test conditions and resultant difference in signal-to-noise ratio are shown on reverse side.

	Method A	Method B
Bandwidth	4.5 MHz	5.1 MHz
Scan Line Number	525	625
Field Rate	60	50
Black Level	Picture Black	"Capped" Black
Target Voltage	2.3 V	3.0 V
Signal-to-Noise Ratio	59:1	83:1

[m] Measured with amplifier having flat frequency response.

TERMINAL DIAGRAM (Bottom View)

DIRECTION OF LIGHT: PERPENDICULAR TO LARGE END OF TUBE



SMALL-SHELL DIHEPTAL 14-PIN BASE

Pin 1 - Heater

Pin 2 - Grid No.4

Pin 3 - Grid No.3

Pin 4 - Internal Connection— Do Not Use

Pin 5 - Dynode No.2

Pin 6 - Dynode No.4

Pin 7 - Anode

Pin 8 - Dynode No.5

Pin 9 - Dynode No.3

Pin 10 - Dynode No.1, Grid No.2

Pin 11 - Internal Connection— Do Not Use

Pin 12 - Grid No.1

Pin 13 - Cathode

Pin 14 - Heater

ENVELOPE TERMINALS

Terminal Over Pin 2 - Field Mesh

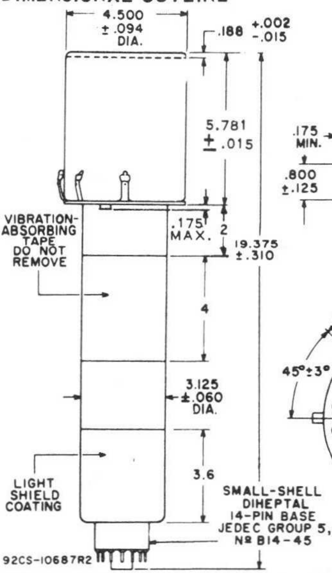
Terminal Over Pin 4 - Photocathode

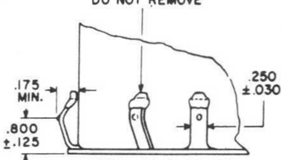
Terminal On Side Of Envelope Opposite Base Key - Grid No.6

Terminal Over Pin 9 - Grid No.5

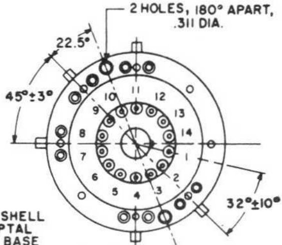
Terminal Over Pin 11 - Target

DIMENSIONAL OUTLINE





DETAIL OF ENVELOPE TERMINALS



ENLARGED BOTTOM VIEW

Dimensions in Inches

Vidicons

1-Inch Diameter

Electrostatic Focus **Magnetic Deflection**

For use in the chroma channels of suitably designed color TV cameras in live pickup service

GENERAL

Overall Length	6.25 in ±0.10 in
Greatest Diameter	1.125 in ±0.010 in
Bulb Diameter	1.025 in ±0.003 in
Faceplate Thickness	0.094 in ±0.012 in
Direct Interelectrode Capacitance:[a]	
Target to all other electrodes	5.0 pF
Focusing Method	Electrostatic
Deflection Method	Magnetic
Heater Power	0.6 W
Photoconductive Layer:	
Maximum useful picture size	0.192 in x 0.256 in

Orientation of quality rectangle--Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin.

Base	Small-Button Ditetrar 8-Pin, (JEDEC No. E8-11)
Socket	Cinch No. 133-98-11-015, or equivalent
Weight	2.8 oz
Operating Position	Any

ABSOLUTE MAXIMUM RATINGS

Grid-No. 6 & Grid-No. 3 Voltage[c]	1200 max. V
Grid-No. 5 Voltage[c]	750 max. V
Grid-No. 4 Voltage	400 max. V
Grid-No. 2 Voltage	850 max. V
Grid-No. 1 Voltage:	
Negative bias value	300 max. V
Positive bias value	0 max. V
Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode	125 max. V
Heater positive with respect to cathode	10 max. V
Heater Voltage	7 max. V
Target Voltage	100 max. V
Target Dark Current	0.05 max. μA
Peak Target Current[d]	0.4 max. μA
Faceplate:	
Illumination	1000 max. fc
Temperature	71 max. °C

TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 0.192 in x 0.256 in
Faceplate Temperature of 25° to 30° C

For All Types

Grid-No. 6 (Decelerator) & Grid-No.3 Voltage	750 V
Grid-No.5 Voltage	250 to 315 V
Grid-No.4 (Beam-Focus Electrode) Voltage. . . .	100 to 125 V
Grid-No.2 (Accelerator) Voltage	100 to 300 V
Grid-No.1 Voltage	-20 V

	4493 (Red)	4494 (Green)	4495 (Blue)	
Illumination[e]	4.5	4.5	4.0	fc
Signal Output Current[f] . .	0.060	0.060	0.020	μA
Signal-to-Dark Current Ratio[f]	6:1	6.1	4:1	
Typical Resolution:[f]				
Center	500	500	500	TV lines
Corner	400	400	400	TV lines
Amplitude Response to a 125 TV Line Square-Wave Test Pattern at Center of Picture[f] . . .	60	60	60	%
Average "Gamma" of Transfer Characteristic[f]	0.65	0.65	0.65	
Lag - Per Cent of Initial Value of Signal-Output Current 1/20 Second after Illumination is Removed[f]	12	12	10	%

[a]This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting-yoke assembly. The resistive component of the output impedance is in order of 100 megohms.

[c]The maximum voltage difference between grids No.6 & 3 and No.5 should not exceed 750 volts.

[d]Video amplifiers must be designed properly to handle peak target currents of this magnitude to avoid amplifier overload or picture distortion.

[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 3100° K. These illumination values are incident on the filters shown in (f) which are interposed between the light source and tube faceplate.

[f]These characteristics are measured using the following standard optical filters, or equivalent:

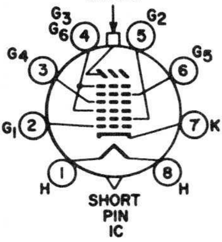
For type 4493 (Red) - Wratten No.25 (A) with 2 Fish-Shurman No. IR650

For type 4494 (Green) - Wratten No.58 with 1 Fish-Shurman No. IR650

For type 4495 (Blue) - Wratten No.47 with 1 Fish-Shurman No. IR650

BASING DIAGRAM (Bottom View)

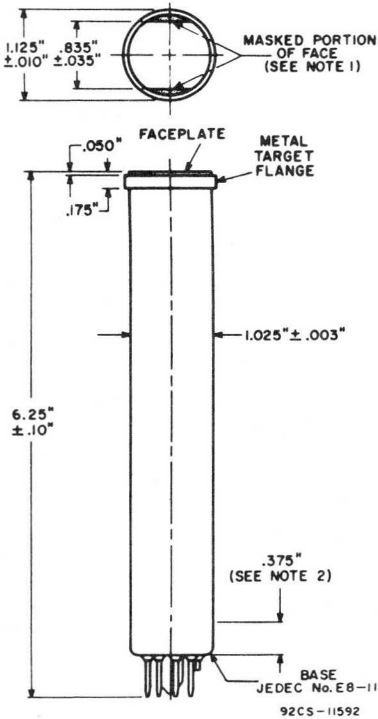
Pin 1 - Heater
Pin 2 - Grid No.1
Pin 3 - Grid No.4
Pin 4 - Grids No.3 & No.6
Pin 5 - Grid No.2
Pin 6 - Grid No.5
Pin 7 - Cathode
Pin 8 - Heater
Flange - Target
Short Index Pin - Internal Connection— Make No Connection



DIRECTION OF LIGHT: INTO FACE END OF TUBE

8LN

DIMENSIONAL OUTLINE



Note 1: Straight Sides Of Masked Portions Are Parallel To The Plane Passing Through Tube Axis And Short Index Pin.

Note 2: Within This Distance, Diameter Of Bulb Is 1.025" + 0.003"-0.030".

Vidicon

MAGNETIC FOCUS
I-INCH DIAMETER

MAGNETIC DEFLECTION
HIGH SENSITIVITY

For Use in Applications Where Scene Motion is Limited and for Slow-Scan TV Pickup Service

GENERAL

Heater, for Unipotential Cathode

Voltage (AC or DC)	6.3 ± 10%	V
Current at 6.3 V	0.6	A

Direct Interelectrode Capacitance[a]

Target to all other electrodes	4.6	pF

Spectral Response . . . . See *Typical Spectral Response*

Photoconductive Layer . . . . 0.62 inch
Maximum useful diagonal of rectangle image (4 x 3 aspect ratio)[b]

Focusing Method . . . . Magnetic

Deflection Method . . . . Magnetic

Overall Length . . . . 6.25 ± 0.25 inch

Greatest Diameter . . . . 1.125 ± 0.010 inch

Operating Position . . . . Any

Weight (Approx.) . . . . 2 oz

Bulb T8

Focusing Coil . . . . Cleveland Electronics[c,d] No. VF-115-5, or equivalent

Deflecting Yoke . . . . Cleveland Electronics[c,d] No. VY-111-3, or equivalent

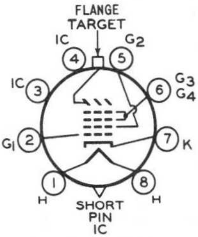
Alignment Coil . . . . Cleveland Electronics[c,d] No. VA-118, or equivalent

Socket . . . . Cinch[e] No. 54A18088, or equivalent

Base . . . . . Small-Button Ditetrar 8-Pin, (JEDEC No. E8-11)

BASING DIAGRAM (Bottom View)

Pin 1 – Heater
Pin 2 – Grid No. 1
Pin 3 – Internal Connection–Do Not Use
Pin 4 – Internal Connection–Do Not Use
Pin 5 – Grid No. 2
Pin 6 – Grids No. 3 and No. 4
Pin 7 – Cathode
Pin 8 – Heater
Flange – Target
Short Index Pin – Internal Connection–Make no Connection



DIRECTION OF LIGHT: INTO FACE END OF TUBE

ABSOLUTE-MAXIMUM VALUES

For scanned area of 1/2 x 3/8 inch

Grid-No.3 & Grid-No.4 Voltage	1000	V
Grid-No.2 Voltage	750	V
Grid-No.1 Voltage		
Negative bias value	300	V
Positive bias value	0	V
Peak Heater-Cathode Voltage		
Heater negative with respect to cathode	125	V
Heater positive with respect to cathode	10	V
Target Voltage	60	V
Dark Current	0.1	μA
Peak Target Current[f]	0.6	μA
Faceplate		
Illumination[g]	1000	fc
Temperature Range		
Storage	-20 to 70	°C
Operating	-10 to 55	°C

TYPICAL OPERATION AND PERFORMANCE DATA

For Standard TV Scan Rates

For scanned area of 1/2 x 3/8 inch. Faceplate temperature of 30°C.

	Low-Voltage Operation	*High-Voltage Operation*	
Grid-No.4 (Decelerator) & Grid-No.3 (Beam-Focus Electrode) Voltage	250[h] to 300	750	V
Grid-No.2 (Accelerator) Voltage	300	300	V
Grid-No.1 Voltage for Picture Cutoff[j]	-45 to -100	-45 to -100	V
Average "Gamma" of Transfer Characteristic	0.7	0.7	
Signal-output current between 0.02 μA & 0.2 μA			
Visual Equivalent Signal-to-Noise Ratio (Approx.)[k]	300:1	300:1	
Lag[m]			
Typical value	55	55	%
Minimum Peak-to-Peak Blanking Voltage			
When applied to grid No.1	75	75	V
When applied to cathode	20	20	V
Limiting Resolution at Center of Picture			
Typical value	600	700	TV Lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern	20	30	%
At center of picture			
Field Strength at Center of Focusing Coil[n]	40	60	G

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

	Low-Voltage Operation	High-Voltage Operation	
Peak Deflecting-Coil Current			
Horizontal	185	375	mA
Vertical	25	43	mA
Field Strength of Adjustable Alignment Coil	0 to 4	0 to 4	G

Average-Light-Level Operation—1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight)	1	fc
Target Voltage[p,q]	7 to 25	V
Dark Current[r]	0.005	μA
Signal-Output Current[s]		
Typical	0.4	μA

Low-Light-Level Operation—0.1 Footcandle on Faceplate

Faceplate illumination (Highlight)	0.1	fc
Target Voltage[p,q]	15 to 45	V
Dark Current[r]	0.02	μA
Signal-Output Current[s]		
Typical	0.16	μA

TYPICAL OPERATION AND PERFORMANCE DATA

For Slow-Scan Applications

Typical Target Voltage	30	V
Typical Dark Current	8	nA
Typical Exposure	0.25	footcandle-seconds
Typical Signal Output		
At frame time of		
1 second	160	nA
2 seconds	70	nA
4 seconds	30	nA
6 seconds	19	nA
10 seconds	10	nA
Lag, or Residual Signal-Time to reach 5 per-cent level	5 to 10	frames
Amplitude Response to 400 TV Lines	50	%
Signal Storage—Time to decay to 50 per-cent level	80	seconds

a This capacitance which effectively is the output impedance of the 4500, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

b Orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

c Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland Ohio.

d These components are chosen to provide tube operation with minimum beam-landing error.

e Made by Cinch Manufacturing Corporation, 1026 S. Homan Ave., Chicago 24, Illinois.

f Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

g For conditions where "white light" is uniformly diffused over entire tube face.

h Definition, focus uniformity, and picture quality decrease with decreasing grid-No.4 and grid-No.3 voltage. In general, grid-No.4 and grid-No.3 should be operated above 250 volts.

j With no blanking voltage on grid No.1.

k Measured with high gain, low-noise, cascode-input-type amplifier having bandwidth of 5 Mc/s and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

m Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

n The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

p The target voltage for each 4500 must be adjusted to the value which gives the desired operating signal current.

q Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

r The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

s Defined as the component of the highlight target current after the dark-current component has been subtracted.

OPERATING CONSIDERATIONS

Target connection may be made by a suitable spring-finger contact bearing against the edge of the metal ring at the face end of the tube.

Faceplate-temperature should not exceed 55°C (131°F), either during operation or storage of the 4500. Operation at a faceplate temperature of about 30°C (86°F) is recommended. The 4500 should be operated at a steady temperature to maintain dark current at a preselected level and thereby insure optimum and stable day-to-day operation. If temperature control cannot be made in the camera installation, changes in target voltage may be required from time to time. The range of target voltage for various dark current levels is shown in *Range of Dark Current*. Individual 4500's will have substantially identical performance characteristics when operated with an identical value of dark current.

Operation at higher electrode voltages may introduce additional beam-landing errors that may be partially compensated for by repositioning the deflecting components. Full compensation may require the application of a modulating voltage of suitable waveform, at both horizontal and vertical scan rates, to the cathode, grid-No.1, and grid-No.2 of the 4500.

Dos and Don'ts on Use of RCA-4500

Dos

1. Adjust camera scanning to utilize maximum useful area of photoconductive layer.
2. Orient the vidicon so that horizontal scan is essentially parallel to the plane passing through tube axis and short index pin.

Dos and Don'ts on Use of RCA-4500

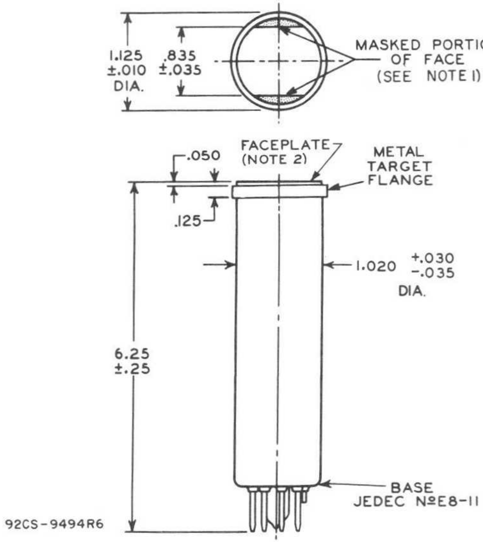
Dos

3. Align electron beam.
4. With lens capped, adjust target voltage for each individual vidicon to the highest value that will still give uniform background.
5. Match any visible raster pattern on photoconductive layer with new scan by reorienting the vidicon as required.
6. Use only sufficient beam current to bring out picture highlights.
7. Open lens iris or increase the scene illumination to obtain the "snappiest" picture without noticeable smear from moving objects. Target voltage should be reduced if light on the tube and/or resultant signal is excessive.
8. Always cap lens when transporting camera (see "Don'ts" 5).

Don'ts

1. Don't underscan the photoconductive layer.
2. Don't change camera size and centering controls once the scanned area of photoconductive layer has been properly positioned.
3. Don't rotate vidicon from its original operating position in deflecting yoke.
4. Don't turn beam of vidicon on without normal scanning or remove scanning before beam of vidicon is turned off.
5. DON'T ALLOW IMAGE OF THE SUN OR OTHER VERY INTENSE SOURCE OF ILLUMINATION TO BE FOCUSED ON PHOTOCONDUCTIVE LAYER AT ANY TIME.

DIMENSIONAL OUTLINE

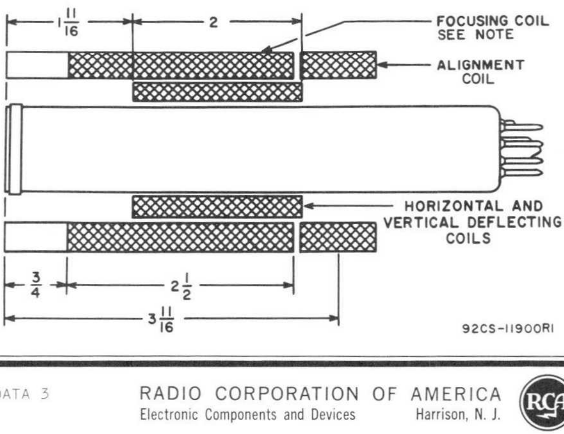


DIMENSIONS IN INCHES

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short pin.

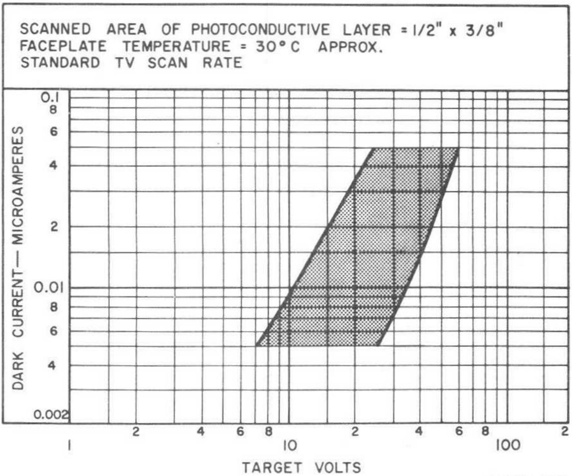
Note 2: Faceplate glass is Corning No. 7056 having a thickness of 0.094 ± 0.012 inch.

COMPONENT LOCATIONS

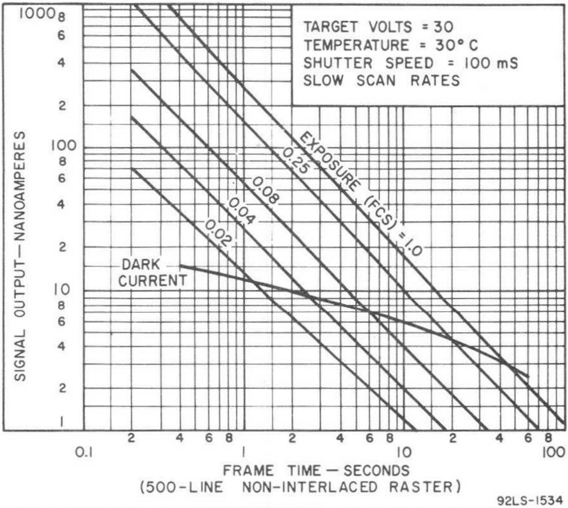


RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

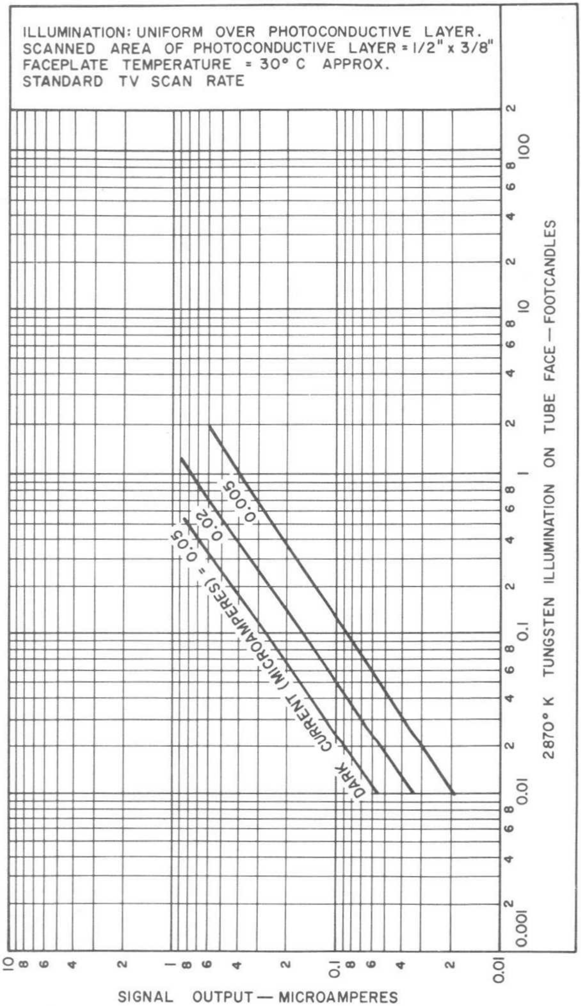
Range of Dark Current



Signal Output as a Function of Scan Speed for Several Values of Illumination



Light Transfer Characteristics



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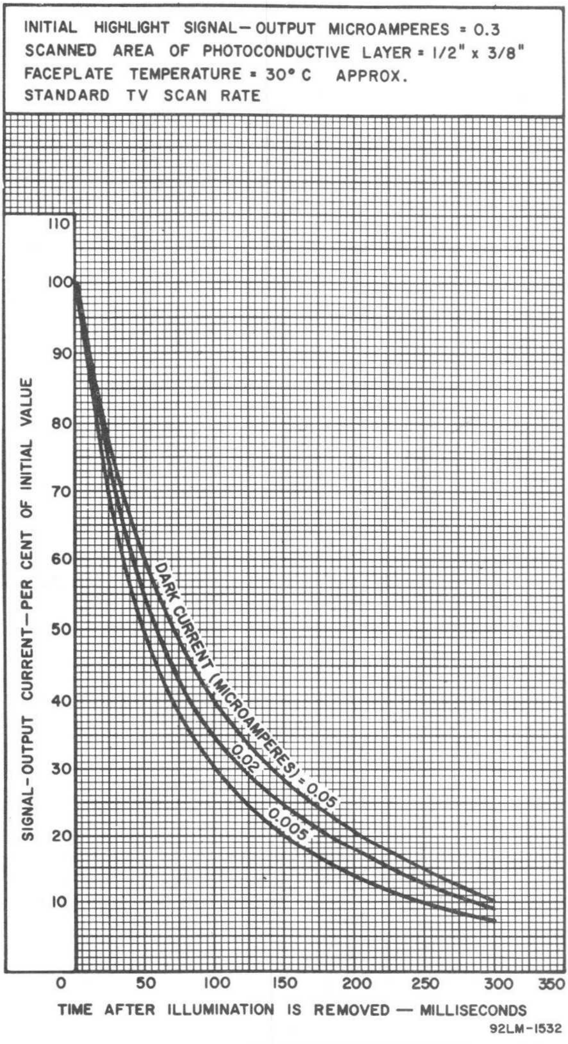
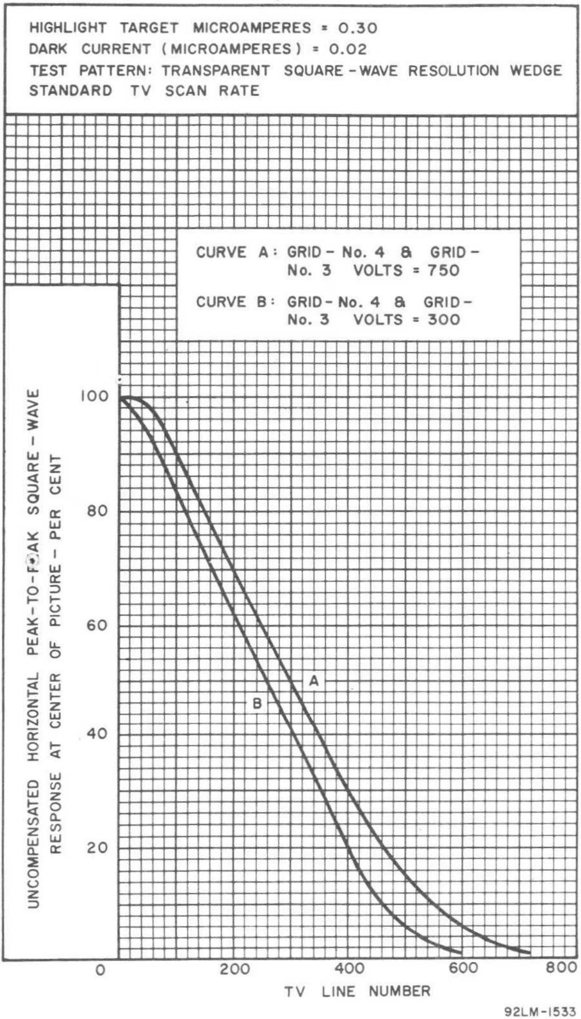
Typical Persistence Characteristics

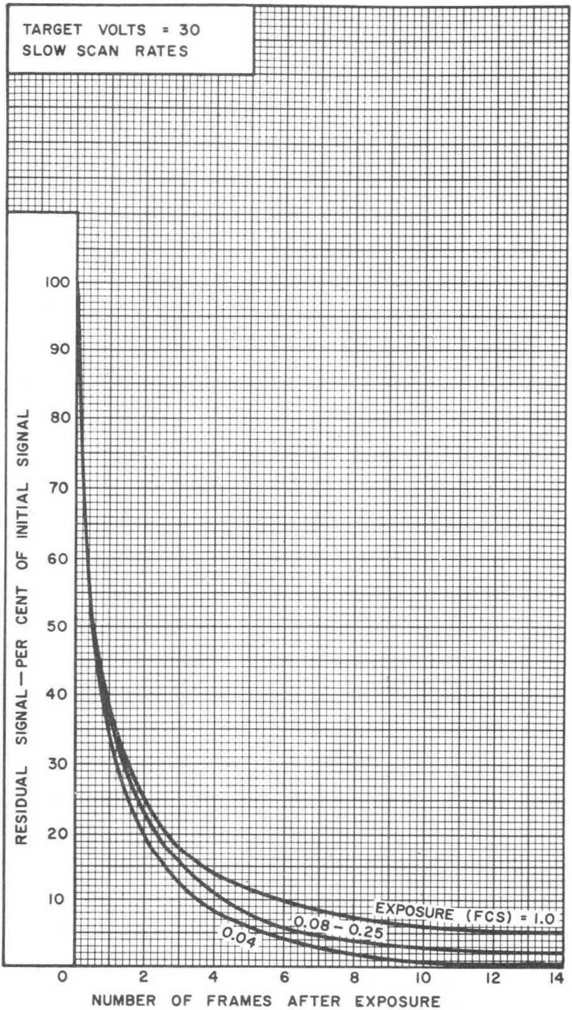


Uncompensated Horizontal Square-Wave Response



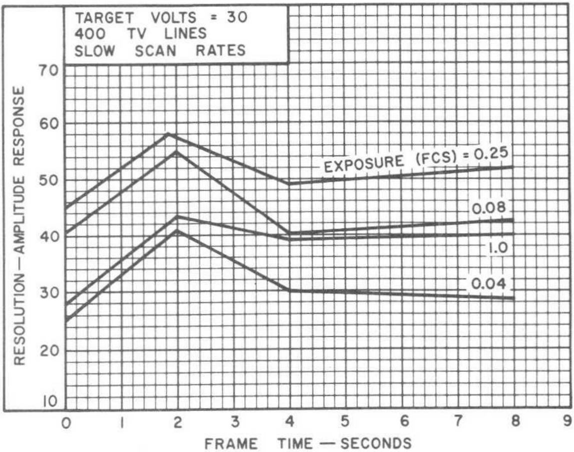
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

Typical Persistence Characteristics



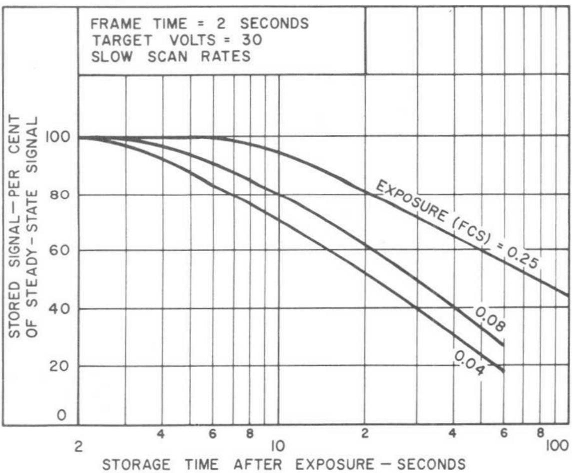
92LM-1537

Typical Response to 400 TV Line Information



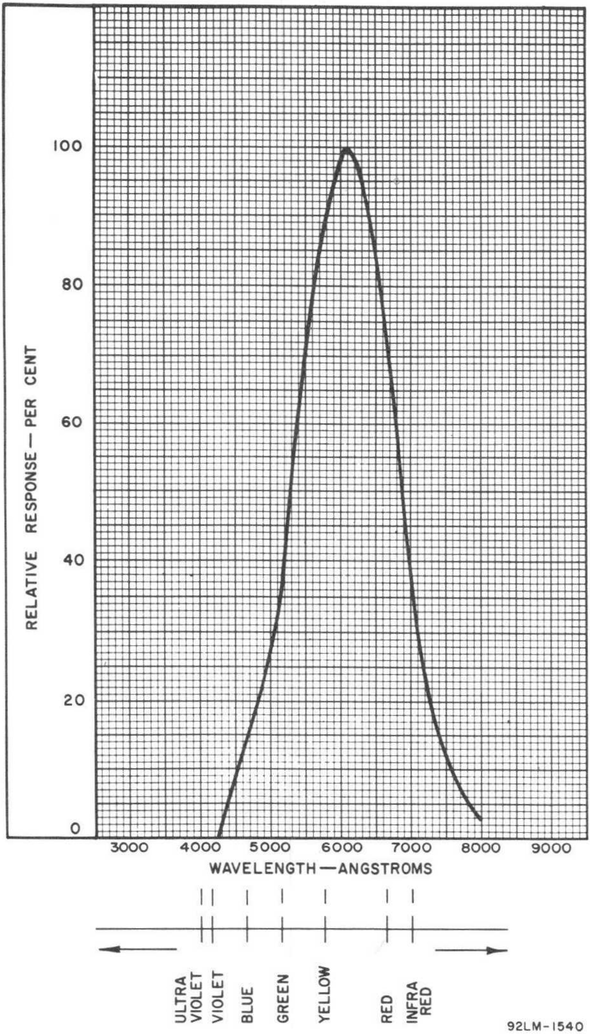
92LS-1538

Typical Storage Characteristics



92LS-1539

Typical Spectral Response



Vidicon

Ruggedized, Magnetic-Focus, Magnetic-Deflection Type Having Separate-Mesh Connection for Compact TV Cameras Where Severe Shock and Vibration Conditions Exist

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	V
Current at 6.3 volts	0.3	A

Direct Interelectrode Capacitance:[a]

Target to all other electrodes	4.6 pF

Spectral Response . . . . See *RCA Type II Spectral Response* at front of this section

Photoconductive Layer:

Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) . . . . 0.62 in

Orientation of quality rectangle-Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method	Magnetic
Deflection Method	Magnetic
Overall Length	5.12" + 0.13"-0.06"
Greatest Diameter	1.125" ± 0.010"
Bulb	T8
Bulb Diameter	1.025" ± 0.003"
Base	Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket	Cinch[b] No.54A18088, or equivalent
Deflecting Yoke-Focusing Coil-Alignment-Coil Assembly	Cleveland Electronics[c,d] VYFA-355-2, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz

ABSOLUTE MAXIMUM RATINGS

For scanned area of 1/2" x 3/8"

Grid-No.4 Voltage[f]	1000 max.	V
Grid-No.3 Voltage[f]	1000 max.	V

Grid-No.2 Voltage	350 max.	V
Grid-No.1 Voltage:		
Negative bias value	150 max.	V
Positive bias value	0 max.	V
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	V
Heater positive with respect to cathode	10 max.	V
Target Voltage	100 max.	V
Dark Current	0.25 max.	μA
Peak Target Current[g]	0.75 max.	μA
Faceplate:		
Illumination[h]	5000 max.	fc
Temperature	71 max.	°C

TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 1/2" x 3/8"

Faceplate Temperature of 30° to 35° C and

Standard TV Scanning Rate

	Low-Voltage Mode	*High-Voltage Mode*	
Grid-No.4 (Decelerator) Voltage[f]	500	900	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	300	540	V
Grid-No.2 (Accelerator) Voltage	300	300	V
Grid-No.1 Voltage for Picture Cutoff[i]	-65 to-100	-65 to-100	V
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 μA and 0.2 μA	0.65	0.65	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[k]	300:1	300:1	
Lag-Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed[m]	20	20	%
Minimum Peak-to-Peak Blanking Voltage:			
When applied to grid No.1	75	75	V
When applied to cathode	20	20	V

Limiting Resolution:			
At center of picture	1000	1100	TV lines
At corner of picture	600	700	TV lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture	50	60	%
Field Strength at Center of Focusing Coil[n]	40 ± 4	58 ± 4	G
Peak Deflecting-Coil Current:			
Horizontal	350	480	mA
Vertical	20	28	mA
Field Strength of Adjustable Alignment Coil[p]	0 to 4	0 to 4	G

High-Sensitivity Operation—0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight)	0.1	fc
Target Voltage[q,r]	30 to 60	V
Dark Current[s]	0.1	μA
Signal-Output Current:[t]		
Typical	0.1	μA

Average-Sensitivity Operation—1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight)	1.0	fc
Target Voltage[q,r]	20 to 40	V
Dark Current[s]	0.02	μA
Signal-Output Current:[t]		
Typical	0.20	μA

High-Light Level Operation—10 Footcandles on Faceplate

Faceplate Illumination (Highlight)	10	fc
Target Voltage[q,r]	10 to 22	V
Dark Current[s]	0.005	μA
Signal-Output Current:[t]		
Typical	0.3	μA

Environmental Performance Data

The 4503A is designed to withstand the following operational and non-operational environmental tests.

Rejection Criteria: After completion of all tests, the tube will meet the performance characteristics specified under Typical Operation and Performance Data. However, the number of spots specified under the Spurious Signal

Test may increase slightly if the tube is subjected to the maximum shock and vibration levels specified below. During the vibration test the tube is positioned so that its major axis is parallel to the surface of the earth.

Operational Tests. The tube is operated as shown under the Typical Low-Voltage Mode in the tabulated data.

1. Low-Frequency Sinusoidal Vibration. The tube is subjected to 10 g peak sinusoidal vibration, 5 to 500 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve C of **Figure 514-1**. The vidicon will show no loss in resolution and the amplitude of any generated spurious signals will not exceed 20 per cent of the maximum white-signal level.
2. High-Frequency Sinusoidal Vibration. The tube is subjected to 10 g peak sinusoidal vibration, 5 to 2000 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve C of **Figure 514-3**. The vidicon will maintain a minimum resolution of 500 TV lines throughout this test. The amplitude of any generated spurious signals will not exceed 75 per cent of the maximum white-signal level.
3. Random Vibration. The tube is subjected to 12 g, RMS, 20 to 2000 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve D of **Figure 514-4**. The vidicon will show no loss in resolution and the amplitude of any generated spurious signals will not exceed 50 per cent of the maximum white-signal level.

Non-Operational Tests

1. Shock. The tube is subjected per MIL-STD-810A, method 516.1, **Figure 516-1**, procedure V, to a 100 g, 6 millisecond terminal peak sawtooth shock pulse in each of three orthogonal axes, one of which is parallel to the major axis of the tube. A total of 18 impact shocks are applied.
2. Vibration

   a. Sinusoidal – The tube is subjected to 15 g peak sinusoidal vibration, 5 to 2000 Hz per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve D on **Figure 514-3.**

b. Random – The tube is subjected to 25 g, RMS, 20 to 2000 Hz, per MIL-STD-810A, Equipment Class 3, Equipment Mounting A, Curve G on **Figure 514-4.**

3. Temperature-Pressure (Altitude) Tests. The vidicon and associated components are subjected, per MIL-E-5400A* par.3.2.20, 3.2.20.1, and 3.2.20.1.1, to the separate and combined effects of varying temperature of 0^{o} to $+55^{o}$ C and to varying barometric pressure of 30" to 3.4" of mercury. The pressure corresponds to sea level and to an altitude of 50,000 feet, respectively.
4. Temperature-Humidity Tests. The vidicon is subjected, per MIL-E-5400A* par.3.2.30.2B, to relative humidities up to and including 95 per cent at temperatures up to and including $+50^{o}$ C.

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* 1 January 1956

[a] This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, Ill. 60007.

[c] Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

[d] This component is chosen to provide tube operation with minimum beam-landing error and is used to evalute tube performance data. The Environmental Performance Data are obtained using a Cleveland Electronics assembly No.VYFA-164-2, or equivalent. When the tube is to be operated in severe environments, this or other suitably ruggedized components should be used to take full advantage of the environmental capabilities of the tube.

[f] Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to

5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

[g] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[h] For conditions where "white light" is uniformly diffused over entire tube face.

[i] With no blanking voltage on grid No. 1.

[k] Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

[m] For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

[n] The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[p] The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

[q] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[r] The target voltage for each tube must be adjusted to that value which gives the desired operating signal current.

[s] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[t] Defined as the component of the highlight target current after the dark-current component has been subtracted.

Spurious Signal Test

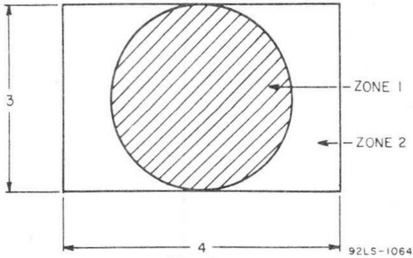


Fig.1

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in **Figure 1**. The 4503A is operated under the conditions specified under Typical Operation and Performance Data with the lens adjusted to provide a target current of 0.3 microampere. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.

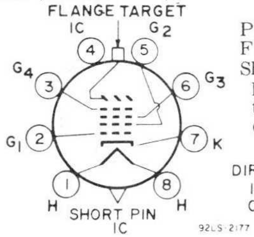
Table 1 *For scanned area of 1/2" x 3/8"*

Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	0
4 but not including 3	0	1
3 but not including 1	2	3
1 or less	■	■

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.
■Spots of this size are allowed unless concentration causes a smudged appearance.

TERMINAL DIAGRAM (Bottom View)

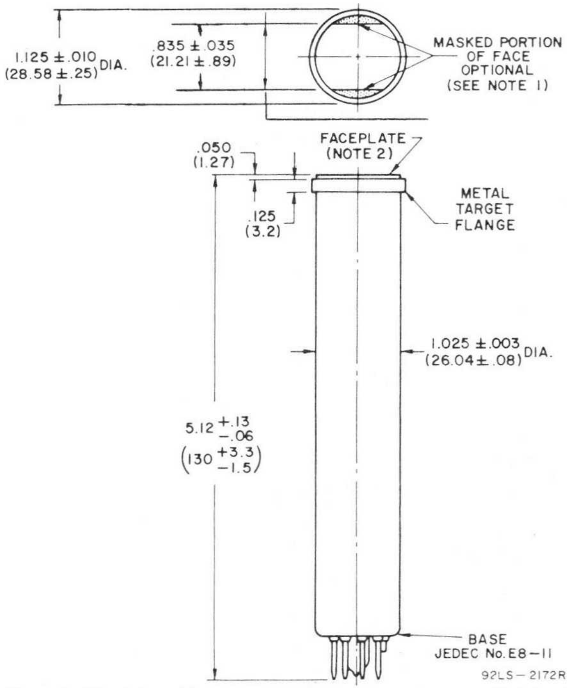
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode



Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection – Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

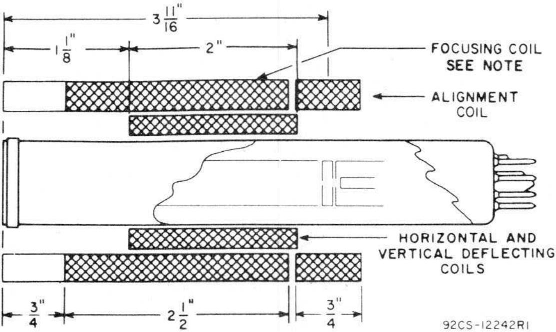
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.
Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

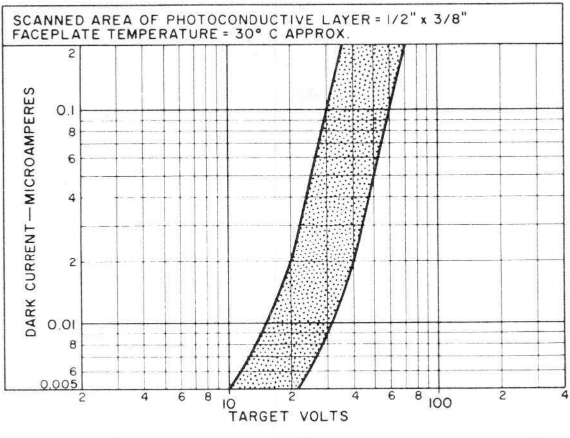
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To Obtain Minimum Beam-Landing Error

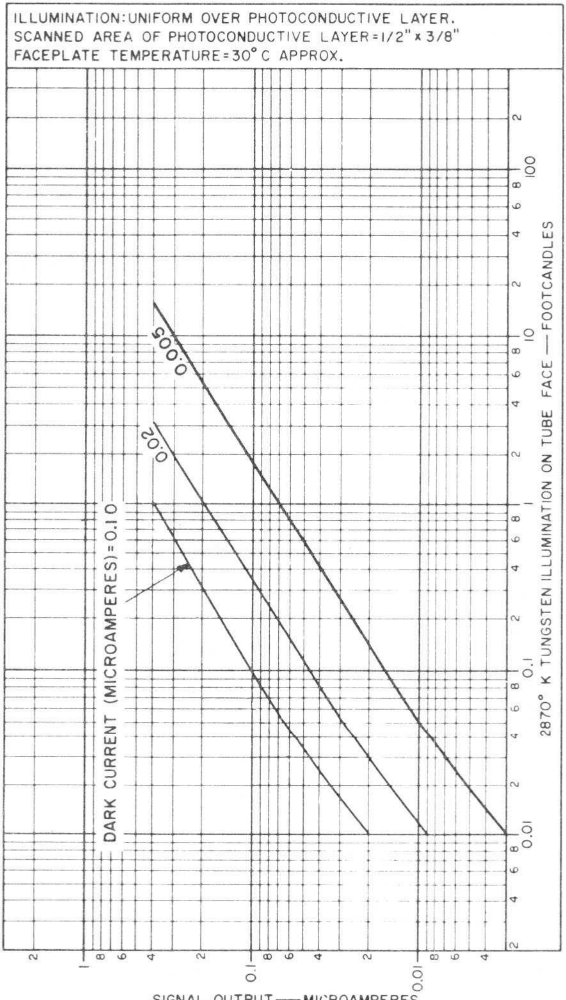


Note: Cross-hatching indicates wound portion of focusing coil.

RANGE OF DARK CURRENT

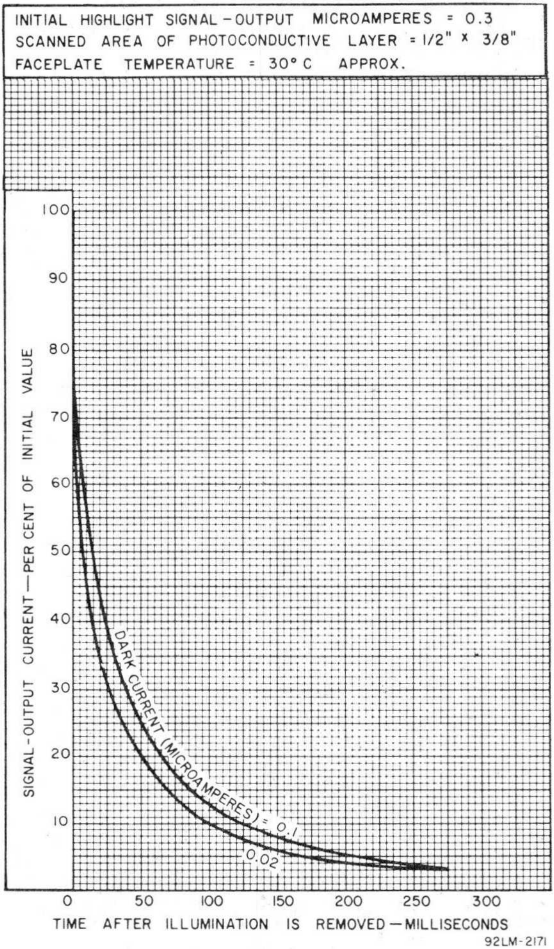


LIGHT TRANSFER CHARACTERISTICS

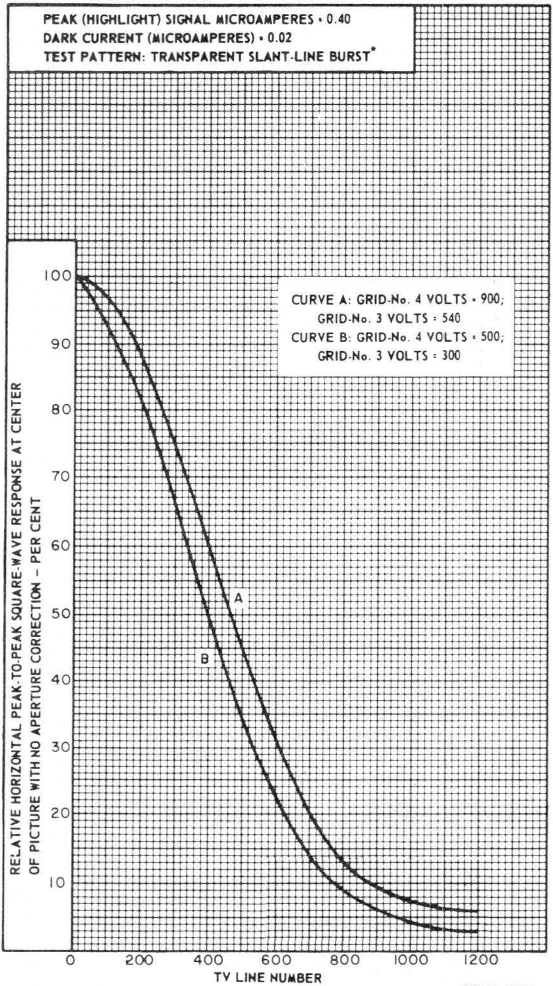


92CM-12245R1

TYPICAL PERSISTENCE CHARACTERISTICS



HORIZONTAL SQUARE-WAVE RESPONSE



*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

Photomultiplier Tube

2" Diameter, 12-Stage, Head-On Type Having a Bialkali Photocathode

General Data

Spectral Response	See **Figure 1**
Wavelength of Maximum Response	385 ± 50 nm
Cathode, Semitransparent	Cesium-Potassium-Antimony (Bialkali)
Minimum projected area	2.54 sq in (16.4 cm^2)
Minimum diameter	1.80 in (4.57 cm)
Window	Pyrex Corning[a] No.7740, or equivalent
Shape	Spherical Segment
Index of refraction at 589.3 nanometers	1.47
Dynodes:	
Substrate	Copper-Beryllium
Secondary-emitting surface	Beryllium-Oxide
Structure	In-Line Electrostatic Focus Type
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.12	5 pF
Anode to all other electrodes	6 pF
Maximum Overall Length	5.71 in (14.5 cm)
Seated Length	4.98 ± 0.08 in (12.6 ± 0.2 cm)
Maximum Diameter	2.10 in (5.3 cm)
Bulb	T16
Base	RCA 21-Pin (See Base Drawing)
Socket	RCA-AJ2144, AJ2145, or AJ2180[b]
Magnetic Shield	Perfection Mica[c] Part No.22P50, or equivalent
Operating Position	Any
Weight (Approx.)	6 oz

Maximum and Minimum Ratings, Absolute-Maximum Values:

DC Supply Voltage:

Between anode and cathode	2500	max.	V
Between anode and dynode No.12	300	max.	V
Between consecutive dynodes	300	max.	V
Between dynode No.1 and cathode	600	max.	V
Between focusing electrode and cathode	600	max.	V

Average Anode Current[e]	0.2	max.	mA
Ambient-Temperature Range[f]	−80 to +85		^{o}C

Characteristics Range Values for Equipment Design:

Under conditions with a dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I, and at a a temperature of 22^{o} C, except as noted.

With E = 1500 volts (Except as noted).

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g], at 385 nm	–	1.8×10^{5}	–	A/W
Luminous[h] (2870^{o} K)	20	160	750	A/lm
With blue light source[j]	2.6	21	97	A/incident lm
Cathode Sensitivity:				
Radiant[k], at 385 nm	–	0.097	–	A/W
Luminous[m] (2870^{o} K)	7.3×10^{-5}	8.5×10^{-5}	–	A/lm
With blue light source[n]	9.5×10^{-6}	1.1×10^{-5}	–	A/incident lm
Quantum efficiency at 385 nm	–	31	–	%
Current Amplification	–	1.9×10^{6}	–	
Anode Dark Current[p] at 50 A/lm	–	2×10^{-10}	2×10^{-9}	A
Equivalent Anode Dark Current Input at 50 A/lm . .	–	4×10^{-12}[q]	4×10^{-11}[q]	lm
	–	3.5×10^{-15}[r]	3.5×10^{-14}[r]	W
Equivalent Noise Input[s]	–	4.0×10^{-13}	–	lm
	–	3.5×10^{-16}[t]	–	W
Anode Pulse Rise Time[u] at 2500 V	–	2.4×10^{-9}	–	s
Electron Transit Time[v], at 2500 V	–	3.4×10^{-8}	–	s

a Made by Corning Glass, Corning, NY 14830.

b The AJ2145 is designed specifically for chassis mounting. The AJ2180 is similar to the AJ2145, but is light-tight. The AJ2144 is designed for use in any desired mounting arrangement. It is supplied with an unattached clamp ring which fits to either the top or bottom of its socket body to permit chassis mounting. The ring is not normally required for other mounting arrangements and can be discarded to make such arrangements more compact.

The 4507 is supplied without a socket. The AJ2144, AJ2145, or the AJ2180 may be ordered from your nearest RCA Field Sales Office.

c Made by Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago, IL 60622.

e Averaged over any interval of 30 seconds maximum.

f Tube operation at 22° C or below is recommended.

g This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

h These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode blue sensitivity (A/incident lm)}}{0.13}$$

The value of 0.13 is the average value of the ratio of the anode current measured under the conditions specified in footnote (j) to the anode current measured under the same conditions but with the blue filter removed.

j 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 1×10^{-7} lumen.

k This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

m These values are calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode blue sensitivity (A/incident lm)}}{0.13}$$

The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote

(n) to the cathode current measured under the same conditions but with the blue filter removed.

n Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870^{o} K. The value of light flux incident on the filter is 1 x 10^{-4} lumen and 500 volts are applied between cathode and all other electrodes connected as anode.

p Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 1 x 10^{-7} lumen. The supply voltage E is adjusted to obtain an anode current of 0.65 microamperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 50 amperes per lumen. Dark current is measured with incident light removed.

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

r At 385 nanometers. These values are calculated from the EADCI values in lumens using a conversion factor of 1140 lumens per watt.

s Under the following conditions: An equivalent bandwidth of 1 Hz, 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.

t At 385 nanometers. This value is calculated from the ENI value in lumens using a conversion factor of 1140 lumens per watt.

u 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.

v 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 Considerations

Anode-Dark Current

The 4507 is intended for use in systems requiring very low dark current. Accordingly, the base of the tube and its socket should never be allowed to become contaminated by handling. Such contamination produces leakage and dark current. It is recommended that if the tube base or its socket is handled that it be washed with a solution of alkaline soap cleaner such as Alconox*, or equivalent, and de-ionized or distilled water having a temperature not exceeding 60° C. Careful scrubbing between pins or socket contacts is useful, but not usually required. The base of socket should then be rinsed in de-ionized or distilled water (60°) for several minutes and then air-blown dry.

A temporary increase in anode dark current by as much as 3 orders of magnitude may occur if the tube is exposed momentarily to high-intensity ultraviolet radiation from sources such as fluorescent room lighting even though voltage is not applied to the tube. The increase in dark current may persist for a period up to 48 hours following such irradiation.

Cathode Current

A peak cathode current of 5×10^{-9} ampere at a tube temperature of 22° C or 1×10^{-11} ampere at −80° C should not be exceeded. Because of the resistivity of the photocathode, the voltage drop caused by higher peak cathode currents may produce radial electric fields on the photocathode which can result in poor photoelectron collection by the first dynode. Photocathode resistivity increases with decreasing temperature.

Leakage Current

The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding the tube at the photocathode end should not be permitted unless such materials are chosen to limit leakage current to the tube envelope to 1×10^{-12} ampere or less.

In addition to increasing dark current and noise output because of voltage gradients developed across the bulb wall, such high voltage may produce minute leakage current to the cathode, through the tube envelope and insulating materials, which can permanently damage the tube.

---

*Distributed by Arthur H. Thomas Company, Vine Street and 3rd, Philadelphia, PA 19105.

Ambient Atmosphere

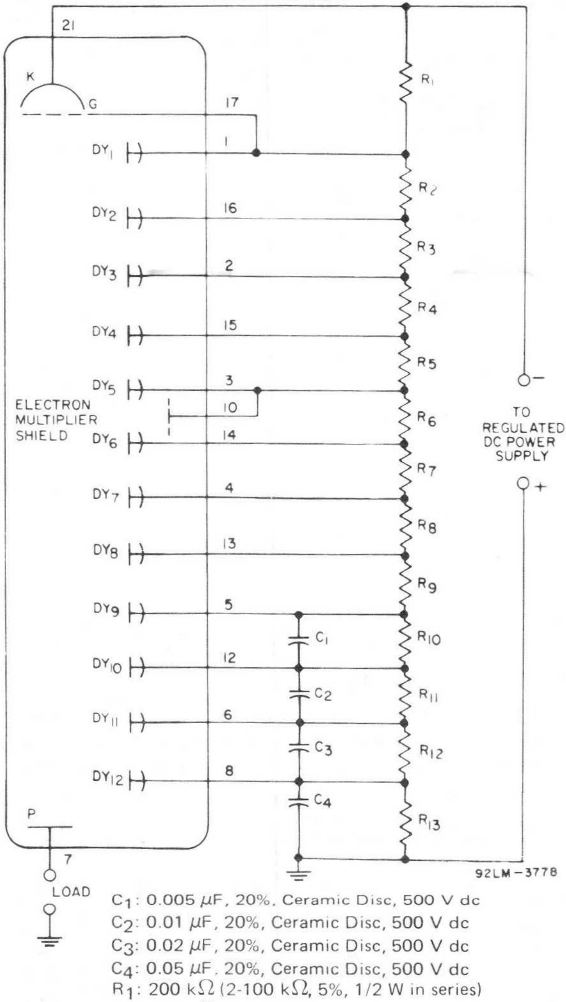
Operation or storage of this tube in environments where helium is present should be avoided. Helium may permeate through the tube envelope and may lead to eventual tube destruction.

Table I	
Voltages To Be Provided by Divider	
Between the Following Electrodes Cathode (K), Dynode (Dy), and Anode (P)	6.94% of Supply Voltage (E) Multiplied By
K – Dy1	2.0
Dy1 – Dy2	1.0
Dy2 – Dy3	1.4
Dy3 – Dy4	1.0
Dy4 – Dy5	1.0
Dy5 – Dy6	1.0
Dy6 – Dy7	1.0
Dy7 – Dy8	1.0
Dy8 – Dy9	1.0
Dy9 – Dy10	1.0
Dy10 – Dy11	1.0
Dy11 – Dy12	1.0
Dy12 – P	1.0
K – P	14.4

Focusing Electrode (Pin 17) is connected to dynode No.1 potential.

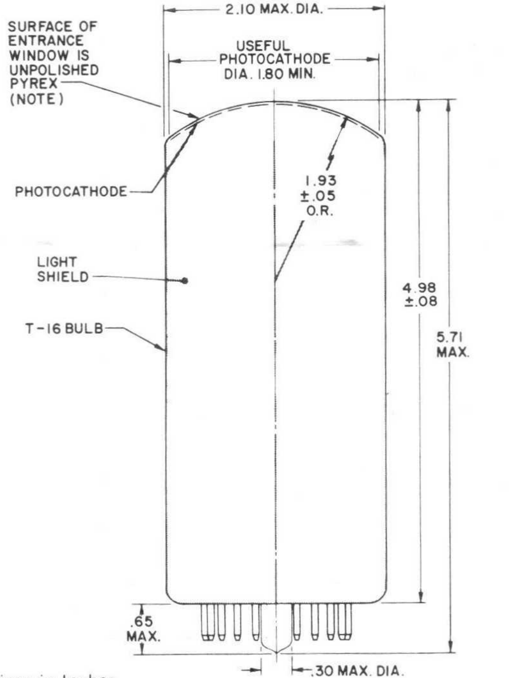
Electron Multiplier Shield (Pin 10) is connected to dynode No.5 potential.

TYPICAL CIRCUIT ARRANGEMENT



C_1: 0.005 μF, 20%, Ceramic Disc, 500 V dc
C_2: 0.01 μF, 20%, Ceramic Disc, 500 V dc
C_3: 0.02 μF, 20%, Ceramic Disc, 500 V dc
C_4: 0.05 μF, 20%, Ceramic Disc, 500 V dc
R_1: 200 kΩ (2-100 kΩ, 5%, 1/2 W in series)
R_2: 100 kΩ, 5%, 1/2 W
R_3: 130 kΩ, 5%, 1 W
R_4 through R_{13}: 100 kΩ, 5%, 1/2 W

DIMENSIONAL OUTLINE



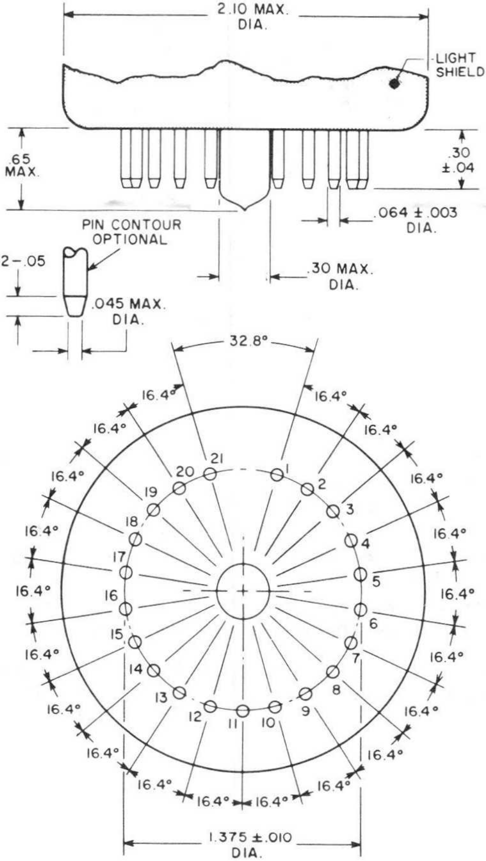
Dimensions in Inches

Note: Caution must be employed when handling this tube because of the thinness (approx. 0.02 inch thick) of the entrance window.

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

Inch	mm	Inch	mm	Inch	mm
.003	.08	.05	1.3	1.375	34.93
.010	.25	.064	1.63	1.80	45.7
.02	.5	.08	2.0	1.93	49.0
.04	1.0	.30	7.6	2.10	53.3
.045	1.14	.65	16.5	4.98	126.5
				5.71	145.0

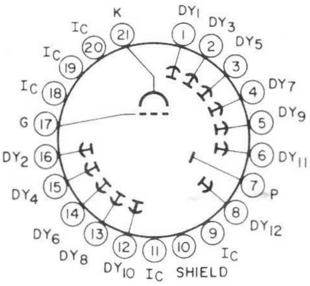
DETAIL OF BASE ARRANGEMENT



92CS-13040R3

Dimensions in Inches

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: Dynode No.11
Pin 7: Anode
Pin 8: Dynode No.12
Pin 9: Internal Connection, Do not use
Pin 10: Electron Multiplier Shield
Pin 11: Internal Connection, Do not use
Pin 12: Dynode No.10
Pin 13: Dynode No.8
Pin 14: Dynode No.6
Pin 15: Dynode No.4
Pin 16: Dynode No.2
Pin 17: Focusing Electrode
Pin 18: Internal Connection, Do not use
Pin 19: Internal Connection, Do not use
Pin 20: Internal Connection, Do not use
Pin 21: Photocathode

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

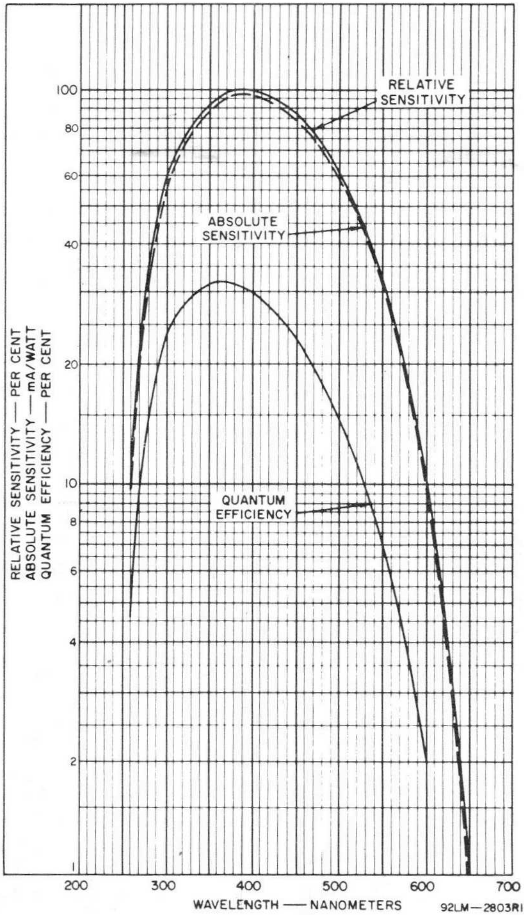


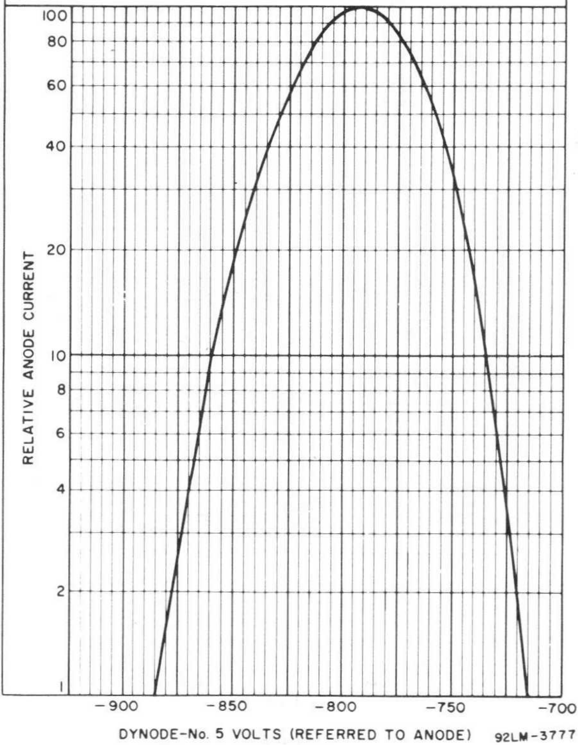
Figure 1

TYPICAL DYNODE MODULATION CHARACTERISTIC

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.94% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	2.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
CATHODE IS AT GROUND POTENTIAL.

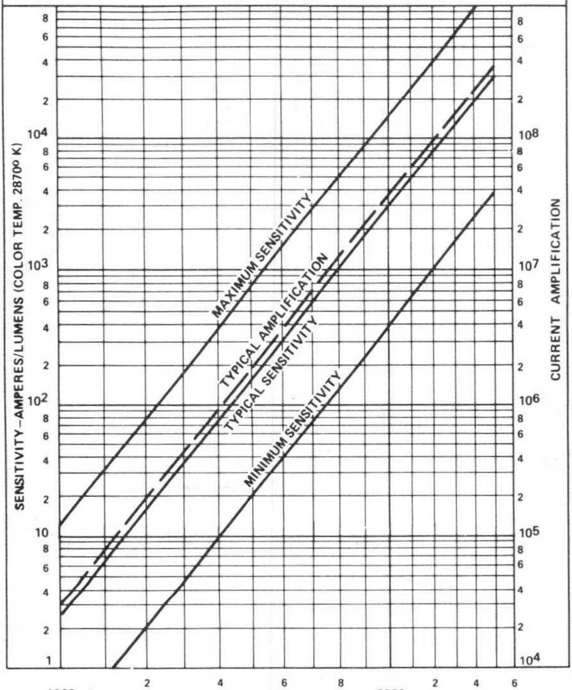


TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.94% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	2.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE No.5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.



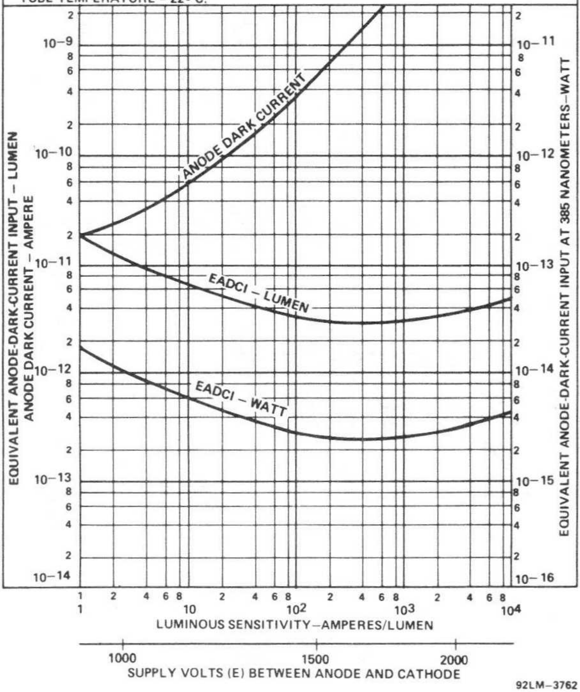
92LM-3761

TYPICAL ANODE DARK CURRENT AND EACDI CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.94% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	2.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.4

ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE No.5 POTENTIAL.
FOCUSING ELECTRODE IS CONNECTED TO DYNODE No.1 POTENTIAL.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 22° C.



92LM–3762

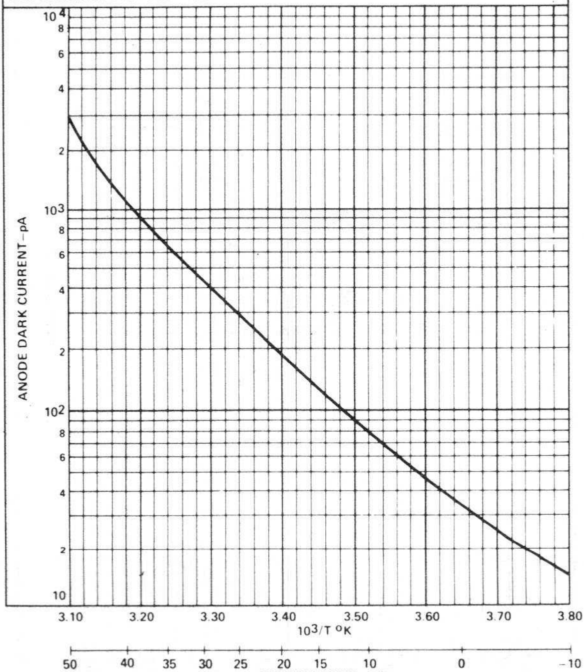
TYPICAL ANODE DARK CURRENT AS A FUNCTION OF TEMPERATURE

WITH SUPPLY VOLTAGE ADJUSTED TO PROVIDE AN ANODE LUMINOUS SENSITIVITY OF 50 AMPERES PER LUMEN.

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.94% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	2.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE No.5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

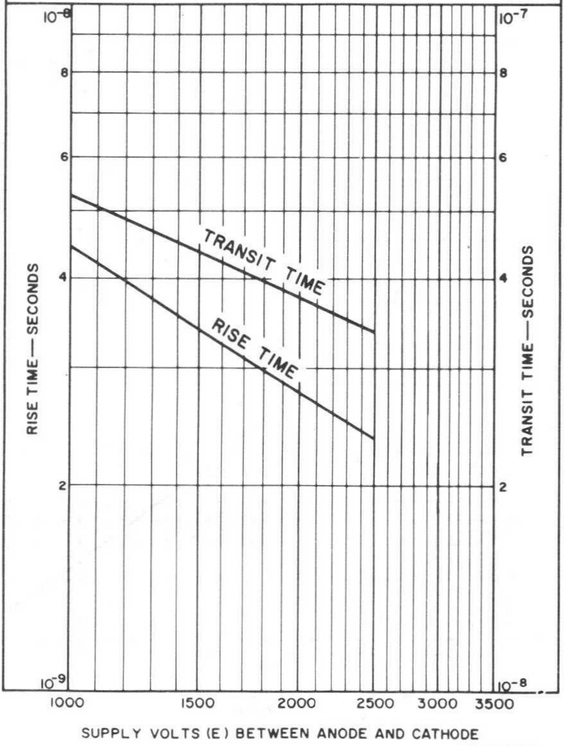


92LM-3763

TYPICAL TIME-RESOLUTION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:	
BETWEEN	6.94% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	2.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

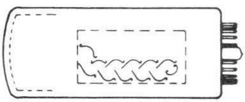


TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

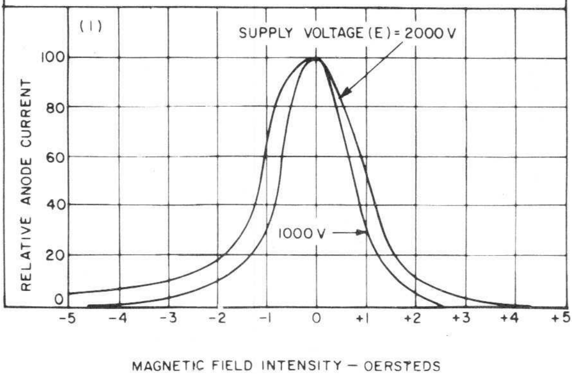
BETWEEN	6.94 % OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	2.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No.5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

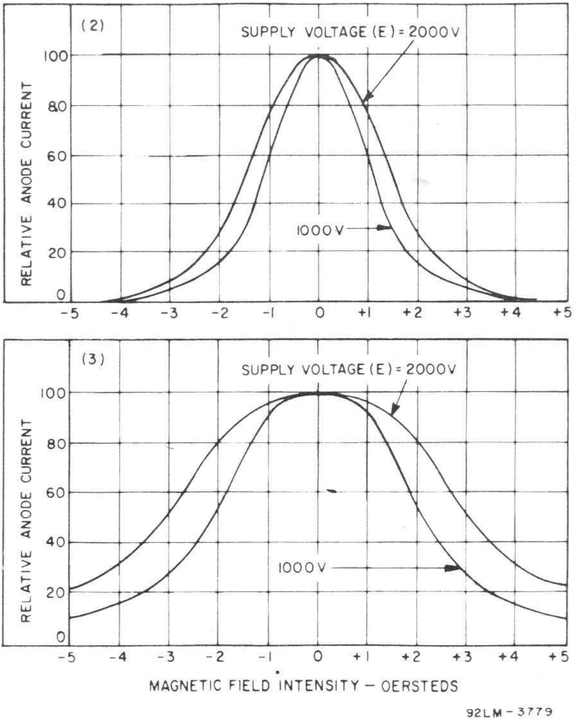


POSITIVE VALUE OF H IN DIRECTION SHOWN.
(1)* •, (2) ↑ OR (3) →

* DIRECTION (1) IS OUT OF PAPER



TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)



Photomultiplier Tubes

10-Stage, Head-On Types Having Bialkali Photocathode.

GENERAL

Spectral Response . . . . . See accompanying *Typical Spectral Response Characteristics*

Wavelength of Maximum Response . . . . 4000 ± 500 Å

Cathode, Semitransparent . . Potassium-Cesium-Antimony (Bialkali)

Type 4516

Minimum projected area . . . . 0.2 in^2 (1.26 cm^2)

Minimum diameter . . . . 0.5 in (1.27 cm)

Type 4517

Minimum projected area . . . . 1.2 in^2 (7.8 cm^2)

Minimum diameter . . . . 1.24 in (31.5 mm)

Window . . . . Corning[a] No.0080, or equivalent

Index of refraction at 4360 angstroms 1.523

Type 4516

Shape . . . . Plano-Concave

Type 4517

Shape . . . . Plano-Plano

Dynodes:

Substrate . . . . Copper-Beryllium

Secondary-Emitting Surface . . . . Beryllium-Oxide

Structure . . . . **(4516)** In-Line, Electrostatic-Focus Type
(4517) Circular-Cage, Electrostatic-Focus Type

Direct Interelectrode Capacitances (Approx.):

Type 4516

Anode to dynode No.10 . . . . 2.4 pF

Anode to all other electrodes . . . . 3.2 pF

Type 4517

Anode to dynode No.10 . . . . 4 pF

Anode to all other electrodes . . . . 7 pF

Type 4516

Maximum Overall Length
(Excluding semiflexible leads) . . . . 3.94 in (10 cm)

Maximum Diameter . . . . 0.78 in (2 cm)

Bulb T6

Base . . . . See Dimensional Outline

Magnetic Shield . . . . Millen[c] Part No.80801N, or equivalent

Operating Position . . . . Any

Weight (Approx.) . . . . 0.9 oz (25.5 g)

GENERAL (Cont'd)

Type 4517

Maximum Overall Length	4.57 in (116 mm)
Seated Length	3.88 in ± 0.19 in (98.6 mm ± 4.8 mm)
Maximum Diameter	1.56 in (39.6 mm)
Bulb	T12
Base	Small-Shell Duodecal 12-pin, JEDEC No.B12-43
Socket	Eby[b] No.9058, or equivalent
Magnetic Shield	Millen[c] No.80802C, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz

MAXIMUM RATINGS, *Absolute-Maximum Values*

DC Supply voltage:		
Between anode and cathode	1800 max.	V
Between anode and dynode No.10		
Type 4516	300 max.	V
Type 4517	250 max.	V
Between consecutive dynodes	300 max.	V
Between dynode No.1 and cathode		
Type 4516	300 max.	V
Type 4517	400 max.	V
Average Anode Current[e]	0.5 max.	mA
Ambient-Temperature Range[f]	-100 to +85	^{o}C

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages as shown in Table I and at a temperature of 22^{o} C, except as noted.

With E = 1500 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g] at 4000 angstroms	–	5.6×10^4	–	A/W
Luminous[h] (2870^{o} K)				
Type 4516	10	47	170	A/lm
Type 4517	10	47	150	A/lm

CHARACTERISTICS RANGE VALUES (Cont'd)

	Min.	Typical	Max.	
Current with blue light source[j] (2870°K + C.S. No.5-58)				
Type 4516	1.5×10^{-6}	7×10^{-6}	2.6×10^{-5}	A
Type 4517	1.5×10^{-5}	7×10^{-5}	2.2×10^{-4}	A
Cathode Sensitivity:				
Type 4516				
Radiant[k] at 4000 angstroms	–	0.071	–	A/W
Luminous[m] (2870°K) . .	5.3×10^{-5}	6×10^{-5}	–	A/lm
Current with blue light source[n] (2870° K + C.S. No.5-58)	8×10^{-9}	9×10^{-9}	–	A
Quantum Efficiency at 4000 angstroms.	–	22	–	%
Type 4517				
Radiant[k] at 4000 angstroms	–	0.079	–	A/W
Luminous[m] (2870°K) . .	–	6.7×10^{-5}	–	A/lm
Current with blue light source[n] (2870° K + C.S. No.5-58)	8×10^{-10}	1×10^{-9}	–	A
Quantum Efficiency at 4000 angstroms	–	24	–	%
Type 4516				
Current Amplification . .	–	8×10^{5}	–	
Anode Dark Current at 7 A/lm[p]	–	2×10^{-10}	6×10^{-10}	A
Equivalent Anode Dark Current Input at 7 A/lm	–	2.9×10^{-11} [p]	8.6×10^{-11} [p]	lm
	–	2.4×10^{-14} [q]	7.2×10^{-14} [q]	W
Equivalent Noise Input[r] . .	–	4.1×10^{-13}	–	lm
	–	3.5×10^{-16} [s]	–	W
Dark Pulse Summation:[t]				
1 to 32 photoelectrons . (See *Typical Dark-Pulse Spectrum*)	–	250	–	cps
Pulse Height Resolution[u].	–	8.5	–	%
Anode-Pulse Rise Time[v,w] at 1800 V	–	1.7×10^{-9}	–	s
Electron Transit Time[v,x] at 1800 V	–	1.8×10^{-8}	–	s

➤ Indicates a change or addition.

CHARACTERISTIC RANGE VALUES (Cont'd)

Type 4517	Min.	Typical	Max.	
Current Amplification . .	–	7×10^{5}	–	
Anode Dark Current at 7 A/lm[p]	–	2×10^{-10}	7×10^{-10}	A
Equivalent Anode Dark Current Input at 7 A/lm	–	2.9×10^{-11}[p]	1×10^{-10}[p]	lm
	–	2.4×10^{-13}[q]	8.4×10^{-12}[q]	W
Equivalent Noise Input[r] . .	–	3.9×10^{-13}	–	lm
	–	3.3×10^{-16}[s]	–	W
Dark Pulse Summation:[t]				
1 to 32 photoelectrons . (See *Typical Dark-Pulse Spectrum*)	–	250	–	cps
Pulse Height Resolution[u].	–	8.5	–	%
Anode-Pulse Rise Time[v,w] at 1800 V	–	2.1×10^{-9}	–	s
Electron Transit Time[v,x] at 1800 V	–	2.4×10^{-8}	–	s

Typical Potential Distribution	**Type 4516**	**Type 4517**
Between:	**8.25% of Supply Voltage (E) Multiplied by:**	**8.13% of Supply Voltage (E) Multiplied by:**
Cathode and Dynode No.1	1.2	1.7
Dynode No.1 and Dynode No.2	1.2	1.3
Dynode No.2 and Dynode No.3	1.7	1.3
Dynode No.3 and Dynode No.4	1.0	1.0
Dynode No.4 and Dynode No.5	1.0	1.0
Dynode No.5 and Dynode No.6	1.0	1.0
Dynode No.6 and Dynode No.7	1.0	1.0
Dynode No.7 and Dynode No.8	1.0	1.0
Dynode No.8 and Dynode No.9	1.0	1.0
Dynode No.9 and Dynode No.10	1.0	1.0
Dynode No.10 and Anode	1.0	1.0
Anode and Cathode	12.1	12.3

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 Tube operation at room temperature or below is recommended.

g This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1190 lumens per watt.

h These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.15 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}$$

The value of 0.15 is the average value of the ratio of the anode current measured under the conditions specified in footnote (j) to the anode current measured under the same conditions but with the blue filter removed.

j 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 1×10^{-5} lumen.

k This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1190 lumens per watt.

m This value is calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.15 \times \text{Light Flux of } 1 \times 10^{-4}}$$

The value of 0.15 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (n) to the cathode current measured under the same conditions but with the blue filter removed.

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 1×10^{-4} lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

p Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 10 microlumens. The supply voltage (E) is adjusted to obtain an anode current of 10 microamperes. Sensitivity of the tube under these conditions is approximately equivalent to 7 amperes per lumen. Dark current is measured with no light incident on the tube.

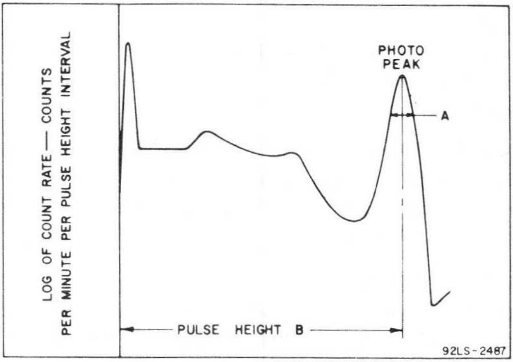
q At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1190 lumens per watt.

r Under the following conditions: External shield connected to cathode, an equivalent bandwidth of 1 Hz, 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.

s At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1190 lumens per watt.

t Measured with the tube in complete darkness. The pulse height for the single photoelectron equivalent is determined by using a light source operated at a low color temperature to assure the high probability of single photoelectron emission from the photocathode of the tube. The intensity of the light source is adjusted for approximately 10^4 photons per second. This light is removed before the dark pulse summation is measured.

u The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 1-1/2" x 1-1/2" thallium-activated sodium-iodide scintillator [NaI (TI) -type 6D6] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, OH 44106, and is rated by the manufacturer as having a resolution capability of 8.5%. The Cs^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the tube by a coupling fluid such as Dow Corning Corp., Type DC200 (viscosity of 60,000 centistokes) – Manufactured by the Dow Corning Corp., Midland, MI 48640, or equivalent. Pulse height resolution in per cent is defined as 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height (A) to the pulse height at maximum photopeak count rate (B).



v 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.

w 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.

x 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 CONSIDERATIONS

SHIELDING

Electrostatic shielding of the 4516 and 4517 is ordinarily required. When a shield is used, it must be connected to the cathode terminal.

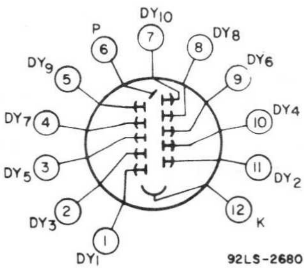
Magnetic shielding of the 4516 and 4517 is ordinarily required. See accompanying curves for the effect of variation in magnetic field intensity on the anode current for a tube with no magnetic shielding.

OPERATING VOLTAGES

In general, the operating potential between anode and cathode should not be less than 500 volts. The suggested voltage distribution shown in Table I is a typical, average distribution for obtaining a good compromise between output current and time and energy resolution. However, it may be necessary to individually adjust these distribution voltages by as much as ±15% to obtain optimum current amplification, pulse-height resolution, or time resolution.

LEAD CONNECTIONS (4516)

Bottom View

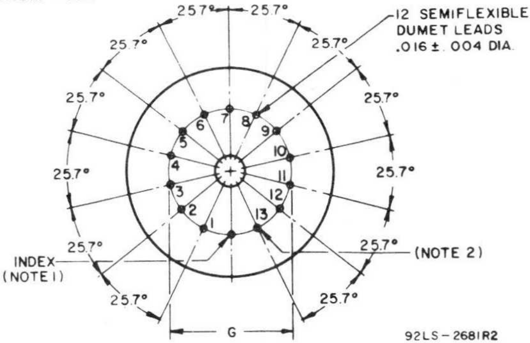


92LS-2680

Lead 1: Dynode No.1	Lead 7: Dynode No.10
Lead 2: Dynode No.3	Lead 8: Dynode No.8
Lead 3: Dynode No.5	Lead 9: Dynode No.6
Lead 4: Dynode No.7	Lead 10: Dynode No.4
Lead 5: Dynode No.9	Lead 11: Dynode No.2
Lead 6: Anode	Lead 12: Photocathode

LEAD ORIENTATION (4516)

Bottom View



Note 1: Lead No.14 is cut off within 0.04 inch of the glass button for indexing.

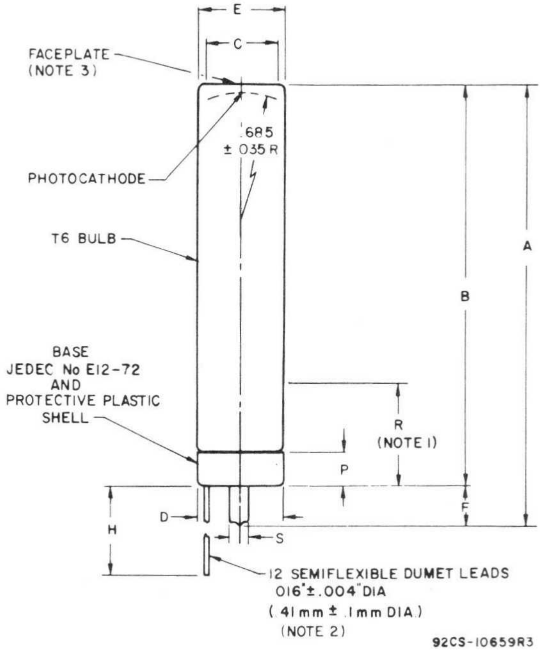
Note 2: Lead No.13 is cut off within 0.04 inch of the glass button.

OUTLINE DIMENSIONS(4516)

Dimensions	Inches	mm
A	3.94 max.	100.0 max.
B	3.50 $^{+.06}_{-.12}$	88.9 $^{+1.5}_{-3}$
C	.5 min. dia.	12.7 min. dia.
D	.78 max. dia.	19.8 max. dia.
E	.755 max. dia.	19.18 max. dia.
F	.38 max.	9.7 max.
G	.47 ± .01 dia.	11.9 ± .25 dia.
H	.75 min.	19.0 min.
P	.30 max.	7.6 max.
R	1.0 max.	25 max.
S	.17 max.	4.3 max.

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

DIMENSIONAL OUTLINE (4516)

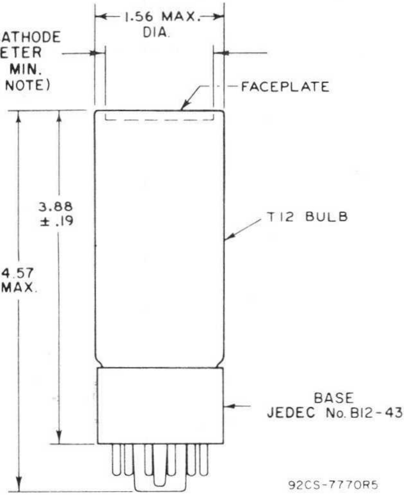


Note 1: Within this length, maximum diameter of tube is 0.78".

Note 2: The semiflexible leads of the tube may be soldered or welded into the associated circuit. If desired, the leads may be trimmed to within 1/4 inch of the protective shell. Care must be exercised when making such connections to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the protective shell is recommended. Excessive bending of the leads is to be avoided.

Note 3: Deviation from flatness will not exceed 0.006" from peak to valley.

DIMENSIONAL OUTLINE (4517)



Dimensions in Inches

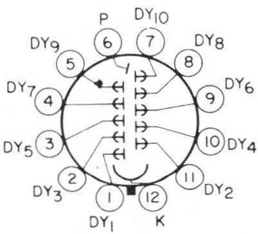
Note: Deviation from flatness will not exceed 0.010" from peak to valley.

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

PIN CONNECTIONS (4517)

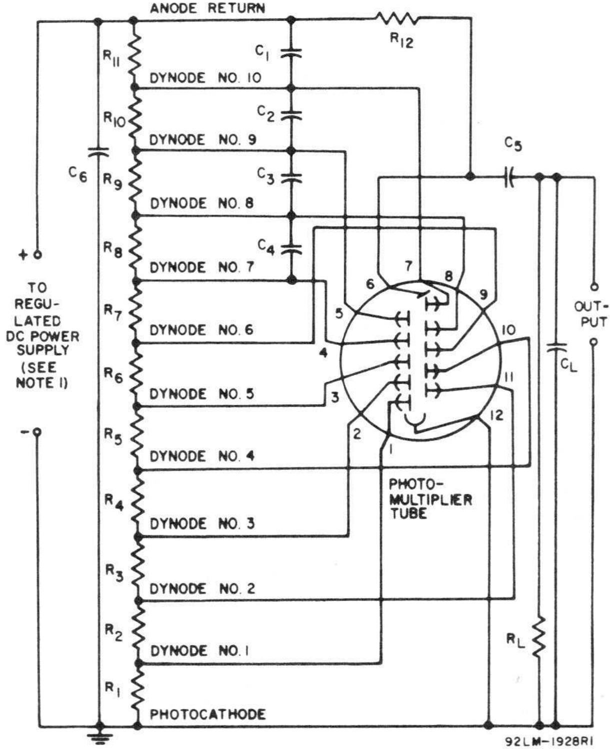
Bottom View

DIRECTION OF LIGHT: INTO END OF BULB



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

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS (4516, 4517)



C_1: 0.05 μF, 500 volts
C_2: 0.02 μF, 500 volts
C_3: 0.01 μF, 500 volts
C_4: 0.005 μF, 500 volts
C_5 and C_6: 0.005 μF, 3000 V
R_1 and R_2: 560,000 ohms, 1/2 watt
R_3: 820,000 ohms, 1/2 watt
R_4 through R_{11}: 470,000 ohms, 1/2 watt
R_{12}: 1 megohm, 1/2 watt
R_{13}: 100,000 ohms, 1/2 watt

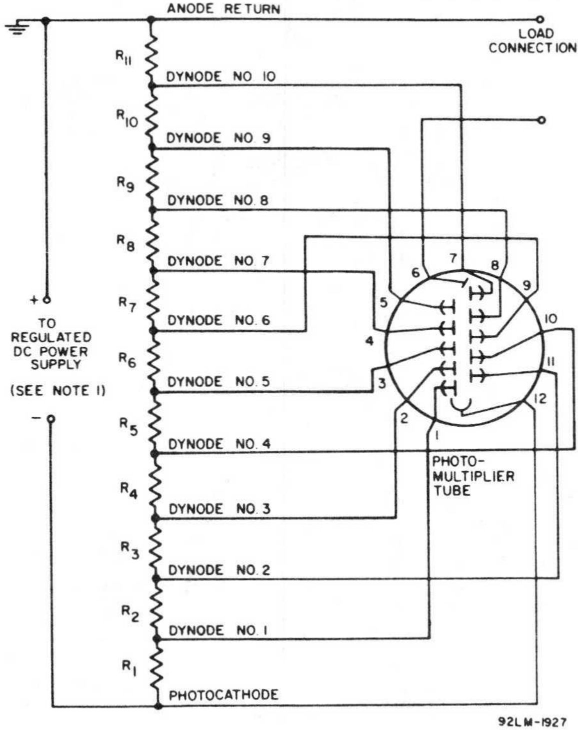
Note 1: Adjustable between approximately 500 and 1800 V dc.

Note 2: Capacitors C_1 through C_6 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.

Note 4: The value of the load elements, R_L and C_L, depend on the application:
$R_L C_L$ = 10 microseconds for most applications

TYPICAL VOLTAGE-DIVIDER ARRANGEMEN WHICH PERMITS DIRECT COUPLING TO THE ANODE (4516, 4517)

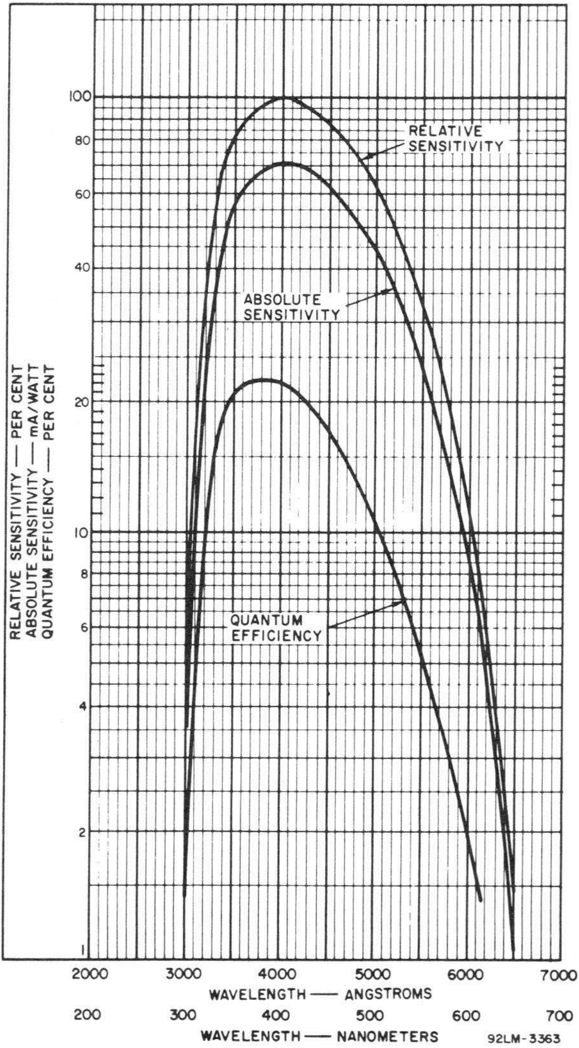


R_1 and R_2: 560,000 ohms, 1/2 watt
R_3: 820,000 ohms, 1/2 watt
R_4 through R_{11}: 470,000 ohms, 1/2 watt

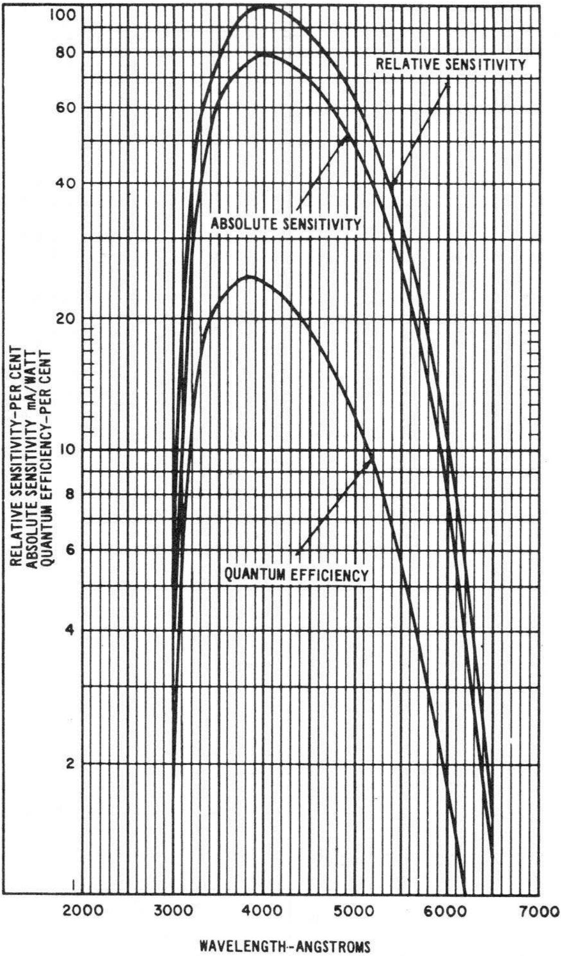
Note 1: Adjustable between approximately 500 and 1800 volts dc.

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

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS (4516)



TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS (4517)

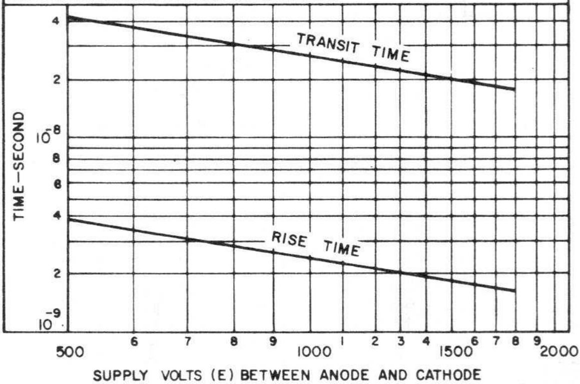


92LM-1997R1

TYPICAL TIME-RESOLUTION CHARACTERISTICS

TYPE 4516

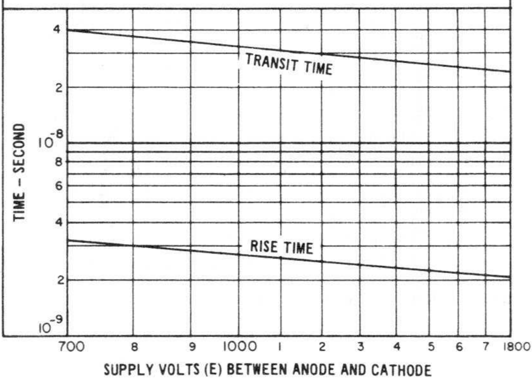
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No.1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No.10 AND ANODE
THE PHOTOCATHODE IS FULLY ILLUMINATED.



92LS-1163

TYPE 4517

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.
THE PHOTOCATHODE IS FULLY ILLUMINATED.



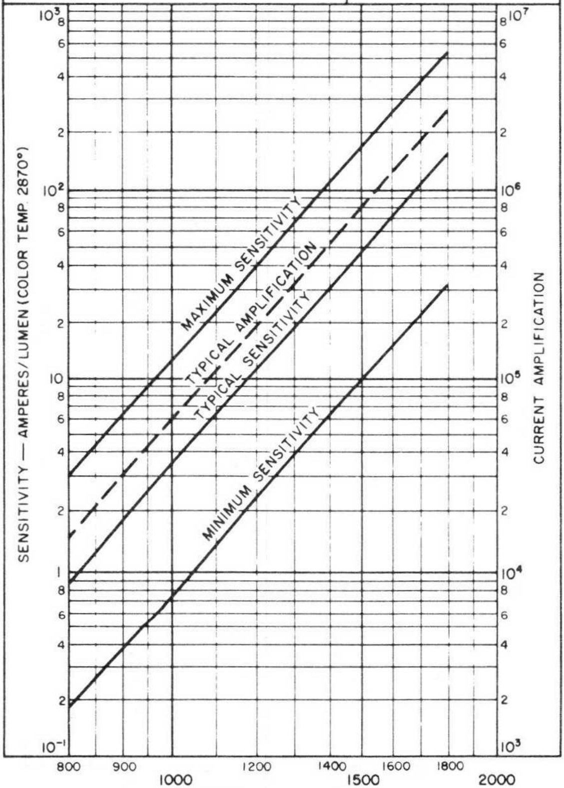
92LS-1945

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

TYPE 4516

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	8.25% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	1.2
DYNODE No. 1 AND DYNODE No. 2	1.2
DYNODE No. 2 AND DYNODE No. 3	1.7
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	12.1

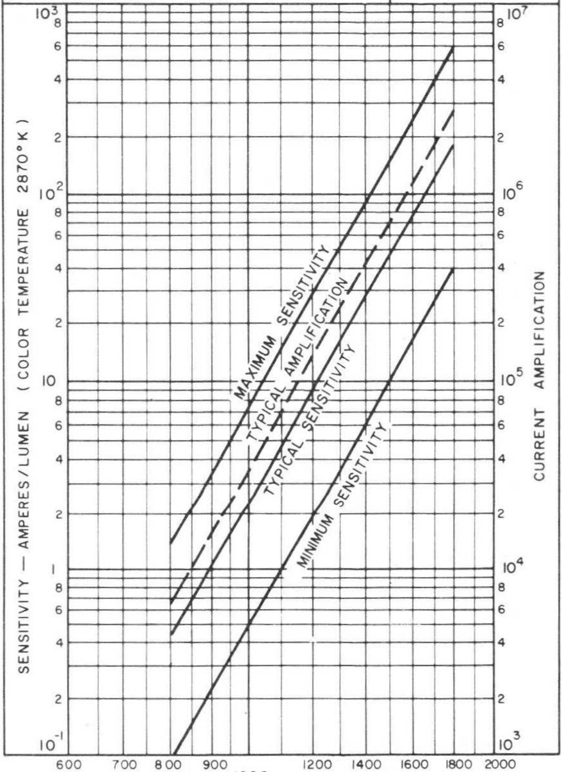


TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

TYPE 4517

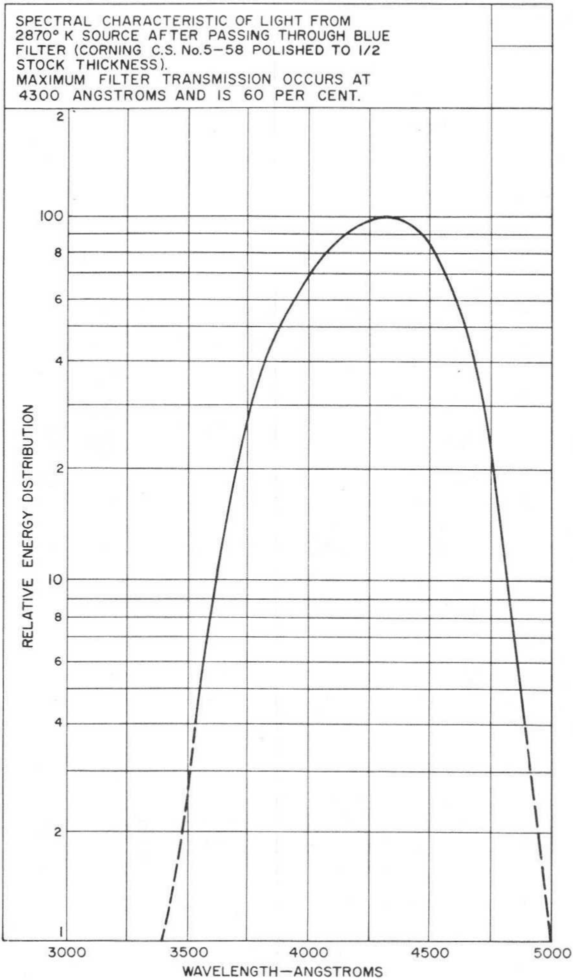
THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS.

BETWEEN:	8.13 % OF (E) MULTIPLIED BY
CATHODE AND DYNODE No. 1	1.7
DYNODE No. 1 AND DYNODE No. 2	1.3
DYNODE No. 2 AND DYNODE No. 3	1.3
EACH SUCCEEDING DYNODE-STAGE	1.0
ANODE AND CATHODE	12.3



92LM-2753R1

SPECTRAL ENERGY DISTRIBUTION OF 2870°K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER



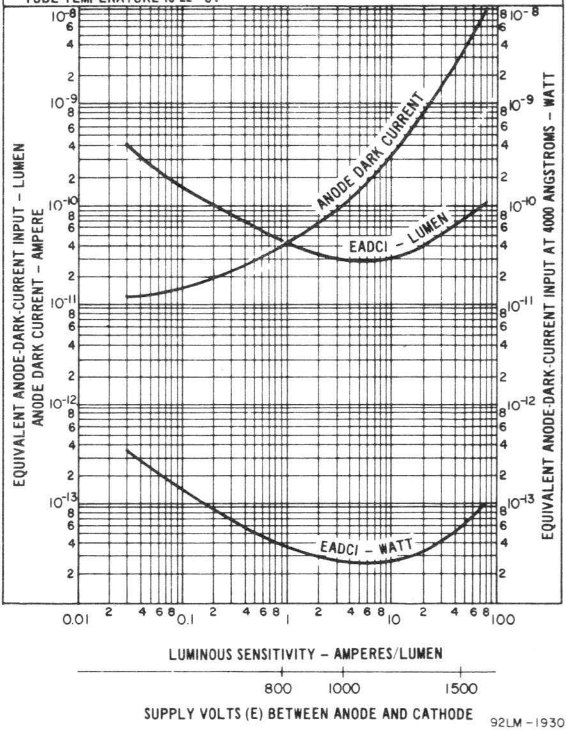
TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

TYPE 4516

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	8.25% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	1.2
DYNODE No. 1 AND DYNODE No. 2	1.2
DYNODE No. 2 AND DYNODE No. 3	1.7
EACH SUCCEEDING DYNODE-STAGE	1.0
ANODE AND CATHODE	12.1

TUBE TEMPERATURE IS 22° C.



92LM-1930R1

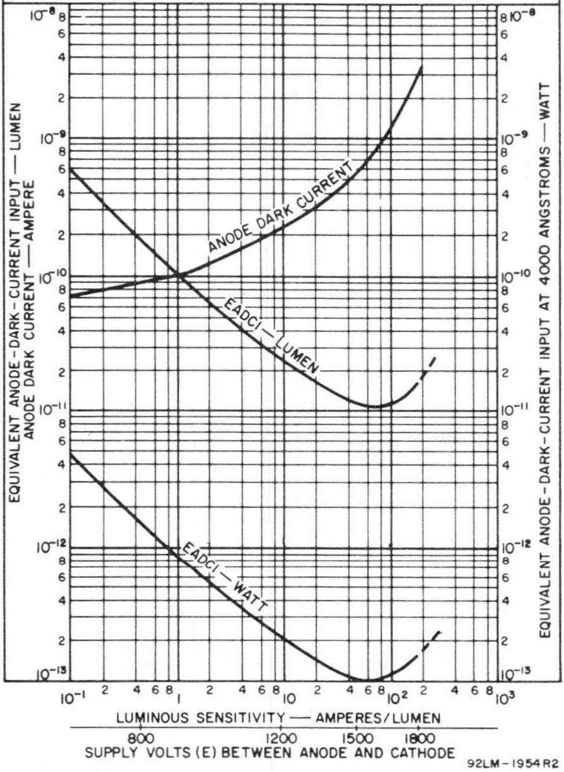
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

TYPE 4517

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	8.13 % OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	1.7
DYNODE No. 1 AND DYNODE No. 2	1.3
DYNODE No. 2 AND DYNODE No. 3	1.3
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	12.3

TUBE TEMPERATURE = 22°C

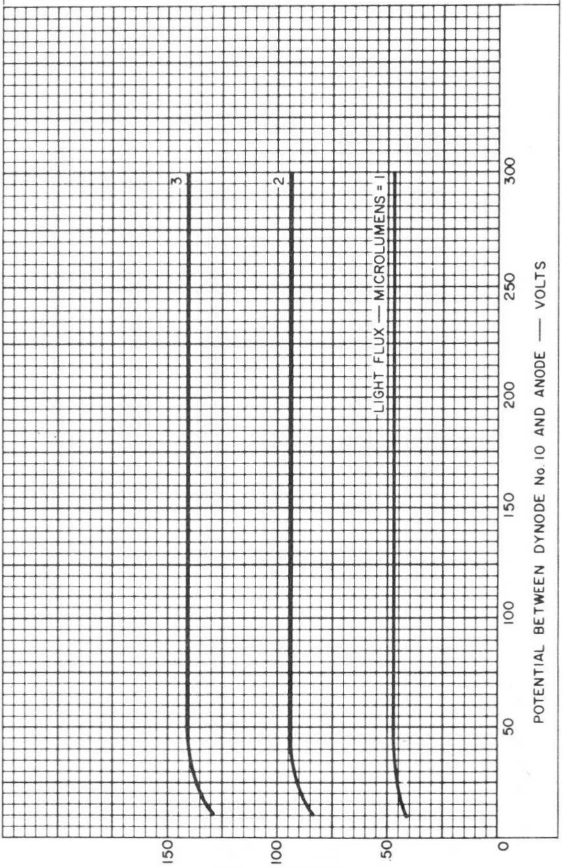


92LM-1954R2

TYPICAL ANODE CHARACTERISTICS

TYPE 4516

CATHODE-TO-DYNODE No.1 VOLTS = 149
DYNODE No.1-TO-DYNODE No.2 VOLTS = 149
DYNODE No.2-TO-DYNODE No.3 VOLTS = 210
EACH SUCCEEDING DYNODE-STAGE VOLTS = 124
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.

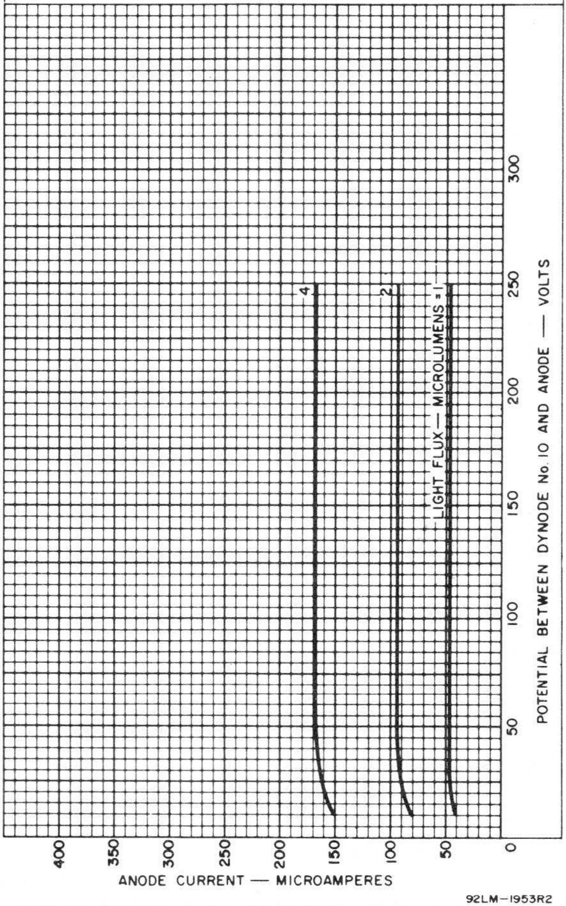


92LM-1924RI

TYPICAL ANODE CHARACTERISTICS

TYPE 4517

CATHODE-TO-DYNODE No. 1 VOLTS = 208
DYNODE No. 1-TO-DYNODE No. 2 VOLTS = 158
DYNODE No. 2-TO-DYNODE No. 3 VOLTS = 158
EACH SUCCEEDING DYNODE-STAGE VOLTS = 122
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.

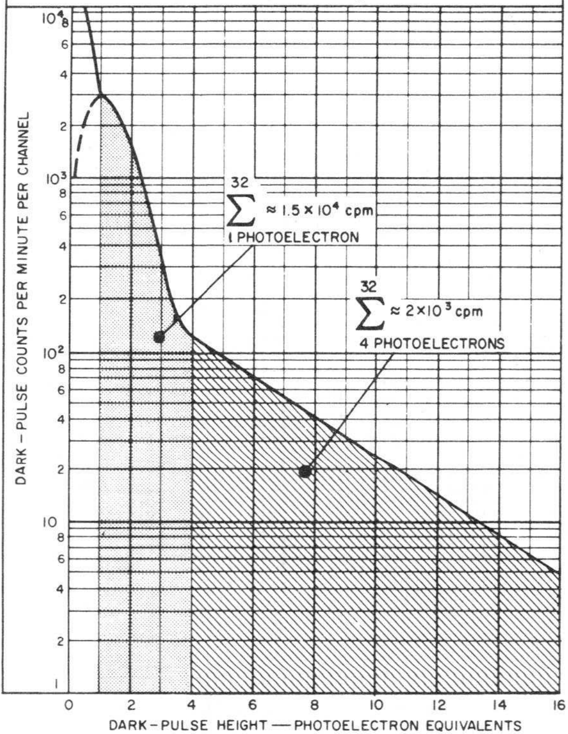


92LM-1953R2

TYPICAL DARK-PULSE SPECTRUM

	4516	4517
CATHODE-TO-DYNODE No. 1 VOLTS	149	208
DYNODE No. 1-TO-DYNODE No. 2 VOLTS	149	158
DYNODE No. 2-TO-DYNODE No. 3 VOLTS	210	158
EACH SUCCEEDING DYNODE-STAGE VOLTS	124	122
ANODE-TO-CATHODE VOLTS	1500	1500

DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE IS NORMALIZED TO COINCIDE WITH SINGLE PHOTOELECTRON PEAK OF DARK PULSE SPECTRUM AND IS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES ARE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22°C
ONE PHOTOELECTRON PULSE HEIGHT = 4 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 30 μ SEC. (R_L = 300 kΩ C = 100 pF).



92LM-1940R2

TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4516

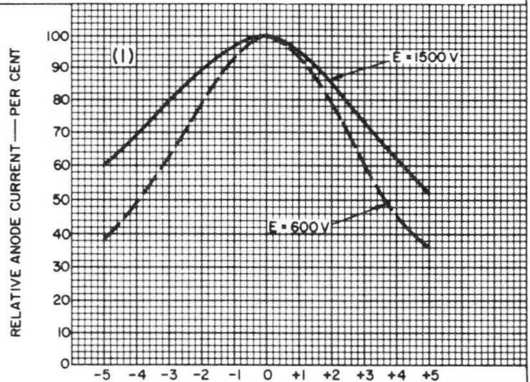
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No. 1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No. 10 AND ANODE.

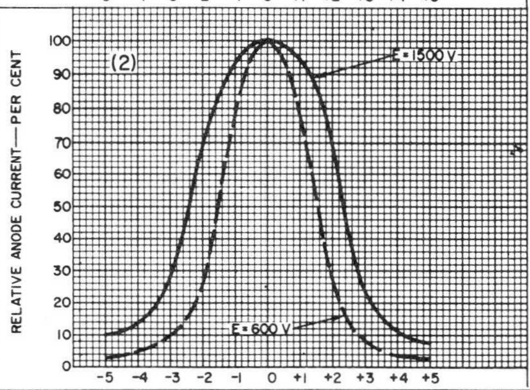
PHOTOCATHODE IS FULLY ILLUMINATED.

(1) H ←, (2) H ↓, (3) H ● *

POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION.

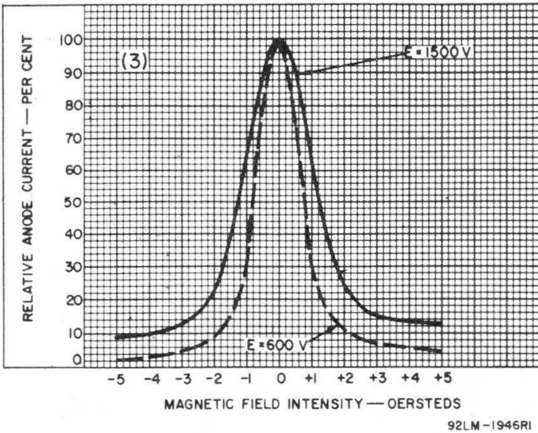
*POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX OUT OF PAPER.





TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4516 (Cont'd)

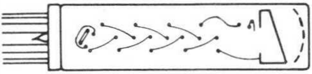


TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4517

SUPPLY VOLTAGE E IS 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.

PHOTOCATHODE IS FULLY ILLUMINATED.
TUBE IS ORIENTED IN MAGNETIC FIELD AS SHOWN BELOW:

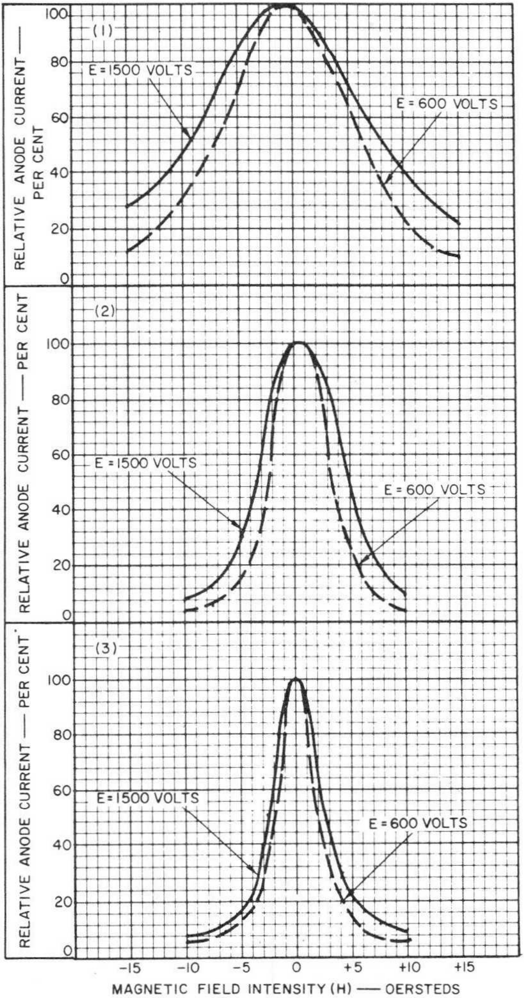


POSITIVE VALUE OF H IN DIRECTION SHOWN:
(1) →, (2) ↓, (3) ●*

* DIRECTION (3) IS OUT OF PAPER

TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4517 (Cont'd)



92LM-2223RI

Photomultiplier Tube

2-Inch Diameter, 10-Stage, Head-On Type
Bialkali Photocathode of High Quantum Efficiency
Circular-Cage Electrostatically-Focused Dynode Structure

For use in pulse counting and other low light level detection and measurement systems

GENERAL

Spectral Response. . . . . See accompanying *Spectral Response Characteristics*
Wavelength of Maximum Response. . . . 4000 ±500 angstroms
Cathode, Semitransparent . . . . . Cesium-Potassium-Antimony (Bialkali)
  Shape . . . . Spherical Section
  Minimum projected area . . . . $2.2\ in^2$
  Minimum diameter . . . . 1.68 in.
Window . . . . Corning[a] No.0080, or equivalent
  Shape . . . . Plano-Concave
  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 pF
Maximum Overall Length. 5.81 in.
Seated Length . . . . 4.87 in. ±0.19 in.
Maximum Diameter. . . . . 2.31 in.
Bulb. T-16
Socket . . . . .Cinch-Jones[b] No.3M14, or equivalent
Magnetic Shield . . . . Millen[c] No.80802B, or equivalent
Operating Position . . . . Any
Weight (Approx.). . . . . 5.2 oz
Base .Medium-Shell Diheptal 14-Pin (JEDEC No.B14-38), Non-hygroscopic

ABSOLUTE-MAXIMUM RATINGS

DC Voltage:

Between anode and cathode.	2000 max.	V
Between anode and dynode No.10	250 max.	V
Between consecutive dynodes	400 max.	V
Between dynode No.1 and cathode	300 max.	V
Between focusing electrode and cathode .	400 max.	V
Average Anode Current[e]	0.5 max.	mA
Ambient-Temperature Range[f]	-100 to +85	°C

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing voltages as shown in Table I, except as noted.

With E = 1500 volts except as noted

	Min.	Typ.	Max.	
Sensitivity				
Radiant[g] at				
4000 angstroms	-	3.9×10^{4}	-	A/W
Cathode Radiant[h]				
at 4000 angstroms	-	0.079	-	A/W
Luminous:				
With tungsten				
light source[i]	13	33	200	A/lm
With blue light source[k]..	2×10^{-5}	5×10^{-5}	3×10^{-4}	A
Cathode Luminous:				
With tungsten				
light source[m]	-	6.7×10^{-5}	-	A/lm
With blue light source[n]..	8×10^{-10}	1×10^{-9}	-	A
Quantum Efficiency				
at 4000 angstroms	-	24	-	%
Current Amplification	-	5×10^{5}	-	
Anode Dark Current[p]	-	2.4×10^{-10}	5×10^{-10}	A
Equivalent Anode-				
Dark-Current Input	-	3×10^{-11}[q]	-	lm
	-	2.5×10^{-14}[r]	-	W
Dark-Pulse Spectrum[s].....	-	(x)	-	
Pulse-Height Resolution[t] ..	-	9	-	%
Anode-Pulse Rise Time[u,v] .	-	2.3×10^{-9}	-	s
Electron Transit Time[u,w] ..	-	2.7×10^{-8}	-	s

[a]Made by Corning Glass Works, Corning, New York 14830.

[b]Made by Cinch Manufacturing Co., 1026 S. Homan Ave., Chicago, Ill. 60624

[c]Made by James Millen Manufacturing Co., 150 Exchange St., Malden, Mass. 02148

[e]Averaged over any interval of 30 seconds maximum.

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

[g]This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1190 lumens per watt.

[h]This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1190 lumens per watt.

[i]These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.15 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}$$

The value of 0.15 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions but with the blue filter removed.

[k]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, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 10 microlumens.

[m]This value is calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.15 \times \text{Light Flux of } 1 \times 10^{-4} \text{ (lm)}}$$

The value of 0.15 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

[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, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 100 microlumens and 200 volts are applied between cathode and all other electrodes connected as anode.

[p]At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C. S. No.5-58, polished to 1/2 stock thickness). The light flux incident on

the filter is 10 microlumens. The supply voltage (E) is adjusted to obtain an anode current of 10 microamperes. Sensitivity of the 4518 under these conditions is approximately equivalent to 7 amperes per lumen. Dark current is measured with no light incident on the tube.

[q]With supply voltage (E) adjusted to give an equivalent luminous sensitivity of 7 amperes per lumen.

[r]At 4000 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 1190 lumens per watt.

[s]Measured under the following conditions: A Nuclear Data Model No.ND-180 Multichannel Pulse-Height Analyzer is used. The single-photoelectron pulse height is established by fully illuminating the photocathode with a weak light source, such as a tungsten-filament lamp operated at a low color temperature, to assure the high probability of single photoelectron emission from the photocathode of the 4518. The intensity of the light source is adjusted for approximately 50 per cent counting loss. The dark-pulse spectrum is then obtained, using the same gain setting of the Multichannel Pulse-Height Analyzer, with the light source removed.

[t]Pulse-height resolution is defined as the quotient of the full width of the photopeak at half height by the pulse height at maximum count rate under the following conditions: The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator [NaI(T1)-type 8D8] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio, and is rated by the manufacturer as having a resolution capability of 7.5%. The Cs^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the 4518 by a coupling fluid such as Dow Corning Corp., Type DC200 (viscosity of 60,000 centistokes) – Manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

[u]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 potential is adjusted as shown in Table I.

[v]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.

[w]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.

[x]See accompanying *Typical Dark-Pulse Spectrum*.

TABLE I

TYPICAL POTENTIAL DISTRIBUTION

Between:	7.75% of Supply Voltage (E) Multiplied by:
Cathode and Dynode No.1	1.8
Dynode No.1 and Dynode No.2	1.4
Dynode No.2 and Dynode No.3	1.5
Dynode No.3 and Dynode No.4	1.2
Dynode No.4 and Dynode No.5	1.0
Dynode No.5 and Dynode No.6	1.0
Dynode No.6 and Dynode No.7	1.0
Dynode No.7 and Dynode No.8	1.0
Dynode No.8 and Dynode No.9	1.0
Dynode No.9 and Dynode No.10	1.0
Dynode No.10 and Anode	1.0
Anode and Cathode	12.9

Focusing Electrode is connected to arm of potentiometer between cathode and dynode No.1. The focusing-electrode voltage is varied between 10% and 60% of dynode No.1 potential (referred to cathode) to give maximum anode current.

OPERATING CONSIDERATIONS

The *base pins* of the 4518 fit a diheptal 14-contact socket, such as Cinch-Jones No.3M14 or equivalent. The socket should be made of high-grade, low-leakage material, and should be installed so that incident light falls on the face end of the tube.

The *operating stability* of the 4518 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 stability is of prime importance, the use of an average anode current of 1 microampere or less is recommended.

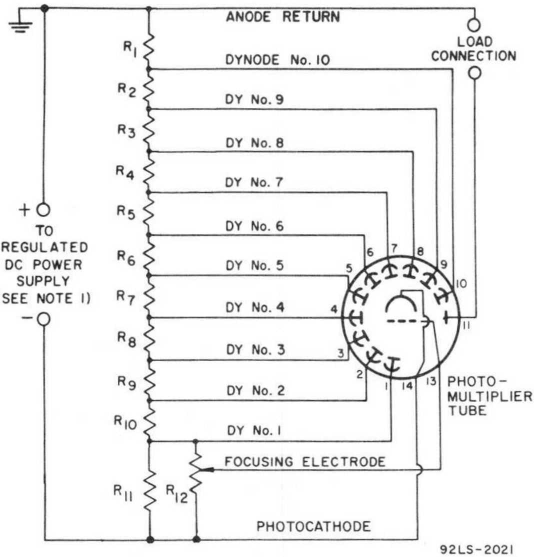
Electrostatic and magnetic shielding of the 4518 is ordinarily required. When a shield is used, it must be at cathode potential.

The *high voltages* at which the 4518 is operated are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

Accompanying typical voltage-divider arrangements are recommended for use with the 4518. The resistance values for the voltage dividers range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for any voltage-divider network is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the regulated power supply and the required power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode.

The use of high resistance values per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum value of anode current, and may limit anode-current response to pulsed light. The latter effect may be reduced by connecting capacitors between the tube socket terminals for dynodes No.7 and No.8, dynodes No.8 and No.9, dynodes No.9 and No.10, and between dynode No.10 and anode return. In addition to non-linearity and pulse-limiting effects, the use of resistance values exceeding 10 megohms per stage make the 4518 more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT WHICH PERMITS DIRECT COUPLING TO THE ANODE

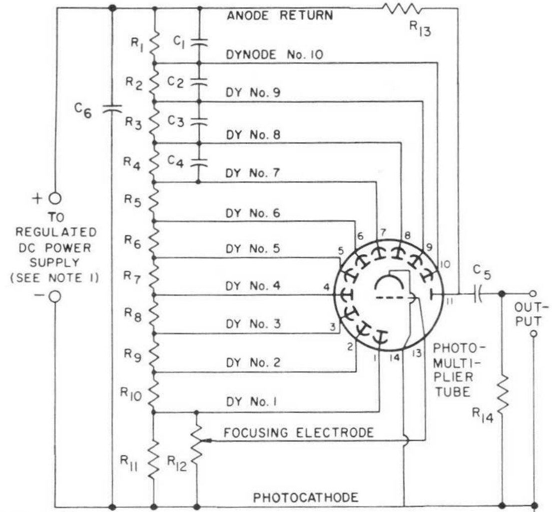


R_1 through R_7: 390,000 ohms, 1/2 watt
R_8: 470,000 ohms, 1/2 watt
R_9: 620,000 ohms, 1/2 watt
R_{10}: 560,000 ohms, 1/2 watt
R_{11}: 720,000 ohms, 1/2 watt
R_{12}: 5 megohms, 1/2 watt, adjustable

Note 1: Adjustable between approximately 500 and 2000 volts dc.

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

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS



92LS-2022

C_1: 0.05 μF, 500 volts (dc working)
C_2: 0.02 μF, 500 volts (dc working)
C_3: 0.01 μF, 500 volts (dc working)
C_4: 0.005 μF, 500 volts (dc working)
C_5 and C_6: 0.005 μF, 3000 volts (dc working)
R_1 through R_7: 390,000 ohms, 1/2 watt
R_8: 470,000 ohms, 1/2 watt
R_9: 620,000 ohms, 1/2 watt
R_{10}: 560,000 ohms, 1/2 watt
R_{11}: 720,000 ohms, 1/2 watt
R_{12}: 5 megohms, 1/2 watt, adjustable
R_{13}: 1 megohm, 1/2 watt
R_{14}: 100,000 ohms, 1/2 watt

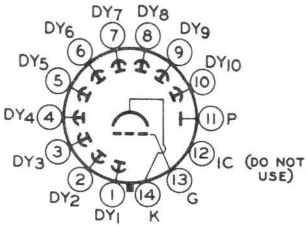
Note 1: Adjustable between approximately 500 and 2000 volts dc.

Note 2: Capacitors C_1 through C_6 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)

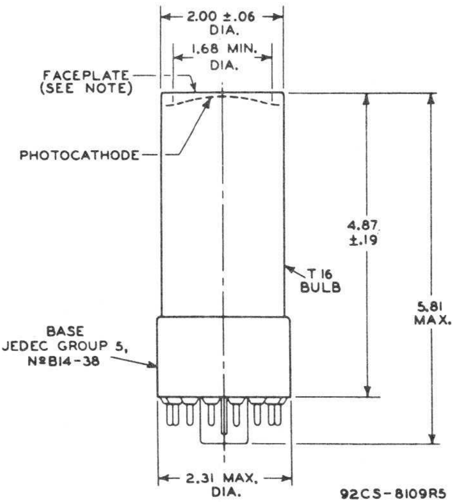
Pin 1: Dynode No.1
Pin 2: Dynode No.2
Pin 3: Dynode No.3
Pin 4: Dynode No.4
Pin 5: Dynode No.5
Pin 6: Dynode No.6
Pin 7: Dynode No.7
Pin 8: Dynode No.8
Pin 9: Dynode No.9
Pin 10: Dynode No.10
Pin 11: Anode
Pin 12: Internal Connection – Do Not Use
Pin 13: Focusing Electrode
Pin 14: Photocathode



DIRECTION OF RADIATION: INTO END OF BULB

14AA

DIMENSIONAL OUTLINE



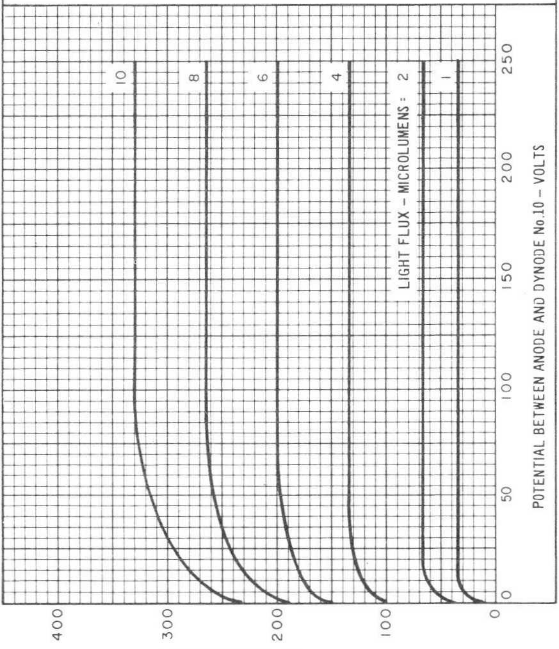
DIMENSIONS IN INCHES

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

Note: Within 1.68" diameter, deviation from flatness of external surface of faceplate will not exceed 0.010" from peak to valley.

TYPICAL ANODE CHARACTERISTICS

CATHODE-TO-DYNODE-No.1 VOLTS = 280
DYNODE-No.1-TO-DYNODE-No.2 VOLTS = 220
DYNODE-No.2-TO-DYNODE-No.3 VOLTS = 230
DYNODE-No.3-TO-DYNODE-No.4 VOLTS = 185
EACH SUCCEEDING DYNODE-STAGE VOLTS = 155
FOCUSING ELECTRODE IS CONNECTED TO THE ARM OF A POTENTIOMETER BETWEEN CATHODE AND DYNODE-No.1. FOCUSING ELECTRODE VOLTAGE IS ADJUSTED BETWEEN 10% AND 60% OF DYNODE-No.1 POTENTIAL TO GIVE MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K



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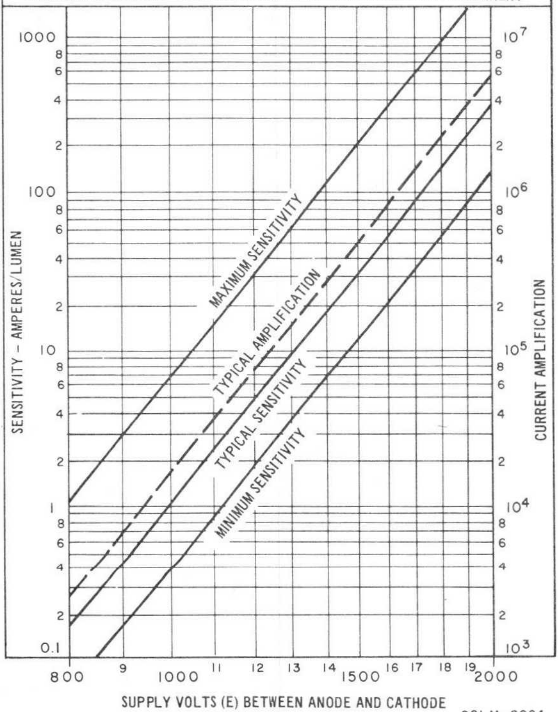
SENSITIVITY AND CURRENT-AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE–DIVIDER WHICH DISTRIBUTES THE VOLTAGE AS FOLLOWS:

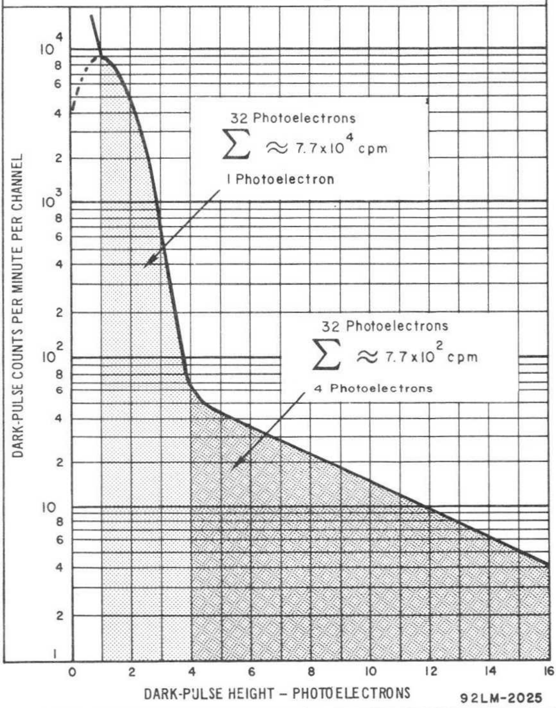
BETWEEN:	7.75% OF E MULTIPLIED BY:
CATHODE AND DYNODE No.1	1.8
DYNODE No.1 AND DYNODE No.2	1.4
DYNODE No.2 AND DYNODE No.3	1.5
DYNODE No.3 AND DYNODE No.4	1.2
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	12.9

FOCUSING ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM ANODE CURRENT



TYPICAL DARK-PULSE SPECTRUM

CATHODE-TO-DYNODE No.1 VOLTAGE = 280
DYNODE No.1-TO-DYNODE No.2 VOLTAGE = 220
DYNODE No.2-TO-DYNODE No.3 VOLTAGE = 230
DYNODE No.3-TO-DYNODE No.4 VOLTAGE = 185
EACH SUCCEEDING DYNODE-STAGE VOLTAGE = 155
ANODE-TO-CATHODE VOLTAGE = 2000
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO GIVE MAXIMUM ANODE CURRENT
DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE IS NORMALIZED TO COINCIDE WITH SINGLE PHOTOELECTRON PEAK OF DARK PULSE SPECTRUM AND IS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES ARE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22^0 C.
ONE PHOTOELECTRON PULSE HEIGHT = 4 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 30 μ SEC. (R_L = 300 k, C = 100 pF).



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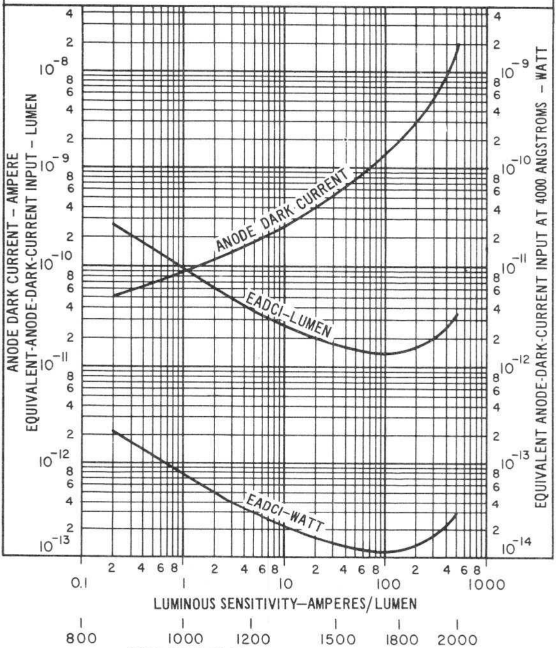
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY POTENTIAL (E) ACROSS A VOLTAGE DIVIDER WHICH DISTRIBUTES (E) AS FOLLOWS:

BETWEEN:	7.75% OF E MULTIPLIED BY:
CATHODE AND DYNODE No.1	1.8
DYNODE No.1 AND DYNODE No.2	1.4
DYNODE No.2 AND DYNODE No.3	1.5
DYNODE No.3 AND DYNODE No.4	1.2
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	12.9

FOCUSING ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM ANODE CURRENT

TUBE TEMPERATURE = 22° C

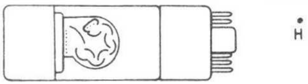


92LM-2026

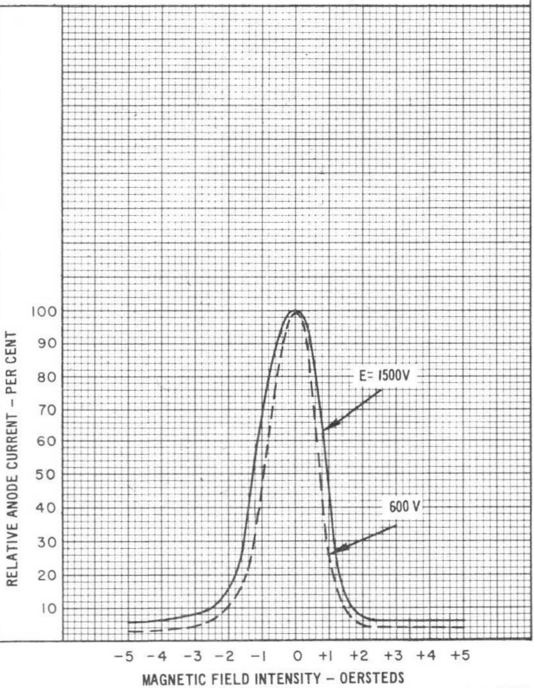
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

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.

THE PHOTOCATHODE IS FULLY ILLUMINATED.



POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX OUT OF PAPER

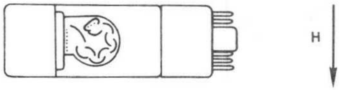


92LM-2028

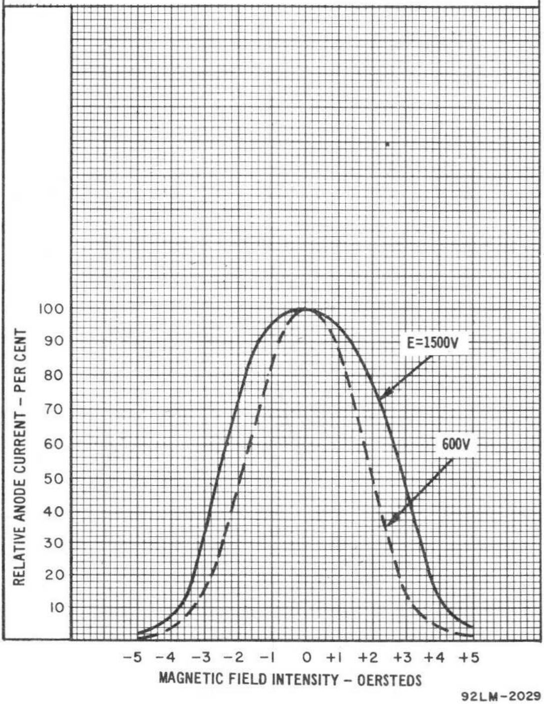
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

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.

THE PHOTOCATHODE IS FULLY ILLUMINATED.



POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION

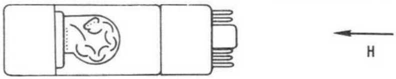


92LM-2029

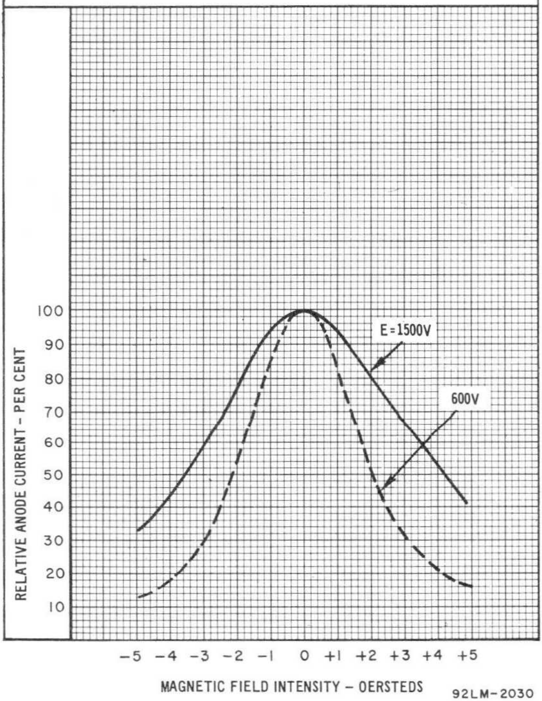
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

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.

THE PHOTOCATHODE IS FULLY ILLUMINATED.

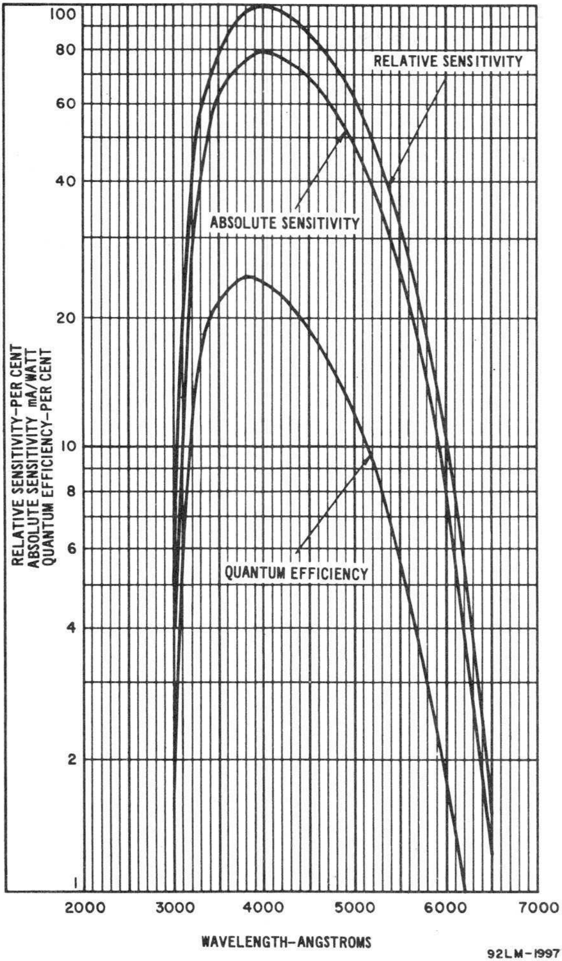


POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION

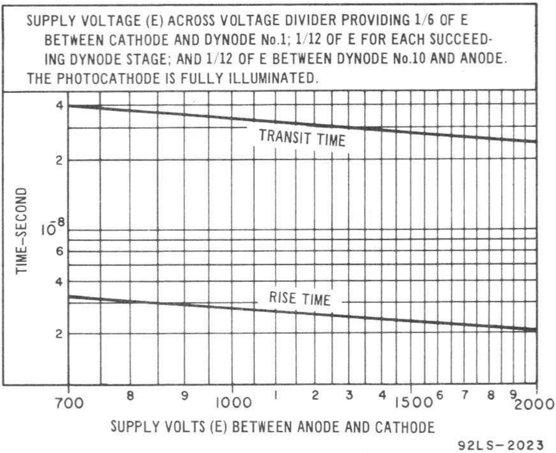


92LM-2030

SPECTRAL RESPONSE CHARACTERISTICS



TYPICAL TIME-RESOLUTION CHARACTERISTICS



Photomultiplier Tube

3"-Diameter, 10-Stage, Venetian-Blind Type Having a Bialkali Photocathode and Aluminum-Oxide Window

GENERAL

Spectral Response	See Accompanying *Typical Spectral Response Characteristics*
Wavelength of Maximum Response	4000 ± 500 Å
Cathode, Semitransparent	Potassium-Cesium-Antimony (Bialkali)
Minimum area	5.27 in^2 (34.1 cm^2)
Minimum diameter	2.59 in (6.6 cm)
Window	Aluminum Oxide
Shape	Plano-Plano
Index of refraction at 4100 angstroms	1.78
Dynodes:	
Substrate	Copper-Beryllium
Secondary-Emitting Surface	Beryllium-Oxide
Structure	Venetian-Blind
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.10	3.3 pF
Anode to all other electrodes	8.9 pF
Maximum Overall Length	5.86 in (14.8 cm)
Maximum Diameter	3.055 in (7.75 cm)
Bulb	See Dimensional Outline
Base (Temporary)	Small-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-45)
Socket	Cinch[a] No.3M14, or equivalent
Magnetic Shield	See Footnote b
Operating Position	Any
Weight (Approx.)	10.6 oz (300 g)

MAXIMUM RATINGS, Absolute-Maximum Values:

DC Supply Voltage:		
Between anode and cathode	2000 max.	V
Between anode and dynode No.10	300 max.	V
Between consecutive dynodes	250 max.	V
Between dynode No.1 and cathode	600 max.	V
Between focusing electrode and cathode	600 max.	V
Average Anode Current[d]	0.5 max.	mA
Ambient-Temperature Range[e]	-100 to +85	°C

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing the electrode voltages shown in Table I, except as noted, and at a temperature of 22° C.

With E = 1500 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[f] at 4000 angstroms	–	1.9×10^4	–	A/W
Luminous[g] (2870° K) . .	7.5	18	165	A/lm
Current with blue light source[h] (2870° K + C.S. No.5-58).	9×10^{-6}	2.2×10^{-5}	2×10^{-4}	A
Cathode Sensitivity:				
Radiant[j] at 4000 angstroms	–	0.087	–	A/lm
Luminous[k] (2870° K) . .	6.7×10^{-5}	8.3×10^{-5}	–	A/lm
Current with blue light source[m] (2870° K + C.S. No.5-58).	8×10^{-10}	1×10^{-9}	–	A
Quantum Efficiency at 4000 angstroms	–	27	–	%
Current Amplification . .	–	2.2×10^5	–	
Anode Dark Current[n] . . .	–	2×10^{-9}	6×10^{-9}	A
Equivalent Anode Dark Current Input[n]	–	2.7×10^{-10}	8×10^{-10}	lm
	–	2.6×10^{-13} [p]	7.7×10^{-13} [p]	W
Equivalent Noise Input[s] .	–	1.8×10^{-12}	–	lm
	–	1.7×10^{-15} [r]	–	W
Pulse Height Resolution[q] .	–	7.5	–	%
Mean Gain Deviation:[t]				
With count rate change of 10,000 to 1,000 cps[u]. . .	–	1	–	%
For period of 16 hours at a count rate of 10,000 cps[v]	–	1	–	%
Anode-Pulse Rise Time[w,x] at 2000 V.	–	1.3×10^{-8}	–	s
Electron Transit Time[w,y] at 2000 V.	–	5.8×10^{-8}	–	s

a Made by Cinch Manufacturing Company, 1501 Morse Avenue, Elk Grove Village, IL 60007.

b Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago, IL, 60622, or equivalent.

d Averaged over any interval of 30 seconds maximum.

e Tube operation at room temperature or below is recommended.

f This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1040 lumens per watt.

g These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current with blue light source) (A)}}{0.12 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}$$

The value of 0.12 is the average value of the ratio of the anode current measured under the conditions specified in footnote (h) to the anode current measured with the blue filter removed.

h 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) from a tungsten-filament lamp operated at a color temperature of 2870^{o} K. The value of light flux incident on the filter is 10 microlumens.

j This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1040 lumens per watt.

k This value is calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.12 \times \text{Light Flux of } 1 \times 10^{-4} \text{ (lm)}}$$

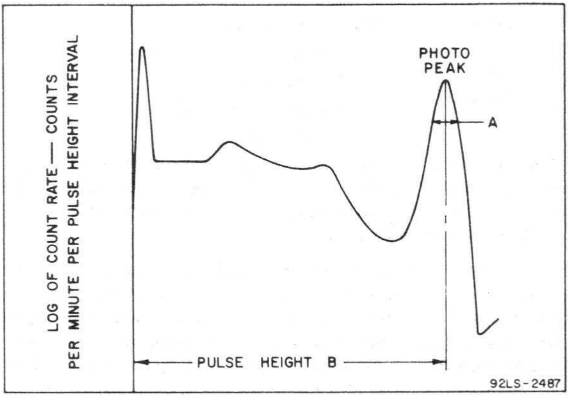
The value of 0.12 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

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) from a tungsten-filament lamp operated at a color temperature of 2870^{o} K. The value of light flux incident on the filter is 1×10^{-4} lumen and 300 volts are applied between cathode and all other electrodes connected as anode.

n Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 10 microlumens. The supply voltage E is adjusted to obtain an anode current of 9 microamperes. Sensitivity of the 4521 under these conditions is approximately equivalent to 7.5 amperes per lumen. Dark current is measured with no light incident on the tube.

p At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1040 lumens per watt.

q With a supply voltage E of 1100 volts. Anode load is a 100-kilohm resistor in parallel with a total capacitance of 100 pF. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 3" x 3" thallium-activated sodium-iodide scintillator [NaI (Tl)-type 12A12, Serial No.DH184 or equivalent] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, OH. The Cs^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the tube by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 60,000 centistokes) – Manufactured by the Dow Corning Corp., Midland, MI, or equivalent. Pulse-height resolution in per cent is defined at 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height (A) to the pulse height at maximum photopeak count rate (B).



r At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1040 lumens per watt.

s Under the following conditions: External shield connected to cathode, an equivalent bandwidth of 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.

t Mean gain deviation is defined as follows:

$$\mathrm{MGD} = \frac{\sum_{i=1}^{i=n} |\overline{p} - p_i|}{n} \cdot \frac{100}{\overline{p}}$$

Where:

$\overline{p}$ = mean pulse height

p_i = pulse height at the "ith" reading

n = total number of readings

u Under the following conditions: The scintillator and Cs^{137} radiation source of (s) are employed. The radiation source is initially centered, on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 10,000 cps. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 1,000 cps. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. Mean gain deviation is defined as shown in (t).

v Under the same conditions as shown in (u) except the tube is operated for a period of 1/2 hour with the radiation source located at the point providing a pulse count rate of 10,000 cps. Following this time interval, the pulse height is sampled, at this count rate, at 1-hour intervals for a period of 16 hours. Mean gain deviation is defined as shown in (t).

w 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.

x 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.

y 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 CONSIDERATIONS

Terminal Connections

The 4521 is supplied with a small-shell diheptal base attached to semiflexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the 4521 in a given system.

SHIELDING

Electrostatic and magnetic shielding of the 4521 is usually required. When a shield is used it must be at cathode potential.

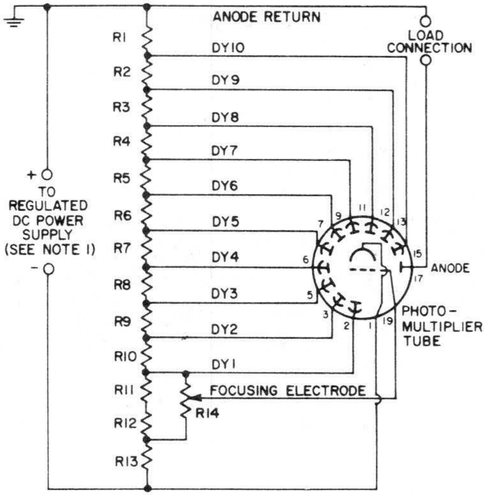
OPERATING VOLTAGES

The high voltages at which the 4521 is operated are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages.

For additional information on this type write to RCA Commercial Engineering, Harrison, N.J. 07029 for technical bulletin.

Voltage To Be Provided By Divider	
Between	**7.7% of Supply Voltage (E) Multiplied by**
Cathode and Dynode No.1	3
Dynode No.1 and Dynode No.2	1
Dynode No.2 and Dynode No.3	1
Dynode No.3 and Dynode No.4	1
Dynode No.4 and Dynode No.5	1
Dynode No.5 and Dynode No.6	1
Dynode No.6 and Dynode No.7	1
Dynode No.7 and Dynode No.8	1
Dynode No.8 and Dynode No.9	1
Dynode No.9 and Dynode No.10	1
Dynode No.10 and Anode	1
Anode and Cathode	13
The focus voltage shall be adjusted to the potential which gives maximum anode current and is between 70 and 100 per cent of dynode No.1 potential (referred to cathode).	

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR GENERAL PHOTOMETRIC APPLICATIONS



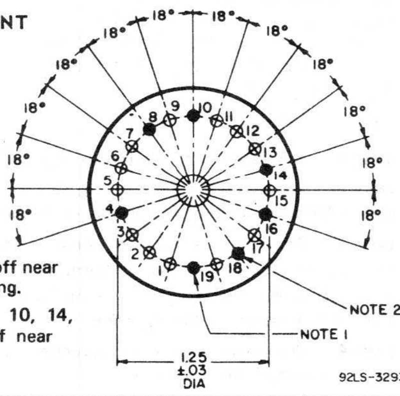
R_1 through R_{13}: 470 kΩ, 5%, 1/2 W

R_{14}: 5 MΩ, 20%, 1/2 W, (Adjustable)

Note 1: Adjustable between approximately 800 and 2000 volts dc.

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

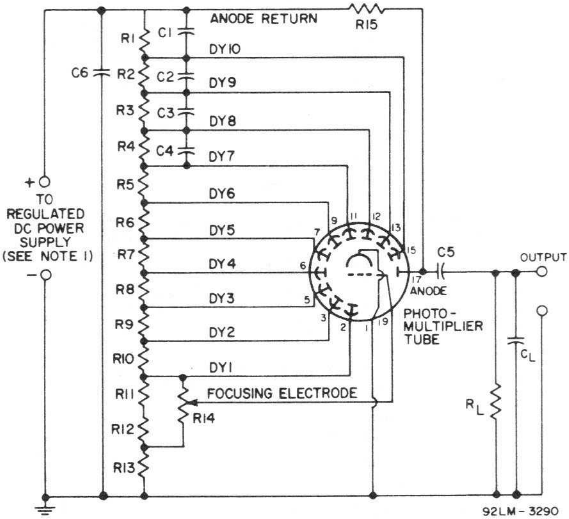
BASE ARRANGEMENT BOTTOM VIEW



Note 1: Lead is cut off near glass button for indexing.

Note 2: Leads 4, 8, 10, 14, 16, and 18 are cutoff near button.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR SCINTILLATION-COUNTING APPLICATIONS



C_1: 0.05 μF, 500 volts
C_2: 0.02 μF, 500 volts
C_3: 0.01 μF, 500 volts
C_4: 0.005 μF, 500 volts
C_5 and C_6: 0.005 μF, 3000 volts
R_1 through R_{13}: 470 kΩ, 5%, 1/2 W
R_{14}: 5 MΩ, 20%, 1/2 W, (Adjustable)
R_{15}: 1 MΩ, 5%, 1/2 W
R_L: 100 kΩ, 5%, 1/2 W

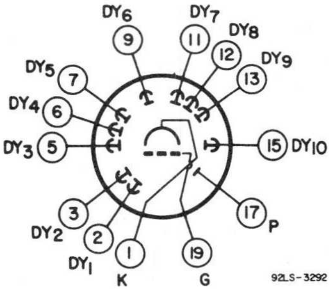
Note 1: Adjustable between approximately 800 and 2000 volts dc.

Note 2: Capacitors C_1 through C_6 should be connected at tube socket for optimum high-frequency performance.

Note 3: The value of the load elements, R_L and C_L, depend on the application. For most applications, $R_L \times C_L$ = 10 microseconds. It is to be noted that R_{15} is in parallel with R_L and must be considered when selecting the R_L value.

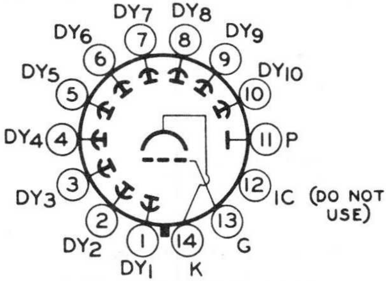
Note 4: Component values are dependent upon nature of application and output signal desired.

LEAD CONNECTIONS
BOTTOM VIEW (WITH BASE REMOVED)



Lead 1: Photocathode
Lead 2: Dynode No.1
Lead 3: Dynode No.2
Lead 5: Dynode No.3
Lead 6: Dynode No.4
Lead 7: Dynode No.5
Lead 9: Dynode No.6
Lead 11: Dynode No.7
Lead 12: Dynode No.8
Lead 13: Dynode No.9
Lead 15: Dynode No.10
Lead 17: Anode
Lead 19: Focusing Electrode

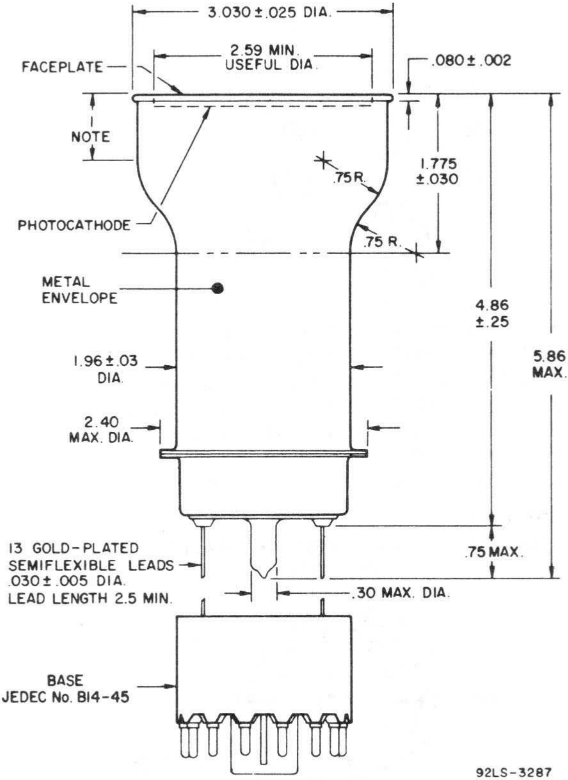
BASING DIAGRAM
BOTTOM VIEW (WITH TEMPORARY BASE)



DIRECTION OF RADIATION:
INTO END OF BULB

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

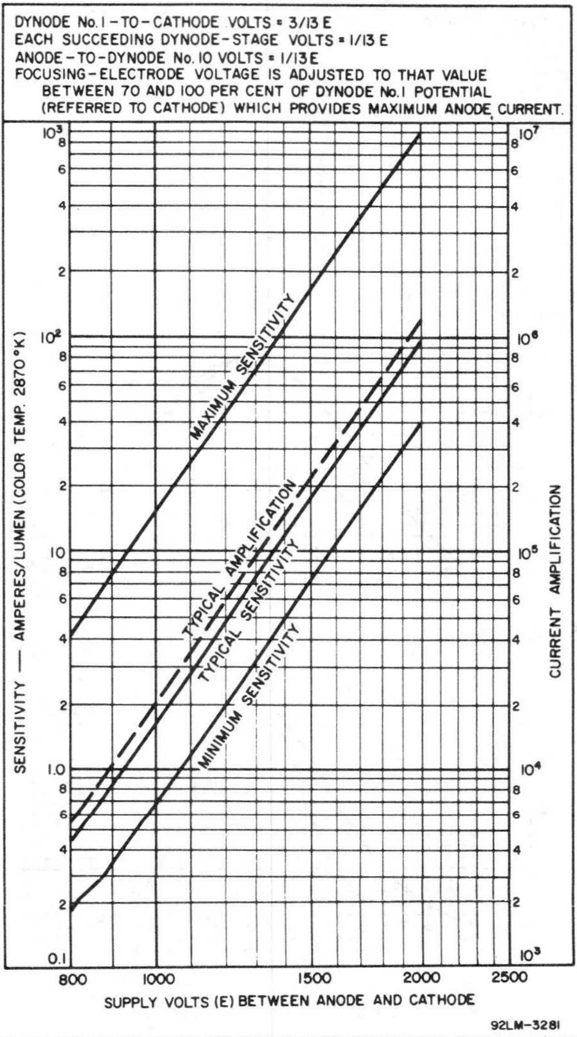
DIMENSIONAL OUTLINE



Dimensions are in inches unless otherwise stated.

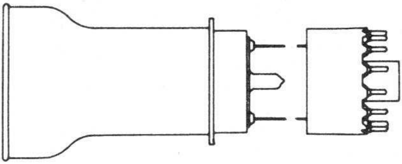
Inch	mm	Inch	mm
.005	.127	2.34	59.4
.025	.63	2.40	60.9
.030	.76	2.5	63.5
.08	2.0	2.59	66
.25	6.3	3.03	76.9
.75	19.1	4.86	123.4
2.0	50.8	5.86	148.8

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

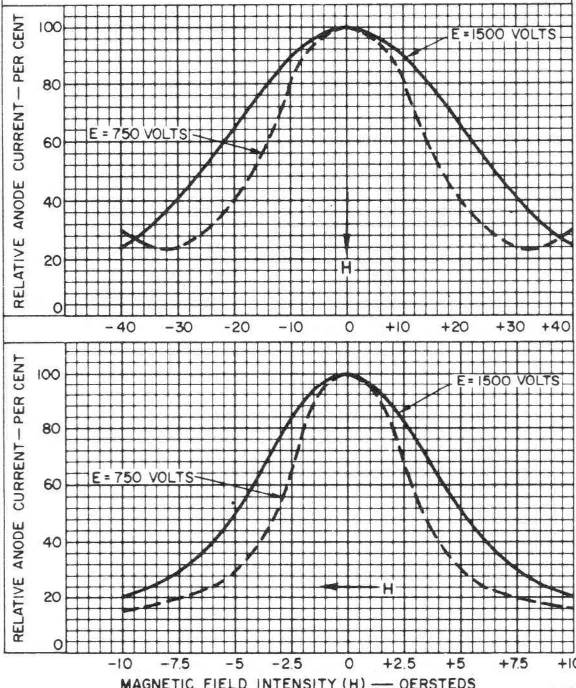


TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 3/13 OF E BETWEEN CATHODE AND DYNODE No.1; 1/13 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/13 OF E BETWEEN DYNODE No.10 AND ANODE.
FOCUSING ELECTRODE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS FULLY ILLUMINATED.
TUBE IS ORIENTED IN MAGNETIC FIELD AS SHOWN BELOW:



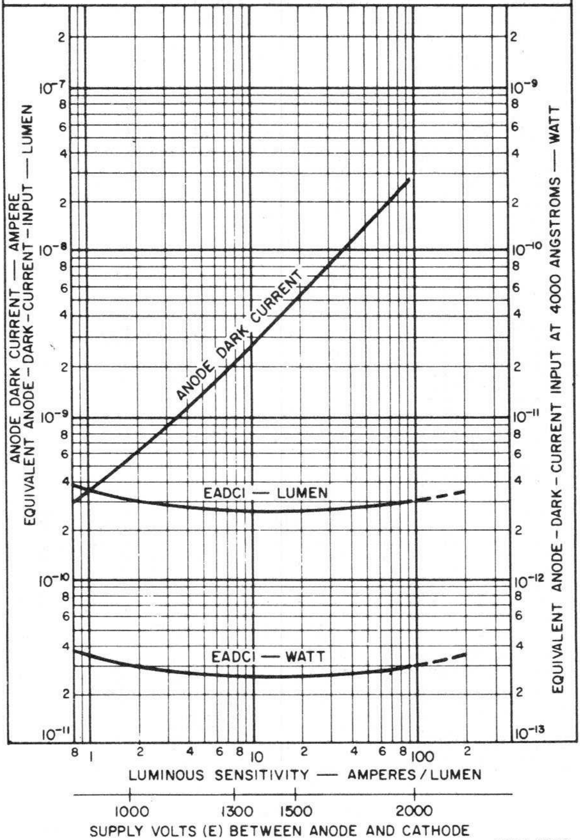
POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION.



92LM-3289

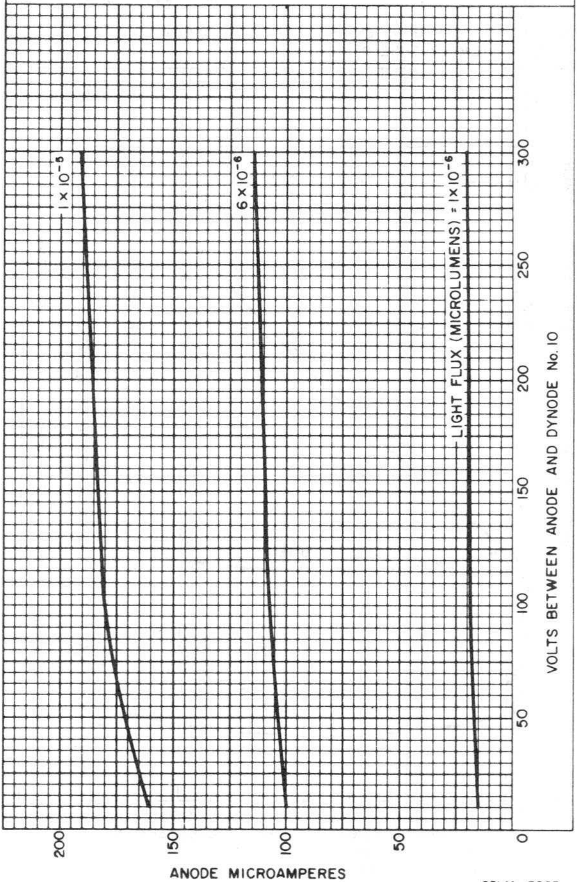
TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No.1 - TO - CATHODE VOLTS = 3/13 E
EACH SUCCEEDING DYNODE - STAGE VOLTS = 1/13 E
FOCUSING - ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 70 AND 100 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.



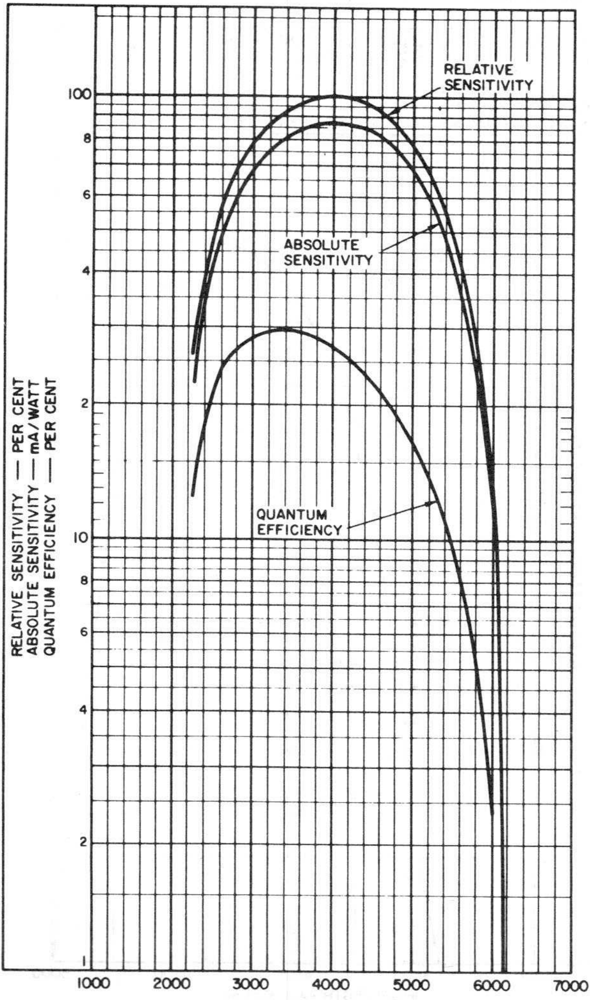
TYPICAL ANODE CHARACTERISTICS

DYNODE No.1-TO-CATHODE VOLTS = 345
EACH SUCCEEDING DYNODE-STAGE VOLTS = 115
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 70 AND 100 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.



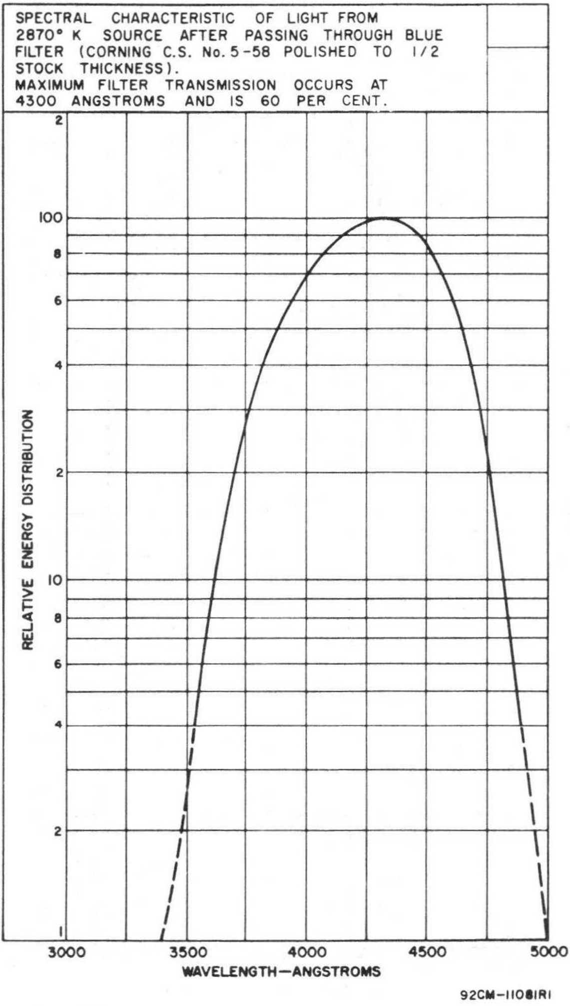
92LM-3283

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

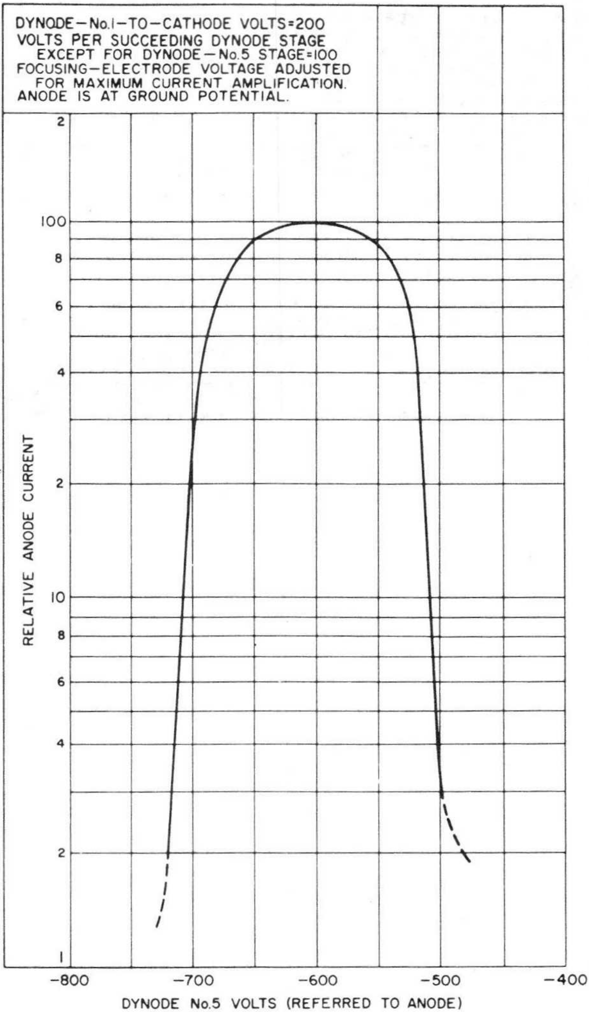


92LM-3279

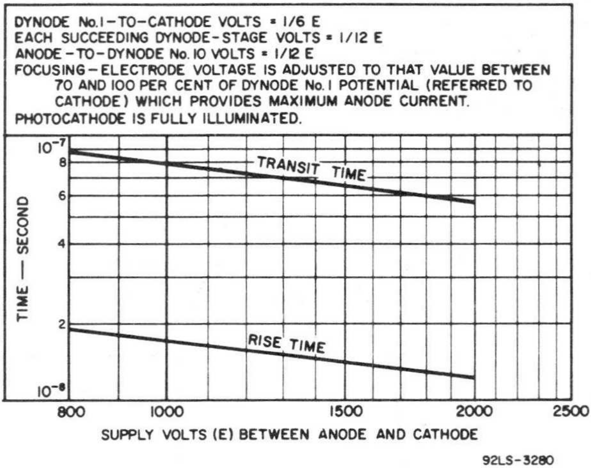
SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER



TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-NO.5 VOLTS



TYPICAL TIME RESOLUTION CHARACTERISTICS



Photomultiplier Tube

5-Inch Diameter, 14-Stage, Head-On Type
High Quantum Efficiency Bialkali Photocathode
In-Line Electrostatically-Focused Dynode Structure

For Use in Nuclear Physics Applications, Especially When a High Degree of Time Definition is Required

GENERAL

Spectral Response	See accompanying *Typical Spectral Response Characteristics*
Wavelength of Maximum Response	4000 ± 500 Å
Cathode, Semitransparent	Cs-K-Sb(Bialkali)
Shape	Spherical Section
Minimum projected area	16 sq. in (103 sq. cm)
Minimum diameter	4.5 in (11.4 cm)
Window	UV-transmitting, Corning[a] No.9741, or Equivalent
Shape	Spherical Section
Index of refraction at 4047 angstroms	1.48
Dynodes:	
Substrate	Copper-Beryllium
Secondary-Emitting Surface	Beryllium-Oxide
Structure	In-Line Electrostatic-Focus
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.14	5.5 pF
Anode to all other electrodes	7.0 pF
Maximum Overall Length	12 in (30.5 cm)
Maximum Diameter	5.25 in (13.3 cm)
Base	See Base Drawing
Socket	RCA-AJ2144 or AJ2145
Magnetic Shield	See Note (b)
Operating Position	Any
Weight (Approx.)	21 oz (590 g)

MAXIMUM AND MINIMUM RATINGS, *Absolute-Maximum Values*

DC Supply Voltage:		
Between anode and cathode:		
With Voltage Distribution A or B, shown in Table I	3000 max.	V
With Voltage Distribution C, shown in Table I	3500 max.	V
Between anode and dynode No.14	600 max.	V
Between dynode No.14 & dynode No.13	800 max.	V
Between other consecutive dynodes	400 max.	V
Between dynode No.1 and cathode	800 max.	V
	300 min.	V
Average Anode Current[d]	0.5 max.	mA
Ambient-Temperature Range	−100 to +85	°C

CHARACTERISTICS RANGE VALUES

	Min.	Typ.	Max.	
With a DC Supply Voltage (E) = 2000 volts (Except as noted)				
Voltage Distribution A, Table I				
Anode Sensitivity:				
Radiant[e] at 4000 Å[c] . .	–	2.6×10^{6}	–	A/W
Luminous[f] (2870°K) .	6.5×10^{2}	2.3×10^{3}	6.5×10^{3}	A/lm
With blue light source[g] (2870°K + C.S. No.5-58) . . .	8.5×10^{-6}	3×10^{-5}	8.5×10^{-5}	A
Cathode Sensitivity:				
Radiant[h] at 4000 Å . . .	–	8.8×10^{-2}	–	A/W
Luminous[i] (2870° K) . .	–	7.7×10^{-5}	–	A/lm
With blue light source[k] (2870° K + C.S. No.5-58)	8×10^{-10}	1×10^{-9}	–	A
Cathode Quantum Efficiency at 3600 Å	–	29	–	%
Current Amplification . . .	–	3×10^{7}	–	
Anode Dark Current[m] . . .	–	6×10^{-8}	1×10^{-6}	A
Equivalent Anode Dark Current Input . . .	–	3×10^{-11}[n]	5×10^{-10}[n]	lm
	–	2.6×10^{-14}[p]	–	W
With E = 2500 volts				
Voltage Distribution B, Table I				
Pulse Height Resolution[q]	–	7.5	–	%
Mean Gain Deviation[r] . . .	–	1	–	%
Dark Pulse Spectrum . . .		See *Typical Dark Pulse Spectrum*		
With E = 3000 volts				
Voltage Distribution A, Table I				
Anode-Pulse Rise Time .	–	2.9×10^{-9}	–	s
Electron Transit Time . .	–	6.6×10^{-8}	–	s
With E = 3000 volts				
Voltage Distribution C, Table I				
Pulse Current:[u]				
Linear[v]	–	0.13	–	A
Saturated	–	0.32	–	A

[a] Made by Corning Glass Works, Corning, New York 14830.

[b] Magnetic shielding is available from manufacturers such as the Magnetic Shield Division, Perfection Mica Co., 1322 North Elston, Chicago 22, Illinois.

[d] Averaged over any 500-microsecond interval.

[e] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

[f] These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-7} \text{ (lm)}}$$

The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote (k) to the cathode current measured under the same conditions but with the blue filter removed.

[g] Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.1 microlumen.

[h] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

[i] These values are calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-4} \text{ (lm)}}$$

The value of 0.13 is an average value. (See footnote f).

[k] Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 100 microlumens and 300 volts are applied between cathode and all other electrodes connected as anode.

[m] At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 0.1 microlumen. The supply voltage E is adjusted to obtain an anode current of 26 microamperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 2000 amperes per lumen. Dark current is measured with incident light removed.

n With supply voltage E adjusted to give a calculated value of anode luminous sensitivity of 2000 amperes per lumen.

p At 4000 Å. Calculated from the luminous EADCI value using a conversion factor of 1140 lumens per watt.

q With a supply voltage E of 2500 volts across a voltage divider providing electrode voltages shown in Table I, Distribution B. Anode load is a 10-kilohm resistor in parallel with a total capacitance of 1000 pF. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. 662 keV photons from a one-microcurie Cs^{137} source and a cylindrical 5" dia. x 4" thallium-activated sodium-iodide scintillator NaI (TI)-type Harshaw■ 20A16, Serial No.CW-675 or equivalent are used. The Cs^{137} source is in direct contact with the metal end of the scintillator container. The faceplate end of the crystal is coupled to the faceplate adapter (RCA-AJ2142) by an optical coupling material such as Dow Corning* *20-057.

r Under the same conditions as shown in (q) except the tube is operated for a period of 1 hour with the radiation source located at the point providing a pulse count rate of 1000 counts per second. Following this time interval, the pulse height is sampled at 1-hour intervals for a period of 24 hours.

u Using a pulsed light source having a pulse duration of 0.5 microsecond and repetition rate of 30 pulses per second. The interstage voltages of the tube should not deviate more than 2 per cent from the recommended voltage distribution shown by Voltage Distribution C of Table I. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure this operating condition.

v Maximum deviation from linearity is 5 per cent.

■Made by Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio.

*Made by Dow Corning Corp., Midland, Michigan.

OPERATING CONSIDERATIONS

The base pins of the tube fit a 21-contact socket such as the RCA-AJ2144 and AJ2145. The 4522 can replace types 58AVP and 58OVP by use of Socket Adapter, RCA-AJ2143.

The operating stability of the 4522 is dependent on the magnitude of the average anode current.

The use of an average anode current well below the

the maximum rated value of 500 microamperes is recommended when stability of operation is important. When maximum stability is required, the average anode current should not exceed 0.1 microampere.

Magnetic shielding of the tube is generally required. Magnetic shielding materials are available from manufacturers such as the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston, Chicago 22, Illinois. The curves under *Typical Voltage-Divider arrangements* show the effect of magnetic fields on anode current under the conditions indicated. With increase in voltage between anode and cathode, the effect of a given magnetic field will cause less decrease in anode current.

The high voltages at which the tube is operated are very dangerous. Care should be taken in the design of apparatus to prevent personnel from coming in contact with these high voltages. Precautions should include the enclosure of high-voltage terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatur is required.

Accompanying typical voltage-divider arrangements are recommended for use with the 4522. The choice of resistance values for the voltage-divider string is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the supply and the required wattage rating of the resistors increase. Phototube noice may also increase, due to heating, if the divider metwork is mounted near the tube. The use of high values of resistance per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum average anode current and may limit anode current response to pulsed light.

The supply voltage may be applied in 500-volt steps up to 2000 volts, and 200-volt steps from 2000 to 3000 volts and with no less than 1 minute between each step.

OPERATING VOLTAGES

Table I shows three electrode voltage distributions recommended for the 4522.

Voltage Distribution A is used to measure the tube performance values listed under *Characteristic Range Values* and is suggested for general purpose applications.

Voltage Distribution B is recommended where high dynode-No.1 gain is important, such as in low light level and scintillation counting applications. Voltage Distribution B maintains the cathode-to-dynode-No.1 voltage at 660 volts; it is especially useful when the supply voltage is adjusted over a wide range to achieve large changes in anode sensitivity. A suggested circuit using voltage distribution B is shown under *Typical Circuit Arrangement for Scintillation-Counting Applications.*

Voltage Distribution C is recommended for high peak-pulse current applications.

TYPICAL FOCUSING ELECTRODE CHARACTERISTIC

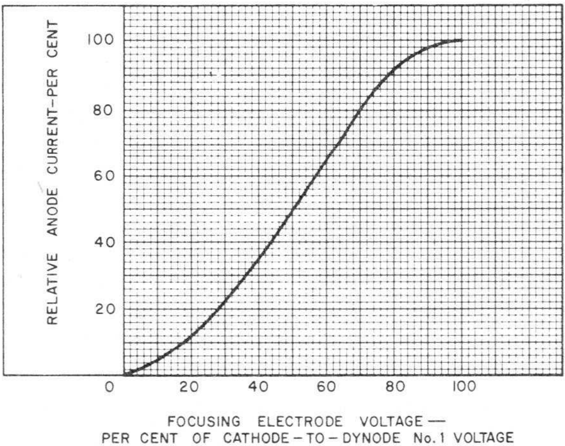


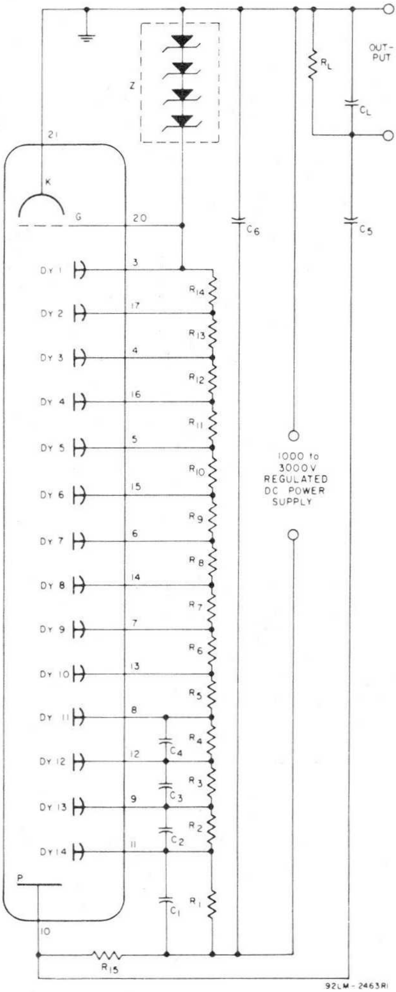
TABLE I			
Voltage Distribution			
Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	A	B●	C
	5.9% of K-P Voltage (E) Multiplied by:	6.9% of Dyl-P Voltage (E) Multiplied by:	3.85% of K-P Voltage (E) Multiplied by:
K - Dy1	3	•	6
Dy1 - Dy2	1	1	1
Dy2 - Dy3	1	1.5	1.5
Dy3 - Dy4	1	1	1
Dy4 - Dy5	1	1	1
Dy5 - Dy6	1	1	1
Dy6 - Dy7	1	1	1
Dy7 - Dy8	1	1	1
Dy8 - Dy9	1	1	1
Dy9 - Dy10	1	1	1
Dy10 - Dy11	1	1	1
Dy11 - Dy12	1	1	1.5
Dy12 - Dy13	1	1	2
Dy13 - Dy14	1	1	4
Dy14 - P	1	1	2
Dy1 - P	–	14.5	–
K - P	17	–	26
Focusing electrode▲ is connected to Dynode-No.1 voltage.			

● Use distribution B for optimum pulse-height resolution performance. See *Operating Voltages*.

• Cathode-to-Dynode-No.1 Voltage maintained at 660 volts.

▲ Focusing electrode may be connected to arm of potentiometer between cathode and dynode No.1; the focusing-electrode voltage is varied to give maximum anode current.

TYPICAL CIRCUIT ARRANGEMENT FOR FAST PULSE RESPONSE AND HIGH PEAK CURRENT APPLICATIONS



PARTS LIST FOR TYPICAL CIRCUIT ARRANGEMENTS FOR SCINTILLATION COUNTING APPLICATIONS

C_1: 0.05 μF, 20%, 500 V dc Ceramic-Disc Type
C_2: 0.02 μF, 20%, 500 V dc Ceramic-Disc Type
C_3: 0.01 μF, 20%, 500 V dc Ceramic-Disc Type
C_4: 0.005 μF, 20%, 500 V dc Ceramic-Disc Type
C_5 & C_6: 0.0047 μF, 20%, 6000 V dc Ceramic-Disc Type
R_1 through R_{12}: 51 KΩ, 5% 1W
R_{13}: 75 KΩ, 5% 1W
R_{14}: 51 KΩ, 5% 1W
R_{15}: 100 KΩ, 5% 1/2 W
Z: (2)-150 V, 1W zener diodes, or equivalent
(2)-180 V, 1W zener diodes, or equivalent

Note: The value of the load elements, R_L and C_L, depend on the application:
$R_L C_L$ = 10 microseconds for most applications

PARTS LIST FOR TYPICAL CIRCUIT ARRANGEMENT FOR FAST PULSE RESPONSE AND HIGH PEAK CURRENT APPLICATIONS

Fast Pulse Response Applications, to 3000V

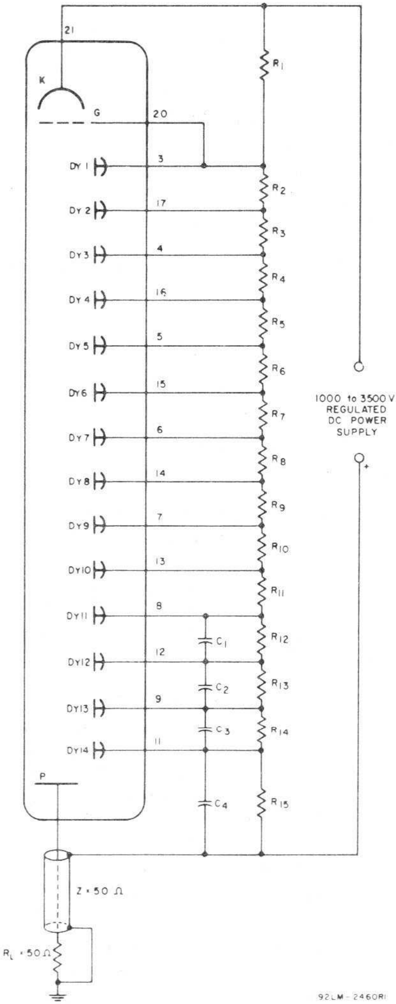
C_1: 0.005 μF, Ceramic Disc, 500 V
C_2: 0.01 μF, Ceramic Disc, 500 V
C_3: 0.02 μF, Ceramic Disc, 500 V
C_4: 0.05 μF, Ceramic Disc, 500 V
R_1: 300 KΩ (3-100 KΩ, 5%, 1/2 W in series)
R_2 through R_{15}: 100 KΩ, 5%, 1/2 W

High Peak Current Applications, to 3500V

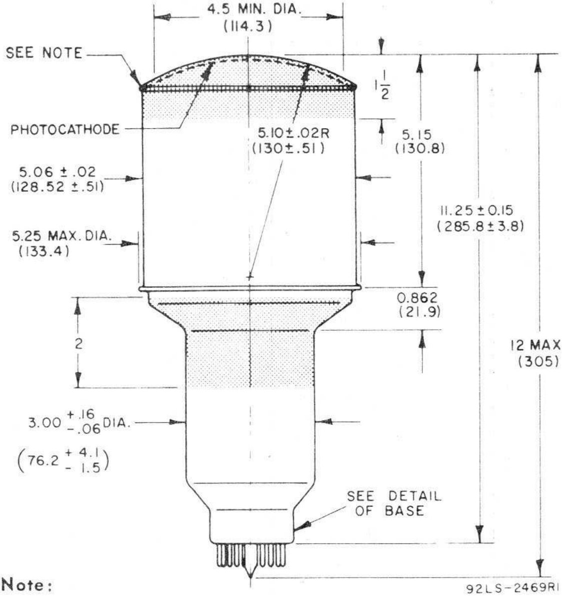
C_1: 0.005 μF, Ceramic Disc, 500 V
C_2: 0.01 μF, Ceramic Disc, 500 V
C_3: 0.02 μF, Ceramic Disc, 1000 V
C_4: 0.05 μF, Ceramic Disc, 500 V
R_1: 168 KΩ (3-56 KΩ, 5%, 2 W, in series)
R_2, R_4 through R_{11}: 27 KΩ, 5%, 1 W
R_3, R_{12}: 39 KΩ, 5%, 2 W
R_{13}, R_{15}: 54 KΩ (2-27 KΩ, 5%, 1 W, in series)
R_{14}: 108 KΩ (4-27 KΩ, 5%, 1 W, in series)

Note: Leads to all capacitors should be as short as possible to minimize inductance effects. Location and spacing of capacitors is critical and may require adjustment for optimum results.

TYPICAL CIRCUIT ARRANGEMENT FOR FAST PULSE RESPONSE AND HIGH PEAK CURRENT APPLICATIONS



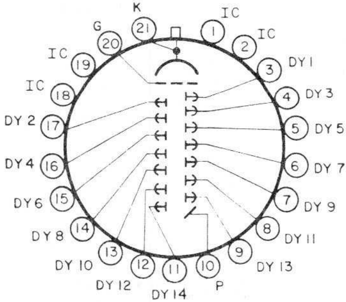
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



Note:

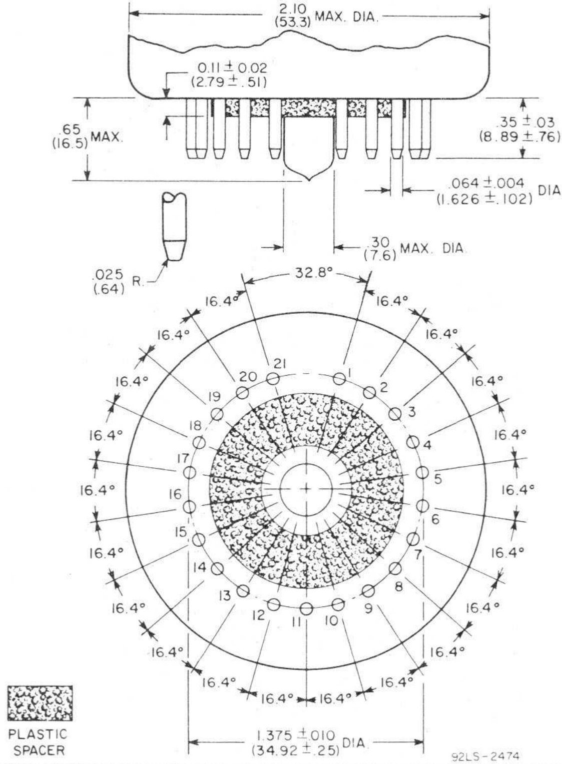
Care must be taken in mounting the tube so that the tube envelope is not subjected to excessive pressure which could strip the glass-to-metal seals. In no case should mounting supports be used in the shaded areas.

BASING DIAGRAM (Bottom View)

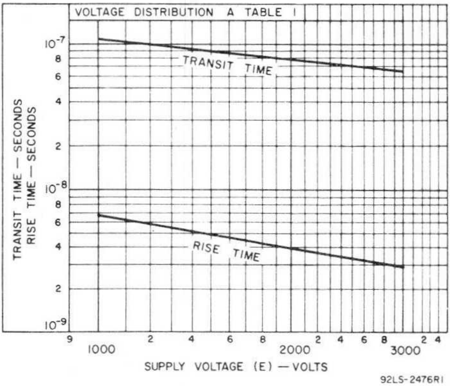


Pin No. 1: Internally connected – Do not use.
Pin No. 2: Internally connected – Do not use.
Pin No. 3: Dynode No.1
Pin No. 4: Dynode No.3
Pin No. 5: Dynode No.5
Pin No. 6: Dynode No.7
Pin No. 7: Dynode No.9
Pin No. 8: Dynode No.11
Pin No. 9: Dynode No.13
Pin No.10: Anode
Pin No.11: Dynode No.14
Pin No.12: Dynode No.12
Pin No.13: Dynode No.10
Pin No.14: Dynode No.8
Pin No.15: Dynode No.6
Pin No.16: Dynode No.4
Pin No.17: Dynode No.2
Pin No.18: Internally connected – Do not use.
Pin No.19: Internally connected – Do not use.
Pin No.20: Focusing Electrode
Pin No.21: Photocathode and Tube Envelope

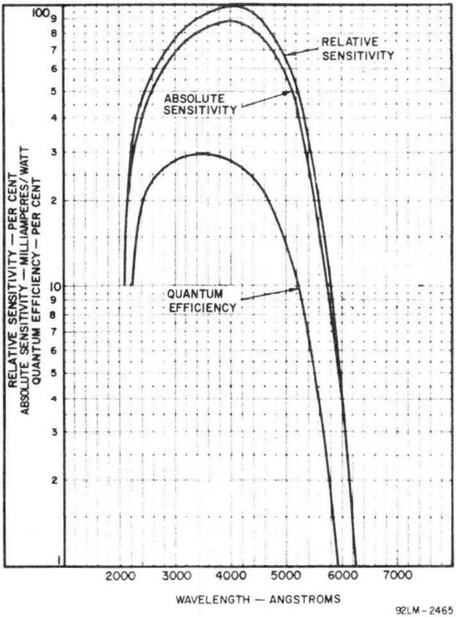
DETAIL OF BASE



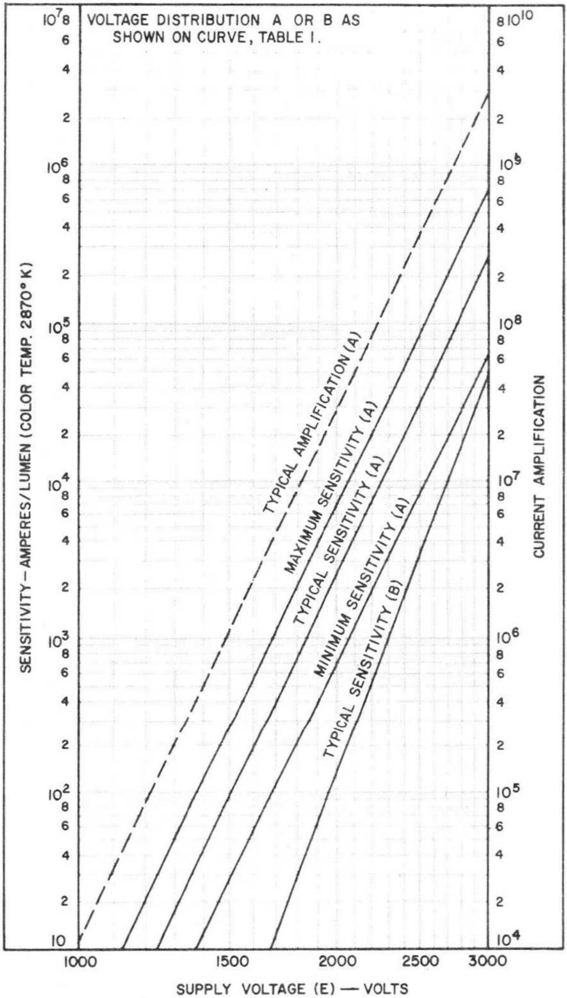
TYPICAL TIME RESOLUTION CHARACTERISTICS



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

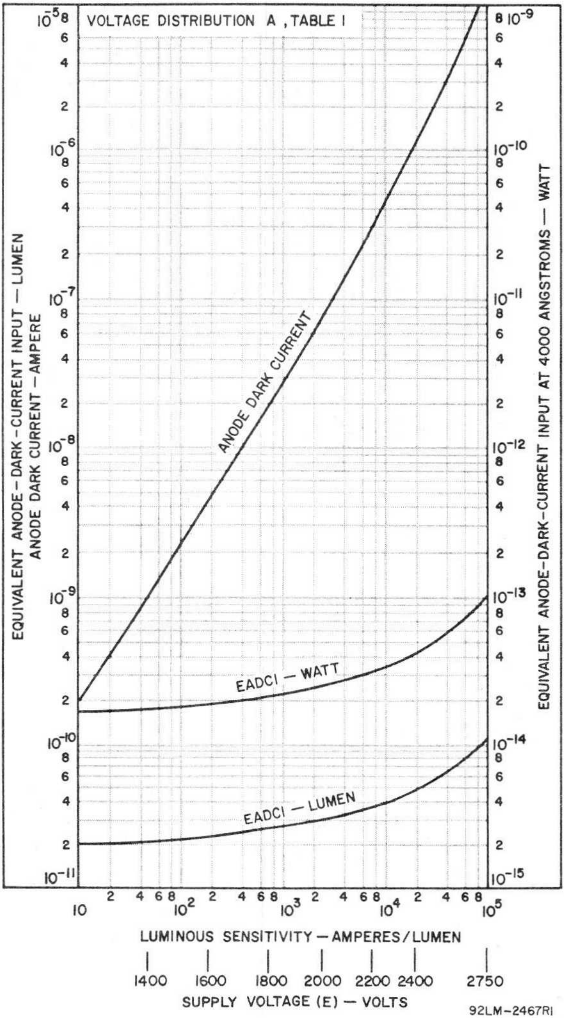


SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

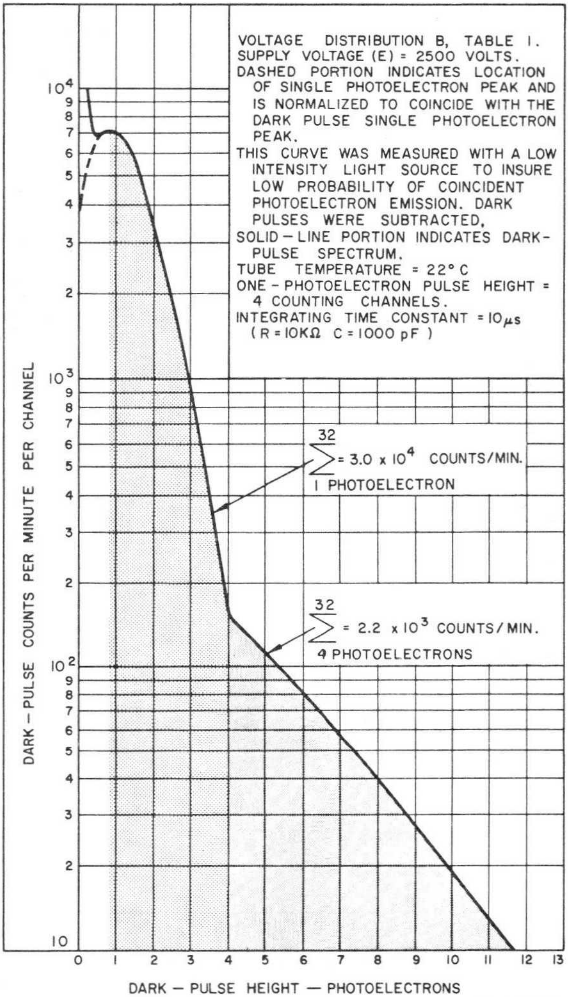


92LM-2466RI

TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS

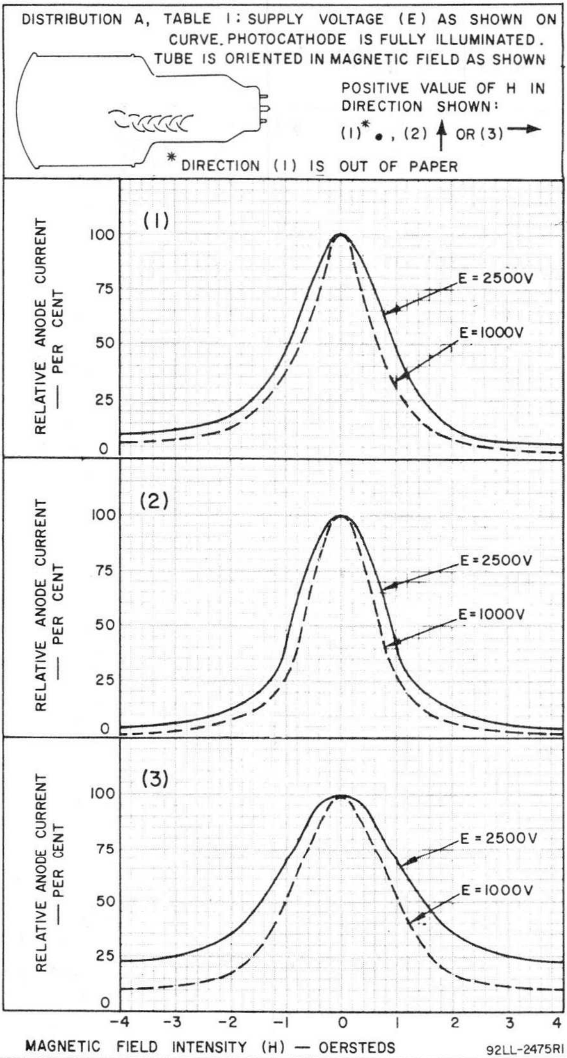


TYPICAL DARK-PULSE SPECTRUM

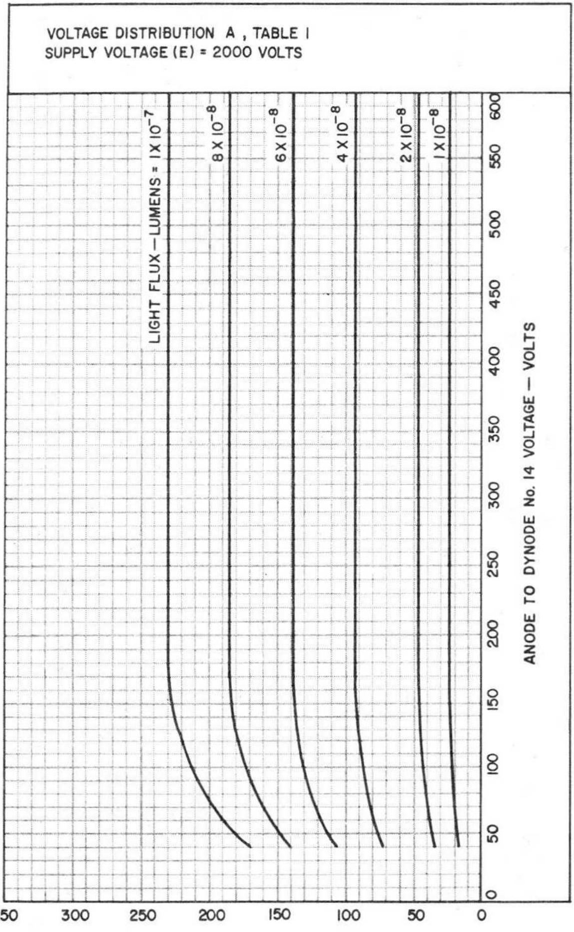


92LM-2472R1

TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT



TYPICAL ANODE CHARACTERISTICS



92LM-2473R1

4523, 4524, 4525

Photomultiplier Tubes

2-INCH DIAMETER—4523
3-INCH DIAMETER—4524
5-INCH DIAMETER—4525

10-STAGE, HEAD-ON TYPE
VENETIAN-BLIND DYNODE STRUCTURE

BIALKALI PHOTOCATHODE OF
HIGH QUANTUM EFFICIENCY

For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation

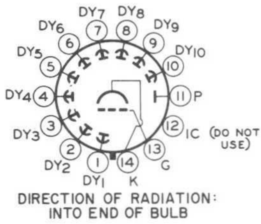
GENERAL

Spectral Response . . . . See *Typical Spectral Response Characteristics*
Wavelength of Maximum Response. . . . . 4000 ± 500 angstroms
Cathode, Semitransparent. . . . . .Cs-K-Sb (Bialkali)
Shape . . . . .Flat, Circular
Minimum area:
4523. . . . . 2.20 sq in
4524. . . . . 5.27 sq in
4525. . . . . 15.1 sq in
Minimum diameter:
4523. . . . . 1.68 in
4524. . . . . 2.59 in
4525. . . . . 4.38 in
Window. . . . . Corning[a] No.0080, or equivalent
Shape . . . . Plano-Plano
Index of refraction at 4360 angstroms 1.523
Dynodes
Substrate . . . . Cu-Be
Secondary-emitting surface. . . . . .Be-O
Structure . . . . .Venetian-Blind
Direct Interelectrode Capacitances (Approx.)
Anode to dynode No.10 . . . . 7 pF
Anode to all other electrodes . . . . 8.5 pF
Maximum Overall Length
4523. . . . . 5.81 in
4524. . . . . 6.31 in
4525. . . . . 7.69 in
Seated Length
4523. . . . . 4.87 ± 0.19 in
4524. . . . . 5.38 ± 0.18 in
4525. . . . . 6.75 ± 0.19 in
Maximum Diameter
4523. . . . . 2.31 in
4524. . . . . 3.06 in
4525. . . . . 5.31 in
Envelope
4523. . . . . T16
4524. . . . . J24
4525. . . . . J42
Socket. . . . . Cinch[b] No.3M14, or equivalent

Magnetic Shield	
4523	JAN[c] Part No.S-2004, or equivalent
4524	Millen[d] Part No.80803J, or equivalent
4525	Millen[d] Part No.80805M, or equivalent
Operating Position	Any
Weight (Approx.)	
4523	7 oz
4524	9 oz
4525	1 lb 7 oz
Base	Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-38)

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



14AA

Unless indicated otherwise, the following ratings and characteristic range values apply to all types

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage		
Between anode and cathode	2500	V
Between anode and dynode No.10	300	V
Between consecutive dynodes	300	V
Between dynode No.1 and cathode	600	V
Between focusing electrode and cathode	600	V
Average Anode Current[e]	0.5	mA
Ambient-Temperature Range[f]	-100 to +85	°C

CHARACTERISTIC 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, except as noted. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No. 1 potential (Referred to cathode) which provides maximum anode current.

With E = 1500 volts except as noted

	Min	*Typ*	*Max*	
Sensitivity				
Radiant[g] at 4000 angstroms.	-	3.2×10^{4}	-	A/W
Cathode radiant[h] at 4000 angstroms:				
4523, 4524.	-	0.071	-	A/W
4525.	-	0.08	-	A/W
Luminous:				
With tungsten light source[j].	10	27	100	A/lm
With blue light source[k].	1.5×10^{-5}	4×10^{-5}	1.5×10^{-4}	A
Cathode luminous:				
With tungsten light source[m]				
4523, 4524.	-	6×10^{-5}	-	A/lm
4525.	-	6.7×10^{-5}	-	A/lm
With blue light source[n]				
4523, 4524.	7×10^{-10}	9×10^{-9}	-	A
4525.	7×10^{-10}	1×10^{-10}	-	A
Quantum efficiency at 4000 angstroms:				
4523, 4524.	-	22	-	%
4525.	-	25	-	%
Current Amplification				
4523, 4524.	-	4.5×10^{5}	-	
4525.	-	4×10^{5}	-	
Anode Dark Current[p]				
4523.	-	5×10^{-10}	3×10^{-9}	A
4524.	-	1×10^{-9}	3×10^{-9}	A
4525.	-	1.5×10^{-9}	4×10^{-9}	A
Equivalent Anode-Dark-Current Input				
4523.	-	3.8×10^{-11}[q]	-	lm
	-	3.2×10^{-14}[r]	-	W
4524.	-	7.7×10^{-11}[q]	-	lm
	-	6.5×10^{-14}[r]	-	W
4525.	-	1.1×10^{-10}[q]	-	lm
	-	9.3×10^{-14}[r]	-	W
Dark-Pulse Spectrum[s].	See *Typical Dark-Pulse Spectrum*			
Pulse Height Resolution[s,t].	-	7.5	-	%

	Min	Typ	Max	
Mean Gain Deviation[s,u]				
With count rate change of 10,000 to 1,000 Hz[v] .	-	1	-	%
For period of 16 hours at a count rate of 10,000 Hz[w]	-	1	-	%
Anode Pulse Rise Time[x]				
4523.	-	1.2×10^{-8}	-	s
4524.	-	1.4×10^{-8}	-	s
4525.	-	1.8×10^{-8}	-	s
Electron Transit Time[y]				
4523.	-	5.9×10^{-8}	-	s
4524.	-	6.5×10^{-8}	-	s
4525.	-	1.1×10^{-7}	-	s

a Made by Corning Glass Works, Corning, New York.

b Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.

c Made by JAN Hardware Manufacturing Corp., 38-01, Queens Blvd., Long Island City 1, N.Y.

d Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Mass.

e Averaged over any interval of 30 seconds maximum.

f Tube operation at or below room temperature is recommended.

g This value is calculated from the typical luminous sensitivity rating using a conversion factor of 1190 lumens per watt.

h This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1190 lumens per watt.

j These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source)(A)}}{0.15 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}$$

The value of 0.15 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions but with the blue filter removed.

k 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, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 10 microlumens.

m This value is calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source)(A)}}{0.15 \times \text{Light Flux of } 1 \times 10^{-4} \text{(lm)}}$$

The value of 0.15 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (n) to the cathode current measured under the same conditions but with the blue filter removed.

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, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 1×10^{-4} lumen and 300 volts are applied between cathode and all other electrodes connected as anode.

p At a tube temperature of 22°C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 10 microlumens. The supply voltage E is adjusted to obtain an anode current of 20 microamperes. Sensitivity of these types under these conditions is approximately equivalent to 13 amperes per lumen. Dark current is measured with no light incident on the tube.

q With supply voltage E adjusted to give an equivalent luminous sensitivity of 13 amperes per lumen.

r At 4000 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 1190 lumens per watt.

s With the following voltage distribution: 3/13 of E between cathode and dynode No.1, 1/13 of E for each succeeding dynode stage, and 1/13 of E between dynode No.10 and anode. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

t Pulse height resolution is defined as the quotient of the full width of the photopeak at half height by the pulse height at maximum count rate under the following conditions: The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 2 inch x 2 inch (for 4523), 3 inch x 3 inch (for 4524 or 4525) thallium-activated sodium-iodide scintillator [NaI(Tl)-type 8D8 (for 4523), 12D12 (for 4524 or 4525)] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio, and is rated by the manufacturer as having a resolution capability of 7.5%. The Cs^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the types by a coupling fluid such as Dow Corning Corp., Type DC200 (viscosity of 100 centipoise) — Manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

u Mean Gain Deviation is defined as follows:

$$\mathrm{MGD} = \frac{\sum_{i=1}^{i=n} \left| \overline{p} - p_i \right|}{n} \cdot \frac{100}{\overline{p}}$$

where $\overline{p}$ = mean pulse height
p_i = pulse height at the "i^{th}" reading
n = total number of readings

v Under the following conditions: The scintillator and Cs^{137} radiation source of (t) are employed. The radiation source is initially centered on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 10,000 Hz. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 1,000 Hz. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. Mean gain deviation is defined as shown in (u).

w Under the same conditions as shown in (v) except the tube is operated for a period of 1/2 hour with the radiation source located at the point providing a pulse count rate of 10,000 Hz. Following this time interval, the pulse height is sampled at this count rate at 1-hour intervals for a period of 16 hours. Mean gain deviation is defined as shown in (u).

x 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.

y 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 CONSIDERATIONS

The *base pins* of these types fit a diheptal 14-contact socket, such as Cinch No.3M14, or equivalent. The socket should be made of high-grade, low-leakage material, and should be installed so that incident light falls on the face end of the tube.

The *operating stability* of these types are 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 stability is of prime importance, the use of an average anode current of 1 microampere or less, commensurate with satisfactory output signal, is recommended.

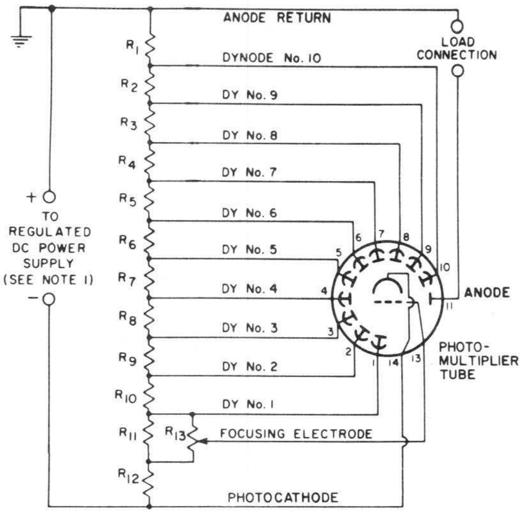
Electrostatic and magnetic shielding of these types may be required in some applications. When a shield is used, it must be at cathode potential.

The *high voltages* at which these types are operated are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

Accompanying Typical Voltage-Divider Arrangements are recommended for use with these types. Recommended resistance values for the voltage dividers range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for any voltage-divider network is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the regulated power supply and the required wattage rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode. The use of resistance values near 1 megohm per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum value of anode current, and may limit anode-current response to pulsed light. The latter effect may be reduced by connecting capacitors between the tube socket terminals for dynodes No.7 and No.8, dynodes No.8 and No.9, dynodes No.9 and No.10, and between dynode No.10 and anode return. In addition to nonlinearity and pulse-limiting effects, the use of resistance values exceeding 1 megohm per stage make these types more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
FOR GENERAL PHOTOMETRIC APPLICATIONS

4523 4524 4525



92LM-1611

R_1 through R_{12}: 470,000 ohms, 1/2 watt

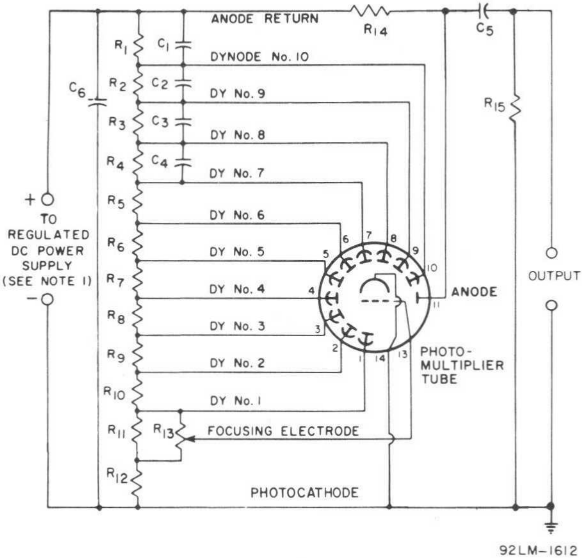
R_{13}: 5 megohms, 1/2 watt, adjustable

Note 1: Adjustable between approximately 800 and 2500 volts dc.

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

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
FOR SCINTILLATION COUNTER APPLICATIONS

4523 4524 4525



C_1: 0.05 μF, 500 volts (dc working)
C_2: 0.02 μF, 500 volts (dc working)
C_3: 0.01 μF, 500 volts (dc working)
C_4: 0.005 μF, 500 volts (dc working)
C_5 and C_6: 0.005 μF, 3000 volts (dc working)
R_1 through R_{10}: 470,000 ohms, 1/2 watt
R_{11} and R_{12}: 750,000 ohms, 1/2 watt
R_{13}: 5 megohms, 1/2 watt, adjustable
R_{14}: 1 megohm, 1/2 watt
R_{15}: 100,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 800 and 2500 volts dc.

Note 2: Capacitors C_1 through C_5 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.

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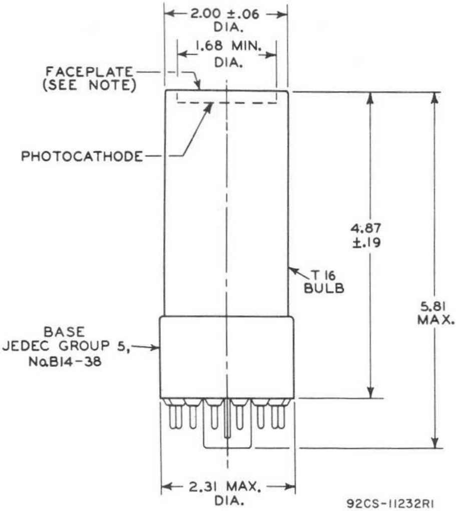
DIMENSIONAL OUTLINE

4523

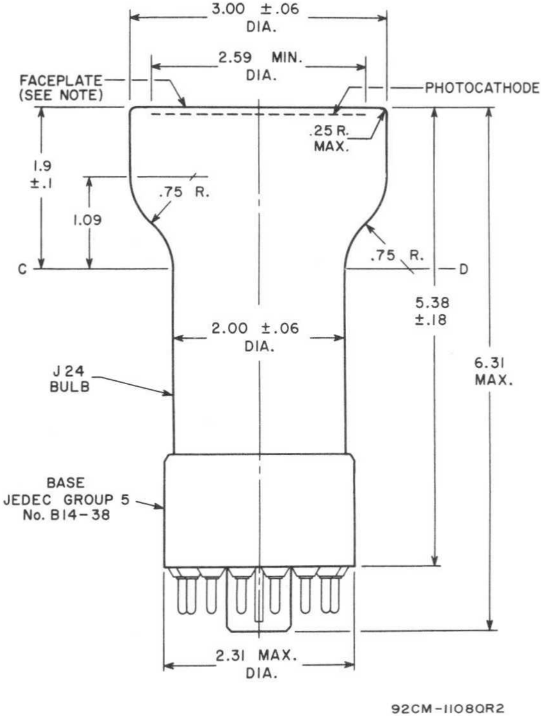


DIMENSIONS IN INCHES

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

Note: Within 1.68-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.100 inch from peak to valley.

DIMENSIONAL OUTLINE
4524

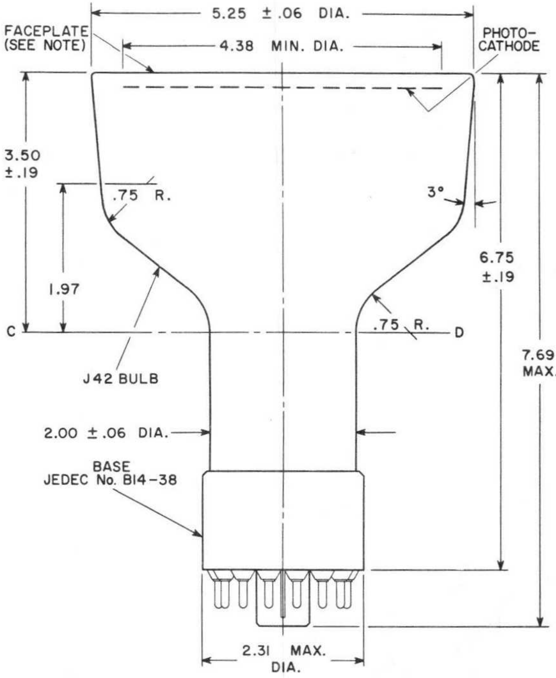


DIMENSIONS IN INCHES

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

Note: Within 2.59-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

DIMENSIONAL OUTLINE
4525



92CM-11148R2

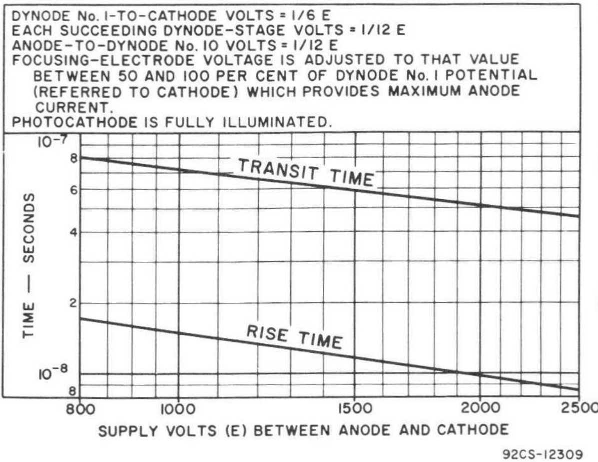
DIMENSIONS IN INCHES

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

Note: Within 4.38-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

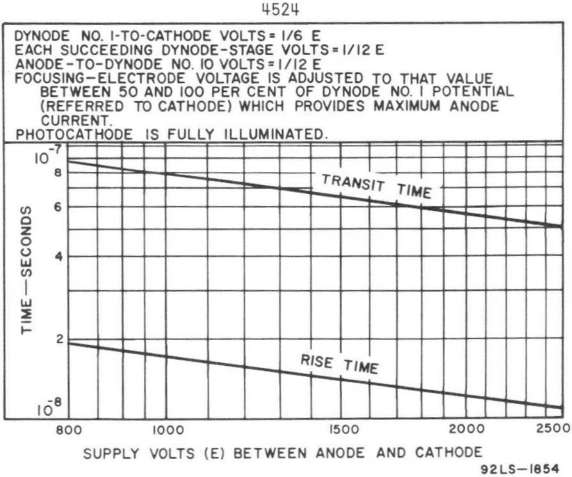
Typical Time Resolution Characteristics

4523



Typical Time Resolution Characteristics

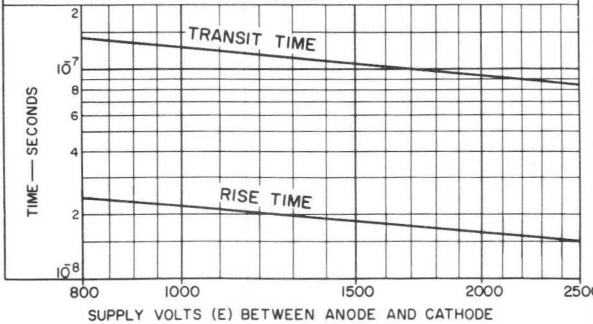
4524



Typical Time Resolution Characteristics

4525

DYNODE No.1–TO–CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE–STAGE VOLTS = 1/12 E
ANODE–TO–DYNODE No.10 VOLTS = 1/12 E
FOCUSING–ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS FULLY ILLUMINATED.

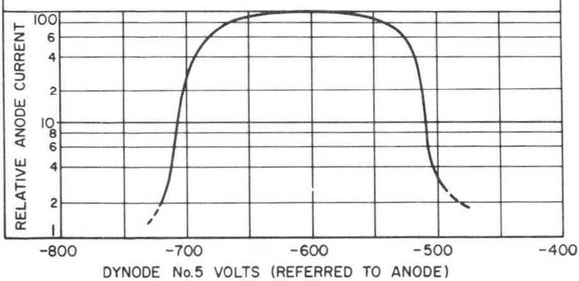


92CS–12313

Typical Characteristic of Output Current as a Function of Dynode-No.5 Volts

4523 4524 4525

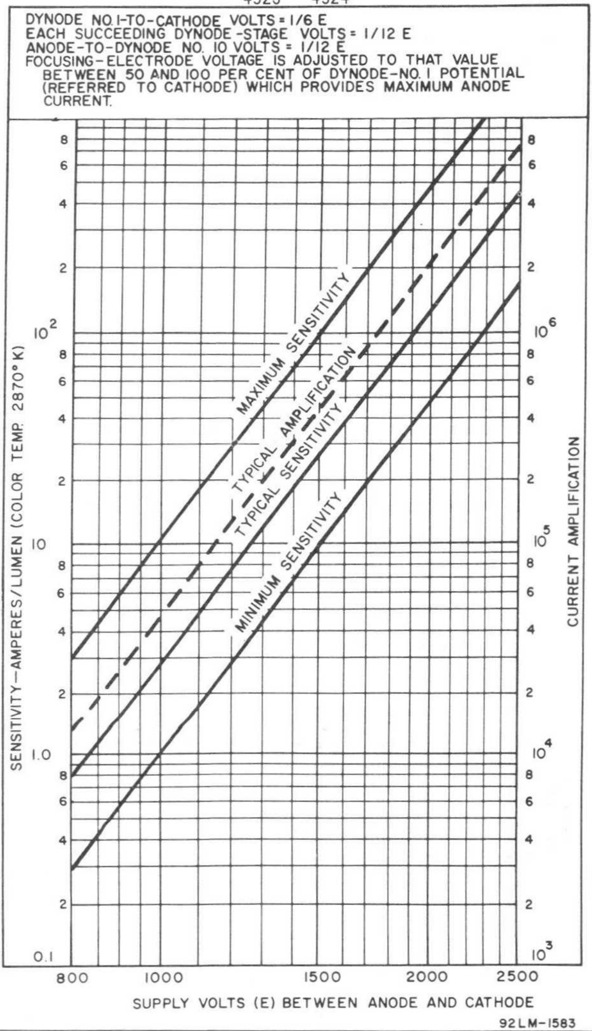
DYNODE No.1–TO–CATHODE VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE–No.5 STAGE = 100
ANODE–TO–DYNODE No.10 VOLTS = 100
FOCUSING–ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
ANODE IS AT GROUND POTENTIAL.



92CS–11078R1

Sensitivity and Current Amplification Characteristics

4523 4524



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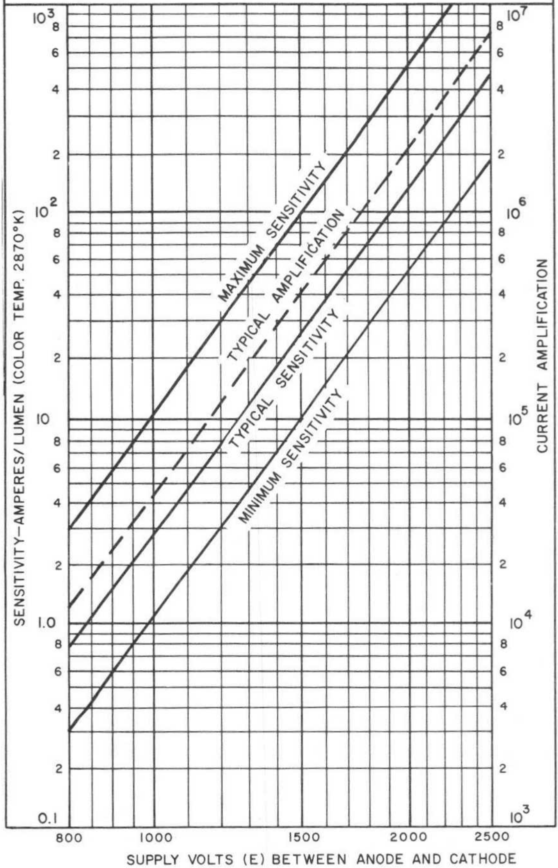
Sensitivity and Current Amplification Characteristics

4525

DYNODE NO. I-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE NO. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE NO. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.

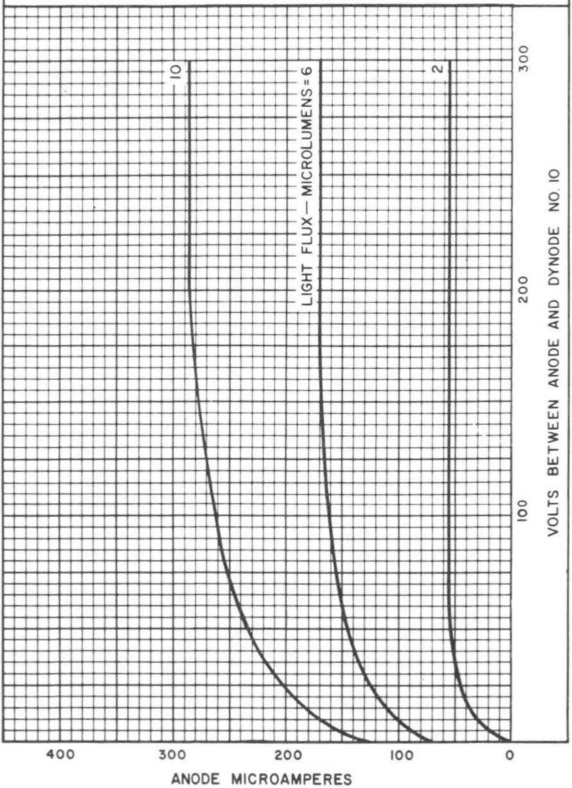


92LM-1753

Typical Anode Characteristics

4523 4524 4525

DYNODE NO. 1-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 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.



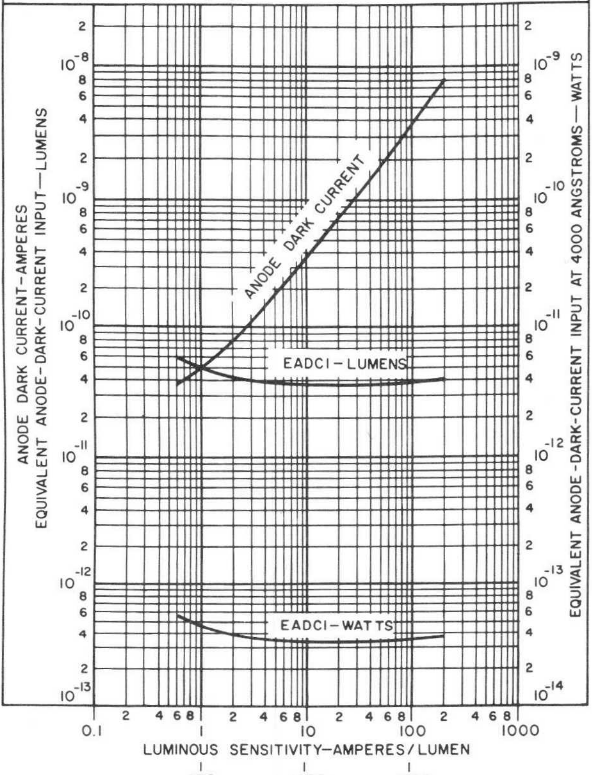
92LM-1555

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

Typical EADCI and Anode Dark Current Characteristics

4523

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E)
DYNODE NO. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE NO. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 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.

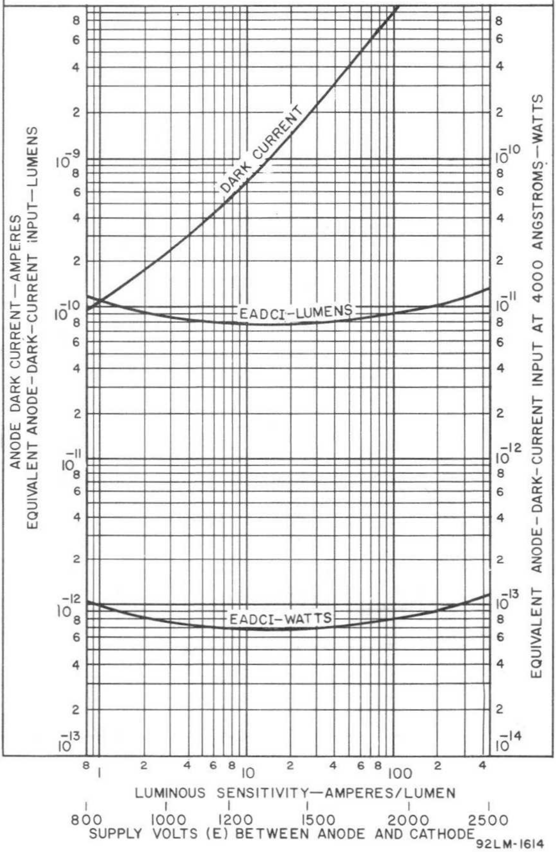


92LM-1777

Typical EADCI and Anode Dark Current Characteristics

4524

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE NO. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 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.



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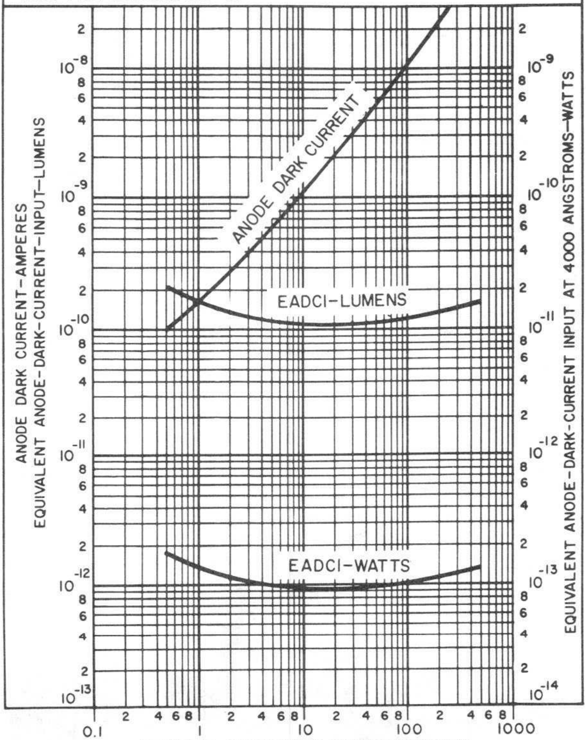
Typical EADCI and Anode Dark Current Characteristics

4525

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E)
DYNODE NO. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE NO. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 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.

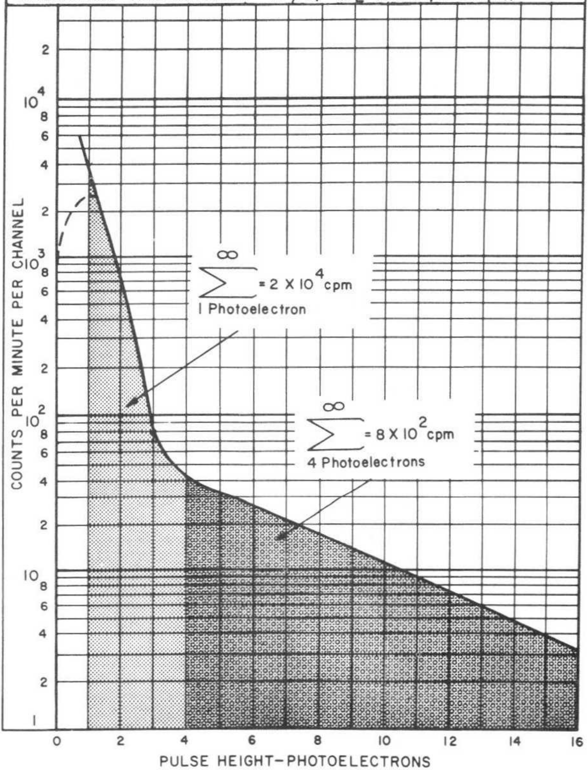


92LM-1752

Typical Dark-Pulse Spectrum

4523

CATHODE-TO-DYNODE-NO.1 VOLTS = 430
EACH SUCCEEDING DYNODE-STAGE VOLTS = 142
ANODE-TO-CATHODE VOLTS = 1850
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE WAS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES WERE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22° C.
ONE-PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 10 μs, (R_L = 100 kΩ, C = 100 pF).



92LM-1778

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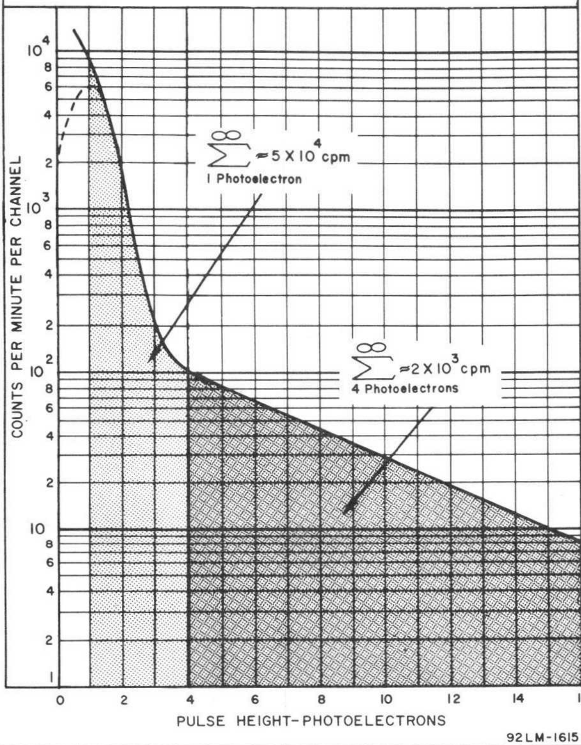
Typical Dark-Pulse Spectrum

4524

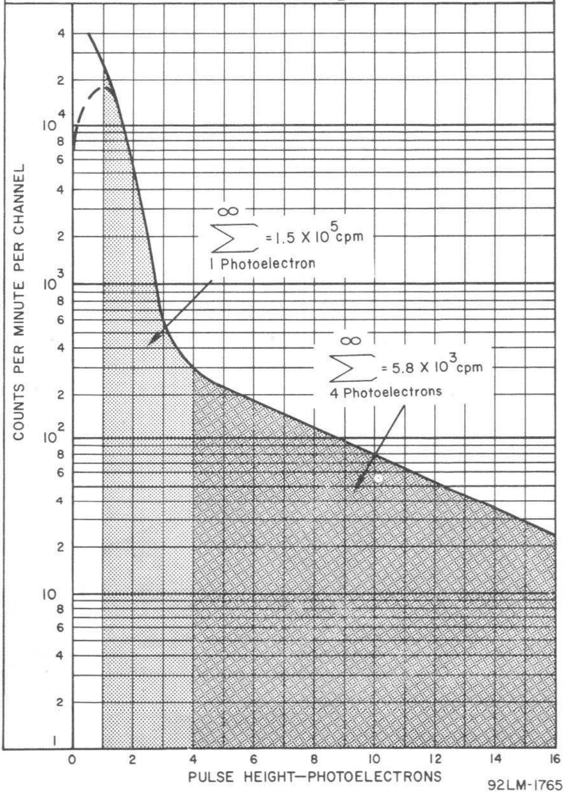
CATHODE-TO-DYNODE-NO. 1 VOLTS = 430
EACH SUCCEEDING DYNODE-STAGE VOLTS = 142
ANODE-TO-CATHODE VOLTS = 1850
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE WAS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES WERE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22°C
ONE-PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 10 μs, (R_L = 100 kΩ, C = 100 pF).



Typical Dark-Pulse Spectrum

4525

CATHODE-TO-DYNODE-NO. 1 VOLTS = 430
EACH SUCCEEDING DYNODE-STAGE VOLTS = 142
ANODE-TO-CATHODE VOLTS = 1850
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE WAS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES WERE SUBTRACTED.
SOLID-LINE PORTION INDICATES DARK-PULSE SPECTRUM.
TUBE TEMPERATURE = 22° C
ONE-PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS.
INTEGRATING TIME CONSTANT = 10 μs, (R_L = 100 kΩ, C = 100 pF).



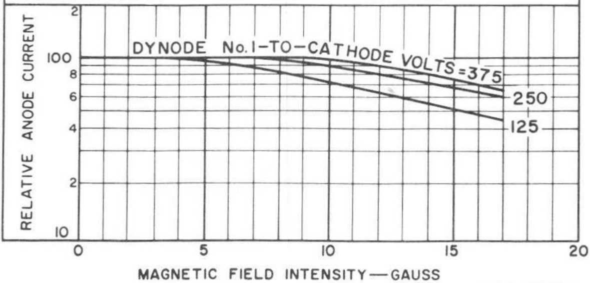
92LM-1765

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

Typical Effect of Magnetic Field on Anode Current

4523

DYNODE No. I-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No. 10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE POSITIONED APPROX. I FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.

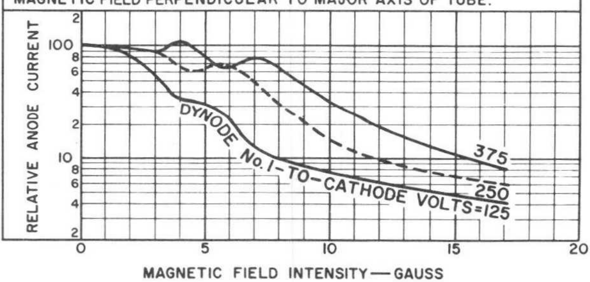


92CS-11235R2

Typical Effect of Magnetic Field on Anode Current

4523

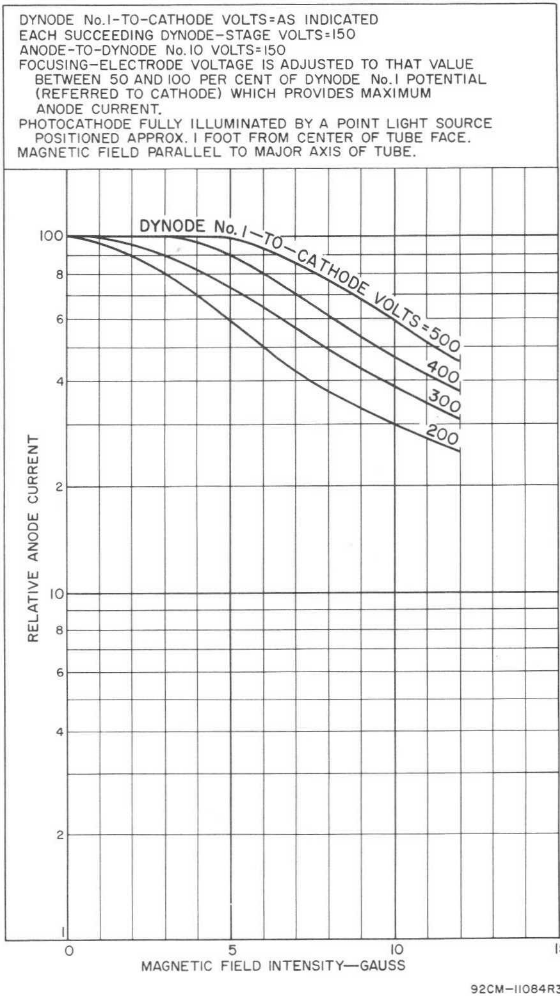
DYNODE No. I-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No. 10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE POSITIONED APPROX. I FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PERPENDICULAR TO MAJOR AXIS OF TUBE.



92CS-11236R2

Typical Effect of Magnetic Field on Anode Current

4524



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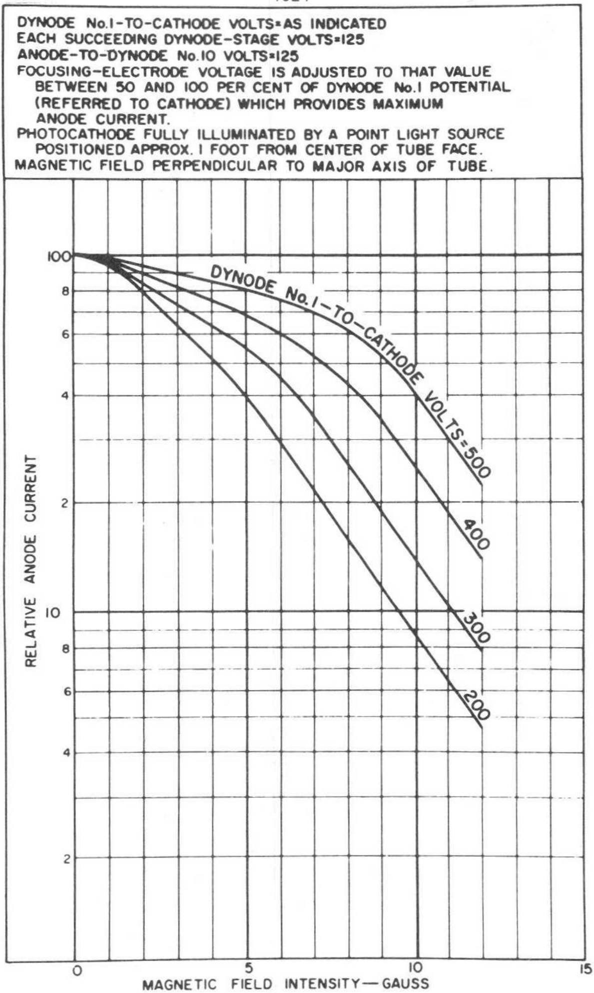
Typical Effect of Magnetic Field on Anode Current

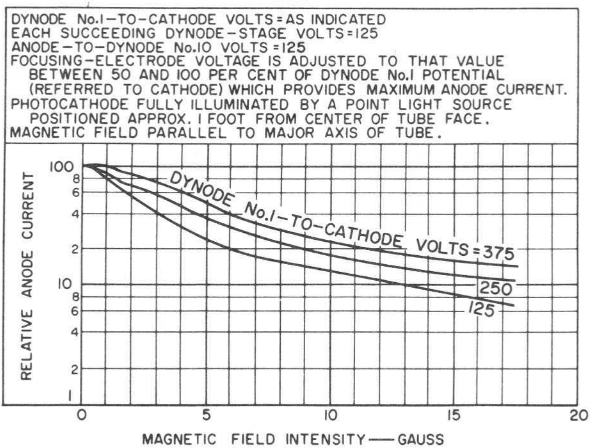
4524



92CM-11085R2

Typical Effect of Magnetic Field on Anode Current

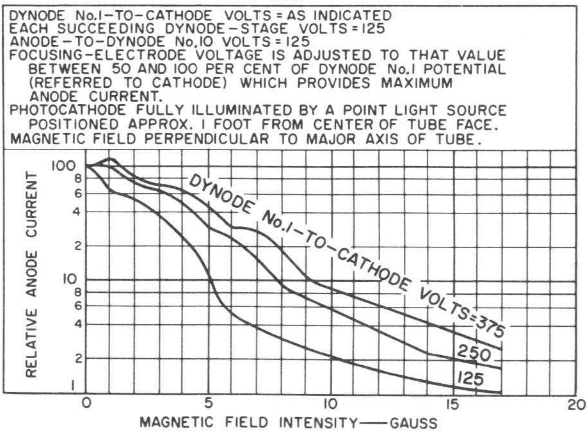
4525



92CS-11187R2

Typical Effect of Magnetic Field on Anode Current

4525

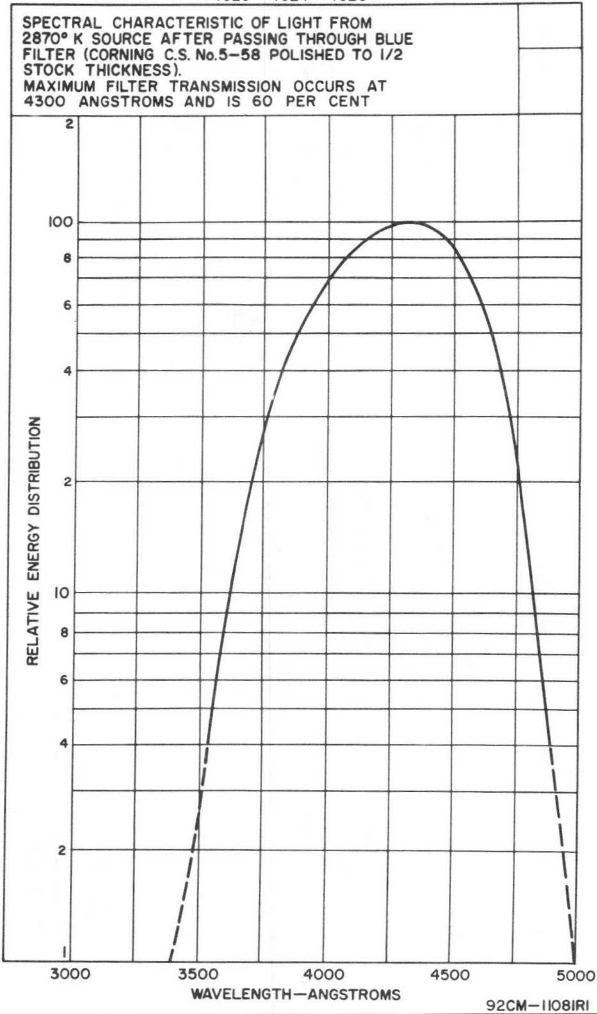


92CS-11188R2

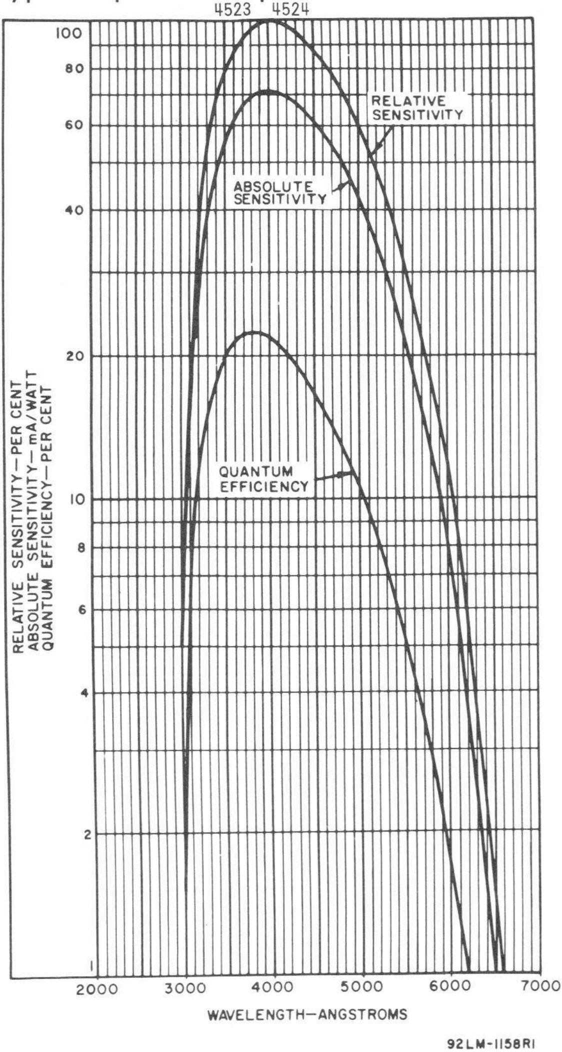
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

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

4523 4524 4525



Typical Spectral Response Characteristics



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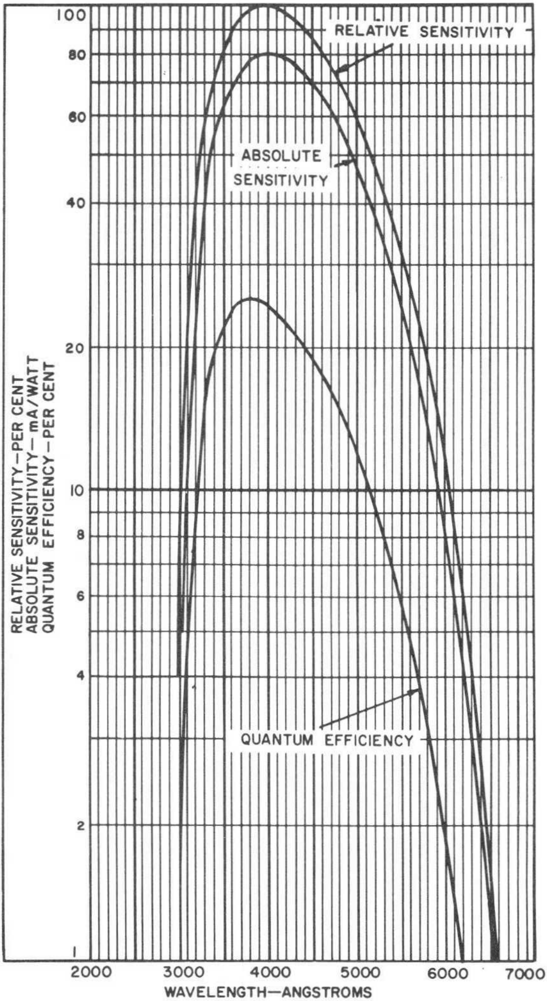
Typical Spectral Response Characteristics

4525



92LM-1779

Photomultiplier Tube

10-Stage Dormer-Window Type Having Multialkali Photocathode Deposited on a Reflective Substrate

- **Detects Low-Level Light Signals in Presence of Relatively High Background Illumination**
- **Highly Suitable for Star-Tracking and Laser Detection Systems to Approximately 8000 Angstroms**

General Data

Spectral Response . . . . See Fig.1
Wavelength of Maximum Response . . . . 5300 ± 500 Å
Cathode, Semitransparent on Reflective Substrate . . . . Potassium-Sodium-Cesium-Antimony (Multialkali)
  Shape . . . . Concave Spherical Surface
  Minimum projected length on plane of window . . . 0.65 in (16.5 mm)
  Minimum projected width on plane of window . . . 0.50 in (12.7 mm)
Window . . . . Corning[a] No.0080, or equivalent
  Shape . . . . Rectangular
  Index of refraction at 5893 angstroms 1.51
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 . . . . 6.5 pF
Maximum Overall Length
  (Excluding leads and attached base) . . . . . 3.01 in (76.4 mm)
Maximum Diameter . . . . 1.56 in (39.6 mm)
Base (Temporary) . . Small-Shell Duodecal 12-Pin JEDEC No.B12-43
  Socket . . . . Eby[b] Part No.9058, or equivalent
Bulb . . . . T12 with Special End Contour
Magnetic Shield . . . . . . Millen[c] Part No.80802M, or equivalent
Operating Position . . . . Any
Weight (Approx.):
  With base attached . . . . 3 oz (85.1 g)
  Without base . . . . 2 oz (56.7 g)

Maximum Ratings, Absolute-Maximum Values:[d]

DC Supply Voltage:
  Between anode and cathode . . . . 2000 max. V
  Between anode and dynode No.10 . . . . 250 max. V
  Between consecutive dynodes . . . . 300 max. V
  Between dynode No.1 and cathode . . . . . . 400 max. V
Average Anode Current[e] . . . . 100 max. μA
Ambient Temperature . . . . 85 max. °C

Characteristics Range Values for Equipment Design:

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 = 1250 volts except as noted

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[f] at 5300 angstroms . .	–	4.4×10^{3}	–	A/W
Luminous (2870° K)[g]	5	15	75	A/lm
Cathode Sensitivity:				
Radiant[h] at 5300 angstroms . .	–	8.9×10^{-2}	–	A/W
Luminous (2870° K)[i]	2×10^{-4}	3×10^{-4}	–	A/lm
With red light (2870° K + C.S. No.2-62 filter)[k]	8×10^{-8}	1.2×10^{-7}	–	A
With blue light (2870° K + C.S. No.5-58 filter)[m]	7×10^{-9}	9×10^{-9}	–	A
Quantum Efficiency at 5000 angstroms	–	21	–	%
Current Amplification	–	5×10^{4}	–	
Anode Dark Current[n]	–	2×10^{-9}	1×10^{-8}	A
Equivalent Anode-Dark-Current Input[n]	–	1×10^{-10}	5×10^{-10}	lm
	–	3.4×10^{-13}[p]	1.7×10^{-12}[p]	W
Equivalent Noise Input[q]	–	1.5×10^{-12}	–	lm
	–	5.1×10^{-15}[r]	–	W
With E = 1500 volts				
Anode Pulse Rise Time[s]	–	2×10^{-9}	–	s
Electron Transit Time	–	2×10^{-8}	–	s

[a] Made by Corning Glass Works, Corning, New York.

[b] Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia 44, Pa. This socket mates with the temporary B12-43 base and is not required after initial testing of the tube.

[c] Made by James Millen Manufacturing Co., 150 Exchange Street, Malden 48, Mass.

[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 295 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 2870° 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 295 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. The value of light flux is 0.001 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

[k] Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62 Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.001 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, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.001 lumen and 200 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 20 amperes per lumen.

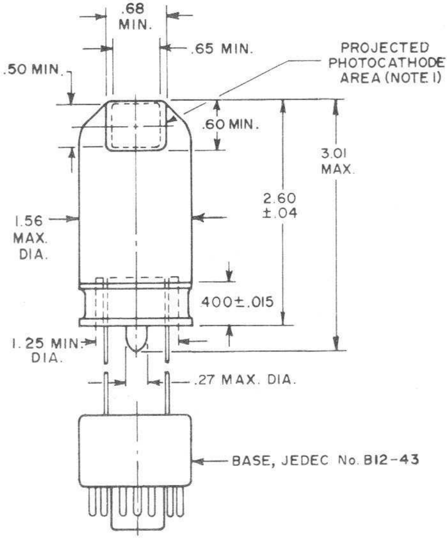
[p] At 5300 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 295 lumens per watt.

[q] Under the following conditions: Supply voltage (E) is as shown, 22° C tube temperature, 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 5300 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 295 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.

DIMENSIONAL OUTLINE

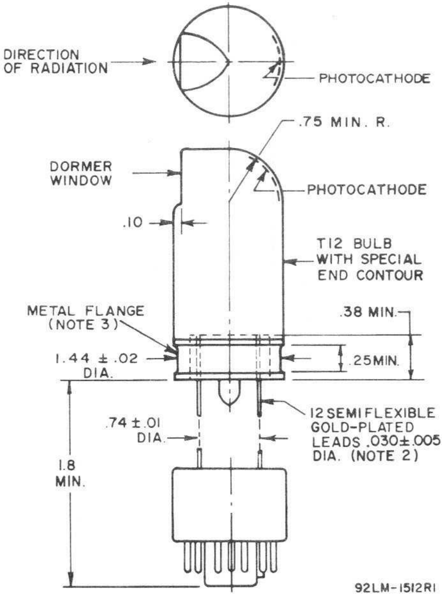


Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Inch Dimension Equivalents in Millimeters

Inch	mm	Inch	mm	Inch	mm
.005	.127	.38	9.65	1.44	36.5
.015	.38	.40	10.1	1.56	39.6
.02	.50	.50	12.7	1.80	45.7
.03	.76	.60	15.2	2.60	66.0
.04	1.0	.65	16.5	3.01	76.4
.10	2.5	.68	17.2		
.25	6.3	.75	19.0		
.27	6.8	1.25	31.7		

DIMENSIONAL OUTLINE – cont'd

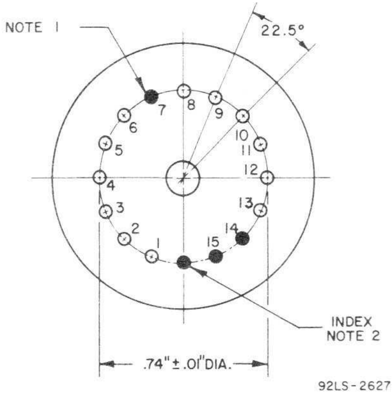


Note 1: Projected area lies between dashed lines.

Note 2: The semiflexible leads of the 4526 may be soldered, welded, or crimp connected into the associated circuit. However, when soldering or welding is employed for making such connections, care should be exercised to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the glass-metal seals is recommended.

Note 3: Metal flange is connected internally to the photocathode.

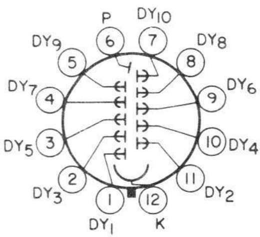
Lead Orientation Bottom View



Note 1: Leads 7, 14, and 15 are cut off within 0.16" (4 mm) of the glass button.

Note 2: Lead is cut off within 0.16" (4 mm) of the glass button for indexing.

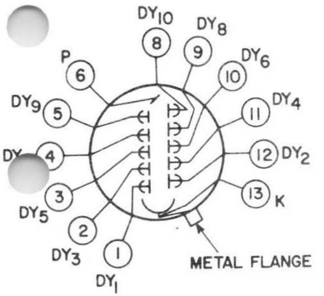
Basing Diagram Bottom View (With Temporary Base)



DIRECTION OF LIGHT: INTO END OF BULB

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

Lead Connections Bottom View (With Base Removed)



Lead 1 - Dynode No.1
Lead 2 - Dynode No.3
Lead 3 - Dynode No.5
Lead 4 - Dynode No.7
Lead 5 - Dynode No.9
Lead 6 - Anode
Lead 8 - Dynode No.10
Lead 9 - Dynode No.8
Lead 10 - Dynode No.6
Lead 11 - Dynode No.4
Lead 12 - Dynode No.2
Lead 13 and Metal Flange - Photocathode

Typical Effect of Indicated Magnetic Field on Anode Current

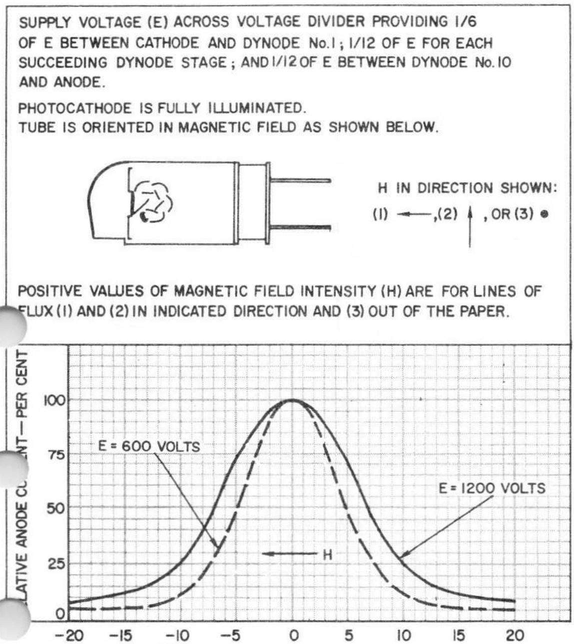


Figure 1

TYPICAL EFFECT OF INDICATED FIELD ON ANODE CURRENT – cont'd

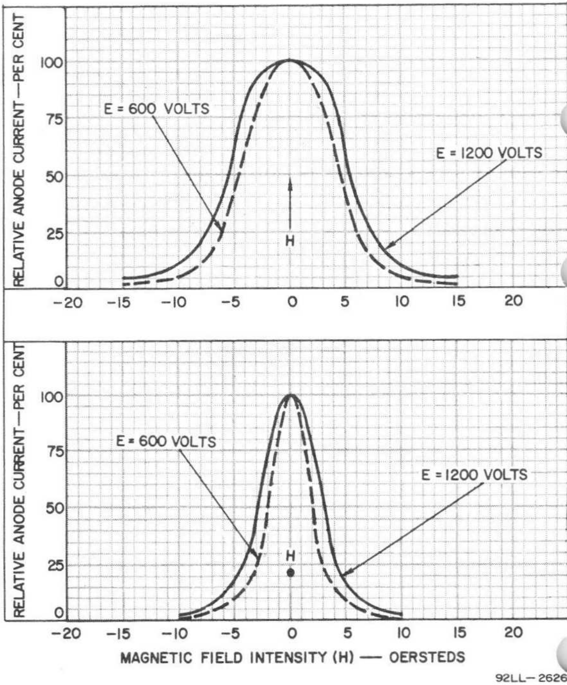


Figure 2

SCHEMATIC ARRANGEMENT OF TYPE 4526

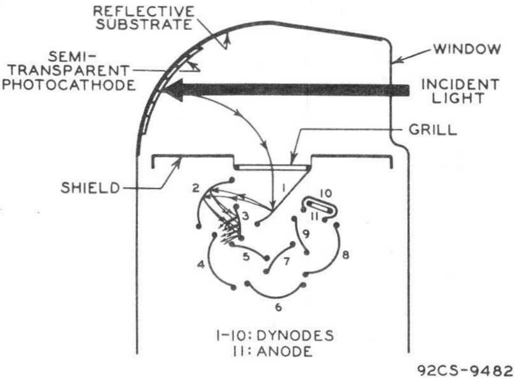


Figure 3

TYPICAL TIME-RESOLUTION CHARACTERISTICS

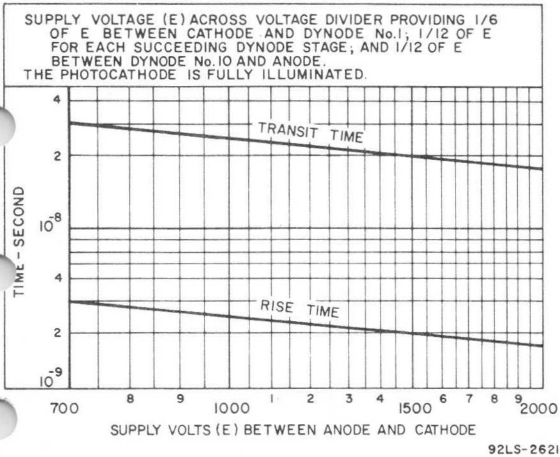


Figure 4

SPECTRAL RESPONSE CHARACTERISTICS

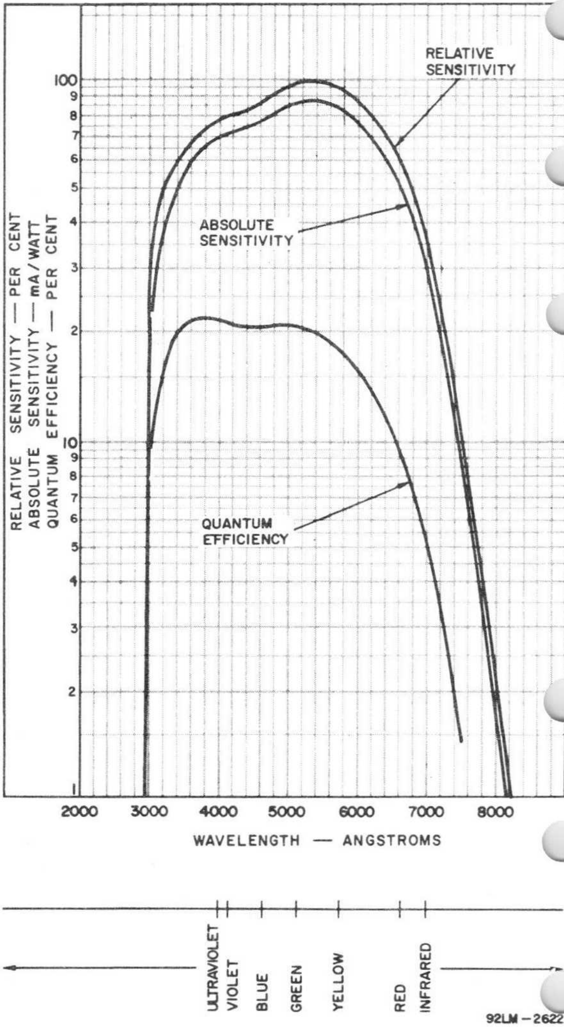


Figure 5

TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

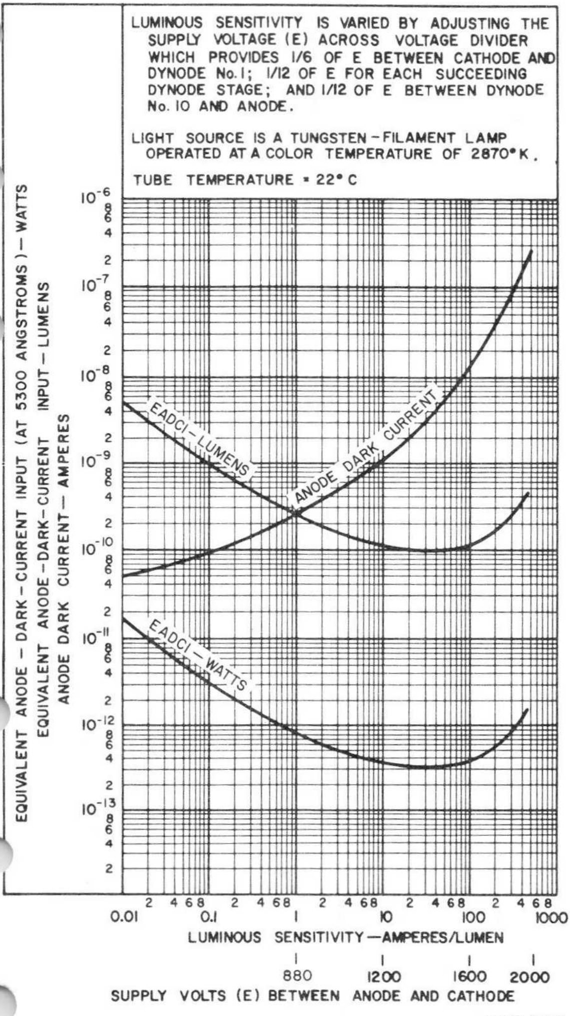


Figure 6

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

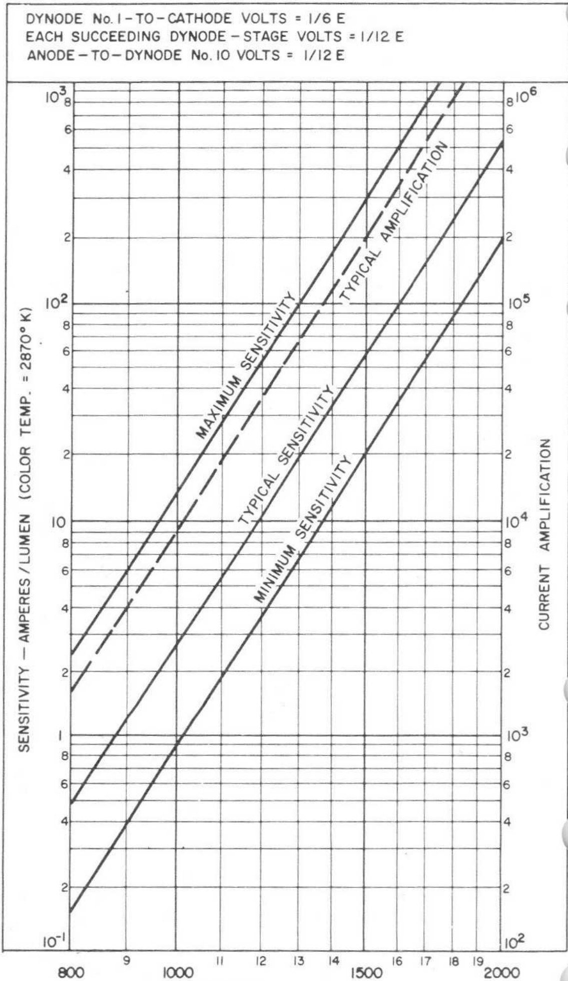


Figure 7

TYPICAL ANODE CHARACTERISTICS

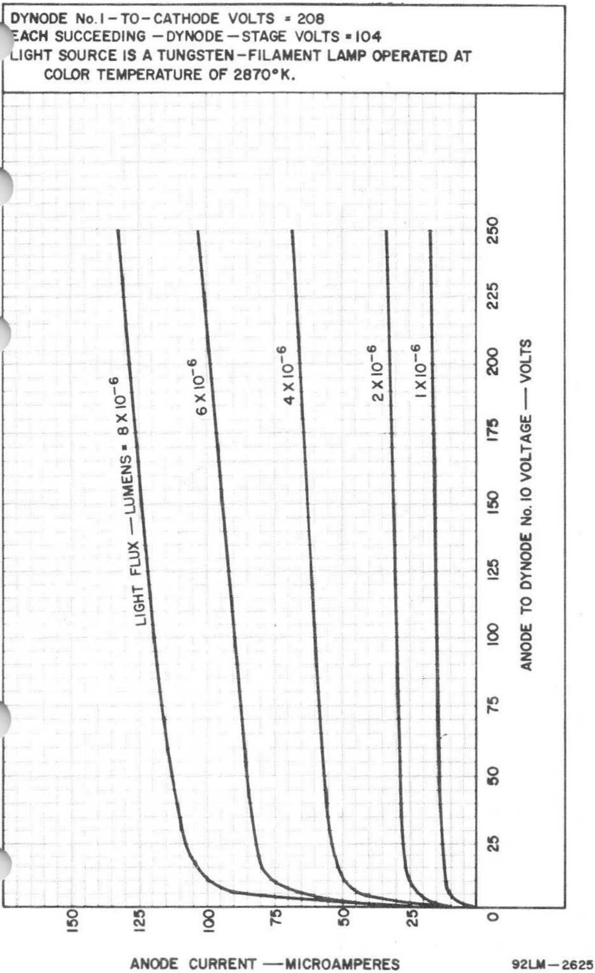
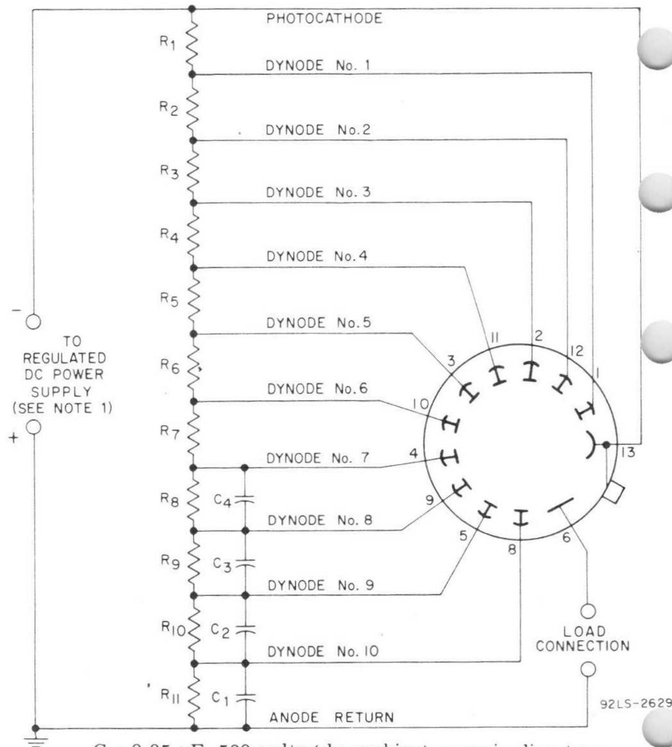


Figure 8

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



C_1: 0.05 µF, 500 volts (dc working) ceramic-disc type
C_2: 0.02 µF, 500 volts (dc working) ceramic-disc type
C_3: 0.01 µF, 500 volts (dc working) ceramic-disc type
C_4: 0.005 µF, 500 volts (dc working) ceramic-disc type
R_1: 330 kΩ ± 5%, 1 W
R_2 through R_{11}: 160 kΩ ± 5%, 1 W

Note 1: Adjustable between approximately 500 and 2000 volts dc.

Note 2: Component values are dependent upon nature of application and output signal desired. See discussion on **Typical Voltage Divider Arrangements** – Page 5.

Figure 9

Image Orthicon

4-1/2-Inch Diameter Type
For RCA TK-42 and TK-43 TV Color Cameras
Type 4536 is Unilaterally Interchangeable with Types 4492, 4492V1, and 4492V2

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	V
Current	0.6	A

Direct Interelectrode Capacitance:

Anode to all other electrodes	12	pF
Target-to-Mesh Spacing	0.001 (0.0254 mm)	in
Spectral Response		S-10
Wavelength of Maximum Response .	4500 ± 300	angstroms

Photocathode, Semitransparent:

Rectangular image (4 x 3 aspect ratio):

Useful size of . . . . . . 1.6 in (41 mm) max. Diagonal

Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value.

Focusing Method . . . . Magnetic
Deflection Method . . . . Magnetic
Overall Length . . . . 19.375 in (492 mm) ± 0.310 in
Greatest Diameter of Bulb. . . 4.500 in (114 mm) ± 0.094 in
Envelope Terminals 5
End Base . . . . Small-Shell Diheptal 14-Pin Base (JEDEC Group 5, No.B14-45)
Socket . . . . Cinch Part No.3M14, or equivalent
Operating Position . . . . The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.

Weight (Approx.)	2.3 lb	(993 g)
Minimum Inside Diameter of Deflecting Coil	3.2 in	(81 mm)
Deflecting-Coil Length	7 in	(178 mm)
Focusing-Coil Length	15 in	(381 mm)

Alignment Coil:

Position on neck . . Centerline of magnetic field should be located 9.25 in (235 mm) from the flat area of the shoulder

ABSOLUTE MAXIMUM AND MINIMUM RATINGS

Operating Temperature:[b]		
Any part of bulb	65 max.	°C
Of bulb at large end of tube (Image section)	35 min.	°C
Temperature Difference:		
Between image section and any part of bulb hotter than image section	5 max.	°C
Photocathode:		
Illumination	50 max.	lm/ft^2
	(footcandles)–538 lux	
Voltage	–700 max.	V
Grid-No.6 Voltage	–700 max.	V
Target Voltage:		
Positive value	10 max.	V
Negative value	10 max.	V
Field-Mesh Voltage[c]	30 max.	V
Grid-No.5 Voltage	300 max.	V
Grid-No.4 Voltage	350 max.	V
Grid-No.3 Voltage	400 max.	V
Grid-No.2 & Dynode-No.1 Voltage	350 max.	V
Grid-No.1 Voltage:		
Negative bias value	125 max.	V
Positive bias value	0 max.	V
Voltage Between Consecutive Dynodes	350 max.	V
Anode-Supply Voltage	1650 max.	V
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	V
Heater positive with respect to cathode	10 max.	V

TYPICAL OPERATING VALUES[d]

Heater Voltage	6.3	V
Photocathode Voltage	–600	V
Grid-No.6 Voltage (Image Focus)		
Approx. 70% of Photocathode Voltage[e]	–370 to –470	V
Target Voltage Above Cutoff[f]	Adjusted as required	
Field-Mesh Voltage[c]	15 to 25	V
Grid-No.5 Voltage (Decelerator)	40	V
Grid-No.4 Voltage (Beam Focus)	70 to 90	V

Grid-No.3 Voltage[g]	250 to 275	V
Grid-No.2 & Dynode-No.1 Voltage.	280	V
Grid-No.1 Voltage for Picture Cutoff	−45 to −115	V
Dynode-No.2 Voltage	600	V
Dynode-No.3 Voltage[h]	800	V
Dynode-No.4 Voltage	1000	V
Dynode-No.5 Voltage[h]	1200	V
Anode Voltage	1250	V
Recommended Target Temperature Range[b]	35 to 45	°C
Peak-to-Peak Blanking Voltage	8	V
Field Strength of Focusing Coil:[i]		
At center of scanning section (Approx.)	60	G
In plane of photocathode (Approx.)	120	G
Field Strength of Alignment Coil	0 to 3	G

PERFORMANCE DATA

With conditions shown under Typical Operating Values including Recommended Target Temperature Range; target voltage adjusted to 3 volts above cutoff; and operation in a 525-line, 30-frame TV system; except as otherwise indicated.

	Min.	Max.	
Signal-Output Current (Peak to Peak) at Maximum Multiplier Gain	15	100	µA
Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current[k]	39.5	–	dB
Photocathode Illumination at 2870° K Required to Bring Picture Highlights to the "Knee" of Light Transfer Characteristic	–	0.052	lm/ft^2 (fc)
Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[m]	45	–	%
Uniformity:			
Ratio of Shading (Background Signal to Highlight Signal):			
Over full scanned area	–	0.12	
Between center and peripheral areas	–	0.07	
Variation of Highlight Signal (Per cent of maximum highlight signal over full scanned area)	–	20	%

[b] Operation outside of the *Recommended Target Temperature Range* shown under *Typical Operating Values* will not damage the 4536 provided the *Maximum Temperature Ratings* of the tube are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the *Recommended Target Temperature Range*.

[c] With respect to grid No.4.

[d] With the 4536 operated in an RCA MI-557770-A1 deflection assembly, or equivalent, and at fixed photocathode voltage.

[e] Adjust for optimum focus.

[f] The target supply voltage should be adjustable from −5 to +5 volts.

[g] Adjust to give the most uniformly shaded picture near maximum signal.

[h] The voltages shown provide maximum multiplier gain. Normally, dynode-No.3 and dynode-No.5 voltages are simultaneously adjusted to obtain the required value of signal current at the video-amplifier input.

[i] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[k] Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level. The value shown is measured under the following conditions using a Video Noise Meter, Model UPSF (North American Version), or equivalent. This meter is manufactured by Rohde and Schwarz, Munich, West Germany.

Signal: Blanked video, 0.7 V peak-to-peak including 0.07 V set-up.

Noise Meter: Gated with horizontal and vertical blanking signal of camera system. Video pass band is shaped by means of self-contained 100 kHz high-pass and 4.2 MHz low-pass filters.

Weighting filters matching the response of the human eye (CCIR Rec.421, Annex III) are not used and the color subcarrier, 3.58 MHz, is not present during the measurement.

[m] Measured with amplifier having flat frequency response.

DOS and DON'TS on Use of RCA-4536

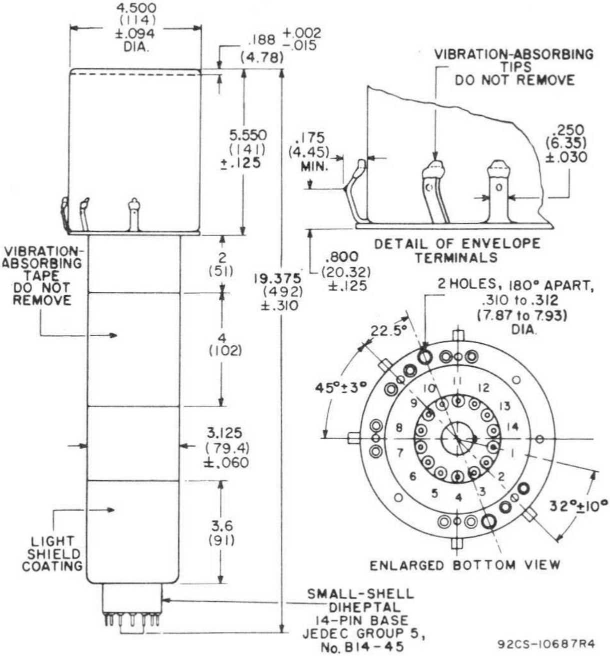
Here are the "dos" –

1. Hold temperature of the 4536 within the recommended operating range.
2. Make sure tube is properly aligned.
3. Adjust beam-focus control for best usable resolution.
4. Select target voltage according to operating needs. This freedom of operation results from use of the electronically-conducting glass target.
5. Determine proper operating point with target voltage adjusted to the desired voltage above target-cutoff.
6. Open lens before voltages are applied to the 4536.

Here are the "don'ts" –

1. Don't force the 4536 into its envelope terminal socket.
2. Don't operate the 4536 without scanning.
3. Don't use more beam current than necessary to discharge the highlights of the scene.
4. Don't turn off beam while tube is capped (and voltages applied).

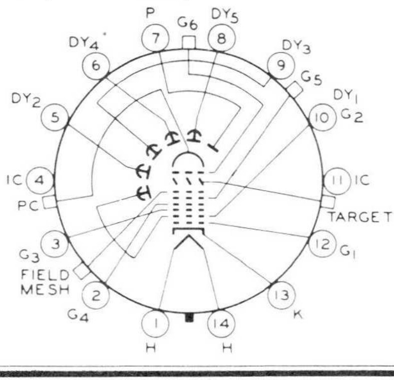
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



TERMINAL DIAGRAM (Bottom View)

DIRECTION OF LIGHT:

PERPENDICULAR TO LARGE END OF TUBE



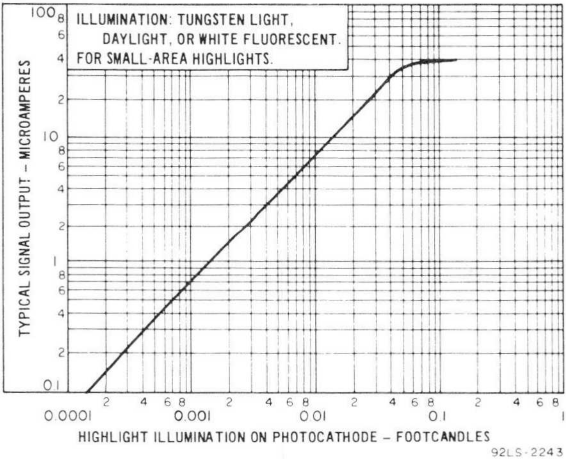
SMALL-SHELL DIHEPTAL 14-PIN BASE

Pin 1: Heater
Pin 2: Grid No.4
Pin 3: Grid No.3
Pin 4: Internal Connection – Do Not Use
Pin 5: Dynode No.2
Pin 6: Dynode No.4
Pin 7: Anode
Pin 8: Dynode No.5
Pin 9: Dynode No.3
Pin 10: Dynode No.1, Grid No.2
Pin 11: Internal Connection – Do Not Use
Pin 12: Grid No.1
Pin 13: Cathode
Pin 14: Heater

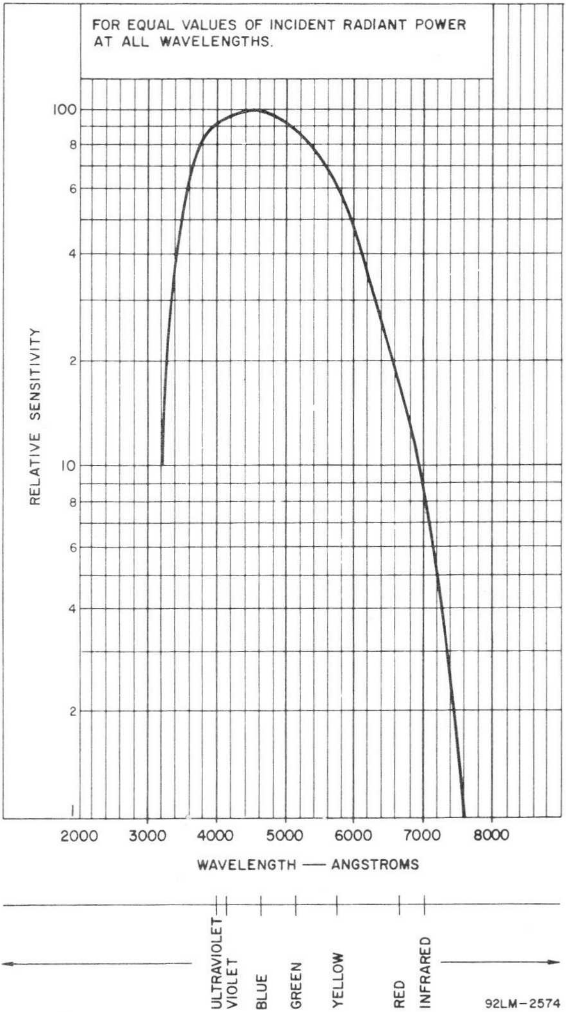
ENVELOPE TERMINALS

Terminal over Pin 2: Field Mesh
Terminal over Pin 4: Photocathode
Terminal on side of envelope opposite base key: Grid No.6
Terminal over Pin 9: Grid No.5
Terminal over Pin 11: Target

BASIC LIGHT TRANSFER CHARACTERISTIC



TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC



Vidicon

1''-Diameter, Magnetic Focus and Deflection Vidicon for Signal-Storage Applications

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10% V
Current at 6.3 volts	0.1 A

Direct Interelectrode Capacitance:[a]

Target to all other electrodes	4.6 pF

Spectral Response . . . . See *RCA Type IV Spectral Response* at front of this section

Photoconductive Layer:

Maximum useful diagonal of rectangular image (1 x 1 aspect ratio) . . . . 0.885 in

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method	Magnetic
Deflection Method	Magnetic
Overall Length	6.250 in ± 0.125 in
Greatest Diameter	1.125 in ± 0.010 in
Bulb	T8
Base	Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket	Cinch[b] No.54A18088, or equivalent
Deflecting Yoke-Focusing Coil-Alignment Coil Assembly	Cleveland Electronics[c,c] No.VYFA-355-2, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz

ABSOLUTE-MAXIMUM RATINGS

For scanned area of 5/8" x 5/8"

Grid-No.4 Voltage[f]	1000 max.	V
Grid-No.3 Voltage[f]	1000 max.	V
Grid-No.2 Voltage	350 max.	V
Grid-No.1 Voltage:		
Negative bias value	150 max.	V
Positive bias value	0 max.	V

Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode	125 max. V
Heater positive with respect to cathode	10 max. V
Target Voltage	100 max. V
Dark Current	0.25 max. μA
Peak Target Current[g]	0.75 max. μA
Faceplate:	
Illumination[h]	5000 max. fc
Temperature	71 max. °C

TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 5/8" x 5/8"
Faceplate temperature of 30° to 35° C
and Standard TV Scanning Rate

Grid-No.4 (Decelerator) Voltage[f]	750	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	450	V
Grid-No.2 (Accelerator) Voltage	300	V
Grid-No.1 Voltage for Picture Cutoff[i]	-45 to -100	V
Average "Gamma" of Transfer Characteristic for Signal-Output Current Between 0.02 μA and 0.2 μA	0.7	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[k]	300:1	
Lag–Per Cent of Initial Value of Signal-Output Current:[m]		
1 second after illumination is removed	45 to 65	%
15 seconds after illumination is removed	10 min.	%
30 seconds after illumination is removed	10 max.	%
Minimum Peak-to-Peak Blanking Voltage:		
When applied to grid No.1	75	V
When applied to cathode	20	V
Limiting Resolution:		
At center of picture	1000	TV Lines

Amplitude Response to a 400 TV Line Square–Wave Test Pattern at Center of Picture[n]	60	%
Field Strength at Center of Focusing Coil[p]	52 ± 4	G
Peak Deflecting-Coil Current:		
Horizontal	225	mA
Vertical	41	mA
Field Strength of Adjustable Alignment Coil[q]	0 to 4	G

High-Sensitivity Operation – 0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight)	0.1	fc
Target Voltage[r,s]	15 to 65	V
Dark Current[t]	0.02	μA
Signal-Output Current:[u]		
Typical	0.2	μA
Minimum	0.15	μA

[a] This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Made by Cinch Manufacturing Corporation, 1026 S. Homan Avenue, Chicago 24, Illinois.

[c] Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

[d] These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

[f] Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

[g] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[h] For conditions where "white light" is uniformly diffused over entire tube face.

[i] With no blanking voltage on grid No.1.

[k] Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

[m] For initial signal-output current of 0.20 microampere and a dark current of 0.02 microampere.

[n] Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

[p] The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[q] The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

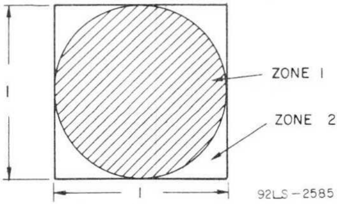
[r] The target voltage for each tube must be adjusted to that value which gives the desired operating dark current.

[s] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[t] The deflecting circuits must provide extremely linear scanning for good signal reproduction because both dark current and signal are proportional to scanning velocity.

[u] Defined as the component of the highlight target current after the dark-current component has been subtracted.

SPURIOUS SIGNAL TEST (Fig. 1)



This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in *Fig.1*. The target is adjusted to provide a dark current of 0.1 µA with no light on the vidicon faceplate. The test pattern shown in *Fig.1,* is then focused on the vidicon faceplate and the iris is opened to provide a total target current of 0.4 µA (signal current of 0.3 µA). The 4542 is adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for both white and black spots. Smudges, streaks, or mottled and grainy background must have a contrast of at least 10% of a 0.3 µA peak signal amplitude to constitute a reject item.

Table 1 *For scanned area of 5/8" x 5/8"*

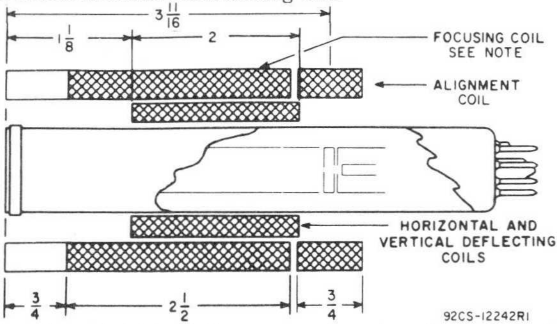
Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	Any Number Allowed Under 4 TV Lines (Max.)
4 but not including 3	1	
3 but not including 1	4	
1 or less	■	

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

■Spots of this size are allowed unless concentration causes a smudged appearance.

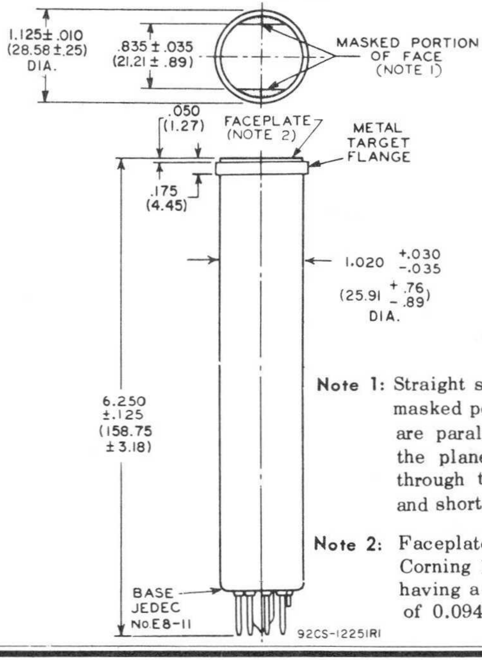
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To obtain minimum beam-landing error



Note: Cross-hatching indicates wound portion of focusing coil.

DIMENSIONAL OUTLINE-Dimensions in Inches (mm)

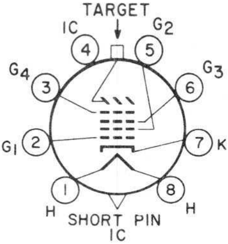


Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

TERMINAL DIAGRAM (Bottom View)

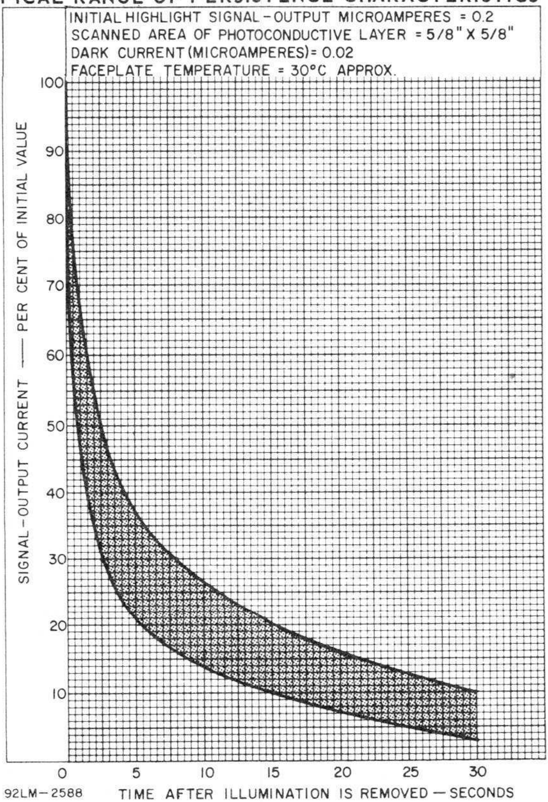
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater



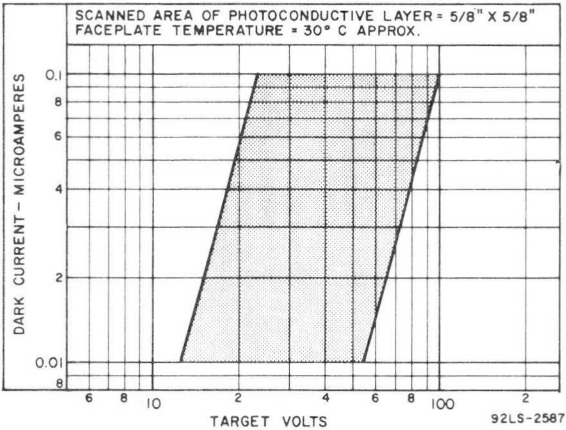
Flange: Target
Short Index Pin – Internal Connection – Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

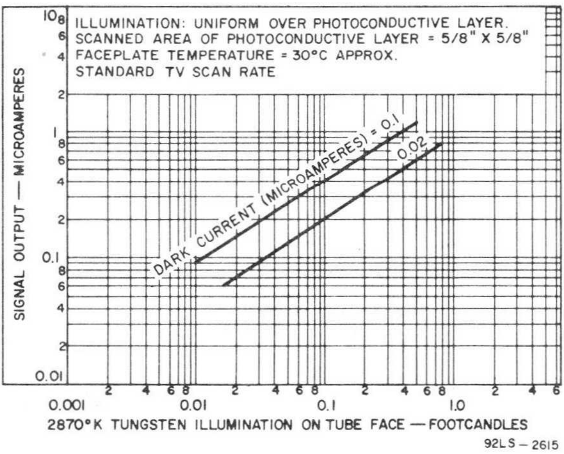
TYPICAL RANGE OF PERSISTENCE CHARACTERISTICS



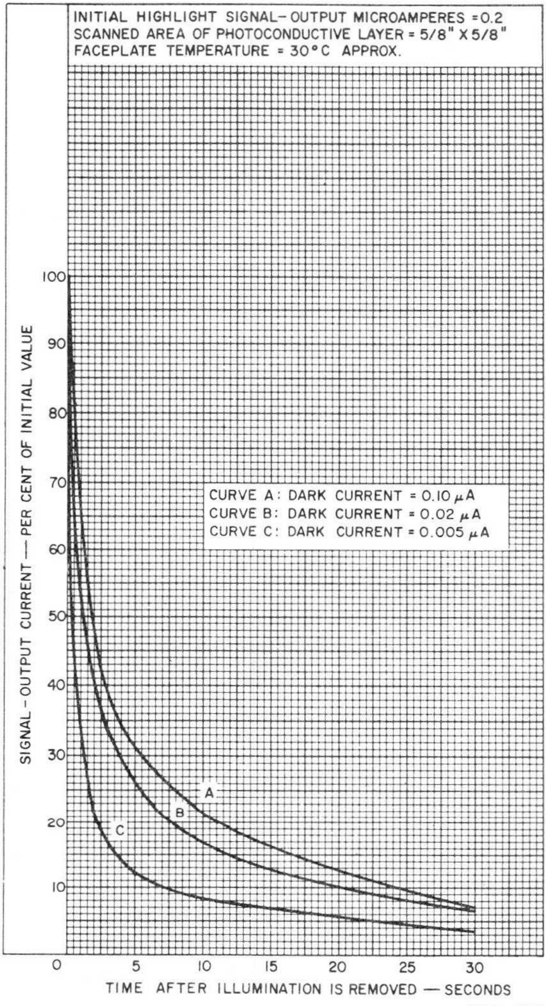
RANGE OF DARK CURRENT



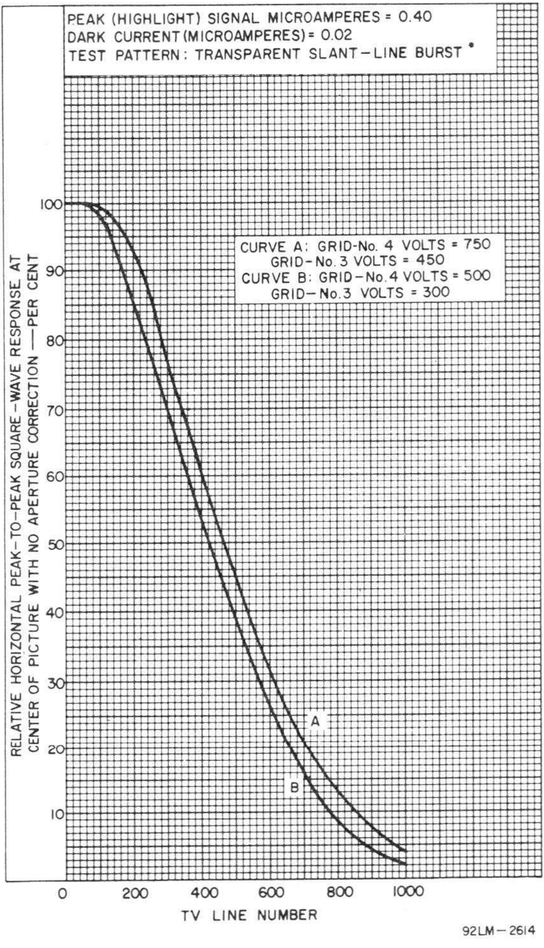
LIGHT TRANSFER CHARACTERISTICS



VARIATION OF TYPICAL PERSISTENCE CHARACTERISTICS WITH CHANGES IN DARK CURRENT



HORIZONTAL SQUARE-WAVE RESPONSE



*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

Image Intensifier Tube

- Variant of 8606 Having Automatic Brightness Control
- Integral Oscillator and Voltage Multiplier
- Fiber-Optic Input and Output Faceplates
- Ruggedized Construction
- ERMA Photocathode
- P20 Phosphor Screen

The 4549 is available with ERMA spectral responses to provide the minimum photocathode sensitivities specified in the table below.

Spectral Response	Luminous – µA/lm	Radiant – mA/W	
		At 800 nm	At 850 nm
ERMA6-1	175	6	1
ERMA12-5	200	12	5
ERMA20-12	225	20	12
ERMA25-15	250	25	15

General Data

Spectral Response . . . . S-20 with extended red response

Wavelength of Maximum Response . . . . 500 + 140 nanometers − 70 nanometers

Photocathode:

- Material . . . . Na-K-Cs-Sb (Multialkali)
- Minimum useful area . . . . $11.1\ cm^2$ ($1.70\ in^2$)
- Minimum useful diameter . . . . 37.5 mm (1.47 in)
- Image surface:
  - Shape . . . . Flat, Circular
  - Material . . . . Fiber-Optics

Fluorescent Screen:

- Minimum useful area . . . . $13.8\ cm^2$ ($2.14\ in^2$)
- Minimum useful diameter . . . . 42 mm (1.65 in)
- Phosphor . . . . P20, Aluminized
  - Fluorescence and phosphorescence . . . . Yellow-Green
  - Persistence . . . . Medium to Medium Short
- Image surface:
  - Shape . . . . Flat, Circular
  - Material . . . . Fiber-Optics

Focusing Method . . . . Electrostatic

Tube Dimensions:

Maximum overall length .... 12.028 in (302.51 mm)

Maximum diameter .... 3.747 in (95.10 mm)

Operating Position .... Any

Weight (Approx.) .... 4 lbs 8 oz (2.04 kg)

Maximum Ratings, Absolute-Maximum Values:

DC Input Voltage .... 7.0 max. V

Ambient-Temperature Range:

Non-operating .... -54^{o} to $+68^{o}$ C

Operating .... -54^{o} to $+52^{o}$ C

Typical Performance Characteristics

Under conditions with 6.75 volts dc applied and at an ambient temperature of 22^{o} C, unless otherwise noted.

	Min.	Typical	Max.	
Resolution:				
Center[b]	25	35	–	Line-Pairs/mm
Edge[c] (Peripheral)	23	30	–	Line-Pairs/mm
Maximum Screen Luminance (Brightness) See **Figure 3** ...	–	140	–	fL
Luminance Gain:[d]				
At 22^{o} C	3.5×10^{4}	8×10^{4}	–	fL/fc
At -54^{o} C	2.8×10^{4}	–	–	fL/fc
Equivalent Screen Background Input:				
Luminous[e]	–	–	2×10^{-11}	lm/cm^{2}
Photocathode Sensitivity:				
Radiant:				
At 470 nm[f]	–	4.6×10^{-2}	–	A/W
At 800 nm	6×10^{-3}	–	–	A/W
At 850 nm	1×10^{-3}	–	–	A/W
Luminous[g]	1.75×10^{-4}	2×10^{-4}	–	A/lm
Luminance Uniformity	–	–	3:1[h]	
Modulation Transfer Function (MTF):[j] (See **Figure 4**)				
For 2.5 Line-Pairs/mm ...	90	95	–	%
For 7.5 Line-Pairs/mm ...	55	60	–	%
For 16 Line-Pairs/mm ...	10	20	–	%

Paraxial Image Magnification (Cmx)[k]	0.82	–	1.0	
Edge Image Magnification[m].	1.0	–	–	
Image Alignment[n]	–	–	0.06	in
Image Stability in 30 Seconds[p]	–	–	0.005	in
Distortion[q]	–	–	21	%

Cathode and Screen Quality Tests

Cathode and screen quality are measured under the following conditions: The photocathode is fully illuminated with the light level adjusted to sharply define on the screen any dark spots, bright spots, streaks, or blemishes. The size and quantities of such spots, streaks, and blemishes are observed by means of a 10-power microscope fitted with a reticle and shall not exceed the size and quantities shown in Table I.

Table I

Size of dark spots, bright spots, streaks, or blemishes observed at screen. Note 1	Number of dark spots, bright spots, streaks, or blemishes		
	Area "A" Note 2	Area "B" Note 3	Area "C" Note 4
Greater than 0.015"	0	0	0
0.012" to and including 0.015"	0	1	2
0.009" to less than 0.012"	0	3	8
0.006" to less than 0.009"	0	12	24
0.003" to less than 0.006"	3	55	Min.
Less than 0.003"	Min.	Min.	Min.

Note 1 – Two spots separated by a distance of less than the maximum dimension of either spot are considered one spot with a size equal to the sum of the maximum dimensions of the two spots plus the distance separating them.

Note 2 – Area "A" is defined as the area within a 0.76 cm (0.30")-diameter circle concentric with the major axis of the tube.

Note 3 – Area "B" is defined as the area bounded by a 0.76 cm (0.30")-diameter circle and a 3.0 cm (1.2")-diameter circle both of which are concentric with the major axis of the tube.

Note 4 – Area "C" is defined as the area bounded by a 3.0 cm (1.2")-diameter circle and a 3.75 cm (1.47")-diameter circle both of which are concentric with the major axis of the tube.

Environmental Testing

The C33088P1 is designed to withstand military environmental requirements of 75 g's shock (peak amplitude), vibration at a frequency of 10 to 55 Hz at a double amplitude of 0.10", and temperature extremes of -54° C to +68° C. Military environmental test procedures can be supplied on request, and customer environmental requirements may be submitted for these devices if desired. Unless requested, environmental tests will not be performed.

b The resolution, both horizontal and vertical, is determined with a test pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated a "line-pair."

c This minimum value applies at a distance of 11 mm from the major (optical) axis of the tube.

d Luminance Gain is defined as the quotient of screen brightness in footlamberts by the photocathode illumination in footcandles provided by a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light input radiation on the photocathode image surface is in the range of 1×10^{-5} to 3×10^{-5} footcandle.

e Defined as the equivalent value of luminous flux from a tungsten-filament lamp operating at 2854° K that would be required to cause an increase in screen brightness equal to screen background brightness.

f For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

g Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The light spot has a minimum diameter of 1.1".

h The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 32.5 mm in diameter centered on the image screen. No distinct line of demarcation between light and dark areas is permitted. Alternatively, tubes will conform to MIL-E-55493 (EL) Uniformity Specification dated 26 November, 1968.

j A two-dimensional resolution pattern, providing constant illumination in the Y direction, and sinusoidal variation of intensity in the X direction is projected on the photocathode. Per cent image modulation M may then be defined as:

$$M = \frac{W - B}{W + B} \times 100$$

where W = maximum illumination in white line
B = minimum illumination in black line

Output image brightness is also a sinusoidal function of the distance across one direction of the pattern, and the output modulation is equal to or less than the input modulation. The modulation transfer function (MTF) is defined as the ratio of the output modulation to input modulation expressed as a function of the spatial frequency of the incident illumination pattern. MTF for the C33088P1 is measured using Modulation Transfer Function Analyzer Model No.K1-b, a product of Optics Technology, Inc., Belmont, CA, using the specified procedure for that instrument.

k Paraxial Image Magnification (Cmx) is defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the two corresponding image points on the photocathode. The image points on the photocathode are separated by a distance of 2 mm and are located equal distances from the major axis of the tube.

m Under the same conditions as shown in footnote (k) except the test points on the photocathode are separated by 32 mm.

n The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will fall within a circle concentric with the optical axis of the screen having the specified diameter.

p The center of the image produced on the screen of the tube as specified in footnote (n) will not shift more than the specified value during 30 seconds of operation.

q A second magnification value (Emx) is obtained as stated in footnote (n) except the image points on the photocathode are separated by a distance of 32 mm. Per-cent distortion is defined by the equation

$$\text{Per-cent Distortion} = \frac{\text{Emx-Cmx}}{\text{Cmx}} \times 100$$

Operating Considerations

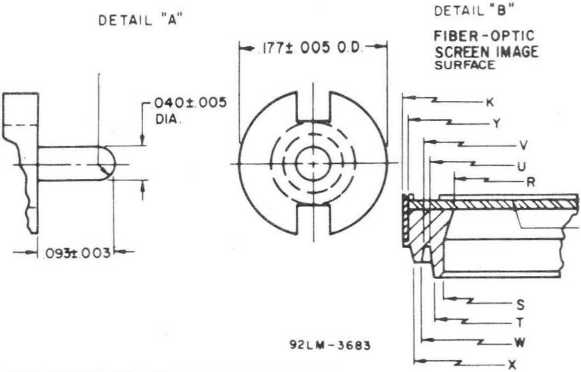
Magnetic shielding of these tubes may be required to minimize the effects of extraneous fields on tube performance. It is to be noted that ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken to insure that the case is completely demagnetized.

Response time for the automatic brightness control to adjust to incident illumination is dependent on the level of incident illumination but never exceeds a few seconds. Response time as a function of incident illumination is shown in Figure I.

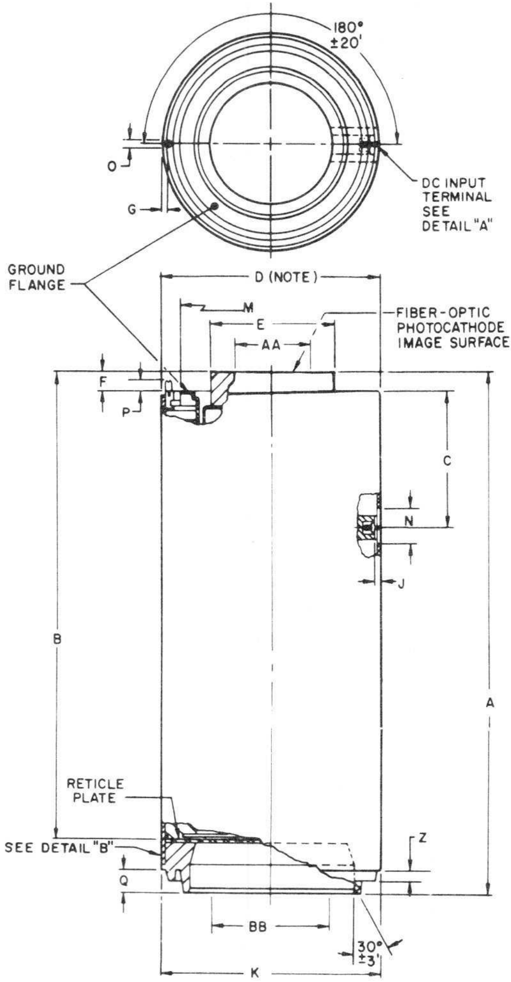
While the gain of the typical 8606 falls rapidly at input illumination levels above 10^{-3} footcandle and falls to unity at approximately 10^{-2} footcandle, the 4549 can operate at input illumination levels up to about 7 footcandles. Screen brightness as a function of incident illumination is shown in **Figure 3.**

The characteristic of **Figure 2** shows battery current as a function of incident illumination. At normal tube operating light levels battery drain is low allowing power conservation.

DIMENSIONAL OUTLINE DETAILS



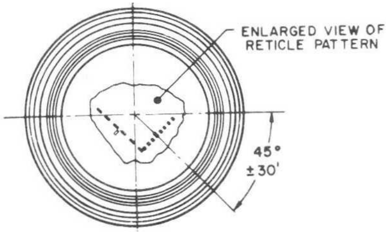
DIMENSIONAL OUTLINE



Note: Dimension applies within 1" of tube end.

DIMENSIONAL OUTLINE

BOTTOM VIEW



OUTLINE DIMENSIONS

Dimensions	Inches		mm	
	Min.	Max.	Min.	Max.
A	11.906	12.028	302.512	305.511
B	11.025	11.115	280.035	282.321
C	2.372	2.398	60.249	60.909
D	3.742 Dia.	3.747 Dia.	95.047 Dia.	95.174 Dia.
E	2.095 Dia.	2.105 Dia.	53.213 Dia.	53.467 Dia.
F	.237	.243	6.020	6.172
G	.082	.092	2.082	2.336
J	.093	.113	2.362	2.870
K	3.737 Dia.	3.747 Dia.	94.92 Dia.	95.10 Dia.
M	2.950 Dia.	3.050 Dia.	74.930 Dia.	77.470 Dia.
N	.620 Dia.	.630 Dia.	15.748 Dia.	16.002 Dia.
O	.120 Dia.	.123 Dia.	3.048 Dia.	3.124 Dia.
P	.208	.218	5.283	5.537
Q	.370	.380	9.398	9.652
R	2.51 Dia.	2.55 Dia.	63.75 Dia.	64.77 Dia.
S	2.781 Dia.	2.791 Dia.	70.637 Dia.	70.891 Dia.
T	2.979 Dia.	2.994 Dia.	75.666 Dia.	76.047 Dia.
U	3.083 Dia.	3.098 Dia.	78.308 Dia.	78.689 Dia.
V	3.245 Dia.	3.260 Dia.	82.423 Dia.	82.804 Dia.
W	3.297 Dia.	3.312 Dia.	83.743 Dia.	84.124 Dia.
X	3.500 Dia.	3.520 Dia.	88.900 Dia.	89.408 Dia.
Y	3.54 Dia.	3.58 Dia.	89.91 Dia.	90.93 Dia.
Z	.183	.193	4.648	4.902
AA	1.47 Dia.	–	37.5 Dia.	–
BB	1.65 Dia.	–	42 Dia.	–

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

RESPONSE TIME FOR SCREEN LUMINANCE (BRIGHTNESS) TO ADJUST TO INCIDENT ILLUMINATION

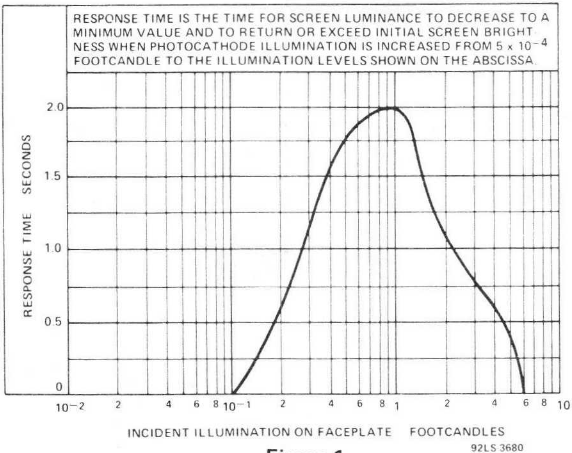


Figure 1

BATTERY CURRENT AS A FUNCTION OF INCIDENT ILLUMINATION

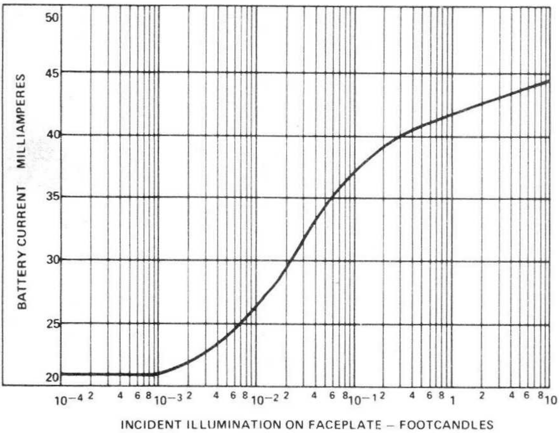
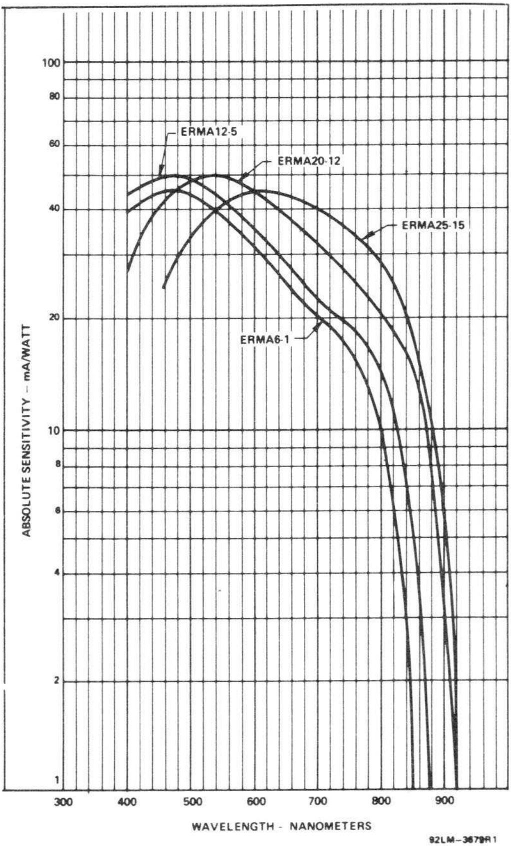


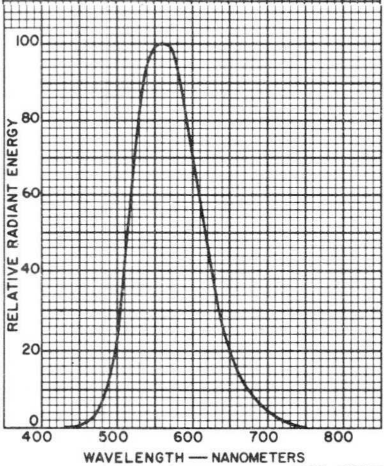
Figure 2

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS



SPECTRAL ENERGY EMISSION CHARACTERISTIC (JEDEC PHOSPHOR P20)

COLOR	C.I.E. COORDINATES	
	X	Y
YELLOW – GREEN	0.426	0.546



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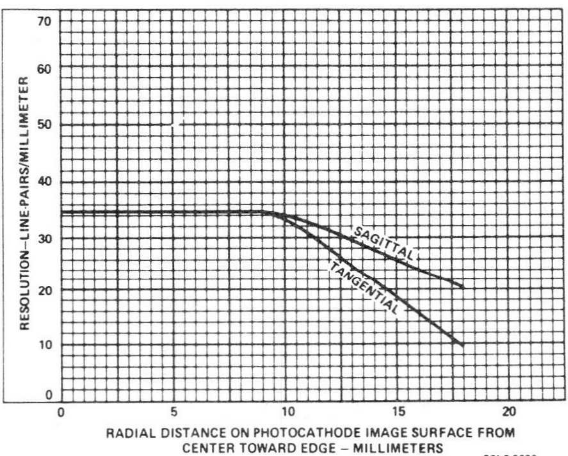
TYPICAL RESOLUTION CHARACTERISTICS



92LS-3682

SCREEN LUMINANCE VS. INCIDENT ILLUMINATION CHARACTERISTIC

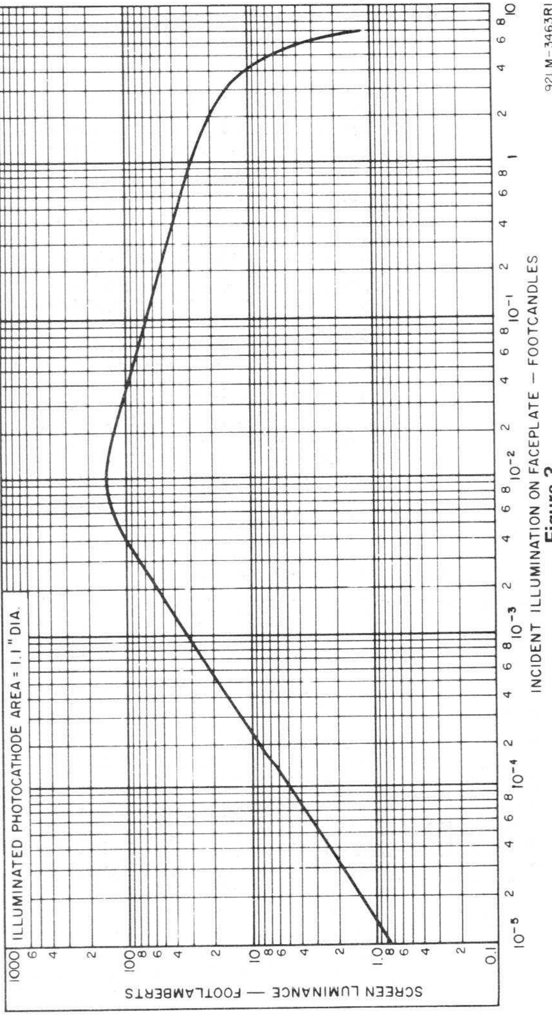


Figure 3

TYPICAL MODULATION TRANSFER FUNCTION VS. FREQUENCY

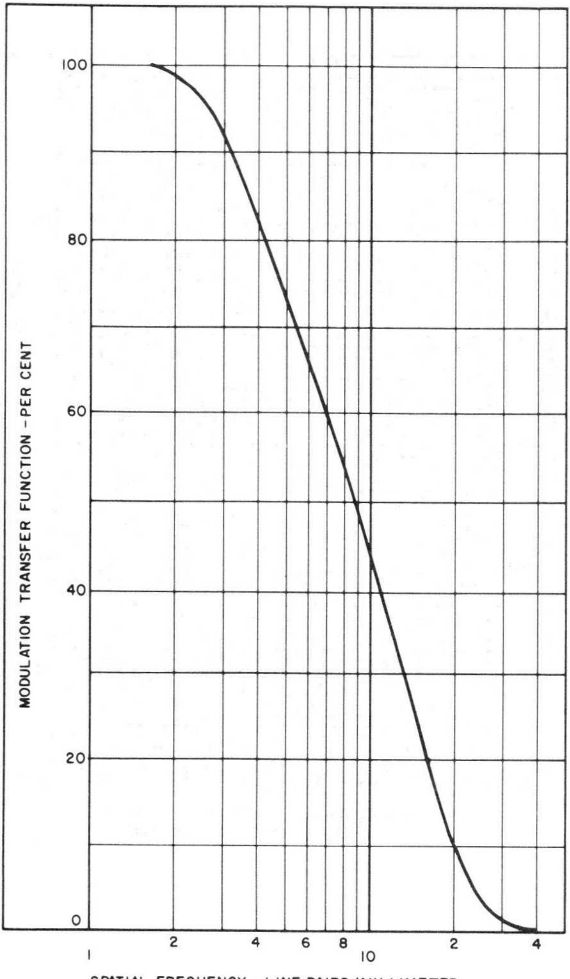
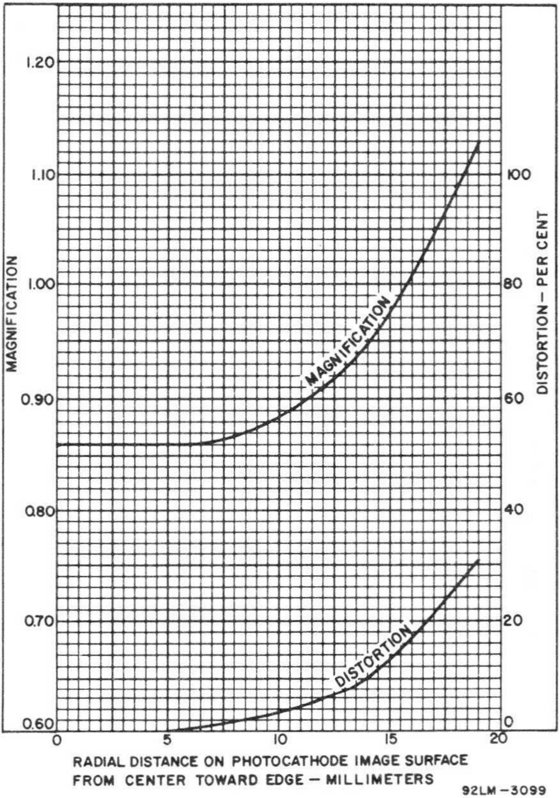


Figure 4

TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS



Photomultiplier Tube

1-1/8" Diameter, Side-On Type Having Bialkali Photocathode

Spectral Response . . . . . . See accompanying *Typical Photocathode Spectral Response Characteristics*

Wavelength of Maximum Response . . . . 400 ± 50 nm
Cathode, Opaque . . . . Potassium-Cesium-Antimony (Bialkali)
Window . . . . Corning No.0080, or equivalent
Dynodes:
 Substrate . . . . Nickel
 Secondary-emitting surface . . . . Cesium-Antimony
 Structure . . . . Circular-Cage, Electrostatic-Focus Type
Direct Interelectrode Capacitances:
 Anode to dynode No.9 . . . . 4.4 pF
 Anode to all other electrodes . . . . 6.0 pF
Socket . . . . Cinch-Jones No.12CS-M, or equivalent
Magnetic Shield . . . . See footnote a

Maximum Ratings, Absolute-Maximum Values:

DC Supply Voltage:		
Between anode and cathode	1250 max.	V
Between anode and dynode No.9	250 max.	V
Between consecutive dynodes	250 max.	V
Between dynode No.1 and cathode	250 max.	V
Average Anode Current (30 seconds max. averaging time)	0.5 max.	mA
Ambient-Temperature Range	−80 to +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, at 400 nanometers	–	1.7×10^5	–	A/W
Voltage required to provide an anode current of 100 μA[b]	250	–	500	V

Cathode Sensitivity:				
Radiant, at 400 nanometers	—	0.054	—	A/W
With blue light source[c] (2870° K + UG-5 and BG-12) (See Figure 2) . .	3.0×10^{-6}	4.5×10^{-6}	—	A/incident lm
Quantum Efficiency at 400 nanometers	—	17	—	%
Current Amplification . .	—	3×10^{6}	—	
Anode Dark Current, at 800 V	—	8×10^{-10}	1×10^{-8}	A

a Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Avenue, Chicago, IL, 60622, or equivalent.

b Under the following conditions: Light incident on the cathode is transmitted through a blue filter combination (Jena UG-5 and Jena BG-12, manufactured by Jenaer Glaswerk, Schott & Gen, Mainz, West Germany) from a tungsten-filament lamp operated at a color temperature of 2870° K. This filter combination is interposed between a 0.172" x 0.700" aperture and the tube entrance window. The light input incident on the filter combination is 1×10^{-2} lumen. The tube is rotated about its major axis to obtain maximum output current.

c Under the same conditions as footnote (b) except 60 volts are applied between cathode and all other electrodes connected as anode.

When the ratio of peak anode current to average anode current is high, non-inductive capacitors should be employed across the latter stages of the tube. The values of these capacitors should be chosen so that sufficient charge is available to prevent a change of more than a few per cent in interstage voltages throughout the pulse duration. The capacitor values across the dynode stages will depend upon the shape and the amplitude of the anode current pulse, and the time duration of the pulse, or train of pulses. When the output pulse is assumed to be rectangular in shape, the following formula applies:

$$C = 100\,\frac{i\cdot t}{V}$$

where C is in farads

i is the amplitude of anode current in amperes

V is the voltage across the capacitor in volts

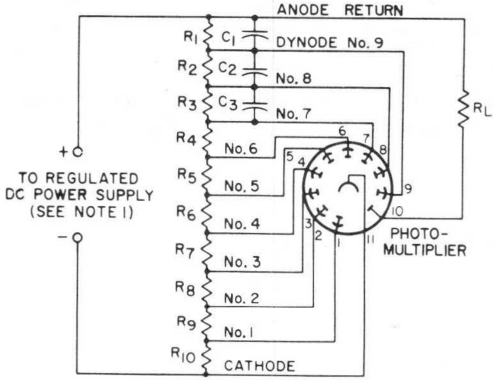
and t is the time duration of the pulse in seconds

This formula applies for the anode-to-final dynode capacitor. The factor 100 is used to limit the voltage change across the capacitor to 1% maximum during a pulse. Capacitor values for preceding stages should take into account the smaller values of dynode currents in these stages. Conservatively, a factor of approximately 2 per stage is used. Capacitors are not required across those dynode stages where the dynode current is less than 1/10 of the current through the voltage-divider network.

For other shaped pulses or for a train of pulses, the total charge q should be substituted for (i·t) and the following formula applies:

$$C = 100\frac{q}{V} \qquad \text{where } q = \int i(t)\,dt \text{ coulombs}$$

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



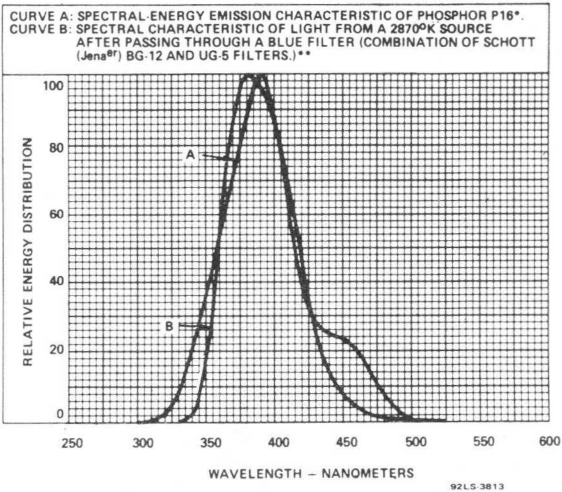
92CS-11382R2

R_1 through R_{10} – 5000 to 1,000,000 ohms

Note: To assure a high degree of linearity, the values of the resistors making up the voltage-divider network should be such that the current through the network, for the selected operating supply voltage, is at least 10 times greater than the maximum average anode current required.

Note: Capacitors C_1 through C_3 should be connected at the tube socket for optimum high-frequency performance. Leads to all capacitors should be as short as possible to minimize inductance effects.

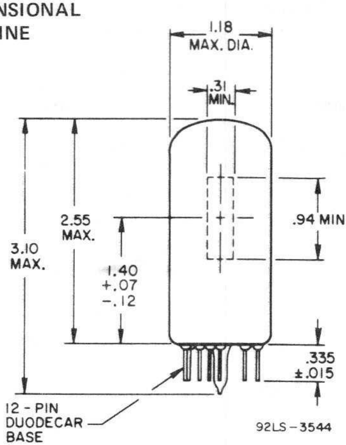
TYPICAL P16 SPECTRAL DISTRIBUTION CHARACTERISTIC AND THE SPECTRAL CHARACTERISTIC OF LIGHT FROM A 2870° K SOURCE AFTER PASSING THROUGH INDICATED FILTERS.



* JEDEC Publication 16A, January 1966.

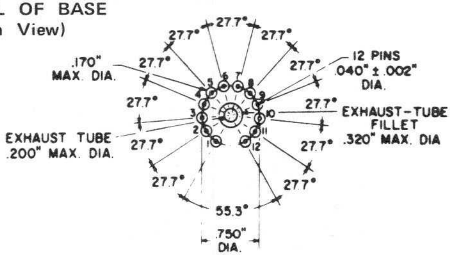
** Curve B is the product of the transmission characteristics of a combination of a BG-12 filter (1 mm thick) and a UG-5 filter (1mm thick) and the emission characteristics of a 2870° K tungsten-filament lamp. The filters are not in optical contact. The transmission characteristics of the filter combination include reflection losses at the air-glass interfaces. Some transmission occurs above 700 nanometers but is not indicated because it is beyond the spectral sensitivity range of the 4555. Information is obtained from "Color Glass Filters", Jena^{er} Glaswerk, Schott & Gen, 200 Park Avenue, NY 10017.

DIMENSIONAL OUTLINE

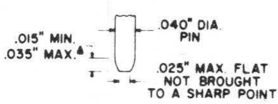


DIMENSIONS IN INCHES

DETAIL OF BASE
(Bottom View)

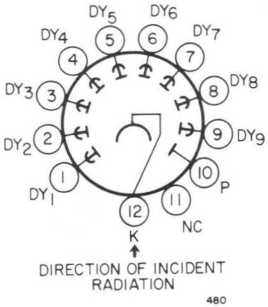


Duodecar-Base-Pin Contour



Base-pin positions are held to tolerances such that entire length of pins will, without undue force, pass into and disengage from flat-plate gauge having a thickness of 0.250" and thirteen holes with diameters of 0.0520" ± 0.0005" so located on a 0.7500" ± 0.0005" diameter circle that the distance along the chord between any two adjacent hole centers is 0.1795" ± 0.0005". Gauge is also provided with a hole 0.375" + 0.005" − 0.000" diameter concentric with the pin circle.

TERMINAL DIAGRAM (Bottom View)

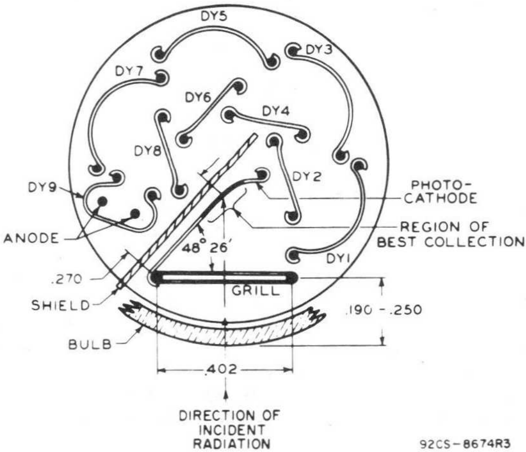


Pin 1—	Dynode No.1
Pin 2—	Dynode No.2
Pin 3—	Dynode No.3
Pin 4—	Dynode No.4
Pin 5—	Dynode No.5
Pin 6—	Dynode No.6
Pin 7—	Dynode No.7
Pin 8—	Dynode No.8
Pin 9—	Dynode No.9
Pin 10—	Anode
Pin 11—	No Internal Connection*
Pin 12—	Photocathode

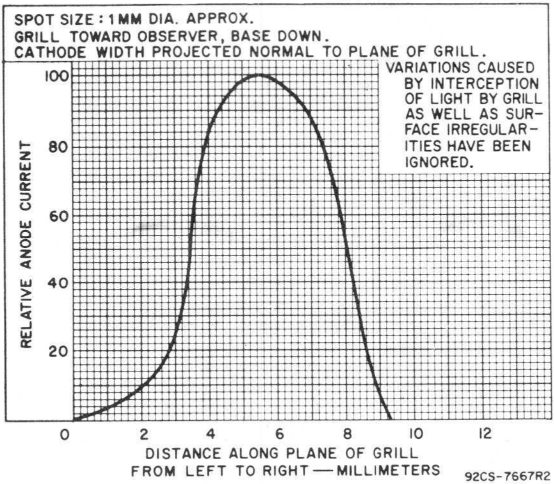
Note: The tube should be rotated about its major axis to provide maximum anode current.

* The socket terminal for Pin 11 may be used as a tie point for the voltage-divider resistor from dynode No.9 to the positive dc supply voltage and the load resistor from the anode to the positive dc supply voltage.

SCHEMATIC REPRESENTATION OF TUBE STRUCTURE



TYPICAL VARIATION OF PHOTOCATHODE SENSIVITY ACROSS PROJECTED WIDTH IN PLANE OF GRILL



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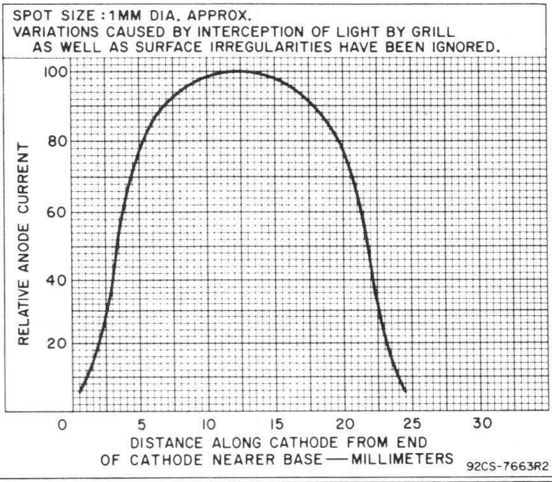
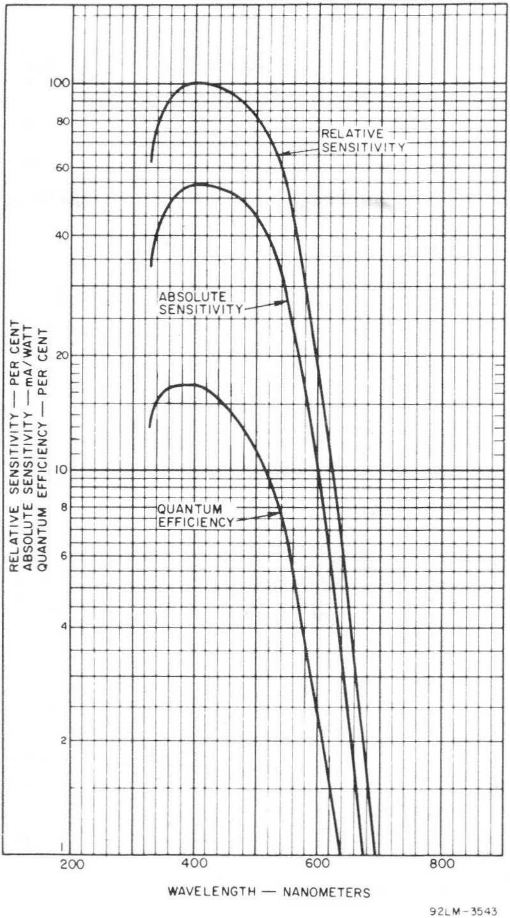
TYPICAL VARIATION OF PHOTOCATHODE SENSIVITY ALONG TUBE LENGTH

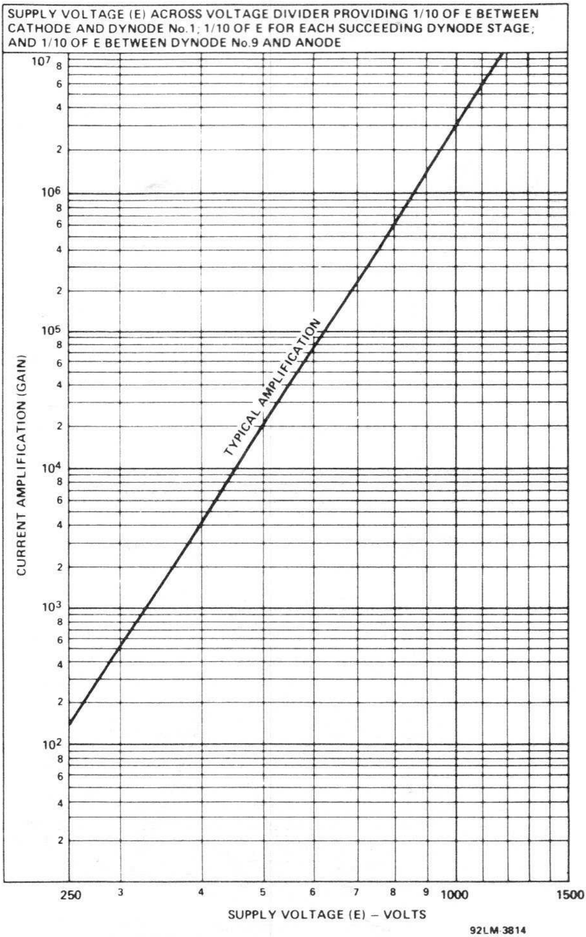


92CS-7663R2

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

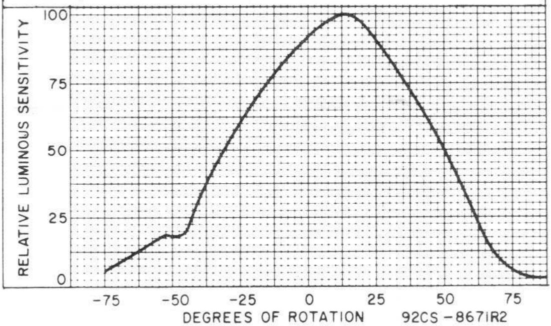


TYPICAL CURRENT AMPLIFICATION CHARACTERISTIC



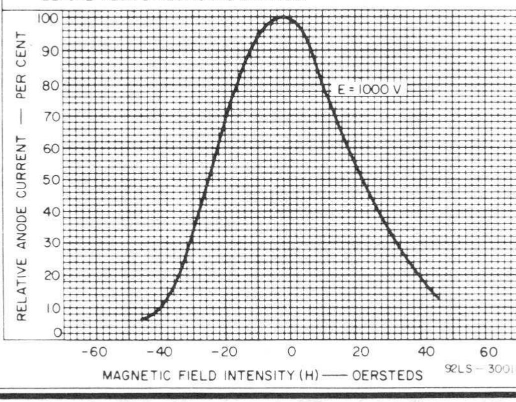
TYPICAL VARIATION OF SENSITIVITY AS TUBE IS ROTATED WITH RESPECT TO FIXED LIGHT BEAM

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE = CONSTANT
ZERO-DEGREE ROTATIONAL POSITION OF TUBE IS ESTABLISHED BY A COLLIMATED LIGHT BEAM PERPENDICULAR TO AND FILLING THE PLANE OF THE GRILL.
TUBE MOUNTED VERTICALLY WITH ALLOWANCE MADE FOR ROTATION ABOUT MAJOR TUBE AXIS.
ROTATIONAL POSITION (TOP VIEW) CLOCKWISE = (−)
ROTATIONAL POSITION (TOP VIEW) COUNTERCLOCKWISE = (+)



TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

SUPPLY VOLTAGE (E) ACROSS 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.
PHOTOCATHODE IS FULLY ILLUMINATED.
UNIFORM MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.
POSITIVE VALUES OF MAGNETIC FLUX ARE FOR LINES OF FORCE TOWARD TUBE BASE.
TUBE IS DEGAUSSED PRIOR TO TEST AND IS AGAIN DEGAUSSED BEFORE FLUX DIRECTION IS CHANGED.



Vidicon

Variant of Type 8507A Having a Fiber-Optic Faceplate

ELECTRICAL

Heater Voltage	6.3 ± 10% V
Heater Current at 6.3 Volts, ac or dc	0.6 nominal A
Focusing Method	Magnetic
Deflection Method	Magnetic
Direct Interelectrode Capacitance:[a]	
Target to all other electrodes	4.6 pF

OPTICAL

Faceplate (Image Surface) Material	Dark-Clad Fiber-Optics
Flatness	Within 0.5 μm
Pitch (Center-to-center spacing)	5.5 ± 1.0 μm
Maximum tilt	2 minutes of arc
Spectral Response	RCA Type II, See accompanying *Typical Spectral Sensitivity Characteristics*
Photoconductor	Antimony Trisulfide

PHOTOCONDUCTIVE LAYER

Maximum useful diagonal of image	0.625 in (16 mm)

Orientation of quality rectangle – Proper orientation is obtained when the horizontal scan is essentially parallel to the plane passing through the tube axis and short index pin.

MECHANICAL

Overall Length	6.250 ± 0.125 in (158.75 ± 3.19 mm)
Greatest Diameter	1.210 ± 0.010 in (30.73 ± 0.25 mm)
Bulb Diameter	1.025 ± 0.003 in (26.04 ± 0.08 mm)
Base	Small-Button Ditetrar 8-Pin (JEDEC No.E8-11)
Socket	Cinch[b] No.8VT (133-98-11-015), or equivalent
Deflecting Yoke – Focusing Coil – Alignment Coil – Assembly	Cleveland Electronics[c,d] No.VYFA-355-2, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz

MAXIMUM AND MINIMUM RATINGS *Absolute-Maximum Values*

For scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm)

	Min.	Max.	
Grid-No.4 Voltage[f]	–	1000	V

Grid-No.4 and Grid-No.3 Voltage Difference	–	600	V
Grid-No.3 Voltage[f]	–	1000	V
Grid-No.2 Voltage	–	350	V
Grid-No.2 Power Dissipation	–	1	W
Grid-No.1 Voltage	-150	0	V
Heater-Cathode Voltage	-125	10	V
Target Voltage	–	100	V
Dark Current	–	0.25	μA
Peak Target Current[g]	–	0.75	μA
Faceplate:			
Illumination[h]	–	5000	lm/ft²
	–	50000	lux
Temperature:			
Operating and storage	–	71	°C

TYPICAL OPERATION

With tube operated in a Cleveland Electronics Assembly Type VYFA-355-2, scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm), faceplate temperature of 30 to 35° C, and standard CCIR "M", or EIA, TV scanning rate (525 lines, interlaced 2:1, frame time 1/30 second)

	Low-Voltage Mode	High-Voltage Mode	
Grid-No.4 (Decelerator) Voltage[f]	500	900	V
Grid-No.3[f] (Beam-Focus Electrode) Voltage	300	540	V
Grid-No.2 (Accelerator) Voltage	300	300	V
Peak-to-Peak Blanking Voltage:			
When applied to grid-No.1	75	75	V
When applied to cathode	20	20	V
Field Strength at Center of Focusing Coil[j]	40 ± 4	58 ± 4	G
Peak-to-Peak Deflecting-Coil Current:			
Horizontal	350	480	mA
Vertical	20	28	mA
Field Strength of Adjustable Alignment Coil[k]	0 to 4	0 to 4	G

TYPICAL PERFORMANCE DATA

Under the conditions shown under Typical Operation

Grid-No.1 Voltage for Picture Cutoff[m]	-65 to -100	-65 to -100	V
Average "Gamma' of Transfer Characteristic for a Signal-Output Current Between 20 nA and 200 nA	0.65	0.65	
Lag – Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed[n]	20	20	%
Limiting Resolution:			
At center of picture	1000	1100	TV Lines
At corner of picture	600	700	TV Lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture[p]	45	55	%

High-Sensitivity Operation

Conditions

Faceplate Illumination (Highlight)	0.1	lm/ft^2 (fc)
Dark Current[q]	0.10	μA

Performance

Target Voltage[r,s]	30 to 60	V
Typical Signal-Output Current:[t]		
For collimated light[u]	0.08	μA

Average-Sensitivity Operation

Conditions

Faceplate Illumination (Highlight)	1.0	lm/ft^2 (fc)
Dark Current[q]	0.02	μA

Performance

Target Voltage[r,s]	20 to 40	V
Typical Signal-Output Current:[t]		
For collimated light[u]	0.16	μA
For diffused light[u]	0.11	μA

a This capacitance, which effectively is the output impedance of the 4589, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

b Made by Cinch Manufacturing Company, 1501 Morse Avenue, Elk Grove,Village, IL 60007.

c Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

d These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

f Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. When the 4589 is positioned within the magnetic assembly, the recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

g Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

h For conditions where "white light" is uniformly diffused over entire tube face.

j The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

k The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

m With no blanking voltage on grid No.1.

n For an initial signal-output current of 300 nanoamperes and a dark current of 20 nanoamperes. Lag will increase with a decrease in initial signal current and/or an increase in dark current.

p Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

q The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

r The target voltage for each 4589 must be adjusted to that value which gives the desired operating dark current.

s Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

t Defined as the component of the highlight target current after the dark-current component has been subtracted.

u Fiber-optic faceplates have the following transmission values:

	Min.	Typical
To collimated light	68%	80%
To diffused light*	50%	55%

*Representative of light output from a phosphor screen fiber-optically coupled.

SPURIOUS SIGNAL TEST

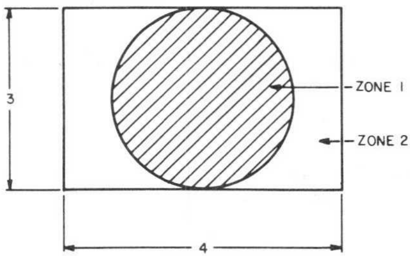


Figure 1

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in **Figure 1.** To be counted as a spot, the spurious signal amplitude must be greater than 10% of a peak white signal of 300 nanoamperes under either highlight or capped conditions, and lines or streaks must be greater than 5%. Lines or streaks having an area not exceeding that of a 6-TV line round spot are counted as spots and are subject to the spot criteria shown below. Grainy or mottled background having a spurious signal amplitude greater than 3% of the peak white signal (300 nA) and block lines and multifiber shading signal amplitudes greater than 5% constitute reject items.

TABLE 1

For scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm)

Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 6	0	0
6 but not including 4	0	2
4 but not including 2	6	6
2 but not including 1	25	25
1 or less	*	*

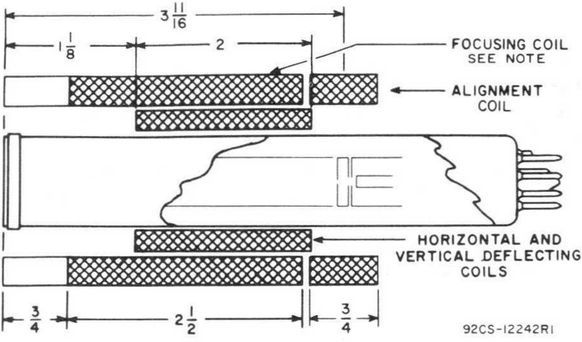
Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.

Fiber-Optic Distortion Errors are normally negligible. In exceptional cases, a typical distortion of 2 TV lines may occur.

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

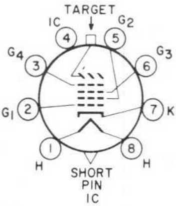
To obtain minimum beam-landing error.



Note: Cross-hatching indicates wound portion of focusing coil.

TERMINAL DIAGRAM (Bottom View)

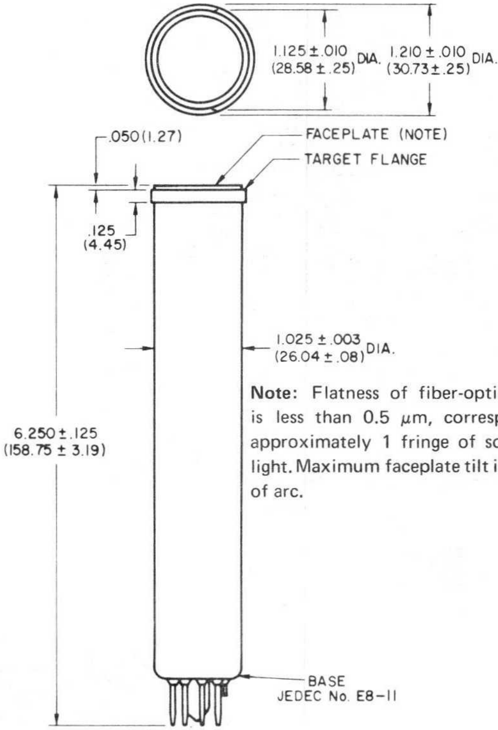
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode



Pin 8: Heater
Flange : Target
Short Index Pin – Internal Connection –
Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

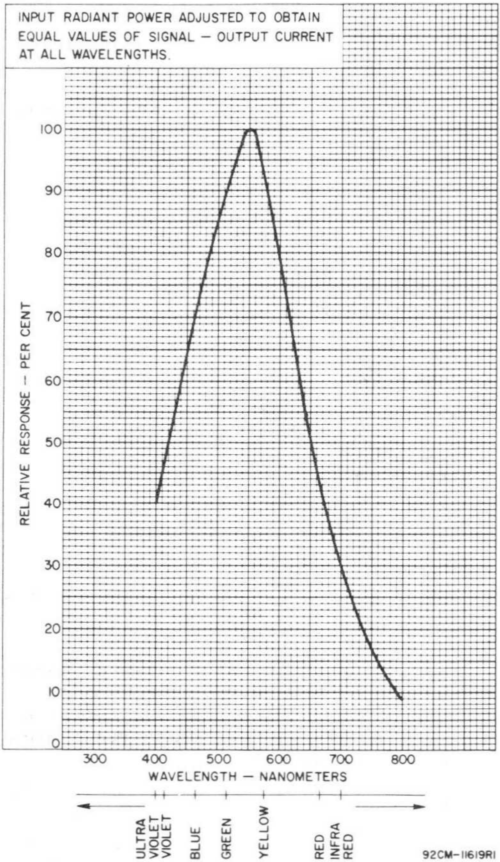
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



Note: Flatness of fiber-optic faceplate is less than 0.5 μm, corresponding to approximately 1 fringe of sodium "D" light. Maximum faceplate tilt is 2 minutes of arc.

92LS-3549

TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC



Photomultiplier Tube

3/4"-Diameter, 12-Stage Type Having S-11 Spectral Response and Copper-Beryllium Dynodes

- Typical Current Amplification: 4×10^6
- Typical Quantum Efficiency: 17% at 440 nm
- Tube Size: 0.78" Max. Diameter, 3.8" Max. Length
- Flat Faceplate for Mounting Scintillators

General Data

Spectral Response	See Figure 1
Wavelength of Maximum Response	440 ± 50 nm
Cathode, Semitransparent	Cesium-Antimony
Minimum projected area	0.2 in^2 (1.26 cm^2)
Minimum diameter	0.5 in (1.27 cm)
Window	Borosilicate Glass (Corning[a] No.7056), or equivalent
Shape	Plano-Concave
Index of refraction at 436 nanometers	1.523
Dynodes:	
Substrate	Copper-Beryllium
Secondary-emitting surface	Beryllium-Oxide
Structure	In-Line, Electrostatic-Focus Type
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.12	2.4 pF
Anode to all other electrodes	3.2 pF
Maximum Overall Length (Excluding Semiflexible Leads)	3.8 in (96.5 mm)
Maximum Diameter	0.78 in (19.8 mm)
Base (Temporary)	Small-Shell Bidecal 20-Pin (JEDEC No.B20-102)
Socket	Cinch[b] No.20-PM, or equivalent
Magnetic Shield	Perfection Mica[c] No.10P40, or equivalent
Operating Position	Any
Weight (Approx.):	
With temporary base removed	1 oz

Maximum Ratings, Absolute-Maximum Values[d]

DC Supply Voltage:

Between anode and cathode	2000	max.	V
Between anode and dynode No.12	300	max.	V
Between adjacent dynodes	200	max.	V
Between dynode No.1 and cathode	400	max.	V
Average Anode Current[e]	0.5	max.	mA
Ambient Temperature[f]	75	max.	^oC

Characteristics Range Values for Equipment Design

Under conditions with a DC supply voltage (E) across a voltage divider providing the electrode voltages as shown in Table I and at an ambient temperature of 22^o C, except as noted.

With E = 1500 volts (except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g] at 440 nanometers	–	2.4×10^5	–	A/W
Luminous[h] (2854^o K)	100	300	3500	A/lm
Cathode Sensitivity:				
Radiant[j] at 440 nanometers	–	6×10^{-2}	–	A/W
Luminous[k] (2854^o K)	5×10^{-5}	7.5×10^{-5}	–	A/lm
Blue response[m] (2854^o K + C.S. No.5-58, 1/2 stock thickness)	5×10^{-6}	7.5×10^{-6}	–	A/incident lm
Quantum efficiency at 440 nanometers	–	17	–	%
Current Amplification	–	4×10^6	–	
Anode Dark Current[n] at 200 A/lm	–	5×10^{-8}	5×10^{-7}	A
Equivalent Anode Dark Current Input[n] at 200 A/lm	–	2.5×10^{-10}	2.5×10^{-9}	lm
	–	3.1×10^{-13}[p]	3.1×10^{-12}[p]	W

Table I

Typical Potential Distribution

Between:	7.1% of Supply Voltage (E) Multiplied by:
Cathode to Dynode No.1	1.2
Dynode No.1 to Dynode No.2	1.2
Dynode No.2 to Dynode No.3	1.7
Dynode No.3 to Dynode No.4	1.0
Dynode No.4 to Dynode No.5	1.0
Dynode No.5 to Dynode No.6	1.0
Dynode No.6 to Dynode No.7	1.0
Dynode No.7 to Dynode No.8	1.0
Dynode No.8 to Dynode No.9	1.0
Dynode No.9 to Dynode No.10	1.0
Dynode No.10 to Dynode No.11	1.0
Dynode No.11 to Dynode No.12	1.0
Dynode No.12 to Anode	1.0
Anode to Cathode	14.1

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

b Made by Cinch Manufacturing Company, 1501 Morse Avenue, Elk Grove Village, IL 60007.

c Made by Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Avenue, Chicago 22, IL 60622.

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 Tube operation at room temperature or below is recommended.

g This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 803 lumens per watt.

h 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.

j This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 803 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 2854° 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 2854° 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 With supply voltage adjusted to give a luminous sensitivity of 200 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

p At 440 nanometers. These values are calculated from the EADCI values in lumens using a conversion factor of 803 lumens per watt.

Operating Considerations

Shielding

Electrostatic shielding of the tube is ordinarily required. When a shield is used, it must be connected to the cathode terminal. The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding the tube at the photocathode end should not be permitted unless such materials are chosen to limit leakage current to the tube envelope to 1×10^{-12} ampere or less.

In addition to increasing dark current and noise output because of voltage gradients developed across the bulb wall, such high voltage may produce minute leakage current to the cathode, through the tube envelope and insulating materials, which can permanently damage the tube.

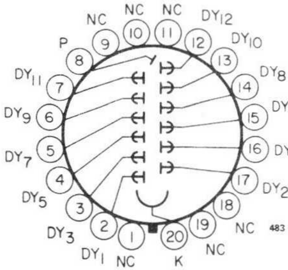
Ambient Atmosphere

Operation or storage of this tube in environments where helium is present should be avoided. Helium may permeate the tube envelope and may lead to eventual tube destruction.

Lead Connections

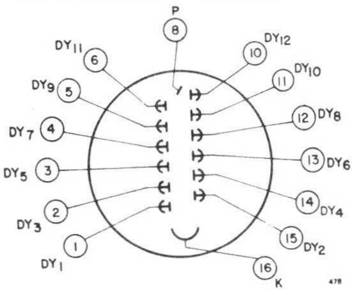
The semiflexible leads of the tube may be soldered or welded into the associated circuit. Care must be exercised when making such connections to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the protective shell is recommended. Excessive bending of the leads is to be avoided.

Basing Diagram – Bottom View (With Temporary Base)



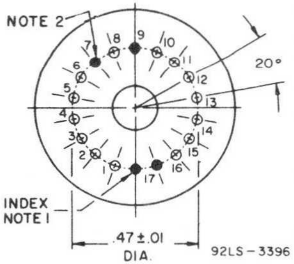
Pin 1: No Connection
Pin 2: Dynode No. 1
Pin 3: Dynode No. 3
Pin 4: Dynode No. 5
Pin 5: Dynode No. 7
Pin 6: Dynode No. 9
Pin 7: Dynode No.11
Pin 8: Anode
Pin 9: No Connection
Pin 10: No Connection
Pin 11: No Connection
Pin 12: Dynode No.12
Pin 13: Dynode No.10
Pin 14: Dynode No. 8
Pin 15: Dynode No. 6
Pin 16: Dynode No. 4
Pin 17: Dynode No. 2
Pin 18: No Connection
Pin 19: No Connection
Pin 20: Photocathode

Lead Connections – Bottom View (With Base Removed)



Lead 1: Dynode No. 1
Lead 2: Dynode No. 3
Lead 3: Dynode No. 5
Lead 4: Dynode No. 7
Lead 5: Dynode No. 9
Lead 6: Dynode No.11
Lead 8: Anode
Lead 10: Dynode No.12
Lead 11: Dynode No.10
Lead 12: Dynode No. 8
Lead 13: Dynode No. 6
Lead 14: Dynode No. 4
Lead 15: Dynode No. 2
Lead 16: Photocathode

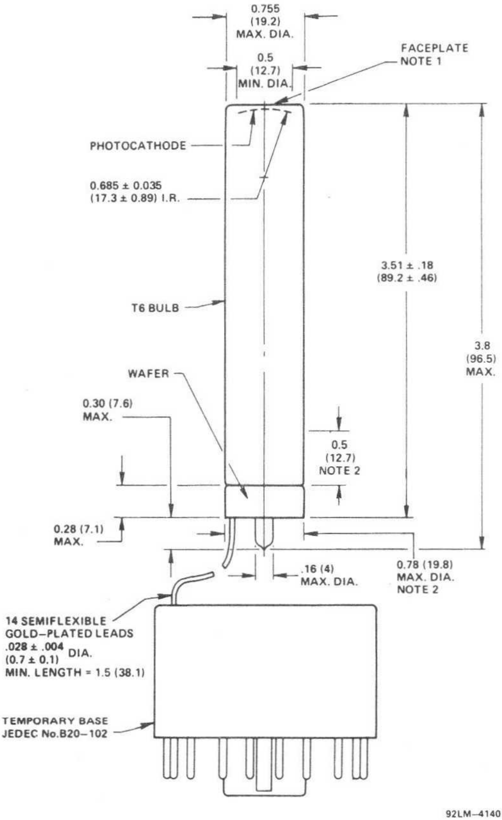
Lead Orientation, Bottom View



Note 1 – Lead is cut off within 0.12" of glass button for indexing.

Note 2 – Lead Nos.7,9, and 17 are cut off within 0.12" of the glass button.

Dimensional Outline



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).

Note 1 – Deviation from flatness will not exceed 0.006" from peak to valley.

Note 2 – Within this length, maximum diameter of tube is 0.78".

Typical Photocathode Spectral Response Characteristics

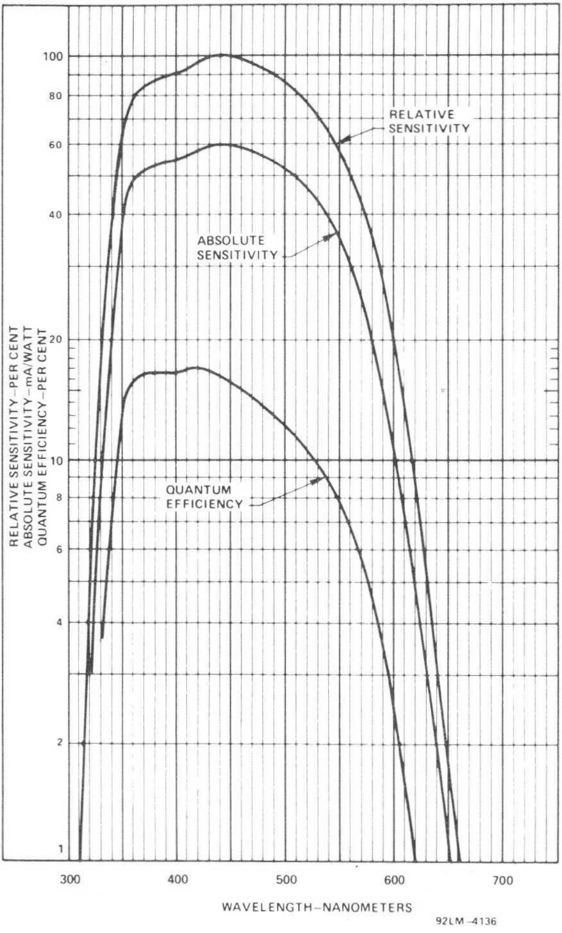


Figure 1

Sensitivity and Current Amplification Characteristics

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:	
BETWEEN	7.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	1.2
DYNODE No.1 AND DYNODE No.2	1.2
DYNODE No.2 AND DYNODE No.3	1.7
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.1

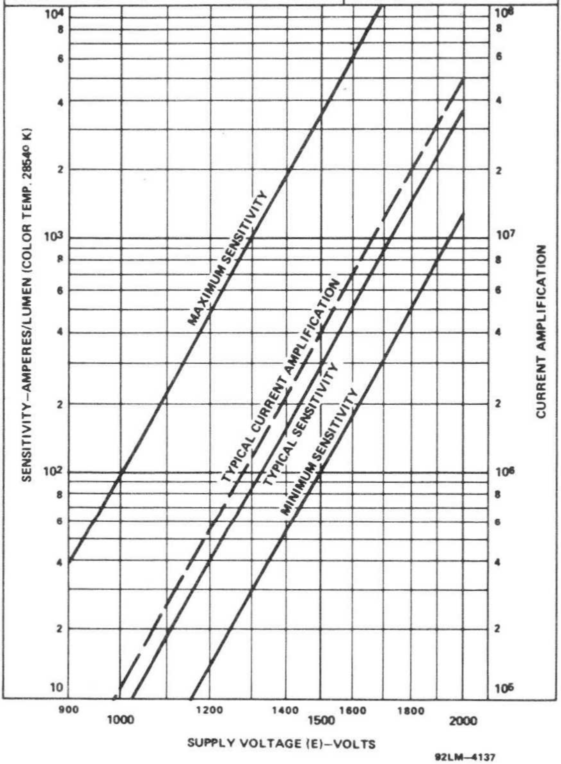


Figure 2

Typical EADCI and Anode Dark Current Characteristics

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	7.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	1.2
DYNODE No.1 AND DYNODE No.2	1.2
DYNODE No.2 AND DYNODE No.3	1.7
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.1

TUBE TEMPERATURE IS 22° C

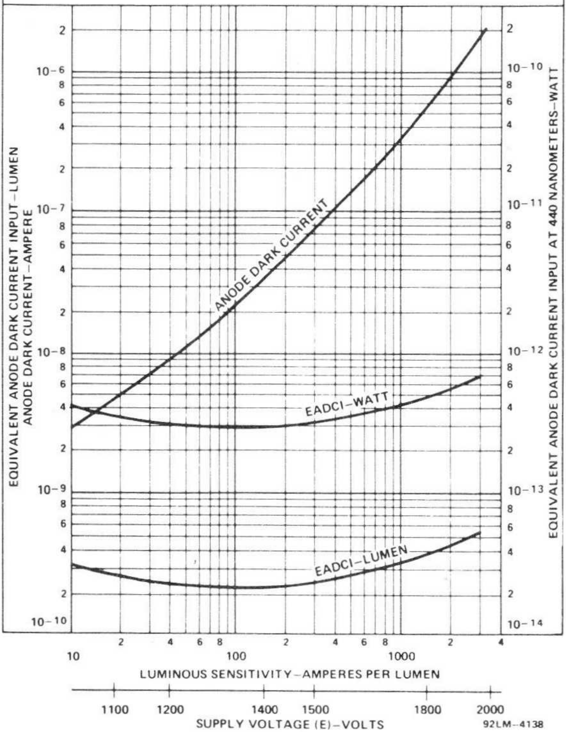
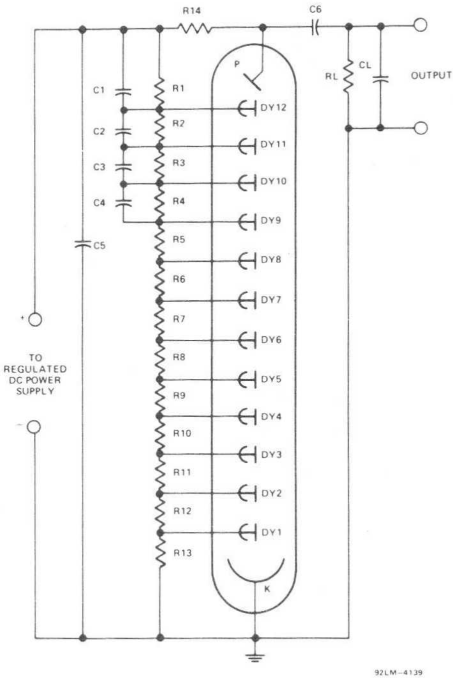


Figure 3

Typical Circuit Arrangement for Scintillation Counting Applications



C_1: 0.05, 500 VDC, Ceramic Disc
C_2: 0.02, 500 VDC, Ceramic Disc
C_3: 0.01, 500 VDC, Ceramic Disc
C_4: 0.005, 500 VDC, Ceramic Disc
C_5, C_6: 0.005, 2500 VDC, Ceramic Disc

R_1 through R_{10}: 270 kΩ±5%, 1/2 W
R_{11}: 470 kΩ±5%, 1/2 W
R_{12}, R_{13}: 330 kΩ±5%, 1/2 W
R_{14}: 1 MΩ±5%, 1/2 W

Note 1 – The value of the load elements R_L and C_L, depend on the application. $R_L \times C_L$ = 10 microseconds for most applications.

Note 2 – Tolerance of all capacitors is ± 20%.

Figure 4

SIT Camera Tubes

Silicon-Intensifier Target (SIT), 16-Millimeter Fiber-Optic Faceplate Types

- **Very High Sensitivity**
- **Sturdy Compact Structure**
- **Excellent Discharge Capability**
- **Low Lag**
- **High Resolution**
- **Low-Power 0.6 Watt Dark Heater**

The 4804A is similar to the 4804, except that the spurious signal (spot) rejection of the 4804A is more stringent than that of the 4804 and where indicated otherwise. The 4804A/P2 and 4804/P2 are potted versions of the 4804A and 4804, respectively.

General Data

The majority of these data apply to both potted and non-potted versions. Where exceptions exist, the data are labeled appropriately.

Spectral Response S-20

Wavelength of Maximum Response . . . . 420 ± 50 nm

Photocathode:

Material . . . . Na-K-Cs-Sb (Multialkali)

Maximum useful diagonal of rectangular image . . . . 16 mm (0.625 in)

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the plane passing through the tube axis and the short index pin.

Image Surface:

Shape . . . . Flat, Circular

Material . . . . Dark-clad Fiber Optics

Pitch (Nominal center-to-center spacing) . . . . 6 μm

Direct Interelectrode Capacitance (Approx.):

Target to all other electrodes . . . . 10 pF

Maximum Overall Length:

Potted . . . . 7.880 in (200 mm)

Non-potted . . . . 7.500 in (190.5 mm)

Maximum Diameter:

Potted . . . . 2.080 in (52.8 mm)

Non-potted . . . (See Figure 11 Note a) 1.515 in (38.5 mm)

Image Section:

Focusing method . . . . Electrostatic

Configuration:

Potted . . . . Diode-connected Triode

Non-potted . . . . Triode

Internal Focus Bleeder (potted only) . . . . . . 1.00 ± 0.10 GΩ

Scanning Section:

Focusing method . . . . Magnetic

Deflection method . . . . Magnetic

Base . . . . Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)

Socket . . . . Cinch[a] No.8VT (133-98-11-015), or equivalent

Deflecting Yoke-Focusing Coil
Alignment Coil Assembly:

Potted . . . . Cleveland Electronics No.SVDA-2037-1 or Penn Tran No.1490-1

Non-Potted . . . . . . Cleveland Electronics,[b] No.SVDA-2037, or Penn Tran[c], No.1490, or equivalent

Operating Position . . . . Any

Approximate Weight:

Potted . . . . 9.3 oz (264 g)

Non-potted . . . . 4.5 oz (127 g)

Maximum Ratings, Absolute-Maximum Values:[d]

	Min.	Max.	
Temperature:			
Operating	−10	60	°C
Non-operating range	−54	71	°C
Image Section:			
Photocathode voltage (negative with respect to anode):			
4804A/P2, 4804A	–	−10,000	V
4804/P2, 4804	–	−9,000	V
DC photocathode current	–	350	nA
Focus Electrode (negative with respect to anode, non-potted):			
4804A	–	−10,000	V
4804	–	−9,000	V
Anode voltage (zero with respect to thermionic cathode)	–	Ground	
Exposure[e]	–	10^4	fc-s

Scanning Section:

Heater-Voltage	6.0	6.6	V
Grid-No.4 Voltage[f]	–	350	V
Grid-No.3 Voltage[f]	–	350	V
Grid-No.2 Voltage	–	350	V
Grid-No.2 Dissipation	–	1	W
Grid-No.1 Voltage	−150	0	V
Heater-Cathode Voltage	−125	10	V
Target Voltage	–	300[g]	V
Peak Target Current	–	750	nA

Typical Operation

With tube operated in a Cleveland Electronics Assembly Type No.SVDA-2037, or equivalent, faceplate image size 1/2" x 3/8" (12.7 mm x 9.53 mm), and standard CCIR "M", or EIA, TV scanning rate (525 lines, interlaced 2:1, frame time 1/30 second)

Temperature	25 to 31	°C
Image Section:		
Photocathode voltage (negative with respect to anode)	−9000 to −2500	V
Focusing-grid voltage (positive with respect to photocathode	1.5 ± 0.5% of photocathode voltage	
Anode voltage (zero with respect to thermionic cathode	Ground	
Scanning Section:		
Heater, for unipotential cathode:		
Current	0.1	A
Nominal voltage for current of 0.1 ampere	6.3	V
Grid-No.4 (Decelerator) Voltage[f]	340	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	300	V
Grid-No.2 (Accelerator) Voltage	300	V
Peak-to-Peak Blanking Voltage:		
When applied to grid No.1	75	V
When applied to cathode	20	V
Target Current	300	nA
Target Voltage[g,h]	8 to 10	V
Focusing-Coil Current[j] (Approx.)	40	mA
Peak-to-Peak Deflecting-Coil Current:		
Horizontal	180	mA
Vertical	20	mA

Field Strength of Each Adjustable Alignment Coil:

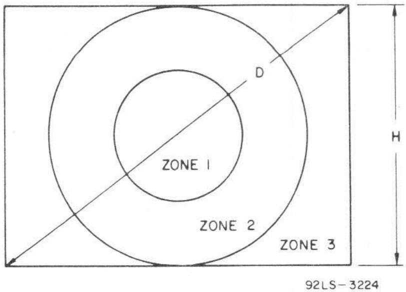
4804A/P2, 4804A	0 to 3	G
4804/P2, 4804	0 to 4	G

Performance Data

Under conditions shown under Typical Operation

	Min.	Typical	Max.	
Grid-No.1 Voltage for Picture Cutoff[k]	−65	−80	−120	V
Gain Ratio for Photocathode Voltage Swing from −9 to −2.5 kV	100	400	–	
Average "Gamma" of Transfer Characteristic for Signal Output Current between 1.0 nA and 700 nA (See **Figure 7**)	–	1	–	
Lag—Per Cent of Initial Signal Output Current 1/20 Second After Illumination is Removed[m] (See **Figure 3**)	–	7	12	%
Contrast Transfer (Amplitude Response) to a 400 TV Line Square-Wave Test Pattern at Center of Picture[n] (See **Figure 2**)				
4804A/P2, 4804A	24	30	–	%
4804/P2, 4804	20	30	–	%
Resolution (See **Figure 6**)	600	700	–	TV Lines
Sensitivity (See **Figure 7**)	250	350	–	μA/lm/ft^2 (μA/fc)
	190,000	270,000	–	μA/lm
Target Current Gain at 9 kV (See **Figure 5**):				
4804A/P2, 4804A	1100	1600	–	
4804/P2, 4804	–	1600	–	
Dark Current for Target Voltage of 8 Volts (See **Figure 4**)	–	7	15	nA
Photocathode Responsivity:				
Luminous (2854° K Tungsten Source)[p]:				
4804A/P2, 4804A	2.6	3.2	–	mA/W-2854° K
4804/P2, 4804	–	3.2	–	
Luminous (See **Figure 8**)				
4804A/P2, 4804A	130	160	–	μA/lm
4804/P2, 4804	–	160	–	μA/lm

Spurious Signal Test



D – Active Target Diameter
H – Raster Height (4 x 3 Aspect Ratio)
Zone 1 – Diameter = H/2, Area ≈ 15%
Zone 2 – Diameter = H, Area ≈ 45%
Zone 3 – Peripheral Area ≈ 40%

Figure 1 – Spurious Signal Test Pattern

This test is performed with the tube viewing a uniformly diffused white test pattern that identifies the three zones shown in **Figure 1**. The tube is operated under the conditions specified under Typical Operating Values and is illuminated to provide a peak highlight signal current of 300 nanoamperes. The tube is adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system.

4804A/P2, 4804A

Allowable spot size for each zone is shown in Table I. To be classified as a spot, the spurious signal amplitude must be at least 10% of the peak white signal under either highlight or capped conditions. Smudges, streaks, or mottled and grainy background must have a spurious signal amplitude of at least 5% to constitute a reject item.

Table I – 4804A/P2, 4804A

Blemish Size (Equivalent Number of Raster Lines)	Zone 1 Allowed Spots	Zone 2 Allowed Spots	Zone3 Allowed Spots
over 8	0	0	0
over 6	1	2	2
over 4	3	7	7
over 1	6	17	22
1 or less	*	*	*

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.

4804/P2, 4804

Allowable spot size for each zone is shown in Table II. To be classified as a spot, the spurious signal amplitude must be at least 10% of the peak white signal under either highlight or capped conditions. Smudges, streaks, or mottled and grainy background (except fiber-optics block lines) must have a spurious signal amplitude of at least 10% to constitute a reject item. Fiber optics block lines under 30% amplitude are not counted.

Table II – 4804/P2, 4804

Blemish Size (Equivalent Number of Raster Lines)	Zone 1 Allowed Spots	Zone 2 Allowed Spots	Zone 3 Allowed Spots
over 12	0	0	0
over 8	0	1	2
over 6	1	3	4
over 4	3	8	9
over 2	11	17	17
2 or less	*	*	*

*Spots of this size are allowed unless concentration causes a smudged appearance.

a Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, IL 60007.

b Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087.

c Made by Penn-Tran Inc., 1155 Zion Road, Bellefonte, PA.

d A description of the Absolute-Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes.

e Excessive faceplate exposure for long periods of time should be prevented whenever possible. For applications covering wide ranges of illumination, suitable combinations of lens stop, light filters and photocathode voltage should be chosen to provide close to typical signal currents.

f Grid-No.4 voltage must always be greater than grid-No.3 voltage. The recommended ratio of grid-No.3 to grid-No.4 voltage is 9/10 to 8/10. The optimum ratio is that ratio providing the most uniform center-to-edge highlight discharge.

g In normal operation, the target voltage should not exceed 15 volts.

h With respect to thermionic cathode.

j The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

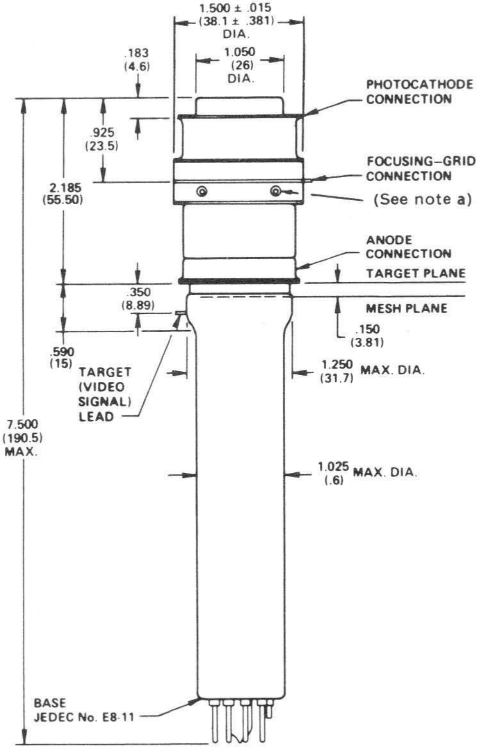
k For picture cutoff with no blanking voltage on grid No.1.

m For an initial signal output current of 300 nanoamperes.

n Measured under the following conditions. Photocathode voltage = 8.0 kV, signal current = 300 nanoamperes, and an RCA P200 slant-burst test pattern is employed.

p The unit, watts-2854^{o} K, is used to designate the total radiated power in watts, integrated over all wavelengths, from a tungsten-filament lamp operated at a color temperature of 2854^{o} K. This unit is directly converted into lumens by the following relationship: 1 watt-2854^{o} K = 20 lumens. From this relationship, sensitivity can be expressed in units of either amperes/lumen or amperes/watt-2854^{o} K.

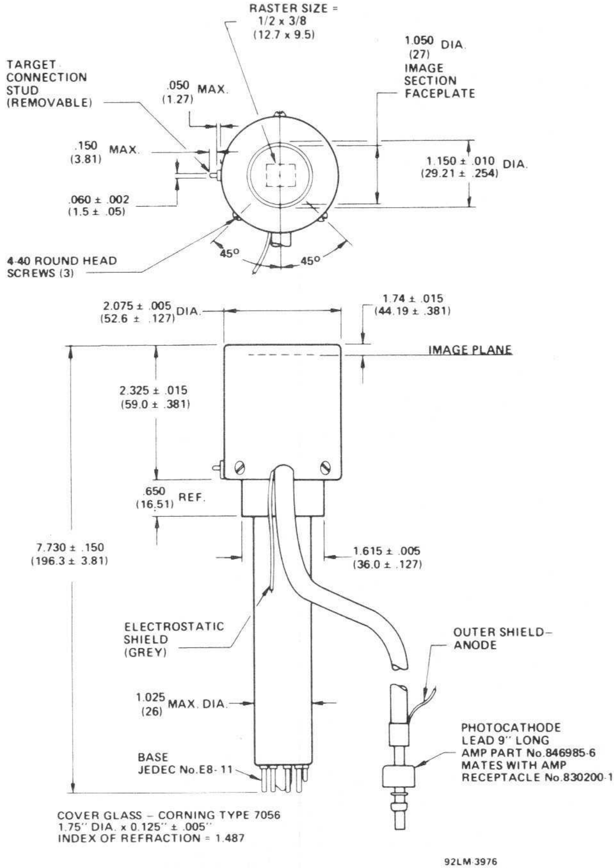
Dimensional Outline of 4804A and 4804 (Non-potted Types)



Note a – Clearance of 1.765 in (44.8) is required to pass all protrusions.

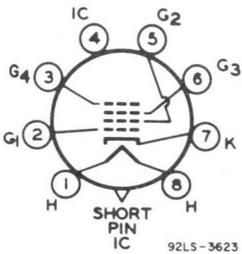
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension. (One inch = 25.4 mm)

Dimensional Outline of 4804A/P2 and 4804/P2 (Potted Types)



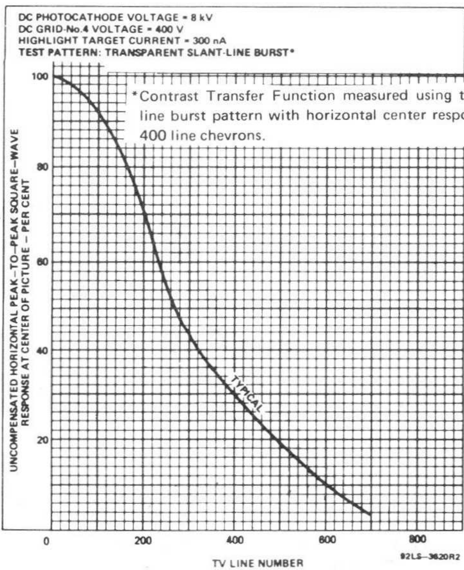
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension. (One inch = 25.4 mm).

Basing Diagram, Bottom View



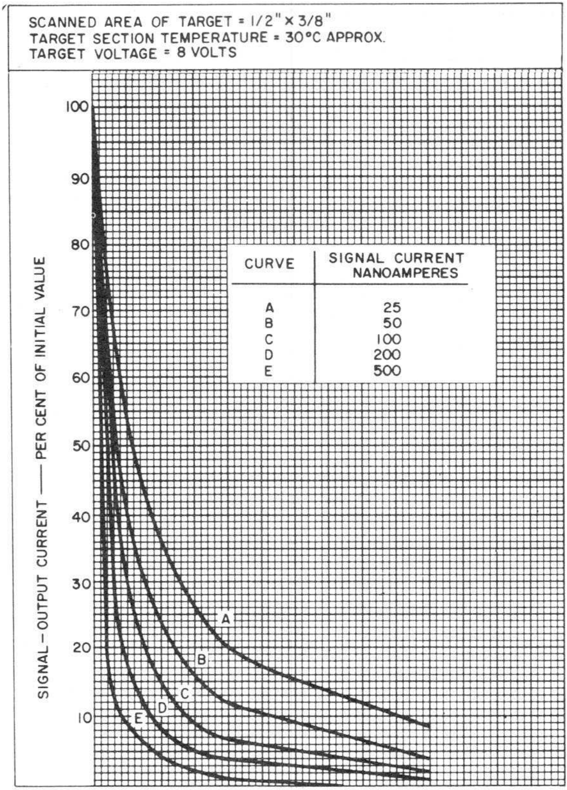
Pin 1— Heater
Pin 2— Grid No.1
Pin 3— Grid No.4
Pin 4— Internal Connection — Do not use
Pin 5— Grid No.2
Pin 6— Grid No.3
Pin 7— Cathode
Pin 8— Heater
Short Index Pin — Internal Connection— Make no connection

Horizontal Square Wave Response (Figure 2)

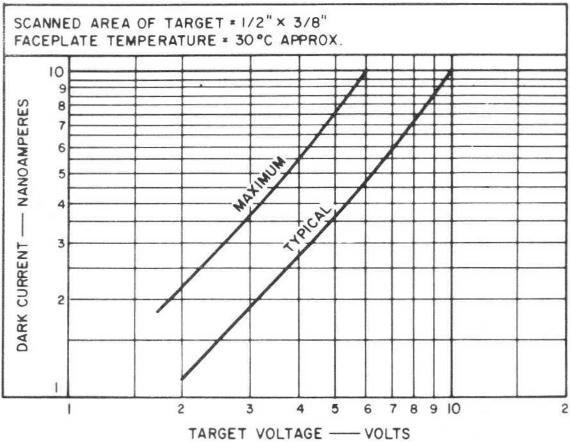


*Contrast Transfer Function measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

Typical Persistence Characteristics (Figure 3)



Dark Current Characteristics (Figure 4)



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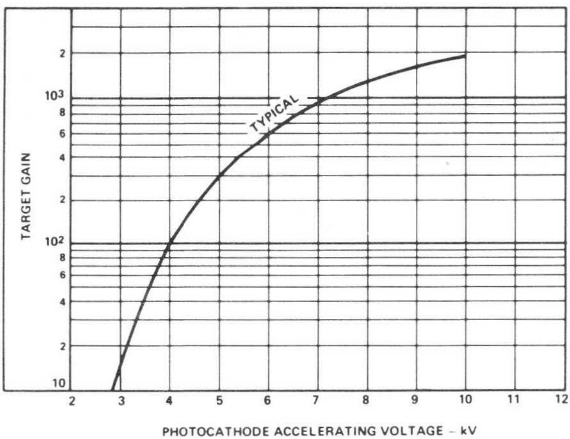
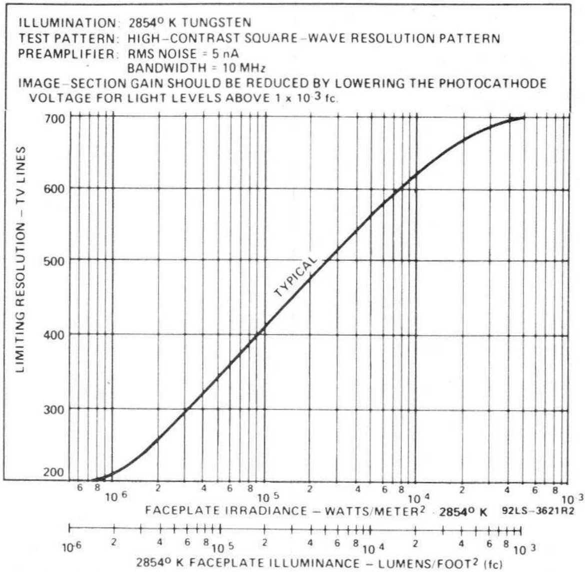
Target Gain Characteristics (Figure 5)

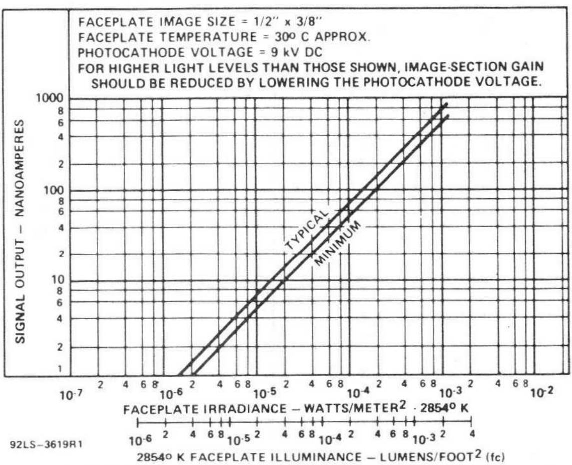


92LS-3641R2

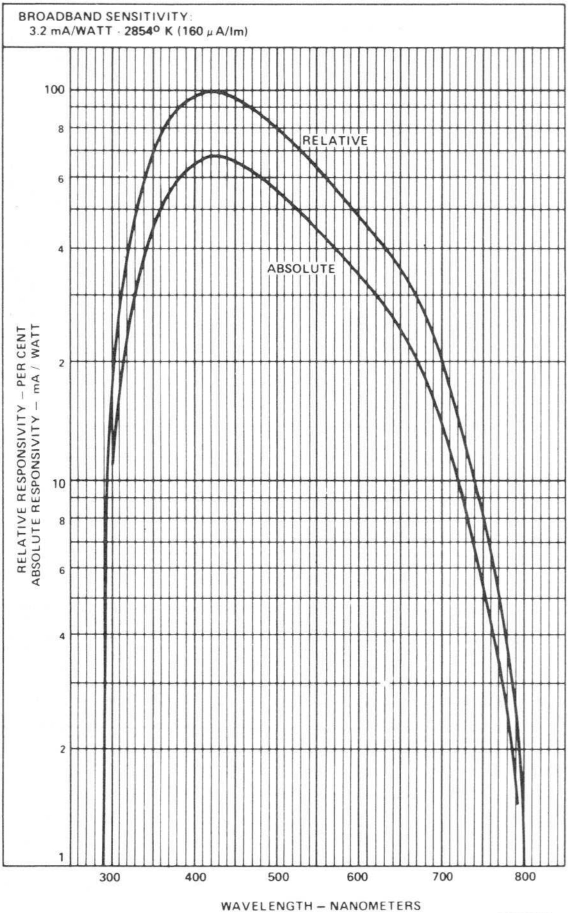
Resolution Characteristics (Figure 6)



Transfer Characteristics (Figure 7)



Typical Photocathode Responsivity (Figure 8)



4807, 4807/V1, 4807A, 4807A/V1

Image Isocon Camera Tubes

For High-Resolution, Real-Time, "Low-Light-Level" TV Systems

For High-Resolution, Real-Time, "Low-Light-Level" TV Systems

- Choice of "Flying Lead" or Permanent Base Types
- Flat Fiber-Optic Faceplate Allowing Excellent Coupling
- Extremely Simple Set-Up Procedure
- No Background Shading
- Single Non-Critical Beam-Current Adjustment
- Very High Signal-to-Noise Ratio
- Extremely High and Uniform Resolution
- Sturdy Target Highly Resistant to Intense Bursts of Light
- Low Lag
- Ruggedized
- Designed for Use With P20 Phosphor-Screen Image Intensifier
- Large Intrascene Dynamic Range Capability
- Especially useful for Coupling With an Image Intensifier
- Types 4807 and 4807A Differ Only in Certain Aspects of Performance Specifications
- Types 4807/V1 and 4807A/V1 Are Permanent Base Versions of Types 4807 and 4807A, Respectively

General Data

Direct Interelectrode Capacitance:

Anode to all other electrodes (output capacitance):

Potted . . . . 24 pF

Non-Potted (including tube base) . . . . 12 pF

Target-to-Mesh Spacing (Nominal) . . . . . . 0.02 in (0.5 mm)

Spectral Response (See **Figure 10**) . . . . . . Modified S-20

Photocathode, Semitransparent:

Material . . . . Na-K-Cs-Sb (Multialkali)

Useful Size of Image:

Maximum target diagonal . . . . 1.4 in (35 mm)

Maximum photocathode diagonal . . . . . . 1.4 in (35 mm)

Note: The size of the optical image focused on the photocathode should be adjusted so its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

Orientation: Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through the center of the faceplate and the index position of the shoulder base. The horizontal and vertical scan should start at the corner of the raster between the unused lead positions 2 and 3 of the shoulder base. See RCA-AJ2206 yoke assembly bulletin for proper tube-yoke orientation.

Image Surface:

Material .... Dark-Clad Fiber-Optics

Pitch (nominal center-to-center spacing) .... 6 μm

Flatness .... Within 0.5 μm

Focusing Method .... Magnetic

Deflection Method .... Magnetic

Shoulder Base .... Annular 3-leads (See Dimensional Outline)

End Base (4807, 4807A) .... Semiflexible leads potted in silicone rubber (See Dimensional Outline)

Element Decoupling .... See Footnote a

Associated Scanning-and Focusing-Coil Assembly .... RCA Type AJ2206, or Equivalent

Operating and Storage Position .... Any

Weight (Approx.) .... 1.5 lbs (680 kg)

Maximum and Minimum Ratings, Absolute-Maximum Values[b]

Voltages are with respect to thermionic cathode unless otherwise specified. All ratings are maximum unless otherwise stated.

Faceplate:

Irradiance[c] .... 25 W/m^2 (watts/square meter)

Illuminance[c] .... { 50 lm/ft^2 (fc) / 500 lm/m^2 (lux) }

Temperature:

Any part of bulb[d] .... 65 °C

Temperature Difference:

Between target section and any part of bulb hotter than target section .... 5 °C

Heater, for Unipotential Thermionic Cathode:

AC or DC current (pin No.1 and pin No.20 or lead No.16 and 17) .... { 0.63 A / 0.57 min. A }

Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode	125 V
Heater positive with respect to cathode	10 V
Photocathode Voltage (E_{pc})	−1000 V
Grid-No.6 Voltage (E_{g6})	−750 V
Target Voltage (E_t):	
Positive value	10 V
Negative value	10 V
Grid-No.5 (Field-Mesh) Voltage[e] (E_{g5})	600 V
Grid-No.4 Voltage (E_{g4})	600 V
Grid-No.3 Voltage (E_{g3})	600 V
Grid-No.2 Voltage (E_{g2})	450 V
Grid-No.1 Voltage (E_{g1})	−150 to −40 V
Steering-Plate Voltages:	
Plate SX_1 (E_{sx1})	600 V
Plate SX_2 (E_{sx2})	600 V
Misalignment-Plate Voltages:	
Plate SY_1 (E_{sy1})	600 V
Plate SY_2 (E_{sy2})	600 V
Anode Voltage (E_b)	1800 V
Voltage Between Adjacent Dynodes[f]	600 V

Typical Operating Values[g]

Regulation of power supply and divider network circuitry should be such that the operating values specified below are held within the limits shown.

Heater Current	±5	%
Focus Coil Current (The values of currents to which this regulation requirement applies are contained in the data sheet describing the magnetic component, e.g., AJ2206	±0.3	%
Grid-No.4 Voltage (As adjusted)	±0.2	%
Other DC Voltages (Fixed or as adjusted)	±1.0	%
Beam Blanking Pulse Voltage	+50	%
	−0	%

Voltages are with respect to thermionic cathodes unless otherwise specified. For circuit design purposes, nominal electrode currents are 10 μA or less, including leakage, except where otherwise noted.

Heater for Unipotential Cathode (Between Pins 1 and 20):			
Current	0.6		A
Voltage (nominal, for current of 0.6 A)	6.3		V
Photocathode Voltage (Image focus)[h]	−900 to −650		V
Grid-No.6 Voltage (Accelerator – approximately 63% of cathode voltage)[j]	−570 to −410		V
Target Voltage[k]	3.5		V
Grid-No.5 (Field-mesh) Voltage[e]	E_{g4} + 12		V
Grid-No.4 Voltage[m]	400 to 440		V
Grid-No.3 Voltage (Max. output)	E_{g4} + 120		V
Grid-No.2 Voltage	400		V
Current	200		μA
Grid-No.1 Voltage for Picture Cutoff	−120 to −60		V
Steering Plate Difference Voltage (Center voltage same value as grid No.4):			
$E_{sx1} - E_{sx2}$	0 to +60	max.	V
Misalignment Plate Difference Voltage (Center voltage same value as grid No.4):			
$E_{sy1} - E_{sy2}$	0 to +60	max.	V
Dynode-No.1 Voltage	375		V
Dynode-No.2 Voltage	700		V
Dynode-No.3 Voltage[n]	750 to 1050		V
Dynode-No.4 Voltage	1350		V
Dynode-No.5 Voltage[p]	1650		V
Anode Voltage	1700		V
Current	25		μA
Target Temperature Range	30 to 50		°C
Beam Blanking Voltage (Applied to grid No.1):			
Peak-to-peak	30		V
Field Strength at Center of Focusing Coil (Approx.)[q]	70		G

Performance Characteristics Range Values

With conditions shown under Typical Operating Values, picture highlights at 2×10^{-3} lm/ft^2 at the photocathode, 525 line scanning, interlaced 2:1, frame time 1/30 second, and 1.4" photocathode diagonal with 4 x 3 aspect ratio.

	Min.	Typ.	Max.	
Photocathode Radiant Responsivity at 440 nanometers	–	60	–	mA/W
Photocathode Luminous Responsivity (2854° K tungsten source)[w]	130	160	–	μA/lm
	2.6	3.2	–	mA/W-2854° K
Signal-Output Current (Peak-to-peak)	3	5	–	μA
Photocathode Illuminance at 2854° K Required to Reach "Knee" of Transfer Characteristic	–	.001	.002	lm/ft^2
Photocathode Irradiance at 440 Nanometers Required to Reach "Knee" of Transfer Characteristic[s]	–	–	5.7×10^{-5}	W/m^2
Signal-To-Noise Ratio:[t]				
Signal to noise-in-signal for highlights:				
4807A, 4807A/V1	26	30	–	dB
4807, 4807/V1	30	32	–	dB
Highlight signal-to-dark current noise	40	46	–	dB
Amplitude Response (Contrast transfer) at 400 TV Lines Per Picture Height (Percent of response to large-area black to large-area white transition)[u]	70	80	–	%
Limiting Resolution:				
At center of picture	1000	1100	–	TV Line
At corner of picture	850	900	–	TV Line
Geometric Distortion	–	1	–	%
Lag-Percent of Initial Signal Output Current 1/20 Second After Illuminance is Removed	–	–	3% at 2×10^{-3}	fc
	–	–	10% at 5×10^{-4}	fc

Shading (Uniformity):[v]				
Black level:				
Variation of output current with tube capped (Percent of maximum highlight signal):				
4807A, 4807A/V1	–	2	5	%
4807, 4807/V1	–	1	2	%
Shading (Uniformity):[v]				
White level:				
Variation of highlight signal (Percent of maximum highlight signal):				
4807A, 4807A/V1	–	15	30	%
4807, 4807/V1	–	12	15	%

a See figure showing Suggested Tube End-Base Decoupling Networks.

b A description of the Absolute Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes.

c Faceplate illuminance is limited to 50 lm/ft^2 continuously. An exposure of 10^4 lm/ft^2 for a maximum period of 5 seconds can be tolerated provided the duty cycle limits the average value to 50 lm/ft^2. See **Figure 4** for time-illuminance relationship for continuously illuminated scenes.

d Operation outside of the recommended target temperature range shown under Typical Operating Values will not damage the 4807 series tubes provided the maximum temperature ratings of the tubes are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the recommended target temperature range.

e With respect to grid No.4. Grid-No.5 (field mesh) voltage must never be less than that of grid No.4.

f Dynode-voltage values are shown under Typical Operating Values.

g With the isocon within a RCA-AJ2206 scanning and focusing-coil assembly.

h Adjust for best focus. Nominal value is −750 V. This value is dependent upon the location of the tube within the yoke assembly with respect to the end of the focusing field.

j Nominal value is −470 V. This voltage should be obtained by means of a voltage-divider network between photocathode and "ground". The resistance values should be chosen to set the grid-No.6 voltage at the recommended 63% of photocathode voltage which provides best focus.

k Normal setting of target voltage is +3.5 volts from thermionic cathode potential. Target cutoff is normally within one volt of thermionic cathode potential. The target supply voltage should be adjustable from −3 to +5 volts. The target connection must never be interrupted while the tube is operating.

m Adjust for best focus. The focusing current of the associated assembly, e.g., AJ2206, should be adjusted to keep grid-No.4 voltage within its recommended voltage range.

n Adjust for required signal current.

p The gain of the electron multiplier may be varied to obtain the signal output current from a given tube most suitable for the associated video amplifier. Gain can be controlled by adjusting the voltage on one or two ot the latter dynode stages; dynode No.3 is the preferred stage. To increase the range of gain control, the voltages on dynode Nos. 3 and 5 may be simultaneously adjusted. Overall multiplier gain varies approximately as the 3rd power of anode voltage.

q Direction of current must be such that a north-seeking pole is attracted to the image end of the focusing coil.

r Dynode-No.3 voltage is adjusted for maximum signal output (approximately 1050 volts).

s The photocathode irradiance at 440 nanometers (the peak of photocathode responsivity) is related to photocathode illuminance at 2854° K by the factor 0.02865 (1/35) derived as follows:

$$\frac{\dfrac{1\ \text{lm}}{\text{ft}^2} \times 10.76\,\dfrac{\text{ft}^2}{\text{m}^2} \times 160\,\dfrac{\mu\text{A}}{\text{lm}}}{60\,\dfrac{\text{mA}}{\text{W}}} = 0.02865\,\frac{\text{W}}{\text{m}^2}$$

When the photocathode is irradiated at some wavelength other than 440 nanometers, the factor will differ as the relative photocathode responsivity.

t The values shown are measured under the following conditions using a Video Noise Meter, Model UPSF (North American Version), or equivalent. This meter is manufactured by Rohde and Schwarz, Munich, West Germany.

Noise Meter: Video pass band is shaped by means of self-contained 100 kHz high-pass and 4.2 MHz low-pass filters.

Signal to noise-in-signal for highlights is measured with lens uncapped viewing a uniform white field; highlight signal to dark current noise, with the lens capped.

u Measured using an RCA test pattern style P200 with the frequency response of the video amplifier systems (essentially "flat") adjusted for uniform response to all scan-generated video frequencies. Substantially identical measurements will be obtained by using a "multi-burst" test pattern with an amplifier having flat (± 0.1 dB) frequency response to at least 14 MHz.

v Variation of responses over scanned area.

w The unit, watts-2854° K, is used to designate the total radiated power in watts, integrated over all wavelengths, from a tungsten-filament lamp operated at a color temperature of 2854° K. This unit is directly converted into lumens by the following relationship: 1 watt-2854° K = 20 lumens. From this relationship, responsivity can be expressed in units of either amperes/lumen or amperes/watt-2854° K.

For example, a responsivity of 160 μA/lm is equivalent to a responsivity of

$$\frac{160\ \mu A}{lm} \times \frac{20\ \text{lumens}}{\text{watt-2854}^{\circ}K} = 3.2\ \text{mA/watt-2854}^{\circ}K$$

Also an illuminance of 1 lm/ft^2 (fc) is equivalent to an irradiance of

$$\frac{1\ lm}{ft^2} \times \frac{\text{watts-2854}^{\circ}\ K}{20\ \text{lumens}} \times \frac{10\ ft^2}{M^2} = 0.5\ \text{watt-2854}^{\circ}\ K/\text{meter}^2$$

Therefore, all references to illuminance in lm/ft^2 may be converted to watts/meter^2-2854° K by multiplication factor 0.5.

Amperes/watt-2854° K responsivity to the entire spectral output of a tungsten-filament lamp at a color temperature of 2854° K should not be confused with the unit of responsivity at a single wavelength, amperes/watt.

Spurious Signal (Blemish) Tests

This test is performed using a uniformly diffused white test pattern that is separated into three zones as shown in **Figure 1.** The tubes are operated under the conditions specified

Set-Up Procedure

The set-up procedure described below should be followed carefully to obtain optimum performance. Before the specified voltages shown under Typical Operating Values are applied to the tube, the scanning coil, tube filament, and focusing coil should be energized. Focusing coil current, using the RCA assembly AJ2206, should be adjusted to 600 milliamperes. The following steps should then be followed sequentially.

Step 1: Light should be admitted to provide a nominal faceplate illumination of 0.01 to 0.1 lumen/ft^2 (footcandle). This is a very important step for all image orthicons and image isocons. Control of target potential may be lost if the tube is started without light on the photocathode. To regain control, turn off the beam and apply light to the photocathode (all voltages applied) for 20 to 30 seconds, then resume normal operation.

Step 2: The voltage values specified under Typical Operating Values may then be applied to the tube with the exception that the steering-plate and misalignment plate differential voltages are set to the voltage values supplied with the tube or to +25 volts.

Step 3: Grid-No.1 voltage is adjusted to provide a small amount of beam current so that video information appears on the monitor.

Step 4: To center the image on the target, adjust the deflection circuits so that the beam will "overscan" the target. Note that overscanning the target results in a smaller-than-normal picture on the monitor. After centering the image, return to normal scan size.

Step 5: Grid-No.1 voltage is readjusted to fully discharge the target.

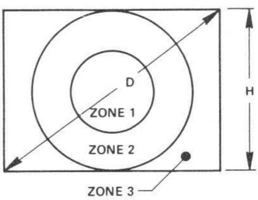
Step 6: Optical elements, photocathode voltage (image-section focus), and grid-No.4 voltage (scanning-under Typical Operating Values. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numb of raster lines in a 525 TV line system. Allowable spots si for each zone is shown in Table I. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots.

Table 1

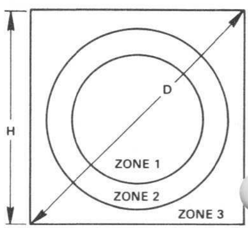
Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots	Zone 3 Allowed Spots
Over 6	0	0	0
6 but not including 4	0	0	4
4 but not including 1	2	6	6
1 or less	Spots of this size are allowed unless concentration causes a smudged appearance.		

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

Spurious Signal Zones



A – 4807, 4807A



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B – 4807/V1, 4807A/V1

4807A, 4807A/V1

D: Active Target Diameter
H: Raster Height (4 x 3 Aspect Ratio)
Zone 1: Diameter - H/2, Area ≈ 15%
Zone 2: Diameter = H, Area ≈ 45%
Zone 3: Area ≈ 40%

4807, 4807/V1

D: Active Target Diameter
H: Raster Height (1 x 1 Aspect Ratio)
Zone 1: Diameter = .62H, Area ≈ 30%
Zone 2: Diameter = .87H, Area ≈ 30%
Zone 3: Area ≈ 40%

section focus) are adjusted to provide best focus. The proper setting for grid No.4, about 420 volts, is that value providing best resolution regardless of picture polarity.

Step 7: Increase positive $E_{sx1} - E_{sx2}$ to picture cut-off and back off to best picture.

Step 8: Reduce target voltage to cut-off and set $E_{sx1} - E_{sx2}$ to the minimum positive value that eliminates bright edges.

Step 9: Increase target voltage to 3.5 volts and adjust $E_{sy1} - E_{sy2}$ for best uniformity. Use the **minimum** value which provides acceptable performance. Readjust beam if necessary.

Step 10: Reduce target voltage to determine new cut-off value. Target cut-off voltage is changed by the adjustment of E_{sy1}-E_{sy2}. (It should not exceed +1.0 volt). Set target voltage to 3.5 ± 0.2 volts.

Principles of Operation

Similar to the conventional image orthicon, the isocon has three functional sections – an image section, a scanning section, and an electron-multiplier-type signal current amplifier section – as shown in **Figure 3.** Operation of both the image section and the multiplier section is identical to that of the conventional image orthicon. The behavior of the scanning beam of the image isocon, however, differs from that encountered in the image orthicon.

Scanning Operation

The charged target is scanned by a low-velocity electron beam produced by a conventional electron gun. The primary (outbound) beam receives the required amount of transverse energy and the proper trajectory to pass through the beam-separation structure by means of transverse fields established by the electrostatic alignment plates.

The beam emerging from the beam-separation structure is focused at the target by the magnetic field of the external focusing coils, the electrostatic field of the wall electrode (grid No.4), and the field mesh (grid No.5). Under the influence of these fields, each electron traverses a helical path; the paths converging at the target. The fields of the steering plates are used to deflect electrons of the primary and return beams to allow control over beam trajectory. Scanning is accomplished by transverse magnetic fields produced by the external scanning coils.

By proper adjustment of electrode voltages including those of the field mesh (grid No.5) and grid No.4, the beam, regardless of its lateral deflection, is caused to approach the target at a fixed angle with zero or nearly zero velocity. The beam deposits sufficient electrons to neutralize the positive charges accumulated during the preceding frame time. Beam electrons having insufficient energy to reach the target are specularly reflected and constitute part of the return beam. Beam electrons reaching the target at positively charged areas but not captured are scattered and also become part of the return beam.

The term scattered electrons applies exclusively to the non-specularly reflected electrons obtained when the beam interacts with the surface of the target and are thus distinguished from the remainder of the returning electrons which are termed reflected electrons. The number of scattered electrons obtained is at a maximum in the lighted portions (positively charged areas) and essentially zero in the dark portions of the target. (It is to be noted that although the total return beam is a minimum in the bright areas of the target where electrons are deposited, the number of scattered electrons is a maximum). The total return beam remains under the influence of the magnetic field of the focusing coil and the electrostatic field of grid No.4. The helices described by the scattered electron portion have greater diameters than those described by the reflected electrons. The return beam now comes under the influence of the field of the steering plates and is directed toward the beam-separation edge. The beam-separation edge passes the scattered electron portion of the return beam and captures the reflected electron portion. The scattered electrons accordingly strike the first dynode of the multiplier section. As a result, secondary emission occurs. The emitted secondaries, after multiplication, are collected by the anode as the signal output current.

Camera Design Notes

1. Unless otherwise noted, the specified voltage values are referenced directly to the thermionic cathode which is grounded. No significant impedances should be introduced between the cathode and power-supply return points ("grounds"). The resistance of normal circuit conductors is deemed insignificant.
2. Designers familiar with conventional image orthicon circuitry are urged to note the following differences when designing circuits for use with the isocon:
   a. Gun (beam) blanking is used instead of target blanking.

   b. The polarity (sense) of the isocon output video signal is the inverse of that of conventional image orthicons. Maximum light produces maximum anode current.

   c. A separate connection is provided for the "persuader" multiplier focus electrode G_3. Its design is such that it may be tied to G_4. Maximum output may require it to be more positive than G_4.

   d. The annular decelerator electrode, G_5, featured in most image orthicons is not used, nor provided in the 4807 series. The designator "G_5" has been reassigned to the field mesh.

   e. The insertion of shading signals is neither recommended nor necessary. This eliminates 2 or 4 controls.

   f. These tubes will NOT operate properly at any beam focus loop number other than that obtained by the application of the magnetic and electric focus fields shown under Typical Operation.

   g. Automatic beam control is not needed.
3. The gain of the electron multiplier output section is readily varied by adjustment of its operating voltages. Depending on the range of control required, the voltage on one or several dynodes may be made adjustable. The following precautions should be observed:

a. Do not vary dynode No.1 voltage for gain-control purposes.

b. Under most conditions, adjustment of only dynode No.3 voltage is the preferred gain control mode.

c. Under no circumstances should operation be attempted where the voltage on a given dynode is outside the range established by the two adjacent dynodes, i.e., $E_{dy(n-1)} \leqslant E_{dy(n)} \leqslant E_{dy(n+1)}$.

Operation outside of these limits will not damage the tube but will result in entirely unsatisfactory multiplier action. (This requirement is not unique to these tubes — the principle applies generally to electron multiplier equipped tubes).

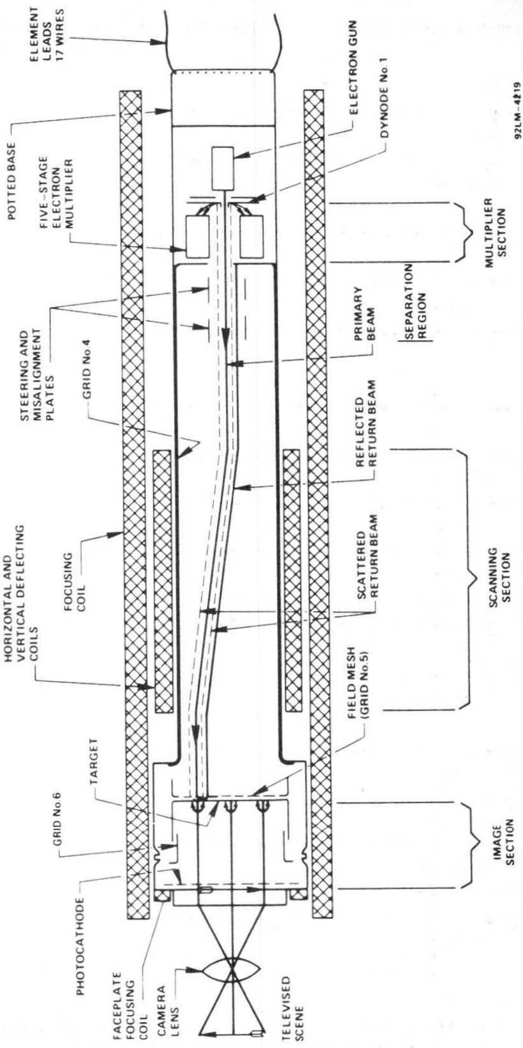
d. If several dynode voltages, including that of dynode No.5 are varied simultaneously, care should be taken to avoid allowing the voltage between dynode No.5 and anode to vary to the point where anode collection efficiency is reduced. A practical minimum voltage for $E_b - E_{dyn5}$ is 35 volts.

4. "Raster Zoom", at least 4:1, can be employed without damage to the tube. Resolution degradation can be expected to the same degree as the change in scan size.

5. Raster orientation (See Data) is extremely important. Vertical scan reversal is normally not recommended and should not be used without contacting your RCA field representative for factory recommendations concerning your system.

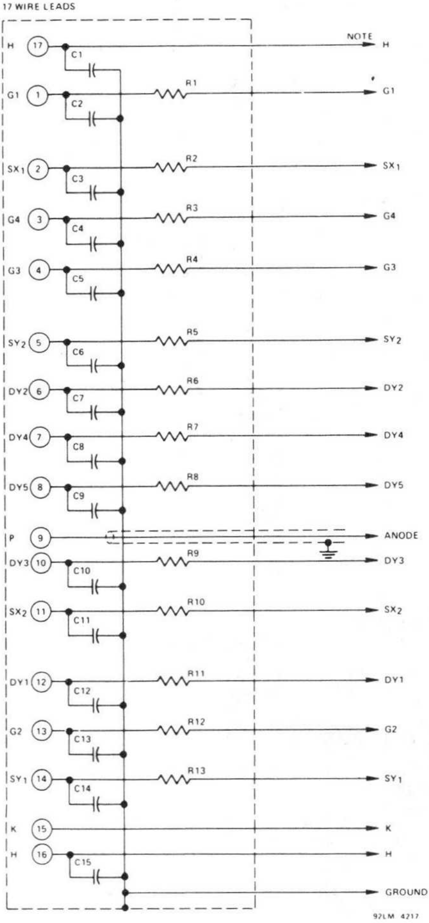
6. Scan-failure protection. Nothing elaborate is needed as long as grid No.1 voltage does not fall to zero. In this context, note that a normal shutdown of equipment could cause damage unless the coupling time constants are such that the (negative) G_1 voltage will decay more slowly than the (positive) voltages on G_2 and/or G_4.

Schematic Arrangement of Type 4807 in AJ2206 Magnetics Assembly



Suggested Tube End-Base Decoupling Networks for 4807, 4807A

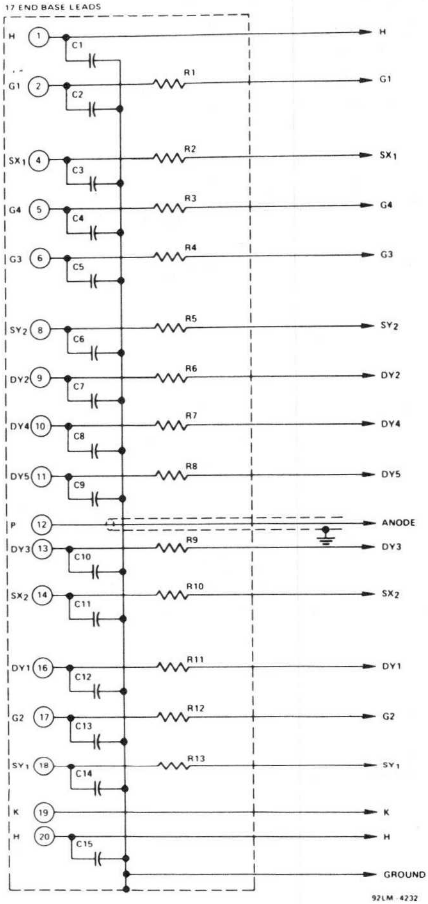
Each lead is identified. Leads are approximately 9" (230 mm) long.



C1, C15: 0.1 μF
C2 through C7: 0.01 μF, 1000 V
C8, C10: 0.01 μF, 1600 V
C9: 0.01 μF, 2000 V

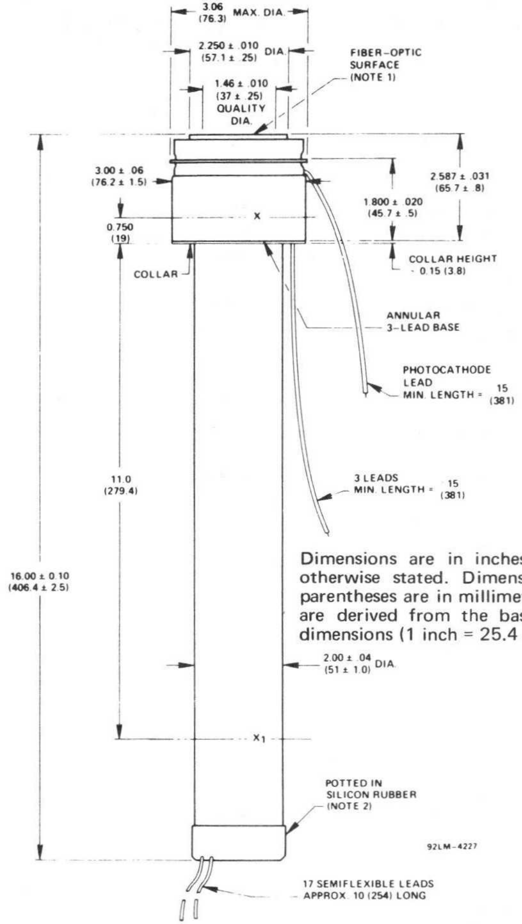
Suggested Tube End-Base Decoupling Networks For 4807/V1, 4807A/V1

Each Lead is identified. Leads are approximately 9" (230 mm) long.



C11 through C14:	0.01 μF, 1000 V	R12:	51 k, 1/4 W
R1 through R11:	100 k, 1/4 W	R13:	100 k, 1/4 W

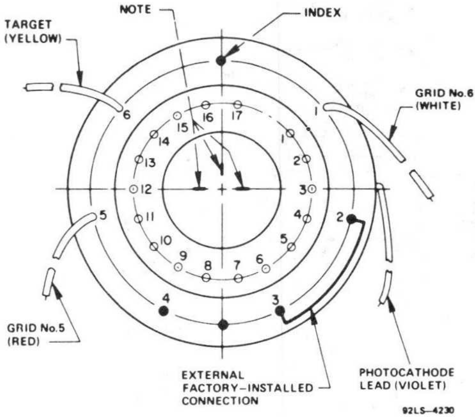
Dimensional Outline For Types 4807 And 4807A



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

Note 1: Perpendicularity to fiber optic surface is 0.002" T.I.R. Centering is determined by holding and rotating at positions X-X_1 above.

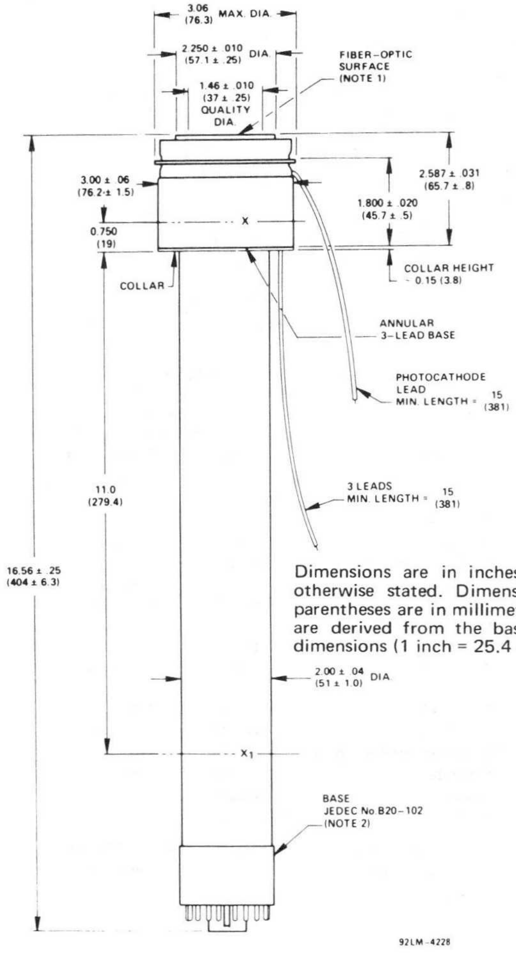
Enlarged Bottom View, Types 4807 And 4807A



Base Lead	Description	Color Code Body	Stripe
1	Grid No.1	Brown	1 Green
2	Steering Plate SX_1 (+)	Blue	–
3	Grid No.4	Brown	1 Red
4	Grid No.3	Brown	1 Orange
5	Misalignment Plate SY_2 (–)	Orange	–
6	Dynode No.2	Brown	2 Green
7	Dynode No.4	Brown	2 Orange
8	Dynode No.5	Brown	2 Red
9	Anode	Red	–
10	Dynode No.3	Brown	2 Yellow
11	Steering Plate SX_2 (–)	Green	–
12	Dynode No.1	Brown	2 Blue
13	Grid No.2	Brown	1 Yellow
14	Misalighment Plate SY_1 (+)	Yellow	–
15	Cathode	Brown	1 Blue
16	Heater	Brown	–
17	Heater	Brown	–

Note – Scribe marks on base for alignment in RCA-AJ2206 yoke assembly. Refer to bulletin AJ2206 for alignment procedure.

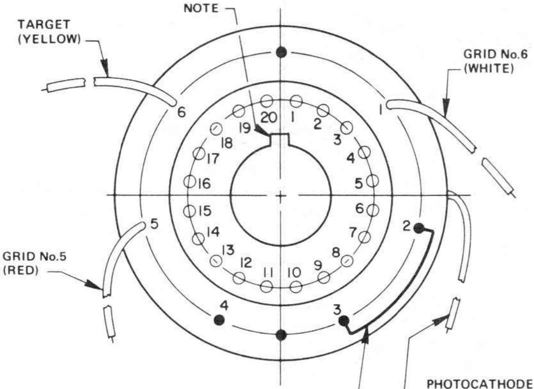
Dimensional Outline For Types 4807/V1 And 4807A/V1



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

Note 1: Perpendicularity to fiber optic surface is 0.002" T.I.R. Centering is determined by holding and rotating at positions X-X_1 above.

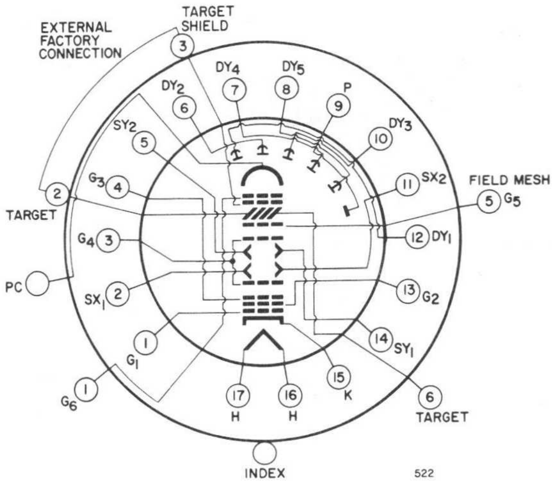
Enlarged Bottom View, Types 4807/V1 And 4807A/V1



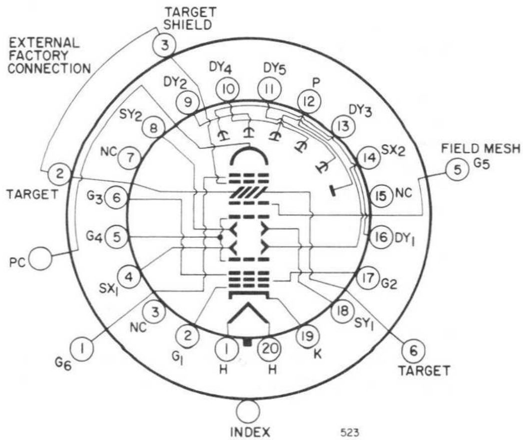
Base Pin	Description
1	Heater
2	Grid No.1
3	Internal Connection – Do Not Use
4	Steering Plate SX_1
5	Grid No.4
6	Grid No.3
7	Internal Connection – Do Not Use
8	Misalignment Plate SY_2
9	Dynode No.2
10	Dynode No.4
11	Dynode No.5
12	Anode
13	Dynode No.3
14	Steering Plate SX_2
15	Internal Connection – Do Not Use
16	Dynode No.1
17	Grid No.2
18	Misalignment Plate SY_1
19	Cathode
20	Heater

Note – Align between "H-H" scribe marks on base of RCA-AJ2206 yoke assembly. Refer to bulletin AJ2206 for alignment procedure.

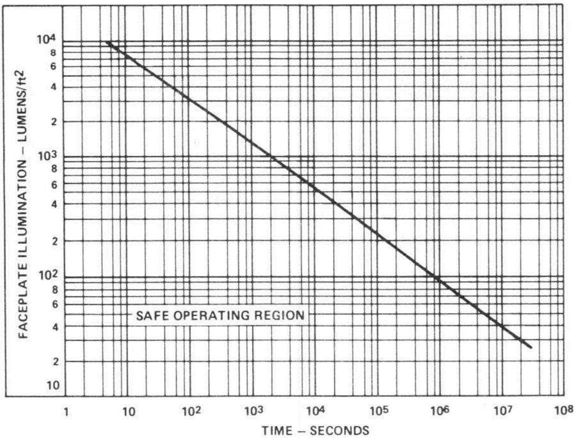
Basing Schematic For Types 4807 And 4807A



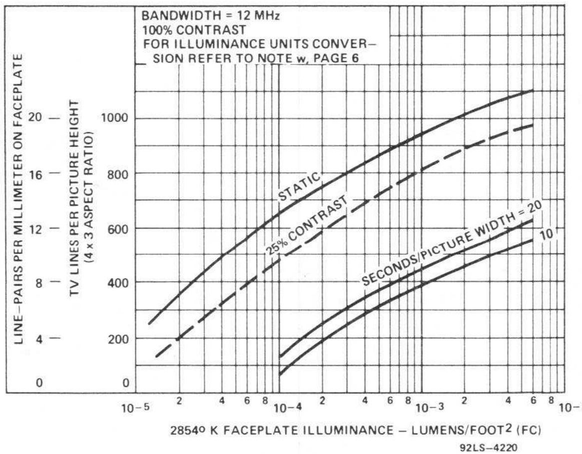
Basing Schematic For Types 4807/V1 And 4807A/V1



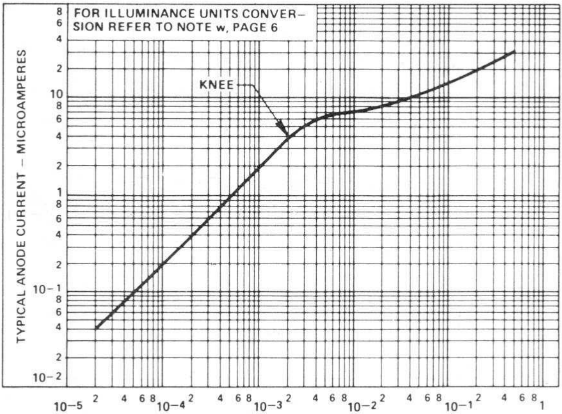
Faceplate Exposure Limit



Typical Dynamic Limiting Resolution

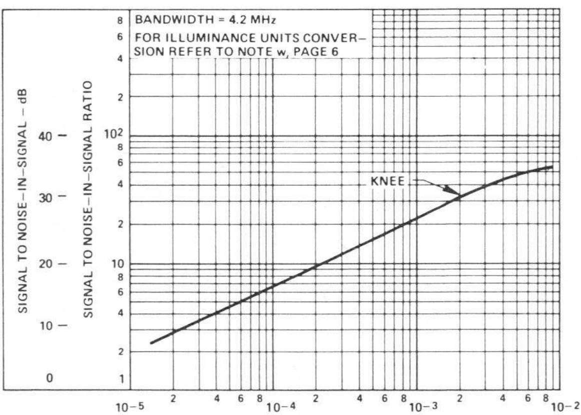


Typical Transfer Characteristic



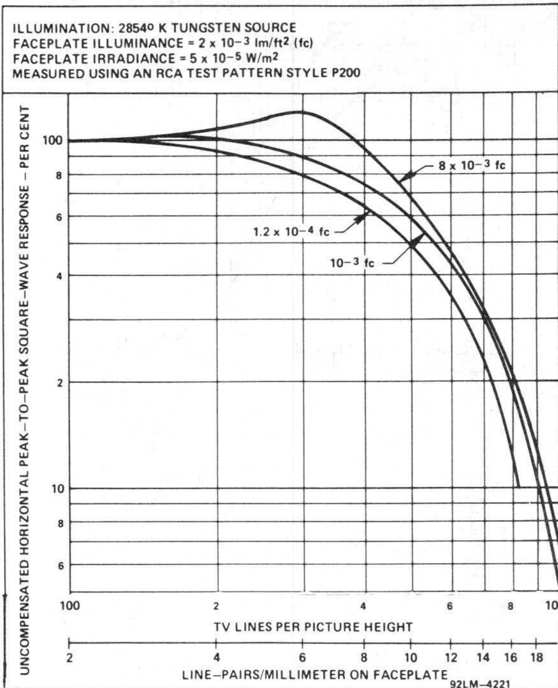
92LS–4225

Typical Signal to Noise-In-Signal Ratio As A Function of Faceplate Illuminance or Irradiance From Flux Levels Within A Given Scene. (Beam Adjustment Fixed At 2 x Knee Setting)

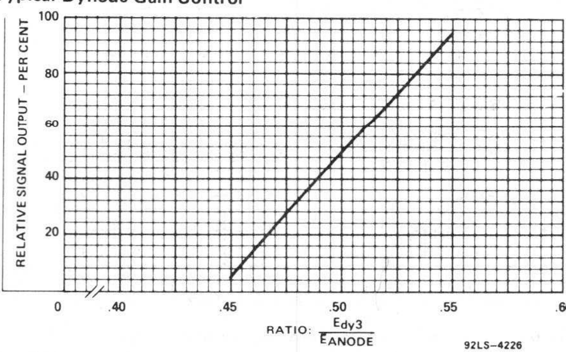


92LS–4222

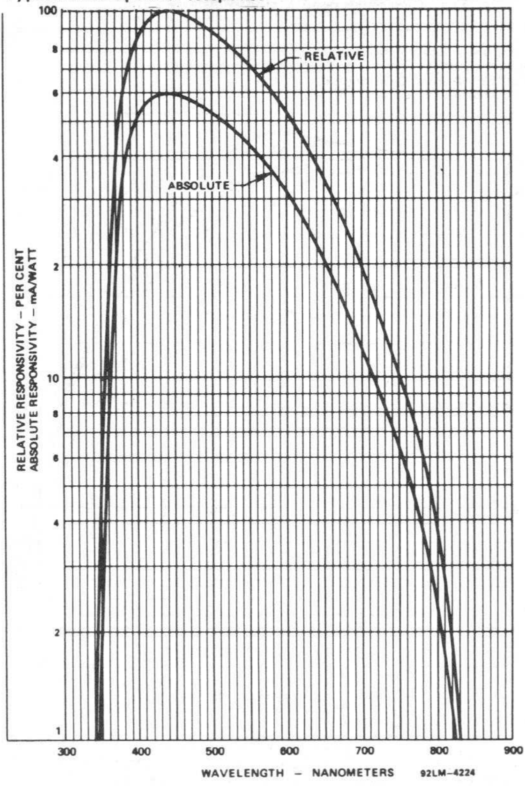
Typical Amplitude Response (CTF) Characteristic



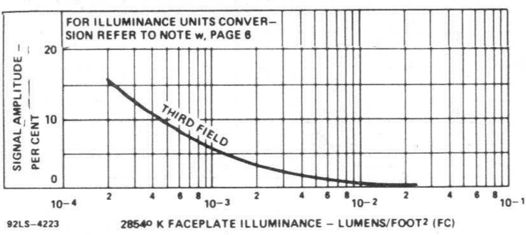
Typical Dynode Gain Control



Typical S-20 Spectral Response



Residual Signal (Lag) Characteristic



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 — 5×10^6 at 1000 volts**
- **Fast Time Resolution Characteristics — Anode Pulse Rise Time, 1.6×10^{-9} s at 1250 volts**
  Electron Transit Time, 1.6×10^{-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[j] (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.

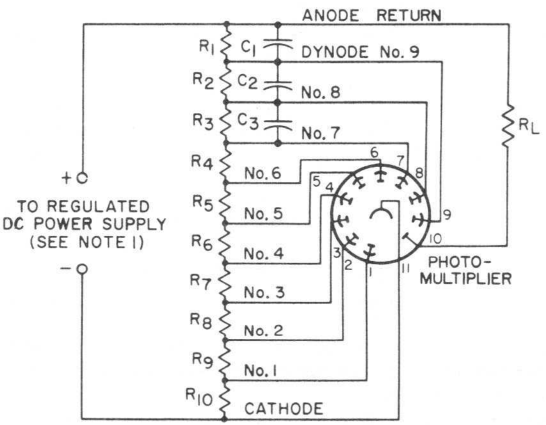
p The electron transit time is the time interval between the arrival of a delta function light pulse at the entrance window of the tube and the time at which the output pulse at the anode terminal reaches peak amplitude. The transit time is measured under conditions with the incident light fully illuminating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



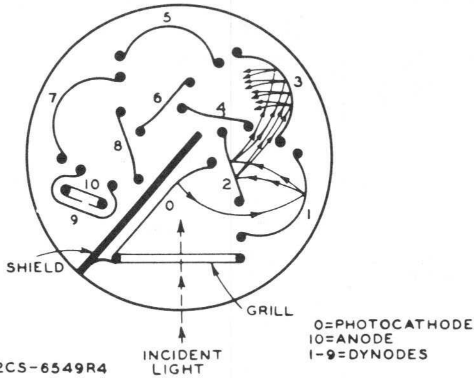
92CS-11382R2

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

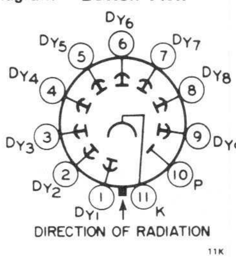
Note 1 – Adjustable between approximately 500 and 1250 volts.

Note 2 – Capacitors C1 through C3 should be connected at tube socket for optimum high-frequency performance.

Schematic Arrangement of Structure

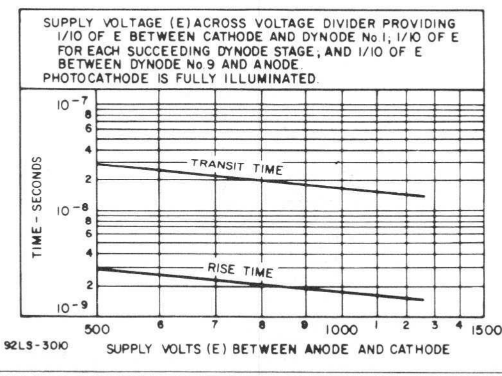


Basing Diagram – Botton View

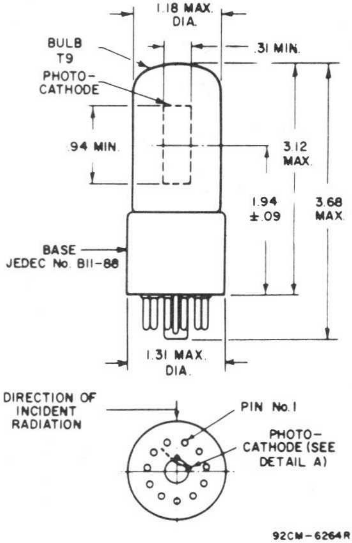


Pin 1: Dynode No.1
Pin 2: Dynode No.2
Pin 3: Dynode No.3
Pin 4: Dynode No.4
Pin 5: Dynode No.5
Pin 6: Dynode No.6
Pin 7: Dynode No.7
Pin 8: Dynode No.8
Pin 9: Dynode No.9
Pin 10: Anode
Pin 11: Photocathode

Typical Time-Resolution Characteristics

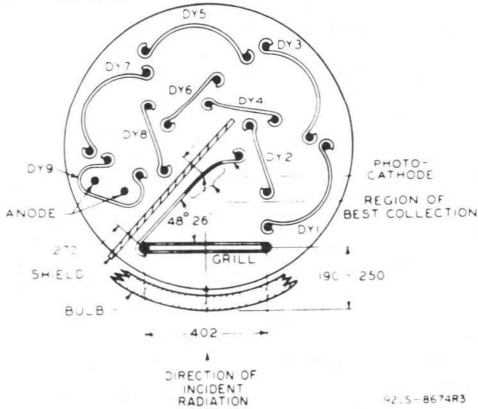


Dimensional Outline



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

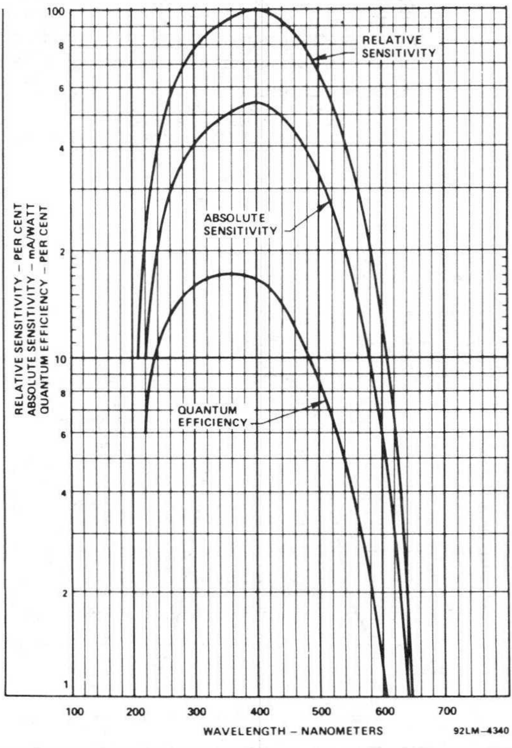
Detail A – Top View



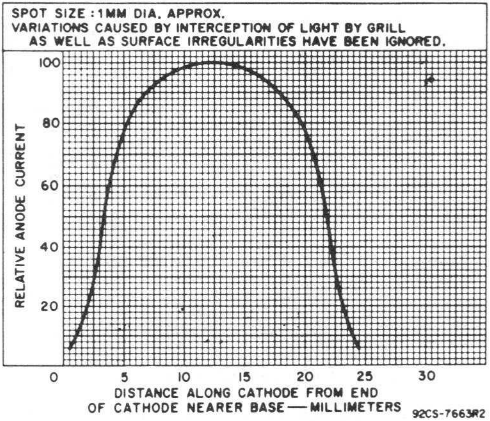
Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

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

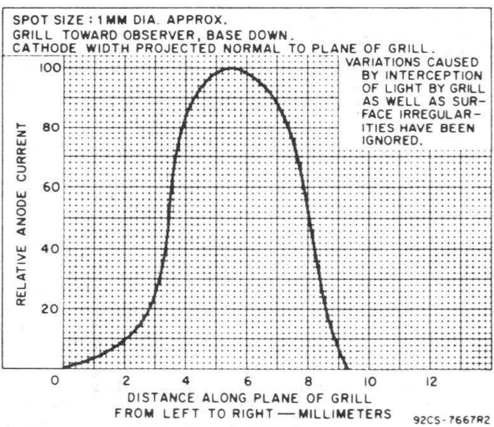
Typical Photocathode Spectral Response Characteristics



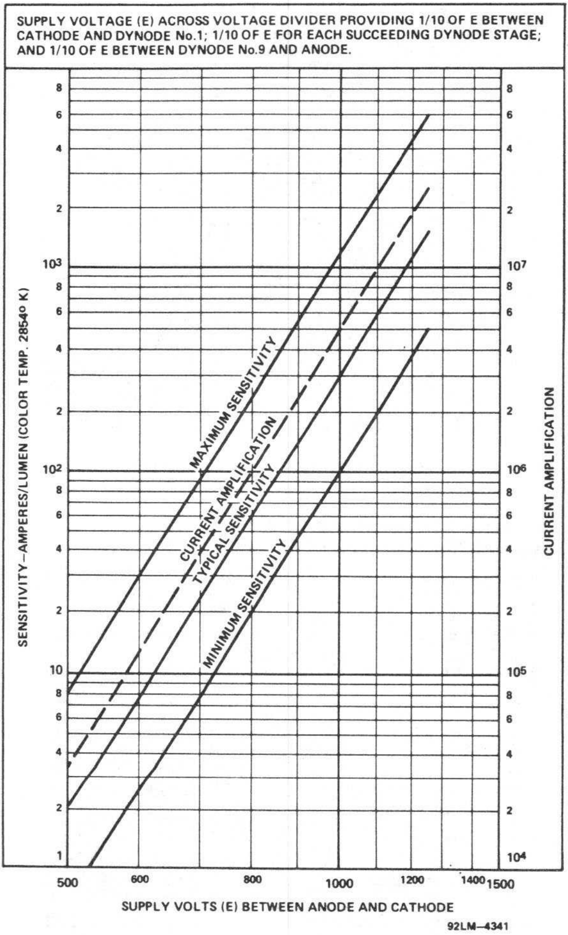
Typical Variation of Photocathode Sensitivity Along Tube Length



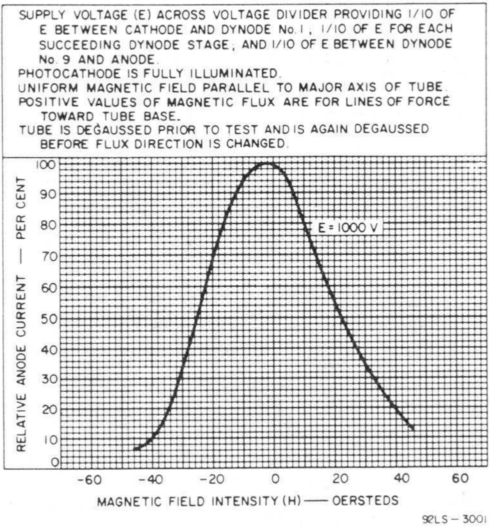
Typical Variation of Photocathode Sensitivity Across Projected Width in Plane of Grill



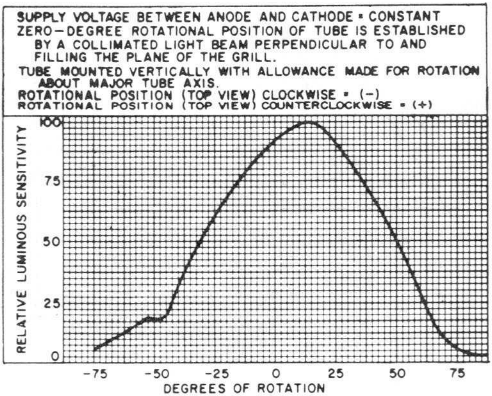
Typical Sensitivity and Current Amplification Characteristics



Typical Effect of Magnetic Field on Anode Current



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



Gas Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

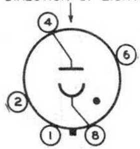
DATA

General:

Spectral Response. S-4
Wavelength of Maximum Response . . . . . 4000 ± 500 angstroms
Cathode:
  Shape. . . . . .Semicylindrical
  Minimum projected length[a]. . . . . 13/16"
  Minimum projected width[a] . . . . 5/8"
Direct Interelectrode Capacitance(Approx.) . . . . . . 2.6 μμf
Maximum Overall Length . . . . 3-1/16"
Maximum Seated Length. . . . . 2-1/2"
Seated Length to Center of Cathode . . . . . 1-5/8" ± 3/32"
Maximum Diameter . . . . 1-9/32"
Operating Position . . . . Any
Weight (Approx.) . . . . 0.9 oz
Bulb T9
Socket . . . . .Cinch No.8JM-1, or equivalent
Base . . . . . .Intermediate-Shell Octal 5-Pin Arrangement 1, (JEDEC No.B5-10)
  Basing Designation for BOTTOM VIEW 3J

DIRECTION OF LIGHT

Pin 1 – No Connection
Pin 2 – No Connection
Pin 4 – Anode



Pin 6 – No Connection
Pin 8 – Photocathode

Maximum Ratings, *Absolute-Maximum Values:*

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC).	80 max.	100 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	60 max.	30 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b] . .	6 max.	3 max.	μa
AMBIENT TEMPERATURE.	75 max.	75 max.	°C

Characteristics:

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4000 angstroms.	–	0.13	–	amp/watt
Luminous:[c]				
At 0 cps	75	135	205	μa/lumen
At 5000 cps.	–	124	–	μa/lumen
At 10000 cps	–	108	–	μa/lumen

← Indicates a change.

	Min.	Median	Max.	
Gas Amplification Factor[d] . . .	–	–	5.5	
Anode Dark Current	–	–	0.05	μa

Minimum Circuit Values:

With an anode-supply voltage of	*80 or less*	*100*	*volts*
DC Load Resistance:			
For dc currents above 3 μa	0.1 min.	–	megohm
For dc currents below 3 μa	0 min.	–	megohms
For dc currents above 1 μa	–	2.5 min.	megohms
For dc currents below 1 μa	–	0.1 min.	megohm

[a] On plane perpendicular to indicated direction of incident light.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

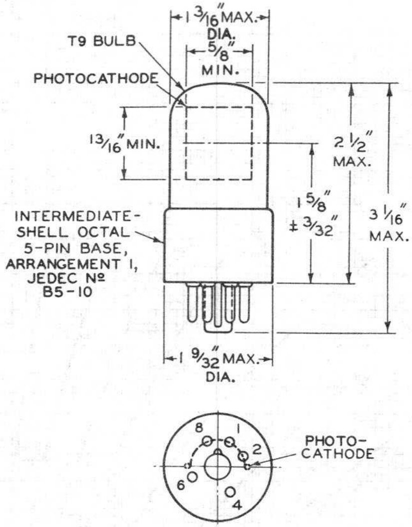
[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE

and

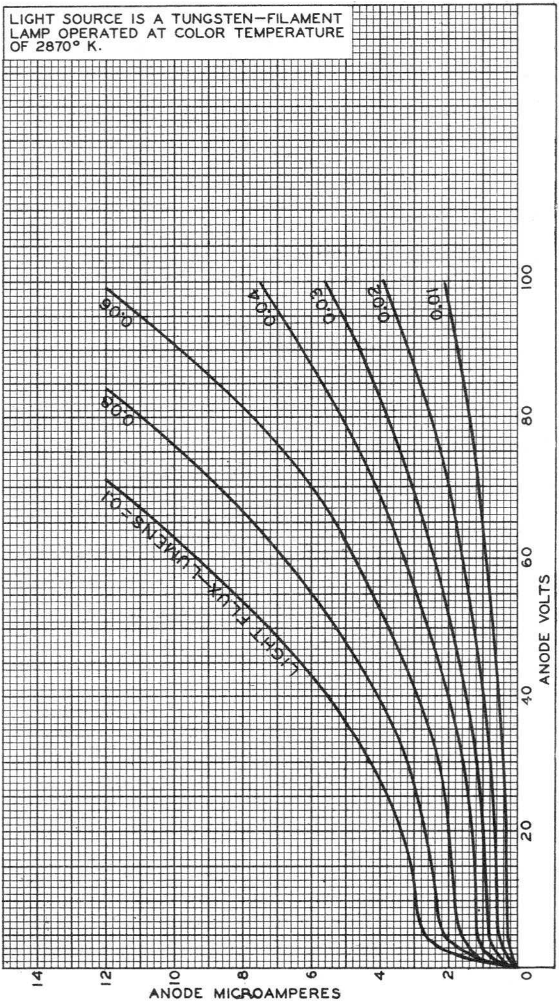
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section


1 3/16" MAX. DIA.
5/8" MIN.
T9 BULB
PHOTOCATHODE
13/16" MIN.
2 1/2" MAX.
1 5/8" ± 3/32"
3 1/16" MAX.
INTERMEDIATE-SHELL OCTAL 5-PIN BASE, ARRANGEMENT 1, JEDEC № B5-10
1 9/32" MAX. DIA.
8
1
2
6
4
PHOTO-CATHODE

92CM-6137R3

AVERAGE ANODE CHARACTERISTICS



92CM-6822RI

RCA

5582

5582

GAS PHOTOTUBE

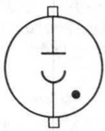
CARTRIDGE TYPE WITH S-4 RESPONSE

For sound reproduction involving a dye-image sound track in conjunction with an incandescent light source

DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length*	5/8"
Minimum projected width*	1/2"
Direct Interelectrode Capacitance	1 μμf
Overall Length	1-21/32" ± 1/16"
Seated Length	1-13/32" ± 1/32" ←
Length from Center of Useful Cathode Area to Plane A-A' *(See Dimensional Outline)*	11/16" ± 1/16"
Maximum Diameter	0.890"
Weight (Approx.)	0.4 oz ←
Mounting Position	Any
Terminals: ←	
Recessed cap	JETEC No.J1-23
Protruding cap	JETEC No.J1-24
Basing Designation	2AQ ←



Maximum Ratings, ***Absolute Values:***

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	100 max.	volts
AVERAGE CATHODE-CURRENT DENSITY°	20 max.	μamp/sq.in. ←
AVERAGE CATHODE CURRENT°	2 max.	μamp
AMBIENT TEMPERATURE	75 max.	°C

Characteristics, ***At 90 Volts on Anode:***

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4000 angstroms	–	0.12	–	μamp/μwatt ←
Luminous:▲				
At 0 cps	80	120	175	μamp/lumen
At 5000 cps	–	110	–	μamp/lumen
At 10000 cps	–	96	–	μamp/lumen
Gas Amplification Factor	–	–	5.5	
Anode Dark Current at 25°C	–	–	0.05	μamp

* On plane perpendicular to indicated direction of incident light.

°,▲: See next page. ← Indicates a change.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5582

GAS PHOTOTUBE

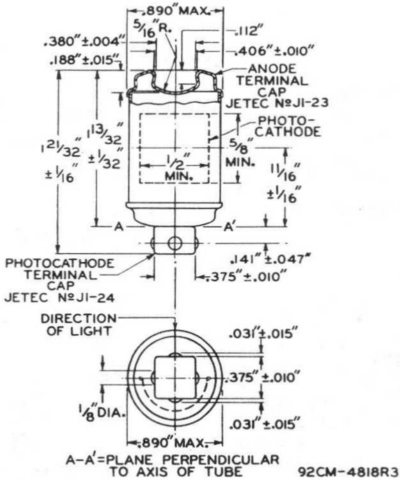
Minimum Circuit Values:

With anode-supply voltage of	*80 or less*	*100*	*volts*
DC Load Resistance:			
For dc currents above 3 μamp	0.1 min.	–	megohm
For dc currents below 3 μamp	0 min.	–	megohm
For dc currents above 1 μamp	–	2.5 min.	megohms
For dc currents below 1 μamp	–	0.1 min.	megohm

○ Averaged over any interval of 30 seconds maximum. This value may be doubled when anode-supply voltage is limited to 80 volts.

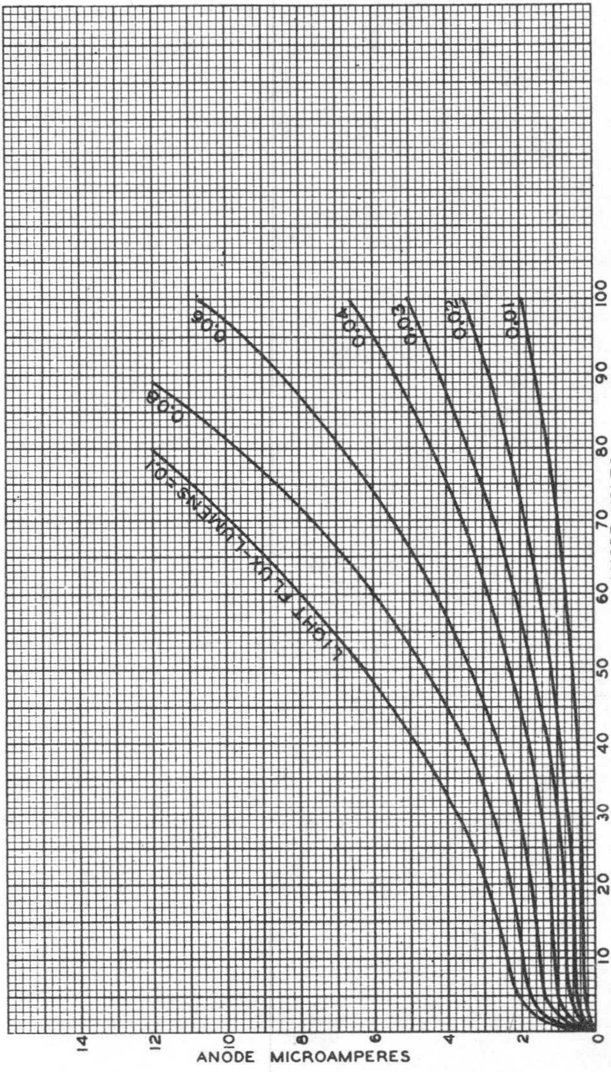
▲ For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurements, a light input of 0.1 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-4 Response
and
FREQUENCY-RESPONSE CHARACTERISTICS
of Gas Phototubes
are shown at the front of this Section



5582

AVERAGE ANODE CHARACTERISTICS



DEC. 27, 1946

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6823

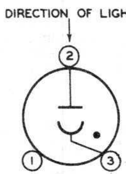
Gas Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:

Spectral Response. S-4
Wavelength of Maximum Response . . . . . 4000 ± 500 angstroms
Cathode:
  Shape. . . . . .Semicylindrical
  Minimum projected length[a]. . . . . 11/16"
  Minimum projected width[a] . . . . 7/16"
Direct Interelectrode Capacitance (Approx.). . . . . . . 2 μμf
Maximum Overall Length . . . . 2-13/32"
Maximum Seated Length. . . . . 1-15/16"
Seated Length to Center of Cathode . . . . . . 1-1/4" ± 3/32"
Maximum Diameter . . . . 0.669"
Operating Position . . . . .Any
Weight (Approx.) . . . . 0.3 oz ←
Bulb T5-1/4
Socket . . . . Amphenol No.78S3S-T, or equivalent ←
Base . . . . Small-Shell Peewee 3-Pin (JEDEC No.A3-1) ←
  Basing Designation for BOTTOM VIEW 2F



Pin 1 – No Connection
Pin 2 – Anode
Pin 3 – Photocathode

Maximum Ratings, ***Absolute-Maximum Values:*** ←

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC).	80 max.	100 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	40 max.	20 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b] .	4 max.	2 max.	μa
AMBIENT TEMPERATURE. . . .	75 max.	75 max.	°C

Characteristics: ←

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4000 angstroms .	–	0.13	–	amp/watt
Luminous:[c]				
At 0 cps	75	135	205	μa/lumen
At 5000 cps.	–	124	–	μa/lumen
At 10000 cps	–	108	–	μa/lumen

← Indicates a change.

	Min.	Median	Max.	
Gas Amplification Factor[d]. . .	–	–	5.5	
Anode Dark Current at 25° C. .	–	–	0.05	μa

Minimum Circuit Values:

With an anode-supply voltage of	*80 or less*	*100*	*volts*
DC Load Resistance:			
For dc currents above 3 μa.	0.1 min.	–	megohm
For dc currents below 3 μa.	0 min.	–	megohms
For dc currents above 1 μa.	–	2.5 min.	megohms
For dc currents below 1 μa.	–	0.1 min.	megohm

[a] On plane perpendicular to indicated direction of incident light.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

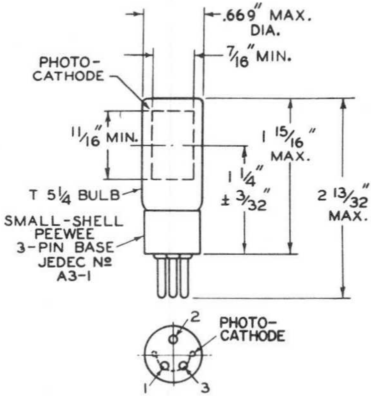
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE

and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section

AVERAGE-ANODE-CHARACTERISTICS CURVE
shown under Type 5581 also applies to the 5583


.669" MAX. DIA.
7/16" MIN.
PHOTO-CATHODE
11/16" MIN.
1 15/16" MAX.
1 1/4" ± 3/32"
2 13/32" MAX.
T 5 1/4 BULB
SMALL-SHELL PEEWEE 3-PIN BASE JEDEC № A3-1
2
PHOTO-CATHODE
1
3

92CM-6053R5

Vacuum Phototube

COMPOSITE-ANODE-CATHODE, SIDE-ON TYPE HAVING S-4 RESPONSE

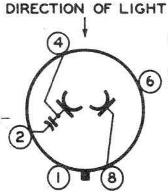
DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode:	
Shape	Flat
Minimum projected length[a]	19/32"
Minimum projected width[a]	1/4"
Direct Interelectrode Capacitances (Approx.):	
Between base pins 4 and 8 (C_1)	1 $\mu\mu$f
Balancing capacitance (C_2)[b]	1 $\mu\mu$f
Capacitance Difference between C_1 and C_2	0.3 max. $\mu\mu$f
Maximum Overall Length	2-7/8"
Maximum Seated Length	2-5/16"
Seated Length to Center of Cathode	1-5/8" ± 3/32"
Maximum Diameter	1-9/32"
Operating Position	Any
Weight (Approx.)	1 oz ←
Bulb	T9
Socket	Cinch No.8JM-1, or equivalent ←
Base	Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No.B5-10) Non-hygroscopic
Basing Designation for BOTTOM VIEW	2AB

DIRECTION OF LIGHT

Pin 1 – No Internal Connection
Pin 2 – Balancing Capacitance
Pin 4 – Anode or Photo-Cathode



Pin 6 – No Internal Connection
Pin 8 – Anode or Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	250 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[c]	30 max.	μa/sq.in.
AVERAGE CATHODE CURRENT[c]	4 max.	μa
AMBIENT TEMPERATURE	75 max.	^{o}C

Characteristics: ←

With an anode-supply voltage of 250 volts

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	0.044	–	amp/watt
Luminous[d]	19	45	70	μa/lumen
Ratio of Cathode Luminous Sensitivities	0.42	1.0	2.4	
Anode Dark Current at 25° C	–	–	0.01	μa

← Indicates a change.

a On plane perpendicular to indicated direction of incident light.

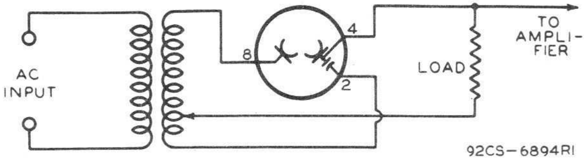
b Measured between pins 2 and 4.

c Averaged over any interval of 30 seconds maximum.

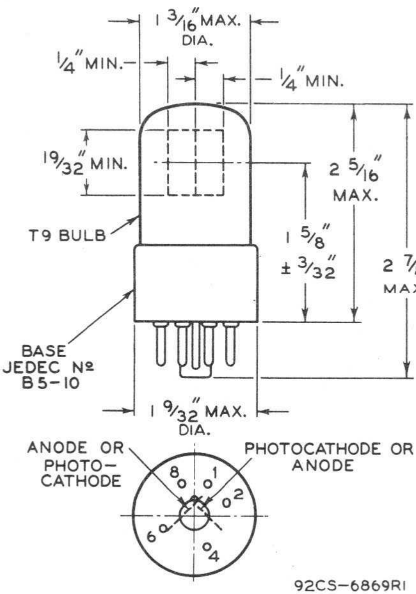
d For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.02 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE
is shown at the front of this section

TYPICAL CIRCUIT

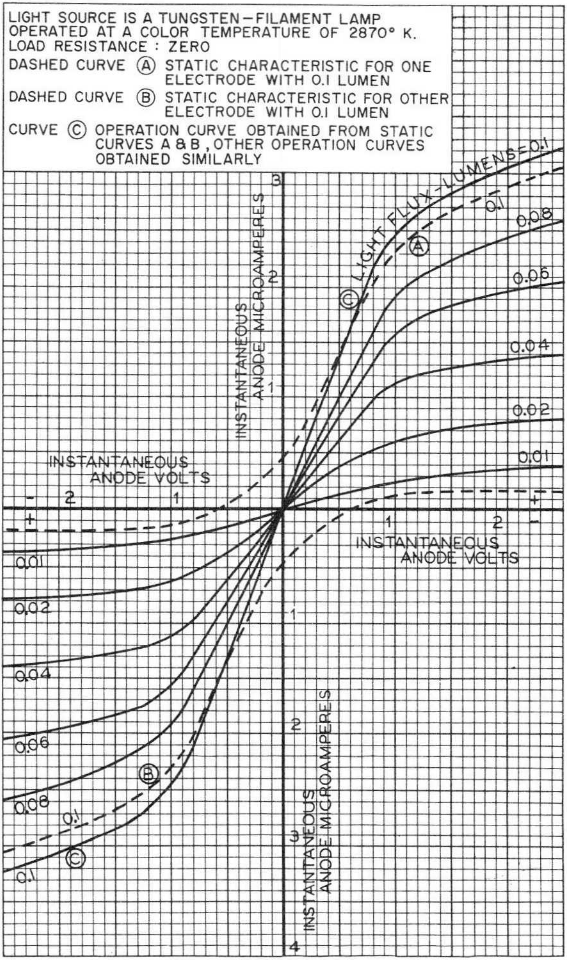


92CS-6894R1



92CS-6869R1

TYPICAL OPERATION CHARACTERISTICS
With AC Voltage Applied Between the Two Electrodes



92CM—6895RI

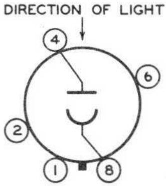
Vacuum Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	13/16"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	2.6 μμf
Maximum Overall Length	3-1/16"
Maximum Seated Length	2-1/2"
Seated Length to Center of Cathode	1-5/8" ± 3/32"
Maximum Diameter	1-9/32"
Operating Position	Any
Weight (Approx.)	0.9 oz ←
Bulb	T9
Socket	Cinch No.8JM-1, or equivalent ←
Base	Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No.B5-10)
Basing Designation for BOTTOM VIEW	3J



Pin 1 – No Internal Connection
Pin 2 – No Internal Connection
Pin 4 – Anode
Pin 6 – No Internal Connection
Pin 8 – Photocathode

Maximum Ratings, *Absolute-Maximum Values:* ←

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	250 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	25 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b]	5 max.	μa
AMBIENT TEMPERATURE	75 max.	°C

Characteristics: ←

With an anode-supply voltage of 250 volts

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4000 angstroms	–	0.044	–	amp/watt
Luminous[c]	20	45	100	μa/lumen
Anode Dark Current at 25° C	–	–	0.25	μa

← Indicates a change.

[a] On plane perpendicular to indicated direction of incident light.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light input of 0.1 lumen are used.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE
is shown at front of this section

DIMENSIONAL OUTLINE
shown under Type 5581 also applies to the 5653

AVERAGE-ANODE-CHARACTERISTICS CURVE
shown under Type 929 also applies to the 5653

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^2 (14.1 cm^2)
Minimum diameter	1.69 in (4.3 cm)
Window	Corning[a] 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[b] No.9709-7, or equivalent
Magnetic Shield	JAN[c] 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[e]	0.75 max.	mA
Ambient Temperature[f]	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.	
Anode Sensitivity:				
Radiant[g] at 4400 angstroms	–	8×10^{4}	–	A/W
Luminous[h] (2870° K)	10	100	300	A/lm
Cathode Sensitivity:				
Radiant[i] at 4400 angstroms	–	0.040	–	A/W
Luminous[k] (2870° K)	4×10^{-5}	5×10^{-5}	–	A/lm
Current with blue light source[m] (2870° K + C.S. No. 5-58)	4×10^{-8}	–	–	A
Quantum Efficiency at 4200 angstroms .	–	11.5	–	%
Current Amplification	–	2×10^{6}	–	
Anode Dark Current[n]	–	6×10^{-9}	4×10^{-8}	A
Equivalent Anode Dark Current Input[n]	–	3×10^{-10}	2×10^{-9}	lm
	–	3.7×10^{-13}[p]	2.5×10^{-12}[p]	W
Equivalent Noise Input[q]	–	1.7×10^{-12}	–	lm
	–	2×10^{-15}[r]	–	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 JAN Hardware Mfg. Co., Inc., 47-27 36th Street, Long Island City, NY 11101.

[e] Averaged over any interval of 30 seconds maximum.

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

[g] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

[h] 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 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° 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° 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° 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.

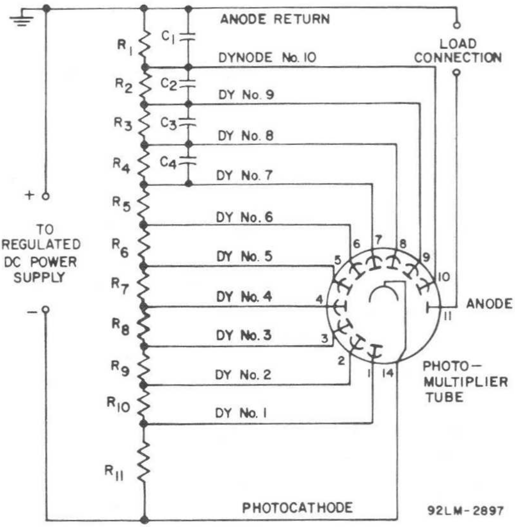
q Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

r At 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.

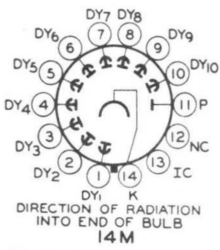
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



C_1: 0.05 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

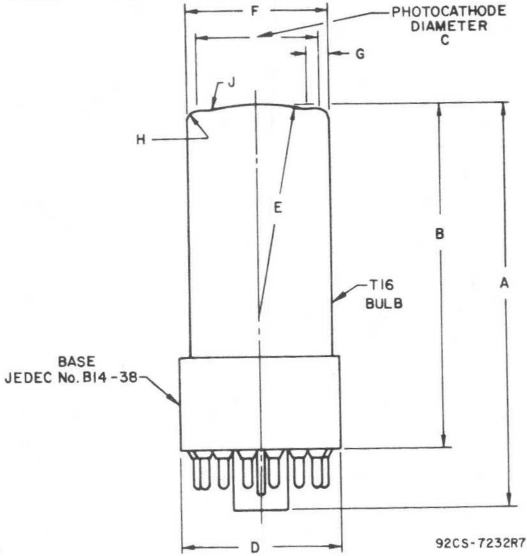
Leads to all capacitors should be as short as possible to minimize inductance effects. The location and spacing of capacitors is critical and may require adjustment for optimum results.

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

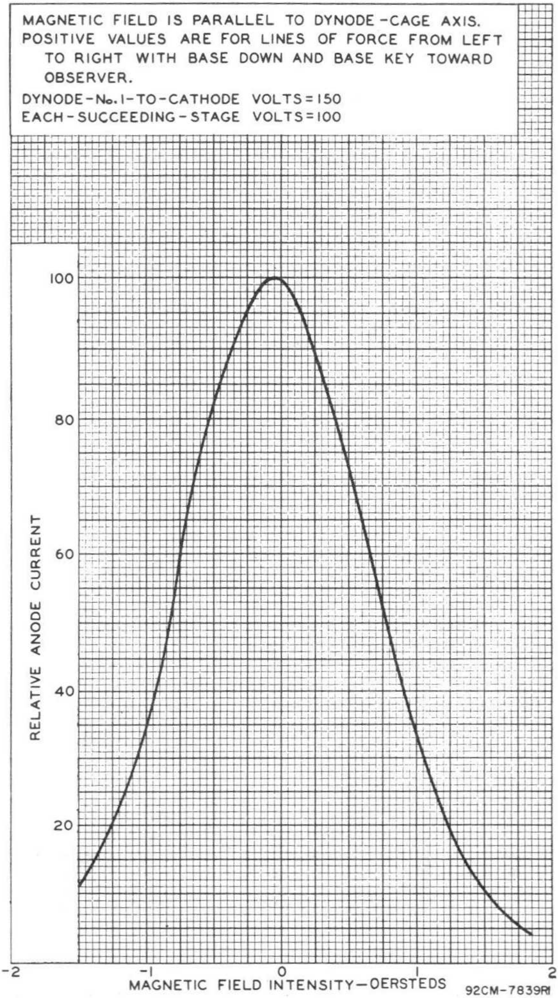


℄ of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

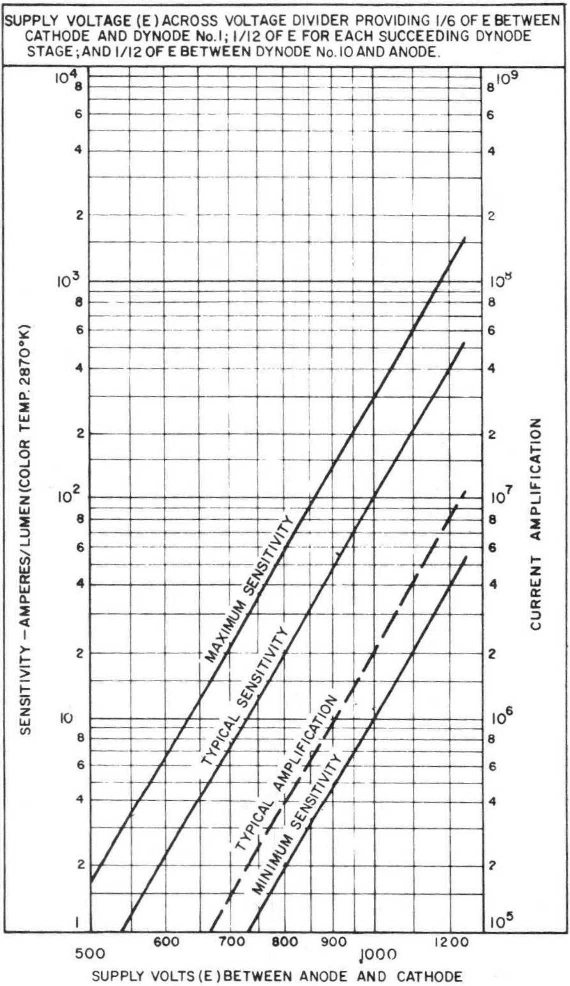
The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

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

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

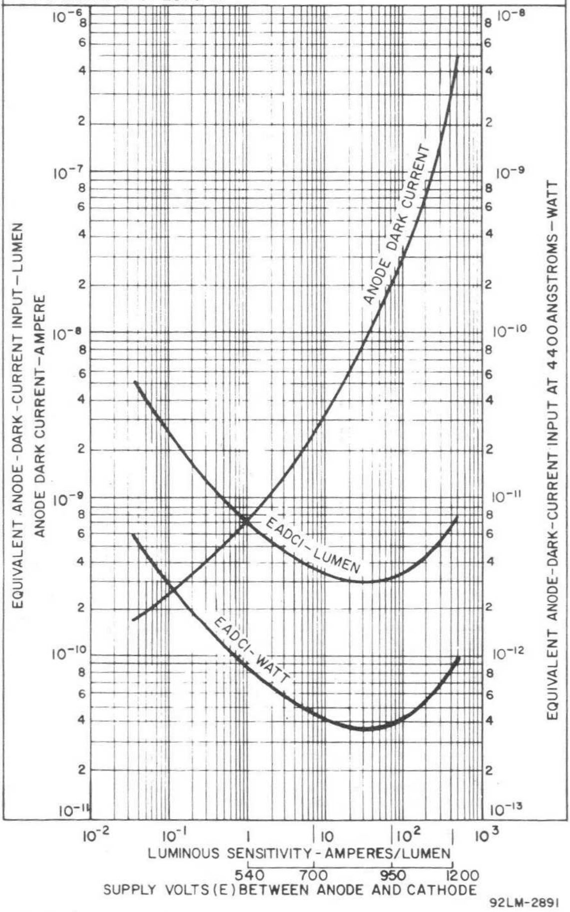


TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



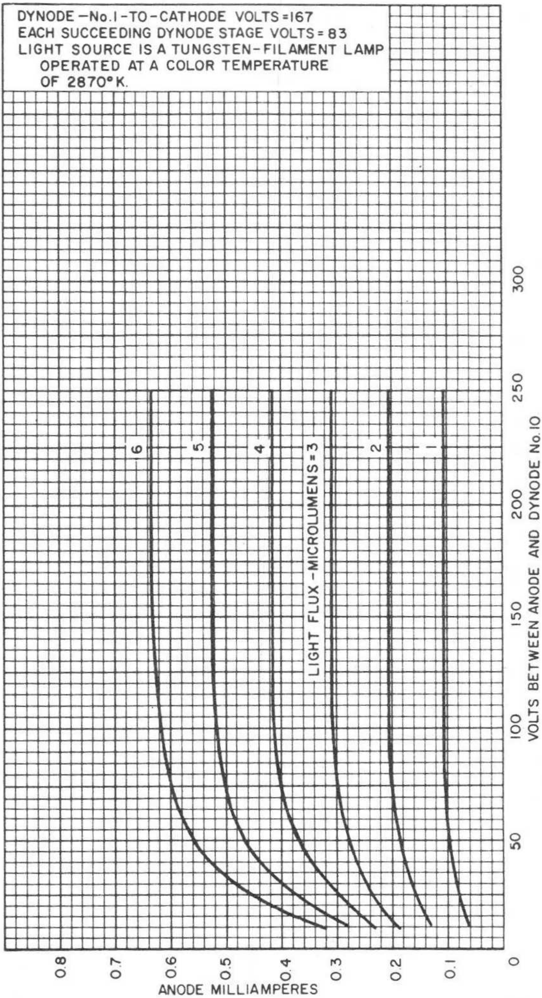
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

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-2891

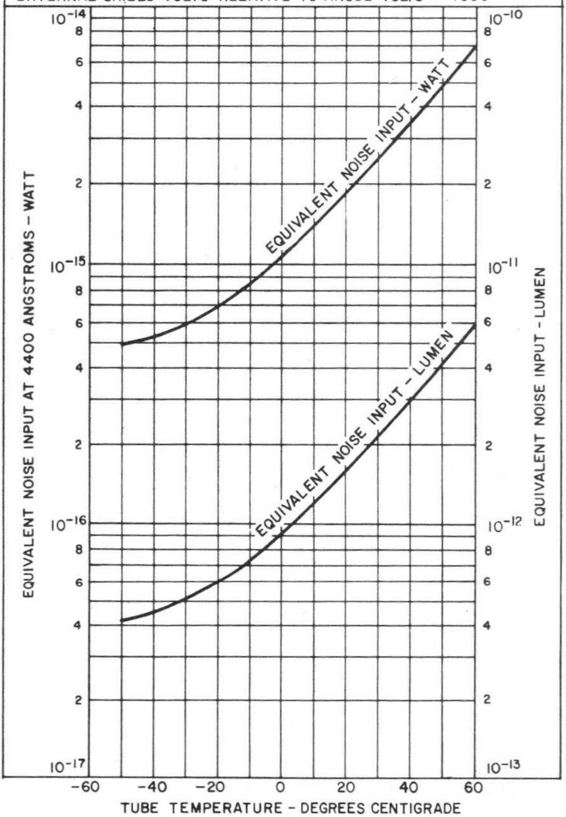
TYPICAL ANODE CHARACTERISTICS



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

Image Orthicon

MAGNETIC FOCUS MAGNETIC DEFLECTION

For Outdoor and Studio Pickup. The 5820A is Unilaterally Interchangeable with Type 5820.

DATA

General:

Heater, for Unipotential Cathode:
  Voltage (AC or DC) . . . . 6.3 ± 10% volts
  Current at 6.3 volts . . . . 0.6 amp
Direct Interelectrode Capacitance:
  Anode to all other electrodes . . . . 12 $\mu\mu$f
Spectral Response S-10
Wavelength of Maximum Response . . . . . 4500 ± 300 angstroms
Photocathode, Semitransparent:
  Rectangular image (4 x 3 aspect ratio):
    Useful size of . . . . 1.8" max. diagonal

Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

  Orientation of . . Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of face-plate and pin 7 of the shoulder base.

Focusing Method . . . . Magnetic
Deflection Method . . . . Magnetic
Overall Length . . . . 15.20" ± 0.25"
Greatest Diameter of Bulb . . . . 3.00" ± 0.06"
Minimum Deflecting-Coil Inside Diameter . . . . 2-3/8"
Deflecting-Coil Length . . . . 5"
Focusing-Coil Length . . . . 10"
Alignment-Coil Length . . . . 15/16"
Photocathode Distance Inside End of Focusing Coil . . . 1/2"
Operating Position . . . The tube should never be operated in a vertical position with the Diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.
Weight (Approx.) . . . . 1 lb 6 oz
Shoulder Base . . . . Keyed Jumbo Annular 7-Pin

BOTTOM VIEW[a]

Pin 1 - Grid No.6
Pin 2 - Photocathode
Pin 3 - Internal Connection—Do Not Use
Pin 4 - Internal Connection—Do Not Use
Pin 5 - Grid No.5
Pin 6 - Target
Pin 7 - Internal Connection—Do Not Use

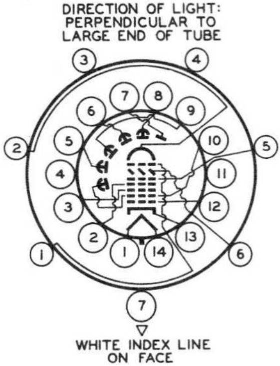
[a] See basing diagram on next page.

5820A

End Base. . . . . .Small-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-45)

BOTTOM VIEW

Pin 1 – Heater
Pin 2 – Grid No.4
Pin 3 – Grid No.3
Pin 4 – Internal Connection—Do Not Use
Pin 5 – Dynode No.2
Pin 6 – Dynode No.4
Pin 7 – Anode
Pin 8 – Dynode No.5
Pin 9 – Dynode No.3
Pin 10 – Dynode No.1, Grid No.2
Pin 11 – Internal Connection—Do Not Use
Pin 12 – Grid No.1
Pin 13 – Cathode
Pin 14 – Heater



Maximum and Minimum Ratings, *Absolute-Maximum Values:*

PHOTOCATHODE:		
Voltage	-550 max.	volts
Illumination.	50 max.	fc
OPERATING TEMPERATURE:		
Of any part of bulb	50 max.	°C
Of bulb at large end of tube (Target section).	35 min.	°C
TEMPERATURE DIFFERENCE:		
Between target section and any part of bulb hotter than target section. . .	5 max.	°C
GRID-No.6 VOLTAGE	-550 max.	volts
TARGET VOLTAGE:		
Positive value.	10 max.	volts
Negative value.	10 max.	volts
GRID-No.5 VOLTAGE	150 max.	volts
GRID-No.4 VOLTAGE	300 max.	volts
GRID-No.3 VOLTAGE	400 max.	volts
GRID-No.2 & DYNODE-No.1 VOLTAGE	350 max.	volts
GRID-No.1 VOLTAGE:		
Negative-bias value	125 max.	volts
Positive-bias value	0 max.	volts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode.	125 max.	volts
Heater positive with respect to cathode.	10 max.	volts
ANODE SUPPLY VOLTAGE[b]	1350 max.	volts
VOLTAGE PER MULTIPLIER STAGE.	350 max.	volts

Typical Operation:

Photocathode Voltage (Image Focus). . . .	-400 to -540	volts
Grid-No.6 Voltage (Accelerator)— Approx. 75% of photocathode voltage . .	-300 to -405	volts

Target-Cutoff Voltage[c]	−3 to +1	volts
Grid-No.5 Voltage (Decelerator)	0 to 125	volts
Grid-No.4 Voltage (Beam Focus)	140 to 180	volts
Grid-No.3 Voltage[d]	225 to 330	volts
Grid-No.2 & Dynode-No.1 Voltage	300	volts
Grid-No.1 Voltage for Picture Cutoff	−45 to −115	volts
Dynode-No.2 Voltage	600	volts
Dynode-No.3 Voltage	800	volts
Dynode-No.4 Voltage	1000	volts
Dynode-No.5 Voltage	1200	volts
Anode Voltage	1250	volts
Minimum Peak-to-Peak Blanking Voltage	5	volts
Field Strength at Center of Focusing Coil[e]	75	gausses
Field Strength of Alignment Coil	0 to 3	gausses

Performance Data:[f]

With conditions shown under Typical Operation and with camera lens set to bring the picture highlights one stop above the "knee" of the light transfer characteristic

	Min.	*Average*	*Max.*	
Cathode Radiant Sensitivity at 4500 angstroms	–	0.03	–	μa/μw
Luminous Sensitivity	30	60	–	μa/lumen
Anode Current (DC)	–	30	–	μa
Signal-Output Current (Peak-to-peak)	3	8	24	μa
Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc	35:1	45:1	–	←
Photocathode Illumination at 2870° K Required to Bring Picture Highlights One Stop Above "Knee" of Light Transfer Characteristic	–	0.02	0.04	fc
Peak-to-Peak Response to Square-Wave Test Pattern at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[g]	35	60	–	% ←
Uniformity:				
Ratio of Shading (Background) Signal to Highlight Signal	–	0.12	0.15	
Variation of Highlight Signal (Per cent of maximum highlight signal)[h]	–	20	25	%

[b] Dynode-voltage values are shown under *Typical Operation.*

[c] Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 to +5 volts.

[d] Adjust to give the most uniformly shaded picture near maximum signal.

← Indicates a change.

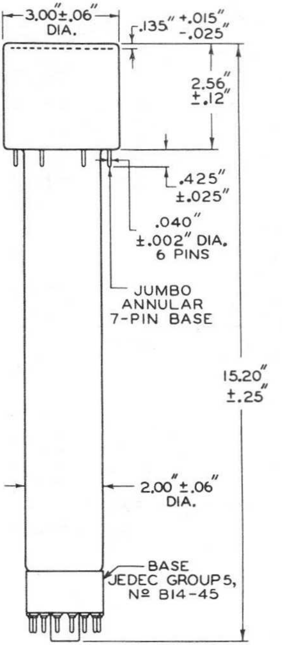
[e] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[f] With 5820A operated in properly adjusted RCA TK-31 camera.

[g] Measured with amplifier having flat frequency response.

[h] Variation of response over scanned area.

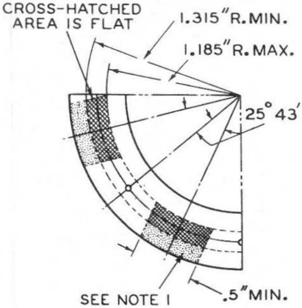
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-10 RESPONSE
is shown at front of this Section



ENLARGED BOTTOM VIEW

92CM-8293R3

DETAIL OF BOTTOM VIEW OF JUMBO ANNULAR BASE



NOTE 1: DOTTED AREA IS FLAT OR EXTENDS TOWARD DIHEPTAL-BASE END OF TUBE BY 0.060" MAX.

ANNULAR-BASE GAUGE

ANGULAR VARIATIONS BETWEEN PINS AS WELL AS ECCENTRICITY OF NECK CYLINDER WITH RESPECT TO PHOTO-CATHODE CYLINDER ARE HELD TO TOLERANCES SUCH THAT PINS AND NECK CYLINDER WILL FIT FLAT-PLATE GAUGE WITH:

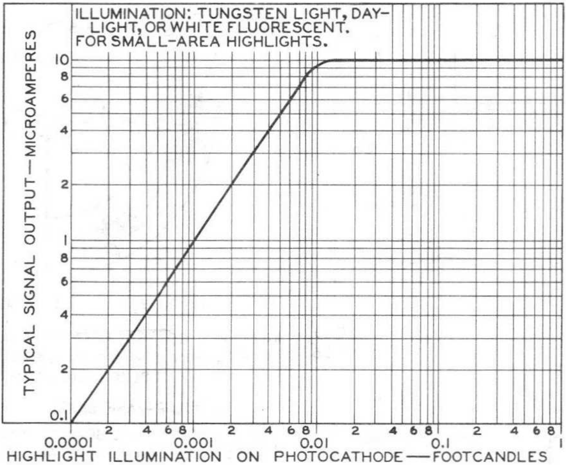
a. SIX HOLES HAVING DIAMETER OF 0.065" ± 0.001" AND ONE HOLE HAVING DIAMETER OF 0.150" ± 0.001". ALL HOLES HAVE DEPTH OF 0.265" ± 0.001". THE SIX 0.065" HOLES ARE ENLARGED BY 45° TAPER TO DEPTH OF 0.047". ALL HOLES ARE SPACED AT ANGLES OF 51°26' ± 5' ON CIRCLE DIAMETER OF 2.500" ± 0.001".

b. SEVEN STOPS HAVING HEIGHT OF 0.187" ± 0.001", CENTERED BETWEEN PIN HOLES TO BEAR AGAINST FLAT AREAS OF BASE.

c. RIM EXTENDING OUT A MINIMUM OF 0.125" FROM 2.812" DIAMETER AND HAVING HEIGHT OF 0.126" ± 0.001".

d. NECK-CYLINDER CLEARANCE HOLE HAVING DIAMETER OF 2.200" ± 0.001".

BASIC LIGHT-TRANSFER CHARACTERISTIC



92CS-7296R2

Image Orthicon

LONG-LIFE NON-DETERIORATING TARGET

MAGNETIC FOCUS — MAGNETIC DEFLECTION

For Outdoor and Studio Pickup with Black-and-White TV Cameras. The 5820A/L is Directly Interchangeable with the 5820 and 5820A in All Cameras.

The 5820A/L is the same as the 5820A except it utilizes a longer-life non-deteriorating glass target.

The sturdy, long-life, non-deteriorating, glass target of type 5820A/L is characterized by high gain, resistance to "burn-in", and the absence of any granular structure. Because charge transportation through this target material is electronic rather than ionic as in ordinary glass targets, the electrical characteristics of the target, such as secondary emission and resistivity, are essentially constant and sensitivity of the 5820A/L is stable throughout life.

Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster "burn-in" due to underscanning are significantly reduced. The resistance of the 5820A/L to image "burn-in" provides a highly desirable operational feature because it is not necessary to use an orbiter or continually move the camera when focused on a stationary scene.

OPERATING CONSIDERATIONS

Dos and Don'ts on Use of RCA-5820A/L

Dos

1. Allow the 5820A/L to warm up prior to operation.
2. Hold temperature of the 5820A/L within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 5820A/L's by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to exactly 2 volts above target cutoff.
7. Cap lens during standby operation.

Don'ts

1. Don't force the 5820A/L into its shoulder socket.
2. Don't operate the 5820A/L without scanning.
3. Don't operate a 5820A/L having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warm-up or standby operation.

Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-11 RESPONSE
1.24-INCH MINIMUM DIAMETER FLAT PHOTOCATHODE

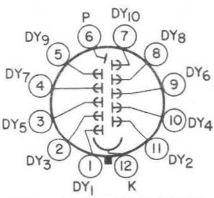
For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Portable Scintillation Counters

GENERAL

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 angstroms
Cathode, Semitransparent	Cs-Sb
Shape	Flat, Circular
Minimum area	1.2 sq in
Minimum diameter	1.24 in
Window	Lime Glass, Corning[a] No.0080, or equivalent
Shape	Plano-Plano
Index of refraction at 5893 angstroms	1.51
Dynodes	
Substrate	Ni
Secondary-emitting surface	Cs-Sb
Structure	Circular-Cage
Direct Interelectrode Capacitances (Approx.)	
Anode to dynode No.10	4.0 pF
Anode to all other electrodes	7.0 pF
Maximum Overall Length	4.57 in
Seated Length	3.88 ± 0.19 in
Maximum Diameter	1.56 in
Operating Position	Any
Weight (Approx.)	2.2 oz
Envelope	JEDEC T12
Base	Small-Shell Duodecal 12-Pin, (JEDEC No.B12-43), Non-hygroscopic
Socket	Eby[b] No.9058, or equivalent
Magnetic Shield	Millen[c] Part No.80802C, or equivalent ←

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

← Indicates a change.

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage		
Between anode and cathode	1250	V
Between dynode No.10 and anode	250	V
Between consecutive dynodes	200	V
Between dynode No.1 and cathode	300	V
Average Anode Current[d]	0.75	mA
Ambient Temperature[e]	75	°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 = 1000 V (Except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant[f] at 4400 angstroms	-	3.6×10^{4}	-	A/W
Cathode radiant[g] at 4400 angstroms	-	0.036	-	A/W
Luminous[h]	10	45	300	A/lm
Cathode luminous:				
With tungsten light source[j]	3×10^{-5}	4.5×10^{-5}	-	A/lm
With blue light source[k]	2.8×10^{-8}	-	-	A
Quantum Efficiency at 4200 angstroms	-	10	-	A/lm
Current Amplification	-	1×10^{6}	-	
Equivalent Anode-Dark-Current Input[m]	-	2.3×10^{-10}[n]	2.5×10^{-9}[n]	lm
	-	2.8×10^{-13}[p]	3.1×10^{-12}[p]	W
Anode Dark Current[m,n]	-	4.5×10^{-9}	-	A
Dark Current to Any Electrode Except Anode (at 22°C)	-	-	7.5×10^{-7}	A
Equivalent Noise Input[q]	-	4×10^{-12}	1.7×10^{-11}	lm
	-	5×10^{-15}[p]	2.1×10^{-14}[p]	W
Anode-Pulse Rise Time[r]	-	2.8×10^{-9}	-	s
Electron-Transit Time[s]	-	3.3×10^{-8}	-	s

[a] Made by Corning Glass Works, Corning, New York.

[b] Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia 44, Pennsylvania.

[c] Made by James Millen Manufacturing Company, 150 Exchange Street, Walden 48, Massachusetts.

[d] Averaged over any interval of 30 seconds maximum.

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

[f] This value is calculated from the typical value for luminous sensitivity using a conversion factor of 804 lumens per watt.

[g] This value is calculated from the typical value for cathode luminous sensitivity using a conversion factor of 804 lumens per watt.

→ Indicates a change.

h 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 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 167 volts are applied between cathode and all other electrodes connected as anode.

k 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°K. The value of light flux incident on the filter is 0.01 lumen and 167 volts are applied between cathode and all other electrodes connected as anode.

m Measured at a tube temperature of 22°C. Dark current may be reduced by use of a refrigerant.

n Measured with supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current is measured with no incident light on tube.

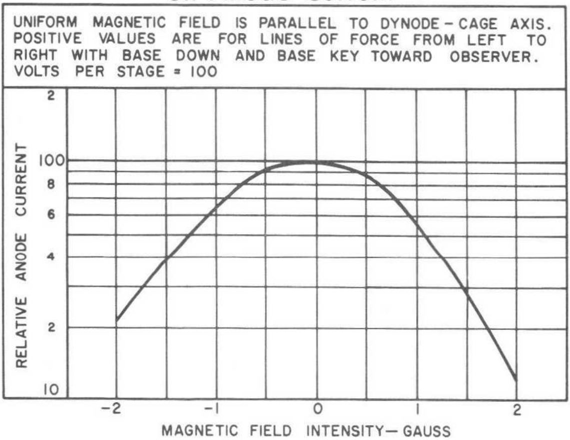
p At 4400 angstroms. This value is calculated from the rating in lumen using a conversion factor of 804 lumens per watt.

q Under the following conditions: Supply voltage (E) is as shown, 22°C tube temperature, 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.

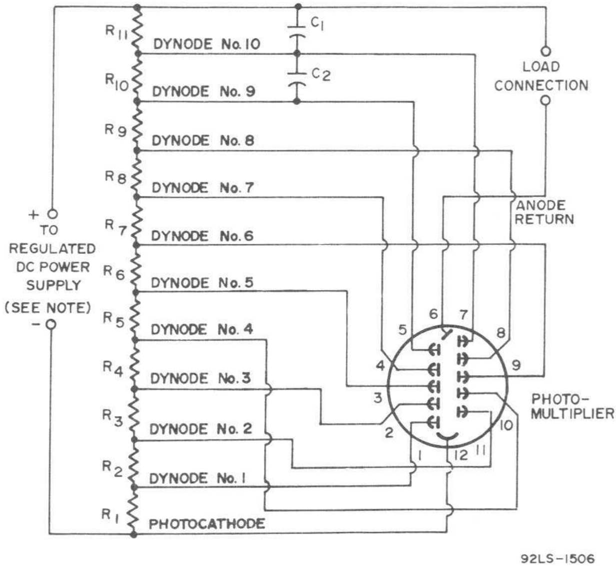
r Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is primarily a function of transit time variation and is measured under conditions with the incident light fully illuminating the photocathode.

s 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.

Typical Effect of Magnetic Field on Anode Current



TYPICAL VOLTAGE DIVIDER ARRANGEMENT



Note: Adjustable between approximately 500 and 1250 volts dc.

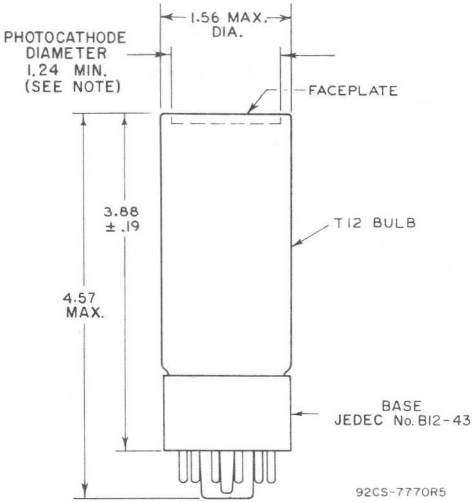
C_1, C_2: 0.01 µF, non-inductive type, 400 volts (dc working) — Values dependent on amplitude and duration of pulse.

R_1: 91,000 ohms, 2 watts

R_2 through R_{11}: 47,000 ohms, 1 watt

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

DIMENSIONAL OUTLINE

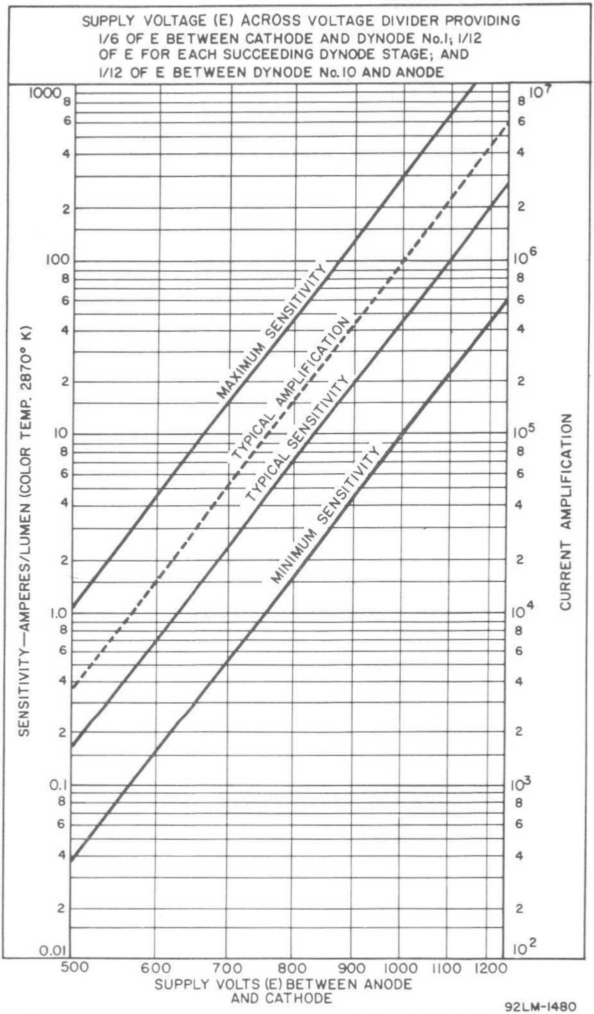


DIMENSIONS IN INCHES

Note: Deviation from flatness within the 1.24-inch diameter area will not exceed 0.010 inch from peak to valley.

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

Typical Sensitivity and Current Amplification Characteristics



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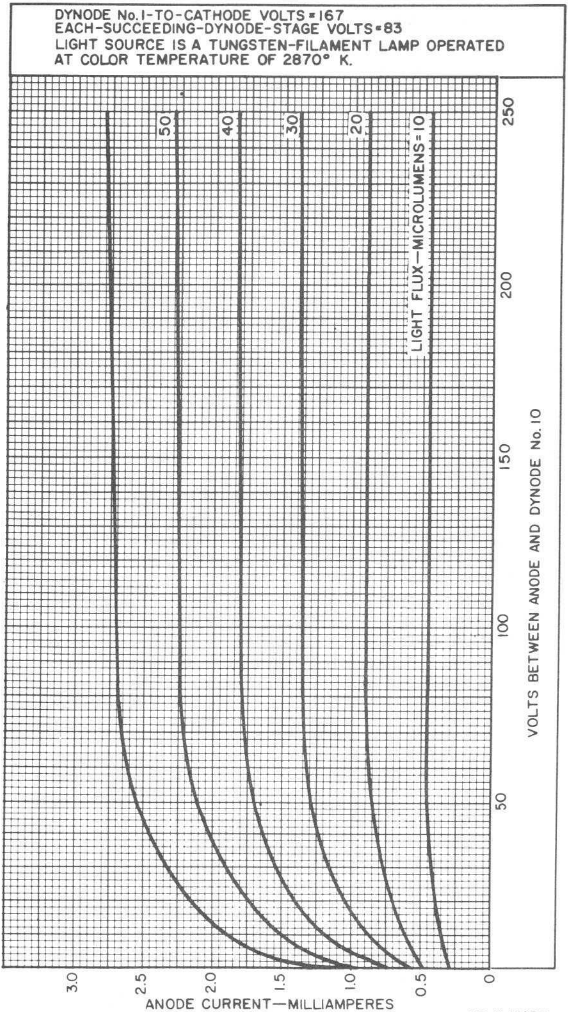
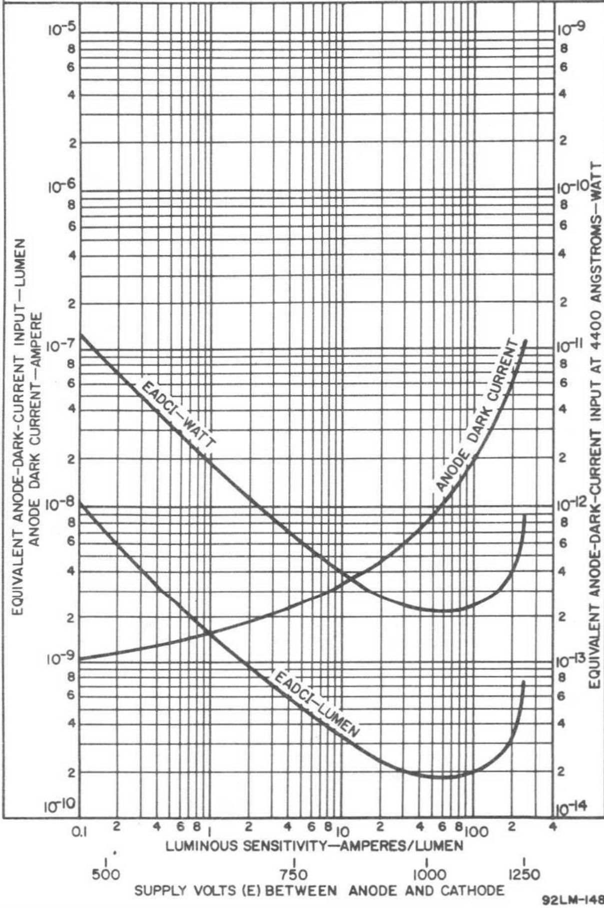
Typical Anode Characteristics



92LM-1483R1

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 1/2 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-1485

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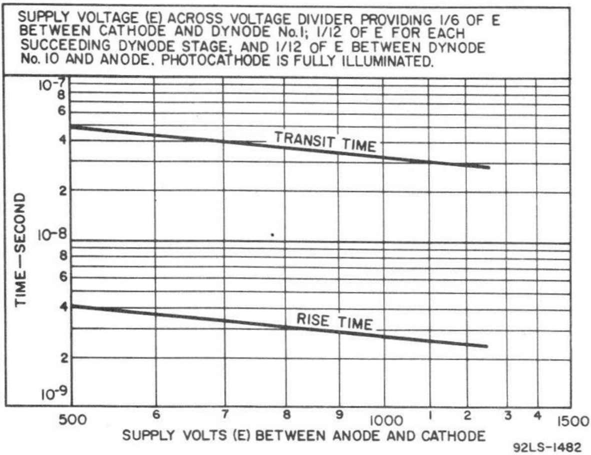
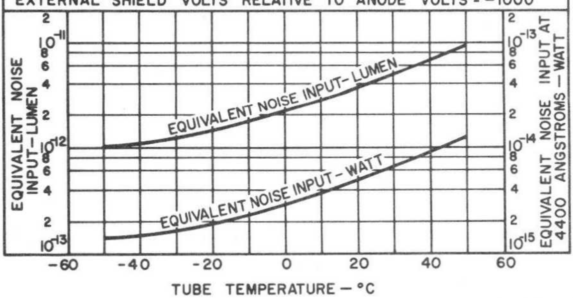
Typical Time-Resolution Characteristics



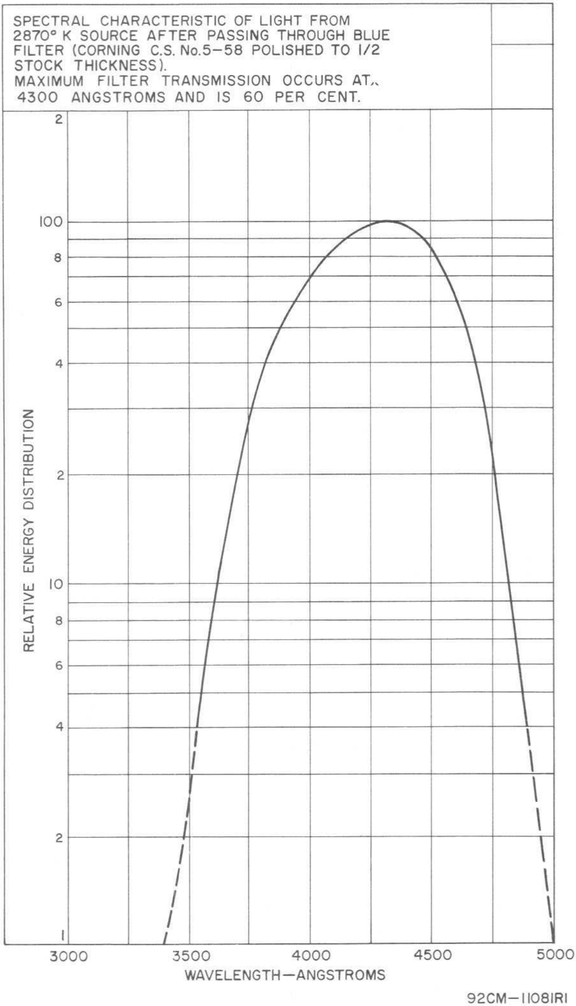
92LS-1482

Typical ENI Characteristics



92LS-1486

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



92CM—11081R1

Photomultiplier Tube

10-STAGE, CURVED-FACEPLATE TYPE HAVING S-10 RESPONSE

1-11/16 INCH MINIMUM DIAMETER CURVED PHOTOCATHODE

GENERAL

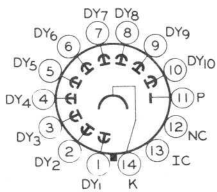
Spectral Response	S-10
Wavelength of Maximum Response	4500 ± 300 angstroms
Cathode, Semitransparent	Ag-Bi-O-Cs
Shape	Curved, Circular ←
Minimum area	2.2 sq in
Minimum diameter	1-11/16 in
Window	Lime Glass (Corning[a] No.0080), or equivalent ←
Index of refraction	1.51
Dynode Material	Cs-Sb ←
Direct Interelectrode Capacitances (Approx.)	
Anode to dynode No.10	4.2 pF
Anode to all other electrodes	6.5 pF
Maximum Overall Length	5.81 in
Seated Length	4.87 ± 0.19 in
Maximum Diameter	2.31 in
Operating Position	Any
Weight (Approx.)	5.2 oz
Envelope	JEDEC T16
Base	Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-38), Non-hygroscopic
Socket	Eby[b] No.9709-7, or equivalent ←
Magnetic Shield	JAN[c] No.S-2004, or equivalent ←

ABSOLUTE-MAXIMUM RATINGS

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 ←
Average Anode Current[d]	0.75	mA
Ambient Temperature	75	°C

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 – Do Not Use
Pin 14 – Photocathode



DIRECTION OF RADIATION: INTO END OF BULB

14M

← Indicates a change.

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 V (Except as noted)

	Min	Typ	Max	
Sensitivity				
Radiant, at 4500 angstroms	-	5.1×10^{4}	-	A/W
Cathode radiant, at 4500 angstroms	-	0.02	-	A/W
Luminous, at 0 c/s[e]	10	100	300	A/lm
Cathode luminous				
With tungsten light source[f]	2×10^{-5}	4×10^{-5}	-	A/lm
With red-infrared light source[g]	5×10^{-8}	-	-	A
Current Amplification	-	2.5×10^{6}	-	
Equivalent Anode-Dark-Current Input[h]	-	1.4×10^{-9}	2.5×10^{-8}	lm
At a luminous sensitivity of 20 A/lm				
Equivalent Noise Input[j]	-	4×10^{-11}	1.7×10^{-10}	lm
Dark Current	-	-	7.5×10^{-7}	A
To any electrode except anode at 25 °C				

With E = 750 V (Except as noted)

	Min	Typ	Max	
Sensitivity				
Radiant, at 4500 angstroms	-	5.1×10^{3}	-	A/W
Cathode radiant, at 4500 angstroms	-	0.02	-	A/W
Luminous, at 0 c/s[e]	-	10	-	A/lm
Cathode luminous				
With tungsten light source[f]	2×10^{-5}	4×10^{-5}	-	A/lm
With red-infrared light source[g]	5×10^{-8}	-	-	A
Current Amplification	-	2.5×10^{5}	-	

[a] Made by Corning Glass Works, Corning, New York.

[b] Made by Hugh H. Eby Company, 4701 Germantown Avenue, Philadelphia 44, Pa.

[c] Made by JAN Hardware Manufacturing Company, 38-01 Queens Blvd., Long Island City 1, New York.

[d] Averaged over any interval of 30 seconds maximum. For best stability, the average anode current value should not exceed 100 microamperes.

[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°K and a light input of 10 microlumens is used.

[f] 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 167 volts are applied between cathode and all other electrodes connected as anode.

[g] Under the following conditions: Light incident on the cathode is transmitted through a red-infrared filter (Combination of Corning C.S. Nos. 3-67 and 7-59, Glass Code No. 3482 and 5850, respectively—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux

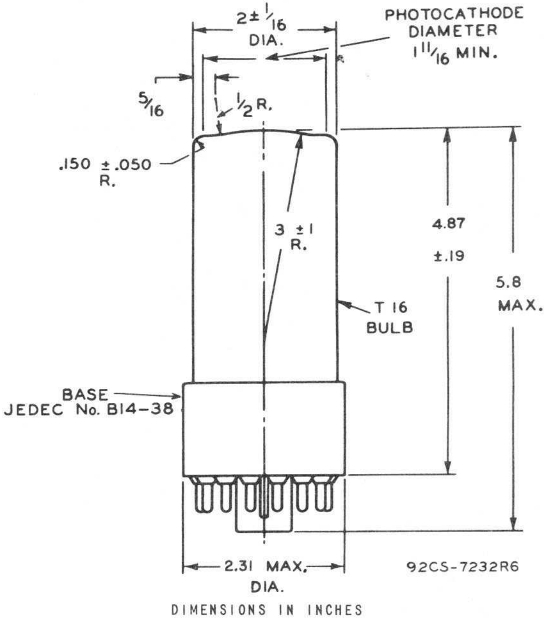
→ Indicates a change.

incident on the filter is 0.01 lumen and 167 volts are applied between cathode and all other electrodes connected at anode.

h At a tube temperature of 25°C. Prior to measurement, tube is stored in dark for a period of 30 minutes. Dark current may be reduced by use of a refrigerant.

j Under the following conditions: Supply voltage (E) is as shown, 25°C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

DIMENSIONAL OUTLINE



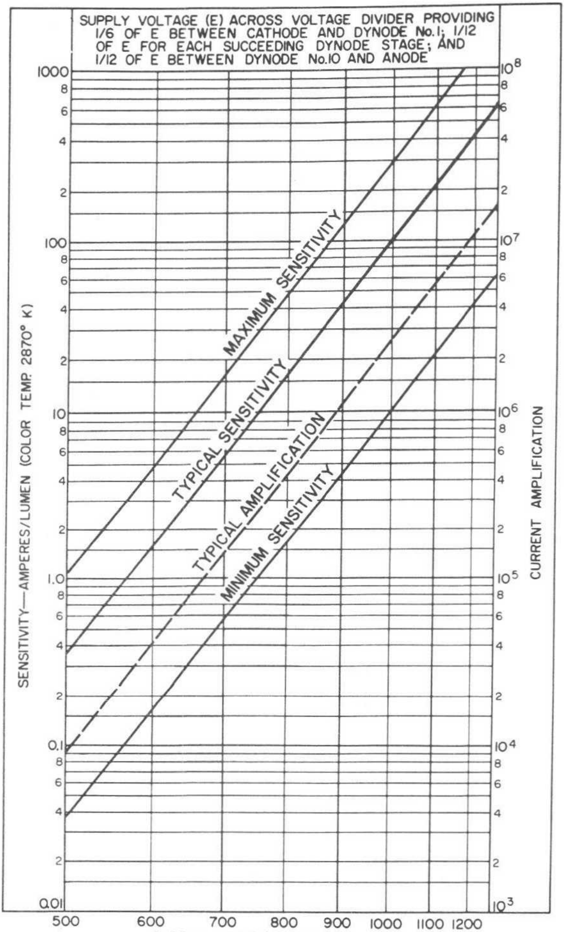
DIMENSIONS IN INCHES

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

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-10 Response
is shown at the front of this Section

TYPICAL ANODE CHARACTERISTICS
are the same as those shown for Type 6199

Typical Sensitivity and Current Amplification Characteristics



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

Photomultiplier Tube

9-STAGE, SIDE-ON TYPE HAVING S-4 RESPONSE

For AC-Operated Control Applications Such as Automobile-Headlight Control

GENERAL

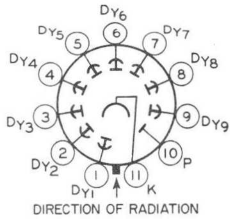
Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode, Opaque	Cs-Sb ←
Minimum projected length[a]	0.93 in
Minimum projected width	0.31 in
Window	Lime Glass, (Corning[b] No.0080), or equivalent ←
Dynode Material	Cs-Sb
Direct Interelectrode Capacitances (Approx.)	
Anode to dynode No.9	4.2 pF
Anode to all other electrodes	5.5 pF
Maximum Overall Length	3.12 in
Maximum Seated Length	2.69 in
Length	1.56 ± 0.09 in
From base seat to center of useful cathode area	
Maximum Diameter	1.31 in
Operating Position	Any
Weight (Approx.)	1.6 oz
Envelope	JEDEC T9
Base	Small-Shell Neosubmagnal 11-Pin (JEDEC No.B11-104), Non-hygroscopic
Socket	Amphenol[c] No.78S11T, or equivalent ←
Magnetic Shield	Millen[d] No.80801B, or equivalent ←

ABSOLUTE-MAXIMUM RATINGS

Peak AC Supply Voltage		
Between anode and cathode	1400	V ←
Between dynode No.9 and anode	250	V ←
Between consecutive dynodes	250	V ←
Between dynode No.1 and cathode	250	V ←
Average Anode Current[e]	0.1	mA
Ambient-Temperature	75	°C

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 – Anode
Pin 11 – Photocathode



←Indicates a change.

CHARACTERISTICS RANGE VALUES

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

With E = 1000 V dc

	Min	Typ	Max	
Sensitivity				
→ Radiant, at 4000 angstroms	-	3.4×10^{4}	-	A/W
Luminous, at 0 c/s[f] . . .	-	35	-	A/lm
Dark Current to Any Electrode At 25°C	-	-	7.5×10^{-7}	A

→ With E = Adjustable 60 c/s ac Voltage

	Min	Typ	Max	
Anode-to-Cathode Voltage[g] . . . . RMS values	525	750	990	V
Anode Dark Current[h] . . . . At 25°C	-	-	1×10^{-7}	A

[a] On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

[b] Made by Corning Glass Works, Corning, New York.

[c] Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 54, Illinois.

[d] Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts.

[e] Averaged over any interval of 30 seconds maximum.

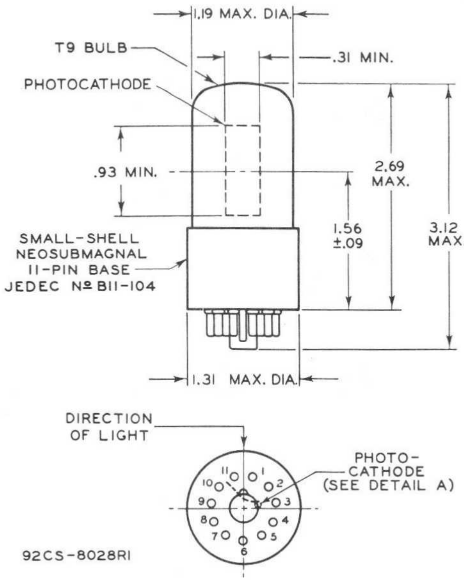
[f] Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870°K and a light input of 10 microlumens is used.

[g] Under the following conditions: Light incident on the cathode is transmitted through a filter (Corning C.S. No. 2-62, Glass Code No. 2418 which has an effective transmission of luminous flux of 5%—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870°K. The value of light flux incident on the filter is 10 microlumens. Supply voltage (E) is adjusted to give an anode current of 8 microamperes.

[h] For conditions same as (g) except no radiant flux on photocathode.

→ Indicates a change.

DIMENSIONAL OUTLINE

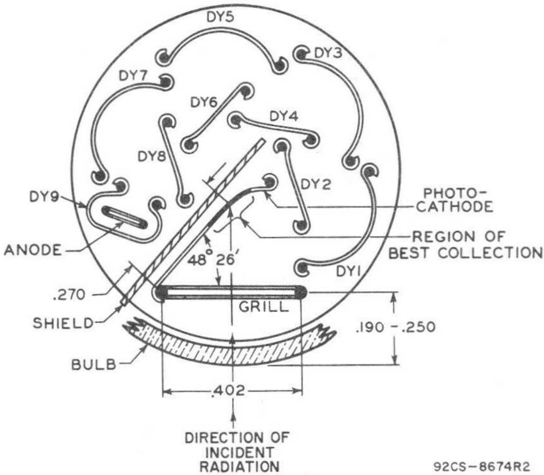


Center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

Note: The maximum angular variation between the planes through pins 1 and 11 and the plane of the grill will not exceed 6°.

DIMENSIONS IN INCHES

DETAIL A



92CS-8674R2

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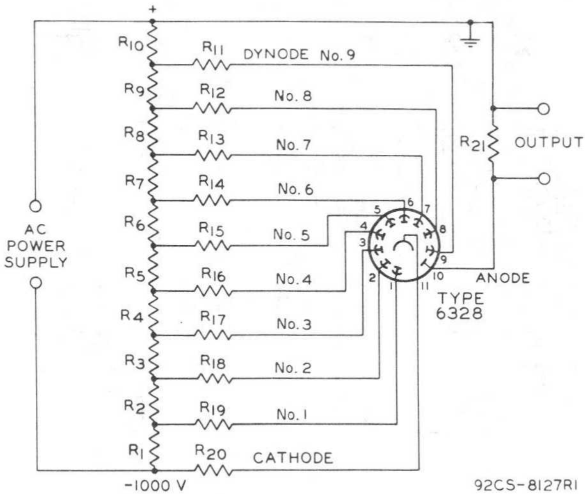
RECOMMENDED VOLTAGE-DIVIDER NETWORK FOR USE WITH TYPE 6328 IN HEADLIGHT-CONTROL SERVICE



R1 R2 R3 R4 R5
R6 R7 R8 R9 R10: 1 megohm, 1/2 watt

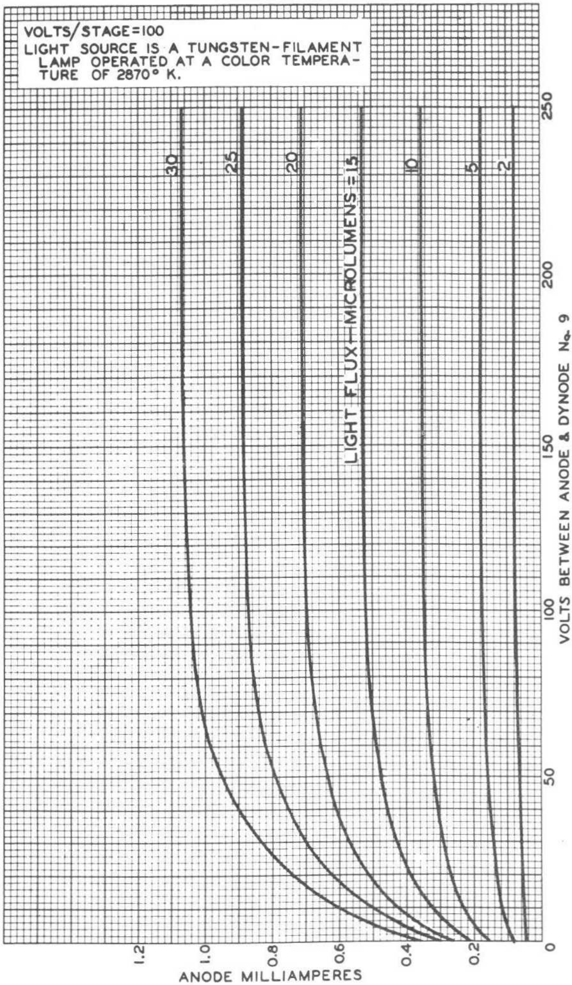
R11: 2 megohms, 1/2 watt

R12: 5.1 megohms, 1/2 watt

R13 R14 R15 R16
R17 R18 R19 R20: 8.2 megohms, 1/2 watt

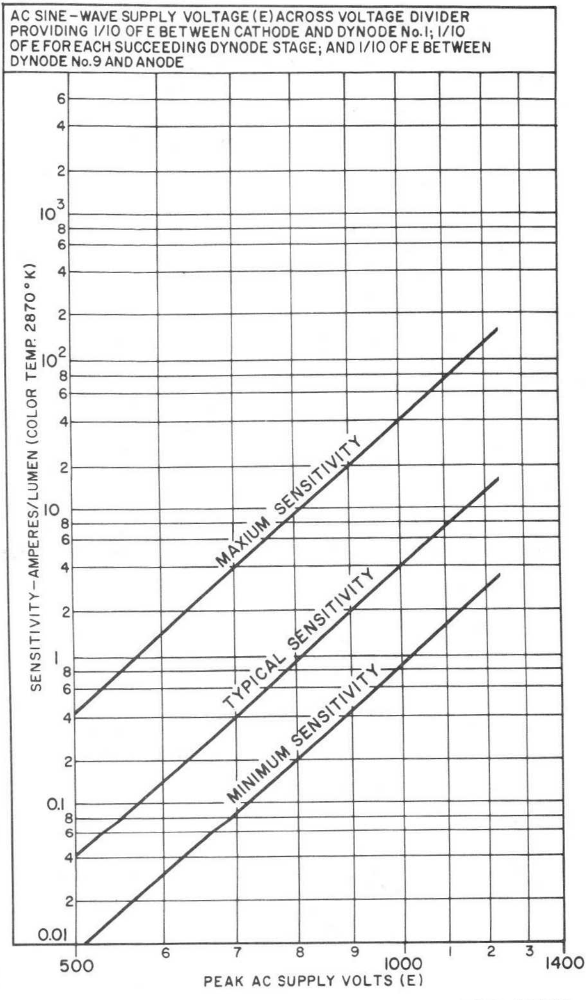
R21: 820,000 ohms, 1/2 watt

Typical Anode Characteristics



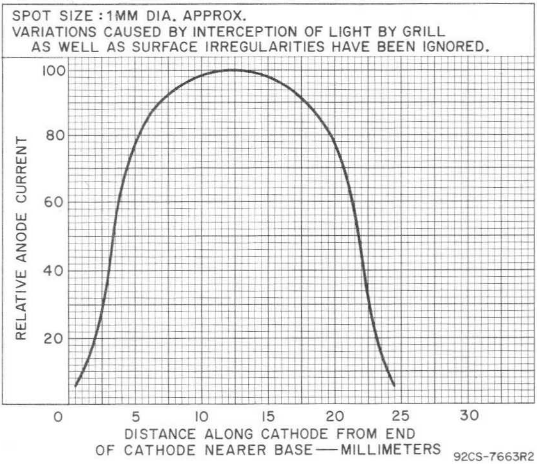
92CM-8029R2

Sensitivity Characteristics

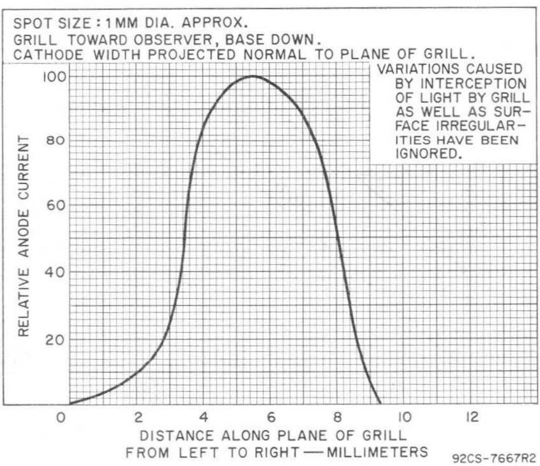


92CM-9571R1T

Variation in Photocathode Sensitivity Along Its Length



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



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

6342A

Multiplier Phototube

10-STAGE, HEAD-ON, FLAT-FACEPLATE | **ELECTROSTATICALLY FOCUSED DYNODE STAGES**

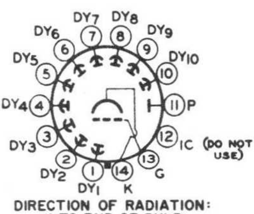
For Detection and Measurement of Nuclear Radiation and other Low-Level Light Sources in Scintillation Counters

DATA

General:

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 angstroms
Cathode, Semitransparent	Cesium-Antimony
Shape	Curved, Circular
Minimum area	2.2 sq. in.
Minimum diameter	1.68 in.
Window	Lime Glass (Corning[a] No.0080), or equivalent
Index of refraction	1.51
Dynode Material	Copper-Beryllium
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"
Seated Length	4.87" ± 0.19"
Maximum Diameter	2.31"
Operating Position	Any
Weight (Approx.)	5.2 oz
Bulb	T16
Socket	Loranger[b] No.2274, or equivalent
Magnetic Shield	Millen[c] No.80802B, 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

6342A

Maximum Ratings, *Absolute-Maximum Values*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC or Peak AC)	1500 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.10 AND ANODE (DC or Peak AC)	250 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.1 AND CATHODE (DC or Peak AC)	400 max.	volts
SUPPLY VOLTAGE BETWEEN FOCUSING ELECTRODE AND CATHODE (DC or Peak AC)	400 max.	volts
AVERAGE ANODE CURRENT[d]	2 max.	ma
AMBIENT TEMPERATURE	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. 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.*	
Sensitivity:				
Radiant, at 4400 angstroms	–	2.5×10^4	–	a/w
Cathode radiant at 4400 angstroms	–	0.064	–	a/w
Luminous:				
At 0 cps[e]	15	31	200	a/lm
With dynode No.10 as output electrode[f]	–	22	–	a/lm
Cathode Luminous:				
With tungsten light source[g]	5×10^{-5}	8×10^{-5}	–	a/lm
With blue light source[h,s]	5×10^{-8}	–	–	a
Current Amplification	–	3.9×10^5	–	
Equivalent Anode-Dark-Current Input[j]	–	2×10^{-10}[k]	2×10^{-9}[k]	lm
	–	2.5×10^{-13}[m]	2.5×10^{-12}[m]	w
Equivalent Noise Input[n]	–	7×10^{-12}	1.7×10^{-11}	lm
	–	8.7×10^{-15}[p]	2.1×10^{-14}[p]	w
Anode-Pulse Rise Time[q]	–	3×10^{-9}	–	sec
Greatest Delay Between Anode Pulses:				
Due to position from which electrons are simultaneously released within a circle centered on tube face having a diameter of —				

→ Indicates a change.

	Min.	Typical	Max.	
1-1/8"	–	1.3×10^{-9} [r]	–	sec
1-9/16"	–	4×10^{-9} [r]	–	sec

[a] Made by Corning Glass Works, Corning, New York.

[b] Made by Loranger Manufacturing Corporation, 36 Clark Street, Warren, Pennsylvania.

[c] Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts.

[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° K and a light input of 10 microlumens 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 a collector. The curves under *Typical Anode Characteristics* do 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° 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° 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.

[j] For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1250 volts is recommended.

[k] Measured at a tube temperature of 25° C and with a supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current may be reduced by use of a refrigerant.

[m] Determined at 4400 angstroms.

[n] Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

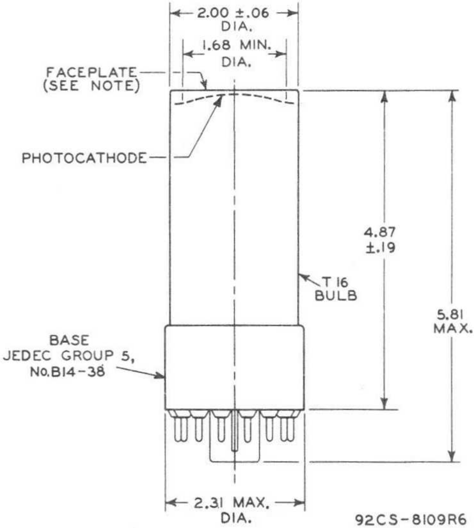
[p] Determined under the same conditions shown under (p) except that use is made of a monochromatic source having radiation at 4400 angstroms.

[q] 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 variations in the multiplier stages and is measured under conditions with an incident-light spot approximately 1 millimeter in diameter centered on the photocathode.

[r] These values also represent the difference in time of transit between the photocathode and dynode No.1 for electrons simultaneously released from the center and from the periphery of the specified areas.

[s] See *Spectral Characteristic of 2870° K Light Source* and *Spectral Characteristic of Light from 2870° K Source after passing through Indicated Blue Filter* at front of this Section.

SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-11 RESPONSE
is shown at the front of this Section

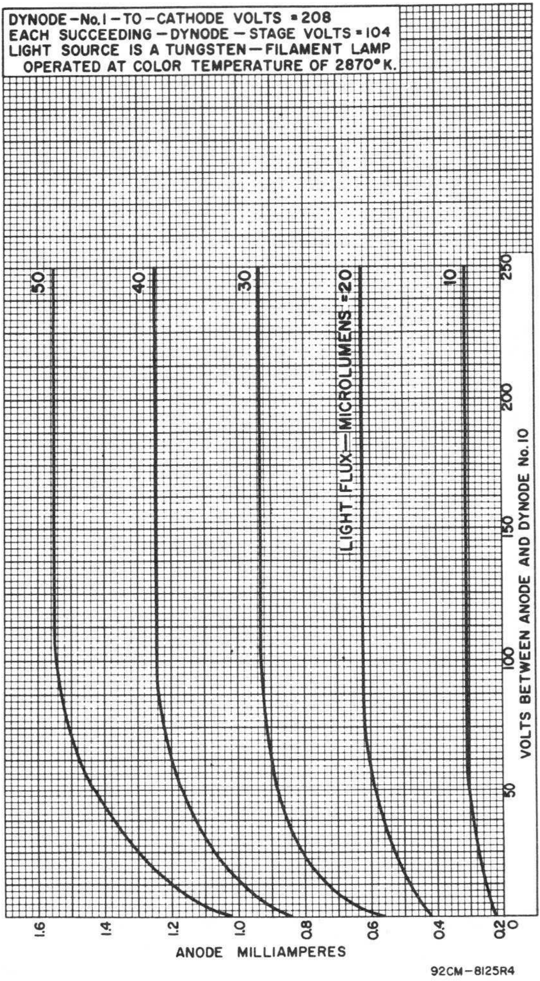


ALL DIMENSIONS IN INCHES

CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

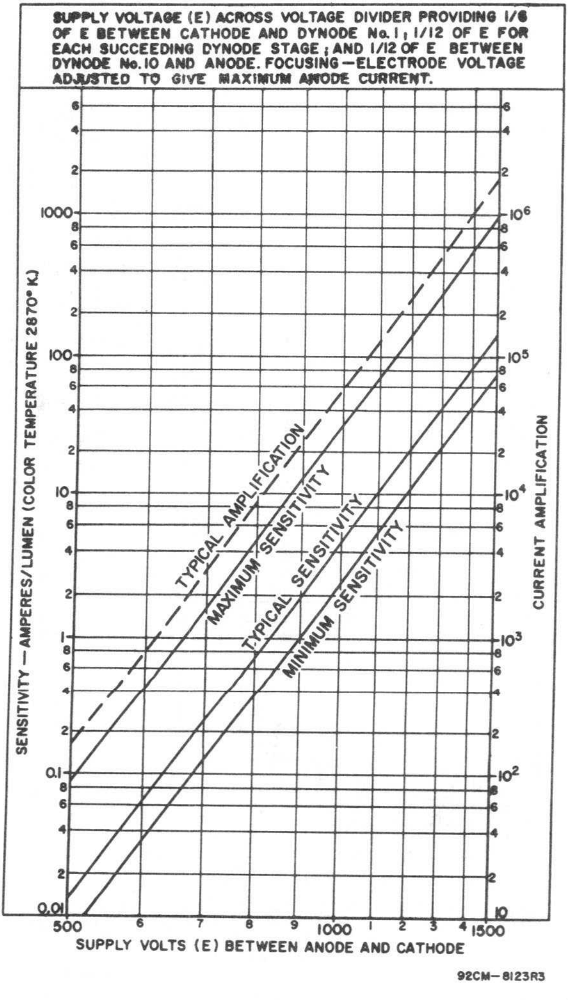
NOTE: WITHIN 1.68" DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.010" FROM PEAK TO VALLEY.

TYPICAL ANODE CHARACTERISTICS

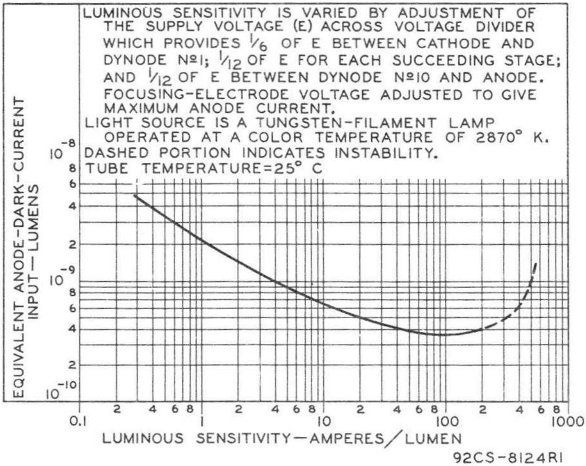


92CM-8125R4

CHARACTERISTICS



TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



Gas Phototube

SIDE-ON TYPE — S-1 RESPONSE

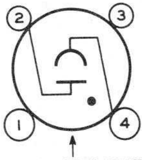
For Industrial Applications Critical as to Microphonics and Sensitivity Gradient

DATA

General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	1-1/4"
Minimum projected width[a]	5/8"
Direct Interelectrode Capacitance (Approx.)	2.6 pf
Maximum Overall Length	4-7/16"
Maximum Seated Length	3-13/16"
Seated Length to Center of Cathode	2-1/8" ± 3/32"
Maximum Diameter	1-1/8"
Operating Position	Any
Weight (Approx.)	1.3 oz
Bulb	T8
Socket	Amphenol No.77-MIP-4-T, or equivalent
Base	Dwarf-Shell Small 4-Pin (JEDEC No.A4-26) Non-hygroscopic
Basing Designation for BOTTOM VIEW	2K

Pin 1 - No Internal Connection
Pin 2 - Anode



DIRECTION OF RADIATION

Pin 3 - No Internal Connection
Pin 4 - Photocathode

Maximum Ratings, *Absolute-Maximum Values:*

	Rating I	*Rating II*	
ANODE SUPPLY VOLTAGE (DC or Peak AC)	70 max.	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	50 max.	25 max.	μa/sq.in.
AVERAGE CATHODE CURRENT[b]	10 max.	5 max.	μa
AMBIENT TEMPERATURE	100 max.	100 max.	°C

Characteristics:

With an anode-supply voltage of 50 volts unless otherwise specified

	Min.	*Typical*	*Max.*	
Sensitivity:				
Radiant, at 8000 angstroms	–	0.0033	–	a/w ←

← Indicates a change.

	Min.	Typical	Max.	
Luminous:[c]				
At 0 cps.	17.5	35	70	μa/lumen
At 5000 cps	–	30	–	μa/lumen
At 10000 cps.	–	26	–	μa/lumen
Sensitivity Difference between highest value and lowest value along cathode length[d] .	–	–	1.1	μa/lumen
Gas amplification Factor [e]. . .	–	–	2.5	
Anode Dark Current at 25° C . .	–	–	0.1	μa

Minimum Circuit Values:

With an anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 5 μa.	0.1 min.	–	megohm
For dc currents below 5 μa.	0 min.	–	megohm
For dc currents above 3 μa.	–	2.5 min.	megohms
For dc currents below 3 μa.	–	0.1 min.	megohm

[a] On plane perpendicular to indicated direction of incident radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply of 50 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

[d] Measured under the same conditions as indicated under "c" with light input of 0.1 lumen and a rectangular light spot having a width of 0.315 inch and a length sufficient to cover the length of the cathode.

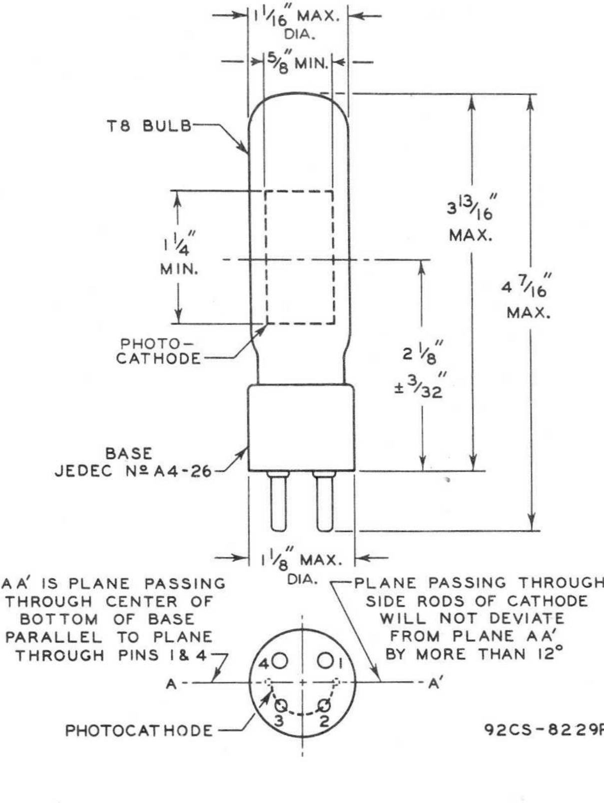
[e] The ratio of luminous sensitivity at an anode-supply voltage of 50 volts to luminous sensitivity at an anode-supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE

and

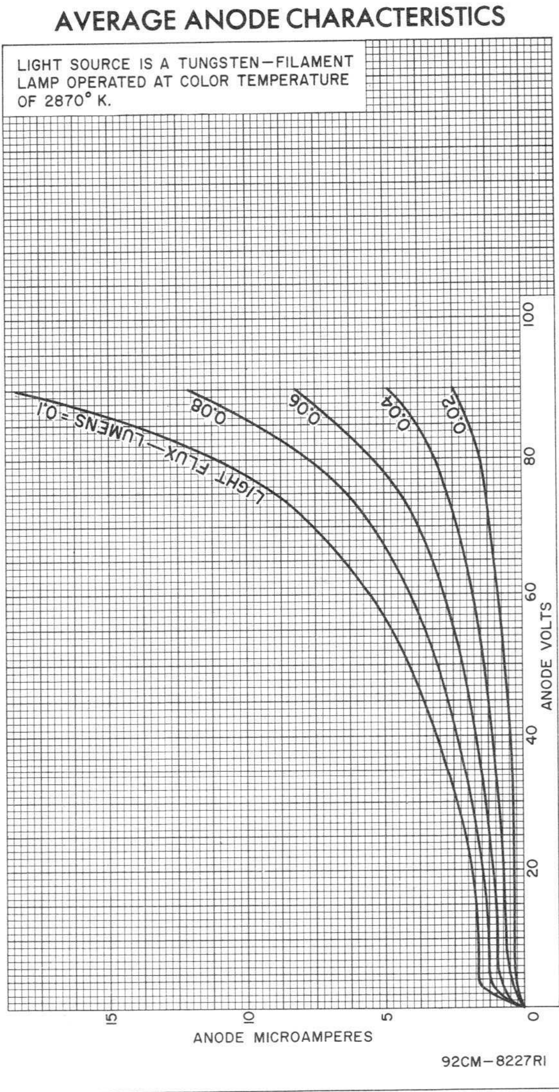
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section


1 1/16" MAX. DIA.
5/8" MIN.
T8 BULB
1 1/4" MIN.
3 13/16" MAX.
4 7/16" MAX.
PHOTO-CATHODE
2 1/8" ± 3/32"
BASE JEDEC No A4-26
1 1/8" MAX. DIA.
AA' IS PLANE PASSING THROUGH CENTER OF BOTTOM OF BASE PARALLEL TO PLANE THROUGH PINS 1 & 4
PLANE PASSING THROUGH SIDE RODS OF CATHODE WILL NOT DEVIATE FROM PLANE AA' BY MORE THAN 12°
A
A'
4
1
3
2
PHOTOCATHODE

92CS-8229R1

6405/1640



RADIO CORPORATION OF AMERICA
Electron Tube Division
Harrison, N. J.

Photomultiplier Tube

S-4 RESPONSE

FLEXIBLE LEADS — SIDE-ON, 9-STAGE TYPE

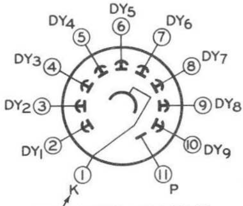
For AC- or DC-Operated Control Applications Which Require High Luminous Sensitivity

GENERAL

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode, Opaque	Cs-Sb ←
Minimum projected length[a]	15/16 in
Minimum projected width[a]	5/16 in
Window	Lime Glass, (Corning[b] No.0080), or equivalent ←
Dynode Material	Cs-Sb ←
Direct Interelectrode Cappacitances (Approx.)	
Anode-to-dynode No.9	3.8 pF
Anode to all other electrodes	4.8 pF
Maximum Overall Length Excluding semiflexible leads	2-3/4 in
Maximum Envelope Length Excluding tip	2-1/4 in
Length From envelope seal to center of useful cathode area	1-1/4 ± 3/32 in
Maximum Diameter	1-3/16 in
Operating Position	Any
Weight (Approx.)	2 oz
Envelope	JEDEC T9
Magnetic Shield	Perfection Mica Co.,[c] No.P-107, or equivalent

TERMINAL DIAGRAM (Bottom View)

Lead 1 – Photocathode
Lead 2 – Dynode No.1
Lead 3 – Dynode No.2
Lead 4 – Dynode No.3
Lead 5 – Dynode No.4
Lead 6 – Dynode No.5
Lead 7 – Dynode No.6
Lead 8 – Dynode No.7
Lead 9 – Dynode No.8
Lead 10 – Dynode No.9
Lead 11 – Anode



ABSOLUTE-MAXIMUM RATINGS

DC or Peak AC Supply Voltage	
Between anode and cathode	1250 V
Between anode and dynode No.9	250 V
Between consecutive dynodes	250 V ←
Between dynode No.1 and cathode	250 V ←
Average Anode Current[d]	0.1 mA
Ambient Temperature	75 °C ←

← Indicates a change.

CHARACTERISTICS RANGE VALUES

Under conditions with 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.

With E = 1000 V dc

	Min	*Typ*	*Max*	
Sensitivity				
Radiant, at 4000 angstroms	-	3.4×10^4	-	A/W
Luminous, at 0 c/s[e]	5	35	250	A/lm
Dark Current to any Electrode	-	-	7.5×10^{-7}	A
At 25°C				

With E = Adjustable 60 c/s ac voltage

	Min	*Typ*	*Max*	
→ Anode-to-Cathode Voltage[f]				
RMS Values	535	775	1000	V
Anode Dark Current[g]	-	-	2.5×10^{-7}	A
At 25°C				

[a] On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

[b] Made by Corning Glass Works, Corning, New York.

[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.

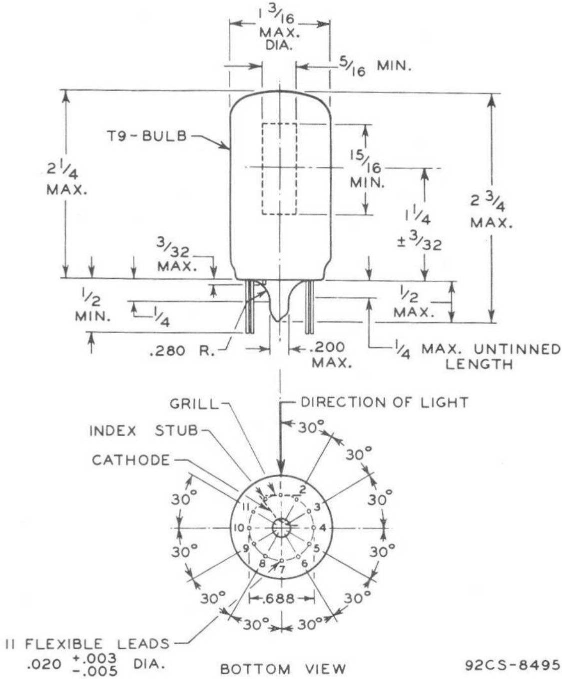
[e] Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870° K and a light input of 10 microlumens is used.

[f] 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 1 microlumen is used. Supply Voltage (E) is adjusted to give an anode current of 7.5 microamperes.

[g] For conditions same as (f) except no radiant flux on photocathode.

→ Indicates a change.

DIMENSIONAL OUTLINE

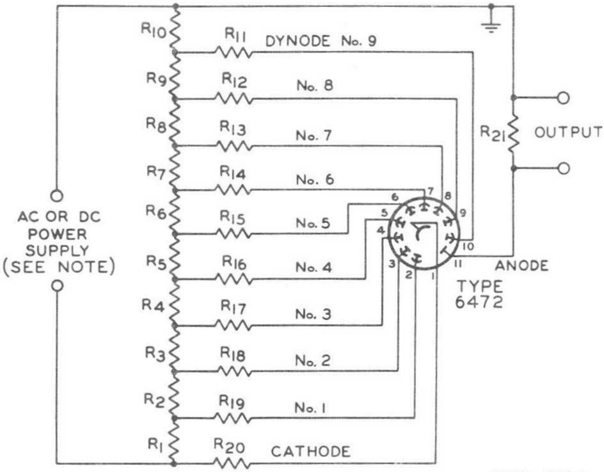


DIMENSIONS IN INCHES

The angular variation between the plane through Lead No.1 and tube axis and the plane perpendicular to the plane of the grill will not exceed 20°.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-4 Response
is shown at front of this section

RECOMMENDED VOLTAGE-DIVIDER NETWORK FOR USE
WITH TYPE 6472 IN HEADLIGHT-DIMMING SERVICE



92CS-8526

R1 R2 R3 R4 R5
R6 R7 R8 R9 R10: 1 megohm, 1/2 watt
R11: 2 megohms, 1/2 watt
R12: 5.1 megohms, 1/2 watt
R13 R14 R15 R16
R17 R18 R19 R20: 8.2 megohms, 1/2 watt
R21: 820,000 ohms, 1/2 watt

Note: Adjustable between approximately 500 and 1000 volts dc or peak ac.

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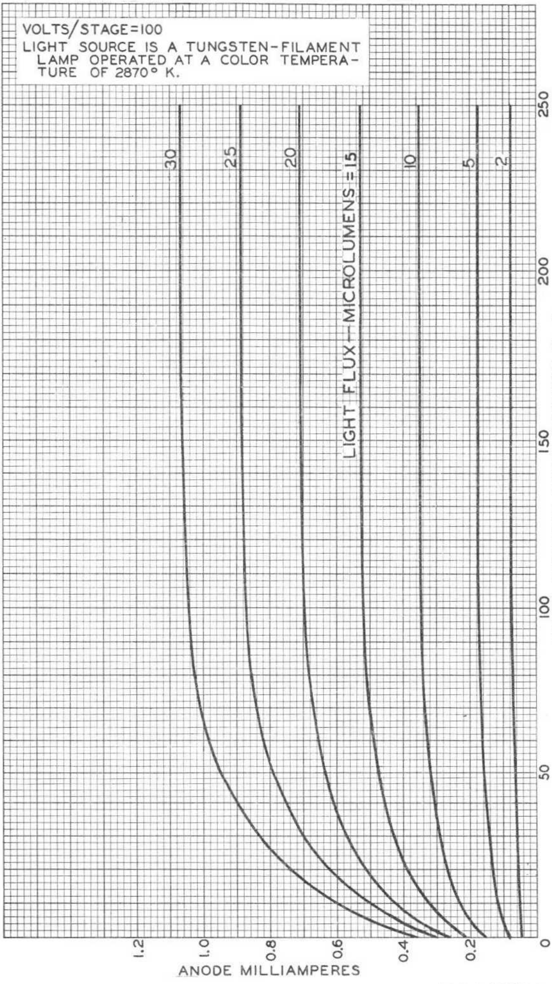
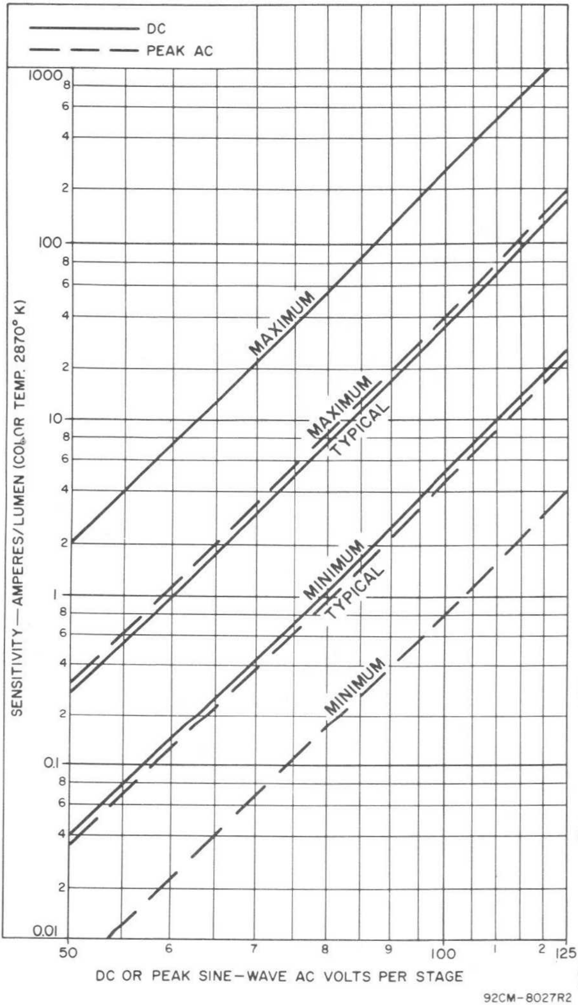
Electronic Components and Devices Harrison, N. J.

Typical Anode Characteristics



92CM-8029R2

Range of Luminous Sensitivity



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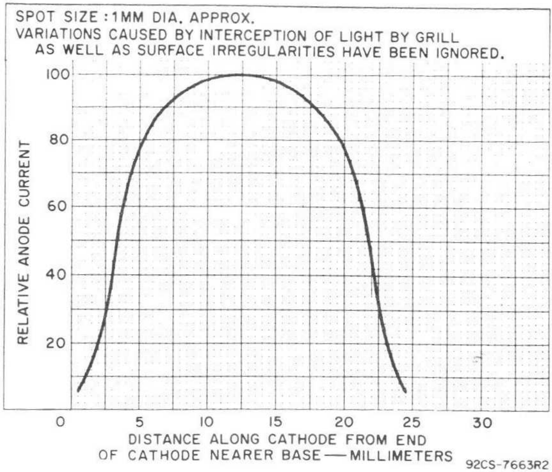
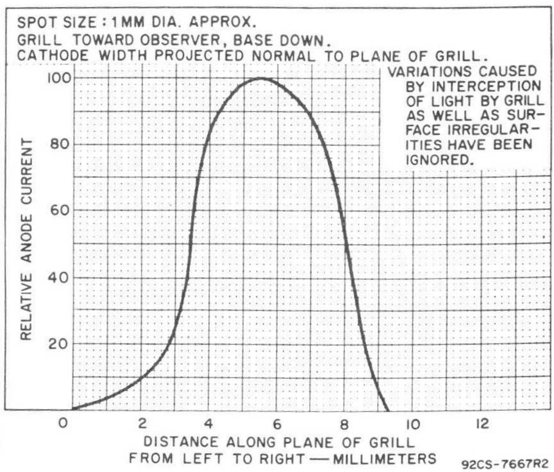
Electronic Components and Devices Harrison, N. J.

Variation in Photocathode Sensitivity Along Its Length



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



6570

VACUUM PHOTOTUBE

LOW-MICROPHONIC TYPE WITH S-1 RESPONSE

DATA

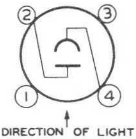
General:

Spectral Response	S-1
Wavelength of Maximum Response	8000 ± 1000 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length*	1-1/4"
Minimum projected width*	5/8"
Direct Interelectrode Capacitance	3 $\mu\mu$f
Overall Length	4-5/16" ± 1/8"
Seated Length	3-11/16" ± 1/8"
Seated Length to Center of Cathode	2-1/8" ± 3/32"
Maximum Diameter	1-1/8"
Mounting Position	Any
Weight (Approx.)	1.3 oz
Bulb	T-8
Base	Dwarf-Shell Small 4-Pin (JETEC No.A4-26), Non-hygroscopic

BOTTOM VIEW

Pin 1 - No Connection

Pin 2 - Anode



Pin 3 - No Connection

Pin 4 - Cathode

Maximum Ratings, *Absolute Values:*

ANODE-SUPPLY VOLTAGE (DC or Peak AC)	500 max.	volts
AVERAGE CATHODE-CURRENT DENSITY°	25 max.	μamp/sq.in.
AVERAGE CATHODE CURRENT°	5 max.	μamp
AMBIENT TEMPERATURE	100 max.	°C

Characteristics at 250 Volts on Anode:

	Min.	*Av.*	*Max.*	
Sensitivity:				
Radiant at 8000 angstroms	–	0.0027	–	μamp/μwatt
Luminous#	20	30	40	μamp/lumen
Sensitivity Difference Between Highest Value and Lowest Value Along Cathode Length▲	–	–	4.5	μamp/lumen
Anode Dark Current at 25°C	–	–	0.013	μamp

* On plane perpendicular to indicated direction of incident light.

° Averaged over any interval of 30 seconds maximum.

For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870°K. A dc anode supply of 250 volts, a 1-megohm load resistor, and a light input of 0.1 lumen are used.

▲ Measured under the same conditions as indicated under (#) with light input of 0.1 lumen and a light spot 1/2 inch in diameter.

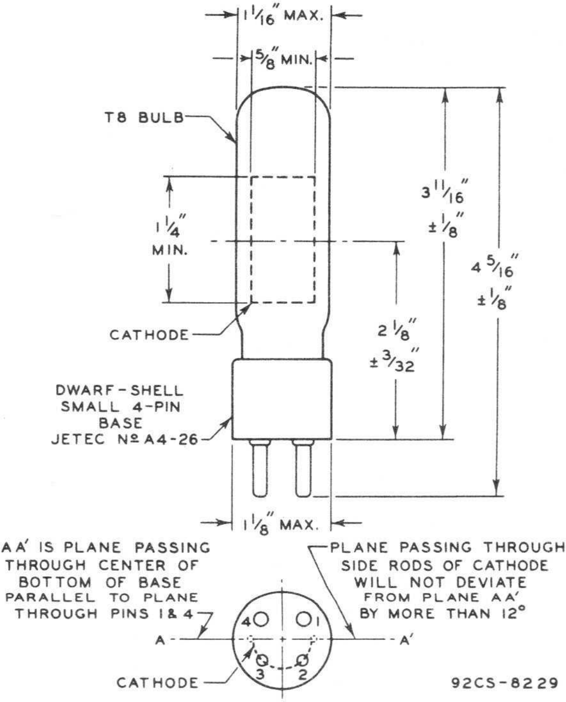
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6570

VACUUM PHOTOTUBE

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-1 Response
is shown at the front of this Section

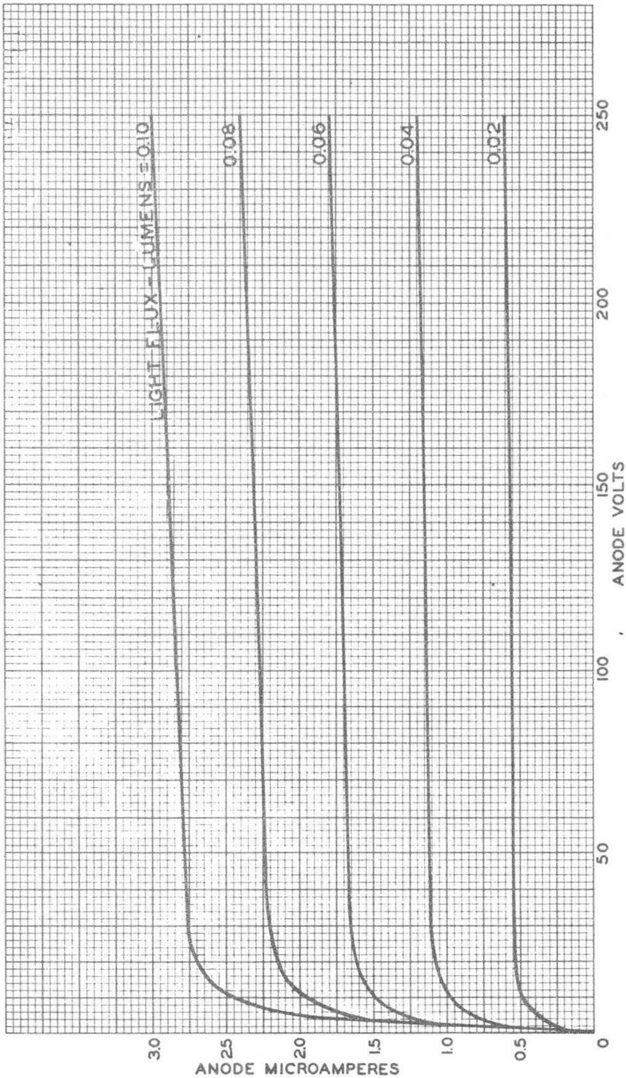


TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6570

AVERAGE ANODE CHARACTERISTICS



DEC. 3, 1954

TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-8491

Photomultiplier Tube

10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-11 RESPONSE
1.68-INCH MINIMUM DIAMETER CURVED PHOTOCATHODE

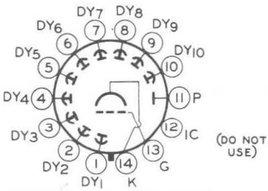
For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources

GENERAL

Spectral Response S-11
Wavelength of Maximum Response . . . . . 4400 ± 500 angstroms
Cathode, Semitransparent . . . . Cs-Sb
  Shape. . . . . Curved, Circular
  Minimum projected area . . . . 2.2 sq in
  Minimum diameter . . . . 1.68 in
Window . . . . . . .Lime Glass, Corning[a] No.0080, or equivalent
  Shape. . . . . Plano-Concave
  Index of refraction at 5893 angstroms. 1.51
Dynodes
  Substrate. . . . . Ni
  Secondary-Emitting Surface . . . . Cs-Sb
  Structure. . . . . .Circular-Cage
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
Seated Length. . . . . 4.87 ± 0.19 in
Maximum Diameter . . . . 2.31 in
Operating Position . . . . Any
Weight (Approx.) . . . . 5.2 oz
Envelope . . . . .JEDEC T16
Base . Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-38), Non-hygroscopic
Socket . . . . Loranger[b] No.2274, or equivalent
Magnetic Shield. . . . . Millen[c] Part No.80802B, or equivalent ←

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 – Do Not Use
Pin 13 – Focusing Electrode
Pin 14 – Photocathode



DIRECTION OF RADIATION: INTO END OF BULB

14AA

←Indicates a change.

→

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage		
Between anode and cathode	1250	V
Between dynode No.10 and anode	250	V
Between consecutive dynodes	200	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[e]	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 per cent of dynode No.1 potential (referred to cathode) which provides maximum anode current.

With E = 1000 V dc (Except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant,[f] at 4400 angstroms	-	9.6×10^{4}	-	A/W
Cathode radiant,[g] at 4400 angstroms	-	0.061	-	A/W
Luminous[h]	10	120	300	A/lm
Cathode luminous:				
With tungsten light source[j]	4×10^{-5}	7.6×10^{-5}	-	A/lm
With blue light source[k]	4×10^{-8}	-	-	A
Quantum Efficiency at 4200 Angstroms	-	17	-	%
Current Amplification	-	1.6×10^{6}	-	
Equivalent Anode-Dark-Current Input[m]	-	3×10^{-10}[n]	2×10^{-9}[n]	lm
	-	3.7×10^{-13}[p]	2.5×10^{-12}[p]	W
Anode Dark Current[m,n]	-	6×10^{-9}	-	A
Equivalent Noise Input[q]	-	8×10^{-13}	2.7×10^{-11}	lm
	-	1×10^{-15}[p]	3.4×10^{-14}[p]	W
Anode-Pulse Rise Time[r]	-	3.4×10^{-9}	-	s
Electron Transit Time[s]	-	3.4×10^{-8}	-	s

[a] Made by Corning Glass Works, Corning, New York.

[b] Made by Loranger Manufacturing Corp., 36 Clark St., Warren, Pa.

[c] Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts.

[d] Averaged over any interval of 30 seconds maximum.

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

[f] This value is calculated from the typical value for luminous sensitivity using a conversion factor of 804 lumens per watt.

[g] This value is calculated from the typical value for cathode luminous sensitivity using a conversion factor of 804 lumens per watt.

[h] 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.

→ Indicates a change.

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 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.

k 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°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.

m Measured at a tube temperature of 22°C. Dark current may be reduced by use of a refrigerant.

n Measured with supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current is measured with no incident light on tube.

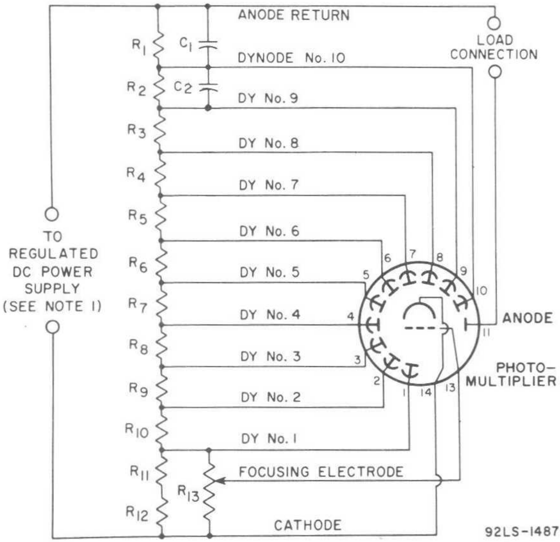
p At 4400 angstroms. This value is calculated from the rating in lumen using a conversion factor of 804 lumens per watt.

q Under the following conditions: Supply voltage (E) is as shown, 22°C tube temperature, 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 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.

s 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.

TYPICAL VOLTAGE DIVIDER ARRANGEMENT



C_1, C_2: 0.01 μF non-inductive type, 400 volts (dc working). Values dependent on amplitude and duration of pulse.

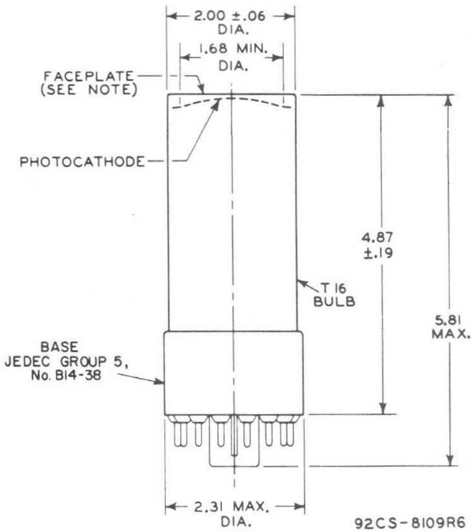
R_1 through R_{12}: 33,000 ohms, 2 watts.

R_{13}: 2.5 megohms, 2 watts, adjustable.

Note 1: Adjustable between approximately 500 and 1250 volts dc.

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

DIMENSIONAL OUTLINE



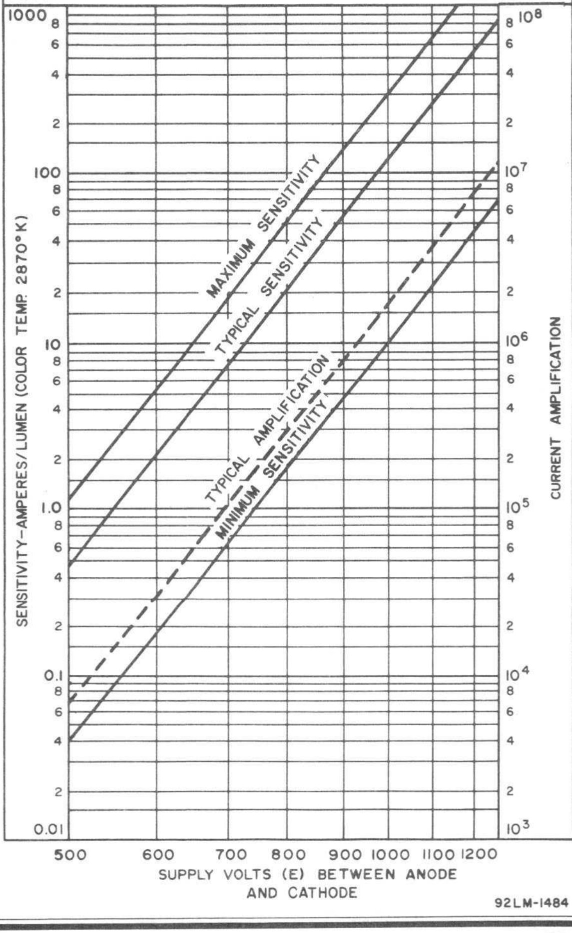
DIMENSIONS IN INCHES

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

Note: Within 1.68 inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

Typical Sensitivity and Current Amplification Characteristics

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.



92LM-1484

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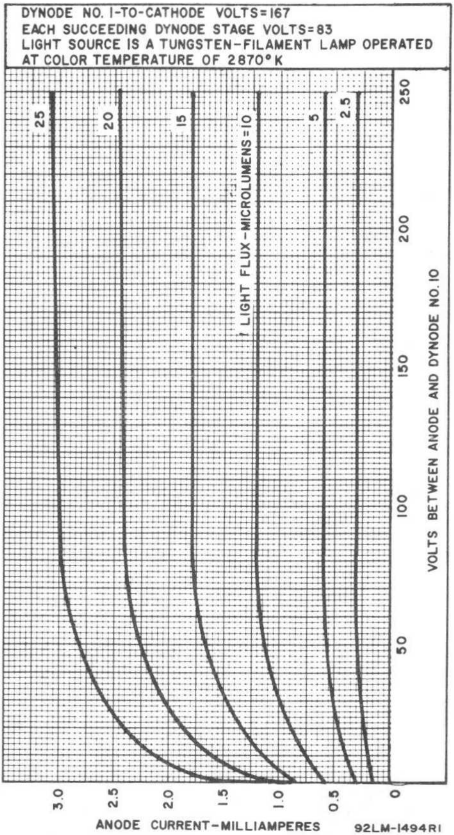
Typical Anode Characteristics



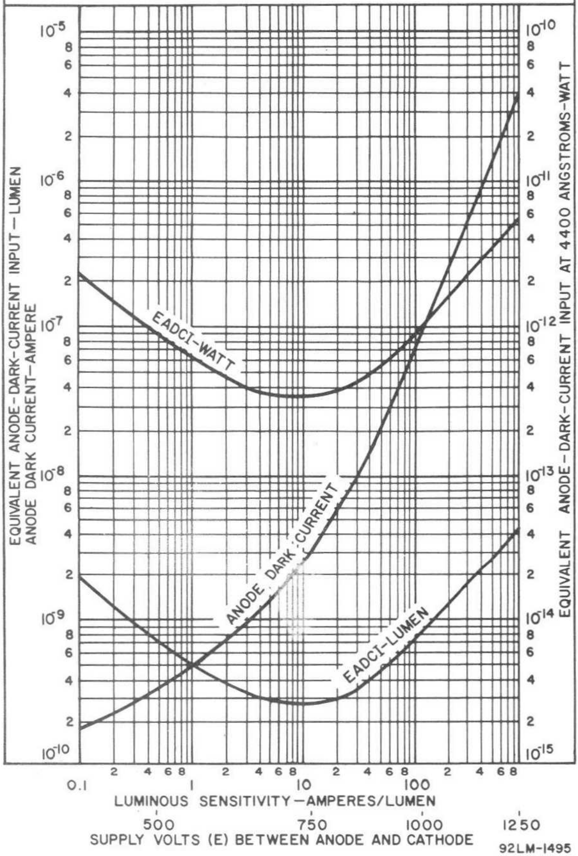
Typical Dark Current and EADCI Characteristics

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.

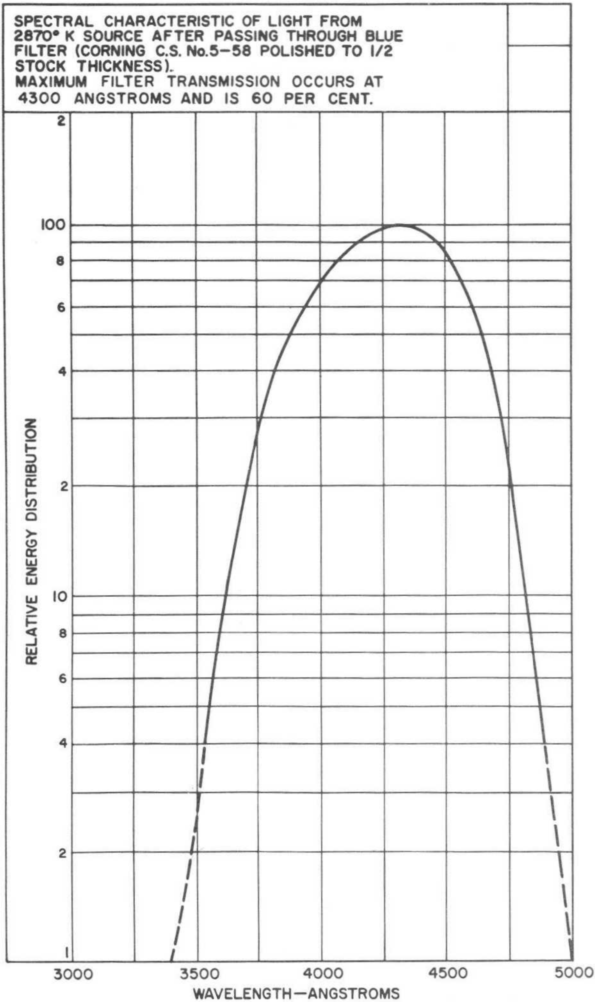
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.

TUBE TEMPERATURE = 22°C.



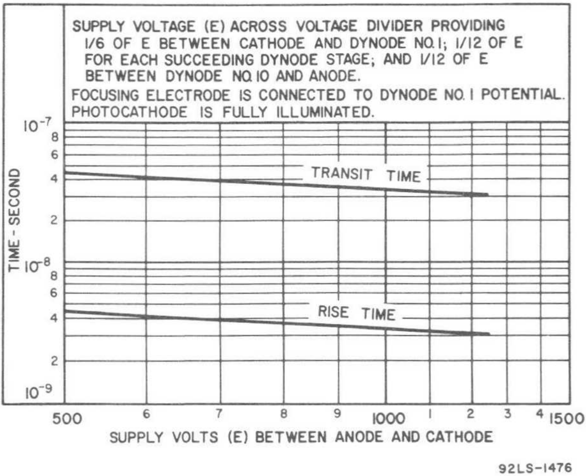
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

Spectral Energy Distribution of 2870°K Light Source after Passing Through Blue Filter



92CM-11081R1

Typical Time-Resolution Characteristics



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

6810A

Photomultiplier Tube

2"- Diameter, 14-Stage, Head-On Type
Having S-11 Spectral Response

GENERAL

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 Å
Cathode, Semitransparent	Cesium-Antimony
Minimum projected area	2.2 in^2 (14.2 cm^2)
Minimum diameter	1.68 in (4.2 cm)
Window	Corning[a] No.0080, or equivalent
Shape	Plano-Concave
Index of refraction at 4360 angstroms	1.523
Dynodes:	
Substrate	Copper-Beryllium
Secondary-Emitting Surface	Beryllium-Oxide
Structure	In-Line, Electrostatic-Focus Type
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.14	2.8 pF
Anode to all other electrodes	6 pF
Dynode No.14 to all other electrodes	7.5 pF
Maximum Overall Length	7.5 in (19 cm)
Seated Length	6.69 in (17 cm) ± 0.19 in
Maximum Diameter	2.38 in (6 cm)
Bulb	T16
Base	Small-Shell Bidecal 20-Pin, JEDEC No.B20-102
Socket	Alden[b] Part 220FTC, or equivalent
Magnetic Shield	Millen[c] No.80802E, or equivalent
Operating Position	Any
Weight (Approx.)	8 oz (226 g)

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC Supply Voltage:		
Between anode and cathode	2400 max.	V
Between anode and dynode No.14	400 max.	V
Between consecutive dynodes	500 max.	V
Between accelerating electrode and grid No.13	±500 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
Ambient Temperature[f]	75 max.	^{o}C

CHARACTERISTICS RANGE VALUES

Voltage Distribution A, Table 1

With E = 2000 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g] at 4400 angstroms .	–	3×10^{6}	–	A/W
Luminous[h] (2870^{o} K).	4.8×10^{2}	3.8×10^{3}	2×10^{4}	A/lm
Cathode Sensitivity:				
Radiant[i] at 4400 angstroms .	–	0.056	–	A/W
Luminous[k] (2870^{o} K).	5×10^{-5}	7×10^{-5}	–	A/lm
Current with blue light source[m] (2870^{o} K + C.S. No.5-58)	5×10^{-8}	7×10^{-8}	–	A
Quantum Efficiency at 4200 angstroms .	–	16	–	%
Current Amplification.	–	5.4×10^{7}	–	
Anode Dark Current[n].	–	1×10^{-6}	3×10^{-6}	A
Equivalent Anode Dark Current Input[n].	–	5×10^{-10}	1.5×10^{-9}	lm
	–	6.2×10^{-13}[p]	1.8×10^{-12}[p]	W
Equivalent Noise Input[q].	–	3.3×10^{-12}	–	lm
	–	4.1×10^{-15}[r]	–	W
Anode-Pulse Rise Time[s] at 2400 V. .	–	3.1×10^{-9}	–	s
Electron Transit Time[t] at 2400 V. .	–	4.4×10^{-8}	–	s

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

[b] Made by Alden Products Co., 262 N. Main Street, Brockton, MA 02403.

→ Indicates a change or addition.

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

[e] Averaged over any interval of 30 seconds maximum.

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

[g] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 803 lumens per watt.

[h] 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 0.1 microlumen is used.

[i] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 803 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 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) 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.

[n] At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 2000 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant. Dark current is measured with incident light removed.

[p] At 4400 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 803 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.

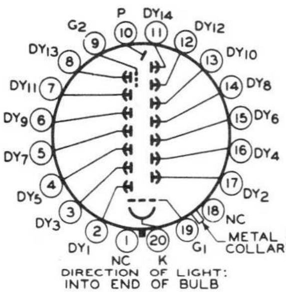
[r] At 4400 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 803 lumens per watt.

[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.

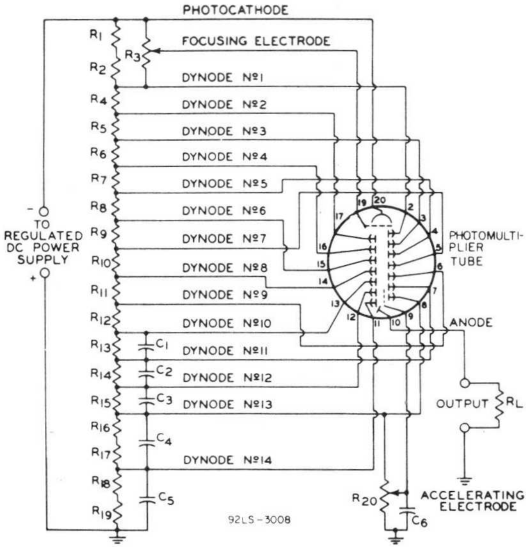
TERMINAL DIAGRAM (Bottom View)

Pin 1: No Connection
Pin 2: Dynode No.1
Pin 3: Dynode No.3
Pin 4: Dynode No.5
Pin 5: Dynode No.7
Pin 6: Dynode No.9
Pin 7: Dynode No.11
Pin 8: Dynode No.13
Pin 9: Grid No.2
(Accelerating Electrode)
Pin 10: Anode
Pin 11: Dynode No.14
Pin 12: Dynode No.12
Pin 13: Dynode No.10
Pin 14: Dynode No.8
Pin 15: Dynode No.6
Pin 16: Dynode No.4
Pin 17: Dynode No.2
Pin 18: No Connection
Pin 19: Grid No.1 (Focusing Electrode)
Pin 20: Photocathode
Metal Collar: No Connection
Note – If used, connect only to photocathode.



20 D

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



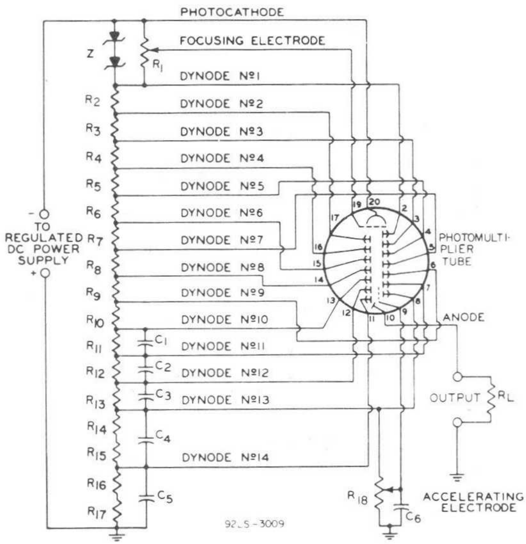
C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (dc working), ceramic disc
R_1: 24000 ohms, 5%, 1 watt
R_2: 22000 ohms, 5%, 1 watt
R_3: 1 megohm, 20%, 2 watts, adjustable
R_4 through R_{13}: 22000 ohms, 5%, 1 watt

R_{14}: 27000 ohms, 5%, 2 watts	R_{17}: 18000 ohms, 5%, 2 watts
R_{15}: 33000 ohms, 5%, 2 watts	R_{18}: 22000 ohms, 5%, 2 watts
R_{16}: 22000 ohms, 5%, 2 watts	R_{19}: 22000 ohms, 5%, 2 watts

R_{20}: 10 megohms, 2 watts, adjustable
R_L: Value will depend on magnitude of peak pulse voltage desired. For a peak pulse amplitude of 100 volts, the value is approximately 300 ohms.

Note 1: Adjustable between approximately 800 and 2400 volts dc.
Note 2: Component values are dependent upon nature of application and output signal desired.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR CONSTANT VOLTAGE BETWEEN CATHODE AND DYNODE NO. 1



C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (dc working), ceramic disc
R_1: 5 megohms, 20%, 1/2 watt, adjustable
R_2 through R_{11}: 22000 ohms, 5%, 1 watt

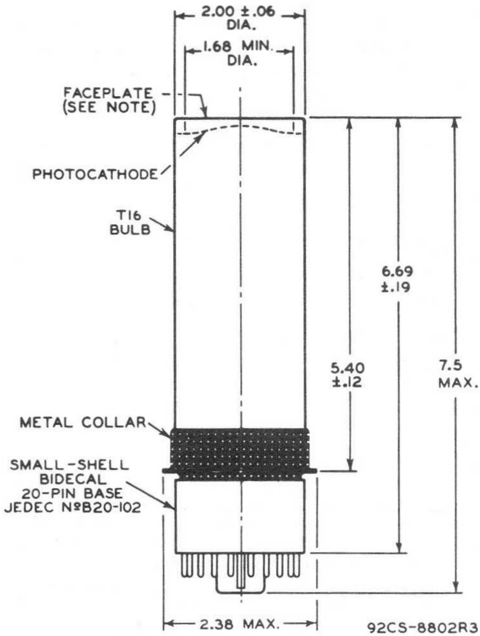
R_{12}: 27000 ohms, 5%, 2 watts	R_{15}: 18000 ohms, 5%, 2 watts
R_{13}: 33000 ohms, 5%, 2 watts	R_{16}: 22000 ohms, 5%, 2 watts
R_{14}: 22000 ohms, 5%, 2 watts	R_{17}: 22000 ohms, 5%, 2 watts

R_{18}: 10 megohms, 2 watts, adjustable
R_L: Value will depend on magnitude of peak pulse voltage desired. For a peak pulse amplitude of 100 volts, the value is approximately 300 ohms.
Z: (2) - 180 V, 2 W zener diodes, or equivalent

Note 1: Adjustable between approximately 800 and 2400 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^{o} in any direction from the perpendicular erected at the center of bottom of the base.

Note: Deviation from flatness of external surface of faceplate will not exceed 0.005" from peak to valley.

Dimensions are in inches unless otherwise stated.

INCH DIMENSION EQUIVALENTS IN MILLIMETERS

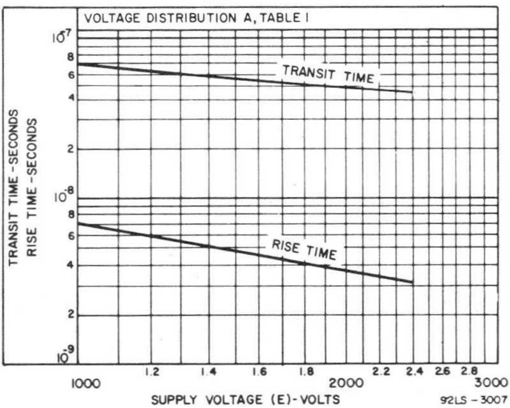
Inch	mm	Inch	mm	Inch	mm
0.06	1.5	1.68	42.6	5.40	137.1
0.12	3.0	2.00	50.8	6.69	169.9
0.19	4.8	2.38	60.4	7.5	190.5

Table 1		
Voltage Distribution		
Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	A 5.4% of Supply Voltage (E) multiplied by	B 6.06% of Supply Voltage (E) multiplied by
K - Dy1	2	♦
Dy1 - Dy2	1	1
Dy2 - Dy3	1	1
Dy3 - Dy4	1	1
Dy4 - Dy5	1	1
Dy5 - Dy6	1	1
Dy6 - Dy7	1	1
Dy7 - Dy8	1	1
Dy8 - Dy9	1	1
Dy9 - Dy10	1	1
Dy10 - Dy11	1	1
Dy11 - Dy12	1.25	1.25
Dy12 - Dy13	1.5	1.5
Dy13 - Dy14	1.75	1.75
Dy14 - P	2	2
Dy1 - P	–	16.5
K-P	18.5	–

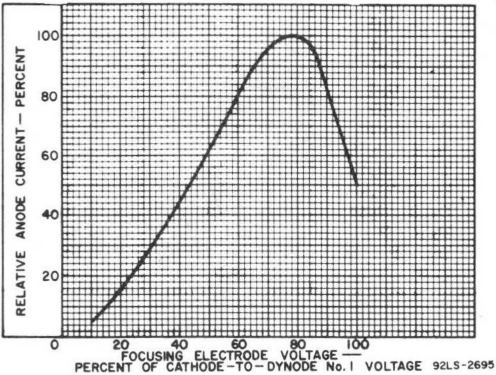
Focusing electrode is connected to arm of potentiometer between cathode and dynode No.1; the focusing electrode voltage is varied to give maximum anode current.

♦Cathode-to-dynode No.1 voltage is maintained at 360 volts.

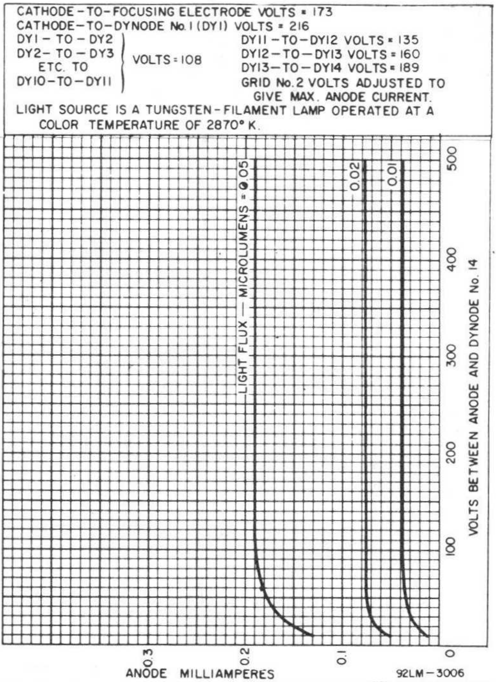
TYPICAL TIME-RESOLUTION CHARACTERISTICS



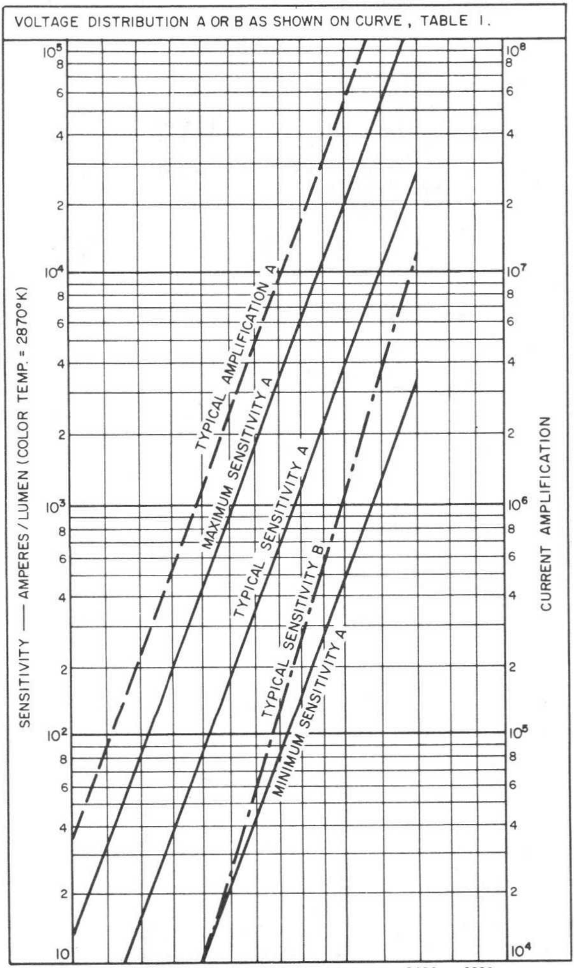
TYPICAL FOCUSING ELECTRODE CHARACTERISTIC



TYPICAL ANODE CHARACTERISTICS



SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

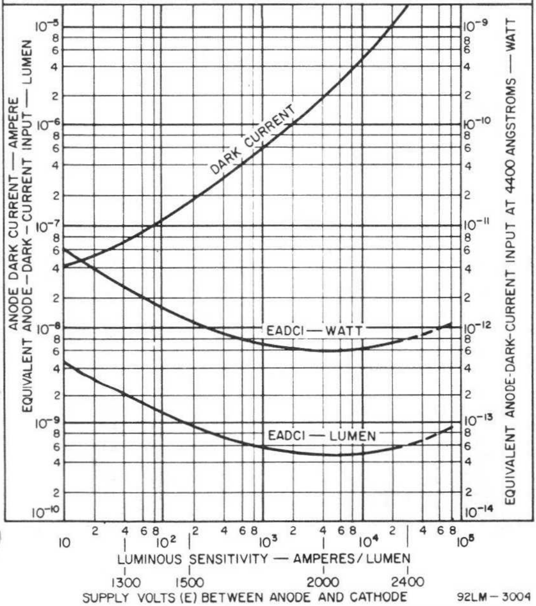


TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

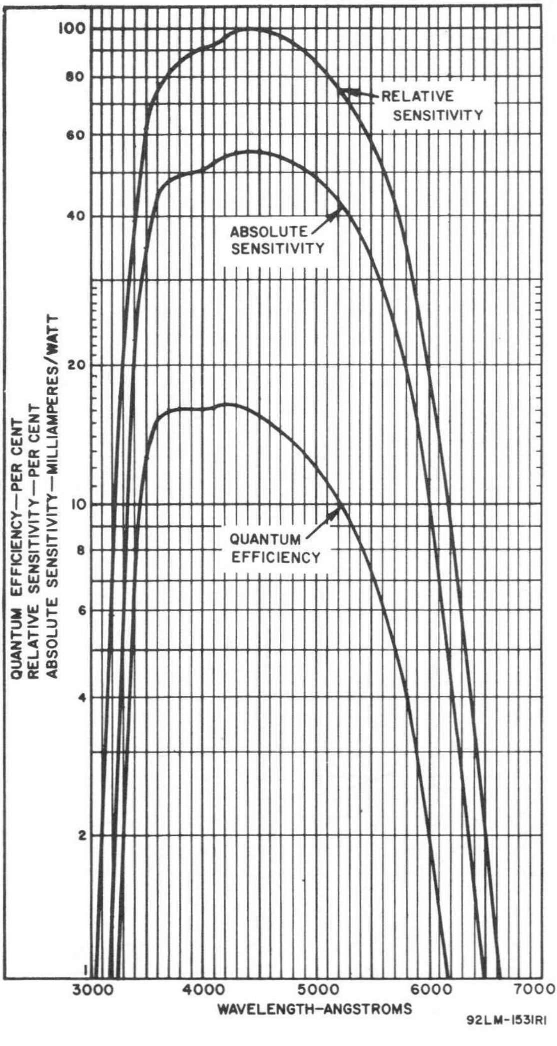
BETWEEN	5.4% OF E MULTIPLIED BY
CATHODE AND FOCUSING ELECTRODE	1.6
CATHODE AND DYNODE No.1 (DY1)	2
DY1 & DY2	1
DY2 & DY3	1
DY3 & DY4	1
DY4 & DY5	1
DY5 & DY6	1
DY6 & DY7	1
DY7 & DY8	1
DY8 & DY9	1
DY9 & DY10	1
DY10 & DY11	1
DY11 & DY12	1.25
DY12 & DY13	1.5
DY13 & DY14	1.75
DY14 & ANODE	2
ANODE & CATHODE	18.5

GRID-No. 2 VOLTS ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22°C



92LM-3004

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



Photomultiplier Tube[a]

S-13 RESPONSE

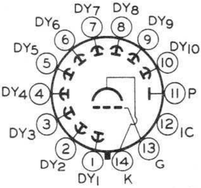
10-STAGE, HEAD-ON, FLAT-FACEPLATE — ELECTROSTATICALLY FOCUSED DYNODE STAGES

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[b] No.59-417, or equivalent
Magnetic Shield . Perfection Mica Co.[c], 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

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 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

With E = 1000 volts (Except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant, at 4400 angstroms	-	7.2×10^4	-	A/W
Cathode radiant, at 4400 angstroms.	-	0.047	-	A/W
Luminous:				
At 0 c/s[e]	10	90	300	A/lm
With dynode No.10 as output electrode[f] . .	-	52	-	A/lm
Cathode luminous:				
With tungsten light source[g]	4×10^{-5}	6×10^{-5}	-	A/lm
With blue light source[h,q]	4×10^{-8}	-	-	A
Current Amplification . . .	-	1.5×10^6	-	
Equivalent Anode-Dark-Current Input[g].	-	5×10^{-10}[k]	2×10^{-9}[k]	lm
	-	6.3×10^{-12}[m]	2.5×10^{-12}[m]	W
Equivalent Noise Input				
Luminous[n]	-	6.7×10^{-12}	2.7×10^{-11}	lm
Radiant[p].	-	8.4×10^{-15}	-	W
Dark Current to any Electrode Except Anode at 25° C.	-	-	7.5×10^{-7}	A

With E = 750 volts (Except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant, at 4400 angstroms	-	6.3×10^3	-	A/W
Cathode radiant, at 4400 angstroms.	-	0.047	-	A/W

→ Indicates a change.

	Min	Typ	Max	
Luminous:				
At 0 c/s[e]	-	7.9	-	A/lm
With dynode No.10 as output electrode[f] . .	-	4.6	-	A/lm
Cathode luminous:				
With tungsten light source[g]	4×10^{-5}	6×10^{-5}	-	A/lm
With blue light source[h]	4×10^{-8}	-	-	A
Current Amplification . . .	-	1.3×10^{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° K and a light input of 10 microlumens 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° 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° 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.

[j] For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.

[k] Measured at a tube temperature of 25° 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.

[m] Determined at 4400 angstroms.

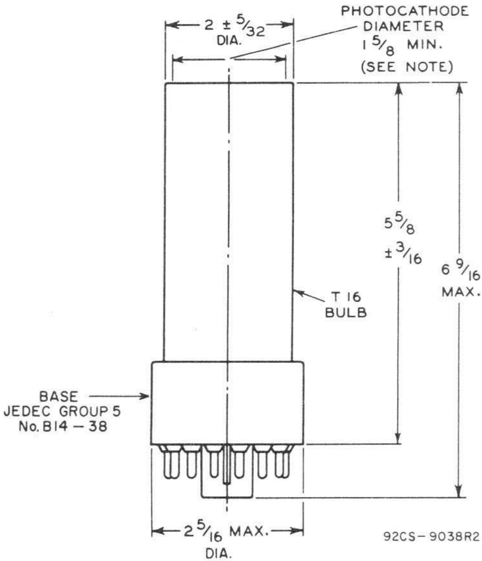
[n] Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period of the pulse is equal to the "off" period.

[p] Under the same conditions as shown under (n) except that use is made of a monochromatic source having radiation at 2537 angstroms.

[q] See *Spectral Characteristic of 2870° K Light Source and Spectral Characteristic of Light from 2870° K Source after Passing through Indicated Blue Filter* at front of this section.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-13 RESPONSE
is shown at the front of this section

DIMENSIONAL OUTLINE

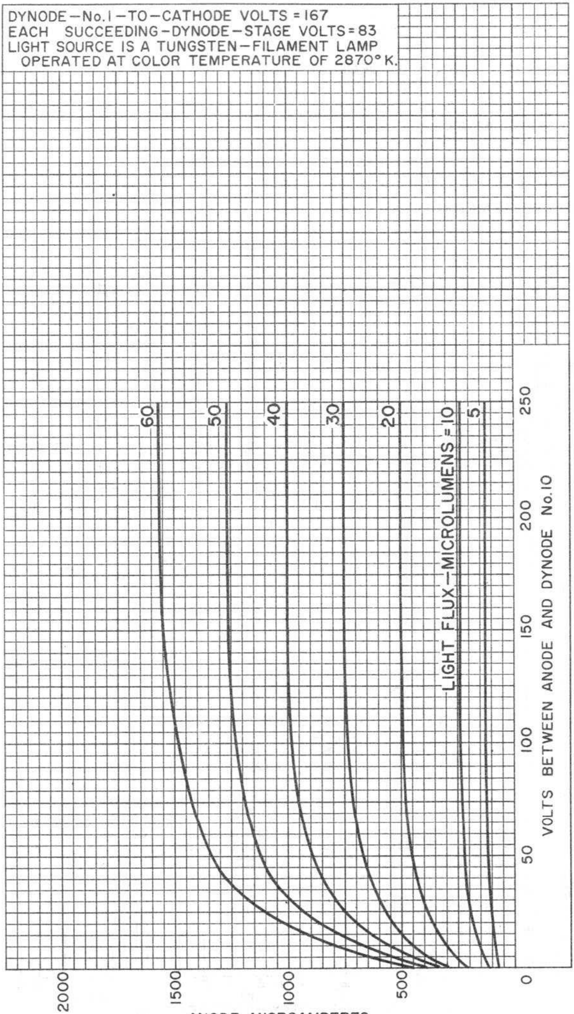


DIMENSIONS IN INCHES

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.

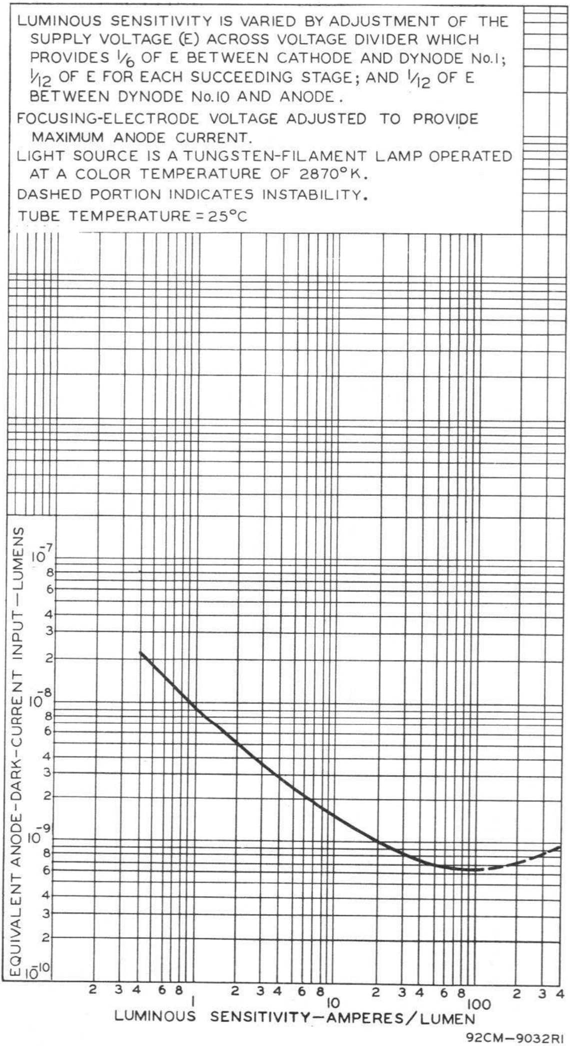
Note: Within minimum diameter, deviation from flatness will not exceed 0.010" from peak to valley.

TYPICAL ANODE CHARACTERISTICS



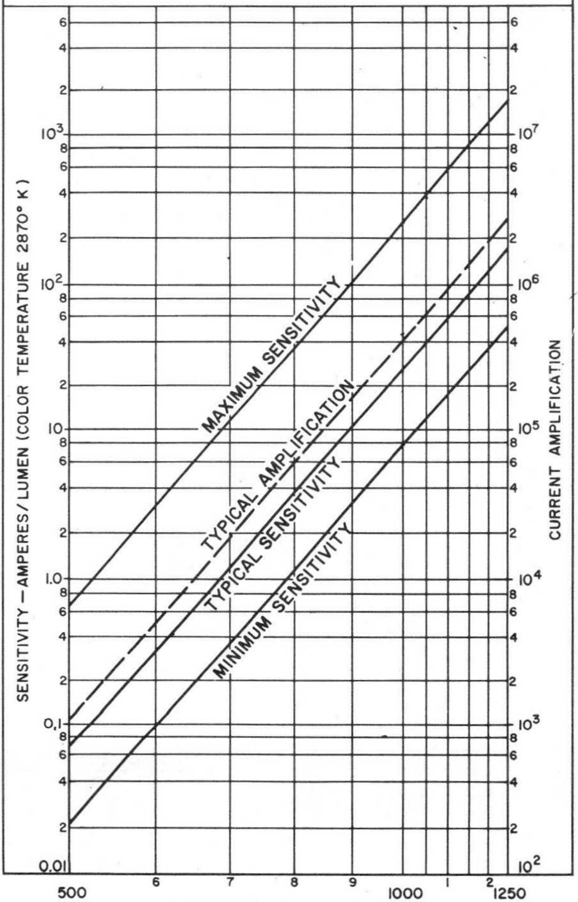
92CM—9039R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



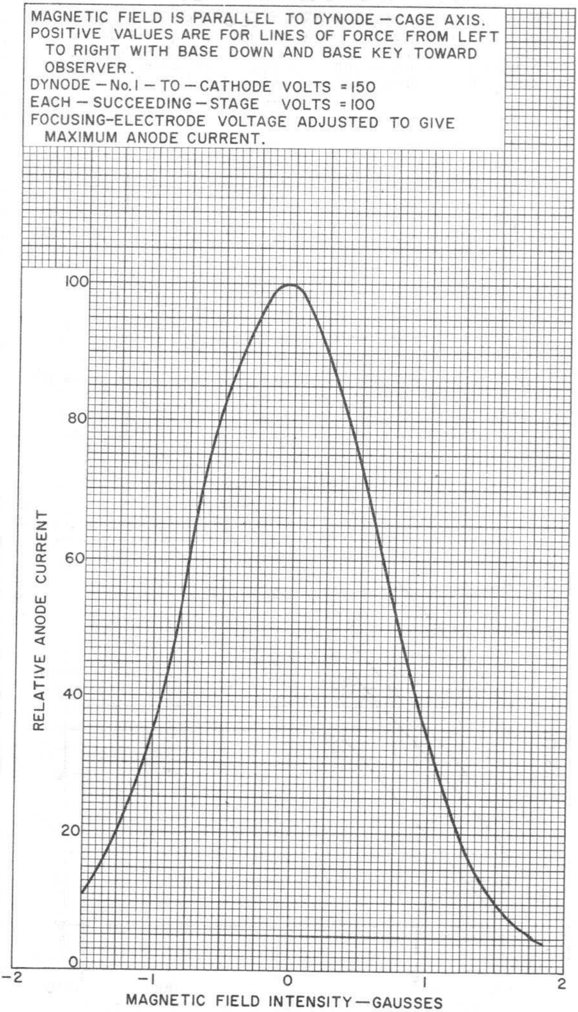
CHARACTERISTICS

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.



92CM-9033R1

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



92CM—8136R2

6914, 6914A

Image Converter Tubes

Monovoltage Types Having S-1 Spectral Response

GENERAL

For Both Types

Spectral Response	S-1
Wavelength of Maximum Response	800 ± 100 nm
Photocathode:	
Material	Ag-O-Cs
Minimum useful diameter	25 mm (1.000 in)
Image surface:	
Shape	Convex
Window	
Index of refraction at 589.3 nm	1.48
Fluorescent Screen:	
Minimum useful diameter	21.8 mm (0.860 in)
Phosphor	P20, Aluminized
Fluorescence and phosphorescence	Yellow-Green
Persistence	Medium to Medium Short
Image surface:	
Shape	Flat
Window	
Index of refraction at 589.3 nm	1.48
Focusing Method	Electrostatic
Tube Dimensions:	
Overall length	2.925 in ± 0.050 in
Maximum diameter	1.880 in ± 0.025 in
Operating Position	Any
Weight	3 oz

MAXIMUM RATINGS, *Absolute-Maximum Values for altitude up to 10,000 feet*

For Both Types

Anode Voltage:[b]		
Average (DC)	16000 max.	V
Peak Instantaneous	17000 max.	V
Average Photocathode Current (Continuous operation)[c]	0.35 max.	μA
Peak Photocathode Current[d]	3.5 max.	μA
Ambient-Temperature Range	-54 to +68	°C

6914, 6914A

Characteristics at Ambient Temperature of 22° C

	Type 6914	Type 6914A	
Anode Voltage (DC)[b]	16000	16000	V
Typical Paraxial Magnification Factor[e]	0.76	0.76	–
Minimum Conversion Index[f]	15	15	–
→ Minimum Resolution[g]	50	50	line-pairs/mm
Maximum Quotient[h] of Screen Background by Conversion Index	2.5×10^{-7}	2.5×10^{-7}	lm/cm^2
Maximum Luminous Equivalent of Infrared Radiation for Threshold Visibility[j]	–	4.1×10^{-11}	lm
Photocathode Sensitivity:			
→ Radiant[k]	2.3	2.3	mA/W
→ Luminous[m]	25	25	µA/lm

b Referred to photocathode.

c Averaged over any interval of 10 seconds maximum.

d The 6914 and the 6914A should not be subjected to this peak photocathode current value more than 10 times during the useful life of the tubes. No single time period during which this current is drawn should exceed 2 minutes.

e Defined as the ratio of the linear size of the image on the fluorescent screen to the linear size of the image on the photocathode. The image on the photocathode consists of two parallel lines 0.08" long, each located 0.10" from the tube axis. Size of the image on the fluorescent screen is determined by measuring the spacing between the two parallel lines.

f Ratio of luminous flux from fluorescent screen to the product of the luminous flux incident on Corning No.2540 infrared filter (Melt No.1613, 2.61 mm thick) or equivalent, and the filter factor of 10.8 per cent. The light source is a tungsten-filament lamp operated at a color temperature of 2854° K.

g The resolution, both horizontally and vertically in a 0.24-inch-diameter circle centered on the photocathode, is determined with a pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated as a "line-pair".

→ Indicates a change or addition

h The value of this quotient for any individual tube multiplied by the square of the magnification factor of the tube gives that value of the incident illumination from 2854° K source required to produce an increase in screen brightness equal to the screen background.

j Radiation from a tungsten lamp operating at a color temperature of 2854° K is passed through a Corning No.2540 infrared filter and focused to a point on the photocathode. The resulting image on the fluorescent screen is viewed by a dark-adapted eye through a 10-power ocular. The amount of infrared radiation for threshold visibility is determined by reducing the incident radiation until the image on the screen can just be discerned. The luminous equivalent of this amount of infrared radiation is the product of the unfiltered luminous flux from the 2854° K source and the filter factor of the Corning No.2540 infrared filter.

k For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

m Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light flux is 1×10^{-2} lumen and 200 volts are applied between the photocathode and anode.

SAFETY PRECAUTIONS

X-Radiation Warning

This tube in operation produces X-rays which can constitute a health hazard unless the tube is adequately shielded. Make sure the shielding provides the required protection against personal injury.

High Voltage

The high voltage at which the tube is operated may be very dangerous. Great care should be taken in the design of apparatus to prevent the user from coming in contact with the high voltage.

Operating Considerations

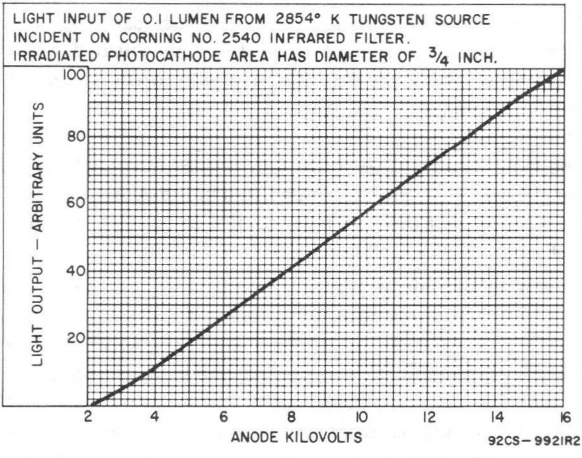
Handling. The tubes should be handled by the metal terminals. Fingerprints on the glass should be avoided since they cause leakage current, corona, and higher screen background. To minimize the possibility of leakage current and corona, the external surface of the glass side wall is coated with a transparent, non-hygroscopic film. This film should be cleaned only with a soft dry cloth.

Subjecting the tubes to intense incident-radiation levels may temporarily decrease the tube's sensitivity even though there is no voltage applied. The magnitude and duration of this decrease depend on the length of exposure. Permanent damage to the tube may result if it is exposed to radiant energy so great as to cause excessive heating of the photocathode.

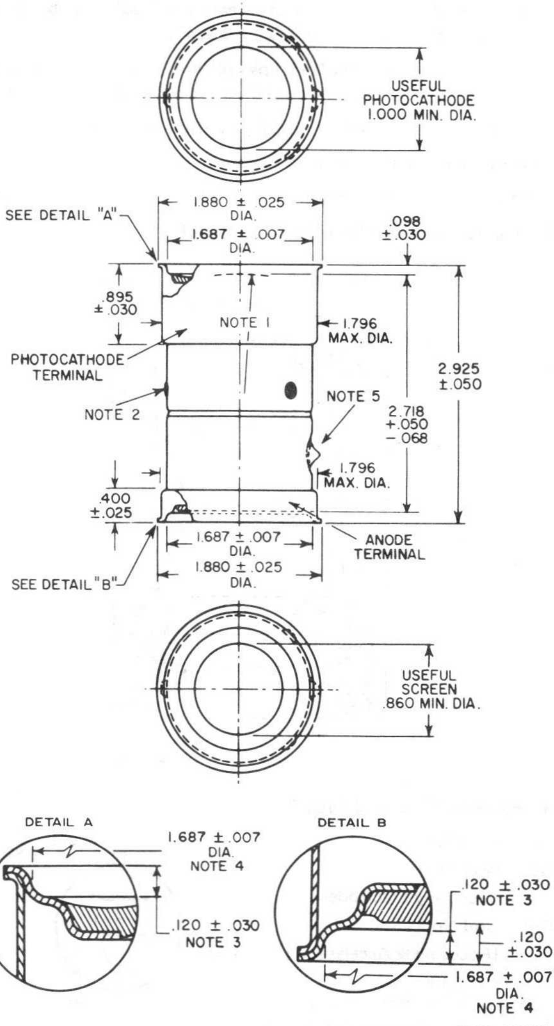
Connections to the two terminals of the tube, indicated on the Dimensional Outline, should not be soldered to the terminals. They may be made by spring fingers engaging the rim or the straight side of each terminal.

Magnetic shielding of these image tubes is required to minimize the effects of extraneous fields on tube performance. It is to be noted that ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken in its construction to insure that the case is completely demagnetized.

TYPICAL CHARACTERISTIC



DIMENSIONAL OUTLINE



Dimensions in Inches

92CM-9922R1

DIMENSIONAL OUTLINE NOTES

Note 1: Radius of curvature of faceplate is 2.38″ ± 0.05″. Faceplate thickness at center is 0.065″ ± 0.004″.

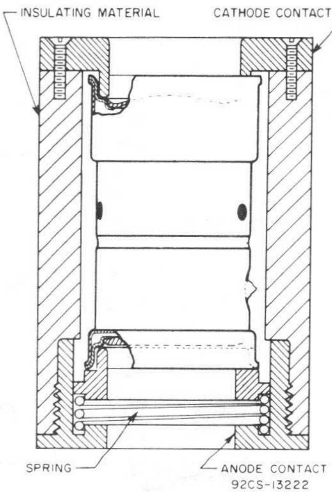
Note 2: Three insulated lead tips will not extend beyond maximum O.D. of tube. Leads are used only during tube manufacture.

Note 3: Depth is measured to tangent of the two radii.

Note 4: Diameter is measured to tangent of the two radii.

Note 5: The exhaust tip will not extend beyond max. dia. of tube.

TYPICAL MOUNTING ARRANGEMENT



TERMINAL CONNECTIONS

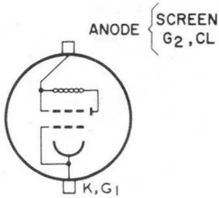
C_L: Collector

G_1: Grid No.1
(Focusing Electrode)

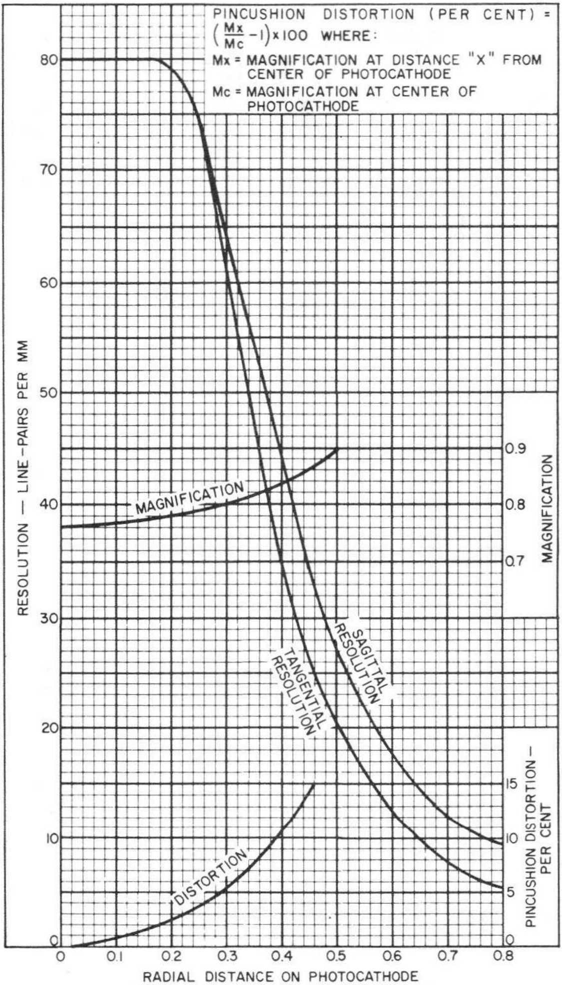
G_2: Grid No.2
(Focusing & Accelerating Electrode)

K: Photocathode

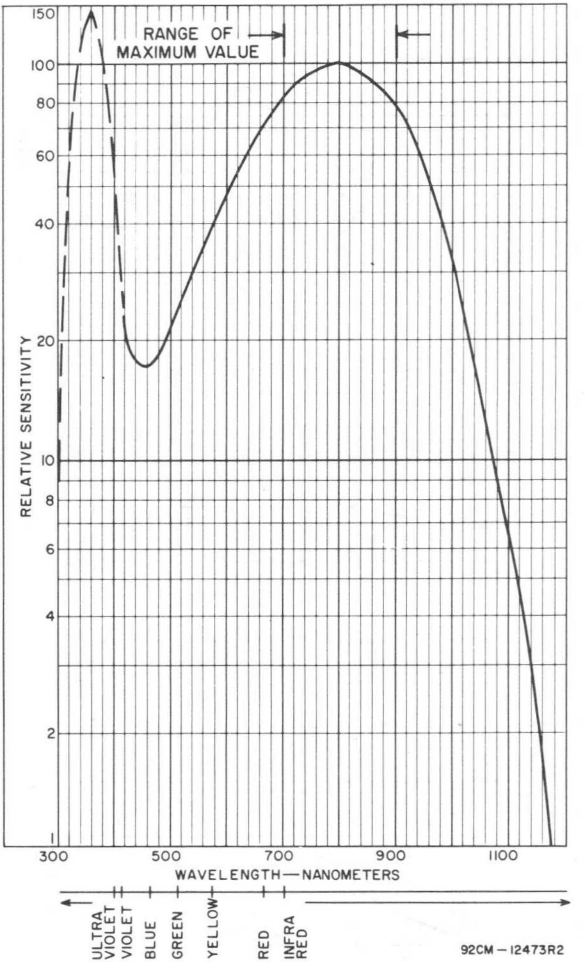
Direction of incident radiation:
Perpendicular to photocathode end of tube



TYPICAL CHARACTERISTICS



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



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

Image Converter Tube

Monovoltage Type Having S-1 Spectral Response

GENERAL

Spectral Response	S-1
Wavelength of Maximum Response	800 ± 100 nm
Photocathode:	
Material	Ag-O-Cs
Minimum useful diameter	19.05 mm (0.750 in)
Image surface:	
Shape	Convex
Window	
Index of refraction at 589.3 nm	1.48
Fluorescent Screen:	
Minimum useful diameter	14.48 mm (0.570 in)
Phosphor	P20, Aluminized
Fluorescence and phosphorescence	Yellow-Green
Persistence	Medium to Medium Short
Image surface:	
Shape	Flat
Window	
Index of refraction at 589.3 nm	1.48
Focusing Method	Electrostatic
Tube Dimensions:	
Overall length	2.285 in ± 0.050 in
Maximum diameter	1.350 in ± 0.025 in
Operating Position	Any
Weight	1.5 oz

MAXIMUM RATINGS, *Absolute-Maximum Values*

Anode Voltage:[b]		
Average (DC)	12500 max.	V
Peak Instantaneous	13000 max.	V
Average Photocathode Current (Continuous operation)[c]	0.35 max.	μA
Peak Photocathode Current[d]	3.5 max.	μA
Ambient Temperature	75 max.	°C

CHARACTERISTICS AT AMBIENT TEMPERATURE OF 22°C

Anode Voltage (DC)[b]	12000	V
Typical Paraxial Magnification Factor[e]	0.75	–
→ Minimum Conversion Index[f]	15	–
→ Minimum Resolution[g]	50	line-pairs/mm
Maximum Quotient[h] of Screen Background by Conversion Index	3.3×10^{-7}	lm/cm^2
Sensitivity:		
→ Radiant[j]	2.3	mA/W
→ Luminous[k]	25	μA/lm

b Referred to photocathode.

c Averaged over any interval of 10 seconds maximum.

d The 6929 should not be subjected to this peak photocathode current value more than 10 times during the useful life of the tube. No single time period during which this current is drawn should exceed 2 minutes.

e Defined as the ratio of the linear size of the image on the fluorescent screen to the linear size of the image on the photocathode. The image on the photocathode consists of two parallel lines 0.08" long, each located 0.08" from the tube axis. Size of the image on the fluorescent screen is determined by measuring the spacing between the two parallel lines.

f Ratio of luminous flux from fluorescent screen to the product of the luminous flux incident on Corning No.2540 infrared filter (Melt No.1613, 2.61 mm thick) or equivalent, and the filter factor of 10.8 per cent. The light source is a tungsten-filament lamp operated at a color temperature of 2854° K.

g The resolution, both horizontally and vertically in a 0.15-inch-diameter circle centered on the photocathode, is determined with a pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated as a "line-pair".

h The value of this quotient for any individual tube multiplied by the square of the magnification factor of the tube gives that value of the incident illumination from 2854° K source required to produce an increase in screen brightness equal to the screen background.

→ Indicates a change

j For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

k Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854^{o} K. The value of light flux is 0.01 lumen and 200 volts are applied between anode and cathode.

SAFETY PRECAUTIONS

X-Radiation Warning

This tube in operation produces X-rays which can constitute a health hazard unless the tube is adequately shielded. Make sure the shielding provides the required protection against personal injury.

High Voltage

The high voltage at which the tube is operated may be very dangerous. Great care should be taken in the design of apparatus to prevent the user from coming in contact with the high voltage.

Operating Considerations

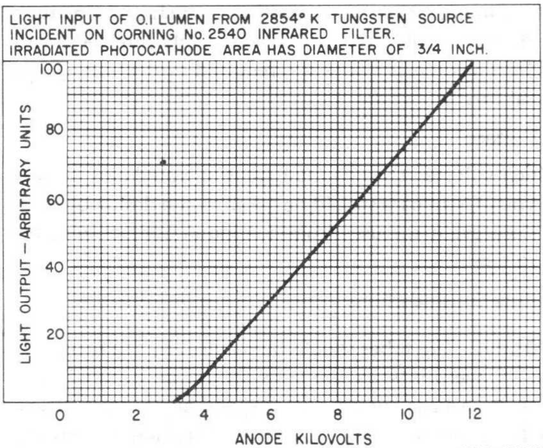
HANDLING The tubes should be handled by the metal terminals. Fingerprints on the glass should be avoided since they cause leakage current, corona, and higher screen background. To minimize the possibility of leakage current and corona, the external surface of the glass side wall is coated with a transparent, non-hygroscopic film. This film should be cleaned only with a soft dry cloth.

Subjecting the tube to intense incident-radiation levels may temporarily decrease the tube's sensitivity even though there is no voltage applied. The magnitude and duration of this decrease depend on the length of exposure. Permanent damage to the tube may result if it is exposed to radiant energy so great as to cause excessive heating of the photocathode.

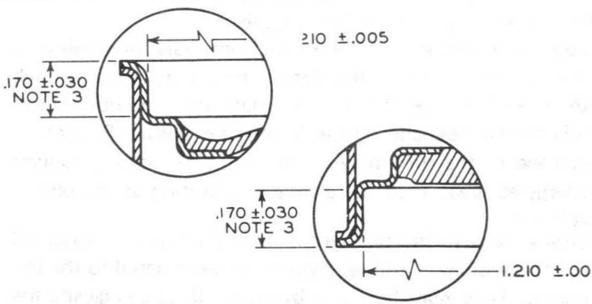
Connections to the two terminals of the tube, indicated on the Dimensional Outline, should not be soldered to the terminals. They may be made by spring fingers engaging the rim or the straight side of each terminal.

Magnetic shielding of this image tube is required to minimize the effects of extraneous fields on tube performance. It is to be noted that ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken in its construction to insure that the case is completely demagnetized.

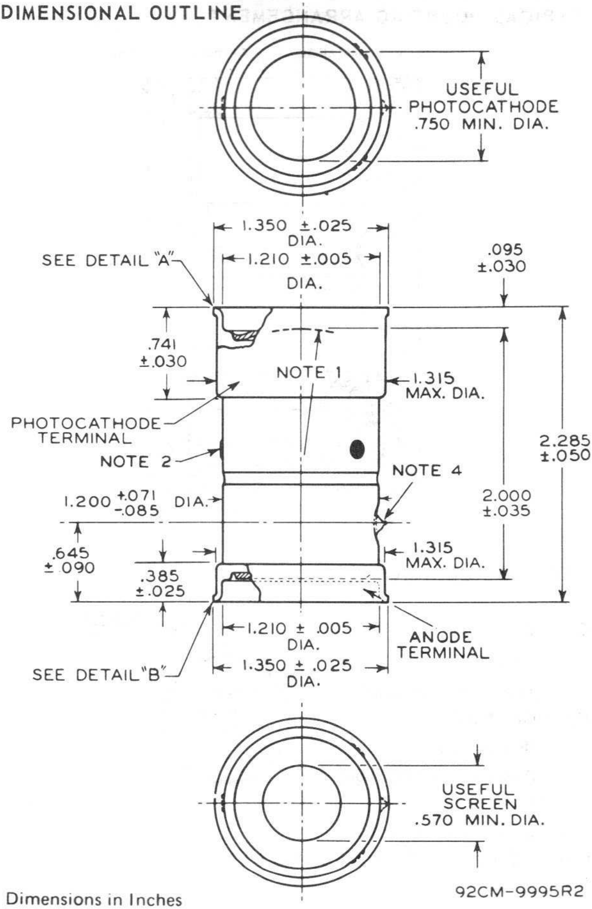
TYPICAL CHARACTERISTICS



DIMENSIONAL OUTLINE DETAILS



DIMENSIONAL OUTLINE



Dimensions in Inches

92CM-9995R2

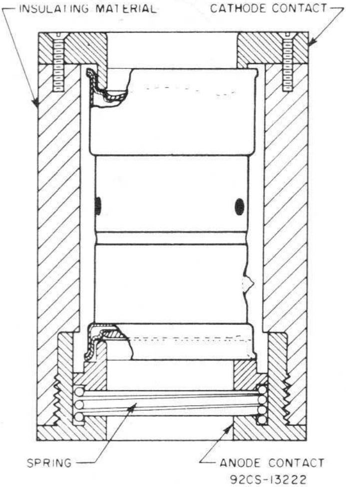
Note 1: Radius of curvature of faceplate is 1.230" ± 0.005"; faceplate thickness at center is 0.060" ± 0.004".

Note 2: Three insulated lead tips will not extend beyond maximum O.D. of tube. Leads are used only during tube manufacture.

Note 3: Depth is measured to tangent of the two radii.

Note 4: Tip will not extend beyond maximum O.D. of tube.

TYPICAL MOUNTING ARRANGEMENT



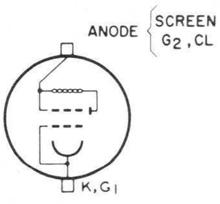
TERMINAL CONNECTIONS

C_L: Collector

G_1: Grid No.1 (Focusing Electrode)

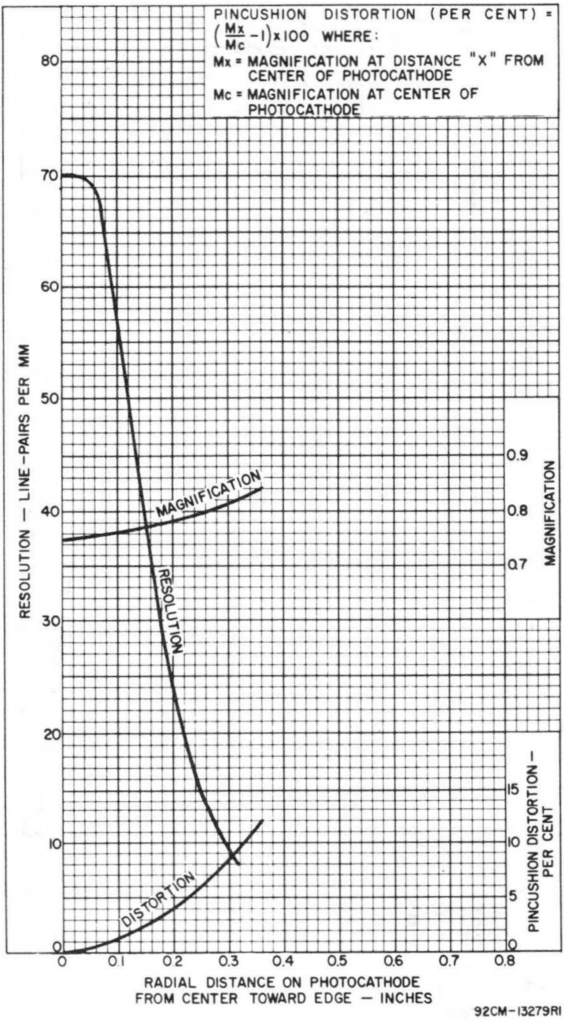
G_2: Grid No.2 (Focusing & Accelerating Electrode)

K: Photocathode

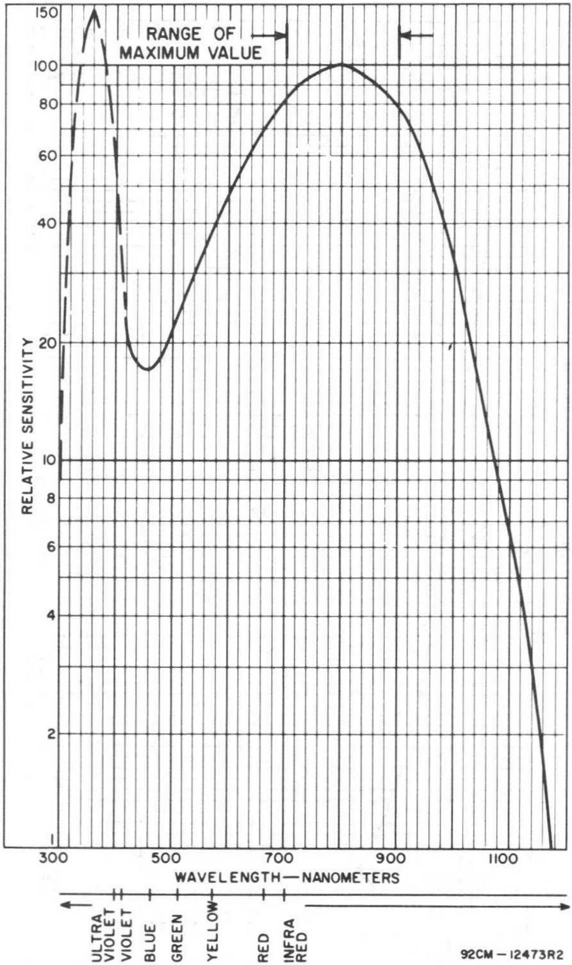


Direction of incident radiation:
Perpendicular to photocathode end of tube

TYPICAL CHARACTERISTICS



TYPICAL SPECTRAL RESPONSE CHARACTERISTIC



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

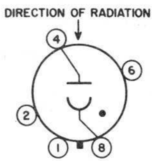
Gas Phototube

SIDE-ON TYPE HAVING UNOBSTRUCTED PHOTOCATHODE AREA AND S-1 RESPONSE

DATA

General:

Spectral Response. S-1
Wavelength of Maximum Response . . . . 8000 ± 1000 angstroms
Cathode:
  Shape. .Semicylindrical
  Minimum unobstructed projected length[a] . . . . . . 23/32"
  Minimum unobstructed projected width[a]. . . . . . . 9/16"
Direct Interelectrode Capacitance (Approx.). . . . . 3 μμf
Maximum Overall Length . . . . 3-1/16"
Maximum Seated Length. . . . . 2-1/2"
Seated Length to Center of Cathode . . . . . 1-5/8" ± 3/32"
Maximum Diameter . . . . 1-9/32"
Operating Position . . . . Any
Weight (Approx.) . . . . 0.9 oz
Bulb T9
Socket . . . . .Cinch No.8JM-1, or equivalent ←
Base . . . . . . .Intermediate-Shell Octal 5-Pin Arrangement 1, (JEDEC No.B5-10)
  Basing Designation for BOTTOM VIEW 3J



Pin 1 – No Connection
Pin 2 – No Connection
Pin 4 – Anode
Pin 6 – No Connection
Pin 8 – Photocathode

Maximum Ratings, *Absolute-Maximum Values:*

	Rating I	*Rating II*	
ANODE-SUPPLY VOLTAGE (DC or Peak AC).	70 max.	90 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[b]	60 max.	30 max.	μa/sq. in.
AVERAGE CATHODE CURRENT[b] . .	6 max.	3 max.	μa
AMBIENT TEMPERATURE.	100 max.	100 max.	°C

Characteristics: ←

With an anode-supply voltage of 90 volts unless otherwise specified

	Min.	*Median*	*Max.*	
Sensitivity: Radiant, at 8000 angstroms.	–	0.019	–	amp/watt

← Indicates a change.

	Min.	Median	Max.	
Luminous:[c]				
At 0 cps.	140	200	330	μa/lumen
At 5000 cps	–	165	–	μa/lumen
At 10000 cps.	–	150	–	μa/lumen
Gas Amplification Factor[d] . . .	–	–	10	
Anode Dark Current at 25° C . .	–	–	0.1	μa

Minimum Circuit Values:

With an anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 3 μa.	0.1 min.	–	megohm
For dc currents below 3 μa.	0 min.	–	megohms
For dc currents above 2 μa.	–	2.5 min.	megohms
For dc currents below 2 μa.	–	1 min.	megohm

[a] On plane perpendicular to indicated direction of incident radiation.

[b] Averaged over any interval of 30 seconds maximum.

[c] For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A dc anode supply voltage of 90 volts and a 1-megohm load resistor are used. For the 0-cycle measurement, a light input of 0.1 lumen is used. For the 5000- and 10,000-cycle measurements, the light input is varied sinusoidally about a mean value of 0.015 lumen from zero to a maximum of twice the mean value.

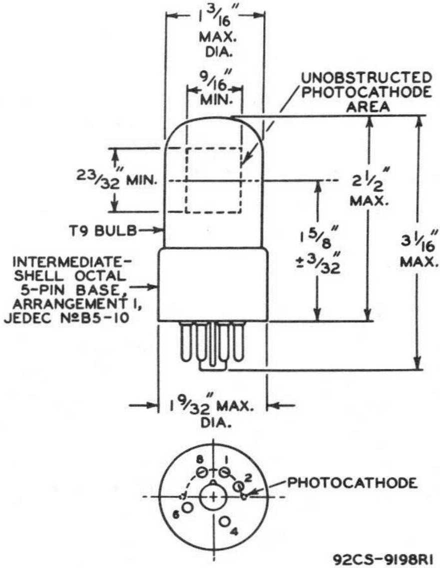
[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light input is 0.1 lumen, and the load resistor has a value of 1 megohm.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-1 RESPONSE

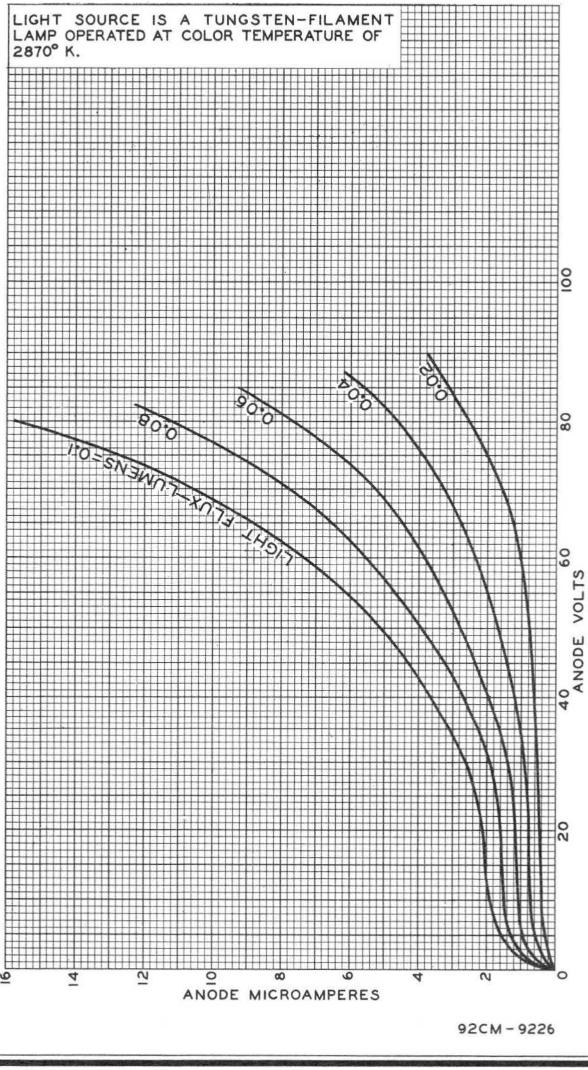
and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section


1 3/16" MAX. DIA.
9/16" MIN.
UNOBSTRUCTED PHOTOCATHODE AREA
23/32" MIN.
2 1/2" MAX.
T9 BULB
1 5/8" ±3/32"
3 1/16" MAX.
INTERMEDIATE-SHELL OCTAL 5-PIN BASE, ARRANGEMENT I, JEDEC №B5-10
1 9/32" MAX. DIA.
8
1
2
6
4
PHOTOCATHODE
92CS-9198RI

AVERAGE ANODE CHARACTERISTICS



92CM-9226

Vidicon

MAGNETIC FOCUS — 1" Diameter — MAGNETIC DEFLECTION

For Live and Film Pickup With Color or Black-and-White TV Cameras

General:

Heater, for Unipotential Cathode:
- Voltage (AC or DC) . . . . 6.3 ± 10% volts
- Current at heater volts = 6.3 . . . . 0.6 amp

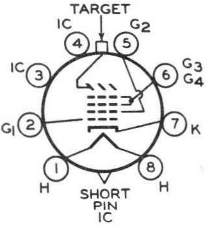
Direct Interelectrode Capacitance:[a]
- Target to all other electrodes . . . . . . 4.6 pf

Spectral Response . . . . See Accompanying *Curves*

Photoconductive Layer:
- Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)[b] . . . . 0.62"

Focusing Method .Magnetic
Deflection Method . . . . .Magnetic
Overall Length . . . . 6.25" ± 0.25"
Greatest Diameter . . . . 1.125" ± 0.010"
Operating Position . . . . Any
Weight (Approx.) . . . . 2 oz
Bulb T8
Focusing Coil . . . . Cleveland Electronics[c,d] No.VF-115-5, or equivalent
Deflecting Yoke . . . . . Cleveland Electronics[c,d] No.VY-111-3, or equivalent
Alignment Coil . . . . . . Cleveland Electronics[c,d] No.VA-118, or equivalent
Socket . . . . Cinch[e] No.54A18088, or equivalent
Base . . . . . . .Small-Button Ditetrar 8-Pin (JEDEC No.E8-11)
- Basing Designation for BOTTOM VIEW 8HM

Pin 1 - Heater
Pin 2 - Grid No.1
Pin 3 - Do Not Use
Pin 4 - Do Not Use
Pin 5 - Grid No.2
Pin 6 - Grid No.3 & No.4
Pin 7 - Cathode
Pin 8 - Heater
Flange - Target
Short Pin - Do Not Use



DIRECTION OF LIGHT:
INTO FACE END OF TUBE

Maximum Ratings, *Absolute-Maximum Values:*

For scanned area of 1/2" x 3/8"

Grid-No.3 & Grid-No.4 Voltage . . . . 750 max. volts
Grid-No.2 Voltage . . . . 750 max. volts
Grid-No.1 Voltage:
- Negative-bias value . . . . 300 max. volts ←
- Positive-bias value . . . . 0 max. volts

← Indicates a change.

Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode.	125 max.	volts
Heater positive with respect to cathode.	10 max.	volts
Dark Current.	0.25 max.	μa
Peak Target Current	0.55 max.	μa
Faceplate:		
Illumination	1000 max.	fc
→ Temperature.	71 max.	°C

Typical Operation:

For scanned area of 1/2" x 3/8" and faceplate temperature of 30° to 35° C

Grid-No.4 (Decelerator) & Grid-No.3 (Beam-Focus Electrode[f]) Voltage	250[g] to 300	volts
Grid-No.2 (Accelerator) Voltage	300	volts
Grid-No.1 Voltage for picture cutoff[h]	−45 to −100	volts
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 μa and 0.2 μa.	0.65	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[j]	300:1	
Minimum Peak-to-Peak Blanking Voltage:		
When applied to grid No.1	75	volts
When applied to cathode	20	volts
Field Strength at Center of Focusing Coil (Approx.).	40	gauss
Field Strength of Adjustable Alignment Coil[k]	0 to 4	gauss

Maximum-Sensitivity Operation for Live-Scene Pickup

Faceplate Illumination (Highlight).	2	fc
Maximum Target Voltage required to produce dark current of 0.2 μa in any tube[m].	110	volts
Target Voltage[n]	60 to 100	volts
Dark Current[p]	0.2	μa
Target Current (Highlight)[q]	0.4 to 0.5	μa
Signal-Putput Current:[r]		
Peak.	0.2 to 0.3	μa
Average	0.08 to 0.1	μa

Average-Sensitivity Operation for Live-Scene Pickup

Faceplate Illumination (Highlight).	15	fc
Maximum Target Voltage required to produce dark current of 0.02 μa in any tube[m].	60	volts
Target Voltage[n]	30 to 50	volts
Dark Current.	0.02	μa
Target Current (Highlight)[q]	0.3 to 0.4	μa
Signal-Output Current:[r]		
Peak.	0.3 to 0.4	μa
Average	0.1 to 0.2	μa

→ Indicates a change.

Minimum-Lag Operation for Film Pickup

Faceplate Illumination (Highlight). . . .	100	fc
Maximum Target Voltage required to produce dark current of 0.004 μa in any tube[m].	30	volts
Target Voltage[n]	15 to 25	volts
Dark Current.	0.004	μa
Target Current (Highlight)[q]	0.3 to 0.4	μa
Signal-Output Current:[r]		
Peak.	0.3 to 0.4	μa
Average	0.1 to 0.2	μa

[a] This capacitance, which effectively is the output impedance of the 7038, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin. The masking is for orientation only and does not define the proper scanned area of photoconductive layer.

[c] Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

[d] These components are chosen to provide tube operation with minimum beam-landing error.

[e] Cinch Manufacturing Corp., 1026 South Homan Avenue, Chicago 24, Ill.

[f] Beam focus is obtained by combined effect of grid-No.3 voltage which should be adjustable over indicated range, and a focusing coil having an average field strength of 40 gauss.

[g] Definition, focus uniformity, and picture quality decrease with decreasing grid-No.4 and grid-No.3 voltage. In general, grid No.4 and grid No.3 should be operated above 250 volts.

[h] With no blanking voltage on grid No.1.

[j] Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 Mc. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of highlight video-signal current to rms noise current, multiplied by a factor of 3.

[k] The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

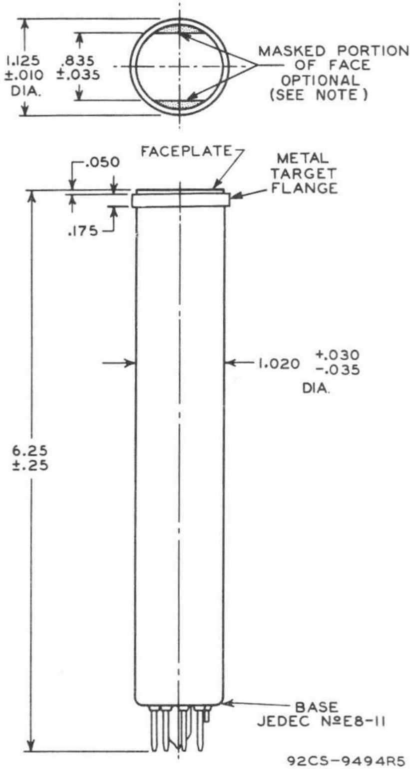
[m] The target voltage for each 7038 must be adjusted to that value which gives the desired operating dark current.

[n] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[p] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[q] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[r] Defined as the component of the target current after the dark-current component has been substracted.

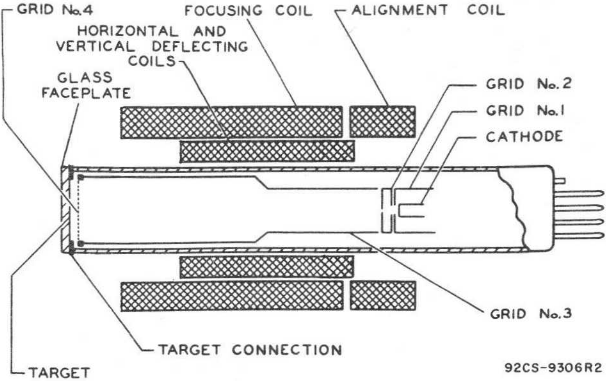


DIMENSIONS IN INCHES

Note: Straight sides of masked portions are parallel to the plate passing through tube axis and short pin.

→ Indicates a change.

SCHEMATIC ARRANGEMENT

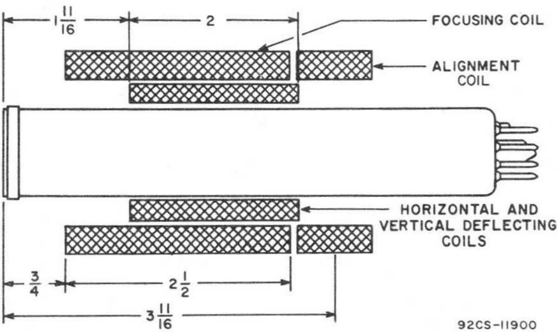


Alignment of the beam is accomplished by a transverse magnetic field produced by external coils located at the base end of the focusing coil.

Deflection of the beam is accomplished by transverse magnetic fields produced by external deflecting coils.

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

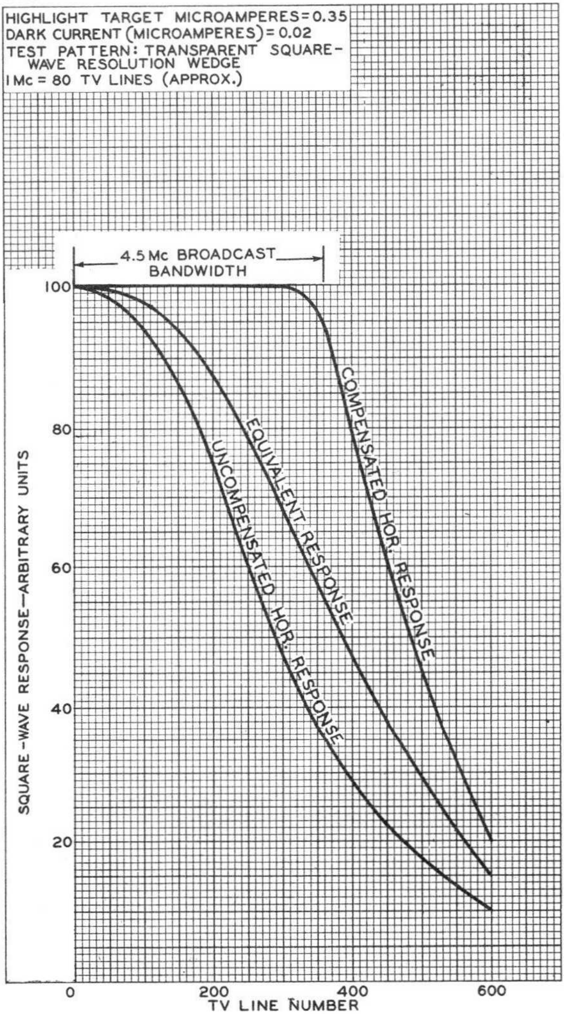
For Minimum Beam-Landing Error



DIMENSIONS IN INCHES

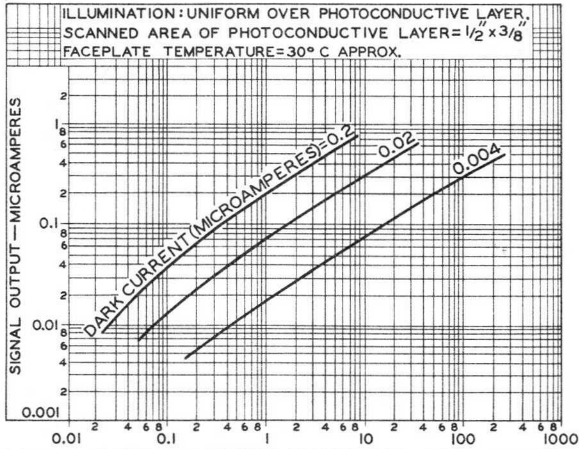
The *deflecting yoke and focusing coil* used with the 7038 are designed to cause the scanning beam to land perpendicularly to the target at all points of the scanned area with minimum beam-landing error and resultant superior uniformity of sensitivity and focus over the scanned area.

HORIZONTAL & EQUIVALENT SQUARE-WAVE RESPONSE CHARACTERISTICS



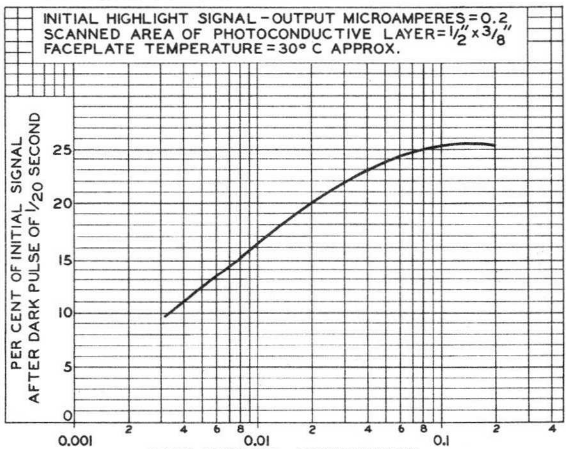
92CM-8117R1

TYPICAL LIGHT-TRANSFER CHARACTERISTICS



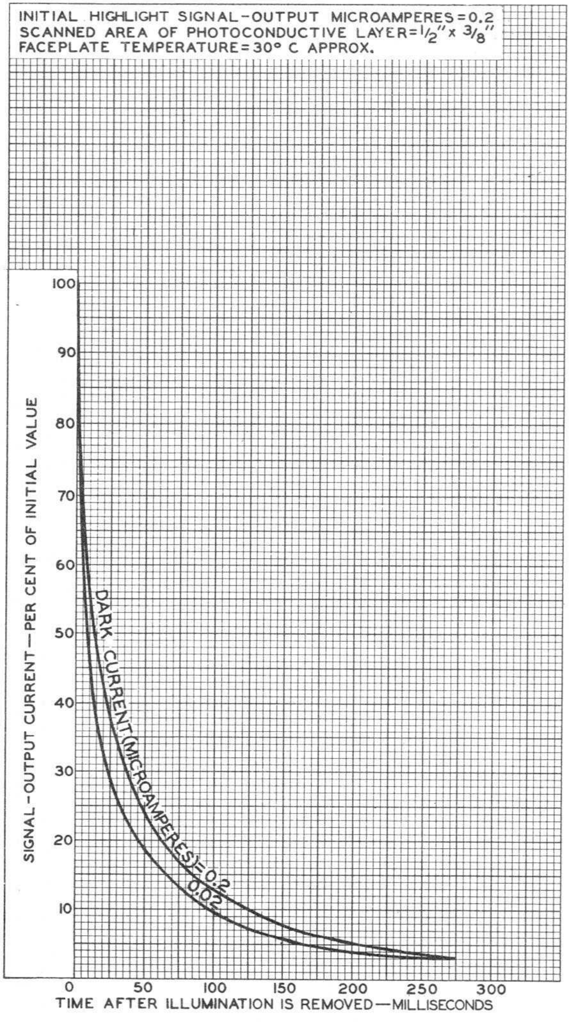
92CS-9495

TYPICAL PERSISTENCE CHARACTERISTIC



92CS-9504R1

TYPICAL PERSISTENCE CHARACTERISTICS

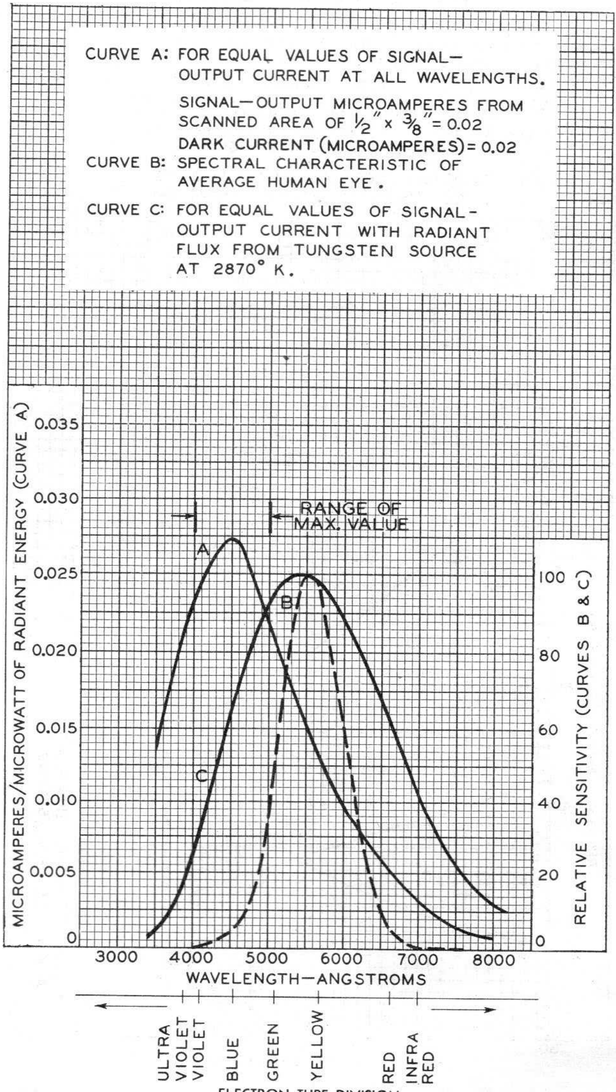


92CM-9505R1

7038

7038

SPECTRAL-SENSITIVITY CHARACTERISTICS



ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

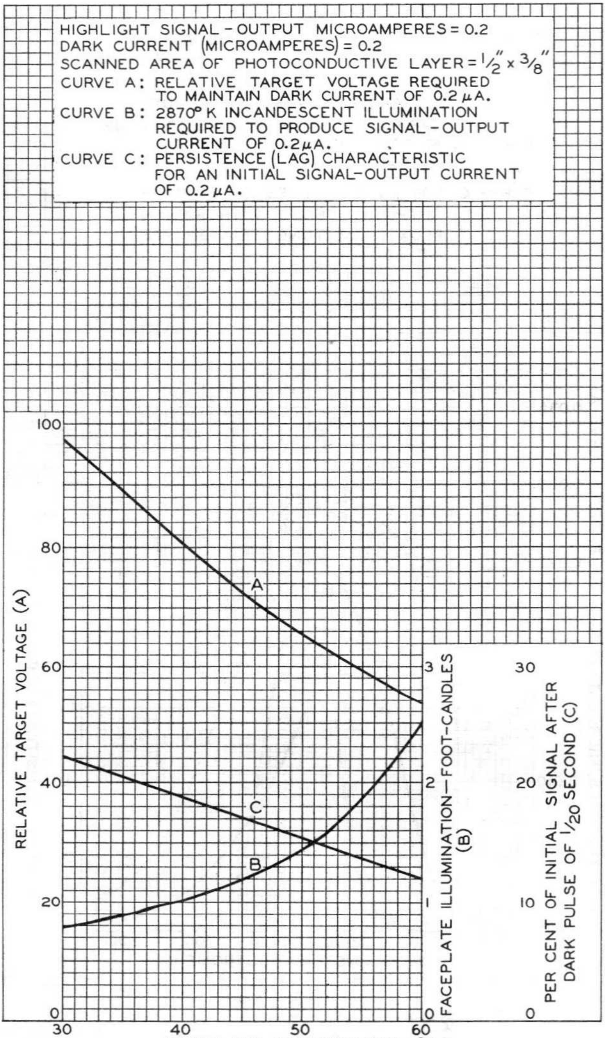
92CM-7783R2

7038

RCA

7038

TYPICAL CHARACTERISTICS

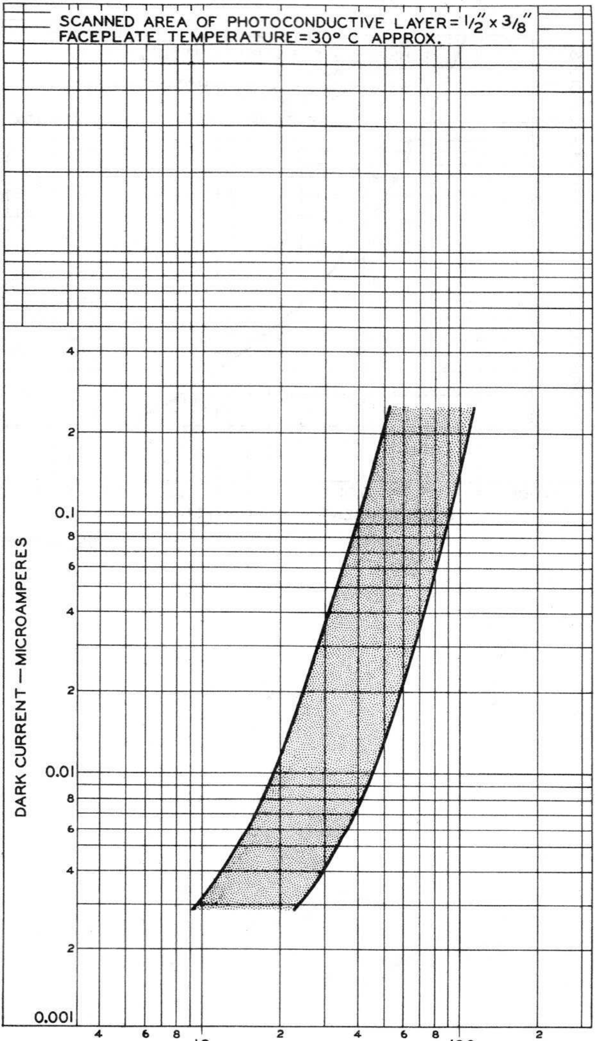


92CM-9499

RCA

7038

DARK-CURRENT RANGE



ELECTRON TUBE DIVISION

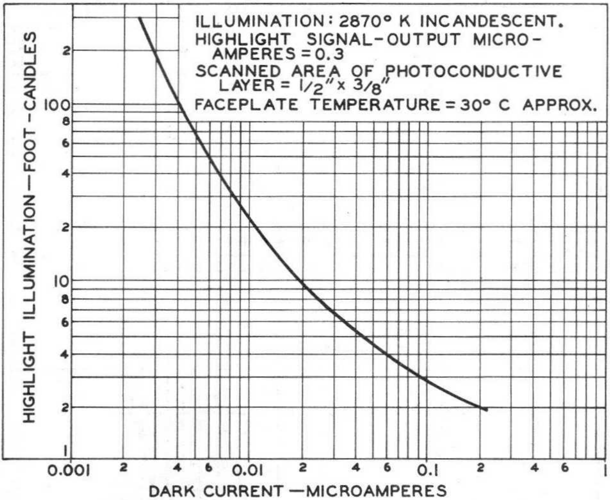
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9497

7038

7038

TYPICAL CHARACTERISTIC



92CS-9493

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.

h 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.

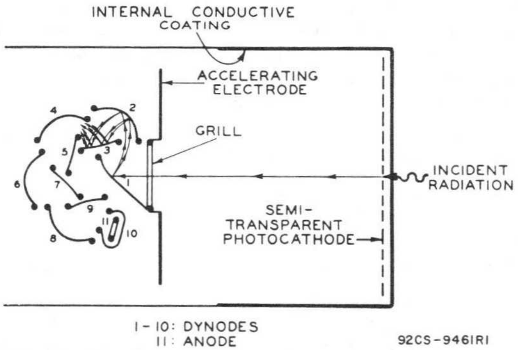
ANODE CURRENT

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.

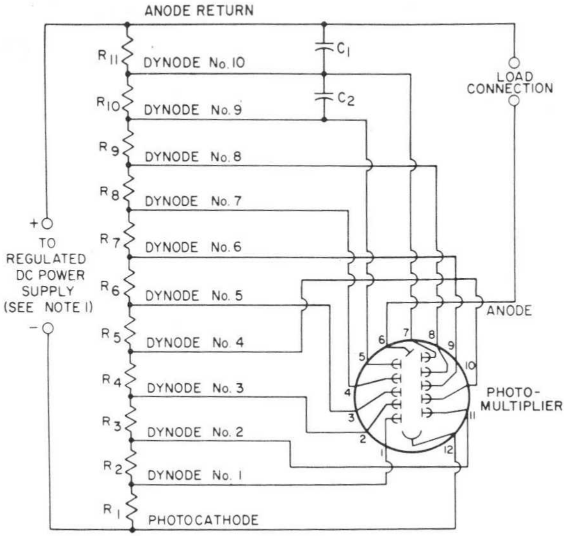
SHIELDING

Electrostatic and/or magnetic shielding of the 7102 may be necessary.

SCHEMATIC ARRANGEMENT OF STRUCTURE



TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



92CS-12481R1

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

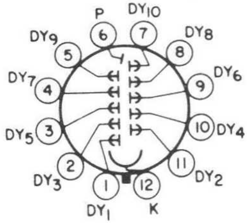
Note 1: Adjustable between approximately 500 and 1500 volts dc.

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.

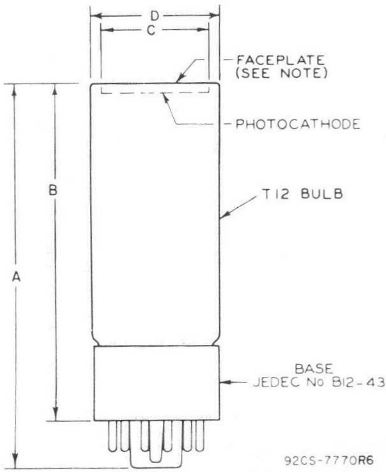
TERMINAL DIAGRAM (Bottom View)

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

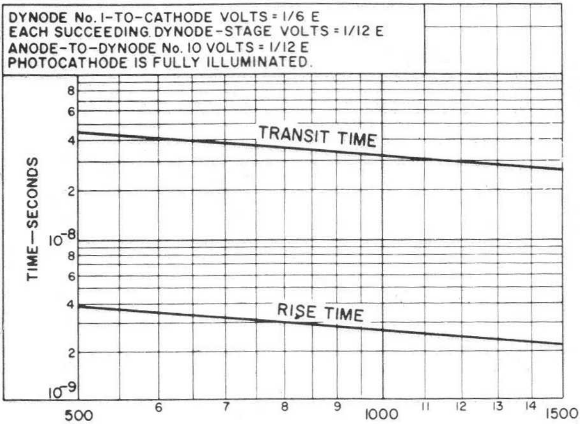


Note: Deviation from flatness will not exceed 0.010" from peak to valley.

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

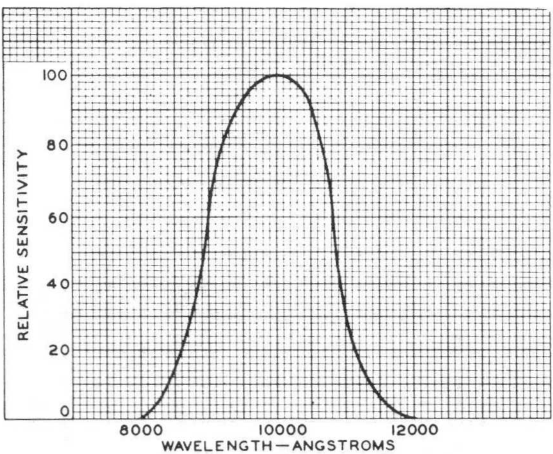
Dimensions	Inches	mm
A	4.57 max.	116.1 max.
B	3.88 ± 0.19	98.5 ± 4.8
C	1.24 min. dia.	31.4 min. dia.
D	1.56 max. dia.	39.6 max. dia.

TYPICAL TIME RESOLUTION CHARACTERISTICS



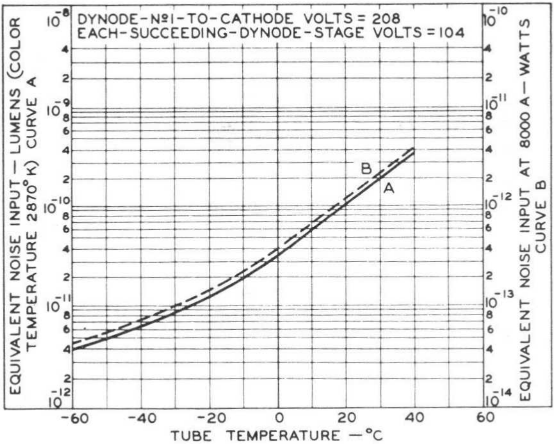
92CS-12475

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



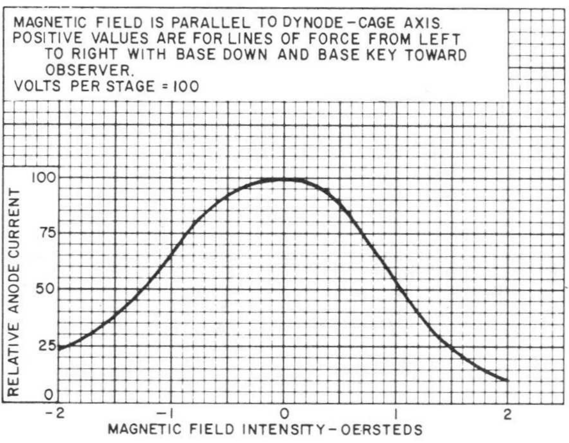
92CS-9456

EQUIVALENT NOISE-INPUT CHARACTERISTICS



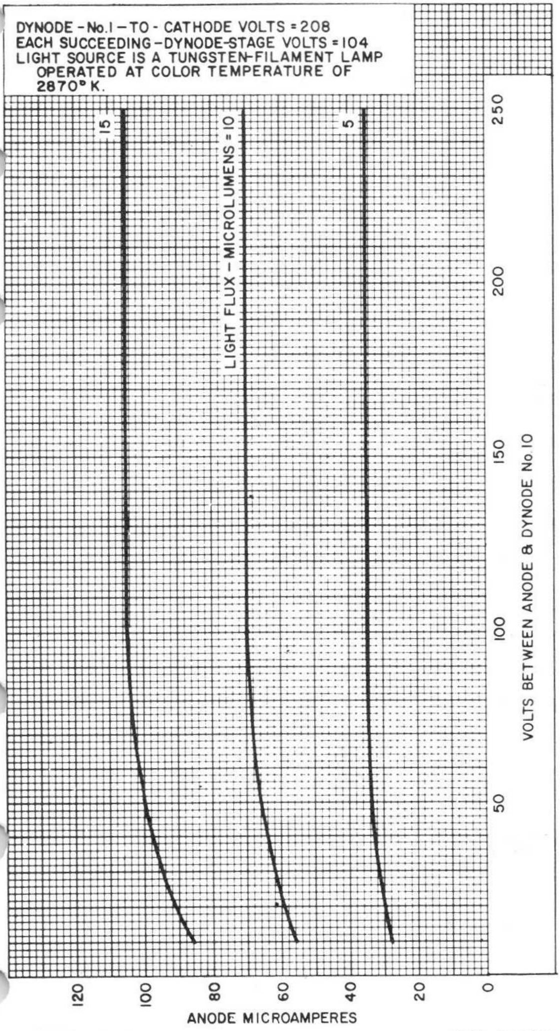
92CS-9462

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



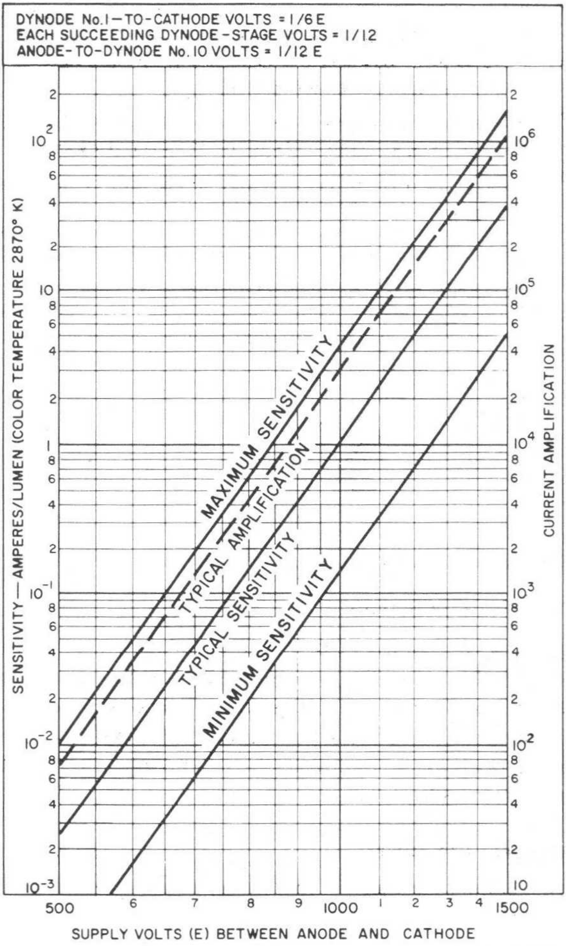
92CS-7813VI

TYPICAL ANODE CHARACTERISTICS

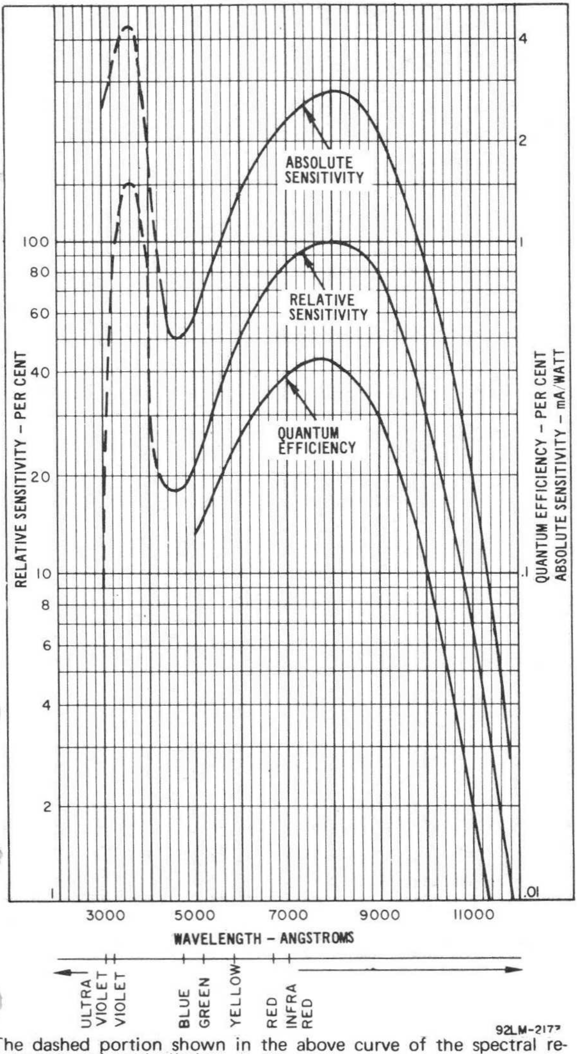


92CM-9460R3

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

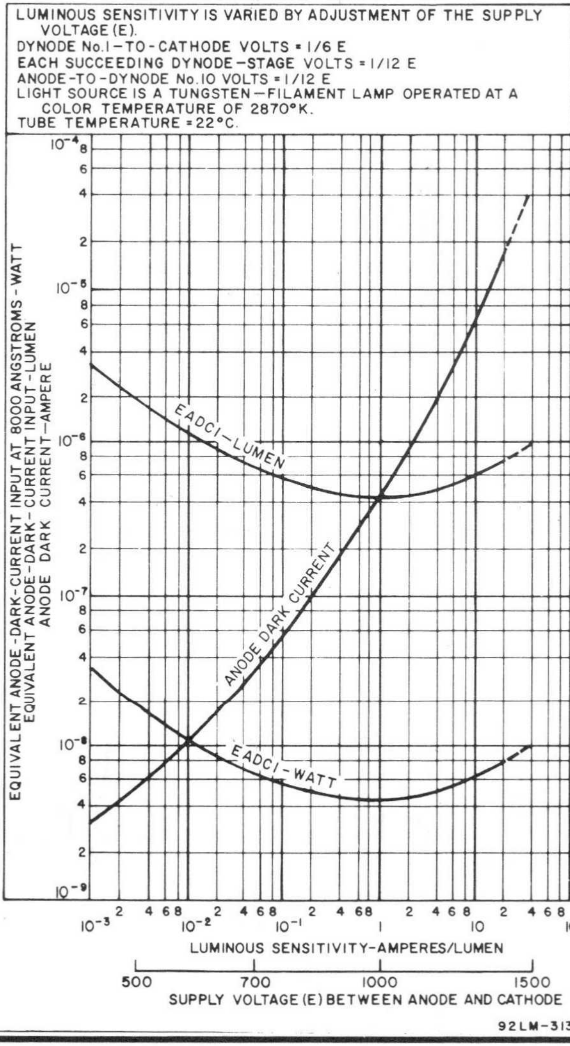


TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



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

TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS



Photomultiplier Tube

9-STAGE, SIDE-ON TYPE HAVING S-4 RESPONSE

For DC-Operated Control Applications Such as Automobile-Headlight Control

GENERAL

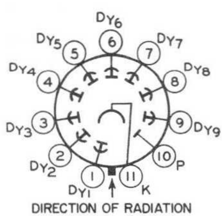
Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode, Opaque	Cs-Sb ←
Minimum projected length[a]	0.93 in
Minimum projected width[a]	0.31 in
Window	Lime Glass, (Corning[b] No.0080), or equivalent ←
Dynode Material	Cs-Sb ←
Direct Interelectrode Capacitances (Approx.)	
Anode to dynode No.9	4.2 pF
Anode to all other electrodes	5.5 pF
Maximum Overall Length	3.12 in
Maximum Seated Length	2.69 in
Length	1.56 ± 0.09 in
From base seat to center of useful cathode area	
Maximum Diameter	1.31 in
Operating Position	Any
Weight (Approx.)	1.6 oz
Envelope	JEDEC T9
Base	Small-Shell Neosubmagnal 11-Pin (JEDEC No.B11-104), Non-hygroscopic
Socket	Amphenol[c] No.78S11T, or equivalent
Magnetic Shield	Millen[d] No.80801B, or equivalent

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage	
Between anode and cathode	1250 V
Between dynode No.9 and anode	250 V
Between consecutive dynodes	250 V ←
Between dynode No.1 and cathode	250 V ←
Average Anode Current[e]	0.1 mA
Ambient Temperature	75 °C

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 – Anode
Pin 11 – Photocathode



11K

← Indicates a change.

CHARACTERISTICS RANGE VALUES

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.

With E = 1000 V (except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
→ Radiant, at 4000 angstroms. . .	-	3.4×10^{4}	-	A/W
Luminous, at 0 c/s[f]	-	34	-	A/lm
→ Electrode Dark Current				
At 25°C				
At anode.	-	-	1×10^{-7}	A
At any other electrode. . . .	-	-	7.5×10^{-7}	A

With E = Adjustable dc voltage

	Min	*Typ*	*Max*	
Anode-to-Cathode Voltage[g]	630	900	1100	V
DC values				

a On plane perpendicular to the indicated direction of incident light and passing through the major axis of the tube.

b Made by Corning Glass Works, Corning, New York.

c Made by Amphenol Electronics Corporation, 1830 South 54th Avenue, Chicago 54, Illinois.

d Made by James Millen Manufacturing Company, 150 Exchange Street, Malden 48, Massachusetts.

e Averaged over any interval of 30 seconds maximum.

f 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.

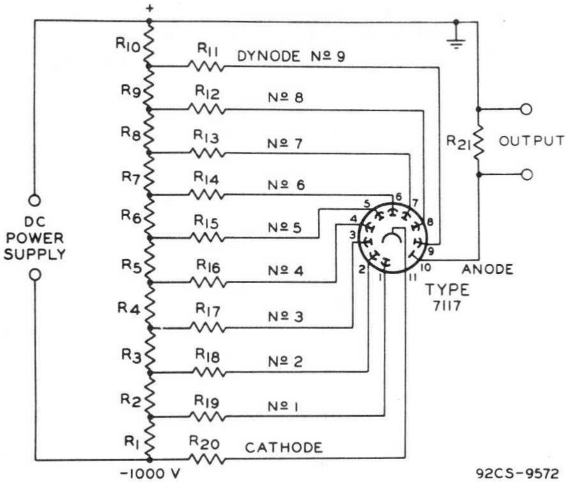
g Under the following conditions: Light incident on the cathode is transmitted through a filter (Corning C.S. No.3-67, Glass Code No.3482—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 10 microlumens. Supply voltage (E) is adjusted to give an anode current of 50 microamperes.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-4 Response
is shown at the front of this Section

DIMENSIONAL OUTLINE
and
AVERAGE-ANODE-CHARACTERISTICS and
VARIATION-IN-SENSITIVITY-OF-PHOTOCATHODE
Curves shown under Type 6328
also apply to the 7117

→ Indicates a change.

RECOMMENDED VOLTAGE-DIVIDER NETWORK FOR USE WITH TYPE 7117 IN HEADLIGHT-CONTROL SERVICE



R1 R2 R3 R4 R5 R6 R7 R8 R9 R10: 1 megohm, 1/2 watt

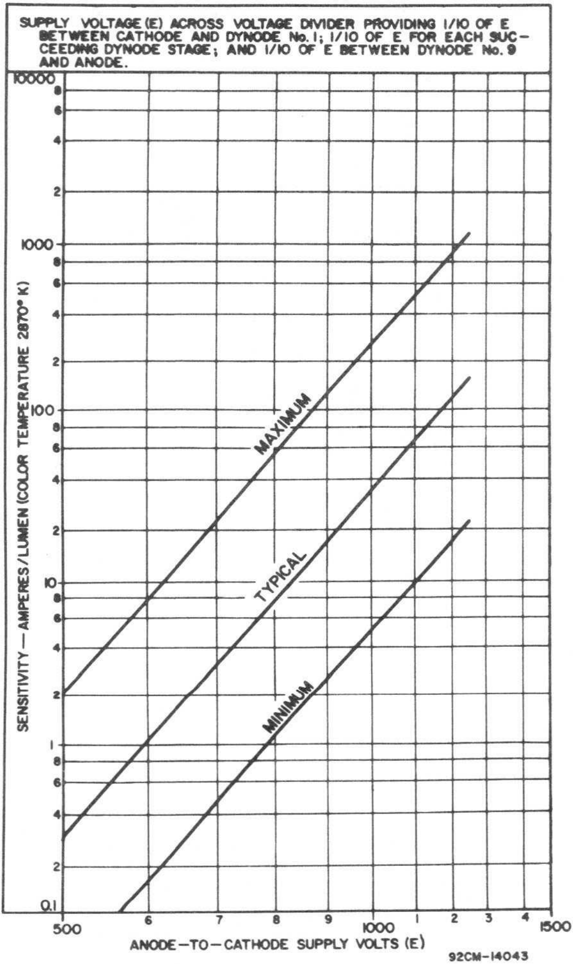
R11: 2 megohms, 1/2 watt

R12: 5.1 megohms, 1/2 watt

R13 R14 R15 R16 R17 R18 R19 R20: 8.2 megohms, 1/2 watt

R21: 820,000 ohms, 1/2 watt

Sensitivity Characteristics



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

7200

MULTIPLIER PHOTOTUBE

9-STAGE TYPE HAVING S-19 RESPONSE

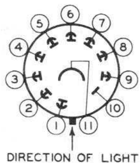
For detection and measurement of ultraviolet radiation

DATA

General:

Spectral Response	S-19
Wavelength of Maximum Response	3300 ± 500 angstroms
Cathode:	
Minimum projected length●	0.94"
Minimum projected width●	0.31"
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.9	4.4 μμf
Anode to all other electrodes	6 μμf
Maximum Overall Length	5.69"
Maximum Seated Length	5.12"
Length from Base Seat to Center of Useful Cathode Area	3.94" ± 0.09"
Maximum Diameter	1.31"
Weight (Approx.)	1.8 oz
Operating Position	Any
Bulb	Fused-Silica Section with Graded Seal
Socket	Amphenol Part No.78RS-11T, or equivalent
Base	Small-Shell Submagnal 11-Pin (JETEC No.B11-88), Non-hygroscopic
Basing Designation for BOTTOM 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

Maximum Ratings, *Absolute Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC or Peak AC)	1250 max.	volts
SUPPLY VOLTAGE BETWEEN ANODE AND DYNODE No.9 (DC or Peak AC)	250 max.	volts
AVERAGE ANODE CURRENT*	0.5 max.	ma
AMBIENT-TEMPERATURE RANGE	-80 to +75	°C

●,*: See next page.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7200

RCA

7200

MULTIPLIER PHOTOTUBE

Characteristics:

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

With E = 1000 volts dc (except as noted)

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at				
3300 angstroms. .	–	65000	–	µa/µw
Cathode radiant, at				
3300 angstroms. .	–	0.065	–	µa/µw
Luminous:#				
At 0 cps.	15	40	300	amp/lumen
Cathode luminous● .	20	40	–	µa/lumen
Current Amplification	–	1000000	–	
Equivalent Anode-Dark-Current Input▲□ . .	–	2×10^{-10}	2×10^{-9}	lumen
Equivalent Noise Input:				
Luminous★—				
At +25° C	–	7.5×10^{-13}	–	lumen
At −78° C	–	4×10^{-14}	–	lumen
Ultraviolet†—				
At +25° C	–	6.6×10^{-16}	–	watt
At −78° C	–	4×10^{-17}	–	watt

● On plane perpendicular to the indicated direction of incident light.

* Averaged over any interval of 30 seconds maximum.

\# For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

● For conditions the same as shown under (#) except that the value of light flux is 0.01 lumen and 100 volts are applied between cathode and all other electrodes connected together as anode.

▲ Supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission and ion feedback may be reduced by the use of a refrigerant.

□ For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1000 volts is recommended.

★ Under the following conditions: Supply voltage (E) is 1000 volts, external shield operated at −1000 volts with respect to anode, 25° C tube temperature, ac-amplifier bandwidth of 1 cycle per second, tungsten light source at 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

† Determined under the same conditions as shown under (★) except that use is made of monochromatic source having radiation of 2537 angstroms.

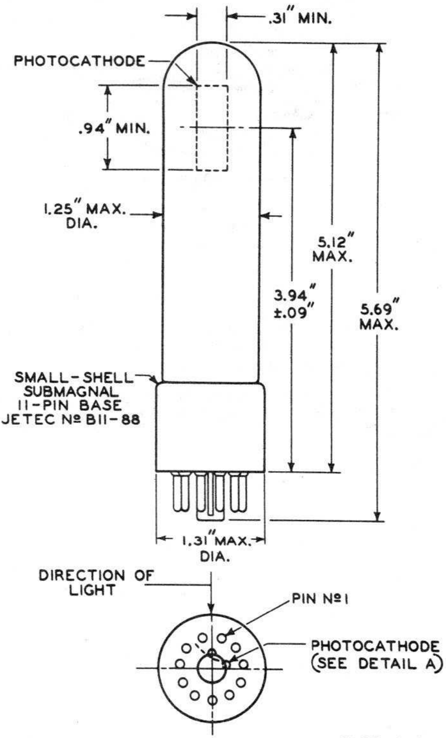
7200
MULTIPLIER PHOTOTUBE

OPERATING CONSIDERATIONS

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.

Electrostatic and/or *magnetic shielding* of the 7200 may be necessary.

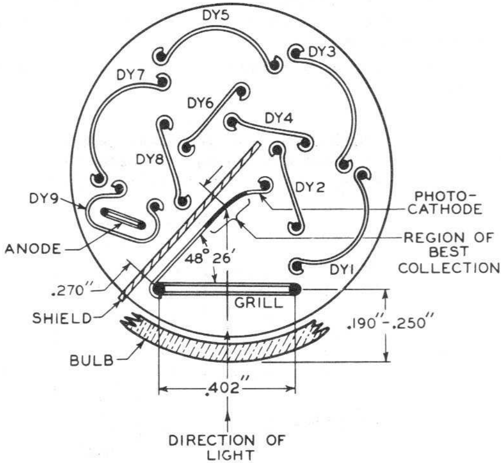
SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-19 Response is shown at the front of this Section



7200

MULTIPLIER PHOTOTUBE

DETAIL A



92CS-8674R1

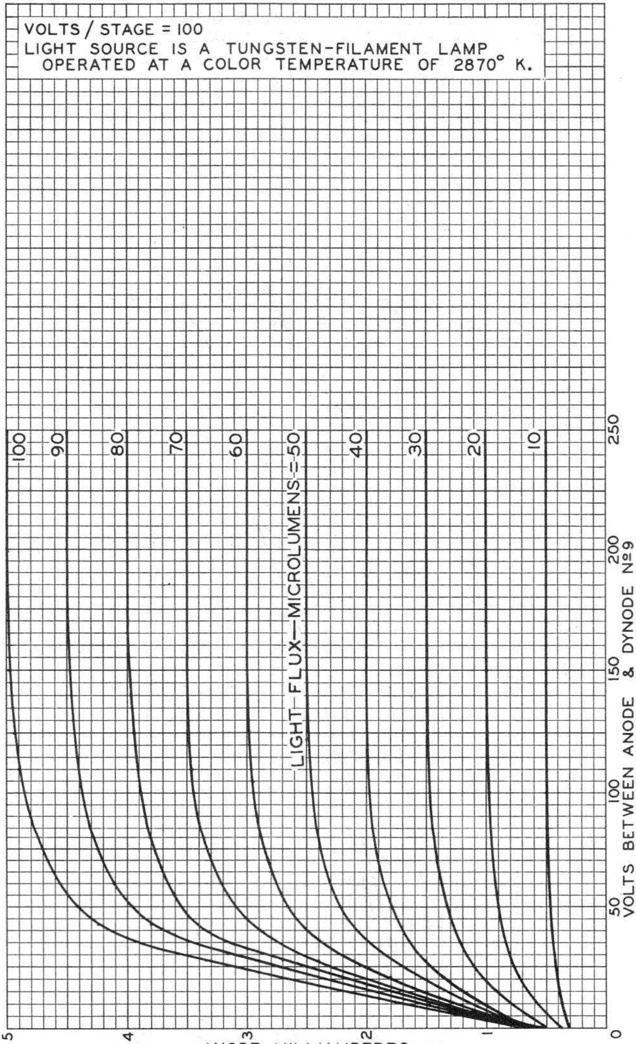
NOTE 1: CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT CENTER OF BOTTOM OF BASE.

NOTE 2: THE MAXIMUM ANGULAR VARIATION BETWEEN THE PLANE THROUGH PINS 1 AND 11 AND THE PLANE OF THE GRILL WILL NOT EXCEED 6°.

RCA

7200

AVERAGE ANODE CHARACTERISTICS



ELECTRON TUBE DIVISION

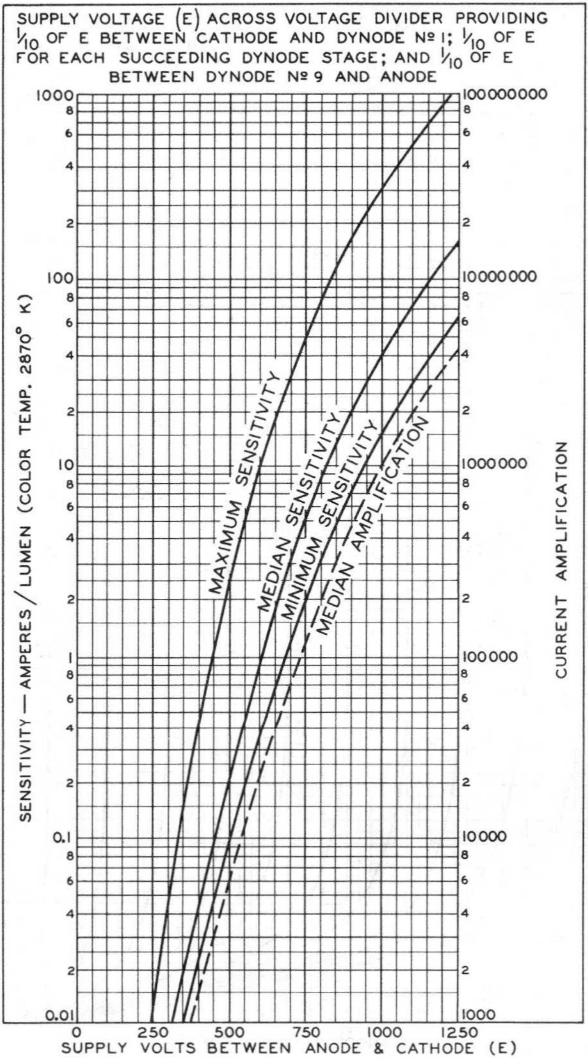
92CM—9577

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

7200

CHARACTERISTICS



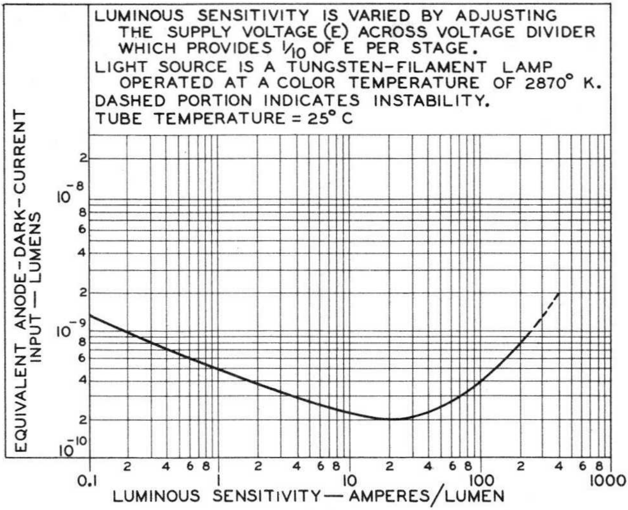
ELECTRON TUBE DIVISION

92CM-9583

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7200

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



92CS-9586

Vidicon

Short, Sturdy, 1-Inch Diameter Type

Magnetic Focus **Magnetic Deflection**

Low Heater Power – 0.6 watt 1000 TV Line Resolution

For Compact, Low-Power Transistorized TV Cameras

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	V
Current at 6.3 volts	0.095	A

Direct Interelectrode Capacitance:[a]

Target to all other electrodes . . .	4.6	pF

Spectral Response. . . . . . . See *Typical Spectral Sensitivity Characteristic*

Photoconductive Layer:

Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)	0.62	inch

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method.	Magnetic
Deflection Method	Magnetic
Overall Length	5.12" ± 0.06"
Greatest Diameter	1.125" ± 0.010"
Bulb.	T8
Base.	Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket	Cinch[b] No.54A18088, or equivalent
Focusing Coil-Deflecting Yoke-Alignment Coil Assembly	Cleveland Electronics[cd] No. VYFA-355-1, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz.

ABSOLUTE MAXIMUM RATINGS

For scanned area of 1/2" x 3/8"

Grid-No.3 & Grid-No. 4 Voltage	1000 max.	volts
Grid-No. 2 Voltage	1000 max.	volts
Grid-No. 1 Voltage:		
Negative bias value.	300 max.	volts
Positive bias value	0 max.	volts

Peak Heater-Cathode Voltage:			
Heater negative with respect to cathode	125 max.		volts
Heater positive with respect to cathode	10 max.		volts
Target Voltage	100 max.		volts
Dark Current	0.25 max.		μA
Peak Target Current[f]	0.55 max.		μA
Faceplate:			
Illumination[g]	5000 max.		fc
Temperature	71 max.		°C

TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 1/2" x 3/8" – Faceplate temperature of 30° to 35°C	*Low-Voltage Operation*	*High-Voltage Operation*	
Grid-No.4 (Decelerator) & Grid-No.3 (Beam-Focus Electrode) Voltage	250 to 300[h]	750	volts
Grid-No.2 (Accelerator) Voltage	300	300	volts
Grid-No.1 Voltage for Picture Cutoff[i]	-45 to -100	-45 to -100	volts
Average "Gamma" of Transfer Characteristic for Signal-Output Current between 0.02μA and 0.2μA	0.65	0.65	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[k]	300:1	300:1	
Lag–Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed:[m]			
Maximum value	28	28	%
Typical value	23	23	%
Minimum Peak-to-Peak Blanking Voltage:			
When applied to grid No.1	75	75	volts
When applied to cathode	20	20	volts
Limiting Resolution:			
At center of picture–Typical value	750	900	TV lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture	30	45	%

Field Strength at Center of Focusing Coil[n]	40	60	gauss
Peak Deflecting-Coil Current:			
Horizontal	340	520	mA
Vertical	20	32	mA
Field Strength of Adjustable Alignment Coil	0 to 4	0 to 4	gauss

High-Sensitivity Operation—
0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight)	0.1	fc
Target Voltage[p,q]	30 to 60	volts
Dark Current[r]	0.10	μA
Signal-Output Current:[s] Typical	0.11	μA

Average-Sensitivity Operation—
1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight)	1.0	fc
Target Voltage[p,q]	20 to 40	volts
Dark Current[r]	0.02	μA
Signal-Output Current:[s] Typical	0.2	μA

High Light Level Operation—
10 Footcandles on Faceplate

Faceplate Illumination (Highlight)	10	fc
Target Voltage[p,q]	10 to 22	volts
Dark Current[r]	0.005	μA
Signal-Output Current:[s] Typical	0.3	μA

[a]This capacitance, which effectively is the output impedance, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b]Made by Cinch Manufacturing Corporation, 1026 S. Homan Ave., Chicago 24, Illinois.

[c]Made by Cleveland Electronics, Inc., 2000 Highland Road, Twinsburg, Ohio. Components are also available from companies such as Syntronic Instruments, Inc., 100 Industrial Road, Addison, Illinois and Celco-Constantine Engineering Laboratories Co., 70 Constantine Drive, Mahwah, New Jersey.

[d]These components are chosen to provide tube operation with minimum beam-landing error.

[f] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[g] For conditions where "white light" is uniformly diffused over entire tube face.

[h] Definition, focus uniformity, and picture quality decrease with decreasing grid-No. 4 and grid-No. 3 voltage. In general, grid No. 4 and grid No. 3 should be operated above 250 volts.

[i] With no blanking voltage on grid No. 1.

[k] Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

[m] For initial signal-output current of 0.3 microampere and a dark current of 0.025 microampere.

[n] The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[p] The target voltage for each 7262A must be adjusted to that value which gives the desired operating signal current.

[q] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

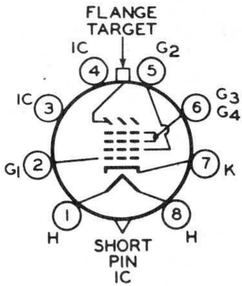
[r] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[s] Defined as the component of the highlight target current after the dark-current component has been subtracted.

OPERATING CONSIDERATIONS

When operated at maximum voltage, the 7262A has a typical center resolution of 1000 TV lines and a typical corner resolution of 600 TV lines. At low operating voltage with minimum deflection and focus power employed, its center resolution will ordinarily be in excess of 650 TV lines and 350 TV lines in the corner.

BASING DIAGRAM (Bottom View)

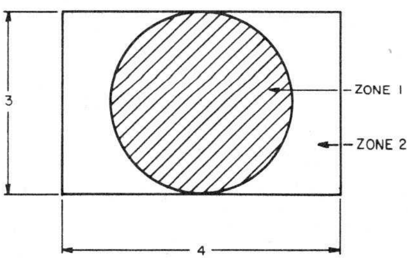


DIRECTION OF LIGHT:
INTO FACE END OF TUBE

8HM

Pin 1: Heater
Pin 2: Grid No. 1
Pin 3: Internal Connection – Do Not Use
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No. 2
Pin 6: Grids No. 3 and No. 4
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection – Make No Connection

Spurious Signal Test



92LS-1064

Fig.1

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in *Fig.1*. The 7262A is operated under the conditions specified under *Typical Operation and Performance Data* with the lens adjusted to provide a target current of 0.3 microampere. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.

Table 1

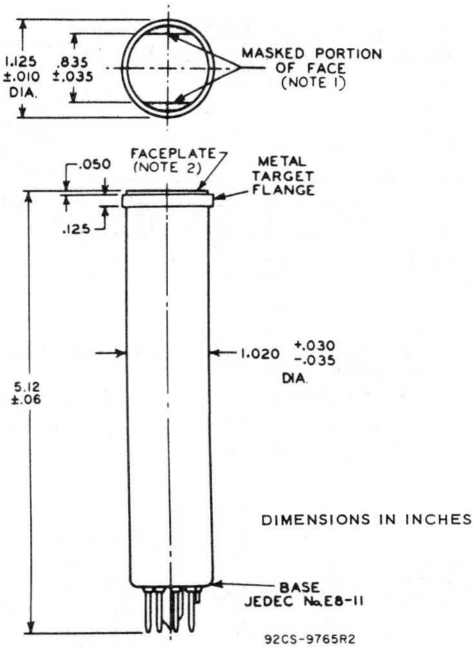
For scanned area of 1/2" x 3/8"

Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	0
4 but not including 3	0	1
3 but not including 1	2	3
1 or less	*	*

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.

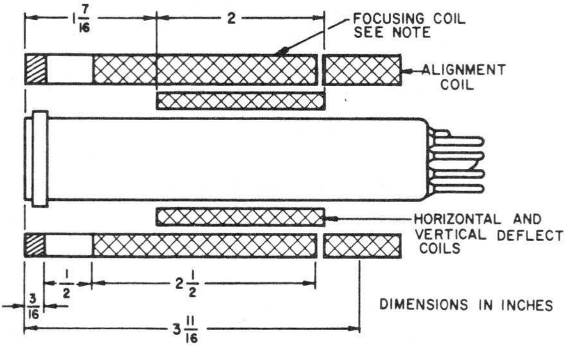
DIMENSIONAL OUTLINE



Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No. 7056 having a thickness of 0.094" ± 0.012".

COMPONENT LOCATIONS

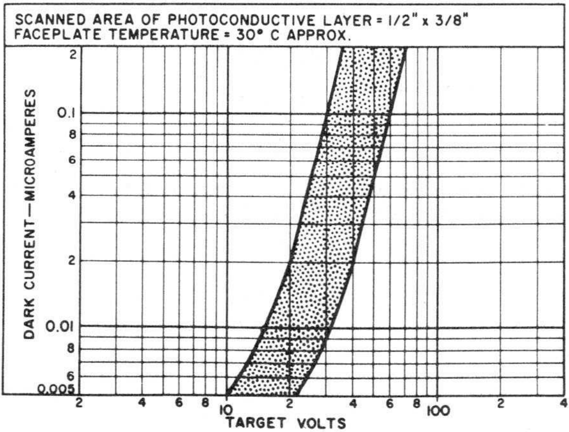


92LS-1760

NOTE: CROSS-HATCHING INDICATES WOUND PORTION OF FOCUSING COIL.

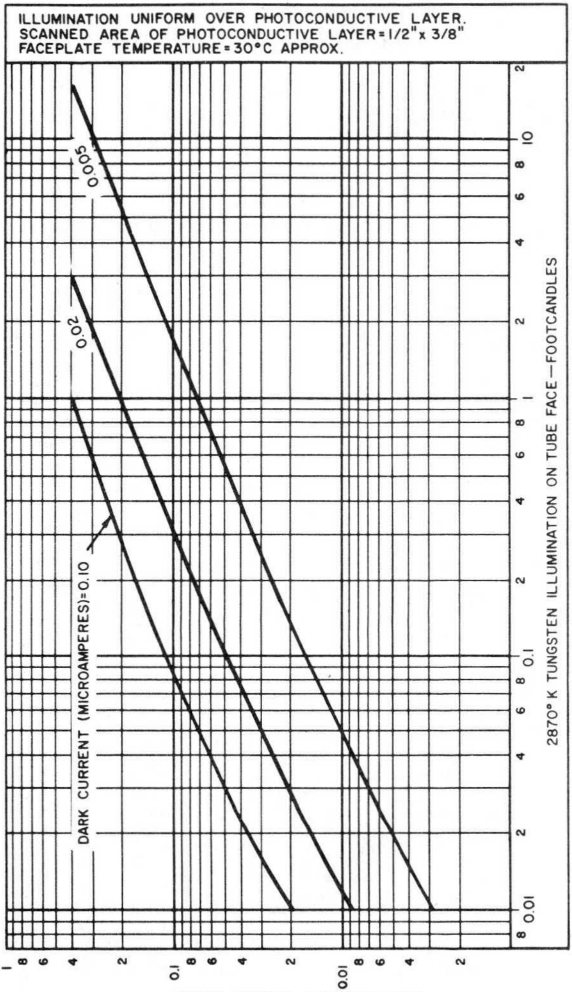
Recommended Location and Length of Deflecting, Focusing, and Alignment Components to obtain Minimum Beam-Landing Error.

RANGE OF DARK CURRENT



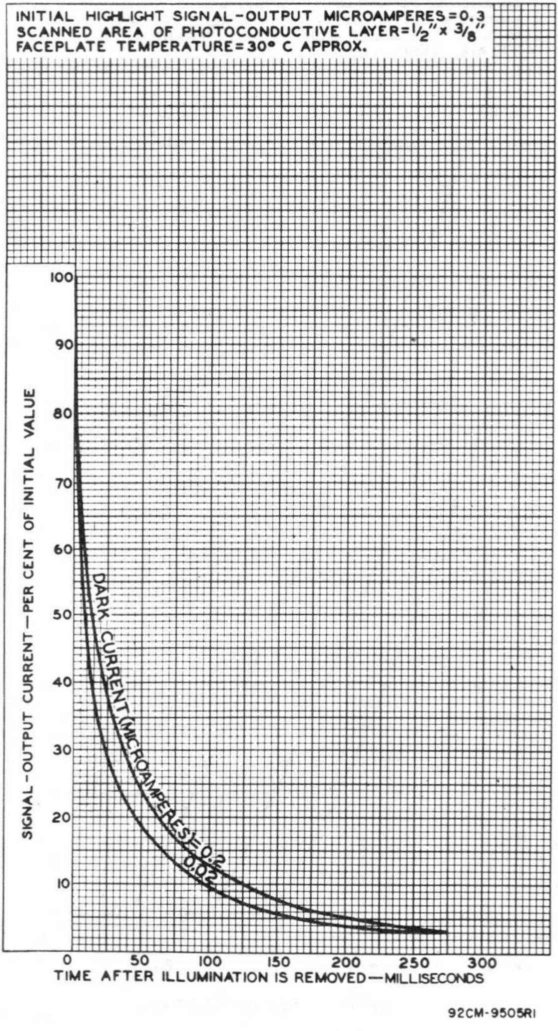
92CS-12235

LIGHT TRANSFER CHARACTERISTICS

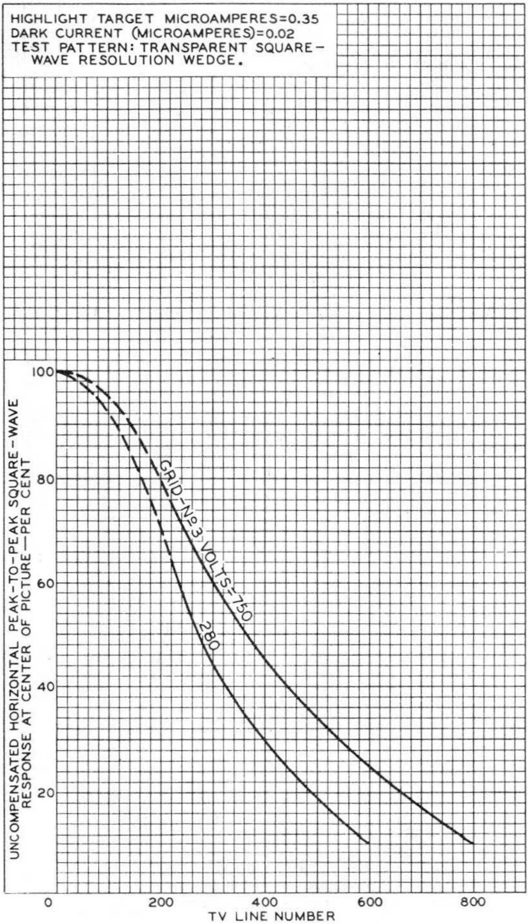


92LM-1761

TYPICAL PERSISTENCE CHARACTERISTIC

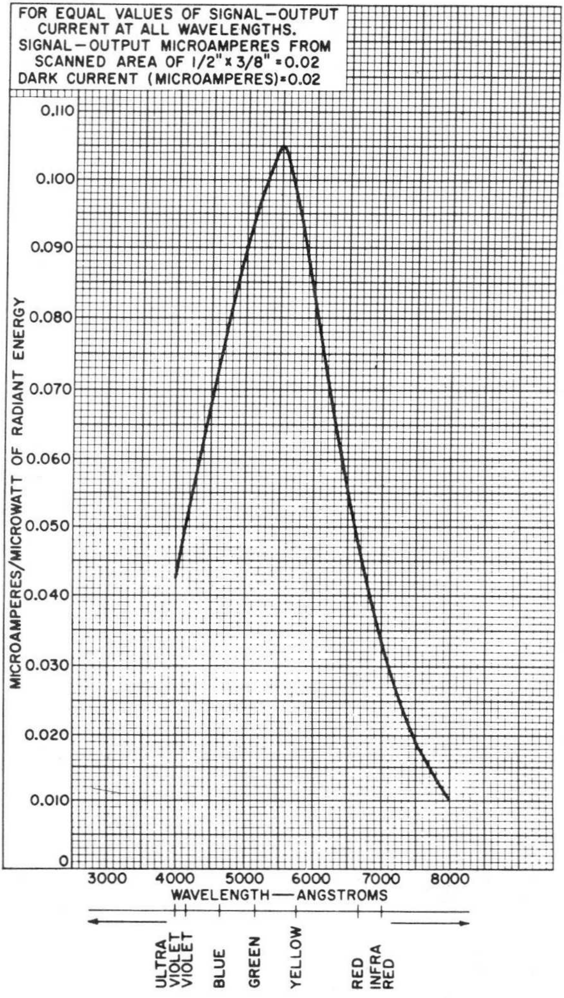


UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE



92CM-10683R1

TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC



Vidicon

Short, Ruggedized, 1-Inch Diameter Type

Magnetic Focus — **Magnetic Deflection**

Low-Power 0.6 W Heater — **1000 TV Line Resolution**

For Compact, Low-Power Transistorized TV Cameras Where Severe Shock and Vibration Conditions Exist

The 7263A is the same as the 7262A except for the following:

SPECIAL PERFORMANCE DATA

In connection with the following tests, sample 7263A's will maintain resolution as determined with a RETMA Resolution Chart, or equivalent, and will faithfully reproduce all resolution wedges and grey scales of the chart.

Vibration Tests These tests are performed under conditions for *Average-Sensitivity Operation* on a sample lot of tubes from each production run. Tubes and their associated components§ are vibrated on apparatus providing dynamic conditions similar to those described in MIL-E-5272B♦, par.4.7.1.

Resonance. Tubes and associated components§ are vibrated (per the method of MIL-E-5272B♦, par.4.7.1.1) for 1 hour at +25° C, for 15 minutes at 0° C, and for 15 minutes at +55° C.

Cycling. Tubes and associated components§ are vibrated (per the method of MIL-E-5272B♦, par.4.7.1.2 pertaining to specimen without vibration isolators) for 1 hour at +25° C, for 15 minutes at 0° C, and for 15 minutes at +55° C.

Temperature-Pressure (Altitude) Tests. Tubes and associated components§ are subjected (per the method of MIL-E-5400* par.3.2.20, 3.2.20.1, and 3.2.20.1.1) to the separate and combined effects of varying temperature 0° to +55° C and varying barometric pressure 30" to 3.4" of mercury. The pressures correspond to sea level and to an altitude of 50,000 feet, respectively.

Shock Tests. These tests are performed with no voltages applied on a sample lot of tubes from each production run. Tubes are subjected in these tests (per MIL-E-5400*, par.3.2.21.2.1) to 18 impact shocks of 15g consisting of 3 shocks in opposite directions along each of three mutually perpendicular axes of the tube. Each shock impulse has a duration of 11 ± 1 milliseconds with a maximum impact acceleration occurring at approximately 5.5 milliseconds. Tube mounting accessories assure the rigid fastening of the tube to the shock test apparatus.

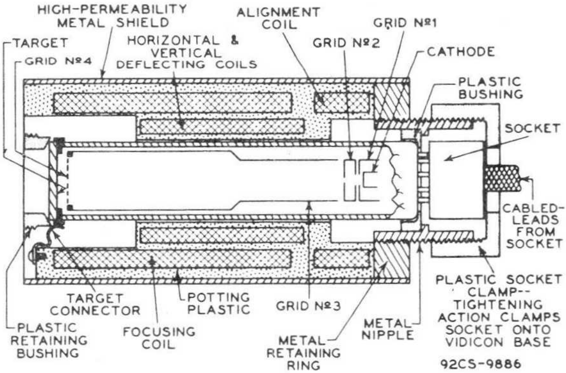
Temperature-Humidity Tests. These tests are performed with no voltages applied to the 7263A. The 7263A is subjected (per the method of MIL-E-5400*, par. 3.2.20.2B) to relative humidities up to and including 95 per cent at temperatures up to and including +50° C.

§ Tube socket such as Cinch No.54A18088 and RCA Assembly No.200SDU501, or equivalent, which consists of the deflecting coils, focusing coil, alignment coil, shield, and target connector.

♦ 5 June 1957, Procedure 1 of Military Specification.

* 1 January 1956.

TYPICAL COMPONENT ASSEMBLY FOR TUBE OPERATION UNDER SEVERE ENVIRONMENTAL CONDITIONS



7264

7264
MULTIPLIER PHOTOTUBE

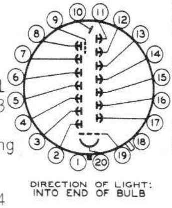
14-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE WITH 1.68"-DIA., SPHERICAL, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE
VERY SHORT TIME-RESOLUTION CAPABILITY

DATA

General:

Spectral Response.		S-11
Wavelength of Maximum Response	4400 ± 500	angstroms
Cathode, Semitransparent:		
Shape.		Spherical
Window:		
Area	2.2	sq. in.
Minimum diameter	1.68	in.
Index of refraction.	1.51	
Direct Interelectrode Capacitances (Approx.):		
Anode to dynode No.14.	2.4	$\mu\mu f$
Anode to all other electrodes. .	5.5	$\mu\mu f$
Dynode No.14 to all other electrodes	7.5	$\mu\mu f$
Maximum Overall Length		7.5"
Seated Length.		6.69" ± 0.19"
Maximum Diameter		2.38"
Operating Position		Any
Weight (Approx.)		8 oz
Bulb		T16
Socket . . . . Alden No.220FT with 20 contacts, or equivalent		
Base . . . . . . .Small-Shell Bidecal 20-Pin (JETEC No.B20-102)		
Basing Designation for BOTTOM VIEW		20D

Pin 1 - No Connection
Pin 2 - Dynode No.1
Pin 3 - Dynode No.3
Pin 4 - Dynode No.5
Pin 5 - Dynode No.7
Pin 6 - Dynode No.9
Pin 7 - Dynode No.11
Pin 8 - Dynode No.13
Pin 9 - Grid No.2 (Accelerating Electrode)
Pin 10 - Anode
Pin 11 - Dynode No.14
Pin 12 - Dynode No.12
Pin 13 - Dynode No.10



DIRECTION OF LIGHT: INTO END OF BULB

Pin 14 - Dynode No.8
Pin 15 - Dynode No.6
Pin 16 - Dynode No.4
Pin 17 - Dynode No.2
Pin 18 - No Connection
Pin 19 - Grid No.1 (Focusing Electrode)
Pin 20 - Photocathode
Metal Collar - No Connection (If used, connect only to photocathode)

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

7264

MULTIPLIER PHOTOTUBE

VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

With supply voltage (E) across voltage divider providing electrode voltages shown in Table I—Column A

Maximum Ratings, *Absolute Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC)	2400 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.14 AND ANODE (DC)	400 max.	volts
SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC)	500 max.	volts
SUPPLY VOLTAGE BETWEEN ACCELERATING ELECTRODE AND DYNODE No.13 (DC)	±500 max.	volts
DYNODE-No.1 SUPPLY VOLTAGE (DC)	400 max.	volts
FOCUSING-ELECTRODE SUPPLY VOLTAGE (DC)	400 max.	volts
AVERAGE ANODE CURRENT●	2 max.	ma
AMBIENT TEMPERATURE	75 max.	°C

Characteristics Range Values for Equipment Design:

With E = 2000 volts (except as noted) and focusing-electrode as well as accelerating-electrode voltage adjusted to give maximum gain

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4400 angstroms	–	0.7	–	amp/μw
Cathode radiant, at 4400 angstroms	–	0.056	–	μa/μw
Luminous:#				
At 0 cps.	120	875	4500	amp/lumen
With dynode No.14 as output electrode†	–	612	–	amp/lumen
Cathode luminous:				
With tungsten light source▲	50	70	–	μa/lumen
With blue light source**♦	0.05	–	–	μa
Current Amplification	–	12.5×10^6	–	
Equivalent Anode-Dark-Current Input⊕■	–	5×10^{-10}	2×10^{-9}	lumen
Equivalent Noise Input:★				
At +25° C	–	3.3×10^{-12}	1.5×10^{-11}	lumen
At −50° C	–	9×10^{-13}	–	lumen
Anode-Pulse Rise Time□	–	3	–	milliμsec

●, #, †, ▲, **, ♦, ⊕, ■, ★, □: See next page.

7264
MULTIPLIER PHOTOTUBE

	Min.	Median	Max.	
Greatest Delay Between Anode Pulses: Due to position from which electrons are simultaneously released within a circle centered on tube face and having a diameter of—				
1.12"	–	0.5‡	–	milliμsec
1.5"	–	1‡	–	milliμsec

HIGH-OUTPUT-PULSE SERVICE

With supply voltage (E) across voltage divider providing electrode voltages shown in Table I—Column B

Maximum Ratings, *Absolute Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC)	2800 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.14 AND ANODE (DC)	400 max.	volts
SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC)	500 max.	volts
SUPPLY VOLTAGE BETWEEN ACCELERATING ELECTRODE AND DYNODE No.13 (DC)	±500 max.	volts
DYNODE-No.1 SUPPLY VOLTAGE (DC)	400 max.	volts
FOCUSING-ELECTRODE SUPPLY VOLTAGE (DC)	400 max.	volts
AVERAGE ANODE CURRENT●	2 max.	ma
AMBIENT TEMPERATURE	75 max.	°C

Characteristics Range Values for Equipment Design:

With E = 2400 volts (except as noted) and focusing-electrode as well as accelerating-electrode voltage adjusted to give maximum gain

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	0.7	–	amp/μw
Cathode radiant, at 4400 angstroms	–	0.056	–	μa/μw
Luminous:#				
At 0 cps.	–	875	–	amp/lumen
With dynode No.14 as output electrode†	–	612	–	amp/lumen
Cathode luminous:				
With tungsten light source▲	50	70	–	μa/lumen
With blue light source**◆	0.05	–	–	μa

●,#,†,▲,**,◆,⊕,■,★,□,‡: See next page.

7264

7264

MULTIPLIER PHOTOTUBE

	Min.	Median	Max.	
Current Amplification. . .	–	12.5×10^6	–	
Equivalent Anode-Dark-Current Input⊕⊕.	–	1.1×10^{-9}	–	lumen
Equivalent Noise Input:★★				
At +25° C.	–	4.6×10^{-12}	–	lumen
At –50° C.	–	1.2×10^{-12}	–	lumen

● Averaged over any interval of 30 seconds maximum.

Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 0.1 microlumen is used. The load resistor has a value of 0.01 megohm.

† An output current of opposite polarity to that obtained at the anode may be provided by using dynode No.14 as the output electrode. With this arrangement, the load is connected in the dynode-No.14 circuit and the anode serves only as collector.

▲ Under the following conditions: The light source is a tungsten-filament lamp 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 together as anode. The load resistor has a value of 0.01 megohm.

** Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning, Glass Code No.5113 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 200 volts are applied between cathode and all other electrodes connected together as anode.

♦ For spectral characteristic of this source, see sheet SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER at front of this section.

⊕ Measured at a tube temperature of 25° C and with the supply voltage (E) adjusted to give a luminous sensitivity of 2000 amperes per lumen. Dark current caused by thermionic emission may be reduced by the use of a refrigerant.

■ For maximum signal-to-noise ratio, operation with a supply voltage (E) below 2000 volts is recommended.

★ Under the following conditions: Supply voltage (E) is 2000 volts, 25°-C tube temperature, external-shield potential of –2000 volts, ac-amplifier bandwidth of 1 cycle per second, tungsten light source 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

□ Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is determined primarily by transit-time variations in the multiplier stages and with an incident-light spot approximately 1 millimeter in diameter centered on the photocathode.

‡ These values also represent the difference in time of transit between the photocathode and dynode No.1 for electrons simultaneously released from the center and from the periphery of the specified areas.

⊕ For maximum signal-to-noise ratio, operation with a supply voltage (E) below 2300 volts is recommended.

★★ Same as (★) except the supply voltage (E) is 2400 volts, and the external-shield potential is –2400 volts.

RCA

7264

MULTIPLIER PHOTOTUBE

TABLE I		
VOLTAGE TO BE PROVIDED BY DIVIDER		
Between	COLUMN A 5.4% of Supply Voltage (E) multiplied by	COLUMN B 2.75% of Supply Voltage (E) multiplied by
Cathode and Focusing Electrode	♣	♣
Cathode and Dynode No.1	2	2
Dynode No.1 and Dynode No.2	1	1
Dynode No.2 and Dynode No.3	1	1
Dynode No.3 and Dynode No.4	1	1
Dynode No.4 and Dynode No.5	1	1
Dynode No.5 and Dynode No.6	1	1
Dynode No.6 and Dynode No.7	1	1.2
Dynode No.7 and Dynode No.8	1	1.5
Dynode No.8 and Dynode No.9	1	1.9
Dynode No.9 and Dynode No.10	1	2.4
Dynode No.10 and Dynode No.11	1	3
Dynode No.11 and Dynode No.12	1.25	3.8
Dynode No.12 and Dynode No.13	1.5	4.8
Dynode No.13 and Dynode No.14	1.75	6
Dynode No.14 and Anode	2	4.8
Anode and Cathode	18.5	36.4

♣ Focusing electrode is connected to arm of potentiometer between cathode and dynode No.1. Focusing-electrode voltage is adjusted to give maximum gain.

7264

7264

MULTIPLIER PHOTOTUBE

OPERATING CONSIDERATIONS

Exposure of the 7264 to strong ultraviolet radiation may cause an increase in anode dark current. After cessation of such irradiation, the dark current drops rapidly.

The *operating stability* of the 7264 depends on the magnitude and duration of the anode current. When the 7264 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 7264 usually recovers a substantial percentage of such loss in sensitivity.

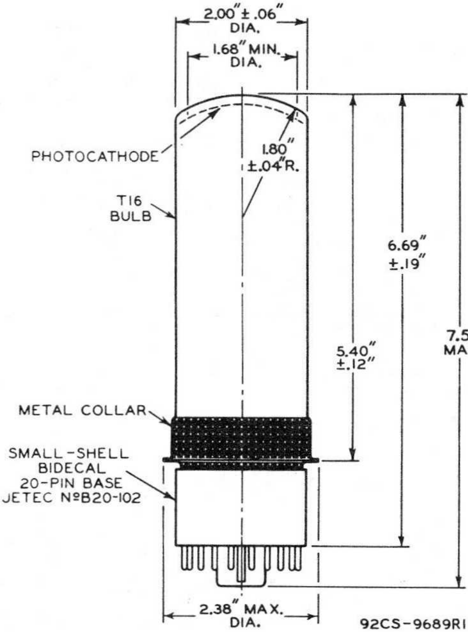
Operation at an average anode current well below the maximum rated value of 2 milliamperes is recommended when stability is important. When maximum stability is required, the anode current should not exceed 250 microamperes.

Electrostatic and/or *magnetic shielding* of the 7264 may be necessary. It is to be noted that the use of an external magnetic and/or electrostatic shield at high negative potential is a safety hazard unless the shield is connected to the potential source through an impedance in the order of 10 megohms. If the shield is not so connected, *extreme care should be observed in providing adequate safeguards to prevent personnel from coming in contact with the high potential of the shield.*

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-11 Response
is shown at the front of this Section

7264

MULTIPLIER PHOTOTUBE



℄ OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF THE BOTTOM OF THE BASE.

7264

RCA

7264

TYPICAL ANODE CHARACTERISTICS

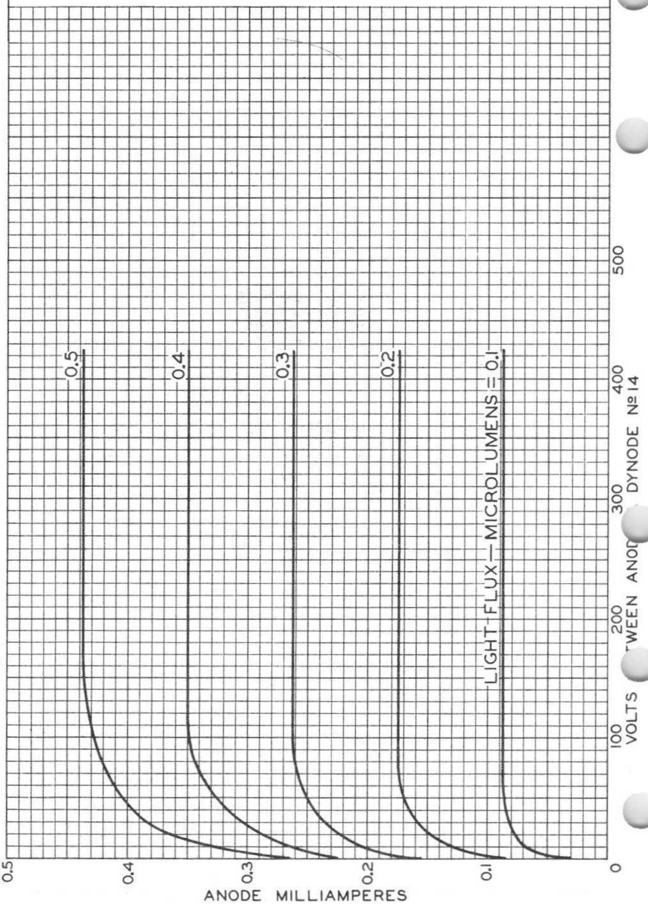
VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

CATHODE-TO-GRID-№1 VOLTS = 108
GRID-№1-TO-DYNODE-№1 (DY_1) VOLTS = 108

DY_1-TO-DY_2
DY_2-TO-DY_3
ETC. TO
DY_{10}-TO-DY_{11} } VOLTS = 108

DY_{11}-TO-DY_{12} VOLTS = 135
DY_{12}-TO-DY_{13} VOLTS = 160
DY_{13}-TO-DY_{14} VOLTS = 189
GRID-№2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.

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



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7264

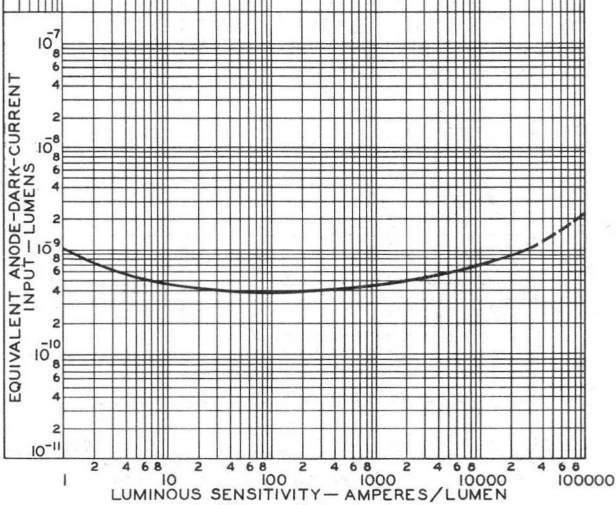
7264

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC
VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	5.4% OF E MULTIPLIED BY
CATHODE & GRID №1	1
GRID №1 & DYNODE №1 (DY_1)	1
DY_1 & DY_2	1
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1
DY_7 & DY_8	1
DY_8 & DY_9	1
DY_9 & DY_{10}	1
DY_{10} & DY_{11}	1
DY_{11} & DY_{12}	1.25
DY_{12} & DY_{13}	1.5
DY_{13} & DY_{14}	1.75
DY_{14} & ANODE	2.
ANODE & CATHODE	18.5

GRID-№2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C
DASHED PORTION INDICATES INSTABILITY.



ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-8848

7264

RCA

7264

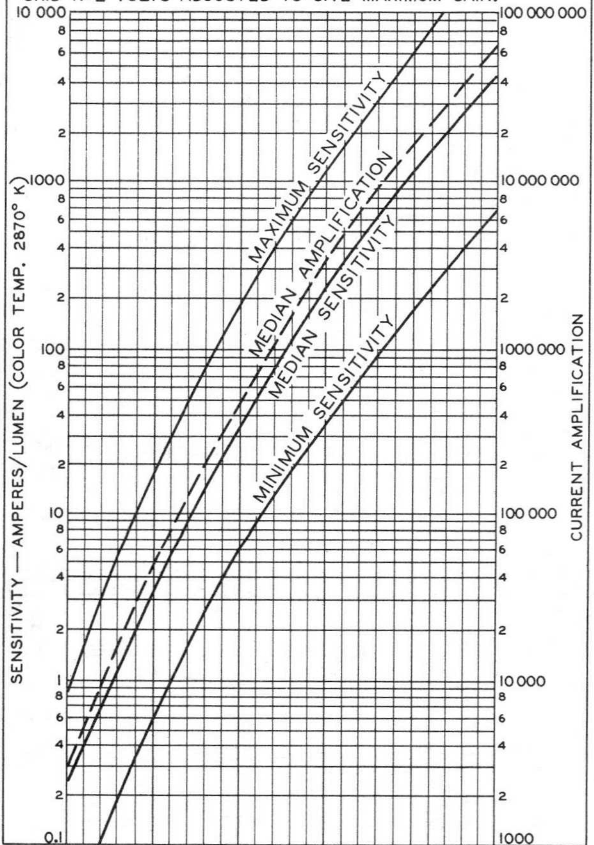
CHARACTERISTICS

VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	5.4 % OF E MULT. BY	BETWEEN	5.4 % OF E MULT. BY
CATHODE & GRID Nº 1	1	DY_{11} & DY_{12}	1.25
GRID Nº 1 & DYNODE Nº 1	1	DY_{12} & DY_{13}	1.5
DYNODE Nº 1 (DY_1) & DY_2 ETC. THRU DY_{10} & DY_{11}	1	DY_{13} & DY_{14}	1.75
		DY_{14} & ANODE	2

GRID-Nº 2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.



ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9687

7264

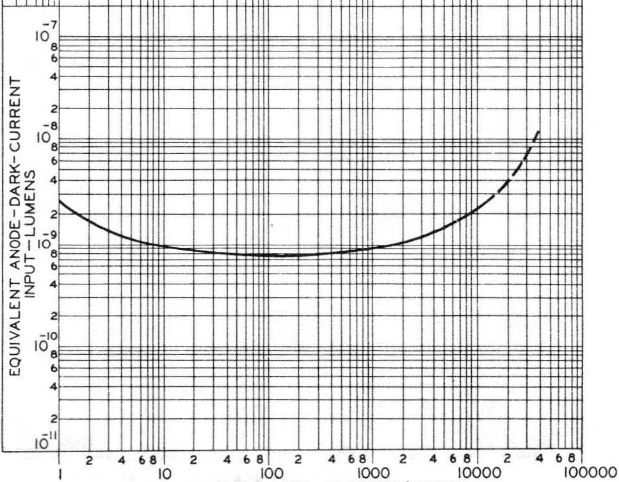
7264

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC
HIGH-OUTPUT-PULSE SERVICE

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	2.75 % OF E MULTIPLIED BY
CATHODE & GRID No. 1	1
GRID No. 1 & DYNODE No. 1 (DY_1)	1
DY_1 & DY_2	1
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1.2
DY_7 & DY_8	1.5
DY_8 & DY_9	1.9
DY_9 & DY_{10}	2.4
DY_{10} & DY_{11}	3
DY_{11} & DY_{12}	3.8
DY_{12} & DY_{13}	4.8
DY_{13} & DY_{14}	6
DY_{14} & ANODE	4.8
ANODE & CATHODE	36.4

GRID-No. 2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE = 25° C
DASHED PORTION INDICATES INSTABILITY.



ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9356

7264

7264

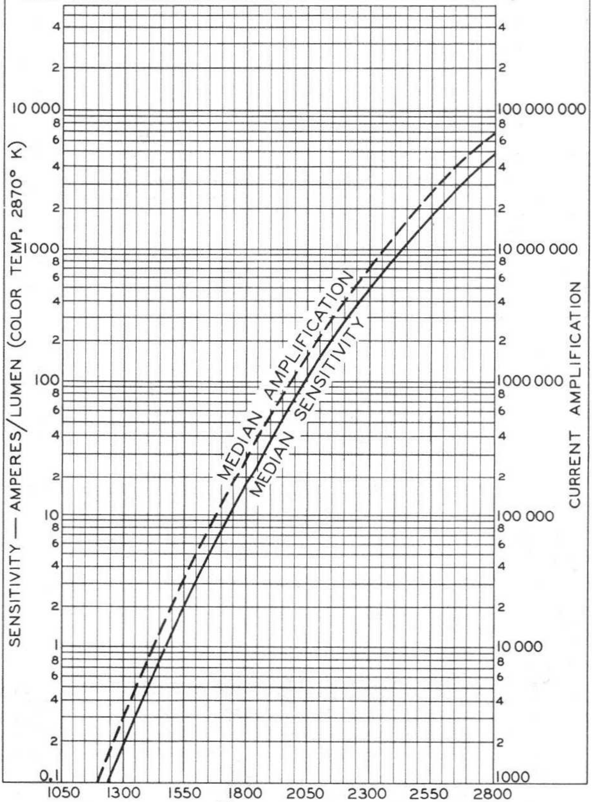
CHARACTERISTICS

HIGH-OUTPUT-PULSE SERVICE

THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	2.75 % OF E MULT. BY	BETWEEN	2.75 % OF E MULT. BY
CATHODE & GRID Nº 1	1	DY_8 & DY_9	1.9
GRID Nº 1 & DYNODE Nº 1 (DY_1)	1	DY_9 & DY_{10}	2.4
DY_1 & DY_2 ETC. THRU DY_5 & DY_6	1	DY_{10} & DY_{11}	3
DY_6 & DY_7	1.2	DY_{11} & DY_{12}	3.8
DY_7 & DY_8	1.5	DY_{12} & DY_{13}	4.8
		DY_{13} & DY_{14}	6
		DY_{14} & ANODE	4.8

GRID-Nº 2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.



ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9685

Photomultiplier Tube

14-Stage, Head-On Type Having S-20 Spectral Response

GENERAL

Spectral Response	S-20
Wavelength of Maximum Response	4200 ± 500 Å
Cathode, Semitransparent	Potassium-Sodium Cesium-Antimony (Multialkali)
Minimum projected area	2.2 in^2 (14.2 cm^2)
Minimum diameter	1.68 in (4.2 cm)
Window	Corning[a] No.0080, or equivalent
Shape	Plano-Concave
Index of refraction at 5893 angstroms	1.512
Dynodes:	
Substrate	Copper-Beryllium
Secondary-Emitting Surface	Beryllium Oxide
Structure	In-Line Electrostatic-Focus Type
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.14	2.8 pF
Anode to all other electrodes	6 pF
Dynode No.14 to all other electrodes	7.5 pF
Maximum Overall Length	7.5 in (19 cm)
Seated Length	6.69 in (17 cm) ± 0.19 in
Maximum Diameter	2.38 in (6 cm)
Bulb	T16
Base	Small-Shell Bidecal 20-Pin, JEDEC No.B20-102
Socket	Alden[b] Part 220FTC, or equivalent
Magnetic Shield	Millen[c] No.80802E, or equivalent
Operating Position	Any
Weight (Approx.)	8 oz (226 g)

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage:		
Between Anode and Cathode	3000 max.	V
Between Anode and Dynode No.14	500 max.	V
Between Consecutive Dynodes	600 max.	V
Between Accelerating Electrode and Dynode No.13	±600 max.	V
Between Dynode No.1 and Cathode	500 max.	V
Between Focusing-Electrode and Cathode	500 max.	V
Average Anode Current[e]	1 max.	mA
Ambient Temperature[f]	85 max.	°C

CHARACTERISTICS RANGE VALUES

With E = 2400 volts (Except as noted)

Voltage Distribution A (See Table)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g] at 4200 angstroms	–	3×10^6	–	A/W
Luminous[h] . . .	8×10^2	7.2×10^3	3.3×10^4	A/lm
Cathode Sensitivity:				
Radiant[i] at 4200 angstroms . . .	–	0.064	–	A/W
Luminous[k] . . .	1×10^{-4}	1.5×10^{-4}	–	A/lm
With red light[m] .	3×10^{-7}	–	–	A
With blue light[n] .	5×10^{-8}	–	–	A
Cathode Quantum Efficiency at 4000 angstroms	–	19	–	%
Current Amplification	–	4.8×10^7	–	
Anode Dark Current[p]	–	5×10^{-8}	8×10^{-7}	A
Equivalent Anode-Dark-Current Input[p]	–	5×10^{-11}	8×10^{-10}	lm
	–	1.2×10^{-13}[q]	1.9×10^{-12}[q]	W
Equivalent Noise Input[r]	–	9×10^{-13}	–	lm
	–	2.1×10^{-15}[s]	–	W
Anode Pulse Rise Time at 3000 V[t]	–	2.7×10^{-9}	–	s
Electron Transit Time at 3000 V[u]	–	4×10^{-8}	–	s

[a] Made by Corning Glass Works, Corning, New York.

[b] Made by Alden Products Co., 262 N. Main St., Brockton, Mass. 02403.

[c] Made by James Millen Manufacturing Co., 150 Exchange Street, Malden 48, Mass.

[e] Averaged over any interval of 30 seconds maximum.

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

[g] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 428 lumens per watt.

[h] 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 0.1 microlumen is used.

i This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 428 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 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 red filter (Corning C.S. No.2-62 Manufactured by the Corning Glass Works, Corning, New York) 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.

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, New York) 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 1000 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant. Dark current is measured with incident light removed.

q At 4200 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 428 lumens per watt.

r 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.

s At 4200 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 428 lumens per watt.

t 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.

[u] 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.

Voltage Distribution		
Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	A 5.4% of Supply Voltage (E) multiplied by	B 6.06% of Supply Voltage (E) multiplied by
K - Dy1	2	♦
Dy1 - Dy2	1	1
Dy2 - Dy3	1	1
Dy3 - Dy4	1	1
Dy4 - Dy5	1	1
Dy5 - Dy6	1	1
Dy6 - Dy7	1	1
Dy7 - Dy8	1	1
Dy8 - Dy9	1	1
Dy9 - Dy10	1	1
Dy10 - Dy11	1	1
Dy11 - Dy12	1.25	1.25
Dy12 - Dy13	1.5	1.5
Dy13 - Dy14	1.75	1.75
Dy14 - P	2	2
Dy1 - P	—	16.5
K - P	18.5	—

Focusing electrode is connected to arm of potentiometer between cathode and dynode No.1; the focusing electrode voltage is varied to give maximum anode current.

The metal collar (See Dimensional Outline) is connected internally to the focusing electrode. Extreme care should be taken in the design of apparatus to prevent operating personnel from coming in contact with the collar when the circuit application is such that the collar is at high potential.

♦Cathode-to-dynode No.1 voltage is maintained at 330 volts.

OPERATING CONSIDERATIONS

The base pins of the 7265 fit a bidecal 20-contact socket, such as Alden No.220FTC or equivalent.

The socket should be made of high-grade, low-leakage material.

The operating stability of the 7265 is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 1 milliampere is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of 1 microampere or less, commensurate with satisfactory output signal, is recommended.

Electrostatic shielding of the tube is ordinarily required. When a shield is used, it must be connected to the cathode terminal. The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding the tube at the photocathode end should not be permitted unless such materials are chosen to limit leakage current to the tube envelope to 1×10^{-12} ampere or less.

Accompanying voltage-divider arrangements are recommended for use with the 7265. Recommended resistance values for the voltage divider range from 10 kilohms per stage to 10 megohms per stage. The choice of resistance values for any voltage-divider network is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the regulated power supply and the required power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode. The use of high resistance values per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum value of average anode current, and may limit anode-current response to pulsed light. The latter effect may be reduced by connecting capacitors between the tube socket terminals for dynodes No.11 and No.12, dynodes No.12 and No.13, dynodes No.13 and No.14, and between dynode No.14 and anode return.

In addition to nonlinearity and pulse-limiting effects, the use of resistance values exceeding 10 megohms per stage make the 7265 more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.

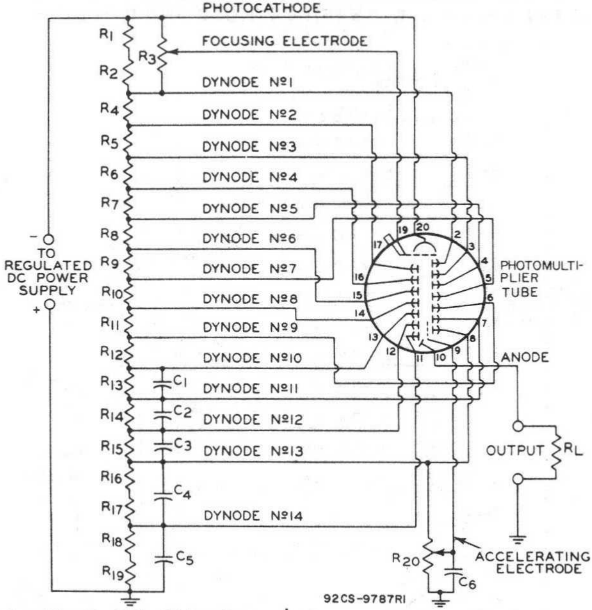
Voltage Distribution B is recommended where high dynode-No.1 gain is important, such as low light level and scintillation counting applications. Voltage Distribution B maintains the cathode to dynode-No.1 voltage constant at 330 volts; it is especially useful when the supply voltage is adjusted over a wide range to achieve large changes in anode sensitivity.

The high voltages at which the 7265 is operated are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

In the use of the 7265 as with other tubes requiring high voltages, it should always be remembered that these high voltages may appear at points in the circuit which are normally at low potential, because of defective circuit parts or incorrect circuit connections.

Therefore, before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors grounded.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



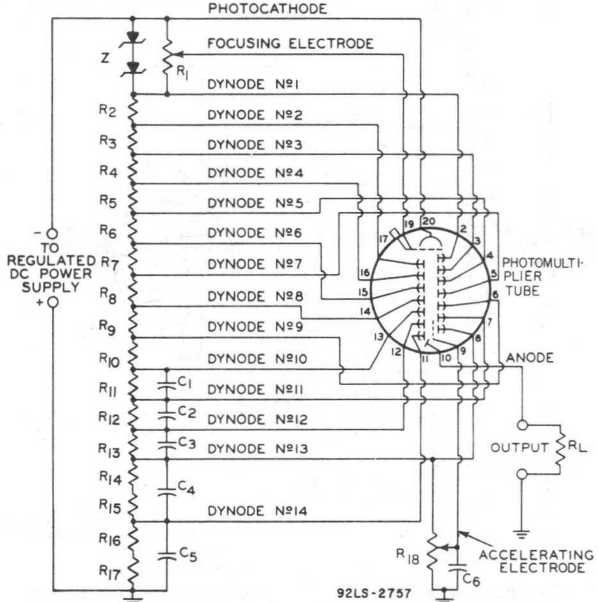
C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (dc working), ceramic disc

R_1: 24000 ohms, 5%, 1 watt
R_2: 22000 ohms, 5%, 1 watt
R_3: 1 megohm, 20%, 2 watts, adjustable
R_4 through R_{13}: 22000 ohms, 5%, 1 watt
R_{14}: 27000 ohms, 5%, 2 watts
R_{15}: 33000 ohms, 5%, 2 watts
R_{16}: 22000 ohms, 5%, 2 watts
R_{17}: 18000 ohms, 5%, 2 watts
R_{18}: 22000 ohms, 5%, 2 watts
R_{19}: 22000 ohms, 5%, 2 watts
R_{20}: 10 megohms, 2 watts, adjustable

R_L: Value will depend on magnitude of peak pulse voltage desired. For a peak pulse amplitude of 100 volts, the value is approximately 300 ohms.

Note 1: Adjustable between approximately 800 and 3000 V dc.
Note 2: Component values are dependent upon nature of application and output signal desired.

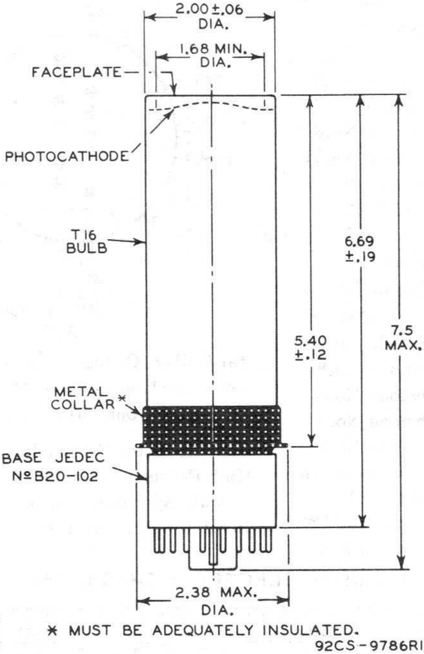
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR CONSTANT VOLTAGE BETWEEN CATHODE AND DYNODE No.1



C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (dc working), ceramic disc
R_1: 5 megohms, 20%, 1/2 watt, adjustable
R_2 through R_{11}: 22000 ohms, 5%, 1 watt
R_{12}: 27000 ohms, 5%, 2 watts
R_{13}: 33000 ohms, 5%, 2 watts
R_{14}: 22000 ohms, 5%, 2 watts
R_{15}: 18000 ohms, 5%, 2 watts
R_{16}: 22000 ohms, 5%, 2 watts
R_{17}: 22000 ohms, 5%, 2 watts
R_{18}: 10 megohms, 2 watts, adjustable
R_L: Value will depend on magnitude of peak pulse voltage desired. For a peak pulse amplitude of 100 volts, the value is approximately 300 ohms.
Z: (1) - 150 V, 1 W zener diode, or equivalent
(1) - 180 V, 1 W zener diode, or equivalent

Note 1: Adjustable between approximately 800 and 3000 V dc.
Note 2: Component values are dependent upon nature of application and output signal desired.

DIMENSIONAL OUTLINE – Dimensions In Inches



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

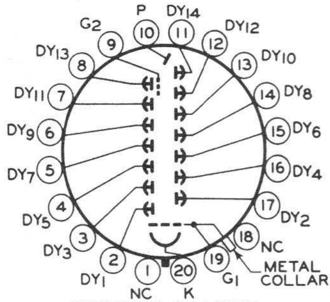
Note: Within 1.68" diameter, deviation from flatness of external surface of faceplate will not exceed 0.005" from peak to valley.

Inch Dimension Equivalents in Millimeters

Inch	mm	Inch	mm	Inch	mm
0.06	1.5	1.68	42.6	5.40	137.1
0.12	3.0	2.00	50.8	6.69	169.9
0.19	4.8	2.38	60.4	7.5	190.5

TERMINAL DIAGRAM (Bottom View)

Pin 1: No Connection
Pin 2: Dynode No.1
Pin 3: Dynode No.3
Pin 4: Dynode No.5
Pin 5: Dynode No.7
Pin 6: Dynode No.9
Pin 7: Dynode No.11
Pin 8: Dynode No.13
Pin 9: Grid No.2 (Accelerating Electrode)
Pin 10: Anode
Pin 11: Dynode No.14
Pin 12: Dynode No.12
Pin 13: Dynode No.10
Pin 14: Dynode No.8
Pin 15: Dynode No.6
Pin 16: Dynode No.4
Pin 17: Dynode No.2
Pin 18: No Connection
Pin 19: Grid No.1 (Focusing Electrode)
Pin 20: Photocathode

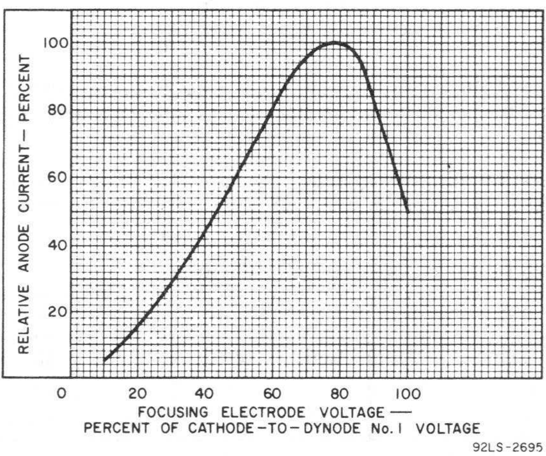


20C

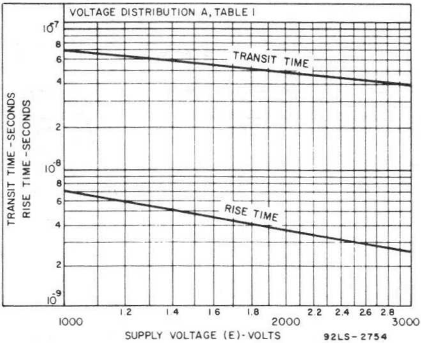
Metal Collar: Connected Internally to Focusing Electrode — Do Not Make Electrical Connection to Collar.

Note: The Metal Collar May be at High Potential Depending on the Circuit Application and Should be Insulated Accordingly.

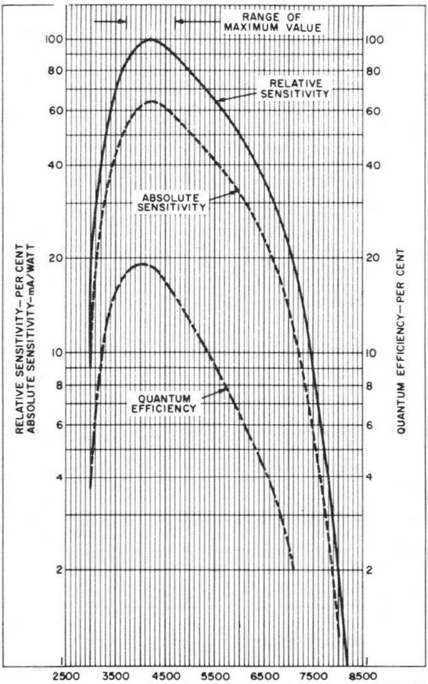
TYPICAL FOCUSING ELECTRODE CHARACTERISTIC



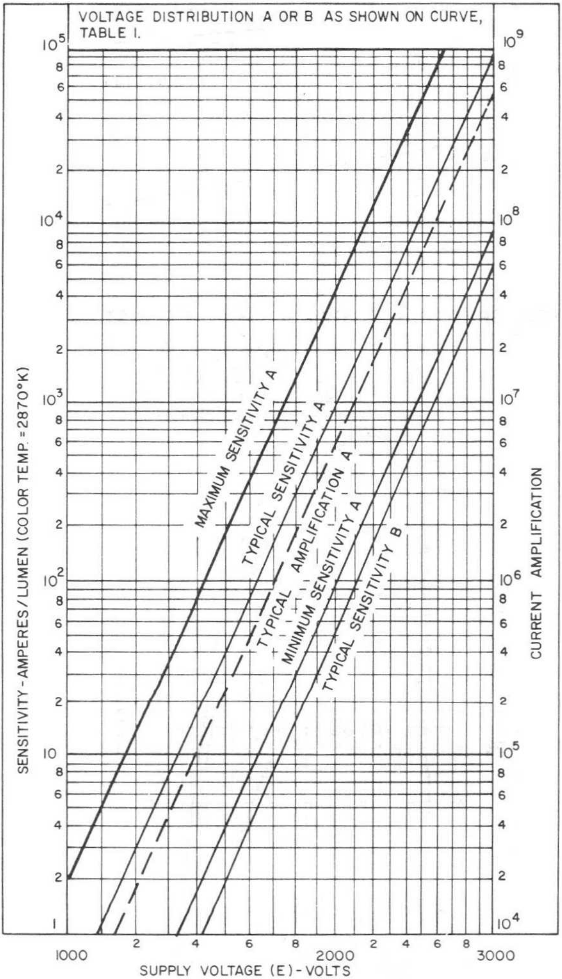
TYPICAL TIME-RESOLUTION CHARACTERISTICS



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

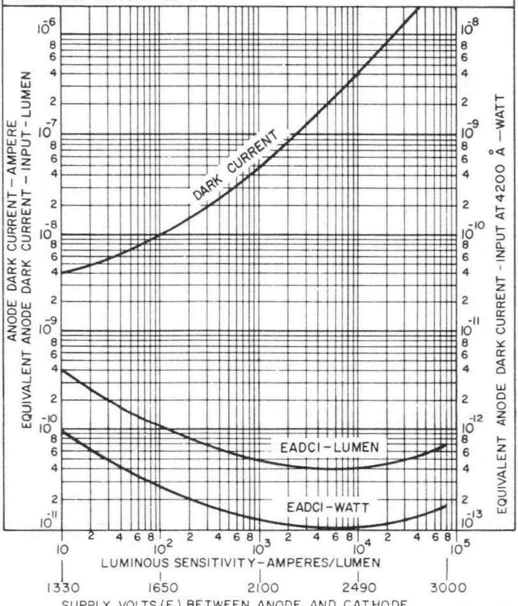


TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	5.4% OF E MULTIPLIED BY
CATHODE & FOCUSING ELECTRODE	1.6
CATHODE & DYNODE No.1 (DY_1)	2
DY_1 & DY_2	1
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1
DY_7 & DY_8	1
DY_8 & DY_9	1
DY_9 & DY_{10}	1
DY_{10} & DY_{11}	1
DY_{11} & DY_{12}	1.25
DY_{12} & DY_{13}	1.5
DY_{13} & DY_{14}	1.75
DY_{14} & ANODE	2
ANODE & CATHODE	18.5

GRID-No.2 VOLTS ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22°C



92LM-2740

TYPICAL ANODE CHARACTERISTICS

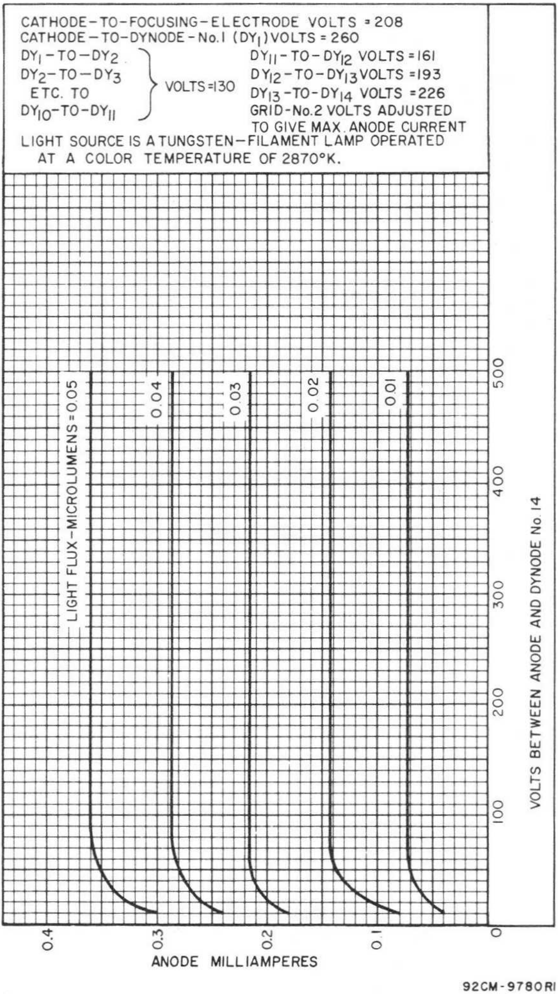


Image Orthicon

MAGNETIC FOCUS **MAGNETIC DEFLECTION**

EXCELLENT RESOLUTION CAPABILITY

For Outdoor and Studio Pickup with High-Quality Black-and-White TV Cameras. The 7295B is Unilaterally Interchangeable with Types 7295 and 7295A.

DATA

General:

Heater, for Unipotential Cathode:
- Voltage (AC or DC) . . . . 6.3 ± 10% volts
- Current at 6.3 volts . . . . 0.6 amp

Direct Interelectrode Capacitance:
- Anode to all other electrodes . . . . 12 pf

Target-to-Mesh Spacing . . . . 0.002 inch

Spectral Response S-10

Wavelength of Maximum Response . . . . . 4500 ± 300 angstroms

Photocathode, Semitransparent:
- Rectangular image (4 x 3 aspect ratio):
  - Useful size . . . . 1.6" max. diagonal

    Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.
  - Orientation . . . . Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of the faceplate and the grid-No.6 envelope terminal. The horizontal and vertical scan should start at the corner of the picture between the grid-No.6 and the photocathode envelope terminals.

Focusing Method . . . . Magnetic

Deflection Method . . . . Magnetic

Overall Length . . . . 19.375" ± 0.310"

Greatest Diameter of Bulb . . . . 4.500" ± 0.094"

Minimum Deflecting-Coil Inside Diameter . . . . 3.2"

Deflecting-Coil Length . . . . 7"

Focusing-Coil Length . . . . 15"

Alignment-Coil:
- Position on neck . . . Centerline of magnetic field should be located 9.25" from the flat area of the shoulder.

Operating Position . . . . See *Operating Considerations*

Weight (Approx.) . . . . 2.3 lbs

Socket . . . . Cinch[a] Part No.3M14, or equivalent

Envelope Terminals 5

BOTTOM VIEW[▲]

Terminal Over Pin 2 – Field Mesh
Terminal Over Pin 4 – Photocathode (PC)
Terminal On Side of Envelope
Opposite Base Key – Grid No.6 (G_6)

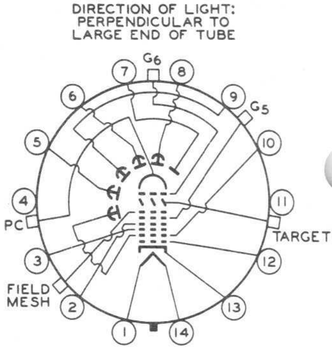
▲ See basing diagram on next page.

Terminal Over Pin 9 - Grid No.5 (G_5)
Terminal Over Pin 11 - Target

End Base. . . . . Small-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-45)

BOTTOM VIEW

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



Maximum and Minimum Ratings, *Absolute-Maximum Values:*

PHOTOCATHODE:			
Voltage	-700	max.	volts
Illumination.	50	max.	fc
OPERATING TEMPERATURE:[b]			
Any part of bulb.	65	max.	°C
Of bulb at large end of tube (Image section)	35	min.	°C
TEMPERATURE DIFFERENCE:			
Between image section and any part of bulb hotter than image section . .	5	max.	°C
GRID-No.6 VOLTAGE	-700	max.	volts
TARGET VOLTAGE:			
Positive value.	10	max.	volts
Negative value.	10	max.	volts
FIELD-MESH VOLTAGE[c]	30	max.	volts
GRID-No.5 VOLTAGE	300	max.	volts
GRID-No.4 VOLTAGE	350	max.	volts
GRID-No.3 VOLTAGE	400	max.	volts
GRID-No.2 & DYNODE-No.1 VOLTAGE	350	max.	volts
GRID-No.1 VOLTAGE:			
Negative-bias value	125	max.	volts
Positive-bias value	0	max.	volts
VOLTAGE PER MULTIPLIER STAGE.	350	max.	volts
ANODE SUPPLY VOLTAGE[d]	1650	max.	volts
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode .	125	max.	volts
Heater positive with respect to cathode .	10	max.	volts

Typical Operating Values:[e]

Photocathode Voltage	-600	volts
Grid-No.6 Voltage (Image Focus) Approx. 50% of photocathode voltage[f]	-250 to -350	volts
Target Voltage Above Cutoff[g]	2.3	volts
Field-Mesh Voltage[c]	15 to 25	volts
Grid-No.5 Voltage (Decelerator)	40	volts
Grid-No.4 Voltage (Beam Focus)	70 to 90	volts
Grid-No.3 Voltage[h]	250 to 275	volts
Grid-No.2 & Dynode-No.1 Voltage	280	volts
Grid-No.1 Voltage for picture cutoff	-45 to -115	volts
Dynode-No.2 Voltage	600	volts
Dynode-No.3 Voltage	800	volts
Dynode-No.4 Voltage	1000	volts
Dynode-No.5 Voltage	1200	volts
Anode Voltage	1250	volts
Recommended Target-Temperature Range[b]	35 to 45	^{o}C
Minimum Peak-to-Peak Blanking Voltage	5	volts
Field Strength of Focusing Coil (Approx.):[j]		
At center of scanning section	60	gausses
In plane of photocathode	120	gausses
Field Strength of Alignment Coil	0 to 3	gausses

Performance Data:

With conditions shown under Typical Operating Values including Recommended Target-Temperature Range, target voltage adjusted to 2.3 volts above cutoff, and with the camera lens set to bring picture highlights one stop above the "knee" of the accompanying Basic Light-Transfer-Characteristic Curve

	Min.	*Average*	*Max.*	
Cathode Radiant Sensitivity at 4500 angstroms	-	0.030	-	a/w
Luminous Sensitivity	30	60	-	μa/lm
Signal-Output Current (Peak to Peak)	10	-	40	μa
Ratio of Peak-to-Peak Highlight Video Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc	60.1	75.1	-	
Photocathode Illumination at 2870^{o} K Required to bring Picture Highlights One Stop above "Knee" of Light-Transfer Characteristic	-	-	0.110	fc
Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[k]	60	75	-	%
Uniformity:[m]				
Ratio of Shading (Background) Signal to Highlight Signal	-	0.10	0.15	

	Min.	Average	Max.	
Decrease from Peak Highlight Signal Level of Signal from any Point on Scanned Area of Target. .	–	12	25	%

[a] Cinch Manufacturing Corporation, 1026 South Homan Avenue, Chicago 24, Illinois.

[b] Operating outside the *Recommended Target-Temperature Range* shown under *Typical Operating Values* will not damage the 7295B provided the *Maximum Temperature Ratings* of the tube are not exceeded. Optimum performance, however, is only obtained when the tube is operated within the *Recommended Target-Temperature Range*.

[c] With respect to grid No.4.

[d] Dynode-voltage values are shown under *Typical Operating Values*.

[e] With 7295B operated in RCA TK-60 camera at fixed photocathode voltage.

[f] Adjust for optimum focus.

[g] The target supply voltage should be adjustable from -5 to 5 volts.

[h] Adjust to give the most uniformly shaded picture near maximum signal.

[j] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

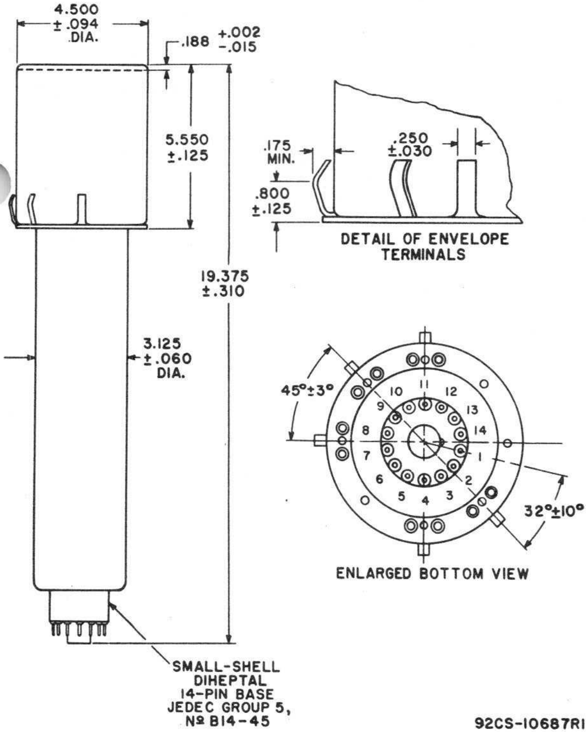
[k] Measured with amplifier having flat frequency response.

[m] With uniform illumination on photocathode.

OPERATING CONSIDERATIONS

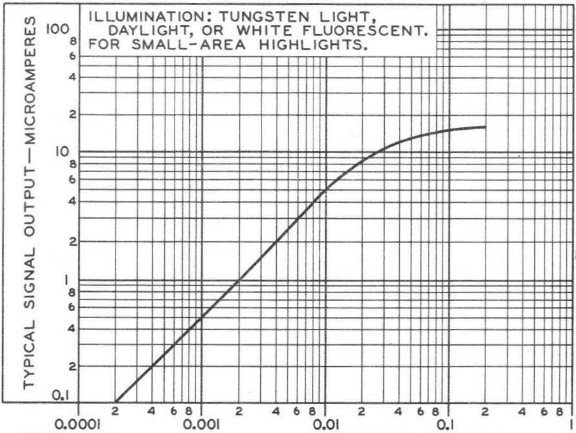
The tube should never be operated in a vertical position with the Diheptal/base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Photosensitive Device having S-10 Response
is shown at the front of this Section



ALL DIMENSIONS IN INCHES

BASIC LIGHT-TRANSFER CHARACTERISTIC



92CS-10692

Image Orthicon

LONG-LIFE TARGET
MAGNETIC FOCUS

FIELD-MESH TYPE
MAGNETIC DEFLECTION

For High-Quality Black-and-White TV Pickup in Studio or Outdoor Service. The 7295C, is Directly Interchangeable with the 7295, 7295A, and 7295B in all Cameras.

The 7295C is the same as the 7295B except utilizes a stable, long-life target.

The stable, long-life, glass target of type 7295C is characterized by high gain, resistance to "burn-in", and the absence of any granular structure. Because charge transportation through this target material is electronic rather than ionic as in ordinary glass targets, the electrical characteristics of the target, such as secondary emission and resistivity, are essentially constant and sensitivity of the 7295C is stable throughout life.

Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster "burn-in" due to underscanning are significantly reduced. The resistance of the 7295C to image "burn-in" provides a highly desirable operational feature because it is not necessary to use an orbiter or continually move the camera when focused on a stationary scene.

OPERATING CONSIDERATIONS

Dos and Don'ts on Use of RCA-7295C

Dos

1. Allow the 7295C to warm up prior to operation.
2. Hold temperature of the 7295C within operation range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 7295C's by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to the desired voltage above target cutoff.
7. Uncap lens before voltages are applied to the 7295C.

Don'ts

1. Don't force the 7295C into its shoulder socket.
2. Don't operate the 7295C without scanning.
3. Don't operate a 7295C having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No. 6, target, dynodes, and anode during warm-up or standby operation.

7326

MULTIPLIER PHOTOTUBE

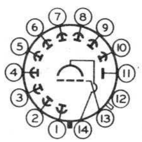
10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE WITH 1.68"-DIAMETER, CURVED, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-20 RESPONSE

DATA

General:

Spectral Response	S-20
Wavelength of Maximum Response	4200 ± 500 angstroms
Cathode, Semitransparent:	
Shape	Curved Circular
Window:	
Area	2.2 sq. in.
Minimum diameter	1.68 in.
Index of refraction	1.51
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.10	2.4 μμf
Anode to all other electrodes	5.5 μμf
Dynode No.10 to all other electrodes	6.5 μμf
Maximum Overall Length	6.78"
Seated Length	5.84" ± 0.19"
Maximum Diameter	2.38"
Operating Position	Any
Weight (Approx.)	6 oz
Bulb	T16
Base	Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-38), Non-hygroscopic
Basing Designation for BOTTOM VIEW	14AM

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



DIRECTION OF LIGHT: INTO END OF BULB

Pin 12 - Internal Connection— Do Not Use
Pin 13 - Focusing Electrode
Pin 14 - Photocathode
Metal Collar - No Connection (If used, connect only to photocathode)

Maximum Ratings, *Absolute Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC)	2400 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.10 AND ANODE (DC)	500 max.	volts
SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC)	600 max.	volts
DYNODE-No.1 SUPPLY VOLTAGE (DC)	500 max.	volts
FOCUSING-ELECTRODE SUPPLY VOLTAGE (DC)	500 max.	volts
AVERAGE ANODE CURRENT•	1 max.	ma
AMBIENT TEMPERATURE	85 max.	°C

•: See next page.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

7326

MULTIPLIER PHOTOTUBE

Characteristics Range Values for Equipment Design:

Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of E between cathode and dynode No. 1; 1/8 of E between cathode and focusing electrode; 1/12 of E for each succeeding dynode stage; and 1/12 of E between dynode No. 10 and anode

With E = 1800 volts (Except as noted)

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4200 angstroms. . . .	–	9600	–	μa/μw
Cathode radiant, at 4200 angstroms. . . .	–	0.064	–	μa/μw
Luminous•.	5	22.5	150	amp/lumen
Cathode luminous:				
With tungsten light source▲.	120	150	–	μa/lumen
With blue light source**♦. . .	0.05	–	–	μa
With red light source□§ . . .	0.3	–	–	μa
Current Amplification. . .	–	1.5×10^5	–	
Equivalent Anode-Dark-Current Input⊕■.	–	3×10^{-10}	1.4×10^{-9}	lumen
Equivalent Noise Input:★				
At +25° C.	–	1.9×10^{-12}	4.3×10^{-12}	lumen
At −80° C.	–	3×10^{-13}	6×10^{-13}	lumen
Anode-Pulse Rise Time⊕.	–	2.5	–	milliμsec
Greatest Delay Between Anode Pulses:				
Due to position from which electrons are simultaneously released within a circle centered on tube face and having a diameter of—				
1.12".	–	1†	–	milliμsec
1.56".	–	3†	–	milliμsec

• Averaged over any interval of 30 seconds maximum.

♦,▲,**,♦,□,§,⊕,■,★,⊕,†: See next page.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7326

MULTIPLIER PHOTOTUBE

♦ Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 0.1 microlumen is used. The load resistor has a value of 0.01 megohm.

▲ Under the following conditions: The light source is a tungsten-filament lamp 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 together as anode. The load resistor has a value of 0.01 megohm.

** Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning, Glass Code No.5113 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm and 200 volts are applied between cathode and all other electrodes connected together as anode.

♦ For spectral characteristic of this source, see sheet SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER at front of this section.

□ Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning, Glass Code No.2418, or equivalent) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm, and 200 volts are applied between cathode and all other electrodes connected together as anode.

§ For spectral characteristic of this source, see sheet SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED RED FILTER at front of this section.

⊕ Measured at a tube temperature of 25° C and with the supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by the use of a refrigerant.

■ For maximum signal-to-noise ratio, operation with a supply voltage (E) below 1800 volts is recommended.

★ Under the following conditions: Supply voltage (E) is 1800 volts, external-shield potential of -1800 volts, ac-amplifier bandwidth of 1 cycle per second, tungsten light source 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

⊕ Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is determined primarily by transit-time variations in the multiplier stages and with an incident-light spot approximately 1 millimeter in diameter centered on the photocathode.

† These values also represent the difference in time of transit between the photocathode and dynode No.1 for electrons simultaneously released from the center and from the periphery of the specified areas.

OPERATING CONSIDERATIONS

Operation at an *average anode current* well below the maximum rated value of 1 milliampere is recommended when stability is important.

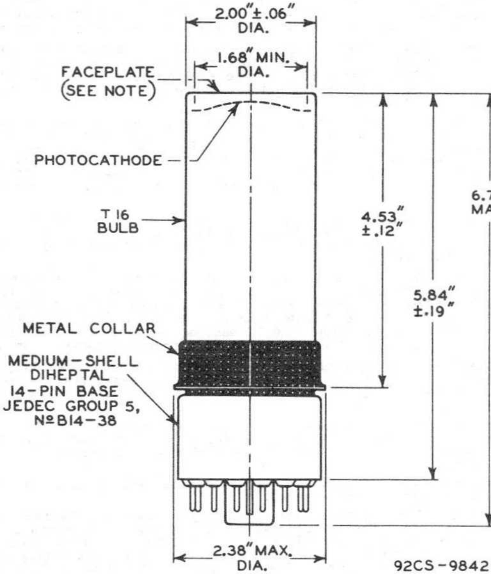
Electrostatic and/or *magnetic shielding* of the 7326 may be necessary.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-20 Response is shown at front of this Section

RCA

7326

MULTIPLIER PHOTOTUBE



CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

NOTE: WITHIN 1.68" DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.005" FROM PEAK TO VALLEY.

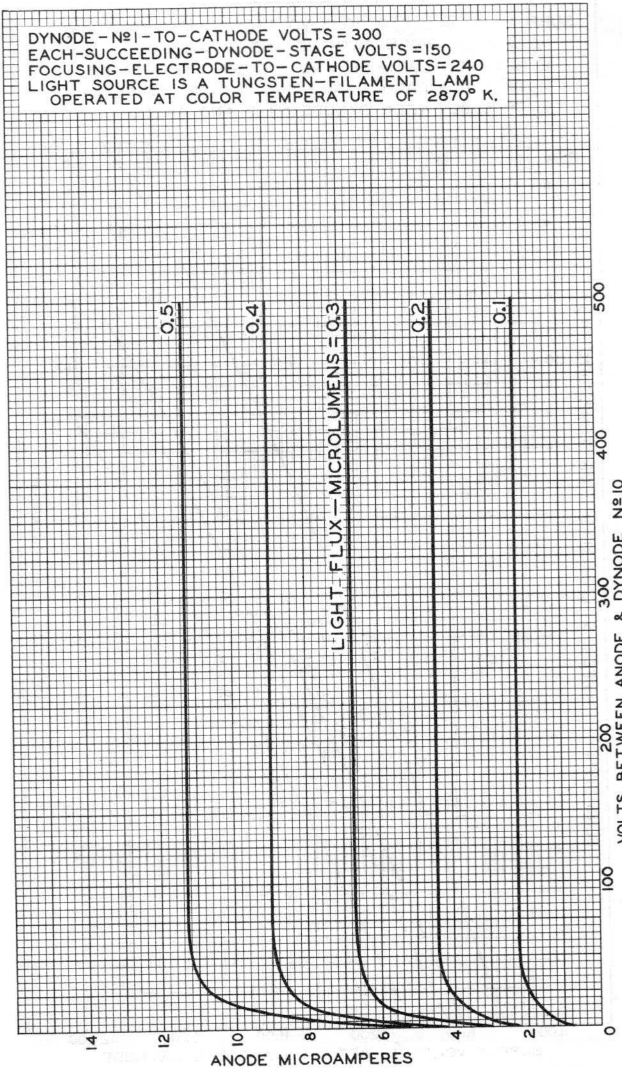
ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

7326

7326

TYPICAL ANODE CHARACTERISTICS



ELECTRON TUBE DIVISION 92CM-9840

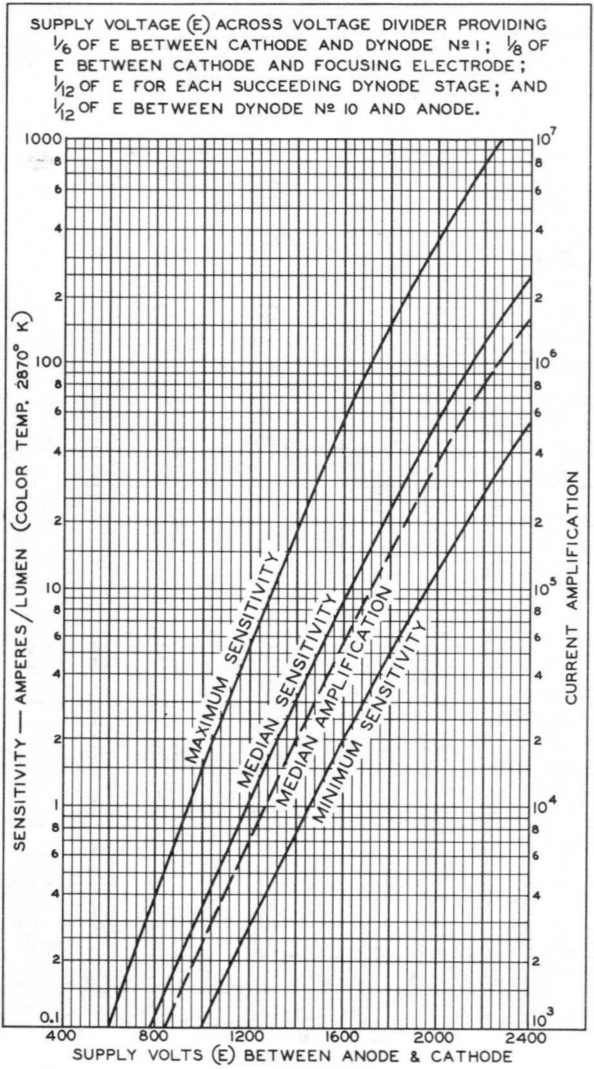
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7326

RCA

7326

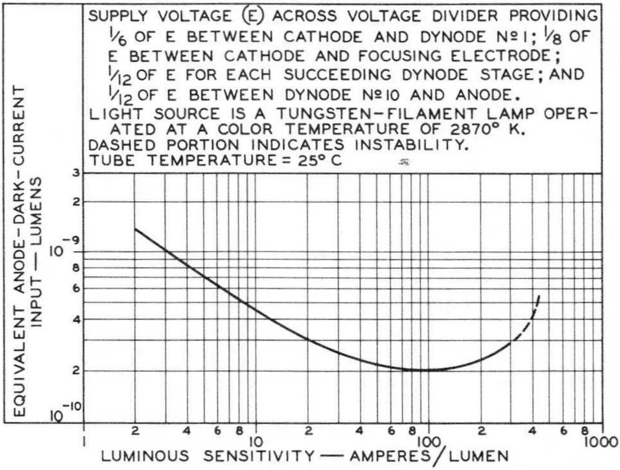
CHARACTERISTICS



ELECTRON TUBE DIVISION 92CM-9839

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



92CS-9841

Anode-Supply Voltage[d]	1650 max.	volts
Voltage Per Multiplier Stage	350 max.	volts

Typical Operating Values:[e]

Photocathode Voltage	-600	volts
Grid-No.6 Voltage (Image focus) Approx. 70% of photocathode voltage[f]	-370 to -470	volts
Target Voltage Above Cutoff[g]	2.3	volts
Field-Mesh Voltage[c]	15 to 25	volts
Grid-No.5 Voltage (Decelerator)	40	volts
Grid-No.4 Voltage (Beam Focus)	70 to 90	volts
Grid-No.3 Voltage[h]	250 to 275	volts
Grid-No.2 & Dynode-No.1 Voltage	280	volts
Grid-No.1 Voltage for Picture Cutoff	-45 to -115	volts
Dynode-No.2 Voltage	600	volts
Dynode-No.3 Voltage	800	volts
Dynode-No.4 Voltage	1000	volts
Dynode-No.5 Voltage	1200	volts
Anode Voltage	1250	volts
Recommended-Target-Temperature Range:[b]	35 to 45	°C
Minimum Peak-to-Peak Blanking Voltage	5	volts
Field Strength of Focusing Coil (Approx.):[j]		
At center of scanning section:	60	gausses
In plane of photocathode	120	gausses
Field Strength of Alignment Coil	0 to 3	gausses

Performance Data:

With conditions shown under Typical Operating Values including Recommended Target-Temperature Range, target voltage adjusted to 2.3 volts above cutoff, and with the camera lens set to bring the picture highlights 1/2 stop above the "knee" of the accompanying Basic Light-Transfer-Characteristic Curve

	Min.	*Typ.*	*Max.*	
Cathode Radiant Sensitivity at 4500 angstroms	–	0.030	–	a/w
Luminous Sensitivity	30	60	–	μa/lm
Anode Current (DC)	–	30	–	μa
Signal-Output Current (Peak to Peak)	10	–	40	μa
Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc.	85:1	95:1	–	
Photocathode Illumination at 2870° K Required to bring Picture Highlights 1/2 Stop above "Knee" of Light Transfer Characteristic	–	0.070	0.130	fc
Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[k]	60	75	–	%

	Min.	Typ.	Max.	
Uniformity:[m]				
Ratio of Shading (Background) Signal to Highlight Signal.	–	0.10	0.15	
Decrease from Peak Highlight Signal Level of Signal from any Point on Scanned Area of Target	–	12	25	%

[a] Cinch Manufacturing Corporation, 1026 South Homan Avenue, Chicago 24, Illinois.

[b] Operating outside the *Recommended Target-Temperature Range* shown under *Typical Operating Values* will not damage the 7389B provided the *Maximum Temperature Ratings* of the tube are not exceeded. Optimum performance however, is only obtained when the tube is operated within the *Recommended Target-Temperature Range*.

[c] With respect to grid No.4.

[d] Dynode-voltage values are shown under *Typical Operating Values*.

[e] With 7389B operated in RCA TK-60 camera at fixed photocathode voltage.

[f] Adjust for optimum focus.

[g] The target supply voltage should be adjustable from -5 to 5 volts.

[h] Adjust to give the most uniformly shaded picture near maximum signal.

[j] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[k] Measured with amplifier having flat frequency response.

[m] With uniform illumination on photocathode.

OPERATING CONSIDERATIONS

The tube should never be operated in a vertical position with the Diheptal/base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Photosensitive Device having S-10 Response
is shown at the front of this Section

Image Orthicon

"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS

FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

MAGNETIC FOCUS — MAGNETIC DEFLECTION

For High-Quality Black-and-White Studio TV Cameras, Live Pickup, and Magnetic Tape Recording Requiring High-Signal-to-Noise Ratio. The 7389B is Unilaterally Interchangeable with the 7389 and 7389A.

General:

Heater, for Unipotential Cathode:
- Voltage (AC or DC) . . . . 6.3 ± 10% volts
- Current at 6.3 volts . . . . 0.6 amp

Direct Interelectrode Capacitance:
- Anode to all other electrodes . . . . 12 pf

Target-to-Mesh Spacing . . . . 0.001 inch

Spectral Response S-10

Wavelength of Maximum Response . . . . . 4500 ± 300 angstroms

Photocathode, Semitransparent:
- Rectangular image (4 x 3 aspect ratio):
  - Useful size of . . . . 1.6" max. diagonal

    Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.
  - Orientation of . . Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and the grid-No.6 envelope terminal. The horizontal and vertical scan should start at the corner of the picture between the grid-No.6 and the photocathode envelope terminals.

Focusing Method . . . . Magnetic

Deflection Method . . . . Magnetic

Overall Length . . . . 19.375" ± 0.310"

Greatest Diameter of Bulb . . . . 4.500" ± 0.094"

Minimum Deflecting-Coil Inside Diameter . . . . 3.2"

Deflecting-Coil Length . . . . 7"

Focusing-Coil Length . . . . 15"

Alignment-Coil:
- Position on neck . . . . Centerline of magnetic field should be located 9.25" from the flat area of the shoulder.

Operating Position . . . . See *Operating Considerations*

Weight (Approx.) . . . . 2.3 lbs

Socket . . . . Cinch[a] Part No.3M14, or equivalent

7389B

Envelope Terminals. 5

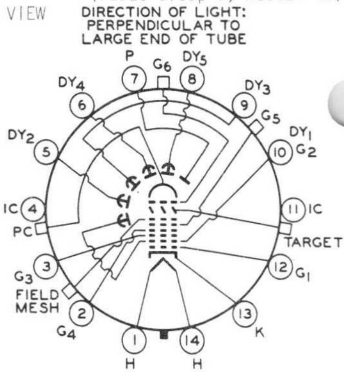
BOTTOM VIEW

Terminal Over Pin 2 – Field Mesh
Terminal Over Pin 4 – Photocathode (PC)
Terminal On Side Of Envelope
Opposite Base Key – Grid No.6 (G_6)
Terminal Over Pin 9 – Grid No.5 (G_5)
Terminal Over Pin 11 – Target

End Base. . . . . Small-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-45)

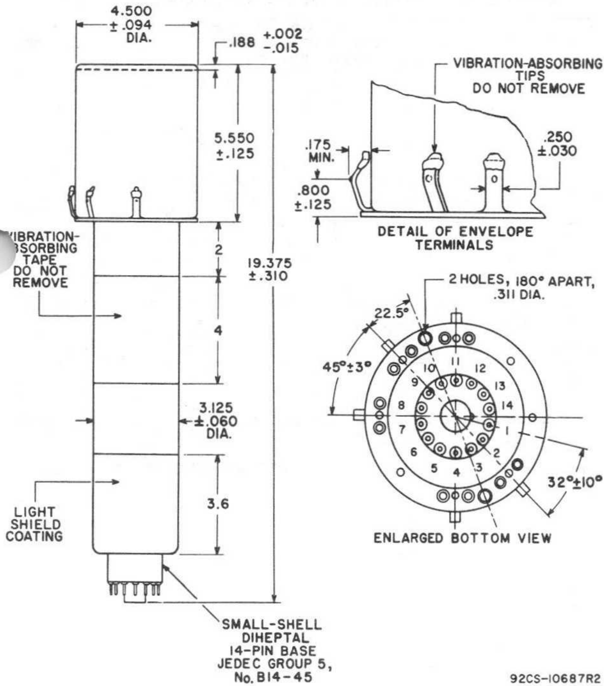
BOTTOM VIEW

Pin 1 – Heater
Pin 2 – Grid No.4
Pin 3 – Grid No.3
Pin 4 – Do Not Use
Pin 5 – Dynode No.2
Pin 6 – Dynode No.4
Pin 7 – Anode
Pin 8 – Dynode No.5
Pin 9 – Dynode No.3
Pin 10 – Dynode No.1, Grid No.2
Pin 11 – Do Not Use
Pin 12 – Grid No.1
Pin 13 – Cathode
Pin 14 – Heater



Maximum and Minimum Ratings, *Absolute-Maximum Values:*

Photocathode:		
Voltage.	−700 max.	volts
Illumination	50 max.	fc
Operating Temperature:[b]		
Any part of bulb	65 max.	°C
Of bulb at larg end of tube (Image section).	35 min.	°C
Temperature Difference:		
Between image section and any part of bulb hotter than image section. . . .	5 max.	°C
Grid-No.6 Voltage.	−700 max.	volts
Target Voltage:		
Positive value	10 max.	volts
Negative value	10 max.	volts
Field-Mesh Voltage[c].	30 max.	volts
Grid-No.5 Voltage.	300 max.	volts
Grid-No.4 Voltage.	350 max.	volts
Grid-No.3 Voltage.	400 max.	volts
Grid-No.2 & Dynode-No.1 Voltage.	350 max.	volts
Grid-No.1 Voltage:		
Negative-bias value.	125 max.	volts
Positive-bias value.	0 max.	volts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode.	125 max.	volts
Heater positive with respect to cathode.	10 max.	volts



DIMENSIONS IN INCHES

BASIC LIGHT-TRANSFER CHARACTERISTIC

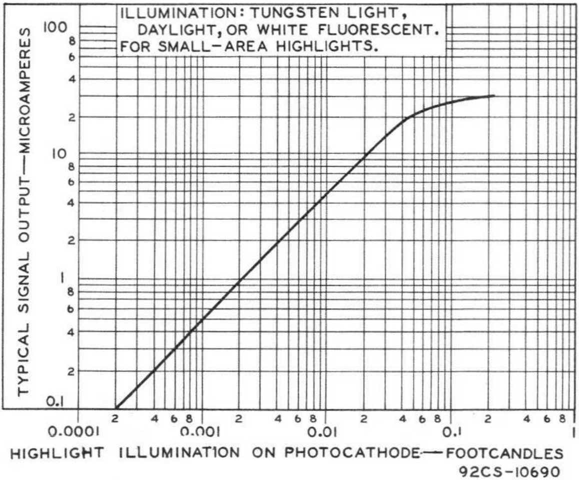


Image Orthicon

"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS
FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

LONG-LIFE TARGET
MAGNETIC FOCUS

FIELD-MESH TYPE
MAGNETIC DEFLECTION

For Extremely High-Quality Performance in Black-and-White Studio TV Cameras and Television Tape-Recording Operations. The 7389C is Directly Interchangeable with the 7389, 7389A, and 7389B in all Cameras.

The 7389C is the same as the 7389B except utilizes a stable, long-life glass target.

The stable, long-life, glass target of type 7389C is characterized by high gain, resistance to "burn-in", and the absence of any granular structure. Because charge transportation through this target material is electronic rather than ionic as in ordinary glass targets, the electrical characteristics of the target, such as secondary emission and resistivity, are essentially constant and sensitivity of the 7389C is stable throughout life.

Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster "burn-in" due to underscanning are significantly reduced. The resistance of the 7389C to image "burn-in" provides a highly desirable operational feature because it is not necessary to use an orbiter or continually move the camera when focused on a stationary scene.

OPERATING CONSIDERATIONS

Dos and Don'ts on Use of RCA-7389C

Dos

1. Allow the 7389C to warm-up prior to operation.
2. Hold temperature of the 7389C within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control to best usable resolution.
5. Condition spare 7389C's by operating several hours once each month.
6. Determine proper operation point with target voltage adjusted to the desired voltage above target cutoff.
7. Uncap lens before voltage are applied to the 7389C.

Don'ts

1. Don't force the 7389C into its shoulder socket.
2. Don't operate the 7389C without scanning.
3. Don't operate a 7389C having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid-No.6, target, dynodes, and anode during warm-up or standby operation.

7412

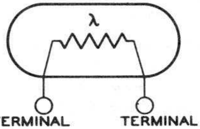
7412
PHOTOCONDUCTIVE CELL

CADMIUM-SULFIDE, HEAD-ON TYPE

DATA

General:

Spectral Response	S-15
Wavelength of Maximum Response	5800 ± 500 angstroms
Sensitive Surface:	
Shape	Rectangular
Length (Minimum)	0.20 in.
Width (Minimum)	0.02 in.
Area (Minimum)	0.004 sq. in.
Maximum Length (Excluding flexible leads)	1.35"
Diameter	0.29" ± 0.01"
Leads, Flexible	2
Minimum length	1.4"
Diameter	0.018" ± 0.005"
Operating Position	Any
Weight (Approx.)	0.06 oz



DIRECTION OF LIGHT:
INTO END OF BULB

λ indicates that the primary characteristic of the element within the envelope symbol is designed to vary under the influence of light.

Maximum Ratings, *Absolute-Maximum Values:*

VOLTAGE BETWEEN TERMINALS (DC or Peak AC)	200 max.	volts
PHOTOCURRENT	1000 max.	μa
POWER DISSIPATION	50 max.	mw
AMBIENT TEMPERATURE	60 max.	°C

Characteristics:

With dc voltage of 12 volts between terminals and an ambient temperature of 25° C

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant•, at 5800 angstroms	–	1580	–	μa/μw
Luminous*#	–	4.5	–	amp/lumen
Illumination*#	100	300	800	μa/fc
Photocurrent▲	–	–	0.1	μa
Rise				See Curves
Decay				See Curves

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7412

RCA

7412

PHOTOCONDUCTIVE CELL

● For conditions where the incident power is 2 x 10^{-9} watt.

* For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K.

\# Incident illumination on the sensitive surface is 0.01 footcandle.

▲ Measured approximately 20 seconds after removal of incident-illumination level of 0.01 footcandle.

OPERATING CONSIDERATIONS

The *flexible leads* of the 7412 are usually soldered to the circuit elements. Soldering of the leads may be made close to the seals provided care is taken to conduct excessive heat away from the seals. Otherwise, the heat of soldering will break the seals and damage the cell.

A *clamp* around the glass envelope may be used to hold the cell in position. However, care must be taken in clamping to avoid cracking the glass envelope or introducing strains in the envelope which could lead to eventual breakage.

The *voltage between terminals* of the 7412 may be applied without regard to polarity.

The *angle of view* of the 7412 may be narrowed by the use of a hood of the desired length placed in front of the cell.

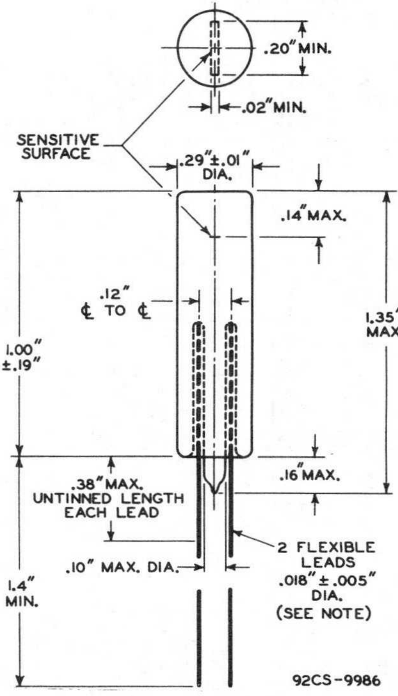
If the source of radiation is some distance from the cell, the use of a lens system may be desirable to utilize more effectively the available radiation. *However, the radiation should not be focused onto such a small area that localized overheating of the sensitive surface may result with consequent adverse affects on its characteristics.* Exposure of the 7412 to radiation (even without voltage applied) so intense as to cause excessive heating of the cell may permanently damage it.

For a given illumination, the output current will have its highest value when the incident illumination is normal (angle of incidence is 90°) to the face of the cell. For smaller angles of incidence, the output current decreases. The decrease depends upon several factors including the angle of incidence of the illumination, the amount of illumination, and the area of sensitive surface illuminated.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Photoconductive Cell having S-15 Response
is shown at the front of this Section

7412

PHOTOCONDUCTIVE CELL

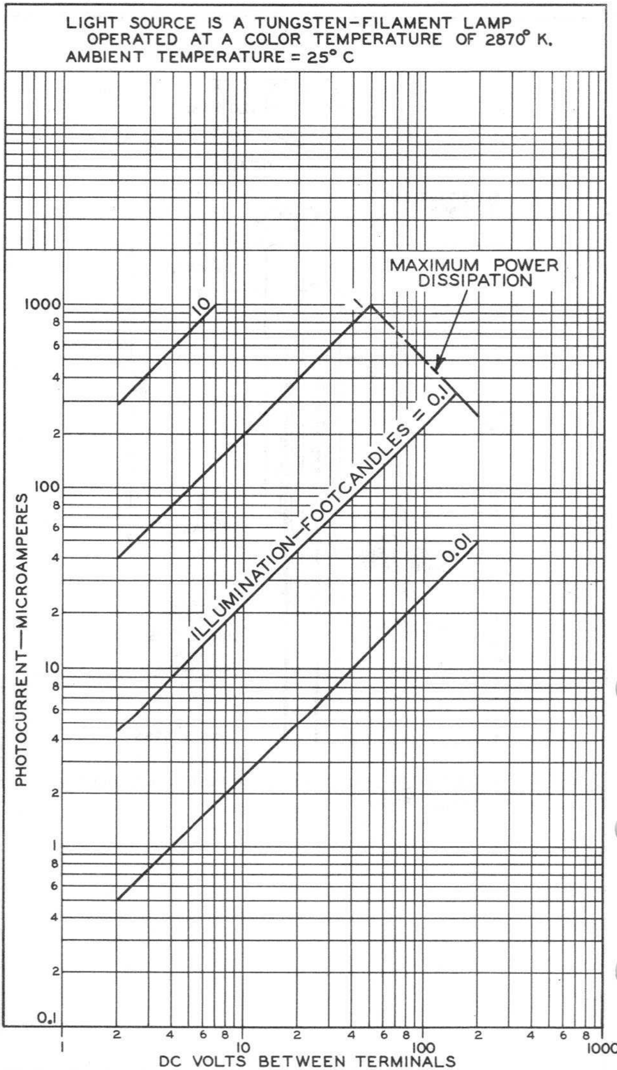


NOTE: THE SPECIFIED LEAD DIAMETER IS MAINTAINED ONLY WITHIN THE UNTINNED LENGTH.

RCA

7412

AVERAGE CHARACTERISTICS



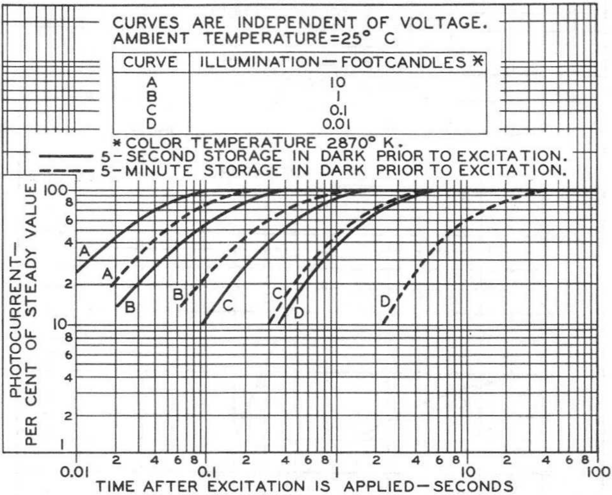
ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9989

RCA

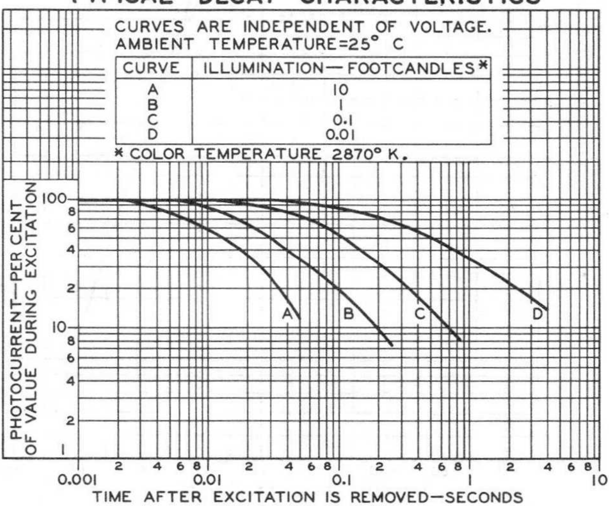
7412

TYPICAL RISE CHARACTERISTICS



92CS-9532

TYPICAL DECAY CHARACTERISTICS

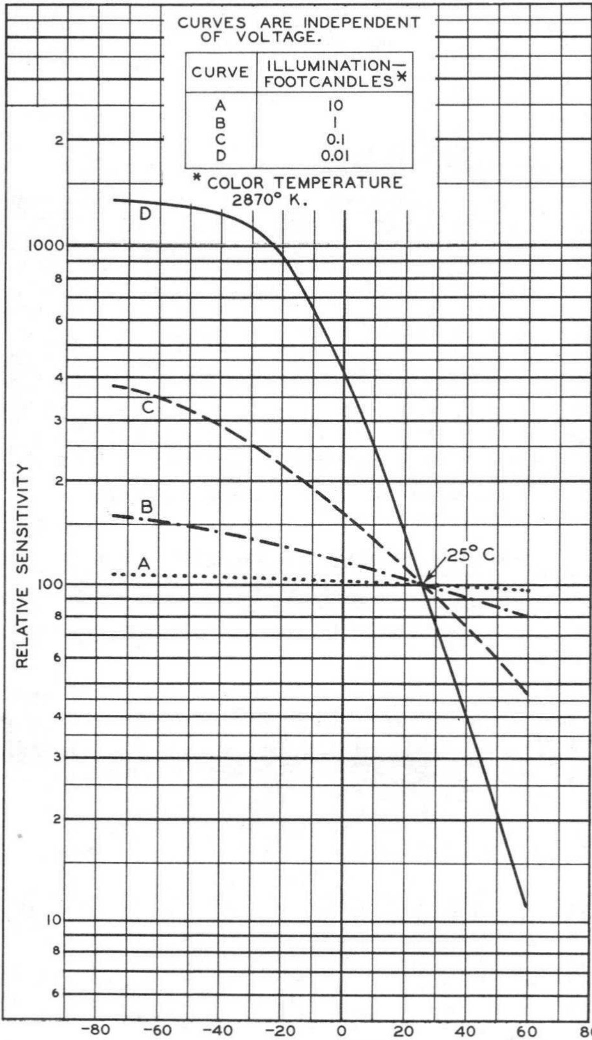


92CS-9533

7412

7412

TYPICAL CHARACTERISTICS

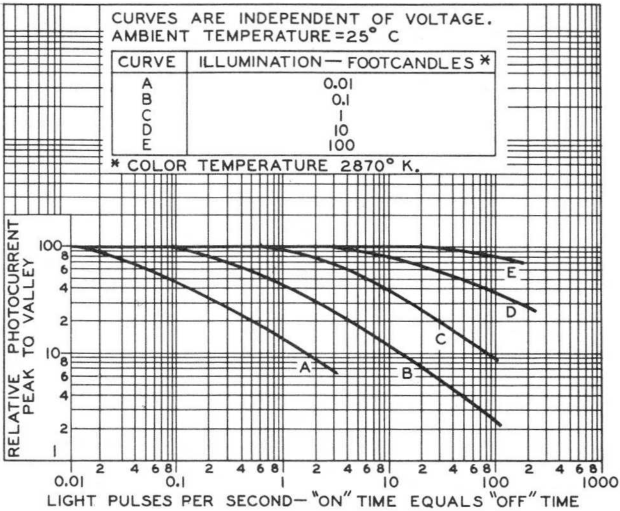


ELECTRON TUBE DIVISION

92CM-9538

7412

RESPONSE CHARACTERISTICS



92CS-9534

Vidicons

Magnetic Focus 1"–Diameter Magnetic Deflection
For Non-Critical Industrial and Consumer Product Closed-Circuit TV

The 7735A and 7735 are the same as the 7735B except for the following items:

TYPICAL OPERATION AND PERFORMANCE DATA

Low-Voltage Operation

	7735A	7735	
Grid No.1 Voltage for Picture Cutoff[a]	–45 to –100	–45 to –100	V
Lag–Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed:[b]			
Maximum Value	28	30	%
Limiting Resolution:			
At center of picture— Typical Value	700	700	TV Lines

AVERAGE SENSITIVITY OPERATION

	7735A	7735	
Faceplate Illumination (Highlight)	1	1	fc
Target Voltage[c,d]	20to 40	15 to 55	V
Dark Current[e]	0.02	0.02	μA
Minimum Signal-Output Current[f]	0.15	0.15	μA

[a] With no blanking voltage on grid No.1.

[b] For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

[c] The target voltage for each tube must be adjusted to that value which gives the desired operating signal current.

[d] Indicated range serves only to illustrate the operating target-voltage range normally encountered.

[e] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[f] Defined as the component of the highlight target current after the dark-current component has been subtracted.

SPURIOUS SIGNAL TEST

Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	0
4 but not including 3	0	1
3 but not including 1	2	3
1 or less	*	*

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*Spots of this size are allowed unless concentration causes a smudged appearance.

Vidicon

Magnetic Focus 1"–Diameter Magnetic Deflection

For Live-Scene Pickup with Color or Black-and-White TV Cameras in Broadcast, Industrial, and Closed-Circuit Systems. The 7735B is Unilaterally Interchangeable with Types 7735 & 7735A.

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	0.6	A

Direct Interelectrode Capacitance:[a]

Target to all other electrodes	4.6	pF

Spectral Response . . See *Type II Spectral Response* at front of this section

Photoconductive Layer:

Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)	0.62	inch

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method	Magnetic
Deflection Method	Magnetic
Overall Length	6.25" ± 0.25"
Greatest Diameter	1.125" ± 0.010"
Bulb	T8
Base.	Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket	Cinch[b] No.54A18088, or equivalent

Cleveland Electronics[cd]

Focusing Coil.	No. VF-115-5, or equivalent
Deflecting Yoke.	No. VY-111-3, or equivalent
Alignment Coil	No. VA-118, or equivalent

Operating Position	Any
Weight (Approx.)	2 oz

ABSOLUTE-MAXIMUM RATINGS

For scanned area of 1/2" x 3/8"

Grid–No. 3 & Grid–No. 4 Voltage . . .	1000 max.	volts
Grid–No. 2 Voltage	1000 max.	volts
Grid–No. 1 Voltage:		
Negative bias value	300 max.	volts
Positive bias value	0 max.	volts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	volts

Heater positive with respect to cathode	10 max.	volts
Target Voltage	100 max.	volts
Dark Current	0.25 max.	µA
Peak Target Current[f]	0.55 max.	µA
Faceplate:		
Illumination	1000 max.	fc
Temperature	71 max.	°C

TYPICAL OPERATION AND PERFORMANCE

For scanned area of 1/2" x 3/8" – Faceplate temperature of 30° to 35°C	*Low-Voltage Operation*	*High-Voltage Operation*	
Grid-No.4 (Decelerator) & Grid-No.3 (Beam-Focus Electrode) Voltage . . .	250[g] to 300	750	volts
Grid-No.2 (Accelerator) Voltage	300	300	volts
Grid-No.1 Voltage for Picture Cutoff[h]	–45 to –100	–45 to –100	volts
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02µa and 0.2 µa	0.65	0.65	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[i]	300:1	300:1	
Lag[k]			
Maximum value	28	28	%
Typical value.	23	23	%
Minimum Peak-to-Peak Blanking Voltage:			
When applied to grid No.1	75	75	volts
When applied to cathode.	20	20	volts
Limiting Resolution:			
At center of picture–			
Typical value	750	900	TV lines
Minimum value	700	–	TV lines
Amplitude Response to a 400 TV Line Square-Wave Test → Pattern at Center of Picture	30	45	%
Field Strength at Center of Focusing Coil[m].	40	60	gauss
Peak Deflecting-Coil Current:			
Horizontal	185	375	mA
Vertical	25	43	mA
Field Strength of Adjustable Alignment Coil	0 to 4	0 to 4	gauss

→ Indicates a change.

High-sensitivity operation—0.5 footcandle on faceplate

	Low-Voltage Operation	High-Voltage Operation	
Faceplate Illumination (Highlight)	0.5	-	fc
Target Voltage[n,p]	30 to 60	-	V
Dark Current[q]	0.10	-	μA
Signal-Output Current[r]			
Typical	0.27	-	μA

Average-sensitivity operation—1.0 footcandle on faceplate

Faceplate Illumination (Highlight)	1.0	-	fc
Target Voltage[n,p]	20 to 40	-	V
Dark Current[q]	0.025	-	μA
Signal-Output Current[r]			
Typical	0.275	-	μA
Minimum	0.265	-	μA

High-Light Level Operation—10 footcandles on faceplate

Faceplate Illumination (Highlight)	10	-	fc
Target Voltage[n,p]	10 to 22	-	V
Dark Current[q]	0.005	-	μA
Signal-Output Current[r]			
Typical	0.3	-	μA

a This capacitance, which effectively is the output impedance of the 7735B, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms

b Orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

c Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

d These components are chosen to provide tube operation with minimum beam-landing error.

e Made by Cinch Manufacturing Corporation, 1026 S. Homan Ave., Chicago 24, Illinois.

f Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

g Definition, focus uniformity, and picture quality decrease with decreasing grid-No.4 and grid-No.3 voltage. In general, grid-No.4 and grid-No.3 should be operated above 250 volts.

h With no blanking voltage on grid No.1.

j Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 Mc/s and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

k Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.3 microampere and a dark current of 0.025 microampere.

m The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

n The target voltage for each 7735B must be adjusted to the value which gives the desired operating signal current.

p Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[q] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change is scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[r] Defined as the component of the highlight target current after the dark-current component has been subtracted.

OPERATING CONSIDERATIONS

Target connection is made by a suitable spring contact bearing against the edge of the metal ring at the face end of the tube.

Faceplate-temperature should not exceed 71°C (160°F), either during operation or storage of the 7735B. Operation with a faceplate temperature in the range from about 25° to 35°C (77° to 95°F) is recommended.

Provisions should also be made in the camera installation to hold the faceplate temperature of the 7735B at a *steady value* within the recommended range. Dark current increases with increasing temperature. It is highly desirable to operate the 7735B at a steady temperature to maintain dark current at a preselected value. This mode of operation ensures both optimum and stable day-to-day performance. If such provisions cannot be made, changes in target voltage may be required from time to time to maintain the desired picture quality.

As shown under *Uncompensated Horizontal Square-Wave Response*, a substantial increase in both limiting resolution and amplitude response of the 7735B may be obtained by increasing the operating voltages on grid No.4 and grid No.3. The focusing-coil field strength must be increased and more deflecting power is required at higher electrode voltages as indicated under *Typical Operation and Performance Data*.

Operation at higher electrode voltages may introduce additional beam-landing errors that may be partially compensated for by repositioning the deflecting components. Full compensation may require the application of a modulating voltage of suitable waveform, at both horizontal and vertical scan rates, to the cathode, grid No.1, and grid No.2 of the 7735B.

Dos and Don'ts on Use of RCA-7735B

Dos

1. Adjust camera scanning to utilize maximum useful area of photoconductive layer.

2. Orient the vidicon so that horizontal scan is essentially parallel to the plane passing through tube axis and short pin.

3. Align electron beam.

4. With lens capped, adjust target voltage for each individual vidicon to the highest value that will still give uniform background.

5. Match any visible raster pattern of photoconductive layer with new scan by reorienting the vidicon as required.

6. Use only sufficient beam current to bring out picture highlights.

7. Open lens iris or increase the scene illumination to obtain the "snappiest" picture without noticeable smear from moving objects. Target voltage should be reduced if light on the tube and/or resultant signal is excessive.

8. Always cap lens when transporting camera (see "Don'ts" 5).

Don'ts

1. Don't underscan the photoconductive layer.

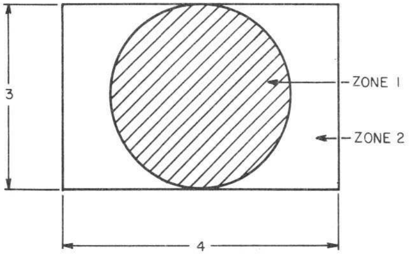
2. Don't change camera size and centering controls once the scanned area of photoconductive layer has been properly positioned.

3. Don't rotate vidicon from its original operating position in deflecting yoke.

4. Don't turn beam of vidicon on without normal scanning or remove scanning before beam of vidicon is turned off.

5. DON'T ALLOW IMAGE OF THE SUN OR OTHER VERY INTENSE SOURCE OF ILLUMINATION TO BE FOCUSED ON PHOTOCONDUCTIVE LAYER AT ANY TIME.

SPURIOUS SIGNAL TEST



92LS-1064

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown above. The 7735B is operated under the conditions specified under *Typical Operation and Performance Data* with the lens adjusted to provide a target current of 0.3 microampere. The 7735B is adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.

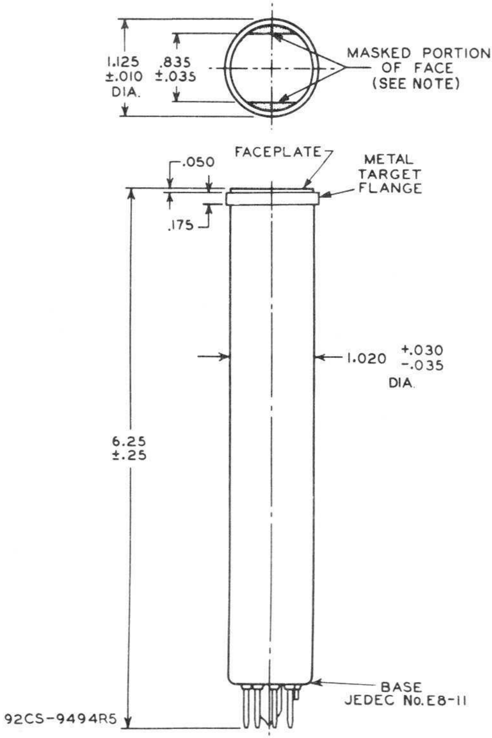
TABLE I *(For scanned area of 1/2" x 3/8")*

Equivalent Number of Raster Lines	ZONE I Allowed Spots	ZONE 2 Allowed Spots
Over 3	0	0
3 but not including 1	1	2
1 or less	footnote s	footnote s

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

s Spots of this size are allowed unless concentration causes a smudged appearance.

DIMENSIONAL OUTLINE



DIMENSIONS IN INCHES

Note: Straight sides of masked portions are parallel to the plane passing through tube axis and short pin.

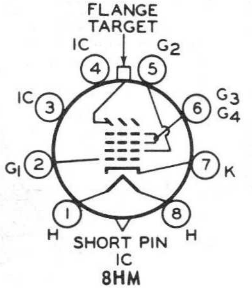
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

ADDITIONAL DIMENSIONAL OUTLINE NOTE:

Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

TERMINAL DIAGRAM (Bottom View)

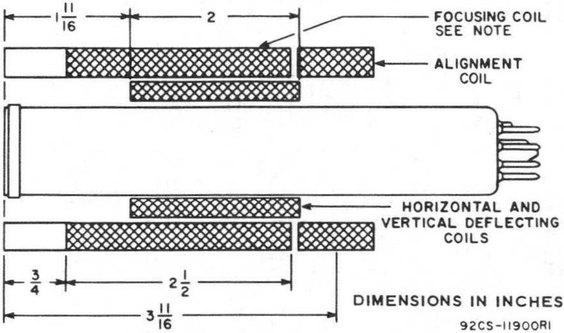
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Internal Connection — Do Not Use
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No. 2
Pin 6: Grids No.2 and No.4
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection — Make No Connection



DIRECTION OF LIGHT: INTO FACE END OF TUBE

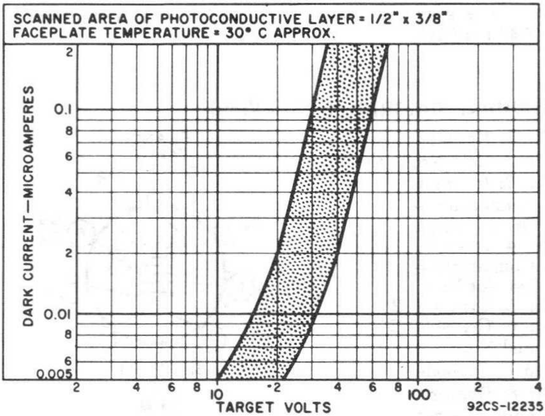
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To obtain minimum beam-landing error

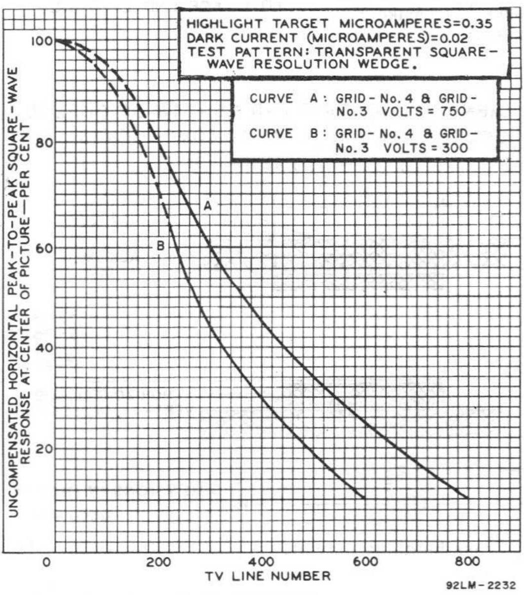


Note: Cross-hatching indicates wound position of focusing coil.

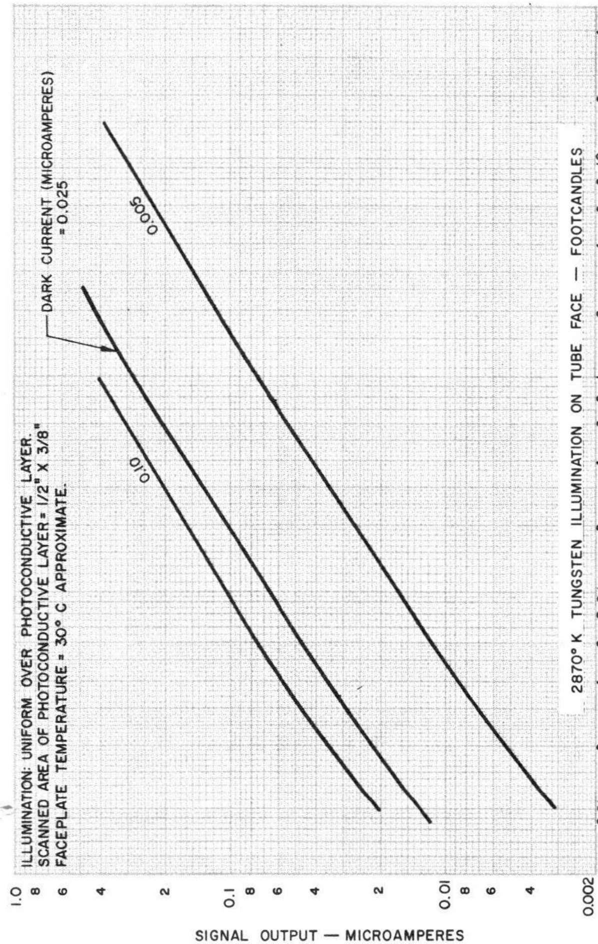
RANGE OF DARK CURRENT



UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE

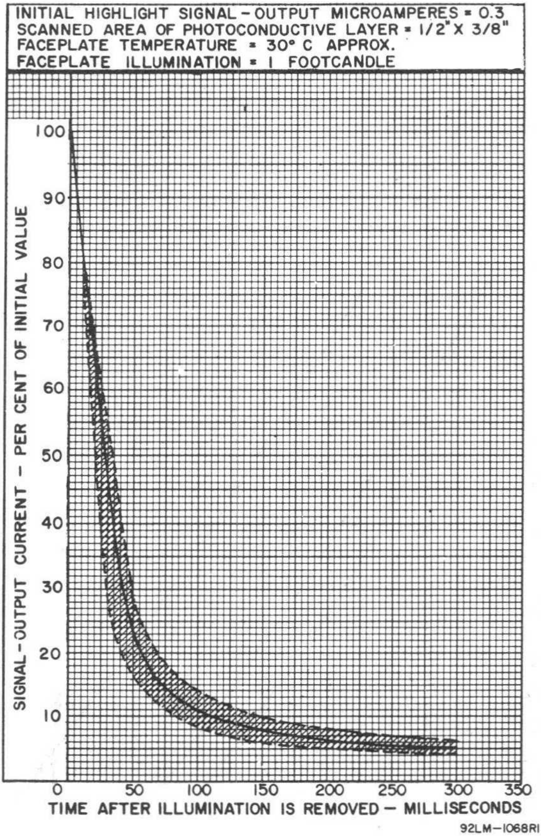


LIGHT TRANSFER CHARACTERISTICS



92LM-1056R1

TYPICAL PERSISTENCE CHARACTERISTIC



Multiplier Phototube

10-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE HAVING ENCLOSED, IN-LINE DYNODE STRUCTURE, 1.68"-DIAMETER, SPHERICAL, SEMITRANSPARENT PHOTOCATHODE, S-11 RESPONSE, AND VERY SHORT TIME-RESOLUTION CAPABILITY

DATA

General:

Spectral Response S-11
Wavelength of Maximum Response . . . . . 4400 ± 500 angstroms
Cathode, Semitransparent:
  Shape . . . . Spherical
  Window:

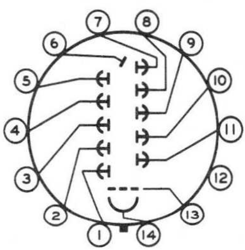
Area (Projected)	2.2	sq. in.
Minimum diameter	1.68	in.
Index of refraction	1.51	

Direct Interelectrode Capacitances (Approx.):

Anode to dynode No.10	3.8	$\mu\mu f$
Anode to all other electrodes . . .	5	$\mu\mu f$
Dynode No.10 to all other electrodes.	6.5	$\mu\mu f$

Maximum Overall Length . . . . 6.12"
Seated Length . . . . 5.18" ± 0.19"
Maximum Diameter . . . . 2.31"
Operating Position . . . . Any
Weight (Approx.) . . . . 6 oz
Bulb T16
Socket . . . . Cinch No.3M14, or equivalent
Base . . . . Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-38)
  Basing Designation for BOTTOM VIEW 14AV

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 - Internal Connection—Do Not Use
Pin 13 - Focusing Electrode
Pin 14 - Photocathode



DIRECTION OF LIGHT: INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND
  CATHODE (DC) . . . . 2500 max. volts

SUPPLY VOLTAGE BETWEEN DYNODE No.10 AND ANODE (DC).	400 max.	volts
SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC).	300 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.1 AND CATHODE (DC).	600 max.	volts
SUPPLY VOLTAGE BETWEEN FOCUSING ELECTRODE AND CATHODE (DC).	600 max.	volts
AVERAGE ANODE CURRENT▲.	2 max.	ma
AMBIENT TEMPERATURE	75 max.	^{o}C

Characteristics Range Values for Equipment Design:

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I

With E = 2000 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4400 angstroms	–	9.6×10^{5}	–	amp/watt
Cathode radiant, at 4400 angstroms. . .	–	0.056	–	amp/watt
Luminous, at 0 cps● .	200	1200	6000	amp/lumen
Cathode luminous:				
With tungsten light source★ . .	50	70	–	µa/lumen
With blue light source♦*. .	0.05	–	–	µa
Current Amplification .	–	1.7×10^{7}	–	
Equivalent Anode-Dark-Current Input● at luminous sensitivity of 230 amperes/lumen.	–	9×10^{-10}	3.5×10^{-9}	lumen
Equivalent Noise Input♠	–	6×10^{-12}	–	lumen
Anode-Pulse Rise Time♣ .	–	2×10^{-9}	–	sec
Greatest Delay Between Anode Pulses:				
Due to position from which electrons are simultaneously released within a circle centered on tube face having a diameter of—				
1.4".	–	3×10^{-10}⊕	–	sec
1.6".	–	5×10^{-10}⊕	–	sec

With E = 1500 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4400 angstroms	–	1×10^{5}	–	amp/watt
Cathode radiant, at 4400 angstroms .	–	0.056	–	amp/watt
Luminous, at 0 cps● .	23	130	680	amp/lumen

	Min.	Median	Max.	
Cathode luminous:				
With tungsten				
light source★ . . .	50	70	-	µa/lumen
Current Amplification .	-	1.8×10^6	-	
Equivalent Anode-Dark-Current Input● at luminous sensitivity of 20 amperes/lumen .	-	8×10^{-10}	2.5×10^{-9}	lumen
Equivalent Noise Input♠	-	4×10^{-12}	1×10^{-11}	lumen
Pulse Height Resolution#	-	8.5	9	%

With E = 1000 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	-	4.8×10^3	-	amp/watt
Cathode radiant, at 4400 angstroms .	-	0.056	-	amp/watt
Luminous, at 0 cps● .	1	6	30	amp/lumen
Cathode luminous:				
With tungsten light source★ . . .	50	70	-	µa/lumen
Current Amplification .	-	8.6×10^4	-	
Equivalent Anode-Dark-Current Input● at luminous sensitivity of 6 amperes/lumen. .	-	5×10^{-10}	-	lumen
Equivalent Noise Input♠	-	5×10^{-12}	-	lumen

▲ Averaged over any interval of 30 seconds maximum.

● Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 0.1 microlumen is used.

★ Under the following conditions: The light source is a tungsten-filament lamp 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 together as anode.

♦ Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning No.C.S. 5-58, Glass Code No.5113 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. A voltage of 200 volts is applied between cathode and all other electrodes connected together as anode.

* For spectral characteristic of this source, see sheet SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER at front of this section.

● Measured at a tube temperature of 25° C. Dark current may be reduced by the use of a refrigerant.

♠ Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield is connected to cathode, bandwidth 1 cycle per second, tungsten light source 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

♣ 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 variations in the multiplier stages and is measured under conditions with an incident-light spot approximately 1 millimeter in diameter centered on the photocathode.

⊕ These values represent the difference in time of transit between the photocathode and dynode No.1 for electrons simultaneously released from the center and from the periphery of the specified areas.

Measured with supply voltage (E) = 1200 to 1300 volts; radiation source, an isotope of cesium having an atomic mass of 137 (Cs^{137}); scintillation counter crystal, a cylindrical 2" x 2" thallium-activated sodium-iodide type [NaI(Tl) — type 8D8S50, Serial No.AL281, manufactured by Harshaw Chemical Co., 1945 E. 97 Street, Cleveland 6, Ohio].

TABLE I

VOLTAGE TO BE PROVIDED BY DIVIDER	
Between	8.06% of Supply Voltage (E) multiplied by
Cathode and Dynode No.1	2
Dynode No.1 and Dynode No.2	1.4
Dynode No.2 and Dynode No.3	1
Dynode No.3 and Dynode No.4	1
Dynode No.4 and Dynode No.5	1
Dynode No.5 and Dynode No.6	1
Dynode No.6 and Dynode No.7	1
Dynode No.7 and Dynode No.8	1
Dynode No.8 and Dynode No.9	1
Dynode No.9 and Dynode No.10	1
Dynode No.10 and Anode	1
Anode and Cathode	12.4
Focusing electrode is connected to arm of potentiometer between cathode and dynode No.1. The focusing-electrode voltage is varied to give maximum current amplification.	

OPERATING CONSIDERATIONS

The *operating stability* of the 7746 is dependent on the magnitude of the anode current and its duration. When the 7746 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 7746 usually recovers a substantial percentage of such loss in sensitivity.

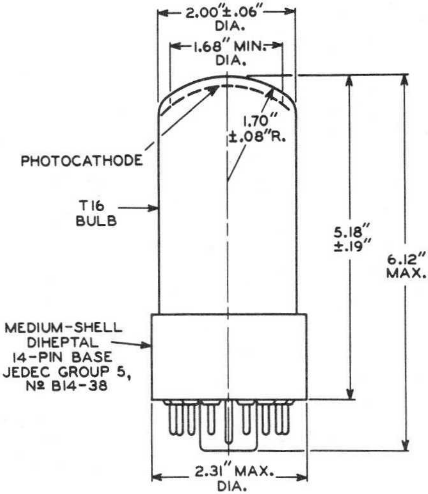
The use of an average anode current well below the maximum-rated value of 2 milliamperes is recommended when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Electrostatic and/or *magnetic shielding* of the 7746 may be necessary.

Adequate *light shielding* should be provided to prevent extraneous light from reaching any part of the 7746.

The *high voltages at which the 7746 is operated are very dangerous.* Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-11 Response
is shown at front of this Section

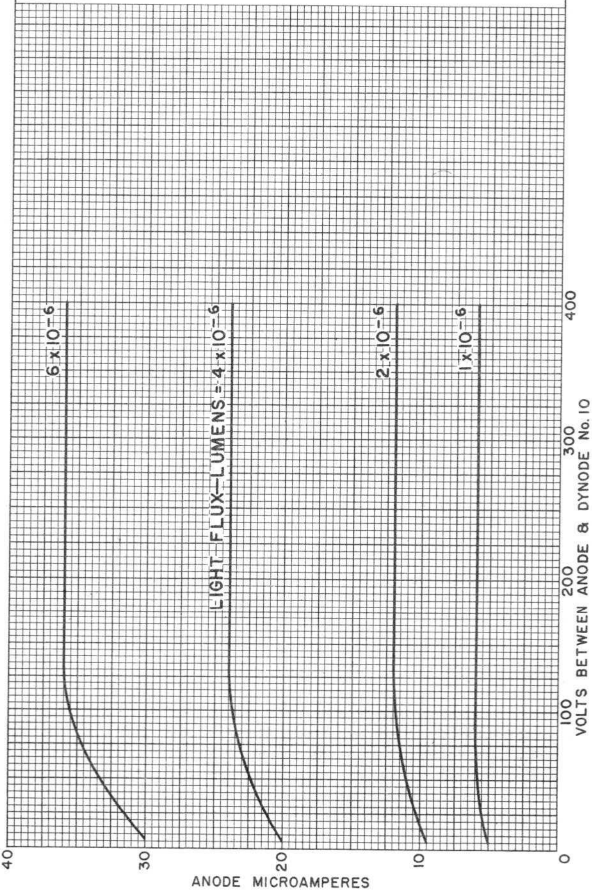


92CS-10592

CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

TYPICAL ANODE CHARACTERISTICS

DYNODE – No. 1 – TO – CATHODE VOLTS = 160
DYNODE – No. 1 – TO – DYNODE – No. 2 VOLTS = 110
EACH SUCCEEDING – DYNODE – STAGE VOLTS = 80
FOCUSING – ELECTRODE VOLTAGE ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.
LIGHT SOURCE IS A TUNGSTEN – FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.



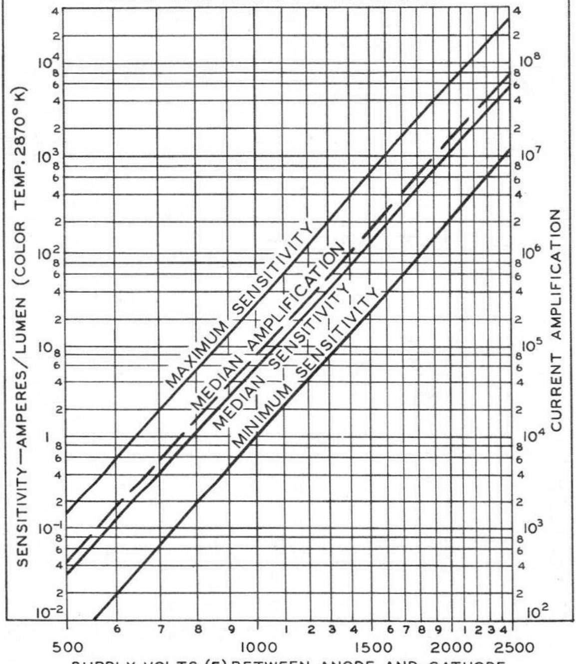
92CM–10596R1

CHARACTERISTICS

THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	8.06 % OF E MULTIPLIED BY
CATHODE & DY1	2
DY1 & DY2	1.4
DY2 & DY3	1
DY3 & DY4	1
DY4 & DY5	1
DY5 & DY6	1
DY6 & DY7	1
DY7 & DY8	1
DY8 & DY9	1
DY9 & DY10	1
DY10 & ANODE	1
ANODE & CATHODE	12.4

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.



92CM-10597R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

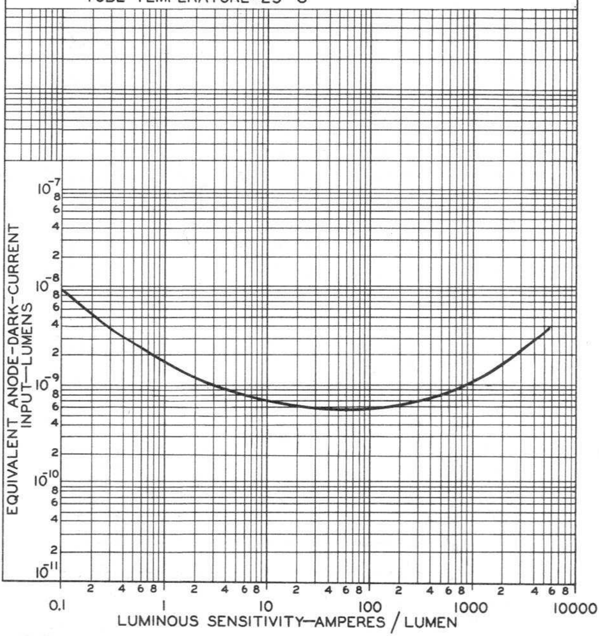
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	8.06% OF E MULTIPLIED BY
CATHODE & DY_1	2
DY_1 & DY_2	1.4
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1
DY_7 & DY_8	1
DY_8 & DY_9	1
DY_9 & DY_{10}	1
DY_{10} & ANODE	1
ANODE & CATHODE	12.4

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.

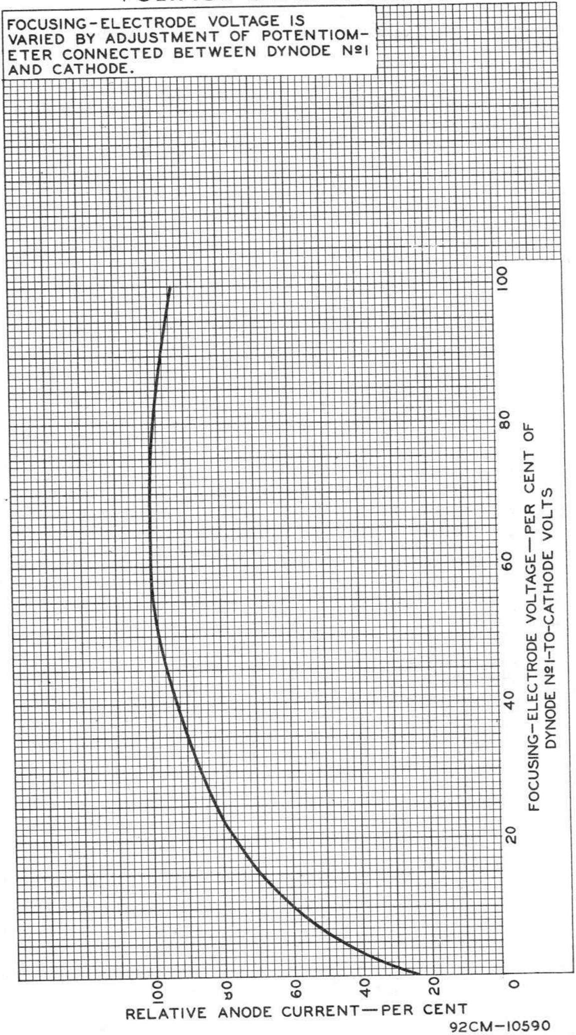
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.

TUBE TEMPERATURE=25° C

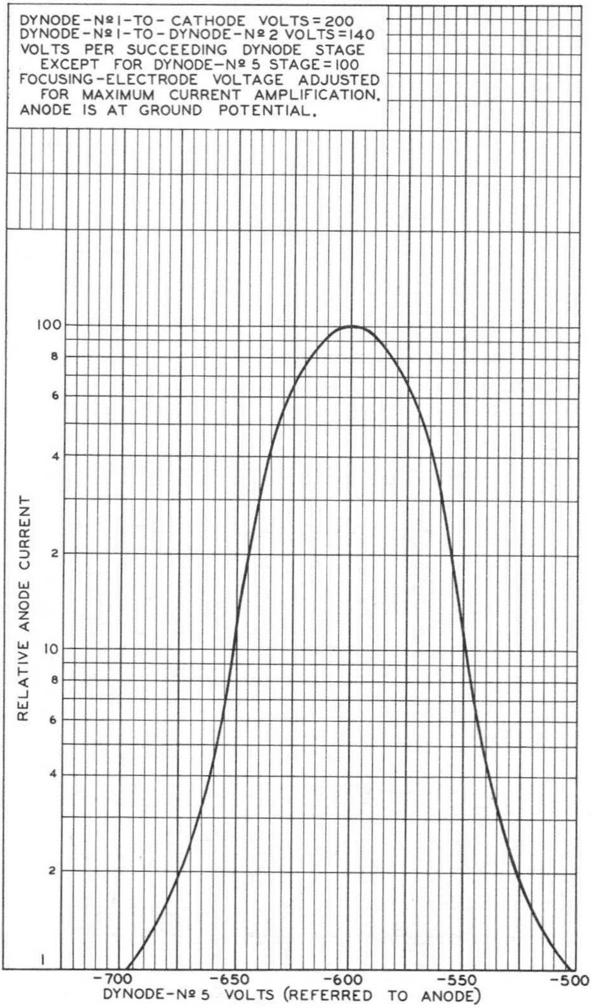


92CM-10593R1

AVERAGE FOCUSING-ELECTRODE-VOLTAGE CHARACTERISTIC



TYPICAL ANODE-CURRENT CHARACTERISTIC



92CM-10598

Multiplier Phototube

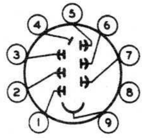
6-STAGE, HEAD-ON, FLAT-FACEPLATE, COMPACT TYPE HAVING IN-LINE DYNODE STRUCTURE, 0.5"-DIAMETER CURVED, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE

DATA

General:

Spectral Response		S-11
Wavelength of Maximum Response	4400 ± 500	angstroms
Cathode, Semitransparent:		
Shape		Curved Circular
Window:		
Area	0.2	sq. in.
Minimum diameter	0.5	in.
Index of refraction	1.51	
Direct Interelectrode Capacitances (Approx.):		
Anode to dynode No.6	1.8	μμf
Anode to all other electrodes	2.8	μμf
Maximum Overall Length		2.75"
Seated Length		2.18" ± 0.06"
Maximum Diameter		0.78"
Operating Position		Any
Weight (Approx.)		0.6 oz
Bulb		T6
Socket		Cinch No.121-11-10-134, or equivalent
Base		Small-Button Ninar 9-Pin (JEDEC No.E9-37)
Basing Designation for BOTTOM VIEW		9NG

Pin 1 - Dynode No.1
Pin 2 - Dynode No.3
Pin 3 - Dynode No.5
Pin 4 - Anode
Pin 5 - Dynode No.6
Pin 6 - Dynode No.4



DIRECTION OF LIGHT: INTO END OF BULB

Pin 7 - Dynode No.2
Pin 8 - Internal Connection— Do Not Use
Pin 9 - Photocathode

Maximum Ratings, *Absolute-Maximum Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC or Peak AC)	1500 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.6 AND ANODE (DC or Peak AC)	300 max.	volts
SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC or Peak AC)	200 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.1 AND CATHODE (DC or Peak AC)	400 max.	volts
AVERAGE ANODE CURRENT	0.5 max.	ma
AMBIENT TEMPERATURE	75 max.	°C

Characteristics Range Values for Equipment Design:

Under conditions with dc supply voltage (E) across a voltage divider providing 1/4 of E between cathode and dynode No.1; 1/8 of E for each succeeding stage; and 1/8 of E between dynode No.6 and anode

With E = 1200 volts (Except as noted)

	Min.	*Median*	*Max.*	
Sensitivity:				
Radiant, at 4400 angstroms	–	0.00024	–	amp/μw
Cathode radiant, at 4400 angstroms	–	0.048	–	amp/watt
Luminous, at 0 cps●	0.1	0.3	1.0	amp/lumen
Cathode luminous:				
With tungsten light source★	40	60	–	μa/lumen
With blue light source♦*	–	0.06	–	μa
Current Amplification	–	5×10^{3}	–	
Equivalent Anode-Dark-Current Input♣	–	1×10^{-8}	3×10^{-8}	lumen
Equivalent Noise Input♠		3×10^{-10}	1×10^{-9}	lumen

▲ Averaged over any interval of 30 seconds maximum.

● Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 10 microlumens is used. The load resistor has a value of 0.01 megohm.

★ Under the following conditions: The light source is a tungsten-filament lamp 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 together as anode.

♦ Under the following conditions: Light incident on the cathode is tramsmitted through a blue filter (Corning, Glass Code No.5113 polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. The load resistor has a value of 0.01 megohm and 200 volts are applied between cathode and all other electrodes connected together as anode.

* For spectral characteristic of this source, see sheet SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER at front of this section.

♣ Measured at a tube temperature of 25° C and with the supply voltage (E) adjusted to give a luminous sensitivity of 0.3 ampere per lumen. Dark current may be reduced by the use of a refrigerant.

♠ Under the following conditions: Supply voltage (E) is as shown, 25°-C tube temperature, external shield is connected to cathode, bandwidth 1 cycle per second, tungsten light source 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 pulses is equal to the "off" period. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

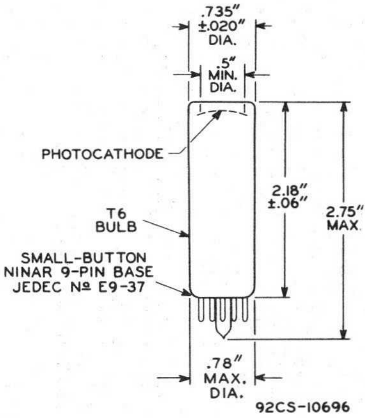
OPERATING CONSIDERATIONS

The use of an *average anode current* will below the maximum-rated value of 0.5 milliampere is recommended when stability of operation is important.

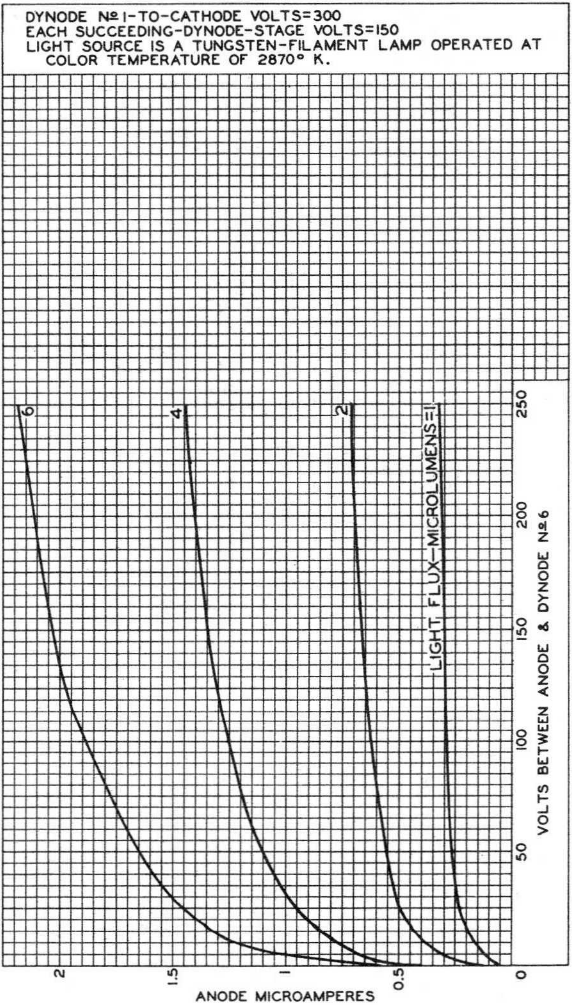
Electrostatic and/or *magnetic shielding of the 7764* may be necessary.

The high voltages at which the 7764 is operated are very dangerous. Before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors grounded.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-11 Response is shown at front of this Section

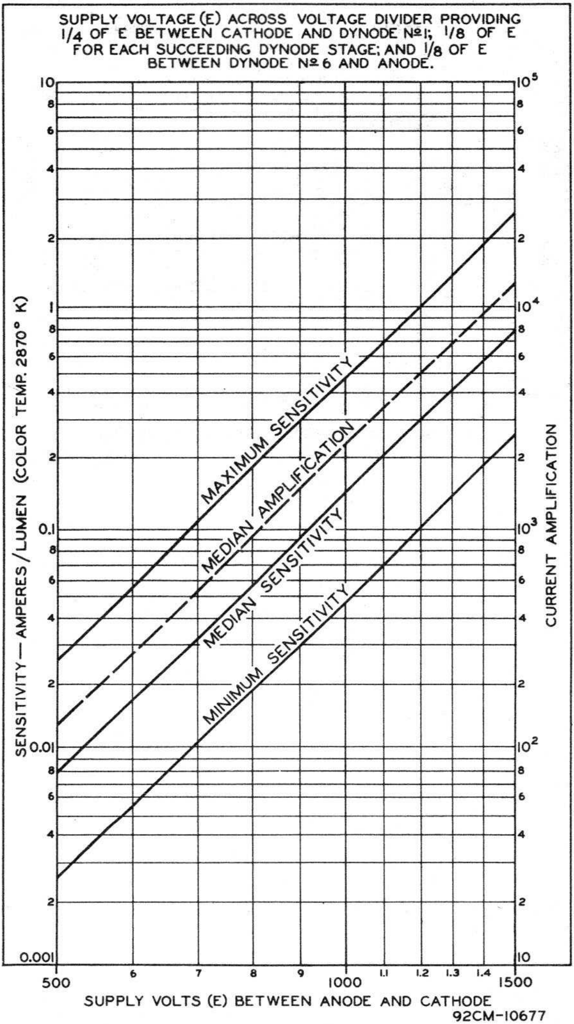


AVERAGE ANODE CHARACTERISTICS

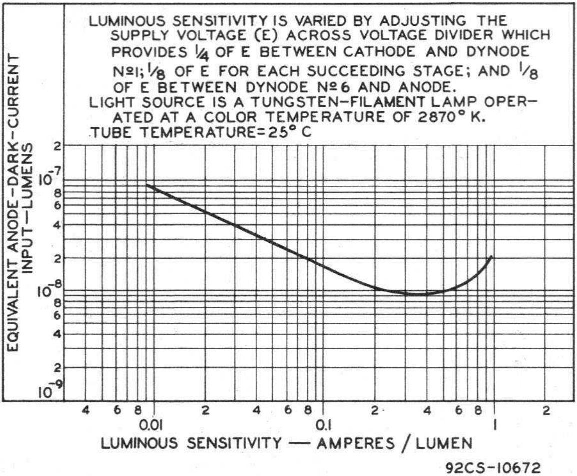


92CM-10673

CHARACTERISTICS



TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



7767

Photomultiplier Tube

Small, ¾"-Diameter, 10-Stage, Head-On Type Having S-11 Spectral Response

For Use In Compact Scintillation Counting Systems And In Other Applications Involving The Detection And Measurement Of Low-Level Light Sources

GENERAL

Spectral Response S-11
Wavelength of Maximum Response . . . . 4400 ± 500 Å
Cathode, Semitransparent . . . . Cesium-Antimony
  Minimum projected area . . . . $0.2\ in^2$ ($1.26\ cm^2$)
  Minimum diameter . . . . 0.5 in (1.27 cm)
Window . . . . . Lime Glass (Corning[a] No.0080), or equivalent
  Shape . . . . Plano-Concave
  Index of refraction at 4360 angstroms 1.523
Dynodes:
  Substrate . . . . Copper-Beryllium
  Secondary-Emitting Surface . . . . Beryllium-Oxide
  Structure . . . . In-Line, Electrostatic-Focus Type
Direct Interelectrode Capacitances (Approx.):
  Anode to dynode No.10 . . . . 2.4 pF
  Anode to all other electrodes . . . . 3.2 pF
Maximum Overall Length
  (Excluding semiflexible leads) . . . . 3.94 in (10 cm)
Maximum Diameter . . . . 0.78 in (2 cm)
Bulb T6
Base . . . . See Dimensional Outline
Magnetic Shield . . . . Millen[b] Part No.80801N, or equivalent
Operating Position . . . . Any
Weight (Approx.) . . . . 0.9 oz (25.5 g)

MAXIMUM RATINGS, *Absolute-Maximum Values*

DC Supply voltage:
  Between anode and cathode . . . . 1500 max. V
  Between anode and dynode No.10 . . . . 300 max. V
  Between consecutive dynodes . . . . 200 max. V
  Between dynode No.1 and cathode . . . . . . 400 max. V
Average Anode Current[d] . . . . 0.5 max. mA
Ambient Temperature[e] . . . . 75 max. °C

→ CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I, except as noted.

With E = 1250 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[f] at 4400 angstroms . . .	–	1.3×10^{4}	–	A/W
Luminous[g] (2870° K).	7	16	60	A/lm
Cathode Sensitivity:				
Radiant[h] at 4400 angstroms . . .	–	0.048	–	A/W
Luminous[i] (2870° K).	4×10^{-5}	6×10^{-5}	–	A/lm
Current with blue light source[k] (2870° K + C.S. No.5-58) . . .	4×10^{-8}	6×10^{-8}	–	A
Quantum Efficiency at 4200 angstroms . .	–	14	–	%
Current Amplification.	–	2.7×10^{5}	–	
Anode Dark Current[m].	–	4×10^{-9}	4×10^{-8}	A
Equivalent Anode Dark Current Input[m]	–	5×10^{-10}	5×10^{-9}	lm
	–	6×10^{-13}[n]	6×10^{-12}[n]	W
Equivalent Noise Input[p].	–	3.2×10^{-12}	–	lm
	–	4×10^{-15}[q]	–	W
Anode-Pulse Rise Time[r,s] at 1500 V . . .	–	1.8×10^{-9}	–	s
Electron Transit Time[r,t] at 1500 V	–	2×10^{-8}	–	s

[a] Made by Corning Glass Works. Corning, New York 14830.

[b] Made by James Millen Manufacturing Company, 150 Exchange Street, Malden, MA 02148.

[d] Averaged over any interval of 30 seconds maximum.

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

[f] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 803 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 2870° K and a light input of 10 microlumens is used.

→ Indicates a change or addition.

[h] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 803 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. The value of light flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

[k] 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.

[m] At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 7.5 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

[n] At 4400 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 803 lumens per watt.

[p] 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.

[q] At 4400 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 803 lumens per watt.

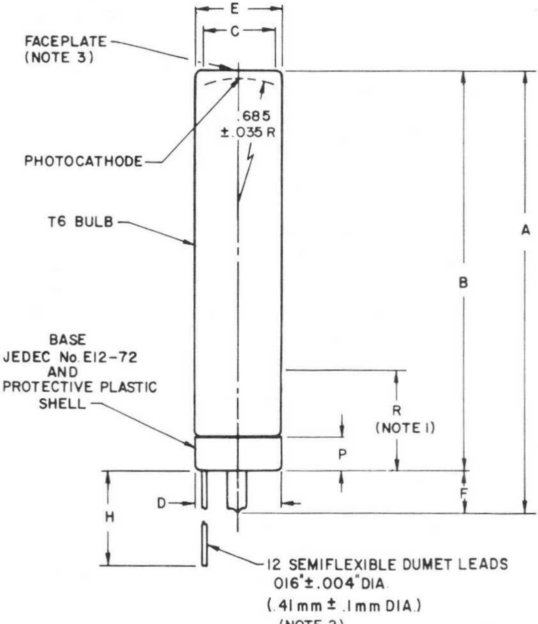
[r] Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of (E) between cathode and dynode No.1; 1/12 of (E) for each succeeding dynode stage; and 1/12 of (E) between dynode No.10 and anode..

[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.

DIMENSIONAL OUTLINE



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Dimensions	Inches	mm
A	3.94 max.	100.0 max.
B	3.50 + .06 - .12	88.9 + 1.5 - 3
C	.5 min. dia.	12.7 min. dia.
D	.78 max. dia.	19.8 max. dia.
E	.755 max. dia.	19.18 max. dia.
F	.38 max.	9.7 max.
G	.47 ± .01 dia.	11.9 ± .25 dia.
H	.75 min.	19.0 min.
P	.30 max.	7.6 max.
R	1.0 max.	25 max.

DIMENSIONAL OUTLINE NOTES

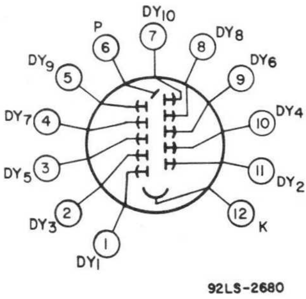
Note 1: Within this length, maximum diameter of tube is 0.78".

Note 2: The semiflexible leads of the tube may be soldered or welded into the associated circuit. If desired, the leads may be trimmed to within 1/4 inch of the protective shell. Care must be exercised when making such connections to prevent tube destruction due to thermal stress of the glass–metal seals. A heat sink placed in contact with the semi-flexible leads between the point being soldered, or welded, and the protective shell is recommended. Excessive bending of the leads is to be avoided.

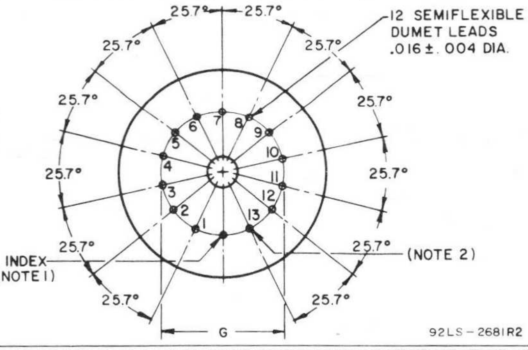
Note 3: Deviation from flatness will not exceed 0.006" from peak to valley.

LEAD CONNECTIONS (BOTTOM VIEW)

Lead 1: Dynode No.1
Lead 2: Dynode No.3
Lead 3: Dynode No.5
Lead 4: Dynode No.7
Lead 5: Dynode No.9
Lead 6: Anode
Lead 7: Dynode No.10
Lead 8: Dynode No.8
Lead 9: Dynode No.6
Lead 10: Dynode No.4
Lead 11: Dynode No.2
Lead 12: Photocathode



LEAD ORIENTATION (BOTTOM VIEW)

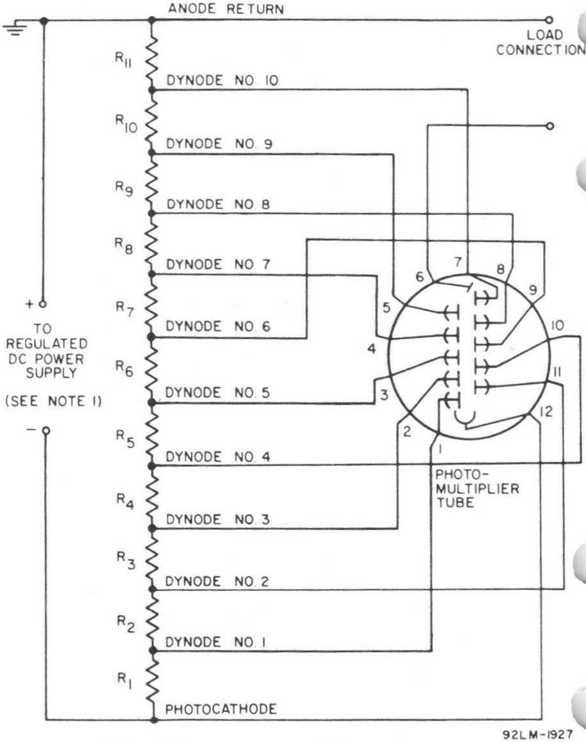


LEAD ORIENTATION NOTES

Note 1: Lead No.14 is cut off within 0.04 inch of the glass button for indexing.

Note 2: Lead No.13 is cut off within 0.04 inch of the glass button.

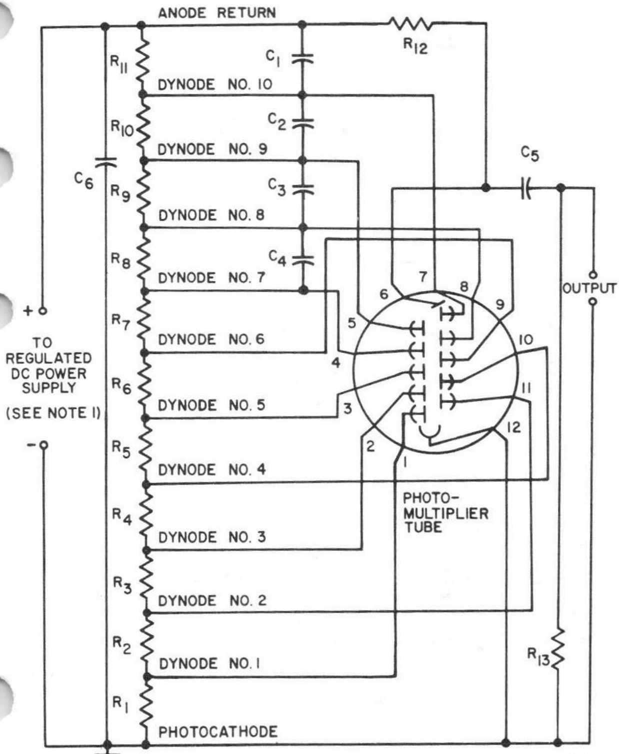
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT WHICH PERMITS DIRECT COUPLING TO THE ANODE



R_1 and R_2: 560,000 ohms, 1/2 watt
R_3: 820,000 ohms, 1/2 watt
R_4 through R_{11}: 470,000 ohms, 1/2 watt

Note 1: Adjustable between approximately 500 and 1500 volts dc.
Note 2: Component values are dependent upon nature of application and output signal desired.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS



92LM-1928

C_1: 0.05 µF, 500 volts (dc working)
C_2: 0.02 µF, 500 volts (dc working)
C_3: 0.01 µF, 500 volts (dc working)
C_4: 0.005 µF, 500 volts (dc working)
C_5 and C_6: 0.005 µF, 3000 volts (dc working)
R_1 and R_2: 560,000 ohms, 1/2 watt
R_3: 820,000 ohms, 1/2 watt
R_4 through R_{11}: 470,000 ohms, 1/2 watt
R_{12}: 1 megohm, 1/2 watt
R_{13}: 100,000 ohms, 1/2 watt

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

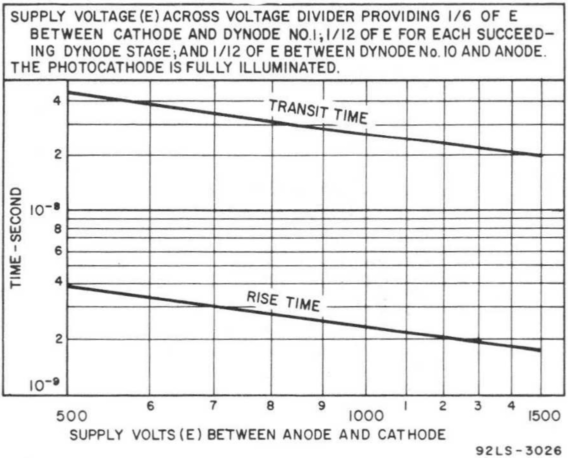
(Continued on next page)

Note 2: Capacitors C_1 through C_6 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.

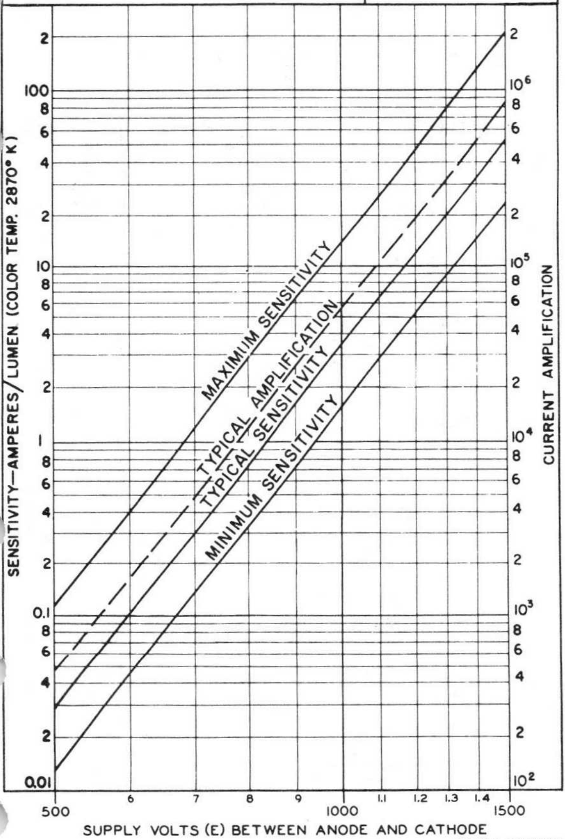
TABLE I	
TYPICAL POTENTIAL DISTRIBUTION	
Between:	**8.25% of Supply Voltage (E) Multiplied by:**
Cathode and Dynode No.1	1.2
Dynode No.1 and Dynode No.2	1.2
Dynode No.2 and Dynode No.3	1.7
Dynode No.3 and Dynode No.4	1.0
Dynode No.4 and Dynode No.5	1.0
Dynode No.5 and Dynode No.6	1.0
Dynode No.6 and Dynode No.7	1.0
Dynode No.7 and Dynode No.8	1.0
Dynode No.8 and Dynode No.9	1.0
Dynode No.9 and Dynode No.10	1.0
Dynode No.10 and Anode	1.0
Anode and Cathode	12.1

TYPICAL TIME-RESOLUTION CHARACTERISTICS



SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:	
BETWEEN	8.25% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	1.2
DYNODE No. 1 AND DYNODE No. 2	1.2
DYNODE No. 2 AND DYNODE No. 3	1.7
EACH SUCCEEDING DYNODE-STAGE	1.0
ANODE AND CATHODE	12.1



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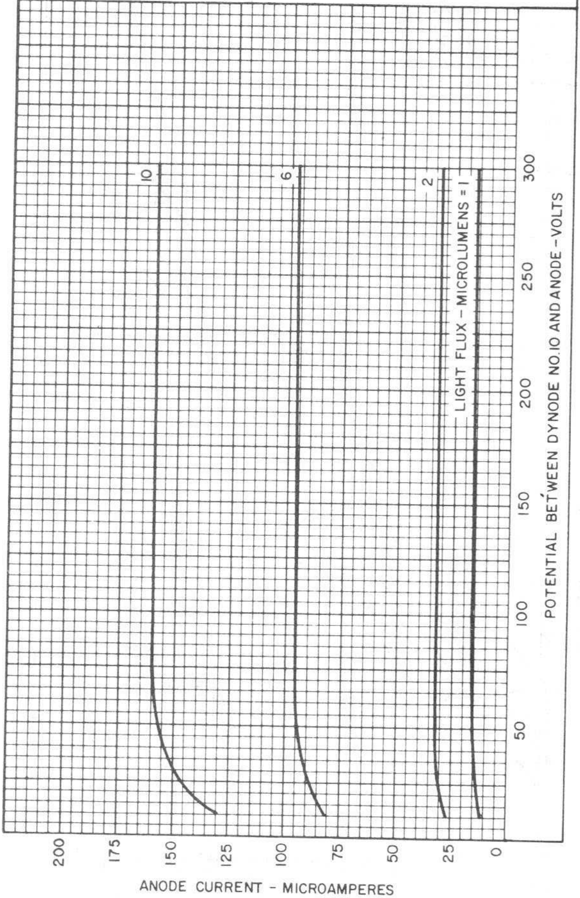
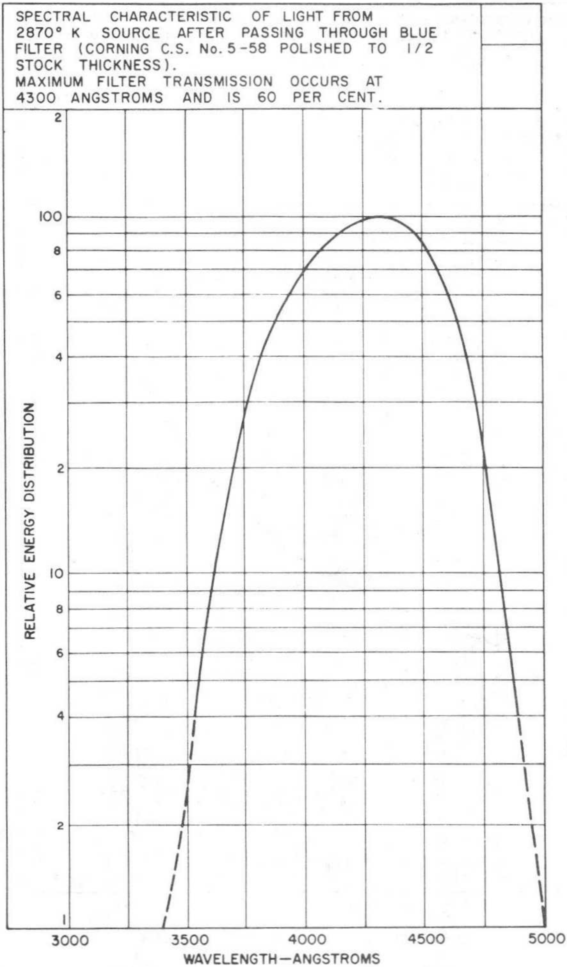
TYPICAL ANODE CHARACTERISTICS

CATHODE-TO-DYNODE-NO.1 VOLTS = 124
DYNODE-NO.1-TO-DYNODE-NO.2 VOLTS = 124
DYNODE-NO.2-TO-DYNODE-NO.3-VOLTS = 175
EACH SUCCEEDING DYNODE-STAGE VOLTS = 103
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.



92LM-3020

SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER



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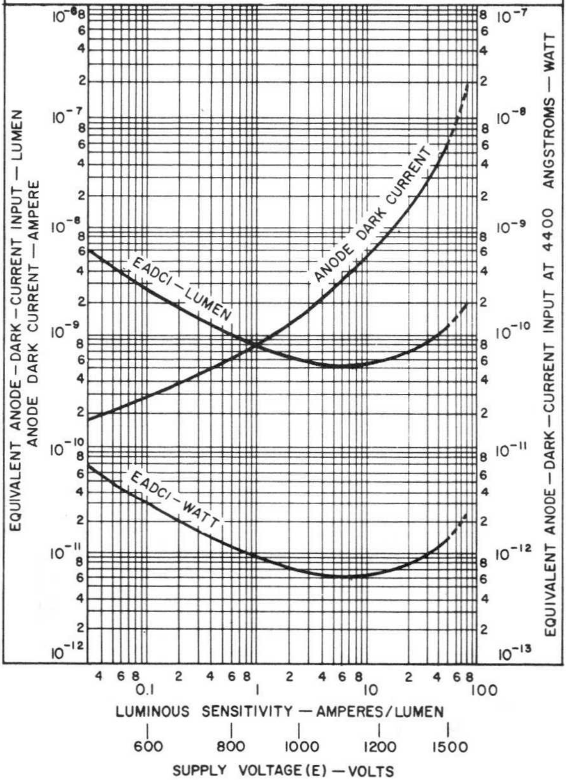
TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

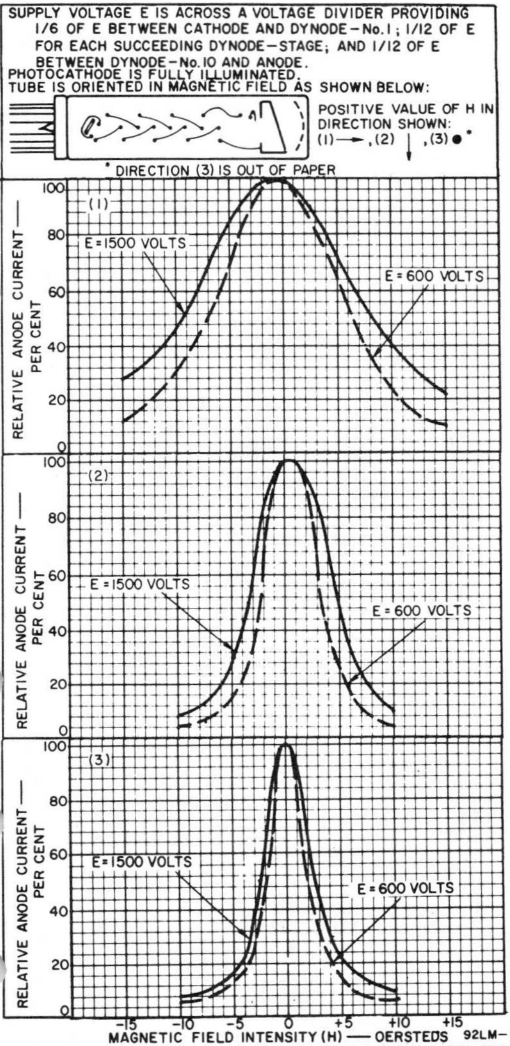
BETWEEN	8.25 % OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	1.2
DYNODE No. 1 AND DYNODE No. 2	1.2
DYNODE No. 2 AND DYNODE No. 3	1.7
EACH SUCCEEDING DYNODE-STAGE	1.0
ANODE AND CATHODE	12.1

TUBE TEMPERATURE IS 22°C.

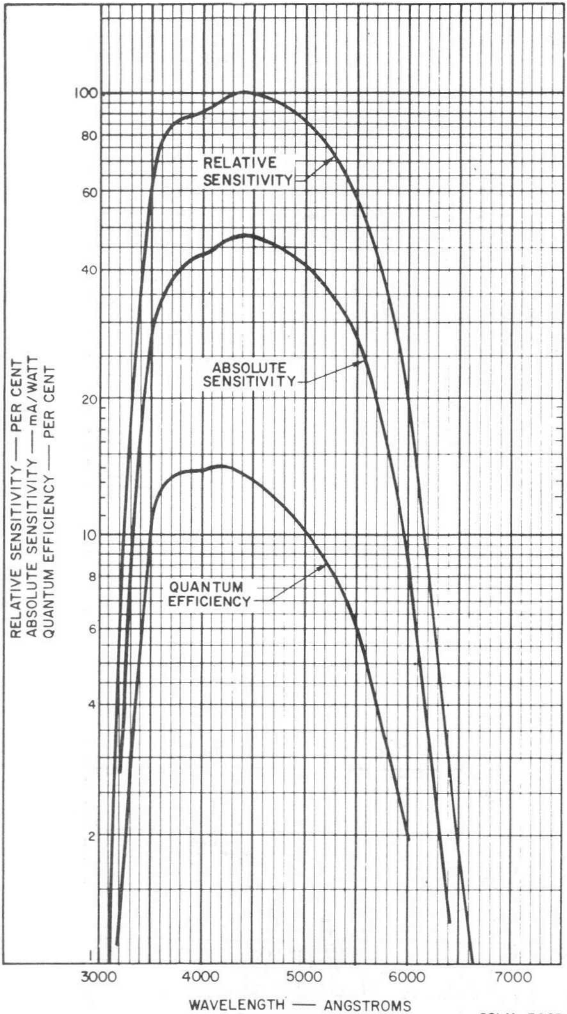


92LS-3028

TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



Multiplier Phototube

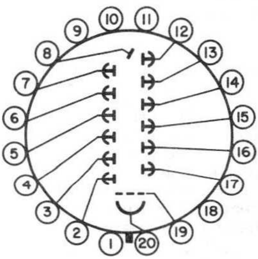
12-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE HAVING ENCLOSED, IN-LINE DYNODE STRUCTURE, 1.68"-DIAMETER, SPHERICAL, SEMITRANSPARENT PHOTOCATHODE, S-11 RESPONSE, HIGH CURRENT AMPLIFICATION, AND EXTREMELY SHORT RISE TIME

DATA

General:

Spectral Response		S-11
Wavelength of Maximum Response		4400 ± 500 angstroms
Cathode, Semitransparent:		
Shape		Spherical
Window:		
Area (Projected)	2.2	sq. in.
Minimum diameter	1.68	in.
Index of refraction	1.51	
Direct Interelectrode Capacitances (Approx.):		
Anode to dynode No.12	3.8	$\mu\mu$f
Anode to all other electrodes	5.7	$\mu\mu$f
Dynode No.12 to all other electrodes	6.8	$\mu\mu$f
Maximum Overall Length		6.31"
Seated Length		5.50" ± 0.19"
Maximum Diameter		2.06"
Operating Position		Any
Weight (Approx.)		7 oz
Bulb		T16
Socket		Cinch No.CX-875[a], or equivalent
Base		Small-Shell Bidecal 20-Pin (JEDEC No.B20-102)
Basing Designation for BOTTOM VIEW		20E

Pin 1 – No Connection
Pin 2 – Dynode No.1
Pin 3 – Dynode No.3
Pin 4 – Dynode No.5
Pin 5 – Dynode No.7
Pin 6 – Dynode No.9
Pin 7 – Dynode No.11
Pin 8 – Anode
Pin 9 – No Connection
Pin 10 – No Connection
Pin 11 – No Connection
Pin 12 – Dynode No.12
Pin 13 – Dynode No.10
Pin 14 – Dynode No.8
Pin 15 – Dynode No.6
Pin 16 – Dynode No.4
Pin 17 – Dynode No.2
Pin 18 – No Connection
Pin 19 – Grid No.1 (Focusing Electrode)
Pin 20 – Photocathode



DIRECTION OF LIGHT: INTO END OF BULB

Maximum Ratings, *Absolute-Maximum Values:*

SUPPLY VOLTAGE BETWEEN ANODE AND CATHODE (DC)	2600 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.12 AND ANODE (DC)	400 max.	volts
SUPPLY VOLTAGE BETWEEN CONSECUTIVE DYNODES (DC)	300 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.1 AND CATHODE (DC)	600 max.	volts
SUPPLY VOLTAGE BETWEEN FOCUSING ELECTRODE AND CATHODE (DC)	600 max.	volts
AVERAGE ANODE CURRENT[b]	2 max.	ma
AMBIENT TEMPERATURE	75 max.	°C

Characteristics Range Values for Equipment Design:

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I

With E = 2300 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	4.8×10^6	–	a/w
Cathode radiant, at 4400 angstroms	–	0.056	–	a/w
Luminous, at 0 cps[c]	1.4×10^3	6×10^3	50×10^3	a/lm
Cathode luminous:				
With tungsten light source[d]	50	70	–	μa/lm
With blue light source[e,f]	0.05	–	–	μa
Current Amplification	–	8.6×10^7	–	
Equivalent Anode-Dark-Current Input[g] at luminous sensitivity of 6000 a/lm	–	4×10^{-10}	2.5×10^{-9}	lm
Equivalent Noise Input[h]	–	3×10^{-12}	–	lm
Anode-Pulse Rise Time[j]	–	2×10^{-9}	–	sec
Greatest Delay Between Anode Pulses:				
Due to position from which electrons are simultaneously released within a circle centered on tube face having a diameter of—				
1.4"	–	3×10^{-10}[k]	–	sec
1.6"	–	5×10^{-10}[k]	–	sec

With E = 1800 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	5.1×10^5	–	a/w
Cathode radiant, at 4400 angstroms	–	0.056	–	a/w
Luminous, at 0 cps[c]	–	640	–	a/lm
Cathode luminous: With tungsten light source[d]	50	70	–	μa/lm
Current Amplification	–	9.1×10^6	–	
Equivalent Anode-Dark-Current Input[g] at luminous sensitivity of 160 a/lm	–	4×10^{-10}	–	lm
Equivalent Noise Input[h]	–	2.4×10^{-12}	–	lm

With E = 1300 volts (Except as noted) and focusing-electrode voltage adjusted to give maximum current amplification

	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	–	2.9×10^4	–	a/w
Cathode radiant, at 4400 angstroms	–	0.056	–	a/w
Luminous, at 0 cps[c]	8	36	300	a/lm
Cathode luminous: With tungsten light source[d]	50	70	–	μa/lm
Current Amplification	–	5×10^5	–	
Equivalent Anode-Dark-Current Input[g] at luminous sensitivity of 9 a/lm	–	5×10^{-10}	2×10^{-9}	lm
Equivalent Noise Input[h]	–	3×10^{-12}	–	lm
Pulse Height Resolution[m]	–	8.5	–	%

[a] Made by Cinch Manufacturing Corporation, 1026 South Homan Avenue, Chicago 24, Illinois.

[b] Averaged over any interval of 30 seconds maximum.

[c] Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A light input of 0.1 microlumen is used.

[d] Under the following conditions: The light source is a tungsten-filament lamp operated at a color temperature of 2870° K. The value of input flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected together as anode.

[e] 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) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux on the filter is 0.01 lumen. A voltage of 200 volts is applied between cathode and all other electrodes connected together as anode.

[f] For spectral characteristic of this source, see sheet SPECTRAL CHARACTERISTIC OF 2870° K LIGHT SOURCE AND SPECTRAL CHARACTERISTIC OF LIGHT FROM 2870° K SOURCE AFTER PASSING THROUGH INDICATED BLUE FILTER at front of this section.

g Measured at a tube temperature of 25° C. Dark current may be reduced by the use of a refrigerant.

h Under the following conditions: Supply voltage (E) is as shown, 25°-C tube temperature, external shield is connected to cathode, bandwidth 1 cycle per second, tungsten light source 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. The output current is measured through a filter which passes only the fundamental frequency of the pulses.

j 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 variations in the multiplier stages and is measured under conditions with an incident light spot approximately 1 millimeter in diameter centered on the photocathode.

k These values represent the difference in time of transit between the photocathode and dynode No.1 for electrons simultaneously released from the center and from the periphery of the specified areas.

m Measured with supply voltage (E) = 1100 to 1400 volts; radiation source, an isotope of cesium having an atomic mass of 137 (Cs^{137}); scintillation-counter crystal, a cylindrical 2" x 2" thallium-activated sodium-iodide type [NaI(Tl) — type 8D8S50, Serial No.AL281, manufactured by Harshaw Chemical Company, 1945 East 97 Street, Cleveland 6, Ohio].

TABLE I

VOLTAGE TO BE PROVIDED BY DIVIDER	
Between	**6.95% of Supply Voltage (E) multiplied by**
Cathode and Dynode No.1	2
Dynode No.1 and Dynode No.2	1.4
Dynode No.2 and Dynode No.3	1
Dynode No.3 and Dynode No.4	1
Dynode No.4 and Dynode No.5	1
Dynode No.5 and Dynode No.6	1
Dynode No.6 and Dynode No.7	1
Dynode No.7 and Dynode No.8	1
Dynode No.8 and Dynode No.9	1
Dynode No.9 and Dynode No.10	1
Dynode No.10 and Dynode No.11	1
Dynode No.11 and Dynode No.12	1
Dynoge No.12 and Anode	1
Anode and Cathode	14.4
Focusing electrode is connected to arm of potentiometer between cathode and dynode No.1. The focusing-electrode voltage is varied to give maximum current amplification.	

OPERATING CONSIDERATIONS

The *operating stability* of the 7850 is dependent on the magnitude of the anode current and its duration. When the 7850 is operated at high average values of anode current, a drop in sensitivity (sometimes called fatigue) may be expected. The extent of the drop below the tabulated sensitivity values depends on the severity of the operating conditions. After a period of idleness, the 7850 usually recovers a substantial percentage of such loss in sensitivity.

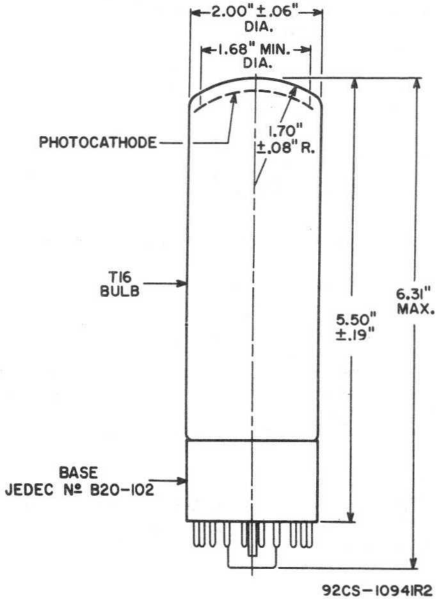
The use of an average anode current well below the maximum-rated value of 2 milliamperes is recommended when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

Electrostatic and/or *magnetic shielding* of the 7850 may be necessary.

Adequate *light shielding* should be provided to prevent extraneous light from reaching any part of the 7850-

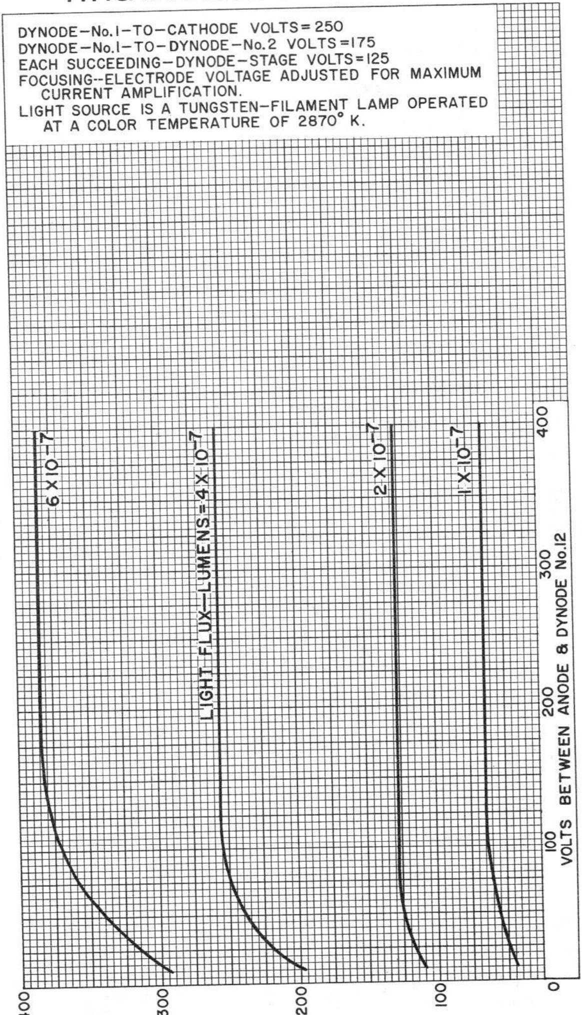
The *high voltages at which the 7850 is operated are very dangerous*. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-11 Response
is shown at the front of this Section



CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

TYPICAL ANODE CHARACTERISTICS



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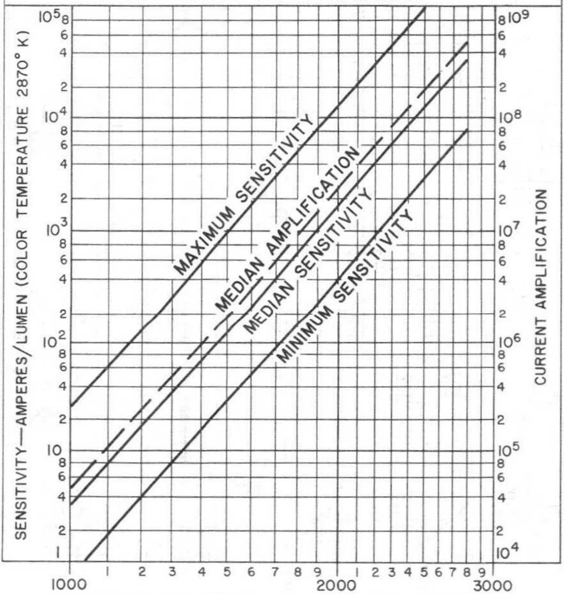
CHARACTERISTICS

THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.95% OF E MULTIPLIED BY
CATHODE & DY_1	2
DY_1 & DY_2	1.4
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1
DY_7 & DY_8	1
DY_8 & DY_9	1
DY_9 & DY_{10}	1
DY_{10} & DY_{11}	1
DY_{11} & DY_{12}	1
DY_{12} & ANODE	1
ANODE & CATHODE	14.4

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.



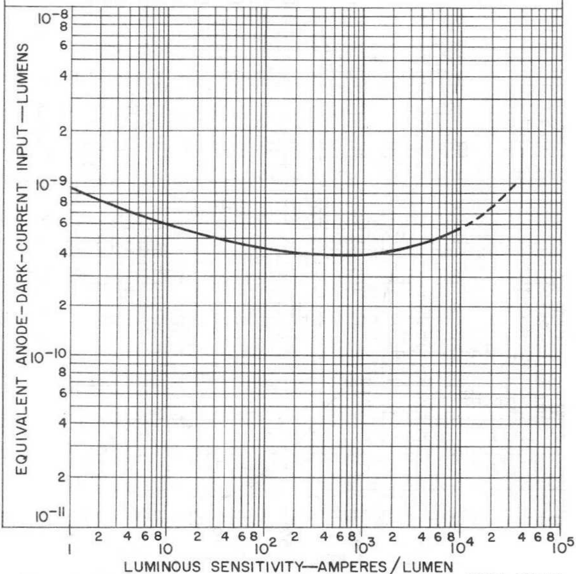
92CM-10946

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

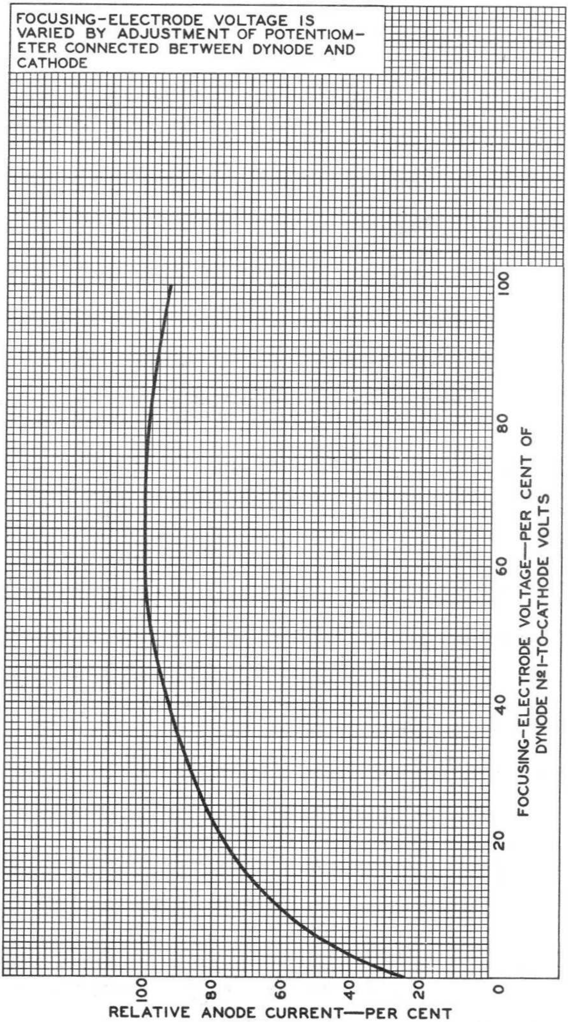
BETWEEN	6.95 % OF E MULTIPLIED BY
CATHODE & DY_1	2
DY_1 & DY_2	1.4
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1
DY_7 & DY_8	1
DY_8 & DY_9	1
DY_9 & DY_{10}	1
DY_{10} & DY_{11}	1
DY_{11} & DY_{12}	1
DY_{12} & ANODE	1
ANODE & CATHODE	14.4

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE=25° C



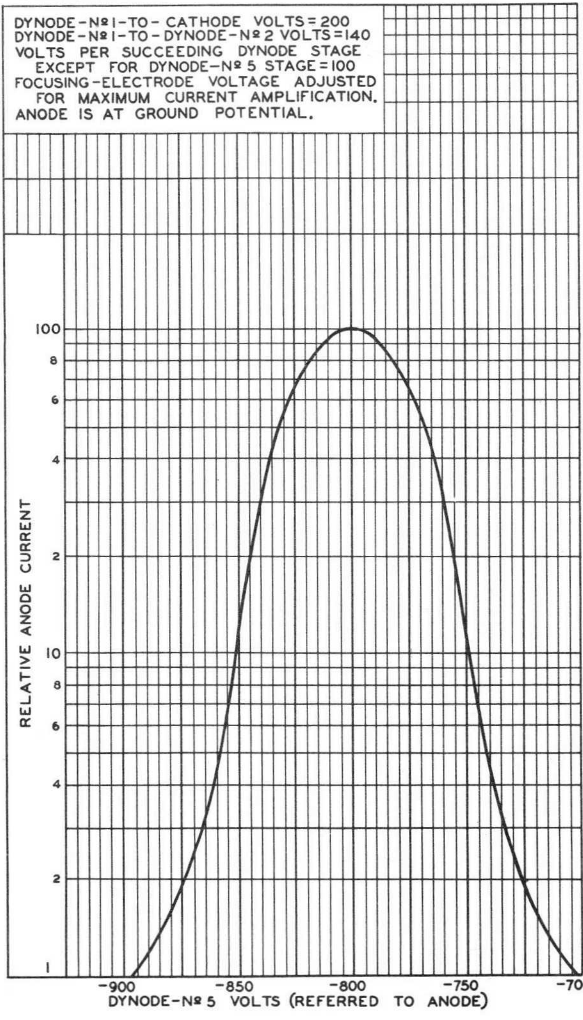
92CM-10940

AVERAGE FOCUSING-ELECTRODE-VOLTAGE CHARACTERISTIC



92CM-10590

TYPICAL ANODE-CURRENT CHARACTERISTIC



92CM-10959

Vidicon

I-1/2" DIAMETER

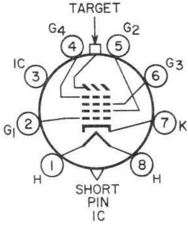
MAGNETIC FOCUS — MAGNETIC DEFLECTION

For Broadcast Film-Pickup or Data Transmission with Color or Black-and-White TV Cameras Requiring Resolutions of more than 1200 TV Lines

General:

Heater, for Unipotential Cathode:	
Voltage (AC or DC)	6.3 ± 10% volts
Current at 6.3 volts	0.6 amp
Direct Interelectrode Capacitance:[a]	
Target to all other electrodes	8.0 pf
Spectral Response	S-18
Wavelength of Maximum Response	4500 +500 −300 angstroms
Photoconductive Layer:	
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)[b]	1"
Focusing Method	Magnetic
Deflection Method	Magnetic
Overall Length	7.75" ± 0.25"
Greatest Diameter	1.59" ± 0.01"
Bulb Diameter	1.50" ± 0.01" ←
Operating Position	Any
Weight (Approx.)	5.25 oz
Bulb	T12
Focusing-Alignment Assembly	Cleveland Electronics[c] No.15-VFA-259, or equivalent
Deflecting Yoke[d]	Cleveland Electronics[c] No.15-VY-258, or equivalent
Socket	Alden[e] No.208-SBSDC, or equivalent ←
Base	Small-Button Super-Ditetrar 8-Pin (JEDEC No.E8-78)
Basing Designation for BOTTOM VIEW	8LB

Pin 1 - Heater
Pin 2 - Grid No.1
Pin 3 - Do Not Use
Pin 4 - Grid No.4
Pin 5 - Grid No.2
Pin 6 - Grid No.3
Pin 7 - Cathode
Pin 8 - Heater
Flange - Target
Short Pin - Do Not Use



DIRECTION OF LIGHT: INTO FACE END OF TUBE

Maximum Ratings, *Absolute-Maximum Values:*

For scanned area of 0.6" x 0.8"

Grid-No.4 Voltage	1500 volts
Grid-No.3 Voltage	1500 volts

← Indicates a change.

Grid-No.2 Voltage	550	volts
Grid-No.1 Voltage:		
Negative-bias value	300	volts
Positive-bias value	0	volts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125	volts
Heater positive with respect to cathode	10	volts
Target Voltage	125	volts
Dark Current	0.25	μa
Peak Target Current[f]	0.60	μa
Faceplate:		
Illumination	1000	fc
→ Temperature	71	°C

→ Typical Operation:

For scanned area of 0.6" x 0.8" and faceplate temperature of 30° to 35° C

Grid-No.4 (Decelerator) Voltage[g]	1400	volts
Grid-No.3 (Beam-Focus Electrode) Voltage[h]	800 to 1000	volts
Grid-No.2 (Accelerator) Voltage	300	volts
Grid-No.1 Voltage for picture cutoff[j]	-45 to -100	volts
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 μa and 0.6 μa	0.65	
Minimum Peak-to-Peak Blanking Voltage:		
When applied to grid No.1	75	volts
When applied to cathode	20	volts
Lag:[k]		
Maximum value	33	%
Typical value	25	%
Limiting Resolution:		
At center of picture—		
Typical value	1500	TV lines
Minimum value	1200	TV lines
At corners of picture—		
Typical value	900	TV lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture:		
Minimum value	60	%
Field Strength at Center of Focusing Coil (Approx.)	46	gauss
Field Strength of Adjustable Alignment Coil[m]	0 to 4	gauss
Peak Deflecting-Coil Current for Specified Deflecting Yoke:		
Horizontal	240	ma
Vertical	50	ma

Average-Sensitivity Operation

Faceplate Illumination (Highlight)	10	fc
Target Voltage[n,p]	20 to 50	volts
Dark Current[q]	0.02	μa
Signal-Output Current[r] (Typical)	0.5	μa

→ Indicates a change.

Minimum-Lag Operation

Faceplate Illumination (Highlight)	50	fc
Target Voltage[n,p]	10 to 30	volts
Dark Current[q]	0.005	μa
Signal-Output Current[r] (Typical)	0.5	μa

[a] This capacitance, which effectively is the output impedance of the 8051 is increased when the tube is mounted in the deflecting-yoke and focusing-alignment assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the plane passing through the axis and short index pin. The masking is for orientation only and does not define the proper scanned area of photoconductive layer. Final orientation should be such that the image also fits inside of any internal mask of the mesh assembly.

[c] Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

[d] For minimum geometric distortion, the deflecting yoke should be located in its proper axial position 3/4-inch from the face of the tube.

[e] Alden Products Co., 9140 North Main Street, Brockton 64, Mass.

[f] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[g] Grid-No.4 voltage must always be greater than grid-No.3 voltage. For minimum "porthole" effect, grid-No.4 voltage should be adjusted to approximately 1.6 times the grid-No.3 voltage value, and the focusing-alignment assembly and deflecting yoke positioned as shown in accompanying diagram.

[h] Beam focus is obtained by the combined effect of grid-No.3 voltage, which should be adjustable over indicated range, and a focusing coil having an average field strength of 46 gauss.

[j] With no blanking voltage on grid No. 1.

[k] Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.2 microampere and a dark current of 0.02 microampere.

[m] The alignment coil should be located on the tube so that its center is at a distance of 6 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

[n] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[p] The target voltage for each 8051 must be adjusted to that value which gives the desired operating dark current.

[q] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

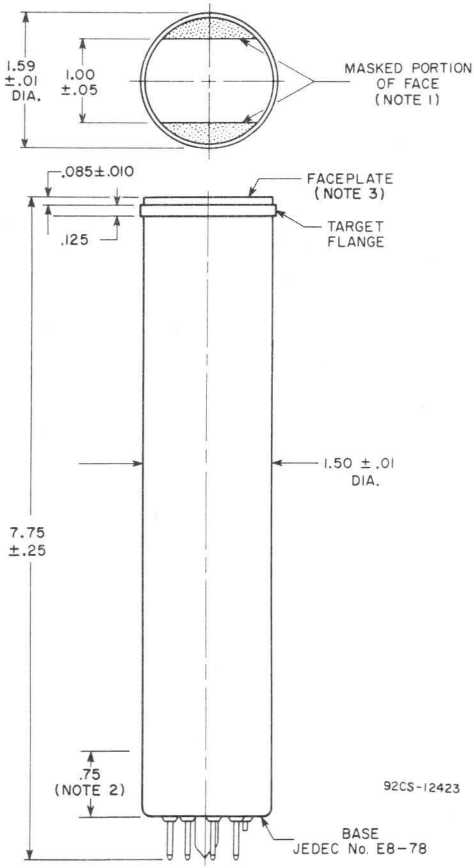
[r] Defined as the component of the highlight target current after the dark-current component has been subtracted.

OPERATING CONSIDERATIONS

The *target connection* is made by a suitable spring contact bearing against the edge of the metal ring at the face end of the tube.

**SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-18 RESPONSE
is shown at front of this section**

DIMENSIONAL OUTLINE



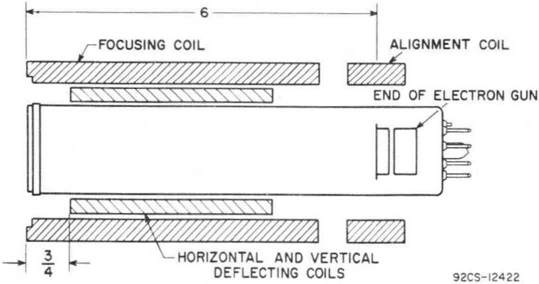
DIMENSIONS IN INCHES

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Within this area the minimum bulb diameter dimension does not apply.

Note 3: Faceplate thickness is 0.135" ± 0.005".

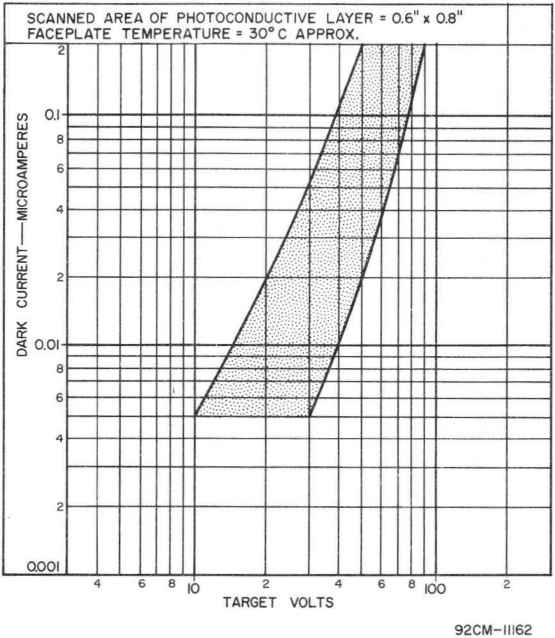
COMPONENT LOCATIONS



92CS-12422

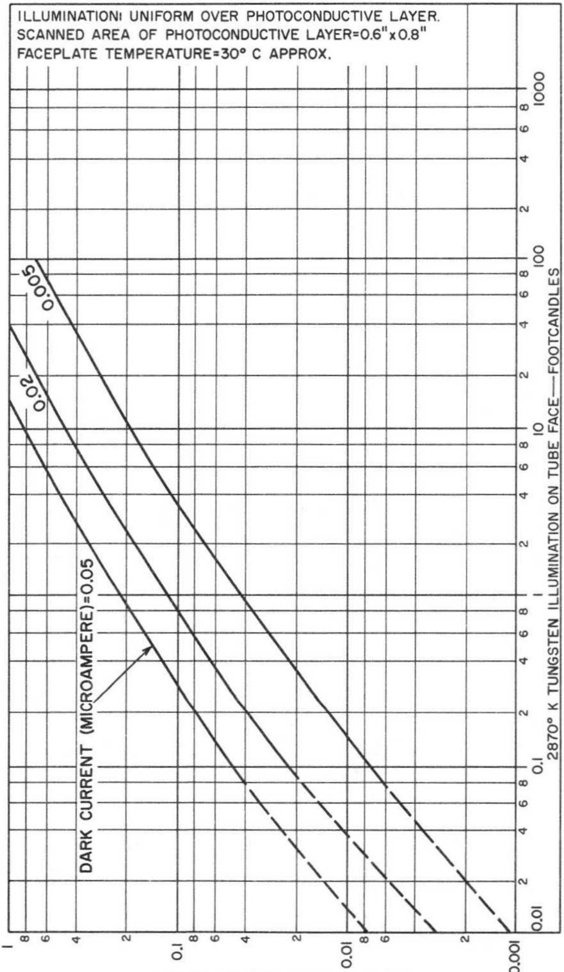
DIMENSIONS IN INCHES

RANGE OF DARK CURRENT



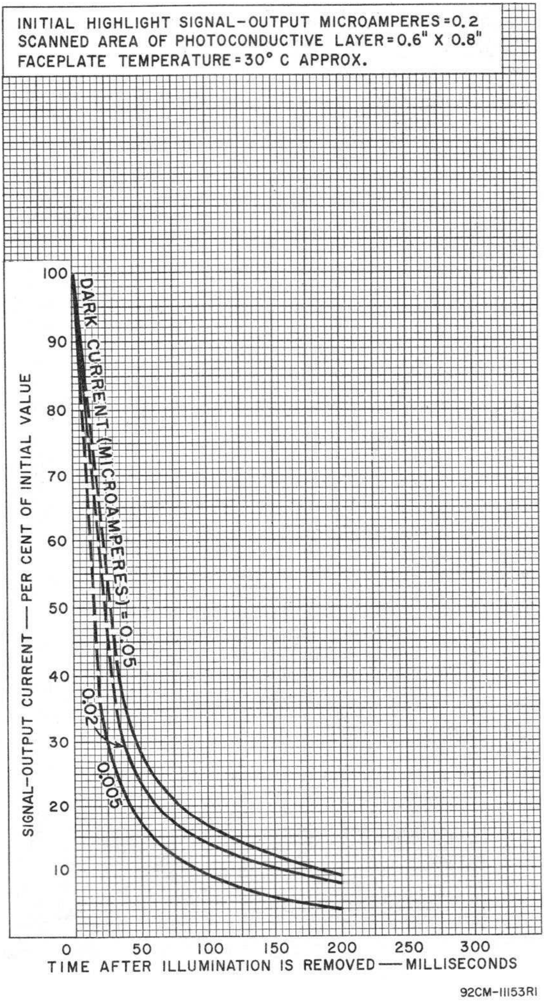
92CM-11162

LIGHT TRANSFER CHARACTERISTICS

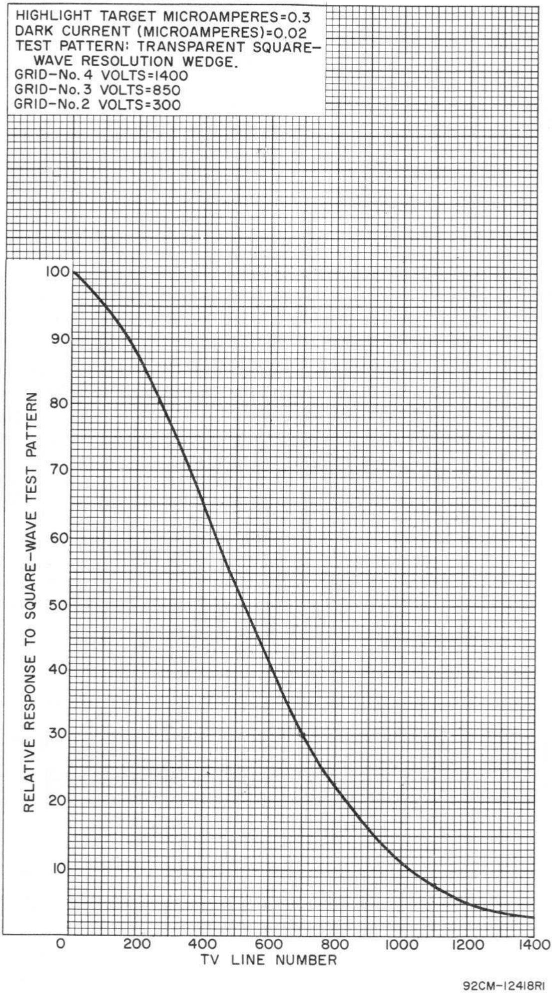


RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

TYPICAL PERSISTENCE CHARACTERISTICS



UNCOMPENSATED HORIZONTAL RESPONSE TO A SQUARE-WAVE TEST PATTERN



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

8053, 8054, 8055

Photomultiplier Tubes

2-INCH DIAMETER—8053
3-INCH DIAMETER—8054
5-INCH DIAMETER—8055

S-11 RESPONSE
10-STAGE, HEAD-ON TYPE

VENETIAN-BLIND
DYNODE STRUCTURE

For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation

GENERAL

Spectral Response	S-11
Wavelength of Maximum Response	4400 ± 500 angstroms
Cathode, Semitransparent	Cesium-Antimony
Shape	Flat, Circular
Minimum area	
8053	2.20 sq. in
8054	5.27 sq. in
8055	15.0 sq. in
Minimum diameter	
8053	1.68 in
8054	2.59 in
8055	4.38 in
Window	Lime glass, 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	Venetian-Blind
Direct Interelectrode Capacitances (Approx.)	
Anode to dynode No.10	7 pF
Anode to all other electrodes	8.5 pF
Maximum Overall Length	
8053	5.81 in
8054	6.31 in
8055	7.69 in
Seated Length	
8053	4.87 ± 0.19 in
8054	5.38 ± 0.18 in
8055	6.75 ± 0.19 in
Maximum Diameter	
8053	2.31 in
8054	3.06 in
8055	5.31 in
Envelope	
8053	T16
8054	J24
8055	J42
Socket	Cinch[b] No.3M14, or equivalent

Magnetic Shield
- 8053 . . . . .JAN[c] No.S-2004, or equivalent
- 8054 . . . . .JAN[c] No.3MI4, or equivalent
- 8055 . . . . .See *footnote*[d]

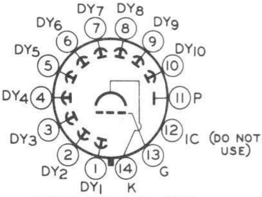
Operating Position . . . . Any

Weight (Approx.)
- 8053 . . . . 7 oz
- 8054 . . . . 9 oz
- 8055 . . . . 1 lb 7 oz

Base . . . . Medium-Shell Diheptal 14-Pin (JEDEC Group 5, No.B14-38)

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



DIRECTION OF LIGHT: INTO END OF BULB

14AA

Unless indicated otherwise, the following ratings and characteristic range values apply to all types

ABSOLUTE-MAXIMUM RATINGS

DC Supply Voltage

Between anode and cathode.	2000	V
Between anode and dynode No.10	300	V
Between consecutive dynodes.	250	V
Between dynode No.1 and cathode.	600	V
Between focusing electrode and cathode	600	V
Average Anode Current[e]	2	mA
Ambient Temperature[f]	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 anode and dynode No.10, except as noted. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

With E = 1500 volts except as noted

	Min	*Typ*	*Max*	
Sensitivity				
Radiant[g], at 4400 angstroms				
8053	-	3.4×10^{4}	-	A/W
8054, 8055	-	3.5×10^{4}	-	A/W
Cathode Radiant[h] at 4400 angstroms				
8053	-	0.056	-	A/W
8054	-	0.064	-	A/W
8055	-	0.088	-	A/W
Luminous:				
With tungsten light source[j]				
8053	9	42	220	A/lm
8054	9	43	220	A/lm
8055	9	44	220	A/lm
With blue light source[k]				
8053	9×10^{-6}	4.2×10^{-5}	2.2×10^{-4}	A
8054	9×10^{-6}	4.3×10^{-5}	2.2×10^{-4}	A
8055	9×10^{-6}	4.4×10^{-5}	2.2×10^{-4}	A
Cathode Luminous:				
With tungsten light source[m]				
8053	-	7×10^{-5}	-	A/lm
8054	-	8×10^{-5}	-	A/lm
8055	-	1.1×10^{-4}	-	A/lm
With blue light source[n]				
8053	6×10^{-8}	7×10^{-8}	-	A
8054	6×10^{-8}	8×10^{-8}	-	A
8055	6×10^{-8}	1.1×10^{-7}	-	A
Cathode Quantum Efficiency at 4400 angstroms:				
8053	-	16	-	%
8054	-	18	-	%
8055	-	25	-	%
Current Amplification				
8053	-	6×10^{5}	-	
8054	-	5.4×10^{5}	-	
8055	-	4×10^{5}	-	
Anode Dark Current[p]	-	4×10^{-9}	7×10^{-9}	A

		Min	Typ	Max	
Equivalent Anode-Dark Current Input.		-	4.4×10^{-10}[q]	7.8×10^{-10}[q]	lm
		-	5.5×10^{-13}[r]	9.7×10^{-13}[r]	W
Equivalent Noise Input . . .		-	3.4×10^{-12}[s]	1×10^{-11}[s]	lm
		-	4.2×10^{-15}[t]	1.3×10^{-14}[t]	W
Pulse-Height Resolution[u,v] .		-	7.5	-	%
Mean Gain Deviation [u,w]					
With count rate change of 10,000 to 1,000 Hz[x]. .		-	1	-	%
For a period of 16 hours at a count rate of 10,000 Hz[y] .		-	1	-	%
Anode-Pulse Rise Time[z]					
8053		-	1.2×10^{-8}	-	s
8054, 8055		-	1.4×10^{-8}	-	s
Electron Transit Time[aa]					
8053		-	5.9×10^{-8}	-	s
8054, 8055		-	6.5×10^{-8}	-	s

[a] Made by Corning Glass Works, Corning, New York. 14830

[b] Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago, Illinois. 60624

[c] Made by JAN Hardware Manufacturing Corp., 38-01, Queens Blvd., Long Island City 1, N. Y.

[d] Magnetic shielding material in the form of foil or tape as available from Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Ave., Chicago 22, Ill., 60622, or equivalent.

[e] Averaged over any interval of 30 seconds maximum.

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

[g] This value is calculated from the typical luminous sensitivity rating using a conversion factor of 804 lumens per watt.

[h] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 804 lumens per watt.

[j] These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.10 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}$$

The value of 0.10 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions, but with the blue filter removed.

[k] 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) from a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2870° K. The value of light flux incident on the filter is 10 microlumens.

[m] This value is calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.10 \times \text{Light Flux of 0.01 (lm)}}$$

The value of 0.10 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (n) to the cathode current measured under the same conditions but with the blue filter removed.

[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) from a tungsten-filament lamp having a lime-glass envelope. The lamp is 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. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a lime-glass envelope, tungsten-filament lamp operating at 2870° K. The light flux incident on the filter is 10 microlumens. The supply voltage E is adjusted to obtain an anode current of 9 microamperes. Sensitivity of these types under these conditions is approximately equivalent to 9 amperes per lumen. Dark current is measured with no light incident on the tube.

q With supply voltage E adjusted to give an equivalent luminous sensitivity of 9 amperes per lumen.

r At 4400 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 804 lumens per watt.

s This value is calculated from the ENI value in watts using a conversion factor of 804 lumens per watt.

t At 4400 angstroms. Under the following conditions: Supply voltage (E) is as shown, 22° C tube temperature, external shield is connected to cathode, bandwidth 1 Hz, light source as shown under (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.

u With the following voltage distribution: 3/13 of E between cathode and dynode No.1, 1/13 of E for each succeeding dynode stage, and 1/13 of E between dynode No.10 and anode. Focusing-electrode voltage is adjusted to that value between 50 and 100 per cent of dynode-No.1 potential (referred to cathode) which provides maximum anode current.

v Pulse height resolution is defined as the quotient of the full width of the photopeak at half height by the pulse height at maximum count rate under the following conditions: The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 3 inch x 3 inch thallium-activated sodium-iodide scintillator [NaI (TI) - type 12D12] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97 Street, Cleveland 6, Ohio, and is rated by the manufacturer as having a resolution capability of 7.5%. The Cs^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the types by a coupling fluid such as Dow Corning Corp., Type DC200 (viscosity of 60,000 centistokes) — manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

w Mean Gain Deviation is defined as follows:

$$MGD = \frac{\sum_{i=1}^{i=n} \left| \bar{p} - p_i \right|}{n} \cdot \frac{100}{\bar{p}}$$

where $\bar{p}$ = mean pulse height
p_i = pulse height at the "i^{th}" reading
n = total number of readings

x Under the following conditions: The scintillator and Cs^{137} radiation source of (v) are employed. The radiation source is initially centered on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 10,000 Hz. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 1,000 Hz. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. Mean gain deviation is defined as shown in (w).

y Under the same conditions as shown in (x) except the tube is operated for a period of 1/2 hour with the radiation source located at the point providing a pulse count rate of 10,000 Hz. Following this time interval, the pulse height is sampled at this count rate at 1-hour intervals for a period of 16 hours. Mean gain deviation is defined as shown in (w).

z 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.

aa 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 CONSIDERATIONS

The *base pins* of these types fit a diheptal 14-contact socket, such as Cinch No. 3M14, or equivalent. The socket should be made of high-grade, low-leakage material, and should be installed so that incident light falls on the face end of the tube.

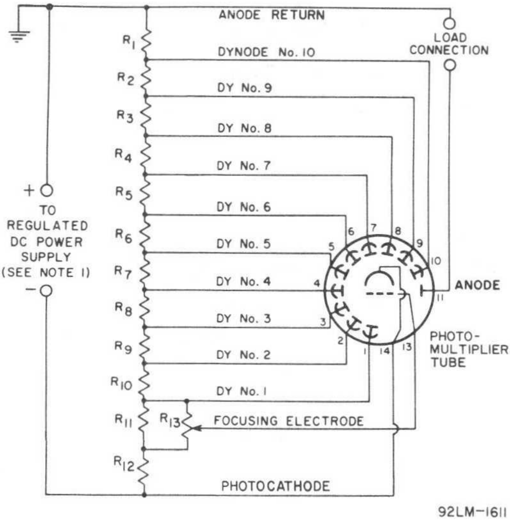
The *operating stability* of these types are dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 2 milliamperes is recommended when stability of operation is important. When stability is of prime importance, the use of an average anode current of 10 microamperes or less, commensurate with satisfactory output signal, is recommended.

Electrostatic and magnetic shielding of these types may be required in some applications. When a shield is used, it must be at cathode potential.

The *high voltages* at which these types are operated are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

Accompanying Typical Voltage-Divider Arrangements are recommended for use with these types. Recommended resistance values for the voltage dividers range from 10,000 ohms per stage to 1,000,000 ohms per stage. The choice of resistance values for any voltage-divider network is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the regulated power supply and the required power rating of the resistors increase. Phototube noise may also increase due to heating if the divider network is mounted near the photocathode. The use of resistance values near 1 megohm per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 10 times that of the maximum value of anode current, and may limit anode-current response to pulsed light. The latter effect may be reduced by connecting capacitors between the tube socket terminals for dynodes No. 7 and No. 8, dynodes No. 8 and No. 9, dynodes No. 9 and No. 10, and between dynode No. 10 and anode return. In addition to nonlinearity and pulse-limiting effects, the use of resistance values exceeding 1 megohm per stage make these types more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
FOR GENERAL PHOTOMETRIC APPLICATIONS
8053 8054 8055



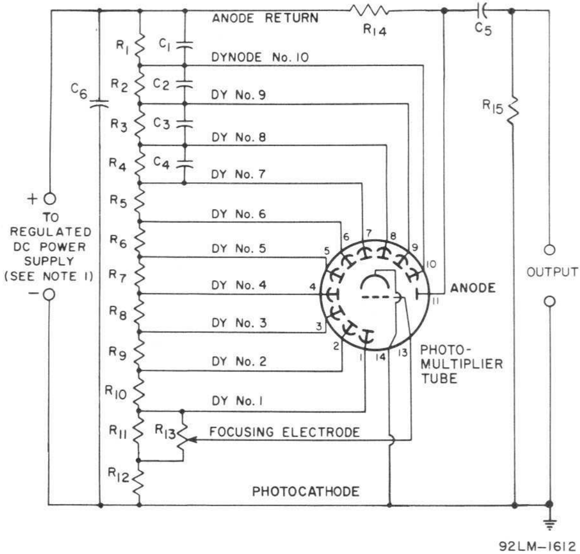
R_1 through R_{12}: 470,000 ohms, 1/2 watt

R_{13}: 5 megohms, 1/2 watt, adjustable

Note 1: Supply voltage should be adjustable between approximately 800 and 2000 volts dc.

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

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
FOR SCINTILLATION-COUNTING APPLICATIONS
8053 8054 8055



C_1: 0.05 μF, 500 volts (dc working)
C_2: 0.02 μF, 500 volts (dc working)
C_3: 0.01 μF, 500 volts (dc working)
C_4: 0.005 μF, 500 volts (dc working)
C_5 and C_6: 0.005 μF, 3000 volts (dc working)
R_1 through R_{10}: 470,000 ohms, 1/2 watt
R_{11} and R_{12}: 750,000 ohms, 1/2 watt
R_{13}: 5 megohms, 1/2 watt, adjustable
R_{14}: 1 megohm, 1/2 watt
R_{15}: 100,000 ohms, 1/2 watt

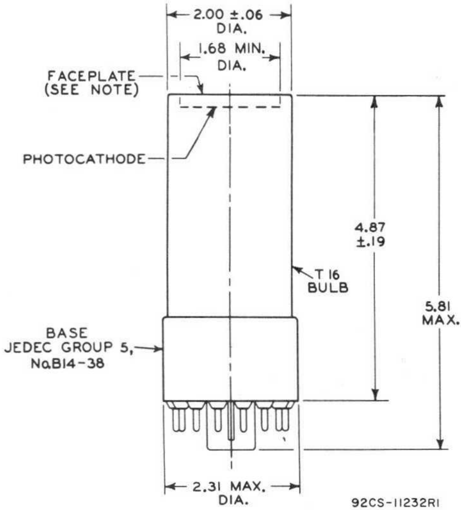
Note 1: Supply voltage should be adjustable between approximately 800 and 2000 volts dc.

Note 2: Capacitors C_1 through C_5 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.

DIMENSIONAL OUTLINE

8053

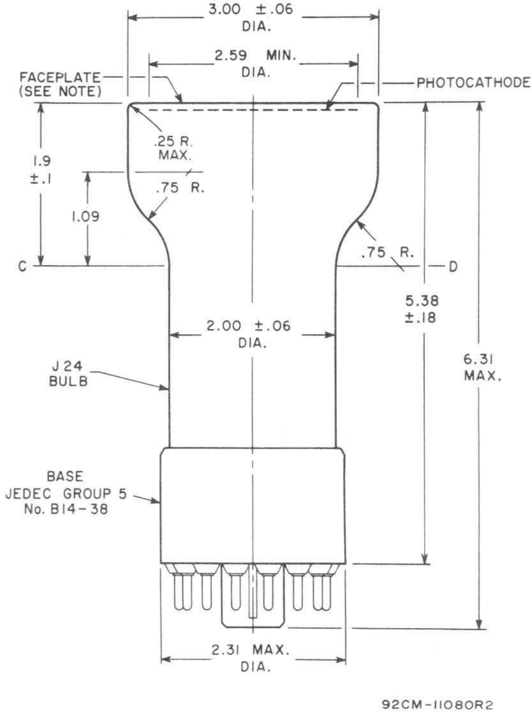


DIMENSIONS IN INCHES

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

Note: Within 2.59-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010-inch from peak to valley.

DIMENSIONAL OUTLINE
8054



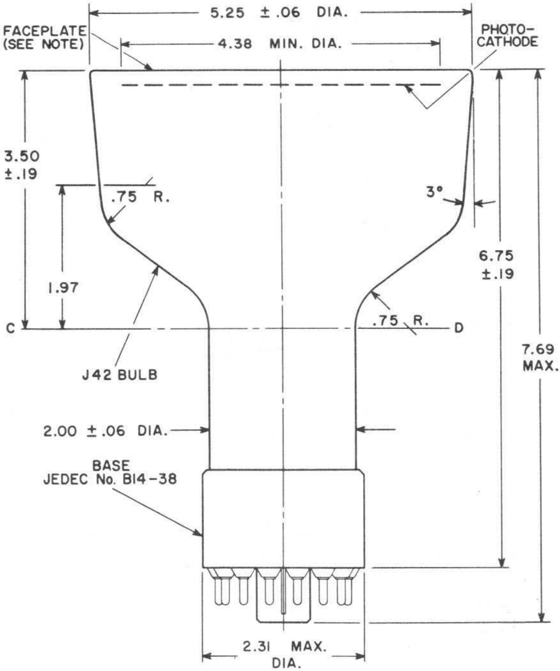
DIMENSIONS IN INCHES

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

Note: Within 2.59-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

DIMENSIONAL OUTLINE

8055



92CM-11148R2

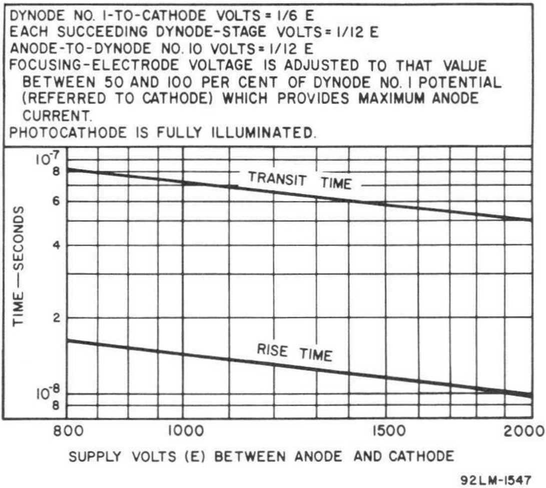
DIMENSIONS IN INCHES

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

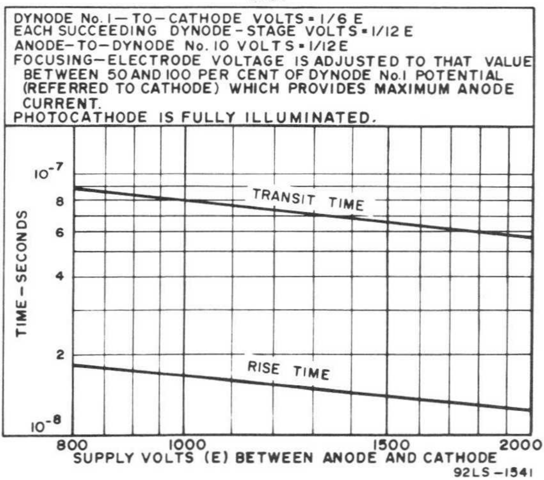
Note: Within 4.38-inch diameter, deviation from flatness of external surface of faceplate will not exceed 0.010 inch from peak to valley.

Typical Time Resolution Characteristics

8053



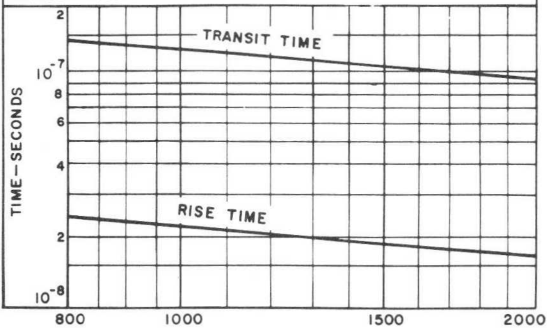
8054



Typical Time Resolution Characteristics

8055

DYNODE NO.1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE NO.10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS FULLY ILLUMINATED.

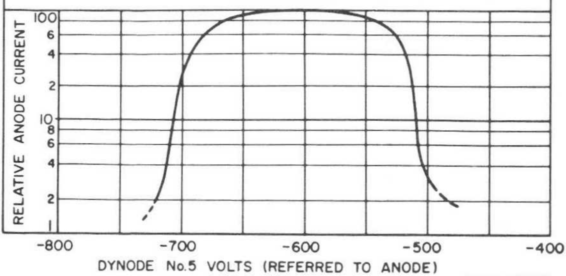


92LS-1546

Typical Characteristic of Output Current As a Function of Dynode-No.5 Volts

8053 8054 8055

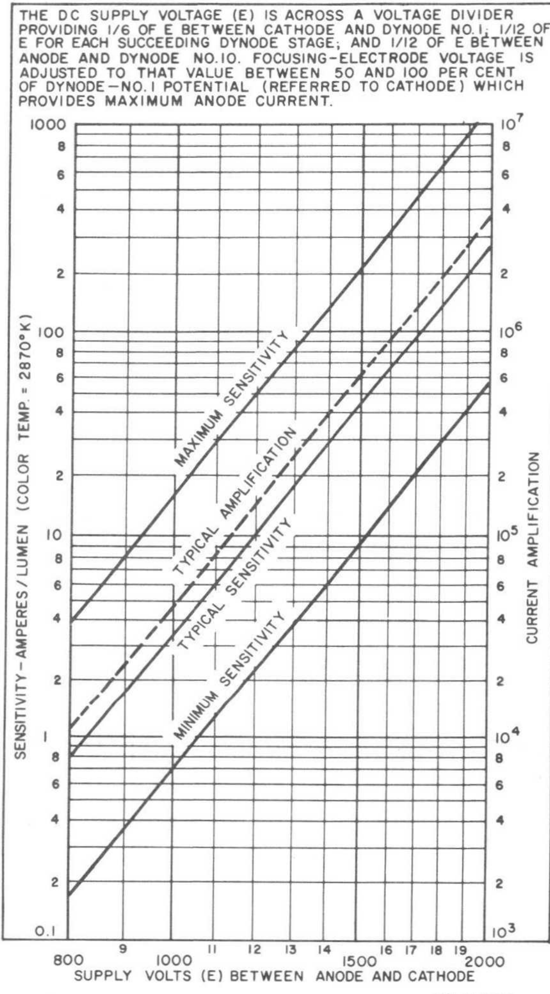
DYNODE No.1-TO-CATHODE VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE-No.5 STAGE = 100
ANODE-TO-DYNODE No.10 VOLTS = 100
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
ANODE IS AT GROUND POTENTIAL.



92CS-11078R1

Typical Sensitivity and Current Amplification Characteristics

8053

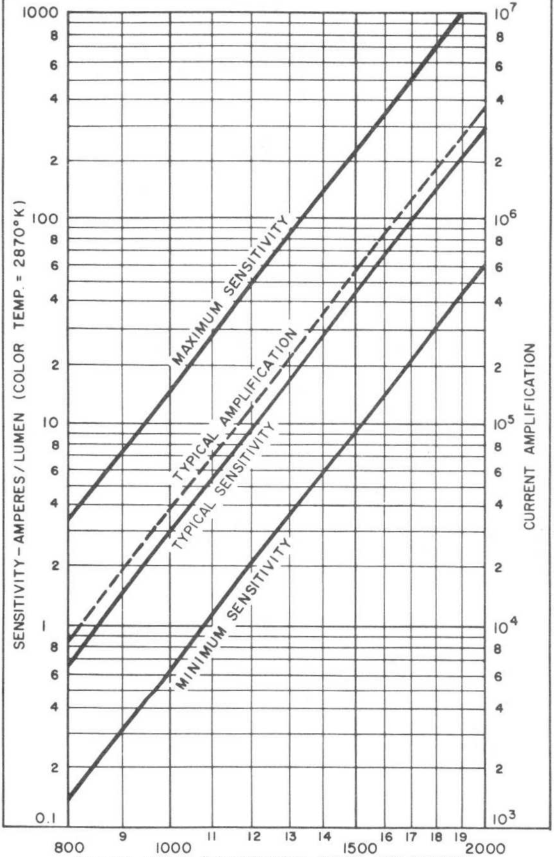


RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

Typical Sensitivity and Current Amplification Characteristics

8054

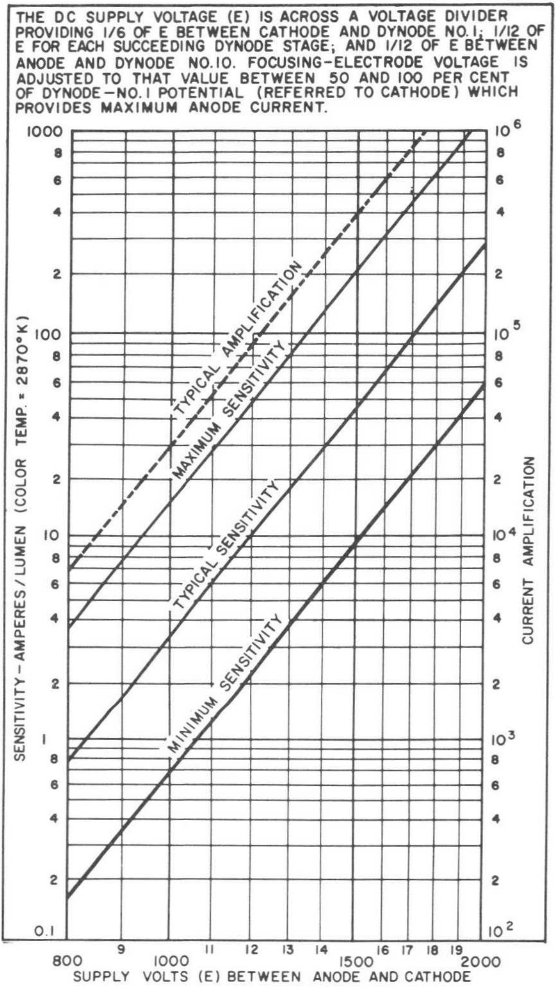
THE DC SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE NO. 1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN ANODE AND DYNODE NO. 10. FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.



92LM-1543

Typical Sensitivity and Current Amplification Characteristics

8055



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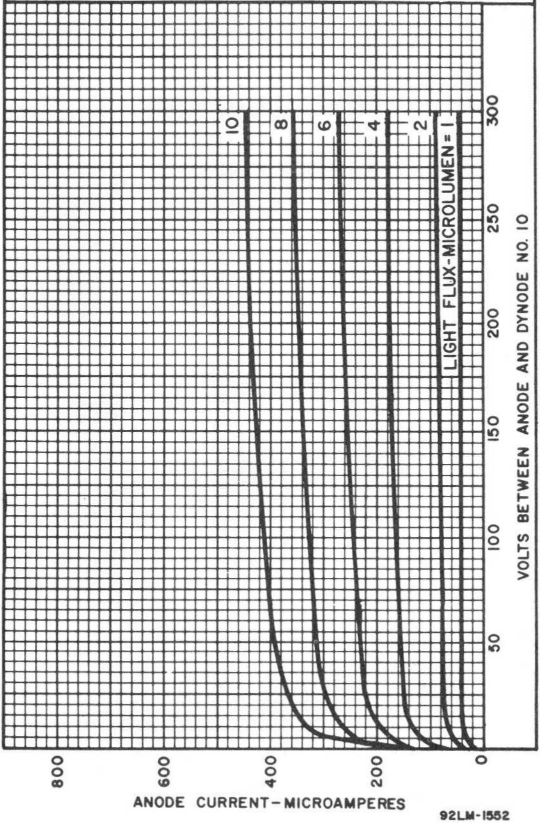
Typical Anode Characteristics

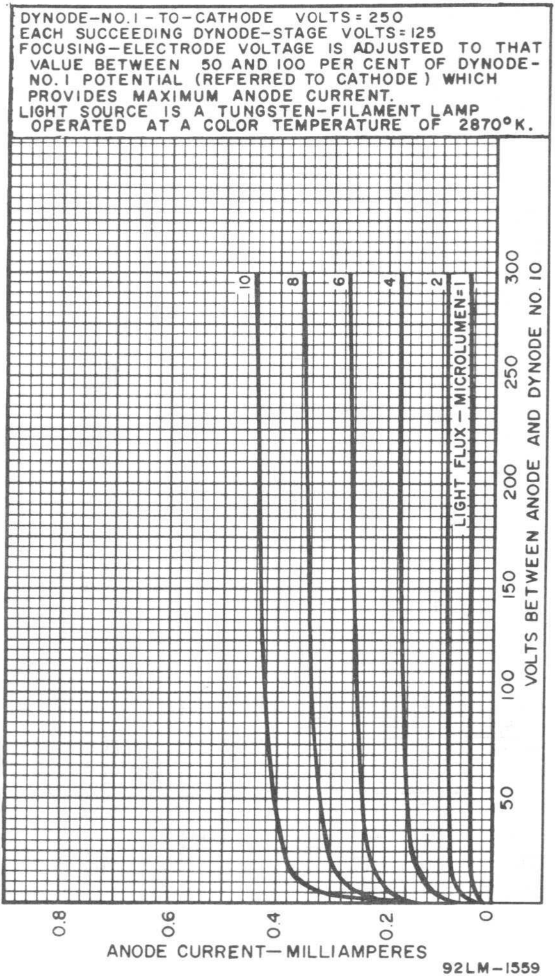
8053

DYNODE NO. I-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE—STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.



Typical Anode Characteristics

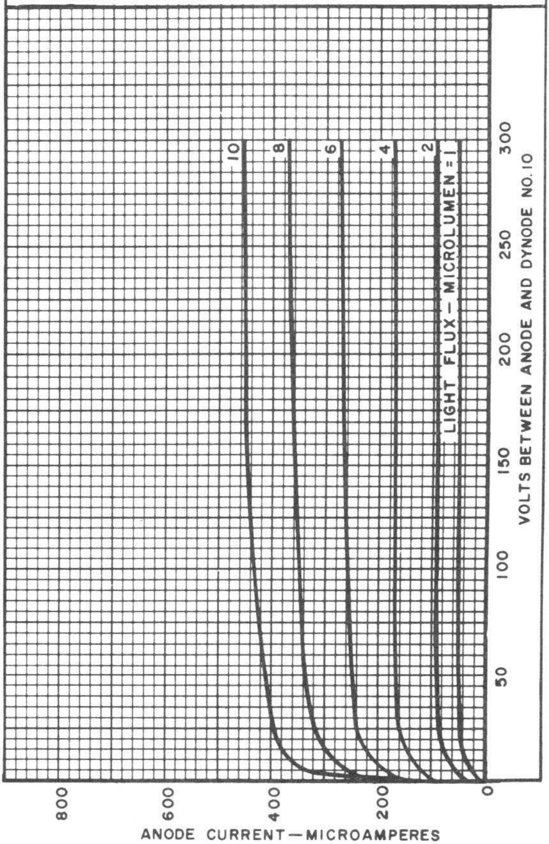
8054



Typical Anode Characteristics

8055

DYNODE NO. 1—TO—CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE—STAGE VOLTS = 125
FOCUSING—ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 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

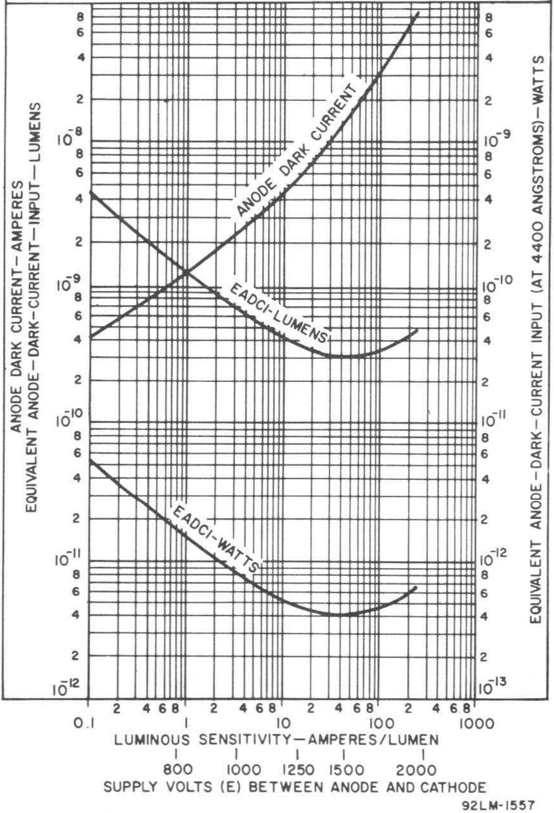


92LM-1551

Typical Dark Current and EADCI Characteristics

8053 8054 8055

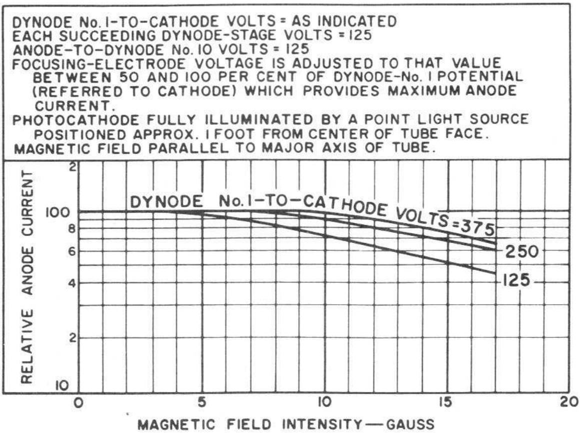
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE NO. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE-NO. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. 1 POTENTIAL (REFERRED 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-1557

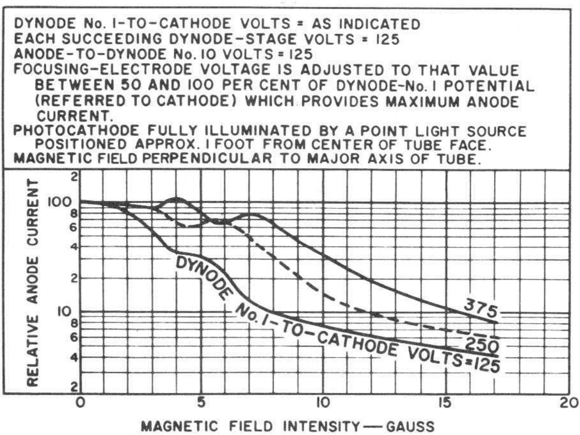
Typical Effect of Magnetic Field on Anode Current

8053



92CS-11235R2

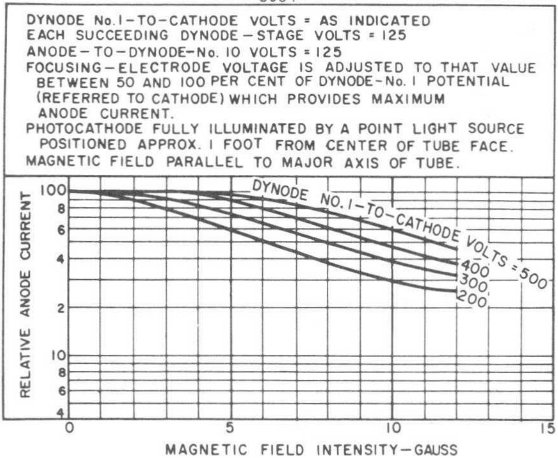
8053



92CS-11236R2

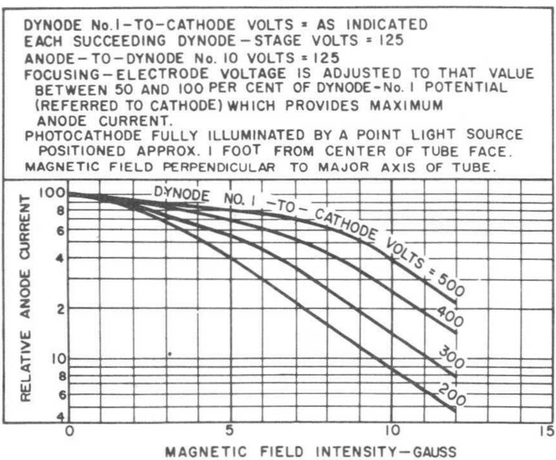
Typical Effect of Magnetic Field on Anode Current

8054



92CM-11084R3

8054



92CM-11085R3

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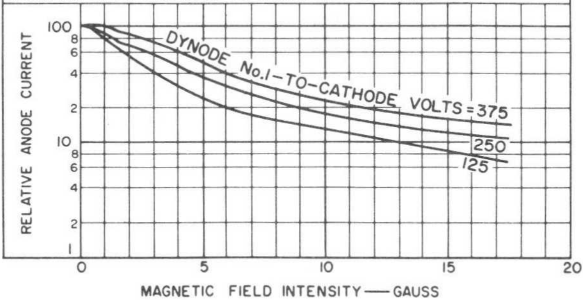
Typical Effect of Magnetic Field on Anode Current

8055

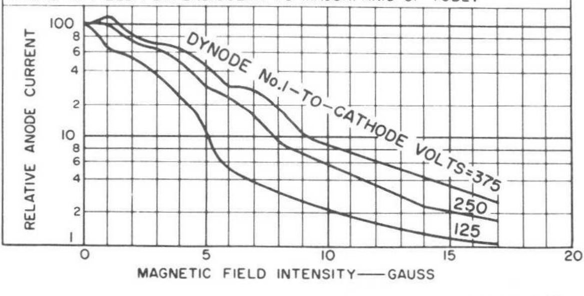
DYNODE No.1–TO–CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE–STAGE VOLTS = 125
ANODE–TO–DYNODE–No.10 VOLTS = 125
FOCUSING–ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE–No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE POSITIONED APPROX. 1 FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE.



92CS-11187R2

8055

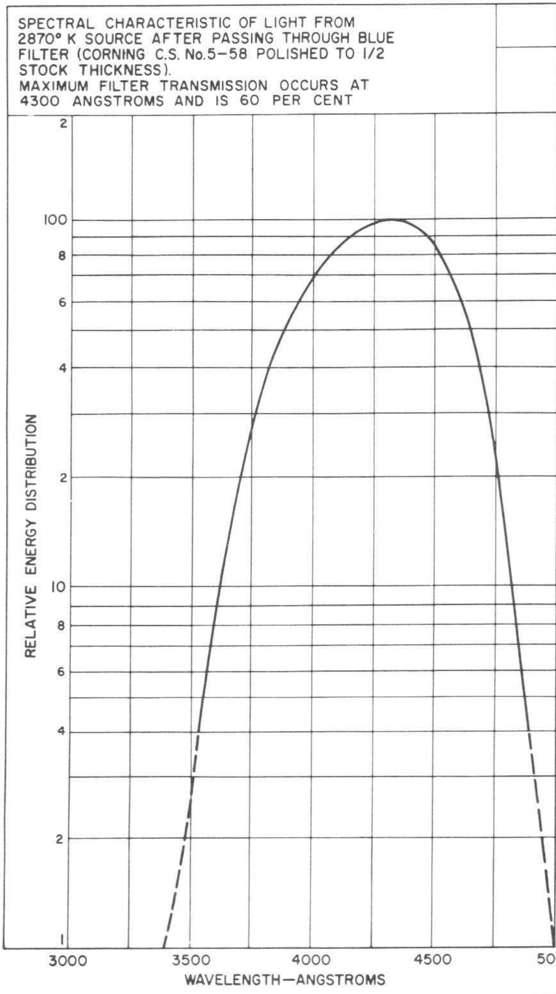
DYNODE No.1–TO–CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE–STAGE VOLTS = 125
ANODE–TO–DYNODE–No.10 VOLTS = 125
FOCUSING–ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE–No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY ILLUMINATED BY A POINT LIGHT SOURCE POSITIONED APPROX. 1 FOOT FROM CENTER OF TUBE FACE.
MAGNETIC FIELD PERPENDICULAR TO MAJOR AXIS OF TUBE.



92CS-11188R2

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

8053 8054 8055

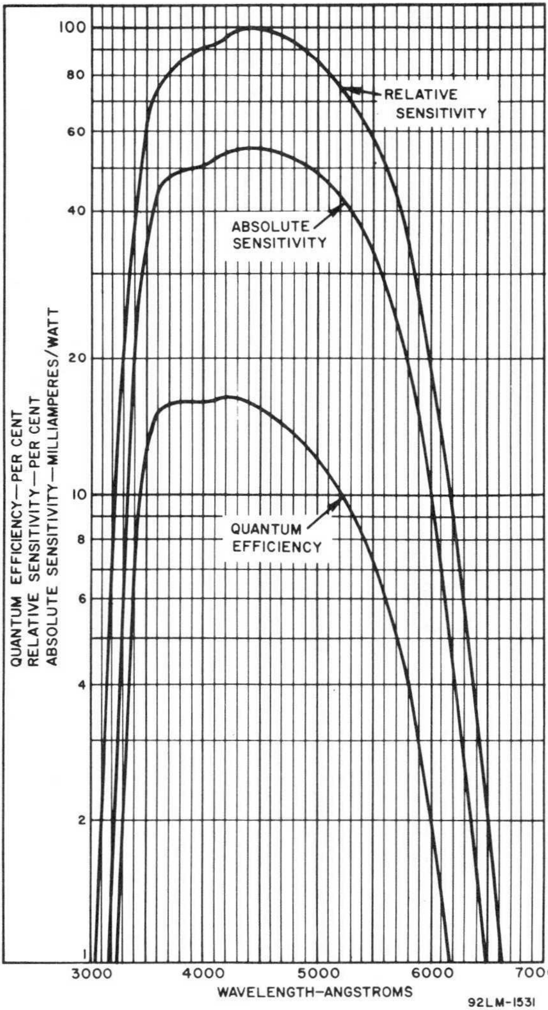


92CM—11081R1

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

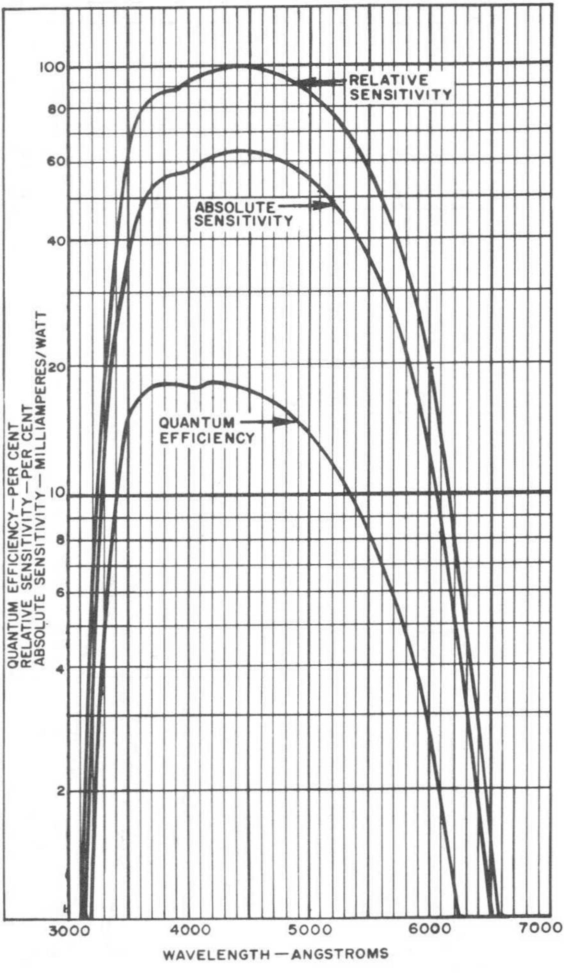
Typical Spectral Response Characteristics

8053



Typical Spectral Response Characteristics

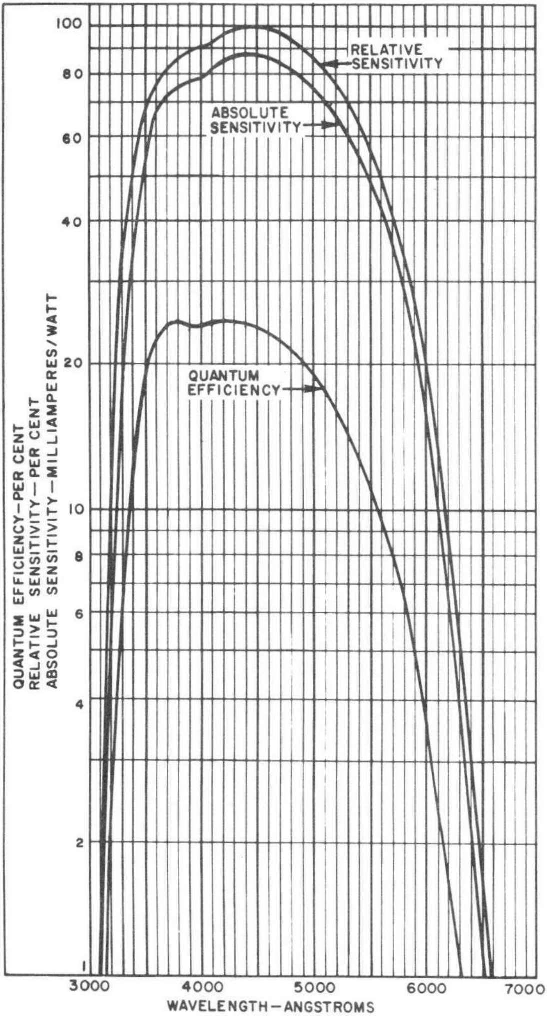
8054



92LS-1542

Typical Spectral Response Characteristics

8055



92LM-1544

Image Orthicon

FIELD MESH	MAGNETIC FOCUS
SEMICONDUCTIVE TARGET	MAGNETIC DEFLECTION

For Low-Light-Level Studio and Remote Color (Scene illumination—40 fc or less) and Black-and-White (Scene illumination—as low as 1 fc) TV Pickup Service

DATA

General:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	0.6	amp
Direct Interelectrode Capacitance:		
Anode to all other electrodes	12	pf
Spectral Response		S-10
Wavelength of Maximum Response	4500 ± 300	angstroms
Photocathode, Semitransparent:		
Rectangular image (4 x 3 aspect ratio):		
Useful size of	1.8" max.	diagonal

Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.

Orientation of. . Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base.

Focusing Method . . . . Magnetic
Deflection Method . . . . Magnetic
Overall Length . . . . 15.20" ± 0.25"
Greatest Diameter of Bulb . . . . 3.00" ± 0.06"
Minimum Deflecting-Coil Inside Diameter . . . . 2-3/8"
Deflecting Coil . . . . Cleveland Electronics, Part No.OY-1[a], or equivalent
Deflecting Coil Length . . . . 5"
Focusing Coil . . . . Cleveland Electronics, Part No.OF-2[a], or equivalent
Focusing Coil Length. 10"
Alignment Coil. . . . . Cleveland Electronics, Part No.OA-3[a], or equivalent
Alignment-Coil Length . . . . 15/16"
Photocathode Distance Inside End of Focusing Coil . . . 1/2"
Operating Position. . . The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.
Weight (Approx.) 1lb 6oz
Socket. . . . . Cinch Part No.3M14[b], or equivalent

8092A

Shoulder Base. . . . . .Keyed Jumbo Annular 7-Pin

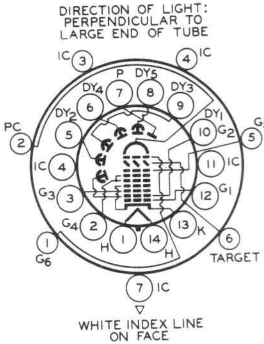
BOTTOM VIEW

Pin 1 – Grid No.6
Pin 2 – Photocathode
Pin 3 – Do Not Use
Pin 4 – Do Not Use
Pin 5 – Grid No.5
Pin 6 – Target
Pin 7 – Do Not Use

End Base . . . . .Small-Shell Diheptal 14-Pin (JEDEC No.B14-45)

BOTTOM VIEW

Pin 1 – Heater
Pin 2 – Grid No.4 & Field Mesh
Pin 3 – Grid No.3
Pin 4 – Do Not Use
Pin 5 – Dynode No.2
Pin 6 – Dynode No.4
Pin 7 – Anode
Pin 8 – Dynode No.5
Pin 9 – Dynode No.3
Pin 10 – Dynode No.1, Grid No.2
Pin 11 – Do Not Use
Pin 12 – Grid No.1
Pin 13 – Cathode & Suppressor[c]
Pin 14 – Heater



Maximum and Minimum Ratings, *Absolute-Maximum Values:*

PHOTOCATHODE:			
Voltage	–550	max.	volts
Illumination.	50	max.	fc
OPERATING TEMPERATURE:			
Of any part of bulb	55	max.	°C
Of bulb at large end of tube (Target section).	0	min.	°C
TEMPERATURE DIFFERENCE:			
Between target section and any part of bulb hotter than target section.	5	max.	°C
GRID-No.6 VOLTAGE	–550	max.	volts
TARGET VOLTAGE:			
Positive value.	10	max.	volts
Negative value.	10	max.	volts
GRID-No.5 VOLTAGE	150	max.	volts
GRID-No.4 VOLTAGE	300	max.	volts
GRID-No.3 VOLTAGE	400	max.	volts
GRID-No.2 & DYNODE No.1 VOLTAGE.	350	max.	volts
GRID-No.1 VOLTAGE:			
Negative bias value	125	max.	volts
Positive bias value	0	max.	volts
VOLTAGE PER MULTIPLIER STAGE.	350	max.	volts
ANODE-SUPPLY VOLTAGE[d]	1350	max.	volts

PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	125	max.	volts
Heater positive with respect to cathode	10	max.	volts

Typical Operating Values:[e]

Photocathode Voltage (Image Focus)[f]	-400 to -540	volts
Grid-No.6 Voltage (Accelerator) - Approx. 75% photocathode voltage	-300 to -405	volts
Target-Cutoff Voltage[g]	-3 to 1	volts
Grid-No.5 Voltage (Decelerator)	0 to 125	volts
Grid-No.4 Voltage (Beam Focus)[f]	140 to 180	volts
Grid-No.3 Voltage[h]	225 to 330	volts
Grid-No.2 & Dynode-No.1 Voltage	300	volts
Grid-No.1 Voltage for Picture Cutoff	-45 to -115	volts
Dynode-No.2 Voltage	600	volts
Dynode-No.3 Voltage	800	volts
Dynode-No.4 Voltage	1000	volts
Dynode-No.5 Voltage	1200	volts
Anode Voltage	1250	volts
Minimum Peak-to-Peak Blanking Voltage	5	volts
Field Strength at Center of Focusing Coil[j]	75	gausses
Field Strength of Alignment Coil	0 to 3	gausses

Performance Data:

With conditions shown under Typical Operating Values and with camera lens set to bring the picture highlights one stop above the "knee" of the accompanying Basic Light-Transfer-Characteristic Curve

	Min.	*Typical*	*Max.*	
Cathode Radiant Sensitivity at 4500 angstroms	-	0.033	-	a/w
Luminous Sensitivity	40	65		μa/lm
Anode Current (DC)	-	30	-	μa
Signal-Output Current (Peak to Peak)	-	5	-	μa
Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current for Bandwidth of 4.5 Mc	-	37:1	-	
Photocathode Illumination at 2870° K Required to bring Picture Highlights one stop above the "Knee" of Light Transfer Characteristic	-	0.007	-	fc

Peak-to-Peak Response to Square-Wave Test Pattern at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[k].	–	65	–	%

[a] Made by Cleveland Electronics Inc., 1974 East 61st Street, Cleveland, Ohio,

[b] Made by Cinch Manufacturing Company, 1026 South Homan Avenue, Chicago 24, Illinois.

[c] The suppressor grid connected to the cathode and the field-mesh grid connected to grid No. 4 are not given as numbered grids in order to conform with industry practice of associating functional camera control knobs with specific grid numbers. For example, beam-focus control is generally associated with knob identified as G4 (grid No. 4), regardless of its position with respect to the cathode.

[d] Dynode-voltage values are shown under *Typical Operating Values*.

[e] With 8092A operated in RCA-TK-11 or -TK-31 camera. Other cameras may require slightly different voltage ranges.

[f] Adjust for best focus.

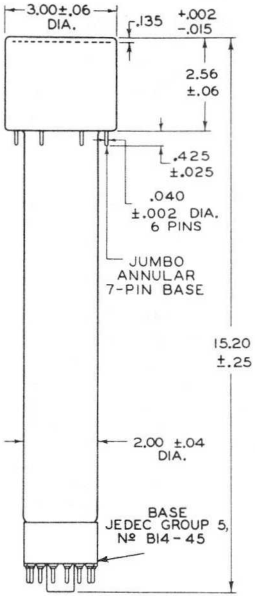
[g] Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 to 5 volts.

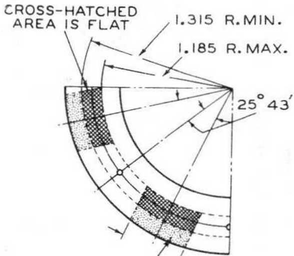
[h] Adjust to give the most uniformly shaded picture near maximum signal.

[j] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with indicator located outside of and at the image end of the focusing coil.

[k] Measured with amplifier having flat frequency response.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-10 RESPONSE is shown at front of this Section





NOTE 1: DOTTED AREA IS FLAT OR EXTENDS TOWARD DIHEPTAL-BASE END OF TUBE BY 0.060" MAX.

ANNULAR BASE GAUGE

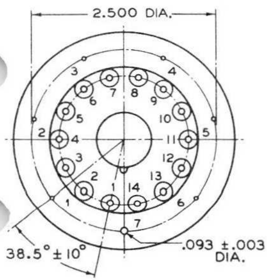
ANGULAR VARIATIONS BETWEEN PINS AS WELL AS ECCENTRICITY OF NECK CYLINDER WITH RESPECT TO PHOTOCATHODE CYLINDER ARE HELD TO TOLERANCES SUCH THAT PINS AND NECK CYLINDER WILL FIT FLAT-PLATE GAUGE WITH:

a. SIX HOLES HAVING DIAMETER OF 0.065" ± 0.001" AND ONE HOLE HAVING DIAMETER OF 0.150" ± 0.001". ALL HOLES HAVE DEPTH OF 0.265" ± 0.001". THE SIX 0.065" HOLES ARE ENLARGED BY 45° TAPER TO DEPTH OF 0.047". ALL HOLES ARE SPACED AT ANGLES OF 51° 26′ ± 5′ ON CIRCLE DIAMETER OF 2.500" ± 0.001".

b. SEVEN STOPS HAVING HEIGHT OF 0.187" ± 0.001", CENTERED BETWEEN PIN HOLES, TO BEAR AGAINST FLAT AREAS OF BASE.

c. RIM EXTENDING OUT A MINIMUM OF 0.125" FROM 2.812" DIAMETER AND HAVING HEIGHT OF 0.126" ± 0.001".

d. NECK-CYLINDER CLEARANCE HOLE HAVING DIAMETER OF 2.200" ± 0.001".

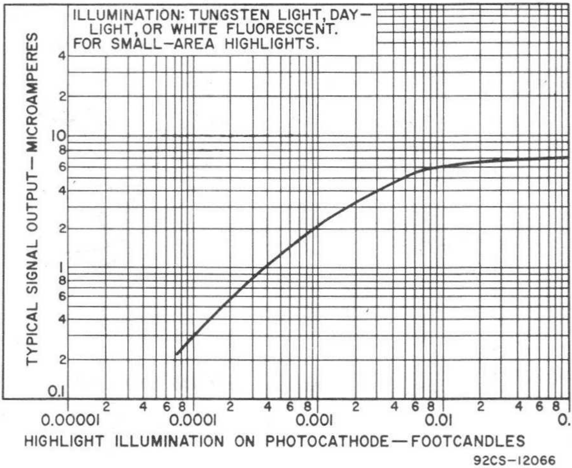


ENLARGED BOTTOM VIEW

DIMENSIONS IN INCHES

92CM-10154R2

BASIC LIGHT-TRANSFER CHARACTERISTIC



Vidicon

For Color Television Film Pickup Service

- Electrostatic-Focus, Magnetic-Deflection
- Low-Power "Dark Heater" – 0.6 Watt
- Separate Mesh Connection
- Precision Outer-Diameter Glass Bulb
- Tested to Stringent Signal Uniformity Specifications

General Data

Dimensions	See Dimensional Outline	
Direct Interelectrode Capacitance[a]:		
Target to all other electrodes	5	pF
Focusing Method	Electrostatic	
Deflection Method	Magnetic	
Heater Power	0.6	W
Maximum Useful Picture Size	0.375 x 0.5 (12.70 x 9.52 mm)	in

Orientation of Quality Rectangle:
Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tubes and short axis index pin.

Base	Small-Button Ditetrar 8-Pin (JEDEC No. E8-11)	
Socket	Cinch[b] No. 133-98-11-015, or equivalent	
Weight	2.8 (79.5 g)	oz
Operating Position	Any	
Deflection Alignment Assembly[c]	Cleveland Electronics No. VYA-300, or equivalent	

Maximum Ratings, Absolute-Maximum Values:[d]

Grid-No.6 & 3 Voltage[e]	1350	V
Grid-No.5 Voltage	1000	V
Grid-No.4 Voltage	400	V
Grid-No.2 Voltage[f]	850	V
Grid-No.1 Voltage:		
Negative bias value	300	V
Positive bias value	0	V
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125	V
Heater positive with respect to cathode	10	V
Heater Voltage	6.3 ± 5%	V
Target Voltage	125	V
Target Dark Current	0.20	μA
Peak Target Current[g]	0.60	μA
Faceplate:		
Illumination[h]	5000	fc
Temperature	71	°C

Typical Operation and Performance Data

Grid-No.6 (Decelerator) & 3 Voltage[e]	750	V
Grid-No.5 Voltage[e]	325 to 450	V
Grid-No.4 (Beam-Focus Electrode) Voltage	90 to 150	V
Grid-No.2 (Accelerator) Voltage[f]	300	V
Grid-No.1 Voltage (For Picture Cutoff)[i]	−45 to −100	V
Signal-To-Noise Ratio (Approximate)[m]	300:1	
Typical Resolution:		
Center	700	TV Lines

Limiting Resolution:		
Center horizontal	500 (min.)	TV Lines
Center vertical	400 (min.)	TV Lines
Amplitude Response to 400 TV Line Square-Wave Test Pattern at Center of Picture[t] ...	30	%
Average "Gamma" of Transfer Characteristic	0.65	
Lag-Per Cent of Initial Value of Signal-Output Current 1/20 Second after Illumination is Removed[n]	20	%

Typical Sensitivity

Faceplate Illumination	4	fc
Target Voltage[p,q]	15 to 30	V
Dark Current[q,r]	0.010	μA
Signal Output Current (Typical)[s]	0.30	μA

Notes

a This capacitance, which effectively is the output impedance of the vidicon, is increased when the tube is mounted in the deflecting-yoke assembly. The resistive component of the output impedance is in order of 100 megohms.

b Made by Alden Products Co., 9140 North Main St., Brockton 64, Massachusetts.

b' Made by Cinch Manufacturing Co., 1026 S. Homan Ave., Chicago 24, Illinois.

c Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

e Grid-No.6 & 3 voltage must always be greater than grid-No.5 voltage. The maximum voltage difference between these electrodes, however, should not exceed 800 volts. The recommended ratio of grid-No.5 to grid-No.6 & 3 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

f The power dissipation at grid No.2 should not exceed one watt, a condition normally met when the tube is operated at the specified maximum grid-No.2 rating and when the specified peak target current rating is not exceeded. However, if the vidicon is operated continuously with grid-No.1 voltage near or approaching zero bias, grid-No.2 voltage should not exceed 350 volts dc maximum.

g Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

h For condition where "white light" is uniformly diffused over entire tube face.

i With no blanking voltage on grid No.1.

m Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

n For initial signal-output current of 0.2 microampere and a dark current of 0.02 microampere.

p Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

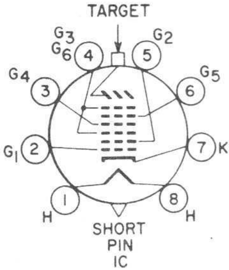
q The target voltage for each vidicon must be adjusted to that value which gives the desired operating dark current.

r The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

s Defined as the component of the highlight target current after the dark-current component has been subtracted.

t This typical capability may be limited by conditions external to the tube such as test pattern material, optics and/or yoke.

Basing Diagram (Bottom View)

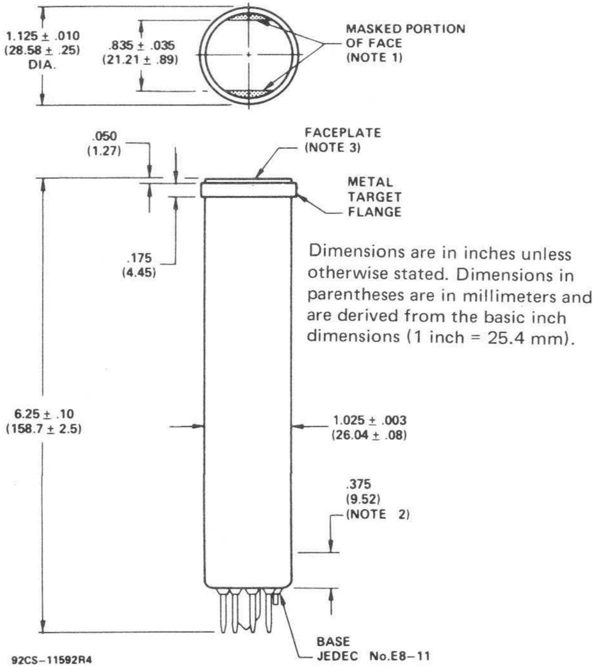


DIRECTION OF LIGHT:
INTO FACE END OF TUBE

8LN

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Grids No.3
& No.6
Pin 5: Grid No.2
Pin 6: Grid No.5
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin:
Internal Connection —
Make No Connection

Dimensional Outline

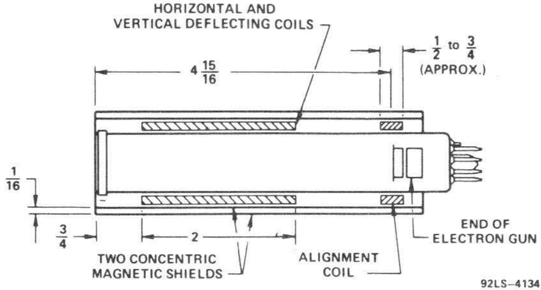


Note 1 – Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2 – Within this distance, diameter of bulb is 1.025" + 0.003" – 0.030". Tube is acceptable regarding camber when it can be inserted into a 1"-long cylinder gauge which has an inner diameter of 1.0280" + 0.0011" – 0.0000". The gauge must pass along the tube length from the base to the metal target flange.

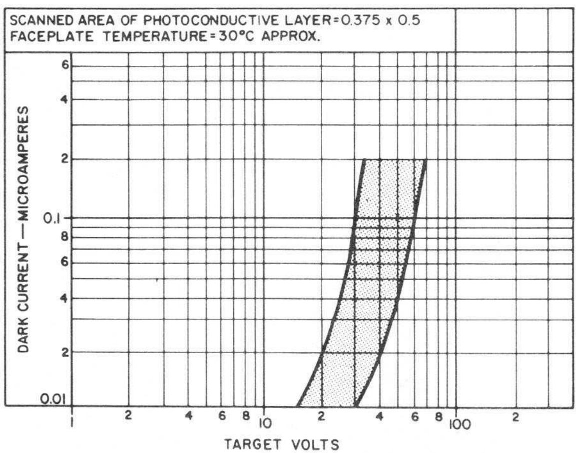
Note 3 – Faceplate is Corning No.7056 glass having a thickness of 0.094" ± 0.012".

Recommended Location of Deflecting Yoke and Alignment Coil to Obtain Optimum Geometry and Optimum Output Signal Uniformity



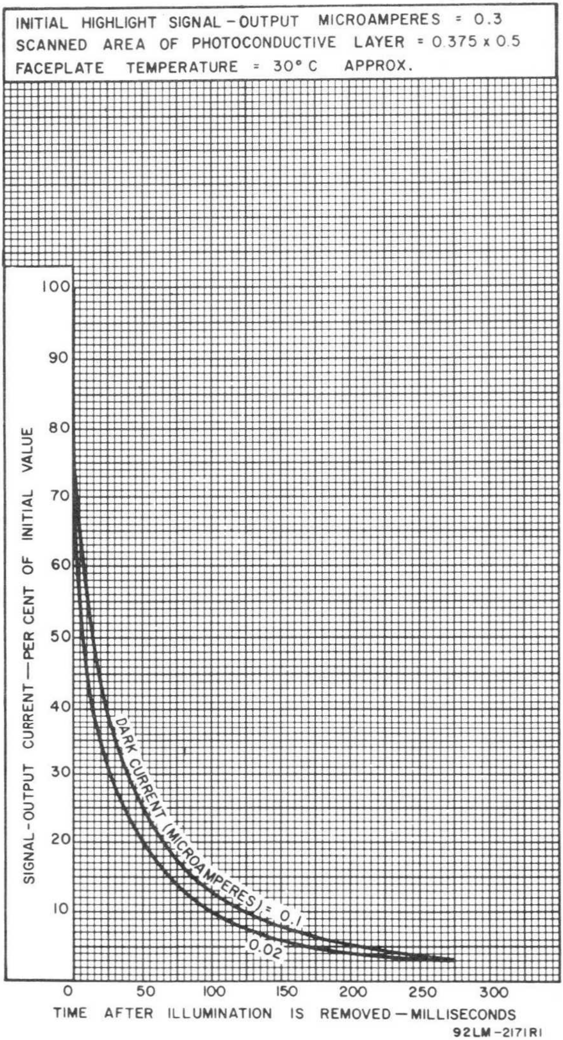
92LS-4134

Typical Range of Dark Current

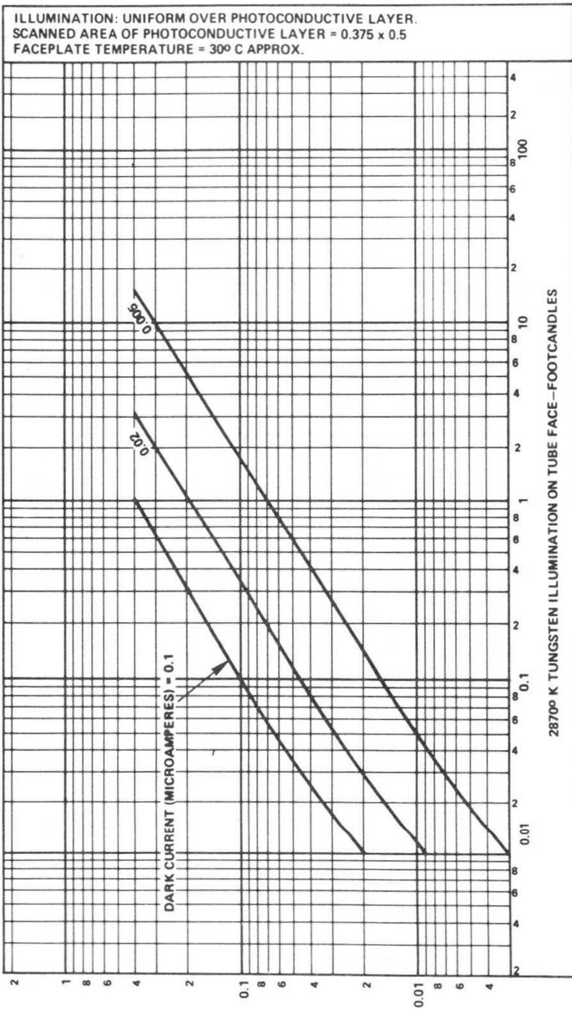


92LS-1467R1

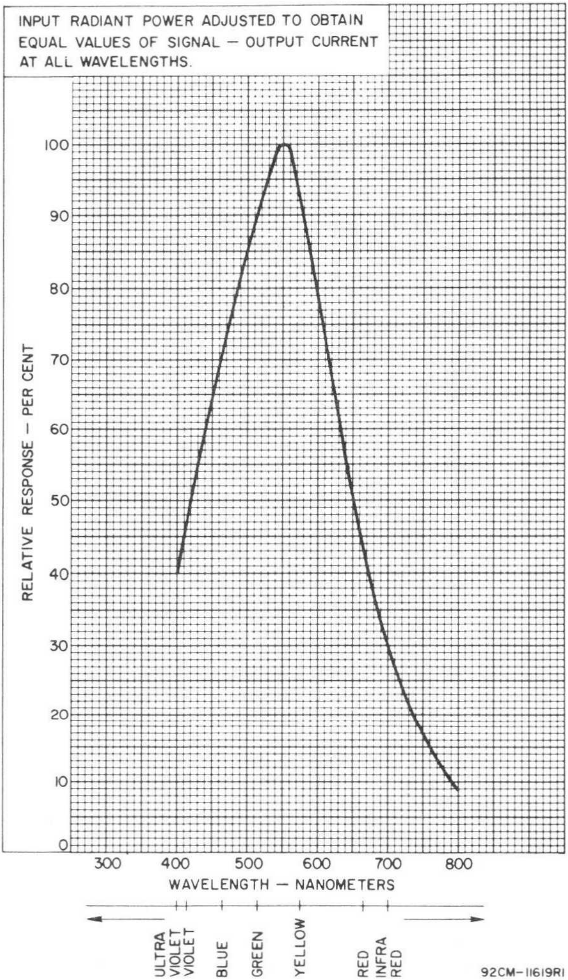
Typical Persistence Characteristics



Light Transfer Characterisitcs



Typical Spectral Sensitivity Characteristic



Vidicon

For Color Television Film Pickup Service

- Electrostatic-Focus, Magnetic-Deflection
- Low-Power "Dark Heater" – 0.6 Watt
- Separate Mesh Connection
- Precision Outer-Diameter Glass Bulb
- Tested to Stringent Signal Uniformity Specifications

General Data

Dimensions	See Dimensional Outline	
Direct Interelectrode Capacitance[a]		
Target to all other electrodes	11	pF
Focusing Method	Electrostatic	
Deflection Method	Magnetic	
Heater Power	0.6	W
Maximum Useful Picture Size	0.6x0.8 (15.24 x 20.32 mm)	in

Orientation of Quality Rectangle: Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin.

Base	Small-Button Super Ditetrar 8-Pin (JEDEC No. E8-78)	
Socket	Alden[b] No.208-SPEC. or equivalent	
Weight	11 (312.4 g)	oz
Operating Position	Any	
Deflection Alignment Assembly[c]	Cleveland Electronics No.15VYA-333, or equivalent	

Maximum Ratings, Absolute-Maximum Values:[d]

Grid-No.6 & 3 Voltage[e]	1500	V
Grid-No.5 Voltage	1500	V
Grid-No.4 Voltage	500	V
Grid-No.2 Voltage[f]	750	V
Grid-No.1 Voltage:		
Negative bias value	300	V
Positive bias value	0	V
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125	V
Heater positive with respect to cathode	10	V
Heater Voltage	6.3 ± 5%	V
Target Voltage	125	V
Target Dark Current	0.25	μA
Peak Target Current[g]	0.60	μA
Faceplate:		
Illumination[h]	5000	fc
Temperature	71	°C

Typical Operation and Performance Data

Grid-No.6 (Decelerator) & 3 Voltage[e]	1400	V
Grid-No.5 Voltage[e]	700 to 840	V
Grid-No.4 (Beam-Focus Electrode) Voltage	230 to 260	V
Grid-No.2 (Accelerator) Voltage[f]	300	V
Grid-No.1 Voltage (For Picture Cutoff)[i]	−45 to −100	V
Signal-To-Noise Ratio (Approximate)[m]	300:1	
Typical Resolution:		
Center	1400/1200	TV Lines
Corner	1000	

Amplitude Response to 400 TV Line Square-Wave Test Pattern at Center of Picture[t]	60/55	%
Average "Gamma" of Transfer Characteristic	0.65	
Lag Per Cent of Initial Value of Signal-Output Current 1/20 Second after Illumination is Removed[n]	25	%

Typical Sensitivity

Faceplate Illumination	10	fc
Target Voltage[p,q]	15 to 45	V
Dark Current[q,r]	0.010	μA
Signal Output Current (Typical)[s]	0.30	μA

Notes

a This capacitance, which effectively is the output impedance of the vidicon, is increased when the tube is mounted in the deflecting-yoke assembly. The resistive component of the output impedance is in order of 100 megohms.

b Made by Alden Products Co., 9140 North Main St., Brockton 64, Massachusetts.

b' Made by Cinch Manufacturing Co., 1026 S. Homan Ave., Chicago 24, Illinois.

c Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

e Grid-No.6 & 3 voltage must always be greater than grid-No.5 voltage. The maximum voltage difference between these electrodes, however, should not exceed 800 volts. The recommended ratio of grid-No.5 to grid-No.6 & 3 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

f The power dissipation at grid No.2 should not exceed one watt, a condition normally met when the tube is operated at the specified maximum grid-No.2 rating and when the specified peak target current rating is not exceeded. However, if the vidicon is operated continuously with grid-No.1 voltage near or approaching zero bias, grid-No.2 voltage should not exceed 350 volts dc maximum.

g Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

h For condition where "white light" is uniformly diffused over entire tube face.

i With no blanking voltage on grid No.1.

m Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

n For initial signal-output current of 0.2 microampere and a dark current of 0.02 microampere.

p Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

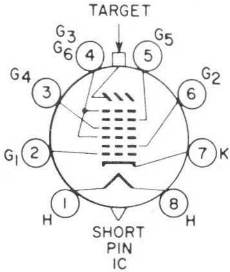
q The target voltage for each vidicon must be adjusted to that value which gives the desired operating dark current.

r The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

s Defined as the component of the highlight target current after the dark-current component has been subtracted.

t This typical capability may be limited by conditions external to the tube such as test pattern material, optics and/or yoke.

Basing Diagram (Bottom View)

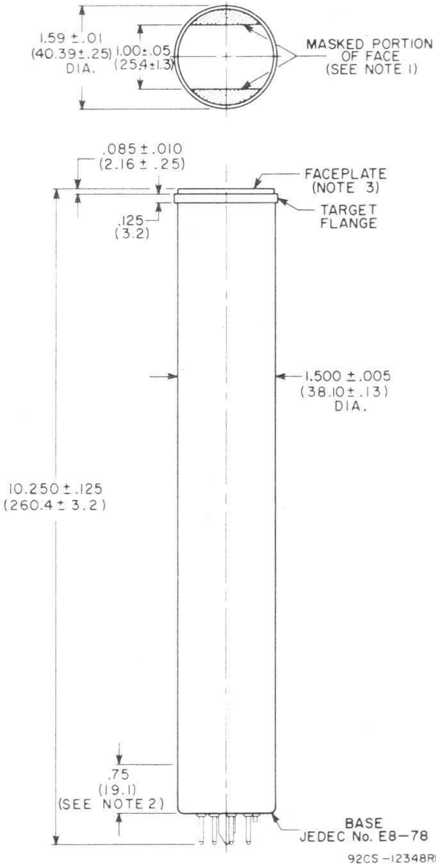


DIRECTION OF LIGHT:
INTO FACE END OF TUBE

8MD

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Grids No.3 & No.6
Pin 5: Grid No.5
Pin 6: Grid No.2
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin:
Internal Connection — Make No Connection

Dimensional Outline



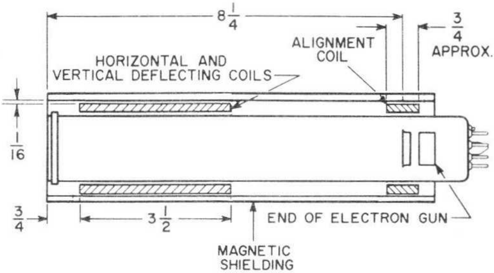
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Note 1 – Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2 – Within this area the minimum bulb diameter dimension does not apply.

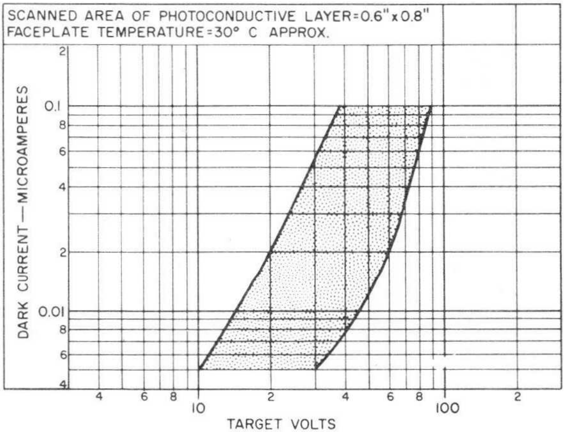
Note 3 – Faceplate thickness is 0.135″ ± 0.005″.

Recommended Location of Deflecting Yoke and Alignment Coil to obtain Optimum Geometry and Optimum Output Signal Uniformity



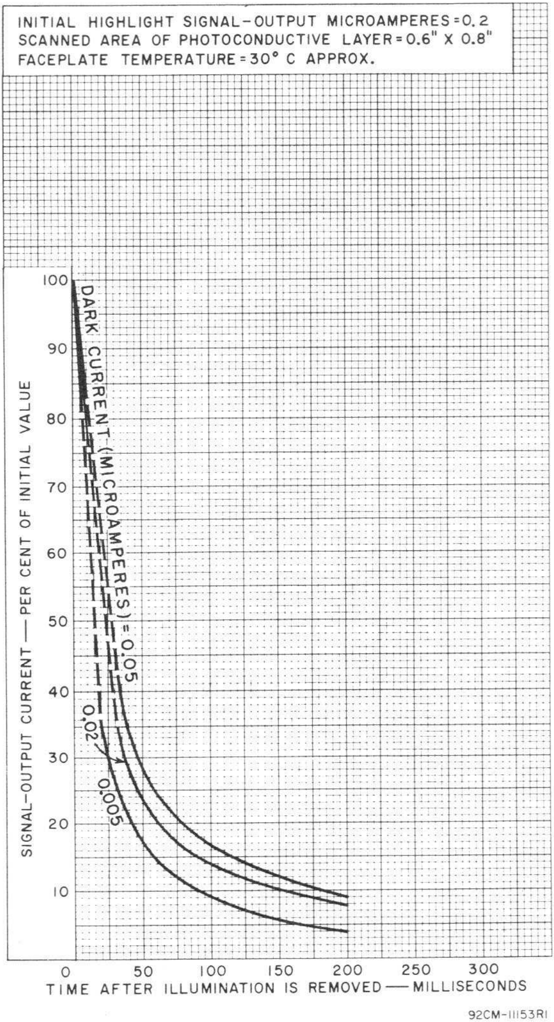
92CS-12349R1

Typical Range of Dark Current

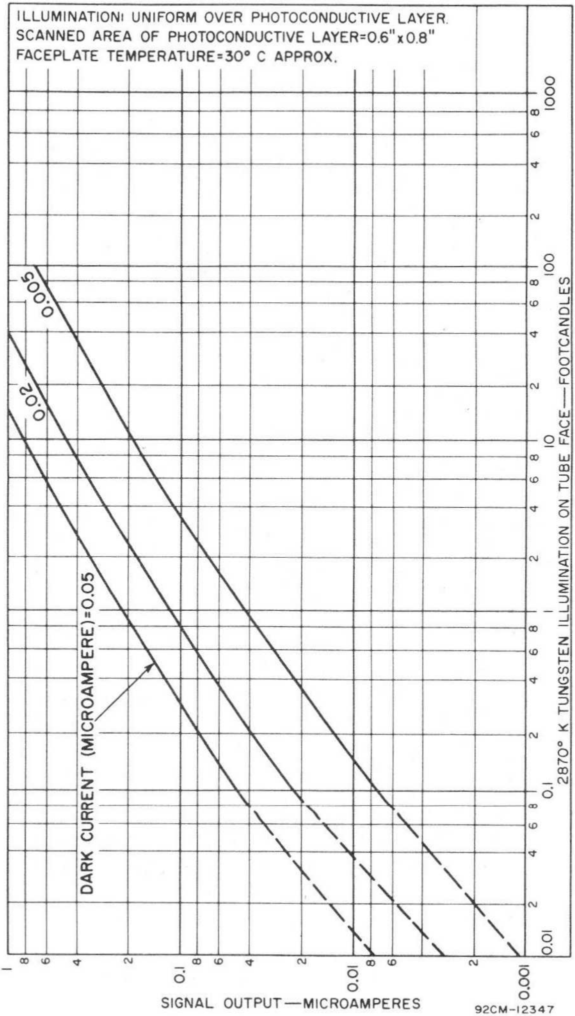


92CS-12345

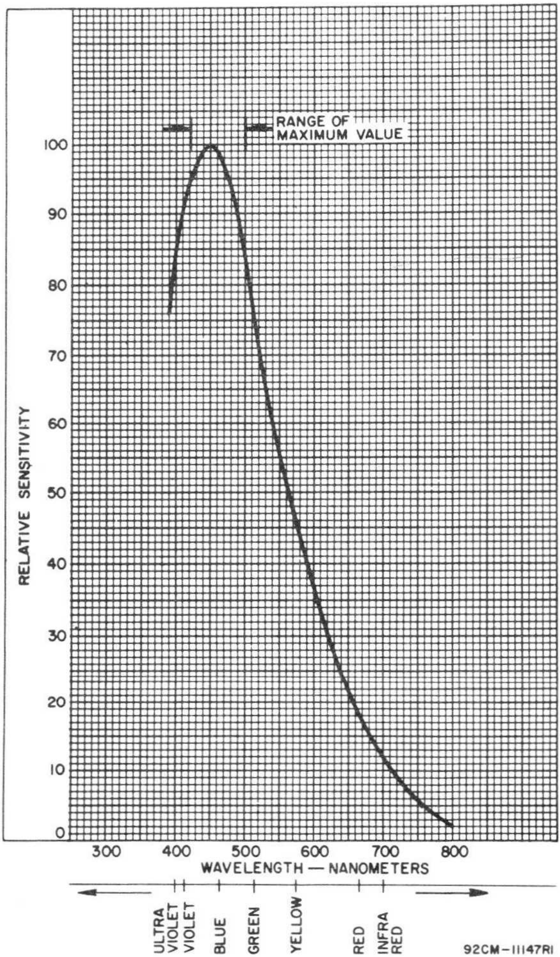
Typical Persistence Characterisitcs



Light Transfer Characteristics



Typical RCA Type I Spectral Response



Vidicon

1-Inch Diameter

Magnetic Focus **Magnetic Deflection**

High-Resolution Type Having High Sensitivity and Low Lag For Live Scene and Film Pickup in Black-and-White and Color TV Cameras

The 8507A is unilaterally interchangeable with the 8507

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	V
Current at 6.3 volts	0.6	A

Direct Interelectrode Capacitance:[a]

Target to all other electrodes	4.6	pF

Spectral Response . . . . . . *See Typical Spectral Sensitivity Characteristic*

Photoconductive Layer:

Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)	0.62	in

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method	Magnetic
Deflection Method	Magnetic
Overall Length	6.250" ± 0.125"
Greatest Diameter	1.125" ± 0.010"
Bulb	T8
Base	Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket	Cinch[b] No.54A18088, or equivalent
Deflecting Yoke-Focusing Coil-Alignment Coil Assembly	Cleveland Electronics[c,d] No.VYFA-355-2, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz

ABSOLUTE-MAXIMUM RATINGS

For scanned area of 1/2" x 3/8"

Grid-No.4 Voltage[f]	1000 max.	V
Grid-No.3 Voltage[f]	1000 max.	V
Grid-No.2 Voltage	350 max.	V
Grid-No.1 Voltage:		
Negative bias value	150 max.	V
Positive bias value	0 max.	V

Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	V
Heater positive with respect to cathode	10 max.	V
Target Voltage	100 max.	V
Dark Current	0.25 max.	µA
Peak Target Current[g]	0.75 max.	µA
Faceplate:		
Illumination[h]	5000 max.	fc
Temperature	71 max.	°C

TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 1/2" x 3/8" – Faceplate temperature of 30° to 35° C and Standard TV Scanning Rate

	Low-Voltage Mode	High-Voltage Mode	
Grid-No.4 (Decelerator) Voltage[f]	500	900	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	300	540	V
Grid-No.2 (Accelerator) Voltage	300	300	V
Grid-No.1 Voltage for Picture Cutoff[j]	–65 to –100	–65 to –100	V
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 µA and 0.2 µA	0.65	0.65	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[k]	300:1	300:1	
Lag – Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed[m]	20	20	%
Minimum Peak-to-Peak Blanking Voltage:			
When applied to grid No.1	75	75	V
When applied to cathode	20	20	V

Limiting Resolution:			
At center of picture . . .	1000	1100	TV lines
At corner of picture . . .	600	700	TV lines
Amplitude Response to a 400 TV Line Square – Wave Test Pattern at Center of Picture[n]	50	60	%
Field Strength at Center of Focusing Coil[p] . . .	40 ± 4	58 ± 4	G
Peak Deflecting-Coil Current:			
Horizontal	180	250	mA
Vertical	33	45	mA
Field Strength of Adjustable Alignment Coil[q]	0 to 4	0 to 4	G

High-Sensitivity Operation – 0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight)	0.1	fc
Target Voltage[r,s]	30 to 60	V
Dark Current[t]	0.10	μA
Signal-Output Current:[u]		
Typical	0.1	μA

Average-Sensitivity Operation – 1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight)	1.0	fc
Target Voltage[r,s]	20 to 40	V
Dark Current[t]	0.02	μA
Signal-Output Current:[u]		
Typical	0.2	μA

High-Light Level Operation – 10 Footcandles on Faceplate

Faceplate Illumination (Highlight)	10	fc
Target Voltage[r,s]	10 to 22	V
Dark Current[t]	0.005	μA
Signal-Output Current:[u]		
Typical	0.3	μA

[a] This capacitance, which effectively is the output impedance of the 8507A, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Made by Cinch Manufacturing Corporation, 1026 S. Homan Avenue, Chicago 24, Illinois.

[c] Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087

[d] These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

[f] Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

[g] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[h] For conditions where "white light" is uniformly diffused over entire tube face.

[i] With no blanking voltage on grid No.1.

[k] Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

[m] For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

[n] Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-

area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

[p] The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[q] The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

[r] The target voltage for each 8507A must be adjusted to that value which gives the desired operating dark current.

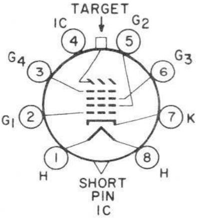
[s] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[t] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[u] Defined as the component of the highlight target current after the dark-current component has been subtracted.

BASING DIAGRAM (Bottom View)
8ME

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin — Internal Connection — Make No Connection



DIRECTION OF LIGHT: INTO FACE END OF TUBE

Spurious Signal Test

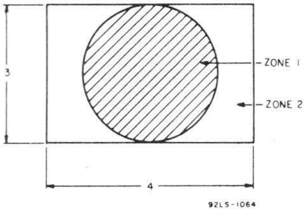


Fig.1

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in *Fig.1*. The 8507A is operated under the conditions specified under *Typical Operation and Performance Data* with the lens adjusted to provide a target current of 0.3 microampere. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system. Allowable spot size for each zone is shown in Table 1. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item.

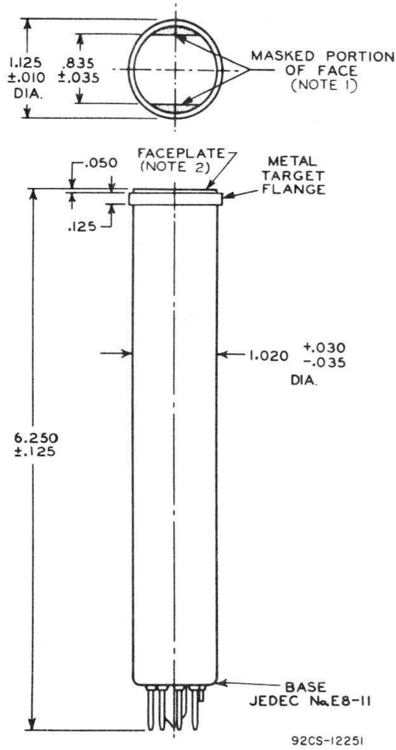
Table 1
For scanned area of 1/2" x 3/8"

Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	0
4 but not including 3	0	1
3 but not including 1	2	3
1 or less	■	■

Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

■Spots of this size are allowed unless concentration causes a smudged appearance.

DIMENSIONAL OUTLINE



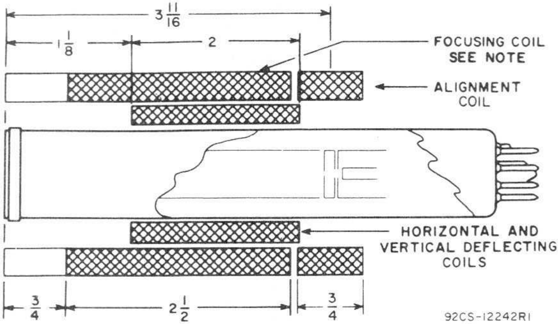
DIMENSIONS IN INCHES

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

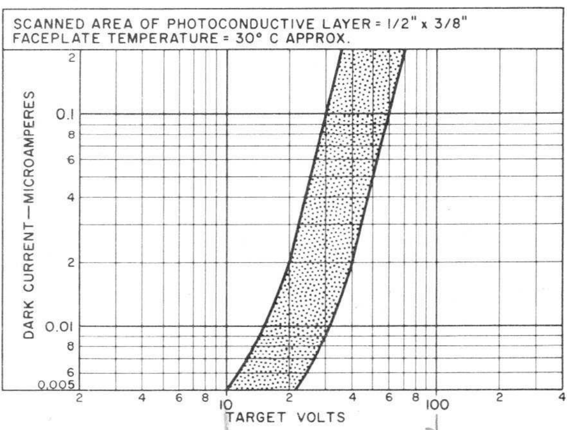
To obtain minimum beam-landing error



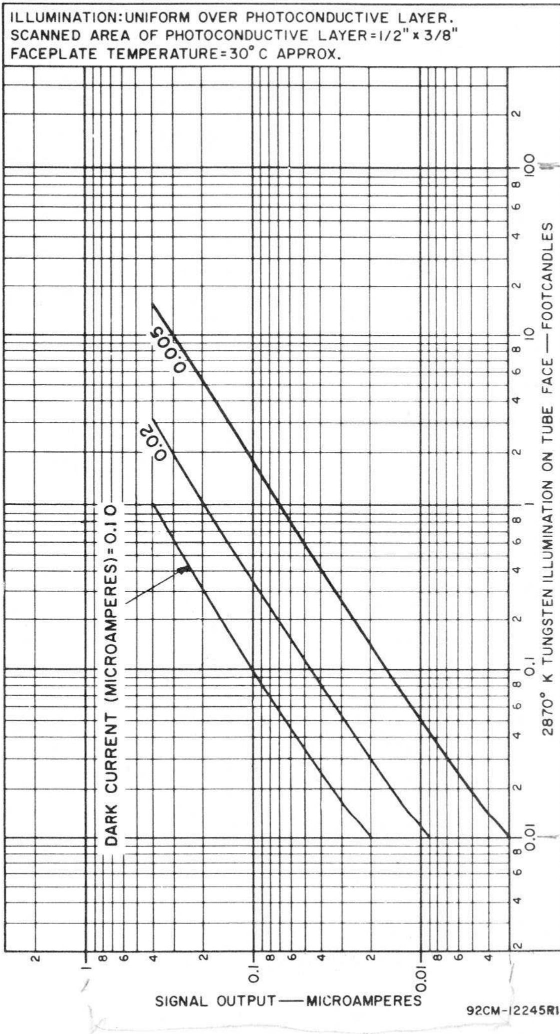
Dimensions in Inches

Note: Cross-hatching indicates wound portion of focusing coil.

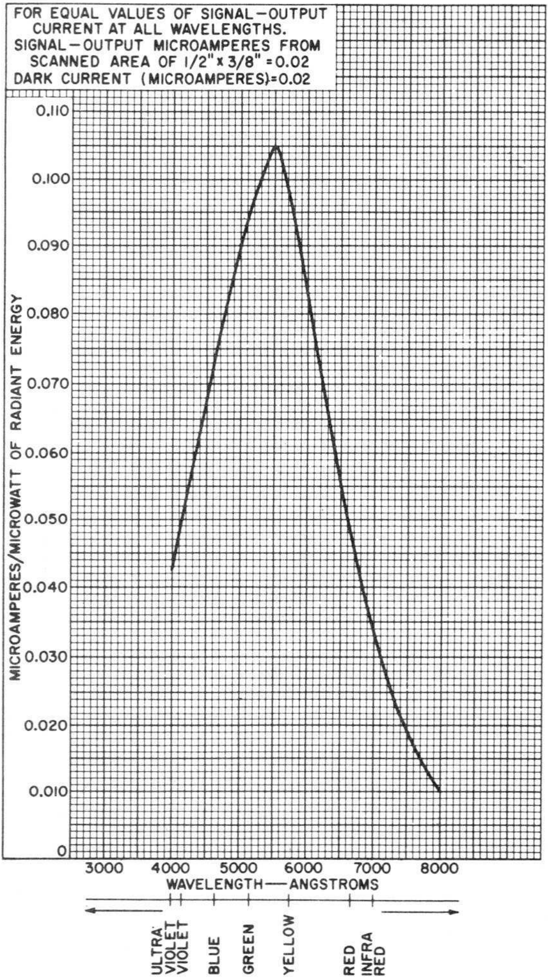
RANGE OF DARK CURRENT



LIGHT TRANSFER CHARACTERISTICS

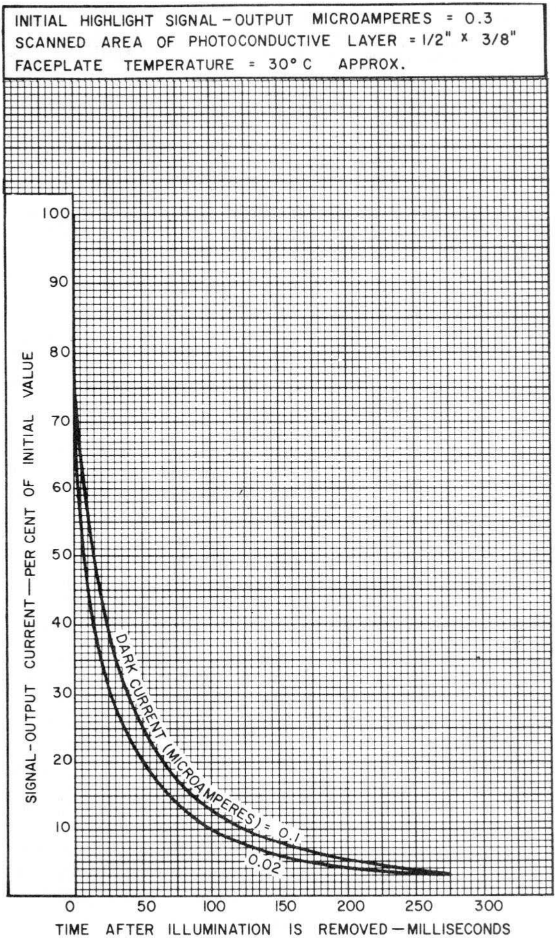


TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC



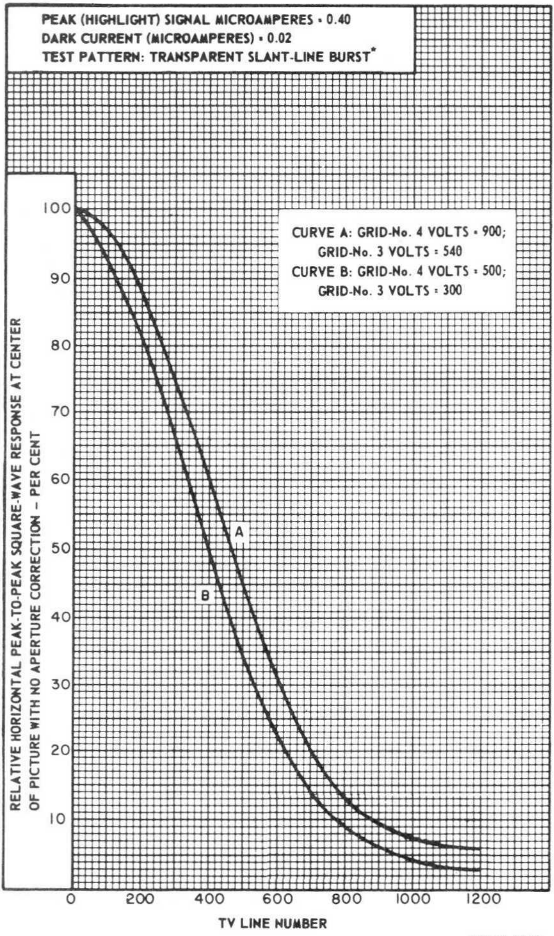
92CM-11619

TYPICAL PERSISTENCE CHARACTERISTICS



92LM-2171

HORIZONTAL SQUARE-WAVE RESPONSE



*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

Vidicon

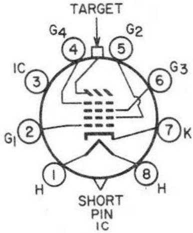
MAGNETIC FOCUS   1-1/2" Diameter   MAGNETIC DEFLECTION

For Black-and-White Pickup in Industrial Closed-Circuit TV Systems Requiring Limiting Resolutions of more than 1200 TV Lines

General:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at heater volts = 6.3	0.6	amp
Direct Interelectrode Capacitance:[a]		
Target to all other electrodes	8.0	pf
Spectral Response	See Accompanying *Curve*	
Photoconductive Layer:		
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)[b]	1"	
Focusing Method	Magnetic	
Deflection Method	Magnetic	
Overall Length	7.75" ± 0.25"	
Greatest Diameter	1.59" ± 0.01"	
Bulb Diameter	1.50" ± 0.01"	
Operating Position	Any	
Weight (Approx.)	5.25 oz	
Bulb	T12	
Focusing-Alignment Assembly	Cleveland Electronics[c] No. 15-VFA-259, or equivalent	
Deflecting Yoke[d]	Cleveland Electronics[c] No. 15-VY-258, or equivalent	
Socket	Alden[e] No. 208-SBSDC, or equivalent	
Base	Small-Button Super-Ditetrar 8-Pin (JEDEC No. E8-78)	
Basing Designation for BOTTOM VIEW	8LB	

Pin 1 - Heater
Pin 2 - Grid No.1
Pin 3 - Do Not Use
Pin 4 - Grid No.4
Pin 5 - Grid No.2
Pin 6 - Grid No.3
Pin 7 - Cathode
Pin 8 - Heater
Flange - Target
Short Index Pin - Do Not Use



DIRECTION OF LIGHT: INTO FACE END OF TUBE

Maximum Ratings, *Absolute-Maximum Values:*

For scanned area of 0.6" x 0.8"

Grid-No.4 Voltage	1500 max.	volts
Grid-No.3 Voltage	1500 max.	volts
Grid-No.2 Voltage	550 max.	volts

Grid-No.1 Voltage:		
Negative-bias value	300 max.	volts
Positive-bias value	0 max.	volts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	volts
Heater positive with respect to cathode	10 max.	volts
Target Voltage	100 max.	volts
Dark Current	0.25 max.	μa
Peak Target Current[f]	0.60 max.	μa
Faceplate:		
Illumination	1000 max.	fc
Temperature	71 max.	°C

Typical Operation:

For scanned area of 0.6" x 0.8" and faceplate temperature of 28° to 34° C

Grid-No.4 (Decelerator) Voltage[g]	1400	volts
Grid-No.3 (Beam-Focus Electrode[h])	800 to 1000	volts
Grid-No.2 (Accelerator) Voltage	300	volts
Grid-No.1 Voltage for picture cutoff[j]	-45 to -100	volts
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 μa and 0.6 μa	0.65	
Minimum Peak-to-Peak Blanking Voltage:		
When applied to grid No.1	75	volts
When applied to cathode	20	volts
Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second after Illumination is Removed:[k]		
Maximum value	45	%
Typical value	30	%
Limiting Resolution:		
At center of picture—		
Typical value	1500	TV lines
Minimum value	1200	TV lines
At corners of picture—		
Typical value	900	TV lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture:		
Minimum value	60	%
Field Strength at Center of Focusing Coil (Approx.)	46	gauss
Field Strength of Adjustable Alignment Coil[m]	0 to 4	gauss
Peak Deflecting-Coil Current for Specified Deflecting Yoke:		
Horizontal	240	ma
Vertical	50	ma

Maximum-Sensitivity Operation—0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight)	0.1	fc

Target Voltage[n,p]	30 to 60	volts
Dark Current[q]	0.1	μa
Signal-Output Current:[r]		
Typical	0.2	μa

Average-Sensitivity Operation—
1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight)	1.0	fc
Target Voltage[n,p]	17 to 35	volts
Dark Current[q]	0.02	μa
Signal-Output Current:[r]		
Typical	0.20	μa
Minimum	0.15	μa

High-Light Level Operation—
10 Footcandles on Faceplate

Faceplate Illumination (Highlight)	10	fc
Target Voltage[n,p]	10 to 20	volts
Dark Current[q]	0.005	μa
Signal-Output Current:[r]		
Typical	0.3	μa

[a] This capacitance, which effectively is the output impedance of the 8521, is increased when the tube is mounted in the deflecting-yoke and focusing-alignment assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the plane passing through the axis and short index pin. The masking is for orientation only and does not define the proper scanned area of photoconductive layer. Final orientation should be such that the image also fits inside of any internal mask of the mesh assembly.

[c] Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

[d] For minimum geometric distortion, the deflecting yoke should be located in its proper axial position 3/4-inch from the face of the tube.

[e] Alden Products Co., 9140 North Main Street, Brockton 64, Mass.

[f] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[g] Grid-No.4 voltage must always be greater than grid-No.3 voltage. For minimum "porthole" effect, grid-No.4 voltage should be adjusted to approximately 1.6 times the grid-No.3 voltage value, and the focusing-alignment assembly and deflecting yoke positioned as shown in accompanying diagram.

[h] Beam focus is obtained by the combined effect of grid-No.3 voltage, which should be adjustable over indicated range, and a focusing coil having an average field strength of 46 gauss.

[j] With no blanking voltage on grid No.1.

[k] For initial signal-output current of 0.2 μa and a dark current of 0.02 μa.

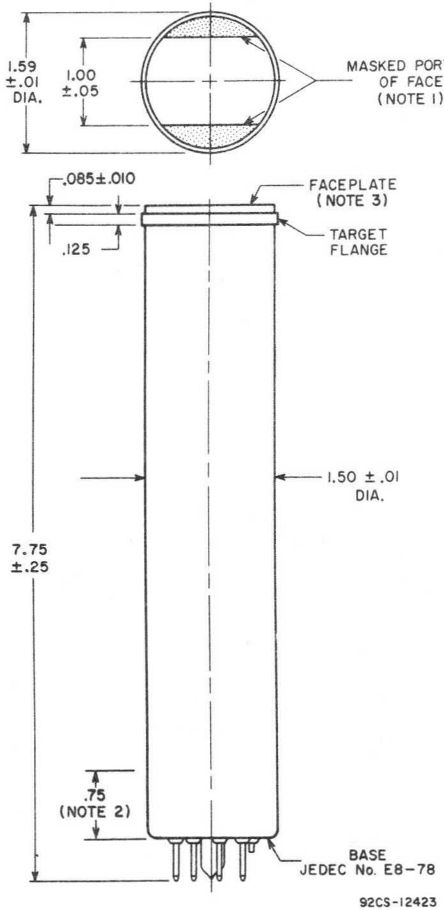
[m] The alignment coil should be located on the tube so that its center is at a distance of 6 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

[n] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[p] The target voltage for each 8521 must be adjusted to that value which gives the desired operating dark current.

[q] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[r] Defined as the component of the highlight target current after the dark-current component has been subtracted.



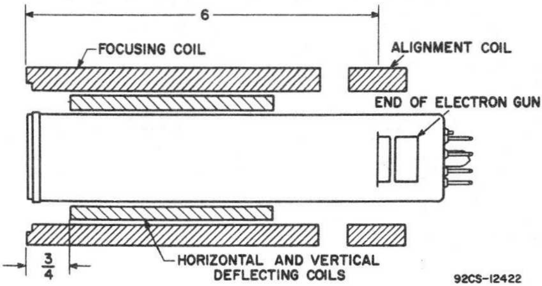
DIMENSIONS IN INCHES

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Within this area the minimum bulb diameter dimension does not apply.

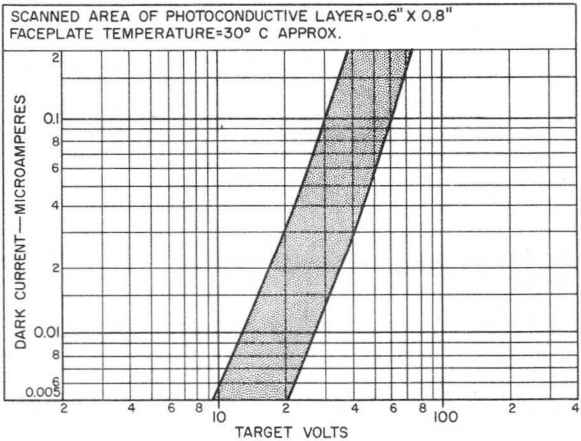
Note 3: Faceplate thickness is 0.135" ± 0.005".

COMPONENT LOCATIONS

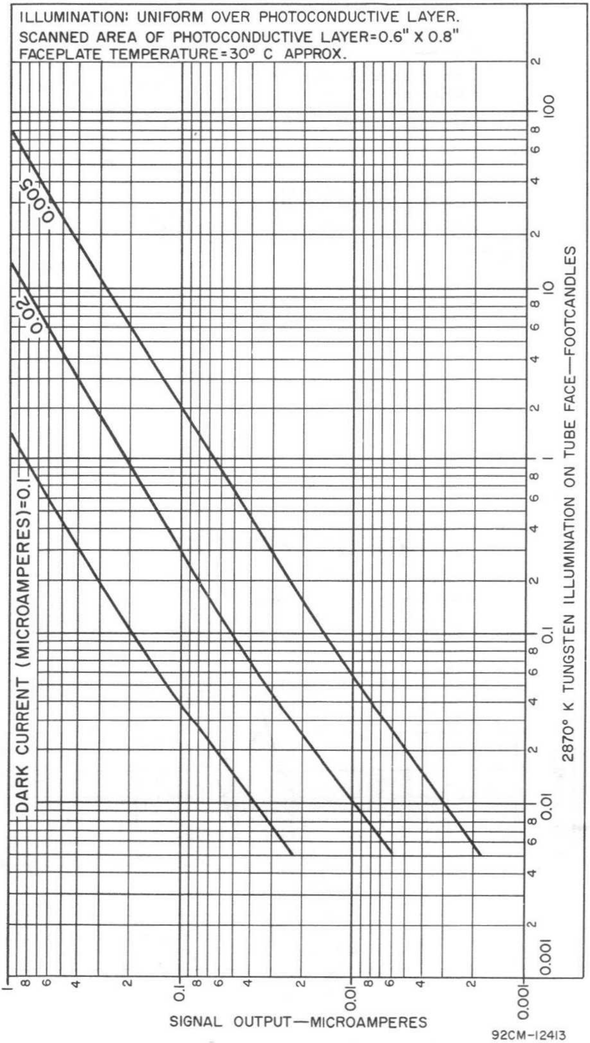


DIMENSIONS IN INCHES

RANGE OF DARK CURRENT

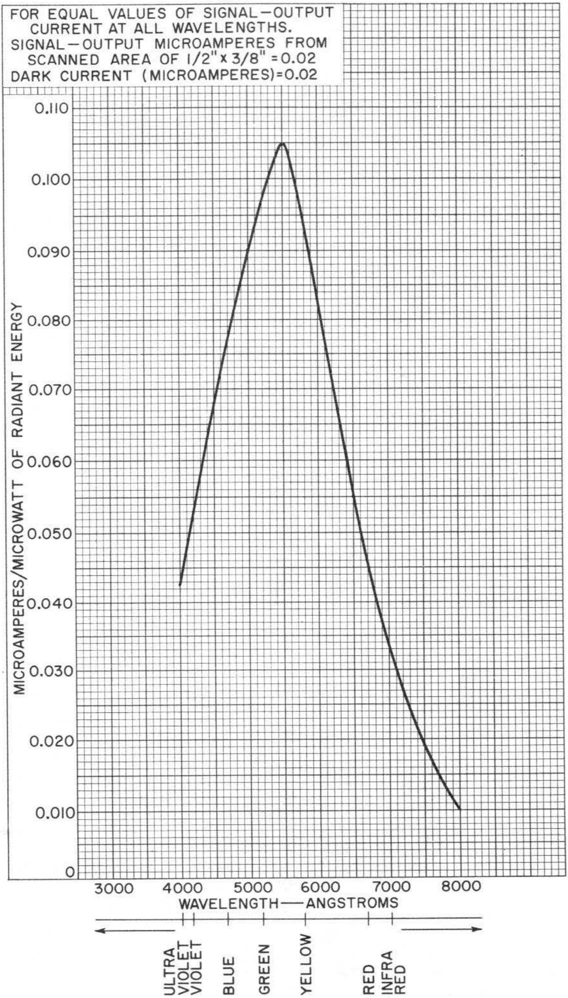


LIGHT TRANSFER CHARACTERISTICS



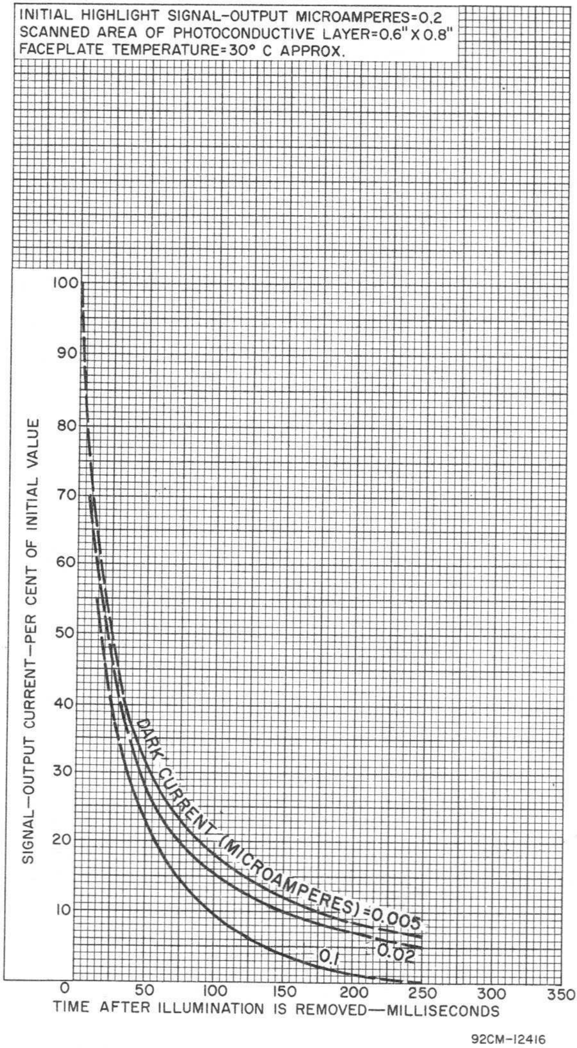
92CM-12413

TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC

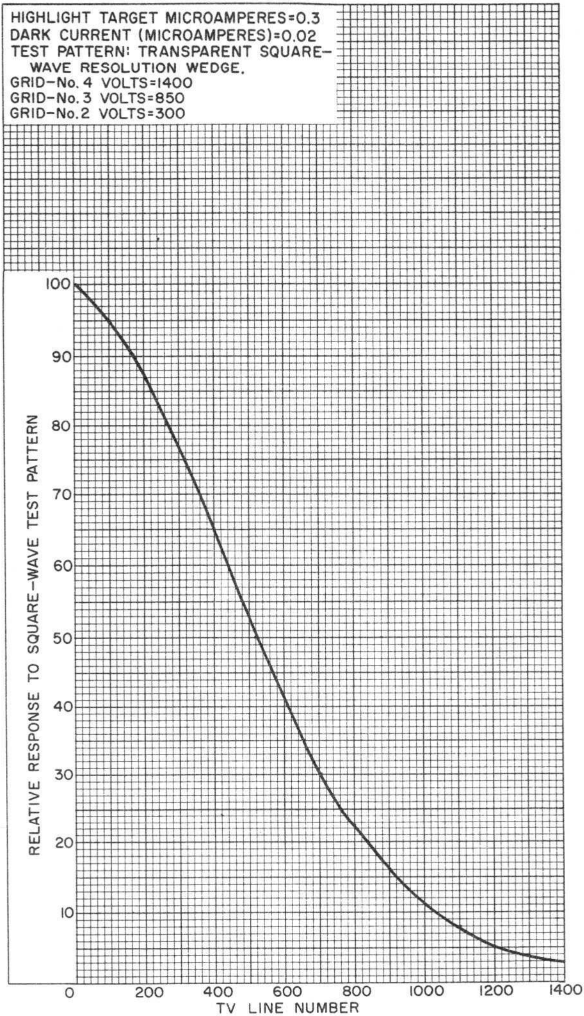


92CM-11619

TYPICAL PERSISTENCE CHARACTERISTICS



UNCOMPENSATED HORIZONTAL RESPONSE TO A SQUARE-WAVE TEST PATTERN



92CM-12418R1

8541, 8541A

Vidicons

- High Resolution – 1100 TV Lines (Typical at 900 Volts)
- High Amplitude Response – 60% (Typical at 900 Volts)
- Separate Mesh Connection
- High Signal Output – 200 Nanoamperes 1 Footcandle on Tube Face and Target Voltage of 30 Volts (Typical)
- Low Lag – 20% of Initial Signal Output After 50 Milliseconds
- 0.6 Watt "Dark Heater"

General Data

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10%	V
Current at 6.3 volts	0.1	A

Direct Interelectrode Capacitance:[a]

Target to all other electrodes	4.6	pF

Spectral Response . . . . See **Figure 5**

Photoconductive Layer:

Maximum useful diagonal of rectangular image . . . . 0.63 in (16 mm)

Orientation of quality rectangle – Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method	Magnetic
Deflection Method	Magnetic
Dimensions	See Dimensional Outline
Bulb	T8
Base	Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket	Cinch[b] 8VT (133-98-11-015), or equivalent
Deflecting Yoke-Focusing Coil-Alignment Coil Assembly	Cleveland Electronics[c,d] No.VYFA-355-2, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz (56.6 g)

Maximum Ratings, Absolute-Maximum Values[e]

For scanned area of 1/2" x 3/8" (12.8 x 9.6 mm^2)

Grid-No.4 Voltage[f]	1000	V
Grid-No.3 Voltage[f]	1000	V
Grid-No.2 Voltage	750	V
Grid-No.2 Dissipation	1	W
Grid-No.1 Voltage:		
Negative bias value	300	V
Positive bias value	0	V
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125	V
Heater positive with respect to cathode	10	V
Target Voltage	100	V
Dark Current	250	nA
Peak Target Current[g]	750	nA
Faceplate:		
Illumination[h]	50,000	lx
	5000	fc
Temperature	71	°C

Typical Operation and Performance Data

For scanned area of 1/2" x 3/8" (12.8 x 9.6 mm^2)

Faceplate temperature of 30° to 35° C and Standard TV Scanning Rate in VYFA-355-2 Coil Assembly

	Low Voltage Mode	High Voltage Mode	
Grid-No.4 (Decelerator) Voltage[f]	500	900	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	300	540	V
Grid-No.2 (Accelerator) Voltage	300	300	V
Field Strength at Center of Focusing Coil[p]	40±4	58±4	G
Peak Deflecting-Coil Current:			
Horizontal	350	480	mA
Vertical	20	28	mA

	Low Voltage Mode	High Voltage Mode	
Field Strength of Adjustable Alignment Coil[q]	0 to 4	0 to 4	G
Minimum Peak-to-Peak Blanking Voltage:			
When applied to grid No. 1	75	75	V
When applied to cathode	20	20	V
Grid-No. 1 Voltage for Picture Cutoff[i]:			
8541A	–65 to –100	–65 to –100	V
8541	–40 to –100	–40 to –100	V
Average "Gamma" of Transfer Characteristic for Signal-Output Current Between 20 nA and 200 nA	0.65	0.65	
Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed[m]:			
Typical	20	20	%
Maximum:			
8541A	25	25	%
8541	30	30	%
Limiting Resolution:			
At center of picture (Typ.) . . .	1000	1100	TV lines
At center of picture (Min.) . . .	950	–	TV lines
At corner of picture (Typ.) . . .	600	700	TV lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture[n]:			
Typical	50	60	%
Minimum:			
8541A	45	–	
8541	35	–	

Sensitivity:

See "Light Transfer Characteristics" (**Figure 7**)

Performance Tests:

Test conditions .... { 1.0 fc on Faceplate; 20 nA Dark Current }

Limit values:

	Min.	Max.	
Target voltage:			
8541A	20	40	V
8541	10	70	V
Signal current:			
8541A	150	–	nA
8541	120	–	nA

a This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

b Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, IL 60007.

c Made by Cleveland Electronics Inc., 14500 Darley Rd., Cleveland, OH 44110.

d These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis as shown in **Figure 2.**

e A description of the Absolute-Maximum Rating is given in the General Section, titled Rating Systems for Electron Tubes.

f Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

g Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

h For conditions where "white light" is uniformly diffused over entire tube face.

i With no blanking voltage on grid No.1.

m For initial signal-output current of 300 nanoamperes and a dark current of 20 nanoamperes.

n Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

p The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

q The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

r The target voltage for each tube must be adjusted to that value which gives the desired operating dark current.

s Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

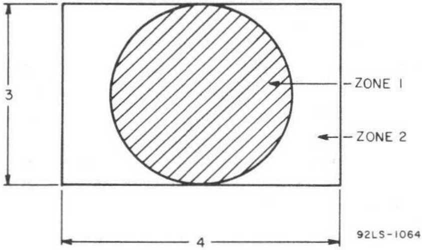
t The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

u Defined as the component of the highlight target current after the dark-current component has been subtracted.

Spurious Signal

This test is performed using a uniformly diffused white test pattern that is separated into two zones as shown in **Figure 1.** The tubes are operated under the conditions specified under Typical Operation and Performance Data and the lens adjusted to provide a target current of 300 nanoamperes. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent numbers of raster lines in a 525 TV line system.

Figure 1 – Spurious Signal Test Pattern



Allowable spot size for each zone is shown in Table I for the 8541A and Table II for the 8541. To be classified as a spot, a contrast ratio of 1.5:1 must exist for white spots and 2:1 for black spots. Smudges, streaks, or mottled and grainy background must have a contrast ratio of 1.5:1 to constitute a reject item. Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

Table I – 8541A
For scanned area of 1/2" x 3/8" (12.8 mm x 9.6 mm)

Blemish Size (Equivalent Number of Raster Lines)	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	0
over 3	0	1
over 1	2	4
1 or less	■	■

Table II – 8541
For scanned area of 1/2" x 3/8" (12.8 mm x 9.6 mm)

Blemish Size (Equivalent Number of Raster Lines)	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 6	0	0
over 4	0	2
over 1	3	6
1 or less	■	■

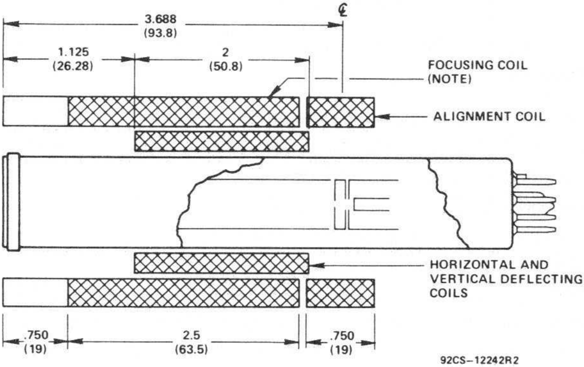
■ Spots of this size are allowed unless concentration causes a smudged appearance.

Operating Considerations

The target connection is made by a suitable spring contact bearing against the edge of the metal ring at the face end of the tube.

The temperature of the faceplate should not exceed 71° C (160° F), either during operation or storage of these tubes. Operation with a faceplate temperature in the range from about 25° to 35° C (77° to 95° F) is recommended.

Figure 2 – Recommended Location and Length of Deflecting, Focusing, and Alignment Components to Obtain Minimum Beam-Landing Error



Note: Cross-hatching indicates wound portion of focusing coil.

Provisions should also be made in the camera installation to hold the faceplate temperature at a steady value within the recommended range. Dark current increases with increasing temperature. It is highly desirable to operate the tube at a steady temperature to maintain dark current at a preselected value. This mode of operation insures both optimum and stable day-to-day performance. If such provisions cannot be made, changes in target voltage may be required from time to time to maintain the desired picture quality.

As target voltage is increased, dark current also increases. The range of target voltage for various dark current levels of different tubes is shown in **Figure 3.** It should be noted that the range of target voltage to produce a given dark current, and therefore a given sensitivity is very narrow for these tubes. Individual tubes will therefore have substantially identical performance characteristics when operated with an identical value of dark current. For proper adjustment of the target voltage on each tube see Set-Up Procedure.

Persistence or lag of the photoconductive layer is given in **Figure 4** for two values of dark current. Each curve shows the decay in signal-output current from an initial value of 300 nanoamperes after the illumination is cut off.

The spectral response of the 8541 and 8541A is shown in **Figure 5.**

As shown in **Figure 6,** a substantial increase in both limiting resolution and amplitude response of the tubes may be obtained by increasing the operating voltages of grid No.4 and grid No.3. The focusing-coil field strength must be increased and more deflecting power is required at higher electrode voltages as indicated under Typical Operation and Performance Data. Very little additional beam-landing error is introduced at the higher voltages provided the recommended operating voltages are used and the associated components are positioned as shown in **Figure 2.**

The power dissipation at grid No.2 should not exceed one watt, a condition normally met when the tube is operated at the specified maximum grid-No.2 rating and when the specified peak target current rating is not exceeded. However, if the tubes are operated continuously with grid-No.1 voltage near or approaching zero bias, grid-No.2 voltage should not exceed 350 volts dc maximum.

Signal-Output and Light Transfer Characteristics

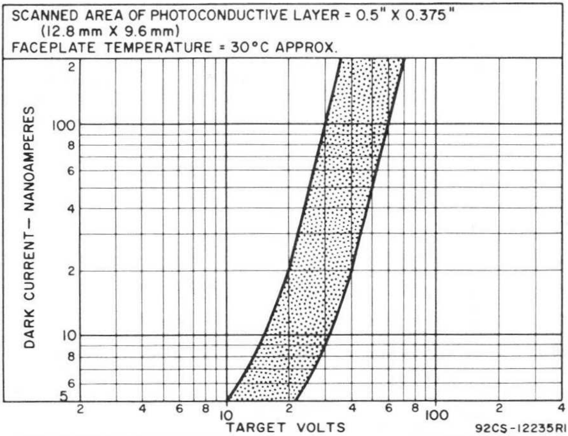
Typical signal output as a function of uniform 2854° K tungsten illumination on the photoconductive layer for different values of dark current is shown in **Figure 7.**

The average "gamma", or slope, of the light transfer characteristic curves shown in **Figure 7** is approximately 0.65. This value is relatively constant over an adjustment range of 4 to 1 in target voltage, or 50 to 1 in dark current, for a signal-output current range between 10 and 300 nanoampere.

Uniformity of the photoconductive layer of the tubes is excellent. When operated with the recommended focus and deflection components, signal output over the entire picture area is also very uniform. When other components are employed, beam-landing errors at the target may contribute to poor signal uniformity or "shading" characteristics in the generated picture. In such instances, compensation for the beam-landing errors to achieve uniform sensitivity can be obtained by supplying a modulating voltage of a suitable waveform to the cathode of the 8541 and 8541A. The desired waveform is parabolic in shape and of such a polarity that the cathode voltage is lowered as the beam approaches the edges of the scanned area.

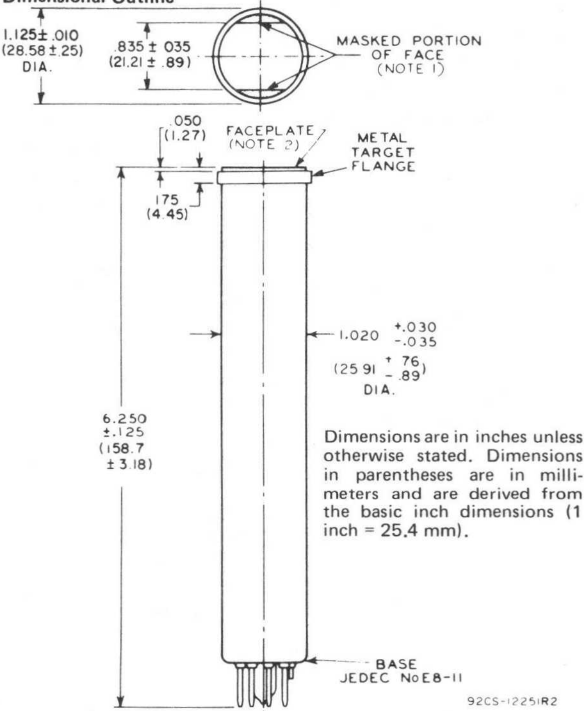
Proper-size scanning of the photoconductive target area should always be used. Both overscanning and underscanning impair performance.

Figure 3 – Range of Dark Current



Failure of scanning even for a few seconds may permanently damage the photoconductive layer. The damaged area shows up as a spot or line in the picture during subsequent operation. To avoid damage during scanning failure, it is necessary to prevent the scanning beam from reaching the layer.
The scanning beam can conveniently be prevented from reaching the layer by increasing the grid-No.1 voltage to cutoff, biasing the target negatively, or removing grid-No.4, grid-No.3, and grid-No.2 electrode voltages.

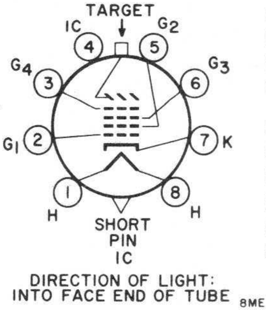
Dimensional Outline



Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094 ± 0.012 in (2.4 ± 0.3).

Basing Diagram — Bottom View



Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection — Make No Connection

Figure 4 — Typical Persistence Characteristics

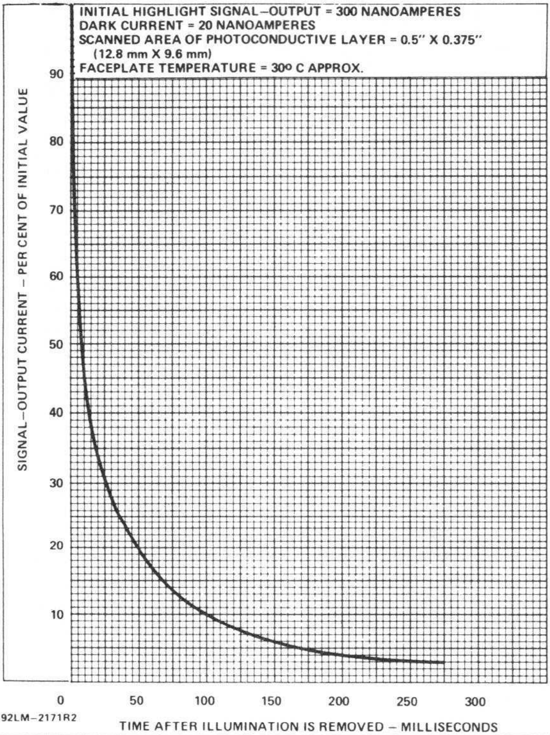


Figure 5 — Typical Spectral Response

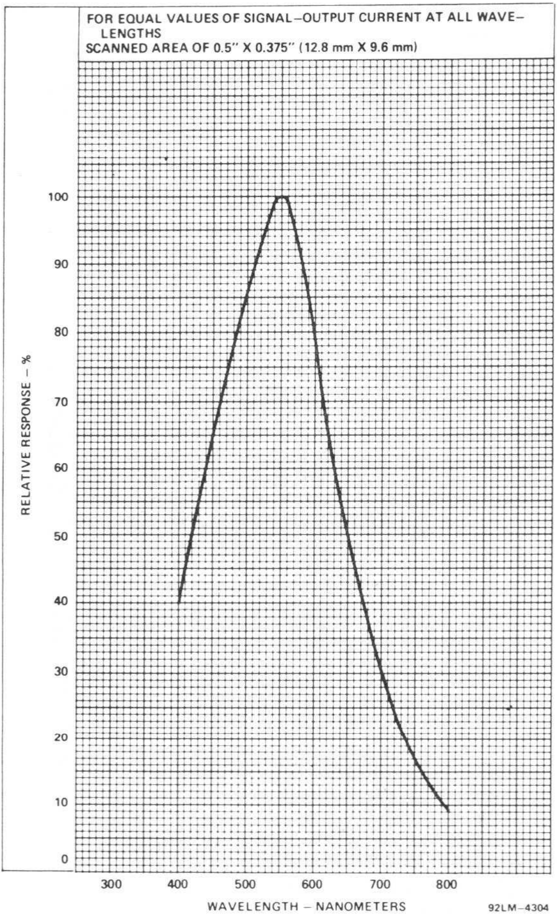
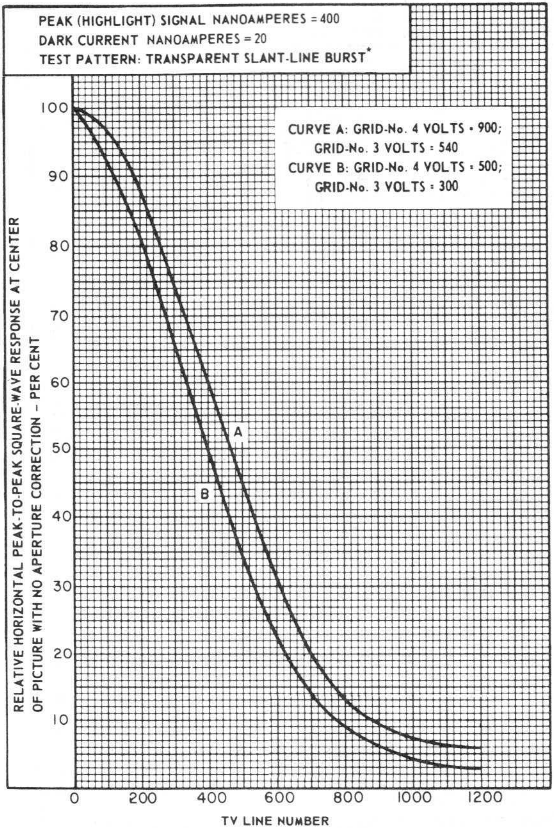


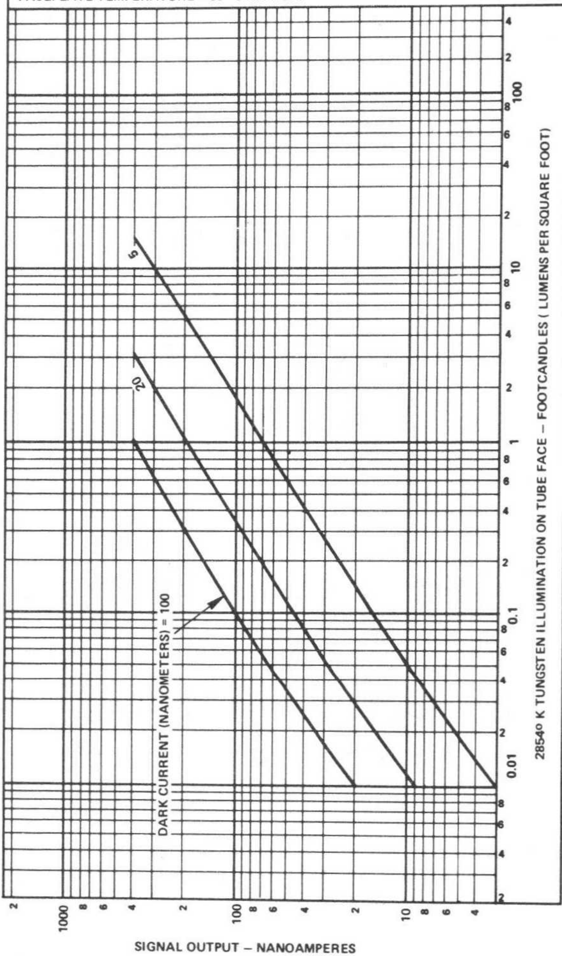
Figure 6 – Horizontal Square-Wave Response



*Amplitude response measured using the RCA-P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

Figure 7 — Light Transfer Characteristics

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 0.5" X 0.375" (12.8 mm X 9.6 mm)
FACEPLATE TEMPERATURE = 30° C APPROX.



92CM–12245R2

Vidicon

LOW-POWER (0.6-WATT)"DARK HEATER" I" DIAMETER PRECISION BULB[a]
ELECTROSTATIC FOCUS RUGGEDIZED MAGNETIC DEFLECTION

For Compact, Lightweight, Transistorized TV Cameras in Industrial and Other Closed-Circuit TV Systems Where Severe Environmental Conditions May be Encountered

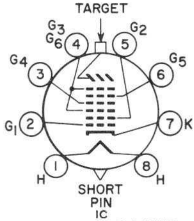
General:

Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	0.095	amp
Direct Interelectrode Capacitance:[b]		
Target to all other electrodes	5.0	pf

Spectral Response . . . . . . See *Typical Spectral-Sensitivity Characteristic*, shown under Type 8134

Photoconductive Layer:
Maximum useful diagonal of rectangular image (4 x 3 aspect ratio)[c] . . . . . . 0.62"
Focusing Method . . . . . . Electrostatic
Deflection Method . . . . . . Magnetic
Overall Length . . . . . . 6.25" ± 0.10"
Greatest Diameter . . . . . . 1.125" ± 0.010"
Operating Position . . . . . . Any
Weight (Approx.) . . . . . . 2.8 oz
Bulb T8
Bulb Diameter . . . . . . 1.025" ± 0.003"
Deflecting-Alignment Assembly . . . . . Cleveland Electronics[d] No. VYA-300, or equivalent
Socket . . . . . . Cinch[e] No. 133-98-11-015, or equivalent
Base . . . . . . Small-Button Ditetrar 8-Pin (JEDEC No. E8-11)
Basing Designation for BOTTOM VIEW 8LN

Pin 1 - Heater
Pin 2 - Grid No. 1
Pin 3 - Grid No. 4
Pin 4 - Grid No. 3 & No. 6
Pin 5 - Grid No. 2
Pin 6 - Grid No. 5
Pin 7 - Cathode
Pin 8 - Heater
Flange - Target
Short Pin - Do Not Use



Maximum Ratings, *Absolute-Maximum Values:*

For scanned area of 1/2" x 3/8"

Grid-No. 6 & Grid No. 3 Voltage[f]	1000	volts
Grid-No. 5 Voltage[f]	1000	volts
Grid-No. 4 Voltage	300	volts
Grid-No. 2 Voltage	750	volts

Grid-No.1 Voltage:		
Negative-bias value	300	volts
Positive-bias value	0	volts
Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125	volts
Heater positive with respect to cathode	10	volts
Target Voltage	100	volts
Dark Current	0.2	μa
Peak Target Current[g]	0.6	μa
Faceplate:		
Illumination	1000	fc
Temperature	71	°C

Typical Operation and Performance Data:

For scanned area of 1/2" x 3/8" and faceplate temperature of 30° to 35° C and standard TV scanning rate

	Low-Voltage	Inter-mediate-Voltage	High-Voltage	
Grid-No.6 (Decelerator) & Grid-No.3 Voltage	300	500	750	volts
Grid-No.5 Voltage	180	300	450	volts
Grid-No.4 (Beam-Focus Electrode) Voltage	20 to 60	50 to 100	90 to 150	volts
Grid-No.2 (Accelerator) Voltage	300	300	300	volts
Grid-No.1 Voltage for picture cutoff[h]	-45 to -100	-45 to -100	-45 to -100	volts
Typical Electrode Currents:				
Grid No.6 & 3	1.7	2.5	3	μa
Grid No.5	0.05	0.20	0.30	μa
Grid No.4	0.0015	0.006	0.008	μa
Grid No.2	375	450	500	μa
Lag[j]				
Maximum value	20	20	20	%
Typical value	15	15	15	%
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 & 0.2 μa	0.65	-	-	
Minimum Peak-to-Peak Blanking Voltage:				
Applied to grid-No.1	75	-	-	volts
Applied to cathode	20	-	-	volts
Limiting Resolution at picture center	600	700	750	TV lines
Amplitude Response to a 400 TV Line Square Wave Test Pattern at picture center	20	25	30	%
Field Strength of Adjustable Alignment Coil[k]	0 to 1	0 to 1	0 to 1	gauss

Average-Sensitivity Operation

Under typical operating conditions specified for either low- or high-voltage operation

Faceplate Illumination (Highlight)	1	fc
Target Voltage[m,n]	20 to 40	volts
Dark Current[p]	0.02	μa
Signal-Output Current[q]	0.2	μa

High-Sensitivity Operation

Under typical operating conditions specified for either low- or high-voltage operation[r]

Faceplate Illumination (Highlight)	0.1	fc
Target Voltage[m,n]	30 to 60	volts
Dark Current[p]	0.10	μa
Signal-Output Current[q]	0.10	μa

[a] The precision outer-diameter bulb permits the use of low-power, close-fitting deflecting yokes of small size and low impedance.

[b] This capacitance, which effectively is the output impedance of the 8567 is increased when the tube is mounted in the deflecting-yoke assembly. The resistive component of the output impedance is in order of 100 megohms.

[c] Proper orientation of quality rectangle is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short pin.

[d] Cleveland Electronics Incorporated, 1974 East 61st Street, Cleveland Ohio. This component is not designed to withstand severe environmental conditions. It is recommended that custom components be used in such service.

[e] Cinch Manufacturing Corporation, 1026 South Homan Avenue, Chicago 24, Illinois.

[f] The maximum voltage difference between grids No. 6 & 3 and No. 5 should not exceed 500 volts.

[g] Video amplifiers must be designed properly to handle peak target currents of this magnitude to avoid amplifier overload or picture distortion.

[h] With no blanking voltage on grid No. 1.

[j] Defined as the per cent of initial value of signal-output current 1/20 second after illumination is removed. Values shown are for initial signal-output current of 0.2 microampere and a dark current of 0.02 microampere.

[k] The alignment coil should be located on the tube so that its center is at a distance of 4-15/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube and the deflecting yoke.

[m] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[n] The target voltage for each 8567 must be adjusted to that value which gives the desired operating dark current.

[p] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[q] Defined as the component of the highlight target current after the dark-current component has been subtracted.

[r] Operation at this higher sensitivity level will result in a decrease in the resolution capability of the 8567.

ENVIRONMENTAL TESTS

The 8567 is designed to withstand the following operational and non-operational environmental tests.

OPERATIONAL TESTS

Rejection Criteria

Tubes are operated as specified under *Typical Operation, Low-Voltage Operation*. Throughout these tests, the amplitude of any generated spurious signals must not exceed 80 per cent of the maximum white-signal value and the tube must provide a resolution of at least 200 TV lines.

Sinusoidal Vibration

These tests are performed on apparatus which applies variable-sinusoidal frequency vibration to the tube. The tube is vibrated in each of three orthogonal axes, one axis being parallel to the major axis of the tube, according to the schedule specified below. A vibration cycle has a duration of 4.5 minutes per axis in which time the frequency is varied from 20 to 1000 and back to 20 cycles per second. One vibration cycle is performed for each axis and the total test period is 13.5 minutes.

Double Ampli-tude inches	Peak Acceleration g's	Sweep Frequencies cps	Sweep Cycle Duration per Axis minutes
0.250	-	20 to 40	4.5
-	20	40 to 400	
-	Decreased linearly from 20 to 3	400 to 1000	
-	Increased linearly from 3 to 20	1000 to 400	
-	20	400 to 40	
0.250	-	40 to 20	

Random Vibration

The 8567 is also subjected to random vibration having a spectral density of 0.1 g^2/cps in a bandwidth of 20 to 1000 cycles per second (10 g's — rms value) for a period of 3 minutes in each of the three orthogonal axes specified above. The total test period for each tube is 9 minutes.

NON-OPERATIONAL TESTS

Rejection Criteria

After completion of these tests, tubes will meet the performance characteristics specified under *Typical Operation*.

Shock

These tests are performed on apparatus which provides half-wave sinusoidal shock pulses. The 8567 is subjected to three impact shocks in each direction of the three orthogonal axes specified above. The peak acceleration of the impact shock is 30 g's and the time duration is 11 milliseconds. Each tube is subjected to a total of 18 impact shocks.

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Sinusoidal Vibration

These tests are performed on apparatus which applies variable sinusoidal frequency vibration to the tube. The tube is vibrated in each of the three orthogonal axes previously specified. A vibration cycle has a duration of 30 minutes per axis in which time the frequency is varied from 5 to 2000 and back to 5 cycles per second. One vibration cycle is performed for each axis and the total test period is 90 minutes.

Double Amplitude inches	Peak Accelera-tion g's	Sweep Frequencies cps	Sweep Cycle Duration per Axis minutes
0.250	–	5 to 20	30
–	5	20 to 2000	
–	5	2000 to 20	
0.250	–	20 to 5	

Random Vibration

The 8567 is also subjected to random vibration having a spectral density of 0.05 g^2/cps in a bandwidth of 20 to 2000 cycles per second (10 g's — rms value) for a period of 10 minutes in each of the three orthogonal axes specified above. The total test period for each tube is 30 minutes.

Acoustical Noise

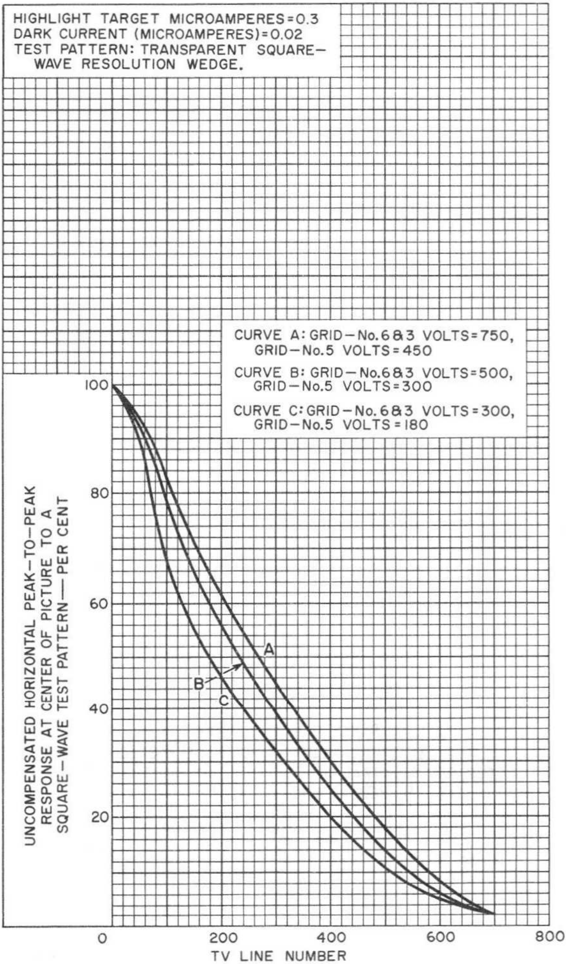
The 8567 is subjected to an overall external noise of 140 db for a period of 5 minutes.

Static Acceleration

The 8567 is subjected to a static acceleration of 20 g's in each of the three orthogonal axes specified above for a period of 5 minutes. The total test period for each tube is 15 minutes.

**DIMENSIONAL OUTLINE,
RECOMMENDED LOCATION OF DEFLEC-
TING YOKE AND ALIGNMENT COIL,
DARK-CURRENT RANGE,
TYPICAL LIGHT-TRANSFER CHARACTERISTICS,
TYPICAL SPECTRAL-SENSITIVITY CHARACTERISTIC,
TYPICAL PERSISTENCE CHARACTERISTICS,
and
TYPICAL HORIZONTAL-DEFLECTION-CURRENT-CHARACTERISTIC
shown under Type 8134 also apply to the 8567**

UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE



92CM-12614

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Photomultiplier Tube[a]

S-4 RESPONSE

VERY SMALL, RUGGEDIZED, SIDE-ON, 9-STAGE TYPE

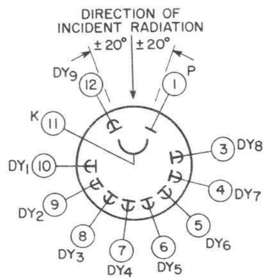
TESTED FOR SHOCK, VIBRATION, CONSTANT ACCELERATION, AND TEMPERATURE CYCLING

For Ultra-Compact Systems in Low-Light Detection and Measurement Applications

GENERAL

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode	Cesium-Antimony
Minimum projected length[b]	0.375 in
Minimum projected width[b]	0.06 in
Minimum projected area[b]	0.023 sq. in
Secondary-Emitting Surface	Cesium-Antimony
Window	Lime Glass, (Corning[c] No.0080), or equivalent
Direct Interelectrode Capacitances (Approx.)	
Anode-to-dynode No.9	2.5 pF
Anode to all other electrodes	3.0 pF
Maximum Overall Length	1.37 in
Excluding semiflexible leads	
Length	0.43 ± 0.03 in
Bulb top to useful center cathode area	
Maximum Diameter	0.53 in
Operating Position	Any
Weight (Approx.)	0.17 oz
Bulb	T-4
Magnetic Shield	See footnote ([d])
Base	See *Dimensional Outline* and *Base Drawing*
Basing Designation for BOTTOM VIEW	12FZ

Lead 1 – Anode
Lead 3 – Dynode No.8
Lead 4 – Dynode No.7
Lead 5 – Dynode No.6
Lead 6 – Dynode No.5
Lead 7 – Dynode No.4
Lead 8 – Dynode No.3
Lead 9 – Dynode No.2
Lead 10 – Dynode No.1
Lead 11 – Photocathode
Lead 12 – Dynode No.9



MAXIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

DC Supply Voltage	
Between anode and cathode[e]	1250 V
Between anode and dynode No.9	250 V
Between consecutive dynodes	250 V
Between dynode No.1 and cathode	250 V

Average Anode Current[f]	20	μA
Ambient Temperature.	75	°C
Lead Temperature	250	°C
1/16" ± 1/32" from protective shell for 10 sec. max.		

CHARACTERISTICS RANGE VALUES

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.

With E = 1000 volts (except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant, at 4000 angstroms	-	7.3×10^{4}	-	A/W
Cathode Radiant, at 4000 angstroms.	-	0.034	-	A/W
Luminous, at 0 c/s[g]. . . .	20	75	300	A/lm
Cathode Luminous[h]. . . .	2×10^{-5}	3.5×10^{-5}	-	A/lm
Cathode Quantum Efficiency at 3800 Angstroms (Approx.).	-	10.5	-	%
Current Amplification. . . .	-	2.1×10^{6}	-	
Equivalent Anode-Dark-Current Input[j]	-	1×10^{-10} [k]	5×10^{-10} [k]	lm
	-	1×10^{-13} [m]	5.1×10^{-13} [m]	W
Anode-Pulse Rise Time[n] . . .	-	1.4×10^{-9}	-	s
Electron Transit Time[p] . . .	-	6×10^{-9}	-	s

With E = 750 volts (except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant, at 4000 angstroms.	-	1×10^{4}	-	A/W
Cathode Radiant, at 4000 angstroms.	-	0.034	-	A/W
Luminous, at 0 c/s[g]. . . .	-	10	-	A/lm
Cathode Luminous[h]. . . .	2×10^{-5}	3.5×10^{-5}	-	A/lm
Cathode Quantum Efficiency at 3800 Angstroms (Approx.)	-	10.5	-	%
Current Amplification. . . .	-	3×10^{5}	-	
Equivalent Anode-Dark-Current Input[j]	-	1×10^{-10} [k]	5×10^{-10} [k]	lm
	-	1×10^{-13} [m]	5.1×10^{-13} [m]	W
Anode-Pulse Rise Time[n] . . .	-	1.8×10^{-9}	-	s
Electron Transit Time[p] . . .	-	7.4×10^{-9}	-	s

a Alternate designation is Multiplier Phototube.

b On a plane parallel to the grill wires. See *Schematic Arrangement of Structure*.

c Made by Corning Glass Works, Corning, N.Y.

d Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Prefection Mica Company, 1322 North Elston Avenue, Chicago 22, Illinois, or equivalent.

e Operation with a supply voltage (E) of less than 500 volts dc is usually not recommended. If such a supply voltage is used, illumination must be limited to such a value that the average cathode photocurrent does not exceed approximately 5×10^{-9} ampere.

f Averaged over any interval of 30 seconds maximum.

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[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°K. A light input of 1 microlumen is used and the approximate spot size of the beam incident on the tube envelope is 0.35 inch by 0.05 inch. The tube is rotated to provide maximum anode output current.

[h] 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 0.001 lumen and 100 volts is applied between cathode and all other electrodes connected as anode. The approximate spot size of the beam incident on the tube envelope is 0.35 inch by 0.05 inch. The tube is rotated to provide maximum output current.

[j] At a tube temperature of 22°C. Dark current may be reduced by use of a refrigerant.

[k] With supply voltage (E) adjusted to give a luminous sensitivity of 20 amperes per lumen.

[m] At 4000 angstroms.

[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.

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE

is shown at the front of this section

ENVIRONMENTAL TESTS

The 8571 is designed to withstand the following environmental tests:

Shock. With no voltage applied, the 8571 is subjected to a total of 18 impact shocks, three in each direction of the three orthogonal axes, on apparatus which applies half-wave sinusoidal shock pulses. The peak acceleration of the impact shock is 30 ± 3g's and the time duration is 11 ± 1 milliseconds.

Vibration. With no voltage applied, the 8571 is vibrated, in each of the three orthogonal axes and as specified below, on apparatus which applies variable-sinusoidal frequency vibration to the tube. A vibration sweep has a duration of 5 minutes per axis in which time the frequency is varied logarithmically from 5 to 2000 and back to 5 cycles per second. Six vibration sweeps are performed for each axis and the total test period is 1-1/2 hours.

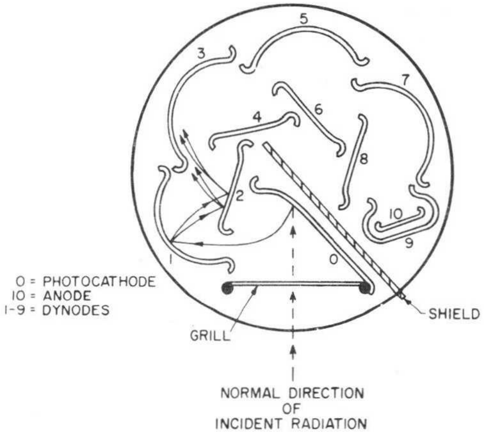
Double Amplitude inches	Accelera-tion g's	Fre-quency c/s	Total Sweep Duration Per Axis minutes
0.45	-	5-30	30
-	20	30-2000	
-	20	2000-30	
0.45	-	30-5	

Constant Acceleration. With no voltage applied, the 8571 is subjected for five minutes to an acceleration test level of 15 g's in both directions of the three orthogonal axes in a centrifuge providing constant acceleration.

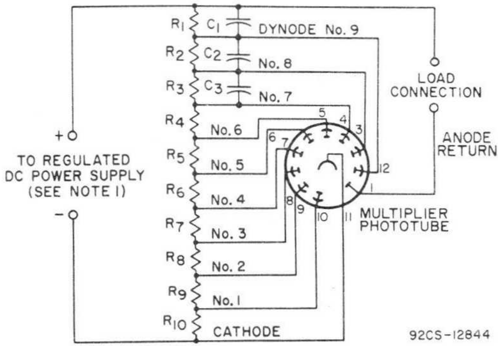
Temperature Cycling. With no voltage applied, the 8571 is subjected to temperature cycling from -45°C to +75°C and back to -45°C in a period of 8 hours. Three temperature cycles are performed.

SCHEMATIC ARRANGEMENT OF STRUCTURE

(Top View)



TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

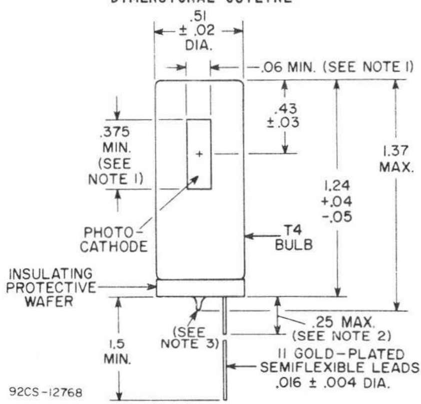


R_1 through R_{10} = 20,000 to 5,000,000 ohms.

NOTE 1: Adjustable between approximately 500 and 1250 volts.

NOTE 2: Capacitors C_1 through C_3 should be connected near tube base for optimum high-frequency performance.

DIMENSIONAL OUTLINE



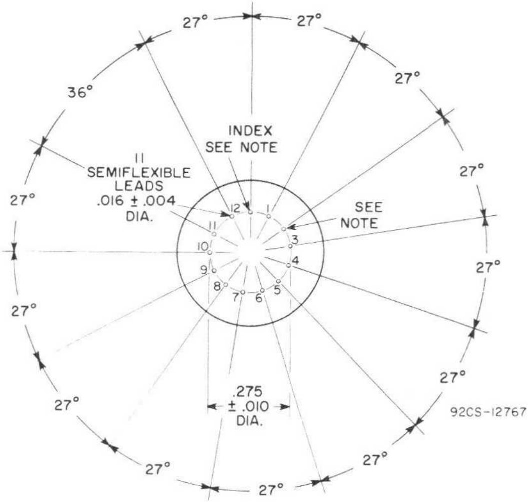
DIMENSIONS IN INCHES

NOTE 1: Minimum projected cathode length and width on plane parallel to grill wires.

NOTE 2: Soldering or welding to the leads within this region is not recommended.

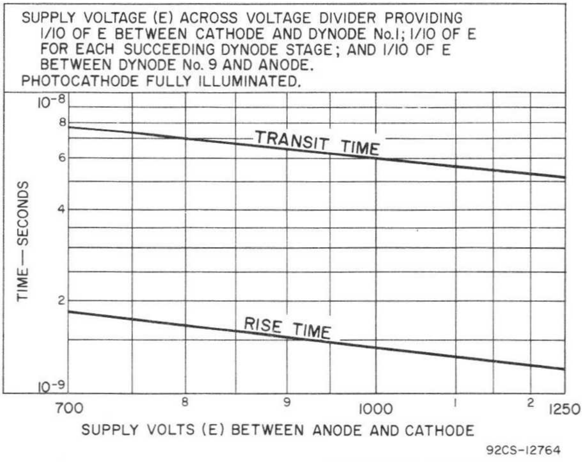
NOTE 3: A 0.15 inch minimum hole diameter should be provided in circuit boards or similar mounting arrangements to allow for clearance of the exhaust tip of the 8571.

BASE DRAWING (Bottom View)



NOTE: Lead is cut off within 0.10 inch of the glass button for indexing.

Typical Time Resolution Characteristics



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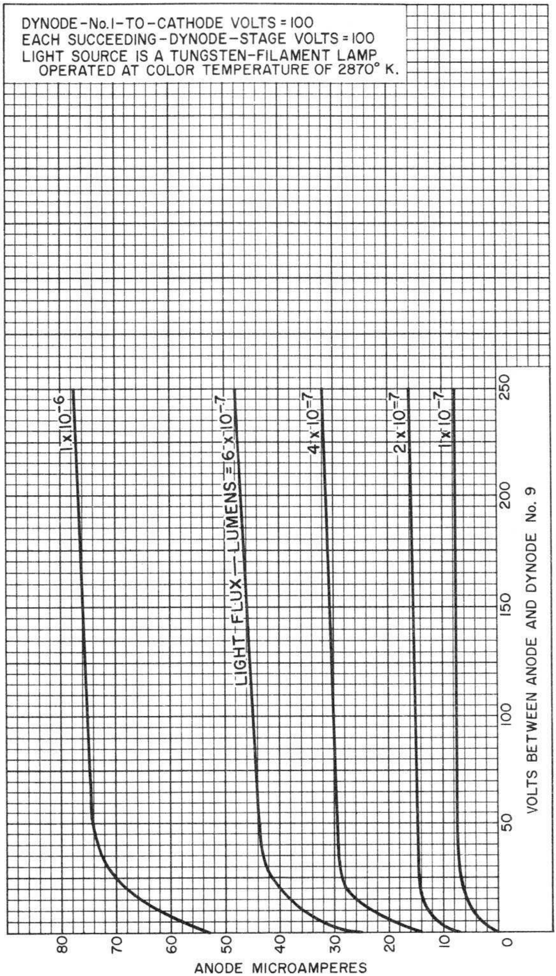
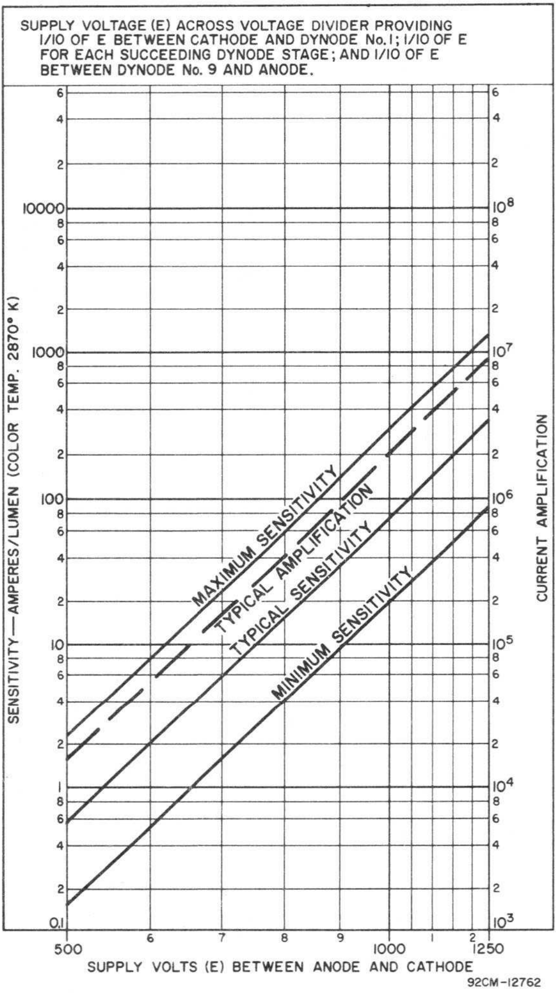
Average Anode Characteristics



92CM-12763

Typical Sensitivity and Current Amplification Characteristics



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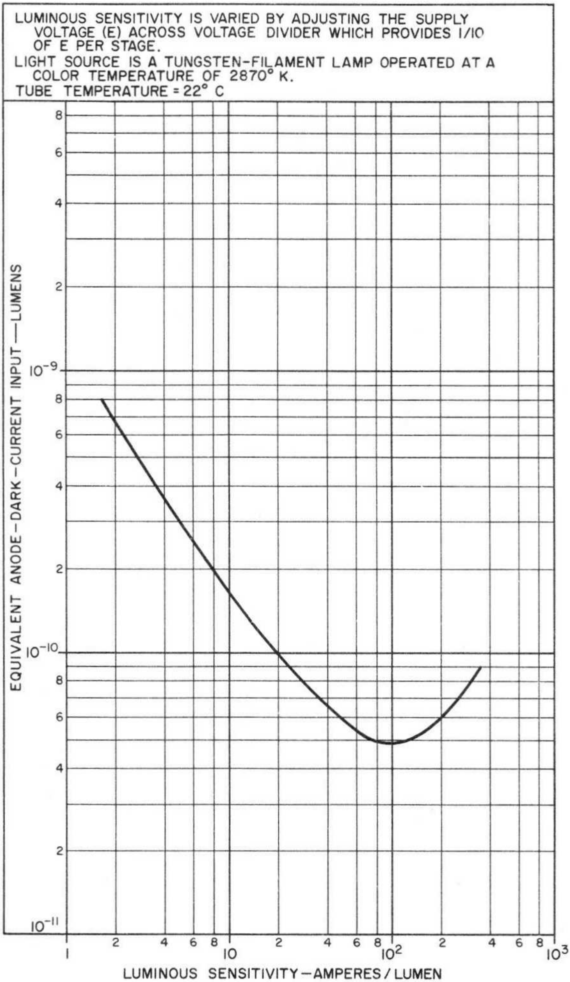
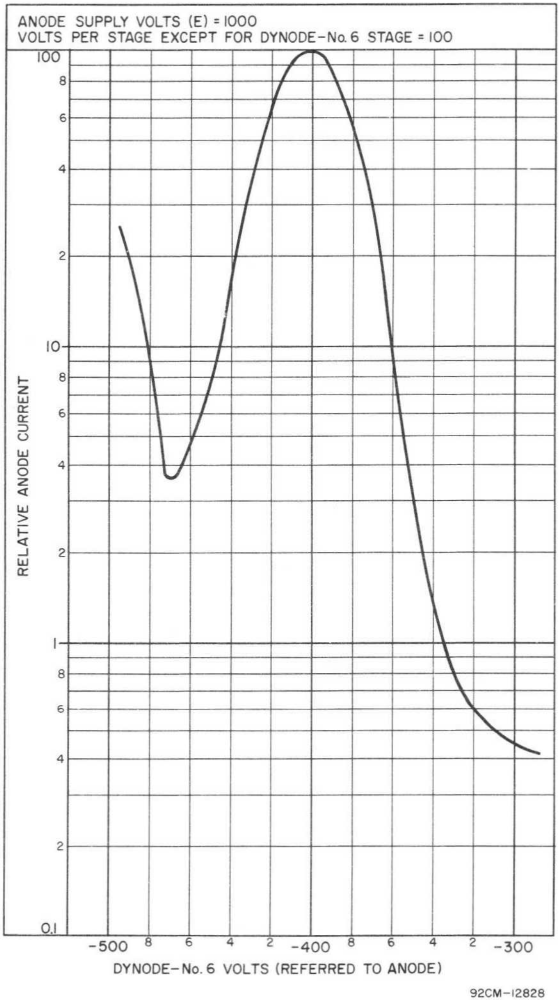
Typical Anode-Dark-Current Characteristic



92CM-12842

Typical Anode Current Modulation Characteristic



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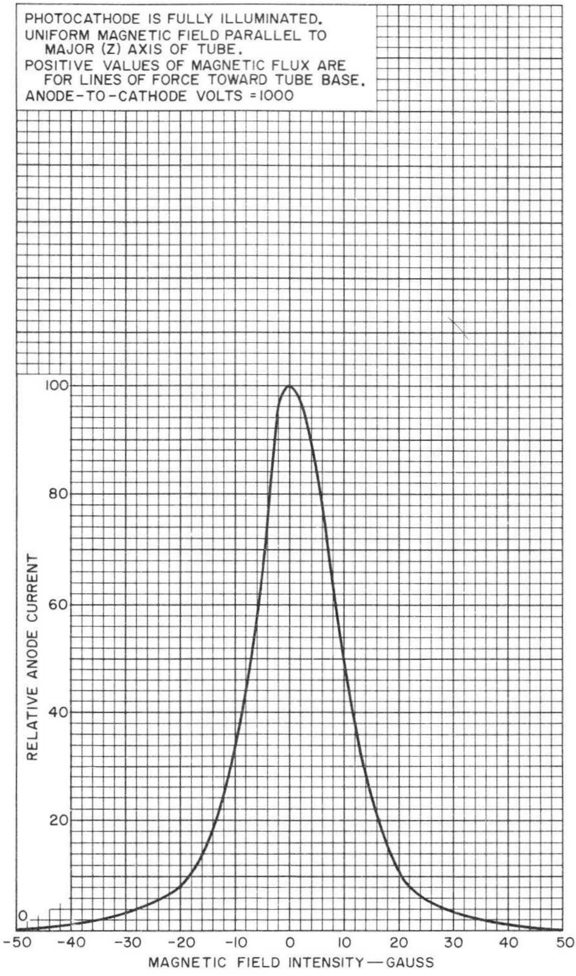
Typical Effect of Magnetic Field on Anode Current



Vidicon

High-Resolution Type for Film Pickup With Color or Black-and-White TV Cameras

GENERAL

Heater, for Unipotential Cathode:

Voltage (AC or DC)	6.3 ± 10% V
Current at 6.3 volts	0.6 A

Direct Interelectrode Capacitance:[a]

Target to all other electrodes	4.6 pF

Spectral Response . . . . . . See accompanying *Typical RCA Type I Spectral Response*

Photoconductive Layer:

Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) . . . . 0.62 in

Orientation of quality rectangle—Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method	Magnetic
Deflection Method	Magnetic
Overall Length	6.250 in ± 0.125 in
Greatest Diameter	1.125 in ± 0.010 in
Bulb	T8
Base	Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)
Socket	Cinch[b] No.54A18088, or equivalent
Deflecting Yoke-Focusing Coil-Alignment Coil Assembly	Cleveland Electronics[c,d] No.VYFA-355-2, or equivalent
Operating Position	Any
Weight (Approx.)	2 oz

ABSOLUTE-MAXIMUM RATINGS

For scanned area of 1/2" x 3/8"

Grid-No.4 Voltage[f]	1000 max. V
Grid-No.3 Voltage[f]	1000 max. V
Grid-No.2 Voltage	750 max. V
Grid-No.1 Voltage:	
Negative bias value	300 max. V
Positive bias value	0 max. V

Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	V
Heater positive with respect to cathode	10 max.	V
Target Voltage	125 max.	V
Dark Current	0.25 max.	μA
Peak Target Current[g]	0.75 max.	μA
Faceplate:		
Illumination[h]	5000 max.	fc
Temperature	71 max.	°C

TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 1/2" x 3/8"
Faceplate temperature of 30° to 35° C and Standard TV Scanning Rate

	Low-Voltage Mode	High-Voltage Mode	
Grid-No.4 (Decelerator) Voltage[f]	500	900	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	300	540	V
Grid-No.2 (Accelerator) Voltage	300	300	V
Grid-No.1 Voltage for Picture Cutoff[j]	-65 to -100	-65 to -100	V
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 μA and 0.2 μA	0.65	0.65	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[k]	300:1	300:1	
Lag—Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed:[m]			
Typical value for minimum lag operation	7.5	7.5	%
Minimum Peak-to-Peak Blanking Voltage:			
When applied to grid No.1	75	75	V
When applied to cathode	20	20	V
Limiting Resolution:			
At center of picture	1000	1100	TV lines
At corner of picture	600	700	TV lines

Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture[n] . .	50	60	%
Field Strength at Center of Focusing Coil[p]	40 ±4	58 ±4	G
Peak Deflecting-Coil Current:			
Horizontal	350	480	mA
Vertical	20	28	mA
Field Strength of Adjustable Alignment Coil[q]	0 to 4	0 to 4	G

Average-Sensitivity Operation (Live-Scene Pickup)
10 Footcandles on Faceplate

Faceplate Illumination (Highlight)	10	fc
Target Voltage[r,s]	25 to 60	V
Dark Current[t]	0.02	µA
Signal-Output Current:[u]		
Typical	0.3	µA

Minimum-Lag Operation (Film Pickup)
100 Footcandles on Faceplate

Faceplate Illumination (Highlight)	100	fc
Target Voltage[r,s]	12 to 30	V
Dark Current[t]	0.004	µA
Signal-Output Current:[u]		
Typical	0.3	µA

[a] This capacitance, which effectively is the output impedance of the tube, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, IL 60007.

[c] Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087.

[d] These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

[f] Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to 5/10; best geometry being provided when the ratio

is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

[g] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[h] For conditions where "white light" is uniformly diffused over entire tube face.

[i] With no blanking voltage on grid No.1.

[k] Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

[m] For initial signal-output current of 0.3 microampere and a dark current of 0.004 microampere.

[n] Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

[p] The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[q] The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

[r] The target voltage for each 8572A must be adjusted to that value which gives the desired operating dark current.

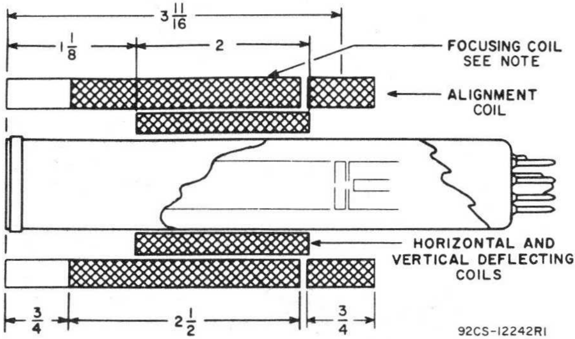
[s] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[t] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal

is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[u] Defined as the component of the highlight target current after the dark-current component has been subtracted.

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS TO OBTAIN MINIMUM BEAM-LANDING ERROR

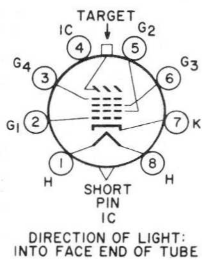


Dimensions in Inches

Note: Cross-hatching indicates wound portion of focusing coil.

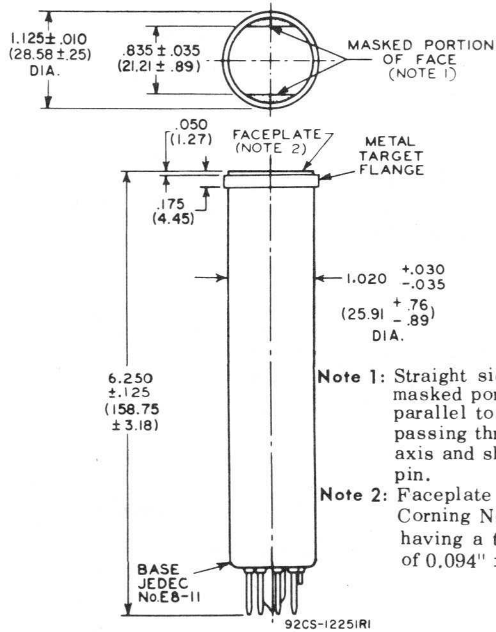
TERMINAL DIAGRAM (Bottom View)

Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin – Internal Connection – Make No Connection



8ME

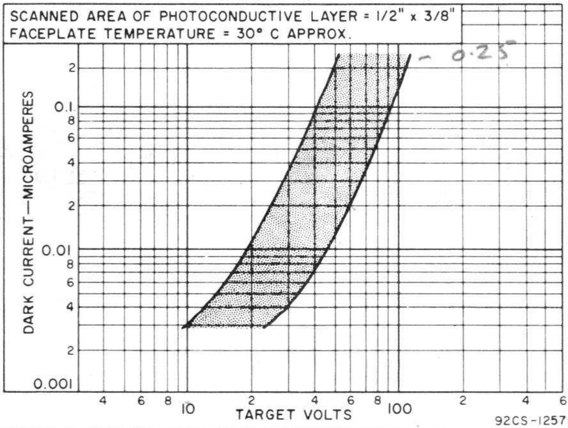
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



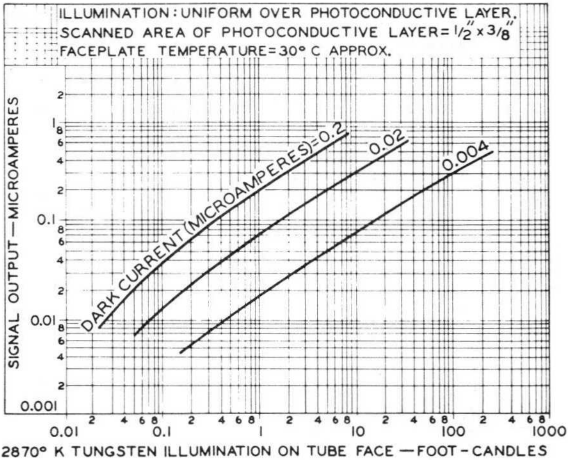
Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

RANGE OF DARK CURRENT

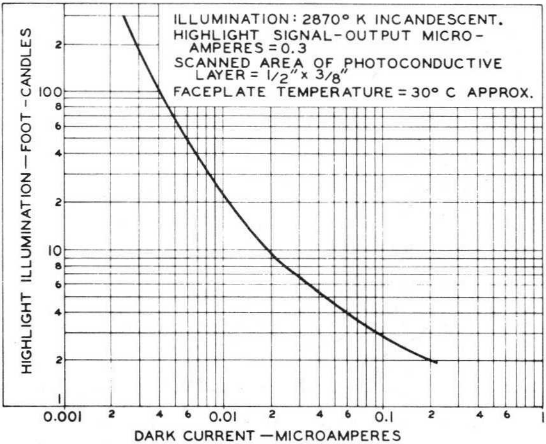


LIGHT TRANSFER CHARACTERISTICS



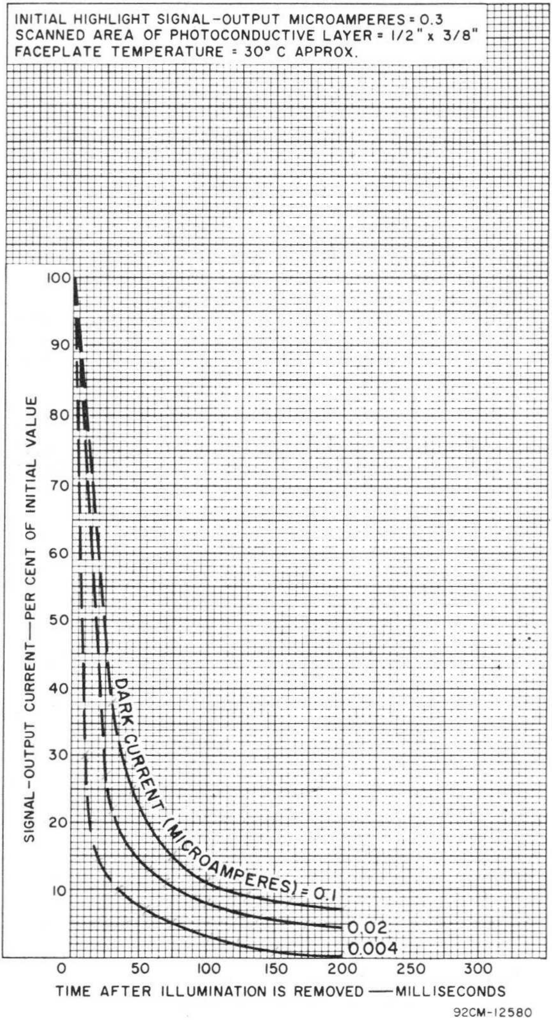
92CS-9495

TYPICAL CHARACTERISTIC



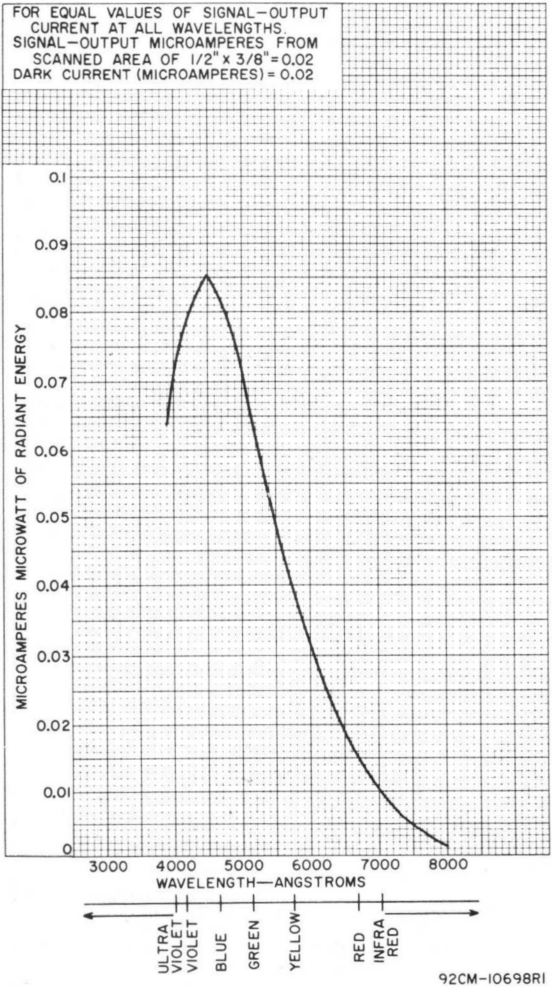
92CS-9493

TYPICAL PERSISTENCE CHARACTERISTICS



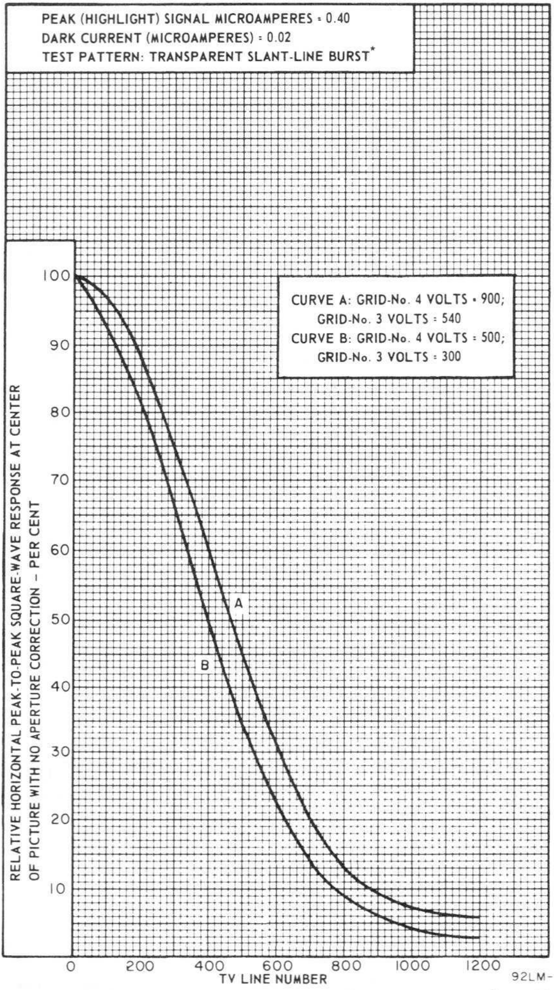
92CM-12580

TYPICAL RCA TYPE I SPECTRAL RESPONSE



92CM-10698R1

HORIZONTAL SQUARE-WAVE RESPONSE



*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

Vidicon

Short, High-Resolution Type Having High Sensitivity and Low Lag for Live Scene Pickup in Transistorized Black-and-White and Color TV Cameras in Industrial and Other Closed-Circuit TV Systems.

GENERAL

Heater, for Unipotential Cathode:
- Voltage (AC or DC) . . . . 6.3 ± 10% V
- Current at 6.3 volts . . . . 0.1 A

Direct Interelectrode Capacitance:[a]
- Target to all other electrodes . . . . 4.6 pF

Spectral Response . . . . See *RCA Type II Spectral Response* at front of this section

Photoconductive Layer:
- Maximum useful diagonal of rectangular image (4 x 3 aspect ratio) . . . . 0.62 in
- Orientation of quality rectangle-Proper orientation is obtained when the horizontal scan is essentially parallel to the straight sides of the masked portions of the faceplate. The straight sides are parallel to the plane passing through the tube axis and short index pin. The masking is for orientation only and does not define the proper scanned area of the photoconductive layer.

Focusing Method. . . . . Magnetic

Deflection Method . . . . Magnetic

Overall Length . . . . 5.12" ± 0.06"

Greatest Diameter . . . . 1.125" ± 0.010"

Bulb. T8

Base . . . . Small-Button Ditetrar 8-Pin, (JEDEC No.E8-11)

Socket . . . . Cinch[b] No.54A18088, or equivalent

Deflecting Yoke-Focusing Coil-Alignment Coil Assembly . . . . Cleveland Electronics[c,d] No.VYFA-355-2, or equivalent

Operating Position . . . . Any

Weight (Approx.). . . . . 2 oz

MAXIMUM RATINGS, *Absolute-Maximum Values:*

For scanned area of 1/2" x 3/8"

Grid-No.4 Voltage[f]	1000 max.	V
Grid-No.3 Voltage[f]	1000 max.	V
Grid-No.2 Voltage	750 max.	V

Grid-No.1 Voltage:	
Negative bias value	300 max. V
Positive bias value	0 max. V
Peak Heater-Cathode Voltage:	
Heater negative with respect to cathode	125 max. V
Heater positive with respect to cathode	10 max. V
Target Voltage	100 max. V
Dark Current	0.25 max. µA
Peak Target Current[g]	0.75 max. µA
Faceplate:	
Illumination[h]	5000 max. fc
Temperature	71 max. °C

TYPICAL OPERATION AND PERFORMANCE DATA

For scanned area of 1/2" x 3/8"
Faceplate temperature of 30° to 35° C and Standard TV Scanning Rate

	Low-Voltage Mode	*High-Voltage Mode*	
Grid-No.4 (Decelerator) Voltage[f]	500	900	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	300	540	V
Grid-No.2 (Accelerator) Voltage	300	300	V
Grid-No.1 Voltage for Picture Cutoff[i]	-65 to -100	-65 to -100	V
Average "Gamma" of Transfer Characteristic for signal-output current between 0.02 µA and 0.2 µA	0.65	0.65	
Visual Equivalent Signal-to-Noise Ratio (Approx.)[k]	300:1	300:1	

Lag-Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed[m]	20	20	%
Minimum Peak-to-Peak Blanking Voltage:			
When applied to grid No.1	75	75	V
When applied to cathode	20	20	V
Limiting Resolution:			
At center of picture	1000	1100	TV lines
At corner of picture	600	700	TV lines
Amplitude Response to a 400 TV line Square-Wave Test Pattern at Center of Picture[n]	50	60	%
Field Strength at Center of Focusing Coil[p]	40 ± 4	58 ± 4	G
Peak Deflecting-Coil Current:			
Horizontal	350	480	mA
Vertical	20	28	mA
Field Strength of Adjustable Alignment Coil[q]	0 to 4	0 to 4	G

Maximum-Sensitivity Operation – 0.1 Footcandle on Faceplate

Faceplate Illumination (Highlight)	0.1	fc
Target Voltage[r,s]	35 to 70	V
Dark Current[t]	0.2	μA
Signal-Output Current:[u]		
Typical	0.14	μA

Intermediate-Sensitivity Operation – 0.5 Footcandle on Faceplate

Faceplate Illumination (Highlight)	0.5	fc
Target Voltage[r,s]	30 to 60	V
Dark Current[t]	0.10	μA
Signal-Output Current:[u]		
Typical	0.27	μA

Average-Sensitivity Operation –
1.0 Footcandle on Faceplate

Faceplate Illumination (Highlight) . . .	1.0	fc
Target Voltage[r,s]	20 to 40	V
Dark Current[t]	0.02	µA
Signal-Output Current:[u]		
Typical	0.20	µA

High-Light Level Operation –
10 Footcandles on Faceplate

Faceplate Illumination (Highlight) . . .	10	fc
Target Voltage[r,s]	10 to 22	V
Dark Current[t]	0.005	µA
Signal-Output Current:[u]		
Typical	0.3	µA

[a] This capacitance, which effectively is the output impedance of the 8573A, is increased when the tube is mounted in the deflecting-yoke and focusing-coil assembly. The resistive component of the output impedance is in the order of 100 megohms.

[b] Made by Cinch Manufacturing Corporation, 1501 Morse Ave., Elk Grove Village, IL 60007.

[c] Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087.

[d] These components are chosen to provide tube operation with minimum beam-landing error when mounted in the recommended position along the tube axis.

[f] Grid-No.4 voltage must always be greater than grid-No.3 voltage. The maximum voltage difference between these electrodes, however, should not exceed 600 volts. The recommended ratio of grid-No.3 to grid-No.4 voltage is 6/10 to 5/10; best geometry being provided when the ratio is 6/10, and most uniform signal output when the ratio is 5/10. The operator should select the ratio within this range which provides the desired performance.

[g] Video amplifiers must be designed properly to handle target currents of this magnitude to avoid amplifier overload or picture distortion.

[h] For conditions where "white light" is uniformly diffused overentire tube face.

[i] With no blanking voltage on grid No.1.

[k] Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 0.35 microampere. Because the noise in such a system is predominately of the high-frequency type, the visual equivalent signal-to-noise ratio is taken as the ratio of the highlight video-signal current to rms noise current, multiplied by a factor of 3.

[m] For initial signal-output current of 0.3 microampere and a dark current of 0.02 microampere.

[n] Amplitude response is the signal amplitude from a given TV line number (fine picture detail) expressed as a per cent of the signal amplitude from a very-low-frequency (large-area) picture element. In practice, the large-detail reference is usually 15 TV lines with signal amplitude set equal to 100 per cent. The TV line numbers are determined by the number of equal-width black and white lines that will fit into the physical height of the image focused on the camera-tube faceplate.

[p] The polarity of the focusing coil should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[q] The alignment coil should be located on the tube so that its center is at a distance of 3-11/16 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

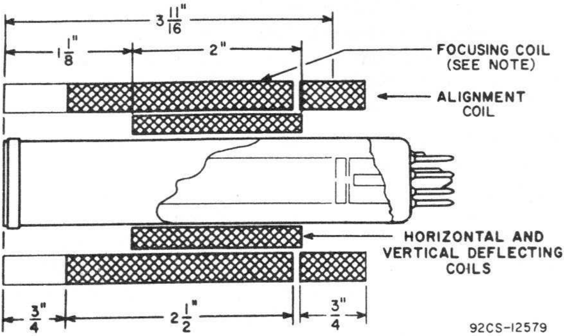
[r] The target voltage for each 8573A must be adjusted to that value which gives the desired operating dark current.

[s] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[t] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

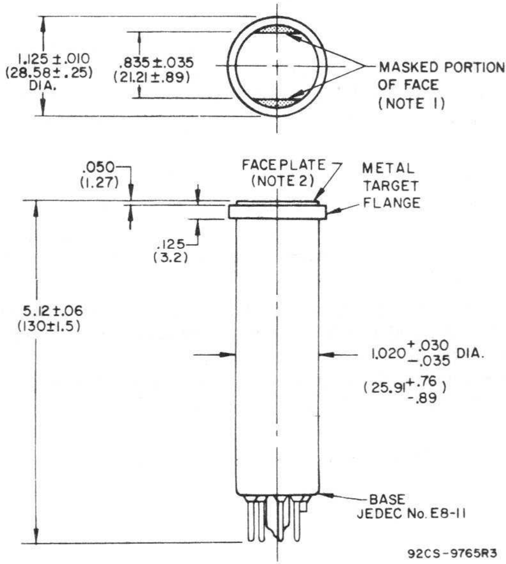
[u] Defined as the component of the highlight target current after the dark-current component has been subtracted.

COMPONENT LOCATIONS



Note: Cross-hatching indicates wound portion of focusing coil.

DIMENSIONAL OUTLINE



NOTES FOR DIMENSIONAL OUTLINE

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

TERMINAL DIAGRAM (Bottom View)

Pin 1: Heater

Pin 2: Grid No.1

Pin 3: Grid No.4

Pin 4: Internal Connection – Do Not Use

Pin 5: Grid No.2

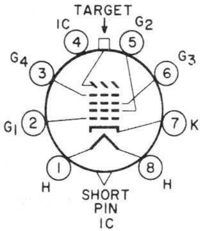
Pin 6: Grid No.3

Pin 7: Cathode

Pin 8: Heater

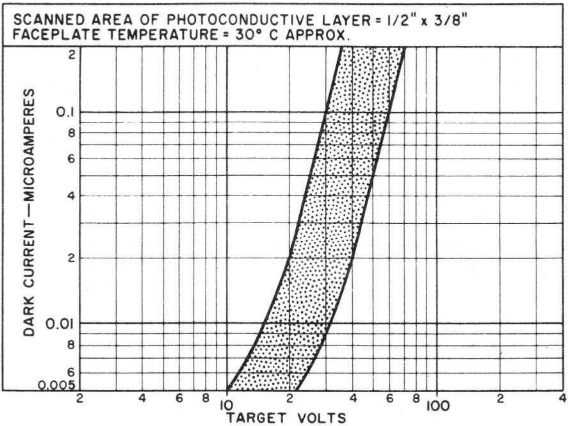
Flange: Target

Short Index Pin – Internal Connection – Make No Connection



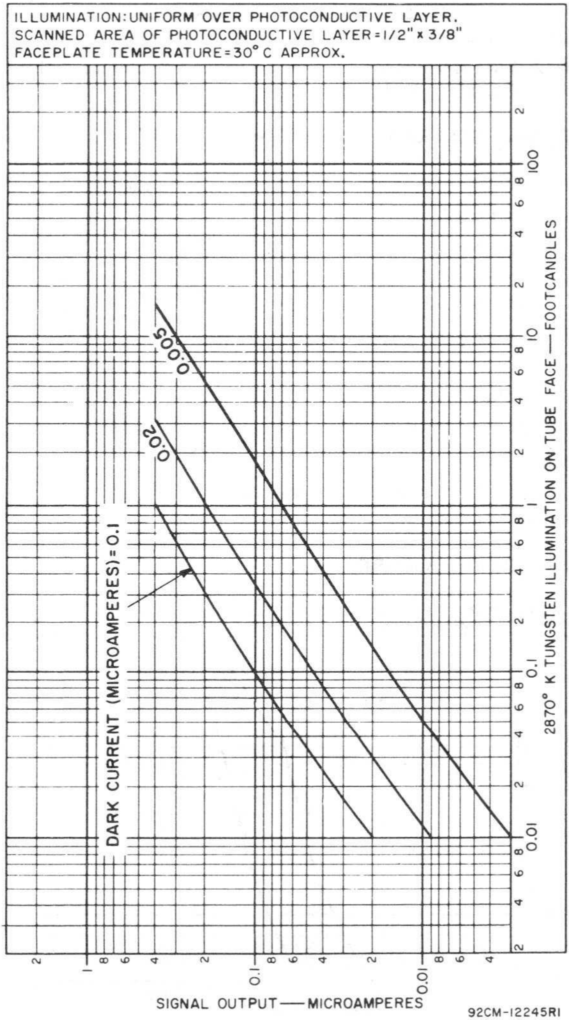
DIRECTION OF LIGHT: INTO FACE END OF TUBE

RANGE OF DARK CURRENT



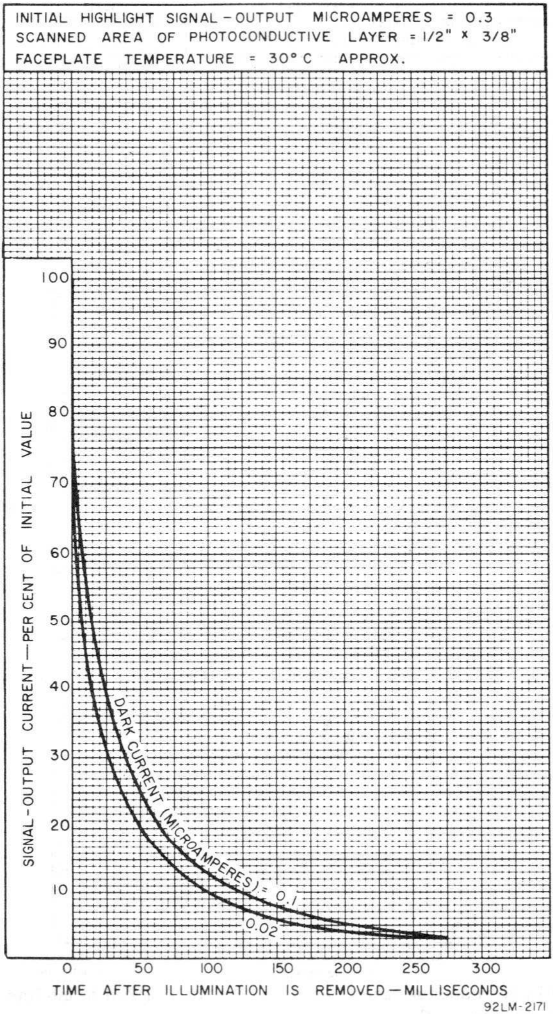
92CS-12235

LIGHT TRANSFER CHARACTERISTICS

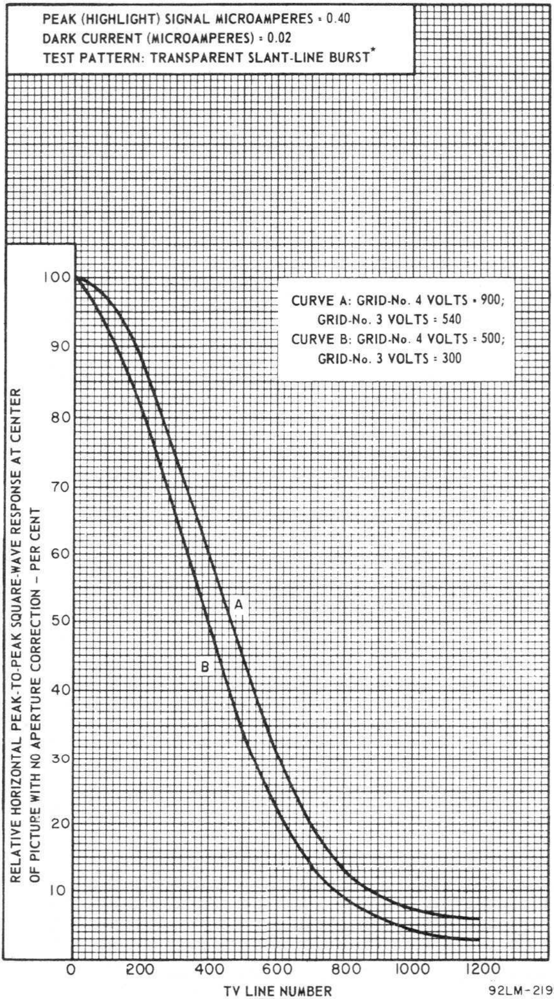


92CM-12245R1

TYPICAL PERSISTENCE CHARACTERISTICS



HORIZONTAL SQUARE-WAVE RESPONSE



*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

Photomultiplier Tube

2"-Diameter, 12-Stage, Head-On Type Having Bialkali Photocathode and In-Line Electrostatically-Focused Dynode Structure

GENERAL

Spectral Response	See accompanying *Typical Photocathode Spectral Response Characteristics*
Wavelength of Maximum Response	3850 ± 500 angstroms
Cathode, Semitransparent	Cesium-Potassium-Antimony (Bialkali)
Minimum projected area	2.54 sq. in
Minimum diameter	1.80 in
Window	Pyrex, Corning[a] No.7740, or equivalent
Shape	Plano-Concave
Index of refraction at 5893 angstroms	1.47
Dynodes:	
Substrate	Copper-Beryllium
Secondary-Emitting Surface	Beryllium-Oxide
Structure	In-Line Electrostatic-Focus Type
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.12	5 pF
Anode to all other electrodes	6 pF
Maximum Overall Length	5.71 in
Seated Length	4.98 ± 0.08 in
Maximum Diameter	2.10 in
Bulb	T16
Base	See Base Drawing
Socket	RCA AJ2144 or AJ2145[b]
Magnetic Shield	See footnote (c)
Operating Position	Any
Weight (Approx.)	6 oz

MAXIMUM AND MINIMUM RATINGS, *Absolute-Maximum Values:*

DC Supply Voltage:

Between anode and cathode:

With Voltage Distribution A shown in Table I	3000	max.	V
	800	min.	V
With Voltage Distribution B shown in Table I	3000	max.	V
	1300	min.	V

With Voltage Distribution C shown in Table I	3500	max.	V
	800	min.	V
Between anode and dynode No.12	800	max.	V
Between dynode No.12 and dynode No.11	800	max.	V
Between consecutive dynodes	400	max.	V
Between dynode No.1 and cathode	1000	max.	V
	300	min.	V
Between focusing electrode and cathode	1000	max.	V
Average Anode Current[e]	0.2	max.	mA
Ambient-Temperature Range[f]	-100 to +85		°C

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I, and at a temperature of 22° C.

With E = 2000 volts (Except as noted)

Voltage Distribution A, Table I

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[g] at 3850 angstroms	–	9.7×10^5	–	A/W
Luminous[h] (2870° K)	100	850	3000	A/lm
Current with blue light source[j] (2870° K + C.S. No.5-58)	1.3×10^{-6}	1.1×10^{-5}	4×10^{-5}	A
Cathode Sensitivity:				
Radiant[k] at 3850 angstroms	–	0.097	–	A/W
Luminous[m] (2870° K)	6.2×10^{-5}	8.5×10^{-5}	–	A/lm
Current with blue light source[n] (2870° K + C.S. No.5-58)	8×10^{-10}	1.1×10^{-9}	–	A
Quantum Efficiency at 3850 angstroms[p]	–	31	–	%
Current Amplification	–	1×10^7	–	
Anode Dark Current[q]	–	1×10^{-9}	4×10^{-9}	A

→ Indicates a change or addition.

	Min.	Typ.	Max.	
Equivalent Anode Dark Current Input[q]	–	5×10^{-12}	2×10^{-11}	lm
	–	4.4×10^{-15}[r]	1.8×10^{-14}[r]	W
Equivalent Noise Input[s]	–	1.8×10^{-13}	–	lm
	–	1.6×10^{-16}[t]		W
Dark Pulse Summation[u]:				
1/8 photoelectron to 16 photoelectrons .	–	660	–	counts per seconds
See *Typical Dark-Pulse Spectrum*				
Anode-Pulse Rise Time[v] at 3000 V . .	–	2.1×10^{-9}	–	s
Electron Transit Time[w] at 3000 V . .	–	3.1×10^{-8}	–	s
With E = 1100 volts (Except as noted)				
Voltage Distribution A, Table I				
Pulse Height Resolution[x]	–	7.5	8	%
Pulse Height[y]	4.9×10^{-12}	1.5×10^{-11}	1.5×10^{-10}	coulombs
Peak-to-Valley Ratio of Pulse Height Spectrum with Fe^{55} Source[z]	–	38	–	
Mean Gain Deviation:[aa]				
With count rate change of 1000 to 10000 cps[bb] . . .	–	1	–	%
For a period of 16 hours at a count rate of 1000 cps[cc]	–	1	–	%
With E = 3000 volts				
Voltage Distribution C, Table I				
Pulse Current:[dd]				
Linear[ee]	–	0.15	–	A
Space-charge limited (saturated)	–	0.50	–	A

a Made by Corning Glass, Corning, NY 14830.

b The AJ2145 is ordinarily supplied with the tube and is designed specifically for chassis mounting. The AJ2144 may be supplied as an alternate socket if requested by the user. The AJ2144 is designed for use in any desired mounting arrangement. It is supplied with an unattached clamp ring which fits to either the top or bottom of its socket body to permit chassis mounting. The ring is not normally required for other mounting arrangements and can be discarded to make such arrangements more compact.

c Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago, IL, 60622, or equivalent.

e Averaged over any interval of 30 seconds maximum.

f Tube operation at room temperature or below is recommended.

g This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

h These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-7}\text{ (lm)}}$$

The value of 0.13 is the average value of the ratio of the anode current measured under the conditions specified in footnote (j) to the anode current measured under the same conditions but with the blue filter removed.

j 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 1×10^{-7} lumen.

k This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

m These values are calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-4}\text{ (lm)}}$$

The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote (n) to the cathode current measured under the same conditions but with the blue filter removed.

n Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870^{o} K. The value of light flux incident on the filter is 100 microlumens and 500 volts are applied between cathode and all other electrodes connected as anode.

p Calculated from the cathode current measured with blue light source.

q Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 0.1 microlumen. The supply voltage E is adjusted to obtain an anode current of 2.6 microamperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 200 amperes per lumen. Dark current is measured with incident light removed.

r At 3850 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1140 lumens per watt.

s Under the following conditions: External shield connected to cathode, an equivalent bandwidth of 1 Hz, 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.

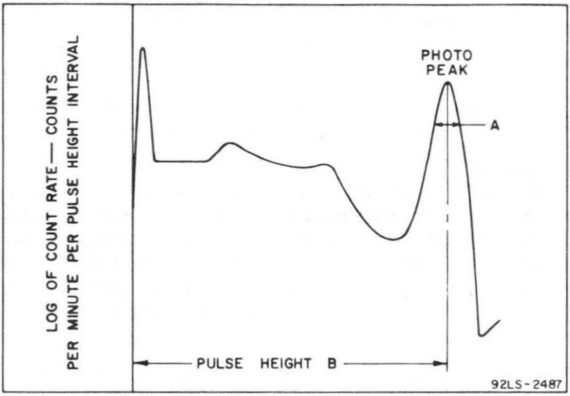
t At 3850 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1140 lumens per watt.

u Measured as shown under (q) and with the tube in complete darkness. The pulse height for the single photoelectron equivalent is determined by using a light source operated at a low color temperature to assure the high probability of single photoelectron emission from the photocathode of the tube. The intensity of the light source is adjusted for approximately 10^4 photons per second. This light is removed before the dark pulse summation is measured.

v 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.

w 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.

x Anode load is a 100 kilohm resistor with a total capacitance of 100 ± 3% pF in parallel. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photon from a 1 microcurie Cs^{137} source and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator [NaI (Tl)-type 8D8S50, Serial No.BR772, or equivalent] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, OH, and is rated by the manufacturer as having a resolving capability of 8.2 per cent to 8.3 per cent. The Cs^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the tube by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 60,000 centistokes)—Manufactured by the Dow Cornign Corp., Midland, MI, or equivalent. Pulse height resolution in per cent is defined as 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height (A) to the pulse height at maximum photopeak count rate (B).



y Pulse height is defined as the average charge collected at the anode from a pulse caused by the photoelectric absorption of a 662 keV photon from Cs^{137} in a thallium-activated sodium-iodide scintillator, NaI(Tl).

z Measured using a Harshaw Type HG 0.005" beryllium window NaI(Tl) scintillator, 0.04" thick and 7/8" in diameter and an isotope of iron having an atomic mass of 55 (Fe^{55}) and an effective activity at the scintillator of one microcurie.

aa Mean gain deviation is defined as follows:

$$\mathrm{MGD} = \frac{\sum_{i=1}^{i=n} \left| \bar{p} - p_i \right|}{n} \cdot \frac{100}{\bar{p}}$$

where: $\bar{p}$ = mean pulse height
p_i = pulse height at the "ith" reading
n = total number of readings

bb Under the following conditions: The scintillator and Cs^{137} radiation source of (x) are employed. The radiation source is initially centered, on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 1000 cps. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 10,000 cps. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. The difference in pulse height between these two measurements is typically 1 per cent.

cc Under the same conditions as (bb) except the count rate position of 1,000 cps is maintained for 16 hours and the pulse height is sampled at 1 hour intervals.

dd The interstage voltages of the tube should not deviate more than 2 per cent from the specified voltage distribution. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure this operating condition.

ee Maximum deviation from linearity is 2 per cent.

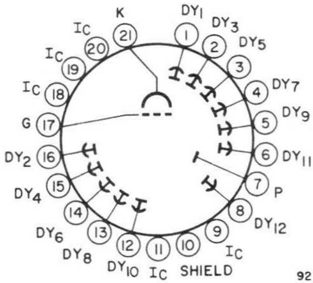
Table I			
Voltages To Be Provided By Divider			
Between the Following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	**Column A**	**Column B**	**Column C**
	6.1% of Supply Voltage (E) multiplied by	**8.06% of Dy1 – P Voltage (E) multiplied by**	**4.6% of Supply Voltage (E) multiplied by**
K – Dy1	4.0	♠	4.0
Dy1 – Dy2	1.0	1.0	1.0
Dy2 – Dy3	1.4	1.4	1.4
Dy3 – Dy4	1.0	1.0	1.0
Dy4 – Dy5	1.0	1.0	1.0
Dy5 – Dy6	1.0	1.0	1.0
Dy6 – Dy7	1.0	1.0	1.0
Dy7 – Dy8	1.0	1.0	1.0
Dy8 – Dy9	1.0	1.0	1.0
Dy9 – Dy10	1.0	1.0	1.5
Dy10 – Dy11	1.0	1.0	2.0
Dy11 – Dy12	1.0	1.0	4.0
Dy12 – P	1.0	1.0	2.0
Dy1 – P	—	12.4	—
K – P	16.4	—	21.9

Focusing Electrode (Pin 17) connected to dynode No.1 potential.
Electron Multiplier Shield (Pin 10) connected to dynode No.5 potential.
♠Cathode-to-Dynode-No.1 Voltage maintained at 660 volts.

TERMINAL CONNECTIONS

The base pins of the tube fit a 21-contact socket such as the RCA-AJ2144 and the AJ2145.

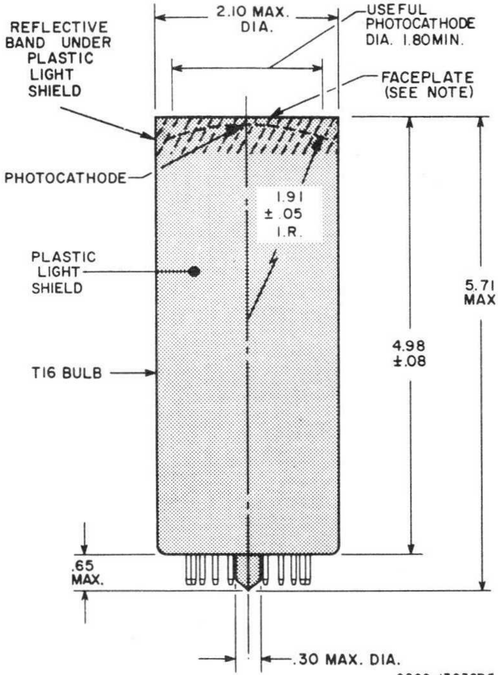
BASING DIAGRAM (BOTTOM VIEW)



DIRECTION OF RADIATION:
INTO END OF BULB

92LS-2812

DIMENSIONAL OUTLINE



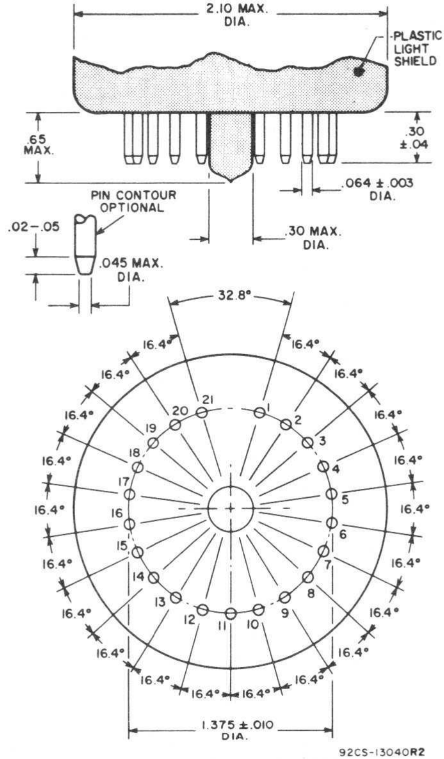
Dimensions in Inches

Note: Deviation from Flatness of External Surface of Faceplate will not exceed 0.010" from Peak to Valley.

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

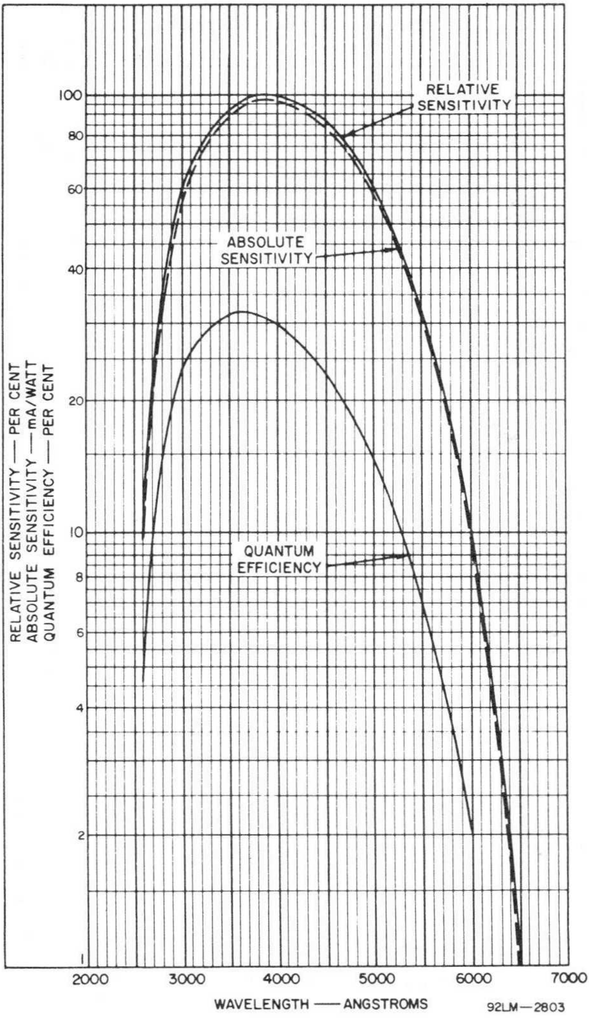
Inch	mm	Inch	mm	Inch	mm
.003	.08	.05	1.3	1.375	34.93
.010	.25	.064	1.63	1.80	45.7
.02	.5	.08	2.0	1.91	48.5
.04	1.0	.30	7.6	2.10	53.3
.045	1.14	.65	16.5	4.98	126.5
				5.71	145.0

DETAIL OF BASE ARRANGEMENT



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: Dynode No.11
Pin 7: Anode
Pin 8: Dynode No.12
Pin 9: Internal Connection, Do not use
Pin 10: Electron Multiplier Shield
Pin 11: Internal Connection, Do not use
Pin 12: Dynode No.10
Pin 13: Dynode No.8
Pin 14: Dynode No.6
Pin 15: Dynode No.4
Pin 16: Dynode No.2
Pin 17: Focusing Electrode
Pin 18: Internal Connection, Do not use
Pin 19: Internal Connection, Do not use
Pin 20: Internal Connection, Do not use
Pin 21: Photocathode

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

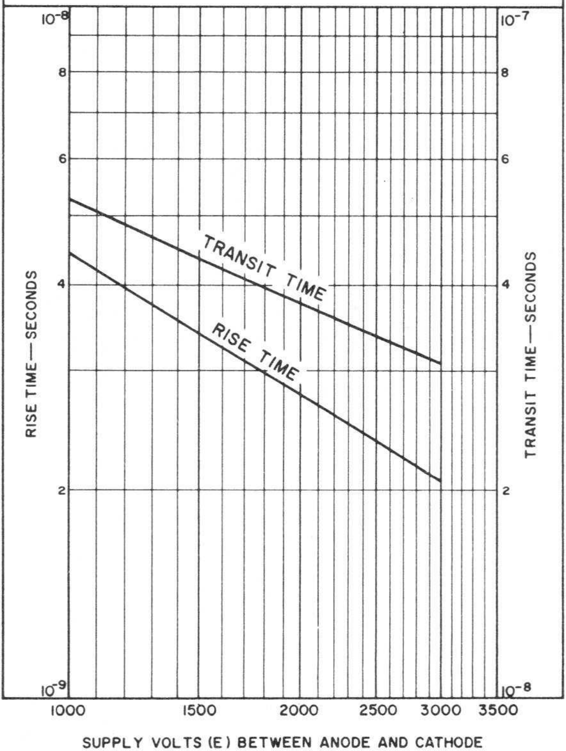


TYPICAL TIME-RESOLUTION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	4.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE-STAGE VOLTS	1.0
ANODE AND CATHODE	16.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.



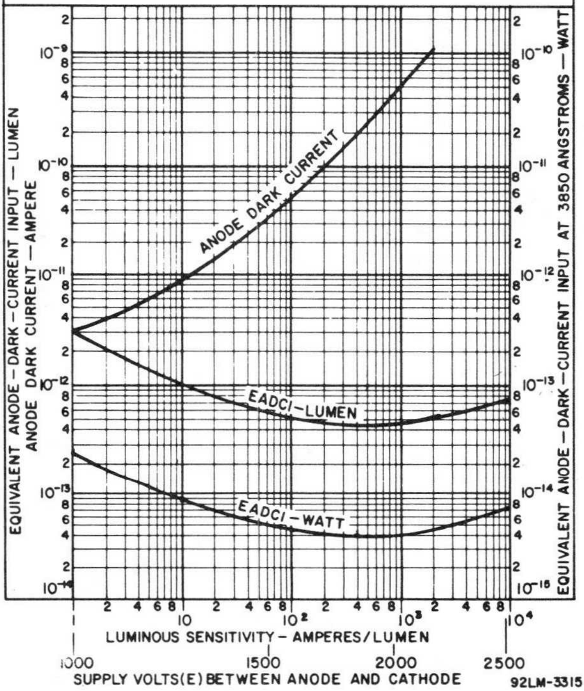
92CM-13042

TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN	6.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	4.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE-STAGE VOLTS	1.0
ANODE AND CATHODE	16.4

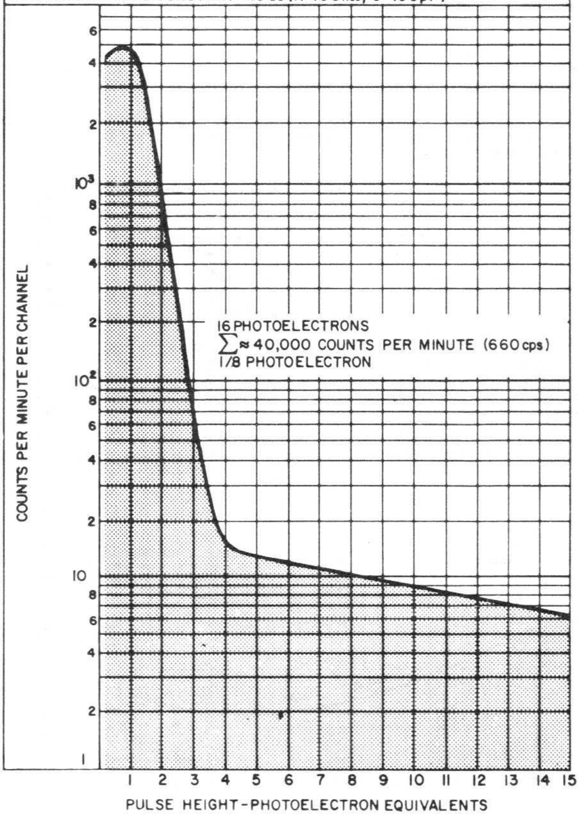
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE No. 5 POTENTIAL.
FOCUSING ELECTRODE IS CONNECTED TO DYNODE No. 1 POTENTIAL.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22°C



92LM-3315

TYPICAL DARK-PULSE SPECTRUM

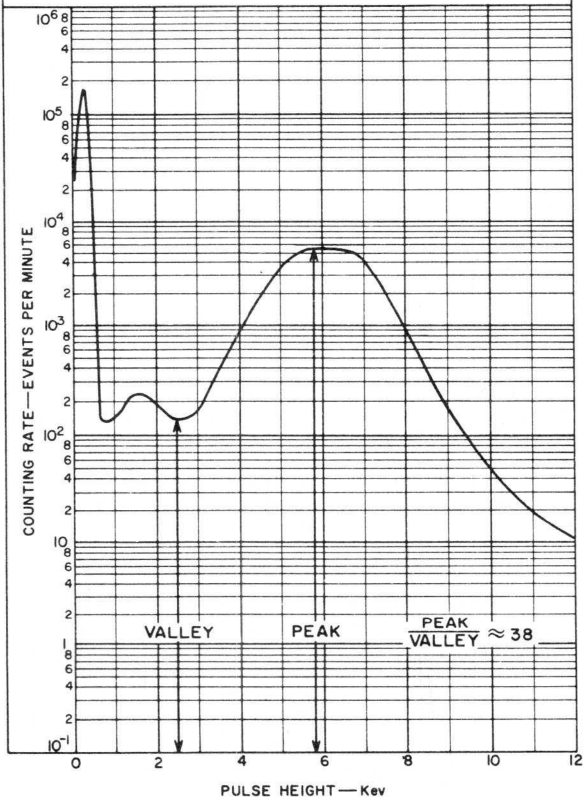
MEASURED UNDER THE FOLLOWING CONDITIONS: LIGHT ON CATHODE IS TRANSMITTED THROUGH A BLUE FILTER (CORNING C.S. No. 5-58, POLISHED TO 1/2 STOCK THICKNESS). LIGHT ON FILTER IS 0.1 MICROLUMEN. VOLTAGE DISTRIBUTION (A) IS USED AND SUPPLY VOLTAGE ADJUSTED TO OBTAIN AN ANODE CURRENT OF 2.6 MICROAMPERES. LIGHT IS EXCLUDED DURING MEASUREMENT.
FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No.1 POTENTIAL
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL
TUBE TEMPERATURE = 22°C
ONE PHOTOELECTRON PULSE HEIGHT = 8 COUNTING CHANNELS
INTEGRATING TIME CONSTANT = 10 us (R = 100kΩ, C = 100pF)



92LM-3314

DIFFERENTIAL FE^{55} SPECTRUM

Fe^{55} SOURCE, ACTIVITY 1 μ CURIE
SCINTILLATOR: HARSHAW, TYPE HG 0.005" BERYLLIUM WINDOW, NaI(Tl), 7/8" DIAMETER, 0.040" THICK
CATHODE-TO-DYNODE-No. 1 VOLTS = 420
DYNODE-No. 1-TO-DYNODE-No. 2 VOLTS = 105
DYNODE-No. 2-TO-DYNODE-No. 3 VOLTS = 155
EACH SUCCEEDING DYNODE-STAGE VOLTS = 105
ANODE-TO-CATHODE VOLTS = 1700
FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.



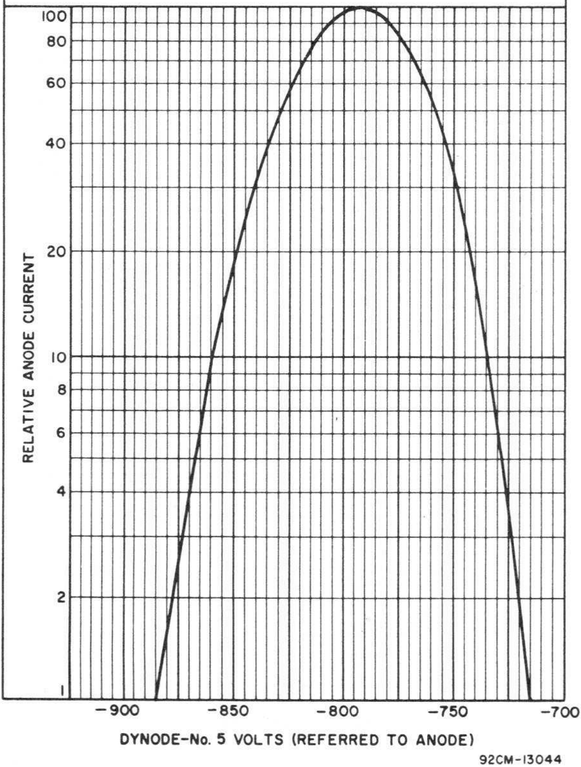
92CM-13047

TYPICAL DYNODE MODULATION CHARACTERISTIC

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

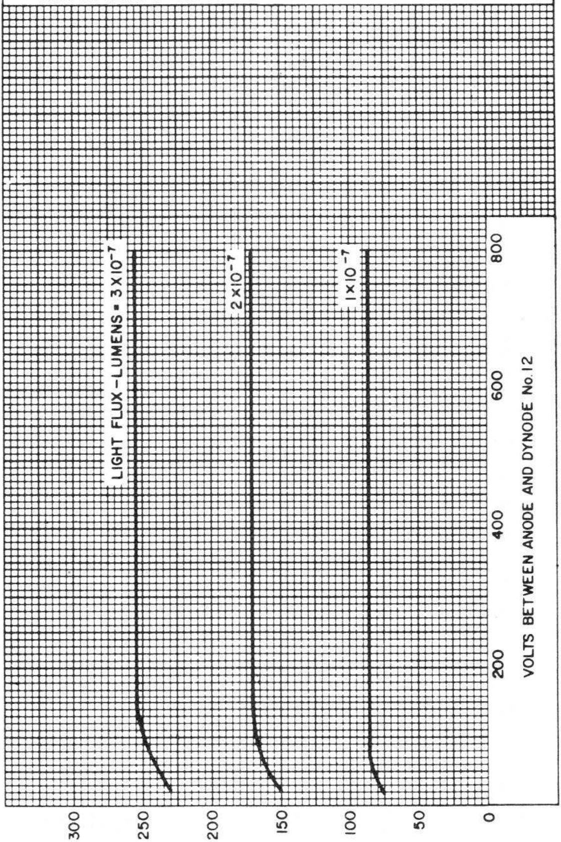
BETWEEN	6.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	4.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE-STAGE VOLTS	1.0
ANODE AND CATHODE	16.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
CATHODE IS AT GROUND POTENTIAL.



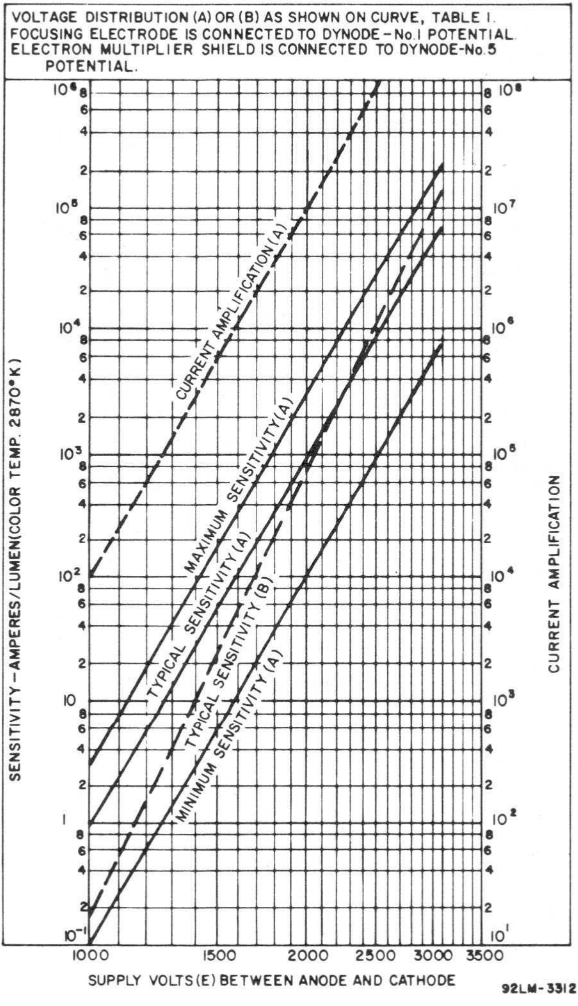
TYPICAL ANODE CHARACTERISTICS

CATHODE-TO-DYNODE-No.1 VOLTS = 488
DYNODE-No.1-TO-DYNODE-No.2 VOLTS = 122
DYNODE-No.2-TO-DYNODE-No.3 VOLTS = 175
EACH SUCCEEDING DYNODE-STAGE VOLTS = 122
ANODE—TO—CATHODE VOLTS = 2000
FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No.5 POTENTIAL
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.



92LM-3313

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

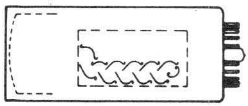


TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

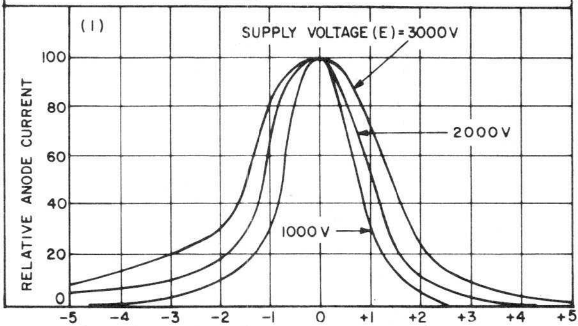
THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

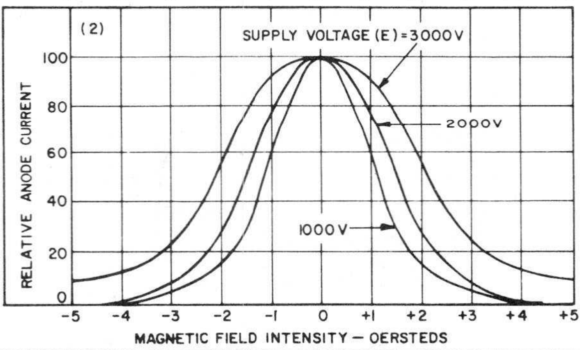
BETWEEN:	6.1 % OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	4.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	16.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

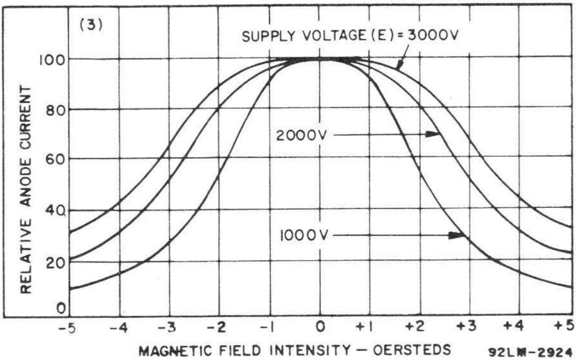


POSITIVE VALUE OF H IN DIRECTION SHOWN:
(1)* •, (2) ↑ OR (3) →
* DIRECTION (1) IS OUT OF PAPER





TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)



TYPICAL FOCUSING-ELECTRODE CHARACTERISTIC

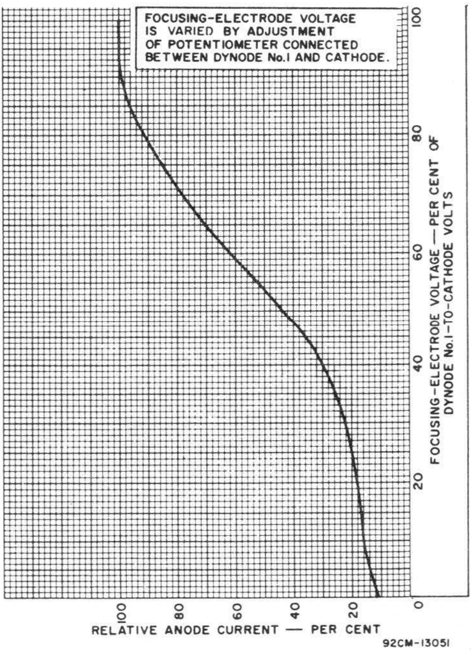


Image Intensifier Tubes

Fiber-Optic Input and Output Faceplates

Integrated Voltage Multiplier Incorporated in 8606

Ruggedized Construction

S-20 Spectral Response with Extended Red Sensitivity

P20 Phosphor Screen

GENERAL

Each Type

Spectral Response	S-20 with extended red response
Wavelength of Maximum Response	4700 +1000 Å / - 500 Å
Photocathode:	
Material	Na-K-Cs-Sb (Multialkali)
Minimum useful area	
Type 8606	11.1 cm^2 (1.70 in^2)
Types 8605/V1, 8605/V2	12.6 cm^2 (1.96 in^2)
Minimum useful diameter	
Type 8606	37.5 mm (1.47 in)
Types 8605/V1, 8605/V2	40 mm (1.58 in)
Image surface:	
Shape	Flat, Circular
Material	Fiber-Optics
Fluorescent Screen:	
Minimum useful area	13.8 cm^2 (2.14 in^2)
Minimum useful diameter	42 mm (1.65 in)
Phosphor	P20, Aluminized
Fluorescence and phosphorescence	Yellow-Green
Persistence	Medium to Medium Short
Image surface:	
Shape	Flat, Circular
Material	Fiber-Optics
Focusing Method	Electrostatic

♦**Note**: The 8605/V1 is equivalent to the image intensifier designated 8605-1 by the military and the 8605/V2 is equivalent to the image intensifiers designated 8605-2 and 8605-3.

Tube Dimensions:

Maximum overall length

Type 8606	12.028 in (302.51 mm)
Types 8605/V1, 8605/V2	3.705 in (94.2 mm)

Maximum diameter

Type 8606	3.737 in (95.10 mm)
Types 8605/V1, 8605/V2	3.05* in (77.5 mm)

Operating Position . . . . Any

Weight (Approx.)

Type 8606.	4 lbs 8 oz (2.04 kg)
Types 8605/V1, 8605/V2	14 oz (0.396 kg)

MAXIMUM RATINGS, *Absolute-Maximum Values*

Peak-to-Peak AC Input Voltage[b]

Type 8606 . . . . 2.8 kV, 1200 to 2000 Hz

DC Anode-to-Cathode Voltage

Types 8605/V1, 8605/V2 . . . . . . 16 kV

Screen Luminance (Brightness)

Types 8605/V1, 8605/V2 . . . . . . 125 fL

Each Type

Ambient-Temperature Range:

Non-operating	-54° to +68° C
Operating	-54° to +52° C

ELECTRICAL CHARACTERISTICS, Type 8606 Only

	Min.	Typical	Max.
Input Capacity[c]	22	–	55

*Excluding exhaust tubulation cap.

TYPICAL PERFORMANCE CHARACTERISTICS

Characteristic	Type 8606 Under conditions with 2.7 ± .05 kV 1500 Hz applied and at an ambient temperature of 22° C, unless otherwise noted.			Type 8605/V1 Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.			Type 8605/V2 Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.			
	Min.	Typical	Max.	Min.	Typical	Max.	Min.	Typical	Max.	Units
Resolution:										
Center[d]	25	35	–	57	70	–	57	70	–	Line-Pairs/mm
Edge[e] (Peripheral) . . .	23	30	–	45	–	–	45	–	–	Line-Pairs/mm
Screen Luminance (Brightness) . . .	–	–	125[f]	–	–	–	–	–	–	fL
Luminance Gain:[g]										
At 22° C	3.5×10^4	–	–	65[h]	–	–	–	–	–	fL/fc
At -54° C	2.8×10^4	–	–	–	–	–	–	–	–	fL/fc
With green light source	–	–	–	–	–	–	22[i]	–	–	fL/fc

TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

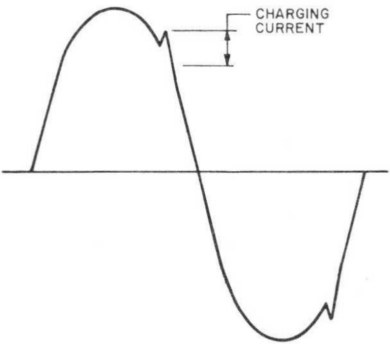
Characteristic	**Type 8606** Under conditions with 2.7 ± .05 kV 1500 Hz applied and at an ambient temperature of 22° C, unless otherwise noted.			**Type 8605/V1** Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.			**Type 8605/V2** Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.			
Equivalent Screen Background Input:										
Luminous[k]	–	–	2×10^{-11}	–	–	2×10^{-11}	–	–	2×10^{-10}	lm/cm^2
Photocathode Sensitivity:										
Radiant:										
At 4700 Å[m] . . .	–	4.6×10^{-2}	–	–	4.6×10^{-2}	–	–	4.6×10^{-2}	–	A/W
At 8000 Å	6×10^{-3}	–	–	6×10^{-3}	–	–	–	–	–	A/W
At 8500 Å	1×10^{-3}	–	–	1×10^{-3}	–	–	–	–	–	A/W
Luminous[n]	1.75×10^{-4}	2×10^{-4}	–	1.75×10^{-4}	2×10^{-4}	–	–	1.6×10^{-4}	–	A/lm
Luminance Uniformity	–	–	3:1[p]	–	1.4:1[q]	2:1[q]	–	1.4:1[r]	2:1[r]	
Modulation Transfer Function (MTF):[s] (S[illegible]ext page)										

TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

Characteristic	**Type 8606** Under conditions with 2.7 ± .05 kV 1500 Hz applied and at an ambient temperature of 22° C, unless otherwise noted.			**Type 8605/V1** Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.			**Type 8605/V2** Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.			
For 2.5 Line-Pairs/mm	90	95	–	–	–	–	–	–	–	%
For 7.5 Line-Pairs/mm	55	60	–	–	–	–	–	–	–	%
For 16 Line-Pairs/mm	10	20	–	–	–	–	–	–	–	%
Paraxial Image Magnification (Cmx)†	0.82	–	1.0	0.94	–	1.0	0.94	–	1.0	
Edge Image Magnification[u] . .	1.0	–	1.06	–	–	–	–	–	–	
Image Alignment[v]	–	–	0.06	–	–	0.02	–	–	0.02	in
Image Stability in 30 seconds[w]	–	–	0.005	–	–	0.005	–	–	0.005	in
Distortion[x]	–	–	25	–	–	8	–	–	8	%

[b] Suitable oscillators providing this input voltage are available from the Microsemiconductor Corporation, Culver City, CA; Varo, Inc., Plano, TX 75074; or Venus Scientific Inc., 25 Bloomingdale Road, Hicksville, NY 11801.

[c] At the maximum rated peak-to-peak ac input voltage of 2.8 kV, 1200 to 2000 Hz, the maximum dc charging current will not exceed 200 microamperes. Charging current is defined as the peak value of the rectified charging current after the sinusoidal component has been subtracted. See waveshape below. Input capacity is measured at a temperature of +52° C, with operating voltage applied, no light incident on the photocathode, and the tube shielded in a close-fitting, grounded metallic cylinder.



92LS-3104

[d] The resolution, both horizontal and vertical, is determined with a test pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated a "line-pair."

[e] This minimum value applies at a distance of 11 mm from the major (optical) axis of the tube.

[f] With 1×10^{-3} footcandle or greater on the photocathode. The 8606 must be protected from overload by the use of a low power output oscillator when exposed to illumination levels above the specified value. Oscillators meeting the Military Specification 052374 are satisfactory. Vendors see footnote (b).

[g] Luminance Gain is defined as the quotient of screen brightness in footlamberts by the photocathode illumination in footcandles provided by a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light input radiation on the photocathode image surface is in the range of 1×10^{-5} to 3×10^{-5} footcandle.

[h] Under same conditions of footnote (g) except input radiation on photocathode is 5×10^{-2} footcandle. Anode voltage is 15 kV.

[i] Under the same conditions of footnote (g) except that a light input of 5×10^{-2} footcandle is incident on Corning C.S. No.3-71 and C.S. No.4-67 interposed between the light source and the tube. Anode voltage is 15 kV. Use of these filters in conjunction with the 2854° K source closely approximates the P20 spectral distribution.

[k] Defined as the equivalent value of luminous flux from a tungsten-filament lamp operating at 2854° K that would be required to cause an increase in screen brightness equal to screen background brightness.

[m] For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

[n] Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The light spot has a minimum diameter of 1.1".

[p] The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 32.5 mm in diameter centered on the image screen. No distinct line of demarcation between light and dark areas is permitted. Alternatively, tubes will conform to MIL-I-55493 (EL) Uniformity Specification dated 26 November, 1968.

[q] The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 38 mm in diameter centered on the image screen. No distinct line of demarcation between light and dark areas is permitted.

[r] Under the same conditions as shown in footnote (q) except that Corning C.S. No.3-71 and C.S. No.4-67 filters are interposed between the light source and the tube.

s A two-dimensional resolution pattern, providing constant illumination in the Y direction, and sinusoidal variation of intensity in the X direction is projected on the photocathode. Per cent image modulation M may then be defined as:

$$M = \frac{W - B}{W + B} \times 100$$

where W = maximum illumination in white line
B = minimum illumination in black line

Output image brightness is also a sinusoidal function of the distance across one direction of the pattern, and the output modulation is equal to or less than the input modulation. The modulation transfer function (MTF) is defined as the ratio of the output modulation to input modulation expressed as a function of the spatial frequency of the incident illumination pattern. MTF for type 8606 is measured using Modulation Transfer Function Analyzer Model No.K1-b, a product of Optics Technology, Inc., Belmont, CA, using the specified procedure for that instrument.

t Paraxial Image Magnification (Cmx) is defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the two corresponding image points on the photocathode. The image points on the photocathode are separated by a distance of 2 mm and are located equal distances from the major axis of the tube.

u Under the same conditions as shown in footnote (t) except the test points on the photocathode are separated by 32 mm.

v The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will fall within a circle concentric with the optical axis of the screen having the specified diameter.

w The center of the image produced on the screen of the tube as specified in footnote (v) will not shift more than the specified value during 30 seconds of operation.

x A second magnification value (Emx) is obtained as stated in footnote (v) except the image points on the photocathode are separated by a distance of 32 mm. Per-cent distortion is defined by the equation

$$\text{Per-cent Distortion} = \frac{\text{Emx-Cmx}}{\text{Cmx}} \times 100$$

OPERATING CONSIDERATIONS

Magnetic Shielding

Magnetic shielding of these tubes may be required to minimize the effects of extraneous fields on tube performance. It is to be noted that ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken to insure that the case is completely demagnetized.

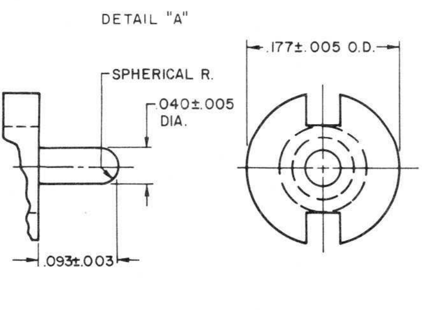
High Humidity for Types 8605/V1 and 8605/V2

To avoid possible corona effects, it is recommended that these tubes not be operated under conditions of high humidity unless potted in silicone rubber, or equivalent, and that sharp bends in terminal connection leads be avoided.

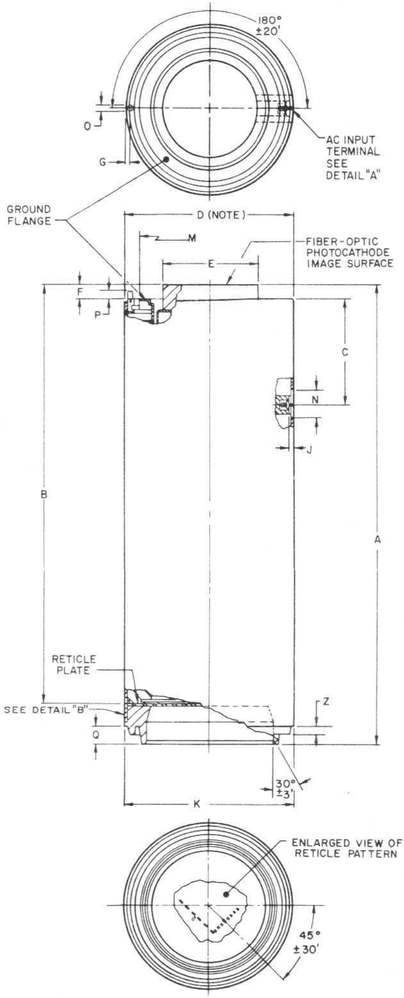
DC Power Supply for Types 8605/V1 and 8605/V2

The dc supply voltage for these tubes may be obtained from a suitable high-voltage power-supply unit. Such units are offered commercially by several manufacturers listed in buyers' guides.

DIMENSIONAL OUTLINE
TYPE 8606

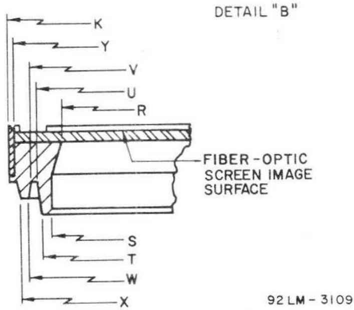


DIMENSIONAL OUTLINE
TYPE 8606



Note: Dimension applies with 1" of tube end.

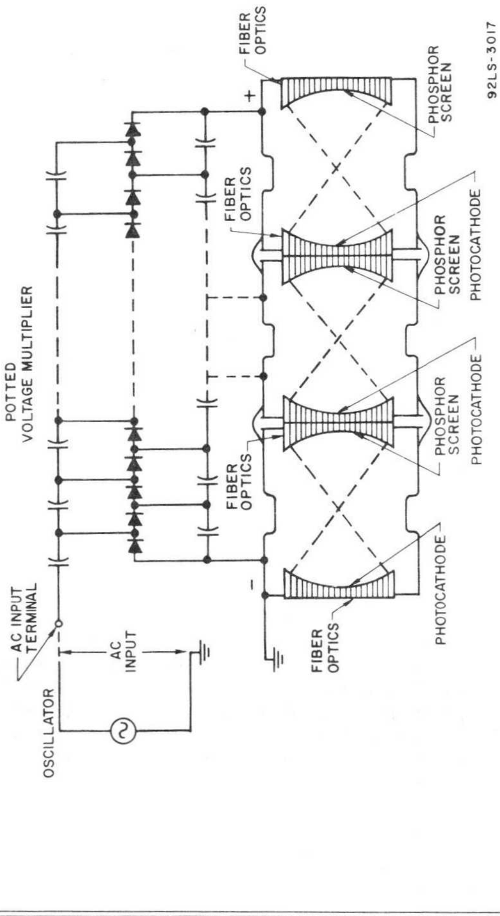
DIMENSIONAL OUTLINE
TYPE 8606



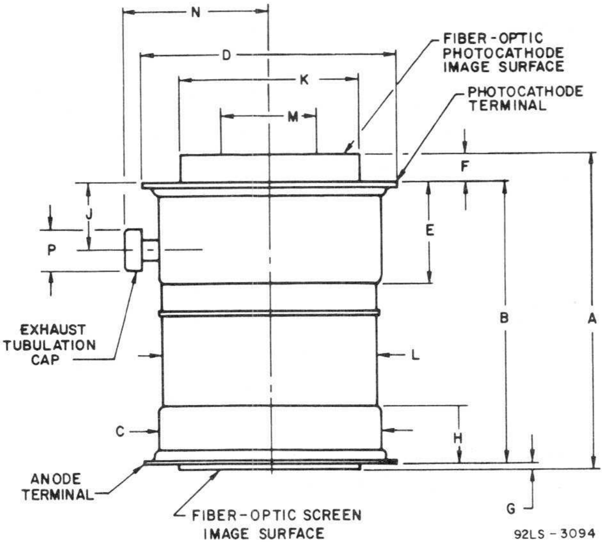
Dimen-sions	Inches		mm	
	Min.	Max.	Min.	Max.
A	11.906	12.028	302.512	305.511
B	11.025	11.115	280.035	282.321
C	2.372	2.398	60.249	60.909
D	3.742 Dia.	3.747 Dia.	95.047 Dia.	95.174 Dia.
E	2.095 Dia.	2.105 Dia.	53.213 Dia.	53.467 Dia.
F	.237	.243	6.020	6.172
G	.082	.092	2.082	2.336
J	.093	.113	2.362	2.870
K	3.737 Dia.	3.747 Dia.	94.92 Dia.	95.10 Dia.
M	2.950 Dia.	3.050 Dia.	74.930 Dia.	77.470 Dia.
N	.620 Dia.	.630 Dia.	15.748 Dia.	16.002 Dia.
O	.120 Dia.	.123 Dia.	3.048 Dia.	3.124 Dia.
P	.208	.218	5.283	5.537
Q	.370	.380	9.398	9.652
R	2.51 Dia.	2.55 Dia.	63.75 Dia.	64.77 Dia.
S	2.781 Dia.	2.791 Dia.	70.637 Dia.	70.891 Dia.
T	2.979 Dia.	2.994 Dia.	75.666 Dia.	76.047 Dia.
U	3.083 Dia.	3.098 Dia.	78.308 Dia.	78.689 Dia.
V	3.245 Dia.	3.260 Dia.	82.423 Dia.	82.804 Dia.
W	3.297 Dia.	3.312 Dia.	83.743 Dia.	84.124 Dia.
X	3.500 Dia.	3.520 Dia.	88.900 Dia.	89.408 Dia.
Y	3.54 Dia.	3.58 Dia.	89.91 Dia.	90.93 Dia.
Z	.183	.193	4.648	4.902

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

SCHEMATIC ARRANGEMENT OF TYPE 8606



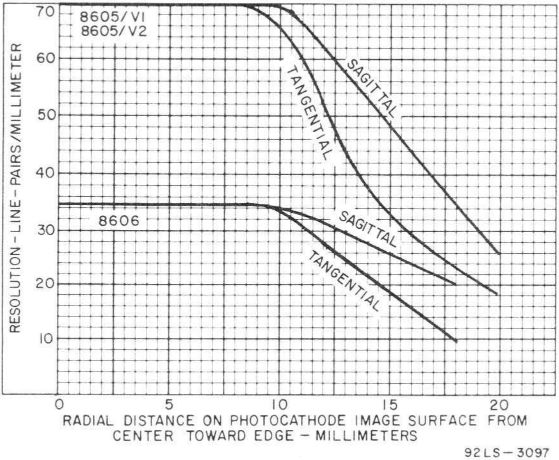
DIMENSIONAL OUTLINE
TYPES 8605/V1 AND 8605/V2



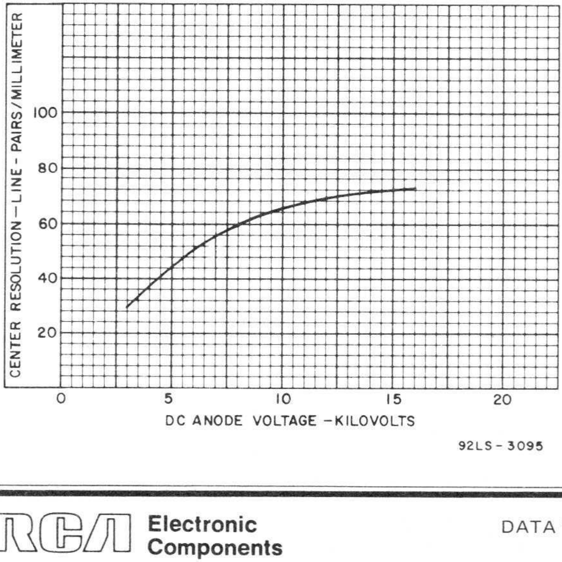
Dimensions	Inches	mm
A	3.690 ± .015	93.7 ± .4
B	3.337	84.8
C	2.600 ± .015 Dia.	66 ± .4 Dia.
D	3.00 ± .05 Dia.	76.2 ± 1.3 Dia.
E	1.15	29.2
F	.320 ± .020	8.13 ± .51
G	.042 ± .02	1.1 ± .5
H	.70	17.8
J	.77 ± .03	19.6 ± .8
K	2.100 ± .005 Dia.	53.3 ± .13 Dia.
L	2.50 Dia.	63.5 Dia.
M	1.575 Min. Dia.	40 Min. Dia.
N	1.70 Max. R.	43.2 Max. R.
P	.55 Dia.	14 Dia.

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

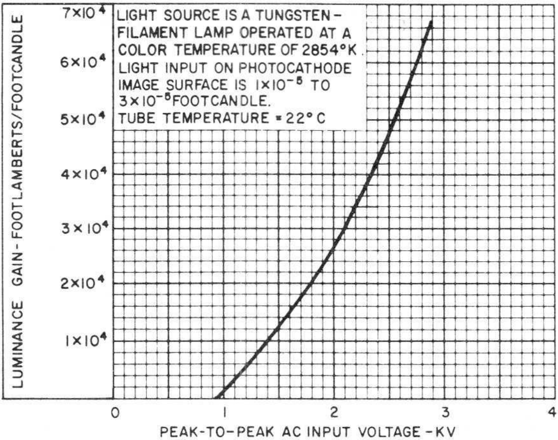
TYPICAL RESOLUTION CHARACTERISTICS FOR ALL TYPES



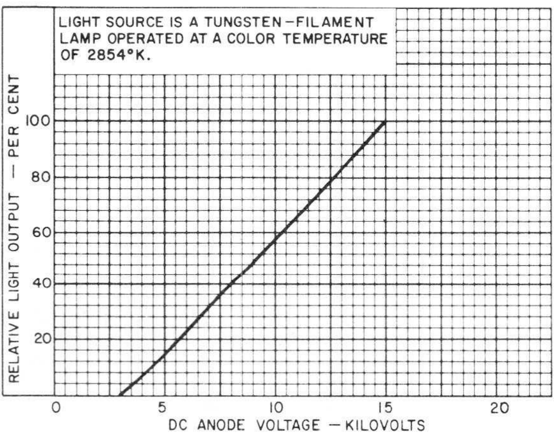
TYPICAL RESOLUTION CHARACTERISTICS FOR TYPES 8605/V1 AND 8605/V2



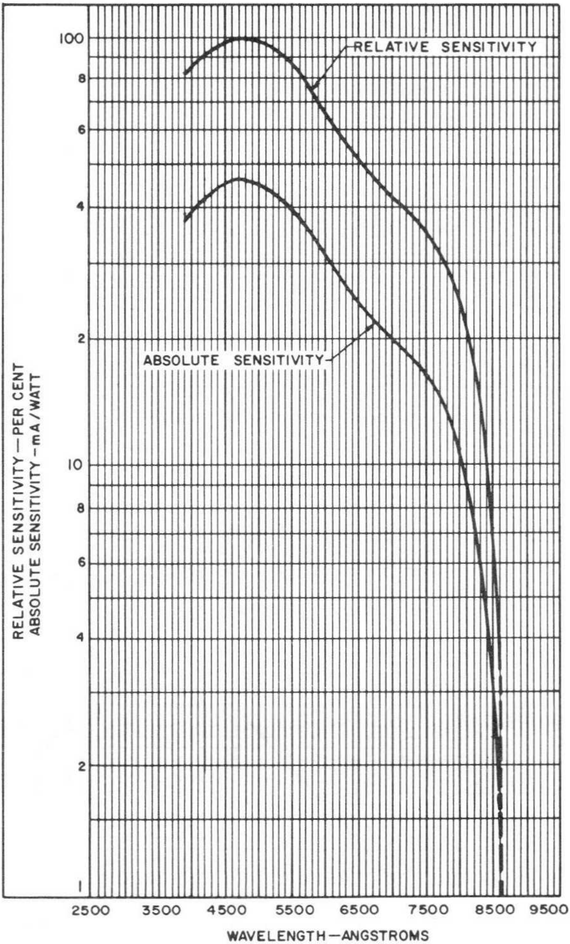
LUMINANCE GAIN AS A FUNCTION OF VOLTAGE FOR TYPE 8606



RELATIVE LIGHT OUTPUT CHARACTERISTIC FOR TYPES 8605/V1 AND 8605/V2

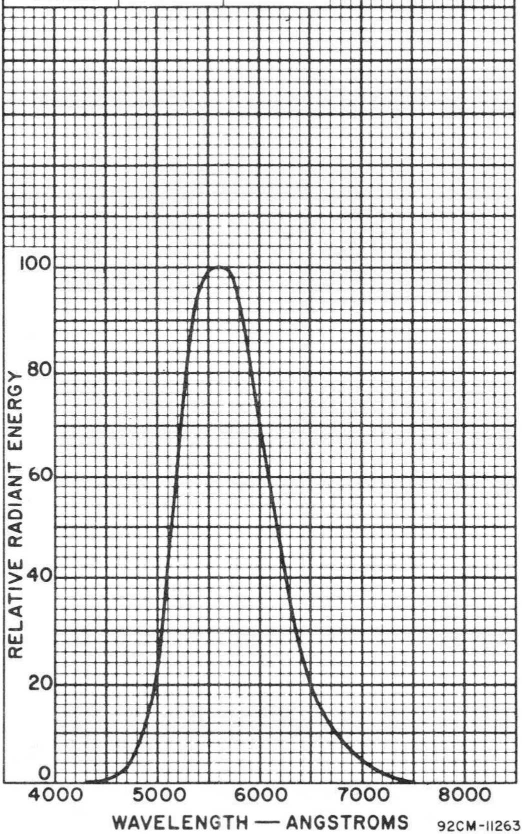


TYPICAL SPECTRAL RESPONSE CHARACTERISTIC FOR ALL TYPES

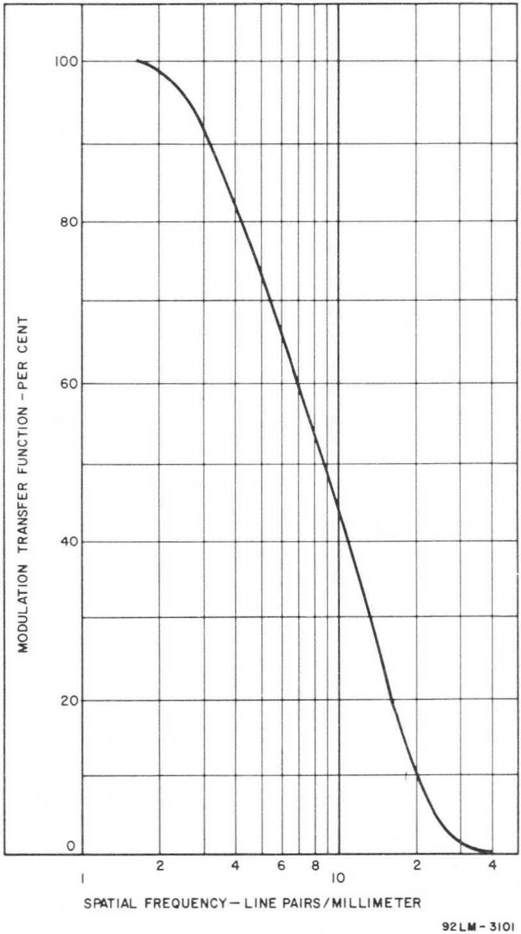


SPECTRAL ENERGY EMISSION CHARACTERISTICS
(JEDED PHOSPHOR P20) FOR ALL TYPES

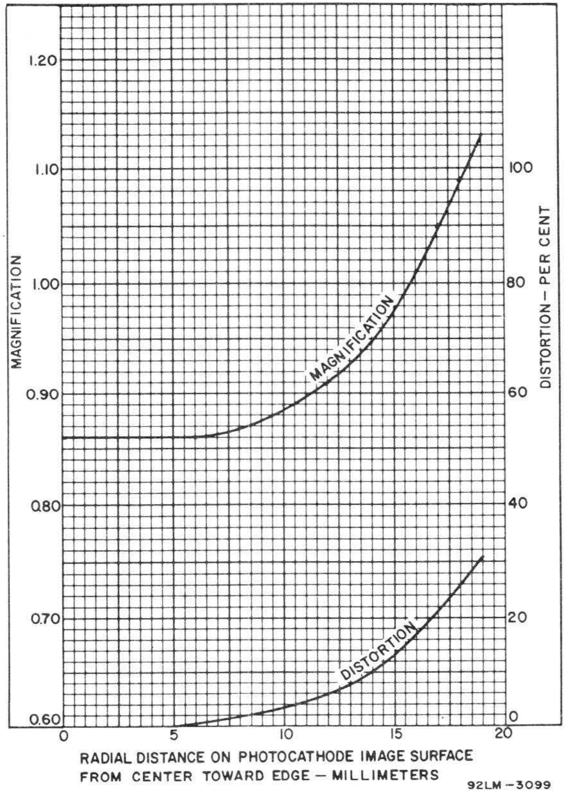
COLOR	C.I.E. COORDINATES X	C.I.E. COORDINATES Y
YELLOW-GREEN	0.426	0.546



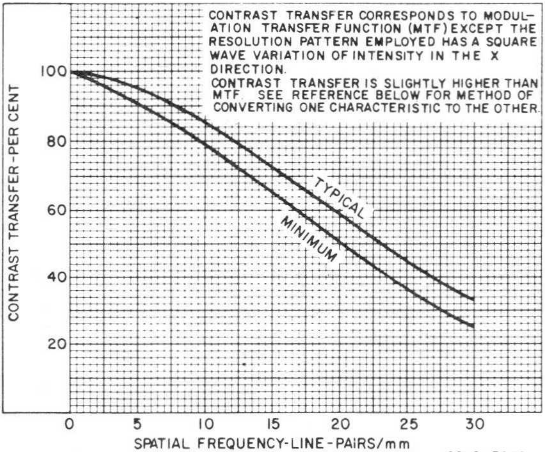
TYPICAL MODULATION TRANSFER FUNCTION
VERSUS FREQUENCY FOR TYPE 8606



TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPE 8606



CONTRAST TRANSFER CHARACTERISTICS FOR TYPES 8605/V1 AND 8605/V2



92LS-3098

Photomultiplier Tubes

3/4 Inch Diameter, 10-Stage, Head-On Types
Multialkali Photocathode of High Quantum Efficiency
In-Line Electrostatically-Focused Dynode Structure

For miniaturized low-level light detection and measurement systems and laser detection equipment to approximately 8000 angstroms. Typical quantum efficiency of these tubes at 6943 angstroms, is 2.5 per cent.

GENERAL

Spectral Response S-20
Wavelength of Maximum Response. . . . 4200 ± 500 angstroms
Cathode, Semitransparent . . . . . . Potassium-Sodium-Cesium-Antimony (Multialkali)
  Shape . . . . Sperical Section
  Minimum area . . . . 0.2 sq.in (129 sq.mm)
  Minimum diameter . . . . 0.5 in.(12.7 mm)
Window . . . . Borosilicate, Corning[a] No.7056, or equivalent
  Shape . . . . .Plano-Concave
  Index of refraction at 5893 angstroms 1.49
Dynodes:
  Substrate. . . . . Copper-Beryllium
  Secondary-Emitting Surface . . . . Beryllium-Oxide
  Structure . . . . In-Line Electrostatic-Focus Type
Direct Interelectrode Capacitances (Approx.):
  Anode to dynode No.10. . . . . 2.4 pF
  Anode to all other electrodes. . . . . 3.6 pF
Maximum Overall Length (Excluding leads):
  8644. . . . . 3.9 in (99 mm)
  8645. . . . . 4.55 in (115.6 mm)
Maximum Diameter:
  8644. . . . . 0.78 in (19.8 mm)
  8645. . . . . 0.95 in (24.1 mm)
Bulb. T6
Lead Connections . . . . (See *Dimensional Outline*)
Temporary Base . . . . . .Small-Shell Duodecal, JEDEC B12-43
Magnetic Shield . . . . See footnote (b)
Operating Position . . . . .Any
Weight (Approx.):
  8644
    With temporary base. . . . . .1.7 oz (48.2 g)
→ Without temporary base. . . . . .0.9 oz (25.5 g)
  8645. . . . . 4.5 oz (127.6 g)

→ Indicates a change.

ABSOLUTE-MAXIMUM RATINGS

	8644	8645	
Supply Voltage (DC or Peak AC):			
Between Anode and Cathode	2100 max.	1800 max.	V
Between Anode and Dynode No.10.	300 max.	300 max.	V
Between Consecutive Dynodes. . .	200 max.	–	V
Between Dynode No.1 and Cathode.	400 max.	–	V
→ Average Anode Current[d]	0.5 max.	0.1 max.	mA
→ Ambient Temperature	85 max.	55 max.	°C

CHARACTERISTICS RANGE VALUES

→ *Under conditions with dc supply voltage (E) across a voltage divider as shown in Table I. This voltage distribution is provided by the integral voltage-divider network of type 8645.*

With E = 1500 volts dc *(Except as noted)*

For Both Types:	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4200 angstroms.	–	5.1×10^{3}	–	A/W
Cathode radiant, at 4200 angstroms	–	0.064	–	A/W
Luminous[f]	4	12	60	A/lm
Cathode luminous:				
With tungsten light source[g]	1.2×10^{-4}	1.5×10^{-4}	–	A/lm
With blue light source[h]	5.5×10^{-8}	8.5×10^{-8}	–	A
With red light source[i]	4×10^{-7}	5.2×10^{-7}	–	A
Current Amplification . .	–	8×10^{4}	–	
Equivalent Anode-Dark-Current Input[k,m]	–	4×10^{-11}	6×10^{-10}	lm
	–	9.4×10^{-14}[n]	1.4×10^{-12}[n]	W
→ Anode Dark Current[k,m] .	–	1.2×10^{-9}	–	A
Equivalent Noise Input[p]	–	2.5×10^{-12}	–	lm
	–	6×10^{-15}[n]	–	W
Anode-Pulse Rise Time[q]	–	1.8×10^{-9}	–	s
Electron Transit Time[r]. .	–	2×10^{-8}	–	s

With E = 2000 volts dc *(Except as noted)*

For Type 8644 Only:	Min.	Typ.	Max.	
Sensitivity:				
Radiant, at 4200 angstroms.	–	4.7×10^{4}	–	A/W

→ Indicates a change.

Cathode radiant,				
at 4200 angstroms	–	0.064	–	A/W
Luminous[f]	–	110	–	A/lm
Cathode luminous:				
With tungsten				
light source[g]	1.2×10^{-4}	1.5×10^{-4}	–	A/lm
With blue				
light source[h]	5.5×10^{-8}	8.5×10^{-8}	–	A
With red				
light source[i]	4×10^{-7}	5.2×10^{-7}	–	A
Current Amplification . .	–	7.3×10^{5}	–	
Equivalent Anode-	–	4×10^{-11}	6×10^{-10}	lm
Dark-Current Input[k,m]	–	9.4×10^{-14}[n]	1.4×10^{-12}[n]	W
Anode Dark Current	–	5×10^{-9}	–	A
Anode-Pulse Rise Time[q]	–	1.5×10^{-9}	–	s
Electron Transit Time[r] . .	–	1.7×10^{-8}	–	s

[a] Made by Corning Glass Works, Corning, New York.

[b] Magnetic shielding material, for type 8644, in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston, Chicago 24, Illinois, or equivalent. Type 8645 has an integral magnetic shield.

[d] Averaged over any interval of 30 seconds maximum.

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

[f] 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 1 microlumen is used.

[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° K. The value of light flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode. This characteristic can not be measured after type 8645 is encapsulated in its potting compound.

[h] 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, New York) 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. This characteristic can not be measured after type 8645 is encapsulated in its potting compound.

[i] Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62—Manufactured by the Corning Glass Works, Corning, New York) 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. This characteristic can not be measured after type 8645 is encapsulated in its potting compound.

k At a tube temperature of 22° C. Dark current may be reduced by use of a refrigerant.

m With supply voltage (E) adjusted to give a luminous sensitivity of 30 amperes per lumen.

n At 4200 angstroms. This value is calculated using a conversion factor of 428 lumens per watt.

p Under the following conditions: Supply voltage (E) is as shown, 22° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, 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.

q 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.

r 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 CONSIDERATIONS

Terminal Connections and Mounting Considerations:

Type 8644

The 8644 is supplied with a small-shell duodecal base attached to semiflexible leads to facilitate testing. After testing, the attached base should be removed prior to installing the 8644 in a given system.

The *semiflexible leads* of the 8644 may be soldered or welded into the associated circuit. However, extreme caution must be exercised when making such connections to the leads to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the glass button is recommended.

Excessive bending of the leads—especially in the region close to the glass button—must be avoided.

Direct clamping to the bulb for mounting purposes is not recommended. It is suggested that a resilient material, such as Silastic* RTV 881, RTV 882, or equivalent, be used between the bulb and clamp.

The application of high voltage, with respect to cathode, to insulating or other materials supporting or shielding the 8644 at the photocathode end of the tube should not be permitted unless such materials are chosen to limit leakage current to the tube envelope to 1×10^{-12} ampere or less. In addition to increasing dark current and noise output because of voltage gradients developed across the bulb wall, such high voltage may produce minute leakage current to the cathode through the tube envelope and insulating materials which can permanently damage the tube.

Type 8645

Support for the 8645 may be effected by clamping directly to the magnetic shield. However, only that amount of uniformly distributed pressure necessary to hold the tube firmly in position should be employed.

Shielding:

Type 8644

Electrostatic and magnetic shielding of the 8644 is usually required. When a shield is used it must be at cathode potential.

See accompanying curves which show the effect of magnetic fields on anode current of the 8644 under the conditions indicated. The effects of hysteresis due to residual magnetism of the materials used in the tube structure have been neglected.

Type 8645

The 8645 is encapsulated with an insulating plastic potting compound in a magnetic shield and has

* Trademark of Dow Corning Corporation, Midland, Michigan.

an integral voltage-divider network. The magnetic shield is electrically connected to the photocathode.

See accompanying curve which shows the effect of magnetic fields on anode current of the 8645 under the conditions indicated. The effects of hysteresis due to residual magnetism of the materials used in the tube have been neglected.

See accompanying voltage-divider network and supply voltage connections for the 8645.

Dark Current:

A very small *anode dark current* is observed when voltage is applied to the electrodes of these tubes in complete darkness. Among the components contributing to dark current are ohmic leakage between the anode and adjacent elements and pulses produced by electrons thermionically released from the cathode, secondary electrons released by ionic bombardment of the dynodes, support rods, or cathode, and by cold emission from the electrodes.

Typical anode dark current as a function of luminous sensitivity at a temperature of $+22^{\circ}$ C is shown in accompanying Typical-Dark Current and EADCI Characteristics.

A temporary increase in anode dark current by as much as 3 orders of magnitude may occur if these tubes are exposed momentarily to high-intensity ultraviolet radiation from sources such as fluorescent room lighting even though voltage is not applied to the tubes. The increase in dark current may persist for a period of 24 to 48 hours following such irradiation.

For *optimum tube performance* it is also recommended that the 8644 and 8645 be operated at or below room temperature. Dark current may be reduced by use of a refrigerant such as dry ice.

Operating Stability:

The operating stability of the 8644 and the 8645 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 0.5 microampere is recommended.

Operating Voltages:

The 8645 is supplied with an integral voltage-divider network. The following considerations, accordingly, apply only to type 8644.

The *voltage applied between cathode and dynode No.1* should be nearly constant and have a value of at least 150 volts to insure high conversion efficiency, i.e., high photon quantum efficiency, high collection efficiency, and high first dynode gain. Zener diodes, or other constant voltage sources, may be employed across these elements to provide constant voltage in applications where tube sensitivity is varied by adjusting the supply voltage.

The *operating voltage between dynode No.10 and anode* should be kept as low as will permit operation over the knee of the accompanying anode characteristic curves. With low operating voltage between dynode No.10 and anode, the ohmic leakage current to the anode is reduced. Operation over the knee occurs in the approximate range of 100 to 150 volts for the light level range shown. Under high pulse current conditions, saturation due to space-charge limitations will occur and higher voltage will be required. To obtain the suggested operating voltage between dynode No.10 and anode, it is necessary to increase the supply voltage between these electrodes by an amount equal to the voltage drop across a particular output load.

The *operating voltages* for the 8644 can be supplied by spaced taps on a voltage divider across a regulated dc power supply. The current through the voltage divider will depend on the applied voltage and the linearity required by the application. In general, the current in the divider should be at least 5 times greater than the maximum average value of anode current. The resistance value of the voltage divider should be adequate to prevent variation of dynode potentials by signal current. Resistance values greater than 10 megohms should not be employed between adjacent tube elements. Location of the voltage-divider arrangement should be such that the power dissipated in the resistor string does not increase the temperature of the tube. In pulse applications requiring low-noise operation, it is recommended that the *negative high-voltage terminal be* grounded.

See *Typical voltage-divider arrangement* for use with the 8644. The choice of resistance values for the voltage-divider string is usually a compromise. If low values of resistance per stage are utilized, the power drawn from the supply and the required wattage rating of the resistors increase. Phototube noise may also increase, due to heating, if the divider network is mounted near the tube. The use of high values of resistance per stage may cause deviation from linearity if the voltage-divider current is not maintained at a value of at least 5 times that of the maximum average anode current and may limit anode current response to pulsed light.

When the ratio of peak anode current to average anode current is high, non-inductive high-quality capacitors should be employed across the latter stages of the tube. The values of these capacitors should be chosen so that sufficient charge is available to prevent a change of more than a few per cent in the interstage voltages throughout the pulse duration.

Damping resistors in series with each of the dynode leads of the latter stages of the tube may be used to suppress spurious oscillations under high peak current conditions. Typical values for these resistors are in the range of 5 to 50 ohms. These values are chosen to provide sufficient damping while minimizing the voltage drop across the resistors.

The *high voltages at which these tubes are operated* are very dangerous. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break the primary circuit of the high-voltage power supply when access to the apparatus is required.

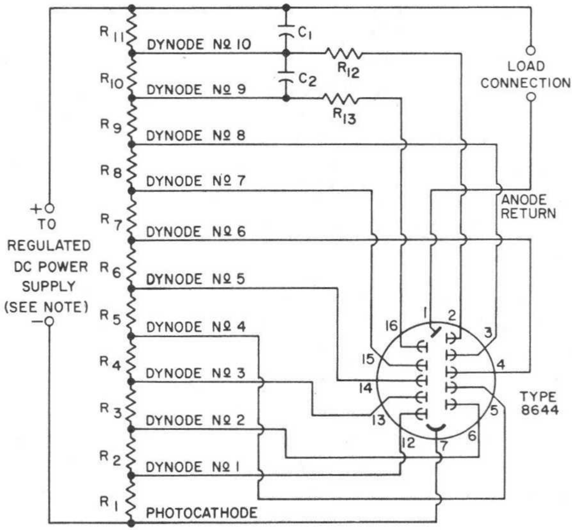
In the use of the 8644 and the 8645, as with other tubes requiring high voltages, it should always be remembered that these high voltages may appear at points in the circuit which are normally at low potential, because of defective circuit parts or incorrect circuit connections. Therefore, before any part of the circuit is touched, the power-supply switch should be turned off and both terminals of any capacitors grounded.

TABLE I

TYPICAL VOLTAGE DISTRIBUTION

Between:	8.33% of Supply Voltage (E) Multiplied by:
Cathode and Dynode No.1	1.1
Dynode No.1 and Dynode No.2	1.2
Dynode No.2 and Dynode No.3	1.7
Dynode No.3 and Dynode No.4	1.0
Dynode No.4 and Dynode No.5	1.0
Dynode No.5 and Dynode No.6	1.0
Dynode No.6 and Dynode No.7	1.0
Dynode No.7 and Dynode No.8	1.0
Dynode No.8 and Dynode No.9	1.0
Dynode No.9 and Dynode No.10	1.0
Dynode No.10 and Anode	1.0
Anode and Cathode	12.0

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR TYPE 8644



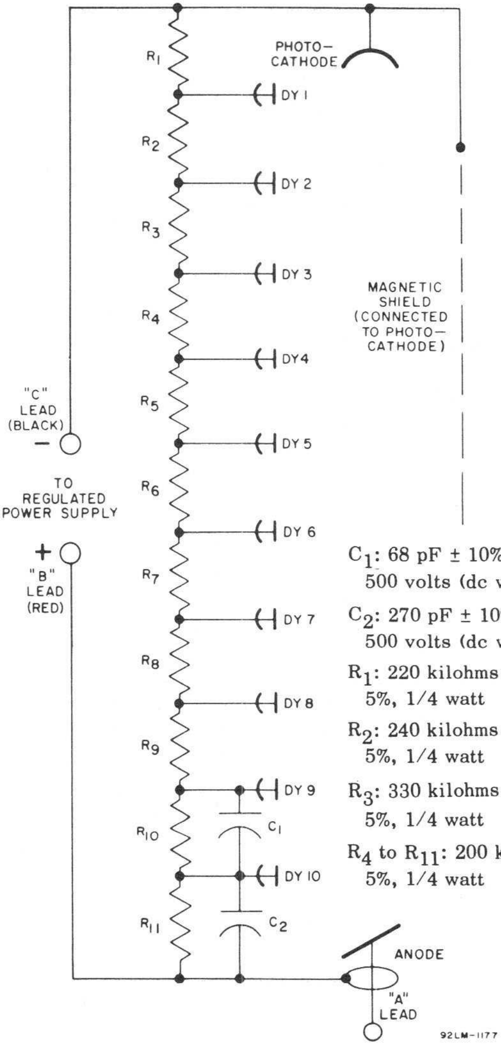
NOTE: Adjustable between approximately 500 and 2100 volts dc.

C_1, C_2: 0.01 µF, non-inductive type, 400 volts (dc working)

R_1: 51 kilohms, 5%, 1 watt
R_2: 56 kilohms, 5%, 1 watt
R_3: 82 kilohms, 5%, 2 watt
R_4 through R_{11}: 47 kilohms, 5%, 1 watt
R_{12}, R_{13}: 10 to 50 ohms, 10%, 1/2 watt

(See *Damping resistors* under *Operating Considerations, Operating Voltages*)

INTEGRAL VOLTAGE-DIVIDER NETWORK OF TYPE 8645



C_1: 68 pF ± 10%, 500 volts (dc working)

C_2: 270 pF ± 10%, 500 volts (dc working)

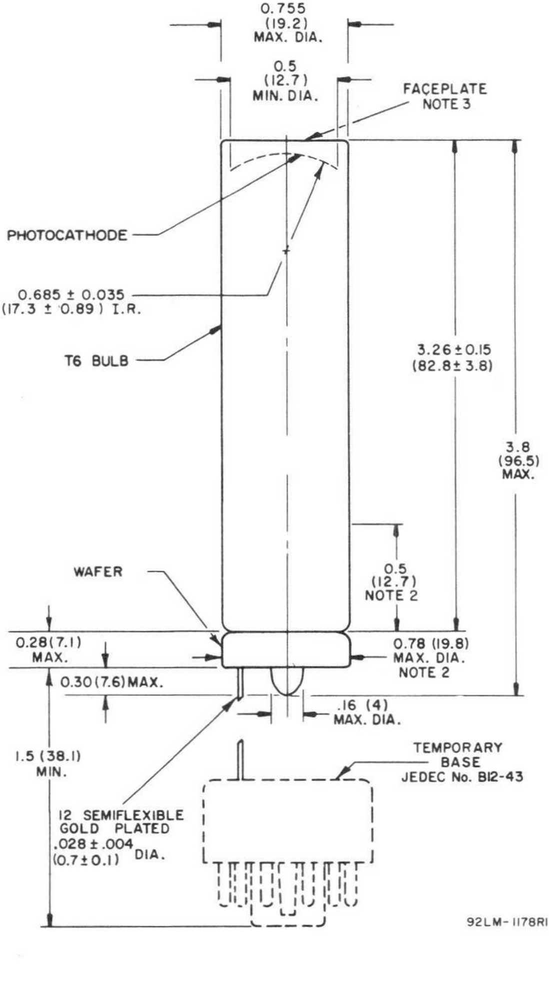
R_1: 220 kilohms, 5%, 1/4 watt

R_2: 240 kilohms, 5%, 1/4 watt

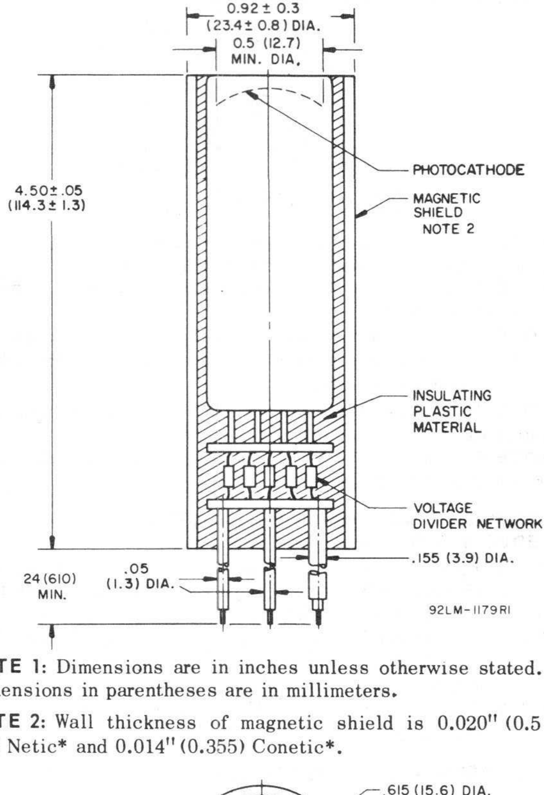
R_3: 330 kilohms, 5%, 1/4 watt

R_4 to R_{11}: 200 kilohms, 5%, 1/4 watt

DIMENSIONAL OUTLINE (TYPE 8644)

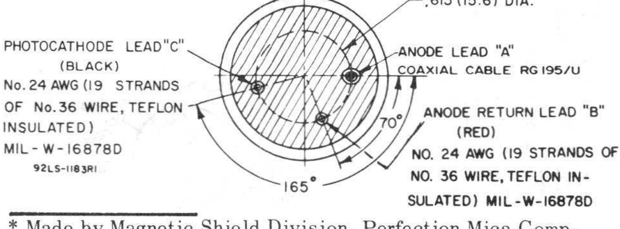


DIMENSIONAL OUTLINE (TYPE 8645)



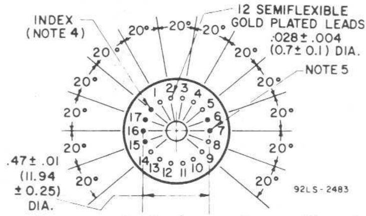
NOTE 1: Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters.

NOTE 2: Wall thickness of magnetic shield is 0.020" (0.5 mm) Netic* and 0.014" (0.355) Conetic*.



* Made by Magnetic Shield Division, Perfection Mica Company, 1322 North Elston, Chicago 24, Illinois, or equivalent material.

LEAD ORIENTATION (Bottom View)



NOTE 1: Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters.

NOTE 2: Within this length, maximum diameter of tube is 0.78 inch (19.8 mm).

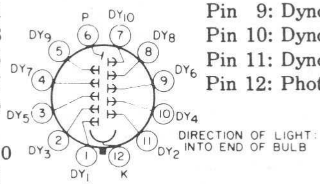
NOTE 3: Deviation from flatness within a concentric circle, 0.55 inch (14 mm) diameter will not exceed 0.006 inches (0.15 mm) peak to valley.

NOTE 4: Lead is cut off within 0.06 inch (1.5 mm) of glass button for indexing.

NOTE 5: Leads 6, 7, 15, 16, and 17 are cut off within 0.06 inch (1.5 mm) of glass button.

TERMINAL DIAGRAM With Temporary Base, JEDEC B12-43, Bottom View

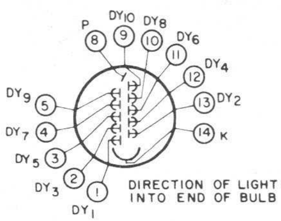
Pin 1: Dynode No.1
Pin 2: Dynode No.3
Pin 3: Dynode No.5
Pin 4: Dynode No.7
Pin 5: Dynode No.9
Pin 6: Anode
Pin 7: Dynode No.10
Pin 8: Dynode No.8



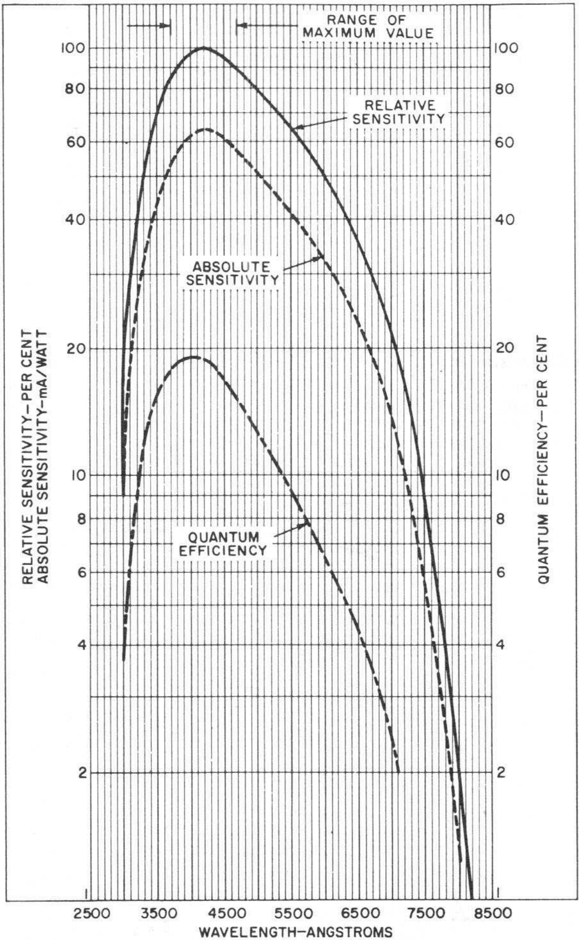
Pin 9: Dynode No.6
Pin 10: Dynode No.4
Pin 11: Dynode No.2
Pin 12: Photocathode

LEAD TERMINAL CONNECTIONS (Bottom View)

Lead 1: Dynode No.1
Lead 2: Dynode No.3
Lead 3: Dynode No.5
Lead 4: Dynode No.7
Lead 5: Dynode No.9
Lead 8: Anode
Lead 9: Dynode No.10
Lead 10: Dynode No.8
Lead 11: Dynode No.6
Lead 12: Dynode No.4
Lead 13: Dynode No.2
Lead 14: Photocathode

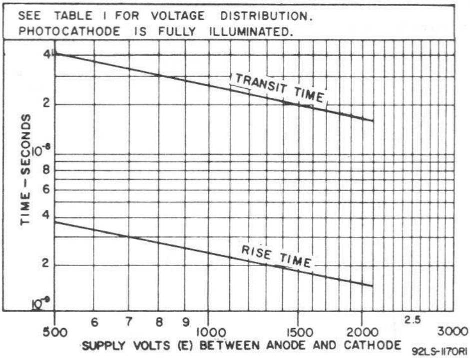


SPECTRAL RESPONSE CHARACTERISTICS

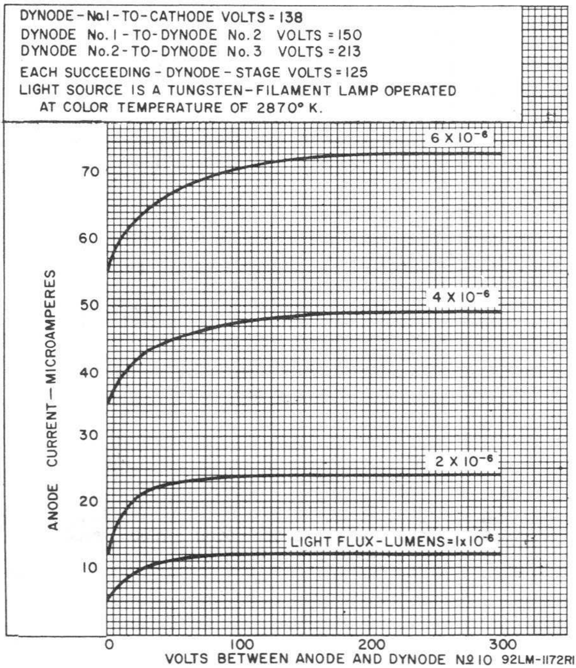


92LM-1169

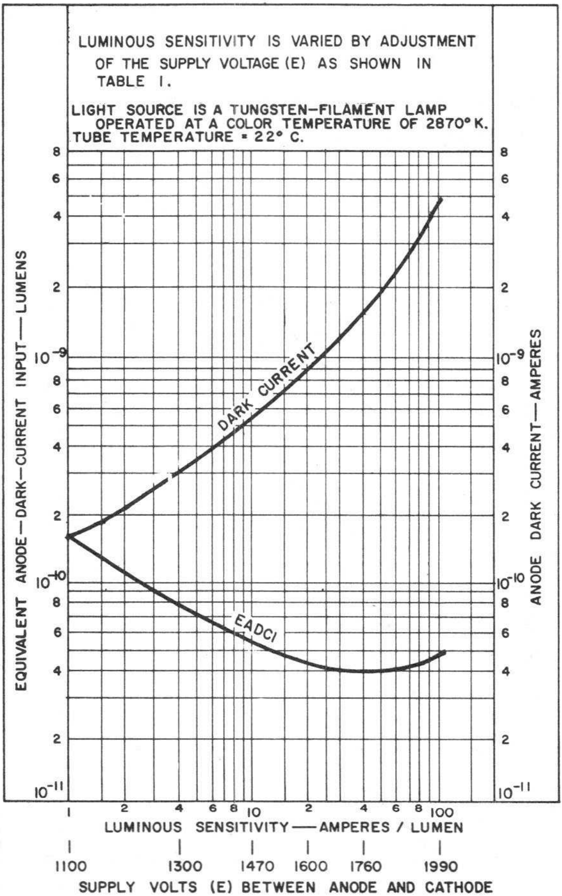
TYPICAL TIME-RESOLUTION CHARACTERISTICS



AVERAGE ANODE CHARACTERISTICS FOR TYPE 8644

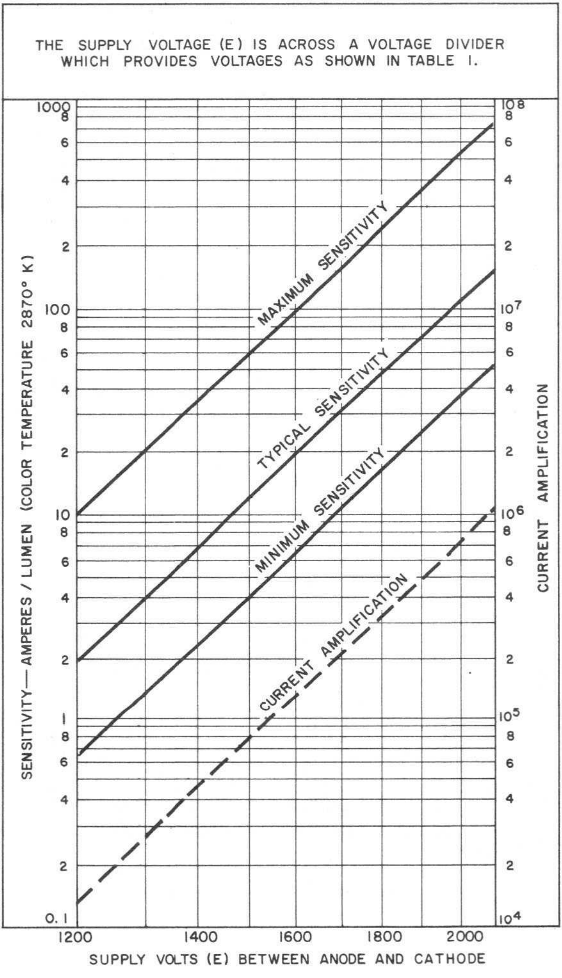


TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS



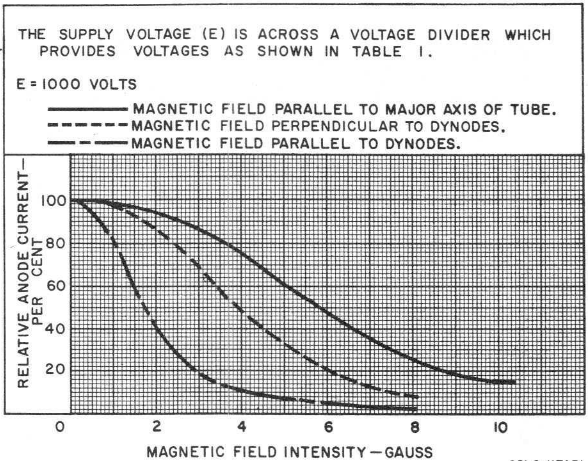
92LM-1173R1

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



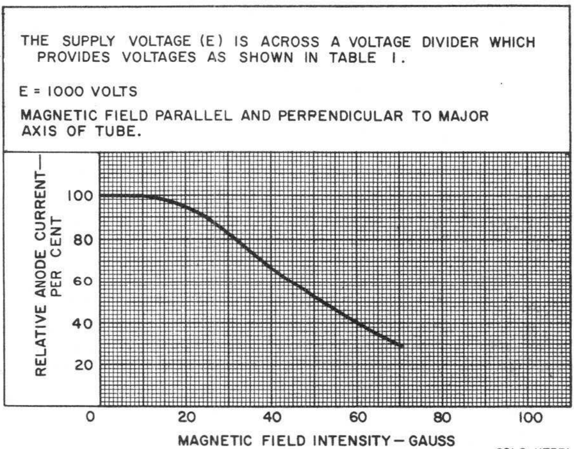
92LM-1171R1

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT FOR TYPE 8644



92LS-1174RI

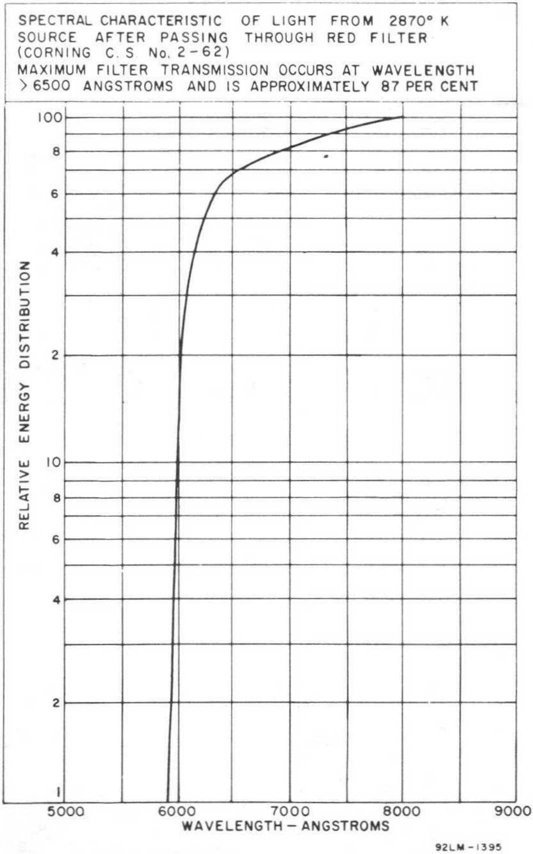
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT FOR TYPE 8645



92LS-1175RI

→ Indicates a change

SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH RED FILTER



For *Spectral Energy Distribution* of 2870° K Light Source after passing through *Blue* Filter, see front of this section.

Photomultiplier Tube

Ruggedized, 2"-Diameter, 10-Stage Type

GENERAL

Spectral Response	See *accompanying Spectral Response Characteristics*
Wavelength of Maximum Response	4000 ± 500 Å
Cathode, Semitransparent	Cesium-Potassium-Antimony (Bialkali)
Minimum area	2.54 in^2 (16.4 cm^2)
Minimum diameter	1.8 in (4.6 cm)
Window	UV-Grade Sapphire
Shape	Plano-Plano
Index of refraction	See Table I
Dynodes	
Substrate	Copper-Beryllium
Secondary-Emitting Surface	Beryllium-Oxide
Structure	Venetian-Blind
Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.10 and guard ring	9.5 pF
Anode to all other electrodes	9.5 pF
Maximum Overall Length	4.00 in (10.2 cm)
Maximum Diameter	2.06 in (5.2 cm)
Magnetic Shield	See footnote a
Operating Position	Any
Weight (Approx.)	7 oz (190 g)

MAXIMUM RATINGS, *Absolute-Maximum Values:*

DC Supply Voltage:		
Between anode and cathode	2000 max.	V
Between anode and dynode No.10	300 max.	V
Between anode and guard ring[c]	300 max.	V
Between consecutive dynodes	250 max.	V
Between dynode No.1 and cathode	600 max.	V
Average Anode Current[d]	2 max.	mA
Ambient-Temperature Range[e]	-100 to + 75 max.	°C

CHARACTERISTICS RANGE VALUES

Under conditions with dc supply voltage (E) across a voltage divider providing 3/13 of E between cathode and dynode No.1; 1/13 of E for each succeeding dynode stage; and 1/13 of E between dynode No.10 and anode. The guard ring is operated at or near anode potential.

With E = 1500 Volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[f] at 4000 angstroms	–	1.8×10^{4}	–	A/W
Luminous[g] (2870°K)	7	17	165	A/lm
Current with blue light source[h] (2870°K + C.S. No. 5-58)	9×10^{-6}	2×10^{-5}	2×10^{-4}	A
Cathode Sensitivity:				
Radiant[i] at 4000 angstroms	–	6.9×10^{-2}	–	A/W
Luminous[k] (2870° K)	5.8×10^{-5}	6.7×10^{-5}	–	A/lm
Current with blue light source[m] (2870° K + C.S. No.5-58)	7×10^{-11}	8×10^{-11}	–	A
Quantum Efficiency[n] at 3750 angstroms	–	22	–	%
Current Amplification	–	2.6×10^{5}	–	
Anode Dark Current[p]	–	1×10^{-9}	9×10^{-9}	A
Equivalent Anode Dark Current Input[p]	–	1.3×10^{-10}	1.2×10^{-9}	lm
	–	1.3×10^{-13}[q]	1.2×10^{-12}[q]	W
Equivalent Noise Input[r]	–	1.4×10^{-12}	–	lm
	–	1.4×10^{-15}[s]	–	W
Peak-to-Valley Ratio of Pulse Height Spectrum with Fe^{55} Source[t]	10	30	–	
Dark Pulse Spectrum		See *accompanying Typical Dark Pulse Spectrum*		
Anode-Pulse Rise Time[u] at 2000 V . .	–	7×10^{-9}	–	s
Electron Transit Time[v] at 2000 V . .	–	4×10^{-8}	–	s

With E = 1100 Volts

Pulse Height Resolution[w]	–	7.7	8	%
Pulse Height[x] . . .	6×10^{-12}	–	–	coulombs

Under conditions with dc supply voltage (E) across a voltage divider providing the following cathode-to-anode voltage distribution: 2, 1, 1, 1, 1, 1, 1, 4, 3.5, 4, and 4.8. The guard ring is connected at or near anode potential.

With E = 2000 Volts

	Min.	Typical	Max.	
Pulse Current:				
Space-Charge Limited (Saturated)[y]	–	0.5	–	A
Linear[z]	–	0.033	–	A

[a] Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 N. Elston Avenue, Chicago, Ill., 60622, or equivalent.

[c] The guard ring is an electrode located between dynode No.10 and anode. Its function is to minimize leakage current flowing to the anode.

[d] 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 is recommended.

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

[f] This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 1030 lumens per watt.

[g] These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.12 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}$$

The value of 0.12 is the average value of the ratio of the anode current measured under the conditions specified in footnote (h) to the anode current measured under the same conditions but with the blue filter removed.

[h] 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, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 1×10^{-5} lumen.

[i] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1030 lumens per watt.

[k] These values are calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.12 \times \text{Light Flux of } 1 \times 10^{-5} \text{ (lm)}}$$

The value of 0.12 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

[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, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 1×10^{-5} lumen and 250 volts are applied between cathode and all other electrodes connected as anode.

[n] Calculated from the typical cathode radiant sensitivity value.

[p] At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C. S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 10 microlumens. The supply voltage (E) is adjusted to obtain an anode current of 9 microamperes. Sensitivity of the 8664 under these conditions is approximately equivalent to 7.5 amperes per lumen. Dark current is measured with no light incident on the tube.

[q] At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1030 lumens per watt.

[r] Under the following conditions: Supply voltage (E) is as shown, 22° C tube temperature, 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.

[s] At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1030 lumens per watt.

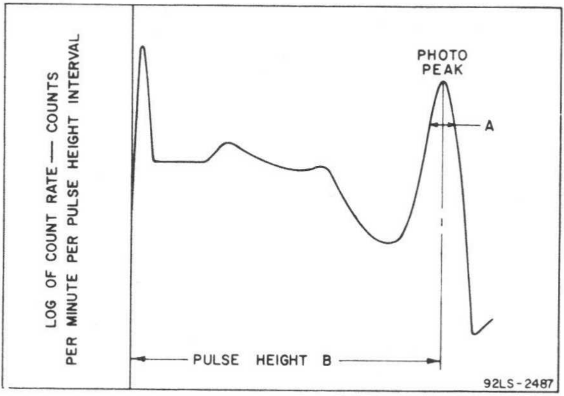
[t] Light incident on the photocathode is obtained from a Harshaw Type HG 0.005" beryllium window NaI(Tl) scintillator, 0.04" thick and 7/8" in diameter (or equivalent) and an isotope of iron having an atomic mass of 55 (Fe^{55}) and an effective activity of 1 μcurie.

[u] 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.

[v] 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.

[w] With a supply voltage E of 1100 volts. Anode load is a 100-kilohm resistor in parallel with a total capacitance of 100 pF. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photons from a one-microcuire Cs^{137} source and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator NaI(Tl)-type Harshaw Type 8D8S50, Serial No. CJ-156, or equivalent, are used. The Cs^{137} source is in direct contact with the metal end of the scintillator container. The faceplate end of the crystal is coupled to the faceplate of the tube using a coupling fluid such as Nujol mineral oil, or equivalent. Pulse-height resolution in per cent is de-

fined at 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height (A) to the pulse height at maximum photopeak count rate (B).



x Pulse height is defined as the average charge collected at the anode from a pulse caused by the photoelectric absorption of a 662 keV photon from Cs^{137} in a thallium-activated sodium-iodide scintillator, NaI(Tl).

y The interstage voltages of the 8664 should not deviate more than 2 per cent from the recommended voltage distribution. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure the operating condition.

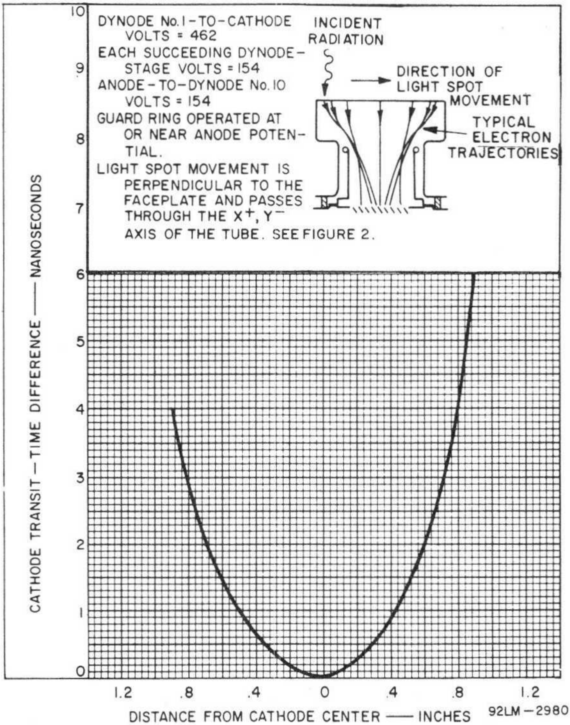
z Maximum deviation from linearity is 5 per cent.

TABLE 1

Wavelength - Å	1830	2652	3021	4046	5461	6438	7065
Index of Refraction for Sapphire Window	3.0	1.83	1.81	1.79	1.77	1.77	1.76

For additional information on this type write for Technical Bulletin to RCA Commercial Engineering, Harrison, N. J. 07029

TYPICAL ELECTRON TRANSIT TIME DIFFERENCE AS A FUNCTION OF SPOT POSITION OF INCIDENT RADIATION ON TUBE FACEPLATE



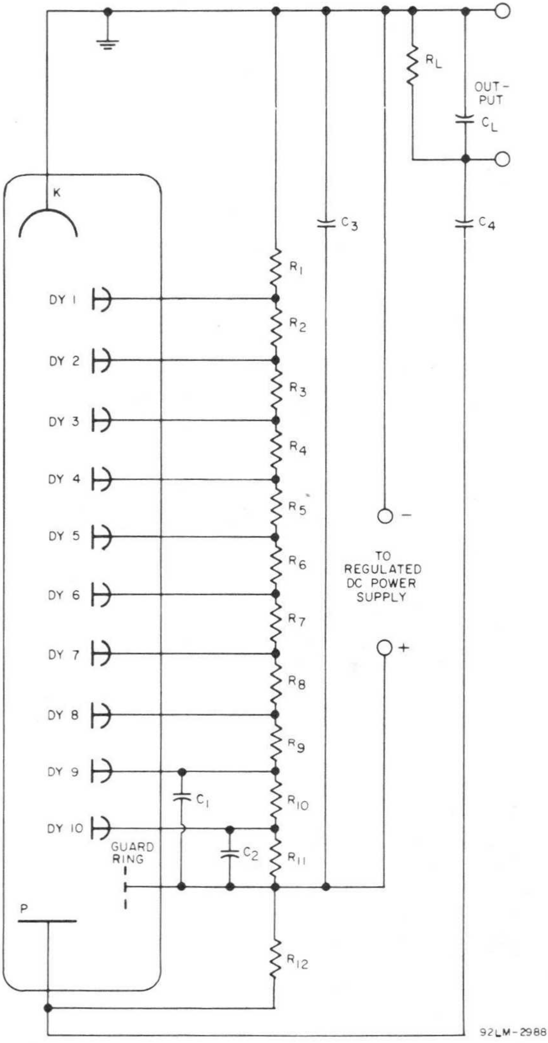
PARTS LIST FOR TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

C_1: 0.005 μF, 20%, 1000 V dc, ceramic disc
C_2: 0.01 μF, 20%, 1000 V dc, ceramic disc
C_3, C_4: 0.01 μF, 20%, 3000 V dc, ceramic disc
R_1: 10 MΩ, 5%, 1/2 Watt
R_2 through R_{11}: 3.3 MΩ, 5%, 1/2 Watt
R_{12}: 1 MΩ, 5%, 1/2 Watt

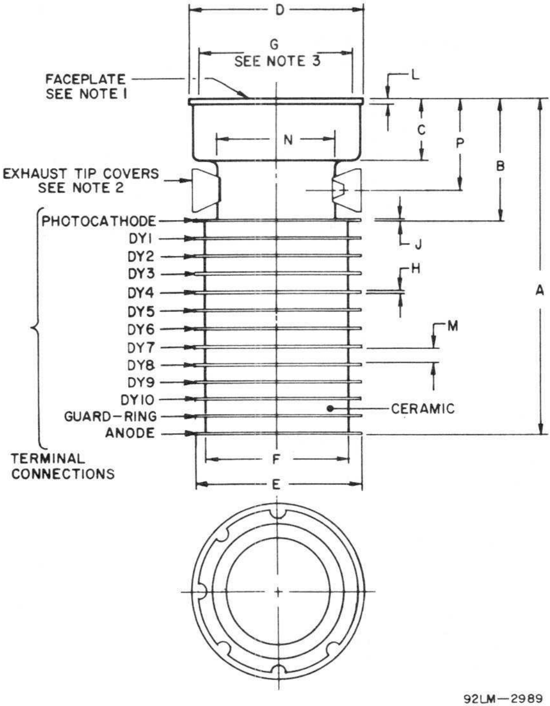
Note: The value of the load elements, R_L and C_L, depend on the application:

$R_L C_L$ = 10 microseconds for most applications

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



DIMENSIONAL OUTLINE



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

Note 1: Deviation from flatness of external surface of faceplate will not exceed 0.005" from peak to valley.

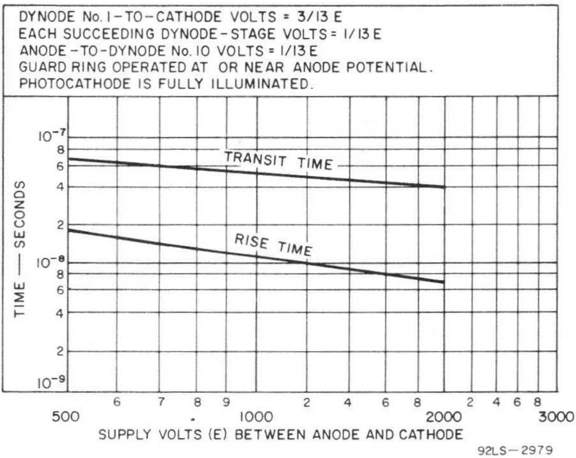
Note 2: The maximum dimension of both exhaust tip covers will not extend beyond the maximum diameter of the tube. Care should be exercised not to subject these covers to any stress or strain.

Note 3: Minimum useful photocathode diameter.

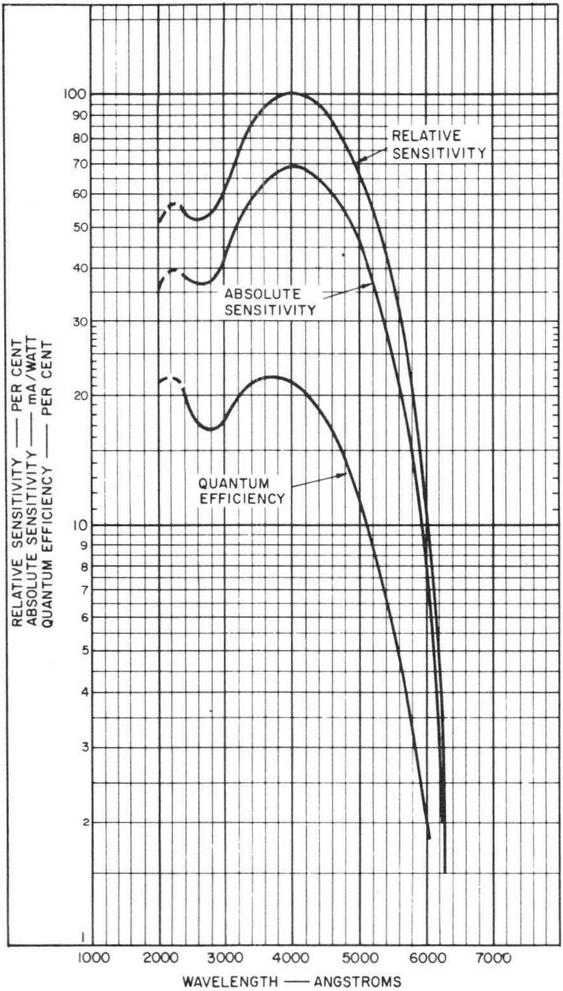
OUTLINE DIMENSIONS

Dimensions	Inches	mm
A	4.00 Max.	101.6 Max.
B	1.45	36.8
C	.73	18.5
D	2.06 Max. Dia.	52.3 Max. Dia.
E	2.00 Dia.	50.8 Dia.
F	1.80 Max. Dia.	45.7 Max. Dia.
G	1.80 Max. Dia.	45.7 Max. Dia.
H	.02	.5
J	.03	.8
L	.06	1.5
M	.18	4.6
N	1.37 Dia.	34.8 Dia.
P	1.075	27.3

TYPICAL TIME-RESOLUTION CHARACTERISTICS

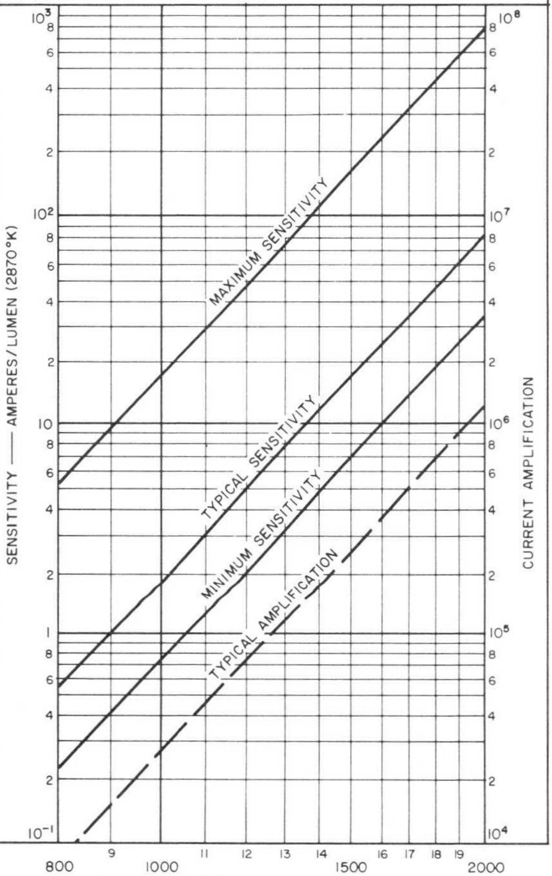


SPECTRAL RESPONSE CHARACTERISTICS



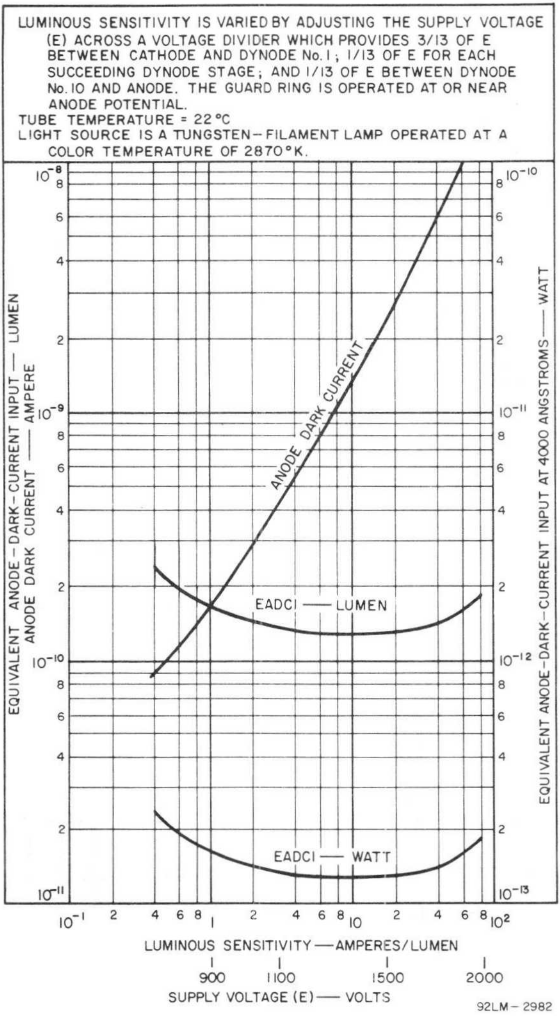
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

UNDER CONDITIONS WITH DC SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER PROVIDING 3/13 OF E BETWEEN CATHODE AND DYNODE No.1; 1/13 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/13 OF E BETWEEN DYNODE No.10 AND ANODE. THE GUARD RING IS OPERATED AT OR NEAR ANODE POTENTIAL.

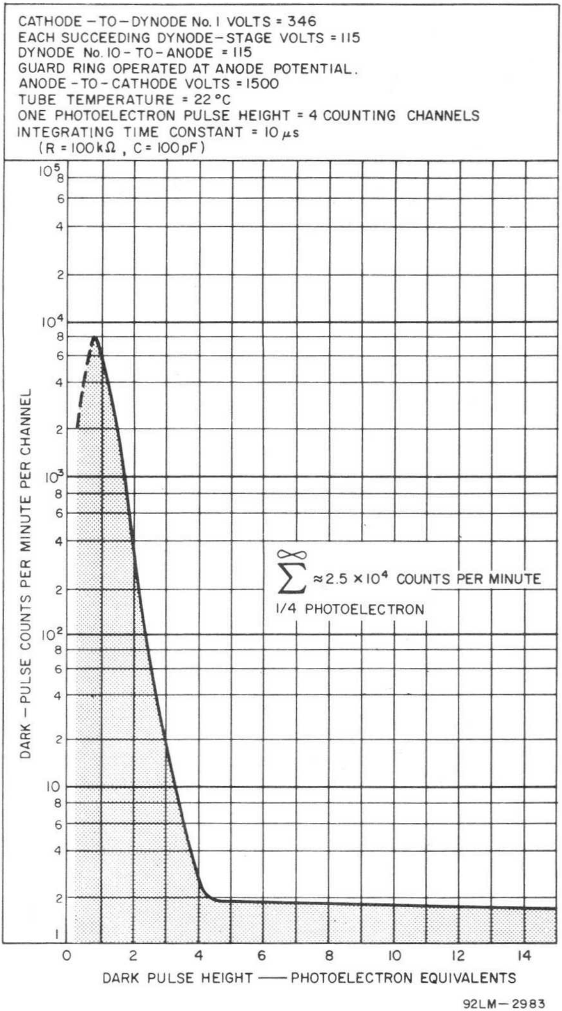


92LM—2981

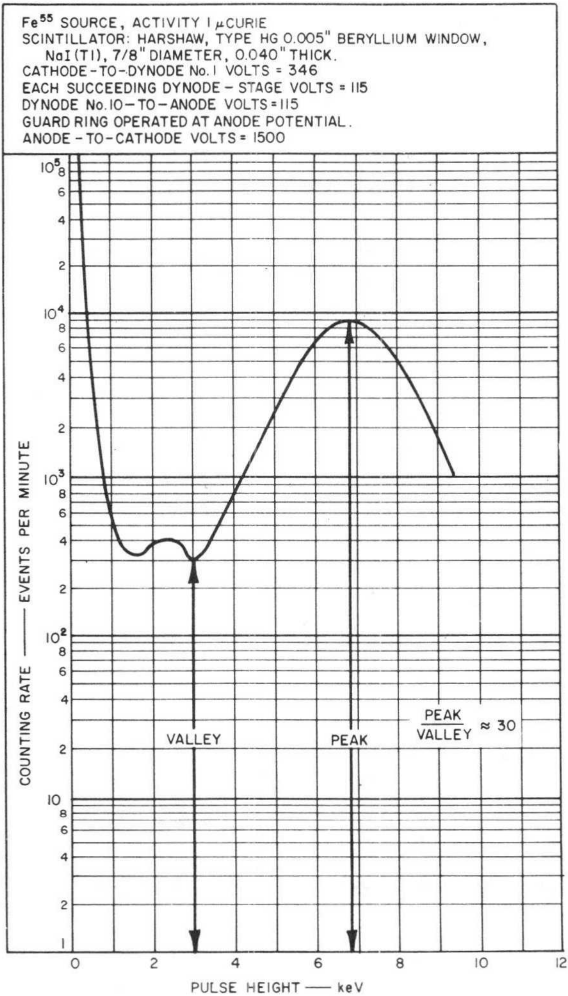
TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS



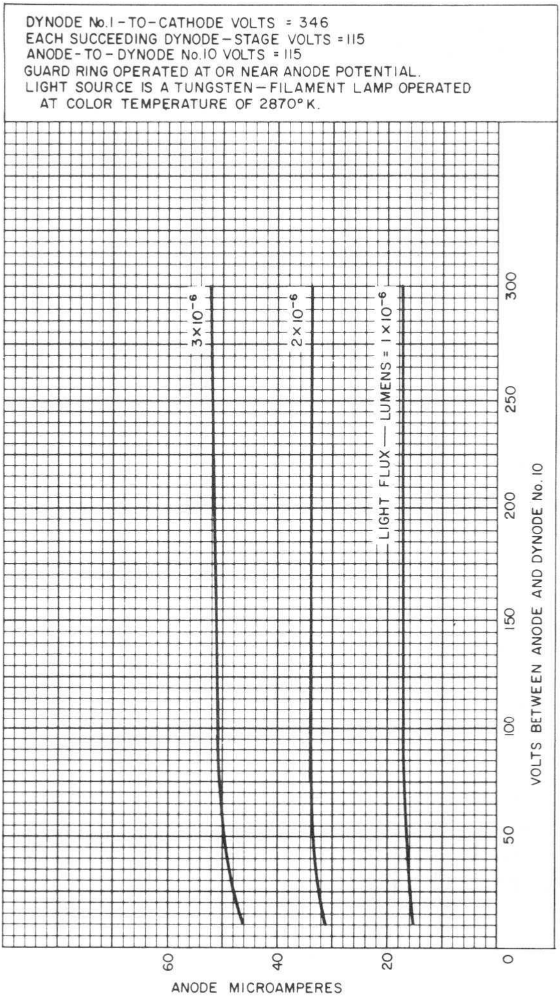
TYPICAL DARK PULSE SPECTRUM



DIFFERENTIAL Fe^{55} SPECTRUM



TYPICAL ANODE CHARACTERISTICS

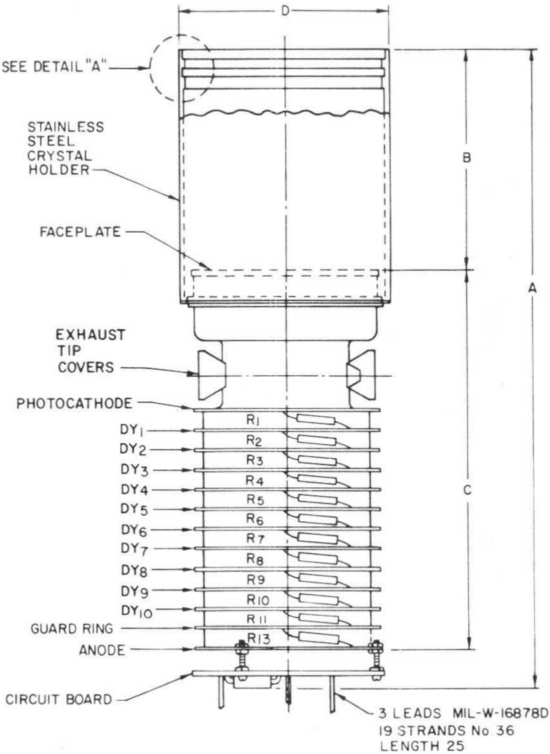


92LM-2987

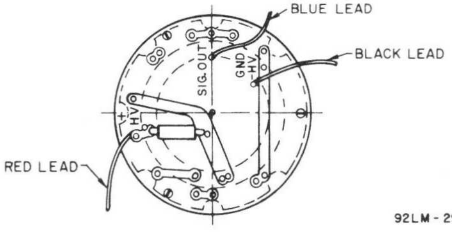
Photomultiplier Tube

RCA-8664/VI is a variant of type 8664 incorporating in its design a scintillation-crystal holder and a voltage-divider network. Ratings and characteristics for the 8664/VI are the same as shown for type 8664.

DIMENSIONAL OUTLINE (Front View)

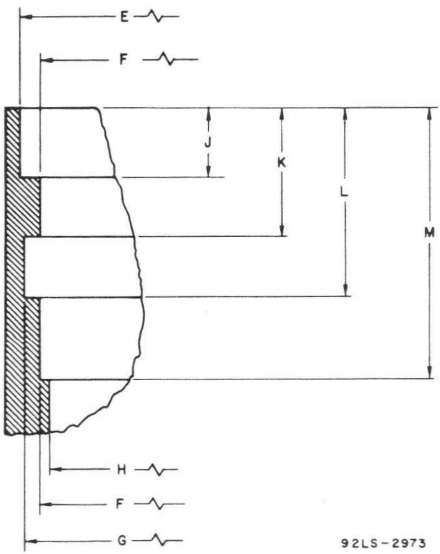


DIMENSIONAL OUTLINE (Bottom View)



92LM-2977

DETAIL "A"



92LS-2973

OUTLINE DIMENSIONS

Dimensions	Inches	mm
A	6.99 Max.	177.5 Max.
B	2.352 ± .005	59.740 ± .127
C	4.00 Max.	102 Max.
D	2.250 ± .010 Dia.	57.15 ± .25 Dia.
E	2.210 ± .005 Dia.	56.134 ± .127 Dia.
F	2.150 ± .005 Dia.	54.610 ± .127 Dia.
G	2.190 ± .005 Dia.	55.626 ± .127 Dia.
H	2.120 Dia.	53.85 Dia.
J	.098 ± .005	2.499 ± .127
K	.188 ± .005	4.775 ± .127
L	.280 + .005	7.112 + .127
M	$.406\ ^{+.030}_{-.000}$	$10.31\ ^{+.76}_{-.00}$

PARTS LIST FOR ACCOMPANYING TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

C_1: 0.005 μF, 20%, 1000 V dc, ceramic disc
C_2: 0.01 μF, 20%, 1000 V dc, ceramic disc
C_3, C_4: 0.01 μF, 20%, 3000 V dc, ceramic disc

R_1: 22 MΩ, 5%, 1/2 Watt
R_2 through R_{10}: 8.2 MΩ, 5%, 1/2 Watt
R_{11}: 2.4 MΩ, 5%, 1/2 Watt
R_{12}: 1 MΩ, 5%, 1/2 Watt
R_{13}: 1.1 MΩ, 5%, 1/2 Watt
R_{14}: 10 MΩ, 5%, 1/2 Watt

TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

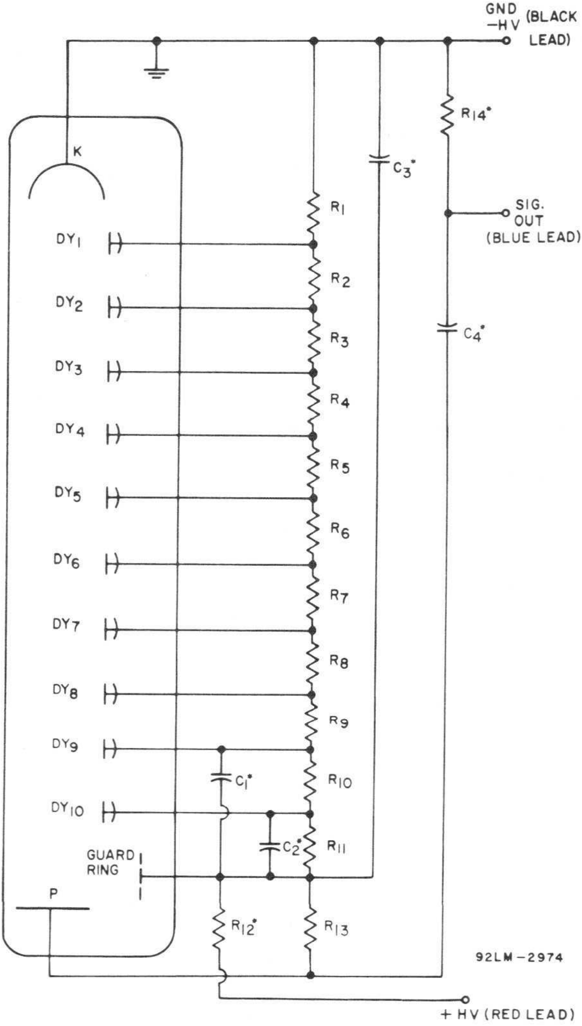


Image Orthicon

3-INCH DIAMETER
MAGNETIC FOCUS

LONG-LIFE TYPE
MAGNETIC DEFLECTION

For Exceptionally High-Quality Performance in Color and Black-and-White Studio Television

The 8673 is designed to replace types 4513, 7513, 7513/L, 8093, 8093A, and 8093A/L

GENERAL

Heater, for Unipotential Cathode
- Voltage (AC or DC) . . . . 6.3 ± 10% V
- Current at 6.3 V . . . . 0.600 A

Direct Interelectrode Capacitance
- Anode to all other electrodes. . . . . 12 pF

Target-to-Mesh Spacing . . . . .0.001 (0.0254 mm) in

Spectral Response. . . . . See *Typical Spectral Sensitivity Characteristic*
- Window Material. . . . . . . .Corning[a] No.7056, or equivalent
- Photocathode Material. . . . . Bialkali (Cs-K-Sb)

Photocathode Semitransparent
- Rectangular image (4 × 3 aspect ratio):[b]
- Useful Size[c] . . . . 1.8-inch max. diagonal

Focusing Method. . . . . Magnetic

Deflection Method. Magnetic

Overall Length . . . . 15.2 in (386 mm) ± 0.25 in

Greatest Diameter of Bulb . . . . 3.00 in (76.2 mm) ± 0.06 in

Minimum Deflecting Coil Inside Diameter. . . . . 2-3/8 in

Deflecting Coil. . . . . . Cleveland Electronics, OV-Series,[d] or equivalent

Deflecting-Coil Length . . . . 5 in

Focusing Coil. . . . . . . Cleveland Electronics, OF-Series,[d] or equivalent

Focusing-Coil Length . . . . 10 in

Alignment Coil . . . . . . Cleveland Electronics, OA-Series,[d] or equivalent
- Length . . . . 15/16 in
- Location . . . . Axially centered 11 inches to rear of tube faceplace

Photocathode Distance Inside End of Focusing Coil. . . . 1/2 in

Operating Position . . . The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.

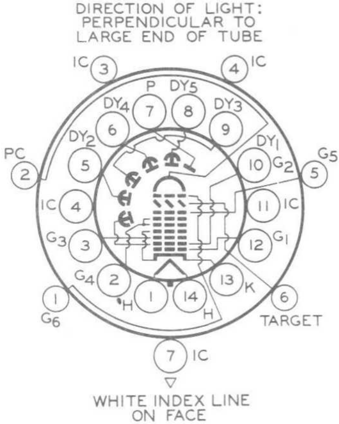
Socket . . . . Cinch Part No.3M14,[e] or equivalent

Weight (Approx.) . . . . 1 lb 6 oz (600 g)

TERMINAL DIAGRAM (Bottom View)

Shoulder Base: Keyed Jumbo Annular 7-Pin

Pin 1 - Grid No.6
Pin 2 - Photocathode
Pin 3 - Do Not Use
Pin 4 - Do Not Use
Pin 5 - Grid No.5
Pin 6 - Target
Pin 7 - Do Not Use



End Base: Small-Shell Diheptal 14-Pin (JEDEC No.B14-45)

Pin 1 - Heater
Pin 2 - Grid No.4 & Field Mesh
Pin 3 - Grid No.3
Pin 4 - Do Not Use
Pin 5 - Dynode No.2
Pin 6 - Dynode No.4
Pin 7 - Anode
Pin 8 - Dynode No.5
Pin 9 - Dynode No.3
Pin 10 - Dynode No.1, Grid No.2
Pin 11 - Do Not Use
Pin 12 - Grid No.1
Pin 13 - Cathode & Suppressor Grid
Pin 14 - Heater

Note: In the tube symbol, the suppressor grid connected to the cathode, and the field-mesh grid connected to grid No.4, are intentionally without numbers to avoid upsetting industry practice of associating functional camera control knobs with specific grid numbers. For example, beam-focus control is generally associated with knob identified as G_4 (grid No.4).

ABSOLUTE-MAXIMUM RATINGS

Voltages are with respect to thermionic cathode unless otherwise specified

Photocathode		
Voltage	-600	V
Illumination	50 fc (538 lux)	
Operating Temperature		
Of any part of bulb	50	°C
Of bulb at large end of tube (target section)	35 min	°C
Temperature Difference	5	°C
Between target section and any part of bulb hotter than target section		
Grid-No.6 Voltage	-550	V

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Target Voltage		
Positive value	10	V
Negative value	10	V
Grid-No.5 Voltage	200	V
Grid-No.4 Voltage	300	V
Grid-No.3 Voltage	400	V
Grid-No.2 & Dynode-No.1 Voltage	350	V
Grid-No.1 Voltage		
Negative-bias value	125	V
Positive-bias value	0	V
Peak Heater-Cathode Voltage		
Heater negative with respect to cathode	125	V
Heater positive with respect to cathode	10	V
Anode-Supply Voltage	1350	V
Voltage Between Consecutive Dynodes	400	V

TYPICAL OPERATING VALUES

Photocathode Voltage (Image focus)[f]	-400 to -540	V
Grid-No.6 Voltage (Accelerator)— Approx. 59% to 60% of photocathode voltage[g]	-235 to -325	V
Target Voltage Above Cutoff[h]	2	V
Grid-No.5 Voltage (Decelerator)	0 to 150	V
Grid-No.4 Voltage (Beam focus)[f]	140 to 180	V
Grid-No.3 Voltage[j]	260 to 300	V
Grid-No.2 & Dynode-No.1 Voltage	300	V
Grid-No.1 Voltage for Picture Cutoff	-45 to -115	V
Dynode-No.2 Voltage	600	V
Dynode-No.3 Voltage	800	V
Dynode-No.4 Voltage	1000	V
Dynode-No.5 Voltage	1200	V
Anode Voltage	1250	V
Target-Temperature Range	35 to 45	°C
Peak-to-Peak Target Blanking Voltage	6	V
Field Strength at Center of Focusing Coil (Approx.)[k]	75	G
Field Strength of Alignment Coil (Approx.)	0 to 3	G

PERFORMANCE DATA

With conditions shown under Typical Operating Values, picture highlights at the "knee" of the light-transfer characteristic, 525-line scanning, interlaced 2:1, frame time of 1/30 second, and 1.8-inch picture diagonal with 4x3 aspect ratio. Characteristics are measured in an RCA Model TK-31A camera, or equivalent.

	Min	*Typ*	*Max*	
Cathode Radiant Sensitivity at 4000 angstroms	-	0.08	-	μA/μW
Cathode Luminous Sensitivity[m]	60	100	-	μA
Signal-Output Current (Peak to Peak)	5	-	32	μA
Signal-to-Noise Ratio[n]	38:1 (31.6 dB)	45:1 (33.1 dB)	-	

	Min	Typ	Max	
Photocathode Illumination at 2870^oK Required to Reach "Knee" of Light-Transfer Characteristic.	-	-	0.035	fc(lm/ft^2)
Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[p]	38	55	-	%
Uniformity				
Ratio of Shading (Background) Signal to Highlight Signal. .	-	-	0.15	
Variation of Highlight Signal (Per cent of maximum highlight signal)[q]	-	-	25	%

[a] Made by Corning Glass Works, Corning, New York.

[b] Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base. The horizontal and vertical scan should preferably start at the corner of the raster nearest pin 6 of the shoulder base.

[c] The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponsing electron image on the target should have a size such that the corners of the rectangle just touch the target ring; a condition that may be achieved in some camera designs with a 1.6 inch diagonal image on the photocathode.

[d] Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

[e] Made by Cinch Manufacturing Company, 1026 South Homan Ave., Chicago 24, Ill.

[f] Adjust for best focus.

[g] For minimum highlight flare of "ghost" the grid-No.6 voltage should be 59% of the photocathode voltage.

[h] Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 volts to +5 volts.

[j] Adjust to give the most uniformly shaded picture near maximum signal.

[k] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[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^oK. The value of light flux is 1×10^{-4} lumen and -90 to -175 volts are applied between photocathode and grounded grid No.6 and target.

[n] With a noise equivalent bandwidth of 4.5 MHz. Peak signal output is measured with respect to "picture" black. Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level.

[p] Measured with amplifier having flat frequency responses.

[q] Variation of response over scanned area.

OPERATING TECHNIQUES

With lens uncapped and lens iris opened, proper voltages should be applied to the 8673, and the grid-No.1 voltage should immediately be adjusted to produce a small amount of beam current. This prevents the mesh from being electrostatically pulled into contact with the glass disc. Adjust the deflection circuits so that the beam "overscans" the target, i.e., so that the area of the target scanned is greater than its sensitive area. Note that overscanning the target results in a smaller-than-normal picture on the monitor. The lens should be capped and the tube should be allowed to warm up for 10 minutes before used or before adjustments are made.

Care should be taken to avoid operating the camera with the lens turret removed, or swinging the tube and focusing coil away from the optical system of a color camera, when voltages are applied to the tube. Excessive illumination for short periods of time under these conditions may damage the photocathode of the 8673.

Next, uncap the lens and partially open the lens iris. Increase the target voltage until information appears on the monitor. Then adjust beam focus, image focus, and optical focus until detail can be discerned in the picture. Adjust alignment-coil current controls until picture response is maximum. If picture appears in negative contrast, increase the beam current. Further adjust the alignment-coil current so that the center of the picture does not move when the beam-focus control (grid No.4) is varied, but simply goes in and out of focus. During alignment of the beam, and also during operating of the tube, always keep the beam current as low as possible to give the best picture quality and also to prevent excessive noise.

Next, focus the camera on a test pattern. The camera-to-test pattern distance should be set so that the corners of the test-pattern image just touch the inside of the target ring. The deflection circuits are next adjusted so that the entire test pattern just fills the TV raster. The target voltage is then advanced or reduced to the point where a reproduction of the test pattern is just discernible on the monitor. This value of target voltage is known as the "target-cutoff voltage". The target voltage should then be raised exactly two volts above the cutoff-voltage value, and the beam-current control adjusted to give just sufficient beam current to discharge the highlights.

Then adjust the lens to produce best optical focus, and the voltage on the photocathode as well as the voltage on grid No.4 to produce the sharpest picture. Grid No.4 should be adjustable in the range of 140 to 180 volts. There are several voltage values outside of this range which will provide beam focus. However, such focus modes are not recommended.

Proper adjustment for suppression of highlight flare or "ghost" and proper geometry is obtained when the grid-No.6 voltage is accurately set at 59 per cent of the photocathode voltage. This adjustment may be effected by positioning a small bright spot of light on the edge of the field to be viewed and then adjusting the grid-No.6 voltage so that the "ghost" that appears on the viewing monitor disappears as the image section is brought into sharpest focus. Improper adjustment is evident when a light spot that is observed on the right edge of the viewing monitor produces a "ghost" that appears above the spot and when a light spot observed on the left edge of the viewing monitor produces a "ghost" that appears below the spot.

Grid No.5 should then be adjusted to produce best uniformity of signal, i.e., the absence of dark corners. Such uniformity is best obtained while viewing a uniform white card, or test pattern, with the exposure on the tube well above the knee and with the picture monitor adjusted for low brightness.

After adjustment of the image section voltages, grid-No.3 voltage should be set for maximum signal output. The deflecting yoke and 8673 should be rotated, if necessary, so that the horizontal scanning of the camera is parallel to the horizontal plane of the scene.

Finally, readjust the target voltage so that it is accurately set to 2 volts above target cutoff. In black-and-white service, the lens iris should be opened to 1/2 or 1 lens stop beyond the point where the highlights of the scene reach the knee of the light transfer characteristic. In color camera service, each tube should be operated with white-scene highlights at the knee.

Do and Don'ts on Use of RCA-8673

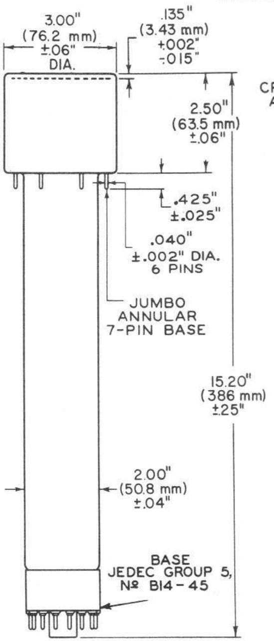
Dos

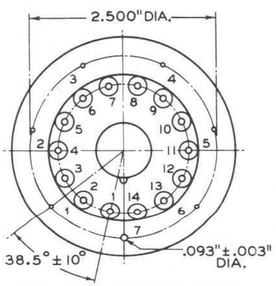
1. Allow the 8673 to warm up prior to operation.
2. Hold temperature of the 8673 within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 8673's by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to exactly 2 volts above target cutoff.
7. Uncap lens before voltages are applied to the 8673.
8. Turn off the camera or the image-section high voltage supply if the lens turret or the yoke and 8673 must be "swung out" to clean the lens of the tube faceplate.

Don'ts

1. Don't force the 8673 into its shoulder socket.
2. Don't operate the 8673 without scanning.
3. Don't operate an 8673 having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warmup or standby operation.
6. Don't remove the lens turret or lens when the camera is turned on, or when voltages are applied to the image section of the 8673, unless the light level incident on the tube can be reduced below 50 footcandles.

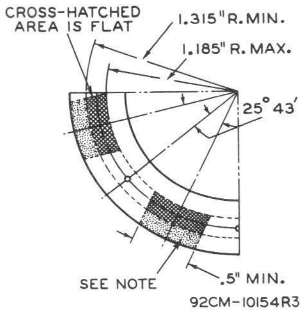
DIMENSIONAL OUTLINE





ENLARGED BOTTOM VIEW

DETAIL OF BOTTOM VIEW
OF JUMBO ANNULAR BASE



Note: Dotted area is flat or extends toward diheptal-base end of tube by 0.060 inch max.

ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

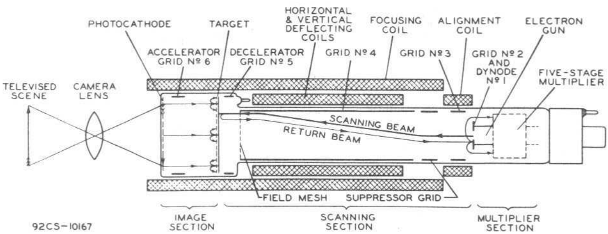
a. Six holes having diameter of 0.065 ± 0.001 inch and one hole having diameter of 0.150 ± 0.001 inch. All holes have depth of 0.265 inch ± 0.001 inch. The six 0.065 inch holes are enlarged by 45° taper to depth of 0.047 inch. All holes are spaced at angles of 51° 26' ± 5' on circle diameter of 2.500 ± 0.001 inches.

b. Seven stops having height of 0.187 ± 0.001 inch, centered between pin holes, to bear against flat areas of base.

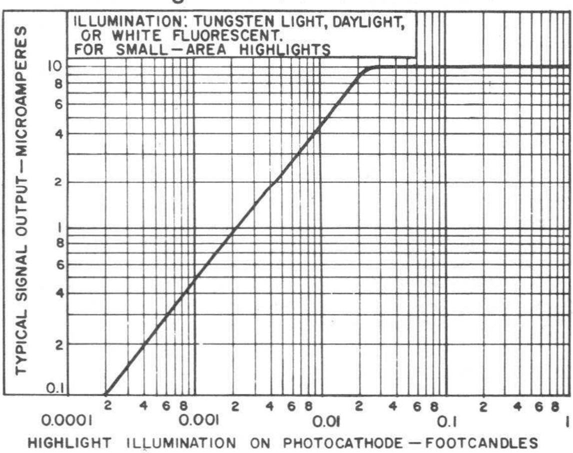
c. Rim extending out a minimum of 0.125 inch from 2.812 inch diameter and having height of 0.126 ± 0.001 inch.

d. Neck-cylinder clearance hole having diameter of 2.200 ± 0.001 inches.

SCHEMATIC ARRANGEMENT OF TYPE 8673



Basic Light Transfer Characteristic



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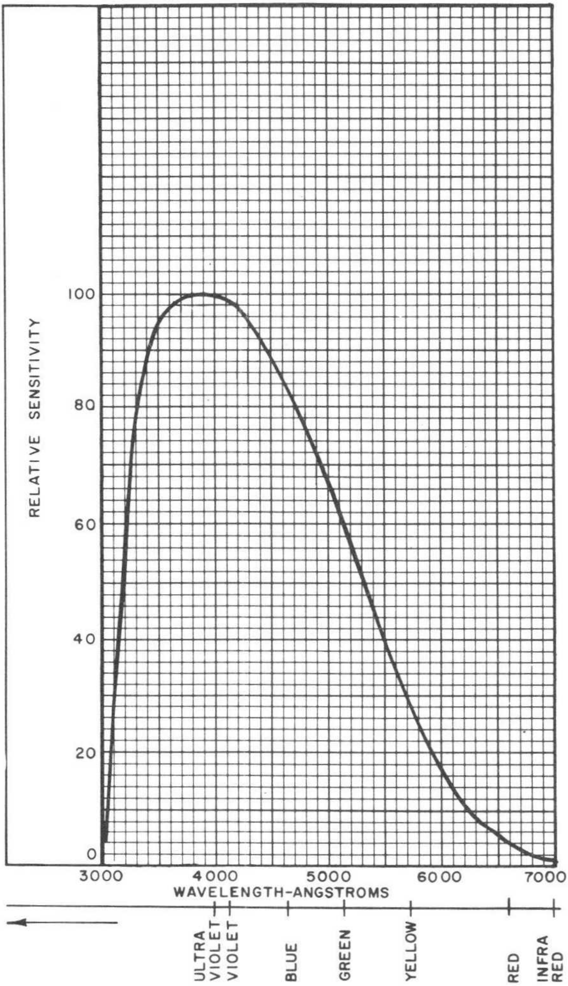
Typical Spectral Sensitivity Characteristic



92LM-1550

Image Orthicon

3-INCH DIAMETER
MAGNETIC FOCUS

LONG-LIFE, HIGH-SENSITIVITY TYPE
MAGNETIC DEFLECTION

For Superior Studio or Remote TV Pickup at Light Levels Available in Black-and-White TV Studios

The 8674 is designed to replace types 4415, 4416, 7293, 7293A, and 7293A/L.

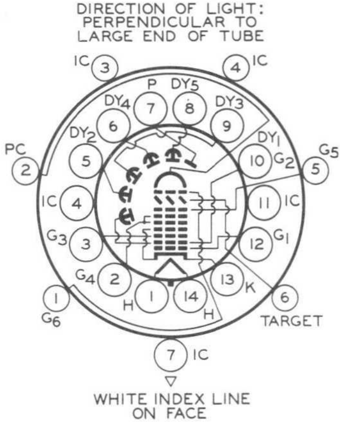
GENERAL

Heater, for Unipotential Cathode
Voltage (AC or DC) . . . . 6.3 ± 10% V
Current at 6.3 V. . . . . 0.600 A
Direct Interelectrode Capacitance
Anode to all other electrodes . . . . 12 pF
Target-to-Mesh Spacing. . . . . 0.002 in (0.051 mm)
Spectral Response . . . . . .See *Typical Spectral Sensitivity Characteristic*
Window Material . . . . . . Corning[a] No.7056, or equivalent
Photocathode Material . . . . Bialkali (Cs-K-Sb)
Photocathode Semitransparent
Rectangular image (4 x 3 aspect ratio):[b]
Useful Size[c]. . . . . .1.8-inch max. diagonal
Focusing Method . . . . .Magnetic
Deflection Method . . . . .Magnetic
Overall Length. . . . . 15.2 in (386 mm) ± 0.25 in
Greatest Diameter of Bulb . . . . .3.00 in (76.2 mm) ± 0.06 in
Minimum Deflecting-Coil Inside Diameter . . . . 2-3/8 in
Deflecting Coil . . . . . .Cleveland Electronics, OV-Series,[d] or equivalent
Deflecting-Coil Length. . . . . 5 in
Focusing Coil . . . . . . .Cleveland Electronics, OF-Series,[d] or equivalent
Focusing-Coil Length. 10 in
Alignment Coil. . . . . . .Cleveland Electronics, OA-Series,[d] or equivalent
Length. . . . . 15/16 in
Location. . . . . Axially centered 11 inches to rear of tube faceplate
Photocathode Distance Inside End of Focusing Coil . . .1/2 in
Operating Position. . . . The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with base up makes an angle of less than 20° with the vertical.
Socket. . . . . .Cinch Part No.3M14,[e] or equivalent
Weight (Approx.). . . . . 1 lb 6 oz (600 g)

TERMINAL DIAGRAM (Bottom View)

Shoulder Base: Keyed Jumbo Annular 7-Pin

Pin 1 - Grid No.6
Pin 2 - Photocathode
Pin 3 - Do Not Use
Pin 4 - Do Not Use
Pin 5 - Grid No.5
Pin 6 - Target
Pin 7 - Do Not Use



End Base: Small-Shell Diheptal 14-Pin (JEDEC No.B14-45)

Pin 1 - Heater
Pin 2 - Grid No.4 & Field Mesh
Pin 3 - Grid No.3
Pin 4 - Do Not Use
Pin 5 - Dynode No.2
Pin 6 - Dynode No.4
Pin 7 - Anode
Pin 8 - Dynode No.5
Pin 9 - Dynode No.3
Pin 10 - Dynode No.1, Grid No.2
Pin 11 - Do Not Use
Pin 12 - Grid No.1
Pin 13 - Cathode & Suppressor Grid
Pin 14 - Heater

NOTE: In the tube symbol, the suppressor grid connected to the cathode, and the field-mesh grid connected to grid No.4, are intentionally without numbers to avoid upsetting industry practice of associating functional camera control knobs with specific grid numbers. For example, beam-focus control is generally associated with knob identified as G_4 (grid No.4).

ABSOLUTE-MAXIMUM RATINGS

Voltages are with respect to thermionic cathode unless otherwise specified

Photocathode		
Voltage	-600	V
Illumination.	50 fc (538 lux)	
Operating Temperature		
Of any part of bulb	50	°C
Of bulb at large end of tube (Target section)	35 min.	°C
Temperature Difference.	5	°C
Between target section and any part of bulb hotter than target section		
Grid-No.6 Voltage	-550	V

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Target Voltage		
Positive value.	10	V
Negative value.	10	V
Grid-No.5 Voltage	200	V
Grid-No.4 Voltage	300	V
Grid-No.3 Voltage	400	V
Grid-No.2 & Dynode-No.1 Voltage	350	V
Grid-No.1 Voltage		
Negative-bias value	125	V
Positive-bias value	0	V
Peak Heater-Cathode Voltage		
Heater negative with respect to cathode .	125	V
Heater positive with respect to cathode .	0	V
Anode-Supply Voltage.	1350	V
Voltage Between Consecutive Dynodes	400	V

TYPICAL OPERATING VALUES

Photocathode Voltage (Image focus)[f]	-400 to -540	V
Grid-No.6 Voltage (Accelerator)— Approx. 59% to 60% of photocathode voltage[g]	-235 to -325	V
Target Voltage above Cutoff[h].	2	V
Grid-No.5 Voltage (Decelerator)	0 to 150	V
Grid-No.4 Voltage (Beam focus).	140 to 180	V
Grid-No.3 Voltage[g].	260 to 300	V
Grid-No.2 & Dynode-No.1 Voltage	300	V
Grid-No.1 Voltage for Picture Cutoff. . . .	-45 to -115	V
Dynode-No.2 Voltage	600	V
Dynode-No.3 Voltage	800	V
Dynode-No.4 Voltage	1000	V
Dynode-No.5 Voltage	1200	V
Anode Voltage	1250	V
Target-Temperature Range.	35 to 45	°C
Peak-to-Peak Target Blanking Voltage. . . .	6	V
Field Strength at Center of Focusing Coil (Approx.)[k]	75	G
Field Strength of Alignment Coil (Approx.).	0 to 3	G

PERFORMANCE DATA

With conditions shown under Typical Operating Values, picture highlights at the "knee" of the light-transfer characteristic, 525-line scanning, interlaced 2:1, frame time of 1/30 second, and 1.8-inch picture diagonal with 4x3 aspect ratio. Characteristics are measured in an RCA Model TK-31A camera, or equivalent.

	Min	*Typ*	*Max*	
Cathode Radiant Sensitivity at 4000 angstroms.	-	0.08	-	µA/µW
Cathode Luminous Sensitivity[m]	60	100	-	µA
Signal-Output Current (Peak to Peak)	5	-	32	µA

	Min	Typ	Max	
Signal-to-Noise Ratio[n] . . .	35:1 (31 dB)	40:1 (32 dB)	-	
Photocathode Illumination at 2870°K Required to Reach "Knee" of Light-Transfer Characteristic	-	-	0.022	fc(lm/ft²)
Amplitude Response at 400 TV Lines per Picture Height (Per cent of large-area black to large-area white)[p]	40	60	-	%
Uniformity				
Ratio of Shading (Background) Signal to Highlight Signal. . . .	-	-	0.15	
Variation of Highlight Signal (Per cent of maximum highlight signal)[q].	-	-	25	%

[a] Made by Corning Glass Works, Corning, New York.

[b] Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base. The horizontal and vertical scan should preferably start at the corner of the raster nearest pin 6 of the shoulder base.

[c] The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have size such that the corners of the rectangle just touch the target ring; a condition that may be achieved in some camera designs with a 1.6-inch diagonal image on the photocathode.

[d] Made by Cleveland Electronics Inc., 1974 East 61st St., Cleveland, Ohio.

[e] Made by Cinch Manufacturing Company, 1026 South Homan Ave., Chicago 24, Ill.

[f] Adjust for best focus.

[g] For minimum highlight flare or "ghost" the grid-No.6 voltage should be 59% of the photocathode voltage.

[h] Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 volts to +5 volts.

[j] Adjust to give the most uniformly shaded picture near maximum signal.

[k] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

[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 1 x 10^{-4} lumen and -90 to -175 volts are applied between photocathode and grounded grid No.6 and target.

[n] With a noise equivalent bandwidth of 4.5 MHz. Peak signal output is measured with respect to "picture" black. Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level.

[p] Measured with amplifier having flat frequency responses.

[q] Variation of response over scanned area.

OPERATING TECHNIQUES

With lens uncapped and lens iris opened, proper voltages should be applied to the 8674, and the grid-No.1 voltage should immediately be adjusted to produce a small amount of beam current. Adjust the deflection circuits so that the beam "overscans" the target, i.e., so that the area of the target scanned is greater than its sensitive area. The lens should be capped and the tube should be allowed to warm up for 10 minutes before used or before adjustments are made.

Care should be taken to avoid operating the camera with the lens turret removed, or swinging the tube and focusing coil away from the optical system of a color camera, when voltages are applied to the tube. Excessive illumination for short periods of time under these conditions may damage the photocathode of the 8674.

Next, uncap the lens and partially open the lens iris. Increase the target voltage until information appears on the monitor. Then adjust beam focus, image focus, and optical focus until detail can be discerned in the picture. Adjust alignment-coil-current controls until picture response is maximum. If picture appears in negative contrast, increase the beam current. Further adjust the alignment-coil current so that the center of the picture does not move when the beam-focus control (grid No.4) is varied, but simply goes in and out of focus. During alignment of the beam, and also during operation of the tube, always keep the beam current as low as possible to give the best picture quality and also to prevent excessive noise.

Next, focus the camera on a test pattern. The camera-to-test pattern distance should be set so that the corners of the test-pattern image just touch the inside of the target ring. The deflection circuits are next adjusted so that the entire test pattern just fills the TV raster. The target voltage is then advanced or reduced to the point where a reproduction of the test pattern is just discernible on the monitor. This value of target voltage is known as the "target-cutoff voltage". The target voltage should then be raised exactly two volts above the cutoff-voltage value, and the beam-current control adjusted to give just sufficient beam current to discharge the highlights.

Then adjust the lens to produce best optical focus, and the voltage on the photocathode as well as the voltage on grid No.4 to produce the sharpest picture, Grid No.4 should be adjustable in the range of 140 to 180 volts. There are several voltage values outside of this range which will provide beam focus. However, such focus modes are not recommended.

Proper adjustment for suppression of highlight flare or "ghost" and proper geometry is obtained when the grid-No.6 voltage is accurately set at 59 per cent of the photocathode voltage. This adjustment may be effected by positioning a small bright spot of light on the edge of the field to be viewed and then adjusting the grid-No.6 voltage so that the "ghost" that appears on the viewing monitor disappears as the image section is brought into sharpest focus. Improper adjustment is evident when a light spot that is observed on the right edge of the viewing monitor produces a "ghost" that appears above the spot and when a light spot observed on the left edge of the viewing monitor produces a "ghost" that appears below the spot.

Grid No.5 should then be adjusted to produce best uniformity of signal, i.e., the absence of dark corners. Such uniformity is best obtained while viewing a uniform white card, or test pattern, with the exposure on the tube well above the knee and with the picture monitor adjusted for low brightness.

After adjustment of the image section voltages, grid-No.3 voltage should be set for maximum signal output. The deflecting yoke and the 8674 should be rotated, if necessary, so that the horizontal scanning of the camera is parallel to the horizontal plane of the scene.

Finally, readjust the target voltage so that it is accurately set to 2 volts above target cut-off. In black-and-white service, the lens iris should be opened to 1/2 or 1 lens stop beyond the point where the highlights of the scene reach the knee of the light transfer characteristic. In color camera service, each tube should be operated with white-scene highlights at the knee.

Dos and Don'ts on Use of RCA-8674

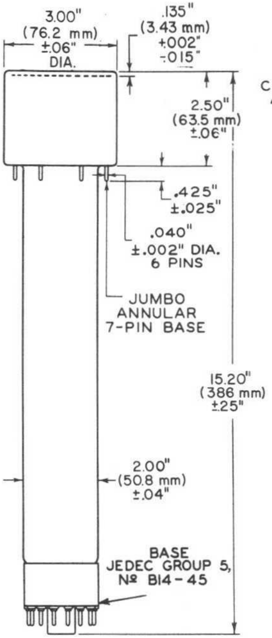
Dos

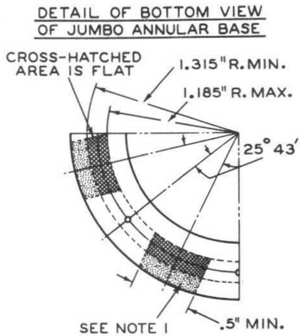
1. Allow the 8674 to warm up prior to operation.
2. Hold temperature of the 8674 within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Condition spare 8674's by operating several hours once each month.
6. Determine proper operating point with target voltage adjusted to exactly 2 volts above target cutoff.
7. Uncap lens before voltages are applied to the 8674.
8. Turn off the camera or the image-section high voltage supply if the lens turret or the yoke and 8674 must be "swung out" to clean the lens of the tube faceplate.

Don'ts

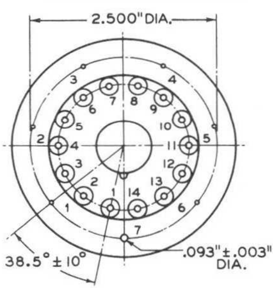
1. Don't force the 8674 into its shoulder socket.
2. Don't operate the 8674 without scanning.
3. Don't operate the 8674 having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warmup or standby operation.

6. Don't remove the lens turret or lens when the camera is turned on, or when voltages are applied to the image section of the 8674, unless the light level incident on the tube can be reduced below 50 footcandles.





Note 1: Dotted area is flat or extends toward diheptal-base end of tube by 0.060 inch max.



ENLARGED BOTTOM VIEW

ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flatplate gauge with:

a. Six holes having diameter of 0.065 ± 0.001 inch and one hole having diameter of 0.150 ± 0.001 inch. All holes have depth of 0.265 ± 0.001 inch. The six holes are enlarged by 45° taper to depth of 0.047 inch. All holes are spaced at angles of 51° 26' ± 5' on circle diameter of 2.500 ± 0.001 inches.

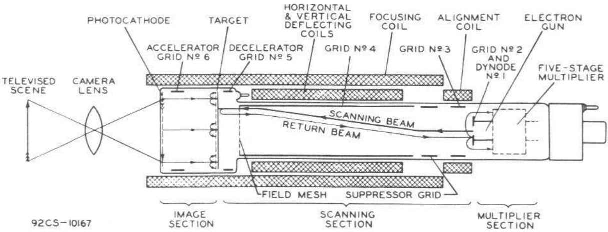
b. Seven stops having height of 0.187 ± 0.001 inch, centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125 inch from 2.812 inch diameter and having height of 0.126 ± 0.001 inch.

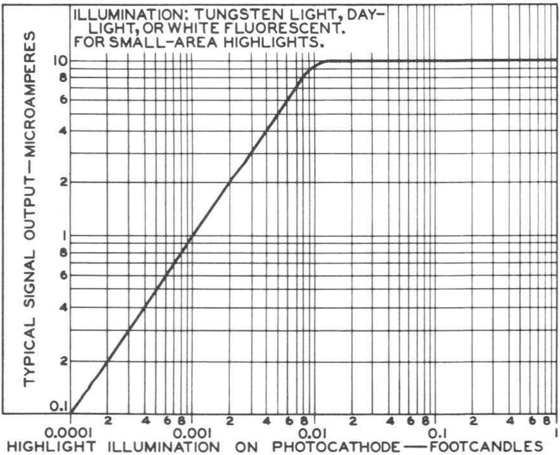
d. Neck-cylinder clearance hole having diameter of 2.200 ± 0.001 inches

92CM-10154R3

SCHEMATIC ARRANGEMENT OF TYPE 8674

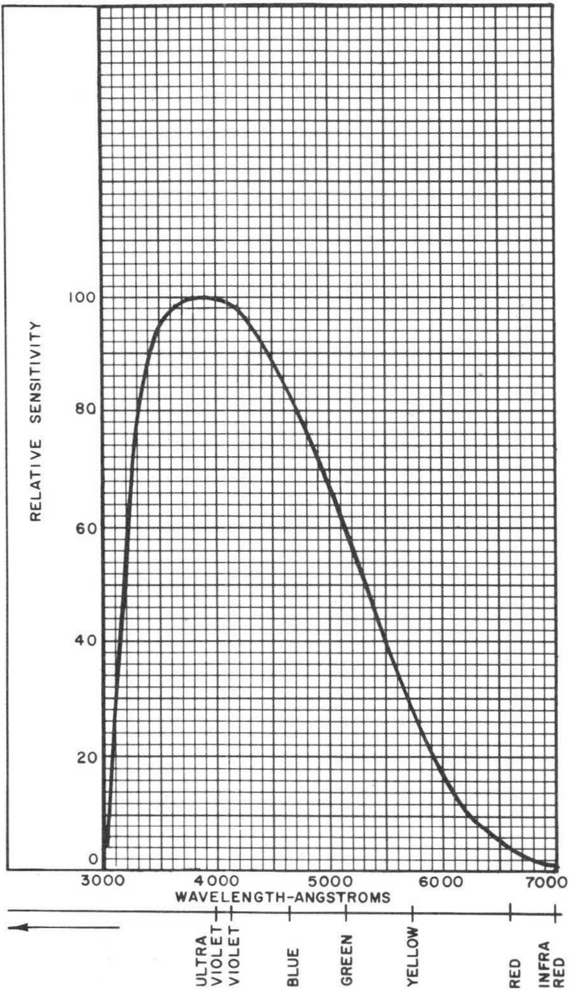


Basic Light Transfer Characteristic



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

Typical Spectral Sensitivity Characteristic



92LM-1550

Image Orthicon

"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS
FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

LONG-LIFE ELECTRONICALLY-CONDUCTING GLASS TARGET

MAGNETIC FOCUS
MAGNETIC DEFLECTION

For Extremely High-Quality Performance in Black-and-White Studio and Television Tape-Recording Operations. The 8748 is Directly Interchangeable with the 7389, 7389A, 7389B, and 7389C.

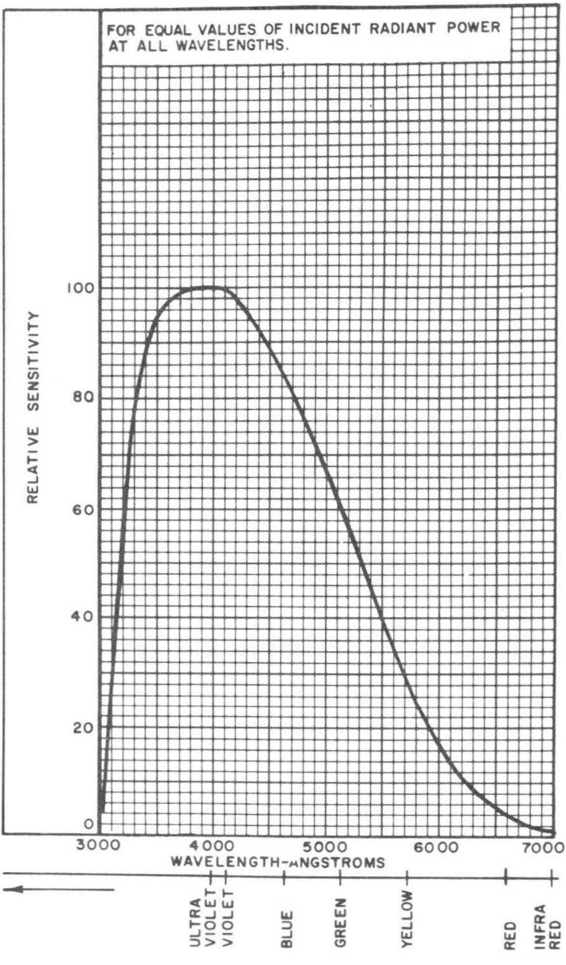
The 8748 is the same as the 7389B except for the following paragraph, Performance Data, and Typical Spectral Sensitivity Characteristic.

Compatibility of the bialkali photocathode and the glass target of the 8748 results in constant high-resolution throughout tube life. The glass target is characterized by stable long-life, resistance to "burn-in", and the absence of granular structure. Charge transport through this target is electronic rather than ionic. Tube life is therefore extended and stable sensitivity is achieved. Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster burn-in are significantly reduced. As a result, the need for an orbiter, or the necessity of continually moving the camera when focused on a stationary scene, is eliminated.

PERFORMANCE DATA

	Min	*Typ*	*Max*	
Cathode Radiant Sensitivity at 4000 angstroms	-	0.08	-	A/W
Cathode Luminous Sensitivity (2870°K)	-	85	-	μA/lm

Typical Spectral Sensitivity Characteristic



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

Image Orthicon

"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS

FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

LONG-LIFE ELECTRONICALLY-CONDUCTIVE GLASS TARGET
MAGNETIC FOCUS

FIELD-MESH TYPE
MAGNETIC DEFLECTION

For Very High-Quality Performance in Black-and-White Studio or Remote TV Cameras. The 8749 is Directly Interchangeable with the 7295, 7295A, 7295B, and 7295C.

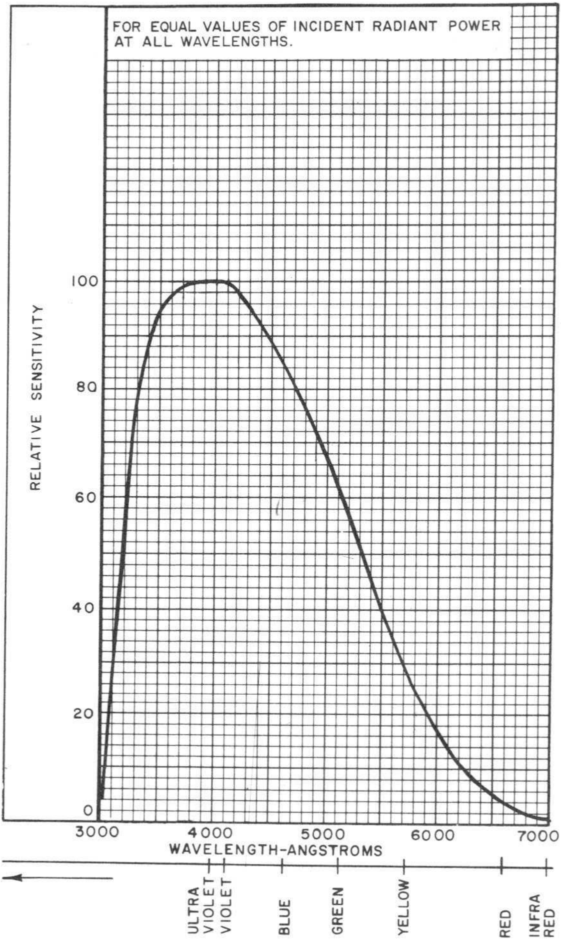
The 8749 is the same as the 7295B except for the following paragraph, Performance Data, and Typical Spectral Sensitivity Characteristic.

Compatibility of the bialkali photocathode and the glass target of the 8749 results in constant high resolution throughout tube life. The glass target is characterized by stable long-life, resistance to "burn-in", and the absence of granular structure. Charge transport through this target is electronic rather than ionic. Tube life is therefore extended and stable sensitivity is achieved. Other important advantages of this target are that the undesirable characteristics of scene retention or "sticking picture" and raster burn-in are significantly reduced. As a result, the need for an orbiter, or the necessity of continually moving the camera when focused on a stationary scene, is eliminated.

PERFORMANCE DATA

	Min	*Typ*	*Max*	
Cathode Radiant Sensitivity at 4000 angstroms	-	0.08	-	A/W
Cathode Luminous Sensitivity (2870°K)	-	85	-	μA/lm

Typical Spectral Sensitivity Characteristic



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

Image Orthicon

3-Inch Diameter, Bialkali Photocathode Long-Life Type

For Remote and Studio Television Service
Types 8775 is designed to replace types 5820, 5820A, 5820A/L, and 5830B

GENERAL

Direct Interelectrode Capacitance:
  Anode to all other electrodes . . . . 12 pF
Target-to-Mesh:
  Spacing . . . . 0.0022 in (0.056 mm)
  Capacitance . . . . 100 pF
Photocathode, Semitransparent:
  Spectral Response . . . . . . See *Typical Bialkali Spectral Sensitivity Characteristic*
    Window material . . . Corning[a] No.7056, or equivalent
    Photocathode material . . Bialkali (Cesium-Potassium-Antimony)
  Rectangular image (4 x 3 aspect ratio):
    Useful size of . . . . 1.8 in (46 mm) max. diagonal
    Note: The size of the optical image focused on the photocathode should be adjusted so that its maximum diagonal does not exceed the specified value. The corresponding electron image on the target should have a size such that the corners of the rectangle just touch the target ring.
    Orientation of . . Proper orientation is obtained when the vertical scan is essentially parallel to the plane passing through center of faceplate and pin 7 of the shoulder base. The horizontal and vertical scan should preferably start at the corner of the raster nearest pin 6 of the shoulder base.

Focusing Method . . . . Magnetic
Deflection Method . . . . Magnetic
Overall Length . . . . 15.20 in (386 mm) ± 0.25 in
Greatest Diameter of Bulb . . . 3.00 in (76.2 mm) ± 0.06 in
Shoulder Base . . . . Keyed Jumbo Annular 7-Pin
End Base . . . . Small-Shell Diheptal 14-Pin
JEDEC Group 5, No.B14-45
  Socket . . . . Cinch Part No.3M14,[b] or equivalent
Operating Position . . . The tube should never be operated in a vertical position with the diheptal-base end up nor in any other position where the axis of the tube with the base up makes an angle of less than 20° with the vertical.
Weight (Approx.) . . . . 1 lb 6 oz (600g)

Minimum Deflecting-Coil Inside Diameter	2-3/8 in (61.3 mm)
Deflecting Coil	Cleveland Electronics, OY-Series[c], or equivalent
Deflecting-Coil Length	5 in (127 mm)
Focusing Coil	Cleveland Electronics, OF-Series[c], or equivalent
Focusing-Coil Length	10 in (254 mm)
Alignment Coil	Cleveland Electronics, OA-Series[c], or equivalent
Alignment-Coil Length	15/16 in (23.8 mm)
Alignment-Coil Location	Axially centered 11 inches to rear of tube faceplate
Photocathode Distance Inside End of Focusing Coil	1/2 in (12.7 mm)

ABSOLUTE MAXIMUM AND MINIMUM RATINGS

Voltages are with respect to thermionic cathode unless otherwise specified.

Heater, for Unipotential Cathode:		
Voltage (AC or DC) applied between end base pin No.1 and pin No.14	6.3 ± 10%	V
Current	0.6	A
Operating Temperature:		
Of any part of bulb	50 max.	°C
Of bulb at large end of tube (Target section)	35 min.	°C
Temperature Difference:		
Between target section and any part of bulb hotter than target section	5 max.	°C
Photocathode:		
Voltage	-550 max.	V
Illumination	50 max.	lm/ft^2 (fc)
	538	lux
Grid-No.6 Voltage	-550 max.	V
Target Voltage:		
Positive value	10 max.	V
Negative value	10 max.	V
Grid-No.5 Voltage	150 max.	V
Grid-No.4 Voltage	300 max.	V
Grid-No.3 Voltage	400 max.	V
Grid-No.2 & Dynode No.1 Voltage	350 max.	V
Grid-No.1 Voltage:		
Negative bias value	125 max.	V
Positive bias value	0 max.	V

Peak Heater-Cathode Voltage:		
Heater negative with respect to cathode	125 max.	V
Heater positive with respect to cathode	10 max.	V
Anode-Supply Voltage	1350 max.	V
Voltage Between Consecutive Dynodes	350 max.	V

TYPICAL OPERATING VALUES

Heater Voltage, for Unipotential Cathode	6.3	V
Photocathode Voltage (Image Focus)[e]	-400 to -540	V
Grid-No.6 Voltage (Accelerator)- Approx. 75% of photocathode voltage	-300 to 405	V
Target Voltage Above Cutoff[g]	2	V
Grid-No.5 Voltage (Decelerator)	0 to 125	V
Grid-No.4 Voltage (Beam Focus)[e]	140 to 180	V
Grid-No.3 Voltage[h]	225 to 330	V
Grid-No.2 & Dynode-No.1 Voltage	300	V
Grid-No.1 Voltage for Picture Cutoff	-45 to -115	V
Dynode-No.2 Voltage	600	V
Dynode-No.3 Voltage	800	V
Dynode-No.4 Voltage	1000	V
Dynode-No.5 Voltage	1200	V
Anode Voltage	1250	V
Target Temperature Range	35 to 45	°C
Target Blanking Voltage (Peak to Peak)	5	V
Field Strength at Center of Focusing Coil (Approx.)[i]	75	G
Field Strength of Alignment Coil	0 to 3	G

PERFORMANCE CHARACTERISTICS RANGE VALUES

With conditions shown under Typical Operating Values, picture highlights at the "knee" of the light transfer characteristic, 525 line scanning, interlaced 2:1, frame time of 1/30 second, and 1.8" picture diagonal with 4 x 3 aspect ratio. Characteristics are measured in an RCA Model TK-31A camera, or equivalent

	Min.	*Typ.*	*Max.*	
Cathode Radiant Sensitivity at 4000 angstroms	–	0.072	–	A/W

Cathode Luminous Sensitivity[k]	–	90	–	µA/lm
Signal-Output Current (Peak-to-Peak)	3	12	30	µA
Signal-to-Noise Ratio[m] . .	32	34	–	dB
Photocathode Illumination at 2870° K Required to Reach "Knee" of Light Transfer Characteristic	–	0.010	0.020	lm/ft^2
Amplitude Response at 400 TV Lines per Picture Height (per cent of large area black to large-area white)[n]	35	50	–	%
Uniformity:				
Ratio of Shading (Background) Signal to Highlight Signal . . .	–	0.12	0.15	
Variation of Highlight Signal (Per cent of maximum highlight signal)[p]	–	20	25	%

[a] Made by Corning Glass Works, Corning, New York.

[b] Made by Cinch Manufacturing Company, 1026 South Homan Ave., Chicago 24, Ill.

[c] Made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, Ohio 44087.

[e] Adjust for best focus.

[f] For minimum highlight flare or "ghost" the grid-No.6 voltage should be 75% of the photocathode voltage.

[g] Test setting of target voltage is +2 volts from target-cut-off. The target supply voltage should be adjustable from -3 to +5 volts to allow user choice of operating target voltage.

[h] Adjust to give the most uniformly shaded picture near maximum signal.

[i] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with indicator located outside of and at the image end of the focusing coil.

[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 1×10^{-4} lumen and -90 to -175 volts are applied between photocathode and grounded grid No.6 and target.

[m] Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level. The value shown is measured under the following conditions using a Video Noise Meter, Model UPSF (North American Version), or equivalent. This meter is manufactured by Rohde and Schwarz, Munich, West Germany.

Signal: Blanked video, 0.7 V peak-to-peak including 0.07 V set-up.

Noise Meter: Gated with horizontal and vertical blanking signal of camera system. Video pass band is shaped by means of self-contained 100 kHz high-pass and 4.2 MHz low-pass filters.

Weighting filters matching the response of the human eye (CCIR Rec.421, Annex III) are not used and the color subcarrier, 3.58 MHz, is not present during the measurement.

[n] Measured with amplifier having flat frequency response.

[p] Variation of response over scanned area.

DOS and DON'TS On Use of RCA-8775

Here are the "dos"

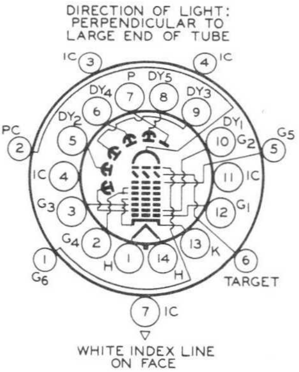
1. Allow the 8775 to warm up prior to operation.
2. Hold temperature of the 8775 within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Select target voltage according to operating needs. This freedom of operation results from use of the electronically-conducting glass target.
6. Uncap lens before voltages are applied to the 8775.

7. Turn off the camera or the image-section high voltage supply as the lens turret or the yoke and 8775 must be "swung out" to clean the lens of the tube faceplate.

Here are the "don'ts"

1. Don't force the 8775 into its shoulder socket.
2. Don't operate the 8775 without scanning.
3. Don't operate an 8775 having an ion spot.
4. Don't use more beam current than necessary to discharge the highlights of the scene.
5. Don't turn off beam while voltages are applied to photocathode, grid No.6, target, dynodes, and anode during warmup or standby operation.
6. Don't remove the lens turret or lens when the camera is turned on, or when voltages are applied to the image section of the 8775, unless the light level incident on the tube can be reduced below 50 footcandles.

TERMINAL DIAGRAM (Bottom View)



SMALL-SHELL DIHEPTAL 14-PIN BASE

Pin 1: Heater
Pin 2: Grid No.4
Pin 3: Grid No.3
Pin 4: Internal Connection – Do not use
Pin 5: Dynode No.2
Pin 6: Dynode No.4
Pin 7: Anode
Pin 8: Dynode No.5
Pin 9: Dynode No.3
Pin 10: Dynode No.1, Grid No.2
Pin 11: Internal Connection – Do not use
Pin 12: Grid No.1
Pin 13: Cathode
Pin 14: Heater

KEYED JUMBO ANNULAR 7-PIN BASE

Pin 1: Grid No.6
Pin 2: Photocathode
Pin 3: Internal Connection – Do not use
Pin 4: Internal Connection – Do not use
Pin 5: Grid No.5
Pin 6: Target
Pin 7: Internal Connection – Do not use

ANNULAR BASE GAUGE

Angular variations between pins as well as eccentricity of neck cylinder with respect to photocathode cylinder are held to tolerances such that pins and neck cylinder will fit flat-plate gauge with:

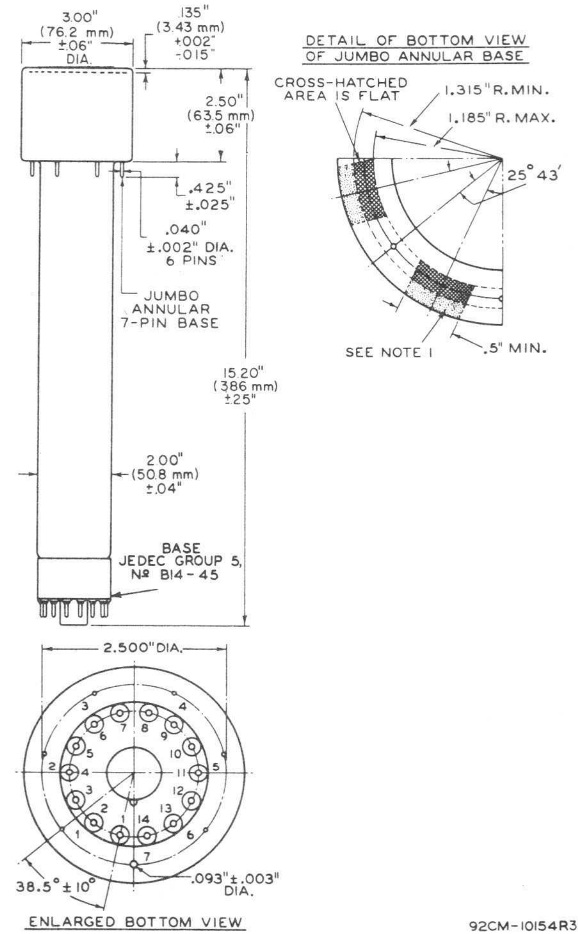
a. Six holes having diameter of 0.065" ± 0.001" and one hole having diameter of 0.150" ± 0.001". All holes have depth of 0.265" ± 0.001". The six 0.065" holes are enlarged by 45° taper to depth of 0.047". All holes are spaced at angles of 51°26' ± 5' on circle diameter of 2.500" ± 0.001).

b. Seven stops having height of 0.187" ± 0.001", centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125" from 2.812" diameter and having height of 0.126" ± 0.001".

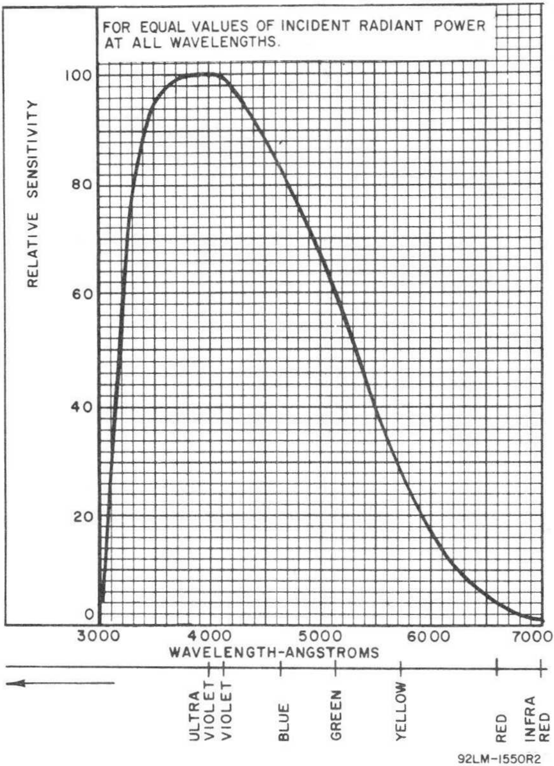
d. Neck-cylinder clearance hole having diameter of 2.200" ± 0.001".

DIMENSIONAL OUTLINE

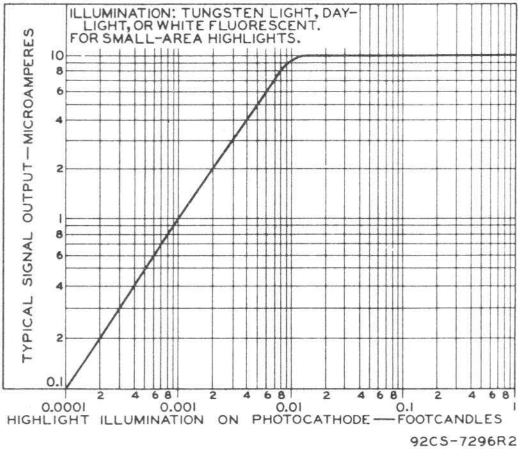


Note 1: Dotted area is flat or extends toward diheptal-base end of tube by 0.060" max.

TYPICAL BIALKALI SPECTRAL SENSITIVITY CHARACTERISTIC



BASIC LIGHT TRANSFER CHARACTERISTIC



Photomultiplier Tube

2"-Diameter Type

RCA-8850 is a 12-stage, head-on QUANTACON* Type Having Extremely High-Gain Gallium-Phosphide First Dynode and High Quantum Efficiency Bialkali Photocathode

GENERAL

Spectral Response . . . . See accompanying *Spectral Response Characteristics*

Wavelength of Maximum Response . . . . 3850 ± 500 Å

Cathode, Semitransparent . . . . Potassium-Cesium-Antimony (Bialkali)

Minimum projected area. . . . . 2.54 sq in
Minimum diameter . . . . 1.80 in

Window . . . . Pyrex, Corning[a] No.7740, or equivalent

Shape . . . . Plano-Concave

Index of refraction at 5893 angstroms 1.47

Dynode No.1:

Secondary Emitting Surface . . . . Gallium-Phosphide, GaP

Dynode No.2 through 12:
Secondary Emitting Surface . . . . Beryllium-Oxide

Dynode Structure . . . . . In-Line Electrostatic Focus-Type
Direct Interelectrode Capacitances (Approx.):
Anode to dynode No.12 . . . . 5 pF
Anode to all other electrodes . . . . 6 pF
Maximum Overall Length . . . . 5.71 in
Seated Length . . . . 4.98 ± 0.08 in
Maximum Diameter . . . . 2.10 in
Bulb T16
Base . . . . See Base Drawing
Socket . . . . RCA AJ2144 or AJ2145[b]
Magnetic Shield . . . . See footnote (c)
Operating Position . . . . Any
Weight (Approx.) . . . . 6 oz

MAXIMUM AND MINIMUM RATINGS, *Absolute-Maximum Values*

DC Supply Voltage:
Between anode and cathode:

With Voltage Distribution A shown in Table I	3000	max.	V
	1300[e]	min.	V
With Voltage Distribution B shown in Table I	3000	max.	V
	1800[e]	min.	V

Between anode and dynode No.12	800	max.	V
Between dynode No.12 and dynode No.11.	800	max.	V
Between consecutive dynodes	400	max.	V
Between dynode No.1 and cathode	1000	max.	V
	600[e]	min.	V
Between focusing electrode and cathode.	1000	max.	V
Average Anode Current[f]	0.2	max.	mA
Ambient-Temperature Range[g]	-100 to +85		°C

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN:

Under conditions with dc supply voltage (E) across a voltage divider providing electrode voltages shown in Table I, Column A.

With E = 2000 volts (Except as noted)

	Min.	Typical	Max.	
Anode Sensitivity:				
Radiant[h] at 3850 angstroms . .	–	7.1×10^{5}	–	A/W
Luminous[i] (2870° K).	46	620	1500	A/lm
Current with blue light source[k] (2870° K + C.S. No.5-58)	6×10^{-7}	8×10^{-6}	–	A
Cathode Sensitivity:				
Radiant[m] at 3850 angstroms . .	–	0.097	–	A/W
Luminous[n] (2870° K)	7.7×10^{-5}	8.5×10^{-5}	–	A/lm
Current with blue light source[p] (2870° K + C.S. No.5-58)	1×10^{-8}	1.1×10^{-8}	–	A
Quantum Efficiency at 3850 angstroms[q]	28	31	–	%
Current Amplification	–	7.3×10^{6}	–	
Anode Dark Current[r]	–	6×10^{-10}	4×10^{-9}	A
Equivalent-Anode-Dark-Current Input[r]	–	3×10^{-12}	2×10^{-11}	lm
	–	2.6×10^{-15}[s]	1.8×10^{-14}[s]	W
Single Photoelectron Pulse Height Resolution at Full-Width-Half-Maximum Point[t]. . .	–	40	–	%

	Min.	Typical	Max.	
Peak-to-Valley Ratio Between Single and Double Photoelectron Pulse Height[†]	1.4	1.6	–	
Peak-to-Valley Ratio of Pulse Height Spectrum with Fe^{55} Source[u]	–	50	–	
Dark Pulse Summation[v] at 2500 V:				
1 to 128 channels .	–	150	660	cps
(See *Typical Dark-Pulse Spectrum*)				
Pulse Height Resolution:[w]				
Cs^{137} source, NaI(Tl) scintillator . . .	–	7.5	8.0	%

The following characteristics were measured with an anode-to-cathode voltage distribution of 4, 1, 1.4, 1, 1, 1, 1, 1, 1, 1, 1, 1, and 1. They are included for guidance purposes only.

With E = 1100 volts (Except as noted)

	Min.	Typical	Max.	
Pulse Height[w,x]				
Cs^{137} source, NaI(Tl) scintillator	–	0.15	–	V
	–	1.5×10^{-11}	–	coulombs
Mean Gain Deviation:[y]				
With count rate change of 1000 to 10000 cps[z]	–	1	–	%
For a period of 16 hours at a count rate of 1000 cps[aa]	–	1	–	%
Anode-Pulse Rise Time[bb] at 3000 Volts	–	2.1×10^{-9}	–	s
Electron Transit Time[cc] at 3000 Volts	–	3.1×10^{-8}	–	s

The following characteristics were measured with anode-to-cathode voltage distribution of 4, 1, 1.4, 1, 1, 1, 1, 1, 1, 1.5, 2, 4, and 2. They are included for guidance purposes only.

With E = 3000 volts (Except as noted)

	Min.	Typical	Max.	
Pulse Current:[dd]				
Linear[ee]	–	0.25	–	A
Saturated	–	0.75	–	A

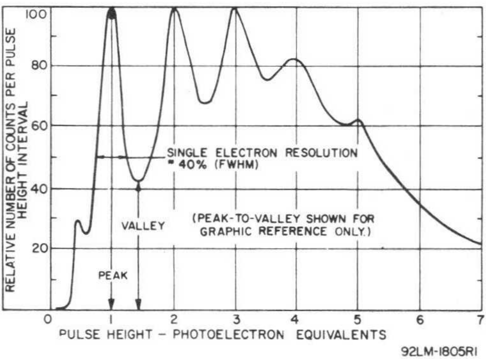
Table I		
Voltage Distribution		
Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	Column A	Column B*
	8.06% of Dyl-P Voltage (E) Multiplied By:	5.45% of K-P Voltage (E) Multiplied By:
K - Dy1	♠	6
Dy1 - Dy2	1	1
Dy2 - Dy3	1.4	1.4
Dy3 - Dy4	1	1
Dy4 - Dy5	1	1
Dy5 - Dy6	1	1
Dy6 - Dy7	1	1
Dy7 - Dy8	1	1
Dy8 - Dy9	1	1
Dy9 - Dy10	1	1
Dy10 - Dy11	1	1
Dy11 - Dy12	1	1
Dy12 - P	1	1
Dy1 - P	12.4	–
K - P	–	18.4

Focusing Electrode is connected to arm of potentiometer between cathode and dynode No.1. The focusing-electrode voltage is varied to give maximum anode current. Multiplier shield is operated at Dynode-No.5 potential.

♠ Cathode-to-Dynode-No.1 Voltage maintained at 660 volts.

* To take full advantage of the operating capabilities of the 8850 it is required that the cathode-to-dynode No.1 voltage be a minimum of 600 volts.

PHOTOELECTRON PULSE HEIGHT SPECTRUM



*QUANTACON is the RCA designation for photomultiplier tubes employing group III/V compounds as secondary emitters and/or photocathodes. A typical compound is gallium-phosphide.

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

[b] The AJ2145 is ordinarily supplied with the tube and is designed specifically for chassis mounting. The AJ2144 may be supplied as an alternate socket if requested by the user. The AJ2144 is designed for use in any desired mounting arrangement. It is supplied with an unattached clamp ring which fits to either the top or bottom of its socket body to permit chassis mounting. The ring is not normally required for other mounting arrangements and can be discarded to make such arrangements more compact.

[c] Magnetic shielding material in the form of foil or tape as available from the Magnetic Shield Division, Perfection Mica Company, 1322 North Elston Avenue, Chicago, IL, 60622, or equivalent.

[e] To take full advantage of the performance capability of the 8850, tube operation at voltage values below these minimum specified values is not recommended.

[f] Averaged over any interval of 30 seconds maximum.

[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 1140 lumens per watt.

[i] These values are calculated as shown below:

$$\text{Luminous Sensitivity (A/lm)} = \frac{\text{Anode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-4}\ \text{(lm)}}$$

The value of 0.13 is the average value of the ratio of the anode current measured under the conditions specified in footnote (k) to the anode current measured under the same conditions but with the blue filter removed.

[k] 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 1×10^{-7} lumen.

[m] This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 1140 lumens per watt.

[n] These values are calculated as shown below:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.13 \times \text{Light Flux of } 1 \times 10^{-4} \text{ (lm)}}$$

The value of 0.13 is an average value. It is the ratio of the cathode current measured under the conditions specified in footnote (p) to the cathode current measured under the same conditions but with the blue filter removed.

[p] Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 100 microlumens and 660 volts are applied between cathode and all other electrodes connected as anode.

[q] Calculated from the cathode current measured with blue light source.

[r] At a tube temperature of 22° C. Light incident on the cathode is transmitted through a blue filter (Corning C.S. No.5-58, polished to 1/2 stock thickness). The light flux incident on the filter is 0.1 microlumen. The supply voltage E is adjusted to obtain an anode current of 2.6 microamperes. Luminous sensitivity of the tube under these conditions is approximately equivalent to 200 amperes per lumen. Dark current is measured with incident light removed.

[s] At 3850 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1140 lumens per watt.

[t] Measured under the following conditions: Dark noise is eliminated by use of a coincidence circuit. As a result, most of the low energy pulses below one photoelectron are not counted. The light source is a gallium-phosphide light-emitting diode having peak output at a wavelength of approximately 5600 angstroms. The diode is pulsed at a rate of 30,000 pps; pulse duration is approximately 0.4 μs; anode circuit integrating time is approximately 10 μs. The light intensity from the diode is adjusted to obtain greater or fewer registered counts in a given multielectron peak to obtain an approximately equal number of counts in the first and second photoelectron peaks. A Multichannel Pulse-Height Analyzer having 256 channels is employed.

[u] Measured using a Harshaw Type HG 0.005" beryllium window NaI (T1) scintillator, 0.04" thick and 7/8" in diameter and an isotope of iron having an atomic mass of 55 (Fe^{55}) and an effective activity at the scintillator of one microcurie.

[v] Measured under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a low color temperature to assure the high probability of single photoelectron emission from the photocathode of the tube. The intensity of the light source is adjusted for approximately 10^4 photons per second.

[w] Pulse-height resolution in per cent is defined as 100 times the ratio of the width of the photopeak at half the maximum count rate in the photopeak height to the pulse height at maximum photopeak count rate under the conditions of (x).

[x] Pulse height is defined as the amplitude of the anode pulse voltage (referred to anode) measured across a 100 kilohm resistor and a total capacitance of 100 $\pm$ 3% pF in parallel. Under pulse conditions, the interstage voltages of the tube should not deviate more than 2% from the interstage voltage values during no-signal conditions. The 662 keV photon from an isotope of cesium having an atomic mass of 137 (Cs^{137}) and a cylindrical 2" x 2" thallium-activated sodium-iodide scintillator [NaI (T1)-type 3D8S50, Serial No.AJ651, or equivalent] are used. This scintillator is manufactured by the Harshaw Chemical Corporation, 1945 East 97th Street, Cleveland 6, OH, and is rated by the manufacturer as having a resolving capability of 8.2 per cent to 8.3 per cent. The Cs^{137} source is in direct contact with the metal end of the scintillator. The faceplate end of the crystal is coupled to the tube by a coupling fluid such as Dow Corning Corp. Type DC200 (Viscosity of 60,000 centistokes)– Manufactured by the Dow Corning Corp., Midland, MI, or equivalent.

[y] Mean gain deviation is defined as the percentage change, regardless of sign, from the average pulse height for a given radiation source and scintillator over a specified time or count rate interval.

[z] Under the following conditions: The scintillator and Cs^{137} radiation source of (x) are employed. The radiation source

is initially centered, on the major axis of the tube and the scintillator, at a point providing a pulse count rate of 1000 cps. The pulse height of the photopeak is measured under this condition. Next, the radiation source is moved rapidly, in approximately 30 seconds, to a new position that is equivalent to a count rate of 10,000 cps. The new position is also centered in the major axis of the tube. The pulse height under this condition is measured. The difference in pulse height between these two measurements is typically 1 per cent.

[aa] Under the same conditions as (z) except the count rate position of 1,000 cps is maintained for 16 hours and the pulse height is sampled at 1 hour intervals.

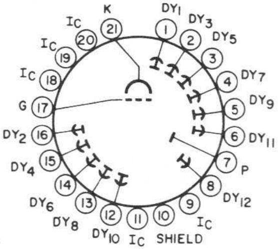
[bb] Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is primarily a function of transit time variation and is measured under conditions with the incident light fully illuminating the photocathode.

[cc] 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.

[dd] The interstage voltages of the tube should not deviate more than 2 per cent from the specified voltage distribution. Capacitors are connected across the individual resistors making up the voltage-divider arrangement to insure this operating condition.

[ee] Maximum deviation from linearity is 2 per cent.

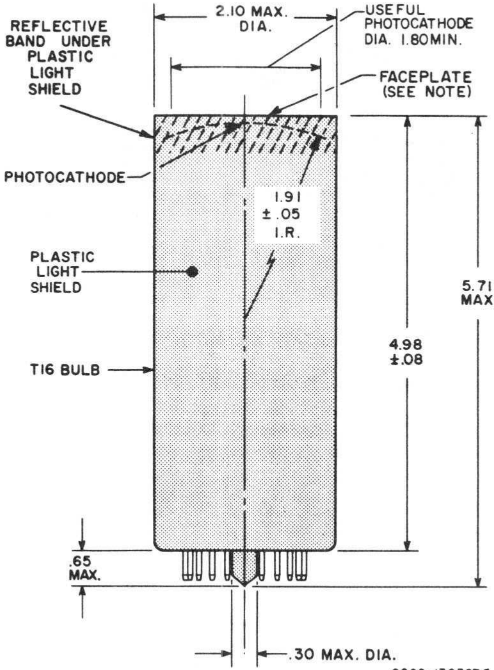
TERMINAL DIAGRAM
(Bottom View)



DIRECTION OF RADIATION: INTO END OF BULB

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: Dynode No.11
Pin 7: Anode
Pin 8: Dynode No.12
Pin 9: Internal Connection, Do not use
Pin 10: Electron Multiplier Shield
Pin 11: Internal Connection, Do not use
Pin 12: Dynode No.10
Pin 13: Dynode No.8
Pin 14: Dynode No.6
Pin 15: Dynode No.4
Pin 16: Dynode No.2
Pin 17: Focusing Electrode
Pin 18: Internal Connection, Do not use
Pin 19: Internal Connection, Do not use
Pin 20: Internal Connection, Do not use
Pin 21: Photocathode

DIMENSIONAL OUTLINE



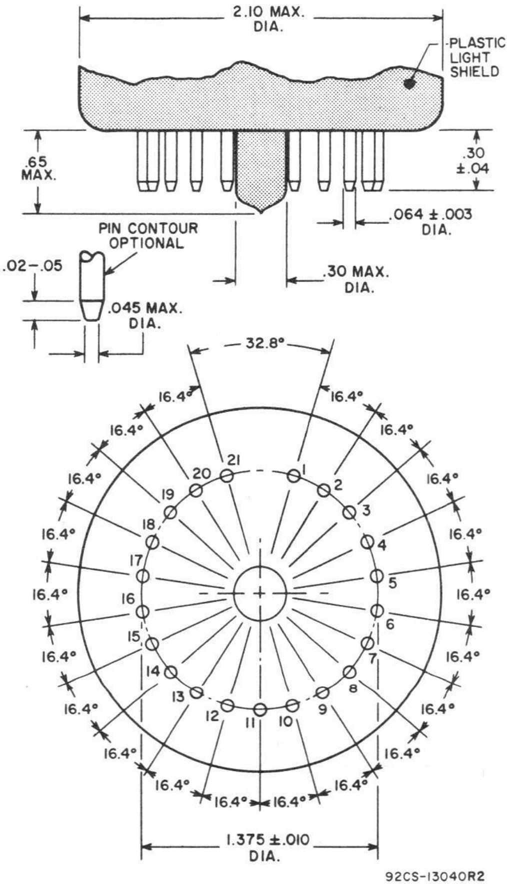
Dimensions in Inches

Note: Deviation from Flatness of External Surface of Faceplate will not exceed 0.010" from Peak to Valley.

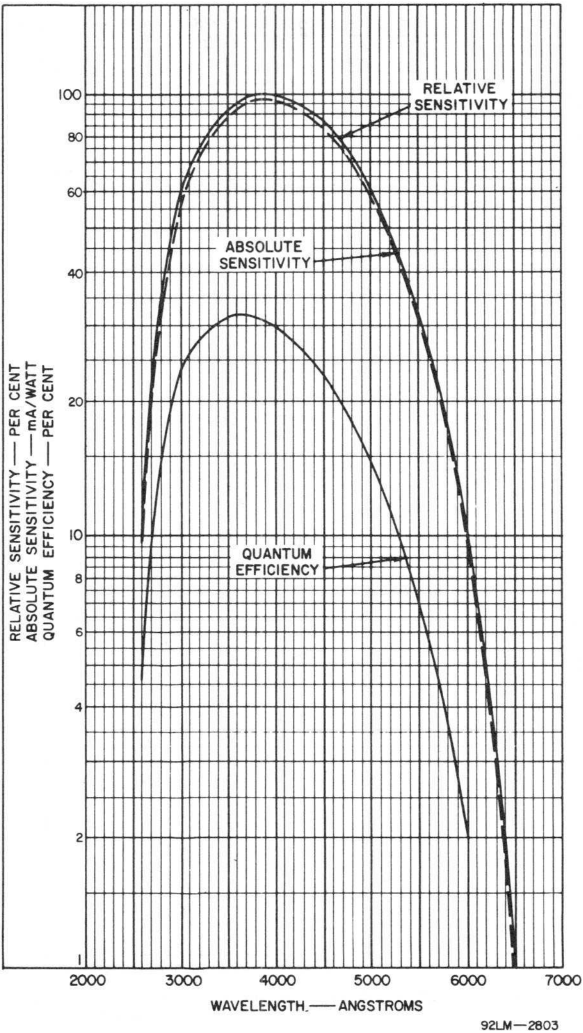
The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

Inch	mm	Inch	mm	Inch	mm
.003	.08	.05	1.3	1.375	34.93
.010	.25	.064	1.63	1.80	45.7
.02	.5	.08	2.0	1.91	48.5
.04	1.0	.30	7.6	2.10	53.3
.045	1.14	.65	16.5	4.98	126.5
				5.71	145.0

DETAIL OF BASE ARRANGEMENT



SPECTRAL RESPONSE CHARACTERISTICS

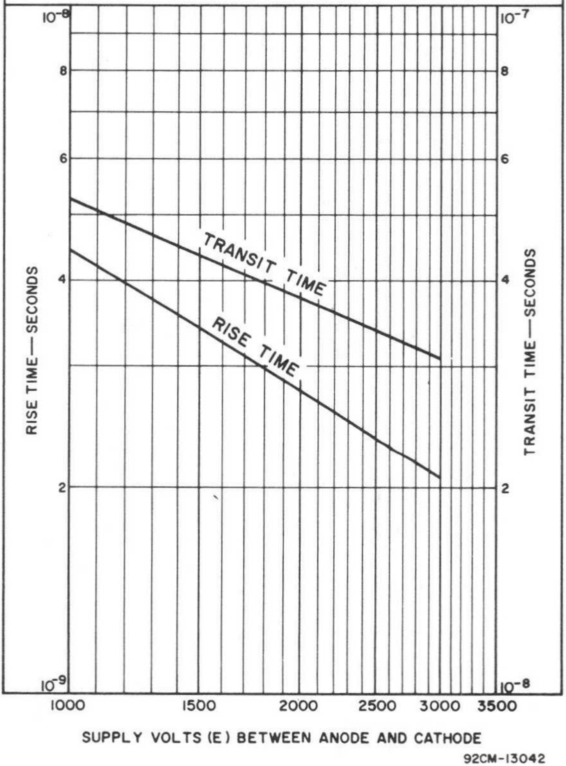


TYPICAL TIME-RESOLUTION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

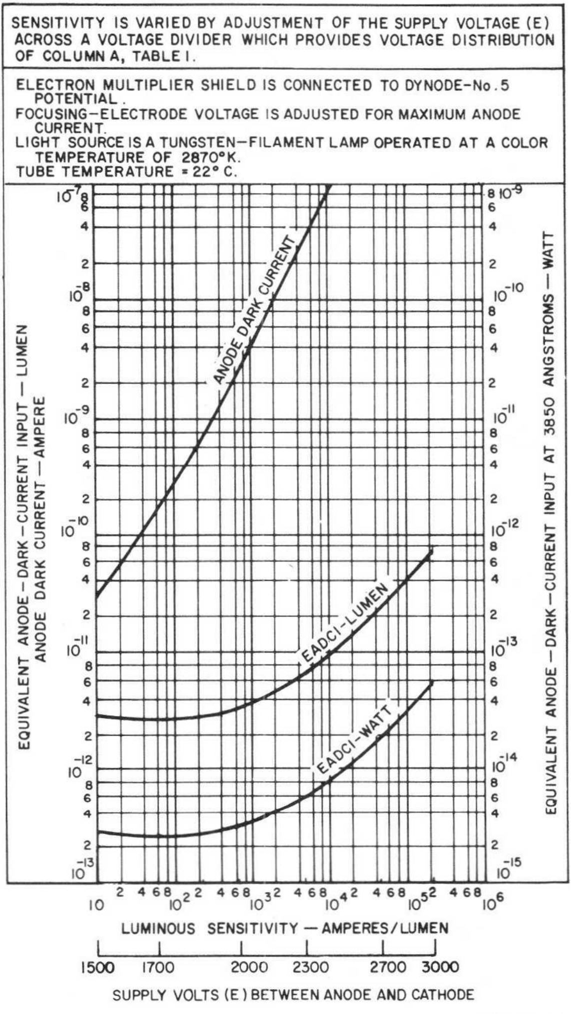
BETWEEN	6.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	4.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE-STAGE VOLTS	1.0
ANODE AND CATHODE	16.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

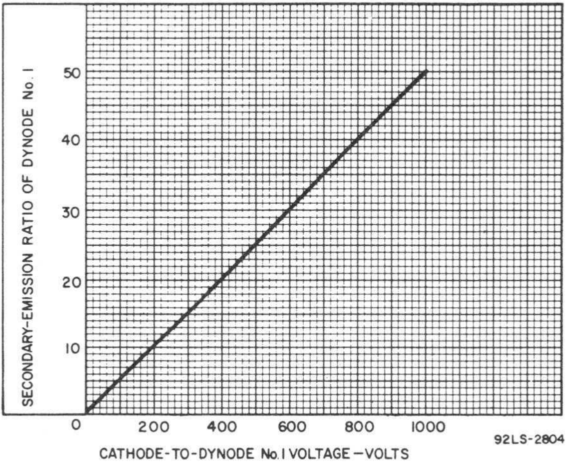


92CM-13042

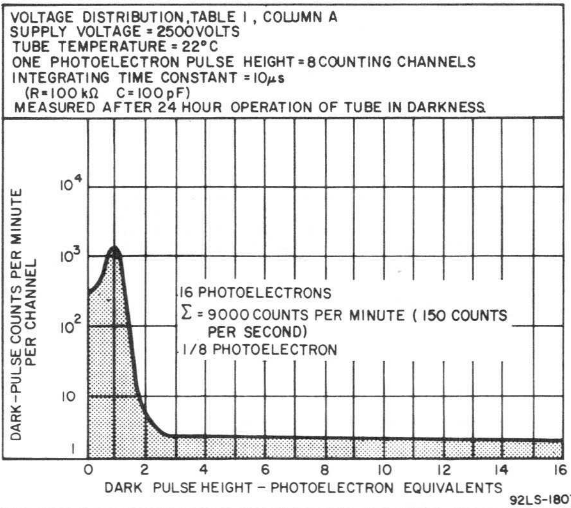
TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS



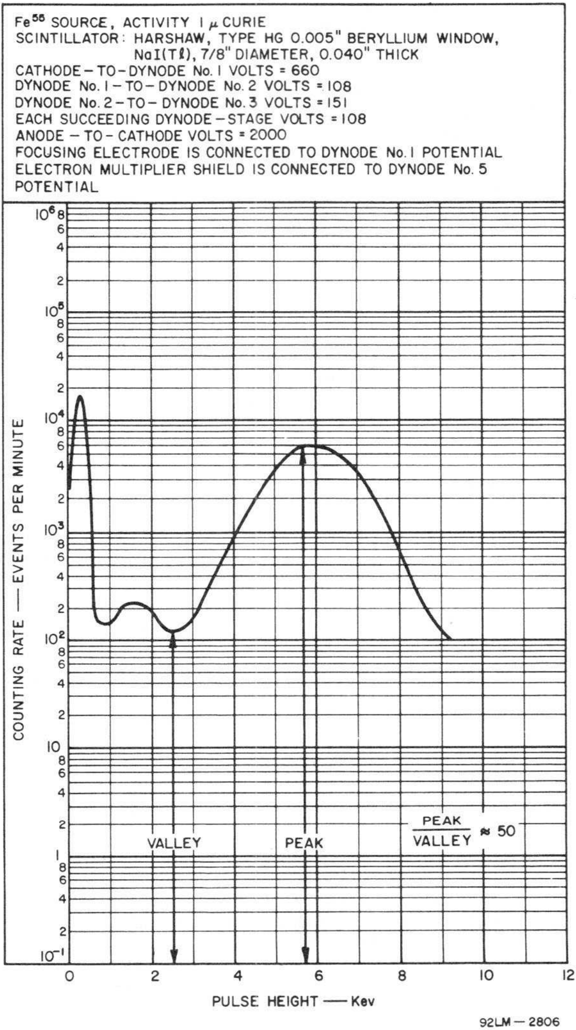
TYPICAL SECONDARY-EMISSION RATIO OF FIRST DYNODE AS A FUNCTION OF CATHODE-TO-DYNODE NO. 1 VOLTAGE



TYPICAL DARK-PULSE SPECTRUM



DIFFERENTIAL Fe^{55} SPECTRUM

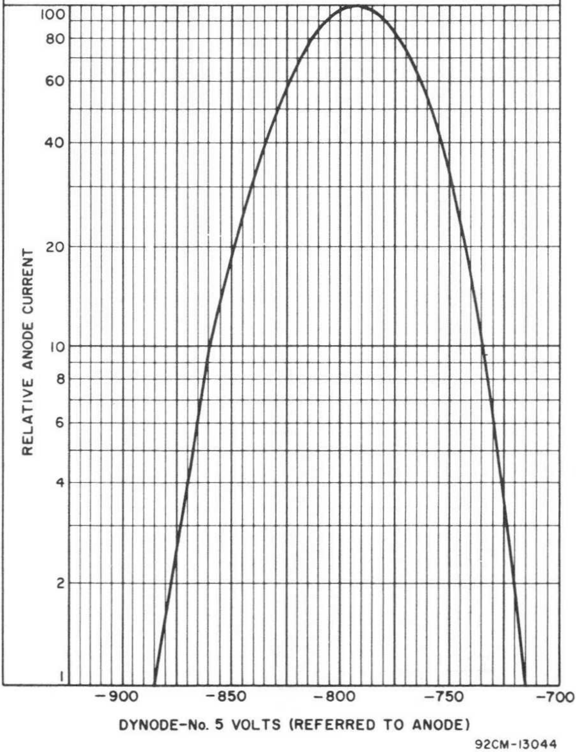


TYPICAL DYNODE MODULATION CHARACTERISTIC

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

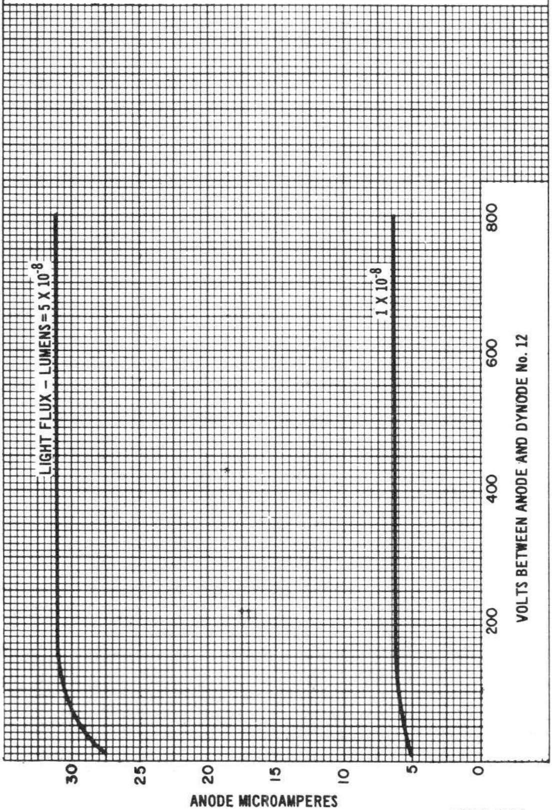
BETWEEN	6.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	4.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE-STAGE VOLTS	1.0
ANODE AND CATHODE	16.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
CATHODE IS AT GROUND POTENTIAL.



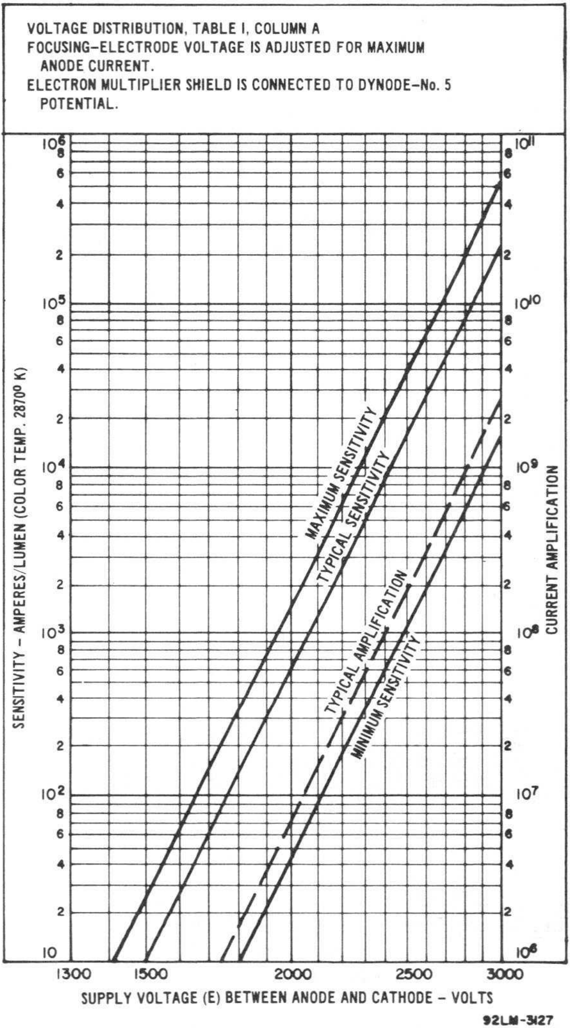
TYPICAL ANODE CHARACTERISTICS

CATHODE–TO–DYNODE–No. 1 VOLTS = 660
DYNODE–No. 1–TO–DYNODE–No. 2 VOLTS = 108
DYNODE–No. 2–TO–DYNODE–No. 3 VOLTS = 151
EACH SUCCEEDING DYNODE–STAGE VOLTS = 108
ANODE–TO–CATHODE VOLTS = 2000
FOCUSING ELECTRODE IS CONNECTED TO DYNODE–No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE–No. 5 POTENTIAL.
LIGHT SOURCE IS A TUNGSTEN–FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.



92LM-3128

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

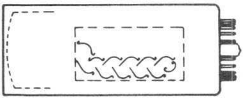


TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

BETWEEN:	6.1 % OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	4.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	16.4

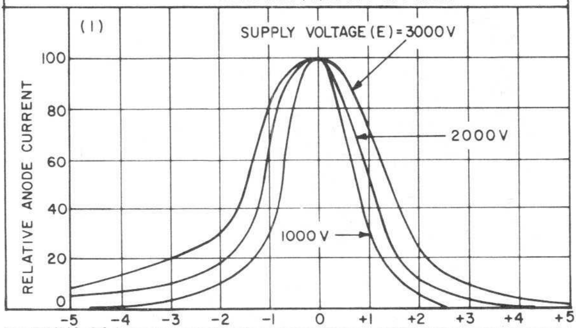
FOCUSING ELECTRODE IS CONNECTED TO DYNODE–No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE–No.5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.

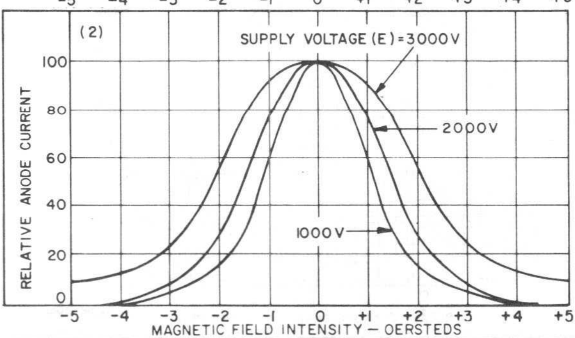


POSITIVE VALUE OF H IN DIRECTION SHOWN:

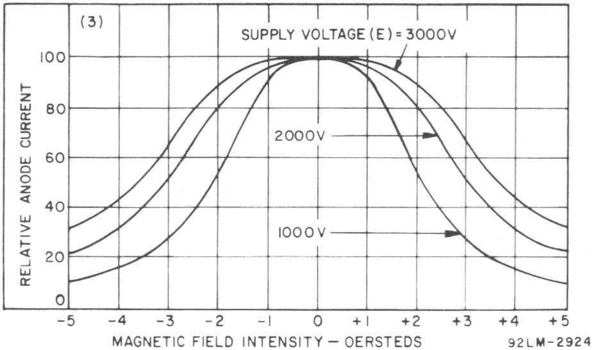
(1)*•, (2)↑ OR (3)→

* DIRECTION (1) IS OUT OF PAPER

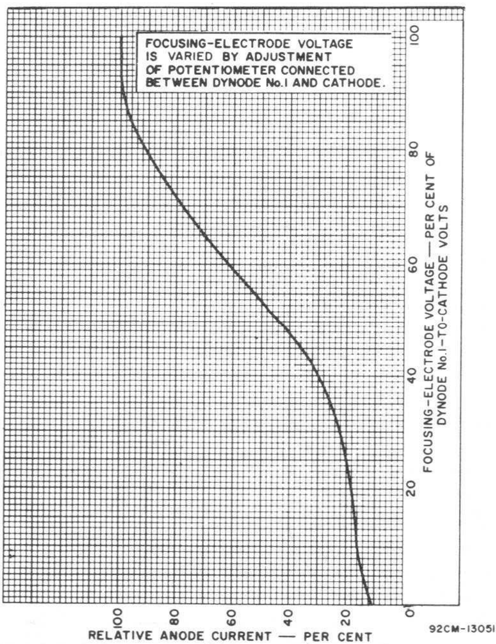




TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)



TYPICAL FOCUSING-ELECTRODE CHARACTERISTIC



Photomultiplier Tube

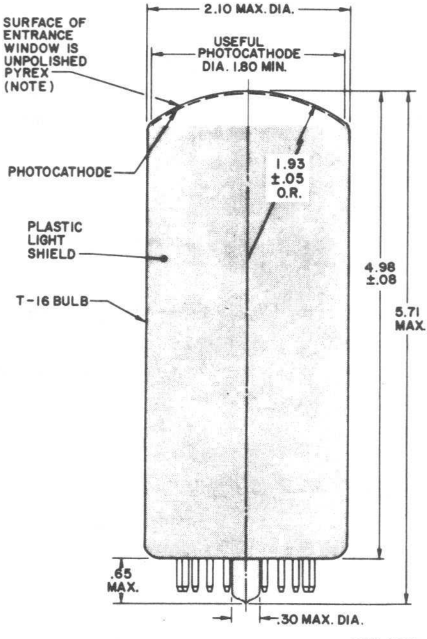
2"-Diameter Type

RCA-8851 is a 2"-diameter, 12-stage, head-on QUANTACON* photomultiplier tube having a bialkali photocathode and a pyrex entrance window. It is identical in all respects to type 8850, except for the shape of its window which is a spherical segment.

*QUANTACON is the RCA designation for photomultiplier tubes employing group III/V compounds as secondary emitters and/or photocathodes. A typical compound is gallium-phosphide.

See Dimensional Outline on Reverse Side.

DIMENSIONAL OUTLINE



Dimensions in Inches

Note: Caution must be employed when handling this tube because of the thinness of the entrance window.

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

Inch	mm	Inch	mm	Inch	mm
.003	.08	.05	1.3	1.375	34.93
.010	.25	.064	1.63	1.80	45.7
.02	.5	.08	2.0	1.93	49.0
.04	1.0	.30	7.6	2.10	53.3
.045	1.14	.65	16.5	4.98	126.5
				5.71	145.0

8857/V1,V2, 8858

Image Intensifier Tubes

18-mm Types Having Fiber-Optic Input and Output Faceplates

GENERAL

All Types

Spectral Response	S-20 with extended red response
Wavelength of Maximum Response	4700 + 1000 Å -500 Å
Photocathode:	
Material	Na-K-Cs-Sb (Multialkali)
Minimum useful area	2.5 cm^2 (0.4 in^2)
Minimum useful diameter	18 mm (0.71 in)
Image surface:	
Shape	Flat, Circular
Material	Fiber-Optics
Fluorescent Screen:	
Minimum useful area	2.5 cm^2 (0.4 in^2)
Minimum useful diameter	18 mm (0.71 in)
Phosphor	P20, Aluminized
Fluorescence and phosphorescence	Yellow-Green
Persistence	Medium to Medium Short
Image surface:	
Shape	Flat, Circular
Material	Fiber-Optics
Focusing Method	Electrostatic
Tube Dimensions:	
Maximum overall length	
Type 8858	5.93 in
Types 8857/V1, 8857/V2	1.926 in
Maximum diameter	
Type 8858	2.08 in
Types 8857/V1, V2	1.480 in[a]
Operating Position	Any
Weight (Approx.)	
Type 8858	1 lb
Types 8857/V1, V2	3 oz

TYPICAL PERFORMANCE CHARACTERISTICS

Type 8858
Under conditions with 2.65 V dc applied, and an ambient temperature of 22° C, unless otherwise noted.

Type 8857/V1 **Type 8857/V2**
Under conditions with a dc anode voltage of 12 kV, and an ambient temperature of 22°C, unless otherwise noted.

	Type 8858			Type 8857/V1			Type 8857/V2			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units
Resolution:										
Center[d]	32	36	–	64	73	–	64	73	–	Line-Pairs/mm
Edge[e] (Peripheral)	30	36	–	64	73	–	64	73	–	Line-Pairs/mm
Screen Luminance (Brightness)[f]	–	1	125	–	–	–	–	–	–	fL
Luminance Gain:[g]										
At 22° C	3×10^4	5×10^4	–	65[h]	–	–	–	–	–	fL/fc
With green light source	–	–	–	–	–	–	22[j]	–	–	fL/fc
Equivalent Screen Background Input:										
Luminous[k]	–	5×10^{-12}	2×10^{-11}	–	–	2×10^{-11}	–	–	2×10^{-10}	lm/cm^2

TYPICAL PERFORMANCE CHARACTERISTICS (Cont'd)

	Type 8858			Type 8857/V1			Type 8857/V2			
Photocathode Sensitivity:	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units
Radiant:										
At 4700 Å[m]	–	4.6×10^{-2}	–	–	4.6×10^{-2}	–	–	4.6×10^{-2}	–	A/W
At 8000 Å	1×10^{-2}	1.3×10^{-2}	–	1×10^{-2}	1.3×10^{-2}	–	–	–	–	A/W
At 8500 Å	3×10^{-3}	7×10^{-3}	–	3×10^{-3}	7×10^{-3}	–	–	–	–	A/W
Luminous[n]	1.75×10^{-4}	2.1×10^{-4}	–	1.75×10^{-4}	2.1×10^{-4}	–	–	1.6×10^{-4}	–	A/lm
Luminance Uniformity	–	3:1[p]	4:1[p]	–	1.4:1[q]	2:1[q]	–	1.4:1[r]	2:1[r]	
Modulation Transfer Function (MTF):[s] (See **Figures 3 and 7**)										
For 2.5 Line-Pairs/mm	93	95	–	–	–	–	–	–	–	%
For 7.5 Line-Pairs/mm	65	73	–	–	–	–	–	–	–	%
For 16 Line-Pairs/mm	25	31	–	–	–	–	–	–	–	%
Paraxial Image Magnification (Cmx)[t]	0.82	0.84	1.0	0.94	–	1.0	0.94	–	1.0	
Image Alignment[u]	–	–	0.06	–	–	0.02	–	–	0.02	in
Image Stability in 30 Seconds[v]	–	–	0.005	–	–	0.005	–	–	0.005	in
Distortion[w]	–	12	20	–	–	6	–	–	6	%

MAXIMUM RATINGS, Absolute-Maximum Values

DC Input Voltage	
Type 8858	3.0 V
DC Voltage:	
Anode with respect to photocathode	
Types 8857/V1,V2	13 max. kV
Average Photocathode Current[c] (Continuous operation)	
Types 8857/V1,V2	0.25 max. µA
Ambient-Temperature Range:	
Non-operating	-54 to +68° C
Operating	-54 to +52° C

---

a Excluding exhaust tip.

c The specified value is the maximum permitted average anode current with the photocathode uniformly illuminated. This value is averaged over any interval of 10 seconds maximum.

d The resolution, both horizontal and vertical, is determined with a test pattern consisting of alternate black and white lines of equal width. Any two adjacent lines are designated a "line pair."

e This minimum value applies at a distance of 7 mm from the major (optical) axis of the tube.

f Maximum screen luminance (brightness) is limited automatically by the oscillator power supply and occurs when the input illumination is equal to or greater than 10^{-3} footcandle. Typical values are measured at 2×10^{-5} footcandle using a 2854° K tungsten lamp.

g Luminance Gain is defined as the quotient of screen brightness in footlamberts by the photocathode illumination in footcandles provided by a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light input radiation on the photocathode image surface is in the range of 1×10^{-5} to 3×10^{-5} footcandle and illuminates uniformly a 0.5"-diameter spot on the photocathode. The output is measured with a photometer centered on a 10-mm diameter spot on the screen.

h Under same conditions of footnote (g) except input radiation on photocathode is 5×10^{-2} footcandle. Anode voltage is 15 kV.

j Under the same conditions of footnote (g) except that a light input of 5×10^{-2} footcandle is incident on Corning C.S. No.3-71 and C.S. No.4-67 interposed between the light source and the tube. Anode voltage is 12 kV. Use of these filters in conjunction with the 2854° K source closely approximates the P20 spectral distribution.

k Defined as the equivalent value of luminous flux from a tungsten-filament lamp operating at 2854° K that would be required to cause an increase in screen brightness equal to screen background brightness.

m For incident radiation at the wavelength of maximum response of the spectral sensitivity characteristic.

n Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. The value of light flux is 0.03 lumen. The light spot has a nominal diameter of 0.5", and 300 volts are applied between anode and photocathode.

p The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 17 mm in diameter centered on the image screen when the photocathode is illuminated uniformly with 1×10^{-5} to 3×10^{-5} footcandle and the output is scanned with a 1 millimeter aperture in a spiral pattern.

q The light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K. Luminance uniformity will not vary more than the ratio stated over a circular area 17 mm in diameter centered on the image screen.

r Under the same conditions as shown in footnote (**q**) except that Corning C.S. No.3-71 and C.S. No.4-67 filters are interposed between the light source and the tube.

s A two-dimensional resolution pattern, providing constant illumination in the Y direction, and sinusoidal variation of intensity in the X direction is projected on the photocathode. Per cent image modulation M may then be defined as:

$$M = \frac{W - B}{W + B} \times 100$$

where W = maximum illumination in white line
B = minimum illumination in black line

Output image brightness is also a sinusoidal function of the distance across one direction of the pattern, and the output modulation is equal to or less than the input modulation. The modulation transfer function (MTF) is defined as the ratio of the output modulation to input modulation expressed as a function of the spatial frequency of the incident illumination pattern. MTF for the tubes is measured using Modulation Transfer Function Anaylzer Model No.K1-b, a product of Optics Technology, Inc., Belmont, CA, using the specified procedure for that instrument.

Modulation is recorded with a square-wave resolution pattern for types 8857/V1 and 8857/V2.

In this case, modulation is expressed as a function of line frequency and is called "contrast transfer characteristic". MTF is calculated from the contrast transfer data using the following relationship.

$$M(N) = \frac{\pi}{4}\left[C(N) + \frac{C(3N)}{3} - \frac{C(5N)}{5} + \frac{C(7N)}{7}\right]$$

where M(N) is the MTF value at line frequency N
and C(N) is the contrast transfer value at line frequency N

t Paraxial Image Magnification (Cmx) is defined as the ratio of the separation of two diametrically opposite image points on the screen to the separation of the two corresponding image points on the photocathode. The image points on the photocathode are separated by a distance of 1 mm and are located equal distances from the major axis of the tube.

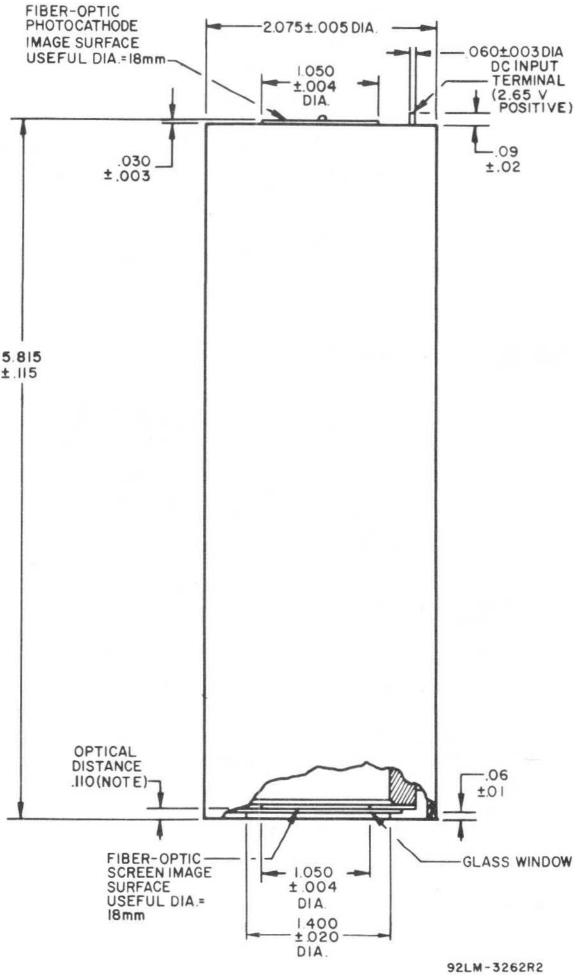
u The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will fall with in a circle concentric with the optical axis of the screen having the specified diameter.

v The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will not shift more than the specified value during 30 seconds of operation.

w A second magnification value (Emx) is obtained as stated in footnote (m) except the image points on the photocathode are separated by a distance of 14 mm. Per-cent distortion is defined by the equation.

$$\text{Per-Cent Distortion} = \frac{\text{Emx-Cmx}}{\text{Cmx}} \times 100$$

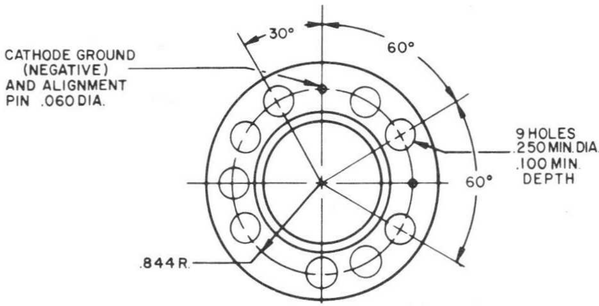
DIMENSIONAL OUTLINE FOR TYPE 8858



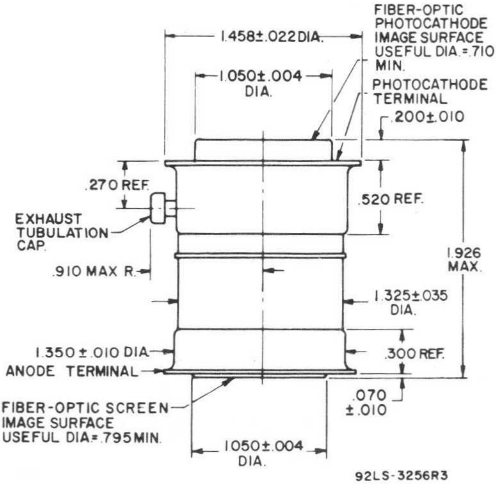
Note: This distance is measured with a depth microscope.

Dimensions in Inches

DIMENSIONAL OUTLINE FOR TYPE 8858

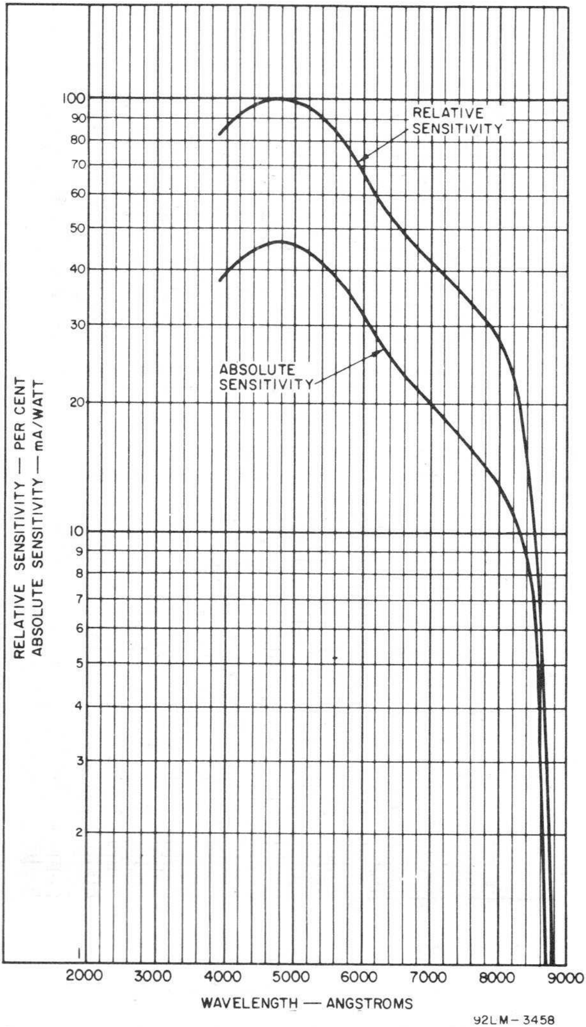


DIMENSIONAL OUTLINE FOR TYPES 8857/V1, 8857/V2

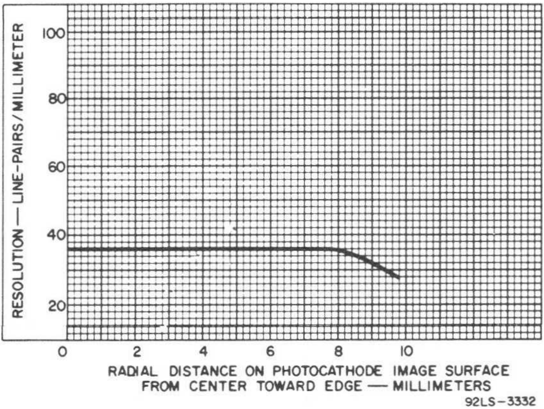


Dimensions in Inches

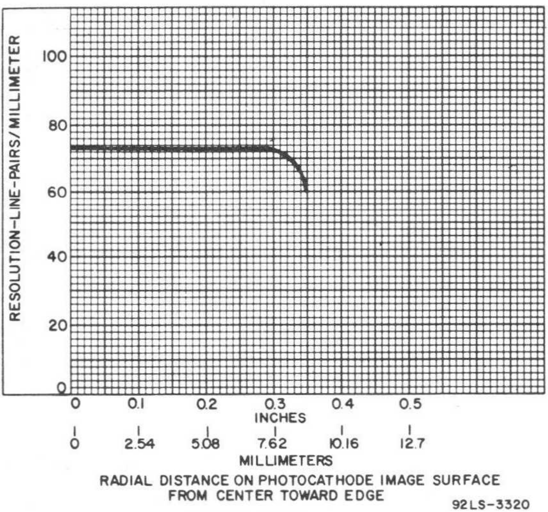
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS FOR ALL TYPES



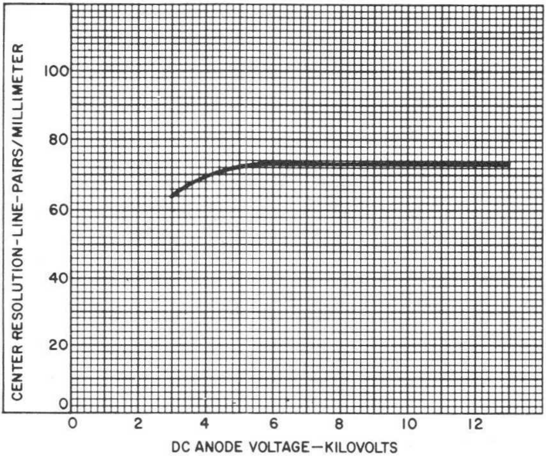
TYPICAL RESOLUTION AS A FUNCTION OF RADIAL DISTANCE ON PHOTOCATHODE FOR TYPE 8858



TYPICAL RESOLUTION AS A FUNCTION OF RADIAL DISTANCE ON PHOTOCATHODE FOR TYPES 8857/V1, 8857/V2

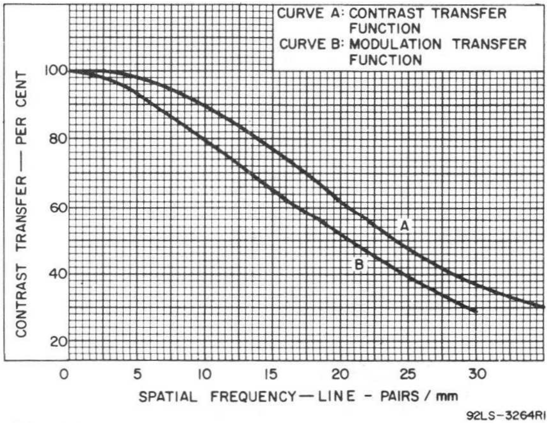


TYPICAL RESOLUTION AS A FUNCTION OF ANODE VOLTAGE FOR TYPES 8857/V1, 8857/V2



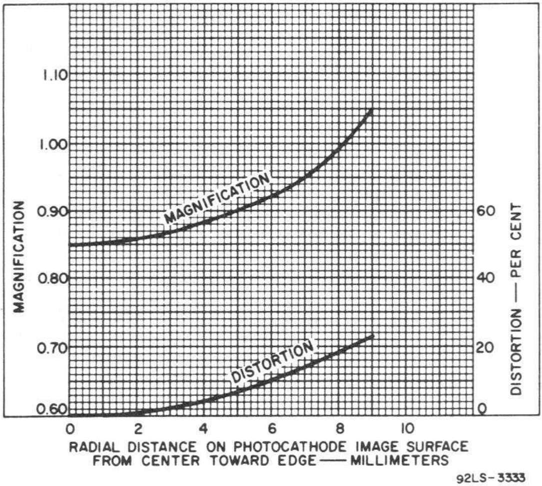
92LS-3319

TYPICAL MODULATION TRANSFER FUNCTION AND CONTRAST TRANSFER CHARACTERISTICS FOR TYPES 8857/V1, 8857/V2

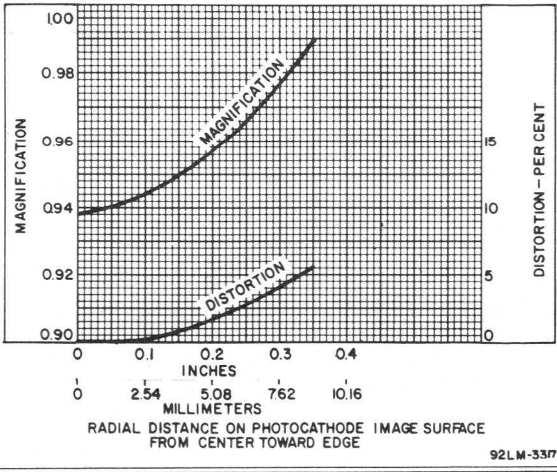


92LS-3264R1

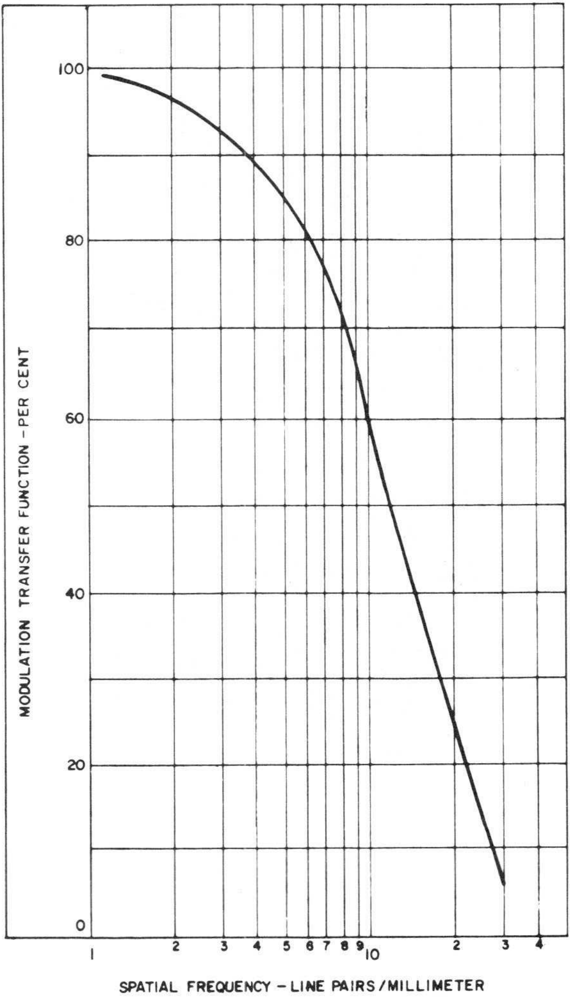
TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPE 8858



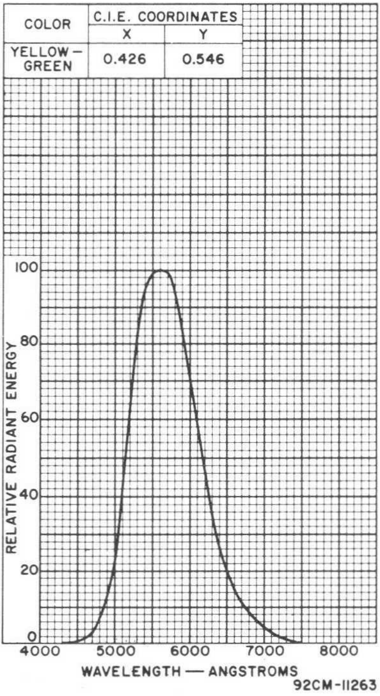
TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPES 8857/V1, 8857/V2



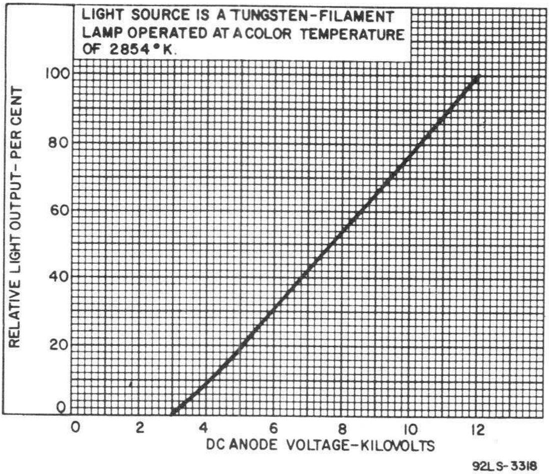
TYPICAL MODULATION TRANSFER FUNCTION FOR TYPE 8858



JEDEC PHOSPHOR P20 FOR ALL TYPES



RELATIVE LIGHT OUTPUT CHARACTERISTIC FOR TYPES 8857/V1, 8857/V2



Thyratrons, Ignitrons, & Glow-Discharge Tubes

RCA TUBE
HANDBOOK
HB-3

THYRATRON, IGNITRON, & GLOW-DISCHARGE TUBE SECTION

This Section contains data on thyratrons, ignitrons, and glow-discharge (cold-cathode) tubes used for voltage-regulator, relay, and voltage-reference applications.

For further Technical Information, write to Commercial Engineering, Tube Division, Radio Corporation of America, Harrison, N. J.

RCA THYRATRON, GLOW-DISCHARGE, IGNITRON, & VACUUM-GAUGE TUBE GUIDE

THYRATRONS

Triodes

MAXIMUM RATINGS						
Anode Current		Tempera-ture Range °C	Peak Inverse Anode Volts	Filament-F or Heater-H		RCA Type
Av Amp	Peak Amp			Volts	Amp	
Mercury-Vapor Types						
0.5	2	40 to 80	5000	2.5 F	5	5557
0.64	2.5	25 to 70	2500	2.5 F	6	627
1.8	10	25 to 55	15000	5.0 F	10	5563A
2.5	15	40 to 80	1000	5.0 H	4.5	5559
4	16	30 to 50	10000	5.0 H	10	677
6.4	40	40 to 80	2500	5.0 H	10	676
Gas Types						
0.04	0.2	-40 to +70	350	2.5 H	2.6	692
0.045	35	-50 to +90	3000	6.3 H	2.3	6130/3C45
0.075	0.3	-75 to +90	350	6.3 H	0.6	884
0.075	0.3	-75 to +90	350	2.5 H	1.5	885
1	8	-55 to +75	1250	2.5 F	6.3	C1K/6014
2.5	30	-55 to +75	1250	2.5 F	9	C3J/5632
2.5	30	-55 to +75	1250	2.5 F	9	C3JA/5684
2.5	30	-55 to +75	1250	2.5 F	9	C3JL
6.4	77	-55 to +75	1250	2.5 F	21	C6J/5C21
6.4	77	-55 to +75	1250	2.5 F	21	C6JA/5685
18	100	-55 to +75	1250	2.5 F	31	C16J/5665
Gas and Mercury-Vapor Types						
1	3	-40 to +80	1250	2.5 F	5	714/7021
1	8	-40 to +80	1250	2.5 F	6.3	716/6855
1.5	6	-40 to +80	1250	2.5 F	7	3C23
2.5	30	-40 to +80	1500	2.5 F	9	710/6011
6.4	77	-40 to +80	1500	2.5 F	21	760/6858

Tetrodes

Mercury-Vapor Types						
2.5	15	40 to 80	1000	5 H	4.5	5560
2.5	30	40 to 80	1500	5 H	5	632B
3.2	40	40 to 80	2500	5 H	5	672A
6.4	40	40 to 80	2000	5 H	10	172
6.4	40	40 to 80	2500	5 H	10	105
Gas Types						
0.025	0.1	-55 to +90	500	6.3 H	0.15	5696[a]
0.1	0.5	-75 to +90	1300	6.3 H	0.6	2D21[a]
0.1	0.5	-75 to +150	1300	6.3 H	0.6	5727[a]
0.1	1	-55 to +90	1300	6.3 H	0.6	502A

Tetrodes (Cont'd)

MAXIMUM RATINGS						
Anode Current: Av Amp	Anode Current: Peak Amp	Temperature Range °C	Peak Inverse Anode Volts	Filament-F or Heater-H: Volts	Filament-F or Heater-H: Amp	RCA Type
Gas Types (Cont'd)						
0.1	1	−75 to +90	1300	6.3 H	0.6	2050
0.1	1	−75 to +90	1300	6.3 H	0.6	2050A
0.5	5	−75 to +90	1300	6.3 H	2.6	6012
0.8	8	−75 to +90	1500	6.3 H	2.6	3D22A

GLOW-DISCHARGE TUBES

Average DC Operating Volts	DC Operating Current Range Milliamperes	Average DC Starting Volts	RCA Type
Voltage-Regulator Types			
59	0.4 to 2	67	991
75	5 to 30	105	0C2[a]
75	5 to 40	100	0A3
78	5 to 40	100	0A3A
108	5 to 30	115	0B2[a]
108	5 to 30	115	6074[a,b]
110	5 to 40	115	0C3A
150	5 to 40	160	0D3A
151	5 to 30	156	0A2[a]
151	5 to 30	156	6073[c]
153	5 to 40	160	0D3
Voltage-Reference Types			
86.5	1.5 to 3.5	107	5651A[a,d]
87	1.5 to 3.5	107	5651[a]

Relay Types

Maximum Peak Inverse Anode Volts	Maximum Cathode Milliamperes: Peak	Maximum Cathode Milliamperes: Average	RCA Type
180	100	25	1C21[e]
200	100	25	5823[a,f]
225	100	25	0A4G[f]

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

IGNITRONS

MAXIMUM RATINGS *For power-supply frequencies of 25 to 60 Hz*						
Anode Current			Demand Power	RMS Supply	Peak Anode Inverse *or* Forward Volts	RCA Type
Av *for* Amp	Time Intervals Sec	Peak Amp	KVA	Volts		
Resistance-Welding Control Service[h]						
4.86	27.8	846	150	250	–	5550
4.86	11.6	354	150	600	–	
12.1	22	1692	300	250	–	
12.1	9.2	708	300	600	–	
30.2	18	3400	600	250	–	5551A
30.2	7.5	1410	600	600	–	
56	18	1130	200	250	–	
56	7.5	466	200	600	–	
75.6	14	6800	1200	250	–	5552A
75.6	5.8	2830	1200	600	–	
140	14	2260	400	250	–	
140	5.8	945	400	600	–	
Intermittent Rectifier Service and Frequency-Changer Welder Service						
4	10	480	–	–	1500	5551A
5	10	600	–	–	1200	
40	6	700	–	–	500	
100	6	1600	–	–	500	5552A[j]
Resistance-Welding-Capacitor Discharge Service						
8	1.25	500	60 dischgs/sec		k	5550
15	0.66	500	60 dischgs/sec		3000	

VACUUM-GAUGE TUBES

Gas Pressure Range		Gauge Type	RCA Type
in mm of Hg (Torr)	in microns		
1 to 0.0001 1 to 0.001[m]	1000 to 0.1 1000 to 1[m]	Thermo-couple	1946
1.5 to below 0.01 0.5 to 0.01[m]	1500 to below 10 500 to 10[m]	Pirani	1947
0.001 to below 0.0001 0.001 and below[m]	1 to below 0.1 0.1 and below[m]	Ionization (Hard Glass)	1949

[a] Miniature.

[b] "Premium" version of OB2 intended for applications critical to shock and vibration.

[c] "Premium" version of OA2 intended for applications critical to shock and vibration.

[d] Like the 5651 but has greater voltage stability.

[e] For operation from a dc supply.

[f] For operation from an ac supply.

[g] Per tube.

[h] Two tubes in inverse-parallel circuit.

[j] Intermittent Rectifier Service only.

[k] Forward volts = 6000, inverse volts = 3000.

[m] Range of greatest sensitivity.

GRID-CONTROLLED RECTIFIER CIRCUITS

Numerical Relationships Among Electrical Quantities

E = Trans. Sec. Voltage (RMS)
E_{av} = Average DC Output Voltage
E_{bmi} = Peak Inverse Anode Voltage
E_m = Peak DC Output Voltage
E_r = Major Ripple Voltage (RMS)
f = Supply Frequency
f_r = Major Ripple Frequency

I_{av} = Average DC Output Current
I_b = Average Anode Current
I_p = Anode Current (RMS)
I_{pm} = Peak Anode Current
P_{al} = Line Volt-Amperes
P_{ap} = Trans. Pri. Volt-Amperes
P_{as} = Trans. Sec. Volt-Amperes

P_{dc} = DC Power ($E_{av} \times I_{av}$)

Note: Conditions assumed involve sine-wave supply; zero voltage drop in tubes; no losses in transformer and circuit; no back emf in the load circuit; and no phase-back.

RATIO	Fig. 1	Fig. 2	Fig. 3	Fig. 4	Fig. 5*	Fig. 6	Fig. 7	Fig. 8
Voltage Ratios								
E/E_{av}	2.22	1.11	1.11	0.854	0.854	0.427	0.785	0.74
E_{bmi}/E	1.41	2.83	1.41	2.45	2.45	2.45	2.83	2.83
E_{bmi}/E_{av}	3.14	3.14	1.57	2.09	2.09	1.05	2.22	2.09
E_m/E_{av}	3.14	1.57	1.57	1.21	1.05	1.05	1.11	1.05
E_r/E_{av}	1.11	0.472	0.472	0.177	0.04	0.04	0.106	0.04
Frequency Ratio								
f_r/f	1	2	2	3	6	6	4	6
Current Ratios								
I_p/I_{av}	1.57	0.785	0.785	0.578	0.289	0.578	0.5	0.408
I_b/I_{av}	1	0.5	0.5	0.33	0.167	0.33	0.25	0.167
Resistive Load								
I_{pm}/I_{av}	3.14	1.57	1.57	1.21	0.52	1.05	1.11	1.05
I_{pm}/I_b	3.14	3.14	3.14	3.63	3.14	3.14	4.5	6.3
Inductive Load■								
I_{pm}/I_{av}	—	1	1	1	0.5	1	1	1
Power Ratios								
Resistive Load								
P_{as}/P_{dc}	3.49	1.74	1.24	—	—	—	—	—
P_{ap}/P_{dc}	2.69	1.23	1.24	—	—	—	—	—
P_{al}/P_{dc}	2.69	1.23	1.24	—	—	—	—	—
Inductive Load■								
P_{as}/P_{dc}	—	1.57	1.11	1.71	1.48	1.05	1.57	1.81
P_{ap}/P_{dc}	—	1.11	1.11	1.21	1.05	1.05	1.11	1.29
P_{al}/P_{dc}	—	1.11	1.11	1.21	1.05	1.05	1.11	1.05

* Bleeder current of 2% full-load current will provide exciting current for balance coil and thus avoid poor regulation at light loading.

■ The use of a large filter-input choke is assumed.

GRID-CONTROLLED RECTIFIER CIRCUITS

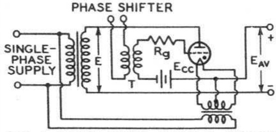


FIG. 1 HALF-WAVE SINGLE-PHASE

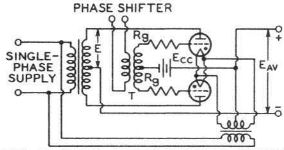


FIG. 2 FULL-WAVE SINGLE-PHASE

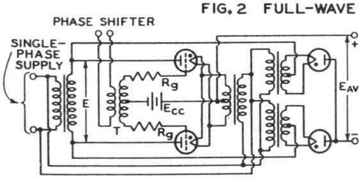


FIG. 3 SERIES SINGLE-PHASE

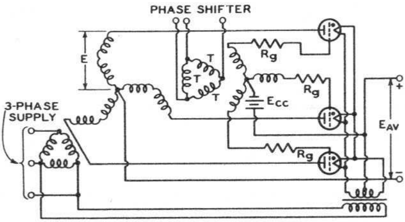


FIG. 4 HALF-WAVE THREE-PHASE

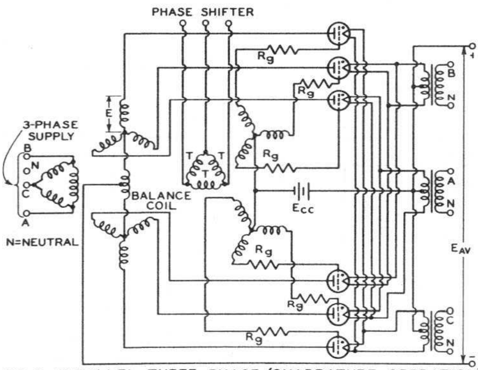


FIG. 5 PARALLEL THREE-PHASE (QUADRATURE OPERATION)

GRID-CONTROLLED RECTIFIER CIRCUITS

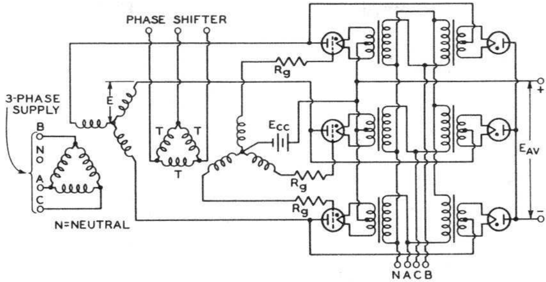


FIG. 6 SERIES THREE-PHASE (QUADRATURE OPERATION)

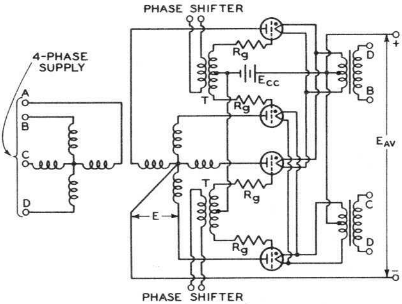


FIG. 7 HALF-WAVE FOUR-PHASE (QUADRATURE OPERATION)

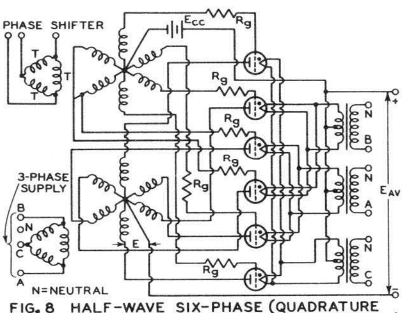


FIG. 8 HALF-WAVE SIX-PHASE (QUADRATURE OPERATION)

NOTE

T = PEAKING TRANSFORMER

92CL-8340

OA2

VOLTAGE REGULATOR

MINIATURE GLOW-DISCHARGE TYPE

GENERAL DATA

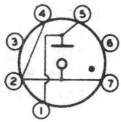
Electrical:

Cathode. . . . . Cold

Mechanical:

Mounting Position. . . . . Any
Maximum Overall Length . . . . 2-5/8"
Maximum Seated Length. . . . . 2-3/8"
Length, Base Seat to Bulb Top (Excluding tip) . . . . 2" ±3/32"
Maximum Diameter . . . . 3/4"
Weight (Approx.) . . . . 0.3 oz ←
Bulb T-5-1/2
Base . . . . . Small-Button Miniature 7-Pin (JETEC No. E7-1) ←
Basing Designation for BOTTOM VIEW 5BO

Pin 1 - Anode
Pin 2 - Cathode
Pin 3 - Internal Connection- Do Not Use
Pin 4 - Cathode



Pin 5 - Anode
Pin 6 - Internal Connection- Do Not Use
Pin 7 - Cathode

Maximum and Minimum Ratings, ***Absolute Values*:**

AVERAGE STARTING CURRENT♦.	75 max.	ma
DC CATHODE CURRENT	30 max.	ma
	5 min.	ma
FREQUENCY.	0 max.	cps ←
AMBIENT-TEMPERATURE RANGE.	-55 to +90	°C

Circuit Values:

Shunt Capacitor. . . . . 0.1 max. μμf
Series Resistor. . . . . *See Operating Considerations*

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN ←

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage.	185■	-	-	volts
Anode Breakdown Voltage.	-	156	185*	volts
Anode Voltage Drop	140●	151	168*	volts
Regulation (5 to 30 ma).	-	2	6*	volts

♦ Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

■ Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

* Maximum individual tube value during useful life.

● Minimum individual tube value during useful life.

←Indicates a change.

OA2

OA2

VOLTAGE REGULATOR

OPERATING CONSIDERATIONS

Sufficient resistance must always be used in series with the OA2 to limit the current through the tube. The value for the series resistor is dependent on the maximum anode-supply voltage and the ratio of the current through the load to the operating current of the OA2, and should be chosen to limit the operating current through the tube to 30 milliamperes at all times after the starting period.

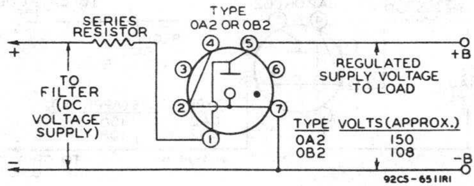
The maximum load current that can be regulated by the OA2 is determined by the minimum and maximum values of the supply voltage. After the value of series resistor for the maximum supply voltage has been calculated as indicated above, it is then in order to determine if this value will permit adequate starting voltage when the supply voltage falls to its minimum value. If adequate starting voltage is not obtained, a new load current of lower value must be used and the calculations repeated. It will be apparent from such calculations that the higher the minimum supply voltage and the smaller the difference between its minimum and maximum values, the higher will be the load current that can be regulated.

When equipment utilizing the OA2 is "turned on", a starting current in excess of the average operating current is permissible as indicated under Maximum Ratings. When the tube is subjected to such high starting currents, the regulated voltage may require up to 20 minutes to drop to its normal operating value. This performance is characteristic of voltage-regulator tubes of the glow-discharge type. Similarly, the regulation is affected by changes in current within the operating current range. For example, the regulation of a tube operated for a protracted period at 5 milliamperes and then changed to 25 milliamperes, may be somewhat different from the value that will be obtained after a long period of operation at 25 milliamperes. Likewise, the regulation may change somewhat after a long idle period.

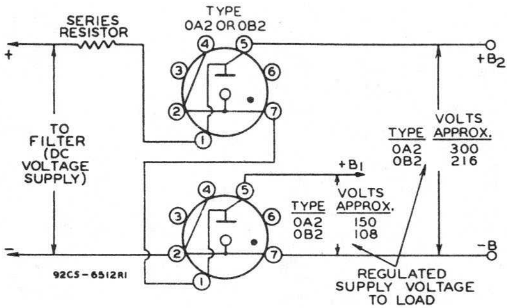
In order to handle more load current, two or more OA2's may be operated in parallel, but such parallel operation requires that a resistance of approximately 100 ohms be used in series with each OA2 in order to equalize division of the current between the paralleled tubes. The disadvantage of this method, of course, is that the use of resistors impairs the regulation which can be obtained.

If the associated circuit has a capacitor in shunt with the OA2, the capacitor should be limited in value to 0.1 μf. A larger value may cause the OA2 to oscillate and thus give unstable regulation performance.

OA2
VOLTAGE REGULATOR



Typical circuit to provide regulated supply voltage of approximately 150 or 108 volts to load. Removal of tube from socket removes voltage from load.

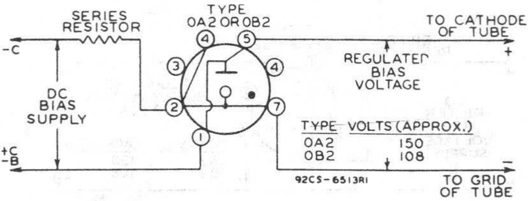


Typical circuit using two OA2's or two OB2's to provide regulated supply voltages of approximately 300 or 216 volts and 150 or 108 volts to load. Socket connections are so made that voltage on load is removed when either tube is taken from its socket.

CIRCUIT FOR BIAS-SUPPLY REGULATION IS SHOWN ON NEXT PAGE.

RCA

OA2
VOLTAGE REGULATOR



Typical circuit for bias-supply regulation. Removal of tube from socket opens B-supply circuit of regulated tubes.

RCA

OA3

VOLTAGE REGULATOR

GLOW-DISCHARGE TYPE

GENERAL DATA

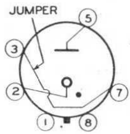
Electrical:

Cathode . . . . Cold

Mechanical:

Mounting Position . . . . Any
Maximum Overall Length. . . . . 4-1/8"
Seated Length . . . . 3-3/8" ± 3/16" ←
Maximum Diameter. . . . . 1-9/16"
Dimensional Outline . . . . *See General Section*
Weight (Approx.). . . . . 1.3 oz ←
Bulb. ST-12
Base. . . . . Small-Shell Octal 6-Pin (JETEC No.B6-3) ←
Basing Designation for BOTTOM VIEW. 4AJ

Pin 1 - No Connection
Pin 2 - Cathode
Pin 3 - Jumper▲



Pin 5 - Anode
Pin 7 - Jumper▲
Pin 8 - No Connection

Maximum and Minimum Ratings, *Absolute Values:*

AVERAGE STARTING CURRENT♦	100 max.	ma
DC CATHODE CURRENT.	40 max.	ma
	5 min.	ma
FREQUENCY	0 max.	cps ←
AMBIENT-TEMPERATURE RANGE	-55 to +90	°C

Circuit Values: ←

Shunt Capacitor	0.1 max.	μf
Series Resistor	*See Operating Considerations*	

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN ←

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage	105■	-	-	volts
Anode Breakdown Voltage	-	100	105*	volts
Anode Voltage Drop	68●	75	85*	volts
Regulation (5 to 40 ma)	-	5	6.5*	volts

▲ With suitable socket connections, jumper within base acts as a switch to open power-supply circuit when voltage regulator tube is removed from socket.

♦ Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

■ Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

* Maximum individual tube value during useful life.

● Minimum individual tube value during useful life.

← Indicates a change.

OA3

VOLTAGE REGULATOR

→

OPERATING CONSIDERATIONS

Sufficient resistance must always be used in series with the OA3 to limit the current through the tube. The value for the series resistor is dependent on the maximum anode-supply voltage and the ratio of the current through the load to the operating current of the OA3, and should be chosen to limit the operating current through the tube to 40 milliamperes at all times after the starting period.

The maximum load current that can be regulated by the OA3 is determined by the minimum and maximum values of the supply voltage. After the value of series resistor for the maximum supply voltage has been calculated as indicated above, it is then in order to determine if this value will permit adequate starting voltage when the supply voltage falls to its minimum value. If adequate starting voltage is not obtained, a new load current of lower value must be used and the calculations repeated. It will be apparent from such calculations that the higher the minimum supply voltage and the smaller the difference between its minimum and maximum values, the higher will be the load current that can be regulated.

When equipment utilizing the OA3 is "turned on", a starting current in excess of the average operating current is permissible as indicated under Maximum Ratings. When the tube is subjected to such high starting currents, the regulated voltage may require up to 20 minutes to drop to its normal operating value. This performance is characteristic of voltage-regulator tubes of the glow-discharge type. Similarly, the regulation is affected by changes in current within the operating-current range. For example, the regulation of a tube operated for a protracted period at 5 milliamperes and then changed to 35 milliamperes, may be somewhat different from the value that will be obtained after a long period of operation at 35 milliamperes. Likewise, the regulation may change somewhat after a long idle period.

In order to handle more load current, two or more OA3's may be operated in parallel, but such parallel operation requires that a resistance of approximately 100 ohms be used in series with each OA3 in order to equalize division of the current between the paralleled tubes. The disadvantage of this method, of course, is that the use of resistors impairs the regulation which can be obtained.

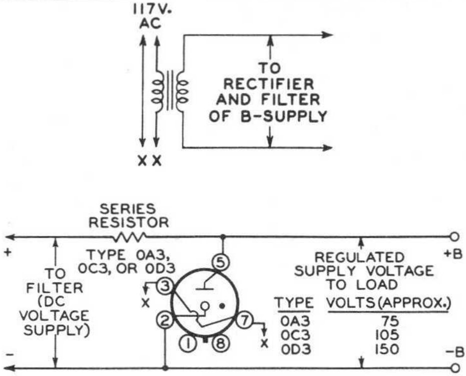
If the associated circuit has a capacitor in shunt with the OA3, the capacitor should be limited in value to 0.1 μf. A larger value may cause the OA3 to oscillate and thus give unstable regulation performance.

→ Indicates a change.

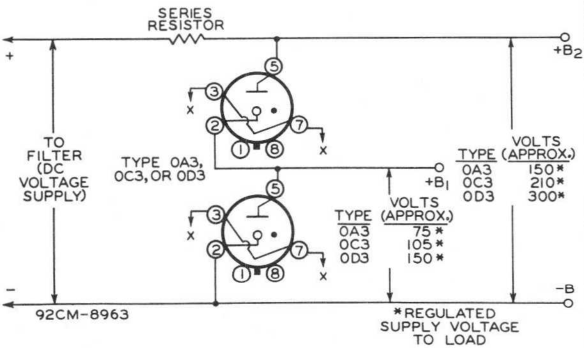
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OA3

VOLTAGE REGULATOR



Typical circuit to provide regulated supply voltage of approximately 75, 105, or 150 volts to load. Removal of tube from socket removes voltage from load.



Typical circuit using two OA3's, two OC3's, or two OD3's to provide regulated supply voltages of approximately 150, 210, or 300 volts and 75, 105, or 150 volts to load. Socket connections are so made that voltage on load is removed when either tube is taken from its socket.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Voltage-Regulator

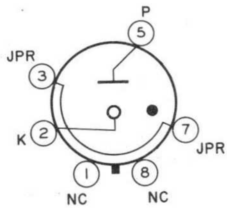
GLOW-DISCHARGE TYPE — 75 VOLTS

For Applications Requiring a Relatively Constant DC Output Voltage, Independent of Load and Supply-Voltage Variations

Mechanical:

Operating Position	Any
Type of Cathode	Cold
Maximum Overall Length	3-1/16"
Maximum Seated Length	2-1/2"
Maximum Diameter	1-9/32"
Dimensional Outline	See *General Section*
Bulb	T9
Base	Intermediate-Shell Octal 6-Pin, Arrangement 1 (JEDEC Group 1, No.B6-8)
Basing Designation for BOTTOM VIEW	4AJ

Pin 1 – No Internal Connection
Pin 2 – Cathode
Pin 3 – Jumper[a]
Pin 5 – Anode
Pin 7 – Jumper[a]
Pin 8 – No Internal Connection



VOLTAGE REGULATOR

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

Average Cathode Starting Current[b]	100 max.	ma
DC Cathode Current	40 max.	ma
	5 min.	ma
DC or AC Jumper Current	2 max.	amp
Ambient-Temperature Range	-55 to +90	°C

Circuit Values:

Shunt Capacitor	0.1 max.	μf
Series Resistor	See *Operating Considerations*	

[a] With suitable socket connections, the jumper within the tube base (between pins 3 and 7) provides for opening the power-supply circuit to protect circuit components when the voltage-regulator tube is removed from its socket.

[b] Averaged over starting period not exceeding 10 seconds. When starting currents greatly in excess of the maximum dc-cathode-current rating of 40 milliamperes are encountered, it may be necessary to operate these tubes as much as 20 minutes under steady-state conditions to assure stable operation.

CHARACTERISTICS RANGE VALUES

Values are initial unless otherwise specified

	Note	Min.	Av.	Max.	
DC Anode Supply Voltage.				See *Note 1*	
DC Anode Starting Voltage in:					
Total darkness	–	–	–	160	volts
Normal ambient light (5 to 50 footcandles). . . .	–	–	100	105	volts
Anode Voltage Drop for dc cathode current of:					
5 ma..	–	70	–	–	volts
30 ma.	–	70	76	79	volts
40 ma.	–	70	78	81	volts
Regulation for dc-cathode-current range of:					
5 to 30 ma..	2	–	3	4.5	volts
5 to 40 ma..	2	–	5	6.5	volts
Tube Noise for dc cathode current of 40 ma.	–	–	–	5	rms mv
DC Leakage Current for dc anode supply voltage of 50 volts and anode resistor of 3000 ohms	–	–	–	10	μa

Note 1: The minimum value to insure starting throughout useful tube life must be equal to the dc anode starting voltage plus the voltage drop across the series resistor at the maximum value of the load current.

Note 2: The maximum values for the specified regulation range apply throughout useful tube life.

OPERATING CONSIDERATIONS

In any given application, the following two considerations must be met to assure safe and reliable operation:

1. The dc cathode current must be kept within the minimum (I_{kmin}) and maximum (I_{km}) ratings.
2. The dc anode starting voltage, E_b (stg), must be available under the worst probable conditions.

Instantaneous cathode starting currents in excess of the maximum dc-cathode-current rating (40 milliamperes) are permissible as indicated under *Maximum and Minimum Ratings*. When the tubes are subjected to such high starting currents, as much as 20 minutes may be required for the regulated dc voltage to reach its normal operating value. The regulated dc voltage may also change after long idle periods. To assure a constant regulated voltage a single value of operating current should be maintained.

Another effect associated with VR tubes is "spot jump", sometimes referred to as "jitter". This phenomenon is an instantaneous shift of the glow on the surface of the cathode and is responsible for small instantaneous changes in anode voltage drop. These changes can be minimized by operating the voltage-regulator tubes at dc cathode currents sufficiently above the minimum dc-cathode-current rating (5 milliamperes) to assure that the glow covers a substantial portion of the cathode surface.

The level of ambient radiation directly affects the dc anode starting voltage of VR tubes. The maximum values required to start any tube under normal ambient-light conditions and in total darkness are given under *Characteristics Range Values*. Shielding should be considered when VR tubes are operated in the presence of strong, varying, magnetic, or nuclear-radiation fields to assure proper performance.

Ambient temperature should be kept relatively constant to minimize voltage drift.

Coupling effects can be minimized by shunting the VR tube with a capacitor not larger than 0.1 μf.

Series connection of VR tubes may be employed to obtain dc regulated voltages greater than those obtainable from a single tube. Different types may be used provided the series current is kept within the maximum dc-cathode-current rating of the lowest-rated tube.

Parallel connection of VR tubes may be employed where it is necessary to obtain dc load currents greater than those obtainable from a single tube but at a loss in regulation. This loss in regulation results from the requirement that a resistor be used in series with each VR tube when in parallel operation.

Combinations of regulated dc voltages may also be obtained by series connection of VR tubes with tapped output as shown in *Typical Circuit 1*.

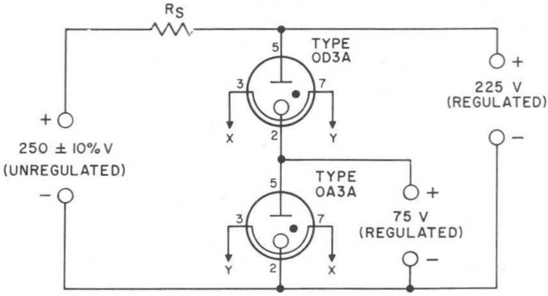
To determine the value of the series resistor for small load currents in a circuit of this type, disconnect the loads and adjust the series resistor for a tube current of not more than 40 milliamperes.

Regulated bias voltages may also be obtained as shown in *Typical Circuit 2*. In this circuit, a single OA3A can supply a regulated dc voltage of -75 volts.

The *jumper* between pins 3 and 7 inside the base makes it possible with suitable socket connections, to open power-supply circuits to protect circuit components when one of the VR tubes is removed from its socket.

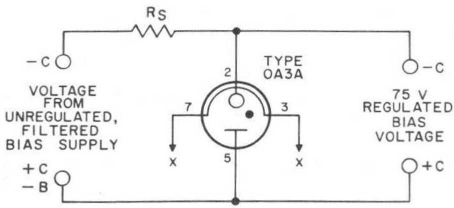
0A3A

TYPICAL CIRCUIT 1



92CS-12055

TYPICAL CIRCUIT 2



92CS-12056

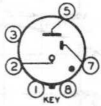
0A4-G

GAS-TRIODE

COLD-CATHODE STARTER-ANODE TYPE

Maximum Overall Length	4-1/8"
Maximum Diameter	1-9/16"
Bulb	ST-12
Base	Small Shell Octal 6-Pin

Pin 1 - No Connection
Pin 2 - Cathode
Pin 3 - No Connection
Pin 5 - Anode
Pin 7 - Starter-Anode
Pin 8 - No Connection



BOTTOM VIEW

CHARACTERISTICS

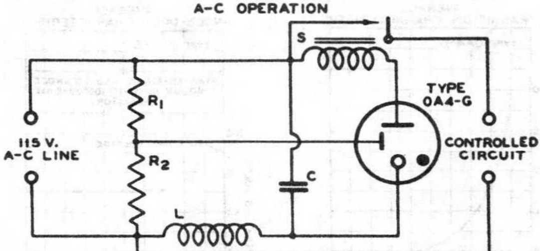
Peak Anode Breakdown Voltage (Starter anode tied to cathode)	225 min.	volts
Peak Positive Starter-Anode Breakdown Voltage	70 min. / 90 max.	volts
Starter-Anode Current (For transition of discharge to anode at 140 volts peak)	100 max.	µamp.
Starter-Anode Drop	60 approx.	volts
Anode Drop	70 approx.	volts

MAXIMUM RATINGS and TYPICAL OPERATING CONDITIONS

Relay Service

Peak Cathode Current	100 max.	ma.
D-C Cathode Current	25 max.	ma.
Typical Operation with A-C Supply:		
Anode-Supply Voltage (RMS)	105 - 130	volts
A-C Starter-Anode Voltage (peak)	70 max.	volts
R-F Starter-Anode Voltage (peak)	55 min.	volts
Sum of A-C and R-F Starter-Anode Voltages (peak)	110 min.	volts

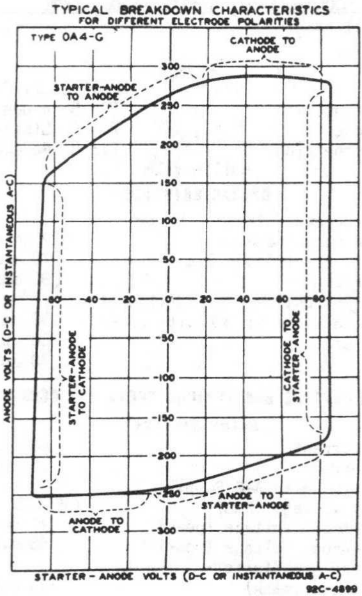
SCHEMATIC RELAY CIRCUIT USING TYPE 0A4-G
A-C OPERATION

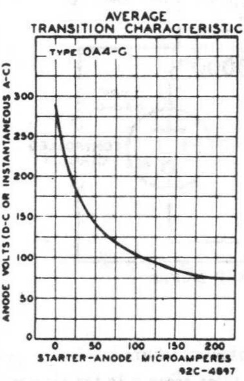


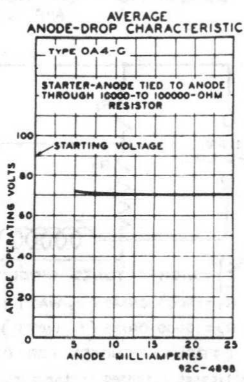
C, L = HIGH-Q TUNED CIRCUIT FOR R-F SIGNAL
R_1 = 15000 OHMS (1/2 WATT)
R_2 = 10000 OHMS (1/2 WATT)
S = RELAY—CHOSEN FOR DESIGN REQUIREMENTS

OA4-G

0A4-G
GAS-TRIODE







APRIL 20, 1938

RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.

92C-4897, 4898, 4899

RCA

OB2

VOLTAGE REGULATOR

MINIATURE GLOW-DISCHARGE TYPE

GENERAL DATA

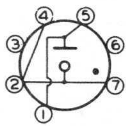
Electrical:

Cathode. . . . . Cold

Mechanical:

Mounting Position. . . . . Any
Maximum Overall Length . . . . 2-5/8"
Maximum Seated Length. . . . . 2-3/8"
Length, Base Seat to Bulb Top (Excluding tip). . . 2" ± 3/32"
Maximum Diameter . . . . 3/4"
Weight (Approx.) . . . . 0.3 oz ←
Bulb T-5-1/2
Base . . . . . . Small-Button Miniature 7-Pin (JETEC No.E7-1) ←
Basing Designation for BOTTOM VIEW 5BO

Pin 1 - Anode
Pin 2 - Cathode
Pin 3 - Internal Connection-Do Not Use
Pin 4 - Cathode



Pin 5 - Anode
Pin 6 - Internal Connection-Do Not Use
Pin 7 - Cathode

Maximum and Minimum Ratings, *Absolute Values*:

AVERAGE STARTING CURRENT♦	75 max.	ma
DC CATHODE CURRENT	30 max.	ma
	5 min.	ma
FREQUENCY.	0 max.	cps ←
AMBIENT-TEMPERATURE RANGE.	-55 to +90	^{o}C

Circuit Values:

Shunt Capacitor.	0.1 max.	$\mu\mu$f
Series Resistor.	*See note below*	

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN ←

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage. . . .	133■	-	-	volts
Anode Breakdown Voltage. . . .	-	115	133*	volts
Anode Voltage Drop	101●	108	114*	volts
Regulation (5 to 30 ma.) . . .	-	1	4*	volts

♦ Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

■ Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

* Maximum individual tube value during useful life.

● Minimum individual tube value during useful life.

The operating considerations and circuit information shown under Type OA2 also apply to Type OB2

←Indicates a change.

RCA

OC2

VOLTAGE REGULATOR

7-PIN MINIATURE, 75-VOLT, GLOW-DISCHARGE TYPE

GENERAL DATA

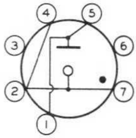
Electrical:

Cathode. . . . . Cold

Mechanical:

Operating Position . . . . .Any
Maximum Overall Length . . . . 2.63"
Maximum Seated Length. . . . . 2.38"
Length, Base Seat to Bulb Top (Excluding tip). 2.00" ± 0.09"
Maximum Diameter . . . . 0.75"
Dimensional Outline. . . . . *See General Section*
Bulb T5-1/2
Base . . . . . . Small-Button Miniature 7-Pin (JETEC No.E7-1)
Basing Designation for BOTTOM VIEW. 5BO

Pin 1 – Anode
Pin 2 – Cathode
Pin 3 – Internal Connection— Do Not Use
Pin 4 – Cathode



Pin 5 – Anode
Pin 6 – Internal Connection— Do Not Use
Pin 7 – Cathode

Maximum and Minimum Ratings, *Absolute Values:*

AVERAGE STARTING CURRENT▲.	75 max.	ma
DC CATHODE CURRENT	30 max.	ma
	5 min.	ma
FREQUENCY.	0 max.	cps
AMBIENT-TEMPERATURE RANGE.	-55 to +90	°C

Maximum Circuit Values:

Shunt Capacitance.	0.1 max.	μf

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage.	*	–	–	volts
Anode Breakdown Voltage:				
Under total darkness	–	–	145**	volts
Under normal ambient light conditions	–	105	115**	volts
Anode Voltage Drop	68●	75	83	volts
Regulation (5 to 30 ma.)	–	3	4.5	volts

▲ Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

* The minimum value to insure "starting" throughout tube life must be equal to the anode breakdown voltage plus the voltage drop across the series resistor at the maximum value of the load current.

** Maximum individual tube value during useful life.

● Minimum individual tube value during useful life.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

OC2

VOLTAGE REGULATOR

OPERATING CONSIDERATIONS

Sufficient resistance must always be used in series with the OC2 to limit the current through the tube.

The value for the series resistor is dependent on the dc supply voltage, anode voltage drop, load current, and cathode current and should be chosen to limit the operating current through the tube to 30 milliamperes at all times after the starting period.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

OC3

VOLTAGE REGULATOR

GLOW-DISCHARGE TYPE

GENERAL DATA

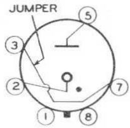
Electrical:

Cathode . . . . .Cold

Mechanical:

Mounting Position . . . . Any
Maximum Overall Length. . . . . 4-1/8"
Seated Length . . . . 3-3/8" ± 3/16"
Maximum Diameter. 1-9/16"
Dimensional Outline . . . . *See General Section*
Weight (Approx.). . . . . 1.3 oz
Bulb. ST-12
Base. . . . . Small-Shell Octal 6-Pin (JETEC No.B6-3)
Basing Designation for BOTTOM VIEW. 4AJ

Pin 1 - No Connection
Pin 2 - Cathode
Pin 3 - Jumper▲



Pin 5 - Anode
Pin 7 - Jumper▲
Pin 8 - No Connection

Maximum and Minimum Ratings, *Absolute Values:*

AVERAGE STARTING CURRENT♦	100 max.	ma
DC CATHODE CURRENT.	40 max.	ma
	5 min.	ma
FREQUENCY	0 max.	cps
AMBIENT-TEMPERATURE RANGE	-55 to +90	°C

Circuit Values:

Shunt Capacitor	0.1 max.	μf
Series Resistor	*See note below*	

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage	133■	-	-	volts
Anode Breakdown Voltage	-	115	133*	volts
Anode Voltage Drop.	103●	108	116*	volts
Regulation (5 to 40 ma)	-	2	4*	volts

▲ With suitable socket connections, jumper within base acts as a switch to open power-supply circuit when voltage regulator tube is removed from socket.

♦ Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady-state operating condition of at least 20 minutes, or tube performance will be impaired.

■ Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

* Maximum individual tube value during useful life.

● Minimum individual tube value during useful life.

The operating considerations and circuit information shown under Type OA3 also apply to Type OC3

← Indicates a change.

OD3

RCA

OD3
VOLTAGE REGULATOR

GLOW-DISCHARGE TYPE

GENERAL DATA

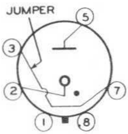
Electrical:

Cathode	Cold

Mechanical:

Mounting Position	Any
Maximum Overall Length	4-1/8"
→ Seated Length	3-3/8" ± 3/16"
Maximum Diameter	1-9/16"
Dimensional Outline	*See General Section*
→ Weight (Approx.)	1.3 oz
Bulb	ST-12
→ Base	Small-Shell Octal 6-Pin (JETEC No.B6-3)
Basing Designation for BOTTOM VIEW	4AJ

Pin 1 – No Connection
Pin 2 – Cathode
Pin 3 – Jumper▲



Pin 5 – Anode
Pin 7 – Jumper▲
Pin 8 – No Connection

Maximum and Minimum Ratings, *Absolute Values:*

AVERAGE STARTING CURRENT♦	100 max.	ma
DC CATHODE CURRENT	40 max.	ma
	5 min.	ma
→ FREQUENCY	0 max.	cps
AMBIENT-TEMPERATURE RANGE	-55 to +90	°C

→ **Circuit Values:**

Shunt Capacitor	0.1 max.	μf
Series Resistor	*See note below*	

→ **CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN**

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage	185■	–	–	volts
Anode Breakdown Voltage	–	160	185*	volts
Anode Voltage Drop	142●	153	165*	volts
Regulation (5 to 40 ma)	–	4	5.5*	volts

▲ With suitable socket connections, jumper within base acts as a switch to open power-supply circuit when voltage regulator tube is removed from socket.

♦ Averaged over starting period not exceeding 10 seconds. This starting period must be followed by a steady state operating condition of at least 20 minutes, or tube performance will be impaired.

■ Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

* Maximum individual tube value during useful life.

● Minimum individual tube value during useful life.

The operating considerations and circuit information shown under Type OA3 also apply to Type OD3

→ Indicates a change.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Voltage-Regulator

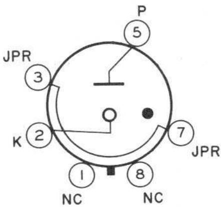
GLOW-DISCHARGE TYPE — 105 VOLTS

For Applications Requiring a Relatively Constant DC Output Voltage, Independent of Load and Supply-Voltage Variations

Mechanical:

Operating Position	Any
Type of Cathode	Cold
Maximum Overall Length	3-1/16"
Maximum Seated Length	2-1/2"
Maximum Diameter	1-9/32"
Dimensional Outline	See *General Section*
Bulb	T9
Base	Intermediate-Shell Octal 6-Pin, Arrangement 1 (JEDEC Group 1, No.B6-8)
Basing Designation for BOTTOM VIEW	4AJ

Pin 1 – No Internal Connection
Pin 2 – Cathode
Pin 3 – Jumper[a]
Pin 5 – Anode
Pin 7 – Jumper[a]
Pin 8 – No Internal Connection



VOLTAGE REGULATOR

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

Average Cathode Starting Current[b]	100 max.	ma
DC Cathode Current	40 max.	ma
	5 min.	ma
DC or AC Jumper Current	2 max.	amp
Ambient-Temperature Range	-55 to +90	°C

Circuit Values:

Shunt Capacitor	0.1 max.	μf
Series Resistor	See *Operating Considerations*	

[a] With suitable socket connections, the jumper within the tube base (between pins 3 and 7) provides for opening the power-supply circuit to protect circuit components when the voltage-regulator tube is removed from its socket.

[b] Averaged over starting period not exceeding 10 seconds. When starting currents greatly in excess of the maximum dc-cathode-current rating of 40 milliamperes are encountered, it may be necessary to operate these tubes as much as 20 minutes under steady-state conditions to assure stable operation.

CHARACTERISTICS RANGE VALUES

Values are initial unless otherwise specified

	Note	Min.	Av.	Max.	
DC Anode Supply Voltage.				See *Note 1*	
DC Anode Starting Voltage in:					
Total darkness	–	–	–	210	volts
Normal ambient light (5 to 50 footcandles). . . .	–	–	115	127	volts
Anode Voltage Drop for dc cathode current of:					
5 ma..	–	105	–	–	volts
30 ma.	–	105	109	111	volts
40 ma.	–	105	110	112	volts
Regulation for dc-cathode-current range of:					
5 to 30 ma..	2	–	1	2	volts
5 to 40 ma..	2	–	2	4	volts
Tube Noise for dc cathode current of 40 ma.	–	–	–	15	rms mv
DC Leakage Current for dc anode supply voltage of 50 volts and anode resistor of 3000 ohms	–	–	–	10	μa

Note 1: The minimum value to insure starting throughout useful tube life must be equal to the dc anode starting voltage plus the voltage drop across the series resistor at the maximum value of the load current.

Note 2: The maximum values for the specified regulation range apply throughout useful tube life.

OPERATING CONSIDERATIONS

shown under Type OA3A also apply to the OC3A

Voltage-Regulator

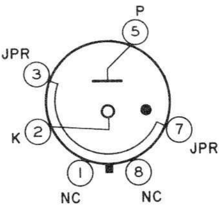
GLOW-DISCHARGE TYPE 150 VOLTS

For Applications Requiring a Relatively Constant DC Output Voltage, Independent of Load and Supply-Voltage Variations

Mechanical:

Operating Position	Any
Type of Cathode	Cold
Maximum Overall Length	3-1/16"
Maximum Seated Length	2-1/2"
Maximum Diameter	1-9/32"
Dimensional Outline	See *General Section*
Bulb	T9
Base	Intermediate-Shell Octal 6-Pin, Arrangement 1 (JEDEC Group 1, No.B6-8)
Basing Designation for BOTTOM VIEW	4AJ

Pin 1 – No Internal Connection
Pin 2 – Cathode
Pin 3 – Jumper[a]
Pin 5 – Anode
Pin 7 – Jumper[a]
Pin 8 – No Internal Connection



VOLTAGE REGULATOR

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

Average Cathode Starting Current[b]	100 max.	ma
DC Cathode Current	40 max.	ma
	5 min.	ma
DC or AC Jumper Current	2 max.	amp
Ambient-Temperature Range	−55 to +90	°C

Circuit Values:

Shunt Capacitor	0.1 max.	μf
Series Resistor	See *Operating Considerations*	

[a] With suitable socket connections, the jumper within the tube base (between pins 3 and 7) provides for opening the power-supply circuit to protect circuit components when the voltage-regulator tube is removed from its socket.

[b] Averaged over starting period not exceeding 10 seconds. When starting currents greatly in excess of the maximum dc-cathode-current rating of 40 milliamperes are encountered, it may be necessary to operate these tubes as much as 20 minutes under steady-state conditions to assure stable operation.

OD3A

CHARACTERISTICS RANGE VALUES

Values are initial unless otherwise specified

	Note	*Min.*	*Av.*	*Max.*	
DC Anode Supply Voltage.				See *Note 1*	
DC Anode Starting Voltage in:					
Total darkness	–	–	–	225	volts
Normal ambient light (5 to 50 footcandles). . . .	–	–	160	180	volts
Anode Voltage Drop for dc cathode current of:					
5 ma..	–	145	–	–	volts
30 ma.	–	145	149	160	volts
40 ma.	–	145	150	162	volts
Regulation for dc-cathode-current range of:					
5 to 30 ma..	2	–	2	4	volts
5 to 40 ma..	2	–	4	5.5	volts
Tube Noise for dc cathode current of 40 ma.	–	–	–	15	rms mv
DC Leakage Current for dc anode supply voltage of 50 volts and anode resistor of 3000 ohms	–	–	–	10	μa

Note 1: The minimum value to insure starting throughout useful tube life must be equal to the dc anode starting voltage plus the voltage drop across the series resistor at the maximum value of the load current.

Note 2: The maximum values for the specified regulation range apply throughout useful tube life.

OPERATING CONSIDERATIONS

shown under Type OA3A also apply to the OD3A

RCA

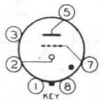
1C21

GAS-TRIODE

COLD-CATHODE GLOW-DISCHARGE TYPE

Maximum Overall Length	2-5/8"
Maximum Seated Height	2-1/16"
Maximum Diameter	1-5/16"
Bulb	T-9
Base	Intermed. Sh. Octal 6-Pin

Pin 1 - No Connection
Pin 2 - Cathode
Pin 3 - No Connection
Pin 5 - Anode



BOTTOM VIEW (G-4V)

Pin 7 - Grid
Pin 8 - No Connection
● - Gas Tube Type

Mounting Position: Any

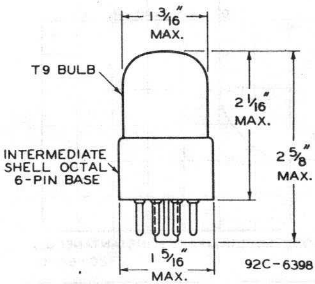
CHARACTERISTICS

Peak Anode Breakdown Voltage (Grid tied to cathode)	180 min.	volts
Peak Positive Grid Breakdown Voltage	66 min.	volts
	80 max.	volts
D-C Anode Extinction Voltage	73 approx.	volts
Grid Current (For transition of discharge to anode at 100 volts peak)	25 av.	µamp.
	50 max.	µamp.
Anode Voltage-Drop	73 approx.	volts
Grid Voltage-Drop	55 approx.	volts

Maximum Ratings Are Design-Center Values

MAXIMUM RATINGS

Peak Cathode Current	100 max.	ma.
D-C Cathode Current	25 max.	ma.
Typical Operation as Relay Tube:		
D-C Anode-Supply Voltage	125 - 145	volts
Peak Positive Grid-Bias Voltage	66 max.	volts
Peak Grid-Signal Voltage	40 min.	volts
Sum of Grid-Bias and Grid-Signal Voltages (Peak)	100 min.	volts
D-C Grid Current	100	µamp.



Dec. 1, 1942

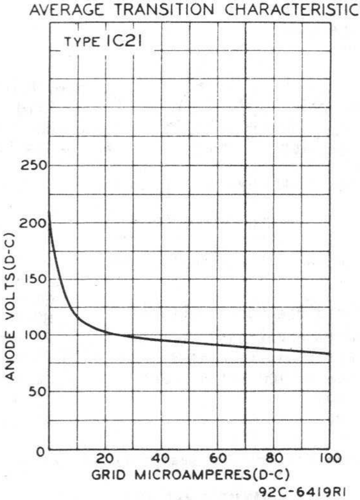
TENTATIVE DATA

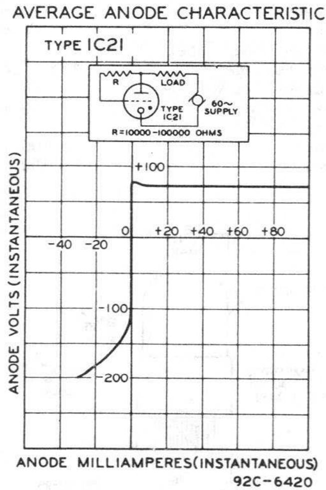
RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.

RCA

1C21

GAS-TRIODE





Dec. 1, 1942

92C-6419R1
92C-6420

RCA

2D21

THYRATRON

GAS TETRODE, MINIATURE TYPE

GENERAL DATA

Electrical: ←

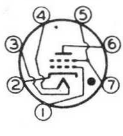
	Min.	Av.	Max.	
Heater, for Unipotential Cathode:				
Voltage (AC or DC)	5.7	6.3	6.9	volts
Current, with heater volts = 6.3	0.54	0.60	0.66	amp
Cathode:				
Heating Time, prior to tube conduction . . .	10	–	–	sec
Direct Interelectrode Capacitances (Approx.):°				
Grid No.1 to Anode			0.026	μμf
Input			2.4	μμf
Output			1.6	μμf
Ionization Time (Approx.):				
For conditions: dc anode volts = 100; grid-No.1 square-pulse volts = 50; peak anode amp. during conduction = 0.5			0.5	μsec
Deionization Time (Approx.):				
For conditions: dc anode volts = 125; grid-No.1 volts = −100, grid-No.1 resistor (ohms) = 1000; dc anode amp. = 0.1			35	μsec
For conditions: dc anode volts = 125; grid-No.1 volts = −10; grid-No.1 resistor (ohms) = 1000; dc anode amp. = 0.1			75	μsec
Maximum Critical Grid Current, with ac anode-supply volts (rms) = 460, and average anode amp. = 0.1			0.5	μamp
Anode Voltage Drop (Approx.)			8	volts
Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0; grid-No.2 volts = 0				250
Grid-No.2 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0; grid-No.2 resistor (megohms) = 0; grid-No.1 volts = 0				1000

° Without external shield.

Mechanical:

Mounting Position . . . . Any
Maximum Overall Length . . . . 2-1/8"
Maximum Seated Length . . . . 1-7/8"
Length, Base Seat to Bulb Top (excluding tip) . . 1-1/2" ± 3/32"
Maximum Diameter . . . . 3/4"
Bulb T-5-1/2
Base . . . . Small-Button Miniature 7-Pin
Basing Designation for BOTTOM VIEW 7BN

Pin 1 – Grid No.1
Pin 2 – Cathode
Pin 3 – Heater
Pin 4 – Heater



Pin 5 – Grid No.2
Pin 6 – Anode
Pin 7 – Grid No.2

← Indicates a change.

2D21

2D21
THYRATRON

RELAY and GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values*:

PEAK ANODE VOLTAGE:		
Forward	650 max.	volts
Inverse	1300 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:		
Peak, before anode conduction	−100 max.	volts
→ Average, during anode conduction■	−10 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Peak, before anode conduction	−100 max.	volts
→ Average, during anode conduction■	−10 max.	volts
CATHODE CURRENT:		
Peak	0.5 max.	amp
Average■	0.1 max.	amp
→ Surge, for duration of 0.1 sec. max.	10 max.	amp
GRID-No.2 CURRENT:		
→ Average■	+0.01 max.	amp
GRID-No.1 CURRENT:		
→ Average■	+0.01 max.	amp
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	25 max.	volts
→ AMBIENT TEMPERATURE RANGE	−75 to +90	°C

→ **Typical Operating Conditions for Relay Service:**

RMS Anode Voltage	117	400	volts
Grid-No.2 Voltage	0	0	volts
RMS Grid-No.1 Bias Voltage□	5	–	volts
DC Grid-No.1 Bias Voltage	–	−6	volts
Peak Grid-No.1 Signal Voltage	5	6	volts
Grid-No.1-Circuit Resistance	1.0	1.0	megohm
Anode-Circuit Resistance#	1200	2000	ohms

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	10 max.	megohms

■ Averaged over any interval of 30 sec. max.

□ Approximately 180° out of phase with the anode voltage.

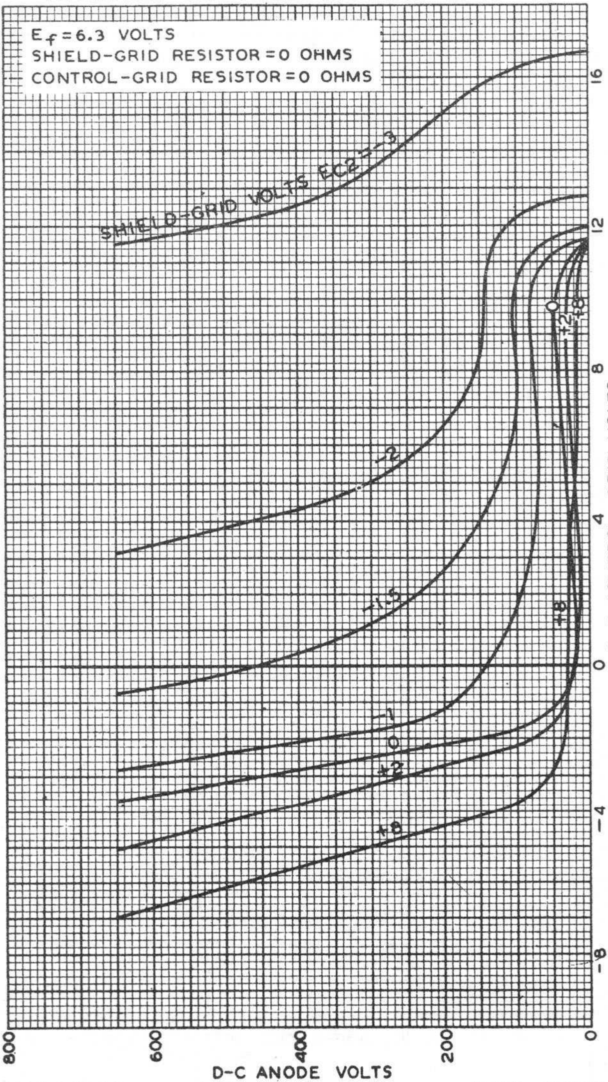
\# Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.

→ Indicates a change.

2D21

2D21

AVERAGE CONTROL CHARACTERISTICS



MAY 2, 1944

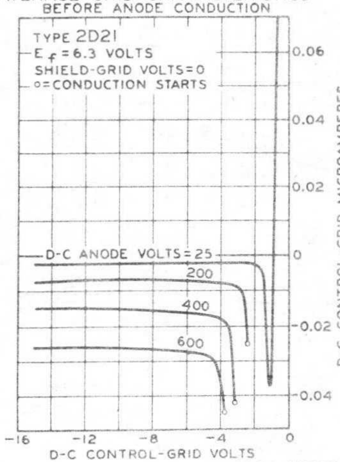
RCA VICTOR DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM—6531R1

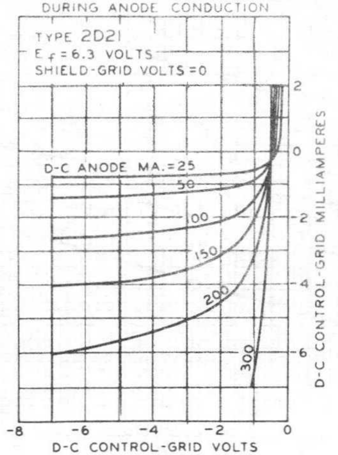
2D21
THYRATRON

AVERAGE GRID CHARACTERISTICS
BEFORE ANODE CONDUCTION



92CM-6532TI

AVERAGE GRID CHARACTERISTICS
DURING ANODE CONDUCTION



92CM-6533T

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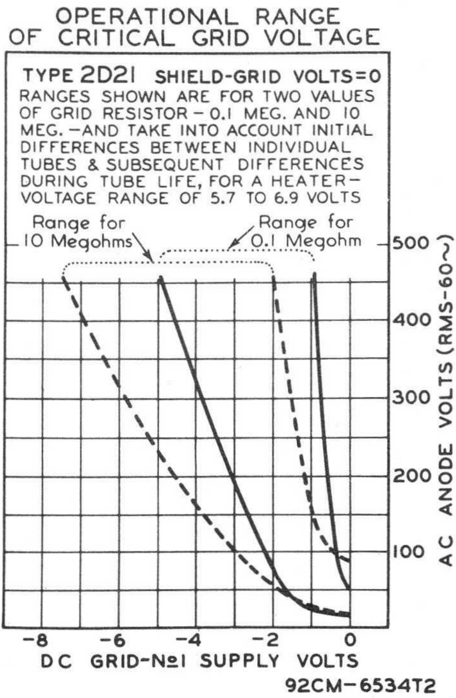
RCA

2D21
THYRATRON



RCA

3C23

GAS-AND-MERCURY-VAPOR THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

Filament, Coated:

Voltage	2.5 ± 5%	ac or dc volts
Current at 2.5 volts	7	amp
Minimum heating time prior to tube conduction	15	sec

Direct Interelectrode Capacitance (Approx.):°

Grid to anode	1.8	$\mu\mu$f

Ionization Time (Approx.):

For conditions: dc anode volts = 100, peak grid volts = +30, and peak anode amperes = 6	3	μsec

Deionization Time (Approx.):

For conditions: dc anode volts = 120, dc grid-supply volts = -20, grid resistor (ohms) = 10000, and dc anode amperes = 1.5	360	μsec
For conditions: dc anode volts = 120, dc grid-supply volts = -500, grid resistor (ohms) = 100000, and dc anode amperes = 1.5	60	μsec
Anode Voltage Drop (Approx.)	15	volts

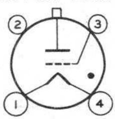
Mechanical:

Mounting Position	Vertical, base down
Maximum Overall Length	6-1/8"
Seated Length	5-1/4" ± 1/4"
Maximum Diameter	2-1/16"
Cooling	Natural circulation of air around tube
Weight (Approx.)	3 oz
Bulb	ST-16
Cap	Medium (JETEC No. C1-5)
Base	Medium-Shell Small 4-Pin with Bayonet (JETEC No. A4-10)
Basing Designation for BOTTOM VIEW	3G

Pin 1 – Filament

Pin 2 – No Connection

Pin 3 – Grid



Pin 4 – Filament

Cap – Anode

CONTROL SERVICE

Maximum Ratings, *Absolute Values: For supply frequency up to 400 cps*

	Operating Condensed-Mercury Temperature Range: -40° to +100°C	-40° to +80°C	
PEAK ANODE VOLTAGE:			
Forward	200 max.	1250 max.	volts
Inverse	200 max.	1250 max.	volts

° Without external shield.

← Indicates a change.

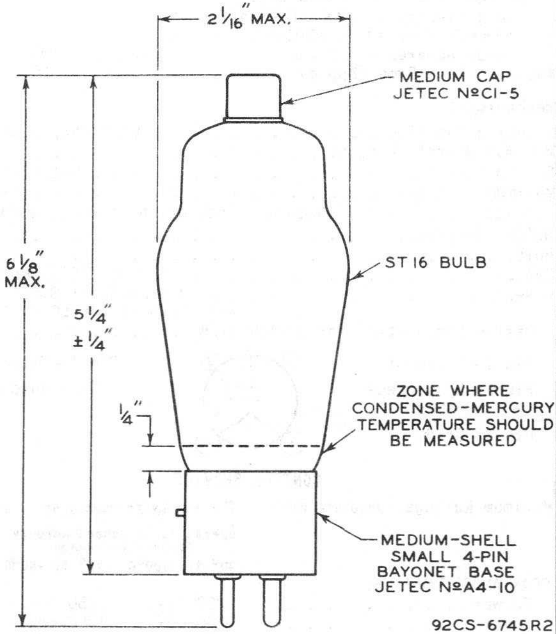
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

3C23

GAS-AND-MERCURY-VAPOR THYRATRON

	Operating Condensed-Mercury Temperature Range -40° to +100°C	-40° to +80°C	
GRID VOLTAGE:			
Peak or DC, before tube conduction	-500 max.	-500 max.	volts
Average▲, during tube conduction	-10 max.	-10 max.	volts
ANODE CURRENT:			
Peak	6 max.	6 max.	amp
Average●	1.5 max.	1.5 max.	amp
Fault, for duration of 0.1 second max.	120 max.	120 max.	amp
GRID CURRENT:			
Average♦	+0.01 max.	+0.01 max.	amp

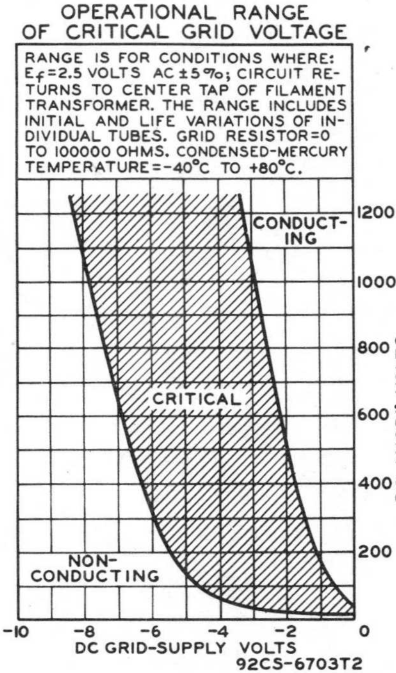
▲ Averaged over one conducting period.
● Averaged over any interval of 5 seconds maximum.
♦ Averaged over period of grid conduction.



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

3C23

GAS - AND - MERCURY-VAPOR THYRATRON



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

3D22-A
GAS THYRATRON

NEGATIVE-CONTROL TETRODE TYPE

Supersedes Type 3D22

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:

	Min.	Av.	Max.	
Voltage	5.7	6.3	6.9	ac or dc volts
Current at 6.3 volts. . .	–	2.6	2.85	amp

Cathode:		
Minimum heating time prior to tube conduction.	30	sec
Maximum outage time without reheating. .	3	sec
Direct Interelectrode Capacitances (Approx.):°		
Grid No.1 to anode*.	0.1	μμf
Grid No.1 to cathode, grid No.2, base shell, and heater	8.5	μμf
Anode to cathode, grid No.2, base shell, and heater	4.6	μμf
Ionization Time (Approx.):		
For conditions: dc anode volts = 100, grid-No.1 square-pulse volts = +100, and peak anode amperes during conduction = 8	0.5	μsec
Deionization Time (Approx.):		
For conditions: dc anode volts = 125, dc grid-No.1 volts = −200, grid-No.1 resistor (ohms) = 1000, and dc anode amperes = 0.8.	150	μsec
For conditions: dc anode volts = 125, dc grid-No.1 volts = −14.8, grid-No.1 resistor (ohms) = 1000, and dc anode amperes = 0.8.	400	μsec
Maximum Critical Grid-No.1 Current:		
For conditions: ac anode-supply volts = 460 (rms), and average anode amperes = 0.8.	0.8	μamp
Anode Voltage Drop (Approx.)	10	volts
Grid-No.1 Control Ratio (Approx.):		
For conditions: grid-No.1 resistor (megohms) = 0 to 0.1, grid-No.2 resistor (megohms) = 0, and grid-No.2 volts = 0	150	
Grid-No.2 Control Ratio (Approx.):		
For conditions: grid-No.1 resistor (megohms) = 0, grid-No.2 resistor (megohms) = 0 to 0.1, and grid-No.1 volts = −3	650	

° Without external shield.

* With all other electrodes and base shell connected to ground.

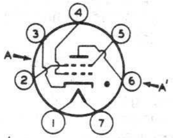
RCA

3D22-A
GAS THYRATRON

Mechanical:

Mounting Position.	.Any
Maximum Overall Length	4-5/8"
Maximum Seated Length.	4"
Maximum Diameter	2-3/8"
Weight (Approx.)	5 oz
Bulb	T-16
Base	Medium-Metal-Shell Giant 7-Pin with Bayonet (JETEC No.A7-17)
Basing Designation for BOTTOM VIEW	.7BV

Pin 1 - Heater
Pin 2 - Grid No.2
Pin 3 - Cathode
Pin 4 - Grid No.1



Pin 5 - Grid No.2
Pin 6 - Anode
Pin 7 - Heater

AA' = PLANE OF ELECTRODES

RELAY AND GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values:*

PEAK ANODE VOLTAGE:		
Forward.	650 max.	volts
Inverse.	1500 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:		
Peak, before tube conduction	-100 max.	volts
Average#, during tube conduction	-10 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Peak or DC, before tube conduction . . .	-200 max.	volts
Average#, during tube conduction	-10 max.	volts
CATHODE CURRENT:		
Peak	8 max.	amp
Average#	0.8 max.	amp
Fault, for duration of 0.1 second max. .	30 max.	amp
AVERAGE GRID-No.2 CURRENT#	+0.1 max.	amp
AVERAGE GRID-No.1 CURRENT#	+0.05 max.	amp
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode.	100 max.	volts
Heater positive with respect to cathode.	25 max.	volts
AMBIENT-TEMPERATURE RANGE.	-75 to +90	°C

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	2 max.	megohms

Averaged over any interval of 30 seconds maximum.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

3D22-A

GAS THYRATRON

SPECIAL PERFORMANCE TESTS

Made in conformance with indicated sections of MIL-E-1B Specifications dated 2 May 1952

4.9.19.2 (F-66) High-Frequency Vibration:

The tube is rigidly mounted on a table vibrating with simple harmonic motion at a frequency of 50 ± 2 cps with a fixed amplitude of 0.040" ± 0.0025" (total excursion is double the amplitude). Maximum acceleration is 10g. No voltage is applied during vibration. Tube is vibrated for 10 minutes in such manner that table motion is along shortest line between anode and cathode. This test will not cause tube to be inoperative.

4.10.19 (F-64) Thyratron High-Voltage Operation:

	Min.	Max.	
Grid-No.1 Supply Voltage (1)	-4.4	-9.2	volts

This test is made after two light taps with a felt hammer (similar to type used for noise tests) in direction from cathode to anode under the following conditions: heater voltage of 6.3 volts rms, anode supply voltage of 500 volts rms, grid No.2 tied to cathode, load resistance of 2000 ohms, and grid-No.1 circuit-resistance of 2 megohms. Tube conduction is indicated by an oscilloscope connected between anode and cathode and ceases when the grid-No.1 supply voltage is increased negatively within indicated range.

Grid-No.1 Supply Voltage (2)	-4.4	-9.2	volts

This test is made as for Grid-No.1 Supply Voltage (1), except that the taps are made in direction from anode to cathode.

Voltage Difference	-	1	volt

The difference between the value of grid-No.1 supply voltage in the first and second grid-No.1 supply voltage tests will not exceed the specified value.

OPERATING CONSIDERATIONS

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

RCA

3D22-A

GRID-CONTROLLED RECTIFIER CIRCUITS

DC Voltage Control

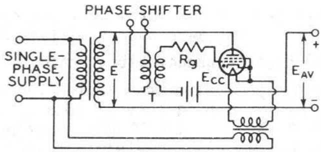


FIG. 1 HALF-WAVE SINGLE-PHASE

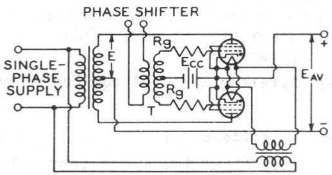


FIG. 2 FULL-WAVE SINGLE-PHASE

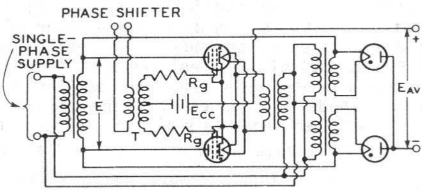


FIG. 3 SERIES SINGLE-PHASE

AC Voltage Control

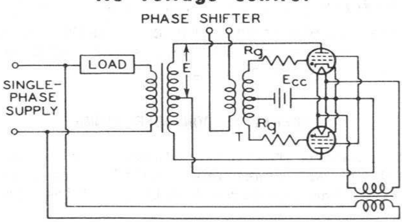


FIG.4 FULL-WAVE SINGLE-PHASE

NOTES

92CL-8596

T = PEAKING TRANSFORMER
IN FIG. 3, THE RECTIFIER TUBES MAY BE 3D22-A's USED AS DIODES. THE 3D22-A IS USED AS A DIODE BY CONNECTING GRIDS No 2 AND No 1 TO CATHODE (PIN 3)

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

3D22-A

GRID-CONTROLLED RECTIFIER CIRCUITS

Numerical Relationships Among Electrical Quantities

E = Trans. Sec. Voltage (RMS)
E_{av} = Average DC Output Voltage
E_{bmf} = Peak Forward Anode Voltage
E_{bmi} = Peak Inverse Anode Voltage
E_m = Peak DC Output Voltage
E_r = Major Ripple Voltage (RMS)
f = Supply Frequency
f_r = Major Ripple Frequency
I_{av} = Average DC Output Current
I_b = Average Anode Current
I_p = Anode Current (RMS)
I_{pm} = Peak Anode Current
P_{ac} = Load Volt-Amperes
P_{al} = Line Volt-Amperes
P_{ap} = Trans. Pri. Volt-Amperes
P_{as} = Trans. Sec. Volt-Amperes
P_{dc} = DC Power ($E_{av} \times I_{av}$)

Note: Conditions assumed involve sine-wave supply; zero voltage drop in tubes; no losses in transformer and circuit; no back emf in the load circuit; and no phase-back.

RATIO	Fig. 1	Fig. 2	Fig. 3	Fig. 4
Voltage Ratios				
E/E_{av}	2.22	1.11	1.11	–
E_{bmi}/E	1.41	2.83	1.41	1.41
E_{bmi}/E_{av}	3.14	3.14	1.57	–
E_m/E_{av}	3.14	1.57	1.57	–
E_r/E_{av}	1.11	0.472	0.472	–
E_{bmf}/E:				
Resistive Load	1.41	1.41	1.41	1.41
Inductive Load■	1.41	2.83	1.41	1.41
Frequency Ratio				
f_r/f	1	2	2	–
Current Ratios				
I_p/I_{av}	1.57	0.785	0.785	–
I_b/I_{av}	1	0.5	0.5	–
Resistive Load				
I_{pm}/I_{av}	3.14	1.57	1.57	–
I_{pm}/I_b	3.14	3.14	3.14	3.14
Inductive Load■				
I_{pm}/I_{av}	--	1	1	–
Power Ratios				
P_{ac}/I_bE_{bmf}	--	–	–	1.57
Resistive Load				
P_{as}/P_{dc}	3.49	1.74	1.24	–
P_{ap}/P_{dc}	2.69	1.23	1.24	–
P_{al}/P_{dc}	2.69	1.23	1.24	–

■: See next page.

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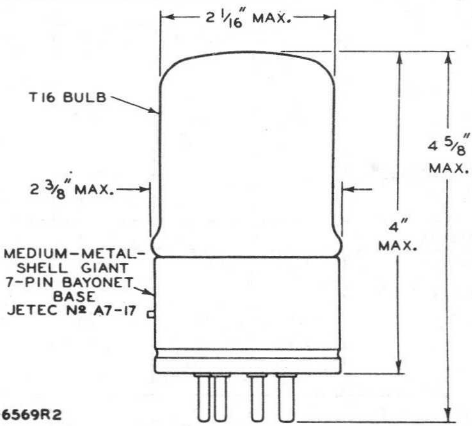
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

3D22-A
GAS THYRATRON

RATIO	Fig. 1	Fig. 2	Fig. 3	Fig. 4
Power Ratios (Cont'd)				
Inductive Load■				
P_{as}/P_{dc}	—	1.57	1.11	–
P_{ap}/P_{dc}	—	1.11	1.11	–
P_{al}/P_{dc}	—	1.11	1.11	–

■ The use of a large filter-input choke is assumed, except for the circuit in Fig.4.

CIRCUIT Single-Phase	MAX. TRANS. SEC. VOLTS (RMS) E	APPROX. DC OUTPUT VOLTS TO FILTER E_{av}	MAX. DC OUTPUT AMPERES I_{av}	MAX. DC OUTPUT WATTS TO FILTER P_{dc}	MAX. AC OUTPUT VOLT-AMPERES P_{ac}
Fig. 1 Half-Wave	460	205	0.8	165	–
Fig. 2 Full-Wave:					
Resistive Load	460	410	1.6	660	–
Inductive Load	230	205	1.6	330	–
Fig. 3 Series	460	410	1.6	660	–
Fig. 4 Full-Wave	460	–	–	–	800



92CM-6569R2

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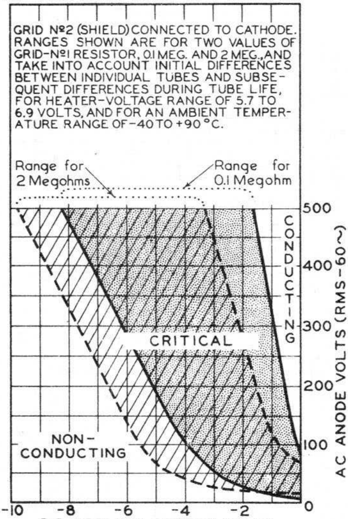
3D22-A

GAS THYRATRON

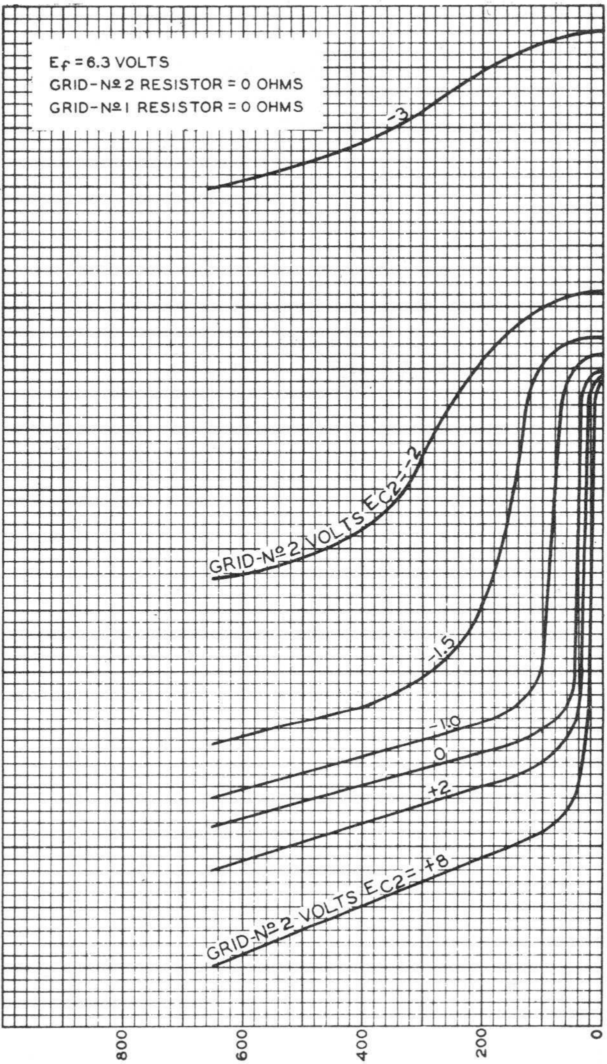
OPERATIONAL RANGE
OF CRITICAL GRID-No1 VOLTAGE



3D22-A

3D22-A

AVERAGE CONTROL CHARACTERISTICS



JAN. 22, 1947

TUBE DIVISION

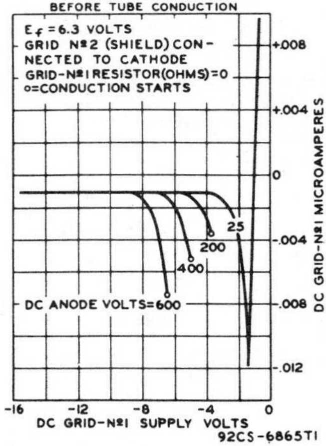
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6831

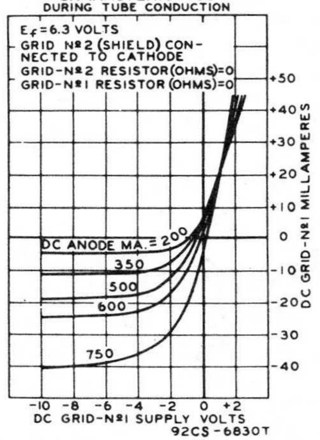
3D22-A

CHARACTERISTIC CURVES

AVERAGE GRID-No1 CHARACTERISTICS
BEFORE TUBE CONDUCTION



AVERAGE GRID-No1 CHARACTERISTICS
DURING TUBE CONDUCTION



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THYRATRON

MERCURY-VAPOR TETRODE

DATA

Electrical:

	Continuous Service		Intermittent Service		
Heater, for Unipotential Cathode:					
Voltage*	5.0	5.0	5.5	5.0	volts
Current.	10.0	10.0	11.0	10.0	amp
Direct Interelectrode Capacitance:					
Grid-No.1 to Anode (Approx.)	0.3	0.3	0.3	0.3	μμf
Peak Voltage Drop (Approx.). .	16	16	16	16	volts
Approx. Control Characteristics:					
Anode Voltage.	100	1000	100	1000	volts
Grid-No.2 Voltage.	0	0	0	0	volts
Grid-No.1 Voltage.	+1	-9	+1	-9	volts
Ionization Time (Approx.). . .	10	10	10	10	μsec.
Deionization Time (Approx.). .	1000	1000	1000	1000	μsec.

Mechanical:

Mounting Position.	Vertical, Base Down
Overall Length	11" ± 1/4"
Seated Length.	10-1/4" ± 1/4"
Greatest Radius.	2-13/16"
Bulb	ST-30
Caps	No. 3917
Base	Super-Jumbo 4-Pin, with Bayonet

Maximum Ratings, Absolute Values:

	Continuous Service	Intermittent Service		
PEAK FORWARD ANODE VOLT.	2500	750	10000	max.volts
PEAK INVERSE ANODE VOLT.	2500	750	10000	max.volts
GRID-No.1 (CONT.GRID) VOLT.:				
Before Conduction. . .	-1000	-1000	-1000	max.volts
During Conduction. . .	-10	-10	-10	max.volts
GRID-No.2 (SH'LD GRID) VOLT.:				
Before Conduction. . .	-500	-500	-500	max.volts
During Conduction. . .	-10	-10	-10	max.volts
INSTANTANEOUS ANODE CUR.:				
Below 25 Cycles. . . .	12.8	5.0	8.0	max.amp
25 Cycles and Higher .	40	77	16	max.amp
AVERAGE ANODE CURRENT. .	6.4	2.5	4.0	max.amp
SURGE ANODE CUR., for 0.1 sec.; max.	400	400	160	max.amp
INSTANTANEOUS GRID-No.1 CUR.	1.0	1.0	1.0	max.amp
AVERAGE GRID-No.1 CUR. .	0.25	0.25	0.25	max.amp
INSTANTANEOUS GRID-No.2 CUR.	2.0	2.0	2.0	max.amp
AVERAGE GRID-No.2 CUR. .	0.5	0.5	0.5	max.amp
TIME OF AVERAGING CURRENT	15	5	15	max.sec
COND.-MERCURY TEMP. RANGE▲	40-80	30-95	25-50	°C

* Must be applied 5 minutes before anode voltage is applied.
▲ Recommended condensed-mercury temperature = 40°C.

RCA

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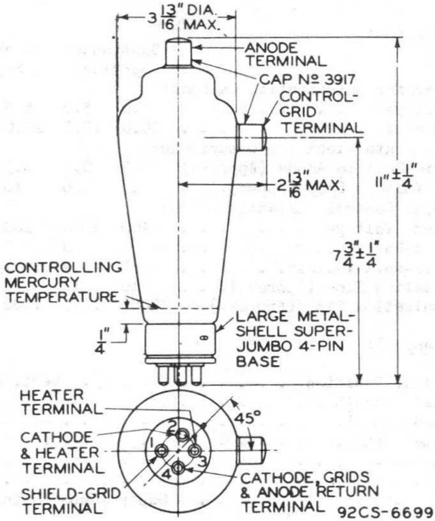
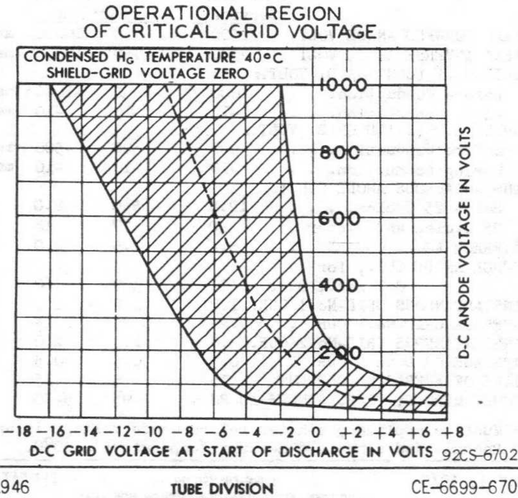
THYRATRON





627

627
THYRATRON
MERCURY-VAPOR TRIODE

DATA

Electrical:

Filament:

Voltage*	2.5	volts
Current	6.0	amp
Direct Interelectrode Capacitance:		
Anode to Grid (Approx.)	2.5	μμf
Peak Voltage Drop	12	volts
Control Characteristic	Negative	
Ionization Time (Approx.)	10	μseconds
Deionization Time (Approx.)	1000	μseconds

Mechanical:

Mounting Position	Vertical, Base Down
Overall Length	6-3/8" ± 1/4"
Seated Length	6" ± 1/4"
Maximum Diameter	2-1/16"
Bulb	S-19
Cap	Medium Metal
Base	Small Shell Super-Jumbo 4-Pin

Maximum Ratings, Absolute Values:
For frequencies up to 150 cycles

PEAK FORWARD ANODE VOLTAGE	1250	max.	volts
PEAK INVERSE ANODE VOLTAGE	2500	max.	volts
PEAK GRID VOLT. (Before Conduction)	-500	max.	volts
PEAK ANODE CURRENT	2.5	max.	amp
AVERAGE ANODE CURRENT**	0.64	max.	amp
SURGE ANODE CURRENT for 0.1 sec. max.	25	max.	amp
GRID CURRENT, Before Conduction (Grid Neg.)	4	max.	μamp
PEAK GRID CURRENT	0.25	max.	amp
AVERAGE GRID CURRENT**	0.06	max.	amp
COND.-MERCURY TEMPERATURE RANGE ▲	25-70		°C

* Filament voltage must be applied at least 10 seconds before start of tube conduction.

** Averaged over any 30-second interval.

▲ Recommended Condensed-Mercury Temperature 40 to 45°C.

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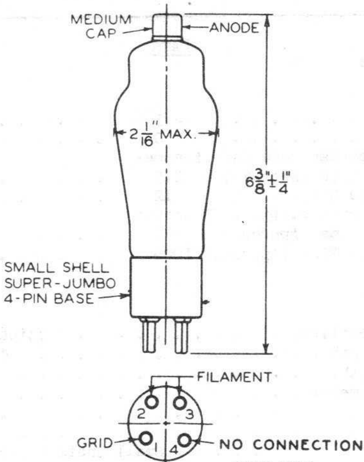
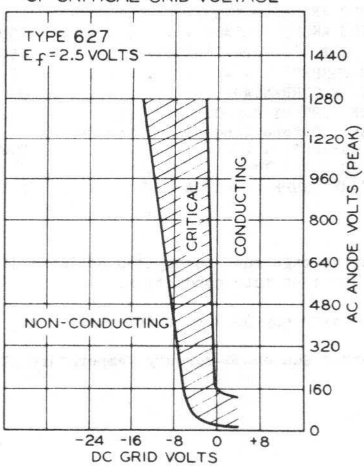
THYRATRON



92CS-6739

OPERATIONAL REGION OF CRITICAL GRID VOLTAGE



92CS-6738

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

632-B

632-B

MERCURY-VAPOR THYRATRON

NEGATIVE-CONTROL TETRODE TYPE

GENERAL DATA

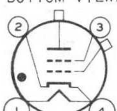
Electrical:

Heater, for Unipotential Cathode:		
Voltage	5•	ac or dc volts
Current	5	amp
Cathode:		
Minimum heating time prior to tube conduction	5	minutes
Direct Interelectrode Capacitances (Approx.):		
Grid No.1 to anode	0.04	$\mu\mu$f
Grid No.2 to anode	3	$\mu\mu$f
Ionization Time (Approx.)	10	μsec
Deionization Time (Approx.)	1000	μsec
Maximum Critical Grid-No.1 Current	2	μamp
Anode Voltage Drop (Approx.)	12	volts

Mechanical:

Mounting Position	Vertical, base down
Maximum Overall Length	8-5/16"
Seated Length	7-1/2" ± 1/4"
Maximum Radius (Including side cap)	1-3/4"
Weight (Approx.)	9 oz
Bulb	T-18
Top Cap	Skirted Medium (JETEC No.C1-29)
Side Cap	Saddle Medium
Base	Skirted-Medium-Shell Small 4-Pin with Bayonet (JETEC No.A4-71)
Basing Designation for BOTTOM VIEW	4CD

Pin 1 - Heater
Pin 2 - Cathode, Circuit Returns
Pin 3 - Grid No.2



Pin 4 - Heater, Cathode
Top Cap - Anode
Side Cap - Grid No.1

Temperature Control:

Heating--When the ambient temperature is so low that the normal rise of condensed-mercury temperature above the ambient temperature will not bring the condensed-mercury temperature up to the minimum value of the operating range specified under *Maximum Ratings*, some form of heat-conserving enclosure or auxiliary heater will be required.

Cooling--When the operating conditions are such that the maximum value of the operating condensed-mercury temperature is exceeded, provision should be made for forced-air cooling sufficient to prevent exceeding the maximum value.

• Under operating conditions where the average anode current does not exceed 0.5 ampere, the heater voltage may be increased to 5.5 volts.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

632-B

632-B

MERCURY-VAPOR THYRATRON

IGNITOR-FIRING AND GRID-CONTROLLED RECTIFIER SERVICE

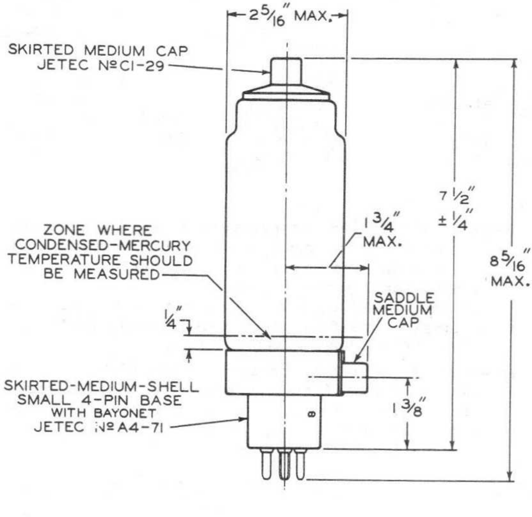
Maximum Ratings, *Absolute Values:*

For anode-supply frequency of 60 cps

	Operating Condensed-Mercury Temperature Range 40° to 80°C■	
PEAK ANODE VOLTAGE:		
Forward	1500 max.	volts
Inverse	1500 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:		
Peak, before tube conduction	-300 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Peak, before tube conduction	-1000 max.	volts
CATHODE CURRENT:		
Peak	30 max.	amp
Average#	2.5 max.	amp
Fault, for duration of 0.1 second max.	150 max.	amp
AVERAGE GRID-No.2 CURRENT#	+0.25 max.	amp
AVERAGE GRID-No.1 CURRENT#	+0.25 max.	amp

■ Recommended temperature range of condensed mercury is 45° to 50°C.

\# Averaged over any interval of 30 seconds maximum.

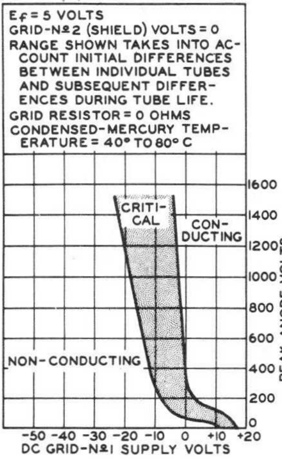


RCA

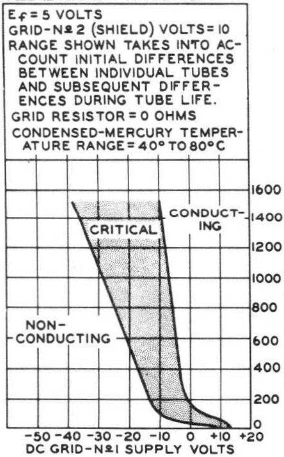
632-B

MERCURY-VAPOR THYRATRON

OPERATIONAL RANGES OF CRITICAL GRID-No.1 VOLTAGE



92CS-9008T



92CS-9007T

672-A
THYRATRON
MERCURY-VAPOR TETRODE

Supersedes Type 672

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:
- Voltage . . . . 5 . . . . ac or dc volts
- Current . . . . 5 . . . . amp

Cathode:
- Min. Heating Time, prior to tube conduction . . . 5 minutes

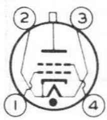
Direct Interelectrode Capacitances:
- Grid No.1 to Anode . . . . 0.04 $\mu\mu$f
- Grid No.2 to Anode . . . . 3 $\mu\mu$f

Ionization Time (Approx.) . . . . 10 μsec
Deionization Time (Approx.) . . . . 1000 μsec
Maximum Critical Grid Current . . . . 2 μamp
Anode Voltage Drop (Approx.) . . . . 12 volts

Mechanical:

Mounting Position . . . . Vertical, Base Down
Overall Length . . . . 7-7/8" ± 1/4"
Seated Length . . . . 7-1/8" ± 1/4"
Maximum Diameter . . . . 2-5/16"
Bulb T-18
Cap . . . . Skirted Medium
Base . . . . Large-Shell Super-Jumbo 4-Pin, Bayonet
- Basing Designation for BOTTOM VIEW 4CE

Pin 1 - Grid No.1
Pin 2 - Heater, Cathode



Pin 3 - Heater
Pin 4 - Grid No.2
Cap - Anode

GRID-CONTROLLED RECTIFIER SERVICE

For frequencies up to 150 cycles

Maximum Ratings, ***Absolute Values:***

PEAK ANODE VOLTAGE:
- Forward . . . . 2500 max. volts
- Inverse . . . . 2500 max. volts

GRID-No.2 (SHIELD-GRID) VOLTAGE:
- Peak, before anode conduction . . . . . . -300 max. volts

GRID-No.1 (CONTROL-GRID) VOLTAGE:
- Peak, before anode conduction . . . . . . -1000 max. volts

CATHODE CURRENT:
- Peak . . . . 40 max. amp
- Average■ . . . . 3.2 max. amp
- Surge, for duration of 0.1 sec. max. . . 150 max. amp

■ See next page.

(continued on next page)

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

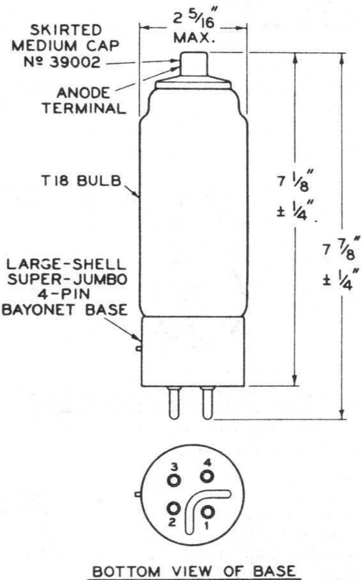
RCA

672-A
THYRATRON

GRID-No. 2 CURRENT:		
Peak	1 max.	amp
Average■	0.25 max.	amp
GRID-No. 1 CURRENT:		
Peak	1 max.	amp
Average■	0.25 max.	amp
COND.-MERCURY TEMPERATURE RANGE▲	40 to 80	^{o}C

■ Averaged over any interval of 15 sec. max.

▲ Recommended condensed-mercury temperature is between 45° and 50°C.



BOTTOM VIEW OF BASE

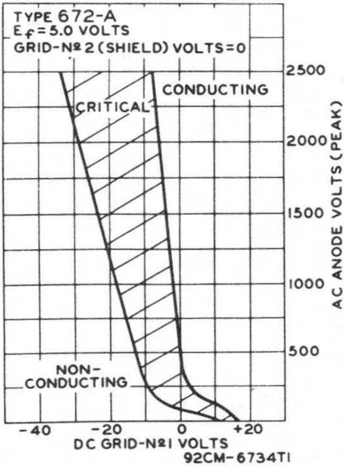
92CS-6735R1

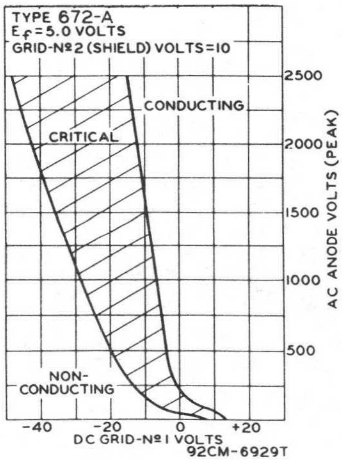
RCA

672-A

THYRATRON

OPERATIONAL RANGES OF CRITICAL GRID-No.1 VOLTAGE





676
THYRATRON
MERCURY-VAPOR TRIODE

DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage*.	5	. . . . volts
Current	10	. . . . amp
Direct Interelectrode Capacitance:		
Grid to Anode (Approx.)	5	. . . . μμf
Peak Voltage Drop	12	. . . . volts
Control Characteristic. .	Negative	
Ionization Time (Approx.)	10	. . . . μseconds
Deionization Time (Approx.)	1000	. . . . μseconds

Mechanical:

Mounting Position	Vertical, Base Down
Overall Length.	11-1/4" ± 1/2"
Maximum Diameter.	3-13/16"
Bulb.	ST-30
Cap	No. 3985
Base.	Large Shell Super-Jumbo 4-Pin

Maximum Ratings, Absolute Values:

For frequencies up to 150 cycles

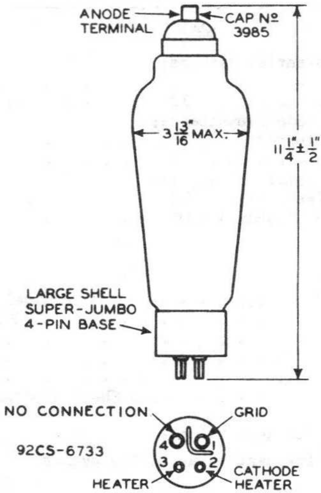
	Continuous Service	Welder-Control Service	
PEAK FORWARD ANODE VOLTAGE	2500 max.	750 max.	volts
PEAK INVERSE ANODE VOLTAGE	2500 max.	750 max.	volts
PEAK GRID VOLTAGE:			
Before Conduction	-500 max.	-500 max.	volts
PEAK ANODE CURRENT.	40 max.	77 max.	amp
AVERAGE ANODE CURRENT . . .	6.4 max.	2.5 max.	amp
SURGE ANODE CURRENT for 0.1 sec. max.	200 max.	200 max.	amp
GRID CURRENT: Before conduction (Grid Negative)	5 max.	5 max.	μamp
PEAK GRID CURRENT	1 max.	1 max.	amp
AVERAGE GRID CURRENT. . . .	0.25 max.	0.25 max.	amp
TIME OF AVERAGING CURRENTS.	15 max.	5 max.	sec
COND.-MERCURY TEMP. RANGE▲	40 - 80	40 - 90	°C

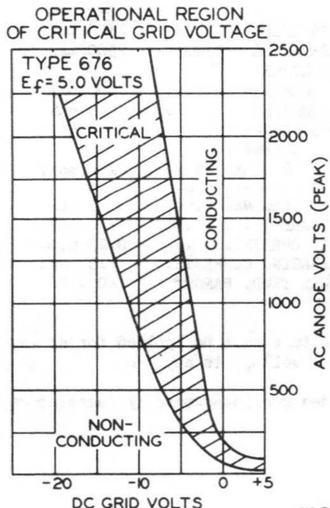
* Heater voltage must be applied for at least 5 minutes before anode voltage is applied.

▲ Recommended condensed-mercury temperature range, 45 - 55°C.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

676
THYRATRON





92CS-6732

677

677

THYRATRON

MERCURY-VAPOR TRIODE

DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage*	5	volts
Current	10	amp
Direct Interelectrode Capacitance:		
Grid to Anode (Approx.)	5	μμf
Peak Voltage Drop	12	volts
Control Characteristic	Negative	
Ionization Time (Approx.)	10	μseconds
Deionization Time (Approx.)	1000	μseconds

Mechanical:

Mounting Position	Vertical, Base Down
Overall Length	11-1/4" ± 1/2"
Maximum Diameter	3-13/16"
Bulb	ST-30
Cap	No. 3985
Base	Large Shell Super-Jumbo 4-Pin

Maximum Ratings, Absolute Values:

For frequencies up to 150 cycles

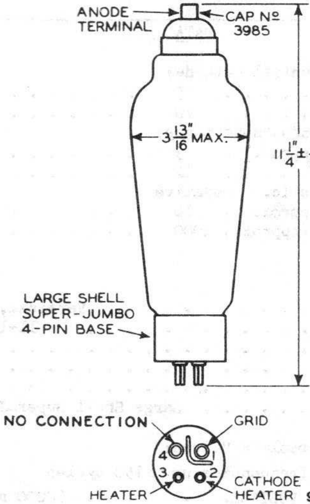
PEAK FORWARD ANODE VOLTAGE	10000 max.	volts
PEAK INVERSE ANODE VOLTAGE	10000 max.	volts
PEAK GRID VOLTAGE:		
Before Conduction	-500 max.	volts
Anode Negative	10 max.	volts
PEAK ANODE CURRENT	15 max.	amp
AVERAGE ANODE CURRENT**	4 max.	amp
SURGE ANODE CURRENT for 0.1 sec., max.	16 max.	amp
GRID CURRENT: Before Conduction (Grid Neg.)	5 max.	μamp
PEAK GRID CURRENT	1 max.	amp
AVERAGE GRID CURRENT**	0.25 max.	amp
COND.-MERCURY TEMPERATURE RANGE▲	30 - 50	°C

* Heater voltage must be applied for at least 5 minutes before anode voltage is applied.

** Averaged over any 15-second interval.

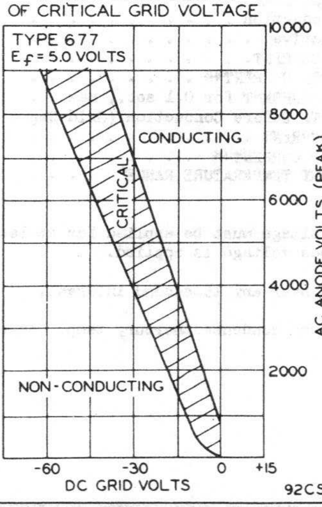
▲ Recommended condensed-mercury temp. range, 35 - 45°C.

677
THYRATRON



92CS-6731

OPERATIONAL REGION OF CRITICAL GRID VOLTAGE



92CS-6730

710/6011

Gas and Mercury-Vapor Thyratron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

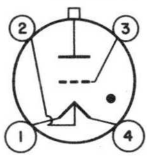
Electrical:

Filament, Coated:		
Voltage (AC or DC) between pins 1 and 4.	2.5	volts
Current at 2.5 volts	9 ± 2	amp
Minimum heating time prior to tube conduction.	20	sec
Direct Interelectrode Capacitances (Approx.):[a]		
Grid to anode.	2	$\mu\mu$f
Grid to cathode.	12	$\mu\mu$f
Ionization Time (Approx.).	10	μsec
Deionization Time (Approx.).	1000	μsec
Peak Tube Voltage Drop at anode amperes = 8.	10	volts

Mechanical:

Operating Position . . . . .Vertical, base down
Maximum Overall Length . . . . 6-1/4"
Maximum Diameter . . . . 1-5/8"
Weight (Approx.) . . . . 4 oz
Bulb T13
Cap. . . . . Medium (JEDEC No.C1-5)
Socket . . . . .Small 4-Contact
Base . . . . Medium-Shell Small 4-Pin with Bayonet (JEDEC No.A4-10)
Basing Designation for BOTTOM VIEW 4CF

Pin 1 - Filament
Pin 2 - Filament Tap, Circuit Returns



Pin 3 - Grid
Pin 4 - Filament
Cap - Anode

Thermal:

Type of Cooling.	Convection	
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.):		
No load.	25	°C
Full load.	30	°C

GRID-CONTROLLED-RECTIFIER SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:		
Forward.	1500 max.	volts
Inverse.	1500 max.	volts

PEAK NEGATIVE GRID VOLTAGE:		
Before tube conduction.	500 max.	volts
During tube conduction.	10 max.	volts
CATHODE CURRENT:		
Peak.	30 max.	amp
Average[b].	2.5 max.	amp
Fault	250 max.	amp
CONDENSED-MERCURY TEMPERATURE RANGE (Operating)[c].	-40 to +80	°C

[a] Without external shield.

[b] Averaged over any interval of 5 seconds maximum.

[c] For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40° and +80° C which corresponds approximately to +10° to +50° C ambient.

Gas and Mercury-Vapor Thyratron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

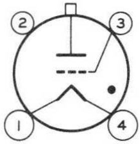
Electrical:[a]

Filament, Coated:		
Voltage (AC or DC)	2.5	volts
Current at 2.5 volts	5.0 ± 0.5	amp
Minimum heating time prior to tube conduction	5	sec
Direct Interelectrode Capacitance (Approx.):[b]		
Grid to anode	2	μμf
Ionization Time (Approx.)	10	μsec
Deionization Time (Approx.)	1000	μsec
Maximum Critical Grid Current	5	μa
Peak Tube Voltage Drop at anode amperes = 3	15	volts

Mechanical:

Operating Position	Vertical, base down
Maximum Overall Length	6-1/8"
Maximum Diameter	2-1/16"
Weight (Approx.)	3 oz
Bulb	ST16
Cap	Medium (JEDEC No.C1-5)
Socket	Small 4-Contact
Base	Medium-Shell Small 4-Pin with Bayonet (JEDEC No.A4-10)
Basing Designation for BOTTOM VIEW	3G

Pin 1 - Filament
Pin 2 - No Internal Connection



Pin 3 - Grid
Pin 4 - Filament
Cap - Anode

Thermal:

Type of Cooling		Convection
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.)	15	°C

GRID-CONTROLLED-RECTIFIER SERVICE[a]

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:		
Forward	1250 max.	volts
Inverse	1250 max.	volts
PEAK NEGATIVE GRID VOLTAGE:		
Before tube conduction	500 max.	volts
During tube conduction	10 max.	volts

ANODE CURRENT:		
Peak.	3 max.	amp
Average[c].	1 max.	amp
Fault	50 max.	amp
CONDENSED-MERCURY TEMPERATURE		
RANGE (Operating)[d].	−40 to +80	°C

[a] With circuit returns to filament-transformer center-tap.

[b] Without external shield.

[c] Averaged over any interval of 5 seconds maximum.

[d] For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40° and +80° C which corresponds approximately to +10° to +50° C ambient.

Gas and Mercury-Vapor Thyratron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

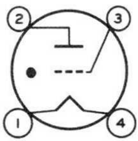
Electrical:[a]

Filament, Coated:		
Voltage (AC or DC)	2.5	volts
Current at 2.5 volts	6.3 ± 0.8	amp
Minimum heating time prior to tube conduction	15	sec
Direct Interelectrode Capacitance (Approx.):[b]		
Grid to anode	3	μμf
Ionization Time (Approx.)	10	μsec
Deionization Time (Approx.)	1000	μsec
Maximum Critical Grid Current	10	μa
Peak Tube Voltage Drop at anode amperes = 5	8	volts

Mechanical:

Operating Position	Vertical, base down
Maximum Overall Length	4-3/8"
Diameter	1.438" to 1.562"
Weight (Approx.)	3 oz
Bulb	T12
Socket	Small 4-Contact
Base	Medium-Shell Small 4-Pin with Bayonet (JEDEC No.A4-10)
Basing Designation for BOTTOM VIEW	4D

Pin 1 - Filament
Pin 2 - Anode



Pin 3 - Grid
Pin 4 - Filament

Thermal:

Type of Cooling	Convection	
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.)	30	°C

GRID-CONTROLLED-RECTIFIER SERVICE[a]

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:		
Forward	1250 max.	volts
Inverse	1250 max.	volts
PEAK NEGATIVE GRID VOLTAGE:		
Before tube conduction	500 max.	volts
During tube conduction	10 max.	volts

CATHODE CURRENT:		
Peak	8 max.	amp
Average[c]	1 max.	amp
Fault	80 max.	amp
CONDENSED-MERCURY TEMPERATURE RANGE (Operating)[d]	-40 to +80	°C

[a] With circuit returns to filament-transformer center-tap.

[b] Without external shield.

[c] Averaged over any interval of 5 seconds maximum.

[d] For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40° and +80° C which corresponds approximately to +10° to +50° C ambient.

Gas and Mercury-Vapor Thyratron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

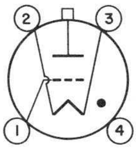
Electrical:[a]

Filament, Coated:		
Voltage (AC or DC)	2.5	volts
Current at 2.5 volts	21 ± 2	amp
Minimum heating time prior to tube conduction	60	sec
Direct Interelectrode Capacitance (Approx.):[b]		
Grid to anode	4	$\mu\mu$f
Ionization Time (Approx.)	10	μsec
Deionization Time (Approx.)	1000	μsec
Maximum Critical Grid Current	10	μa
Peak Tube Voltage Drop at anode amperes = 20	12	volts

Mechanical:

Operating Position	Vertical, base down
Maximum Overall Length	9-1/2"
Maximum Diameter	2-9/16"
Weight (Approx.)	9 oz
Cap	Medium (JEDEC No.C1-5)
Socket	Super-Jumbo 4-Contact
Base	Large-Metal-Shell Super-Jumbo 4-Pin with Bayonet (JEDEC No.A4-18)
Basing Designation for BOTTOM VIEW	4BZ

Pin 1 - Grid
Pin 2 - Filament
Pin 3 - Filament



Pin 4 - No Internal Connection
Cap - Anode

Thermal:

Type of Cooling	Convection	
Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.)	30	°C

GRID-CONTROLLED-RECTIFIER SERVICE[a]

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:		
Forward	1500 max.	volts
Inverse	1500 max.	volts
PEAK NEGATIVE GRID VOLTAGE:		
Before tube conduction	500 max.	volts
During tube conduction	10 max.	volts

CATHODE CURRENT:

Peak	77 max.	amp
Average[c]	6.4 max.	amp
Fault	770 max.	amp

CONDENSED-MERCURY TEMPERATURE RANGE

(Operating)[d]	-40 to +80	°C

[a] With circuit returns to filament-transformer center-tap.

[b] Without external shield.

[c] Averaged over any interval of 15 seconds maximum.

[d] For longest life, the operating condensed-mercury temperature range after warm-up should be kept between +40° and +80° C which corresponds approximately to +10° to +50° C ambient.

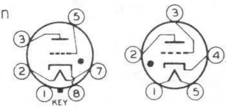
884, 885
THYRATRONS
TRIODE TYPES

For new equipment design, RCA-884 is recommended.

GENERAL DATA

Electrical:	*Type 884*	*Type 885*	
Heater. . . . . Coated Unipotential Cathode			
Voltage	6.3 ± 10%	2.5 ± 10%	a-c or d-c volts
Current	0.6	1.5	. . . . . . amp. ←
Direct Interelectrode Capacitances:			←
Grid to Anode . . .	6	6	. . . . . . μμf
Grid to Cathode . .	2	2	. . . . . . μμf
Anode to Cathode. .	0.6	0.6	. . . . . . μμf
Tube Voltage Drop . .	16	16	. . approx. volts
Physical:			
Mounting Position . .	Any	Any	
Maximum Overall Length	4-1/8	4-3/16	. . . . . inches
Maximum Seated Length	3-9/16	3-9/16	. . . . . inches
Maximum Diameter. . .	1-9/16	1-9/16	. . . . . inches
Bulb.	ST-12	ST-12	
Base.	Small Shell Octal 6-Pin	Small 5-Pin	
Basing Designation	G-6O2	5A2	

Pin 1 - No Connection
Pin 2 - Heater
Pin 3 - Anode
Pin 5 - Grid
Pin 7 - Heater
Pin 8 - Cathode



Pin 1 - Heater
Pin 2 - Anode
Pin 3 - Grid
Pin 4 - Cathode
Pin 5 - Heater

BOTTOM VIEWS

RELAXATION OSCILLATOR — Sweep-Circuit Service△

Maximum Ratings, ***Absolute Values*****:**

PEAK ANODE VOLTAGE.	300 *max.*	volts
PEAK CATHODE CURRENT ●	300 *max.*	ma.
PEAK GRID CURRENT ▲	1 *max.*	ma. ←
PEAK VOLTAGE BETWEEN ANY TWO ELECTRODES OR BETWEEN ANY ELECTRODE AND HEATER . .	350 *max.*	volts
D-C HEATER-CATHODE POTENTIAL.	-100 to +25	volts ←
AMBIENT TEMPERATURE RANGE	-75 to +90	°C ←

△ For best life results, it is desirable to delay tube conduction for about 10 seconds after applying heater voltage in order to allow the cathode to reach normal operating temperature.

● In sweep circuits designed so that the peak cathode current of 300 milliamperes will not be exceeded during condenser discharge, the resultant average cathode current is so small in comparison with the average-current capability of the cathode that a maximum rating for average cathode current is omitted because it has no practical significance.

▲ The resistance of the grid resistor should be not less than 1000 ohms per maximum instantaneous volt applied to the grid. Resistance values in excess of 500000 ohms may cause circuit instability.

← Indicates a change.

RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

884, 885

THYRATRONS

(continued from preceding page)

RELAY & GRID-CONTROLLED RECTIFIER SERVICE □
At Frequencies Below 75 Cycles per Second

Maximum Ratings, *Absolute Values*:

PEAK ANODE VOLTAGE	350 *max.*	volts
PEAK CATHODE CURRENT	300 *max.*	ma.
AVERAGE CATHODE CURRENT #	75 *max.*	ma.
PEAK VOLTAGE BETWEEN ANY TWO ELECTRODES OR BETWEEN ANY ELECTRODE AND HEATER	350 *max.*	volts
→ D-C HEATER-CATHODE POTENTIAL	−100 to +25	volts
→ AMBIENT TEMPERATURE RANGE	−75 to +90	°C

□ The heater voltage should be applied for 10 seconds before tube conduction occurs.

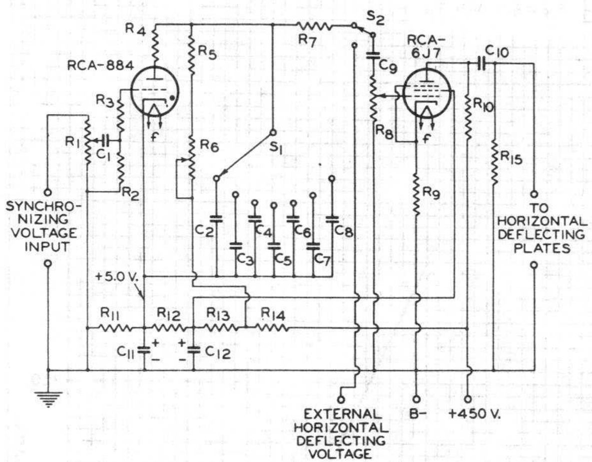
For an averaging period of 30 seconds.

← Indicates a change.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

884

LINEAR SWEEP-CIRCUIT OSCILLATOR AND AMPLIFIER



C_1 = 0.25 µf OR GREATER
C_2 = 0.25 µf, 500 V.
C_3 = 0.1 µf, 500 V.
C_4 = 0.04 µf, 500 V.
C_5 = 0.015 µf, 500 V.
C_6 = 0.005 µf, 500 V.
C_7 = 0.002 µf, 500 V.
C_8 = 0.0008 µf, 500 V.
C_9 = 0.5 µf, 250 V.
C_{10} = 0.5 µf, 500 V.
C_{11} = 25 µf, 15 V.
C_{12} = 8 µf, 200 V.
R_1 = 5000 OHM (MAX.) POTENTIOMETER
R_2 = NOT GREATER THAN 50000 OHMS
R_3 = 2000-3000 OHMS, 0.5 WATT
R_4 = 350-500 OHMS, 0.5 WATT
R_5 = 0.3-0.5 MEGOHM, 0.5 WATT
R_6 = 1 MEGOHM POTENTIOMETER
R_7 = 1 MEGOHM, 0.5 WATT
R_8 = 0.5 MEGOHM POTENTIOMETER
R_9 = 850 OHMS, 0.5 WATT
R_{10} = 0.1 MEGOHM, 0.5 WATT
R_{11} = 1500 OHMS, 0.5 WATT
R_{12} = 25000 OHMS, 1.0 WATT
R_{13} = 60000 OHMS, 1.0 WATT
R_{14} = 60000 OHMS, 1.0 WATT
R_{15} = 2.0 MEGOHMS, 1.0 WATT
S_1 = 7-CONTACT S.P. SWITCH
S_2 = S.P.D.T. SWITCH

92CM-4875R1

APPROXIMATE FREQUENCY RANGE (CYCLES/SEC.)

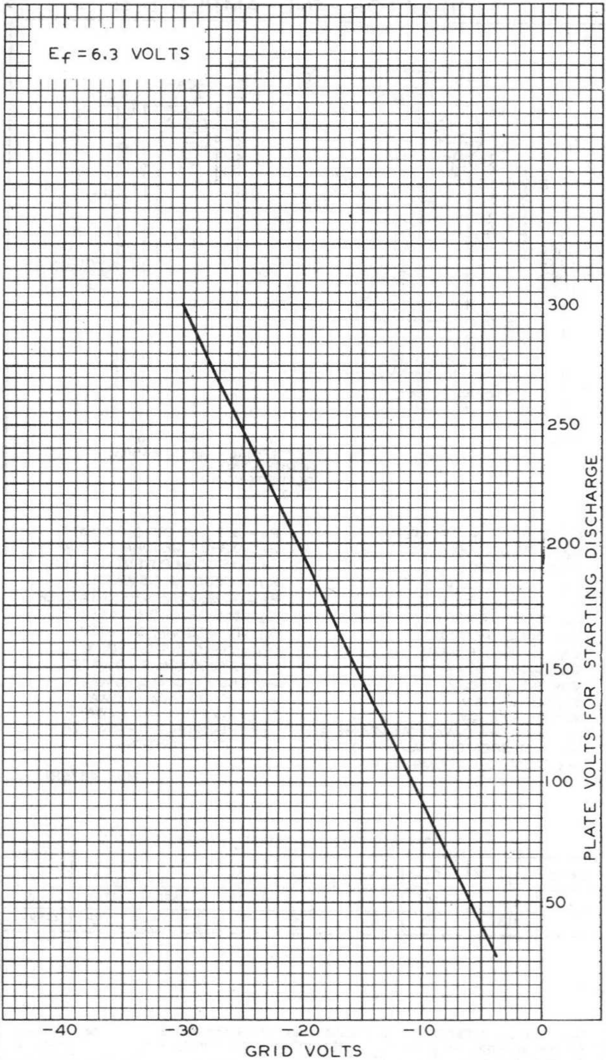
SWITCH (S_1) ON		C_2	C_3	C_4	C_5	C_6	C_7	C_8
R_6 AT	MAX.	20	40	110	280	670	1500	3600
	MIN.	60	130	340	880	2200	4900	11400

 ← Indicates a change.

884

884

AVERAGE CONTROL CHARACTERISTIC

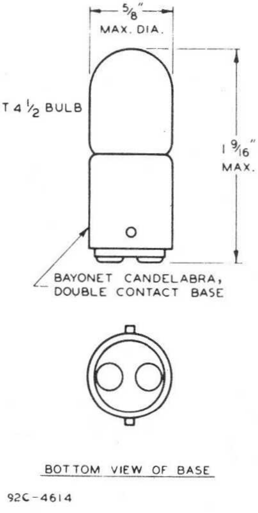


991

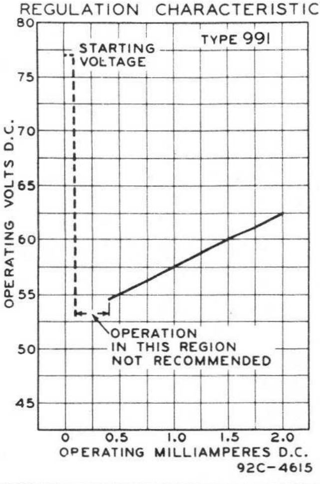
VOLTAGE REGULATOR

Type	Glow Discharge
Maximum Overall Length	1-9/16"
Maximum Diameter	5/8"
Bulb	T-4-1/2
Base	Bayonet Candelabra, Double Contact
Operating Conditions:	
Starting-Supply Voltage (D.C.)	87 min. volts
Peak Current *	3 max. ma.
Continuous Current (D.C.) **	2 max. ma.
Operating Voltage△	67 max. volts 48 min. volts

* If the 991 is used with a pulsating or alternating supply voltage, the peak current should be limited to 3 ma.
** Sufficient resistance must always be used in series with this tube to limit its d-c current to 2 ma.
△ For d-c operating current between 0.4 and 2 ma.



TUBE MOUNTING POSITION
VERTICAL OR HORIZONTAL



RCA RADIOTRON DIVISION
RCA MANUFACTURING COMPANY, INC.

1946
VACUUM-GAUGE TUBE

THERMOCOUPLE TYPE

DATA

General:

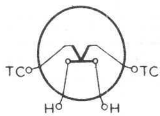
Heater, for Thermocouple:

Voltage (Approx.)	1	ac or dc volts
Current	0.070	amp
Resistance of Thermocouple	5 approx.	ohms
Maximum Overall Length (with tubulation)		6-1/4"
Maximum Diameter		1-11/16"
Bulb		T-12
Tubulation		3/8" Diameter Hard Glass, Corning Code 772 Nonex
Mounting Position		Any
Terminal Arrangement		See Outline Drawing

Terminal Connections:

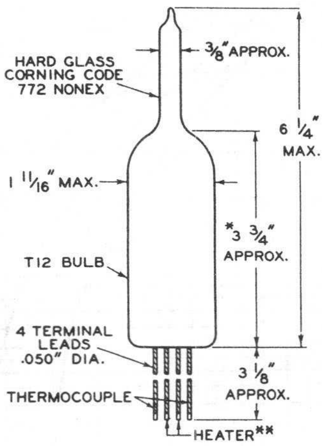
H - Heater

TC - Thermocouple



Calibration:

See next page.



*MEASURED FROM BULB END TO BULB-TOP LINE AS DETERMINED BY RING GAUGE OF 1/2" I.D.

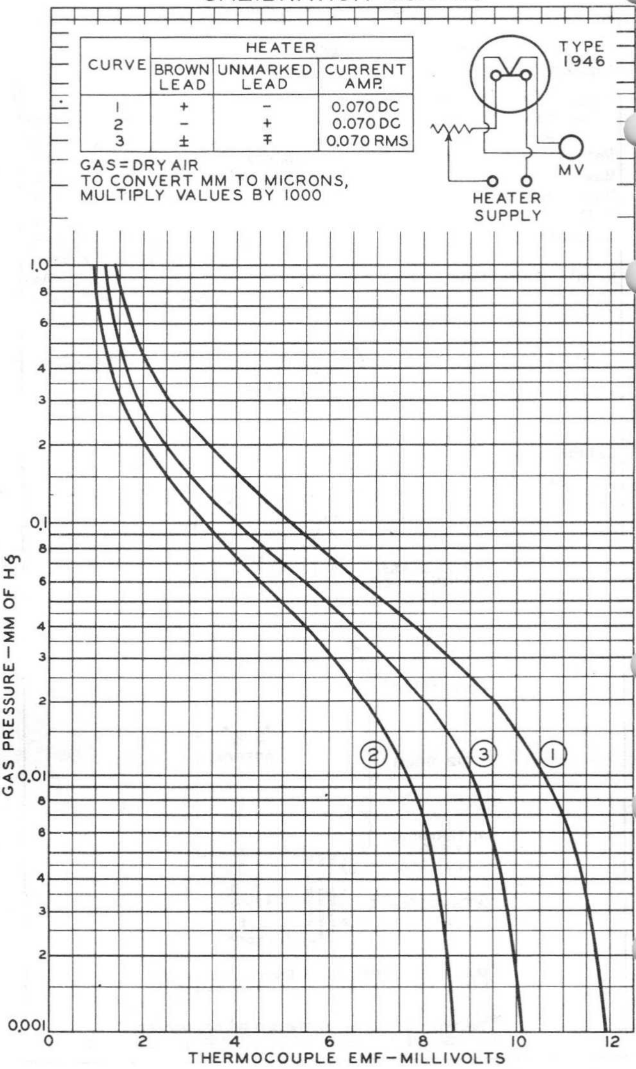
**BROWN HEATER LEAD SHOULD BE CONNECTED TO POSITIVE TERMINAL OF DC HEATER SUPPLY. 92CS-6815

1946

RCA

1946

CALIBRATION CURVES



CURVE	HEATER		
	BROWN LEAD	UNMARKED LEAD	CURRENT AMP.
1	+	−	0.070 DC
2	−	+	0.070 DC
3	±	∓	0.070 RMS

GAS = DRY AIR
TO CONVERT MM TO MICRONS, MULTIPLY VALUES BY 1000

1947
VACUUM-GAUGE TUBE

PIRANI TYPE

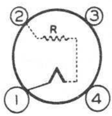
DATA

General:

Filament, Platinum Iridium:		
Voltage (Approx.)	10	dc volts
Current (Varies with Gas Pressure)	70 - 100	ma.
Resistance between base pins No.1 & No.2 under vacuum better than 3×10^{-5} mm of mercury	135.8	ohms
Maximum Overall Length (including tubulation)		7-9/16"
Maximum Diameter		1-3/16"
Bulb		T-9
Tubulation		7/32" Diameter Soft Glass, Corning Code 001 Lead
Mounting Position		Any
Base		Small-Shell Small 4-Pin

BOTTOM VIEW

Pin 1 - Filament
Pin 2 - Filament
Pin 3 - No Connection
Pin 4 - Internal Connection - Do Not Use



R - Series Filament-Calibrating Resistor in base of tube

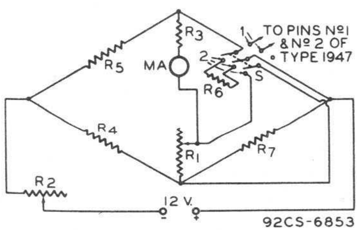
Maximum Ratings, *Absolute Values*:

FILAMENT VOLTAGE . . . . . 16 max. volts

Calibration for 1947 in Accompanying Circuit:

See curve on following sheet.

PIRANI GAUGE BRIDGE CIRCUIT



92CS-6853

R1: 50 Ohms	R3 + METER: 15 Ohms	R6: 120.7 Ohms
R2: 25 Ohms	R4 R5: 10 Ohms each	R7: 135.8 Ohms

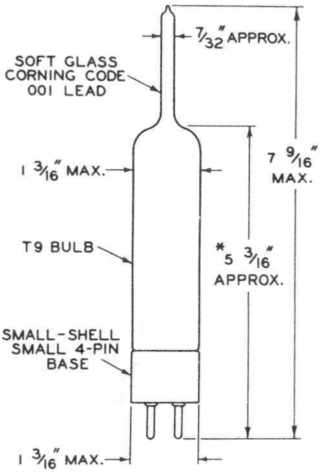
STEP 1: With switch S in position 2, adjust R2 so that meter reads 2.5 milliamperes.

STEP 2: With switch S in position 1, and with dry air at atmospheric pressure in the 1947, adjust R1 so that meter reads 5.0 milliamperes.

STEP 3: With no further adjustments and with switch S in position 1, proceed to use gauge.

RCA

1947
VACUUM-GAUGE TUBE



*MEASURED FROM END OF BASE PINS TO BULB-TOP LINE AS DETERMINED BY RING GAUGE OF 1/2" I.D.

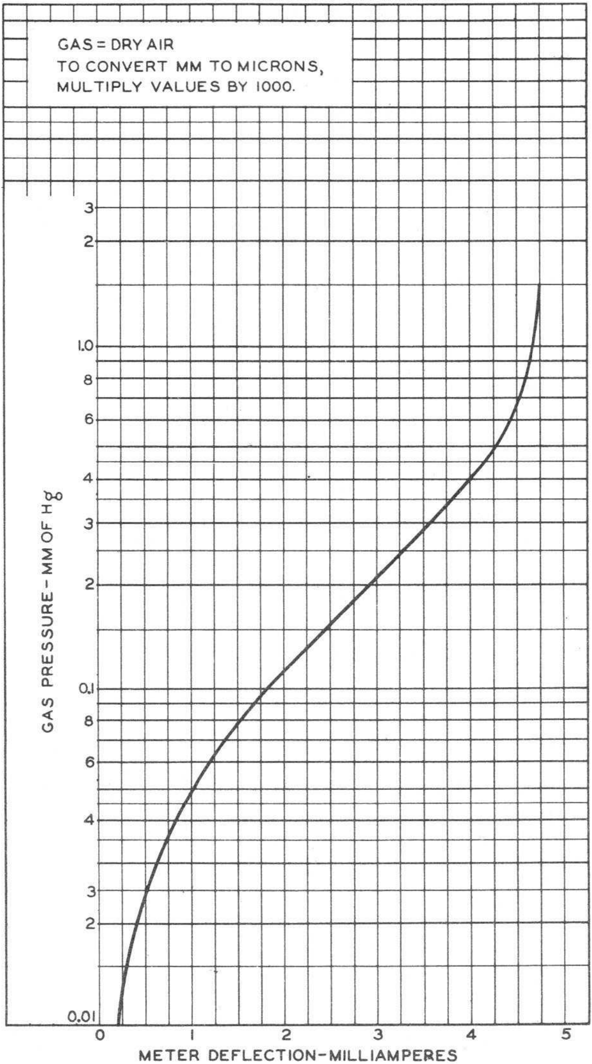
92CS-6816

1947

1947

CALIBRATION CURVE

FOR USE WITH CIRCUIT ON DATA PAGE



MARCH 10, 1947

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6849

RCA

1949

VACUUM-GAUGE TUBE

HARD-GLASS BULB, IONIZATION TYPE

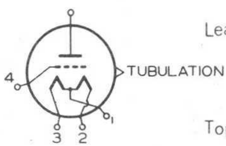
DATA

General:

Filament, Tungsten:*		
Voltage (Approx.)	5	ac or dc volts
Current (Approx.)	3.5	amp
Maximum Tube Length (Including tubulation)		11-1/2"
Maximum Tube Radius		2-3/16"
Maximum Bulb Length		5-1/8"
Maximum Bulb Diameter		2-1/16"
Bulb		T-16
Tubulation		1/2" Diameter Hard Glass, Corning Code 772 Nonex
Operating Position		Vertical with tubulation up or down; Horizontal, with stem press in vertical plane
Terminal Arrangement		See Outline Drawing

Terminal Lead Connections:

Lead 1 – Common Lead to Filaments
Lead 2 – Filament
Lead 3 – Filament (Spare)



Lead 4 – Grid
Top Lead – Plate

Maximum Ratings, *Absolute Values:* ←

FILAMENT VOLTAGE	6.5 max.	volts
DC PLATE VOLTAGE DURING OPERATION . .	–100 max.	volts
DC GRID VOLTAGE DURING OPERATION . .	+200 max.	volts
VOLTAGE ON GRID & PLATE TIED TOGETHER DURING DEGASSING (DC OR PEAK AC)	650 max.	volts
GRID & PLATE DISSIPATION (TOTAL) DURING DEGASSING . .	150 max.	watts
AMBIENT TEMPERATURE DURING OPERATION.	100 max.	°C
GAS PRESSURE	0.001 max.	mm of Hg

Typical Degassing Conditions: ←

Grid Connected to Plate

Filament Voltage (AC or DC) . . .	6	6	volts
Grid & Plate Voltage	350 rms	500 dc	volts
Grid & Plate Current (Average)	100	150	ma

Typical Operation:

DC Plate Voltage	–22.5	–22.5	–22.5	volts

* The 1949 contains two filaments, one of which is a spare. Values shown are for either filament operated alone. The filament voltage should be kept as low as possible during degassing because use of a low filament voltage materially increases filament life.

← Indicates a change

RCA

1949

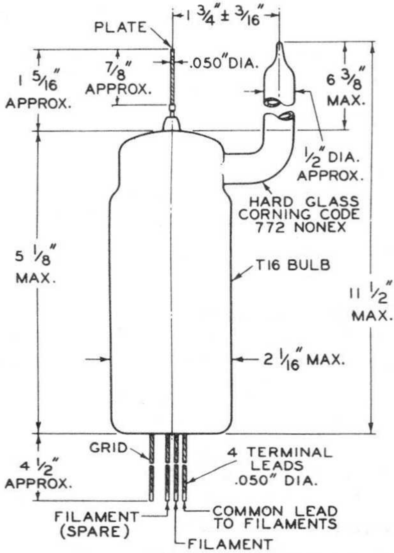
VACUUM-GAUGE TUBE

DC Grid Voltage	+80	+110	+160	volts
Grid Current	10	10	10	ma
Sensitivity	80	110	140	µa/micron▲

Calibration:

See curve on following sheet.

▲ 1 micron = 0.001 mm of mercury.

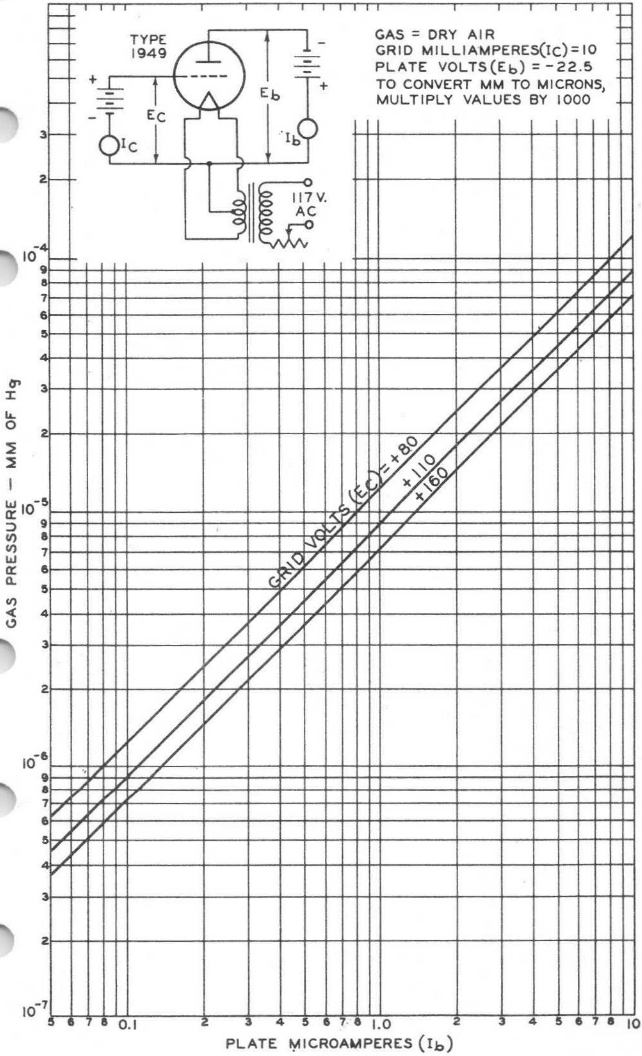


92CS-6817

1949

1949

CALIBRATION CURVES



MAR. 11, 1947

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6851

2050
THYRATRON
GAS TETRODE

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:	*Min.*	*Av.*	*Max.*	
Voltage (AC or DC)	5.7	6.3	6.9	volts
Current, with heater volts = 6.3	0.54	0.60	0.66	amp
Cathode:				
Heating Time, prior to tube conduction . . .	10	–	–	sec

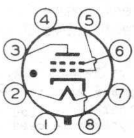
Direct Interelectrode Capacitances (Approx.):●		
Grid No.1 to Anode	0.26	$\mu\mu f$
Input	4.2	$\mu\mu f$
Output	3.6	$\mu\mu f$
Ionization Time (Approx.):		
For conditions: dc anode volts = 100; grid-No. 1 square-pulse volts = 50; and peak anode amp. during conduction = 1.0	0.5	μsec
Deionization Time (Approx.):		
For conditions: dc anode volts = 125; grid-No. 1 volts = −250; grid-No. 1 resistor (ohms) = 1000; dc anode amp. = 0.1	50	μsec
For conditions: dc anode volts = 125; grid-No. 1 volts = −10; grid-No. 1 resistor (ohms) = 1000; dc anode amp. = 0.1	100	μsec
Maximum Critical Grid Current, with ac anode-supply volts (rms) = 460, and average anode amp. = 0.1	0.5	μamp
Tube Voltage Drop (Approx.)	8	volts
Grid-No.1 Control Ratio (Approx.) with grid-No. 1 resistor (megohms) = 0; grid-No. 2 volts = 0		250
Grid-No.2 Control Ratio (Approx.) with grid-No. 1 resistor (megohms) = 0; grid-No. 2 resistor (megohms) = 0; grid-No. 1 volts = 0		800

● Without external shield.

Mechanical:

Mounting Position. . . . . Any
Maximum Overall Length . . . . 4-1/8"
Maximum Seated Length. . . . . 3-9/16"
Maximum Diameter . . . . 1-9/16"
Bulb ST-12
Base . . . . Small-Shell Octal 8-Pin
Basing Designation for BOTTOM VIEW 6BS

Pin 1 – No Connection
Pin 2 – Heater
Pin 3 – Anode
Pin 4 – No Connection



Pin 5 – Grid No.1
Pin 6 – Grid No.2
Pin 7 – Heater
Pin 8 – Cathode

← Indicates a change.

2050
THYRATRON

RELAY and GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values*:

PEAK ANODE VOLTAGE:			
Forward	180 max.	650 max.	volts
Inverse	360 max.	1300 max.	volts
GRID-No. 2 (SHIELD-GRID) VOLTAGE:			
Peak, before anode conduction	-100 max.	-100 max.	volts
Average, during anode conduction■	-10 max.	-10 max.	volts
GRID-No. 1 (CONTROL-GRID) VOLTAGE:			
Peak, before anode conduction	-250 max.	-250 max.	volts
Average, during anode conduction■	-10 max.	-10 max.	volts
CATHODE CURRENT:			
Peak	1.0 max.	1.0 max.	amp
Average■	0.2 max.	0.1 max.	amp
Surge, for duration of 0.1 sec. max.	10 max.	10 max.	amp
→ GRID-No. 2 CURRENT:			
Average■	+0.01 max.	+0.01 max.	amp
→ GRID-No. 1 CURRENT:			
Average■	+0.01 max.	+0.01 max.	amp
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode	100 max.	100 max.	volts
Heater positive with respect to cathode	25 max.	25 max.	volts
AMBIENT TEMPERATURE RANGE	-75 to +90	-75 to +90	°C

→ **Typical Operating Conditions for Relay Service:**

RMS Anode Voltage	117	400	volts
Grid-No. 2 Voltage	0	0	volts
RMS Grid-No. 1 Bias Voltage	5□	-	volts
DC Grid-No. 1 Bias Voltage	-	-6	volts
Peak Grid-No. 1 Signal Voltage	5	6	volts
Grid-No. 1-Circuit Resistance	1.0	1.0	megohm
Anode-Circuit Resistance#	1200	2000	ohms

Maximum Circuit Values:

Grid-No. 1-Circuit Resistance:		
For average anode current below 0.1 amp.	10 max.	megohms
For average anode current above 0.1 amp.	2 max.	megohms

■ Averaged over any interval of 30 sec. max.

□ Approximately 180° out of phase with the anode voltage.

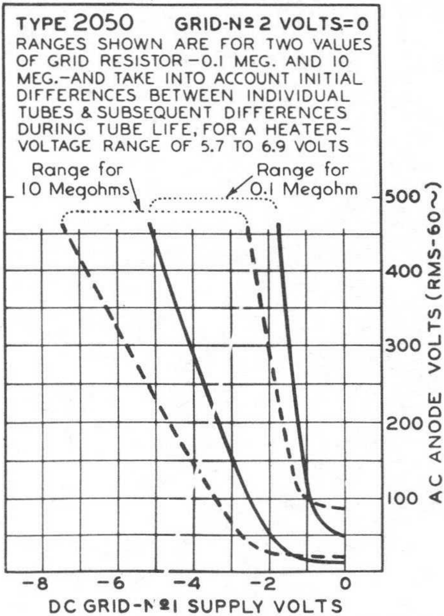
\# Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.

→ Indicates a change.

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

2050
THYRATRON

OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

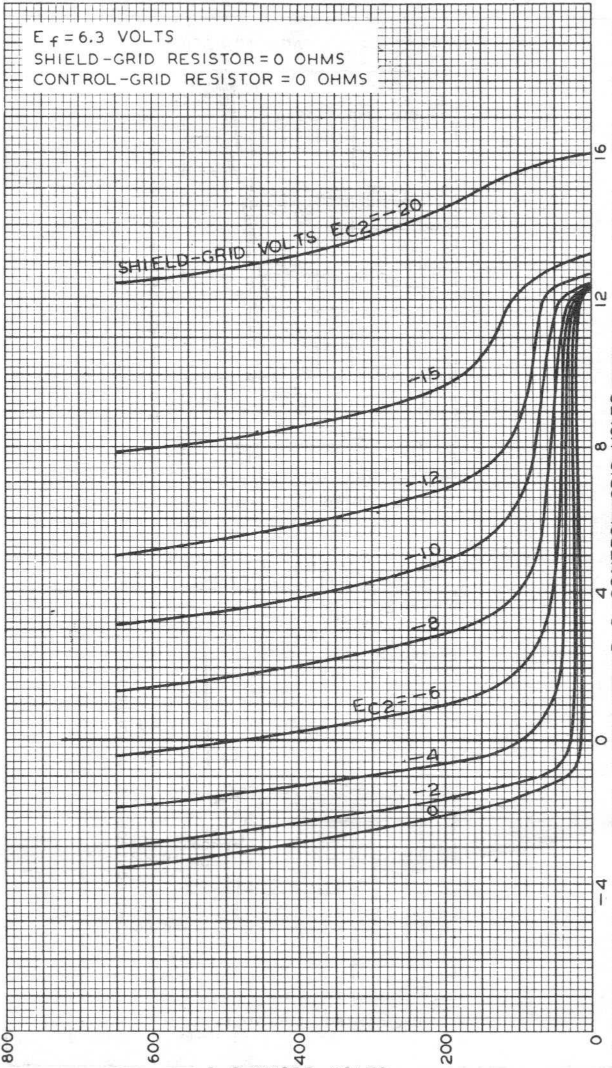


92CM-6540T1

2050

2050

AVERAGE CONTROL CHARACTERISTICS



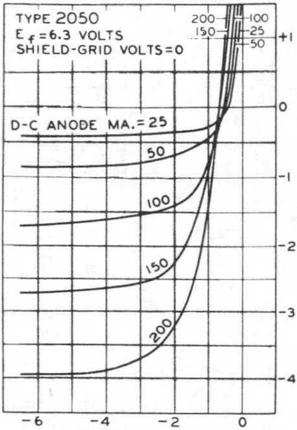
MAY 3, 1944

RCA VICTOR DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6274R1

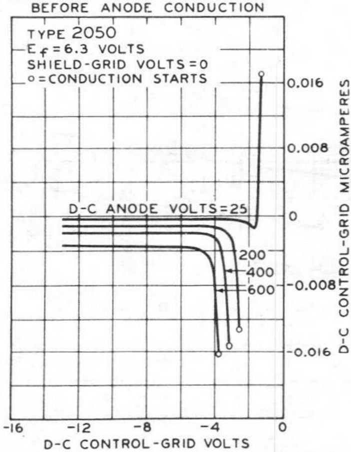
2050
THYRATRON

AVERAGE GRID CHARACTERISTICS
DURING ANODE CONDUCTION



92CM-6275T

AVERAGE GRID CHARACTERISTICS
BEFORE ANODE CONDUCTION



92CM-6541T

2050-A

Gas Thyratron

TETRODE TYPE

For Relay and Grid-Controlled-Rectifier Service

GENERAL DATA

Electrical:

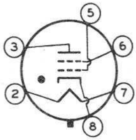
Heater, for Unipotential Cathode:		
Voltage (AC or DC)	6.3 ± 10%	volts
Current at 6.3 volts	0.6	amp
Cathode:		
Minimum heating time prior to tube conduction	10	sec
Direct Interelectrode Capacitances (Approx.):[a]		
Grid No.1 to anode	0.15	$\mu\mu$f
Grid No.1 to cathode and grid No.2	2.2	$\mu\mu$f
Ionization Time (Approx.):		
For dc anode volts = 100, grid-No.1 volts (square-wave pulse) = 50, peak anode amperes during conduction = 1	0.5	μsec
Deionization Time (Approx.):		
With dc anode volts = 125, grid-No.1 volts = -250, grid-No.1 resistor (ohms) = 1000, dc anode amperes = 0.1	50	μsec
With dc anode volts = 125, grid-No.1 volts = -10, grid-No.1 resistor (ohms) = 1000, dc anode amperes = 0.1	100	μsec
Maximum Critical Grid-No.1 Current for dc anode supply volts (rms) = 460, average anode amperes = 0.1	0.5	μa
Anode Voltage Drop (Approx.)	8	volts
Grid-No.1 Control Ratio (Approx.) for grid-No.1 resistor (ohms) = 0, grid No.2 connected to cathode at socket	250	
Grid-No.2 Control Ratio (Approx.) for grid-No.1 resistor (ohms) = 0, grid-No.2 resistor (ohms) = 0, grid No.1 connected to cathode at socket	800	

Mechanical:

Operating Position . . . . Any
Maximum Overall Length . . . . 3-1/16"
Maximum Seated Length . . . . 2-1/2"
Maximum Diameter . . . . 1-9/32"
Dimensional Outline . . . . See *General Section*
Bulb T9
Base . . . . . . Intermediate-Shell Octal 6-Pin, Arrangement 3, with External Barriers (JEDEC Group 1, B6-229)

Basing Designation for BOTTOM VIEW. 6BS

Pin 2 – Heater
Pin 3 – Anode
Pin 5 – Grid No.1



Pin 6 – Grid No.2
Pin 7 – Heater
Pin 8 – Cathode

RELAY AND GRID-CONTROLLED-RECTIFIER SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For anode supply frequency of 60 cps

PEAK ANODE VOLTAGE:			
Forward.	180 max.	650 max.	volts
Inverse.	360 max.	1300 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:			
Peak, before tube conduction	-100 max.	-100 max.	volts
Average[b], during tube conduction	-10 max.	-10 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:			
Peak, before tube conduction	-250 max.	-250 max.	volts
Average[b], during tube conduction	-10 max.	-10 max.	volts
CATHODE CURRENT:			
Peak	1 max.	1 max.	amp
Average[b]	0.2 max.	0.1 max.	amp
Fault, for duration of 0.1 second maximum	10 max.	10 max.	amp
GRID-No.2 CURRENT:			
Average[b]	+0.01 max.	+0.01 max.	amp
GRID-No.1 CURRENT:			
Average[b]	+0.01 max.	+0.01 max.	amp
PEAK HEATER-CATHODE VOLTAGE:			
Heater negative with respect to cathode . . .	100 max.	100 max.	volts
Heater positive with respect to cathode . . .	25 max.	25 max.	volts
AMBIENT-TEMPERATURE RANGE. .	-75 to +90	-75 to +90	°C

Typical Operation for Relay Service:

RMS Anode Voltage.	117	400	volts
Grid No.2.	*Connected to cathode at socket*		
RMS Grid-No.1 Bias Voltage[c].	5	–	volts
DC Grid-No.1 Bias Voltage. .	–	-6	volts
Peak Grid-No.1 Signal Voltage.	5	6	volts
Grid-No.1-Circuit Resistance	1	1	megohm
Anode-Circuit Resistance[d]. .	1200	2000	ohms

Maximum Circuit Values:

Grid-No.1-Circuit Resistance:		
For average anode current below 0.1 ampere.	10 max.	megohms
For average anode current above 0.1 ampere.	2 max.	megohms

[a] Without external shield.
[b] Averaged over any interval of 30 seconds maximum.
[c] Approximately 180^{o} out of phase with the anode voltage.
[d] Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.

OPERATING CONSIDERATIONS

The *heater* is designed to operate on either ac or dc at 6.3 volts. Regardless of the heater-voltage supply used, *the heater voltage must never be allowed to deviate from its rated range.* Heater operation outside of this voltage range will impair tube performance and may cause tube failure. Low heater voltage causes low cathode temperature with resultant cathode sputtering and consequent destruction of the cathode; high heater voltage causes high cathode temperature with resultant heating of the grid and consequent grid emission which produces unpredictable shifts in the critical grid-No.1 voltage for conduction.

The *cathode* should be allowed to reach normal operating temperature before anode current is drawn. *The delay period should not be less than 10 seconds after application of heater voltage.* Unless this recommendation is followed, the cathode will be damaged.

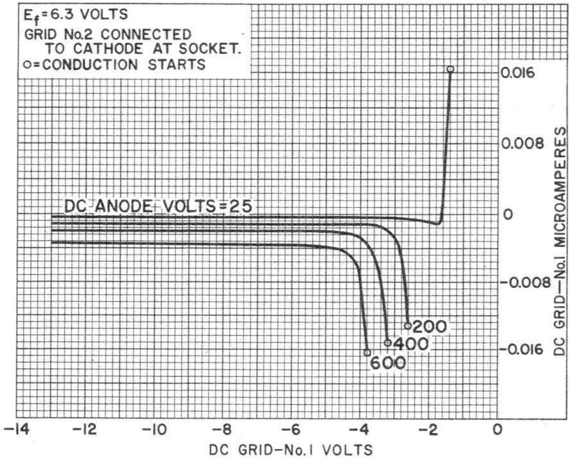
The *shield grid* (grid No.2) is normally connected to the cathode at socket. It may, however, be used as a control electrode because the control characteristic of grid No.1 may be shifted by varying the potential of grid No.2. As grid No.2 is made negative, the grid-No.1 characteristic is shifted in the positive direction. The use of grid No.2 as the control electrode (with grid No.1 connected to cathode at socket) has the advantage of increased sensitivity but consideration must be given to the higher preconduction current, higher capacitance to anode, and less stability of operation.

A *grid-No.1 resistor* having a value as high as 10 megohms to give circuit sensitivity can be used with the 2050-A because its control-grid current is very low. However, when a high value of grid resistor is used, care should be taken to keep the tube base and socket clean and dry in order to make the effect of leakage currents between the control-grid base pin and anode base pin very small.

Sufficient anode-circuit resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

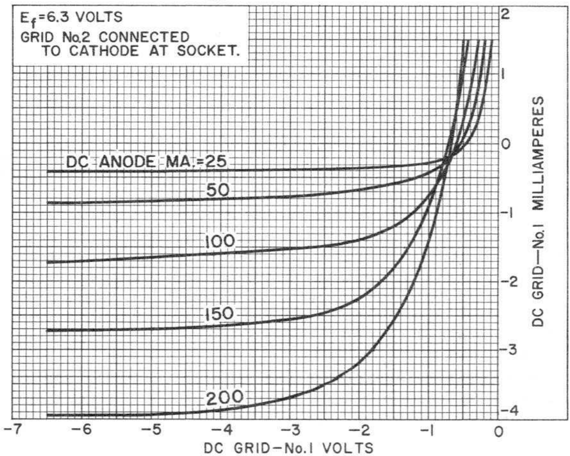
AVERAGE GRID-No.1 CHARACTERISTICS

Before Tube Conduction



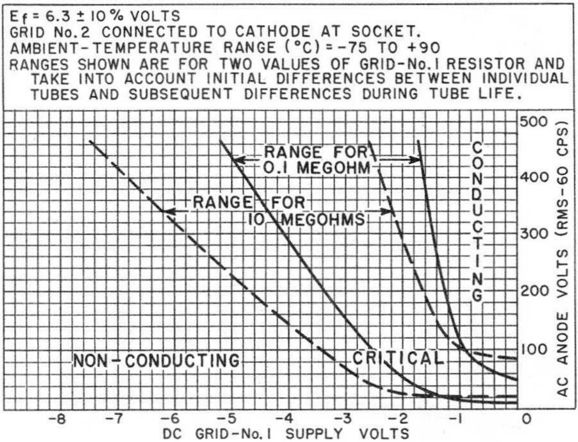
92CS-6541R2

During Tube Conduction



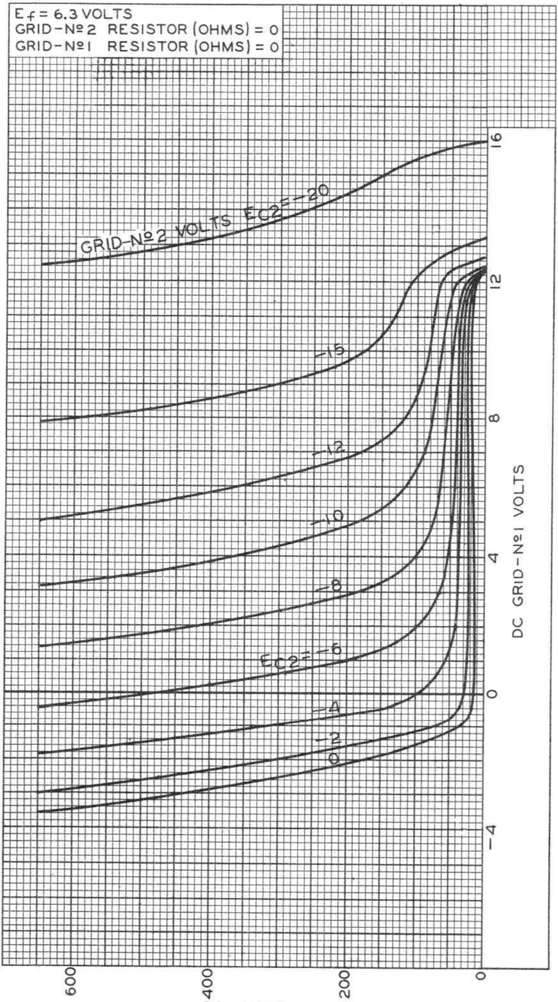
92CS-6275R2

OPERATIONAL RANGE OF CRITICAL GRID-No.1 VOLTAGE



92CS-6540R3

AVERAGE CONTROL CHARACTERISTICS



92CM−6274R2

6130/3C45
HYDROGEN THYRATRON

POSITIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

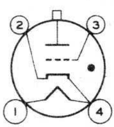
Heater, for Unipotential Cathode:

Voltage	6.3 {+5%, −10%}	ac or dc volts
Current at 6.3 volts:		
Minimum	2	amp
Average	2.3	amp
Maximum	2.5	amp
Minimum heating time	2	minutes
Direct Interelectrode Capacitances (Approx.):		
Grid to anode	3.9	μμf
Grid to cathode	8.6	μμf
Ionization Time (Approx.)□	0.6	μsec
Deionization Time (Approx.)	25	μsec
Anode-Cathode Voltage Drop (Approx.) at middle of pulse duration	150	volts
Maximum Variation in Firing Time (Jitter)	0.06	μsec

Mechanical:

Operating Position	Any
Maximum Overall Length	5-3/16"
Seated Length	4-3/8" ± 3/16"
Maximum Diameter	1-9/16"
Weight (Approx.)	3 oz
Cooling	Natural
Bulb	T12
Cap	Small (JEDEC No.C1-1)
Base	Medium-Shell Small 4-Pin, Micanol (JEDEC No.A4-9)
Basing Designation for BOTTOM VIEW	4BL

Pin 1 – Heater
Pin 2 – Cathode, Circuit Returns



Pin 3 – Grid
Pin 4 – Heater, Cathode
Cap – Anode

PULSE-MODULATOR SERVICE

Maximum and Minimum CCS● Ratings, *Absolute Values:*

	For pressures down to 70 mm of Hg#	
DC ANODE-SUPPLY VOLTAGE	800 min.	volts
PEAK ANODE VOLTAGE:		
Forward (E_{bmf})*	3000 max.	volts
Inverse	5% of E_{bmf} min.	volts
After anode-current pulse:▲		
During first 25 μsec	1500 max.	volts
After first 25 μsec	3000 max.	volts

□,●,#,*,▲: See next page.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

6130

RCA

6130/3C45

HYDROGEN THYRATRON

	For pressures down to 70 mm of Hg#	
GRID VOLTAGE:		
Negative (DC or Peak), before conduction	200 max.	volts
Peak positive-pulse	175 min.	volts
ANODE CURRENT:		
Peak	35 max.	amp
Average°	0.045 max.	amp
Rate of rise	750 max.	amp/μsec
OPERATION FACTOR†	3×10^8 max.	
PULSE DURATION⊕	6 max.	μsec
AMBIENT-TEMPERATURE RANGE	-50 to +90	°C

Typical Operation:♦

	At 2000 pps in accompanying circuit with pulse duration of 0.5 μsec	
DC Anode-Supply Voltage	1250	volts
Peak Anode Voltage:		
Forward	3000	volts
Inverse: Immediately after anode-current pulse	530	volts
GRID VOLTAGE:		
Negative, before conduction	0	volts
Peak positive-pulse (Unloaded)	175	volts
Effective Grid-Circuit Resistance	1000	ohms
ANODE CURRENT:		
Peak	35	amp
Average°	0.035	amp
Operation Factor†	2.1×10^8	
Peak Power Output to Pulse Transformer (T)	43000	watts

Maximum Circuit Values:

Effective Grid-Circuit Resistance	1500 max.	ohms

□ Defined as the time interval between the point on the rising portion of the grid pulse which is 26 per cent of the peak unloaded-pulse amplitude and the point on the anode-current pulse which is 26 per cent of its peak amplitude. The anode-current pulse has a maximum time rise of 0.05 μsec. The grid pulse has a minimum peak amplitude of 130 volts, a maximum rise time of 0.5 μsec, and is supplied by a driver having a maximum internal impedance of 1500 ohms.

● Continuous Commercial Service.

\# Corresponds to altitude of about 50,000 feet.

* In applications where the anode voltage is applied instantaneously, the power-supply filter should be designed so that the peak forward anode voltage is applied at a rate not to exceed 75,000 volts per second.

▲ Exclusive of spike not having more than 0.05 μsec duration.

° Averaged over any cycle.

† Defined as *Peak Forward Anode Volts x Pulse-Repetition Rate (pps) x Peak Anode Amperes* (excluding spike).

⊕, ♦: See next page.

6130/3C45

HYDROGEN THYRATRON

⊕ Pulse duration is defined as the time interval between points on the pulse envelope at which instantaneous amplitudes are equal to 70.7 per cent of the maximum amplitude excluding spike.

● Operation with a bulb temperature within the approximate range of 60° to 90° C measured on the bulb directly opposite the anode is recommended for longest life. To attain this temperature under operating conditions involving low ambient temperature, the use of a heat-conserving enclosure for the tube may be necessary.

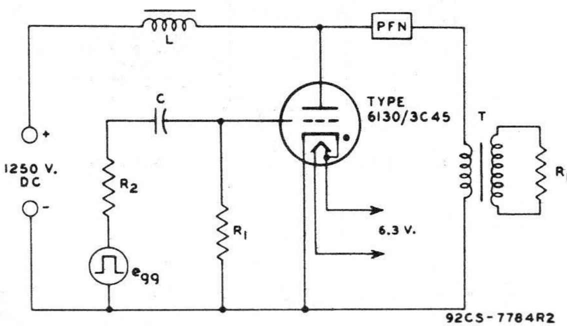
OPERATING CONSIDERATIONS

The *anode* is brought out of the tube to a Small cap. The connector for this cap should be of the heat-radiating type and the connector lead should have ample current-carrying capability for the operating requirements.

Shielding of the 6130/3C45 should be provided if it is operated in the presence of strong electric fields which will ionize the gas within the tube. Any such ionization will cause erratic performance.

Cooling of the 6130/3C45 is accomplished by natural circulation of air around it. Under no circumstances should a stream of cooling air be applied to the glass envelope.

TYPICAL PULSE-MODULATOR CIRCUIT



C: Blocking Capacitor, 0.001 μf

e_{gg}: Pulse Generator supplying peak positive-pulse grid voltage of 175 volts (unloaded)

L: Charging Choke, 5 henries

PFN: Pulse-Forming Network with iterative impedance of 50 ohms, and a two-way transmission time of 0.5 μsec

R_1: Grid Resistor, 30,000 ohms

R_2: Effective Resistance of grid circuit, 1000 ohms

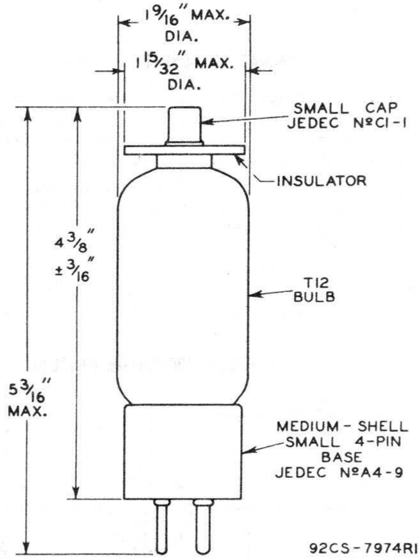
R_L: Load Resistance. Value reflected into primary of transformer (T) is 35 ohms.

T: Matching Pulse Transformer

6130

6130/3C45

HYDROGEN THYRATRON



Ignitron

SEALED, CLAMP-COOLED, MERCURY-POOL-CATHODE TYPE

For Resistance-Welding Control

GENERAL DATA

Electrical:

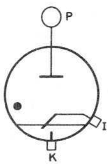
Cathode Excitation. . . . . .Cyclic
Cathode-Spot Starting . . . . .By Ignitor
Minimum Requirements for Cathode Excitation:
- Peak ignitor voltage required to fire . . . . . 200 volts
- Peak ignitor current required to fire . . . . . 30 amp
- Starting time at required voltage or current . . 100 μsec

Tube Voltage Drop:
- At peak anode current of 1697 amperes . . . . . 30 volts
- At peak anode current of 70.4 amperes . . . . . 12 volts

Mechanical:

Operating Position. . . . . .Vertical, flexible lead up
Maximum Overall Length (Including flexible lead). . . . . 17-5/8"
Maximum Diameter. . . . . 2-1/2"
Weight (Approx.). . . . . 1.5 lbs
Terminal Diagram (See *Dimensional Outline*):

P – Anode Terminal (Flexible lead)
K – Cathode Terminal (Lower portion of shell)



I – Ignitor Terminal (Adjacent to exhaust tube)

Cooling:
- Type. . . . . Air or water-cooled clamp
- Clamp height (Approx.). . . . . 1-7/8"
- Clamp location. . . . . See *Dimensional Outline*

RESISTANCE-WELDING-CONTROL SERVICE[a]

Two Tubes in Inverse-Parallel Circuit

Maximum Ratings, *Absolute-Maximum Values:*

For frequencies from 25 to 60 cps

Ratings I-A and I-B Apply to Operation with a Clamp-Temperature Range of 10° to 75° C

RATING I-A

	Column 1[b]	*Column 2*[b]	
SUPPLY VOLTAGE (RMS).	250 max.	250 max.	volts
DEMAND POWER (During conduction) .	50 max.	150 max.	kva

← Indicates a change.

	Column 1[b]	Column 2[b]	
DUTY[c,d]	10 max.	1.8 max.	%
ANODE CURRENT (Per tube):			
Peak	282 max.	846 max.	amp
Demand (RMS, during conduction)[e]	200 max.	600 max.	amp
Average (Averaged over any interval of 27.8 seconds maximum)[e]	9 max.	4.86 max.	amp
Fault, for duration of 0.15 second maximum	1680 max.	1680 max.	amp

RATING I-B

	Column 1[b]	Column 2[b]	
SUPPLY VOLTAGE (RMS)	600 max.	600 max.	volts
DEMAND POWER (During conduction)	50 max.	150 max.	kva
DUTY[c,d]	24 max.	4.32 max.	%
ANODE CURRENT (Per tube):			
Peak	118 max.	354 max.	amp
Demand (RMS, during conduction)[e]	83 max.	250 max.	amp
Average (Averaged over any interval of 11.6 seconds maximum)[e]	9 max.	4.86 max.	amp
Fault, for duration of 0.15 second maximum	700 max.	700 max.	amp

Ratings II-A and II-B Apply to Operation with a Clamp-Temperature Range of 10° to 50° C

RATING II-A

	Column 1[b]	Column 2[b]	
SUPPLY VOLTAGE (RMS)	250 max.	250 max.	volts
DEMAND POWER (During conduction)	100 max.	300 max.	kva
DUTY[c,d]	12.4 max.	2.24 max.	%
ANODE CURRENT (Per tube):			
Peak	564 max.	1692 max.	amp
Demand (RMS, during conduction)[e]	400 max.	1200 max.	amp
Average (Averaged over any interval of 2.2 seconds maximum)[e]	22.4 max.	12.1 max.	amp
Fault, for duration of 0.15 second maximum	3360 max.	3360 max.	amp

RATING II-B

	Column 1[b]	Column 2[b]	
SUPPLY VOLTAGE (RMS)	600 max.	600 max.	volts
DEMAND POWER (During conduction)	100 max.	300 max.	kva
DUTY[c,d]	30 max.	5.4 max.	%

ANODE CURRENT (Per tube):			
Peak	236 max.	708 max.	amp
Demand (RMS, during conduction)[e]	167 max.	500 max.	amp
Average (Averaged over any interval of 9.2 seconds maximum)[e]	22.4 max.	12.1 max.	amp
Fault, for duration of 0.15 second maximum	1400 max.	1400 max.	amp

RESISTANCE-WELDING CAPACITOR-DISCHARGE SERVICE ←

Maximum Ratings, *Absolute-Maximum Values:*

RATING I

CLAMP TEMPERATURE	70 max.	40 max.	°C
NUMBER OF DISCHARGES PER SECOND	60 max.	60 max.	
PEAK ANODE VOLTAGE:			
Forward	3000 max.	3000 max.	volts
Inverse	3000 max.	3000 max.	volts
ANODE CURRENT:			
Peak	500 max.	500 max.	amp
Average[f]	3 max.	15 max.	amp
Averaging time-interval[f]	3.3 max.	0.66 max.	sec
DURATION OF CATHODE-SPOT PER DISCHARGE	0.02 max.	0.02 max.	sec

RATING II

CLAMP TEMPERATURE	60 max.	40 max.	°C
NUMBER OF DISCHARGES PER SECOND	60 max.	60 max.	
PEAK ANODE VOLTAGE:			
Forward	6000 max.	6000 max.	volts
Inverse	3000 max.	3000 max.	volts
ANODE CURRENT:			
Peak	500 max.	500 max.	amp
Average[f]	2.5 max.	8 max.	amp
Averaging time-interval[f]	4 max.	1.25 max.	sec
DURATION OF CATHODE-SPOT PER DISCHARGE	0.02 max.	0.02 max.	sec

IGNITOR ←

Maximum Ratings, *Absolute-Maximum Values:*

PEAK IGNITOR VOLTAGE:		
Positive	900 max.	volts
Negative	5 max.	volts
IGNITOR CURRENT:		
Peak	100 max.	amp
Average (Averaged over any interval of 5 seconds maximum)	1 max.	amp
RMS	10 max.	amp

← Indicates a change.

a RMS Voltage, current, and demand kva are on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

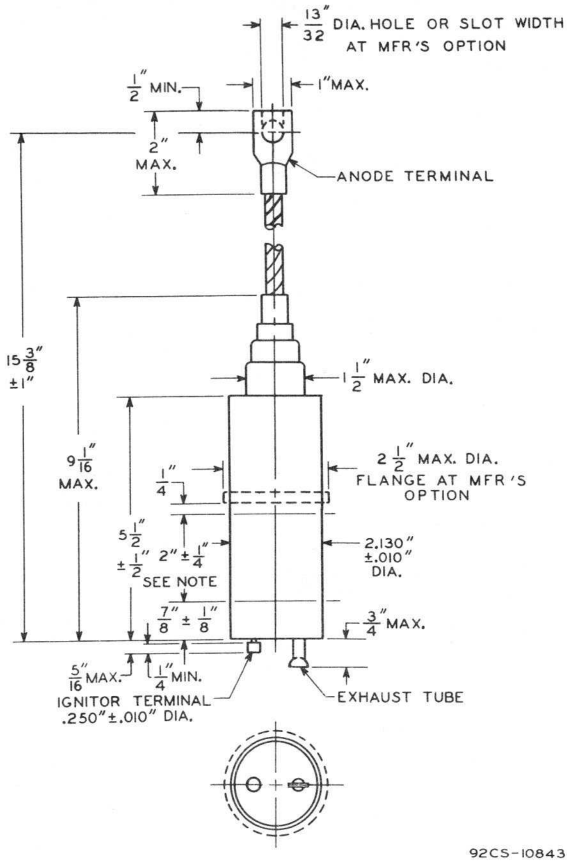
b *Column 1* represents operation at maximum average anode current; *Column 2* represents operation at maximum demand power.

c Defined as (cycles "on")/(cycles "on" + cycles "off") during the specified averaging time.

d For supply voltages between 250 volts and 600 volts, duty is proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

e For supply voltages between 250 volts and 600 volts, demand anode current and averaging time are each inversely proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

f With the use of log-log paper, straight-line interpolation between tabulated points may be used to obtain average-anode-current and maximum-averaging-time ratings at clamp temperatures between the two tabulated values.

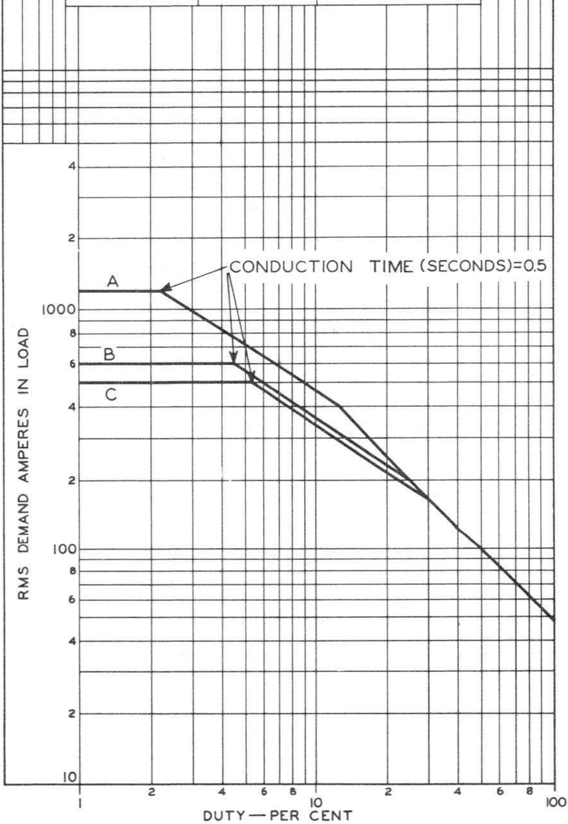


NOTE: CATHODE TERMINAL AND CLAMP-COOLED AREA.

RATING CHART 1
Resistance-Welding-Control Service

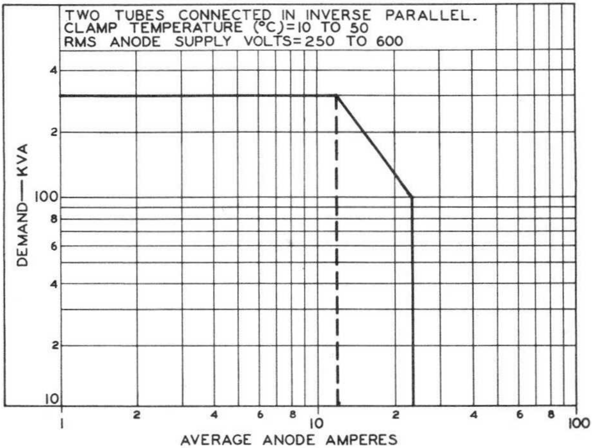
TWO TUBES CONNECTED IN INVERSE PARALLEL.
CLAMP TEMPERATURE (°C)=10 TO 50

CURVE	RMS ANODE SUPPLY VOLTS	MAXIMUM AVERAGING TIME—SECONDS
A	250	22
B	500	11
C	600	9.2



92CM-10840R1

RATING CHART 2
Resistance-Welding-Control Service



92CS-10842R1

RCA

5551-A
IGNITRON

WATER-COOLED, STEEL-JACKETED, MERCURY-POOL-CATHODE TYPE HAVING MOUNTING PLATE FOR THERMOSTATIC CONTROL

For resistance-welding control

GENERAL DATA

Electrical:

Cathode Excitation	Cyclic	
Cathode-Spot Starting	By Ignitor	
Minimum Requirements for Cathode Excitation:		
Peak ignitor voltage required to fire	200	volts
Peak ignitor current required to fire	30	amp
Starting time at required voltage or current	100	µsec
Tube Voltage Drop:		
At peak anode current of 3400 amperes	26	volts
At peak anode current of 176 amperes	13	volts

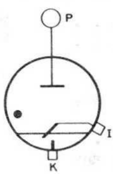
Mechanical:

Operating Position	Vertical, flexible lead up
Maximum Overall Length (Including flexible lead)	23-1/4"
Maximum Radius (Including water connections)	2-7/8"
Weight	3.6 lbs

Terminal Connections *(See Dimensional Outline)*:

P – Anode Terminal (Flexible lead)

K – Cathode Terminal (Bar opposite anode terminal)



I – Ignitor Terminal (Within jacket skirt at cathode end)

Cooling:

Type	Water	
Minimum inlet water temperature	10	°C
Maximum outlet water temperature	40	°C
Minimum water flow	1	gpm
Maximum water-temperature rise	4	°C
Maximum pressure drop	2.5	psi

INTERMITTENT RECTIFIER SERVICE and FREQUENCY-CHANGER WELDER SERVICE

Maximum Ratings, *Absolute-Maximum Values:*

For zero phase-control angle and frequencies from 50 to 60 cps

RATING I

PEAK ANODE VOLTAGE:		
Forward	500 max.	volts
Inverse	500 max.	volts

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RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

5551-A
IGNITRON

ANODE CURRENT:			
Peak		700 max.	amp
Average (Averaged over any interval of 6 seconds maximum)		40 max.	amp
Fault, for duration of 0.15 second maximum		8750 max.	amp

RATING II

PEAK ANODE VOLTAGE:			
Forward	1200 max.	1200 max.	volts
Inverse	1200 max.	1200 max.	volts
ANODE CURRENT:			
Peak	135 max.	600 max.	amp
Average (Averaged over any interval of 10 seconds maximum)	22.5 max.	5 max.	amp
Average (Averaged over any interval of 0.2 second maximum)	22.5 max.	100 max.	amp
Fault, for duration of 0.15 second maximum	7500 max.	7500 max.	amp

RATING III

PEAK ANODE VOLTAGE:			
Forward	1500 max.	1500 max.	volts
Inverse	1500 max.	1500 max.	volts
ANODE CURRENT:			
Peak	108 max.	480 max.	amp
Average (Averaged over any interval of 10 seconds maximum)	18 max.	4 max.	amp
Average (Averaged over any interval of 0.2 second maximum)	18 max.	80 max.	amp
Fault, for duration of 0.15 second maximum	6000 max.	6000 max.	amp

RESISTANCE-WELDING-CONTROL SERVICE[⊕]

Two Tubes in Inverse-Parallel Circuit

Maximum Ratings, *Absolute-Maximum Values:*

For frequencies from 25 to 60 cps

Ratings I-A and I-B Apply to Operation Either (1) Without Water-Saving Thermostat, or (2) With Water-Saving Thermostat Shunted by Auxiliary Contactor

RATING I-A

SUPPLY VOLTAGE (RMS)	250 max.	250 max.	volts
DEMAND POWER (During conduction)	200 max.	600 max.	kva

⊕: See next page.

5551-A
IGNITRON

DUTY▲†	15 max.	2.8 max.	%
ANODE CURRENT (Per tube):			
Peak	1130 max.	3400 max.	amp
Demand (RMS, during conduction)#	800 max.	2400 max.	amp
Average (Averaged over any interval of 18 seconds maximum)#	56 max.	30.2 max.	amp
Fault, for duration of 0.15 second maximum	6720 max.	6720 max.	amp

RATING I-B

SUPPLY VOLTAGE (RMS)	600 max.	600 max.	volts
DEMAND POWER (During conduction)	200 max.	600 max.	kva
DUTY▲†	37 max.	6.7 max.	%
ANODE CURRENT (Per tube):			
Peak	466 max.	1410 max.	amp
Demand (RMS, during conduction)#	333 max.	1000 max.	amp
Average (Averaged over any interval of 7.5 seconds maximum)#	56 max.	30.2 max.	amp
Fault, for duration of 0.15 second maximum	2800 max.	2800 max.	amp

Ratings II-A and II-B Apply to Operation with Water-Saving Thermostat Not Shunted by Auxiliary Contactor

RATING II-A

SUPPLY VOLTAGE (RMS)	250 max.	250 max.	volts
DEMAND POWER (During conduction)	200 max.	600 max.	kva
DUTY▲†	9.7 max.	1.9 max.	%
ANODE CURRENT (Per tube):			
Peak	1130 max.	3400 max.	amp
Demand (RMS, during conduction)#	800 max.	2400 max.	amp
Average (Averaged over any interval of 25.6 seconds maximum)#	36 max.	21 max.	amp
Fault, for duration of 0.15 second maximum	6720 max.	6720 max.	amp

RATING II-B

SUPPLY VOLTAGE (RMS)	600 max.	600 max.	volts
DEMAND POWER (During conduction)	200 max.	600 max.	kva
DUTY▲†	23 max.	4.7 max.	%

⊕,▲,†,#: See next page.

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RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5551-A
IGNITRON

ANODE CURRENT (Per tube):			
Peak	466 max.	1410 max.	amp
Demand (RMS, during conduction)#.	333 max.	1000 max.	amp
Average (Averaged over any interval of 10.7 seconds maximum)#	36 max.	21 max.	amp
Fault, for duration of 0.15 second maximum	925 max.	2800 max.	amp

IGNITOR

Maximum Ratings, *Absolute-Maximum Values:*

PEAK IGNITOR VOLTAGE:		
Positive	Equal to anode	volts
Negative	5 max.	volts
IGNITOR CURRENT:		
Peak	100 max.	amp
Average (Averaged over any interval of 5 seconds maximum).	1 max.	amp
RMS.	10 max.	amp

⊕ RMS voltage, current, and demand kva are on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

▲ Defined as (cycles "on")/(cycles "on" + cycles "off") during the specified averaging time.

† For supply voltages between 250 volts and 600 volts, duty is proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

\# For supply voltages between 250 volts and 600 volts, demand anode current and averaging time are each inversely proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

OPERATING CONSIDERATIONS

The 5551-A is equipped for mounting a thermostatic control with a mounting plate calibrated either for controlling the flow of cooling water through the water jacket, or for protection of the ignitron against overheating.

When the cooling water is circulated successively through the water jackets of two or more ignitrons, the *water-saving thermostat*, if used should be mounted on the ignitron connected directly to the water supply.

The water-saving thermostat, which has normally open contacts, is calibrated to close a circuit energizing a solenoid valve in the water-supply line and thus permit water flow to start when the temperature of the thermostat mounting plate exceeds approximately 35° C. Because of the lag between the heating of the ignitron envelope and the functioning of the water-saving thermostat to start water flow through the water jackets, the ignitron may overheat before the flow of cooling water starts.

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5551-A
IGNITRON

Such overheating can be prevented by the use of an auxiliary contactor shunted across the contacts of the water-saving thermostat and actuated by the welding-control switch. The contactor causes the solenoid valve in the water-supply line to open as soon as welding current flows.

If the water-saving thermostat is not shunted by an auxiliary contactor, it will be necessary to use a lower value of maximum average current than that which is specified when the auxiliary contactor is employed. The lower average current value is achieved by increasing the maximum averaging time and decreasing the maximum duty. Although the same maximum conduction time is permitted for both of these operating conditions, the use of the water-saving thermostat alone, without the auxiliary contactor requires a longer interval between successive welds than when the thermostat is shunted by the contactor.

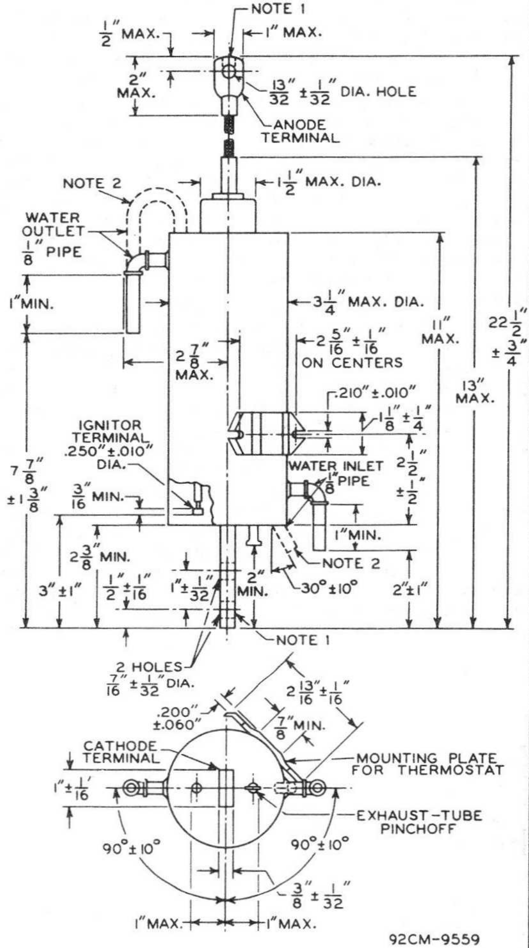
When a *protective thermostat* is used, it should be mounted on an ignitron from which the cooling water discharges into the drain. The protective thermostat is calibrated to open a set of normally closed contacts at a jacket temperature of approximately 52° C. The opening of these contacts causes a protective device to function. This device may be a relay opening the ignitor firing controls, or preferably, a circuit breaker which removes power from the ignitrons.

Care must be taken to insure that the water jacket of each ignitron is completely filled before power is applied. Tube operation with a partially filled water jacket may cause abnormal heating of the tube envelope, with resultant arc-back which impairs tube life. It is also necessary to arrange the cooling system so as to prevent any draining of the water jackets when the flow of water ceases.

RCA

5551-A

IGNITRON



NOTE 1: MAY BE SLOTTED.

NOTE 2: DASHED POSITION MANUFACTURER'S OPTION.

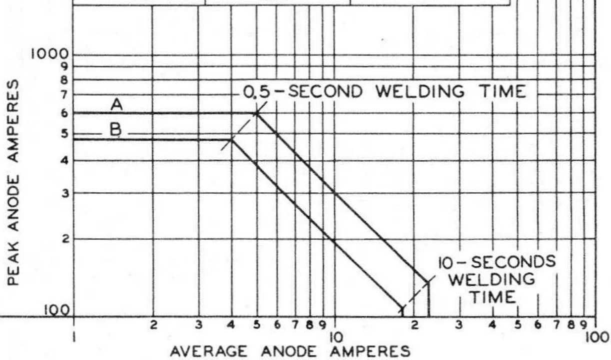
RCA

5551-A

RATING CHARTS

FREQUENCY-CHANGER-WELDER SERVICE

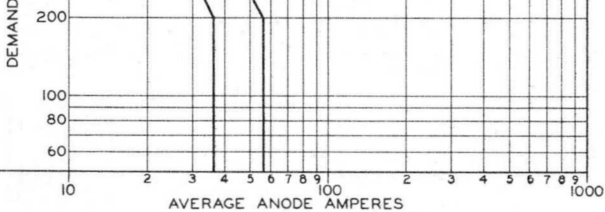
CURVE	PEAK ANODE VOLTS FORWARD OR INVERSE	MAXIMUM AVERAGING TIME—SECONDS
A	1200	10
B	1500	10



92CS-9695

RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
RMS ANODE-SUPPLY VOLTS = 250 TO 600
CURVE A: NO WATER-SAVING THERMOSTAT, OR WATER-SAVING THERMOSTAT SHUNTED BY AUXILIARY CONTACTOR.
CURVE B: WATER-SAVING THERMOSTAT WITHOUT AUXILIARY CONTACTOR.



92CS-9698

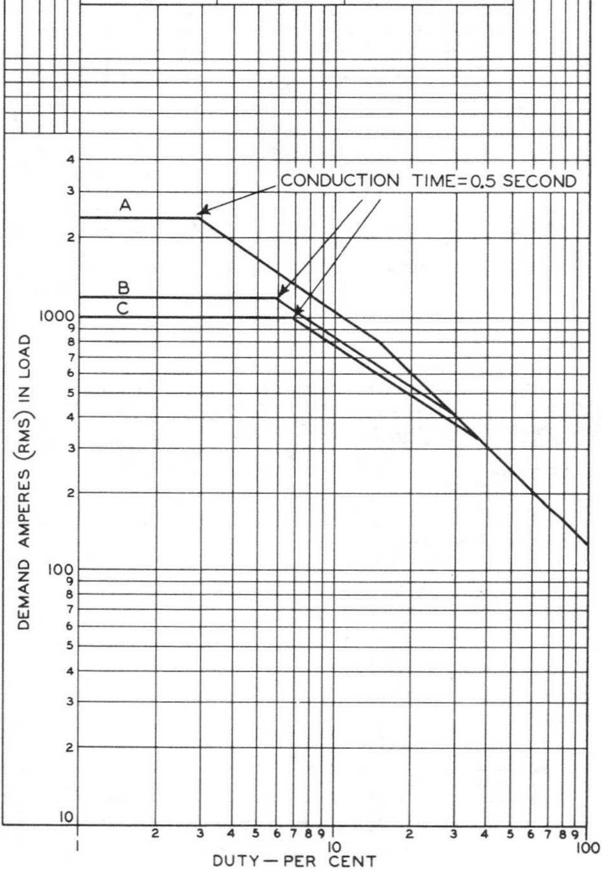
RCA

5551-A

RATING CHART
RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
NO WATER-SAVING THERMOSTAT, OR WATER-SAVING THERMOSTAT SHUNTED BY AUXILIARY CONTACTOR.
PROTECTIVE THERMOSTAT OPTIONAL.

CURVE	RMS ANODE-SUPPLY VOLTS	MAXIMUM AVERAGING TIME—SECONDS
A	250	18
B	500	9
C	600	7.5



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5551-A

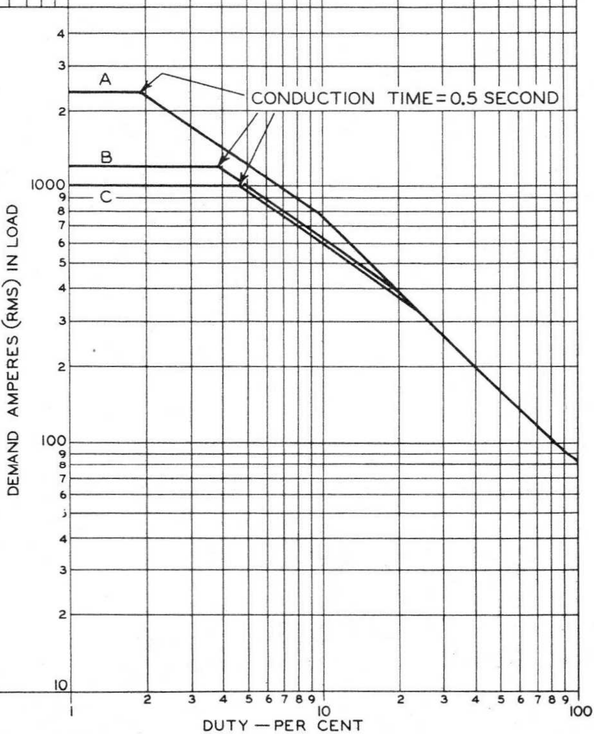
RCA

5551-A

RATING CHART
RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
WATER-SAVING THERMOSTAT WITHOUT
AUXILIARY CONTACTOR.
PROTECTIVE THERMOSTAT OPTIONAL.

CURVE	RMS ANODE-SUPPLY VOLTS	MAXIMUM AVERAGING TIME—SECONDS
A	250	25.6
B	500	12.8
C	600	10.7



ELECTRON TUBE DIVISION

92CM-9692

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RCA

5552-A
IGNITRON

WATER-COOLED, STEEL-JACKETED, MERCURY-POOL-CATHODE TYPE HAVING MOUNTING PLATE FOR THERMOSTATIC CONTROL

For resistance-welding control

GENERAL DATA

Electrical:

Cathode Excitation		Cyclic
Cathode-Spot Starting.		By Ignitor
Minimum Requirements for Cathode Excitation:		
Peak ignitor voltage required to fire. . .	200	volts
Peak ignitor current required to fire. . .	30	amp
Starting time at required voltage or current	100	μsec
Tube Voltage Drop:		
At peak anode current of 6800 amperes. . .	28	volts
At peak anode current of 440 amperes . . .	14	volts

Mechanical:

Operating Position . . . . Vertical, flexible lead up

Maximum Overall Length (Including flexible lead) . . . . 27-1/4"

Maximum Radius (Including water connections) . . . . . . 3-5/8"

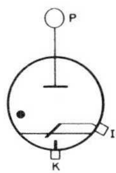
Weight . . . . 8 lbs

Terminal Connections *(See Dimensional Outline)*:

P – Anode Terminal (Flexible lead)

K – Cathode Terminal (Bar opposite anode terminal)

I – Ignitor Terminal (Within jacket skirt at cathode end)



Cooling:

Type		Water
Minimum inlet water temperature.	10	°C
Maximum outlet water temperature	40	°C
Minimum water flow	1.5	gpm
Maximum water-temperature rise	6	°C
Maximum pressure drop.	6	psi

INTERMITTENT RECTIFIER SERVICE

Maximum Ratings, *Absolute-Maximum Values:*

For zero phase-control angle and frequencies from 25 to 60 cps

PEAK ANODE VOLTAGE:		
Forward.	500 max.	volts
Inverse.	500 max.	volts

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5552-A

5552-A

IGNITRON

ANODE CURRENT:		
Peak	1600 max.	amp
Average (Averaged over any interval of 6 seconds maximum)	100 max.	amp
Fault, for duration of 0.15 second maximum.	6000 max.	amp

RESISTANCE-WELDING-CONTROL SERVICE[⊕]

Two Tubes in Inverse-Parallel Circuit

Maximum Ratings, *Absolute-Maximum Values:*

For frequencies from 25 to 60 cps

Ratings I-A and I-B Apply to Operation Either (1) Without Water-Saving Thermostat, or (2) With Water-Saving Thermostat Shunted by Auxiliary Contactor

RATING I-A

	Column 1*	Column 2*	
SUPPLY VOLTAGE (RMS)	250 max.	250 max.	volts
DEMAND POWER (During conduction)	400 max.	1200 max.	kva
DUTY▲†	19 max.	3.5 max.	%
ANODE CURRENT (Per tube):			
Peak	2260 max.	6800 max.	amp
Demand (RMS, during conduction)#.	1600 max.	4800 max.	amp
Average (Averaged over any interval of 14 seconds maximum)#	140 max.	75.6 max.	amp
Fault, for duration of 0.15 second maximum. . . .	13450 max.	13450 max.	amp

RATING I-B

	Column 1*	Column 2*	
SUPPLY VOLTAGE (RMS)	600 max.	600 max.	volts
DEMAND POWER (During conduction)	400 max.	1200 max.	kva
DUTY▲†	47 max.	8.5 max.	%
ANODE CURRENT (Per tube):			
Peak	945 max.	2830 max.	amp
Demand (RMS, during conduction)#.	666 max.	2000 max.	amp
Average (Averaged over any interval of 5.8 seconds maximum)#	140 max.	75.6 max.	amp
Fault, for duration of 0.15 second maximum. . . .	5600 max.	5600 max.	amp

⊕,▲,†,#,*: See next page.

5552-A
IGNITRON

Ratings II-A and II-B Apply to Operation with Water-Saving Thermostat Not Shunted by Auxiliary Contactor

RATING II-A

	*Column 1**	*Column 2**	
SUPPLY VOLTAGE (RMS)	250 max.	250 max.	volts
DEMAND POWER (During conduction)	400 max.	1200 max.	kva
DUTY▲†	11 max.	2 max.	%
ANODE CURRENT (Per tube):			
Peak	2260 max.	6800 max.	amp
Demand (RMS, during conduction)#	1600 max.	4800 max.	amp
Average (Averaged over any interval of 23.5 seconds maximum)#	80 max.	43 max.	amp
Fault, for duration of 0.15 second maximum. . . .	13450 max.	13450 max.	amp

RATING II-B

	*Column 1**	*Column 2**	
SUPPLY VOLTAGE (RMS)	600 max.	600 max.	volts
DEMAND POWER (During conduction)	400 max.	1200 max.	kva
DUTY▲†	26 max.	4.8 max.	%
ANODE CURRENT (Per tube):			
Peak	945 max.	2830 max.	amp
Demand (RMS, during conduction)#	666 max.	2000 max.	amp
Average (Averaged over any interval of 10 seconds maximum)#	80 max.	43 max.	amp
Fault, for duration of 0.15 second maximum. . . .	5600 max.	5600 max.	amp

IGNITOR

Maximum Ratings, *Absolute-Maximum Values:*

PEAK IGNITOR VOLTAGE:		
Positive	Equal to anode	volts
Negative	5 max.	volts
IGNITOR CURRENT:		
Peak	100 max.	amp
Average (Averaged over any interval of 5 seconds maximum).	1 max.	amp
RMS.	10 max.	amp

⊕,▲,†,#,*: See next page.

5552-A
IGNITRON

⊕ RMS voltage, current, and demand kva are on the basis of full-cycle conduction (no phase delay) regardless of whether or not phase control is used.

▲ Defined as (cycles "on")/(cycles "on" + cycles "off") during the specified averaging time.

† For supply voltages between 250 volts and 600 volts, duty is proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

For supply voltages between 250 volts and 600 volts, demand anode current and averaging time are each inversely proportional to supply voltage. For supply voltages lower than 250 volts, the values for 250 volts apply.

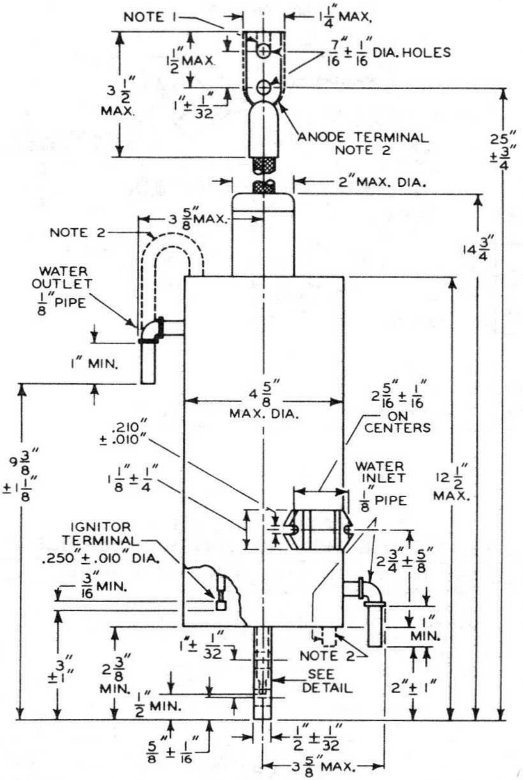
* Column 1 represents operation at maximum average anode current; Column 2 represents operation at maximum demand current.

OPERATING CONSIDERATIONS
for the 5552-A are the same as those shown for Type 5551-A

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5552-A

5552-A
IGNITRON



92CM-9772R1

ELECTRON TUBE DIVISION
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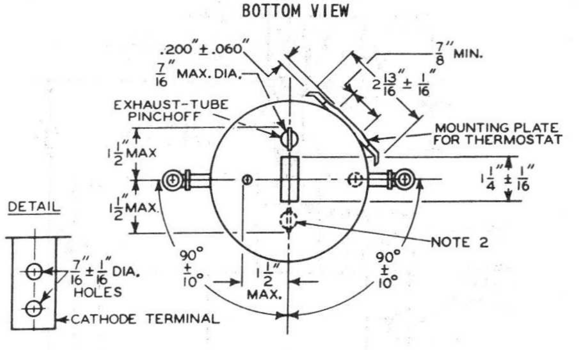
RCA

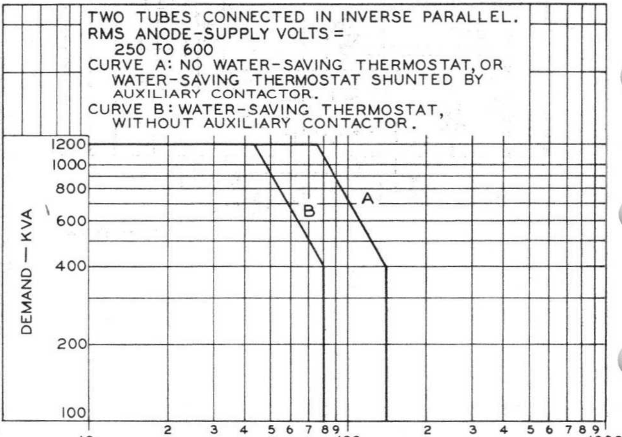
5552-A
IGNITRON



NOTE 1: MAY BE SLOTTED.
NOTE 2: DASHED POSITION AT MANUFACTURER'S OPTION.

4-59 CE-9772R1B

RATING CHART
RESISTANCE-WELDING-CONTROL SERVICE



92CS-9712

5552-A

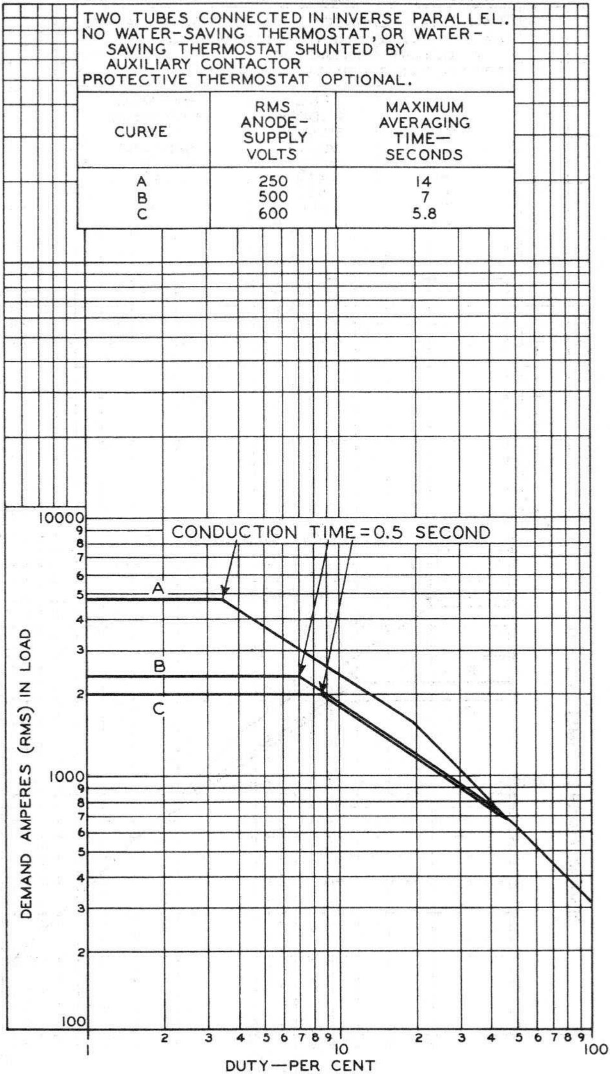
RCA

5552-A

RATING CHART
RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
NO WATER-SAVING THERMOSTAT, OR WATER-SAVING THERMOSTAT SHUNTED BY AUXILIARY CONTACTOR
PROTECTIVE THERMOSTAT OPTIONAL.

CURVE	RMS ANODE-SUPPLY VOLTS	MAXIMUM AVERAGING TIME—SECONDS
A	250	14
B	500	7
C	600	5.8



ELECTRON TUBE DIVISION

92CM-9710

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RCA

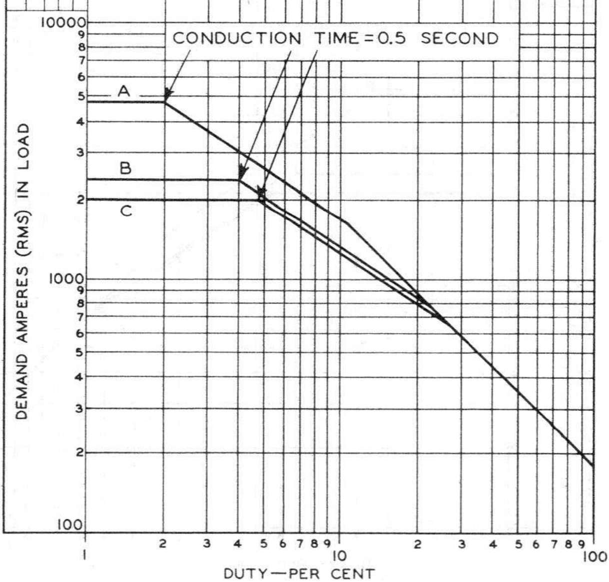
5552-A

RATING CHART

RESISTANCE-WELDING-CONTROL SERVICE

TWO TUBES CONNECTED IN INVERSE PARALLEL.
WATER-SAVING THERMOSTAT WITHOUT AUXILIARY CONTACTOR.
PROTECTIVE THERMOSTAT OPTIONAL.

CURVE	RMS ANODE-SUPPLY VOLTS	MAXIMUM AVERAGING TIME—SECONDS
A	250	23.5
B	500	11.8
C	600	10



ELECTRON TUBE DIVISION

92CM-9711

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5557

5557

MERCURY-VAPOR THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

Filament, Coated:

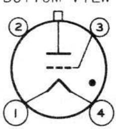
	Min.	*Av.*	*Max.*	
Voltage.	2.38	2.5	2.62	ac or dc volts
Current at 2.5 volts .	–	5.0	5.5	. . . . . .amp

Minimum heating time prior to tube conduction.	5	sec
Direct Interelectrode Capacitances (Approx.):°		
Grid to anode.	2.5	μμf
Grid to cathode.	7	μμf
Ionization Time (Approx.).	10	μsec
Deionization Time (Approx.).	1000	μsec
Anode Voltage Drop (Approx.)	16	volts

Mechanical:

Operating Position . . . . .Vertical, base down
Maximum Overall Length . . . . 6-1/8"
Seated Length. . . . . 5-1/4" ± 1/4"
Maximum Diameter . . . . 2-1/16"
Weight (Approx.) . . . . 3 oz
Bulb ST16
Cap. . . . . Medium (JETEC No.C1-5)
Base . . . . Medium-Shell Small 4-Pin with Bayonet (JETEC No.A4-10)
Basing Designation for BOTTOM VIEW 3G

Pin 1 – Filament
Pin 2 – No Connection



Pin 3 – Grid
Pin 4 – Filament
Cap – Anode

Temperature Control:

Heating--When the ambient temperature is so low that the normal rise of condensed-mercury temperature above the ambient temperature will not bring the condensed-mercury temperature up to the minimum value of the operating ranges specified under *Maximum Ratings*, some form of heat-conserving enclosure or auxiliary heater will be required.

Cooling--When the operating conditions are such that the maximum value of the operating condensed-mercury temperature is exceeded, provision should be made for forced-air cooling sufficient to prevent exceeding the maximum value.

Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.):*
No load. . . . . 17.5 °C

° Without external shield.
* With filament volts = 2.38 and no heat-conserving enclosure.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5557

MERCURY-VAPOR THYRATRON

CONTROL SERVICE

→ **Maximum Ratings,** *Absolute Values:*

For anode-supply frequency of 60 cps

	Operating Condensed-Mercury-Temperature Range			
	40° to 90° C	40° to 80° C	40° to 60° C	
PEAK ANODE VOLTAGE:				
Forward.	1250 max.	2500 max.	5000 max.	volts
Inverse.	1250 max.	5000 max.	10000 max.	volts
GRID VOLTAGE:				
Peak or DC, before tube conduction.	-500 max.	-500 max.	-500 max.	volts
Average▲, during tube conduction.	-10 max.	-10 max.	-10 max.	volts
ANODE CURRENT:				
Peak	3 max.	2 max.	1 max.	amp
Average#	1 max.	0.5 max.	0.25 max.	amp
Fault, for duration of 0.1 second maximum.	40 max.	40 max.	40 max.	amp
GRID CURRENT:				
Average●, positive with anode positive	0.05 max.	0.05 max.	0.05 max.	amp

▲ Averaged over one conducting period.
Averaged over any interval of 15 seconds maximum.
● Averaged over period of grid conduction.

DIMENSIONAL OUTLINE
for Type 5557 is the same as that shown for Type 3C23

→ Indicates a change.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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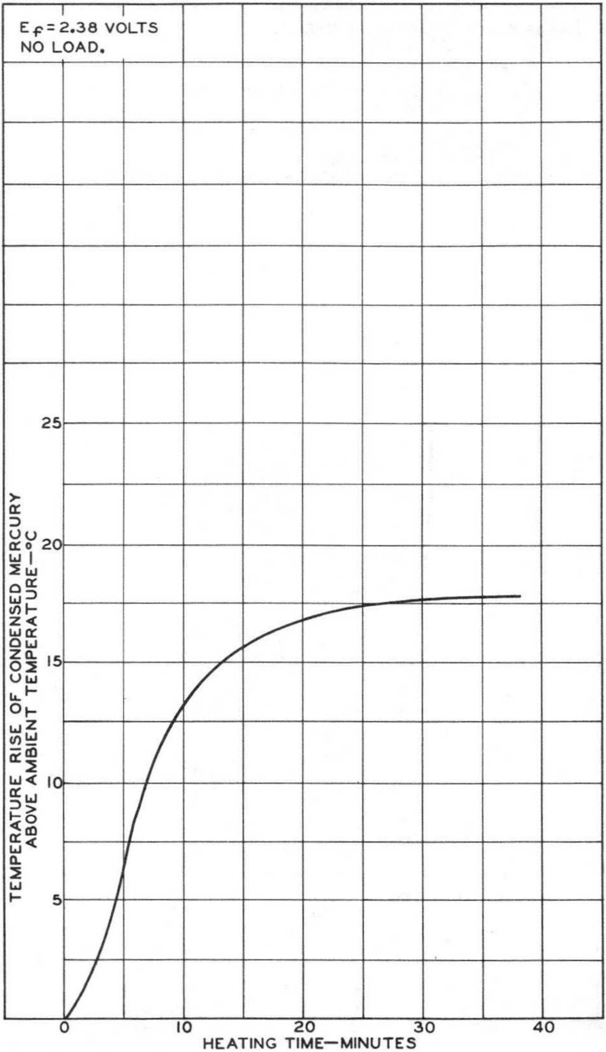
5557
RATE OF RISE OF CONDENSED-MERCURY TEMPERATURE



TUBE DIVISION
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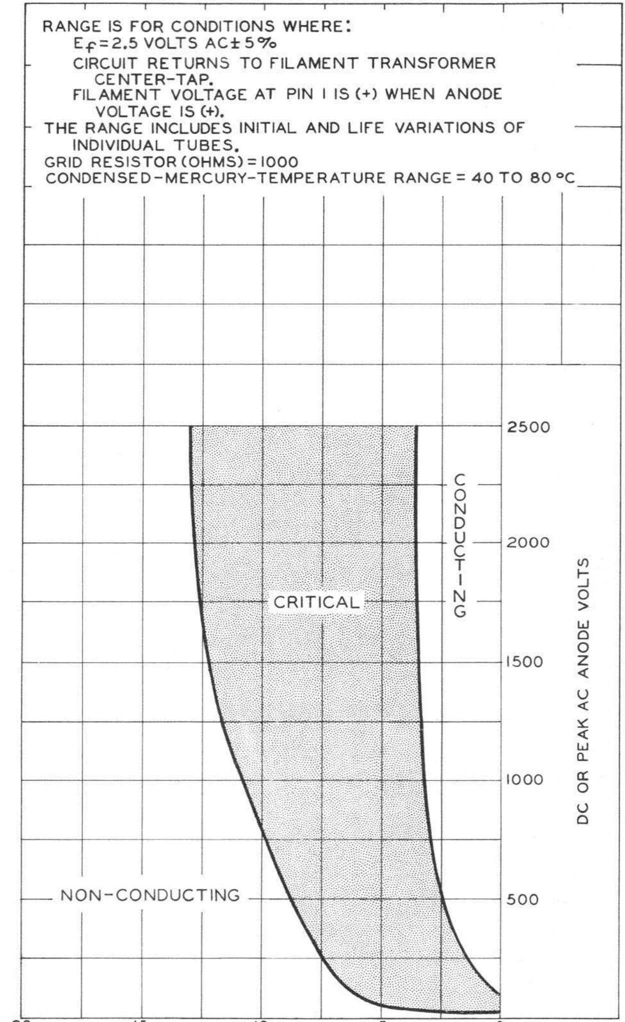
92CM-9301T

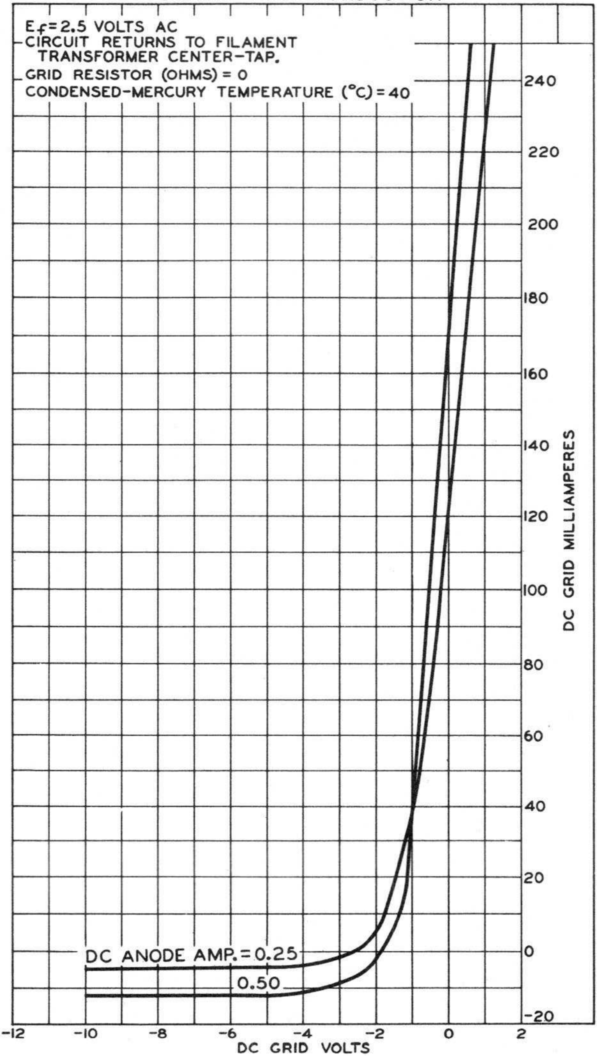
RCA

5557
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE



5557

AVERAGE GRID CHARACTERISTICS
DURING TUBE CONDUCTION



TUBE DIVISION
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92CM-9302T

RCA

5559

THYRATRON

MERCURY-VAPOR TRIODE

DATA

Electrical:

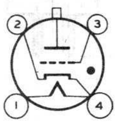
Heater, for Unipotential Cathode:		
Voltage	5.0	volts
Current	4.5	amp
Cathode:		
Minimum Heating Time, prior to tube conduction	5	minutes
Direct Interelectrode Capacitances (Approx.): ←		
Grid to Anode	2.5	$\mu\mu f$
Grid to Cathode	10	$\mu\mu f$
Ionization Time (Approx.)	10	μsec
Deionization Time (Approx.)	1000	μsec
Anode Voltage Drop (Approx.)	16	volts
Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0 ←		220

Mechanical:

Mounting Position	Vertical, Base Down
Overall Length	7" ± 1/4"
Seated Length	6-3/8" ± 1/4"
Maximum Diameter	3"
Bulb	ST-23
Cap	Medium
Base	Medium-Shell Small 4-Pin, Bayonet
Basing Designation for BOTTOM VIEW	4BL

Pin 1 - Heater

Pin 2 - Cathode; Circuit Returns



Pin 3 - Grid

Pin 4 - Heater, Cathode

Cap - Anode

Maximum Ratings, *Absolute Values*:

PEAK ANODE VOLTAGE:		
Forward	1000 max.	volts
Inverse	1000 max.	volts
GRID VOLTAGE:		
Before Conduction	-500 max.	volts
During Conduction	-10 max.	volts ←
CATHODE CURRENT:		
Peak	15 max.	amp
Average**	2.5 max.	amp
Fault, for 0.1 sec. maximum	200 max.	amp
GRID CURRENT:		
Average**	+0.25 max.	amp
COND.-MERCURY TEMPERATURE RANGE▲	+40 to +80	°C
OPERATING FREQUENCY	150 max.	cps ←

** Averaged over any interval of 15 sec. max.

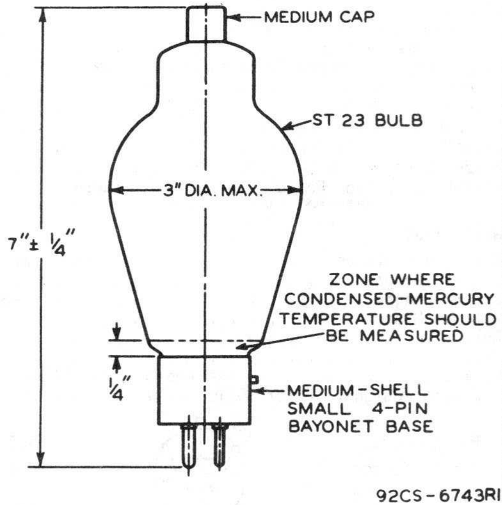
▲ Recommended operating temperature is 40°C.

← Indicates a change.

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

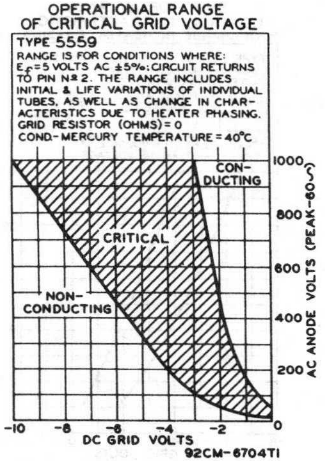
5559
THYRATRON

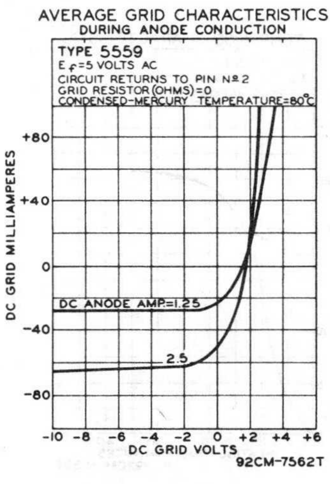


TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5559

THYRATRON



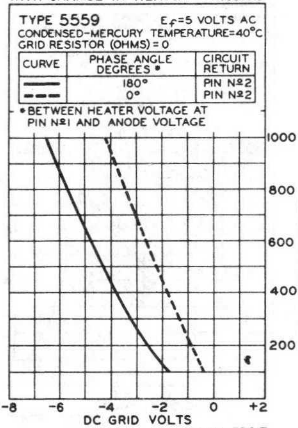


5559

5559

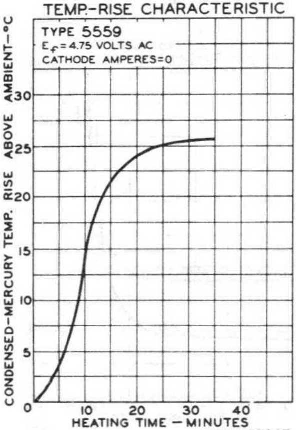
THYRATRON

SHIFT OF AVERAGE CONTROL CHARACTERISTIC WITH CHANGE IN HEATER PHASING



92CM-7561T

TEMP.-RISE CHARACTERISTIC



92CM-7559T

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5560

5560

THYRATRON

MERCURY-VAPOR TETRODE

DATA

Electrical:

Heater, for Unipotential Cathode:

Voltage	5.5□	5.0	volts
Current	5.0□	4.5	amp

Cathode:

Minimum Heating Time, prior to tube conduction	5	minutes

Direct Interelectrode Capacitances (Approx.):

Grid No.1 to Anode	0.2	μμf	
Grid No.1 to Cathode	4.4	μμf	←
Ionization Time (Approx.)	10	μsec	
Deionization Time (Approx.)	1000	μsec	
Anode Voltage Drop (Approx.)	16	volts	
Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (ohms) = 0; grid-No.1 and grid-No.2 volts = 0	170		←
Grid-No.2 Control Ratio (Approx.) with grid No.1 resistor (ohms) = 0; grid-No.1 and grid-No.2 volts = 0	300		←

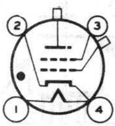
Mechanical:

Mounting Position	Vertical, Base Down	
Overall Length	7-11/16" ± 1/4"	
Seated Length	7-1/16" ± 1/4"	←
Greatest Radius	2-1/4"	
Bulb	ST-23	
Caps (Two)	Medium	
Base	Medium-Shell Small 4-Pin, Bayonet	
Basing Designation for BOTTOM VIEW	4CD	

Pin 1 - Heater

Pin 2 - Cathode; Circuit Returns

Pin 3 - Grid No.2



Pin 4 - Heater, Cathode

Top Cap - Anode

Side Cap - Grid No.1

Maximum Ratings, *Absolute Values*:

PEAK ANODE VOLTAGE:			
Forward		1000 max.	volts
Inverse		1000 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:			
Before Conduction		-300 max.	volts
During Conduction		-5 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:			
Before Conduction		-1000 max.	volts
During Conduction		-10 max.	volts ←
CATHODE CURRENT:			
Peak	30 max.□	15 max.	amp
Average**	0.5 max.□	2.5 max.	amp
Fault, for 0.1 sec. maximum		200 max.	amp

□ **: See next page.

← Indicates a change.

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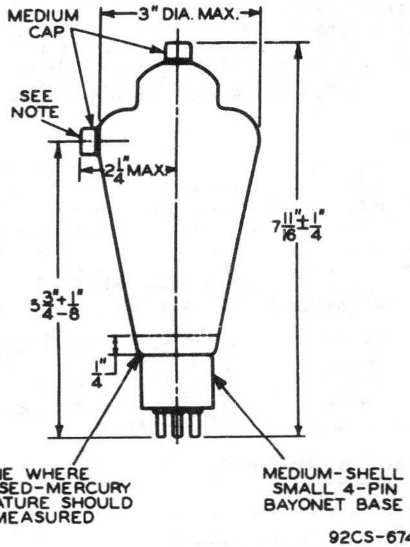
RCA

5560

THYRATRON

GRID-No.2 CURRENT:		
Average**.	0.25 max.	amp
GRID No.1 CURRENT:		
Average**.	0.25 max.	amp
COND.-MERCURY TEMPERATURE RANGE▲	+40 to +80	°C
OPERATING FREQUENCY.	150 max.	cps

□ Applies when this tube is used for ignitor firing.
** Averaged over any interval of 15 sec. max.
▲ Recommended operating temperature is 40°C.



92CS-6742R1

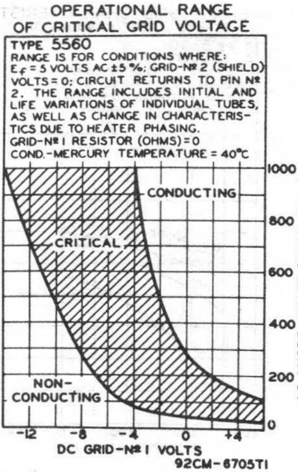
NOTE: THE PLANE THROUGH TUBE AXIS AND CENTER OF GRID-No1 CAP IS 45°±5° FROM THE PLANE THROUGH THE TUBE AXIS AND CENTER OF BAYONET PIN. GRID-No1 CAP IS ON SAME SIDE AS PIN No3.

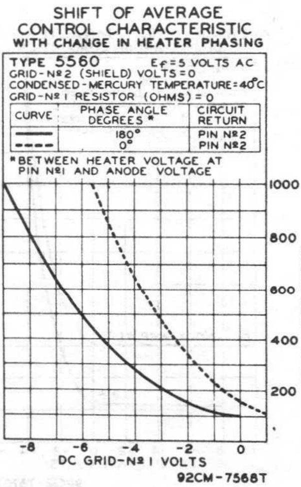
TEMPERATURE-RISE CHARACTERISTIC of the 5560 is the same as that shown for Type 5559

RCA

5560

THYRATRON



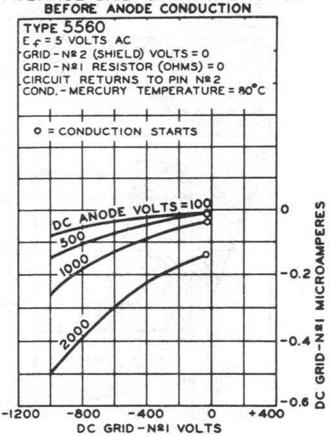


TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA 5560

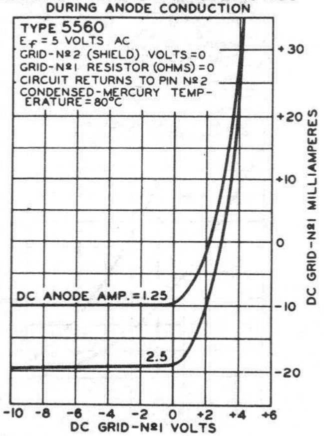
THYRATRON

AVERAGE GRID CHARACTERISTICS
BEFORE ANODE CONDUCTION



92CM-7556T

AVERAGE GRID CHARACTERISTICS
DURING ANODE CONDUCTION



92CM-7570T

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5563-A

MERCURY-VAPOR THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

Supersedes Type 5563

GENERAL DATA

Electrical:

Filament, Coated:

	Min.	*Av.*	*Max.*	
Voltage	4.75	5	5.25	volts
Current at 5 volts	–	10	11	amp

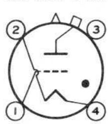
Minimum Heating Time:

On initial installation, with no voltage on grid or anode, for redistribution of mercury to lower part of tube	15	minutes
During subsequent operation, to allow filament to reach operating temperature prior to tube conduction	1	minute
Direct Interelectrode Capacitances:°		
Grid to anode	4	$\mu\mu$f
Grid to cathode	16	$\mu\mu$f
Ionization Time (Approx.)	10	μsec
Deionization Time (Approx.)	1000	μsec
Maximum Critical Grid Current for instantaneous anode volts = 20000	50	μa ←
Anode Voltage Drop (Approx.):		
At anode amperes = 11.5	15	volts
At anode amperes = 70	25	volts
Grid Control Ratio (Approx.):		
Under conditions: 10000-ohm grid resistor, circuit returns to pin 2, filament voltage at pin 4 out of phase with anode voltage by 180°, and condensed-mercury temperature of 40 °C	275	

Mechanical:

Operating Position	Vertical, base down
Overall Length	10-3/32" ± 7/16"
Maximum Diameter	2-5/8" ←
Bulb	T20 ←
Weight (Approx.)	13 oz
Cap	Medium with Tubular Support (JETEC No.C1-39) ←
Socket	Johnson No.123-211, or equivalent ←
Base	Skirted Medium-Metal-Shell Jumbo 4-Pin with Bayonet (JETEC No.A4-69)
Basing Designation for BOTTOM VIEW	3X ←

Pin 1 – Grid
Pin 2 – Filament, Internal Shield, Circuit Returns



Pin 3 – No Connection
Pin 4 – Filament
Cap – Anode

° Without external shield.

← Indicates a change.

TUBE DIVISION
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RCA

5563-A

MERCURY-VAPOR THYRATRON

Temperature Control:

Heating--When the ambient temperature is so low that the normal rise of condensed-mercury temperature above the ambient temperature will not bring the condensed-mercury temperature up to the minimum value of the operating range specified under *Maximum Ratings*, some form of heat-conserving enclosure or auxiliary heater will be required.

Cooling--When the operating conditions are such that the maximum value of the operating condensed-mercury temperature for the applicable service rating is exceeded, provision should be made for forced-air cooling sufficient to prevent exceeding the maximum value.

Temperature Rise of Condensed Mercury to Equilibrium Above Ambient Temperature (Approx.):*

No load	13	°C
Full load	17	°C

CONTROL SERVICE--In-Phase Operation●

Maximum Ratings, *Absolute Values:*

For supply frequency of 25 to 60 cps

	Operating Condensed-Mercury-Temperature Range 25 to 55 °C	25 to 50 °C	
PEAK ANODE VOLTAGE:			
Forward	15000 max.	20000 max.	volts
Inverse	15000 max.	20000 max.	volts
GRID VOLTAGE:			
Peak or DC, before tube conduction	-500 max.	-500 max.	volts
Average▲, during tube conduction	-10 max.	-10 max.	volts
ANODE CURRENT:			
Peak	10 max.	6.4 max.	amp
Average●●	1.8 max.	1.6 max.	amp
→ Fault, for duration of 0.1 second maximum	70 max.	70 max.	amp
GRID CURRENT:			
→ Average positive●●	100 max.	100 max.	ma
Peak positive with anode negative	5 max.	5 max.	ma

Maximum Circuit Values:

Grid-Circuit Resistance	0.1 max.	0.1 max.	megohm

* With filament volts = 4.75 and no heat-conserving enclosure.

● Filament voltage has a phase angle of either 0° or 180° with respect to the anode voltage.

▲,●●: See next page.

→ Indicates a change.

5563-A

MERCURY-VAPOR THYRATRON

CONTROL SERVICE--Quadrature Operation°°

Maximum Ratings, *Absolute Values:*

For supply frequency of 25 to 60 cps

	Operating Condensed-Mercury-Temperature Range 25 to 55 °C	25 to 50 °C	
PEAK ANODE VOLTAGE:			
Forward	15000 max.	20000 max.	volts
Inverse	15000 max.	20000 max.	volts
GRID VOLTAGE:			
Peak or DC, before tube conduction	-500 max.	-500 max.	volts
Average▲, during tube conduction	-10 max.	-10 max.	volts
ANODE CURRENT:			
Peak	11.5 max.	11.5 max.	amp
Average●●	2.5 max.	2.5 max.	amp
Fault, for duration of 0.1 second maximum	70 max.	70 max.	amp ←
GRID CURRENT:			
Average positive●●	100 max.	100 max.	ma ←
Peak positive with anode negative	5 max.	5 max.	ma

Maximum Circuit Values:

Grid-Circuit Resistance	0.1 max.	0.1 max.	megohm

HIGH-SPEED LOAD-CIRCUIT PROTECTION SERVICE♦ ←

Maximum Ratings, *Absolute Values:*

	Operating Condensed-Mercury-Temperature Range 40 to 55 °C	40 to 50 °C	
PEAK ANODE VOLTAGE:			
Forward	15000 max.	20000 max.	volts
Inverse	15000 max.	20000 max.	volts
GRID VOLTAGE:			
Peak or DC, before tube conduction	-500 max.	-500 max.	volts
Average▲, during tube conduction	-10 max.	-10 max.	volts
ANODE CURRENT:			
Peak	100 max.	100 max.	amp
Average□	70 max.	70 max.	amp
Average§	1.05 max.	1.05 max.	amp

Maximum Circuit Values:

Grid-Circuit Resistance	0.1 max.	0.1 max.	megohm

▲,●●,°°,♦,□,§: See next page.

← Indicates a change.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

5563-A

MERCURY-VAPOR THYRATRON

▲ Averaged over one grid-conducting period.

●● Averaged over any period of 20 seconds maximum.

○○ Filament voltage is 60° to 120° out of phase (leading or lagging) with the anode voltage.

♁ In this service, the faults may occur in quick succession or may be separated by several months.

□ Averaged over any period of 0.1 second maximum.

§ Averaged over any period of 20 seconds maximum. This average-anode-current value is specified to indicate the number of faults that are permissible within the 20-second interval. The number of faults that may occur in any 20-second interval depends on the value of anode current over the averaging period less than 0.1 second and may be determined by

$$\text{Number of Faults} = \frac{1.05 \times 20}{\text{Average Anode Current during fault} \times \text{Duration of Fault}}$$

Example:

Assume, that the maximum average anode current is 70 amperes for the maximum duration of 0.1 second. On substitution of these values in the equation, the permissible number of faults is determined to be 3. If the average anode current is less than 70 amperes over an averaging period of less than 0.1 second, it will be obvious that a greater number of faults may occur.

OPERATING CONSIDERATIONS

X rays are produced when the 5563-A is operated with a peak inverse anode voltage above 16000 volts (absolute value). These rays can constitute a health hazard unless the tube is adequately shielded for X-ray radiation. Although relatively simple shielding should prove adequate, make sure it provides the required protection to the operator.

→ *Shields and rf filter circuits* should be provided for the 5563-A if it is subjected to extraneous high-frequency fields during operation. These fields tend to produce breakdown effects in mercury vapor and are detrimental to tube life and performance. When shields are used, special attention must be given to providing adequate ventilation and to maintaining normal condensed-mercury temperature. Radio-frequency filters are employed to prevent damage caused by rf currents which might otherwise be fed back into the 5563-A.

→ Indicates a change.

RCA

5563-A

MERCURY-VAPOR THYRATRON

For Circuit Figures, see Front of this Section

<table>
<tr><th rowspan="2">CIRCUIT</th><th rowspan="2">MAX. TRANS. SEC. VOLTS (RMS)
E</th><th rowspan="2">APPROX. DC OUTPUT VOLTS TO FILTER
E_{av}</th><th colspan="2">MAX. DC OUTPUT AMPERES
I_{av}</th><th colspan="2">MAX. DC OUTPUT KW TO FILTER
P_{dc}</th></tr>
<tr><th></th><th></th><th></th><th></th></tr>
<tr><td>Fig.1
Half-Wave
Single-Phase
In-Phase Operation</td><td>14000□
10600▲</td><td>6300
4700</td><td colspan="2">1.6
1.8</td><td colspan="2">10
8.5</td></tr>
<tr><td>Fig.2
Full-Wave
Single-Phase
In-Phase Operation</td><td>7000□
5300▲</td><td>6300
4700</td><td colspan="2">3.2
3.6</td><td colspan="2">20
17</td></tr>
<tr><td>Fig.3
Series
Single-Phase
In-Phase Operation</td><td>14000□
10600▲</td><td>12700
9500</td><td colspan="2">3.2
3.6</td><td colspan="2">40
34</td></tr>
<tr><td>Fig.4
Half-Wave
Three-Phase
In-Phase Operation</td><td>8100□
6100▲</td><td>9500
7100</td><td colspan="2">4.8
5.4</td><td colspan="2">45
38</td></tr>
<tr><td>Fig.5
Parallel
Three-Phase
Quadrature Operation</td><td>8100□
6100▲</td><td>9500
7100</td><td colspan="2">15.0
15.0</td><td colspan="2">143
106</td></tr>
<tr><td>Fig.6
Series
Three-Phase
Quadrature Operation</td><td>8100□
6100▲</td><td>19000
14200</td><td colspan="2">7.5
7.5</td><td colspan="2">143
106</td></tr>
<tr><td>Fig.7
Half-Wave
Four-Phase
Quadrature Operation</td><td>

7000□
5300</td><td>

9000
6700</td><td>Resistive Load
10.0
10.0</td><td>Inductive Load
10.0
10.0</td><td>Resistive Load
90
67</td><td>Inductive Load
90
67</td></tr>
<tr><td>Fig.8
Half-Wave
Six-Phase
Quadrature Operation</td><td>

7000□
5300▲</td><td>

9500
7100</td><td>Resistive Load
11.0
11.0</td><td>Inductive Load
11.5
11.5</td><td>Resistive Load
105
78</td><td>Inductive Load
110
81</td></tr>
</table>

□ For maximum peak inverse anode voltage of 20000 volts, and condensed-mercury-temperature range of 25 to 50 °C.

▲ For maximum peak inverse anode voltage of 15000 volts, and condensed-mercury-temperature range of 25 to 55 °C.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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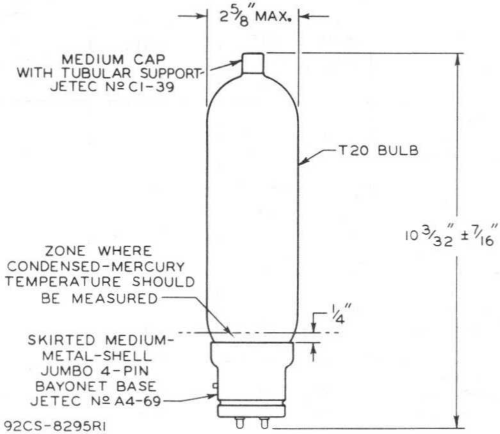
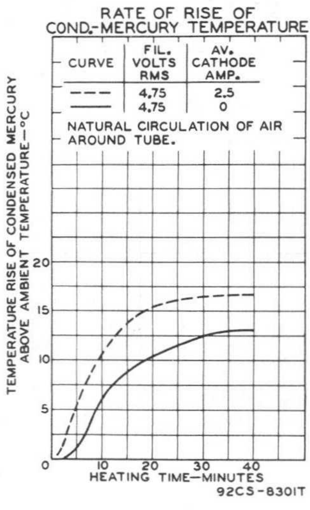
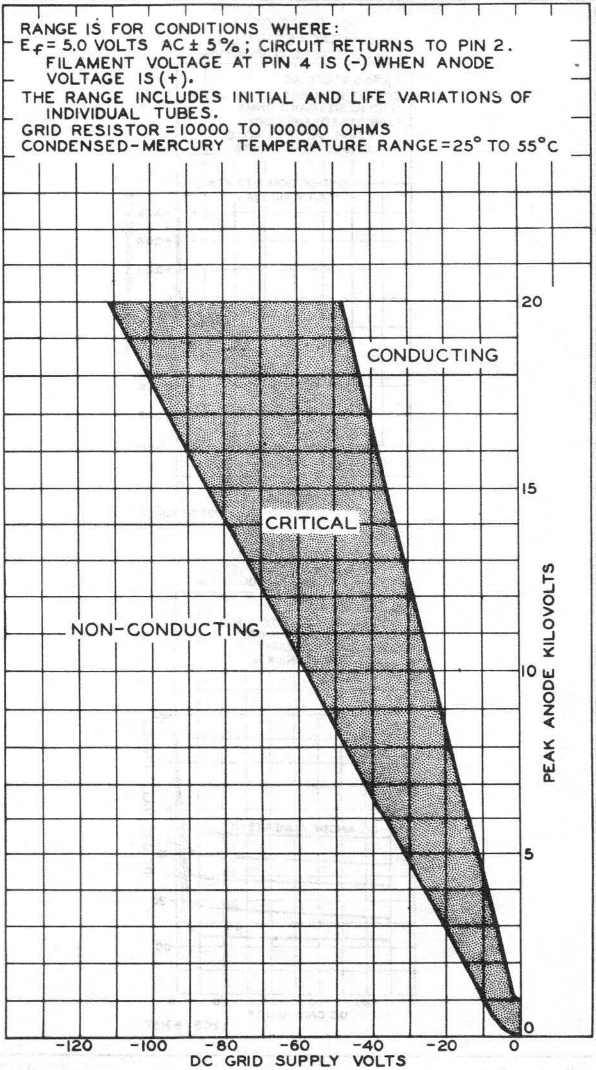
5563-A

MERCURY-VAPOR THYRATRON

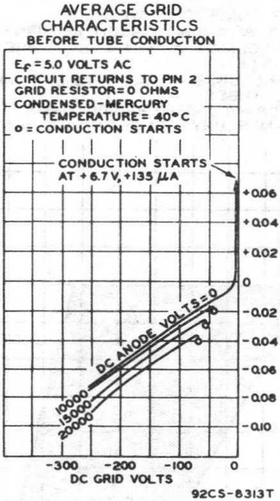


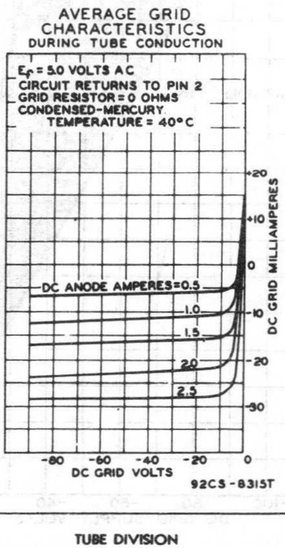


5563-A
OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE



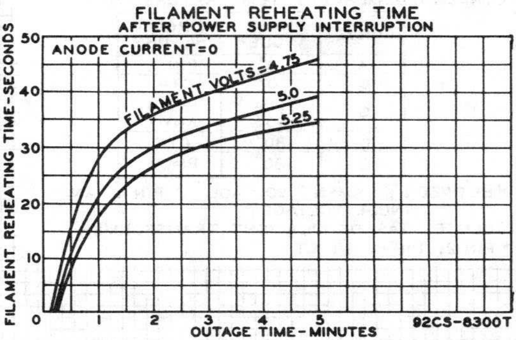
5563-A
CHARACTERISTIC CURVES

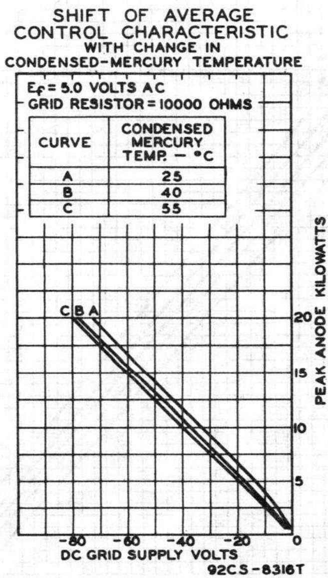




RCA

5563-A
CHARACTERISTIC CURVES





RCA

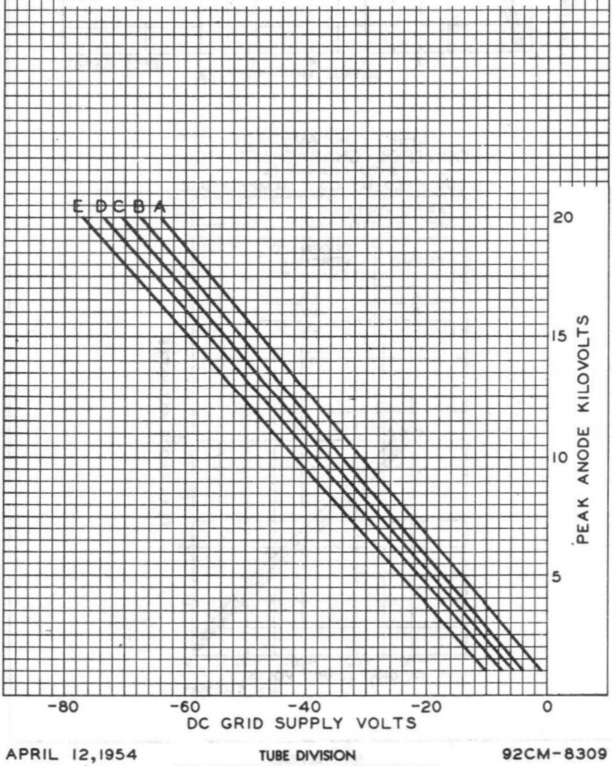
5563-A

SHIFT OF AVERAGE CONTROL CHARACTERISTICS WITH CHANGE IN FILAMENT PHASING AND CIRCUIT RETURN

E_f = 5.0 VOLTS AC
GRID RESISTOR = 10000 OHMS
CONDENSED-MERCURY TEMPERATURE = 40°C

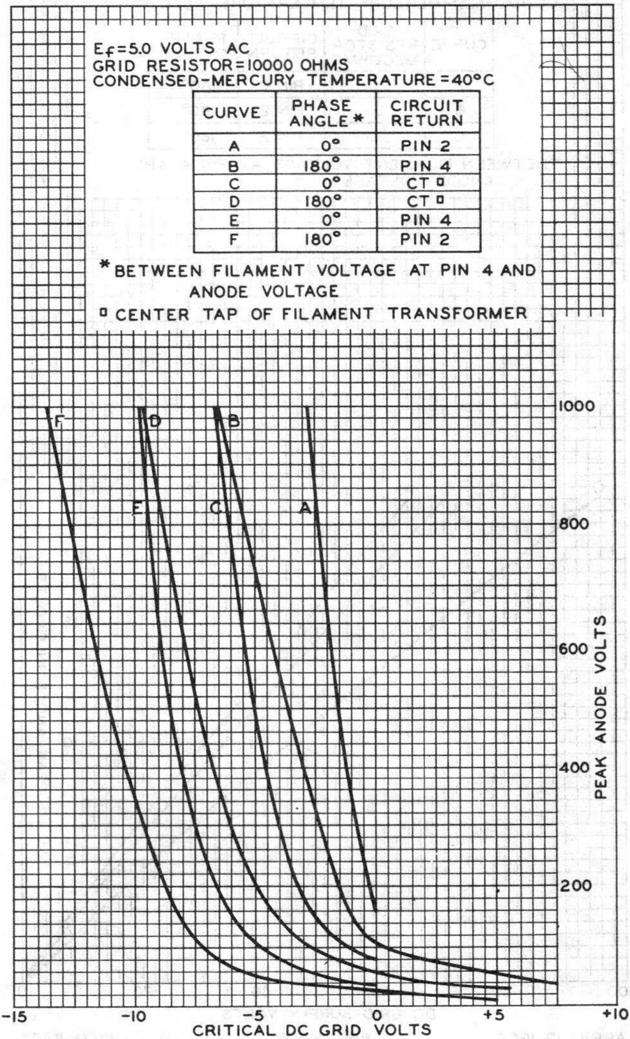
CURVE	PHASE ANGLE*	CIRCUIT RETURN
A	0°	PIN 2
B	0°	CT□
C	0°, 180° 90°	PIN 4 ANY •
D	180°	CT□
E	180°	PIN 2

*BETWEEN FILAMENT VOLTAGE AT PIN 4 AND ANODE VOLTAGE
□ CENTER TAP OF FILAMENT TRANSFORMER
• PIN 2, PIN 4, OR CT



RCA

5563-A
SHIFT OF AVERAGE CONTROL CHARACTERISTICS WITH CHANGE IN FILAMENT PHASING AND CIRCUIT RETURN AT LOW ANODE VOLTAGES



CURVE	PHASE ANGLE*	CIRCUIT RETURN
A	0°	PIN 2
B	180°	PIN 4
C	0°	CT □
D	180°	CT □
E	0°	PIN 4
F	180°	PIN 2

5563-A

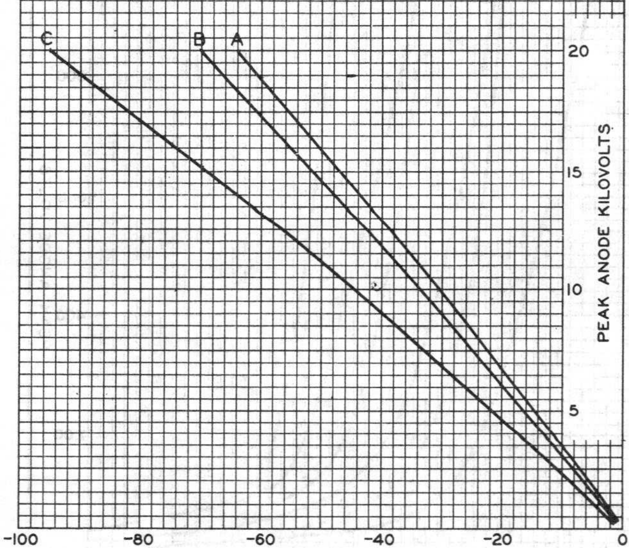
5563-A

SHIFT OF AVERAGE CONTROL CHARACTERISTICS WITH CHANGE IN GRID-RESISTOR VALUE

E_f = 5.0 VOLTS AC
CONDENSED-MERCURY TEMPERATURE = 40°C

CURVE	GRID RESISTOR MEGOHMS	CIRCUIT RETURN	PHASE ANGLE*
A	0.01	PIN 2	180°
B	0.1	PIN 2	180°
C	1	PIN 2	180°

*BETWEEN FILAMENT VOLTAGE AT PIN 4 AND ANODE VOLTAGE



APRIL. 12, 1954

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-8307

Voltage-Reference Tube

7-PIN MINIATURE, GLOW-DISCHARGE TYPE

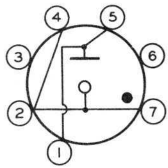
Especially Useful as a Voltage-Reference Tube in DC Power Supplies

DATA

General:

Cathode	Cold
Operating Position	Any
Maximum Overall Length	2-1/8"
Maximum Seated Length	1-7/8"
Length, Base Seat to Bulb Top (Excluding tip)	1-1/2" ± 3/32"
Diameter	0.650" to 0.750"
Dimensional Outline (See *General Section*)	JEDEC No.5-2
Bulb	T5-1/2
Base	Small-Button Miniature 7-Pin (JEDEC No.E7-1)
Basing Designation for BOTTOM VIEW	5BO

Pin 1 - Anode
Pin 2 - Cathode
Pin 3 - Do not use
Pin 4 - Cathode



Pin 5 - Anode
Pin 6 - Do not use
Pin 7 - Cathode

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

DC OPERATING CURRENT (Continuous)	3.5 max.	ma
DC OPERATING CURRENT (Continuous)	1.5 ~~max.~~	ma min
AMBIENT TEMPERATURE RANGE	-55 to 90	°C

Characteristics and Operation Range Values:

	Min.	*Av.*	*Max.*	
DC Starting Voltage	-	107	115[a]	volts
DC Operating Voltage (Variation from tube to tube):				
At 1.5 ma	83	85	87	volts
At 2.5 ma	83.5	85.5	87.5	volts
At 3.5 ma	84.5	86.5	88.5	volts
Regulation (1.5 ma to 3.5 ma)	-	-	3	volts
Temperature Coefficient of Operating Voltage (over ambient temperature range of -55 to 90° C)	-	-4	-	mv/°C
Percentage Variation of Operating Voltage:[b]				
During first 300 hours of life[c]	-	-	0.1	%
During subsequent 1000 hours of life	-	-	0.1	%

	Min.	Av.	Max.	
Short-term (100 hours)				
Variation of Operating Voltage after first 300 hours of life[b]	–	–	0.05	%
Instantaneous Voltage				
Fluctuation (Voltage jump)[d] . . .	–	–	0.1	volt

Circuit Values:

	Min.	Av.	Max.	
Shunt Capacitor	–	–	0.02	μf
Series Resistor		e		

[a] A dc supply voltage of 115 volts minimum should be provided to insure "starting" throughout tube life.

[b] DC operating current = 2.5 ma.

[c] After initial 3-minute warm-up period.

[d] Defined as the maximum instantaneous voltage fluctuation at any current level within the operating current range.

[e] A series resistor must always be used with the 5651A. The resistance value must be chosen so that (1) the maximum current rating of 3.5 ma is not exceeded at the highest anode-supply voltage employed, and (2) the minimum current rating of 1.5 ma is always exceeded when the anode-supply voltage is at its lowest value.

SPECIAL TESTS AND PERFORMANCE DATA

Stability Life Performance:

This test is performed on a sample lot of tubes to assure that the tubes have been properly stabilized. Life testing is performed under the following conditions: DC anode-supply volts = 135, dc operating milliamperes = 2.5, anode-circuit resistance (ohms) = 20000. At the end of 300 hours of operation, tubes will not show a change in dc operating voltage greater than 0.1 per cent from the initial dc operating voltage. At the end of 1300 hours of operation, tubes will not show a change in dc operating voltage greater than 0.1 per cent from the operating voltage at 300 hours. During any 100-hour interval between 300 and 1300 hours of operation, tubes will not show a change in dc operating voltage greater than 0.05 per cent from the dc operating voltage at the start of the interval.

INSTALLATION AND APPLICATION

Make no connections to pins 3 and 6. Any potentials applied to these pins may cause erratic tube performance. The three pin terminals for the cathode (pins 2,4, and 7) and the two for the anode (pins 1 and 5) offer the equipment designer several different possibilities for connection of the 5651A. Any pair of interconnected pins can be used as a jumper connection to a circuit common to either the cathode or to the anode. The use of such a jumper connection provides a means for opening the circuit to protect circuit components when the 5651A is removed from its socket. *Under no circumstances should the current through any pair of interconnected pins exceed one ampere.*

If the load for the regulated power supply is disconnected either directly or by removing the 5651A from its socket, the rectifier capacitors will charge to the rectifier peak voltage. It is important, therefore, that these capacitors be rated to withstand such voltage.

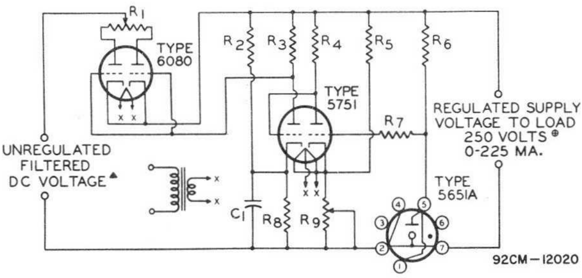
A warm-up period of 3 minutes should be allowed each time the equipment is turned on to insure minimum voltage drift of the 5651A.

When a shunt capacitor is used with the 5651A, its value should be limited to 0.02 μf. A large value of capacitance may cause the tube to oscillate and thus give unstable performance.

Shielding should be utilized for the 5651A to insure maximum stability when the tube is operated in the presence of strong rf or magnetic fields.

SERIES-TYPE STABILIZED-VOLTAGE SUPPLY-CIRCUIT Using RCA-5651A as Voltage-Reference Tube

The voltage regulation of this supply operated at a fixed line voltage of 117 volts and an output voltage of 250 volts is less than 0.2 volt over the current range of 0 to 225 milliamperes. At full current, the regulation for a variation of ±10 per cent in line voltage is less than 0.1 volt.



C_1 – 0.1 μf, 400 volts
R_1 – Plate current balancing potentiometer, 160 ohms, 10 watts
R_2 – 12000 ohms, 2 watts
R_3 – 470000 ohms, 1/2 watt
R_4 – 470000 ohms, 1/2 watt
R_5 – 12000 ohms, 2 watts
R_6 – 68000 ohms, 1 watt
R_7 – 1 megohm, 1/2 watt
R_8 – 15000 ohms, 2 watts
R_9 – Output voltage-control potentiometer, 10000 ohms

▲ 375 volts approx. at zero load current; 325 volts approx. at 225 milliamperes load current.

⊕ Socket connections are made so that removal of the 5651A from its socket opens the load.

5696

5696
THYRATRON

GAS-TETRODE, MINIATURE TYPE

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:
- Voltage . . . . 6.3 . . . . ac or dc volts
- Current . . . . 0.150 . . . . amp

Cathode:
- Minimum Heating Time, prior to tube conduction . . 10 . . . . sec

Direct Interelectrode Capacitances (Approx.):°
- Grid No.1 to Anode . . . 0.03 . . . . $\mu\mu$f
- Input . . . . 1.8 . . . . $\mu\mu$f
- Output . . . . 0.54 . . . . $\mu\mu$f

Ionization Time (Approx.):
- For conditions: dc anode volts = 100; grid-No.1 square-pulse volts = +50; peak cathode amperes during conduction = 0.150 . . . . . 0.5 μsec

Deionization Time (Approx.):
- For conditions: dc anode volts = 500; grid-No.1 volts = −100, grid-No.1 resistor (ohms) = 1000; dc cathode amperes = 0.025 . . . . . 25 μsec
- For conditions: dc anode volts = 500; grid-No.1 volts = −13; grid-No.1 resistor (ohms) = 1000; dc cathode amperes = 0.025 . . . . . 40 μsec

Maximum Critical Grid-No.1 Current, with ac anode-supply volts (rms) = 350, and average cathode amperes = 0.025 . . . . . 0.5 μamp

Anode Voltage Drop (Approx.) . . . . 10 volts

Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0; grid-No.2 volts = 0 250

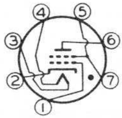
Grid-No.2 Control Ratio (Approx.) with grid-No.1 volts = 0, grid-No.2 resistor (ohms) = 0 15

° Without external shield.

Mechanical:

Mounting Position . . . . Any
Maximum Overall Length . . . . 1-3/4"
Maximum Seated Length . . . . 1-1/2"
Length, Base Seat to Bulb Top (excluding tip) . 1-1/8" ± 3/32"
Maximum Diameter . . . . 3/4"
Bulb T-5-1/2
Base . . . . Small-Button Miniature 7-Pin
Basing Designation for BOTTOM VIEW 7BN

Pin 1 – Grid No.1
Pin 2 – Cathode
Pin 3 – Heater
Pin 4 – Heater



Pin 5 – Grid No.2
Pin 6 – Anode
Pin 7 – Grid No.2

FEB. 1, 1949 TENTATIVE DATA

5696

5696

THYRATRON

RELAY and GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values*:

PEAK ANODE VOLTAGE:		
Forward	500 max.	volts
Inverse	500 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:		
Peak, before anode conduction	-50 max.	volts
Average, during anode conduction■	-10 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Peak, before anode conduction	-100 max.	volts
Average, during anode conduction■	-10 max.	volts
CATHODE CURRENT:		
Peak	0.1 max.	amp
Average■	0.025 max.	amp
Surge, for duration of 0.1 sec. max.	2 max.	amp
GRID-No.2 CURRENT:		
Average■	+0.005 max.	amp
GRID-No.1 CURRENT:		
Average■	+0.005 max.	amp
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	100 max.	volts
Heater positive with respect to cathode	25 max.	volts
AMBIENT TEMPERATURE RANGE	-55 to +90	°C

Typical Operating Conditions for Relay Service:

RMS Anode Voltage	117	volts
Grid No.2	Connected to cathode at socket	
RMS Grid-No.1 Bias Voltage□	5	volts
Peak Grid-No.1 Signal Voltage	5	volts
Grid-No.1-Circuit Resistance	0.1	megohm
Anode-Circuit Resistance#	5000	ohms

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	10 max.	megohms

■ Averaged over any interval of 30 sec. max.

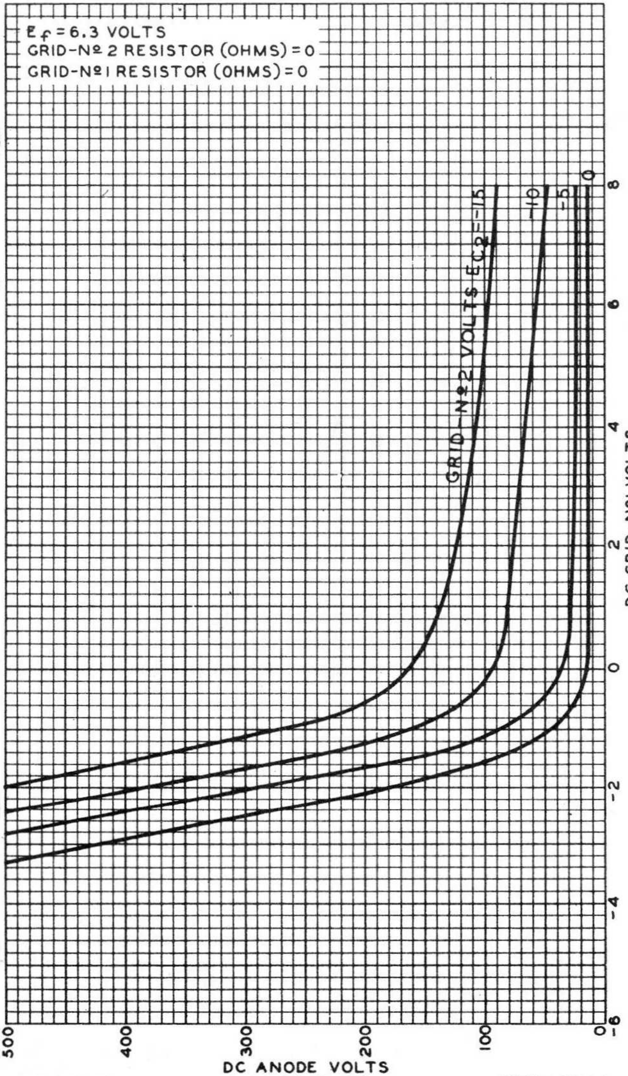
□ Approximately 180° out of phase with the anode voltage.

Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.

RCA

5696

AVERAGE CONTROL CHARACTERISTICS



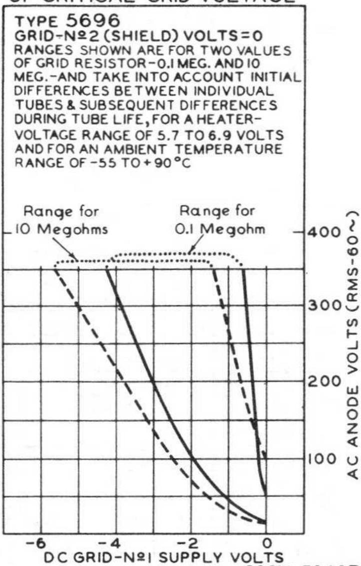
AUG. 6, 1948 — TUBE DEPARTMENT — 92CM-7044

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5696

5696
THYRATRON

OPERATIONAL RANGE
OF CRITICAL GRID VOLTAGE



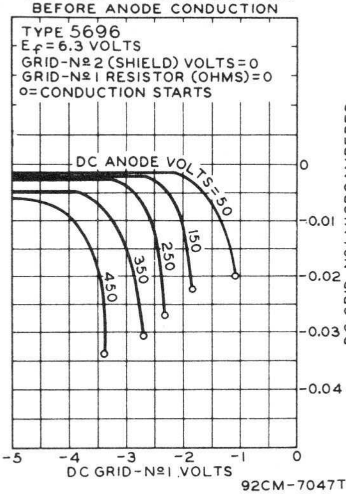
92CM-7045T

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

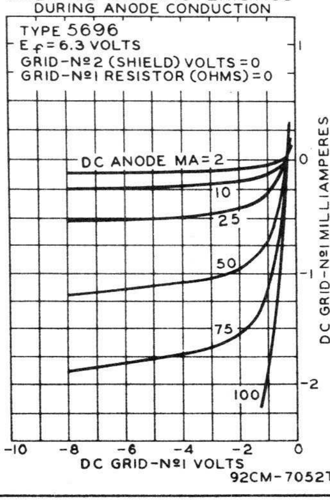
5696

THYRATRON

AVERAGE CHARACTERISTICS
BEFORE ANODE CONDUCTION



AVERAGE CHARACTERISTICS
DURING ANODE CONDUCTION



5727

PREMIUM TYPE 5727

GAS THYRATRON

7-PIN MINIATURE TETRODE TYPE

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:		
Voltage	6.3 ± 10%*	. . . ac or dc volts
Current	0.6	. . . . amp
Cathode:		
Minimum heating time prior to tube conduction	20	sec
Direct Interelectrode Capacitances (Approx.):°		
Grid No.1 to anode.	0.026	$\mu\mu$f
Grid No.1 to cathode, grid No.2, and heater.	2.4	$\mu\mu$f
Anode to cathode, grid No.2, and heater.	1.6	$\mu\mu$f
Ionization Time (Approx.):		
For dc anode volts = 100, grid-No.1 volts (square-wave pulse) = 50, peak anode amperes during conduction = 0.5.	0.5	μsec
Deionization Time (Approx.):		
For dc anode volts = 125, dc anode amperes = 0.1, grid-No.1 resistor (ohms) = 1000, and grid-No.1 volts = -100.	35	μsec
For dc anode volts = 125, dc anode amperes = 0.1, grid-No.1 resistor (ohms) = 1000, and grid-No.1 volts = -10	75	μsec
Maximum Critical Grid-No.1 Current:		
For anode-supply volts (rms) = 460, and average anode amperes = 0.1 . . .	0.5	μa
Anode Voltage Drop (Approx.).	8	volts
Grid-No.1 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0, grid-No.2 volts = 0.	250	
Grid-No.2 Control Ratio (Approx.) with grid-No.1 resistor (megohms) = 0, grid-No.2 resistor (megohms) = 0, grid-No.1 volts = 0.	1000	

Mechanical:

Operating Position. . . . . Any
Maximum Overall Length. . . . . 2-1/8"
Maximum Seated Length . . . . 1-7/8"
Length, Base Seat to Bulb Top (Excluding tip). . 1-1/2" ± 3/32"
Maximum Diameter. . . . . 3/4"
Dimensional Outline . . . . *See General Section*
Bulb. T5-1/2
Base. . . . . . . .Small-Button Miniature 7-Pin (JETEC No.E7-1)

*,°: See next page.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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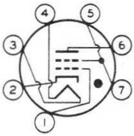
GAS THYRATRON

Basing Designation for BOTTOM VIEW 7BN

Pin 1 – Grid No.1
Pin 2 – Cathode
Pin 3 – Heater
Pin 4 – Heater



Pin 5 – Grid No.2
Pin 6 – Anode
Pin 7 – Grid No.2

RELAY AND GRID-CONTROLLED RECTIFIER SERVICE

Maximum and Minimum Ratings, ***Absolute Values:***

For anode-supply frequency of 60 cps

PEAK ANODE VOLTAGE:		
Forward.	650 max.	volts
Inverse.	1300 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:		
Peak, before tube conduction	-100 max.	volts
Average■, during tube conduction	-10 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Peak, before tube conduction	-100 max.	volts
Average■, during tube conduction	-10 max.	volts
CATHODE CURRENT:		
Peak	0.5 max.	amp
Average■	0.1 max.	amp
Fault, for duration of 0.1 second max.. .	10 max.	amp
GRID-No.2 CURRENT:		
Average■	+0.01 max.	amp
GRID-No.1 CURRENT:		
Average■	+0.01 max.	amp
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode .	100 max.	volts
Heater positive with respect to cathode .	25 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface)	150 max.	°C
AMBIENT TEMPERATURE.	-75 min.	°C

Typical Operation for Relay Service:

RMS Anode Voltage.	117	400	volts
Grid-No.2 Voltage.	0	0	volts
RMS Grid-No.1 Bias Voltage□. . . .	5	–	volts
DC Grid-No.1 Bias Voltage.	–	-6	volts
Peak Grid-No.1 Signal Voltage. . .	5	6	volts
Grid-No.1-Circuit Resistance . . .	1	1	megohm
Anode-Circuit Resistance#.	1200	2000	ohms

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	10 max.	megohms

*,○,■,□,#: See next page.

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GAS THYRATRON

PULSE-MODULATOR SERVICE

For rectangular-wave shapes, duty cycle of 0.001 max., pulse duration of 5 μsec. max., and pulse-repetition rate of 500 pps max.

Maximum and Minimum Ratings, *Absolute Values:*

PEAK ANODE VOLTAGE:		
Forward	500 max.	volts
Inverse	100 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:		
Peak, before tube conduction.	-50 max.	volts
Average, during tube conduction . . .	-10 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Peak, before tube conduction.	-100 max.	volts
Average, during tube conduction . . .	-10 max.	volts
CATHODE CURRENT:		
Peak.	10 max.	amp
Average	0.01 max.	amp
Rate of change.	100 max.	amp/μsec
PEAK GRID-No.2 CURRENT.	0.02 max.	amp
PEAK GRID-No.1 CURRENT.	0.02 max.	amp
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	0 max.	volts
Heater positive with respect to cathode	0 max.	volts
BULB TEMPERATURE (At hottest point on bulb surface).	150 max.	°C
AMBIENT TEMPERATURE	-75 min.	°C

Maximum and Minimum Circuit Values:

Grid-No.1-Circuit Resistance.	0.5 max.	megohm
Grid-No.2-Circuit Resistance.	25000 max.	ohms
	2000 min.	ohms

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

Values are initial, unless otherwise specified

	Note	*Min.*	*Max.*	
Heater Current.	1	540	660	ma
Grid-No.1 Supply Voltage for Tube Conduction (1)	1,2	-2.9	-4.5	volts
Grid-No.1 Supply Voltage for Tube Conduction (2)	1,3	-	-5.2	volts
Grid-No.1 Supply Voltage for Tube Conduction (3)	4,3	-	-6.4	volts
Anode-Supply Voltage for Tube Conduction (1)	1,5	-	38	volts
Anode-Supply Voltage for Tube Conduction (1) at 500 hours .	1,5	-	50	volts
Anode-Supply Voltage for Tube Conduction (2)	6,5	-	50	volts

*,○,■,□,#: See next page.

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	Note	Min.	Max.	
Anode-Supply Voltage for Tube Conduction (3)	7,8	650	-	volts
RMS Grid-No.2 Supply Voltage for Tube Conduction (This voltage is 180° out of phase with anode-supply voltage). .	1,9	1.9	3.3	volts
Heater-Cathode Leakage Current:				
Heater 25 volts positive with respect to cathode . .	1	-	15	μa
Heater 100 volts negative with respect to cathode . .	1	-	15	μa
Heater-Cathode Leakage Current at 500 hours:				
Heater 25 volts positive with respect to cathode . .	1	-	20	μa
Heater 100 volts negative with respect to cathode . .	1	-	20	μa
Leakage Resistance: Grid-No.2 to anode.	1,10	760	-	megohms
Leakage Resistance: Grid-No.2 to anode at 500 hours.	1,10	380	-	megohms

Note 1: With 6.3 volts ac or dc on heater.

Note 2: With anode-supply volts (rms) = 460, grid-No.2 volts = 0, load resistor (ohms) = 3000, and grid-No.1 resistor (megohms) = 0.1.

Note 3: With anode-supply volts (rms) = 460, grid-No.2 volts = 0, load resistor (ohms) = 3000, and grid-No.1 resistor (megohms) = 10.

Note 4: With 7.0 volts ac or dc on heater.

Note 5: With grid-No.2 volts = 0, grid-No.1 volts = 0, load resistor (ohms) = 1000, and grid-No.1 resistor (megohms) = 0.1.

Note 6: With 5.7 volts ac or dc on heater.

Note 7: With 0 volts on heater.

Note 8: With grid-No.1 volts = -100, grid-No.2 volts = 0, and load resistor (ohms) = 10000.

Note 9: With anode-supply volts (rms) = 150, grid-No.1 supply volts (rms and in phase with anode-supply voltage) = 16.

Note 10: With grid-No.2 volts = ±380 with respect to anode and all other electrodes floating.

* For pulse-modulator service, tolerance is +10%, -5%.

○ Without external shield.

■ Averaged over any interval of 30 seconds maximum.

□ Approximately 180° out of phase with the anode voltage.

Sufficient resistance, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings.

SPECIAL RATINGS AND PERFORMANCE DATA

Shock Rating:

Impact Acceleration . . . . 750 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are held rigid and are tested in

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GAS THYRATRON

four different positions. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for heater-cathode leakage current, grid-No. I supply voltage for tube conduction (I) and anode-supply voltage for tube conduction (I).

Fatigue Rating:

Vibrational Acceleration. . . . . 2.5 max. g

This test is performed on a sample lot of tubes from each production run. Tubes are rigidly mounted and subjected in each of three positions to 2.5 g vibrational acceleration at 60 cycles per second for 32 hours. At the end of this test, tubes will not show permanent or temporary shorts or open circuits, and are required to meet established limits for heater-cathode leakage current, grid-No. I supply voltage for tube conduction (I) and anode-supply voltage for tube conduction (I).

Heater-Cycling Life Performance:

Cycles of Intermittent Operation. . . . 2000 min. cycles

Under the following conditions: Heater volts = 7.5 cycled one minute on and one minute off, heater 100 volts negative with respect to cathode, and all other elements connected to ground.

Shorts and Continuity Test:

This test is performed on a sample lot of tubes from each production run. In this test a tube is considered inoperative if it shows a permanent or temporary short or open circuit.

1-Hour Stability Life Performance:

This test is performed on a sample lot of tubes from each production run to insure that tubes have been properly stabilized. Conditions of life testing are specified under 500-hour intermittent life performance, except test run at room temperature. Tubes are initially read for grid-No. I supply voltage for tube conduction (I). At the end of I hour, grid-No. I supply voltage is read. The variation in the 0-hour and 1-hour readings will not exceed 15 per cent. Tubes must also meet established limits of grid-No. I supply voltage.

100-Hour Survival Life Performance:

This test is performed on a sample lot of tubes from each production run to insure a low percentage of early inoperatives. Conditions of life testing are specified under 500-hour intermittent life performance, except test run at room temperature. At the end of 100 hours, a tube is considered inoperative if it shows a permanent or

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RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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temporary short or open circuit or fails to meet established limits of grid-No.1 supply voltage for tube conduction (1).

500-Hour Intermittent Life Performance:

This test is performed on a sample lot of tubes from each production run to insure high quality of the individual tube and to guard against epidemic failures of any of the characteristics indicated below. Life testing is conducted under the following conditions: Heater volts = 6.3, anode-supply volts (rms) = 460, grid-No.2 supply volts = 0, average anode milliamperes = 80, peak anode milliamperes = 500, grid-No.1 resistor (ohms) = 50000, and minimum bulb temperature (°C) = 150. At the end of 500 hours, tube will not show permanent shorts or open circuits and will be criticized for the total number of defects in the sample lot and for the number of tubes failing to pass established initial limits of heater current, grid-No.1 supply voltage (1), and 500-hour limits for anode-supply voltage (1), heater-cathode leakage current, and leakage resistance shown under CHARACTERISTICS RANGE VALUES.

OPERATING CONSIDERATIONS

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

Curves shown under Type 2D21 also apply to the 5727

RCA

5823

GLOW-DISCHARGE TRIODE

COLD-CATHODE, MINIATURE TYPE

GENERAL DATA

Electrical:

Cathode . . . . Cold

Ionization Time (Approx.):

For conditions: Instantaneous anode volts = 185; peak positive starter-electrode pre-firing volts = 70; peak positive starter-electrode triggering volts = 50; anode-circuit series resistor (ohms) = 820; starter-electrode series resistor (ohms) = 100000 . . . . 20 μsec

Deionization Time (Approx.):

For conditions: (Same as for *Ionization Time*) 500 μsec

Anode Voltage Drop. . . . . 62 volts

Starter-Electrode Voltage Drop. . . . . 61 volts

Anode Breakdown Voltage . . . . 290 volts

Starter-Electrode Breakdown Voltage . . . . . . 80 volts

Required Transfer Current (DC or Instantaneous AC) for transition of discharge to anode at 140 volts peak 50 μamp

Mechanical:

Mounting Position . . . . Any

Maximum Overall Length. . . . . 2-1/8"

Maximum Seated Length . . . . 1-7/8"

Length, Base Seat to Bulb Top (excluding tip) . 1-1/2" ±3/32"

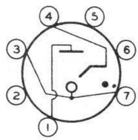
Maximum Diameter. . . . . 3/4"

Bulb. T-5-1/2

Base. . . . . Small-Button Miniature 7-Pin

Basing Designation for BOTTOM VIEW 4CK

Pin 1 – Anode
Pin 2 – Internal Connection–Do Not Use
Pin 3 – Cathode
Pin 4 – Starter Electrode



Pin 5 – Internal Connection–Do Not Use
Pin 6 – Internal Connection–Do Not Use
Pin 7 – Cathode

Maximum Ratings▲, *Absolute Values*:

For First-Quadrant Operation Only

PEAK ANODE AND STARTER-ELECTRODE VOLTAGE:

Inverse . . . . 200 max. volts

Forward . . . . 200 max. volts

▲ These ratings apply to the 5823 when it is operated from a power supply having a frequency of 60 cycles per second. If a contemplated application involves higher supply frequencies, please write, stating the proposed operating frequency, to the attention of Commercial Engineering, RCA, Harrison, New Jersey for information as to required changes in maximum ratings and characteristics.

5823

5823
GLOW-DISCHARGE TRIODE

CATHODE CURRENT:		
Peak.	100 max.	ma
Average*.	25 max.	ma
PEAK STARTER-ELECTRODE CURRENT:		
With starter-electrode voltage positive .	100 max.	ma
AMBIENT TEMPERATURE	-60 to +75	°C

Typical Operating Conditions:

For Relay Service with 60-Cycle AC Supply

AC Anode Supply Voltage (RMS)	117	volts
AC Starter-Electrode Voltage:		
Max. Peak Positive Pre-Firing Voltage	70	volts
Min. Peak Positive Triggering Voltage	35	volts
Min. Firing Voltage (Sum of In-Phase Instantaneous Pre-Firing Voltage and Instantaneous Triggering Voltage)	105	volts

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

For First-Quadrant Operation Only

	Note	*Min.*	*Max.*	
Anode Breakdown Voltage . .	1	200	-	volts
Starter-Electrode Breakdown Voltage. .	2	73	105□	volts
Required Transfer Current (DC or Instantaneous AC) for transition of discharge to anode at 140 volts peak	3	-	400□	μamp
Anode Voltage Drop.	4	-	85□	volts
Starter-Electrode Voltage Drop. .	5	-	75□	volts

Note 1: With a variable dc anode voltage, dc starter-electrode voltage of 0 volts, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 50000 ohms.

Note 2: With dc anode voltage of 0 volts, variable dc starter-electrode voltage, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 50000 ohms.

Note 3: With a variable dc starter-electrode voltage, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 2 megohms.

Note 4: With dc anode voltage of 230 volts, dc starter-electrode voltage of 91 volts, dc cathode current of 50 milliamperes, anode-circuit series resistance of 3000 ohms, and starter-electrode series resistance of 50000 ohms.

Note 5: With dc anode voltage of 0 volts, variable dc starter-electrode voltage, dc starter-electrode current of 10 milliamperes, and starter-electrode series resistance of 3000 ohms.

* Averaged over any interval of 15 seconds maximum.

□ Maximum individual tube values during life.

5823

GLOW-DISCHARGE TRIODE

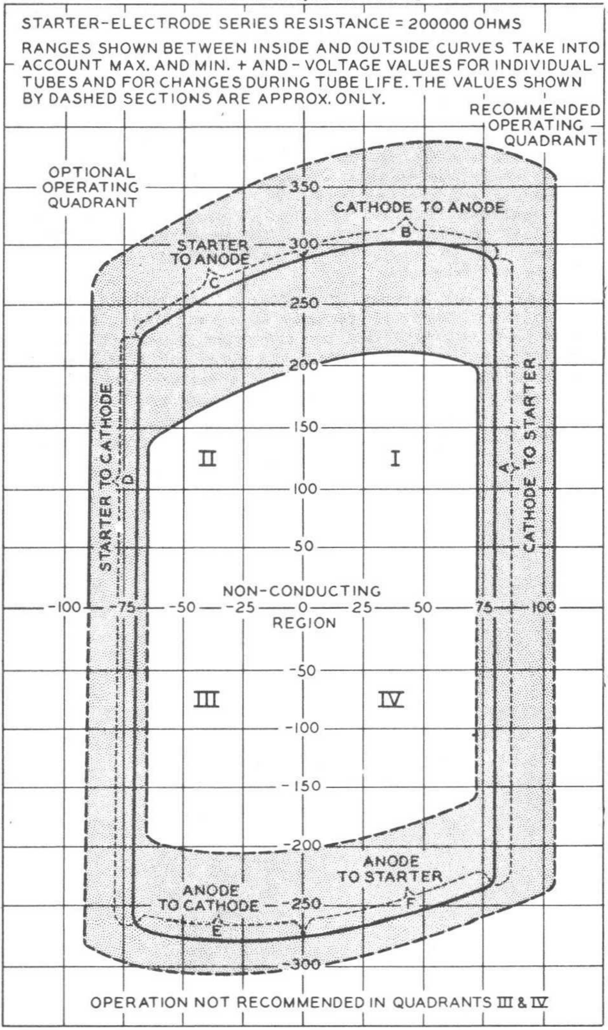
OPERATING NOTES

RCA-5823 is recommended for operation only in that part of the breakdown characteristic designated by Quadrant I. Operation in Quadrant II is satisfactory but changes in tube ratings are necessary. Operation in Quadrants III and IV is not recommended, because the anode and starter electrode are not designed for efficient cathode operation; their use in this manner will result in unstable operation and shorter tube life. The information given for Quadrants III and IV is of value to the equipment designer in that it indicates the need for precautions to be taken in order that the peak inverse voltage rating is not exceeded.

Because of the asymmetrical shape of its anode characteristic the 5823 can be used as a rectifier. When so used (with starter electrode connected through 50000-ohm resistor to anode), the 5823 has a maximum peak inverse anode voltage rating of 200 volts, a maximum peak cathode current of 100 milliamperes, and a maximum dc cathode current of 25 milliamperes. Operation at values of dc cathode current less than 8 milliamperes is not recommended because of resulting instability.

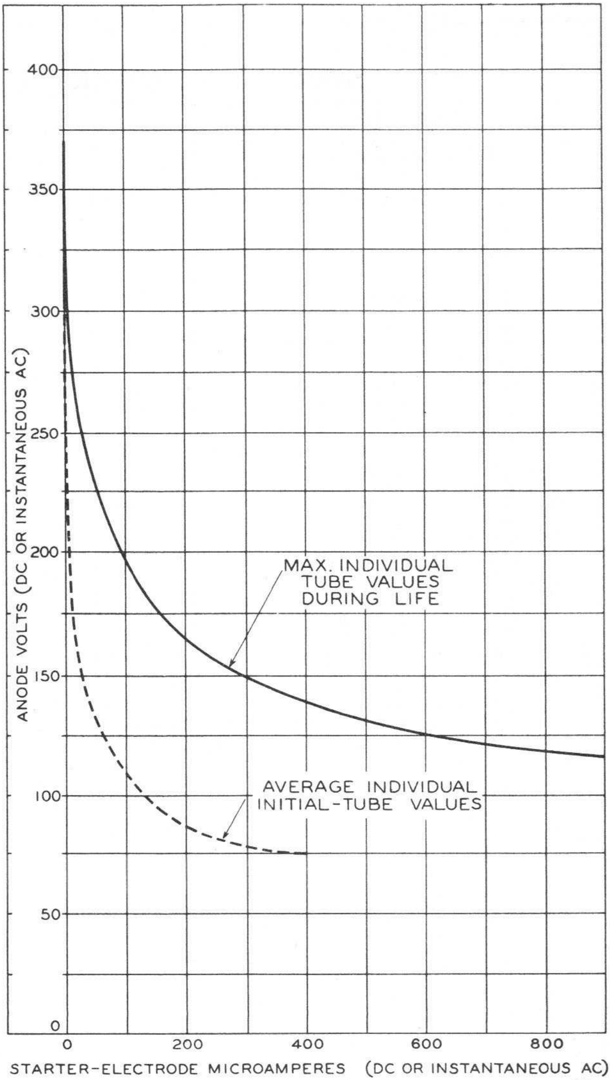
5823

5823
BREAKDOWN CHARACTERISTICS
FOR ALL QUADRANTS



5823

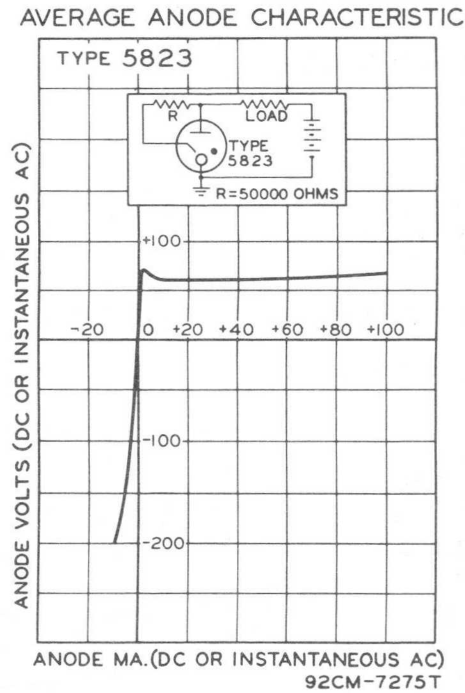
TRANSITION CHARACTERISTIC



5823

5823

GLOW-DISCHARGE TRIODE



TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6012
GAS THYRATRON

NEGATIVE–CONTROL TETRODE TYPE

GENERAL DATA

Electrical:

Heater, for Unipotential Cathode:

	Min.	Av.	Max.	
Voltage	5.7	6.3	6.9	ac or dc volts
Current at 6.3 volts	–	2.6	2.85	amp

Cathode:		
Minimum heating time prior to tube conduction	30	sec
Maximum outage time without reheating	5	sec
Direct Interelectrode Capacitances (Approx.):°		
Grid No.1 to anode	0.23	μμf
Grid No.1 to cathode, grid No.2, and heater	5.8	μμf
Anode to cathode, grid No.2, and heater	3.9	μμf
Ionization Time (Approx.): →		
For conditions: dc anode volts = 100, grid-No.2 volts = 0, grid-No.1 square-pulse volts = +50, and peak anode amperes during conduction = 5	0.5	μsec
Deionization Time (Approx.)	See Table I	→
Maximum Critical Grid-No.1 Current:		
For conditions: ac anode-supply volts = 460 (rms), and average anode amperes = 0.5	3	μamp
Anode Voltage Drop (Approx.)	10	volts
Grid-No.1 Control Ratio (Approx.):		
For conditions: grid-No.1 resistor (megohms) = 0, grid-No.2 resistor (megohms) = 0, and grid-No.2 volts = 0	150	
Grid-No.2 Control Ratio (Approx.):		
For conditions: grid-No.1 resistor (megohms) = 0, grid-No.2 resistor (megohms) = 0, and grid-No.1 volts = 0	650	

Mechanical:

Mounting Position	Any
Maximum Overall Length	3-7/8" →
Maximum Seated Length	3-5/16" →
Maximum Diameter	1-23/32"
Bulb	T-12
Base	Large-Wafer Octal 6-Pin with External Barriers and Sleeve (JETEC No.B6-100) →

° Without external shield.

→ Indicates a change.

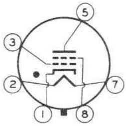
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6012
GAS THYRATRON

Basing Designation for BOTTOM VIEW 6CO

Pin 1 – Cathode
Pin 2 – Heater
Pin 3 – Grid No.1



Pin 5 – Anode
Pin 7 – Heater
Pin 8 – Grid No.2

RELAY AND GRID-CONTROLLED RECTIFIER SERVICE

For anode-supply frequency of 60 cps

Maximum Ratings, *Absolute Values:*

PEAK ANODE VOLTAGE:		
Forward.	650 max.	volts
Inverse.	1300 max.	volts
GRID-No.2 (SHIELD-GRID) VOLTAGE:		
Peak, before tube conduction	−100 max.	volts
Average#, during tube conduction	−10 max.	volts
GRID-No.1 (CONTROL-GRID) VOLTAGE:		
Peak, before tube conduction	−200 max.	volts
Average#, during tube conduction	−10 max.	volts
CATHODE CURRENT:		
Peak	5 max.	amp
Average#	0.5 max.	amp
Fault, for duration of 0.1 second max. .	20 max.	amp
AVERAGE GRID-No.2 CURRENT#	+0.05 max.	amp
AVERAGE GRID-No.1 CURRENT#	+0.05 max.	amp
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode.	100 max.	volts
Heater positive with respect to cathode.	25 max.	volts
AMBIENT-TEMPERATURE RANGE.	−75 to +90	°C

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	2 max.	megohms

Averaged over any interval of 30 seconds maximum.

→ Indicates a change.

TUBE DIVISION
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6012

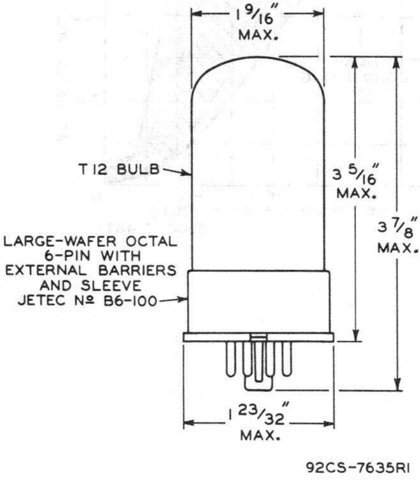
GAS THYRATRON

TABLE I

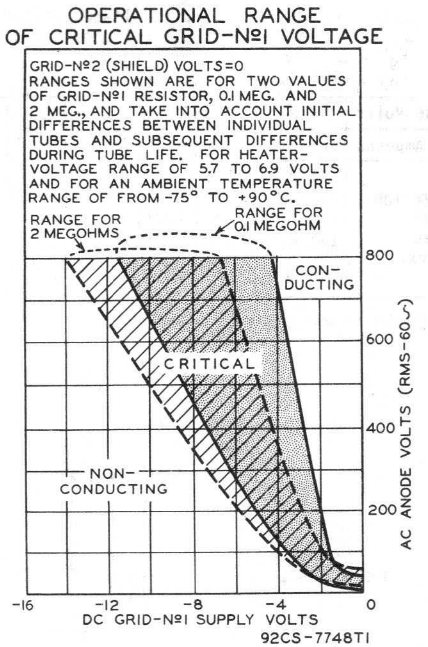
E_{cc_1} = DC Grid-No.1 Supply Voltage (Volts)
E_{cc_2} = DC Grid-No.2 Supply Voltage (Volts)
R_{g_1} = Grid-No.1 Resistor (Megohms)
R_{g_2} = Grid-No.2 Resistor (Ohms)

DC Anode Volts	125		250		R_{g_1}	E_{cc_1}	R_{g_2}*	E_{cc_2}
DC Anode Amperes	0.5	1.0	0.5	1.0				
DEIONIZATION TIME µsec (Approx.)	175	225	250	275	0.001	-13	1000	0
	350	375	450	475	0.1			
	650	700	1100	1200	2			
	100	125	100	125	0.001	-100	1000	0
	125	150	150	175	0.1			
	250	275	275	300	2			

* Series resistor between grid No.2 and cathode.



6012
GAS THYRATRON



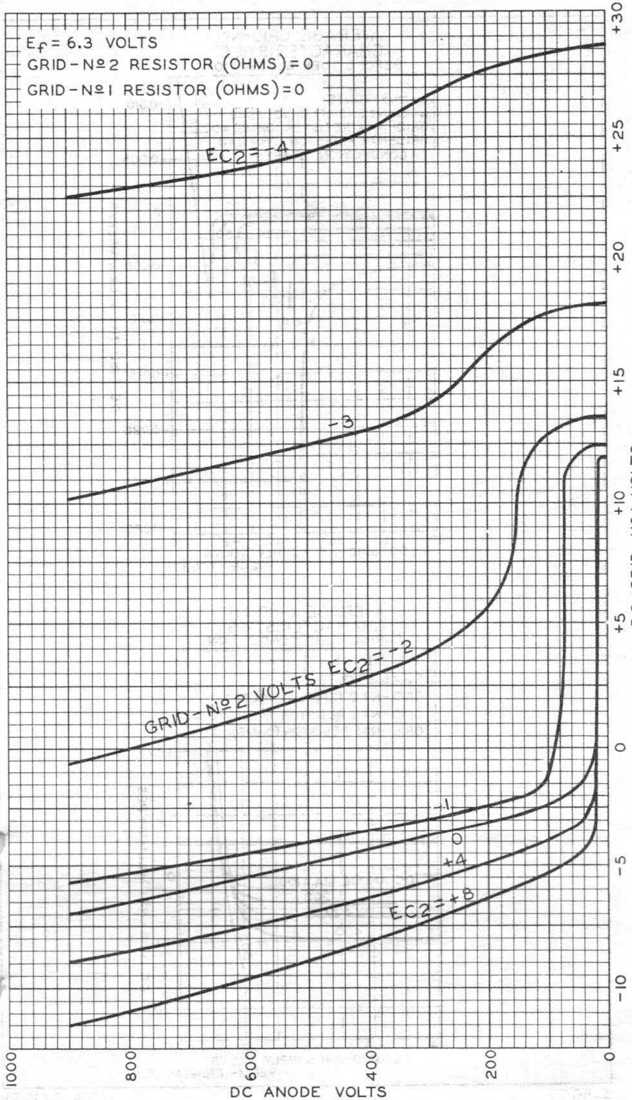
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

6012

RCA

6012

AVERAGE CONTROL CHARACTERISTICS



TUBE DIVISION

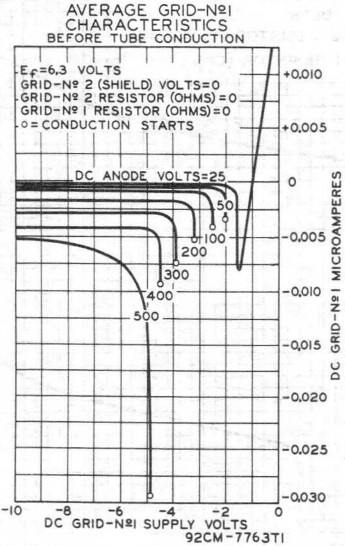
92CM-7747

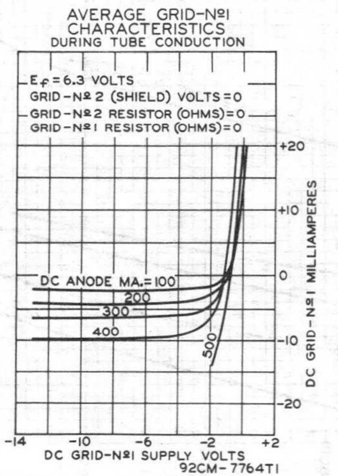
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6012

CHARACTERISTIC CURVES





TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

6073

VOLTAGE REGULATOR

MINIATURE GLOW-DISCHARGE TYPE

Intended for applications where very stable characteristics and dependable performance under shock and vibration are paramount. The 6073 is a "premium" version of the OA2.

DATA

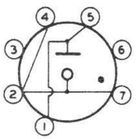
General:

Cathode . . . . Cold

Mechanical:

Mounting Position . . . . Any
Maximum Overall Length. . . . . 2-5/8"
Maximum Seated Length . . . . 2-3/8"
Length, Base Seat to Bulb Top (Excluding tip) . . . 2" ± 3/32"
Maximum Diameter. . . . . 3/4"
Bulb. T-5-1/2
Base. . . . . . Small-Button Miniature 7-Pin (JETEC No. E7-1)
Basing Designation for BOTTOM VIEW 5BQ

Pin 1 - Anode
Pin 2 - Cathode
Pin 3 - Internal Connection-Do Not Use
Pin 4 - Cathode



Pin 5 - Anode
Pin 6 - Internal Connection-Do Not Use
Pin 7 - Cathode

Maximum Ratings, ***Absolute Values*****:**

AVERAGE STARTING CURRENT (See note below) .	75 max.	ma
DC CATHODE CURRENT	30 max.	ma
	5 min.	ma
AMBIENT TEMPERATURE RANGE	-55 to +90	°C
FREQUENCY.	0 max.	cps

Characteristics Range Values for Equipment Design:

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage	185▲	-	-	volts
Anode Breakdown Voltage	-	156	185✠	volts
Anode Voltage Drop.	140★	151	168✠	volts
Regulation (5 to 30 ma)	-	2	6✠	volts

Circuit Values:

Shunt Capacitor	-	-	0.1	μf
Series Resistor			See note below	

NOTE: The notes and circuit information shown under Type OA2 are also applicable to the 6073.

▲,✠,★: See next page.

MAY 1, 1952 TENTATIVE DATA

RCA

6073

VOLTAGE REGULATOR

Shock and Vibration Tests:

These tests are made as indicated in the JAN Specifications JAN 1-A for Electron Tubes, May, 1946 under the sections as follows:

Section F-6b (9e) Shock Test:
Instantaneous Impact Acceleration . . . . 900 max. g

Section F-6b (9f) Vibration Test:
Vibrational Acceleration. . . . . 2.5 max. g

▲ Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

✤ Maximum individual tube value during life.

★ Minimum individual tube value during life.

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6074

VOLTAGE REGULATOR

PREMIUM TYPE 6074

MINIATURE GLOW-DISCHARGE TYPE

Intended for applications where very stable characteristics and dependable performance under shock and vibration are paramount. The 6074 is a "premium" version of the OB2.

DATA

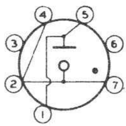
General:

Cathode. . . . . Cold

Mechanical:

Mounting Position. . . . . Any
Maximum Overall Length . . . . 2-5/8"
Maximum Seated Length. . . . . 2-3/8"
Length, Base Seat to Bulb Top (Excluding tip). . . 2" ±3/32"
Maximum Diameter . . . . 3/4"
Bulb T-5-1/2
Base . . . . . . Small-Button Miniature 7-Pin (JETEC No.E7-1)
Basing Designation for BOTTOM VIEW 5BQ

Pin 1 – Anode
Pin 2 – Cathode
Pin 3 – Internal Connection–Do Not Use
Pin 4 – Cathode



Pin 5 – Anode
Pin 6 – Internal Connection–Do Not Use
Pin 7 – Cathode

Maximum Ratings, *Absolute Values*:

AVERAGE STARTING CURRENT (See note below)	75 max.	ma
DC CATHODE CURRENT	30 max.	ma
	5 min.	ma
AMBIENT TEMPERATURE RANGE.	-55 to +90	°C
FREQUENCY.	0 max.	cps

Characteristics Range Values for Equipment Design:

	Min.	*Av.*	*Max.*	
DC Anode-Supply Voltage. . . .	133▲	–	–	volts
Anode Breakdown Voltage. . . .	–	115	133✱	volts
Anode Voltage Drop	101★	108	114✱	volts
Regulation (5 to 30 ma). . . .	–	1	4✱	volts
Circuit Values:				
Shunt Capacitor.	–	–	0.1	μf
Series Resistor.			See note below	

NOTE: The notes and circuit information shown under Type OA2 are also applicable to the 6074.

▲,✱,★: See next page.

MAY 1, 1952 TENTATIVE DATA

6074

6074
VOLTAGE REGULATOR

Shock and Vibration Tests:

These tests are made as indicated in the JAN Specifications JAN 1-A for Electron Tubes, May, 1946 under the sections as follows:

Section F-6b (9e) Shock Test:
Instantaneous Impact Acceleration . . . . 900 max. g

Section F-6b (9f) Vibration Test:
Vibrational Acceleration. . . . . 2.5 max. g

▲ Not less than indicated supply voltage should be provided to insure "starting" throughout tube life.

✠ Maximum individual tube value during life.

★ Minimum individual tube value during life.

CIK/6014

XENON THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

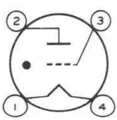
Electrical:

	Min.	*Av.*	*Max.*	
Filament, Coated:				
Voltage	2.4	2.5	2.6	ac or dc volts
Current at 2.5 volts. .	5.5	6.3	7.1	amp
Minimum heating time prior to tube conduction			25	sec
Direct Interelectrode Capacitances (Approx.):				
Grid to anode			1	μμf
Grid to cathode			10	μμf
Maximum Deionization Time			500	μsec
Maximum Critical Grid Current			5	μamp
Anode Voltage Drop:				
Average, at beginning of life			8	volts
Maximum, at end of life			14	volts
Maximum Commutation Factor♦, averaged over first 500 volts of inverse anode voltage rise.			0.15	va/μs^2
Grid Control Ratio (Approx.): For conditions: 10000-ohm grid resistor, circuit returns to filament transformer center-tap, dc anode voltage, and dc grid voltage			230	

Mechanical:

Mounting Position . . . . Any
Maximum Overall Length. . . . . 4-1/4"
Maximum Diameter. . . . . 1-9/16"
Weight (Approx.). . . . . 3 oz
Bulb. T-12
Base. . . . . .Medium-Metal-Shell Small 4-Pin with Bayonet (JETEC No.A4-89)
Basing Designation for BOTTOM VIEW. 4D

Pin 1 - Filament
Pin 2 - Anode



Pin 3 - Grid
Pin 4 - Filament

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, ***Absolute Values:***

PEAK ANODE VOLTAGE:		
Forward	1000 max.	volts
Inverse	1250 max.	volts
GRID VOLTAGE:		
Peak, before tube conduction.	-100 max.	volts

♦ Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.

RCA

CIK/6014

XENON THYRATRON

ANODE CURRENT:			
Peak		8 max.	amp
Average●		1 max.	amp
Overload*, for duration of	0.56 sec.	8 max.	amp
	1 sec.	4.5 max.	amp
	2 sec.	2.25 max.	amp
	3 sec.	1.5 max.	am
	4 sec.	1.13 max.	am
Fault, for duration of 0.1 second maximum		77 max.	amp
AMBIENT-TEMPFRATURE RANGE		-55 to +75	°C

● Averaged over any period of 4.5 seconds.

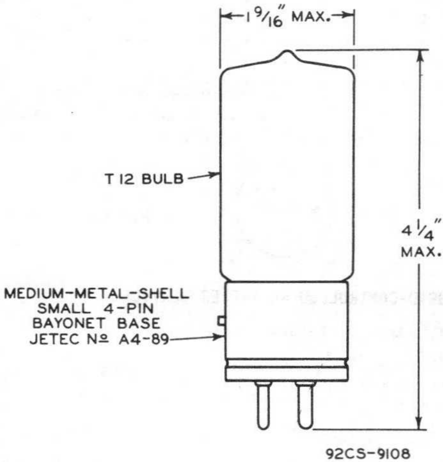
* Averaged for duration of overload occurring no more than once in any period of 4.5 seconds.

OPERATING CONSIDERATIONS

Circuit returns may be made to either side of filament or to transformer center-tap.

The *anode* of the CIK/6014 may show a red color when the tube is operated at full load.

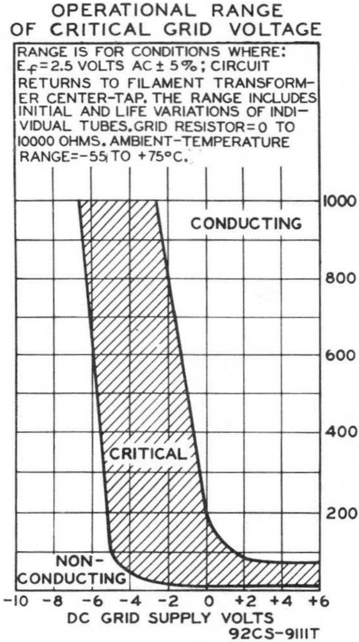
Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

CIK/6014

XENON THYRATRON



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

C3J

RCA

C3J/5632

XENON THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

	Min.	Av.	Max.	
Filament, Coated and Mid-tapped:				
Voltage between pins 1 and 4	2.4	2.5	2.6	ac or dc volts
Current at 2.5 volts	7	9	11	amp
Minimum heating time prior to tube conduction			30	sec
Direct Interelectrode Capacitances (Approx.):				
Grid to anode			2	$\mu\mu$f
Grid to cathode			14	$\mu\mu$f
Maximum Deionization Time			1000	μsec
Maximum Critical Grid Current			10	μamp
Anode Voltage Drop:				
Average, at beginning of life			10	volts
Maximum, at end of life			14	volts
Maximum Commutation Factor♦, averaged over first 350 volts of inverse anode voltage rise			0.66	va/μs^2
Grid Control Ratio (Approx.): For conditions: 10000-ohm grid resistor, circuit returns to filament mid-tap, dc anode voltage, and dc grid voltage			200	

Mechanical:

Mounting Position . . . . Any

Maximum Overall Length . . . . 6"

Maximum Diameter . . . . 1-9/16"

Weight (Approx.) . . . . 3 oz

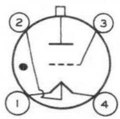
Cap . . . . Medium (JETEC No.C1-5)

Bulb T-12

Base . . . . Medium-Metal-Shell Small 4-Pin with Bayonet (JETEC No.A4-89)

Basing Designation for BOTTOM VIEW 4CF

Pin 1 - Filament
Pin 2 - Filament Mid-Tap & Circuit Returns



Pin 3 - Grid
Pin 4 - Filament
Cap - Anode

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values:*

PEAK ANODE VOLTAGE:		
Forward	900 max.	volts
Inverse	1250 max.	volts

♦ Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.

RCA

C3J/5632

XENON THYRATRON

GRID VOLTAGE:			
Peak, before tube conduction. . . .		-100 max.	volts
ANODE CURRENT:			
Peak.		30 max.	amp
Average●.		2.5 max.	amp
Overload:			
Rating I*, for duration of . .	0.37 sec. . .	30 max.	amp
	0.50 sec. . .	22.5 max.	amp
	1 sec. . .	11.25 max.	amp
	2 sec. . .	5.63 max.	amp
	3 sec. . .	3.75 max.	amp
	4 sec. . .	2.82 max.	amp
Rating II**, for duration of . .	3 sec. . .	3.75 max.	amp
	4 sec. . .	3.40 max.	amp
	4.5 sec. . .	3.30 max.	amp
Fault, for duration of 0.1 second maximum		300 max.	amp
AMBIENT-TEMPERATURE RANGE		-55 to +75	°C

● Averaged over any period of 4.5 seconds.

* Averaged over duration of overload occurring no more than once in any period of 4.5 seconds.

** Averaged over duration of overload occurring no more than once in any period of 30 seconds.

OPERATING CONSIDERATIONS

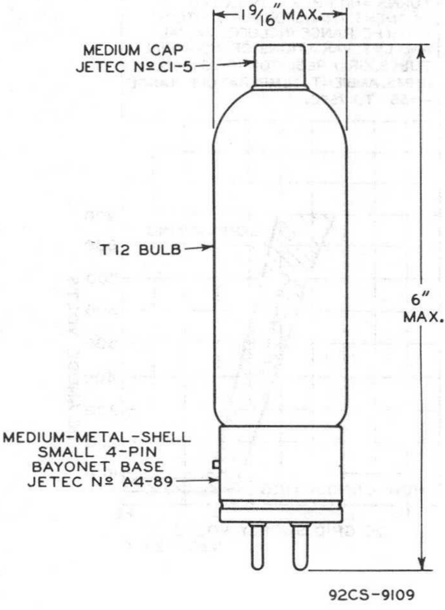
Circuit returns should be connected to filament mid-tap (pin 2).

The *anode* of the C3J/5632 may show a red color when the tube is operated at full load.

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

C3J/5632

XENON THYRATRON



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

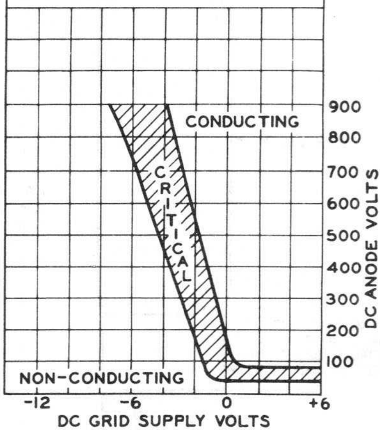
RCA

C3J/5632

XENON THYRATRON

OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE: E_f=2.5 VOLTS ± 5%; CIRCUIT RETURNS AND PIN 2 CONNECTED TO FILAMENT TRANSFORMER CENTER-TAP. THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES. GRID RESISTOR=0 TO 10000 OHMS. AMBIENT-TEMPERATURE RANGE = −55 TO 75°C.



92CS-9117T

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

C3J-A/5684

XENON THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

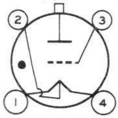
	Min.	Av.	Max.	
Filament, Coated and Mid-tapped:				
Voltage between pins 1 and 4	2.4	2.5	2.6	ac or dc volts
Current at 2.5 volts	7	9	11	amp
Minimum heating time prior to tube conduction			30	sec

Direct Interelectrode Capacitances (Approx.):		
Grid to anode	2	$\mu\mu$f
Grid to cathode	14	$\mu\mu$f
Maximum Deionization Time	1000	μsec
Maximum Critical Grid Current	10	μamp
Anode Voltage Drop:		
Average, at beginning of life	10	volts
Maximum, at end of life	14	volts
Maximum Commutation Factor♦, averaged over first 350 volts of inverse anode voltage rise	0.66	va/μs^2
Grid Control Ratio (Approx.): For conditions: 10000-ohm grid resistor, circuit returns to filament mid-tap, dc anode voltage, and dc grid voltage	200	

Mechanical:

Mounting Position	Any
Maximum Overall Length	6"
Maximum Diameter	1-9/16"
Weight (Approx.)	3 oz
Cap	Medium (JETEC No.C1-5)
Bulb	T-12
Base	Medium-Metal-Shell Small 4-Pin with Bayonet (JETEC No.A4-89)
Basing Designation for BOTTOM VIEW	4CF

Pin 1 – Filament
Pin 2 – Filament Mid-Tap & Circuit Returns



Pin 3 – Grid
Pin 4 – Filament
Cap – Anode

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values:*

PEAK ANODE VOLTAGE:

Forward	1000 max.	volts
Inverse	1250 max.	volts

♦ Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.

12-56 TENTATIVE DATA

C3J-A

C3J-A/5684

XENON THYRATRON

GRID VOLTAGE:			
Peak, before tube conduction		-100 max.	volts
ANODE CURRENT:			
Peak		30 max.	amp
Average●		2.5 max.	amp
Overload:			
Rating I*, for duration of	0.37 sec.	30 max.	amp
	0.50 sec.	22.5 max.	amp
	1 sec.	11.25 max.	amp
	2 sec.	5.63 max.	amp
	3 sec.	3.75 max.	amp
	4 sec.	2.82 max.	amp
Rating II**, for duration of	3 sec.	3.75 max.	amp
	4 sec.	3.40 max.	amp
	4.5 sec.	3.30 max.	amp
Fault, for duration of 0.1 second maximum		300 max.	amp
AMBIENT-TEMPERATURE RANGE		-55 to +75	°C

● Averaged over any period of 4.5 seconds.

* Averaged over duration of overload occurring no more than once in any period of 4.5 seconds.

** Averaged over duration of overload occurring no more than once in any period of 30 seconds.

OPERATING CONSIDERATIONS

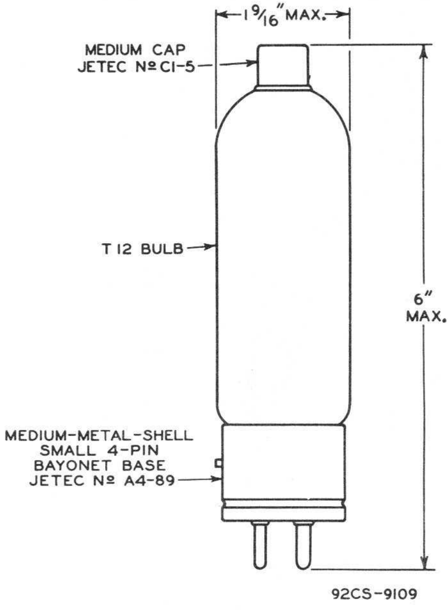
Circuit returns should be connected to filament mid-tap (pin 2).

The *anode* of the C3J-A/5684 may show a red color when the tube is operated at full load.

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

C3J-A/5684

XENON THYRATRON



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

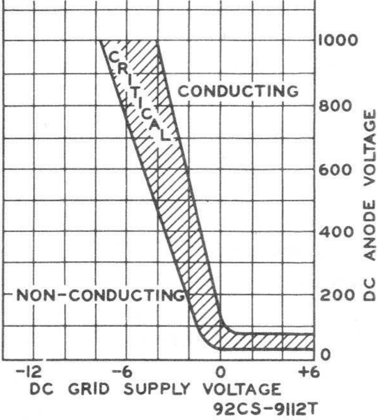
RCA

C3J-A/5684

XENON THYRATRON

OPERATIONAL RANGE
OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE: E_f=2.5 VOLTS± 5%; CIRCUIT RETURNS AND PIN 2 CONNECTED TO FILAMENT TRANSFORMER CENTER-TAP.
THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES.
GRID RESISTOR=0 TO 10000 OHMS.
AMBIENT-TEMPERATURE RANGE=-55 TO 75°C.



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Xenon Thyratron

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

	Min.	*Av.*	*Max.*	
Filament, Coated and Mid-Tapped:				
Voltage (AC or DC) between pins 2 and 3.	2.4	2.5	2.6	volts
Current	7	9	11	amp
Minimum heating time prior to tube conduction.		30		sec
Direct Interelectrode Capacitances (Approx.):				
Grid to anode		2		$\mu\mu$f
Ionization Time (Approx.)		10		μsec
Deionization Time (Approx.)		1000		μsec
Maximum Critical Grid Current		10		μa
Anode Voltage Drop at peak anode amperes = 10.		10		volts
Maximum Commutation Factor[a] averaged over first 350 volts of inverse anode-voltage rise.		0.66		va/μsec^2

Mechanical:

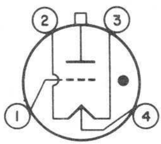
Operating Position.	Any
Maximum Overall Length.	6-3/4"
Maximum Seated Length	6"
Maximum Diameter.	2-3/16"
Weight (Approx.).	3 oz
Cap	Medium (JEDEC No.C1-5)
Base.	Special Metal Shell

Terminal Diagram: BOTTOM VIEW

Pin 1 – Grid

Pin 2 – Filament

Pin 3 – Filament



Pin 4 – Filament Tap & Circuit Returns

Cap – Anode

GRID-CONTROLLED-RECTIFIER SERVICE

Maximum and Minimum Ratings, *Absolute-Maximum Values:*

For anode supply frequency of 60 cps

PEAK ANODE VOLTAGE:		
Forward	900 max.	volts
Inverse	1250 max.	volts
PEAK NEGATIVE GRID VOLTAGE:		
Before tube conduction.	100 max.	volts
During tube conduction.	10 max.	volts

ANODE CURRENT:		
Peak.	30 max.	amp
Average[b].	2.5 max.	amp
Fault	300 max.	amp
AMBIENT-TEMPERATURE RANGE during operation .	-55 to +75	°C

[a] Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse-voltage rise in volts per microsecond following current conduction.

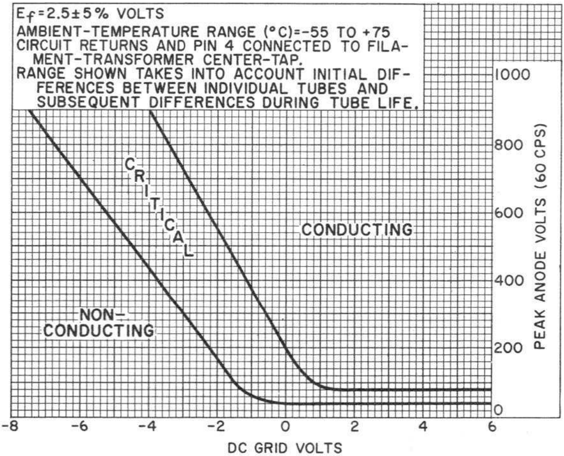
[b] Averaged over any period of 4.5 seconds.

OPERATING CONSIDERATIONS

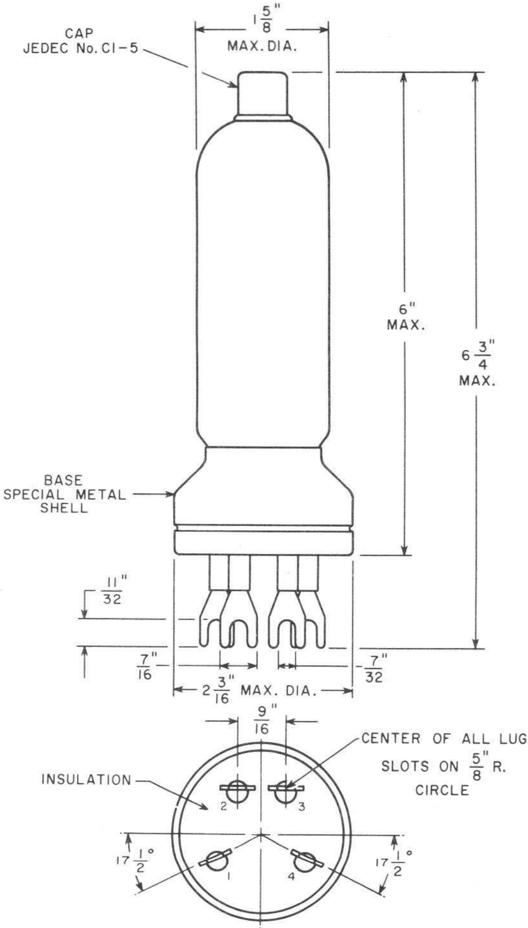
Circuit returns should be connected to filament mid-tap (Pin 4).

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the maximum current ratings of the tube.

OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE



92CS-11323



$1\frac{5}{8}$" MAX. DIA.
CAP JEDEC No. C1-5
6" MAX.
$6\frac{3}{4}$" MAX.
BASE SPECIAL METAL SHELL
$\frac{11}{32}$"
$\frac{7}{16}$"
$\frac{7}{32}$"
$2\frac{3}{16}$" MAX. DIA.
$\frac{9}{16}$"
CENTER OF ALL LUG SLOTS ON $\frac{5}{8}$" R. CIRCLE
INSULATION
2
3
1
4
$17\frac{1}{2}$°
$17\frac{1}{2}$°

92CM-11314

C6J

C6J/5C21

XENON THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

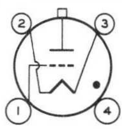
	Min.	Av.	Max.	
Filament, Coated:				
Voltage	2.4	2.5	2.6	ac or dc volts
Current at 2.5 volts. . .	19	21	23	amp

Minimum heating time prior to tube conduction.	60	sec
Direct Interelectrode Capacitances (Approx.):		
Grid to anode	4	μμf
Grid to cathode	21	μμf
Maximum Deionization Time	1000	μsec
Maximum Critical Grid Current	10	μamp
Anode Voltage Drop:		
Average, at beginning of life	9	volts
Maximum, at end of life	12	volts
Maximum Commutation Factor♠, averaged over first 350 volts of inverse anode voltage rise.	0.66	va/μs²
Grid Control Ratio (Approx.): For conditions: 10000-ohm grid resistor, circuit returns to filament transformer center-tap, filament pin 2 negative with respect to filament pin 3 when anode is positive, dc anode voltage, and dc grid voltage.	210	

Mechanical:

Mounting Position . . . . Vertical, base down
Maximum Overall Length. . . . . 9-1/2"
Maximum Diameter. 2-1/32"
Weight (Approx.). . . . . 7 oz
Cap . . . . .Medium (JETEC No.C1-5)
Bulb. T-16
Base. . . . . .Medium-Metal-Shell Super-Jumbo 4-Pin (JETEC No.A4-81)
Basing Designation for BOTTOM VIEW. 4BZ

Pin 1 - Grid
Pin 2 - Filament
Pin 3 - Filament



Pin 4 - No Connection
Cap - Anode

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values:*

PEAK ANODE VOLTAGE:		
Forward	750 max.	volts
Inverse	1250 max.	volts

♠: See next page.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

C6J

C6J/5C21

XENON THYRATRON

GRID VOLTAGE:			
Peak, before tube conduction.		-100 max.	volts
ANODE CURRENT:			
Peak.		77 max.	amp
Average●.		6.4 max.	amp
Overload:			
Rating I*, for duration of . . .	0.5 sec. . . .	77 max.	amp
	1 sec. . . .	38.5 max.	amp
	2 sec. . . .	19.2 max.	amp
	3 sec. . . .	12.8 max.	amp
	4 sec. . . .	9.6 max.	amp
	5 sec. . . .	7.7 max.	amp
Rating II**, for duration of . . .	3 sec. . . .	12.8 max.	amp
	4 sec. . . .	11.2 max.	amp
	5 sec. . . .	10.3 max.	amp
	6 sec. . . .	9.6 max.	amp
Fault, for duration of 0.1 second maximum		770 max.	amp
AMBIENT-TEMPERATURE RANGE		-55 to +75	°C

♦ Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.

● Averaged over any period of 6 seconds.

* Averaged over duration of overload occurring no more than once in any period of 6 seconds.

** Averaged over duration of overload occurring no more than once in any period of 30 seconds.

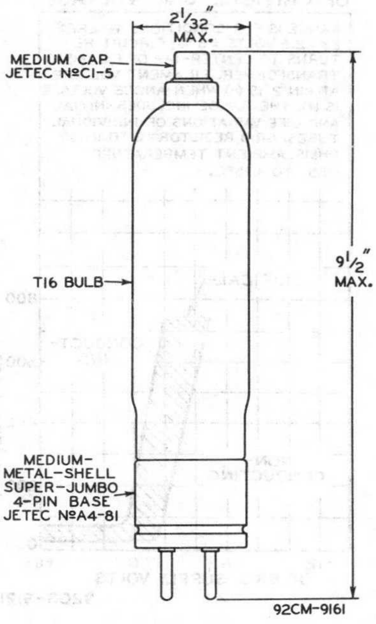
OPERATING CONSIDERATIONS

The *anode* of the C6J/5C21 will show a red color when the tube is operated at full load.

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

C6J/5C21

XENON THYRATRON



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

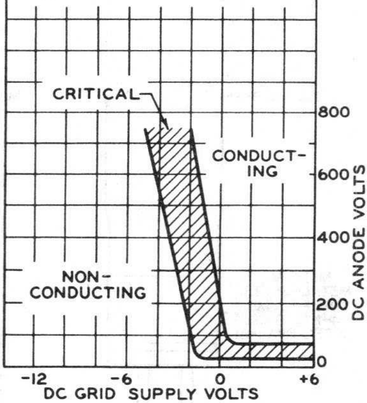
C6J

C6J/5C21

XENON THYRATRON

OPERATIONAL RANGE OF CRITICAL GRID VOLTAGE

RANGE IS FOR CONDITIONS WHERE: E_f = 2.5 VOLTS ± 5 %; CIRCUIT RETURNS TO CENTER-TAP OF FILAMENT TRANSFORMER. FILAMENT VOLTAGE AT PIN 2 IS (–) WHEN ANODE VOLTAGE IS (+). THE RANGE INCLUDES INITIAL AND LIFE VARIATIONS OF INDIVIDUAL TUBES. GRID RESISTOR = 0 TO 10000 OHMS. AMBIENT TEMPERATURE = -55 TO +75°C.



92CS-9121T

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

C6J-A/5685

XENON THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

	Min.	*Av.*	*Max.*	
Filament, Coated:				
Voltage	2.4	2.5	2.6	ac or dc volts
Current at 2.5 volts	19	21	23	amp

Minimum heating time prior to tube conduction	60	sec
Direct Interelectrode Capacitances (Approx.):		
Grid to anode	4	$\mu\mu$f
Grid to cathode	21	$\mu\mu$f
Maximum Deionization Time	1000	μsec
Maximum Critical Grid Current	10	μamp
Anode Voltage Drop:		
Average, at beginning of life	9	volts
Maximum, at end of life	12	volts
Maximum Commutation Factor♦, averaged over first 350 volts of inverse anode voltage rise	0.66	va/μs^2
Grid Control Ratio (Approx.): For conditions: 10000-ohm grid resistor, circuit returns to filament transformer center-tap, filament pin 2 negative with respect to filament pin 3 when anode is positive, dc anode voltage, and dc grid voltage	210	

Mechanical:

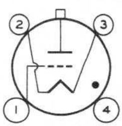
Mounting Position	Vertical, base down
Maximum Overall Length	9-1/2"
Maximum Diameter	2-1/32"
Weight (Approx.)	7 oz
Cap	Medium (JETEC No.C1-5)
Bulb	T-16
Base	Medium-Metal-Shell Super-Jumbo 4-Pin (JETEC No.A4-81)

Basing Designation for BOTTOM VIEW 4BZ

Pin 1 – Grid

Pin 2 – Filament

Pin 3 – Filament



Pin 4 – No Connection

Cap – Anode

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, ***Absolute Values:***

PEAK ANODE VOLTAGE:		
Forward	1000 max.	volts
Inverse	1250 max.	volts

♦: See next page.

C6J-A

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XENON THYRATRON

GRID VOLTAGE:		
Peak, before tube conduction	-100 max.	volts
ANODE CURRENT:		
Peak	77 max.	amp
Average•	6.4 max.	amp
Overload:		
Rating I*, for duration of. . . . 0.5 sec	77 max.	amp
1 sec	38.5 max.	amp
2 sec	19.2 max.	amp
3 sec	12.8 max.	amp
4 sec	9.6 max.	amp
5 sec	7.7 max.	amp
Rating II**, for duration of. . . . 3 sec	12.8 max.	amp
4 sec	11.2 max.	amp
5 sec	10.3 max.	amp
6 sec	9.6 max.	amp
Fault, for duration of 0.1 second maximum.	770 max.	amp
AMBIENT-TEMPERATURE RANGE.	-55 to +75	°C

♦ Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.

• Averaged over any period of 6 seconds.

* Averaged over duration of overload occurring no more than once in any period of 6 seconds.

** Averaged over duration of overload occurring no more than once in any period of 30 seconds.

OPERATING CONSIDERATIONS

The *anode* of the C6J-A/5685 will show a red color when the tube is operated at full load.

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

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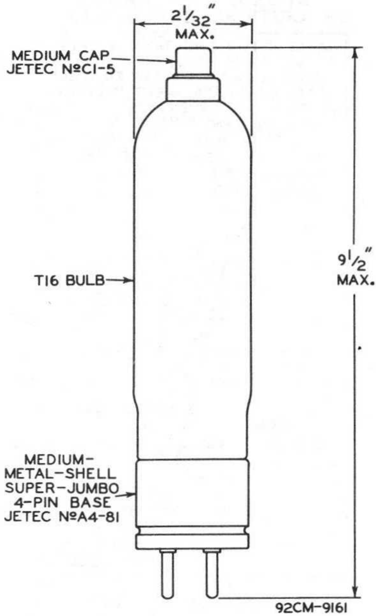
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

C6J-A/5685

XENON THYRATRON



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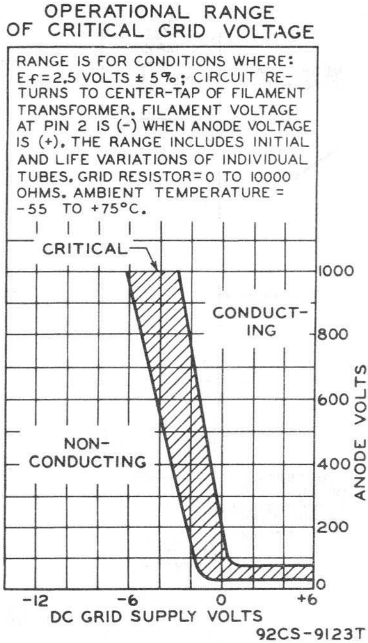
C6J-A/5685

XENON THYRATRON



TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

C16J/5665

XENON THYRATRON

NEGATIVE-CONTROL TRIODE TYPE

GENERAL DATA

Electrical:

	Min.	*Av.*	*Max.*		
Filament, Coated:					
Voltage	2.4	2.5	2.6		ac or dc volts
Current at 2.5 volts	28	31	34		amp
Minimum heating time prior to tube conduction				60	sec
Direct Interelectrode Capacitances (Approx.):					
Grid to anode				8	$\mu\mu$f
Grid to cathode				29	$\mu\mu$f
Maximum Deionization Time				1000	μsec
Maximum Critical Grid Current				10	μamp
Anode Voltage Drop:					
Average, at beginning of life				11	volts
Maximum, at end of life				14	volts
Maximum Commutation Factor♦, averaged over first 330 volts of inverse anode voltage rise				0.66	va/μs^2
Grid Control Ratio (Approx.): For conditions: 10000-ohm grid resistor, circuit returns to filament transformer center-tap, filament lead F- negative with respect to filament lead F+ during conduction period, dc anode voltage and dc grid voltage				270	

Mechanical:

Mounting Position. . . . . .Vertical, base down

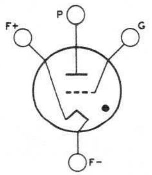
Tube and Base Bracket Dimensions . . . *See Dimensional Outline*

Weight (Approx.) . . . . 14 oz

Bulb T-20

Terminal Connections . . . . *See Dimensional Outline*

BOTTOM VIEW



F- - Filament Lead

F+ - Filament Lead

G - Grid Lead

P - Anode Lead (On end opposite bracket)

GRID-CONTROLLED RECTIFIER SERVICE

Maximum Ratings, *Absolute Values:*

PEAK ANODE VOLTAGE:			
Forward	1000 max.	1000 max.	volts
Inverse	1250 max.	1250 max.	volts

♦ Defined as the product of the rate of current decay in amperes per microsecond just before conduction ceases and the rate of inverse voltage rise in volts per microsecond following current conduction.

C16J/5665

XENON THYRATRON

GRID VOLTAGE:				
Peak, before tube conduction		-100 max.	-100 max.	volts
ANODE CURRENT:				
Peak		160 max.	100 max.	amp
Average●		16 max.	18 max.	amp
Overload:				
Rating I*, for duration of. .	1 sec.	72 max.	81 max.	amp
	2 sec.	36 max.	40.5 max.	amp
	3 sec.	24 max.	27 max.	amp
	3.5 sec.	21 max.	22.8 max.	amp
	4 sec.	18 max.	20.3 max.	amp
Rating II**, for duration of. .	3 sec.	24 max.	–	amp
	3.5 sec.	23 max.	22.8 max.	amp
	4 sec.	22 max.	22.5 max.	amp
	4.5 sec.	21.3 max.	22 max.	amp
Fault, for duration of 0.1 second maximum		1000 max.	1000 max.	amp
AMBIENT-TEMPERATURE RANGE. . .		-55 to +75	-55 to +75	^{o}C

● Averaged over any period of 4.5 seconds.

* Averaged over duration of overload occurring no more than once in any period of 4.5 seconds.

** Averaged over duration of overload occurring no more than once in any period of 30 seconds.

OPERATING CONSIDERATIONS

The *anode* of the C16J/5665 will show a red color when the tube is operated at full load.

Sufficient *anode-circuit resistance*, including the tube load, must be used under any conditions of operation to prevent exceeding the current ratings of the tube.

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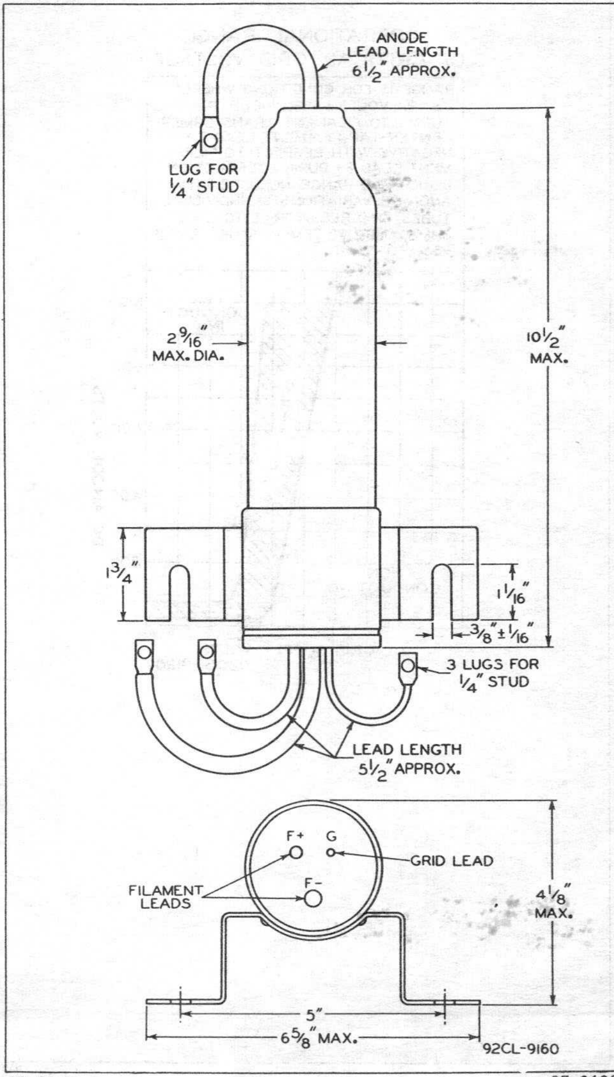
C16J/5665

XENON THYRATRON

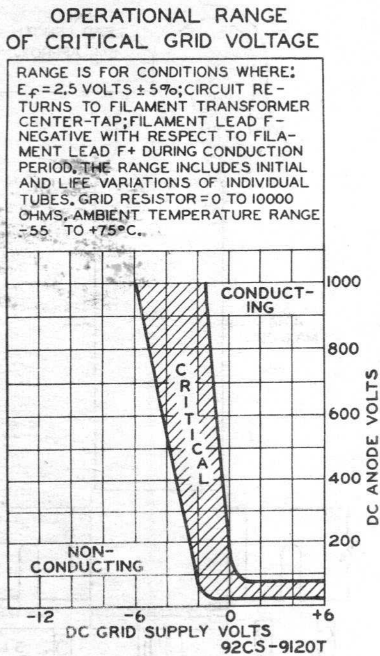


TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

C16J

C16J/5665

XENON THYRATRON



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