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

PHOTOMULTIPLIER TUBES

Spectral Response	Diameter (nominal) in	No. of Stages	Secondary Emitting Surface	RCA Tube Types
S-1	1-1/2	10	[illegible][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
	[illegible]	10	Be-O	2064, 2064B, 8054
	5	10	Be-O	2065, 8055
S-11[b]	[illegible]	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
	[illegible]	12	Be-O	8575

VACUUM AND GAS PHOTODIODES

Spectral Response	Single-Unit		Twin Unit	Anode-Cathode
	Vacuum	Gas	Gas	Vacuum
[illegible]	917 919 [illegible] [illegible] [illegible]	[illegible] 1P41 [illegible] 918 [illegible] [illegible] 927 930 [illegible] [illegible]	[illegible]	
[illegible]	[illegible]	1P29		
S-4	[illegible] [illegible] [illegible] [illegible] [illegible]	1P37 [illegible] [illegible] [illegible] [illegible]		
[illegible]	[illegible]			
[illegible]	[illegible]			

IMAGE-CONVERTER TUBES[d]

Spectral Response	Recommended Service	
	Infrared	Photographic Shutter
[illegible]	[illegible] [illegible] [illegible] [illegible]	
[illegible]		[illegible]

CAMERA TUBES

VIDICONS[e]

Tube Diameter inches	Recommended Service		
	Television Film Pickup	Live Television and Industrial	Space Military and Industrial
1/2			[illegible]
	[illegible] [illegible] [illegible]	[illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]	[illegible] b [illegible] b [illegible] [illegible] b [illegible] b [illegible] 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	Recommended Service: Live Television and Industrial	Recommended Service: Space Military, and Industrial
[illegible]	[illegible] [illegible] 8480/V1		[illegible]

IMAGE ORTHICONS

Tube Diameter inches	Recommended Service: Live Television Pickup: Color	Recommended Service: Live Television Pickup: Black and White	Recommended Service: Military and Industrial
[illegible]	[illegible] [illegible][g] [illegible][h] [illegible][g] [illegible] [illegible]	[illegible]	[illegible][b] [illegible]
[illegible]	[illegible][j]	[illegible]	

IMAGE-INTENSIFIER ORTHICON

Tube Diameter inches	Combined Image-Converter and Image Orthicon Sections — Recommended Service: Extremely Low-Light Level Television Cameras
[illegible]	[illegible]

[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. The 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 1523, 1524, and 1525.

[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.

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.

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 nth power, where 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.

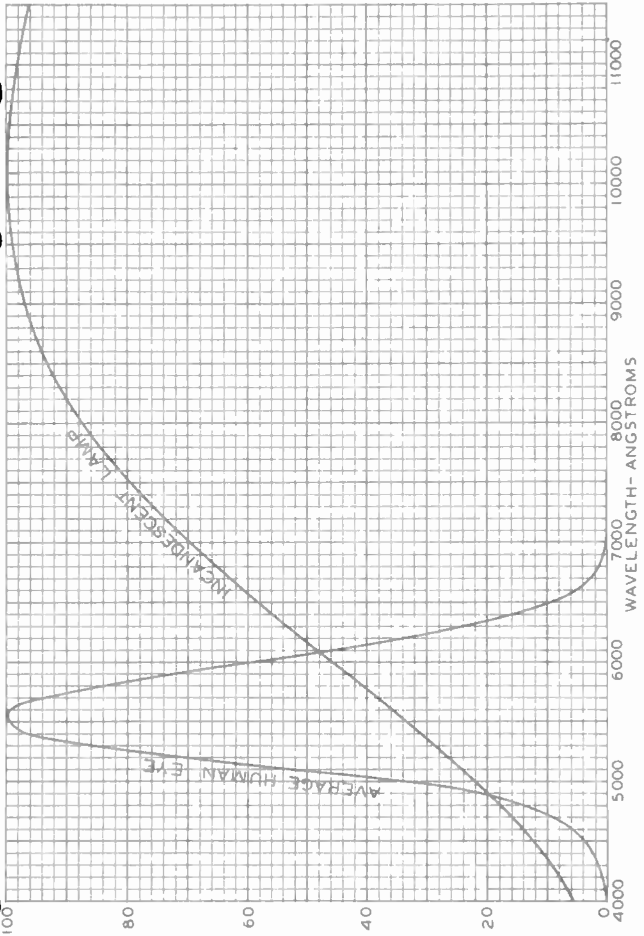
b. **Vacuum Types:** The light source consists of a tungsten lamp operating at a filament color temperature of 2870°K. A steady light input of 0.1 lumen is used, unless otherwise specified, together with a dc anode-supply voltage of 250 volts and a 1-megohm load resistor.

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 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

OCT. 20, 1947

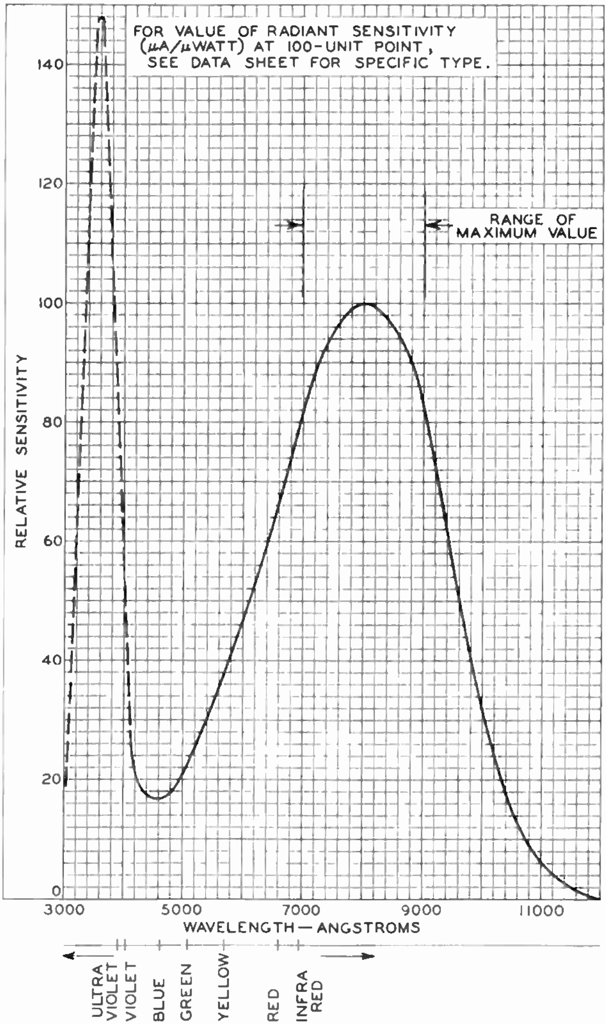
TUBE DEPARTMENT

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6435R1

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-1 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



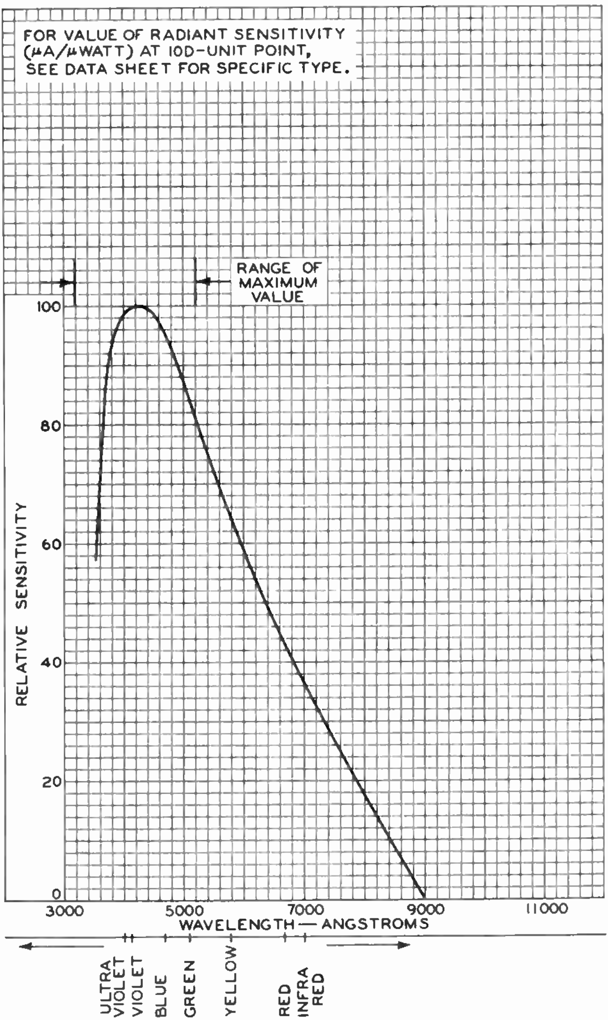
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON NEW JERSEY

92CM-6056R6

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-3 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



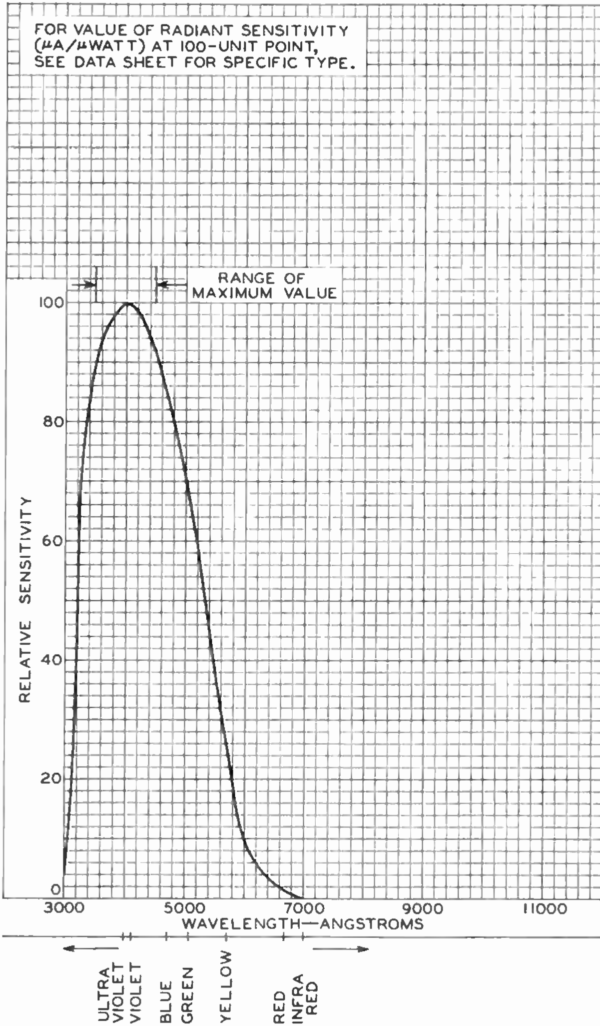
ELECTRON TUBE DIVISION

92CM-6057R6

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-4 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



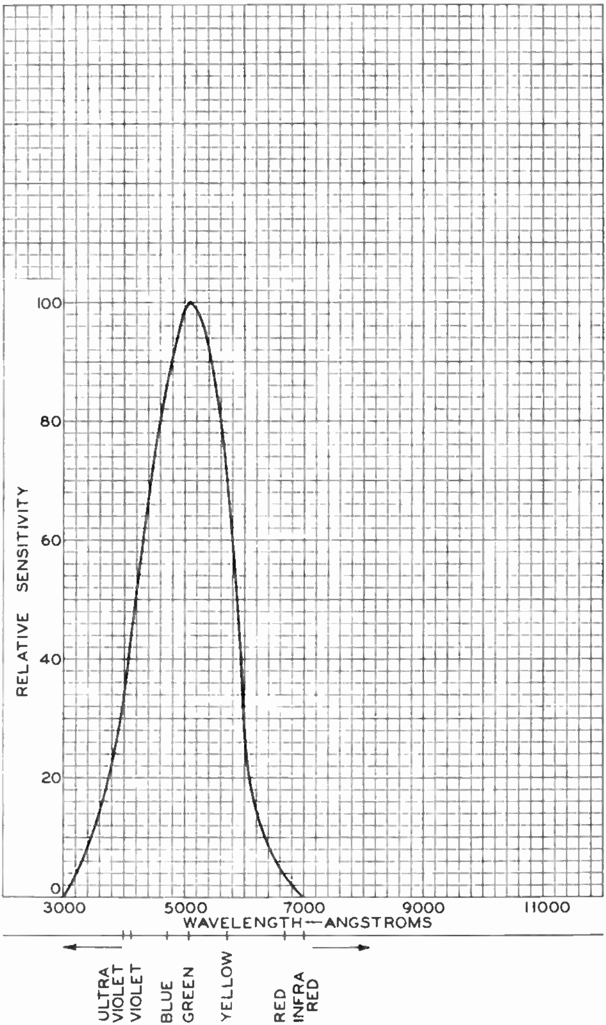
ELECTRON TUBE DIVISION

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

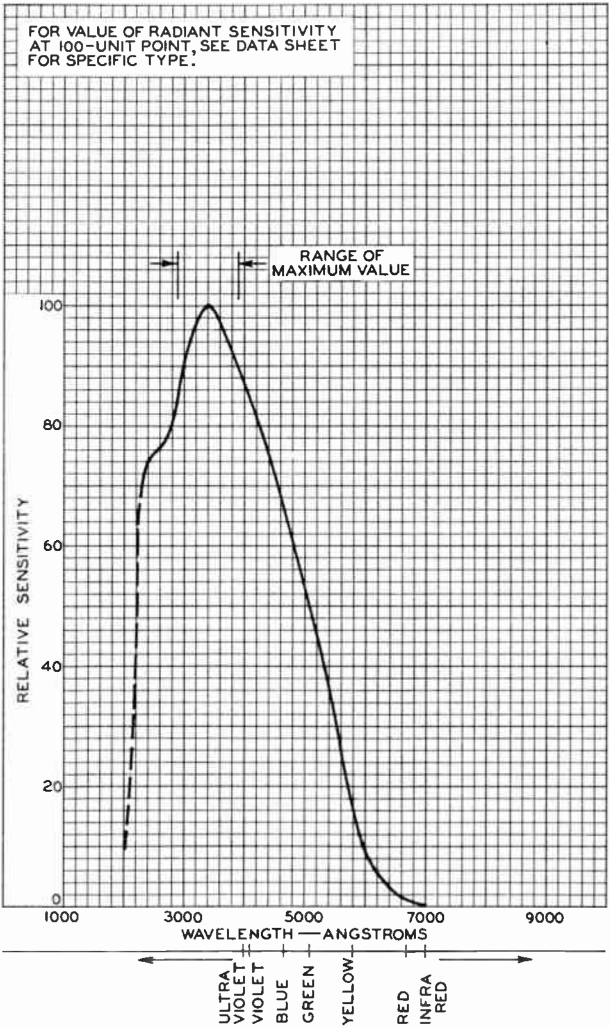


ELECTRON TUBE DIVISION 92CM-6652R3

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-5 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

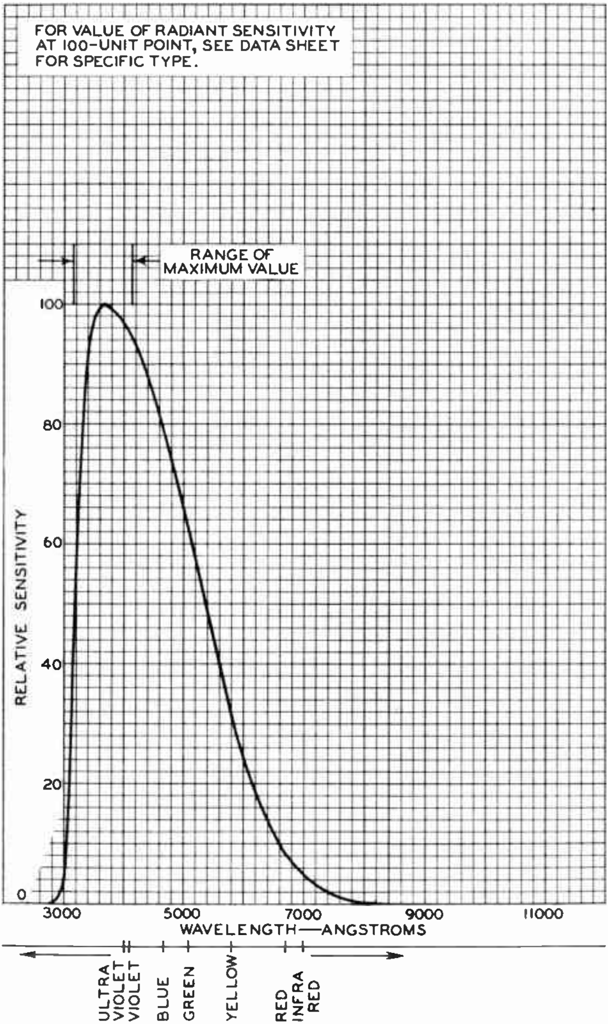


ELECTRON TUBE DIVISION 92CM-6814R2

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOTUBE HAVING S-8 RESPONSE

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

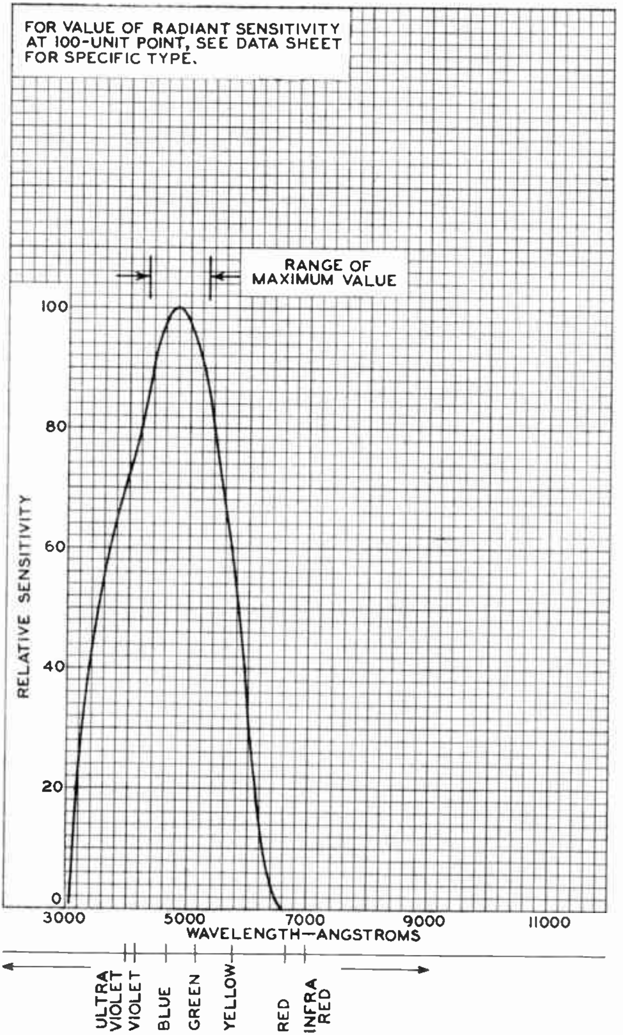


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6592R3

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

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



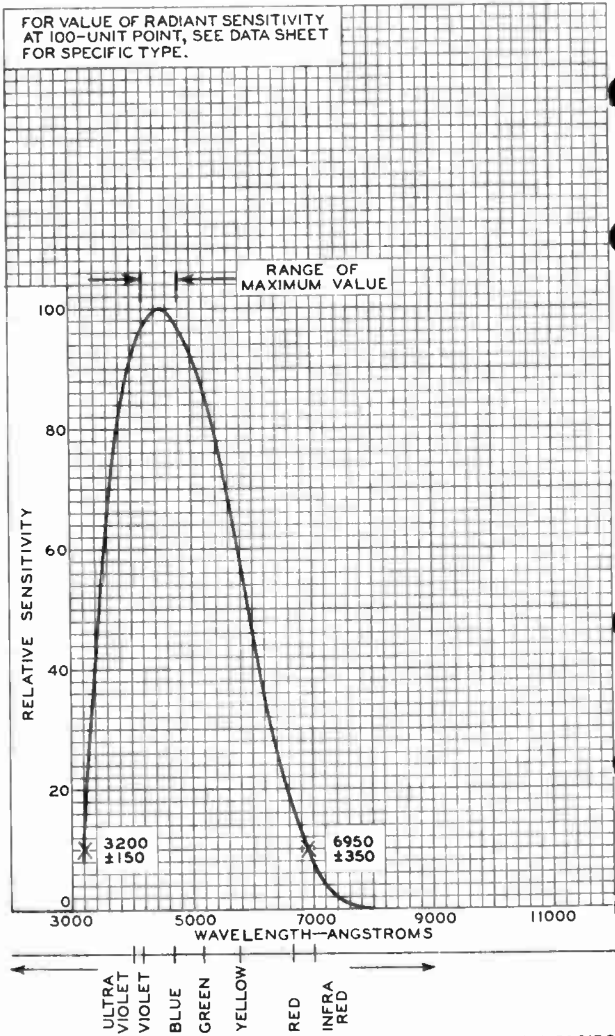
ELECTRON TUBE DIVISION

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



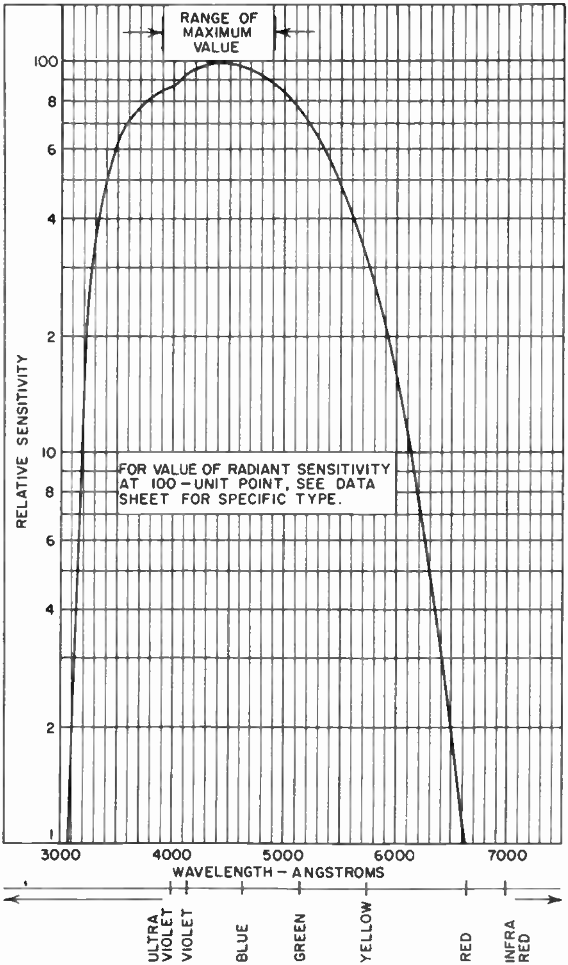
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-7821R2

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

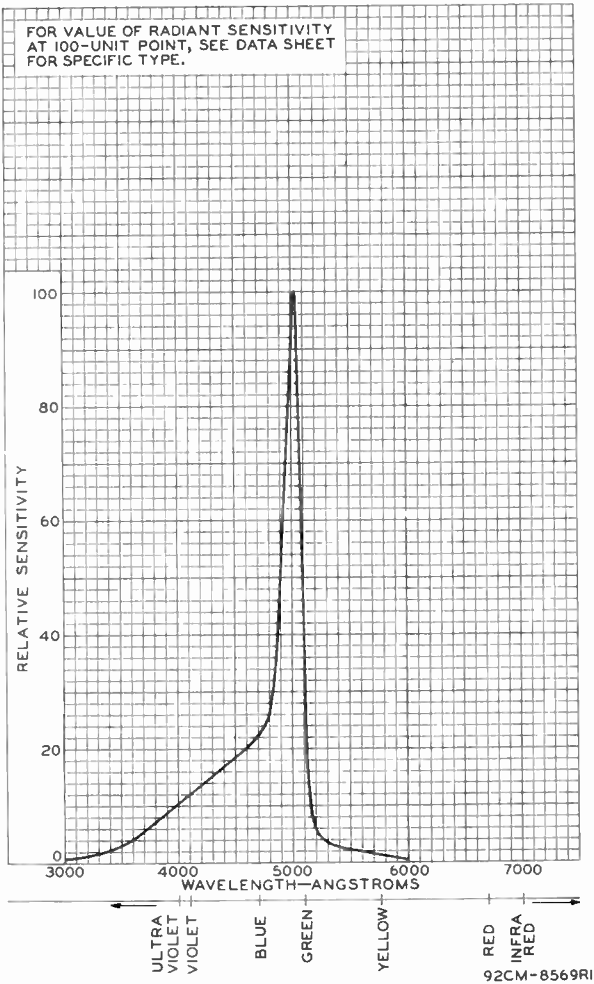
For Equal Values of Radiant Power at All Wavelengths



92CM-10662RI

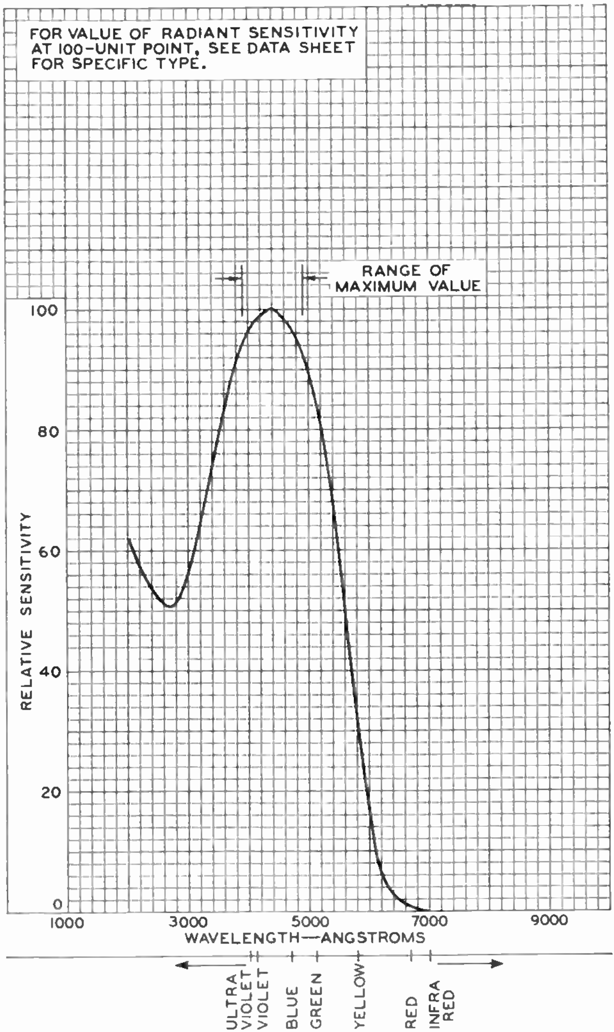
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-12 RESPONSE

For Equal Values of Radiant Power at All Wavelengths



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

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



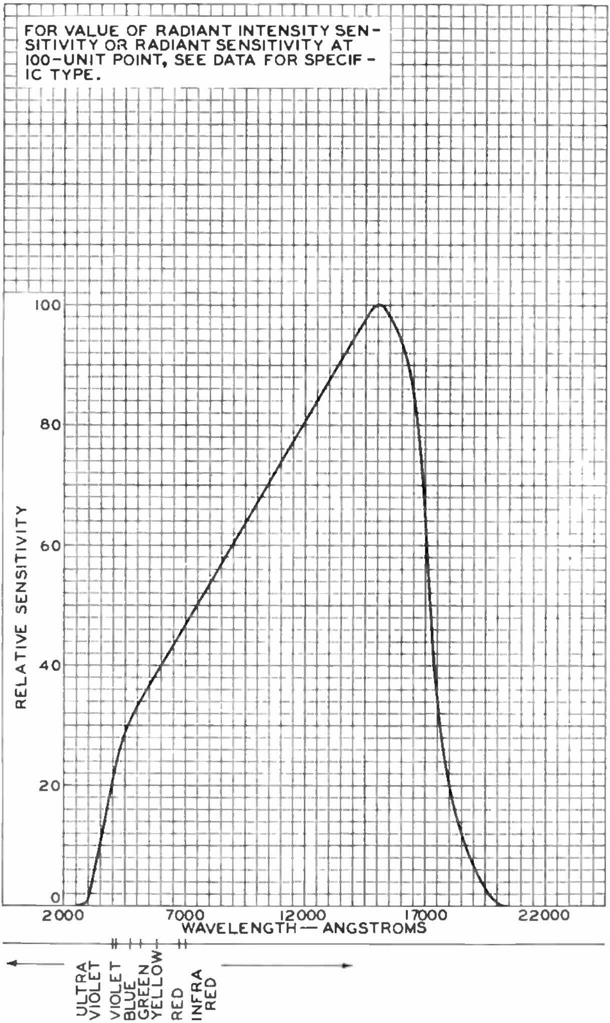
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9037R1

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

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS

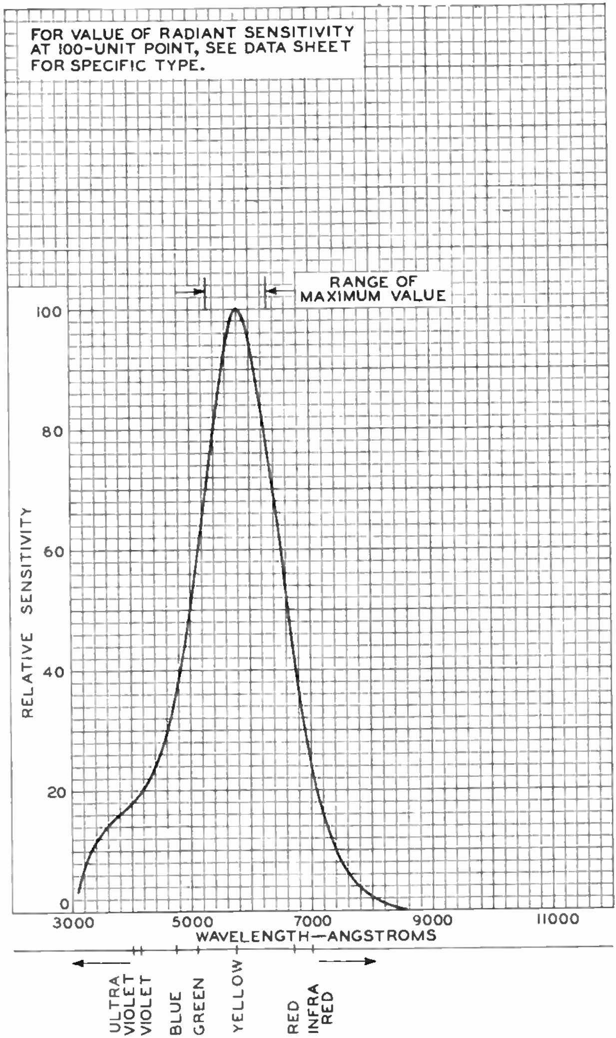


ELECTRON TUBE DIVISION 92CM-9647

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

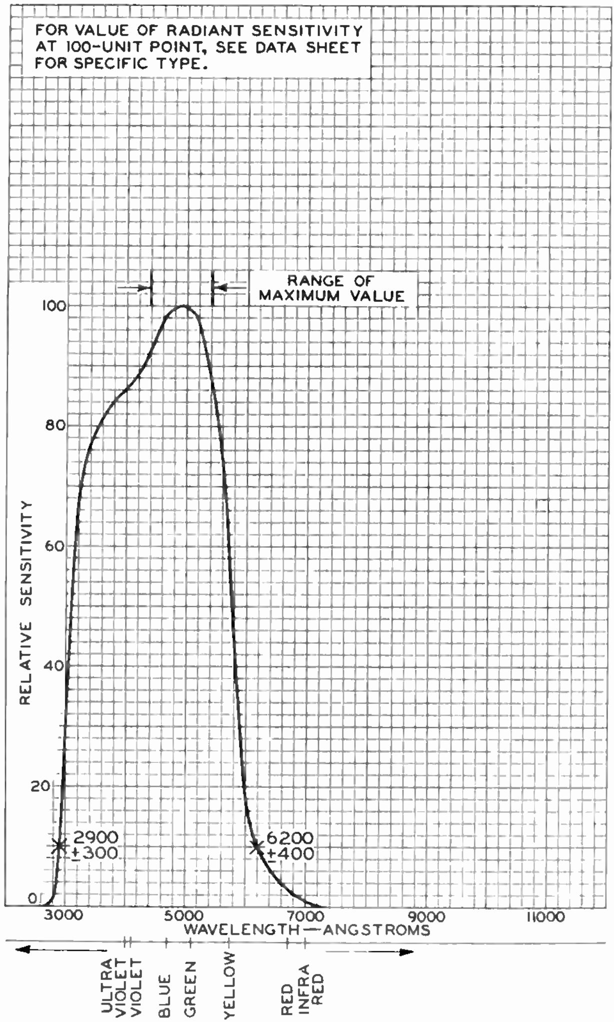


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9206R1

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

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



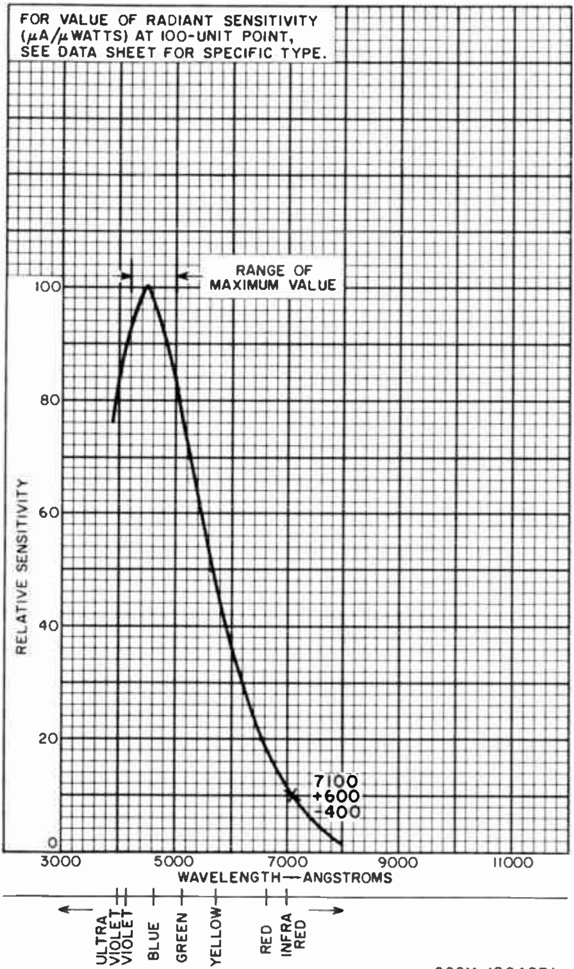
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9477R1

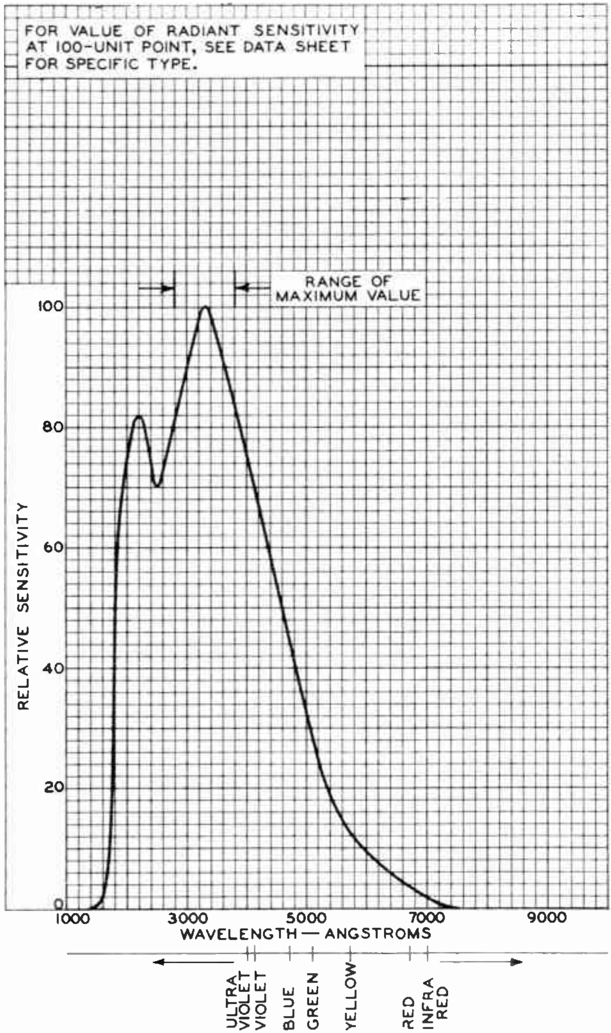
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-18 RESPONSE

For Equal Values of Radiant Power at All Wavelengths



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

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



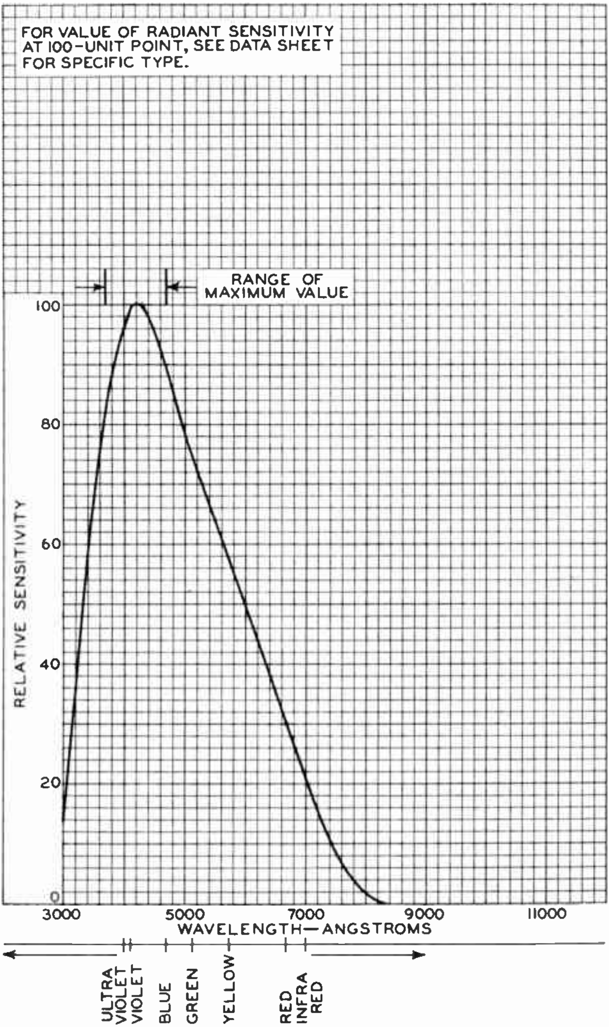
ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9582

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

FOR EQUAL VALUES OF RADIANT FLUX AT ALL WAVELENGTHS



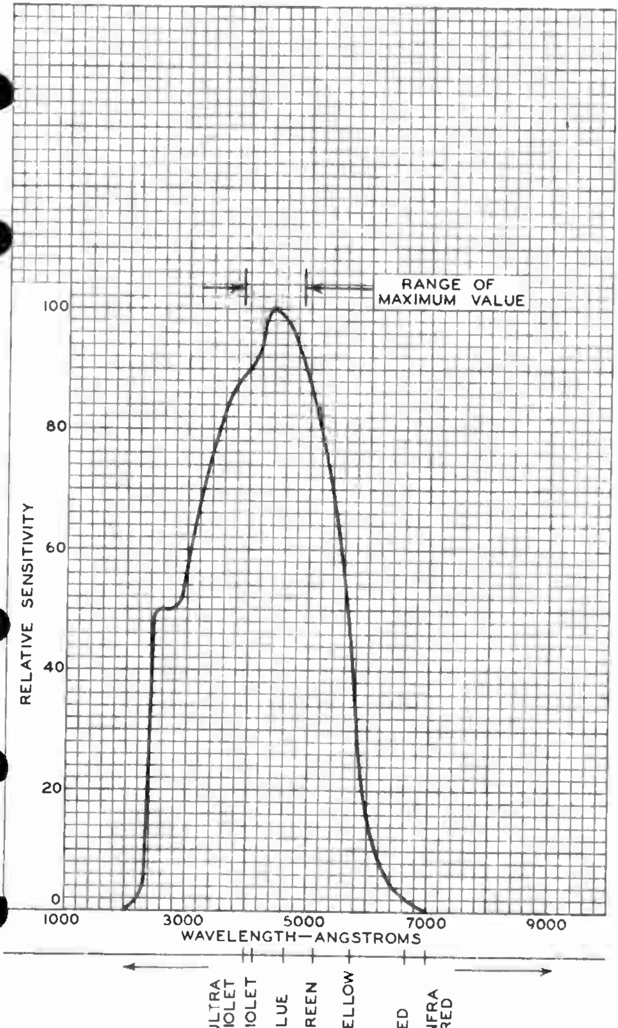
ELECTRON TUBE DIVISION

92CM-9779

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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

FOR EQUAL VALUES OF RADIANT POWER AT ALL WAVELENGTHS

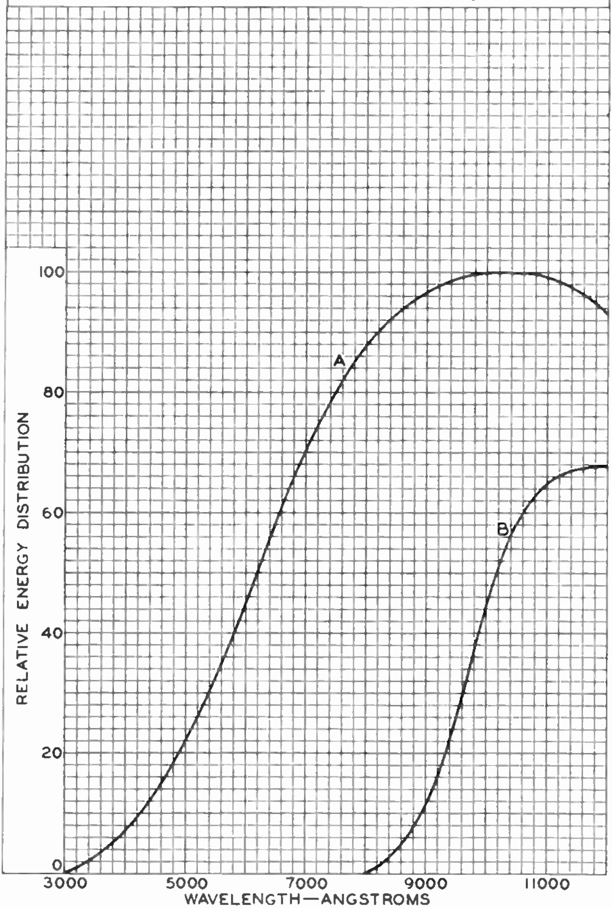


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9980

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).

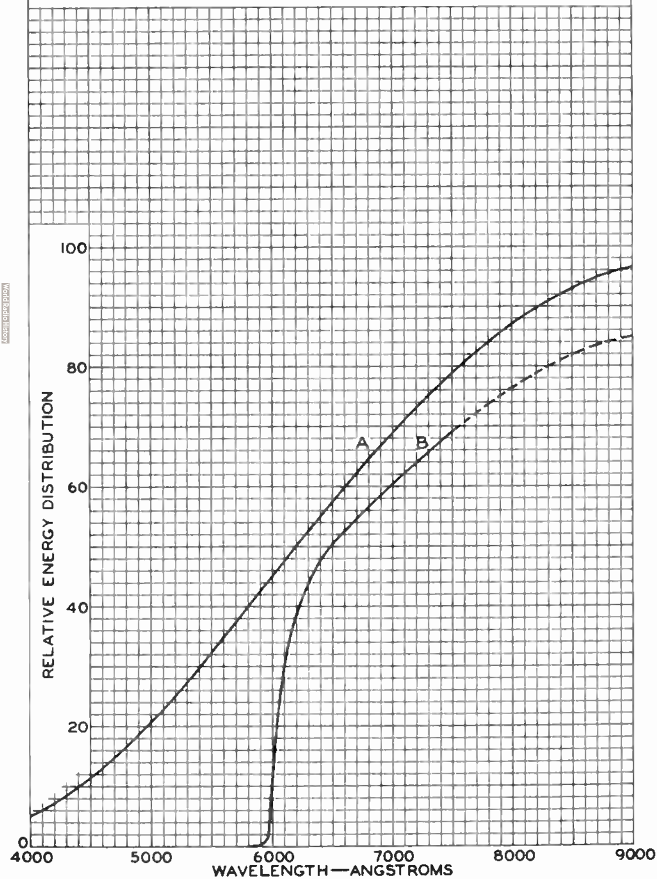


ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

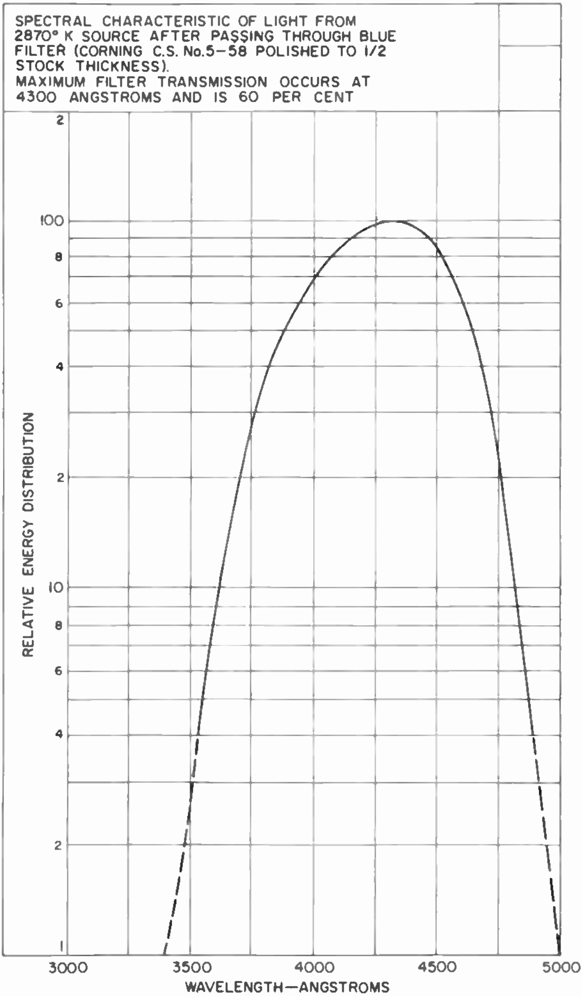
92CM-9454

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.



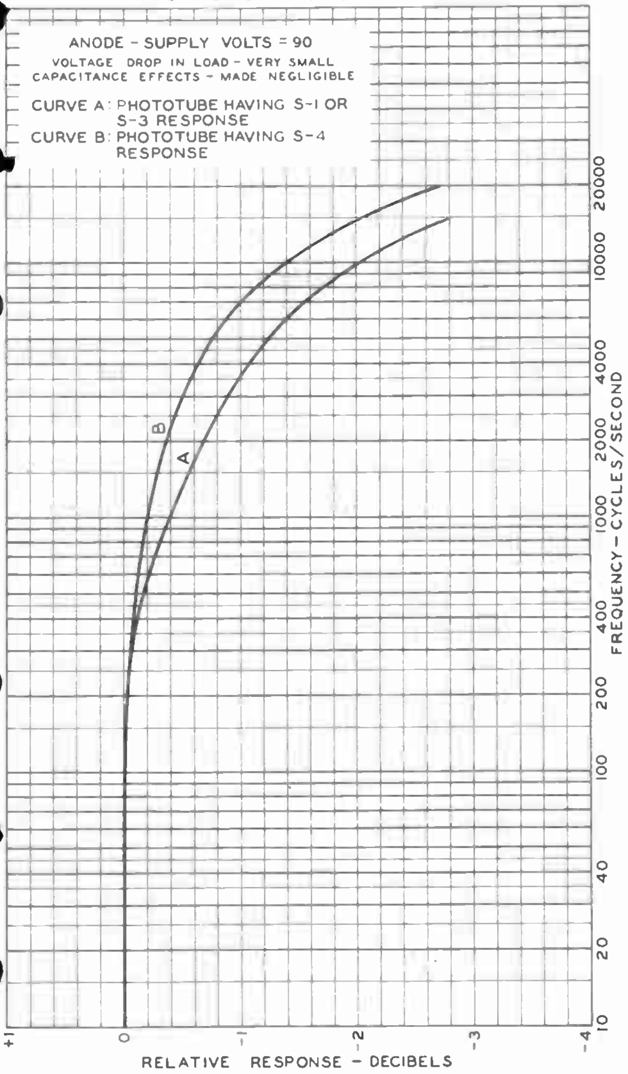
SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER



92CM-11081R1

RCA

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

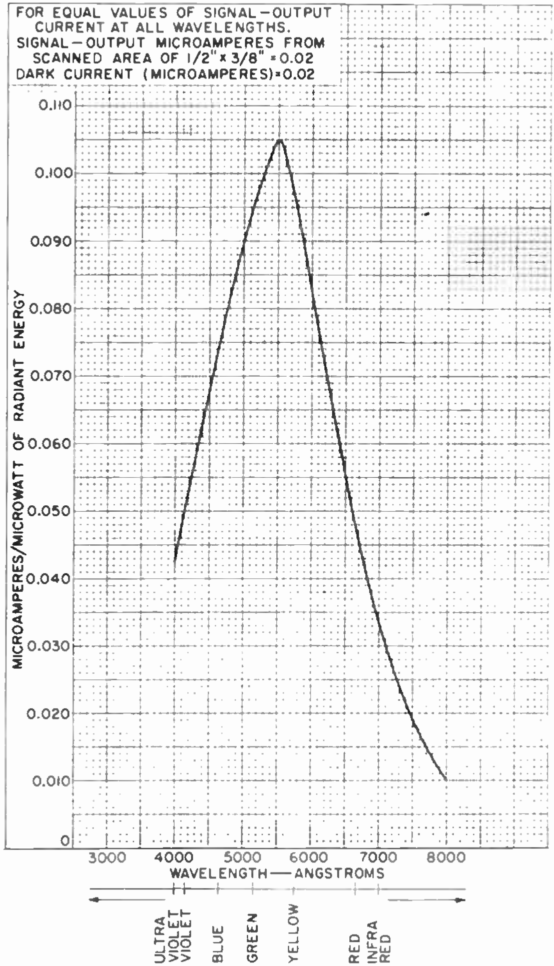


APRIL 30, 1947

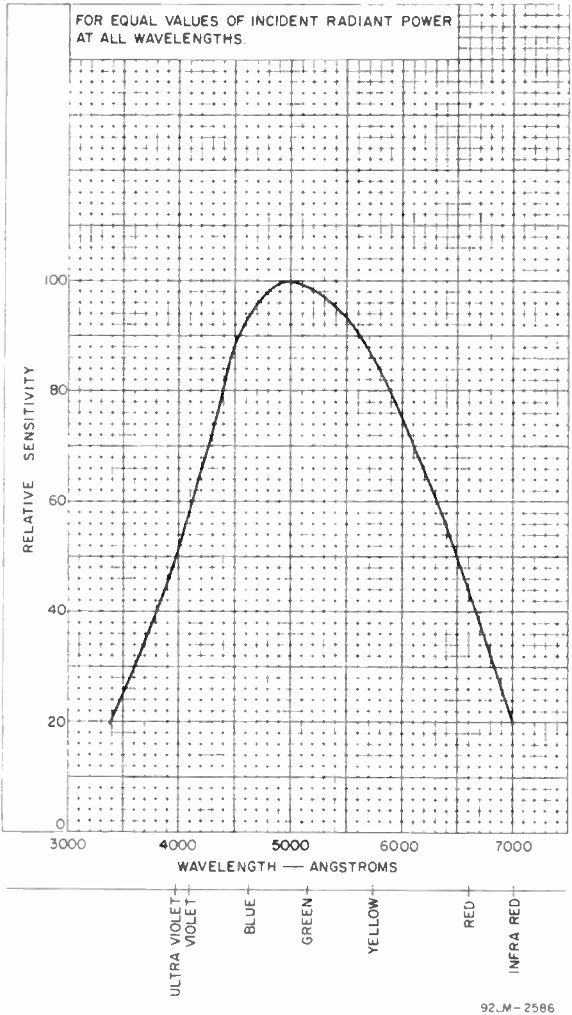
TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-6864

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.

[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.

[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.

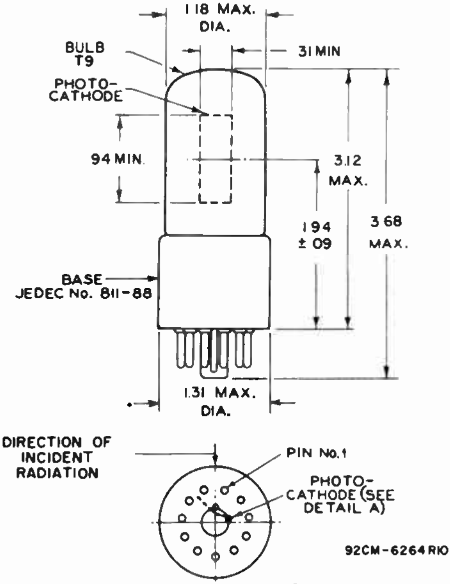
[q] Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period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

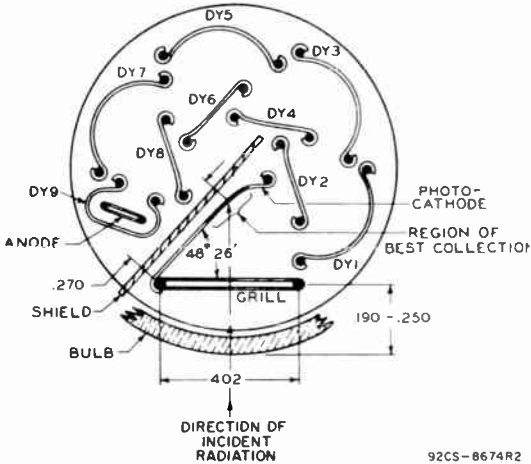


℄ of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base.

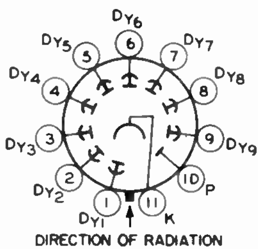
Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters.

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)

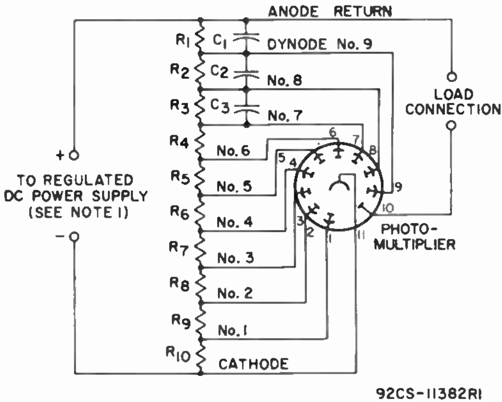


TERMINAL DIAGRAM (Bottom View)



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:

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

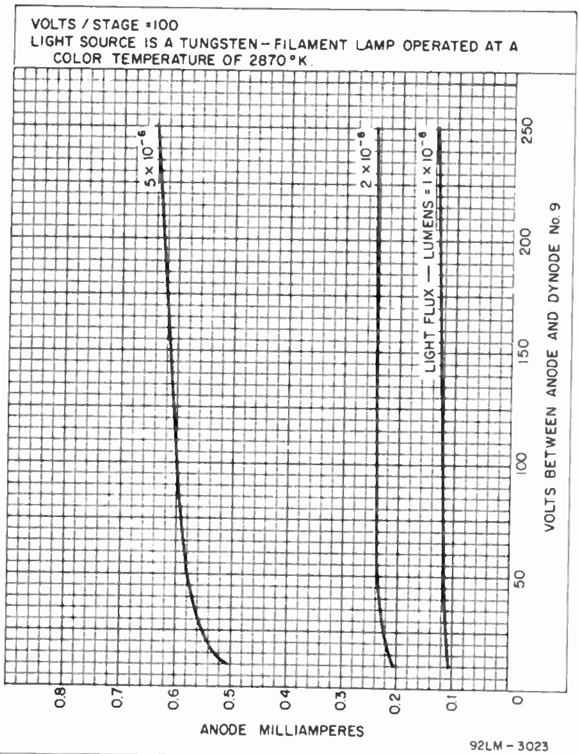
where C is in farads
i is the amplitude of anode current in amperes
V is the voltage across the capacitor in volts
and t is the time duration of the pulse in seconds

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.

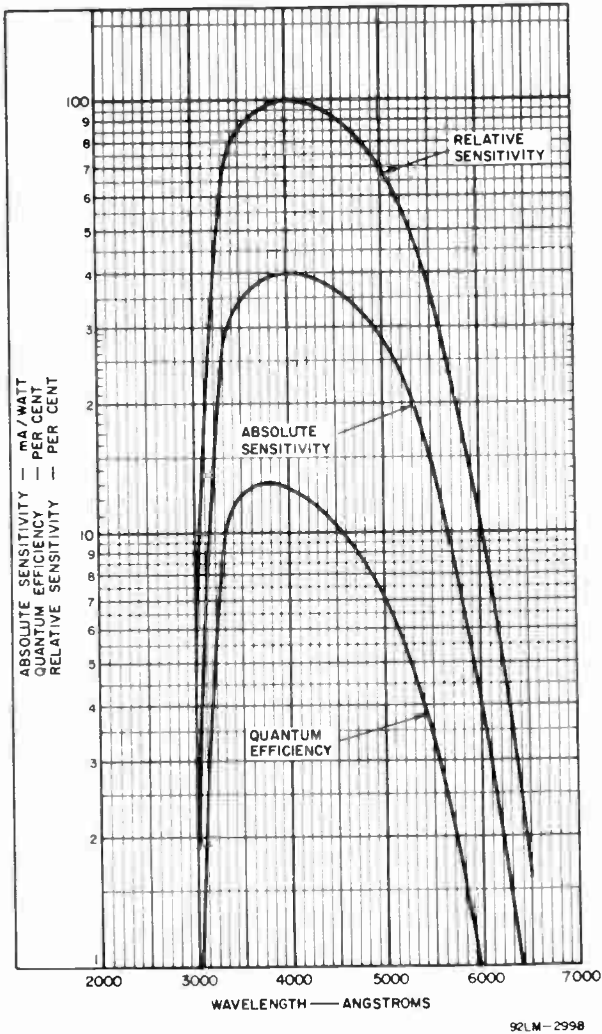
For other shaped pulses or for a train of pulses, the total charge q should be substituted for (i·t) and the following formula applies:

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

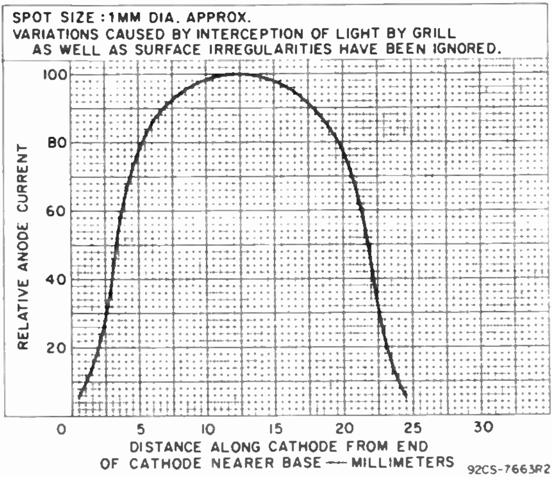
TYPICAL ANODE CHARACTERISTICS



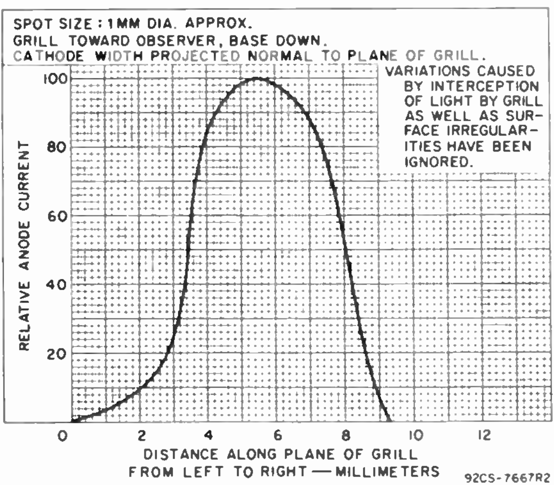
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



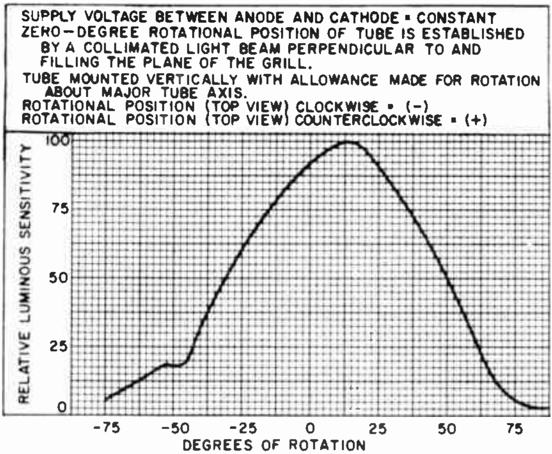
TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ALONG TUBE LENGTH



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

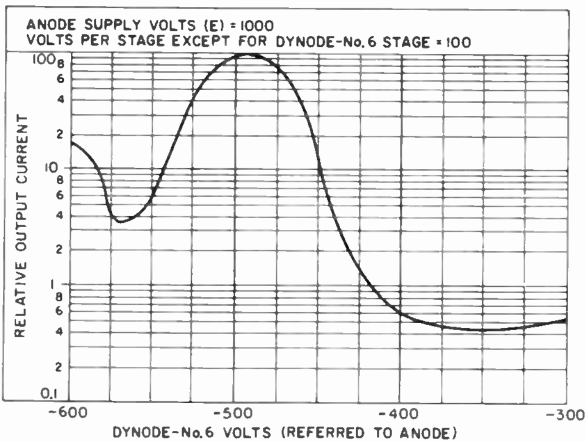


TYPICAL VARIATION OF SENSITIVITY AS TUBE IS ROTATED WITH RESPECT TO FIXED LIGHT BEAM



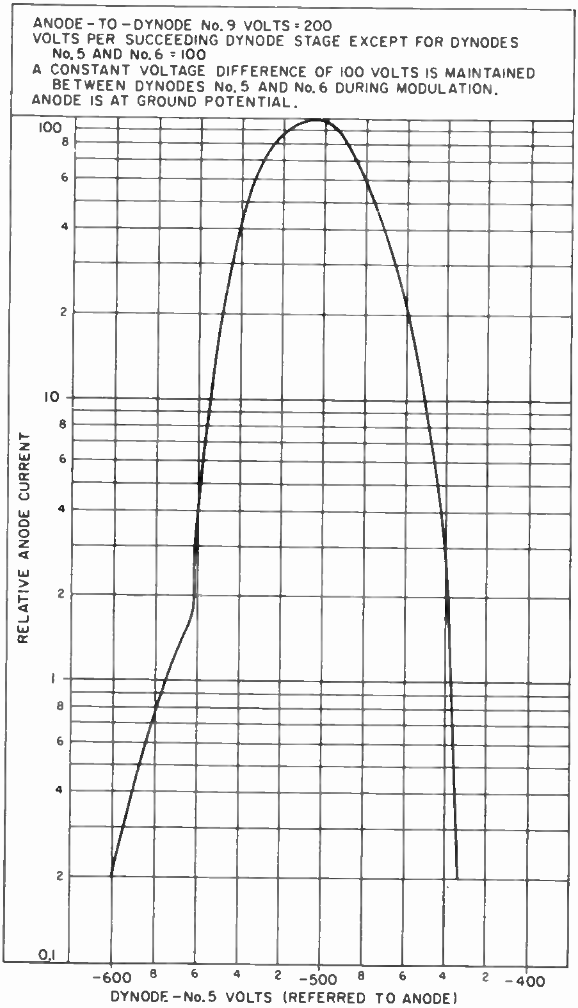
92CS-8671R2

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

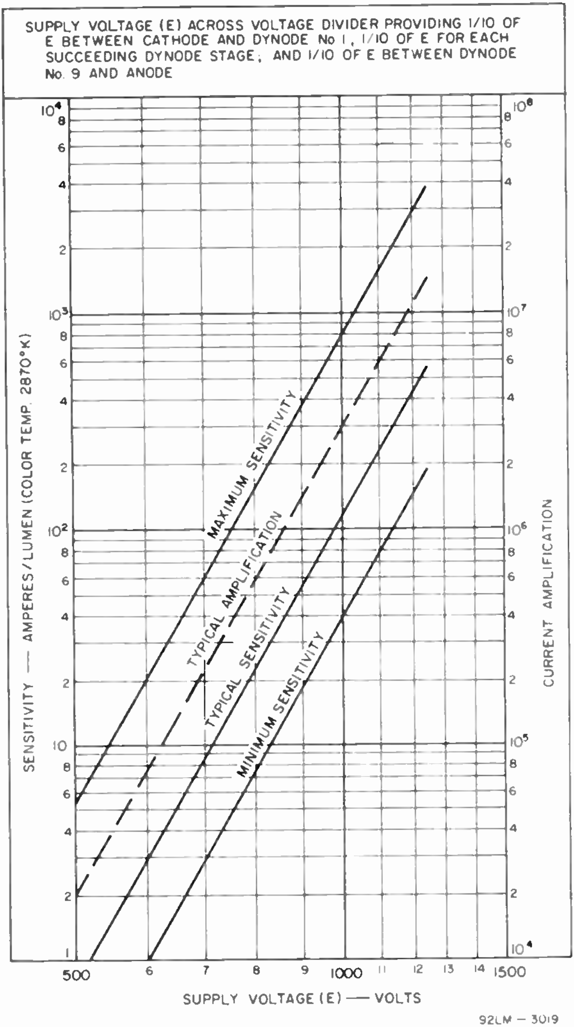


92CS-8672R1

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

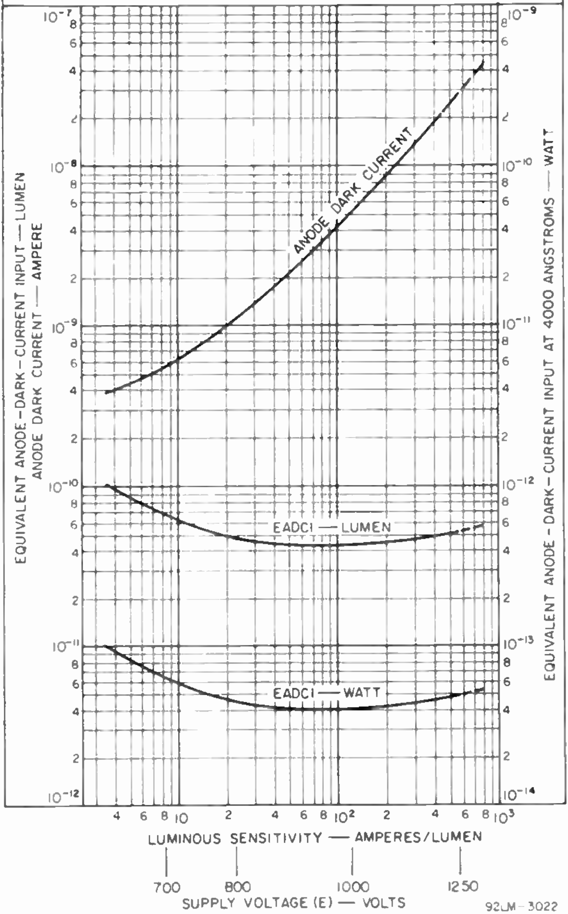


SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



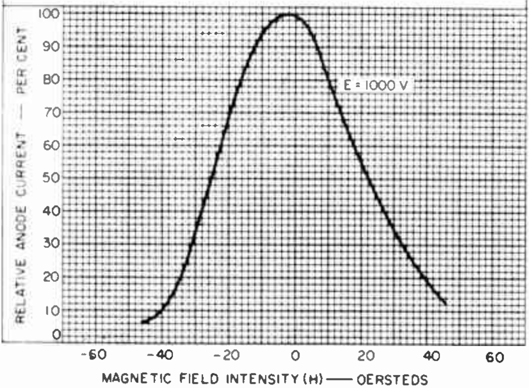
TYPICAL EADCI AND DARK CURRENT CHARACTERISTICS

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



TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

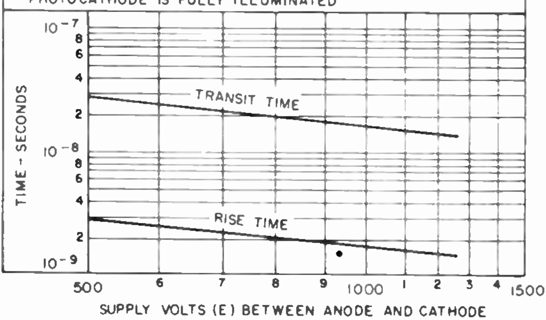
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/10 OF E BETWEEN CATHODE AND DYNODE No 1, 1/10 OF E FOR EACH SUCCEEDING DYNODE STAGE, AND 1/10 OF E BETWEEN DYNODE No 9 AND ANODE
PHOTOCATHODE IS FULLY ILLUMINATED.
UNIFORM MAGNETIC FIELD PARALLEL TO MAJOR AXIS OF TUBE
POSITIVE VALUES OF MAGNETIC FLUX 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

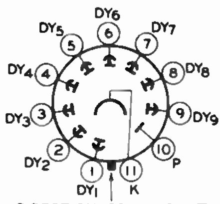
9-STAGE, SIDE-ON TYPE **S-8 RESPONSE**

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



DIRECTION OF INCIDENT RADIATION

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 .4 a/lm[h,j].	-	7.5×10^{-9}	3.75×10^{-8}	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 Electronic Corporation, 1830 South 54th Avenue, Chicago 50, 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.

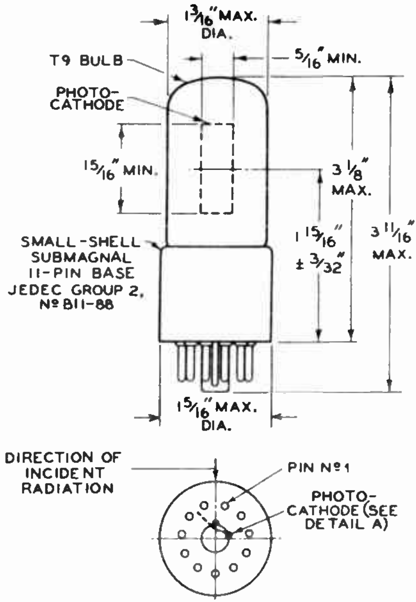
[k] Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating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

→ Indicates a change.

RCA

IP22

MULTIPLIER PHOTOTUBE

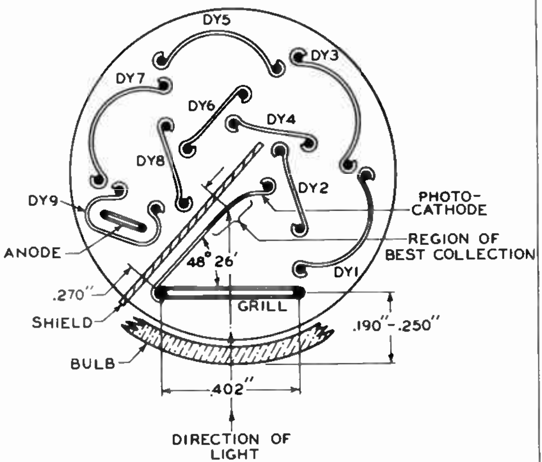


92CM-6264R7

IP22

MULTIPLIER PHOTOTUBE

DETAIL A

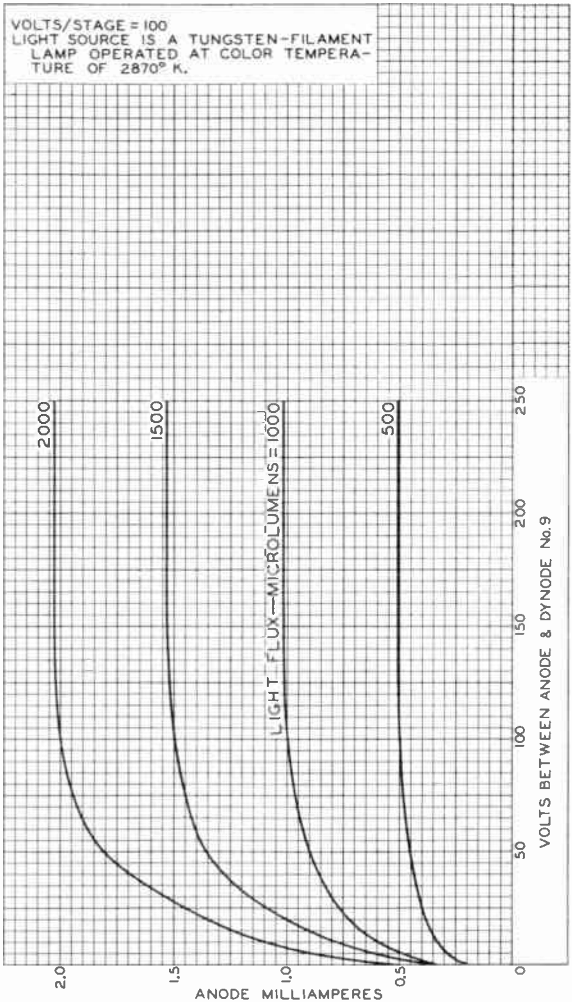


92CS-8674R1

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.

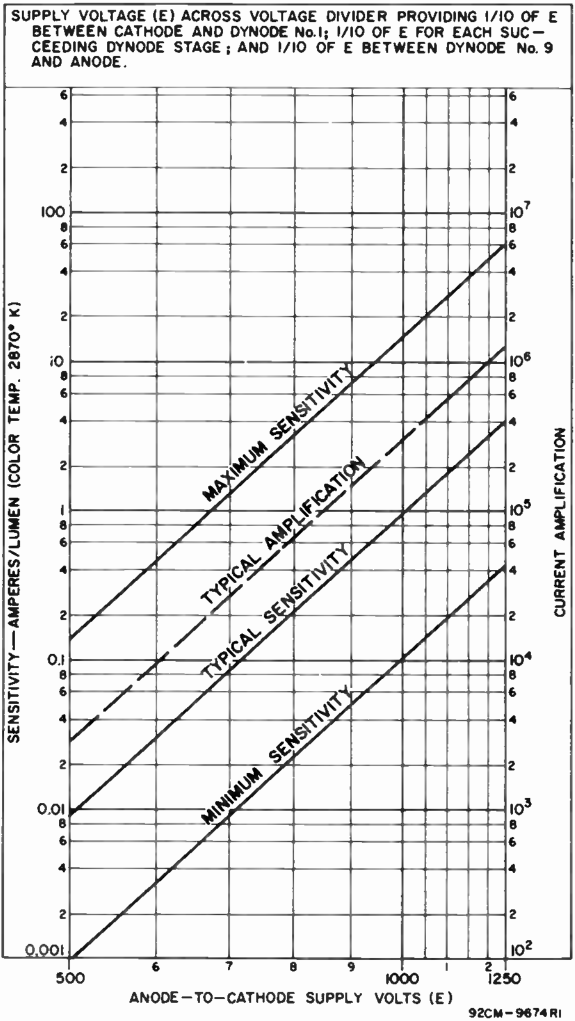
NOTE 2: THE MAXIMUM ANGULAR VARIATION BETWEEN THE PLANE THROUGH PINS 1 AND 11 AND THE PLANE OF THE GRILL WILL NOT EXCEED 6°.

TYPICAL ANODE CHARACTERISTICS



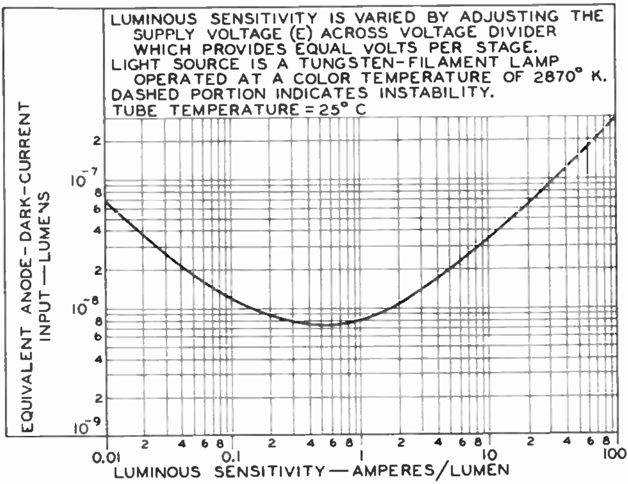
92CM-6585R1

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



IP22

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



92CS-9680

Photomultiplier Tube

9-STAGE, SIDE-ON TYPE — S-5 RESPONSE

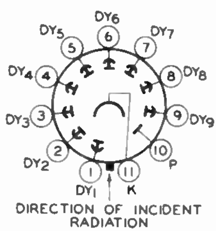
For Detection and Measurement of Ultraviolet and Visible Radiation

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.1 and cathode	250	V
Between consecutive dynodes	250	V
Between dynode No.9 and anode	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
Cathode quantum efficiency at 3400 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 terperature 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.

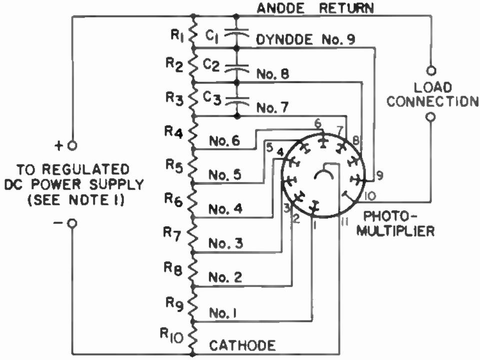
p At 3400 angstroms. This value is calculated from the rating in lumen using a conversion factor of 1252 lumens/watt.

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

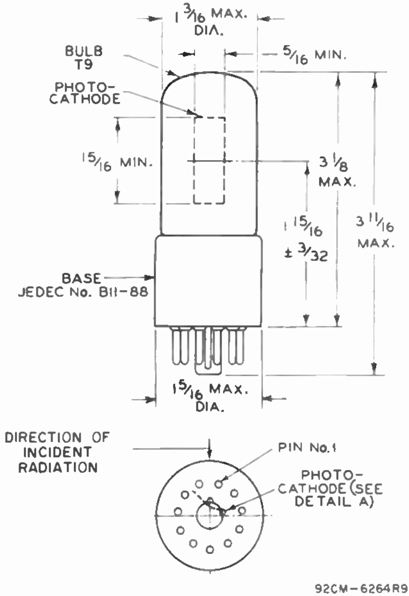
R1 through R10 = 20,000 to 1,000,000 ohms

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.

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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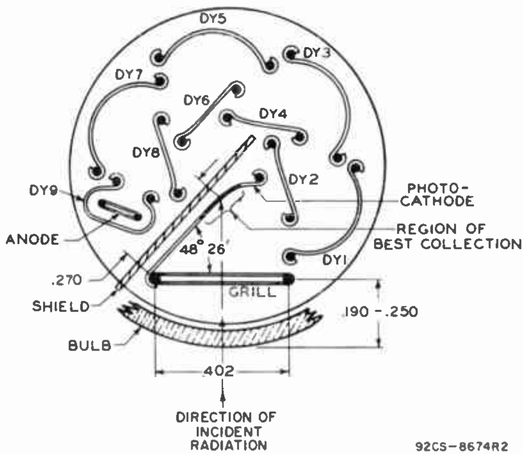
Electronic Components and Devices Harrison, N. J.

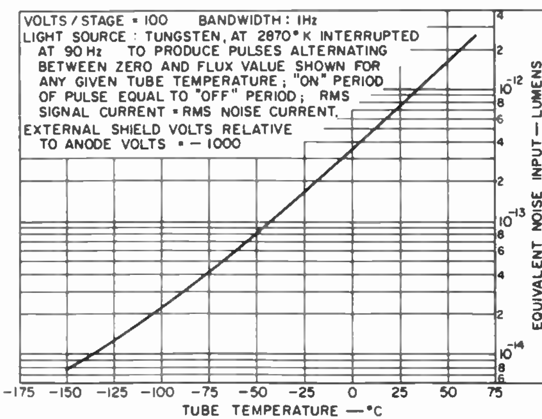
DETAIL A



92CS-8674R2

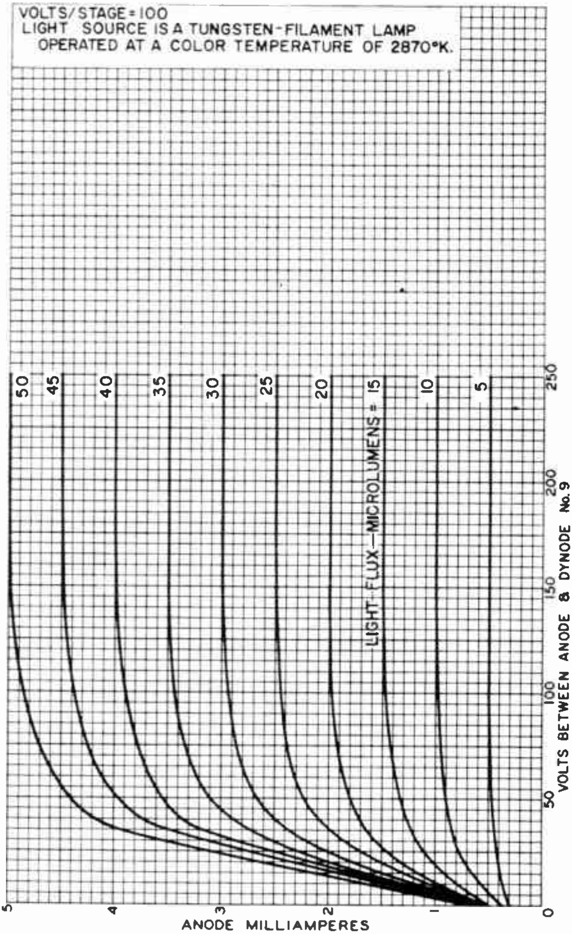
DIMENSIONS IN INCHES

Equivalent-Noise-Input Characteristic

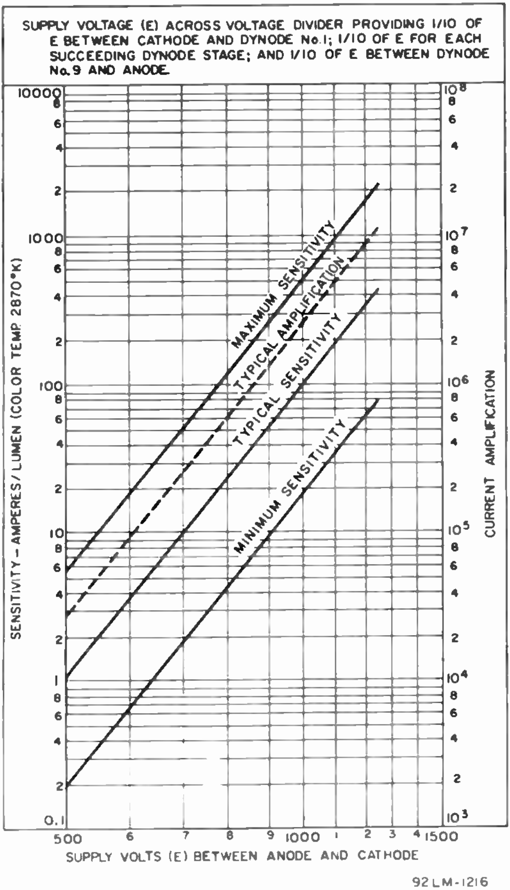


92CS-7503R2

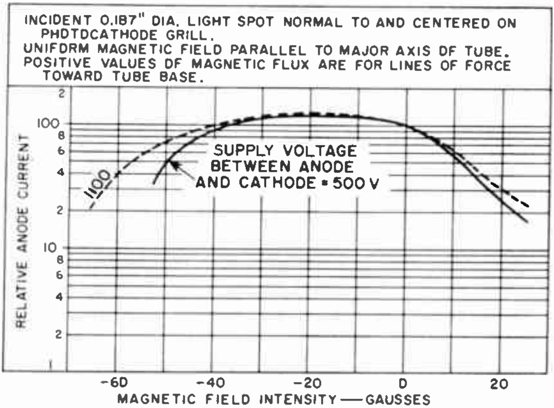
Typical Anode Characteristics



Typical Sensitivity and Current Amplification Characteristics

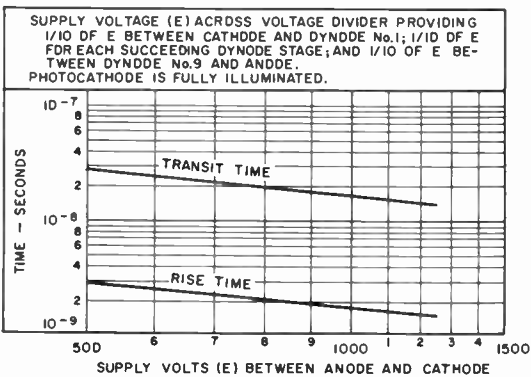


Typical Effect of Magnetic Field on Anode Current



92CS-7664R2

Typical Time-Resolution Characteristics



92LS-1215

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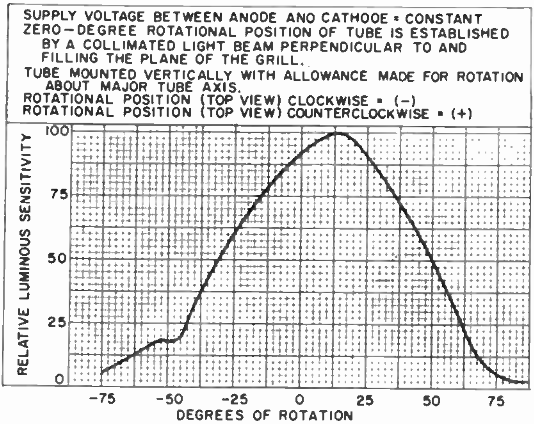
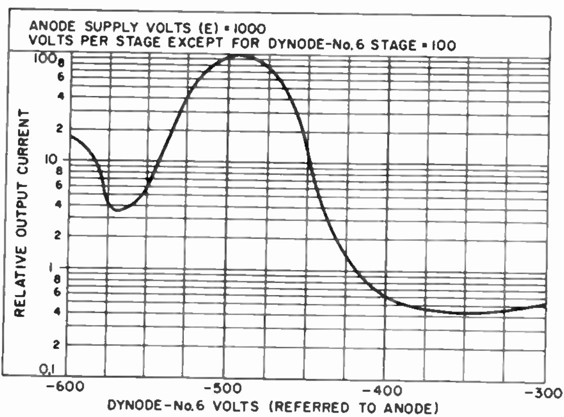
Typical Variation of Sensitivity as Tube is Rotated with Respect to Fixed Light Beam



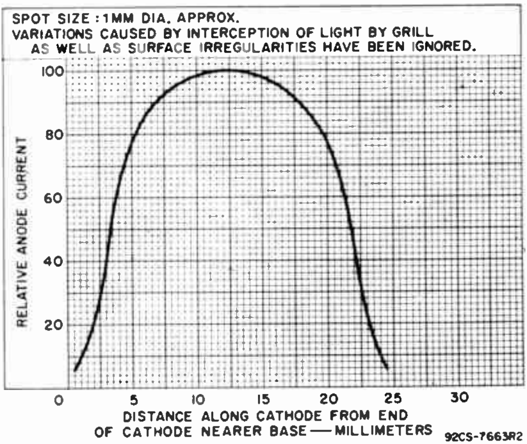
92CS-8671R2

Dynode Modulation Characteristics

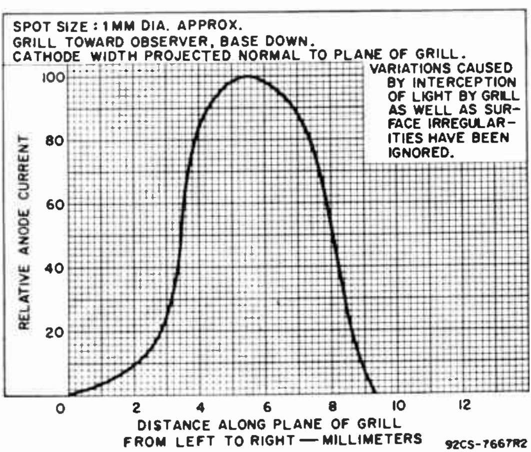


92CS-8672R1

Typical Variation of Photocathode Sensitivity Along Tube Length



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



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

1P28A

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.

1P29

Gas Phototube

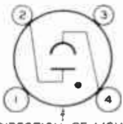
SIDE-ON TYPE HAVING S-3 RESPONSE

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 $\mu\mu$f
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 LIGHT

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.	$^{\circ}$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

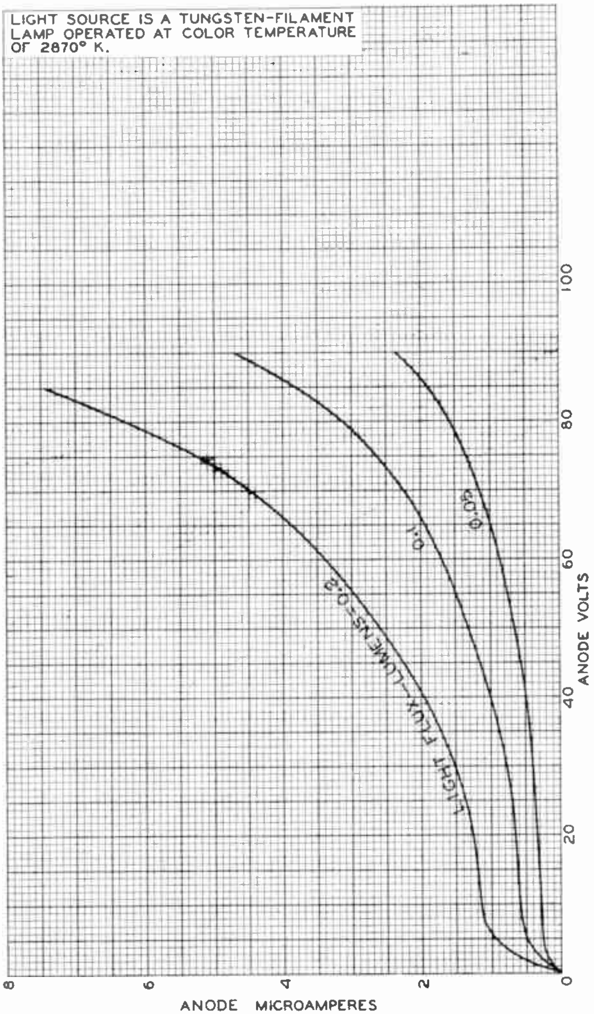
and

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



92CM-6472R2

Gas Phototube

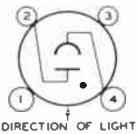
SIDE-ON TYPE HAVING S-4 RESPONSE

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.

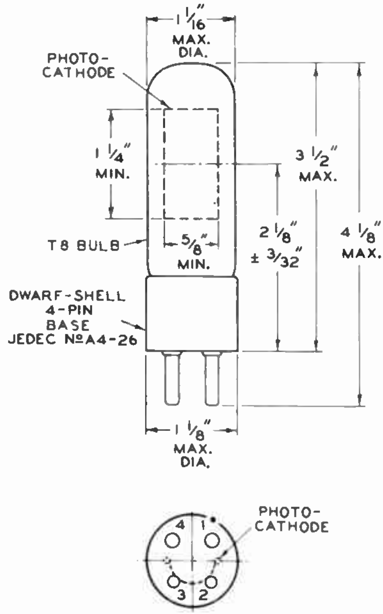
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE

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

92CM-470R5

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.

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.

IP41

GAS PHOTOTUBE

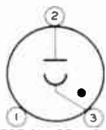
HEAD-ON TYPE WITH S-1 RESPONSE

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



DIRECTION OF LIGHT: INTO END OF BULB

Pin 2 – Anode
Pin 3 – Cathode

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.

TUBE DIVISION
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RCA

IP41

GAS PHOTOTUBE

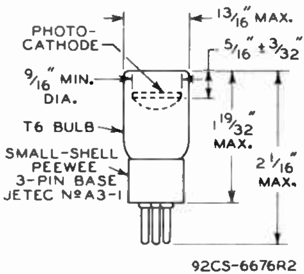
Minimum Circuit Values:

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

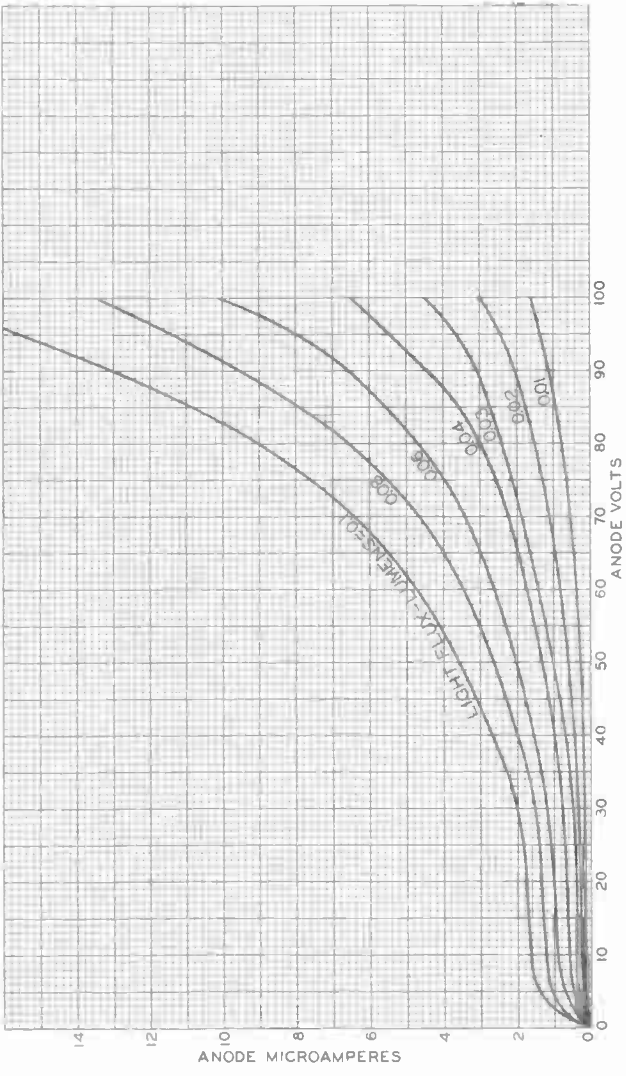


TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

1P41

AVERAGE ANODE CHARACTERISTICS



Vacuum Phototube

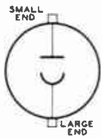
HEAD-ON TYPE WITH S-9 RESPONSE

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 μμf
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



DIRECTION OF LIGHT:
INTO END OF BULB

Large End: Cathode

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.

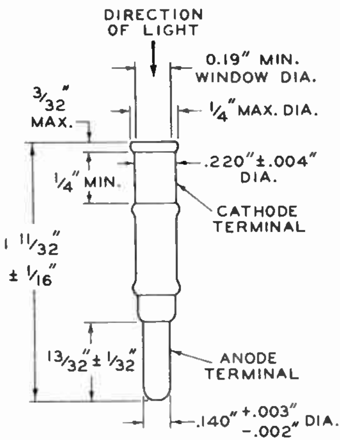
← Indicates a change.

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

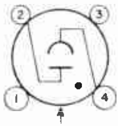
SIDE-ON TYPE HAVING S-1 RESPONSE

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

DIRECTION OF RADIATION

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

917

VACUUM PHOTOTUBE

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

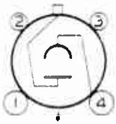
For light-measuring and relay applications

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

DIRECTION OF LIGHT

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.

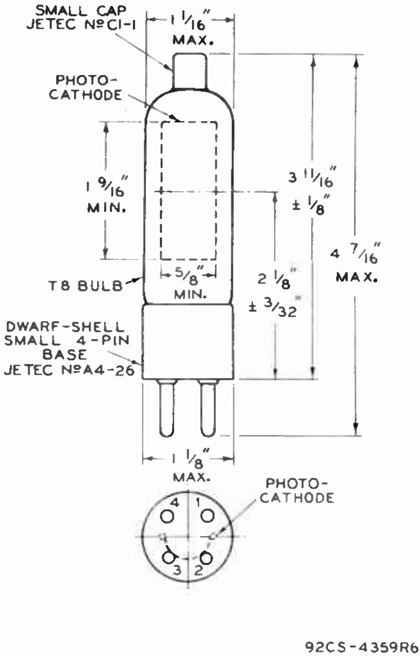
SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-1 Response is shown at front of this Section

← Indicates a change.

TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

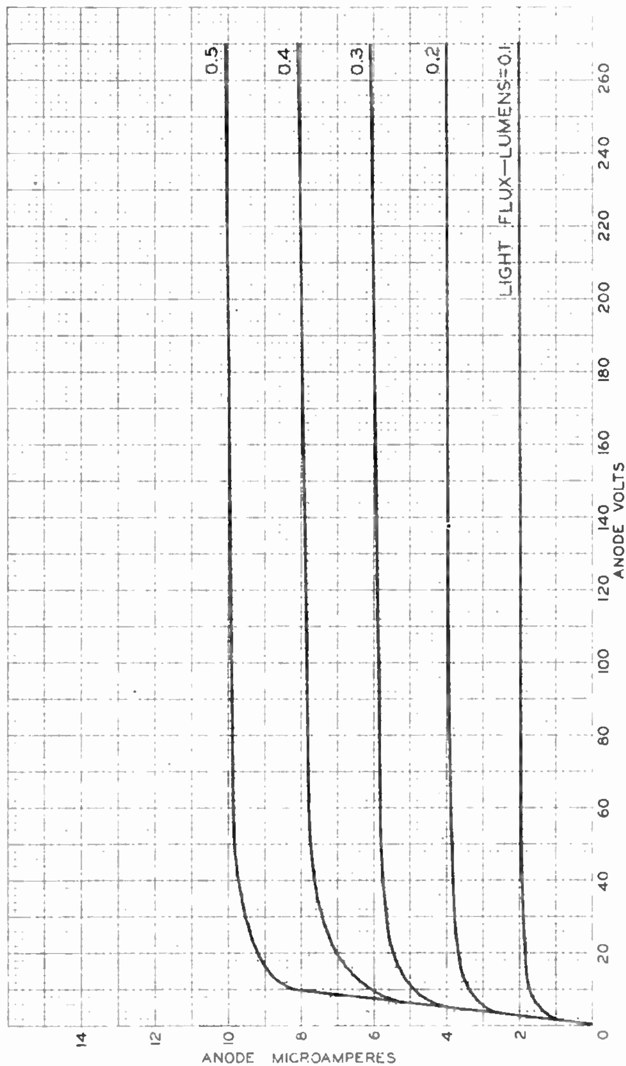
917

VACUUM PHOTOTUBE



917

AVERAGE ANODE CHARACTERISTICS



TUBE DIVISION

RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

92CM-4360R2

Gas Phototube

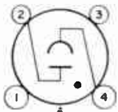
SIDE-ON TYPE HAVING S-1 RESPONSE

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 $\mu\mu$f
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

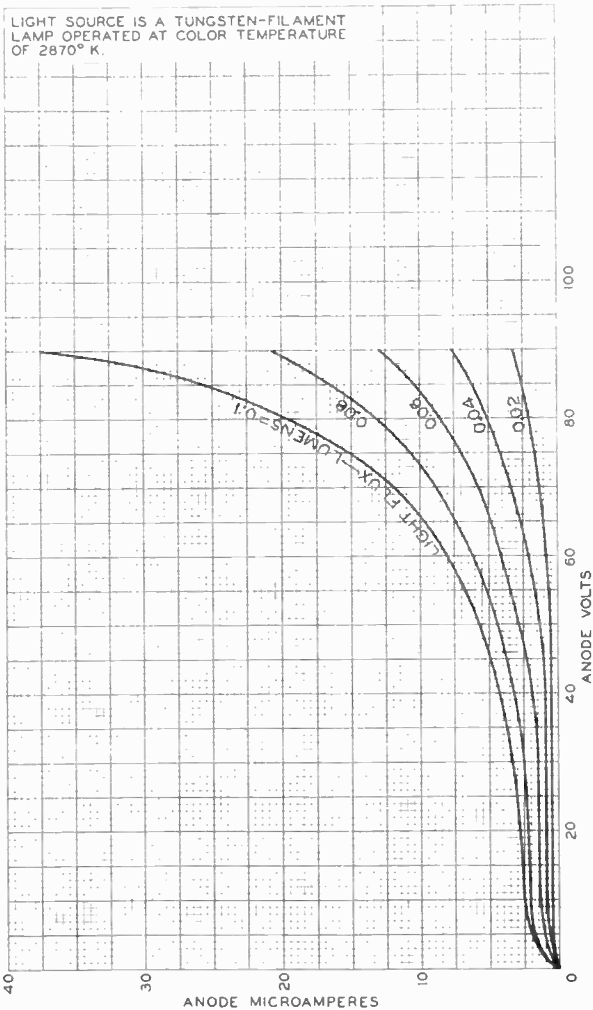
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

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

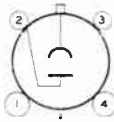
For light-measuring and relay applications

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 1P

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



DIRECTION OF LIGHT

Pin 4 - No Connection
Cap - Cathode

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Gas Phototube

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

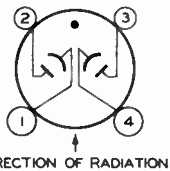
DATA

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 μμf
Cathode to anode[c]	1.6 μμf
Anode to anode[d]	0.4 μμf ←
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 - Photo-cathode of Unit No. 2

Pin 2 - Anode of Unit No. 2



Pin 3 - Anode of Unit No. 1

Pin 4 - Photo-cathode 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.	°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	-	ma/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

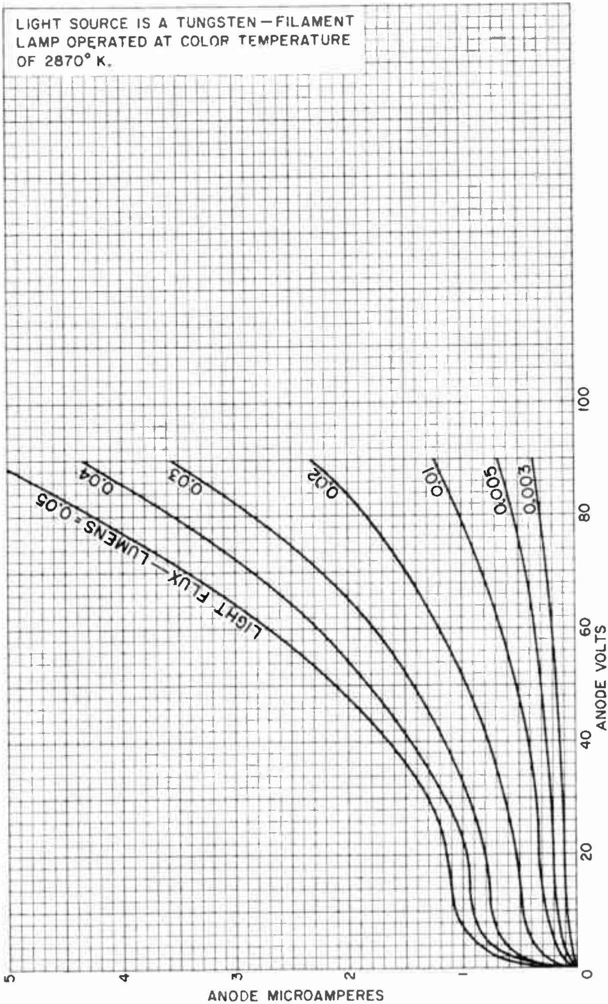
are shown at the front of this section

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

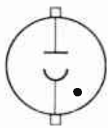
For relay applications

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 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 ←

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.

RCA

921

GAS PHOTOTUBE

Minimum Circuit Values:

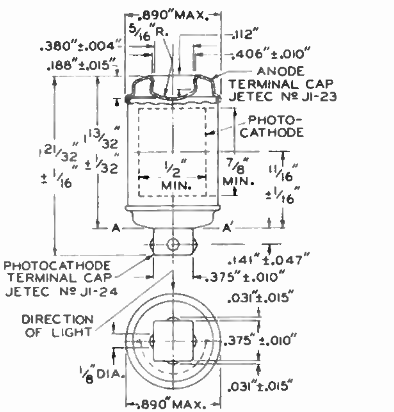
With anode-supply voltage of	*70 or less*	*90*	*volts*
DC Load Resistance:			
For dc currents above 3 μamp	0.1 min.	–	megohm
For dc currents below 3 μamp	0 min.	–	megohm
For dc currents above 2 μamp	–	2.5 min.	megohms
For dc currents below 2 μamp	–	0.1 min.	megohm

○ 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



A-A' = PLANE PERPENDICULAR TO AXIS OF TUBE 92CM-4789R5

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RCA

922
VACUUM PHOTOTUBE

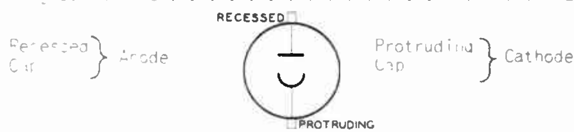
CARTRIDGE TYPE WITH S-1 RESPONSE

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 μμf
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



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.

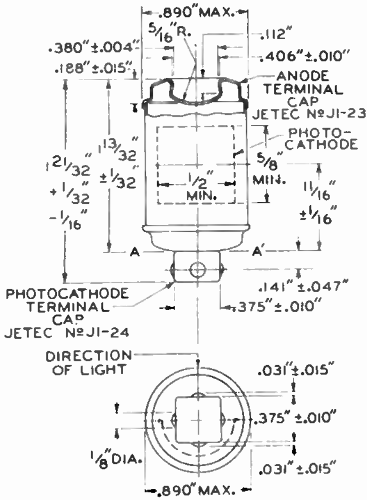
TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

RCA

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



A-A'=PLANE PERPENDICULAR TO AXIS OF TUBE

92CM-4818R5

RCA

923
GAS PHOTOTUBE

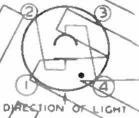
WITH S-1 RESPONSE

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

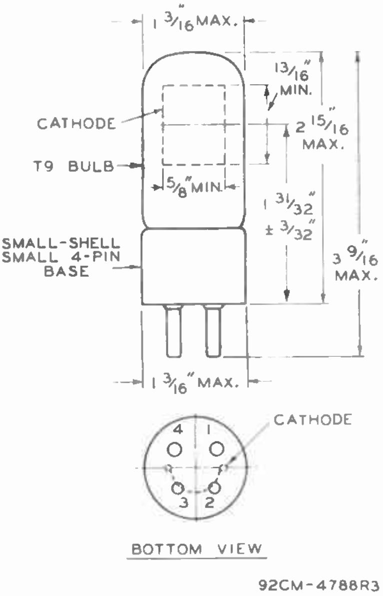
Maximum Ratings, Characteristics, and Curves
for the 923
are the same as those shown
for Type 930

* On plane perpendicular to indicated direction of incident light.

← indicates a change.

RCA

923
GAS PHOTOTUBE



TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Vacuum Phototube

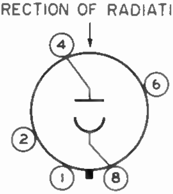
SIDE-ON TYPE HAVING S-1 RESPONSE

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-[illegible]/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. 8CM-1, or equivalent ←
Base . . . . Intermediate-Shell Octal 5-Pin, Arrangement 1 (JEDEC Group 1, No. B5-10)
  Basing Designation for BOTTOM VIEW . . . . 3[illegible]

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

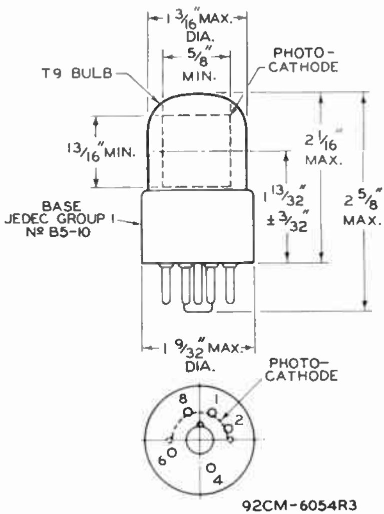
← Indicates a change.

[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

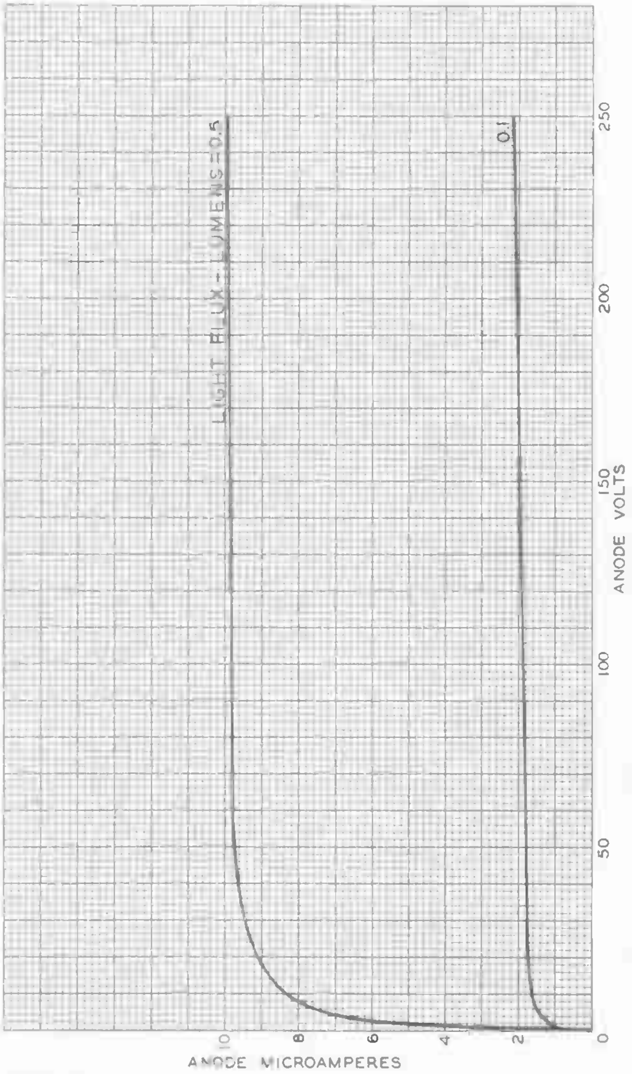


925

RCA

925

AVERAGE ANODE CHARACTERISTICS



JULY 31, 1947

TUBE DEPARTMENT

92CM-6208R1

RCA

926
VACUUM PHOTOTUBE

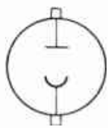
CARTRIDGE TYPE WITH S-3 RESPONSE

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 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 ←



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.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

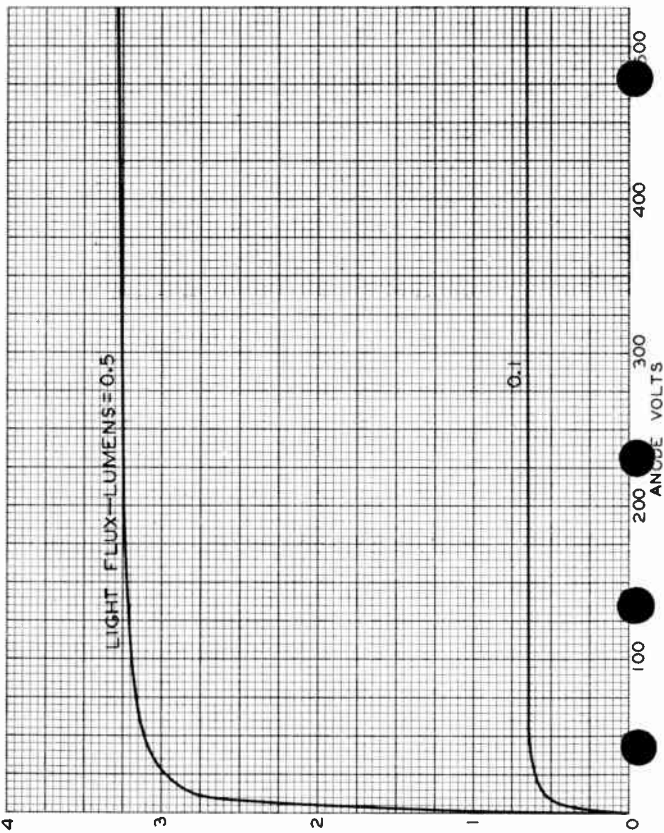
926

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



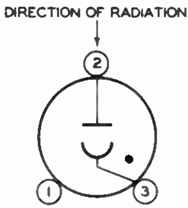
Gas Phototube

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 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 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.	°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.

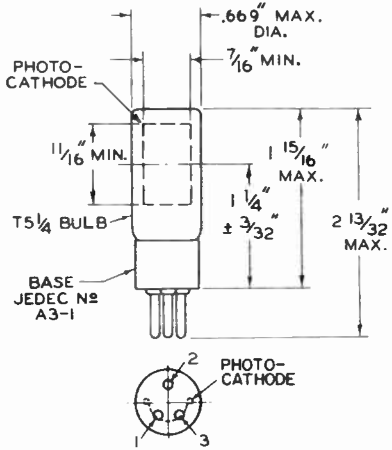
[d] The ratio of luminous sensitivity at an anode-supply voltage of 90 volts to luminous sensitivity at an anode-supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light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

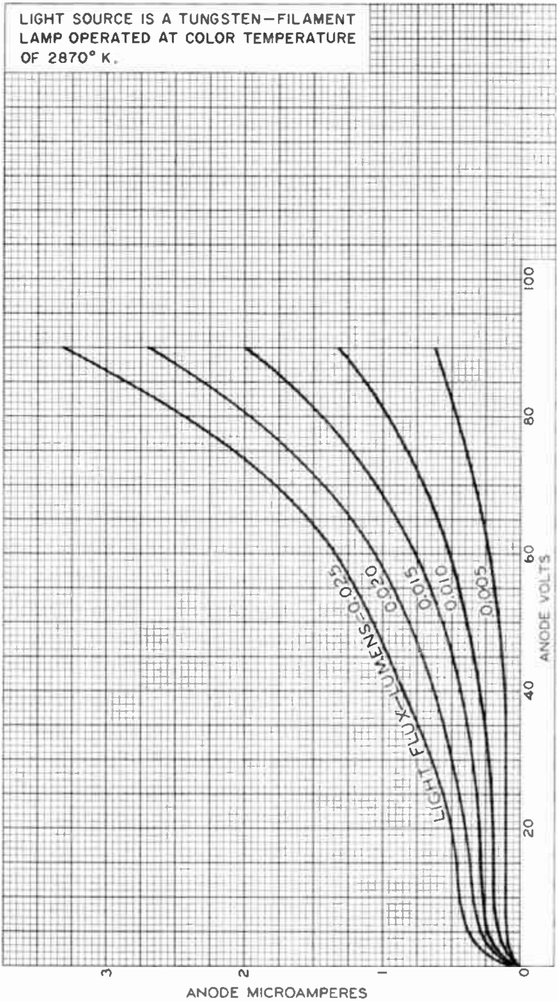
FREQUENCY-RESPONSE CHARACTERISTICS
OF GAS PHOTOTUBES

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 No A3-1
2
PHOTO-CATHODE
1
3

92CM-6053R5

AVERAGE ANODE CHARACTERISTICS



92CM-6258R3

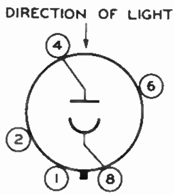
Vacuum Phototube

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.

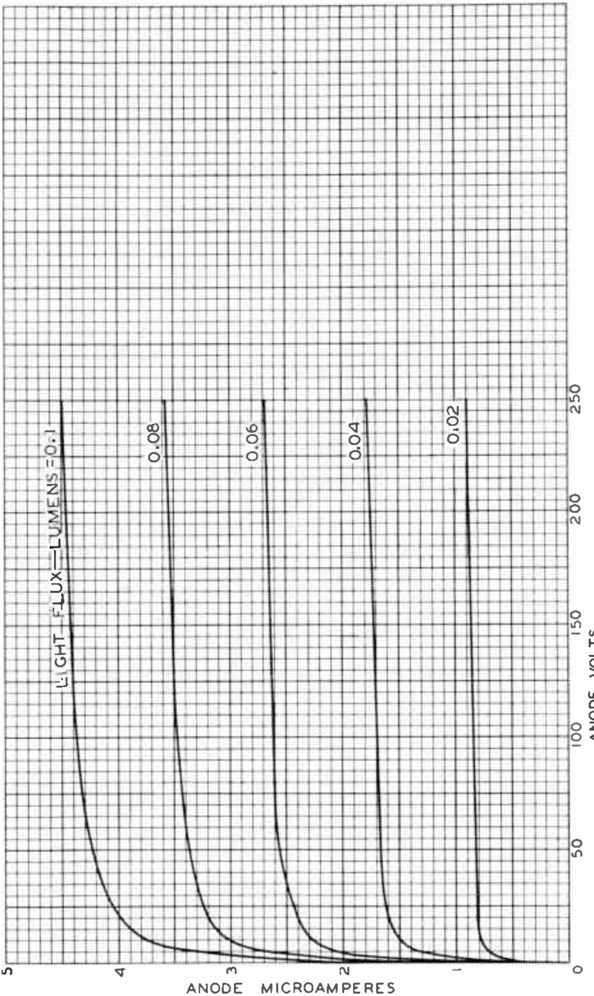
[b] Averaged over any interval of 30 seconds maximum.

[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

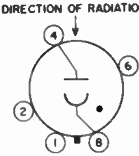
SIDE-ON TYPE HAVING S-1 RESPONSE

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

DIRECTION OF RADIATION



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	–	0.013	–	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

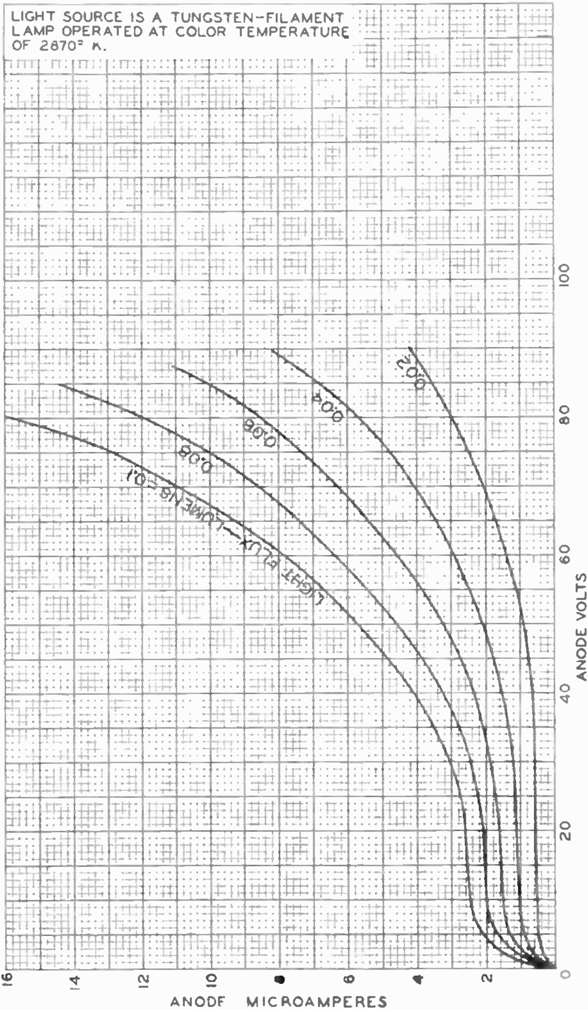
FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

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.

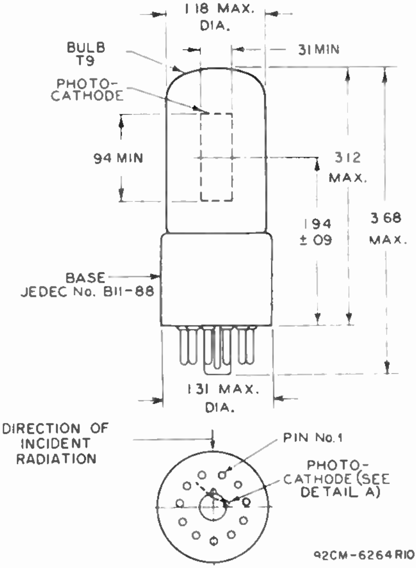
[q] Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period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

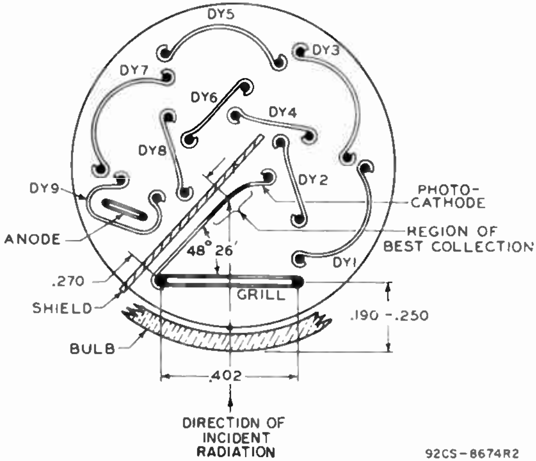
DIMENSIONAL OUTLINE



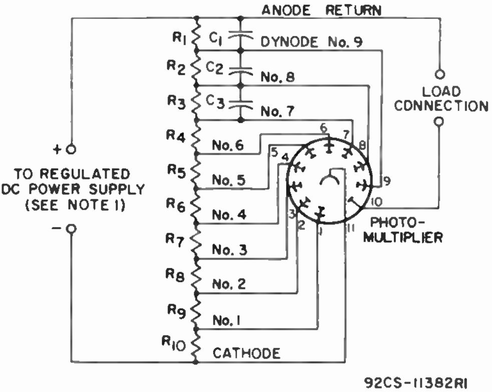
℄ of bulb will not deviate more than 2° in any direction from the perpendicular erected at center of bottom of base. Dimensions are in inches unless otherwise stated.

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)



TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



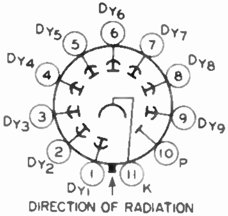
R_1 through R_{10} = 20,000 to 1,000,000 ohms

Note 1: Adjustable between approximately 500 and 1250 volts.

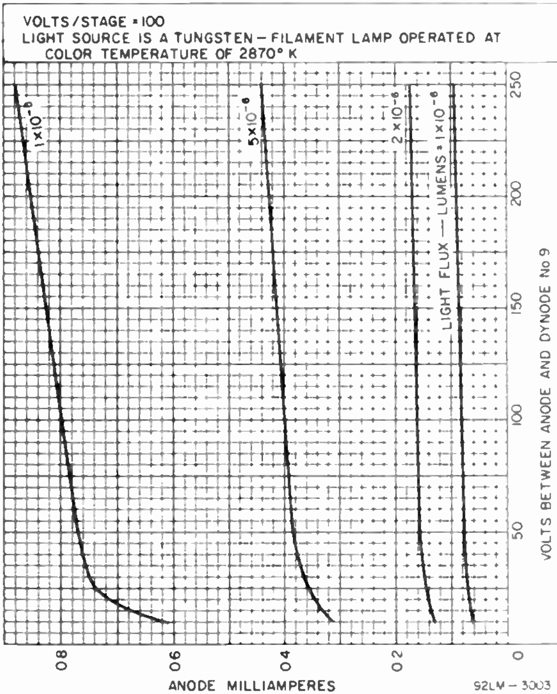
Note 2: Capacitors C_1 through C_3 should be connected at tube socket for optimum high-frequency performance.

TERMINAL DIAGRAM (Bottom View)

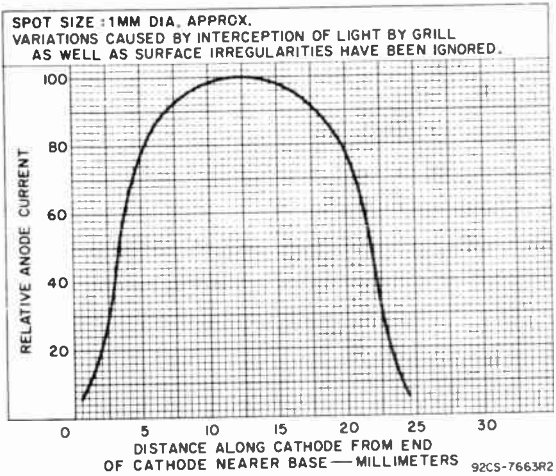
Pin 1: Dynode No.1
Pin 2: Dynode No.2
Pin 3: Dynode No.3
Pin 4: Dynode No.4
Pin 5: Dynode No.5
Pin 6: Dynode No.6
Pin 7: Dynode No.7
Pin 8: Dynode No.8
Pin 9: Dynode No.9
Pin 10: Anode
Pin 11: Photocathode



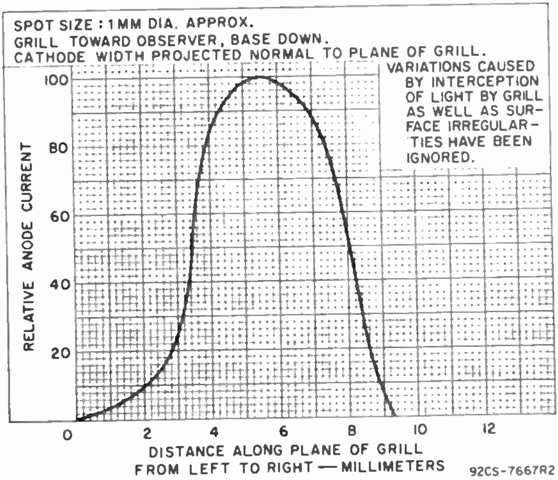
TYPICAL ANODE CHARACTERISTICS



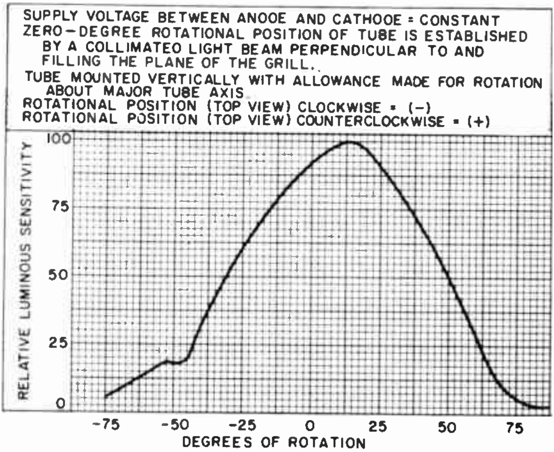
TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ALONG TUBE LENGTH



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

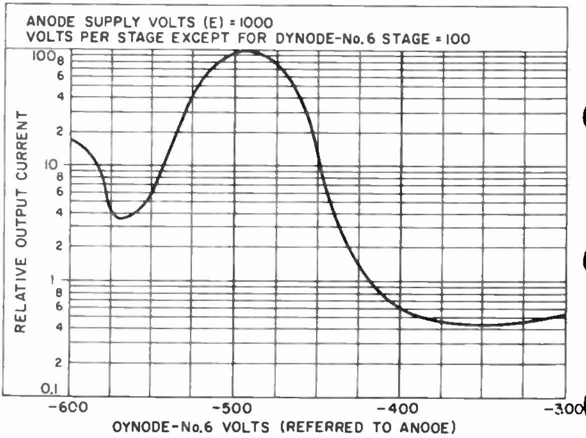


TYPICAL VARIATION OF SENSITIVITY AS TUBE IS ROTATED WITH RESPECT TO FIXED LIGHT BEAM



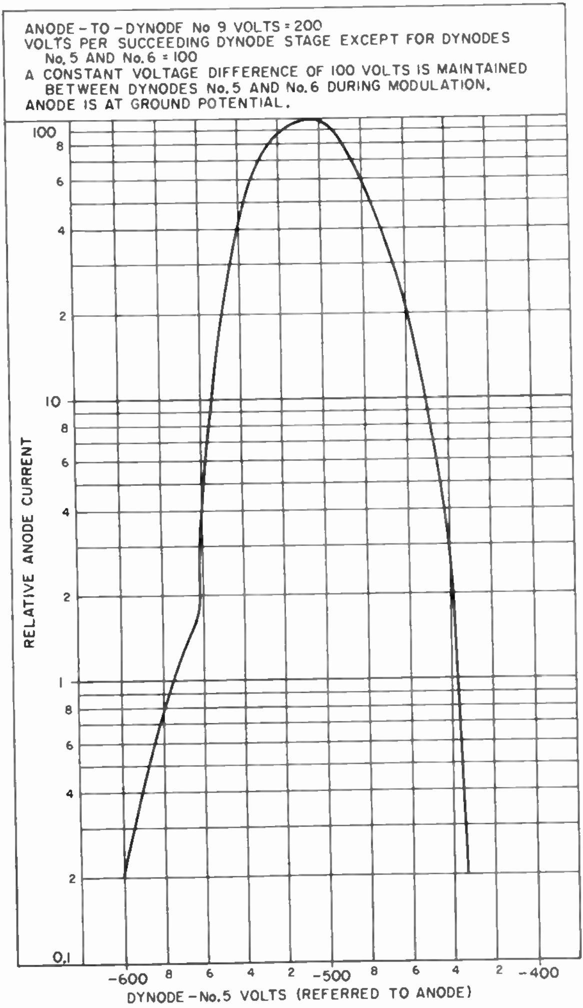
92CS-8671R2

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

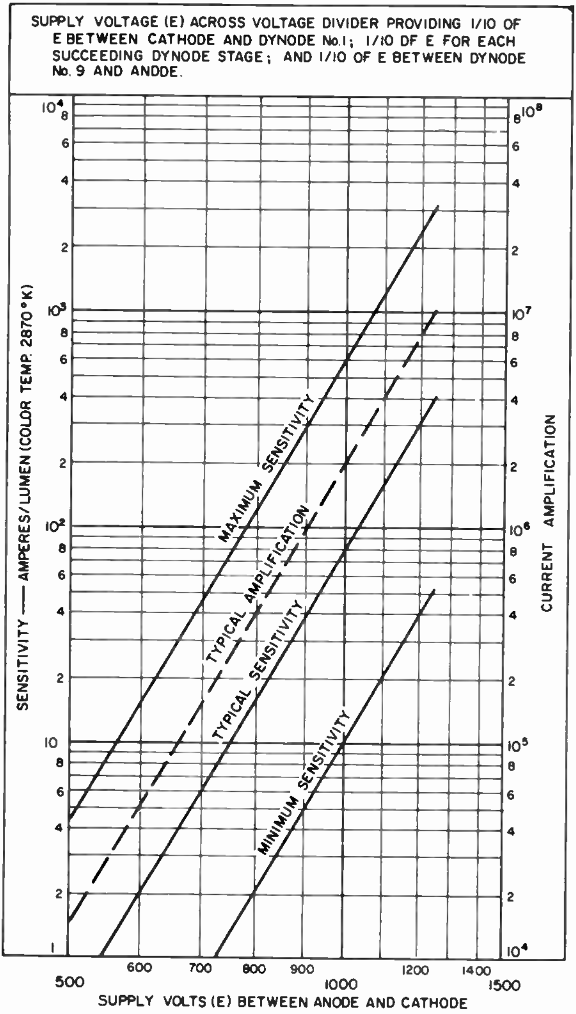


92CS-8672R1

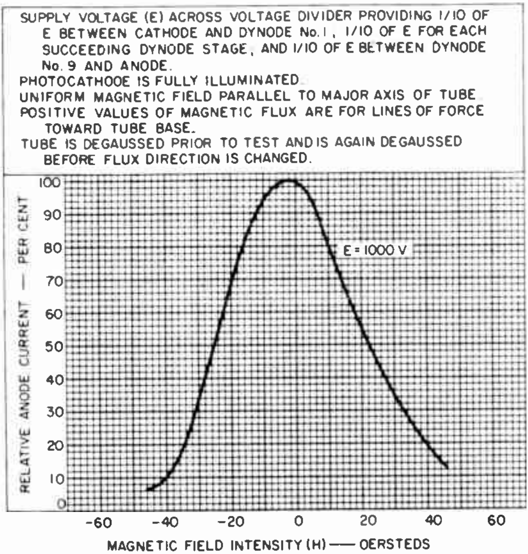
TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF SIMULTANEOUS MODULATION OF DYNODES NO.5 AND NO.6



TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

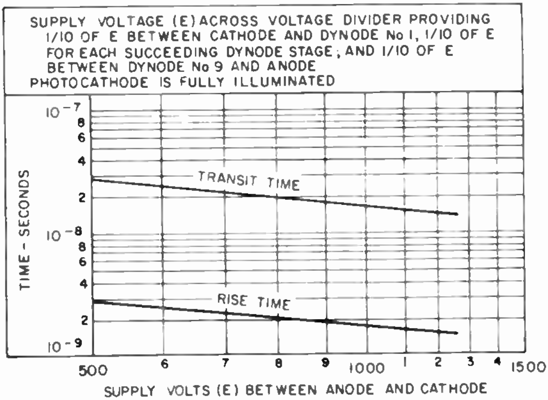


TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



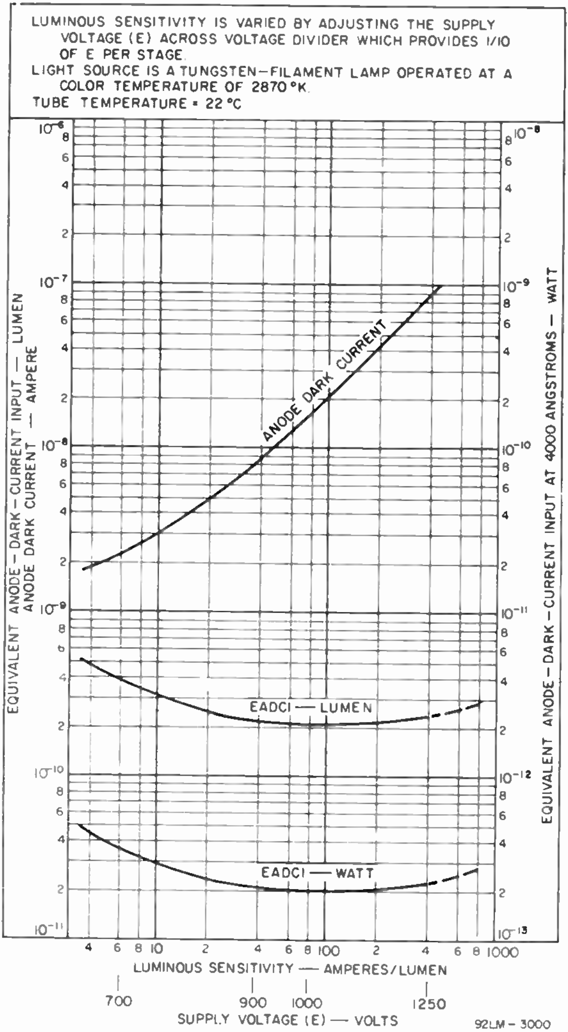
92LS – 3001

TYPICAL TIME-RESOLUTION CHARACTERISTICS



92LS - 3010

TYPICAL EADCI AND DARK CURRENT CHARACTERISTICS



Vacuum Phototube

SIDE-ON TYPE HAVING S-4 RESPONSE

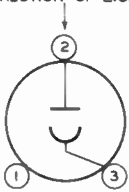
DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode:	
Shape	Semicylindrical
Minimum projected length[a]	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-1, 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.

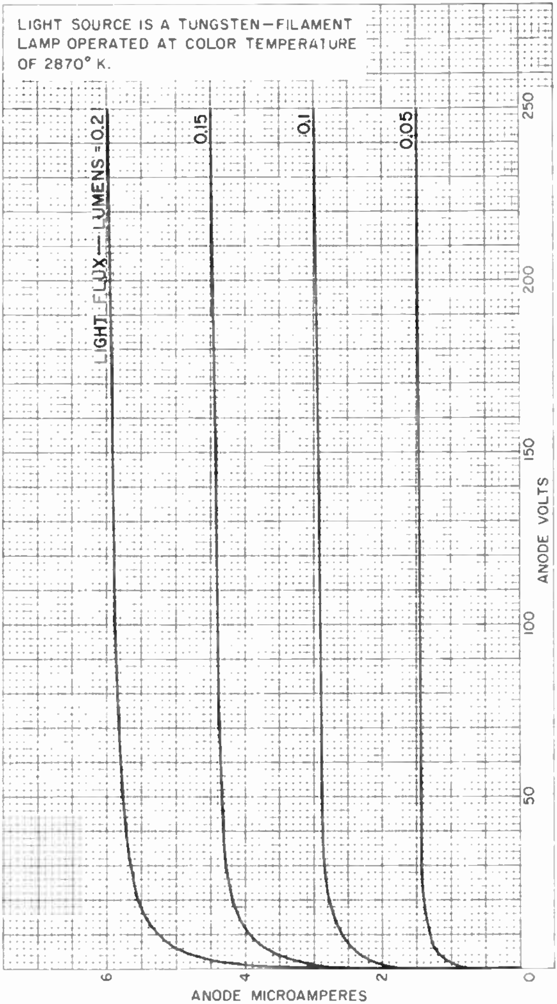
[b] Averaged over any interval of 30 seconds maximum.

[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

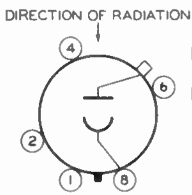
SIDE-ON TYPE HAVING S-5 RESPONSE

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 μμf
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.	°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

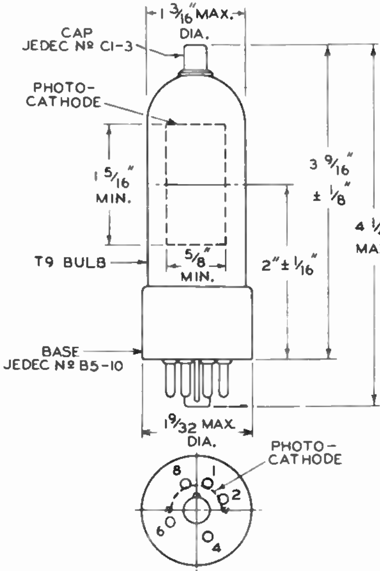
← Indicates a change.

[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

RCA

935

AVERAGE ANODE CHARACTERISTICS

APRIL 20, 1950 | TUBE DEPARTMENT | 92CM-6478R1

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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.

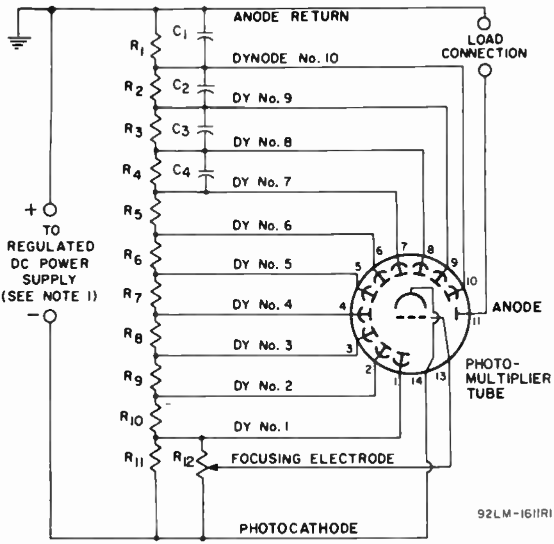
[p] At a tube temperature of 22° C. With supply voltage adjusted to give a luminous sensitivity of 20 amperes per lumen. Dark current caused by thermionic emission may be reduced by use of a refrigerant.

[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

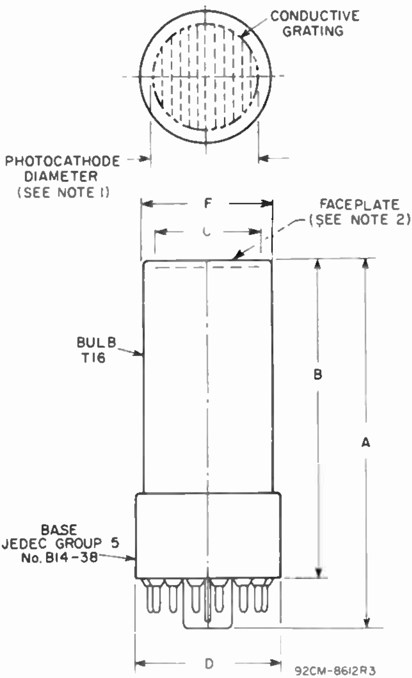


C_1: 0.05 μF, 20%, 500 volts (dc working), ceramic disc
C_2: 0.02 μF, 20%, 500 volts (dc working), ceramic disc
C_3: 0.01 μF, 20%, 500 volts (dc working), ceramic disc
C_4: 0.005 μF, 20%, 500 volts (dc working), ceramic disc
R_1 through R_{10}: 390,000 ohms, 5%, 1/2 watt
R_{11}: 910,000 ohms, 5%, 1/2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

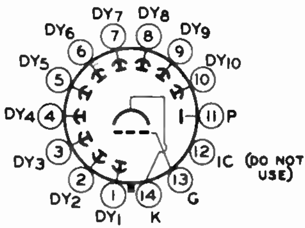
Note 1: The grating consists of 12 equally spaced conductive strips having a maximum width of 0.02" (0.5 mm).

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

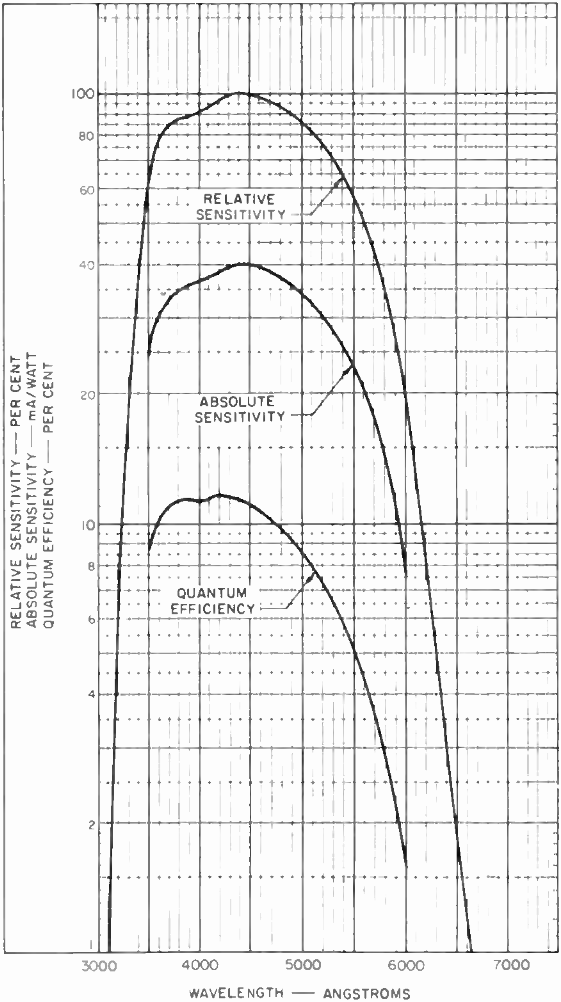
Pin 11: Anode

Pin 12: Internal connection-
Do not use

Pin 13: Focusing Electrode

Pin 14: Photocathode

Typical Spectral Response Characteristics

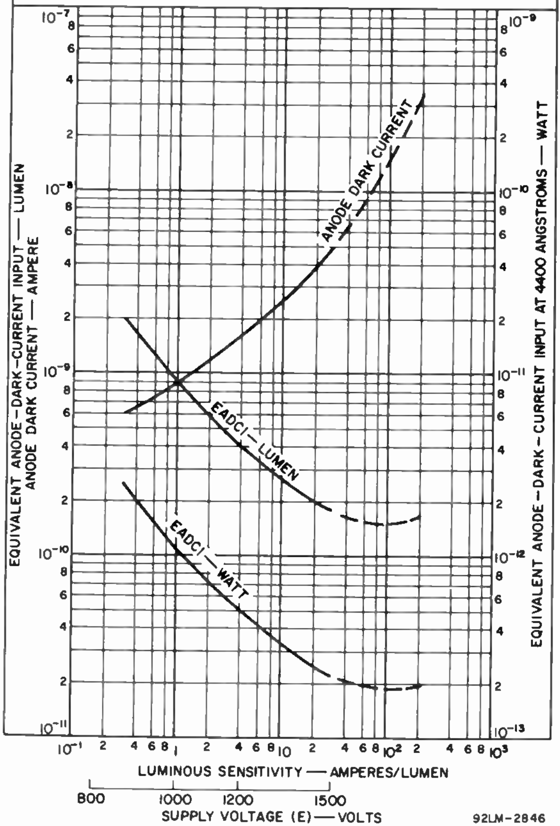


Typical EADCI and Anode Dark Current Characteristics

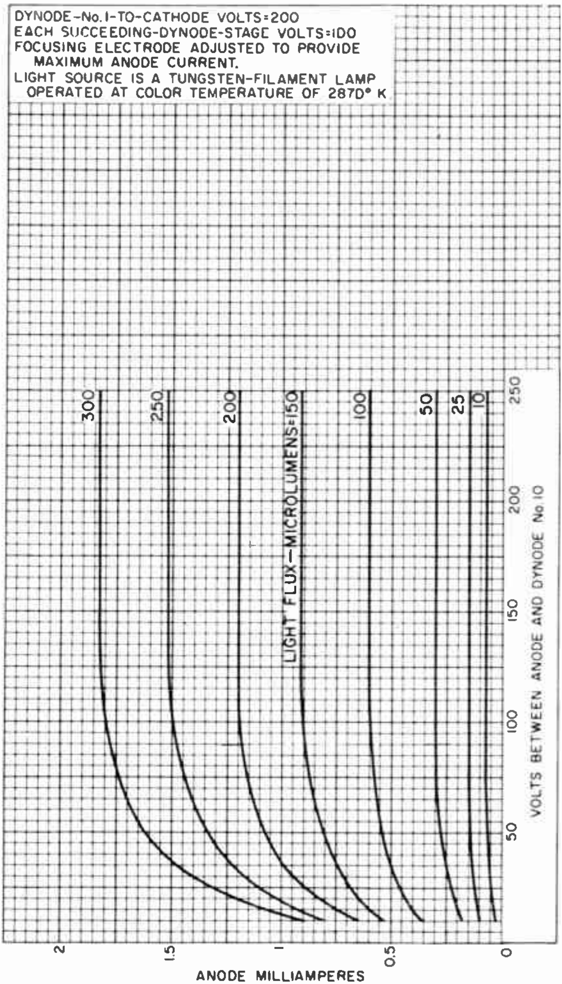
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No. 1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No. 10 AND ANODE.

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



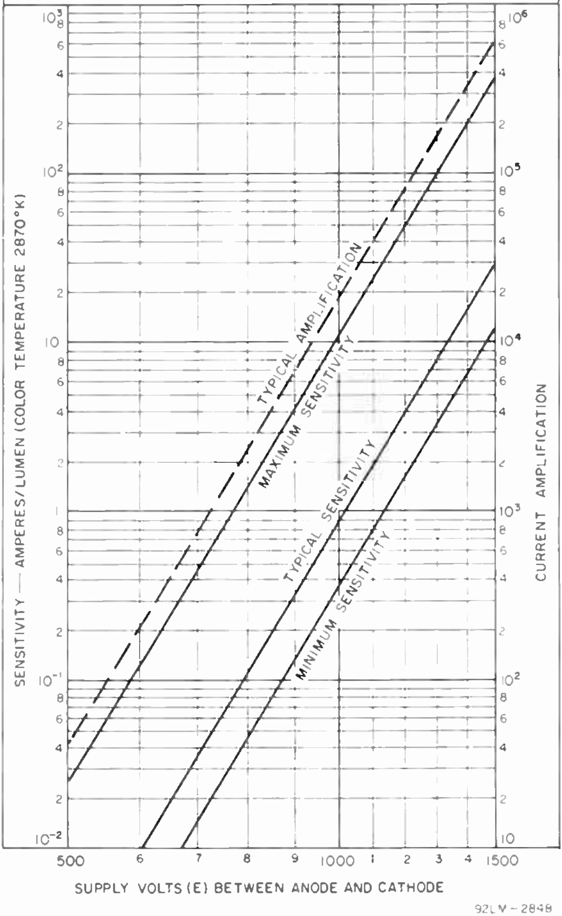
Typical Anode Characteristics



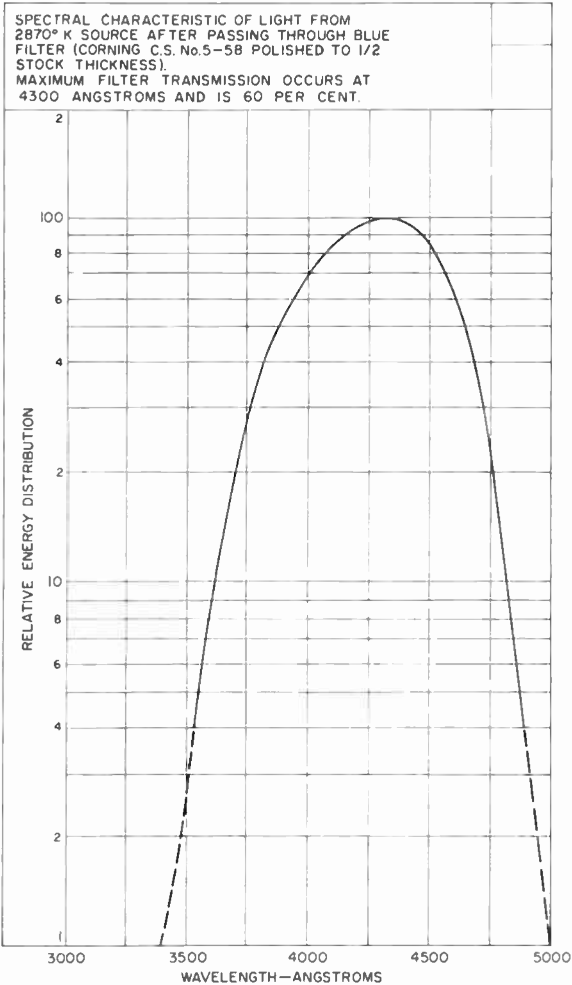
92CM-8641R2

Sensitivity and Current Amplification Characteristics

SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No 1, 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No 10 AND ANODE. FOCUSING-ELECTRODE VOLTAGE ADJUSTED TO GIVE MAXIMUM ANODE CURRENT.

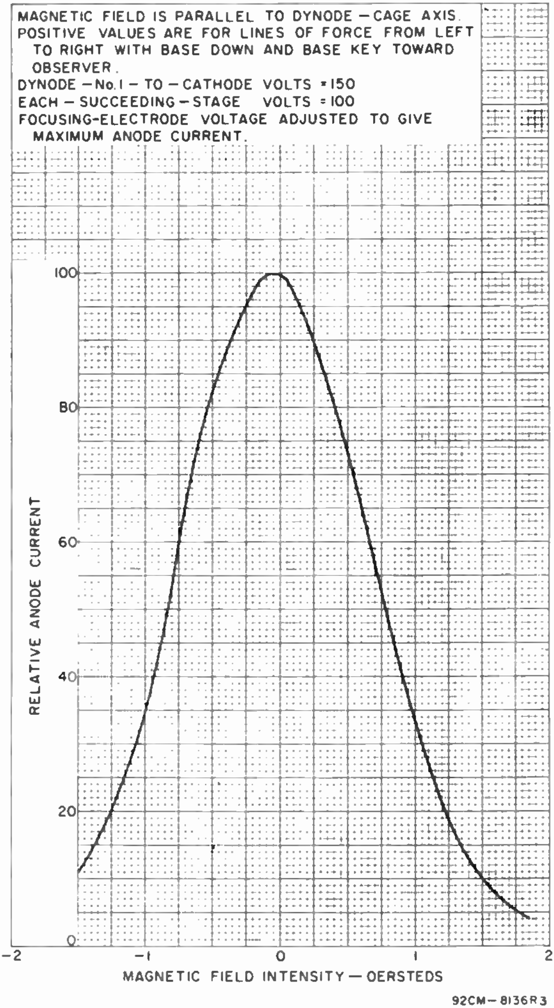


Spectral Energy Distribution of 2870° K Light Source After Passing Through Indicated Filter



92CM-11081R1

Typical Effect of Magnetic Field on Anode Current



Photomultiplier Tube

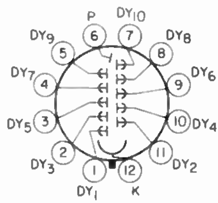
10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE HAVING S-11 RESPONSE
1.24 INCH MINIMUM DIAMETER FLAT PHOTOCATHODE

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

[illegible]

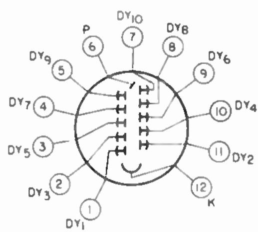


DIRECTION OF RADIATION:
INTO END OF BULB

12AE

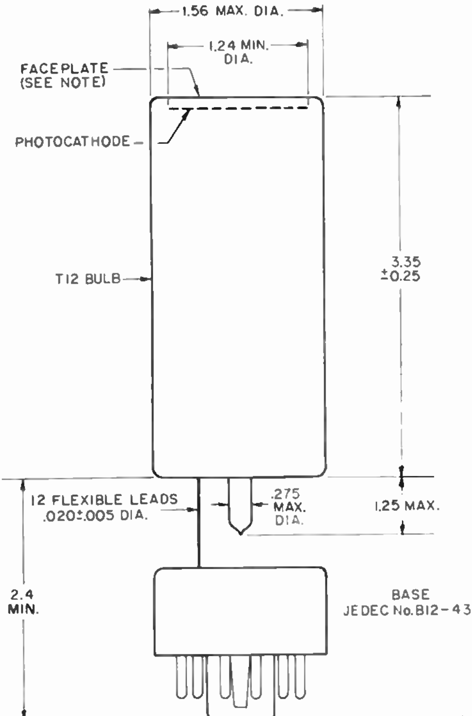
TERMINAL CONNECTIONS (Bottom View)
With Base Removed

[illegible]



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.

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

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.

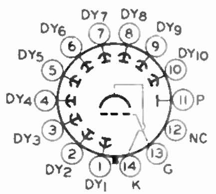
PERFORMANCE CHARACTERISTIC

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 (Cs137) 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 Cs137 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

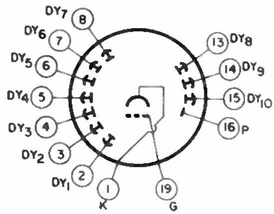
Pin 1 – Dynode No.1
Pin 2 – Dynode No.2
Pin 3 – Dynode No.3
Pin 4 – Dynode No.4
Pin 5 – Dynode No.5
Pin 6 – Dynode No.6
Pin 7 – Dynode No.7
Pin 8 – Dynode No.8
Pin 9 – Dynode No.9
Pin 10 – Dynode No.10
Pin 11 – Anode
Pin 12 – No Connection
Pin 13 – Focusing Electrode
Pin 14 – Photocathode



DIRECTION OF RADIATION: INTO END OF BULB

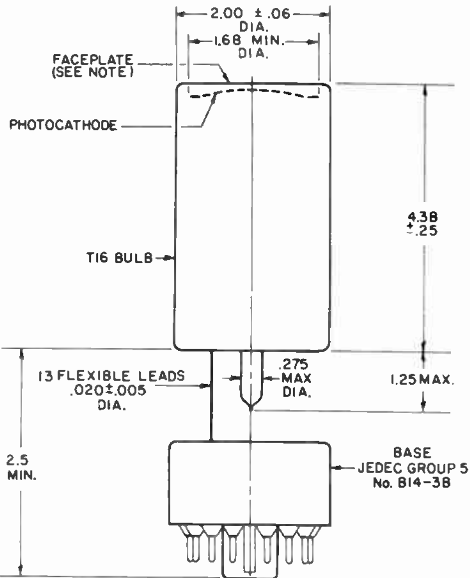
TERMINAL CONNECTIONS (Bottom View)
With Base Removed

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



92LS-1397

DIMENSIONAL OUTLINE



92LM-1399

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.

2062

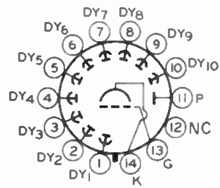
Photomultiplier Tube

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

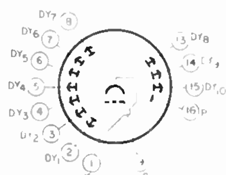
For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources

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.*

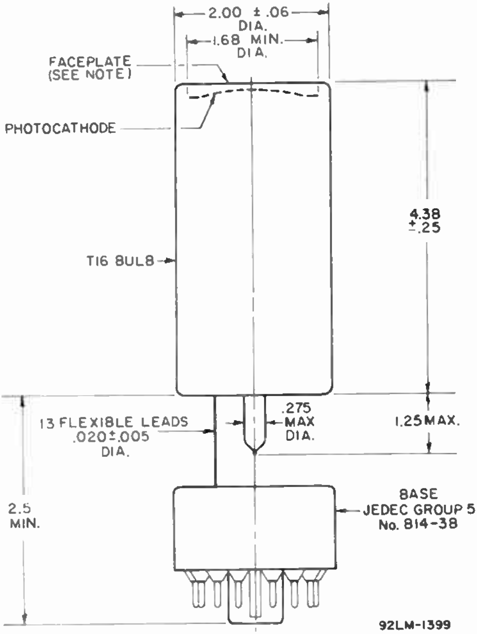
BASING DIAGRAM (Bottom View)
With Base Attached



TERMINAL CONNECTIONS (Bottom View)
With Base Removed



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.

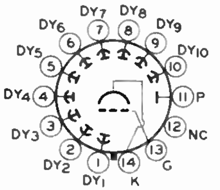
Maximum Anode Dark Current[a]	0.05	µA
Minimum Pulse Height[b]	0.13	V

[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 (Cs137) 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 Cs137 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

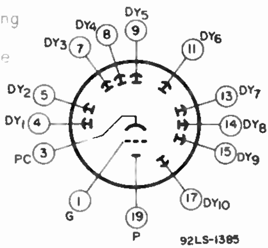


DIRECTION OF RADIATION: INTO END OF BULB

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

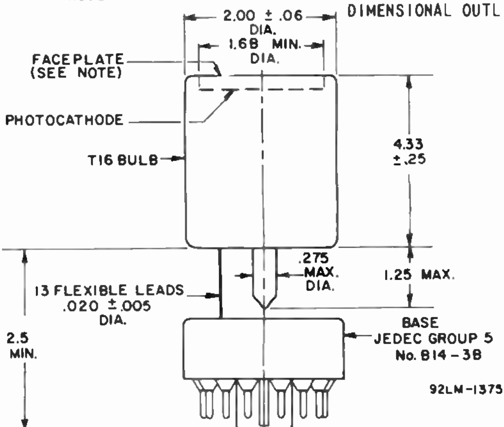
TERMINAL CONNECTIONS (Bottom View) With Base Removed

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.

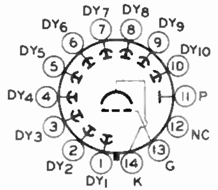
Maximum Anode Dark Current[a]	0.05	µA
Minimum Pulse Height[b]	0.18	V

[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 (Cs137) 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

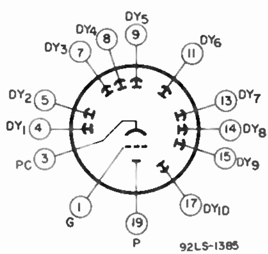
Pin 1 – Dynode No.1
Pin 2 – Dynode No.2
Pin 3 – Dynode No.3
Pin 4 – Dynode No.4
Pin 5 – Dynode No.5
Pin 6 – Dynode No.6
Pin 7 – Dynode No.7
Pin 8 – Dynode No.8
Pin 9 – Dynode No.9
Pin 10 – Dynode No.10
Pin 11 – Anode
Pin 12 – No Connection
Pin 13 – Focusing Electrode
Pin 14 – Photocathode



DIRECTION OF RADIATION:
INTO END OF BULB

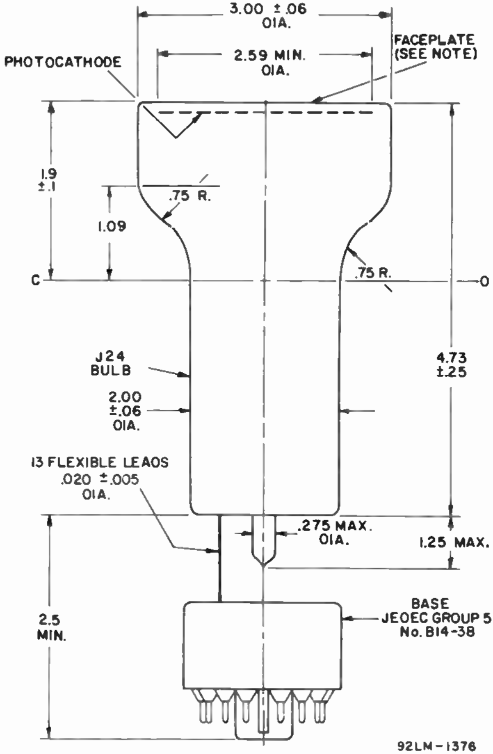
TERMINAL CONNECTIONS (Bottom View)
With base Removed

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



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.

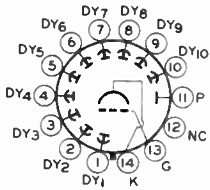
Maximum Anode Dark Current[a]	0.05	µA
Minimum Pulse Height[b]	0.13	V

[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, 150 ± 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 DC 200 (Viscosity of 100 centipoise) manufactured by the Dow Corning Corp., Midland, Michigan, or equivalent.

BASING DIAGRAM (Bottom View)
With Base Attached

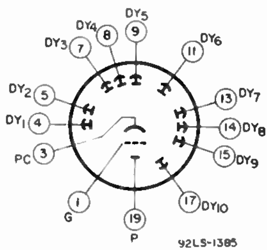
Pin 1 – Dynode No. 1
Pin 2 – Dynode No. 2
Pin 3 – Dynode No. 3
Pin 4 – Dynode No. 4
Pin 5 – Dynode No. 5
Pin 6 – Dynode No. 6
Pin 7 – Dynode No. 7
Pin 8 – Dynode No. 8
Pin 9 – Dynode No. 9
Pin 10 – Dynode No. 10
Pin 11 – Anode
Pin 12 – No Connection
Pin 13 – Focusing Electrode
Pin 14 – Photocathode



DIRECTION OF RADIATION: INTO END OF BULB

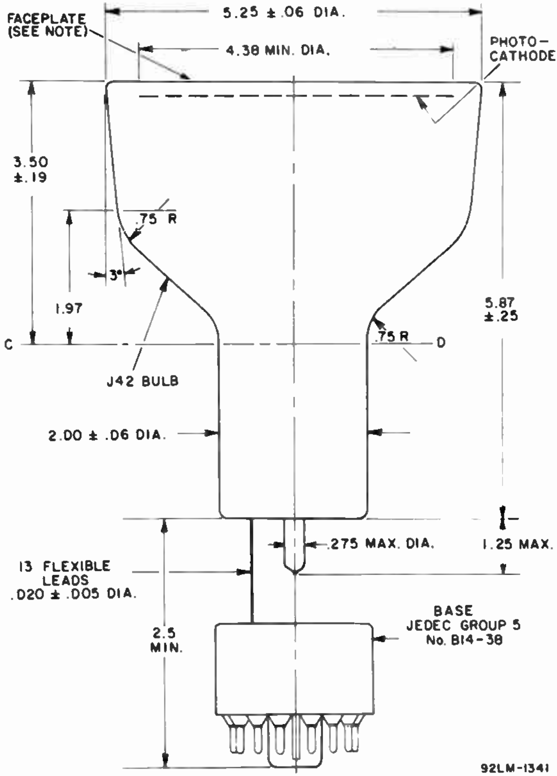
TERMINAL CONNECTIONS (Bottom View)
With Base Removed

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



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

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[j] 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.

§ 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.

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

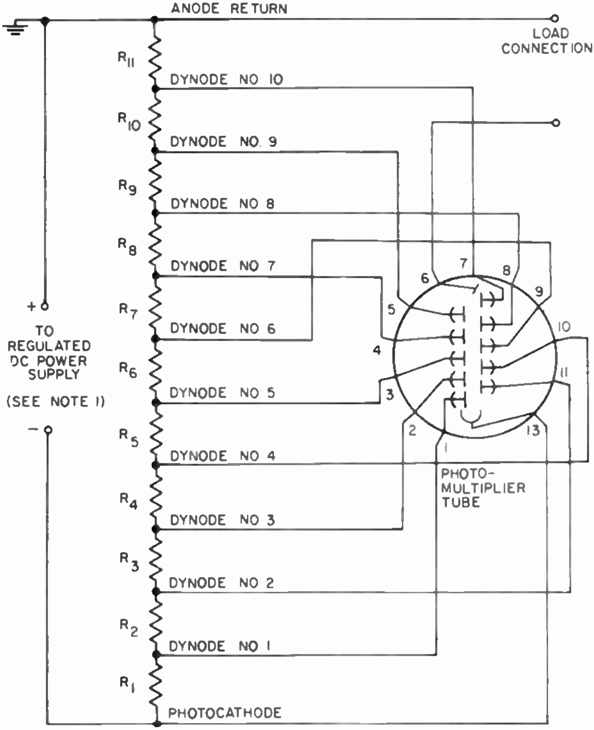
SHIELDING:

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.

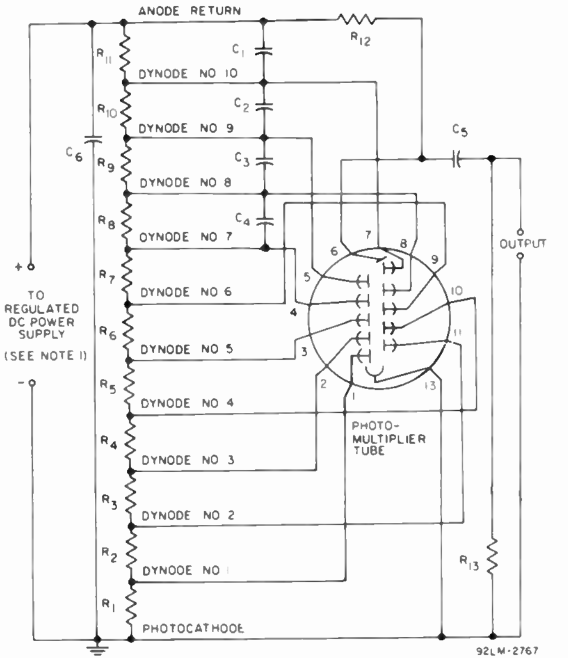
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT WHICH PERMITS DIRECT COUPLING TO THE ANODE



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

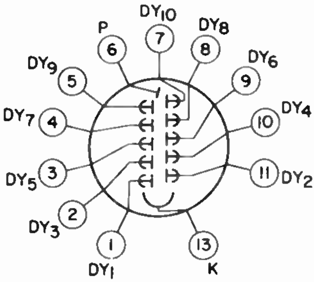
Note 1: Adjustable between approximately 500 and 1250 volts dc.

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)



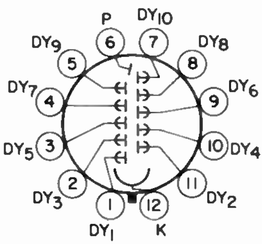
DIRECTION OF LIGHT:
INTO END OF BULB

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

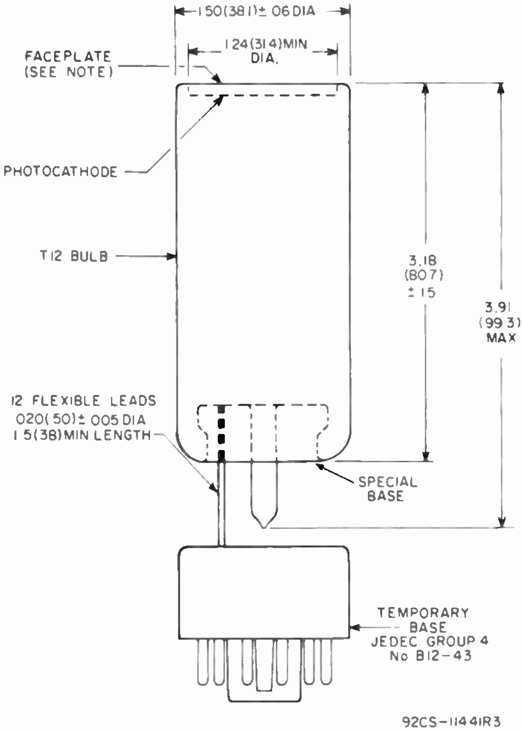
(With Temporary Base)



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

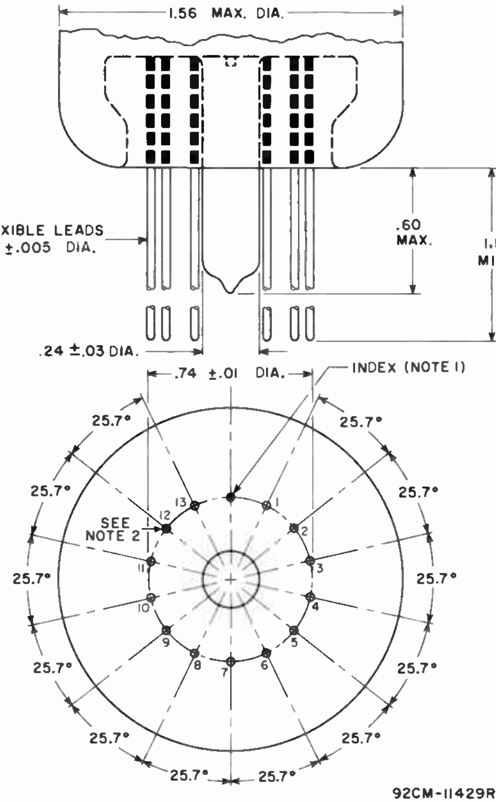


Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

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

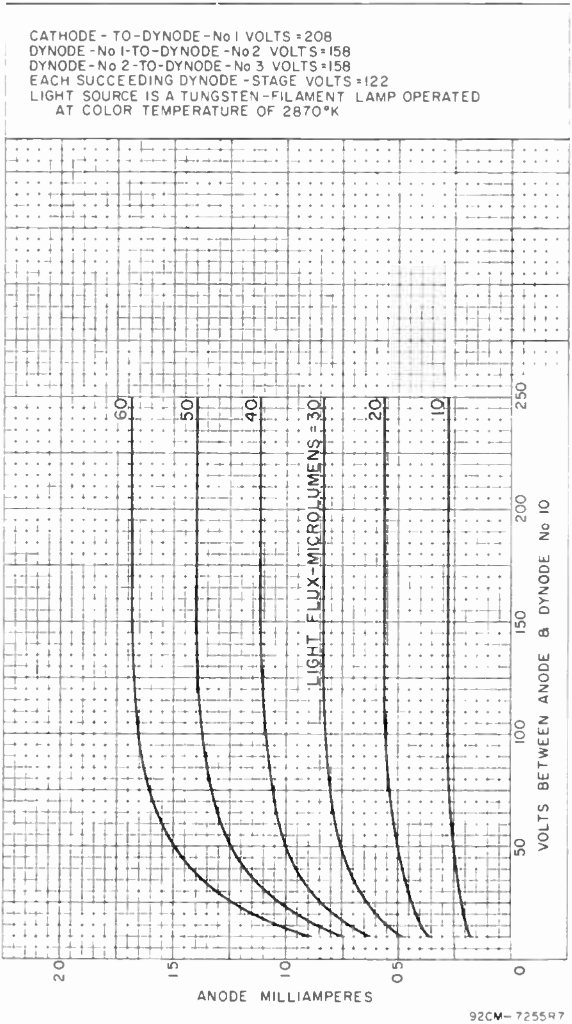


Note 1: Lead is cut off within 0.04 inch of the glass button for indexing.

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.

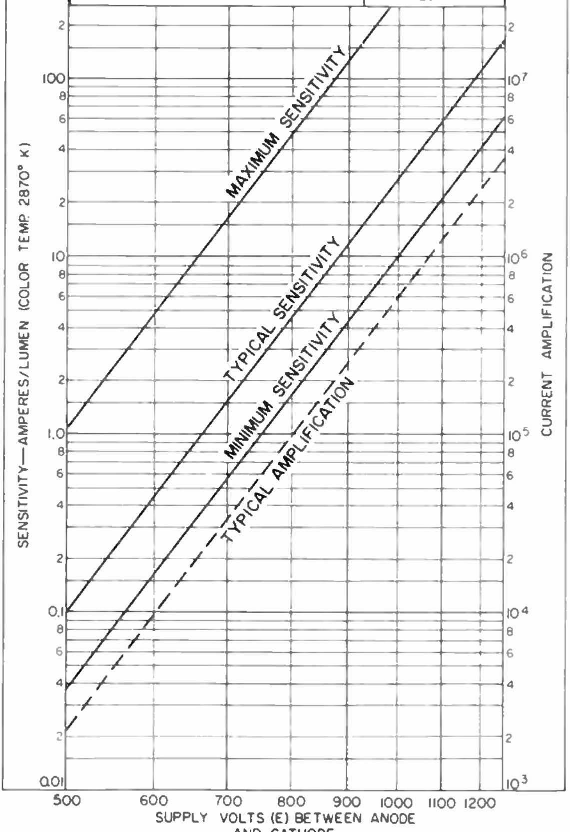
TYPICAL ANODE CHARACTERISTICS



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



TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

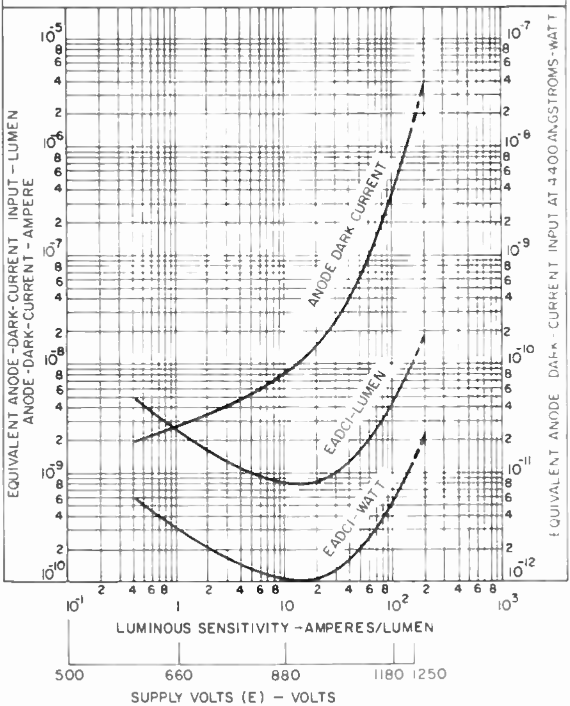
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

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

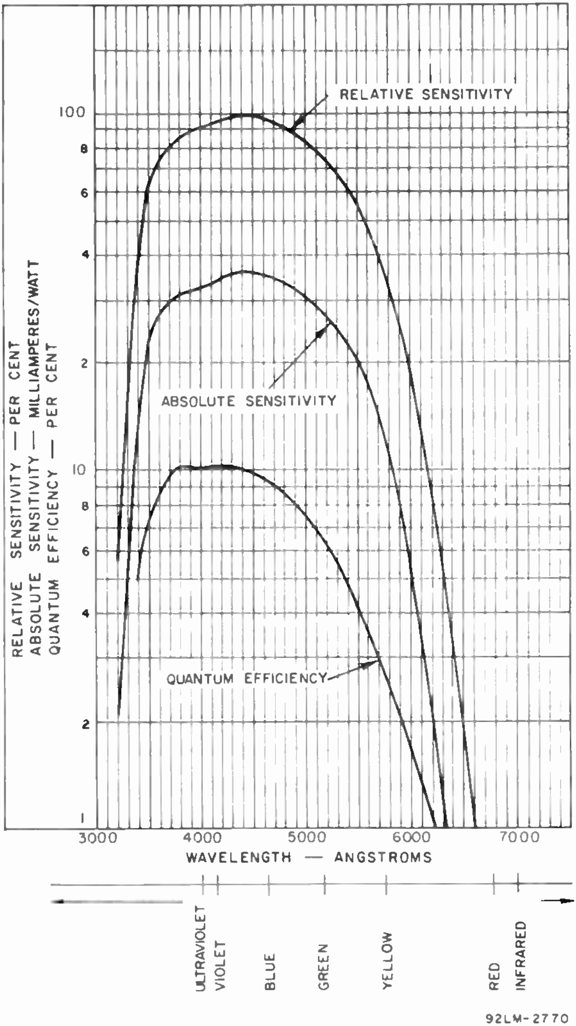
DASHED PORTION INDICATES INSTABILITY

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

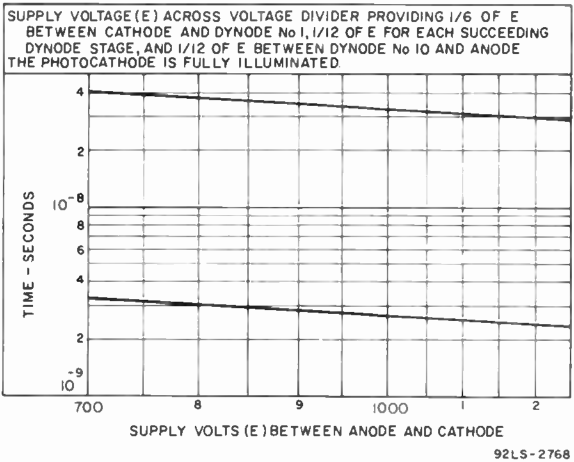


92LM-2769

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



TYPICAL TIME RESOLUTION CHARACTERISTICS



Multiplier Phototube

S-11 RESPONSE

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

ELECTROSTATICALLY FOCUSED DYNODE STAGES

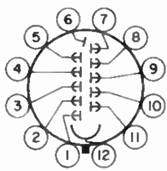
For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Industrial, Military, and Missile Applications

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 50, 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.

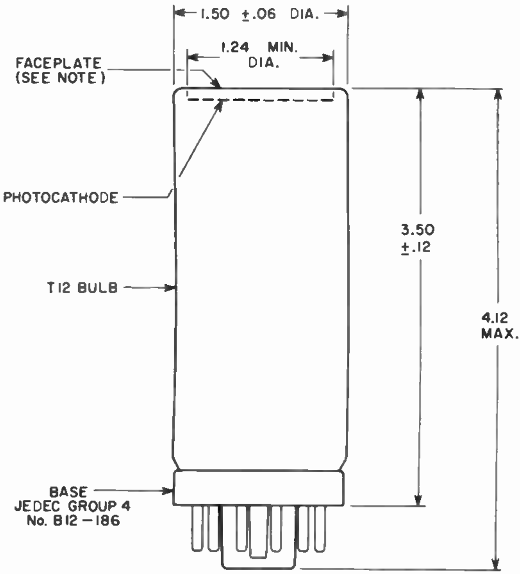
[j] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[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



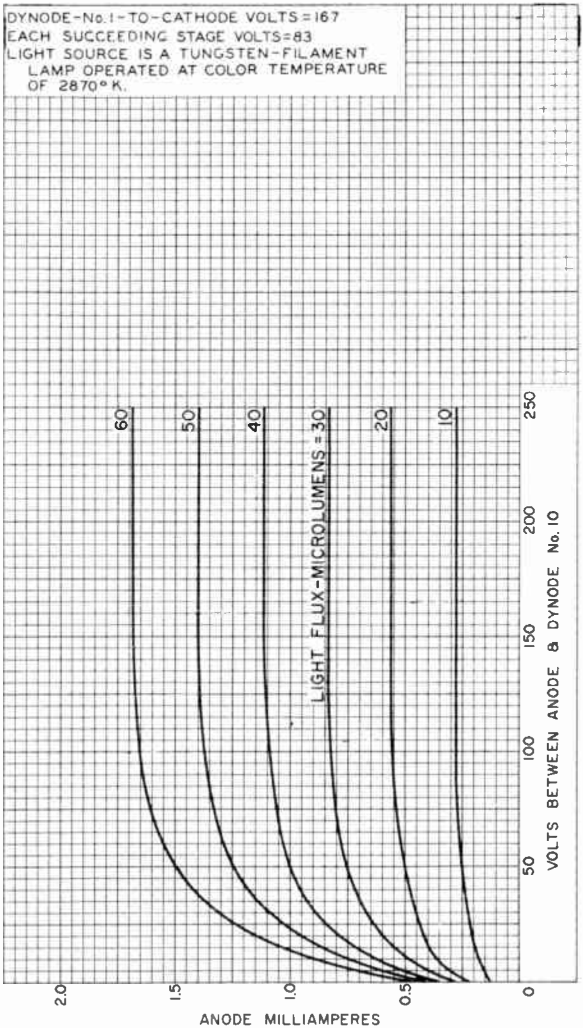
92CS-11435R1

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.

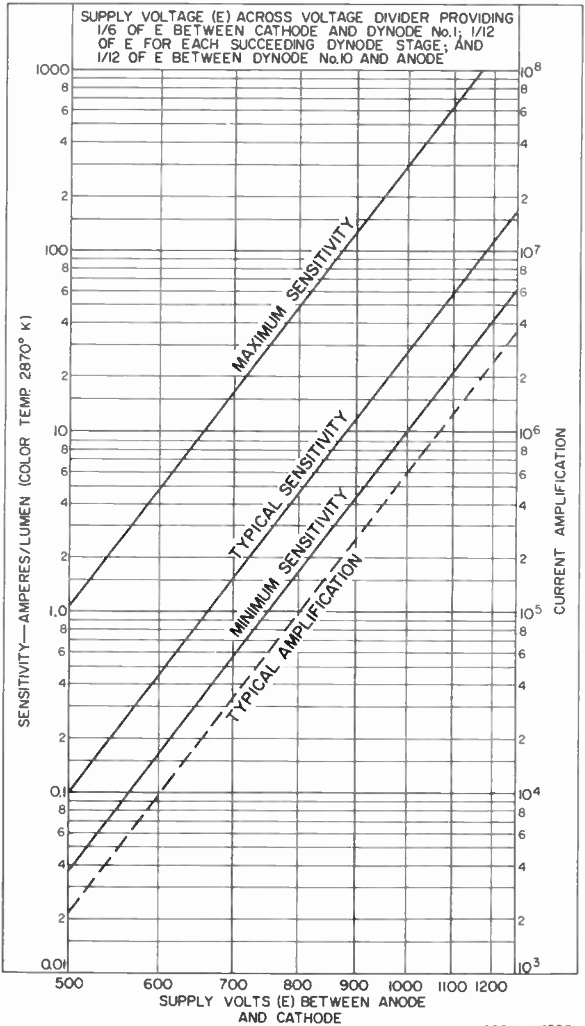
NOTE: WITHIN 1.24 INCH DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.010 INCH FROM PEAK TO VALLEY.

TYPICAL ANODE CHARACTERISTICS



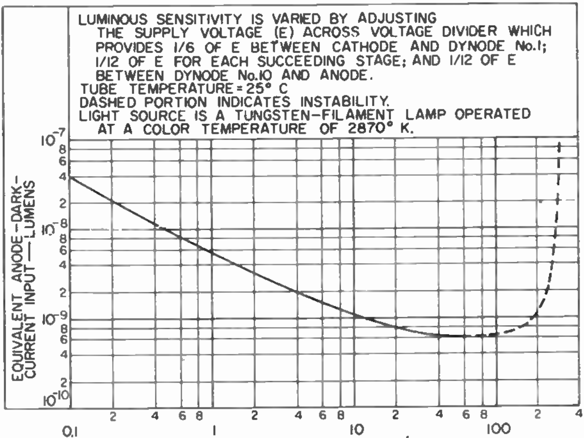
92CM-7255R6

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

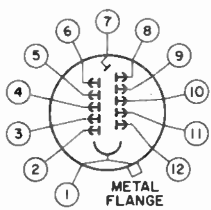
DATA

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)	5.18"
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.

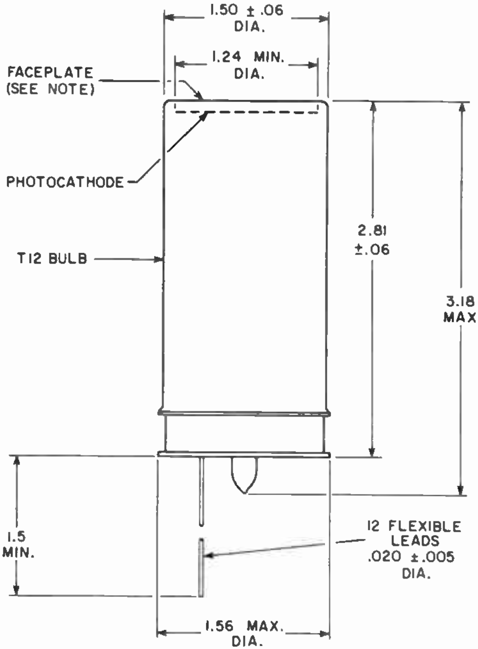
[h] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[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



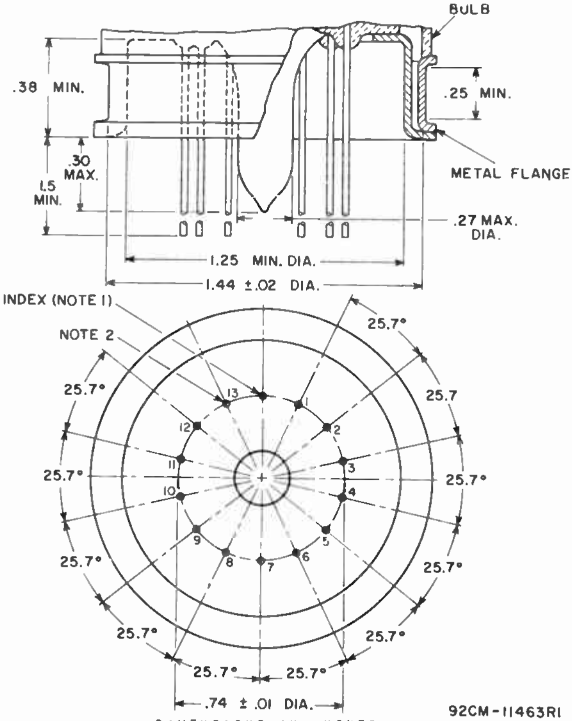
92CS-11464R1

DIMENSIONS IN INCHES

CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN [illegible] 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



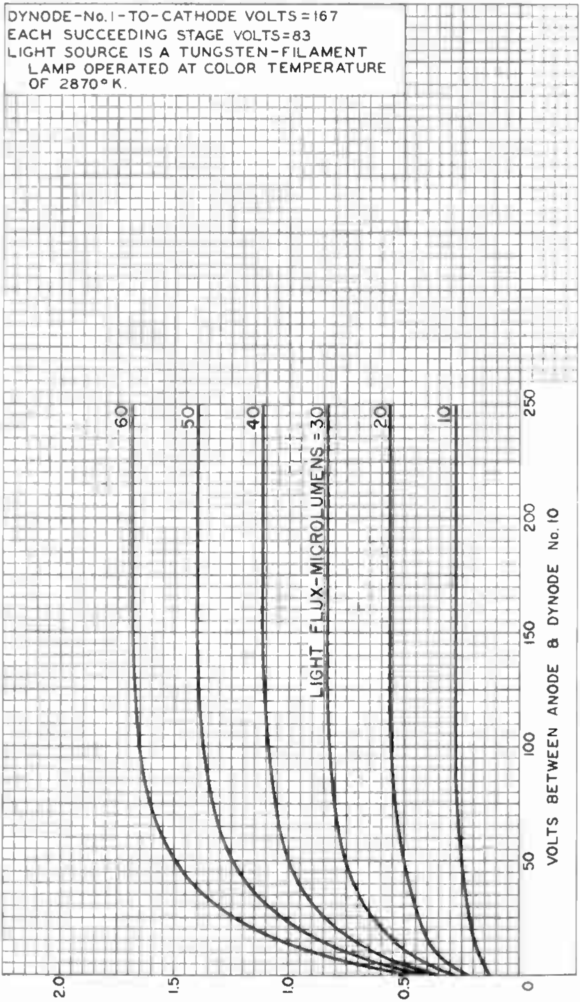
DIMENSIONS IN INCHES

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.

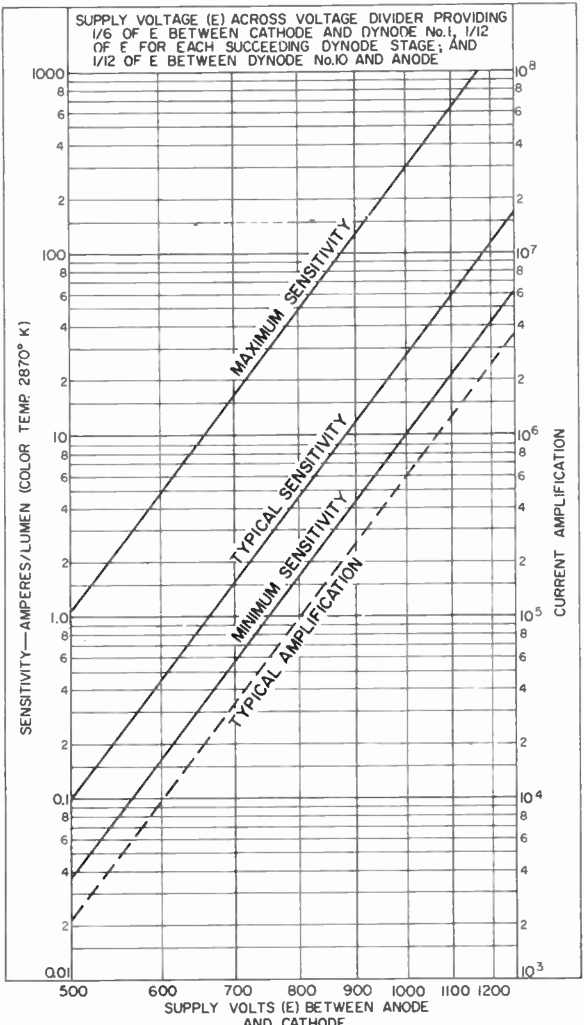
NOTE 2: LEAD NO.13 IS CUT OFF WITHIN 0.04 INCH OF THE GLASS BUTTON.

TYPICAL ANODE CHARACTERISTICS



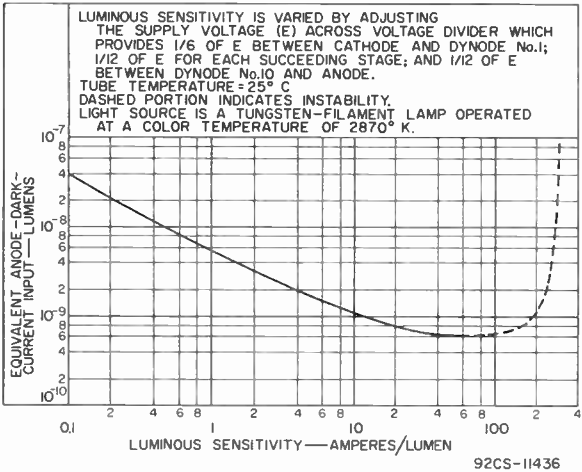
92CM-7255R6

TYPICAL CHARACTERISTICS



92CM-11439R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



Multiplier Phototube

RUGGED VIBRATION-RESISTANT STRUCTURE

S-11 RESPONSE

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

ELECTROSTATICALLY FOCUSED 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 per-cent 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 for the 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
[illegible]	–	20-87	5
–	2[illegible]	87-2,000	
–	2	2000-87	
[illegible]	–	87-20	

Tube Rejection Criterion. After completion of the shock tests, tubes are [illegible] at an anode-to-cathode voltage of 100 volts with the light level incident on the tube adjusted to provide an anode current of 8 microamperes. Electrical and 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 ± [illegible] per cent at any time during the [illegible].

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 [illegible] 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.4.16.7, Proc.III [illegible] that tubes are subjected for one minute to an in-[illegible] acceleration test level of 100 ± [illegible]0 g's in both [illegible] the three orthogonal axes and the tubes are [illegible].

* [illegible] Specification MIL-E-5272C (ASG), 13 April 1959; and Amend-[illegible] 196[illegible].

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 / 10,000	lm/ft² / 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.

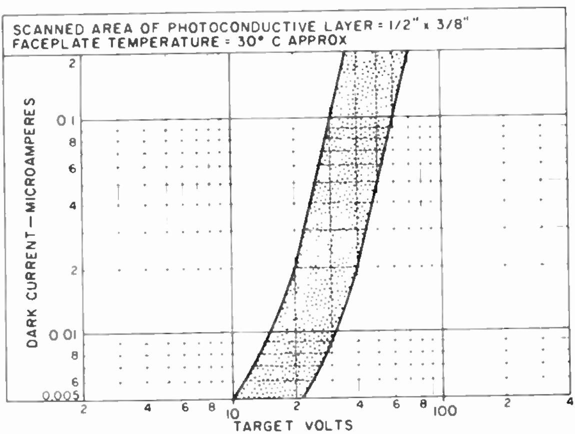
p The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

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

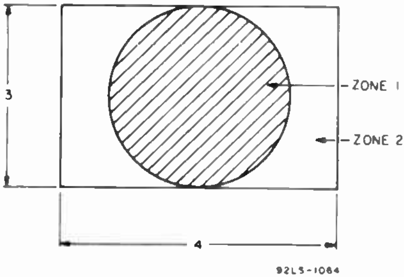


Figure 1
Spurious Signal Test Zones

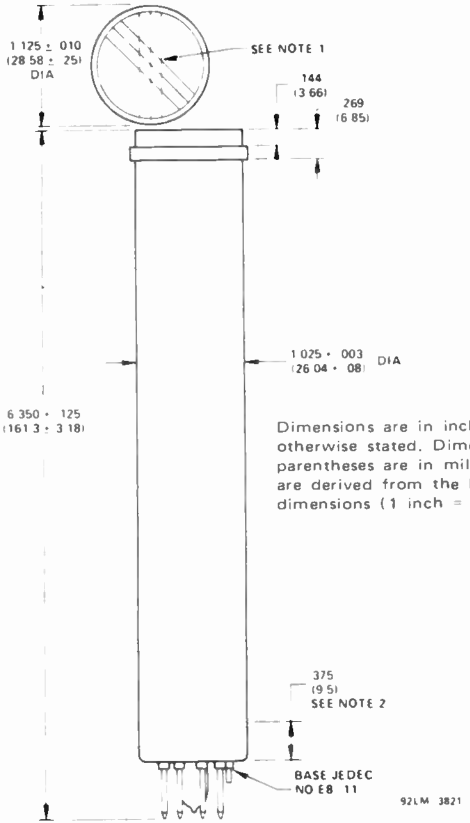
This test is performed using a uniformly illuminated test pattern containing two "zones" as shown in **Figure 1.** Illumination is for a peak signal current of 300 nanoamperes. Under these conditions, a blemish will be counted if its signal amplitude is greater than 45 nanoamperes under either illuminated 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

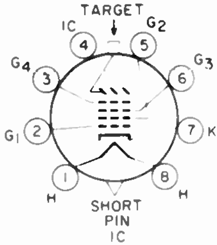


Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Note 1 – Color encoding stripes, 530 line pairs/inch. The yellow (minus blue) stripes are shown vertically on the center-line, 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

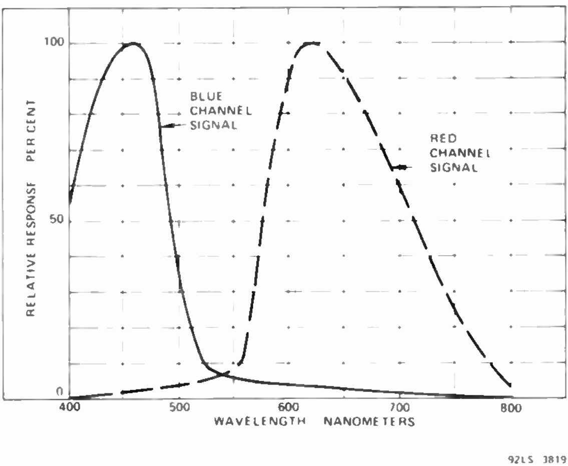


DIRECTION OF LIGHT INTO FACE END OF TUBE

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.



Typical Light Transfer Characteristic

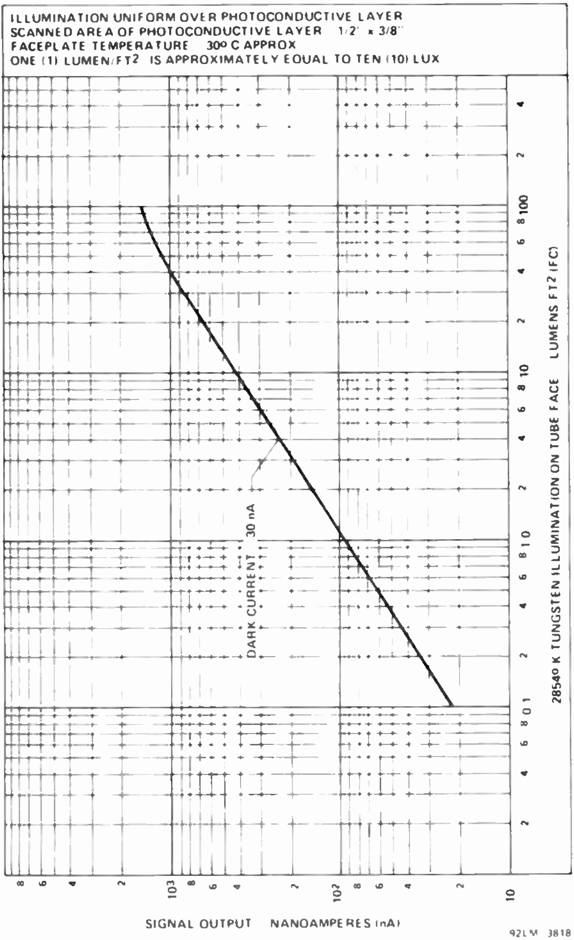


Image-Converter Tube

S-11 RESPONSE

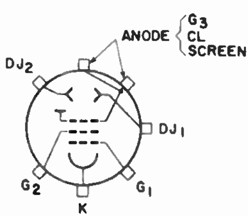
For Use as a High-Speed Light Shutter in Extremely-High-Speed Photography

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*):

G1 - Grid No.1
G2 - 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^{-14}	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 two lines is at 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

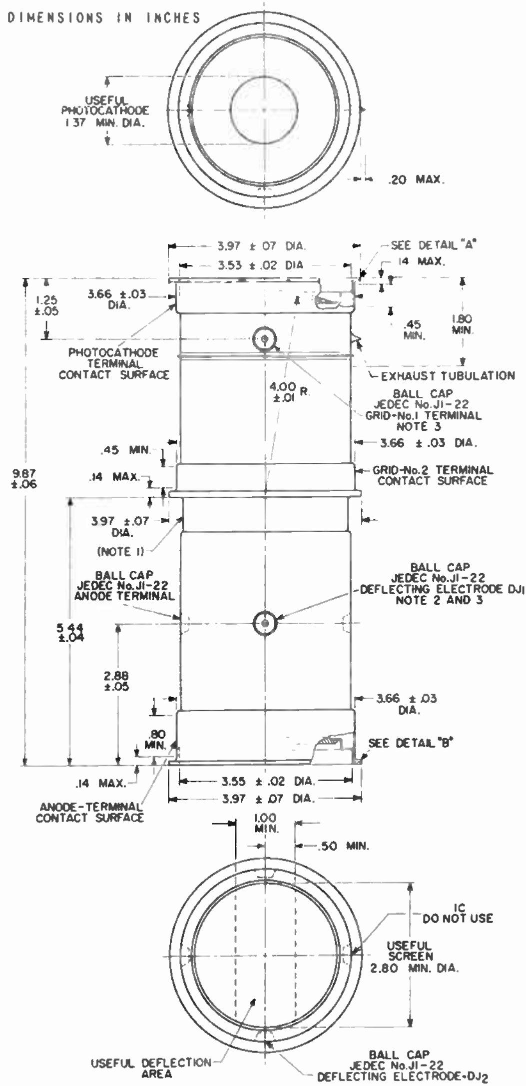
Magnetic shielding of the 4449A is required to minimize the effects of extraneous fields on tube performance; ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken in its construction to insure that the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



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

NOTES FOR DIMENSIONAL OUTLINE

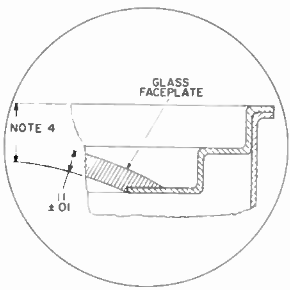
Note 1: Not to be used for mechanical support or electrical connection.

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 [illegible]° from the plane passing through the center of the recessed ball cap DJ1 and the major axis of the tube.

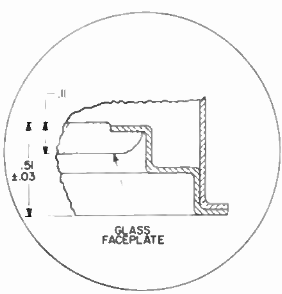
Note 3: The plane passing through the center of the recessed ball cap DJ1 and the major axis of the tube will not deviate more than [illegible]° from the plane passing through the center of the recessed ball cap for grid No. [illegible] and the major axis of the tube.

Note 4: This distance on the major axis of the tube is .33 ± .0[illegible].

DETAIL "A"



DETAIL "B"



DIMENSIONS IN INCHES

Multiplier Phototube

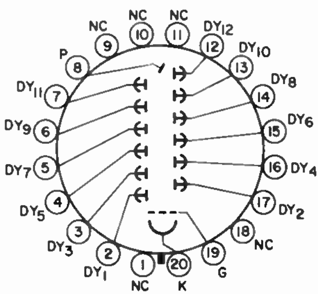
12-STAGE, HEAD-ON SPHERICAL-FACEPLATE TYPE
HIGH CURRENT AMPLIFICATION
S-20 RESPONSE
ENCLOSED, IN-LINE DYNODE STRUCTURE
EXTREMELY SHORT RISE TIME

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 potentiometer between cathode and dynode No. I 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 is 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 area.

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 on the severity of the operating conditions. After a period of idleness, the 4459 usually recovers a substantial percentage of such loss in sensitivity.

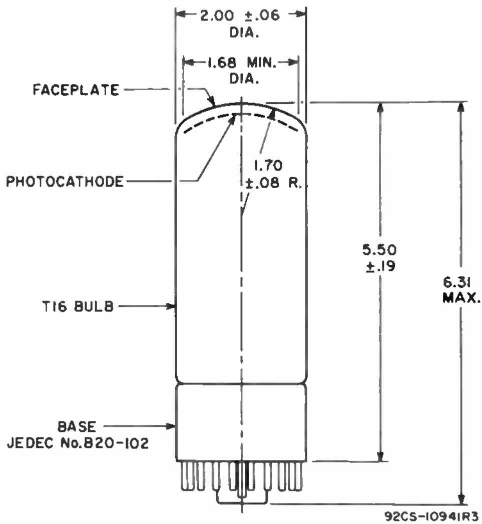
It is recommended that the average anode current be well below the maximum-rated value of 1 milliampere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

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 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.

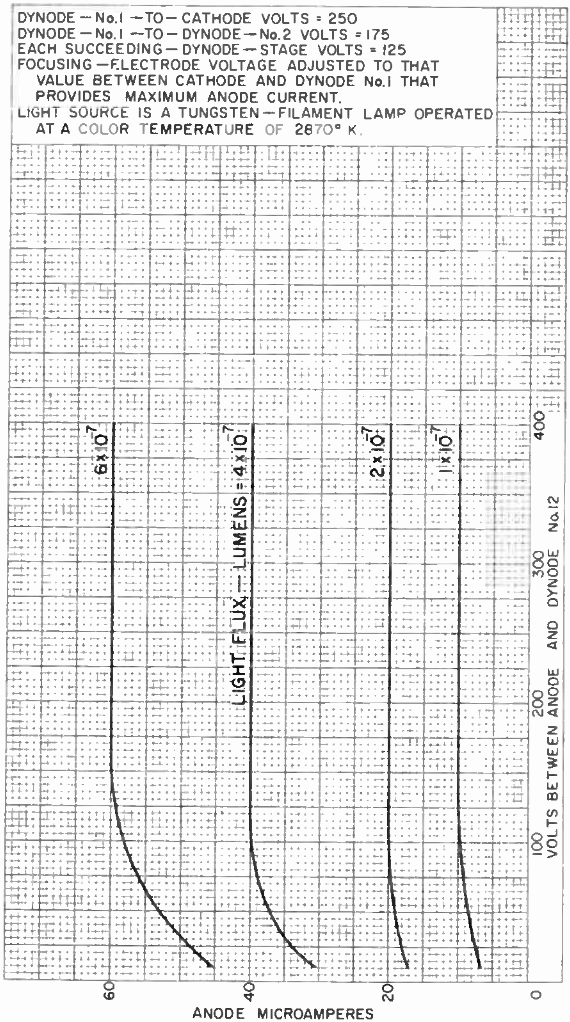
SPECTRAL-SENSITIVITY CHARACTERISTIC
OF PHOTOSENSITIVE DEVICE HAVING S-20 RESPONSE
is shown at the front of this Section



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.

TYPICAL ANODE CHARACTERISTICS



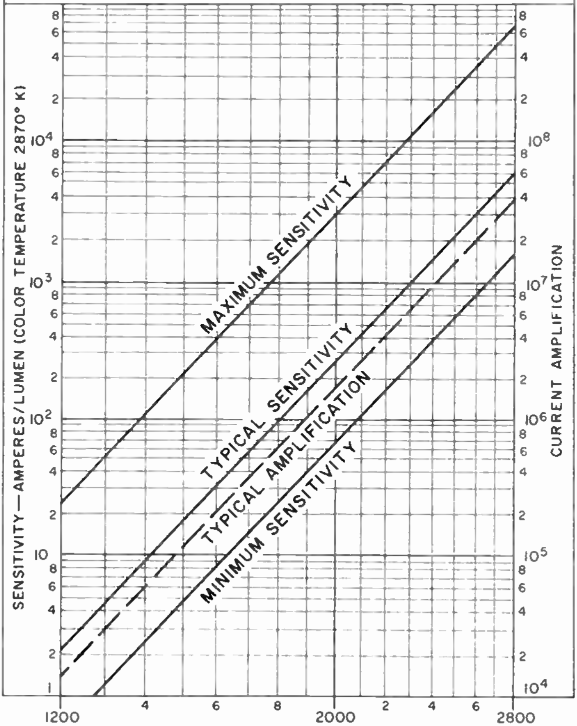
92CM-12212

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.

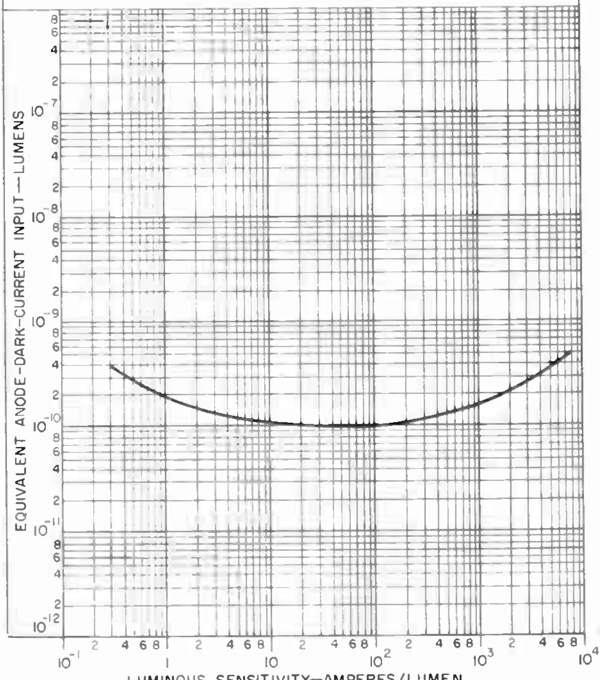


TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

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

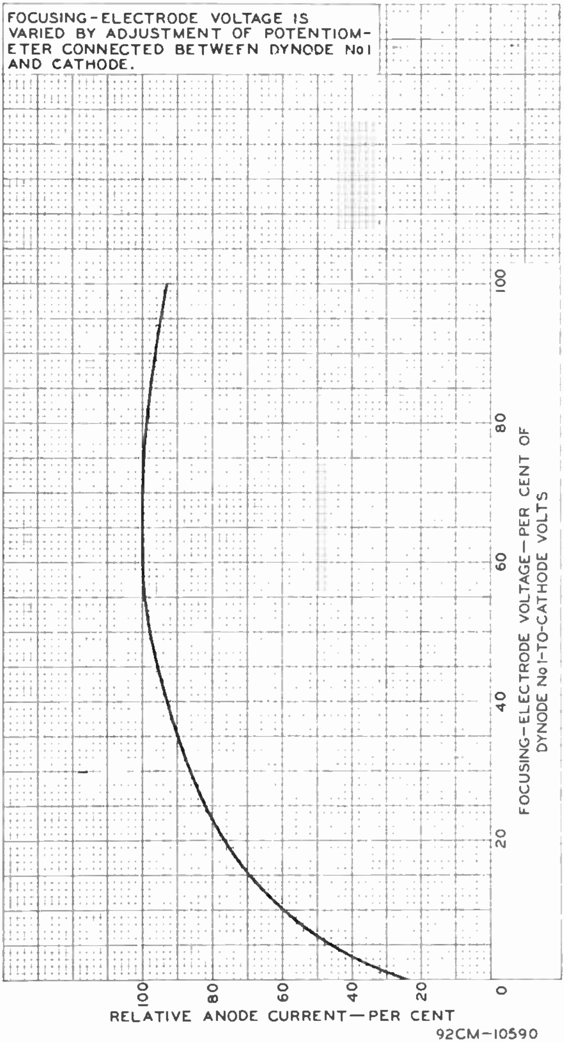
BETWEEN	6.95% OF E MULTIPLIED BY
CATHODE & DY_1	2.0
DY_1 & DY_2	1.4
DY_2 & DY_3 THROUGH DY_{12} & ANODE	1.0
ANODE & CATHODE	14.4

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

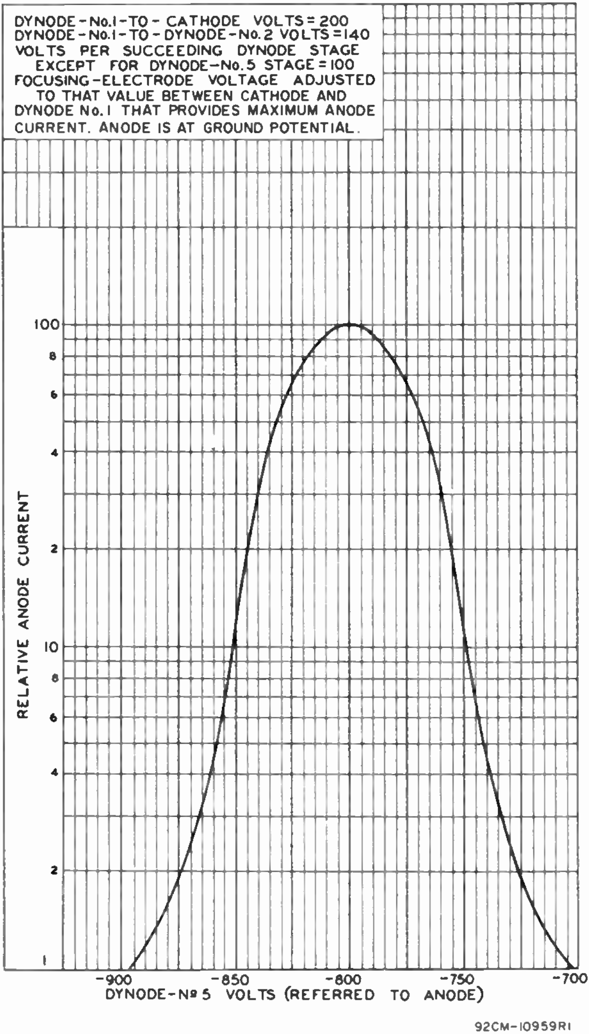


92CM-12215

AVERAGE FOCUSING-ELECTRODE-VOLTAGE CHARACTERISTIC



TYPICAL ANODE-CURRENT CHARACTERISTIC



Multiplier Phototube

S-11 RESPONSE

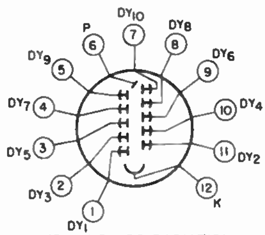
"RUGGEDIZED", 10-STAGE, HEAD-ON, FLAT-FACEPLATE TYPE — ELECTROSTATICALLY FOCUSED IN-LINE DYNODE STAGES

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	12HG

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 Elston, 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.[illegible].1, Procedure [illegible], 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 [illegible] 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 [illegible] 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	

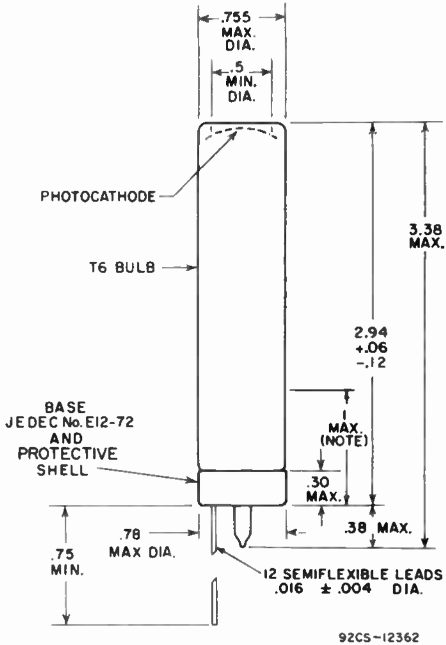
Tube Rejection Criterion. Upon completion of the *One-Hundred Per-Cent Shock and Vibration Testing* each tube is tested at a anode-to-cathode voltage of 1250 volts under the conditions shown under *Characteristics Range Values for Equipment Design* and will meet the specified values.

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.

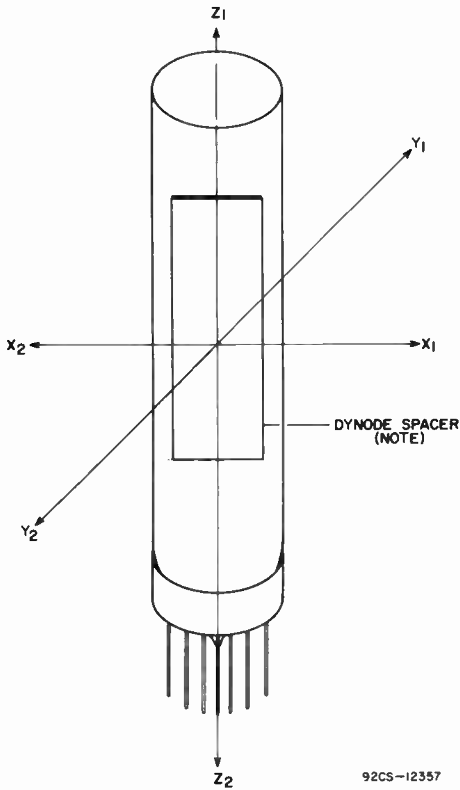
* Military Specification MIL-E-5272C (ASG), 13 April 1959; and Amendment 1, 5 January 1960.



DIMENSIONS IN INCHES

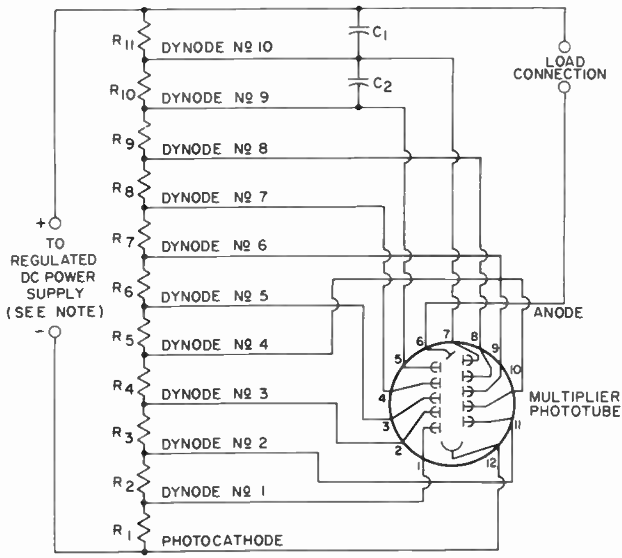
Note: within this length, maximum diameter of tube is 0.78".

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

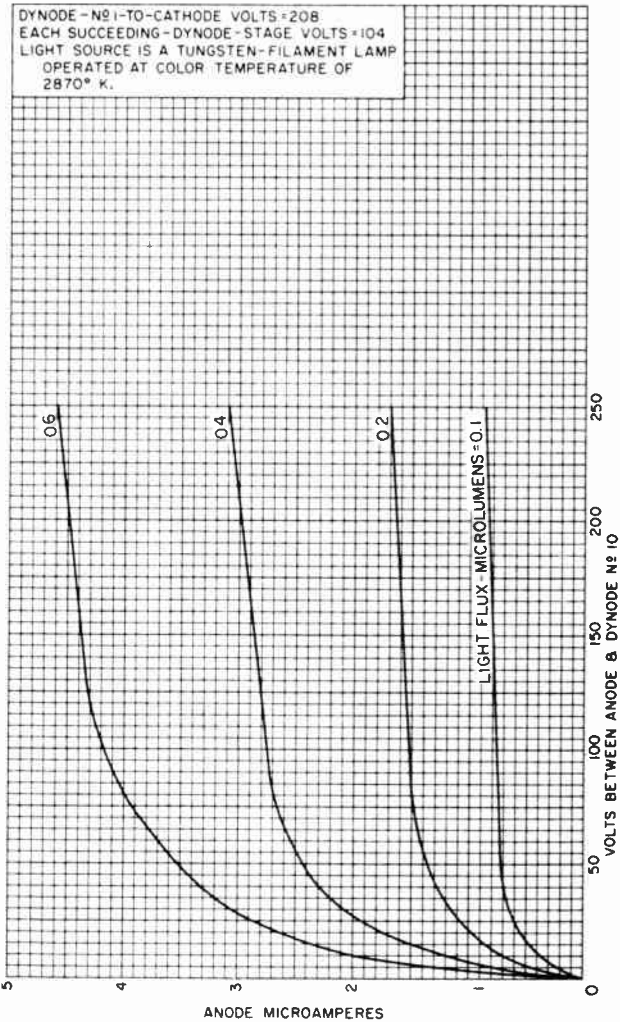


92CS-10656R1

Note: Adjustable between approximately 500 and 1500 volts DC.

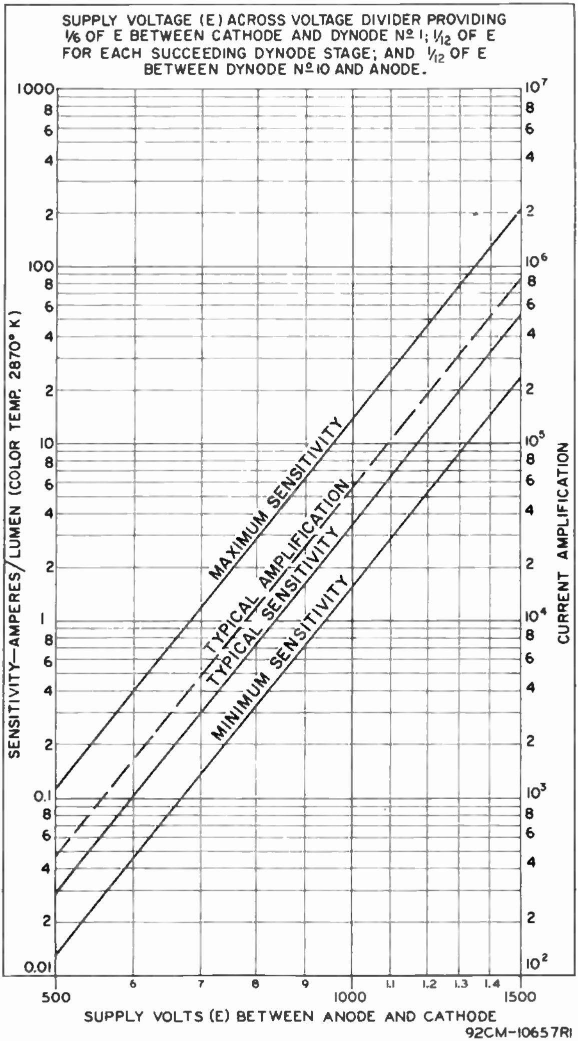
C_1,C_2: 0.01 µf, 500 volts (dc working)
R_1: 91,000 ohms, 2 watts
R_2 through R_{11}: 47,000 ohms, 1 watt

AVERAGE ANODE CHARACTERISTICS

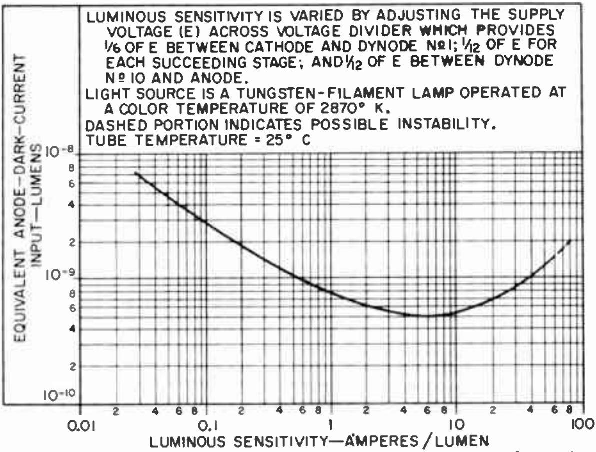


92CM-10660

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

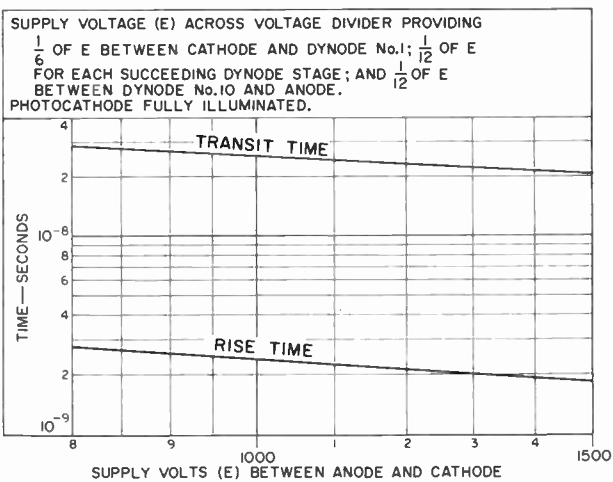


TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



92CS-10661

TYPICAL TIME RESOLUTION CHARACTERISTICS



92CS-12381

Multiplier Phototube

S-20 RESPONSE

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

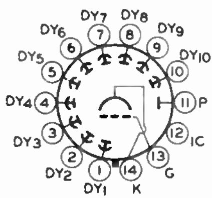
VENETIAN-BLIND-TYPE DYNODE STRUCTURE

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	[illegible]	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	–	[illegible]$.1 \times 10^{3}$	–	a/w
Cathode radiant, at 4200 angstroms .	–	6.8×10^{-2}	–	a/w
Luminous, at 0 cps[e]. .	–	6	–	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.

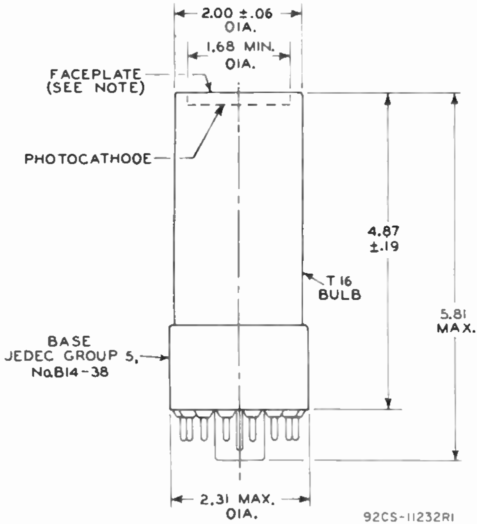
It is recommended that the average anode current be well below the maximum-rated value of 1 milliampere when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

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



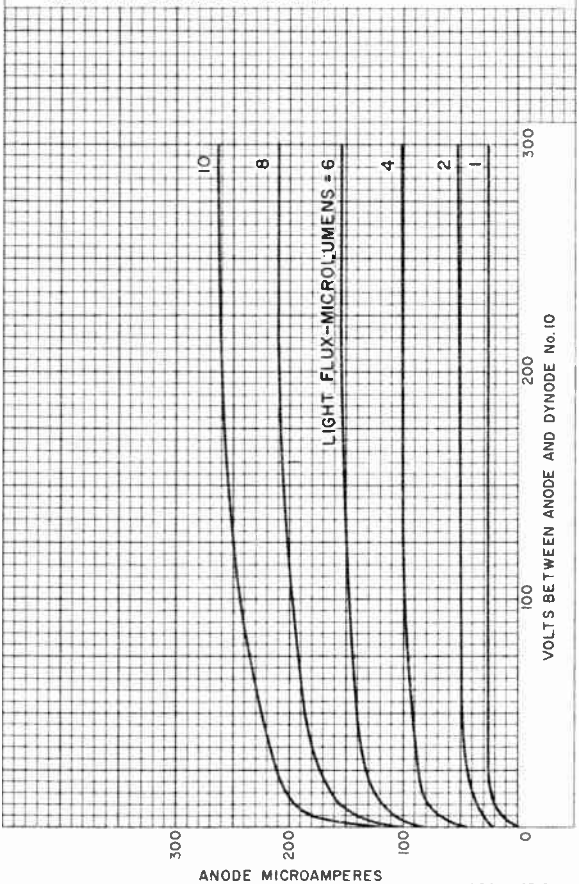
DIMENSIONS IN INCHES

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

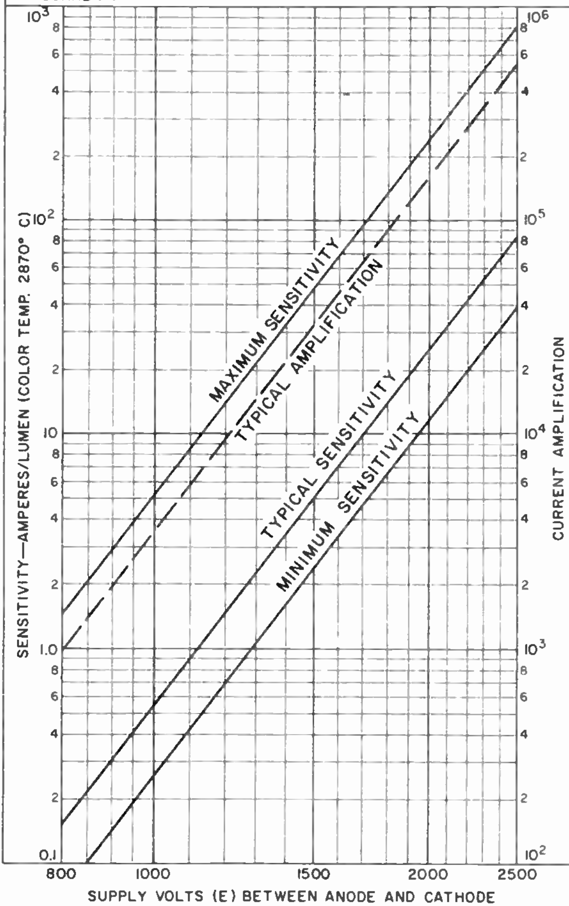
DYNODE No.1-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.



92CM-12310

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

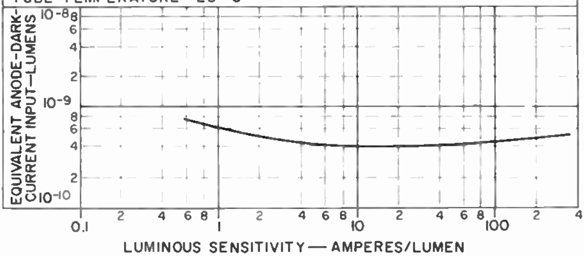
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.



92CM-12312

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

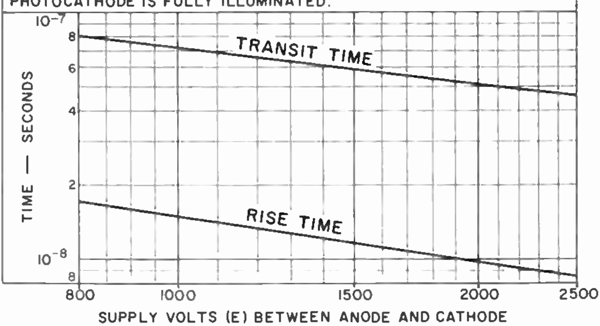
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED 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

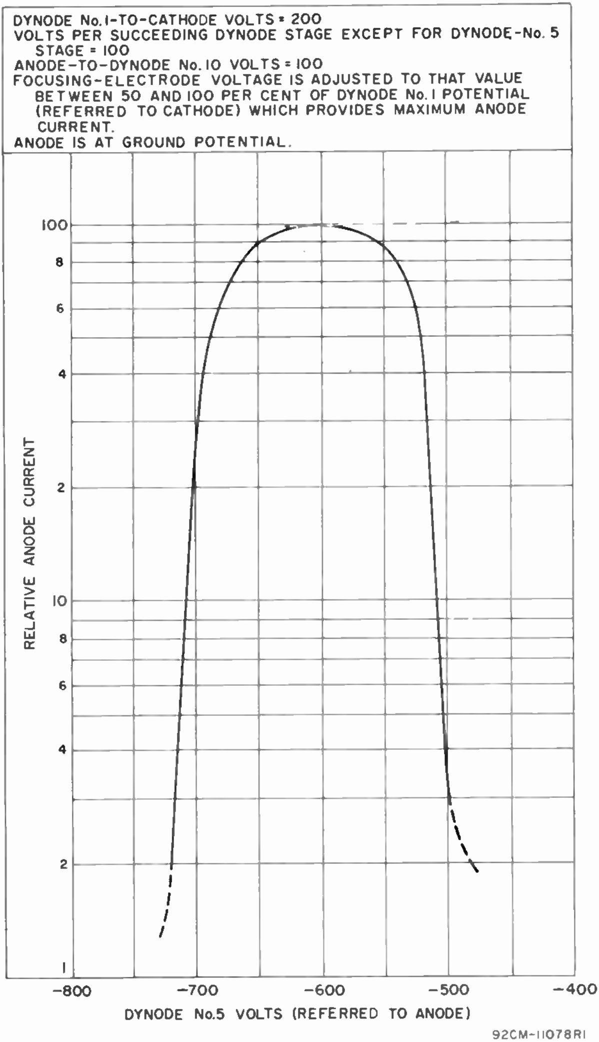
TYPICAL TIME RESOLUTION CHARACTERISTICS

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.



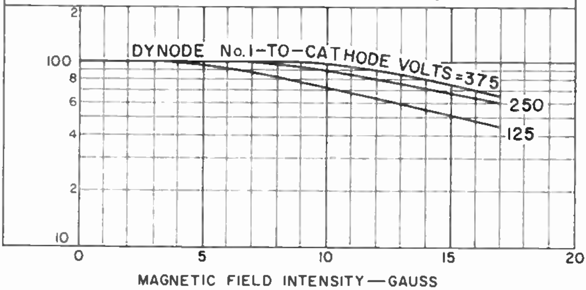
92CS-12309

TYPICAL ANODE-CURRENT CHARACTERISTIC



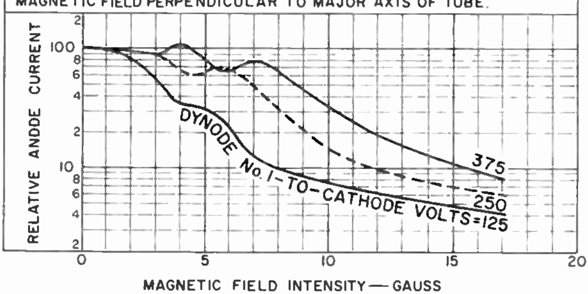
TYPICAL ANODE-CURRENT CHARACTERISTICS

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

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

Multiplier Phototube

S-20 RESPONSE

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

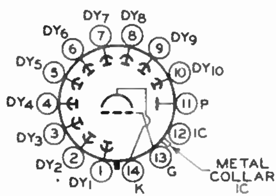
VENETIAN-BLIND-TYPE DYNODE STRUCTURE

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 Elston, 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.

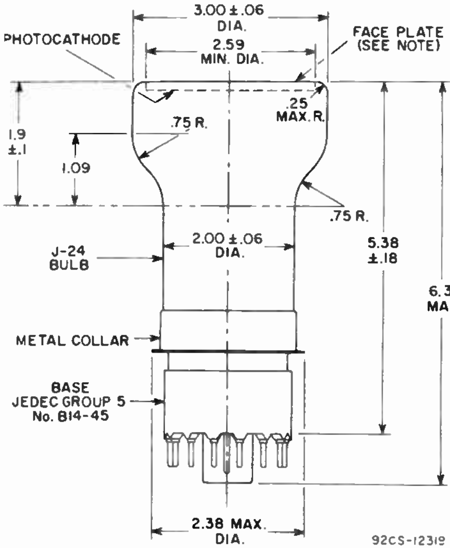
Electrostatic and/or *magnetic shielding* of the 4464 may be necessary.

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

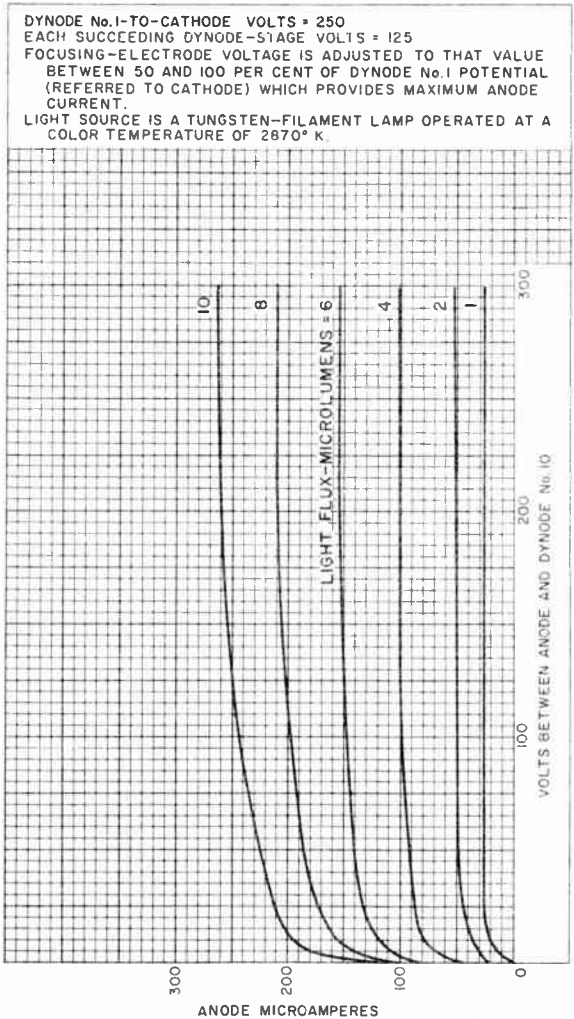


DIMENSIONS IN INCHES

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.

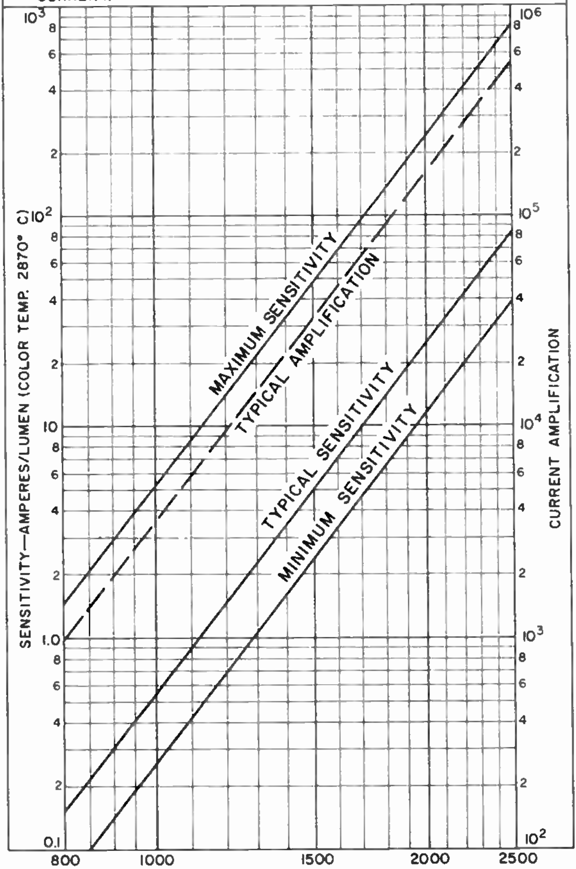
TYPICAL ANODE CHARACTERISTICS



92CM-12310

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

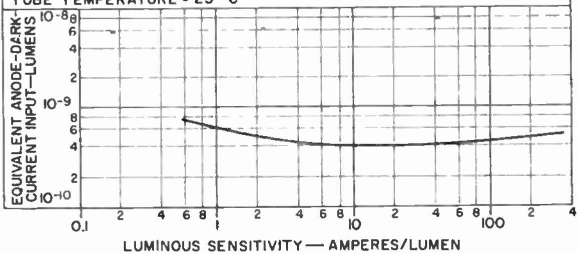
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.



92CM-12312

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

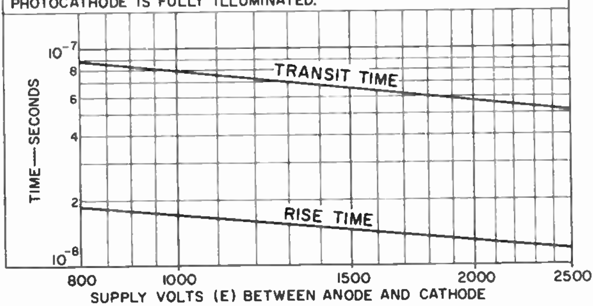
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED 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

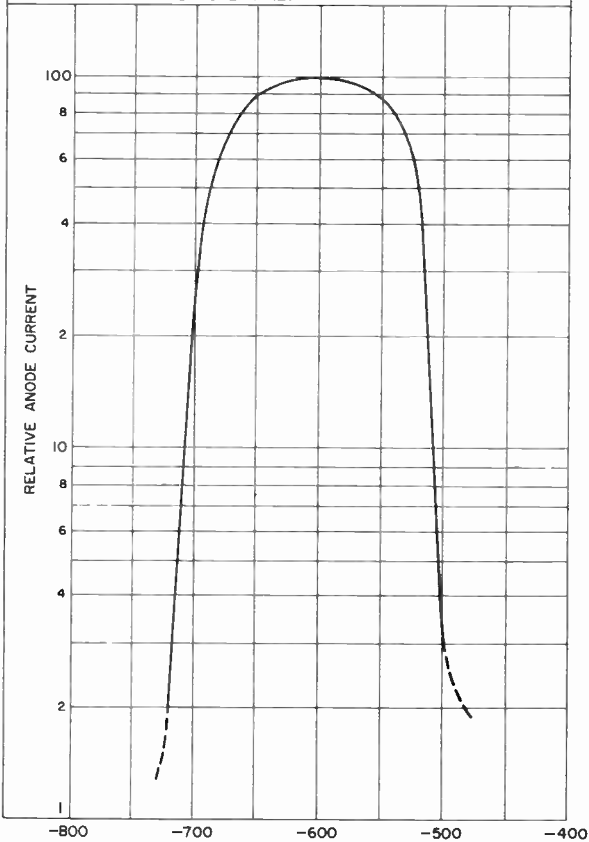
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS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



92CS-12314

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

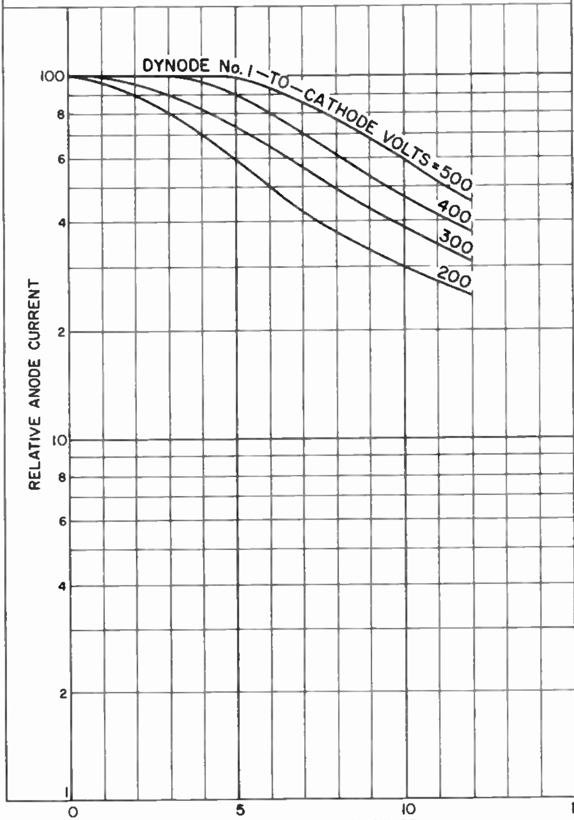
DYNODE No. 1-TO-CATHODE VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE-No. 5 STAGE = 100
ANODE-TO-DYNODE No. 10 VOLTS = 100
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.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



92CM-11078R1

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

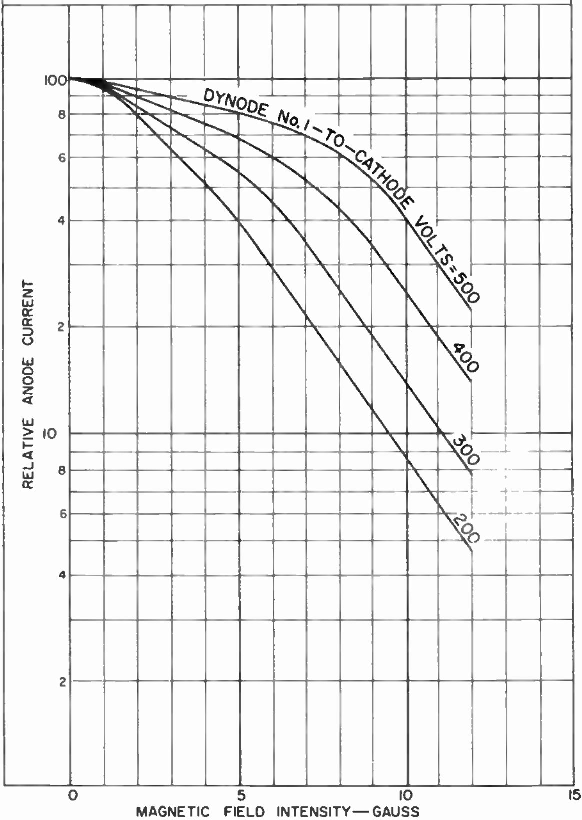
DYNODE No.1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY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



92CM-11084R2

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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.



92CM-11085R2

Multiplier Phototube

S-20 RESPONSE

10-STAGE, HEAD-ON FLAT-FACEPLATE TYPE

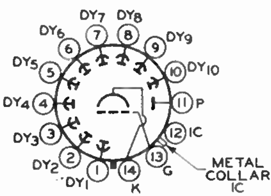
VENETIAN-BLIND-TYPE DYNODE STRUCTURE

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 Elston, 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.

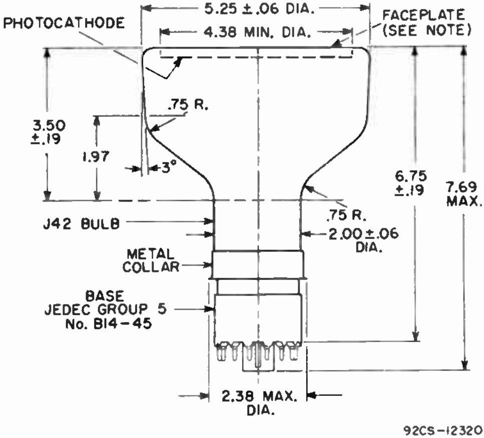
[m] At a tube temperature of 25° C. Dark current may be reduced by use of a refrigerant.

[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



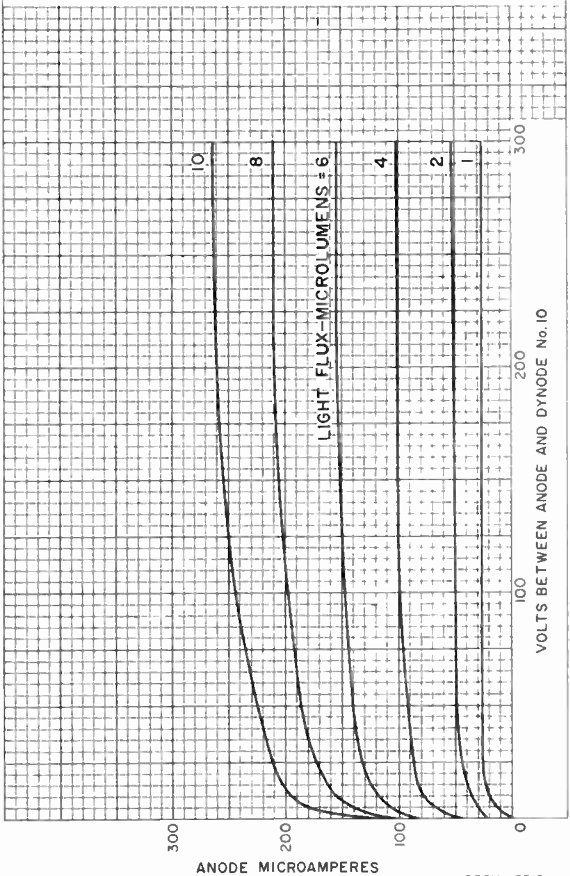
DIMENSIONS IN INCHES

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

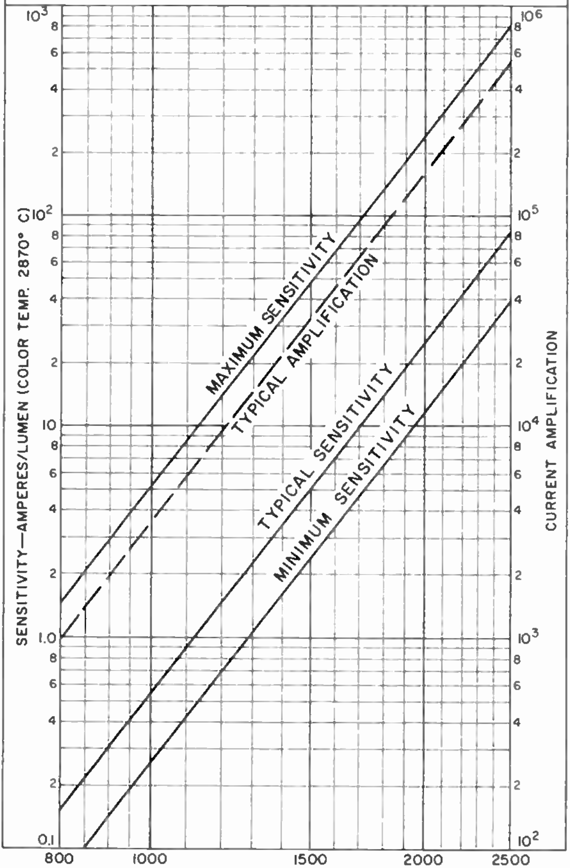
DYNODE No. I-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR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



92CM-12310

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

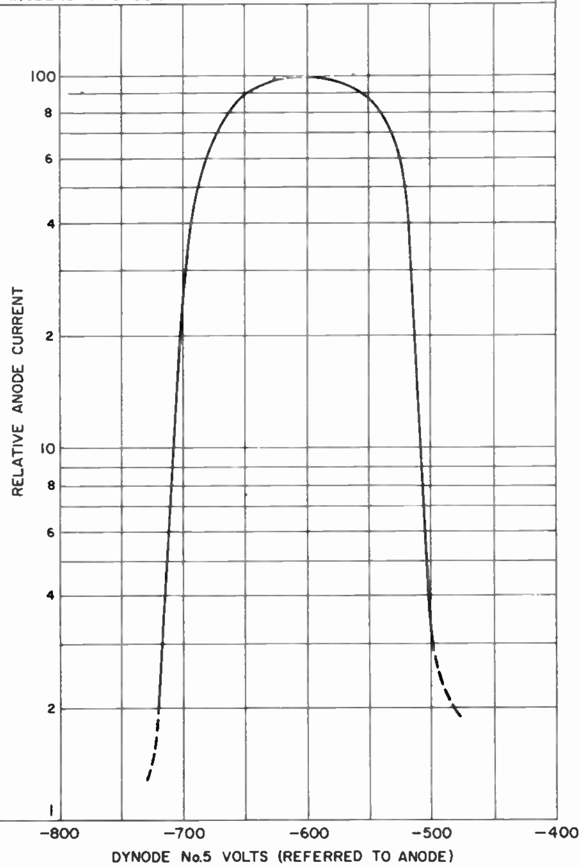
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.



92CM-12312

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

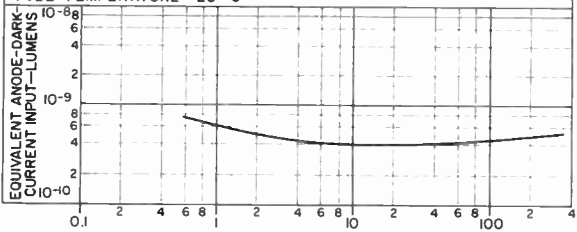
DYNODE No. 1-TO-CATHODE VOLTS = 200
VOLTS PER SUCCEEDING DYNODE STAGE EXCEPT FOR DYNODE-No. 5 STAGE = 100
ANODE-TO-DYNODE No. 10 VOLTS = 100
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.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



92CM-11078R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

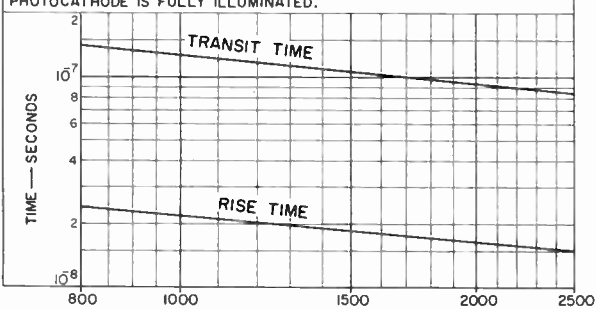
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED 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

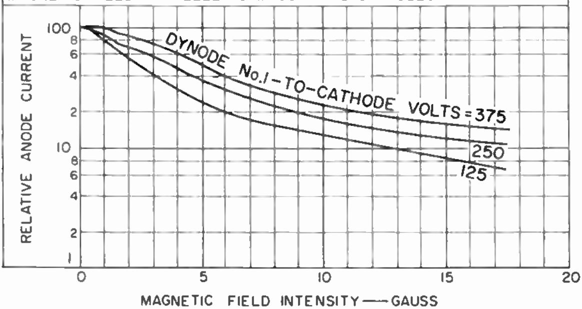
DYNODE No. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS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



92CS-12313

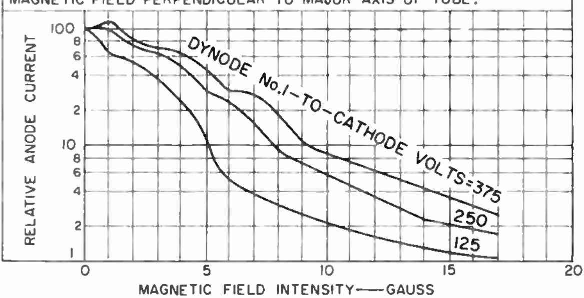
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT CHARACTERISTIC

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

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.

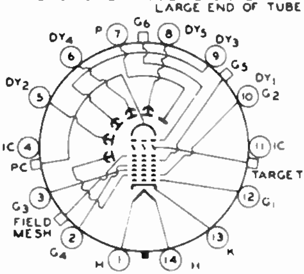
[k] Signal-to-noise ratio is dependent upon tube operating conditions and on the method of measurement. Significant factors affecting this ratio include target voltage, bandwidth, system line number and frame time, and the choice of reference signal black level. Two common test conditions and resultant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

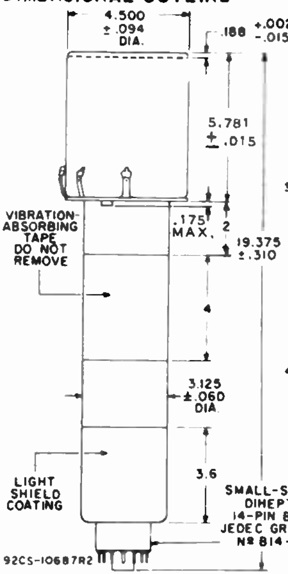
Terminal Over Pin 4 - Photocathode

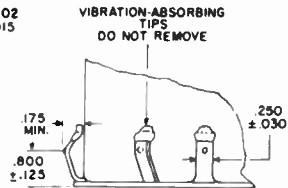
Terminal On Side Of Envelope Opposite Base Key - Grid No.6

Terminal Over Pin 9 - Grid No.5

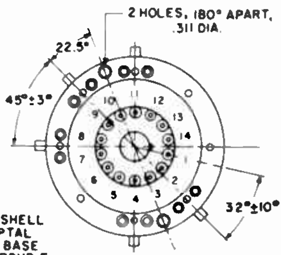
Terminal Over Pin 11 - Target

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:

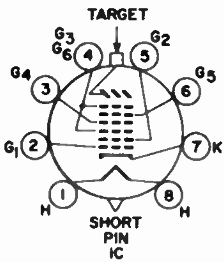
For type 4493 (Red) - Wratten No.25 (A) with 2 Fish-Shurman No. IR650

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)

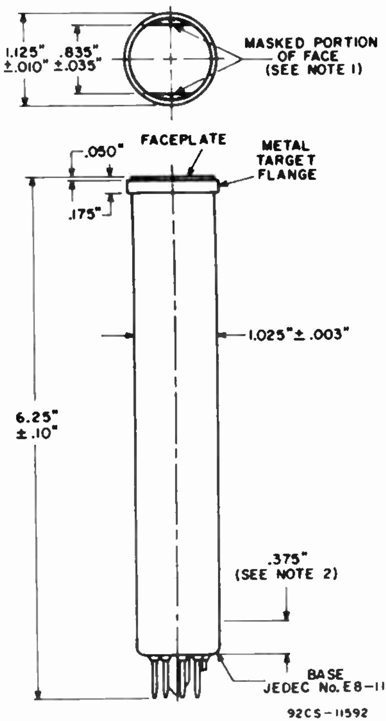
Pin 1 - Heater
Pin 2 - Grid No.1
Pin 3 - Grid No.4
Pin 4 - Grids No.3 & No.6
Pin 5 - Grid No.2
Pin 6 - Grid No.5
Pin 7 - Cathode
Pin 8 - Heater
Flange -Target
Short Index Pin - Internal Connection— Make No Connection



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
1-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

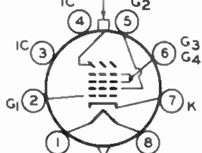
Direct Interelectrode Capacitance[a]
- Target to all other electrodes . . . . 4.6 pF

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.[illegible] 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

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	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
3 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

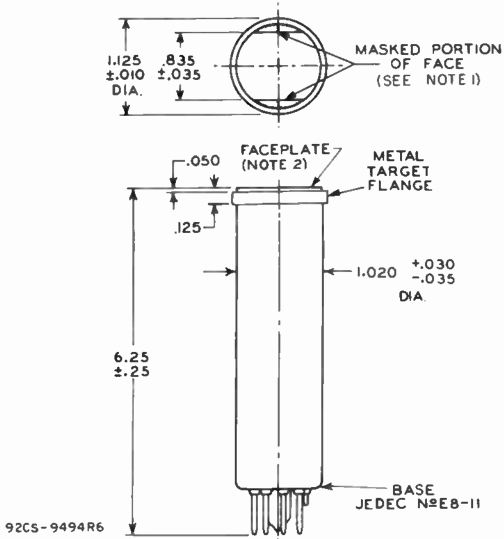
Dos

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

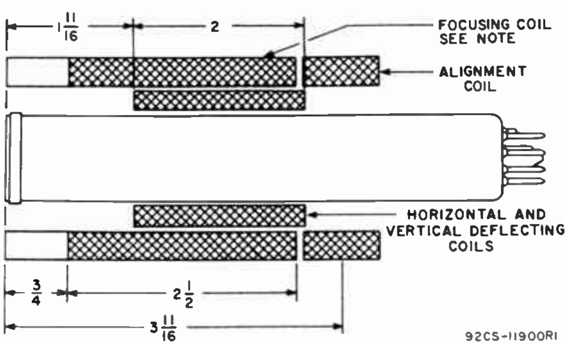


DIMENSIONS IN INCHES

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



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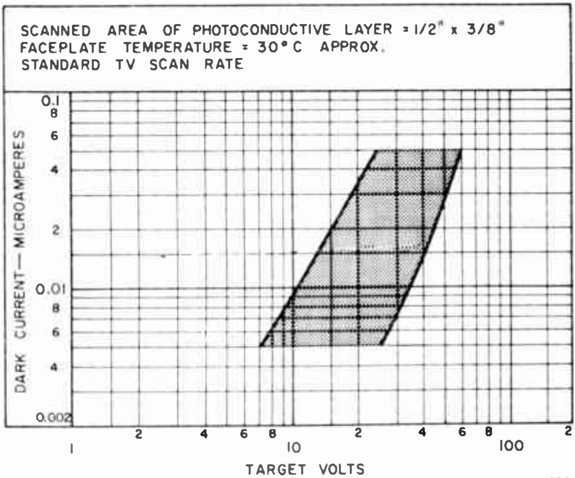
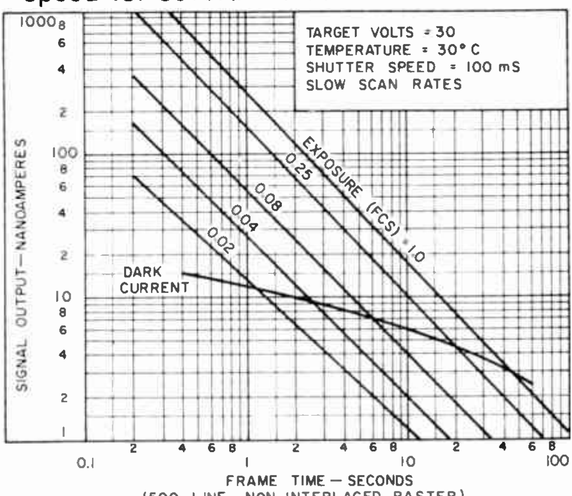
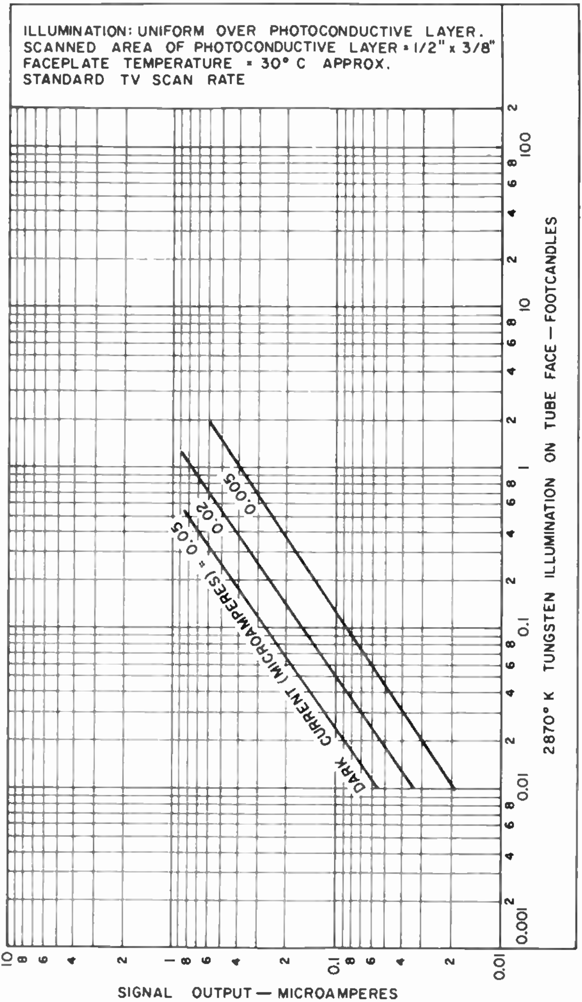
Range of Dark Current



Signal Output as a Function of Scan Speed for Several Values of Illumination

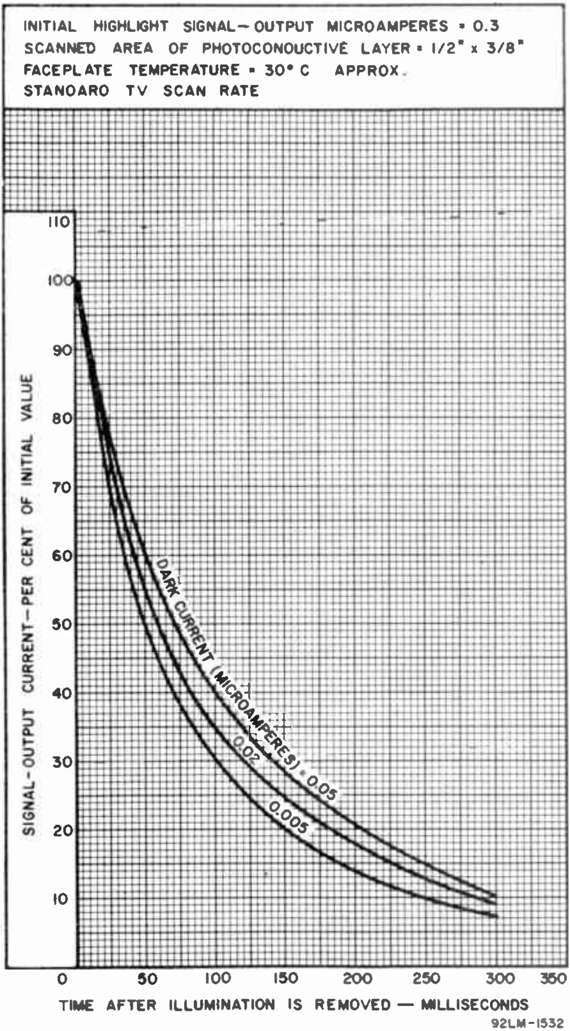


Light Transfer Characteristics

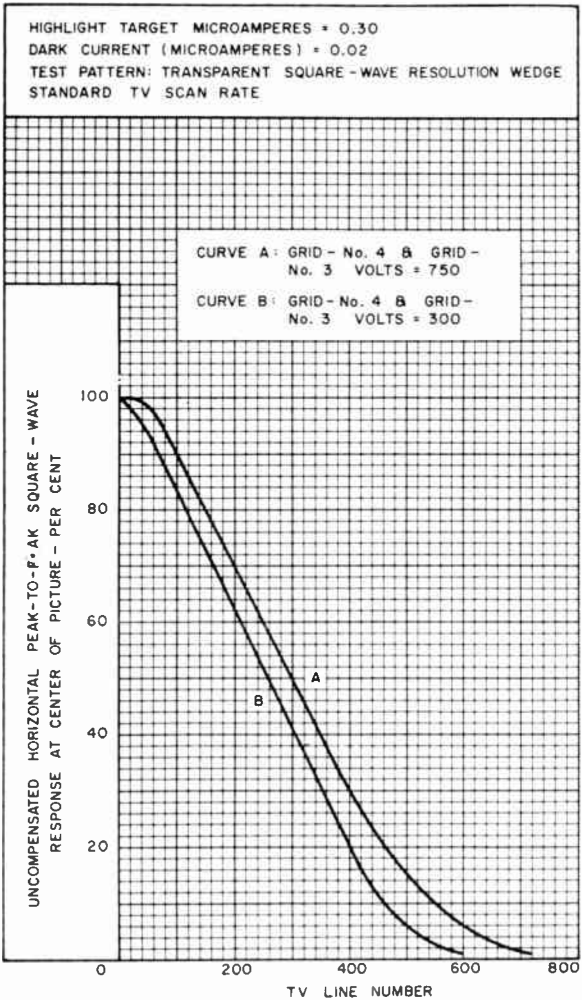


92LM-1536

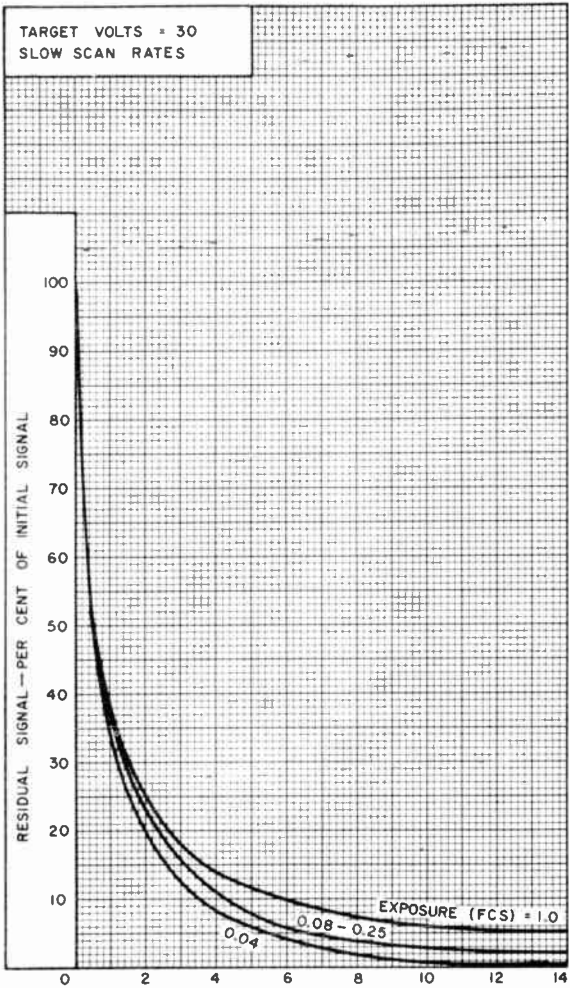
Typical Persistence Characteristics



Uncompensated Horizontal Square-Wave Response

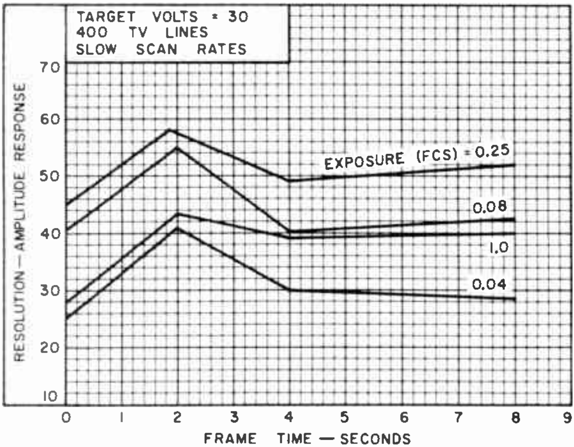


Typical Persistence Characteristics



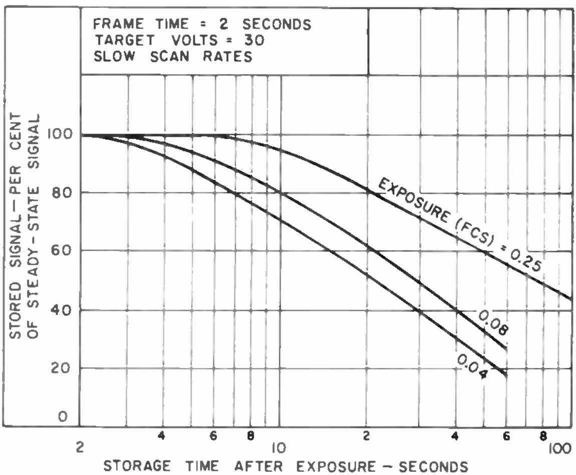
92LM-1537

Typical Response to 400 TV Line Information



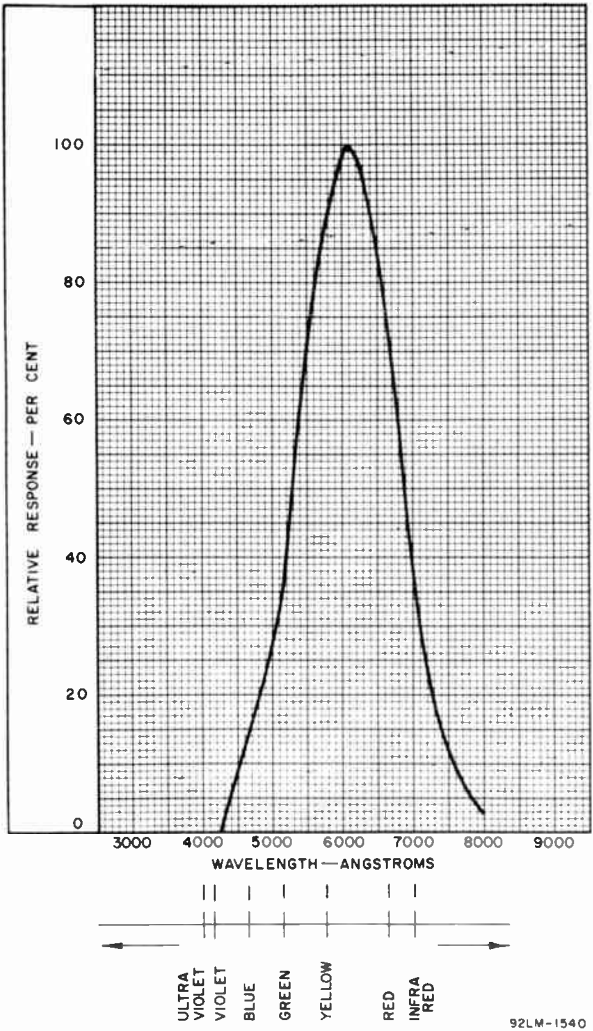
92LS-1538

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

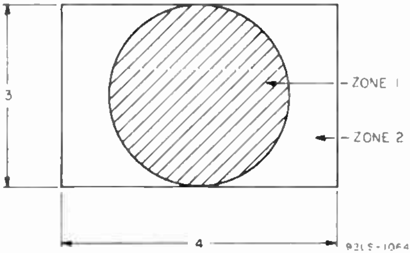


Fig. 1

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"*

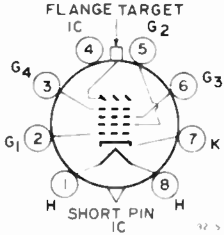
Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	0
4 but not including 3	0	1
3 but not including 1	2	3
1 or less	■	■

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)

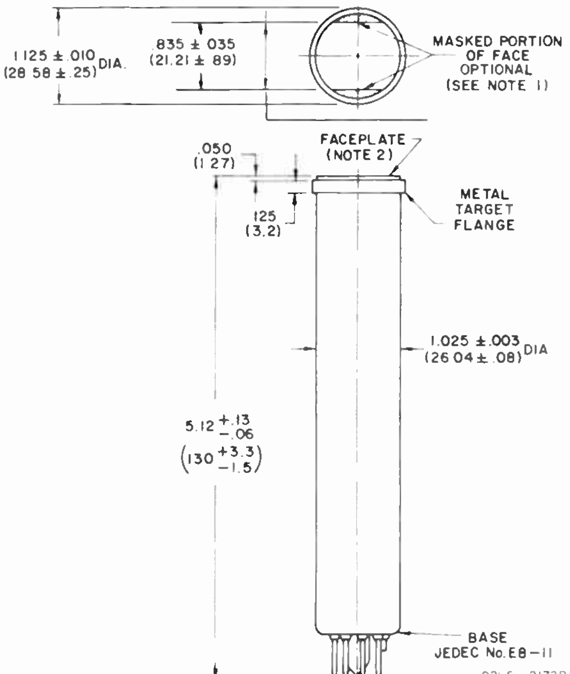
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode



Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection – Make No Connection

DIRECTION OF LIGHT: INTO FACE END OF TUBE

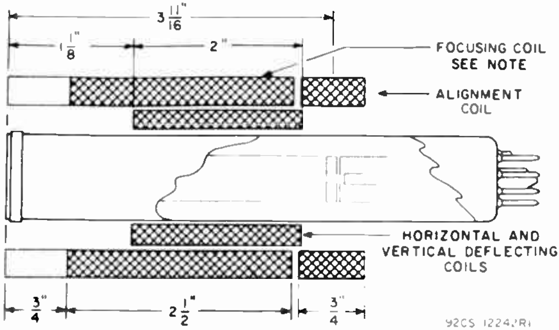
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



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".

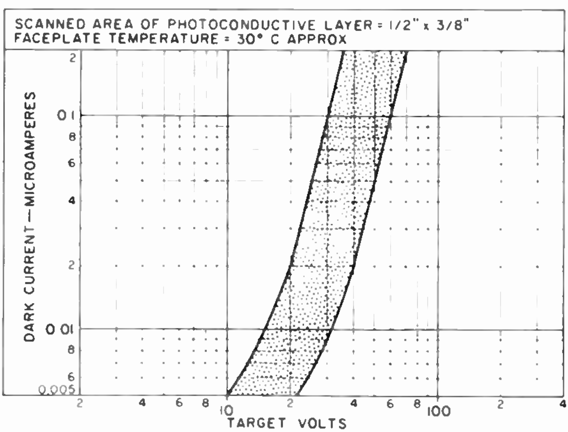
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To Obtain Minimum Beam-Landing Error



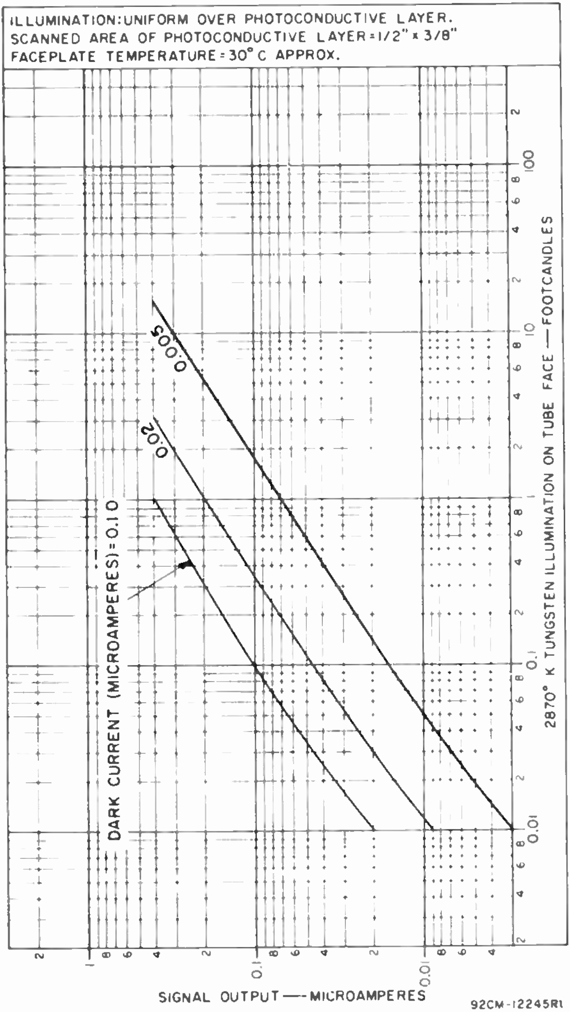
Note: Cross-hatching indicates wound portion of focusing coil.

RANGE OF DARK CURRENT

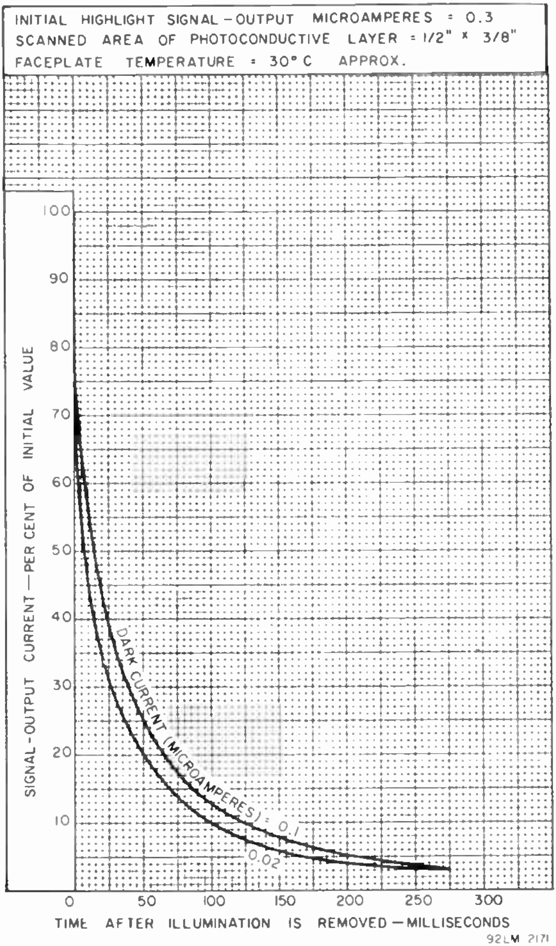


92CS-12235

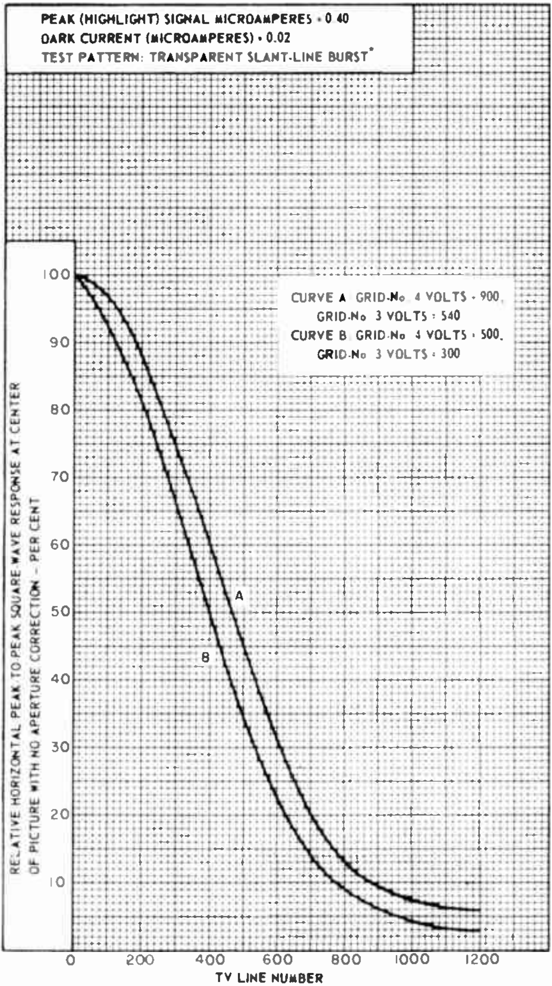
LIGHT TRANSFER CHARACTERISTICS



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 °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° 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° 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° 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° K. The value of light flux incident on the filter is 1×10^{-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 1×10^{-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° 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.

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*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

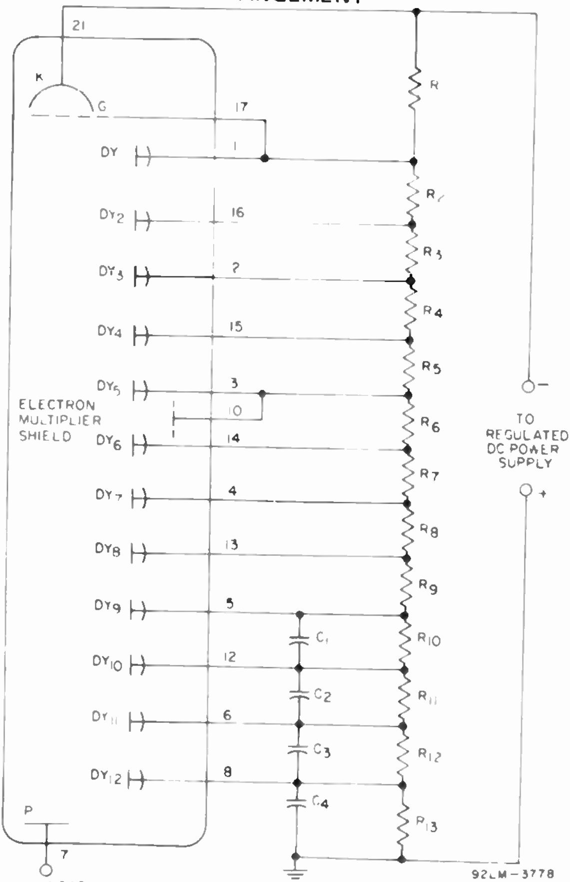
Voltages To Be Provided by Divider

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

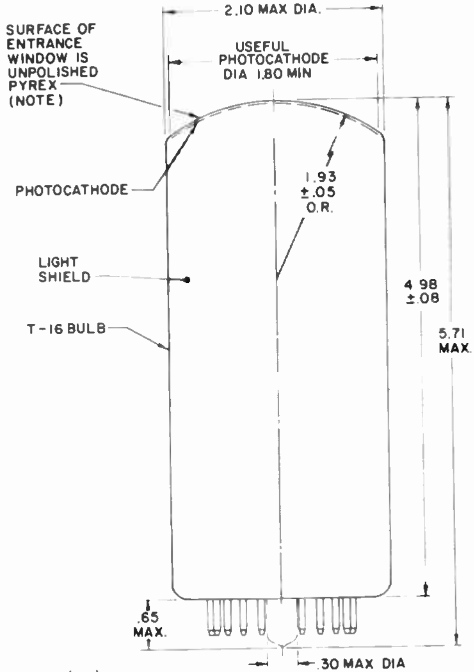
R_1: 200 kΩ (2 100 kΩ, 5%, 1/2 W in series)

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



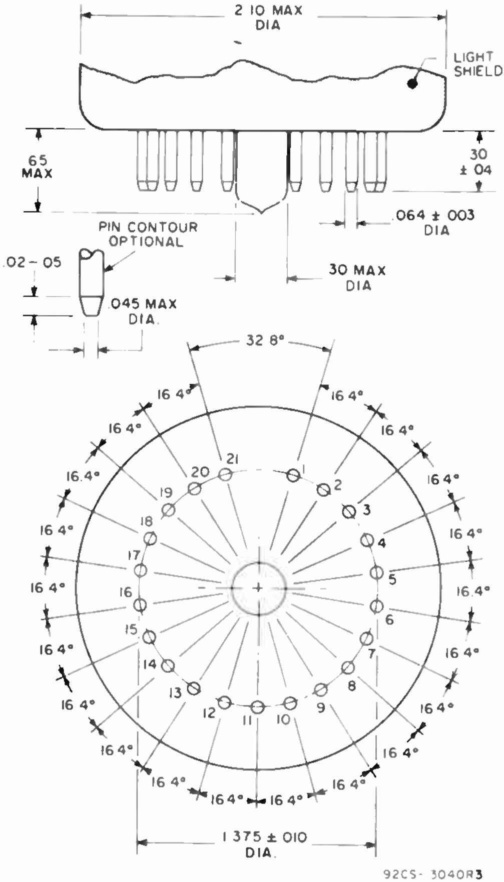
Dimensions in Inches

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).

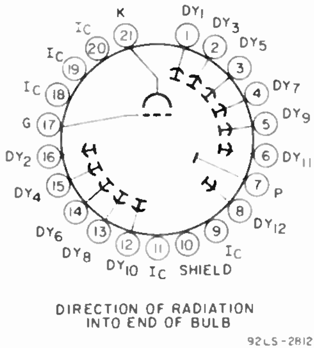
Inch	mm	Inch	mm	Inch	mm
.003	.08	.05	1.3	1.375	34.93
.010	.25	.064	1.63	1.80	45.7
.02	.5	.08	2.0	1.93	49.0
.04	1.0	.30	7.6	2.10	53.3
.045	1.14	.65	16.5	4.98	126.5
				5.71	145.0

DETAIL OF BASE ARRANGEMENT



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

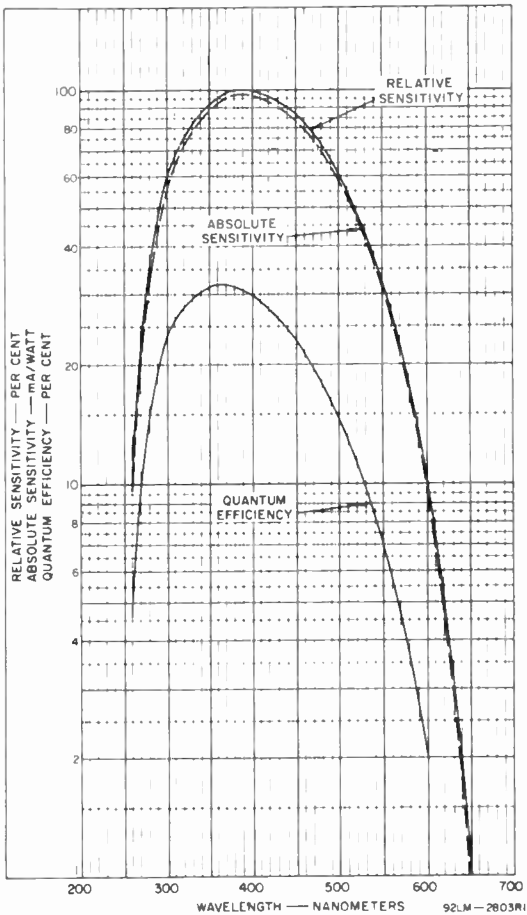


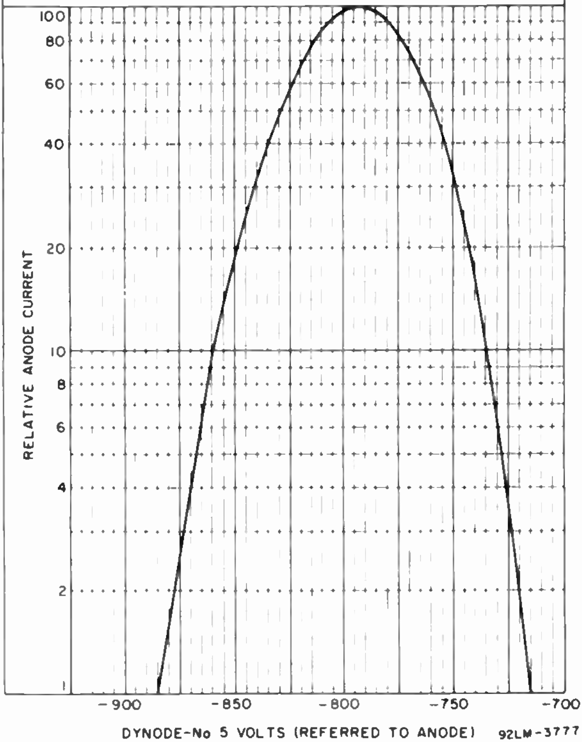
Figure 1

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.

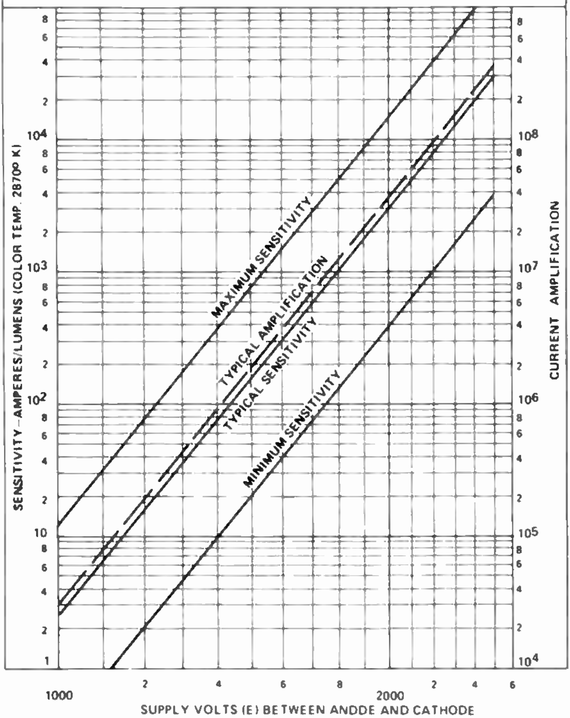


TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

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



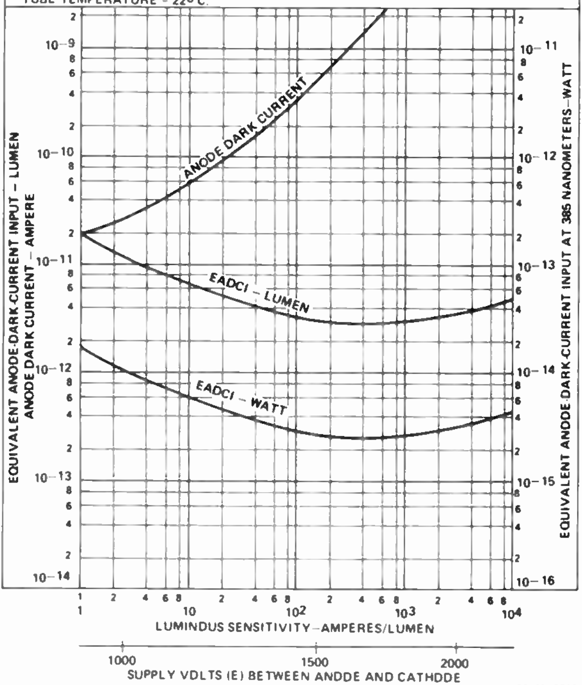
92LM-3761

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

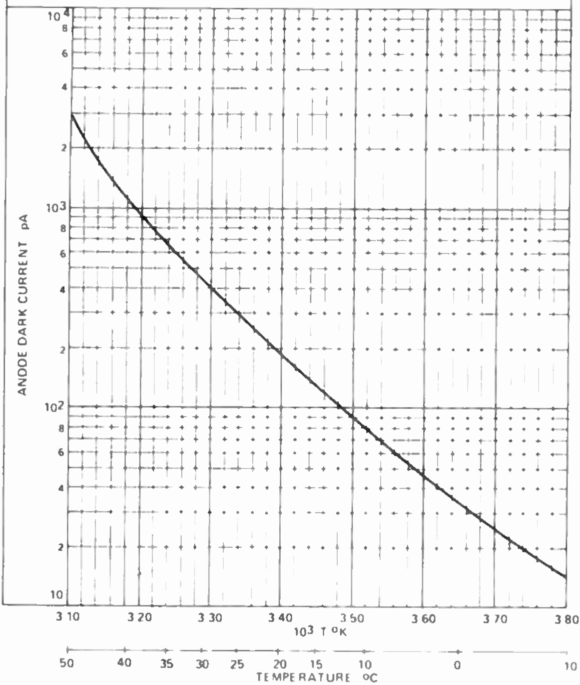
TYPICAL ANODE DARK CURRENT AS A FUNCTION OF TEMPERATURE

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

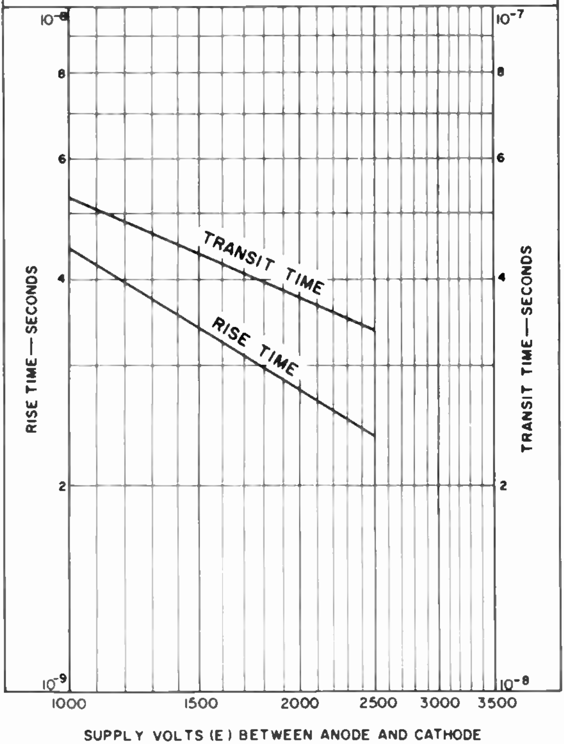


TYPICAL TIME-RESOLUTION CHARACTERISTICS

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.



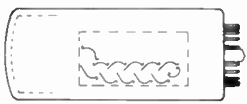
92LM-3776

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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

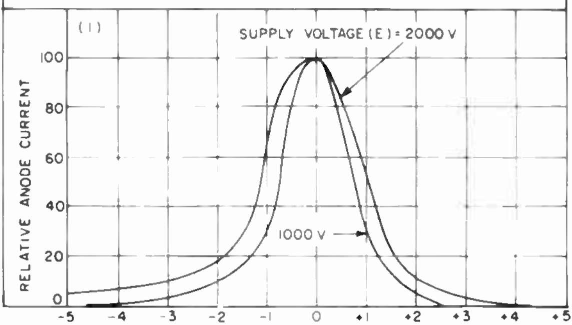
BETWEEN	6.94% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	2.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	14.4

FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No.5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.



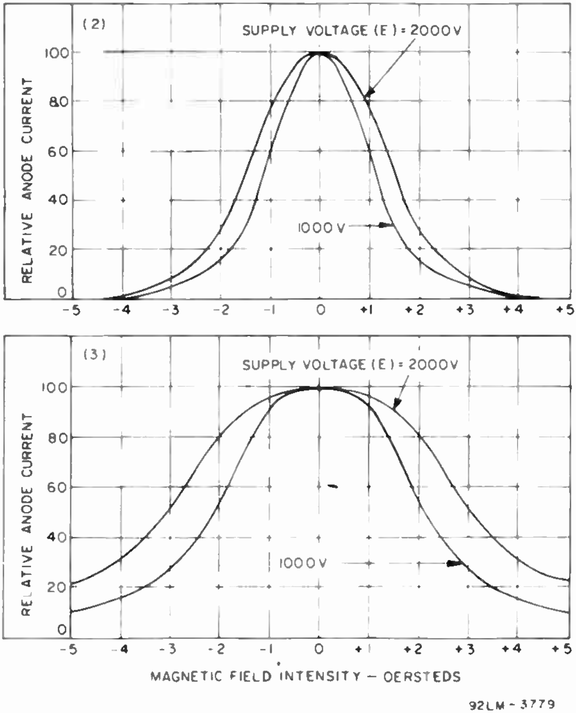
POSITIVE VALUE OF H IN DIRECTION SHOWN
(1)* •, (2) ↑ OR (3) →

* DIRECTION (1) IS OUT OF PAPER



MAGNETIC FIELD INTENSITY — OERSTEDS

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	°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° 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° 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.

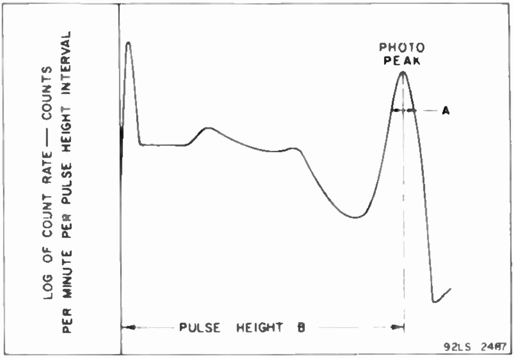
q At 4000 angstroms. These values are calculated from the EADCI values in lumens using a conversion factor of 1190 lumens per watt.

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° 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 (Tl) -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.

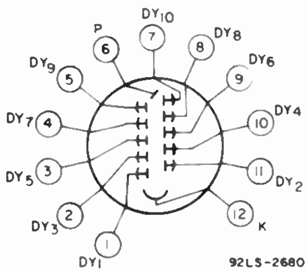
Magnetic shielding of the 4516 and 4517 is ordinarily required. See accompanying curves for the effect of variation in magnetic field intensity on the anode current for a tube with no magnetic shielding.

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)

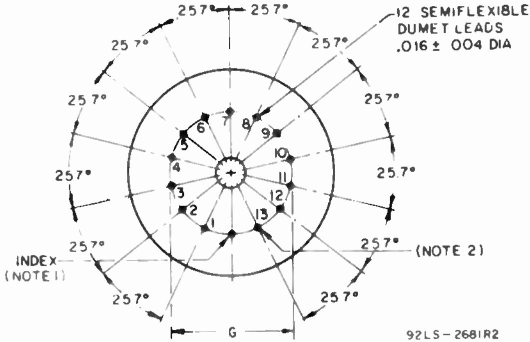
Bottom View



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.

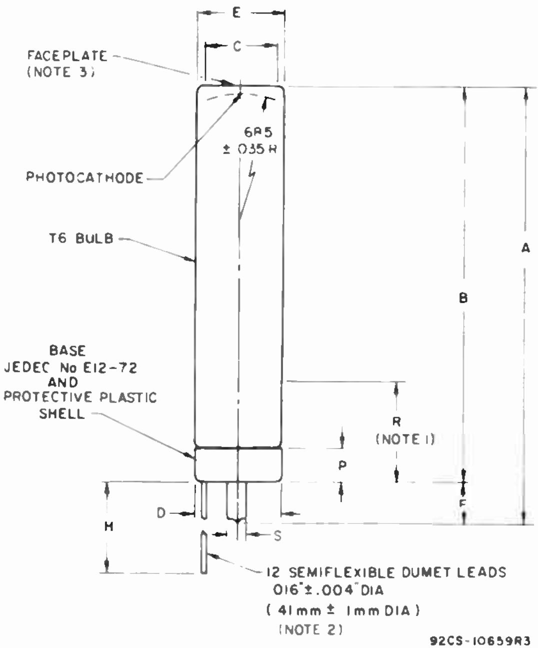
Note 2: Lead No.13 is cut off within 0.04 inch of the glass button.

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)

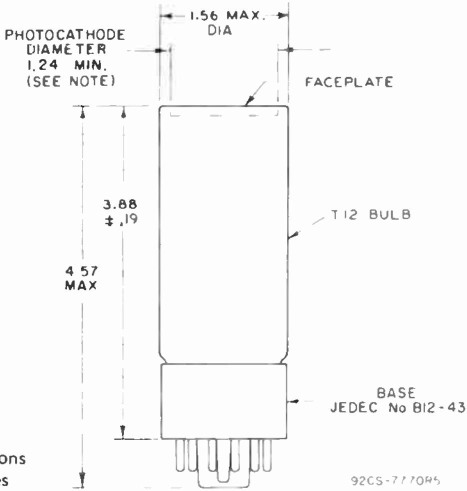


Note 1: Within this length, maximum diameter of tube is 0.78".

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

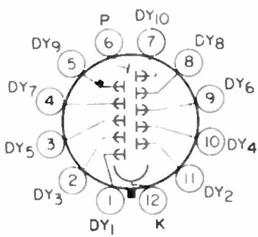
Note: Deviation from flatness will not exceed 0.010" from peak to valley.

℄ 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)

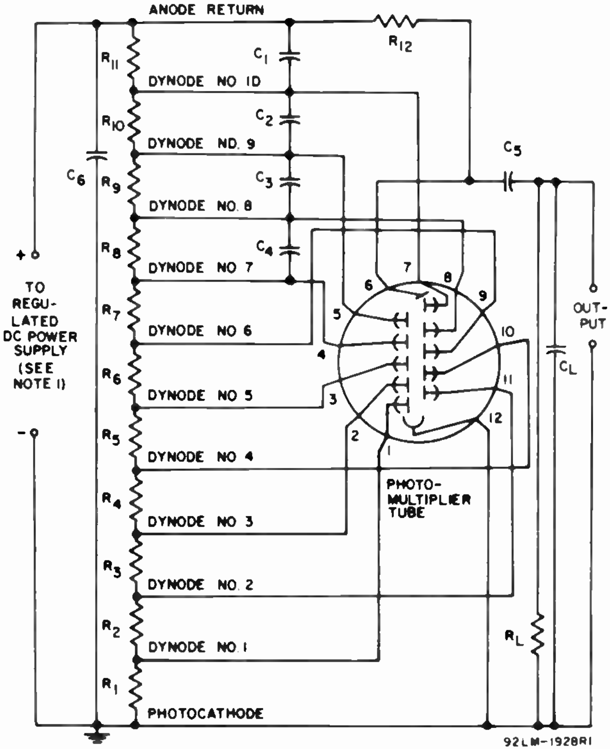
Bottom View

DIRECTION OF LIGHT INTO END OF BULB



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

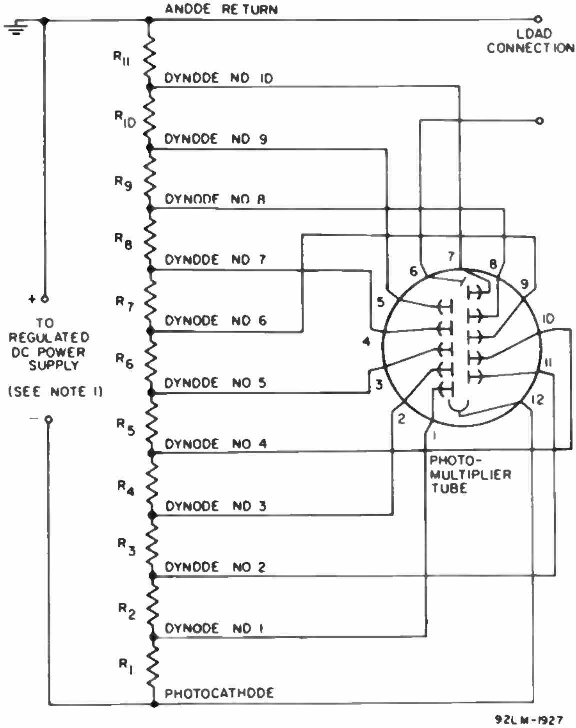
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR USE IN SCINTILLATION-COUNTING APPLICATIONS (4516, 4517)



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)

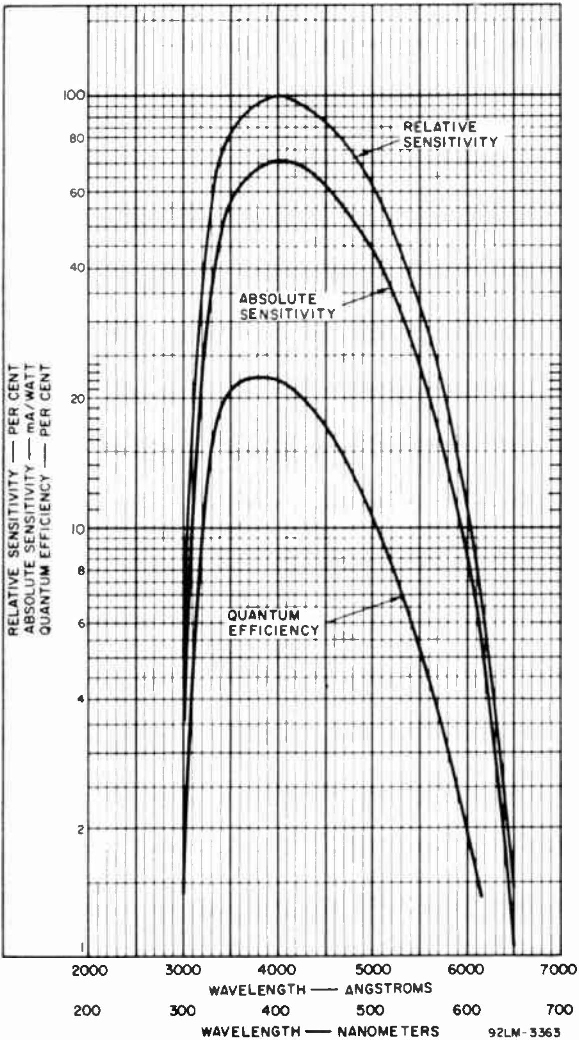


R_1 and R_2: 560,000 ohms, 1/2 watt
R_3: 820,000 ohms, 1/2 watt
R_4 through R_{11}: 470,000 ohms, 1/2 watt

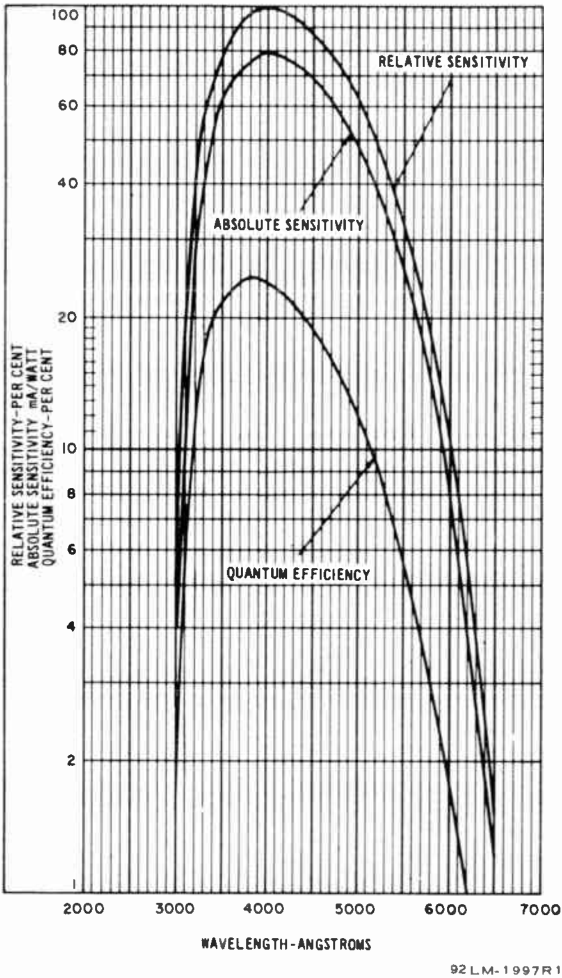
Note 1: Adjustable between approximately 500 and 1800 volts dc.

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

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS (4516)



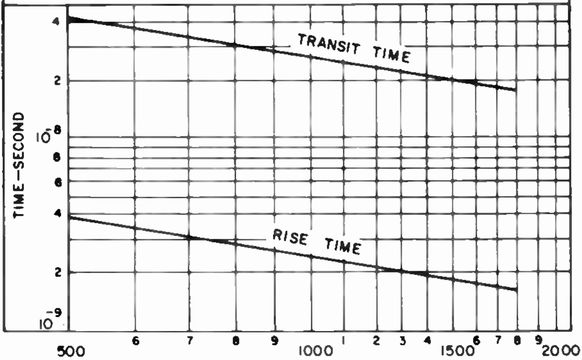
TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS (4517)



TYPICAL TIME-RESOLUTION CHARACTERISTICS

TYPE 4516

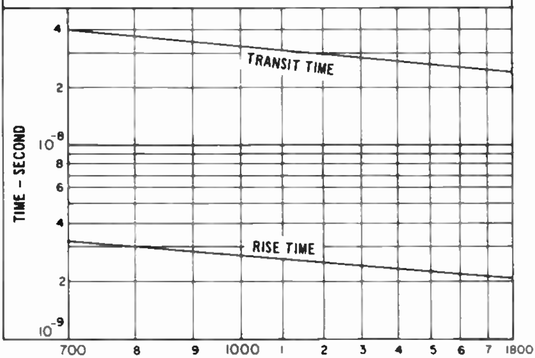
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No 1, 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE, AND 1/12 OF E BETWEEN DYNODE No 10 AND ANODE
THE PHOTOCATHODE IS FULLY ILLUMINATED.



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.

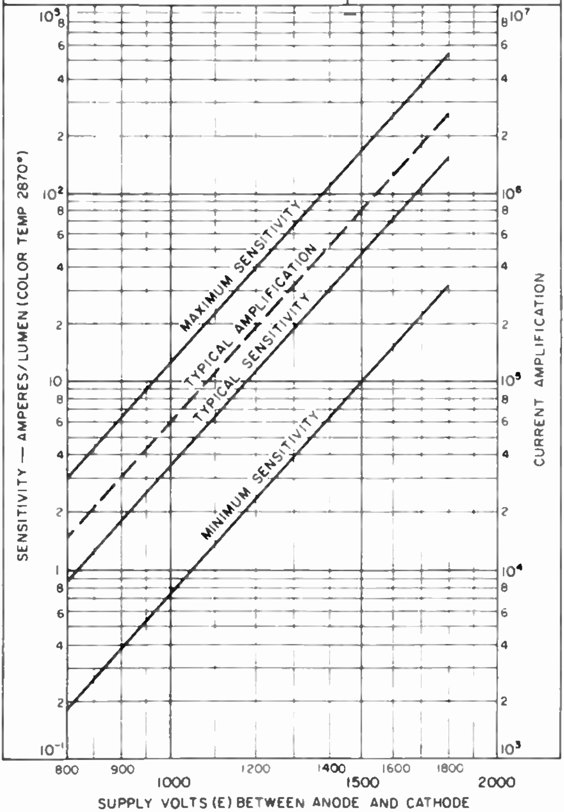


92LS-1945

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



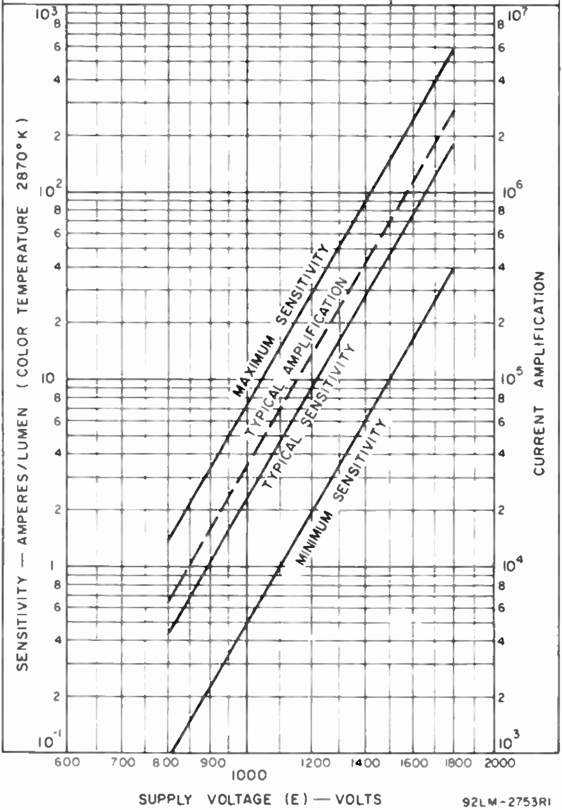
92LM-1939R1

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

TYPE 4517

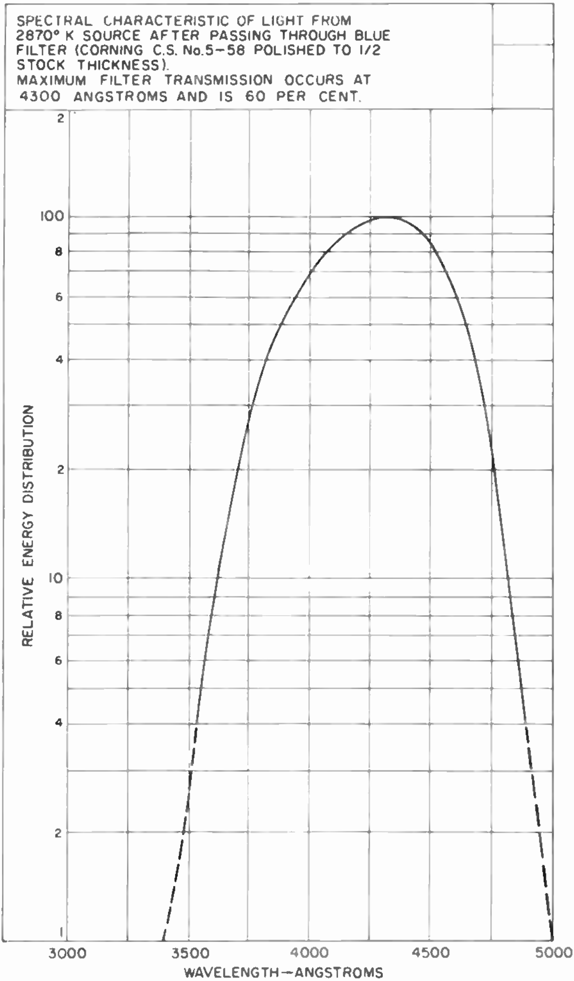
THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS.

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



92CM-11081R1

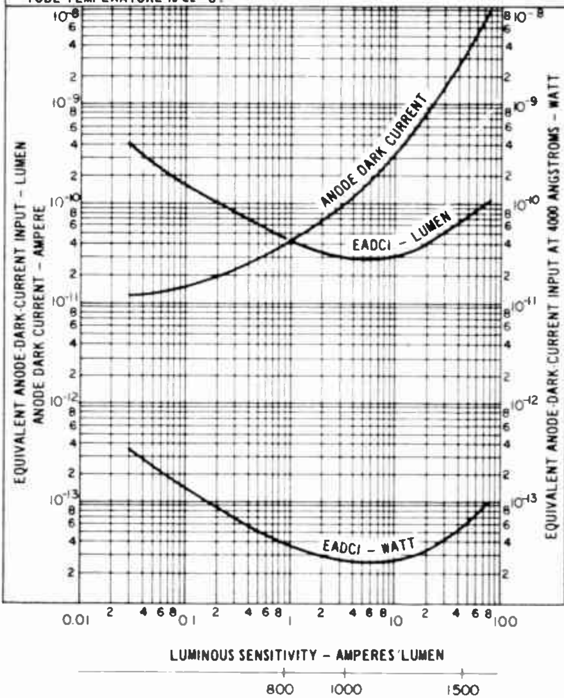
TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

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

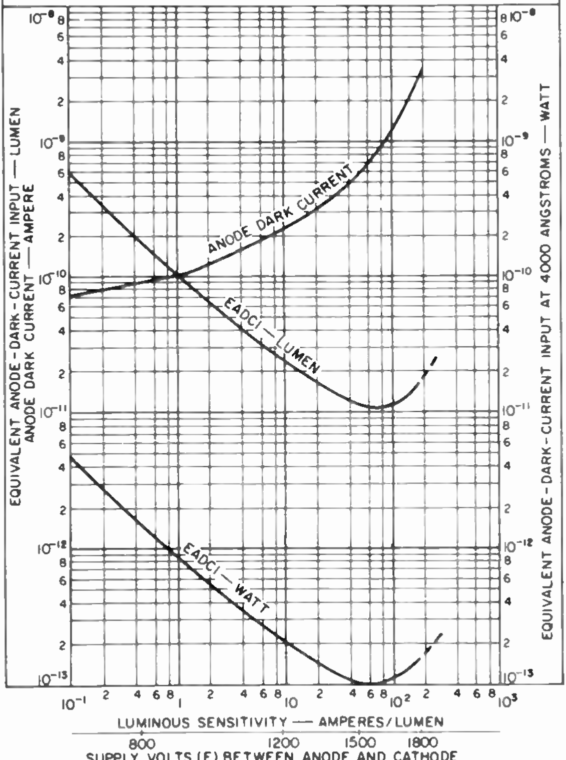
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

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

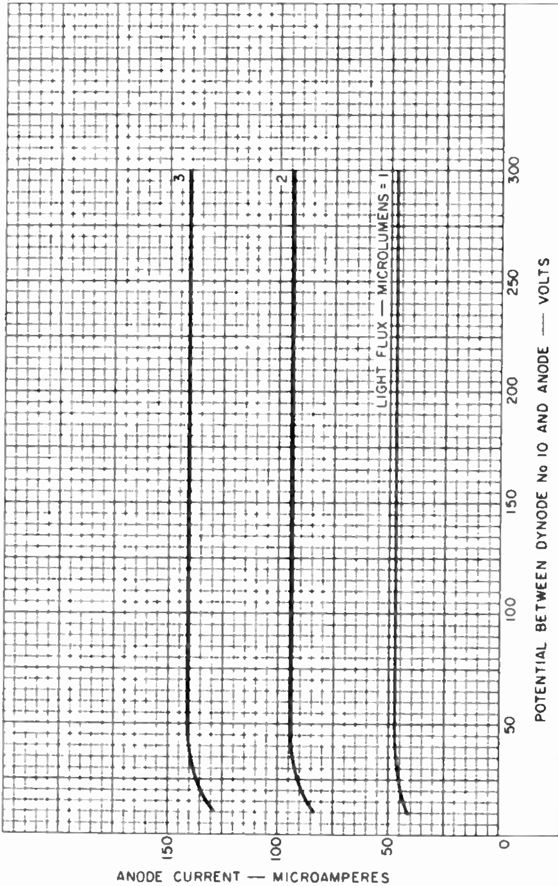


92LM-1954R2

TYPICAL ANODE CHARACTERISTICS

TYPE 4516

CATHODE-TO-DYNODE No I VOLTS = 149
DYNODE No I-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

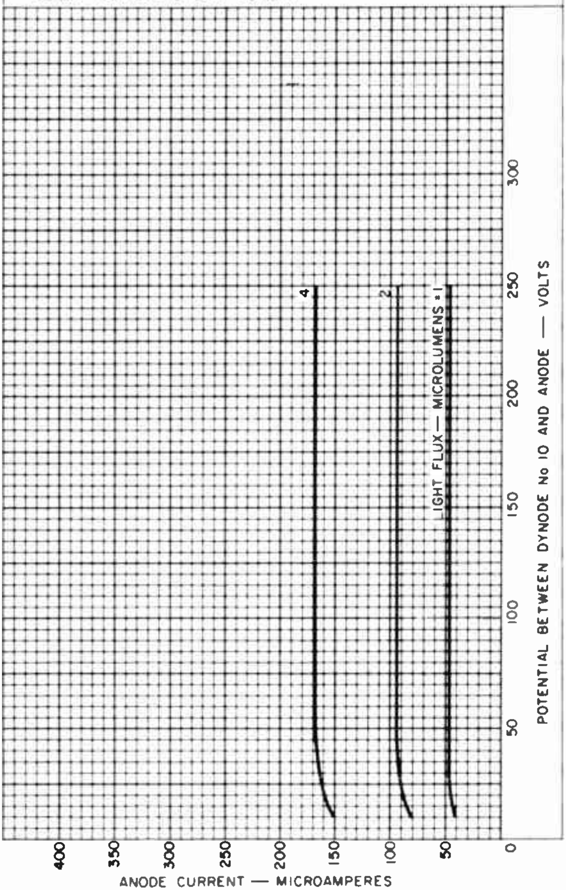


92LM-1924R1

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

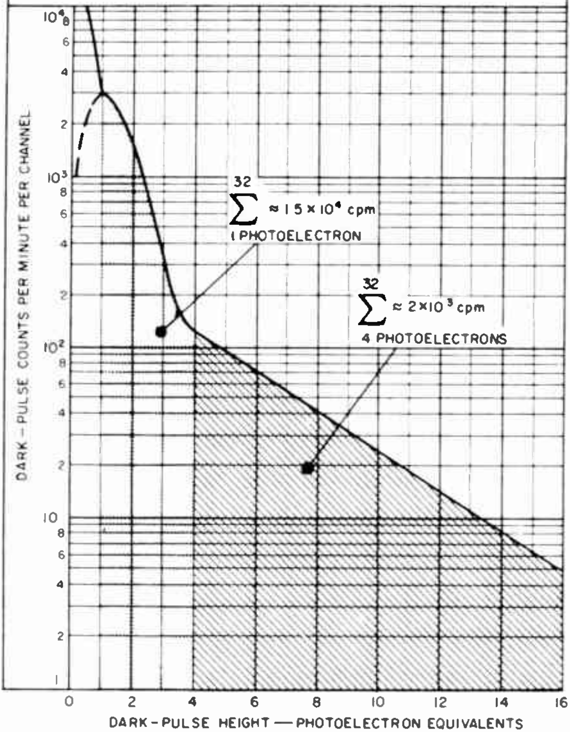
DASHED PORTION INDICATES LOCATION OF SINGLE PHOTOELECTRON PEAK. THIS PORTION OF CURVE IS NORMALIZED TO COINCIDE WITH SINGLE PHOTOELECTRON PEAK OF DARK PULSE SPECTRUM AND IS OBTAINED WITH PHOTOCATHODE FULLY ILLUMINATED BY A TUNGSTEN-FILAMENT LAMP OPERATED AT A LOW COLOR TEMPERATURE. DARK PULSES ARE SUBTRACTED.

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)

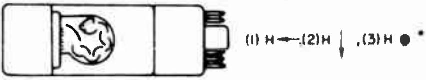


TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4516

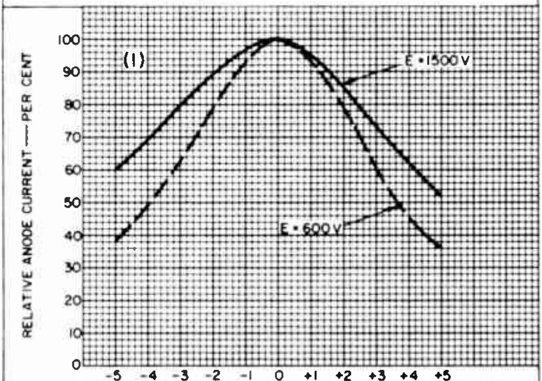
SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE No. 1; 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/12 OF E BETWEEN DYNODE No. 10 AND ANODE.

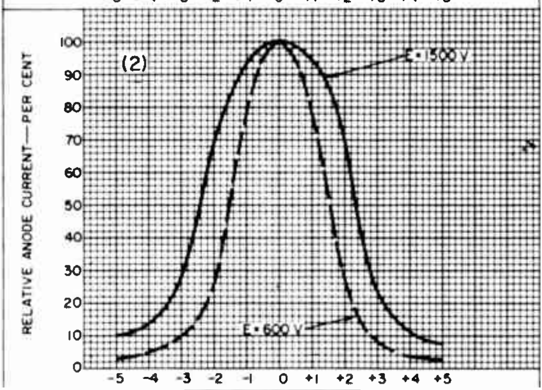
PHOTOCATHODE IS FULLY ILLUMINATED.



POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION.

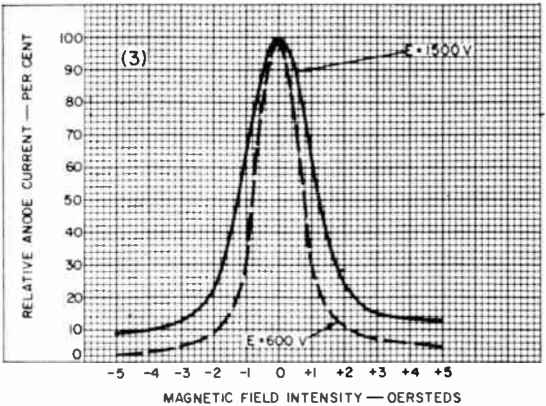
*POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX OUT OF PAPER.





TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4516 (Cont'd)



92LM-1946R1

TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4517

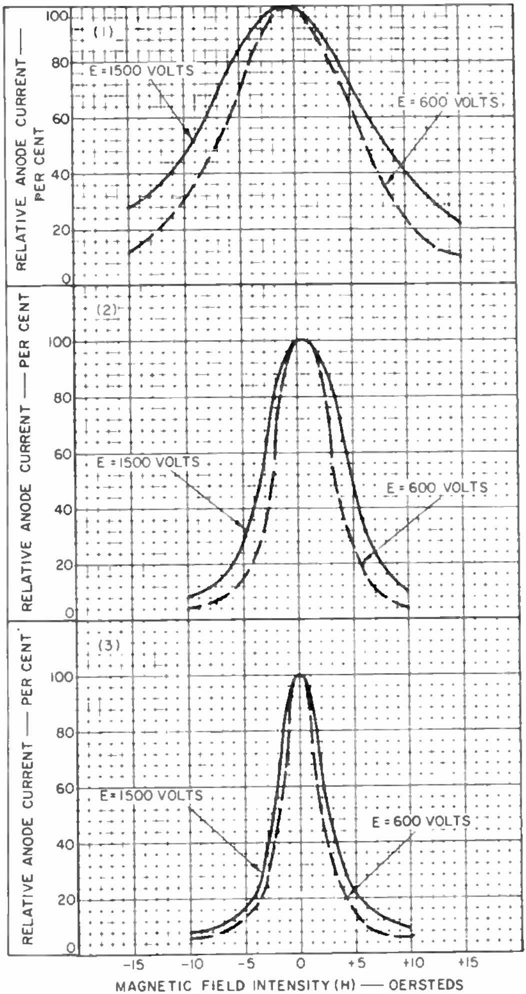
SUPPLY VOLTAGE E IS ACROSS A VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE-No.1; 1/12 OF E FOR EACH SUCCEEDING DYNODE-STAGE; AND 1/12 OF E BETWEEN DYNODE-No.10 AND ANODE.

PHOTOCATHODE IS FULLY ILLUMINATED.
TUBE IS ORIENTED IN MAGNETIC FIELD AS SHOWN BELOW:

* DIRECTION (3) IS OUT OF PAPER

TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

TYPE 4517 (Cont'd)



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 1, 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[j]	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(Tl)-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.

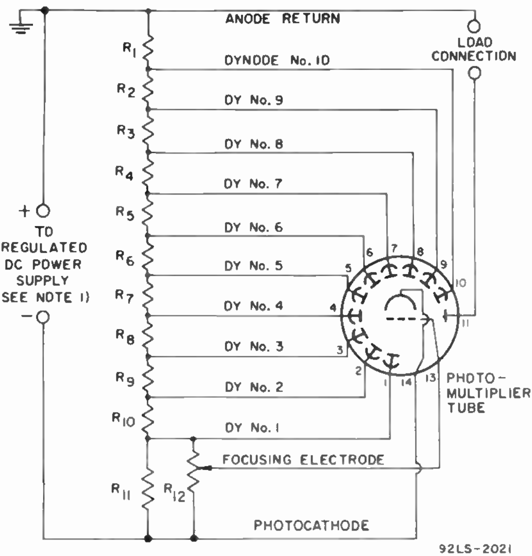
Electrostatic and magnetic shielding of the 4518 is ordinarily required. When a shield is used, it must be at cathode potential.

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

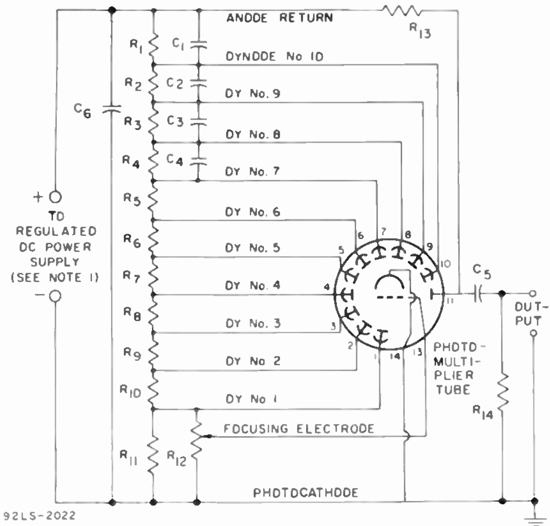


R_1 through R_7: 390,000 ohms, 1/2 watt
R_8: 470,000 ohms, 1/2 watt
R_9: 620,000 ohms, 1/2 watt
R_{10}: 560,000 ohms, 1/2 watt
R_{11}: 720,000 ohms, 1/2 watt
R_{12}: 5 megohms, 1/2 watt, adjustable

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



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

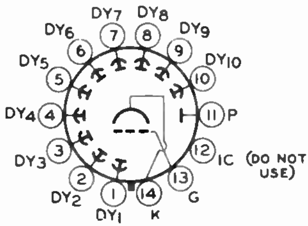
Note 1: Adjustable between approximately 500 and 2000 volts dc.

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)

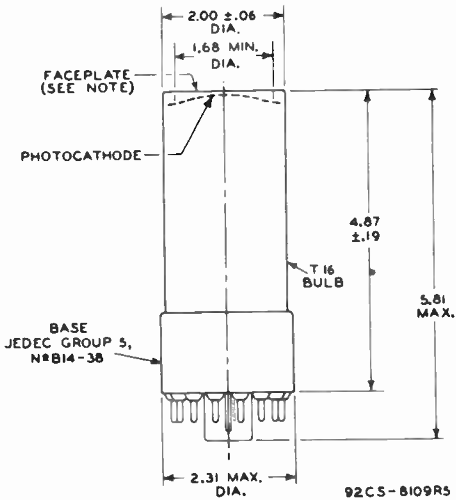
Pin 1: Dynode No.1
Pin 2: Dynode No.2
Pin 3: Dynode No.3
Pin 4: Dynode No.4
Pin 5: Dynode No.5
Pin 6: Dynode No.6
Pin 7: Dynode No.7
Pin 8: Dynode No.8
Pin 9: Dynode No.9
Pin 10: Dynode No.10
Pin 11: Anode
Pin 12: Internal Connection – Do Not Use
Pin 13: Focusing Electrode
Pin 14: Photocathode



DIRECTION OF RADIATION: INTO END OF BULB

14AA

DIMENSIONAL OUTLINE



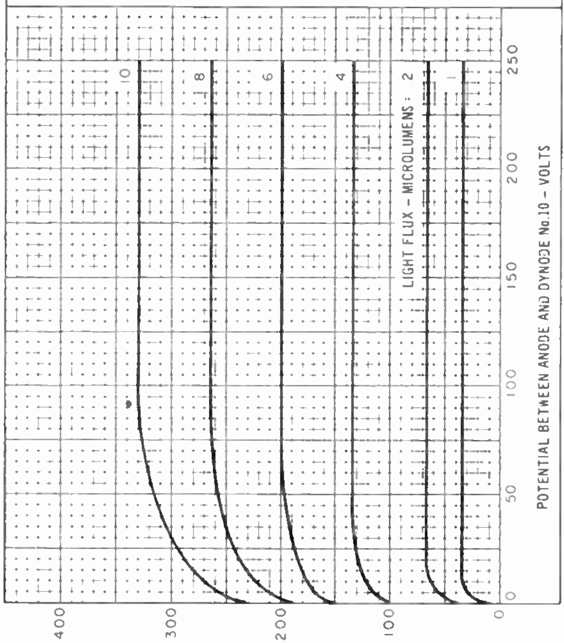
DIMENSIONS IN INCHES

℄ 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



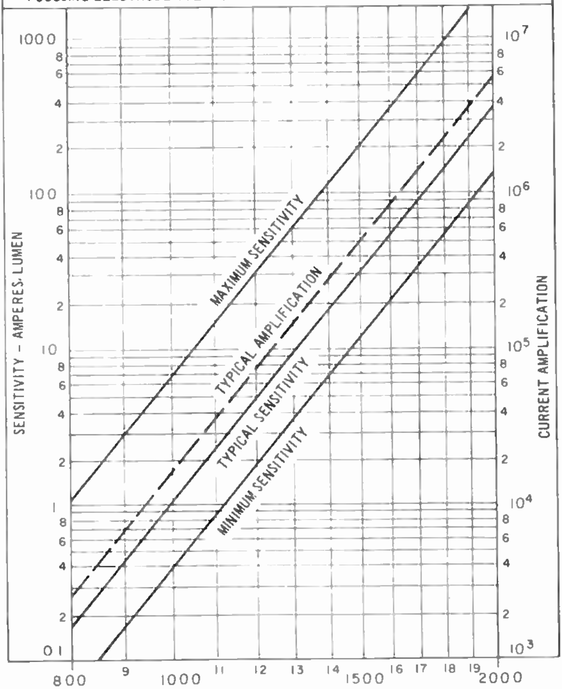
92LM-2027

SENSITIVITY AND CURRENT-AMPLIFICATION CHARACTERISTICS

THE SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE-DIVIDER WHICH DISTRIBUTES THE VOLTAGE AS FOLLOWS:

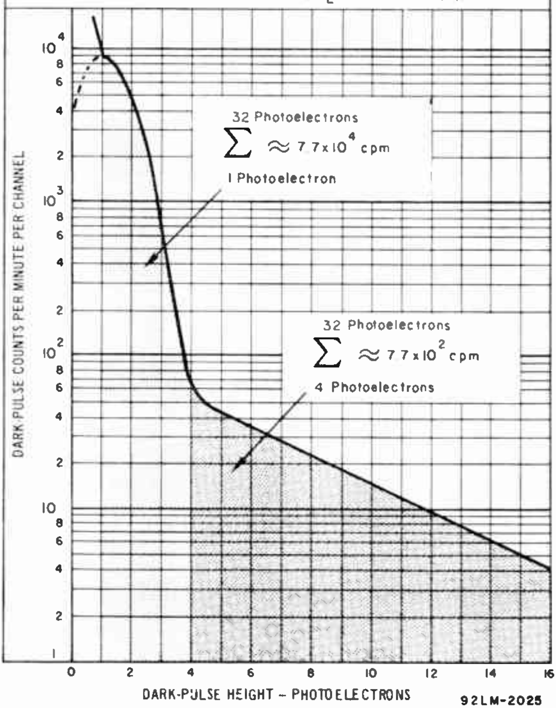
BETWEEN:	7.75% OF E MULTIPLIED BY:
CATHODE AND DYNODE No.1	1.8
DYNODE No.1 AND DYNODE No.2	1.4
DYNODE No.2 AND DYNODE No.3	1.5
DYNODE No.3 AND DYNODE No.4	1.2
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	12.9

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° C
ONE PHOTOELECTRON PULSE HEIGHT = 4 COUNTING CHANNELS
INTEGRATING TIME CONSTANT = 30 μ SEC (R_L = 300 k, C = 100 pF)



92LM-2025

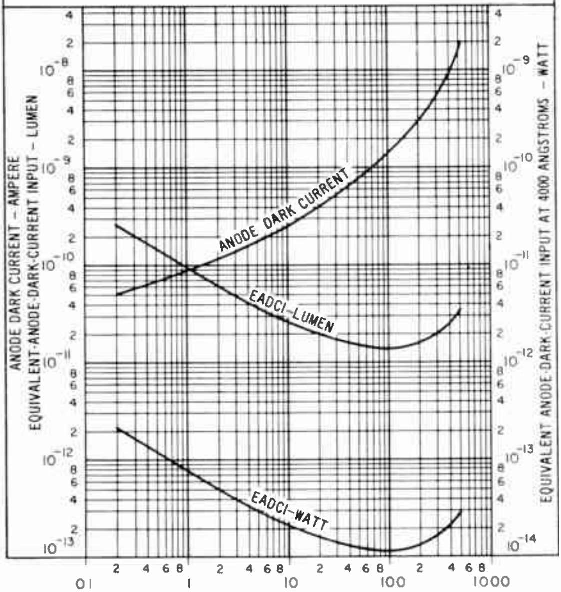
TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

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



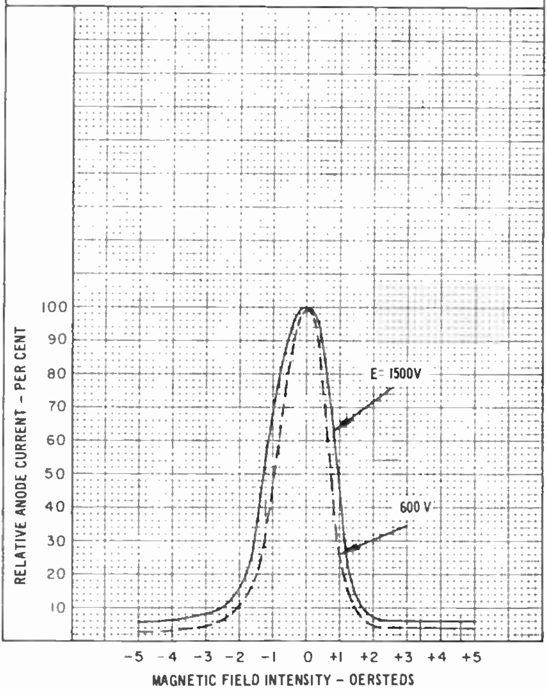
92LM-2026

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

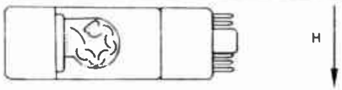


92LM-2028

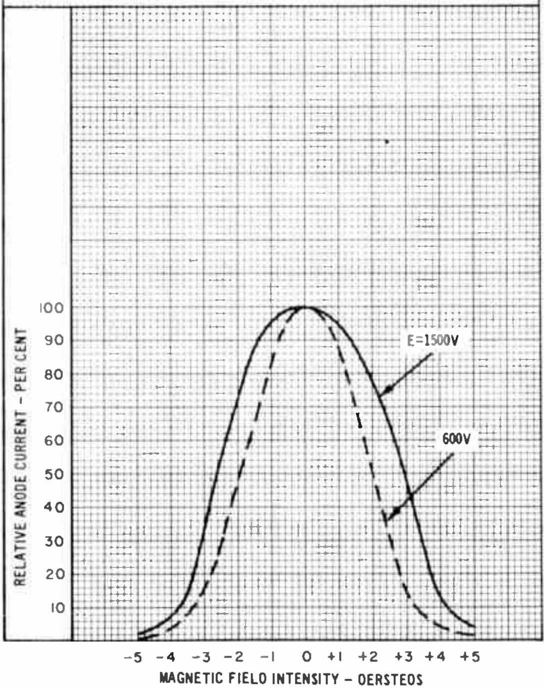
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

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

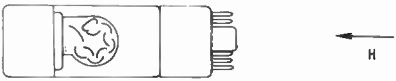


92LM-2029

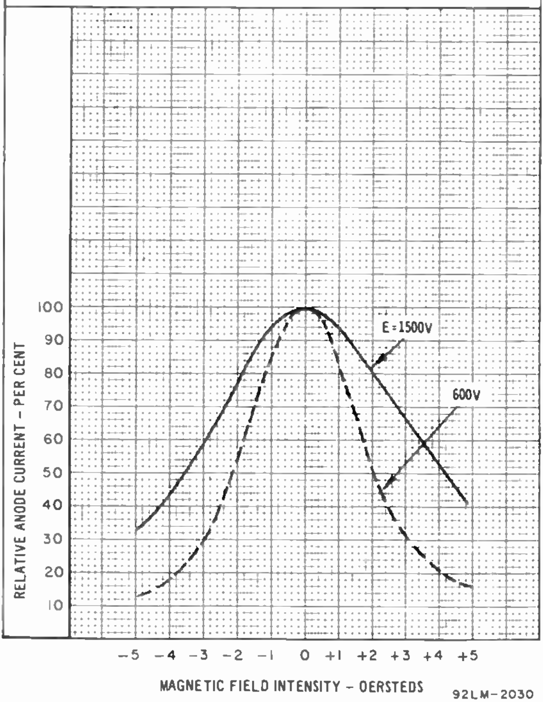
TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

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.

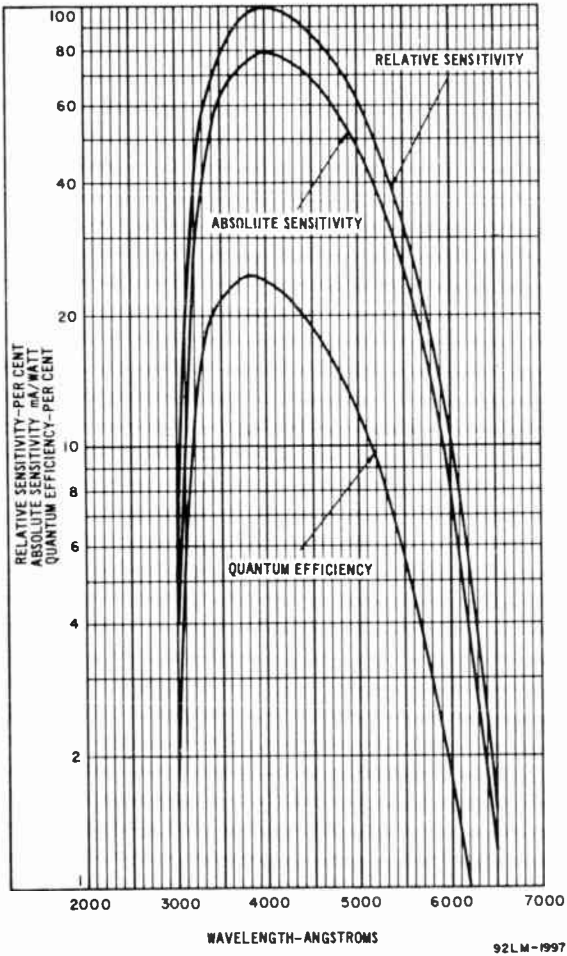


POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION

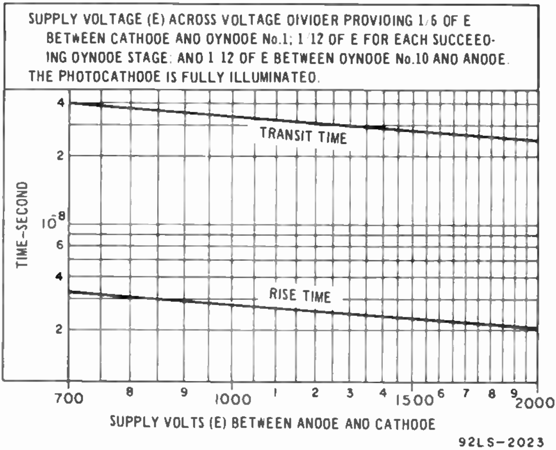


92LM-2030

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 1,000cps[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:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.12 \times \text{Light Flux of } 1 \times 10^{-4}\ \text{(lm)}}$$

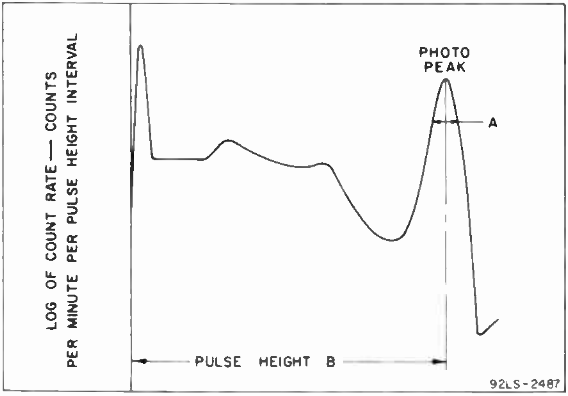
The value of 0.12 is the average value of the ratio of the cathode current measured under the conditions specified in footnote (m) to the cathode current measured under the same conditions but with the blue filter removed.

[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:

$$MGD = \frac{\sum_{i=1}^{i=n} |\bar{p} - p_i|}{n} \cdot \frac{100}{\bar{p}}$$

Where:

$\bar{p}$ = mean pulse height

p_i = pulse height at the "ith" reading

n = total number of readings

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.

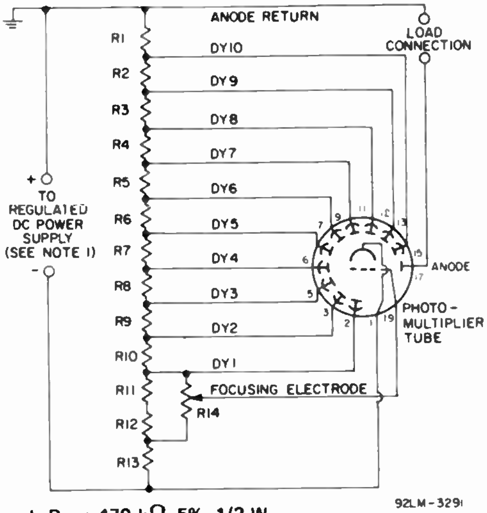
For additional information on this type write to RCA Commercial Engineering, Harrison, N.J. 07029 for technical bulletin.

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



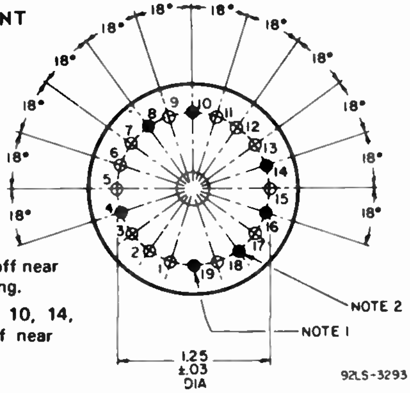
R_1 through R_{13}: 470 kΩ, 5%, 1/2 W

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.

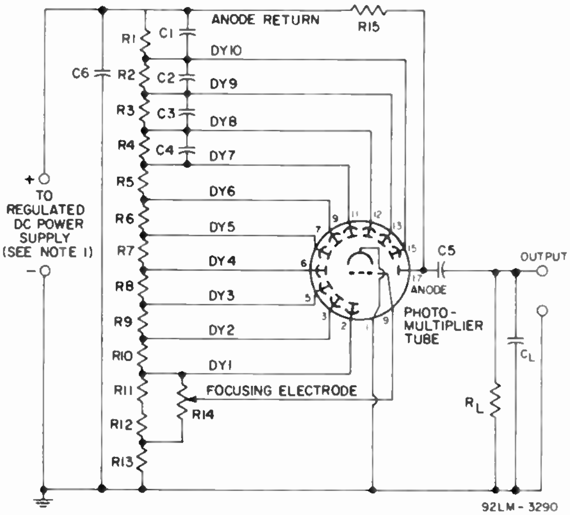
BASE ARRANGEMENT BOTTOM VIEW



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

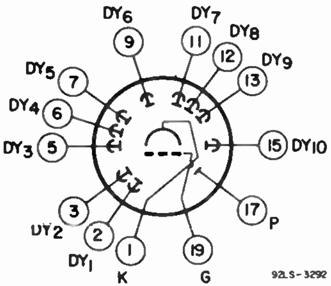
Note 1: Adjustable between approximately 800 and 2000 volts dc.

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.

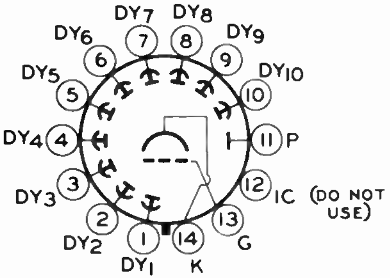
Note 4: Component values are dependent upon nature of application and output signal desired.

LEAD CONNECTIONS
BOTTOM VIEW (WITH BASE REMOVED)



Lead	1: Photocathode	Lead	11: Dynode No.7
Lead	2: Dynode No.1	Lead	12: Dynode No.8
Lead	3: Dynode No.2	Lead	13: Dynode No.9
Lead	5: Dynode No.3	Lead	15: Dynode No.10
Lead	6: Dynode No.4	Lead	17: Anode
Lead	7: Dynode No.5	Lead	19: Focusing Electrode
Lead	9: Dynode No.6		

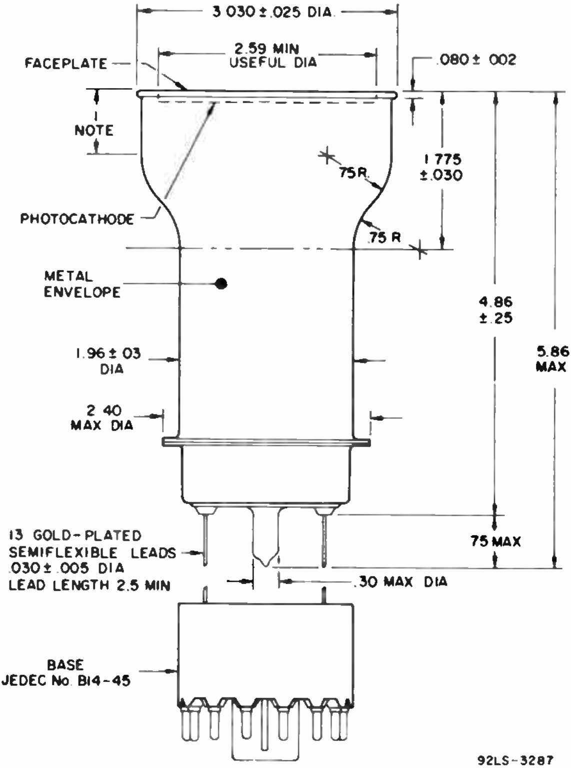
BASING DIAGRAM
BOTTOM VIEW (WITH TEMPORARY BASE)



DIRECTION OF RADIATION:
INTO END OF BULB

Pin 1:	Dynode No.1	Pin 8:	Dynode No.8
Pin 2:	Dynode No.2	Pin 9:	Dynode No.9
Pin 3:	Dynode No.3	Pin 10:	Dynode No.10
Pin 4:	Dynode No.4	Pin 11:	Anode
Pin 5:	Dynode No.5	Pin 12:	Internal Connection—Do Not Use
Pin 6:	Dynode No.6	Pin 13:	Focusing Electrode
Pin 7:	Dynode No.7	Pin 14:	Photocathode

DIMENSIONAL OUTLINE

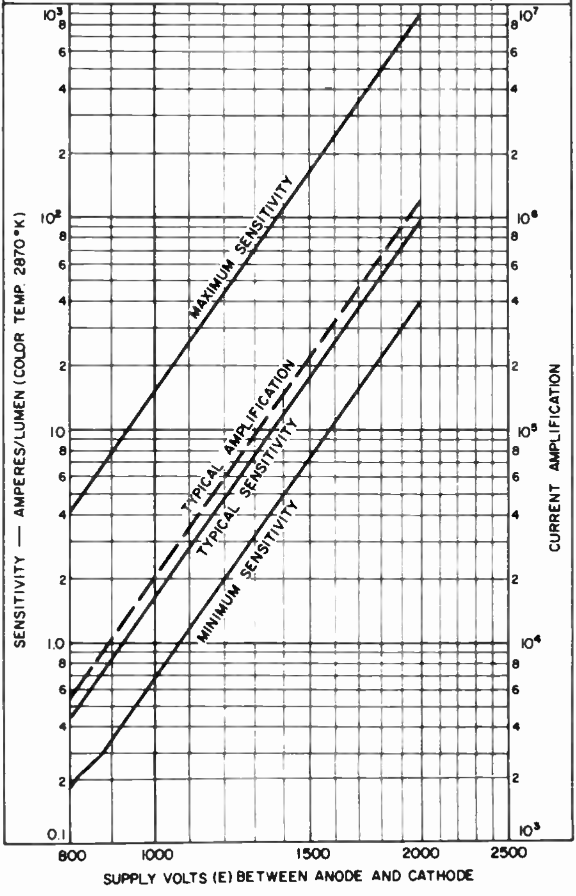


Dimensions are in inches unless otherwise stated.

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

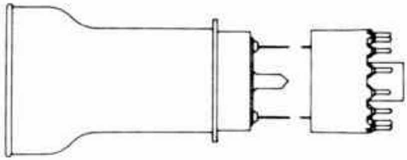
DYNODE No. I - TO - CATHODE VOLTS = 3/13 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/13 E
ANODE-TO-DYNODE No. 10 VOLTS = 1/13 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 70 AND 100 PER CENT OF DYNODE No. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT



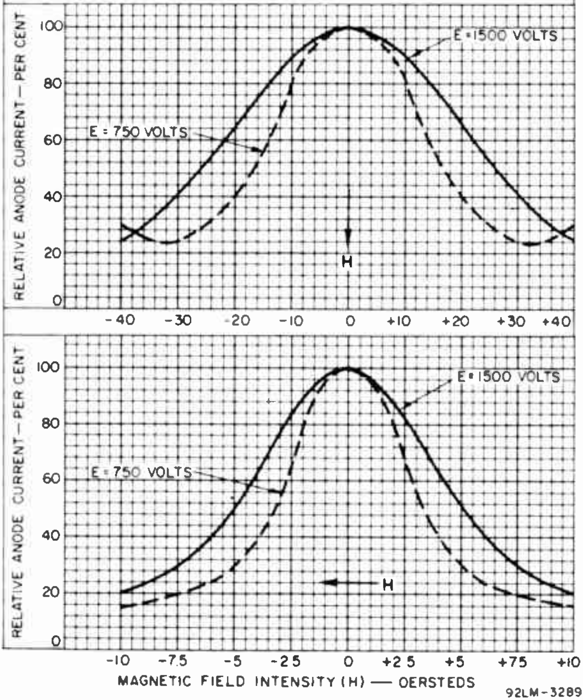
92LM-3281

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

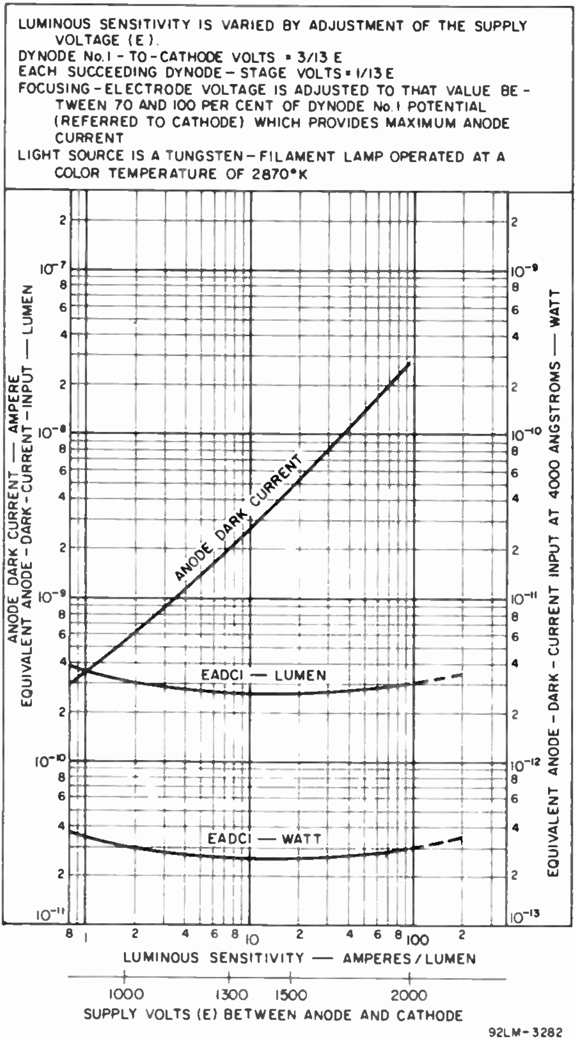


POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX IN INDICATED DIRECTION



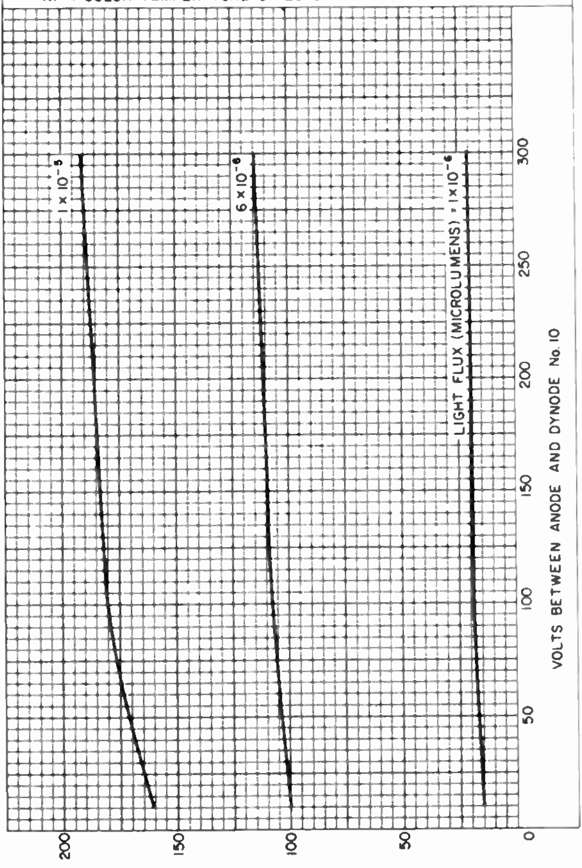
92LM-3289

TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS



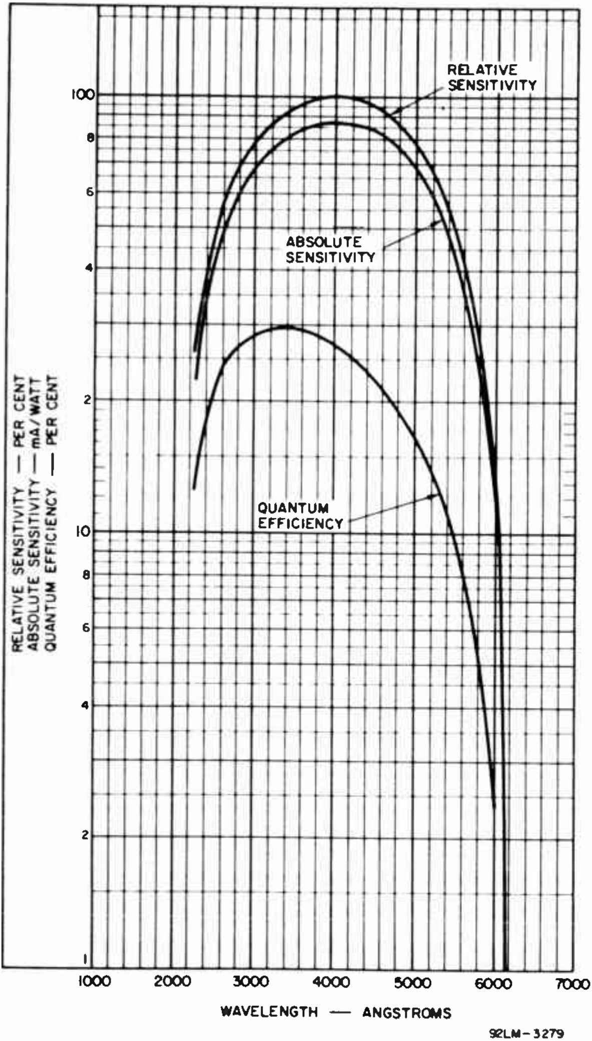
TYPICAL ANODE CHARACTERISTICS

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

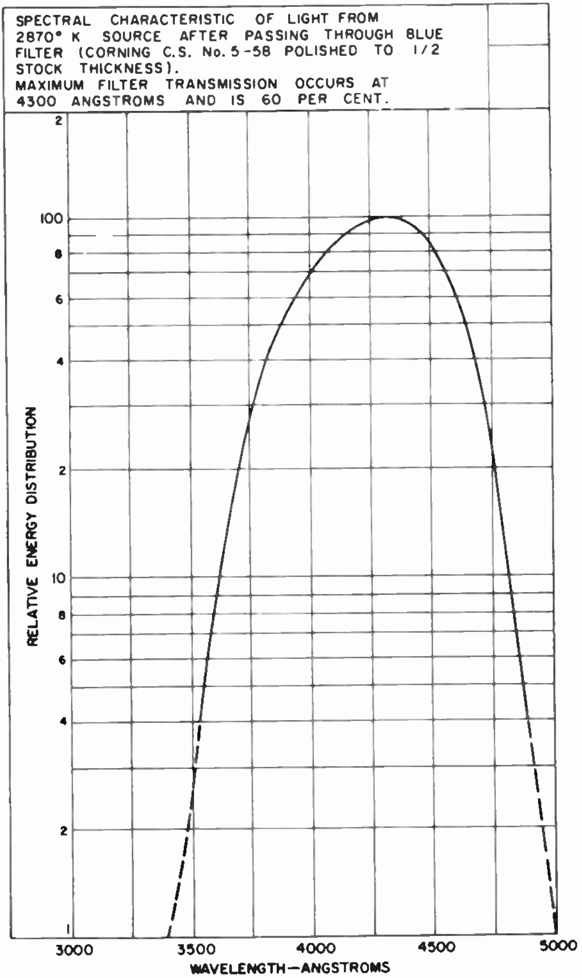


92LM-3283

TYPICAL SPECTRAL RESPONSE CHARACTERISTICS

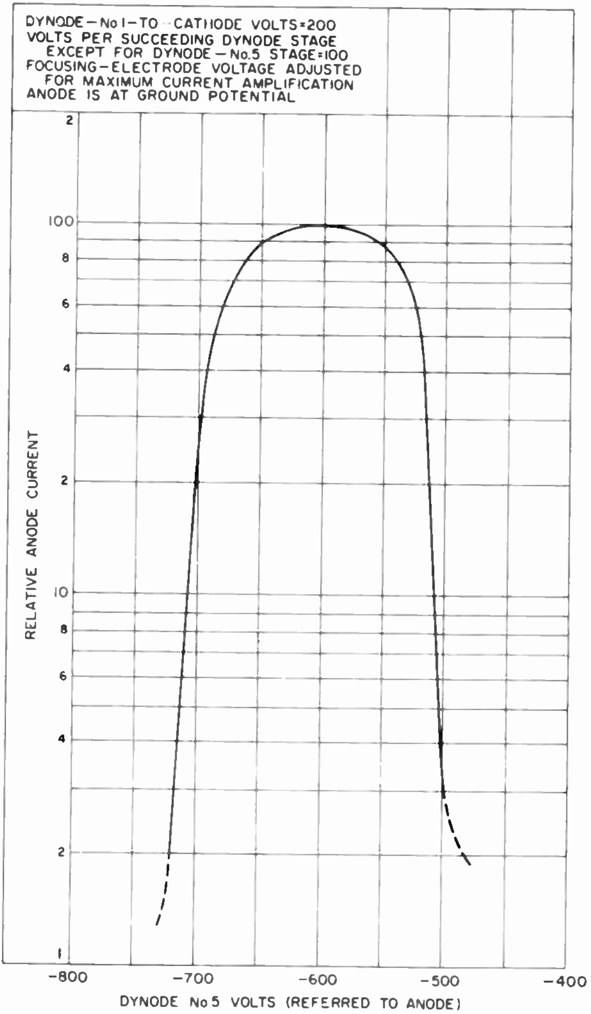


SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER



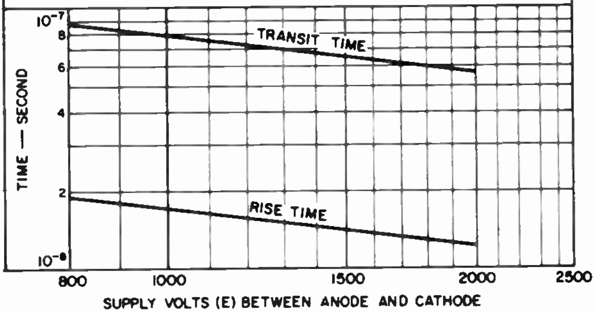
92CM-11081R1

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



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 70 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE IS FULLY ILLUMINATED.



92LS-3280

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 (Tl)-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 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 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

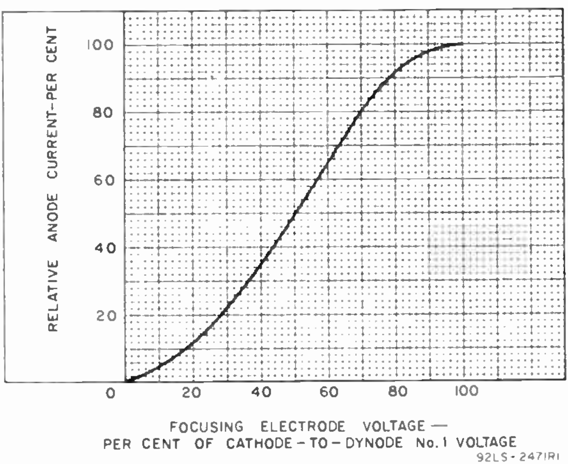


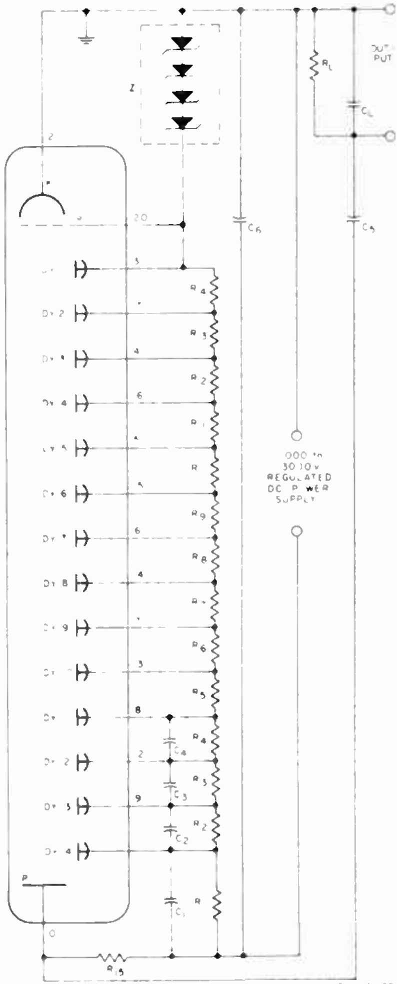
TABLE I			
Voltage Distribution			
Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	A	B●	C
	5.9% of K-P Voltage (E) Multiplied by:	6.9% of Dy1-P Voltage (E) Multiplied by:	3.85% of K-P Voltage (E) Multiplied by:
K - Dy1	3	•	6
Dy1 - Dy2	1	1	1
Dy2 - Dy3	1	1.5	1.5
Dy3 - Dy4	1	1	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

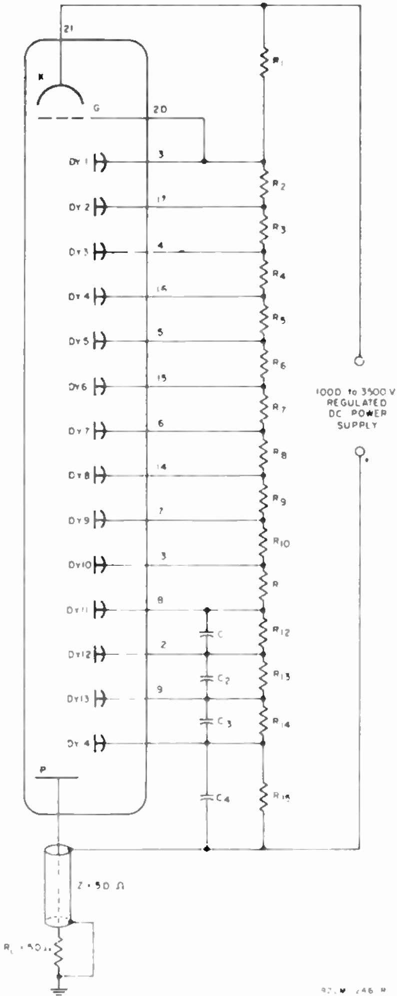
C_1: 0.005 μF, Ceramic Disc, 500 V
C_2: 0.01 μF, Ceramic Disc, 500 V
C_3: 0.02 μF, Ceramic Disc, 500 V
C_4: 0.05 μF, Ceramic Disc, 500 V
R_1: 300 KΩ (3-100 KΩ, 5%, 1/2 W in series)
R_2 through R_{15}: 100 KΩ, 5%, 1/2 W

High Peak Current Applications, to 3500V

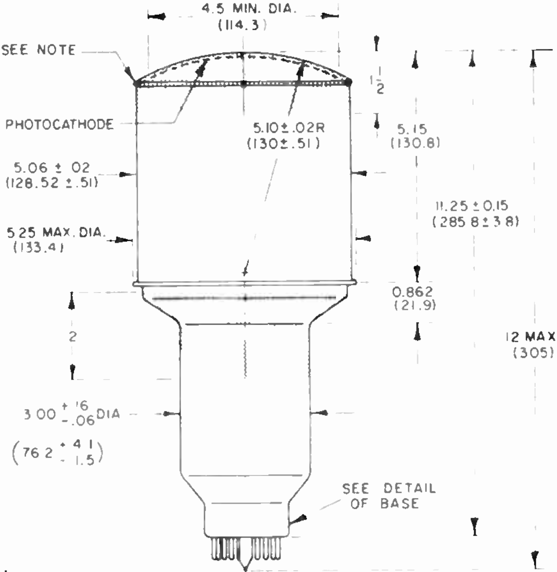
C_1: 0.005 μF, Ceramic Disc, 500 V
C_2: 0.01 μF, Ceramic Disc, 500 V
C_3: 0.02 μF, Ceramic Disc, 1000 V
C_4: 0.05 μF, Ceramic Disc, 500 V
R_1: 168 KΩ (3-56 KΩ, 5%, 2 W, in series)
R_2, R_4 through R_{11}: 27 KΩ, 5%, 1 W
R_3, R_{12}: 39 KΩ, 5%, 2 W
R_{13}, R_{15}: 54 KΩ (2-27 KΩ, 5%, 1 W, in series)
R_{14}: 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



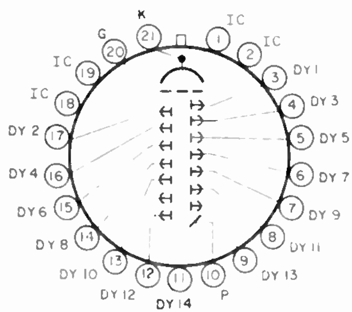
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



Note:

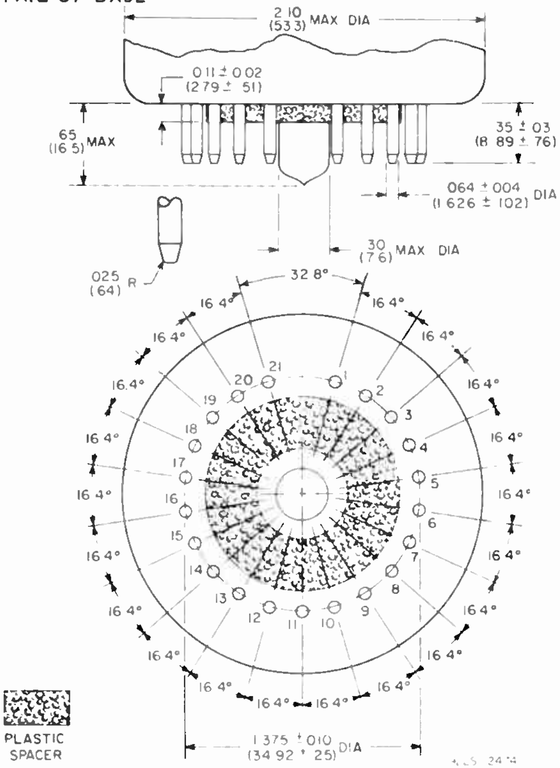
Care must be taken in mounting the tube so that the tube envelope is not subjected to excessive pressure which could strip the glass-to-metal seals. In no case should mounting supports be used in the shaded areas.

BASING DIAGRAM (Bottom View)

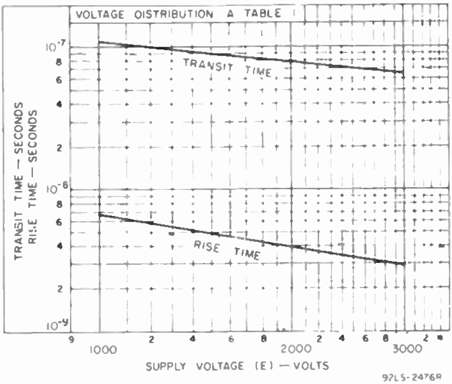


Pin No. 1: Internally connected–Do not use.
Pin No. 2: Internally connected–Do not use.
Pin No. 3: Dynode No.1
Pin No. 4: Dynode No.3
Pin No. 5: Dynode No.5
Pin No. 6: Dynode No.7
Pin No. 7: Dynode No.9
Pin No. 8: Dynode No.11
Pin No. 9: Dynode No.13
Pin No.10: Anode
Pin No.11: Dynode No.14
Pin No.12: 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

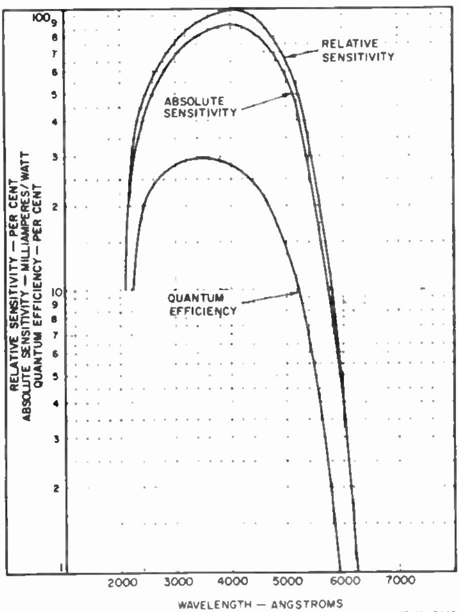
DETAIL OF BASE



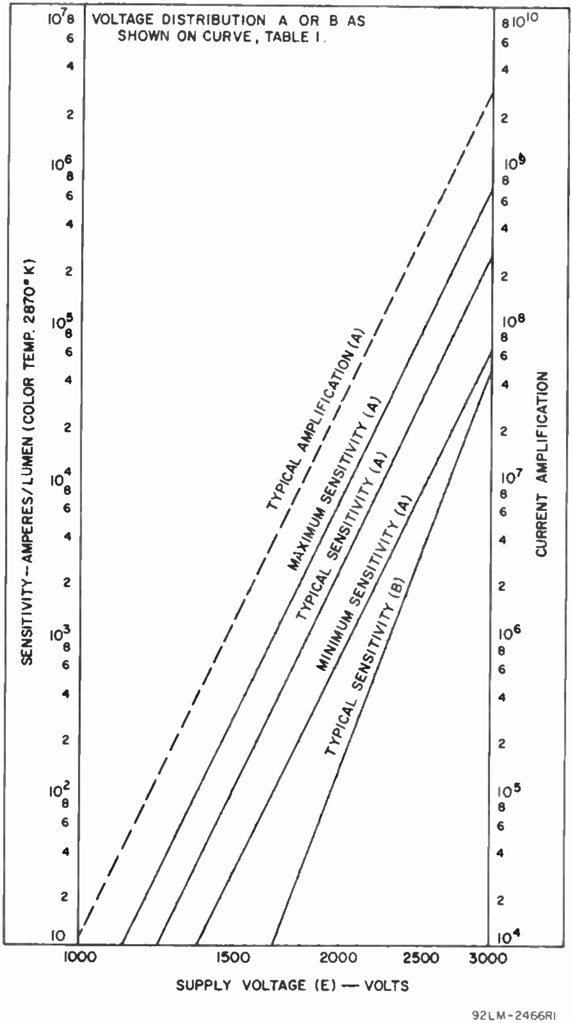
TYPICAL TIME RESOLUTION CHARACTERISTICS



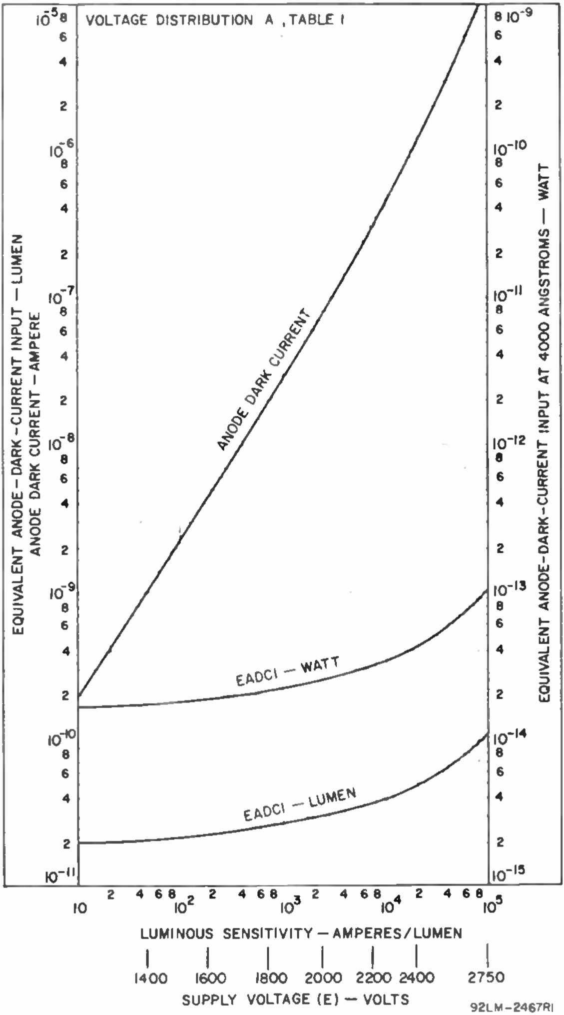
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



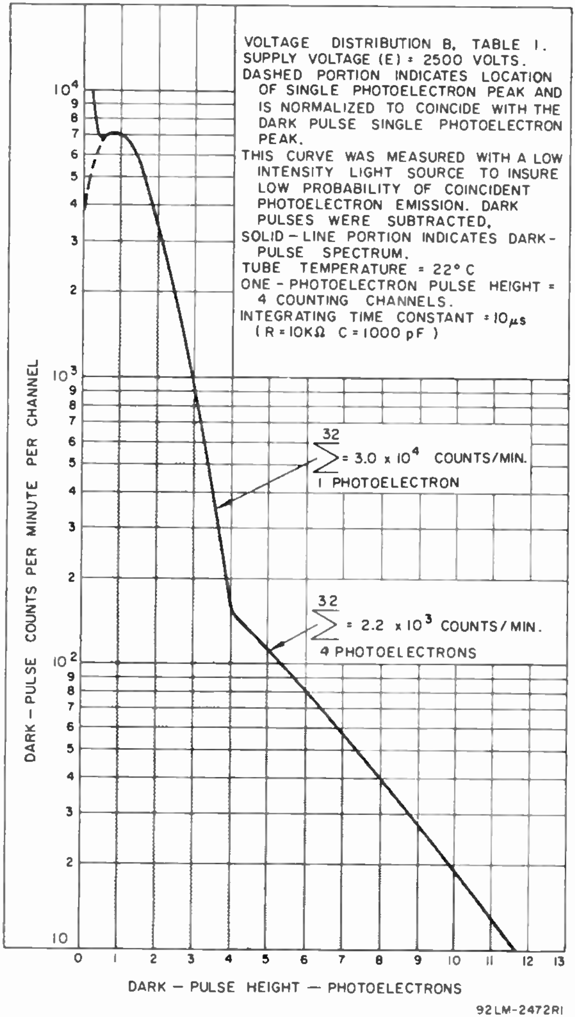
SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



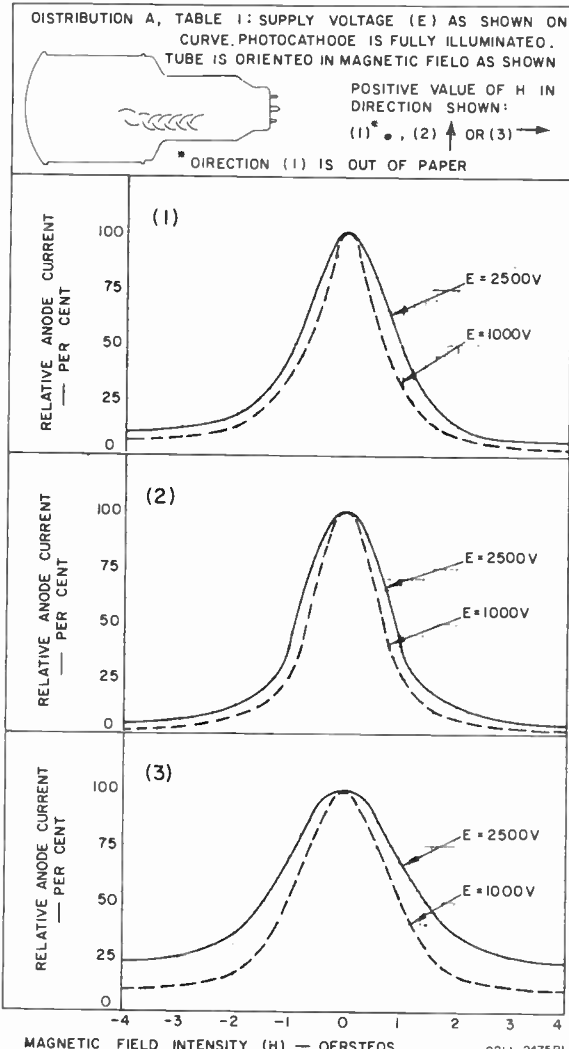
TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS



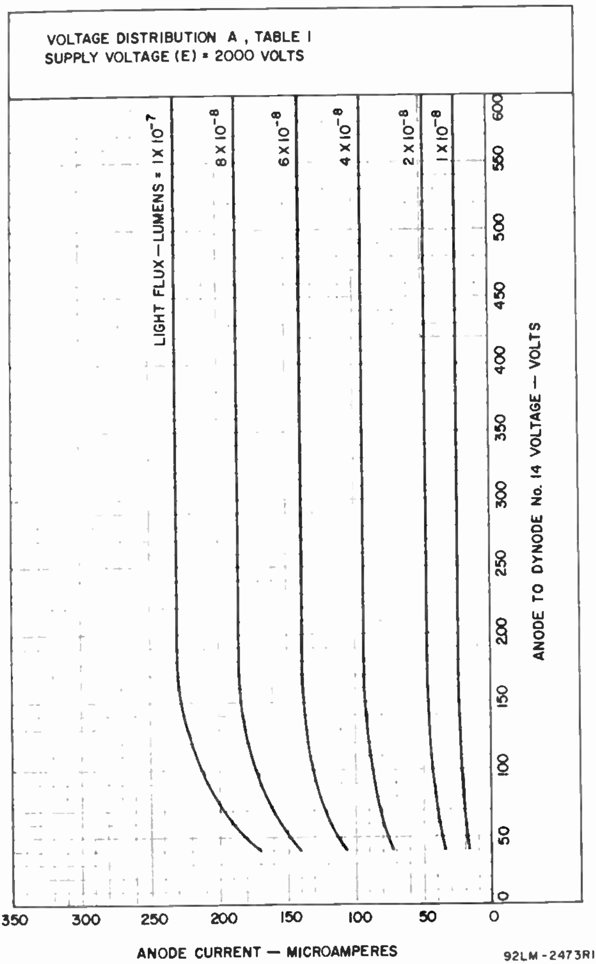
TYPICAL DARK-PULSE SPECTRUM



TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT



TYPICAL ANODE CHARACTERISTICS



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

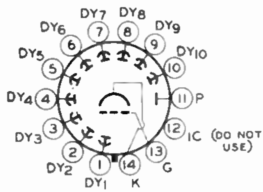
Operating Position. . . . . Any

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



DIRECTION OF RADIATION: 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	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

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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.

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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:

$$\mathrm{MGD} = \frac{\sum_{i=1}^{i=n} \left| \bar{p} - p_i \right|}{n} \cdot \frac{100}{\bar{p}}$$

where $\bar{p}$ = mean pulse height
p_i = pulse height at the "ith" reading
n = total number of readings

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.

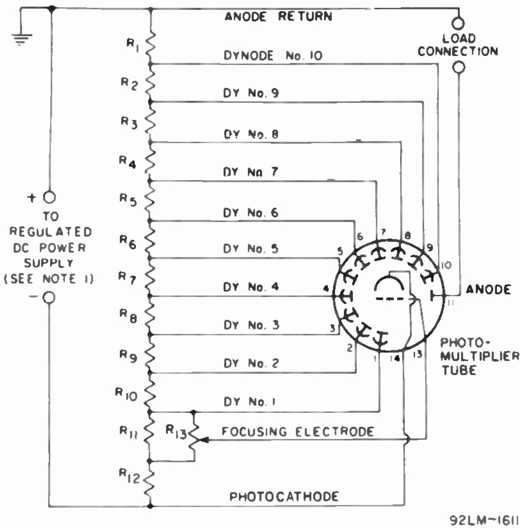
Electrostatic and magnetic shielding of these types may be required in some applications. When a shield is used, it must be at cathode potential.

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



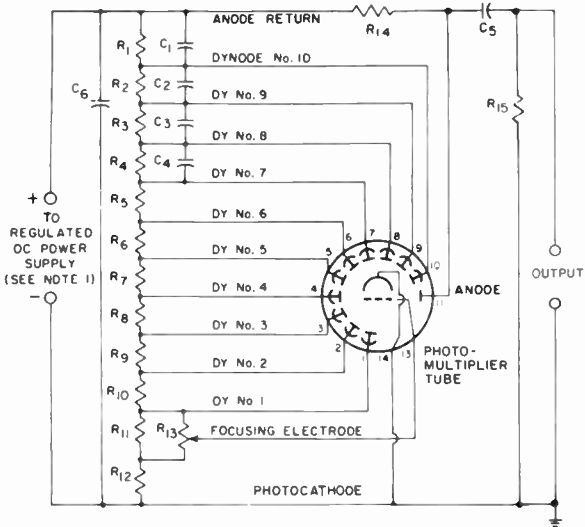
R_1 through R_{12}: 470,000 ohms, 1/2 watt
R_{13}: 5 megohms, 1/2 watt, adjustable

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



92LM-1612

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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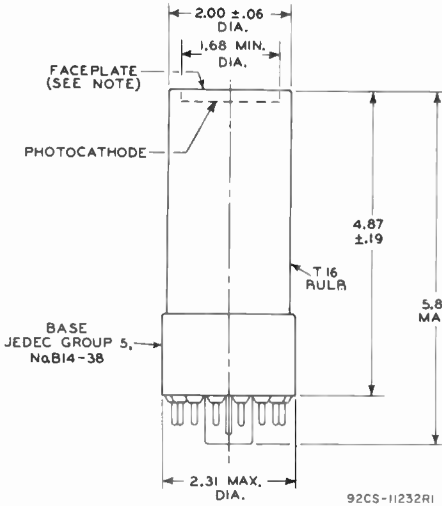
DIMENSIONAL OUTLINE
4523

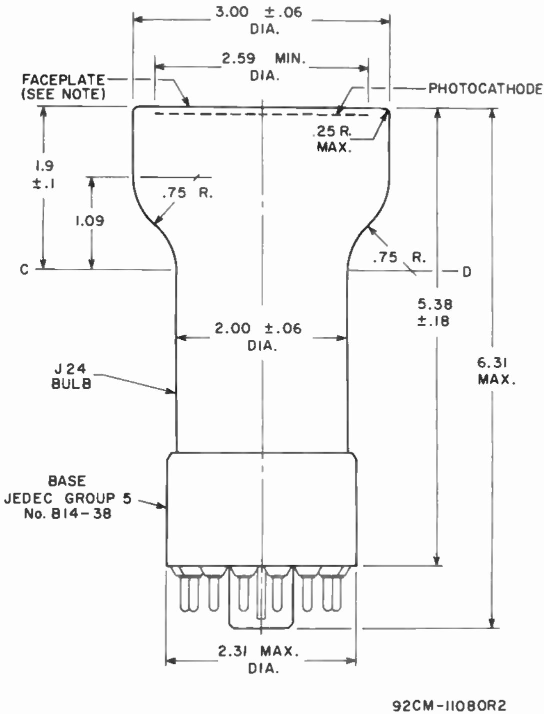


DIMENSIONS IN INCHES

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.

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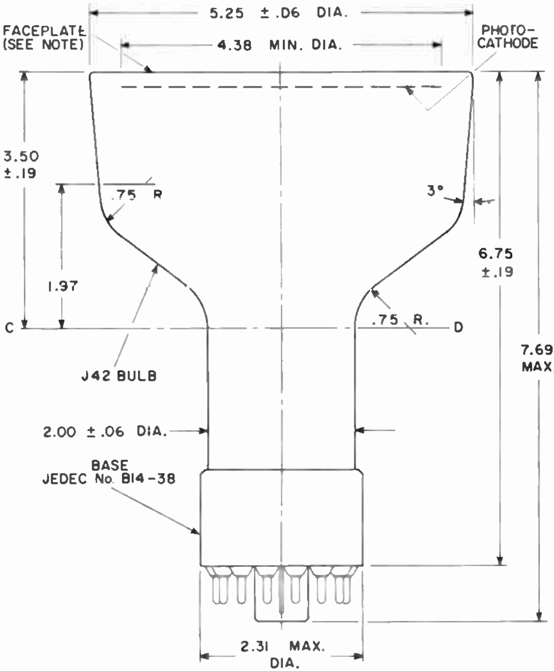
DIMENSIONAL OUTLINE
4525



92CM-11148R2

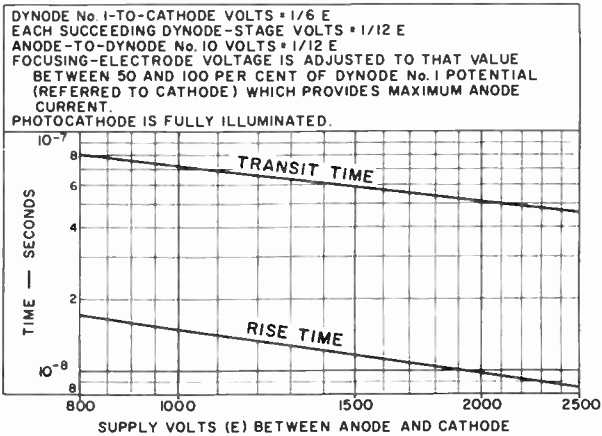
DIMENSIONS IN INCHES

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

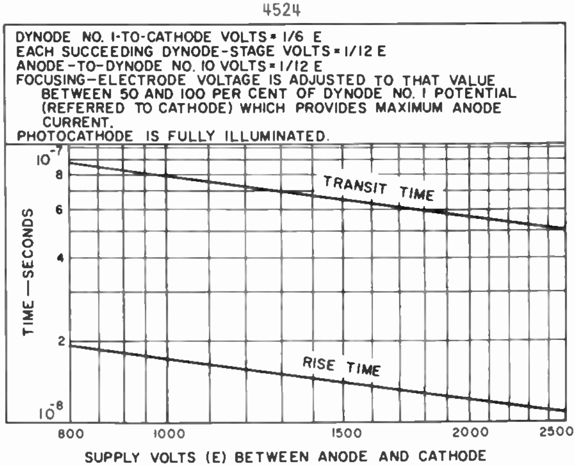
4523



92CS-12309

Typical Time Resolution Characteristics

4524

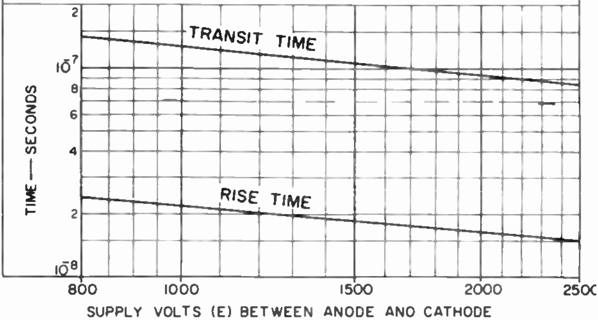


92LS—1854

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.

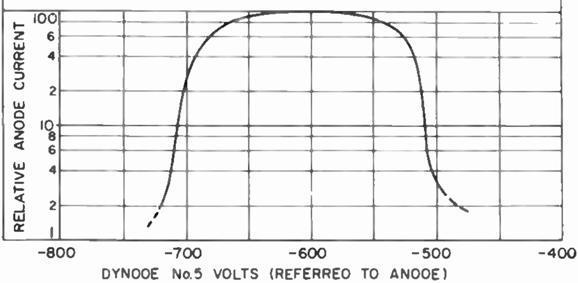


92CS-12313

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.

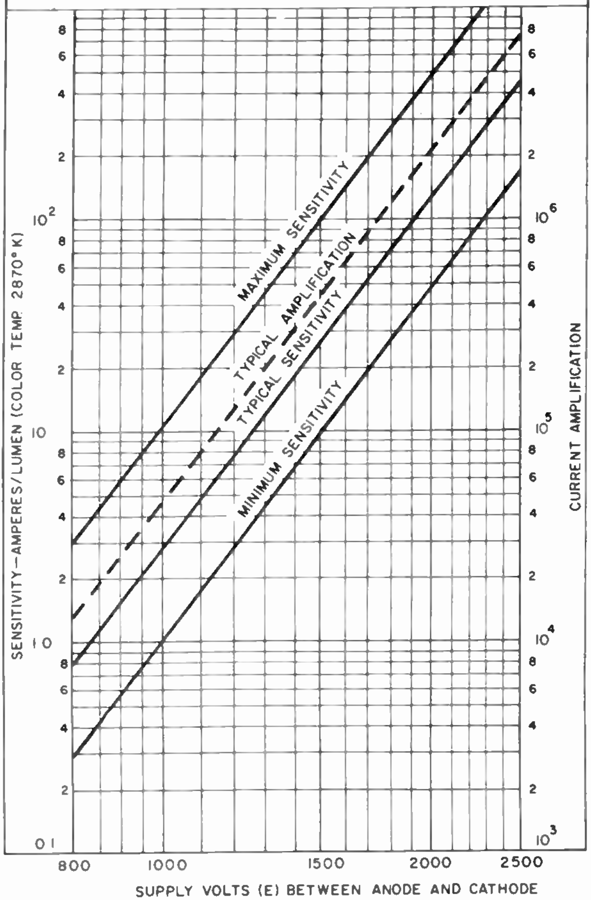


92CS-11078R1

Sensitivity and Current Amplification Characteristics

4523 4524

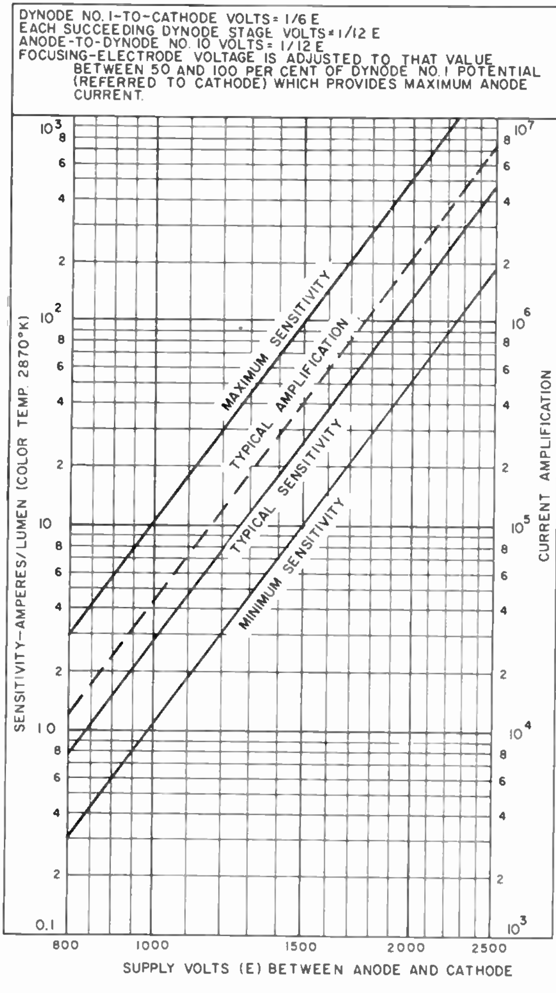
DYNODE NO 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE NO. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT



92LM-1583

Sensitivity and Current Amplification Characteristics

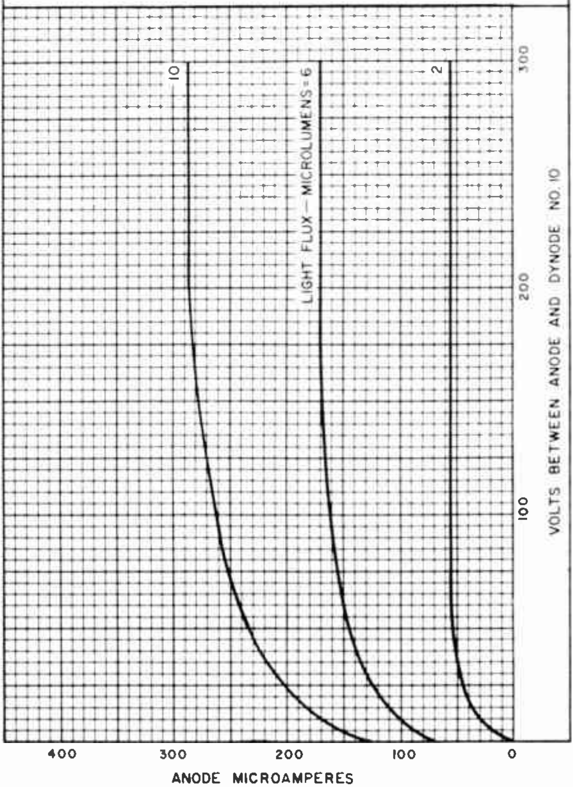
4525



Typical Anode Characteristics

4523 4524 4525

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



92LM-1555

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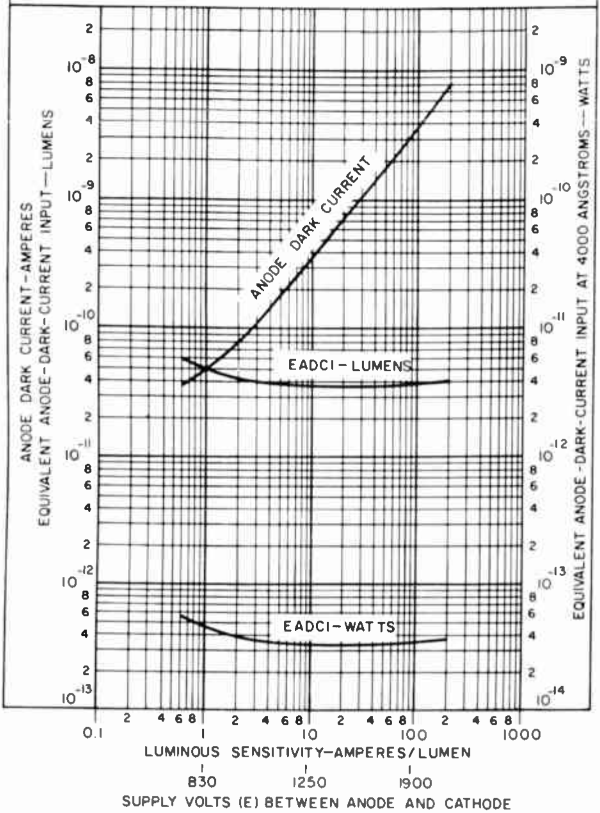
Typical EADCI and Anode Dark Current Characteristics

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

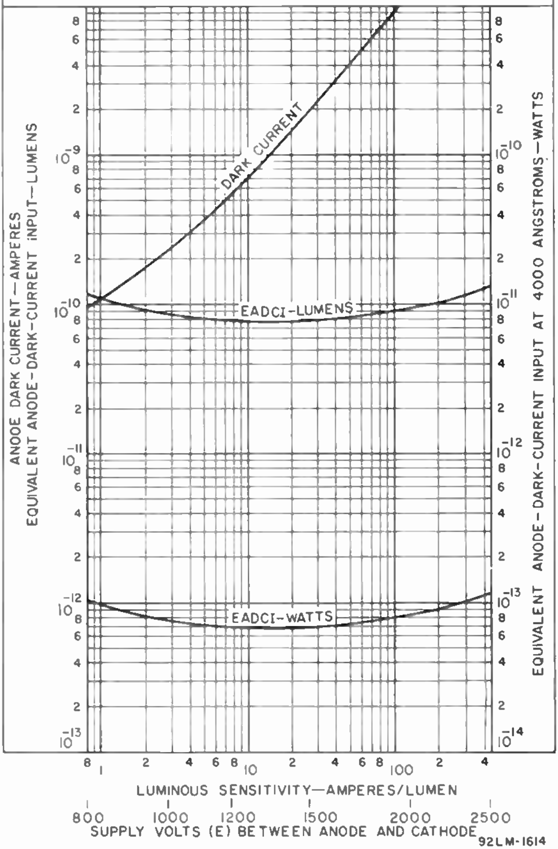


92LM-1777

Typical EADCI and Anode Dark Current Characteristics

4524

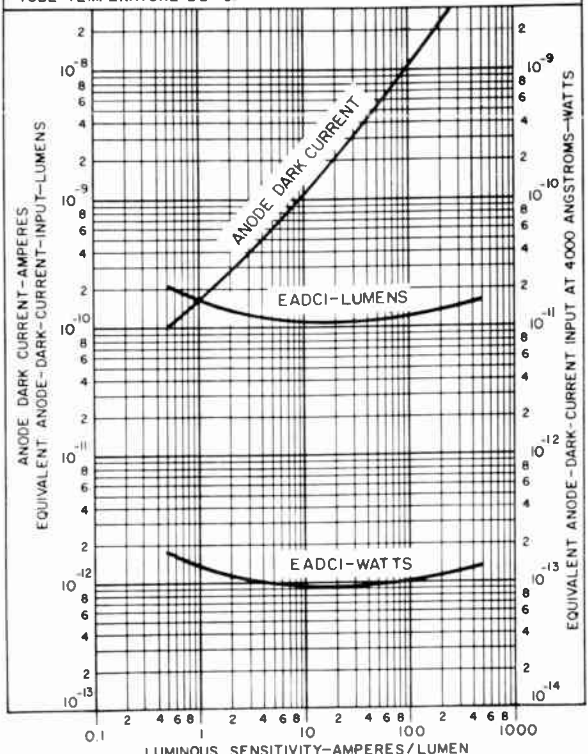
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).
DYNODE NO 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM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



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

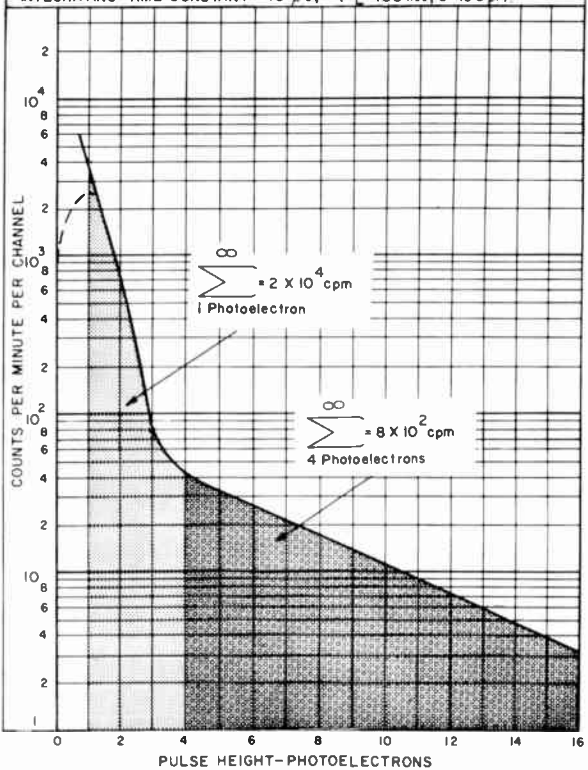


92LM-1752

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)

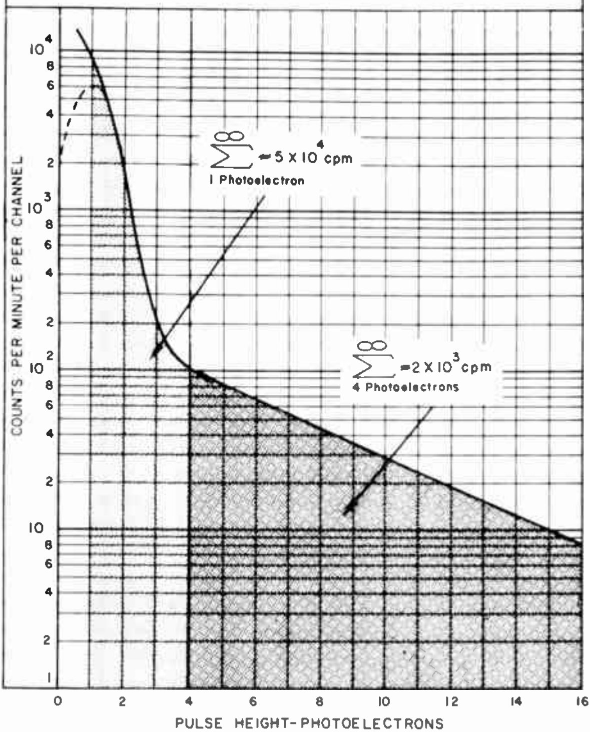


92LM-1778

Typical Dark-Pulse Spectrum

4524

CATHODE-TO-DYNODE-NO. I 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. I 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).

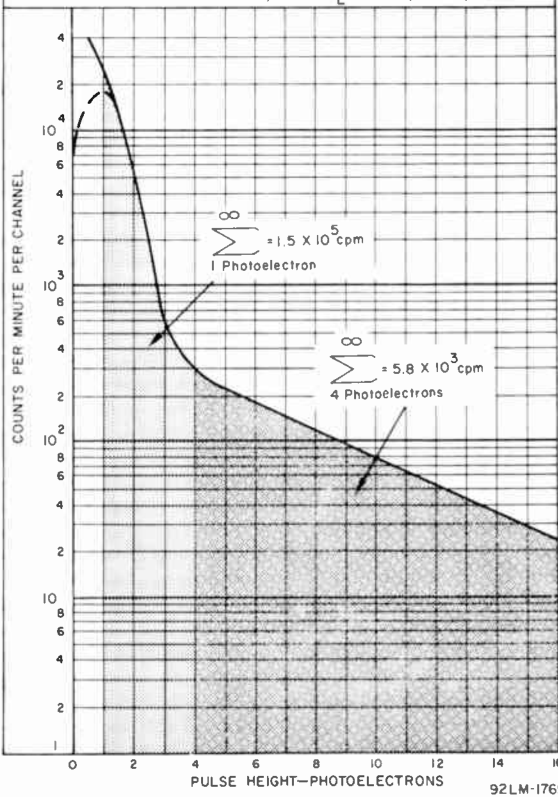


92LM-1615

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)



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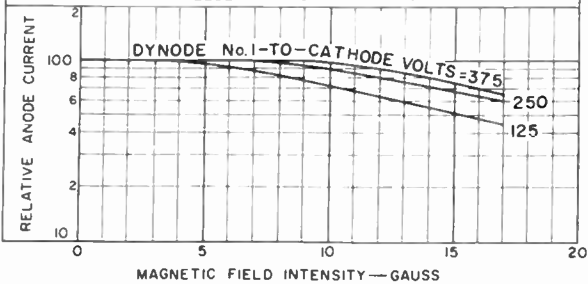
Typical Effect of Magnetic Field on Anode Current

4523

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.

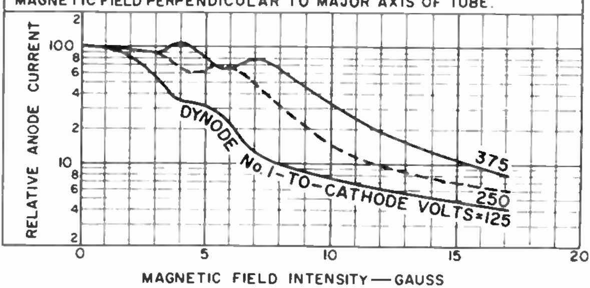


92CS-11235R2

Typical Effect of Magnetic Field on Anode Current

4523

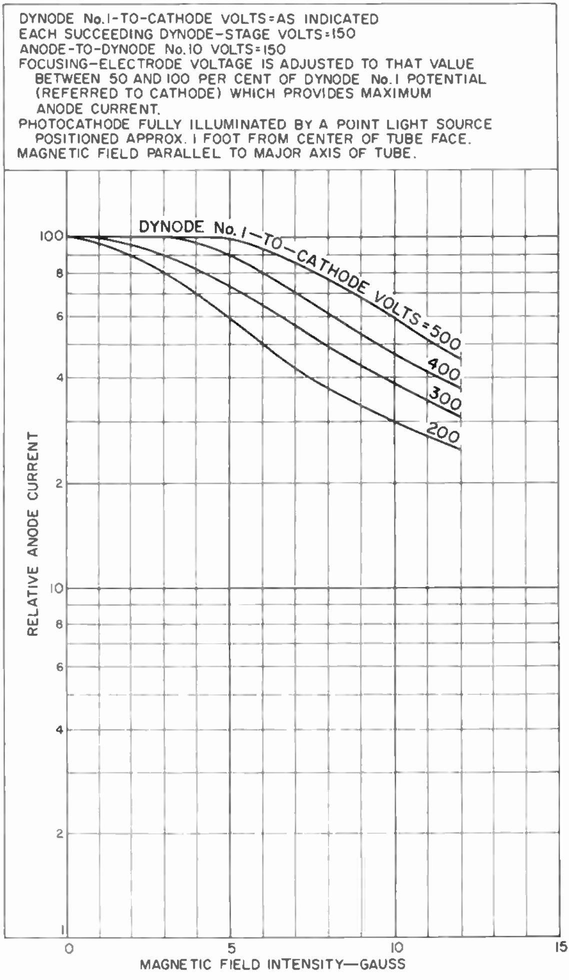
DYNODE No. 1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No. 10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE 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-11236R2

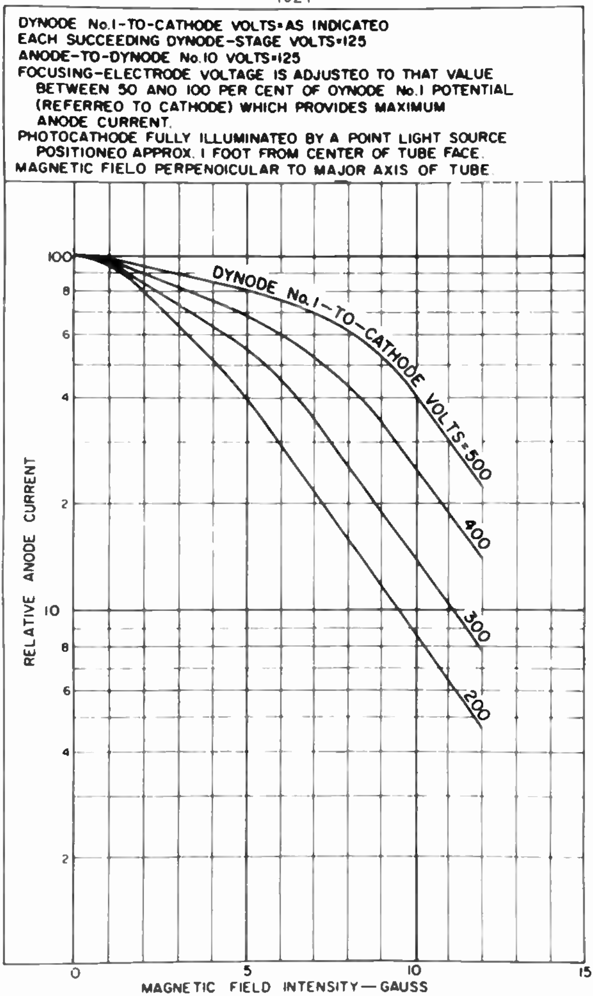
Typical Effect of Magnetic Field on Anode Current

4524



Typical Effect of Magnetic Field on Anode Current

4524

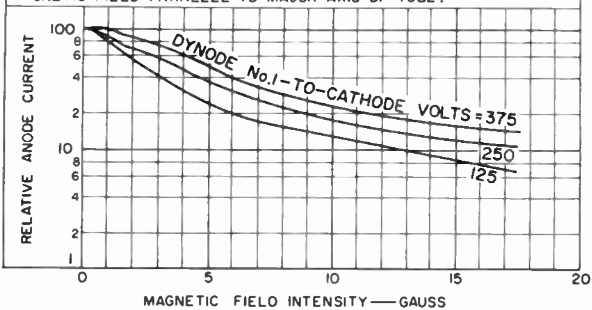


92CM-11085R2

Typical Effect of Magnetic Field on Anode Current

4525

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.

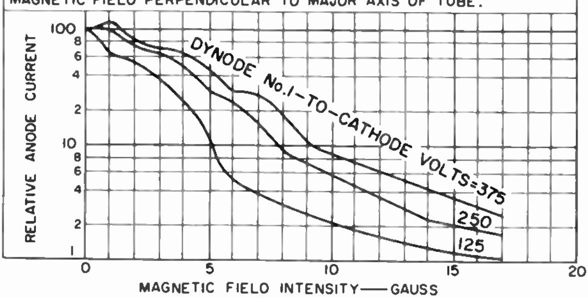


92CS-11187R2

Typical Effect of Magnetic Field on Anode Current

4525

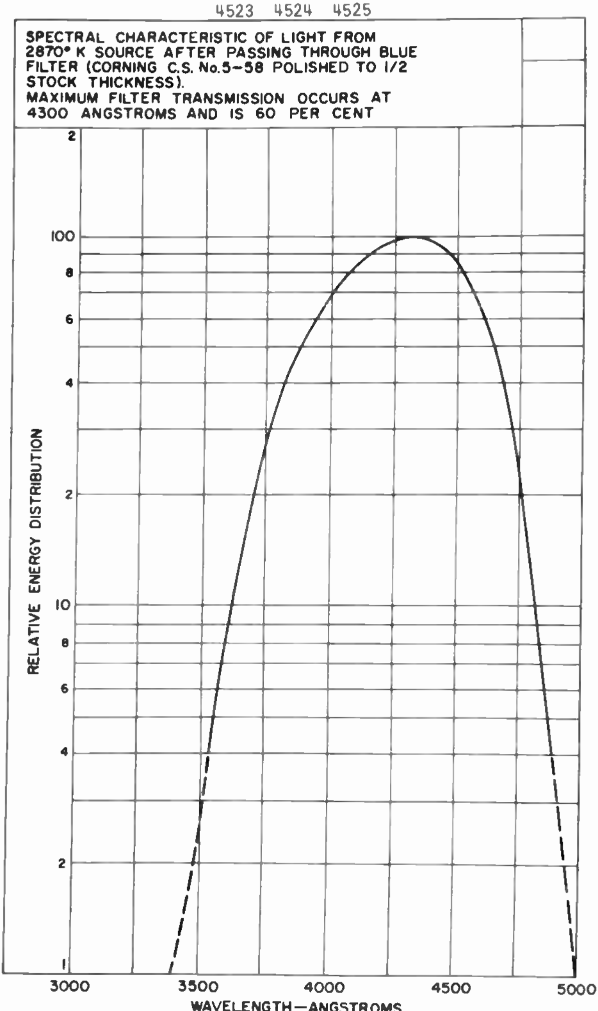
DYNODE No.1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No.10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE No.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE FULLY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



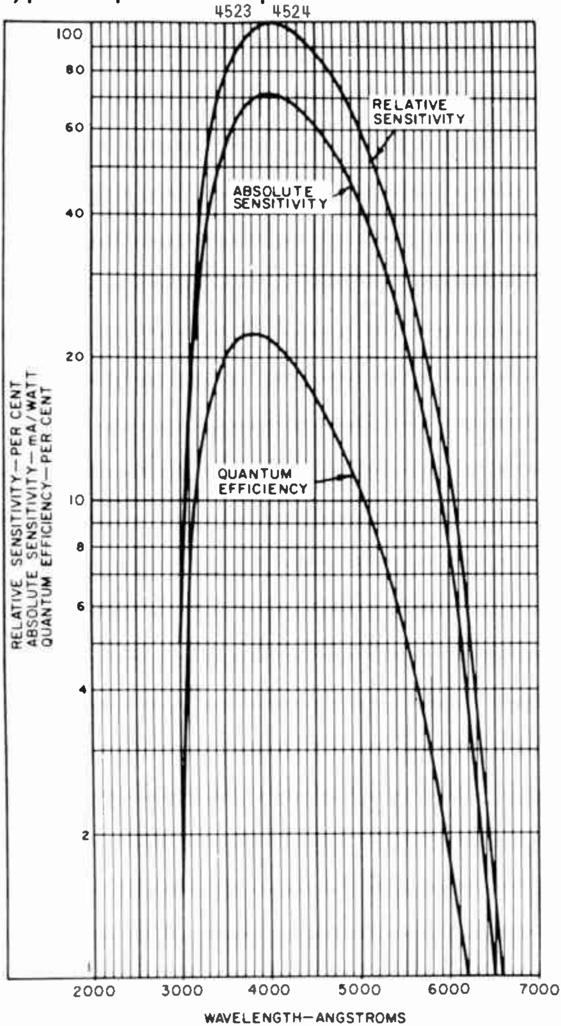
92CS-11188R2

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

4523 4524 4525

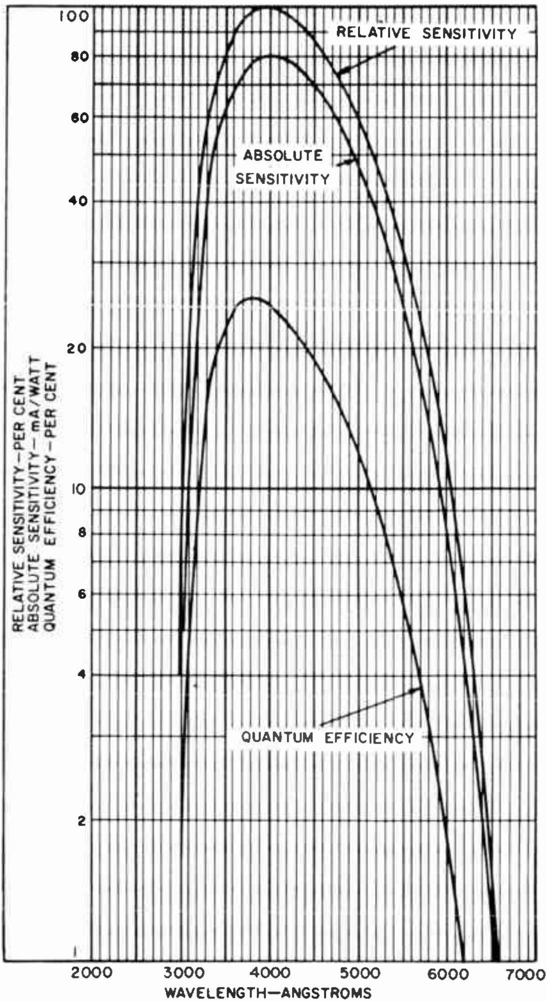


Typical Spectral Response Characteristics



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.

[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 0.001 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.

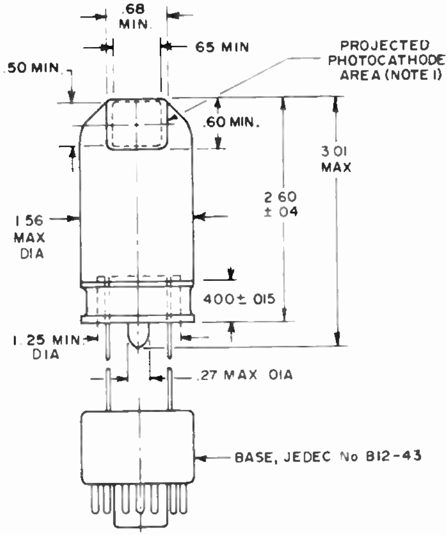
[p] At 5300 angstroms. This value is calculated from the EADCI value in lumens using a conversion factor of 295 lumens per watt.

[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

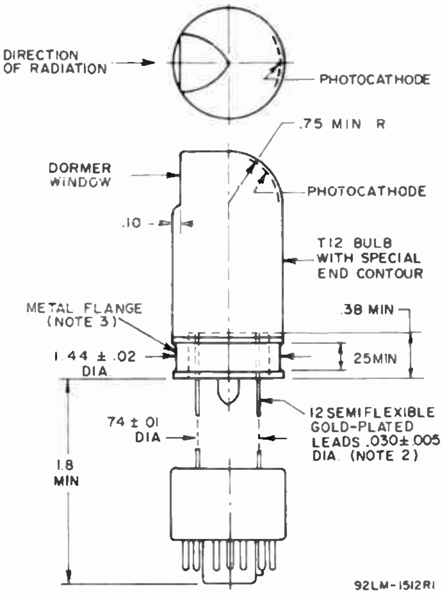


Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

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

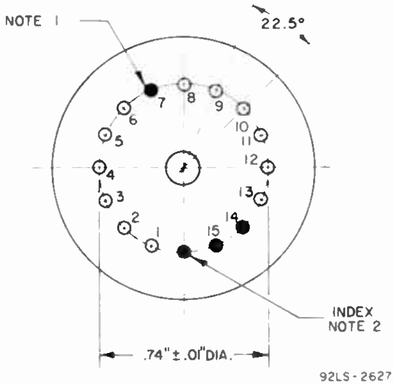


Note 1: Projected area lies between dashed lines.

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.

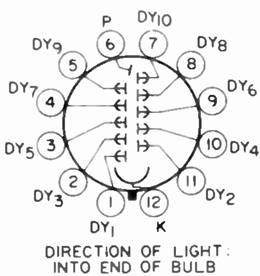
Lead Orientation Bottom View



Note 1: Leads 7, 14, and 15 are cut off within 0.16" (4 mm) of the glass button.

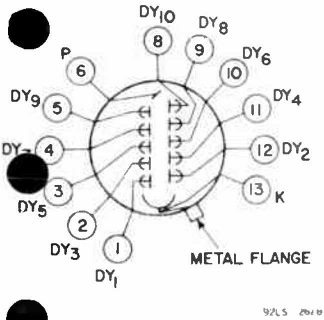
Note 2: Lead is cut off within 0.16" (4 mm) of the glass button for indexing.

Basing Diagram Bottom View (With Temporary Base)



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

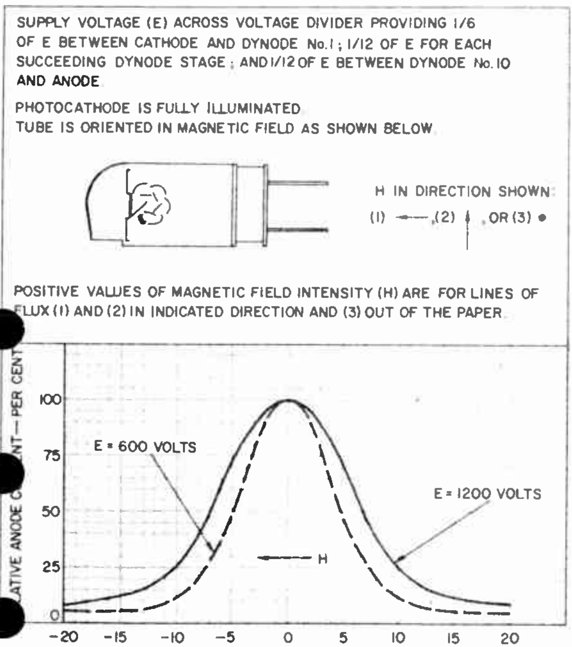


Figure 1

TYPICAL EFFECT OF INDICATED FIELD ON ANODE CURRENT – cont'd

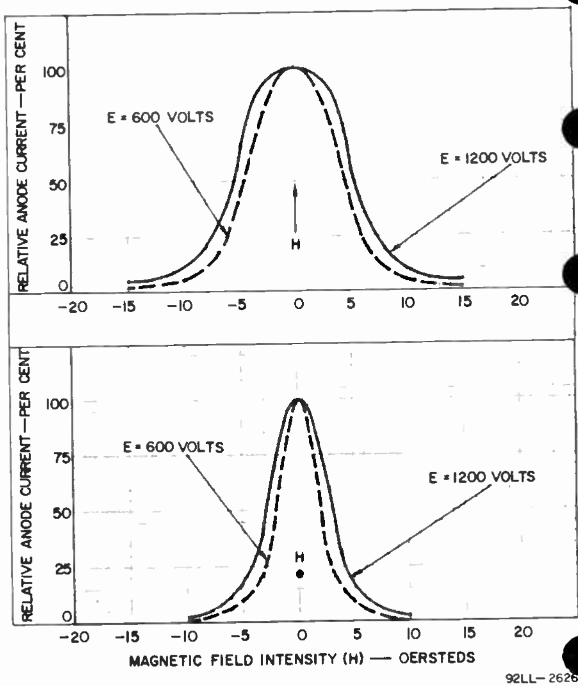


Figure 2

SCHEMATIC ARRANGEMENT OF TYPE 4526

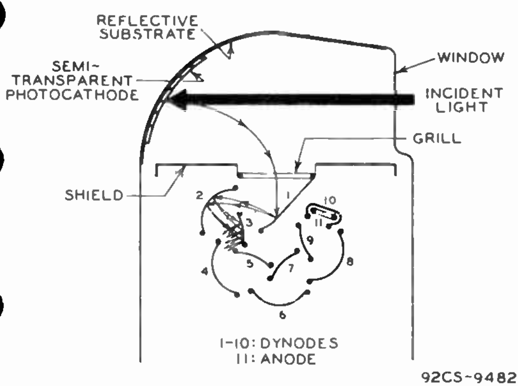


Figure 3

TYPICAL TIME-RESOLUTION CHARACTERISTICS

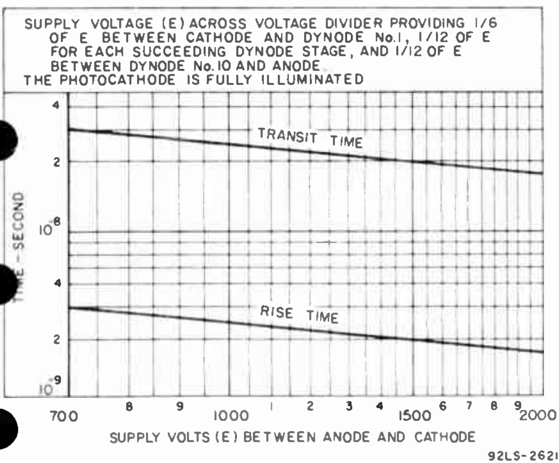


Figure 4

SPECTRAL RESPONSE CHARACTERISTICS

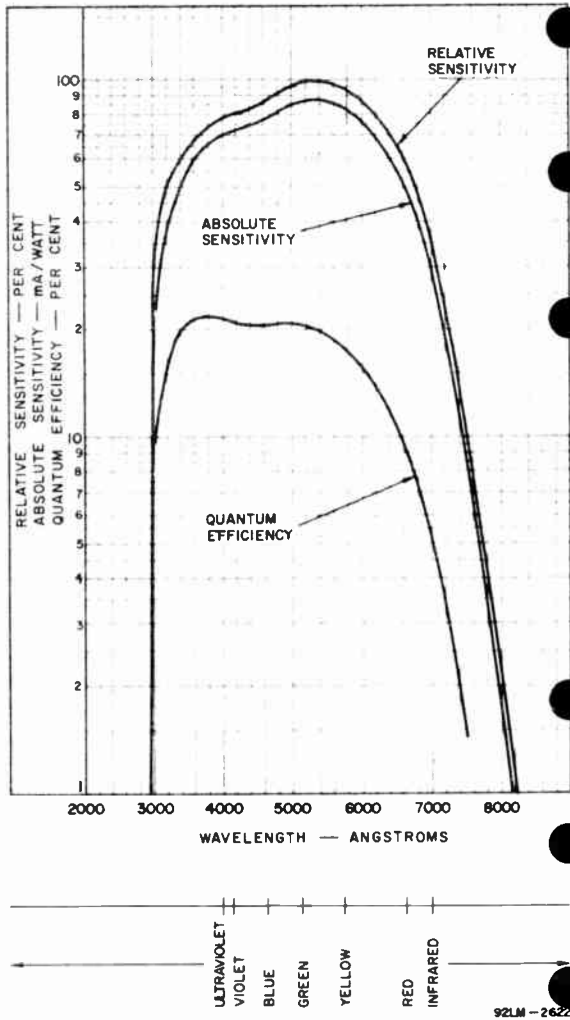


Figure 5

TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

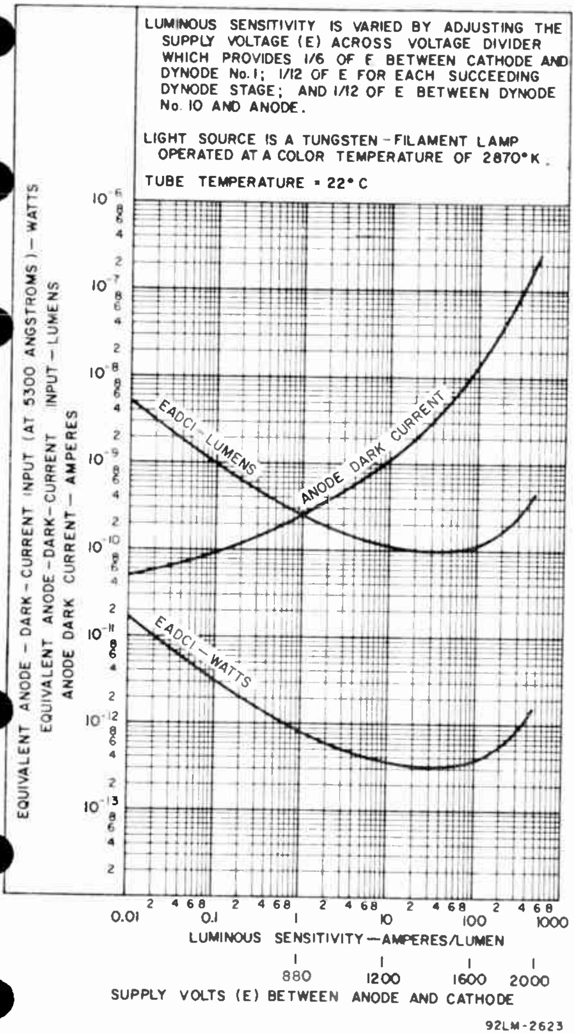


Figure 6

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

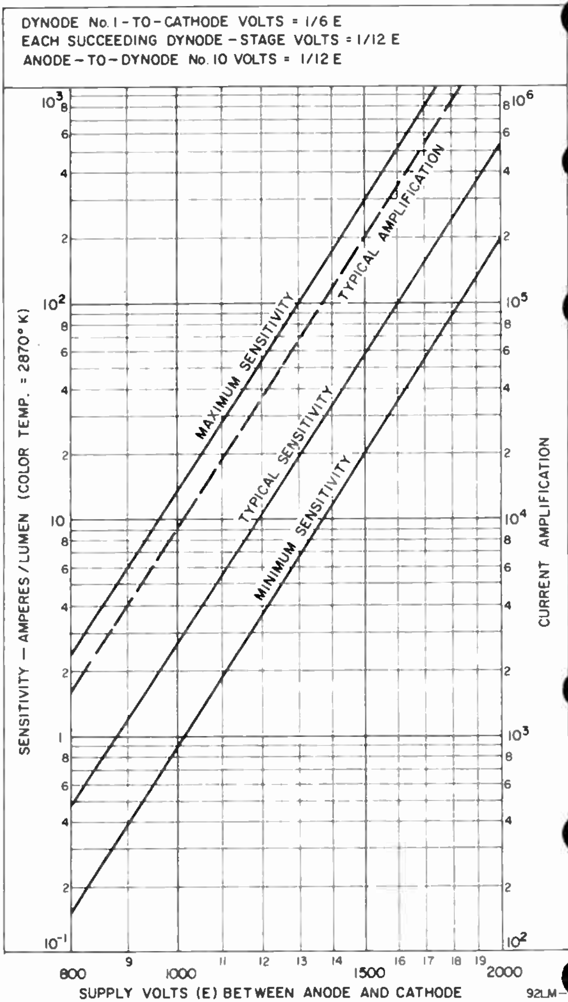


Figure 7

TYPICAL ANODE CHARACTERISTICS

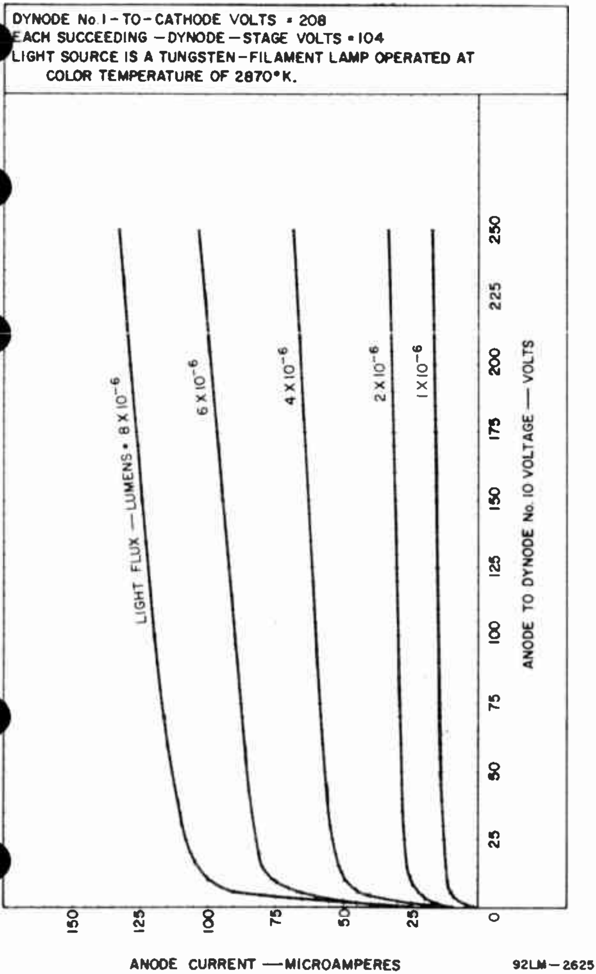
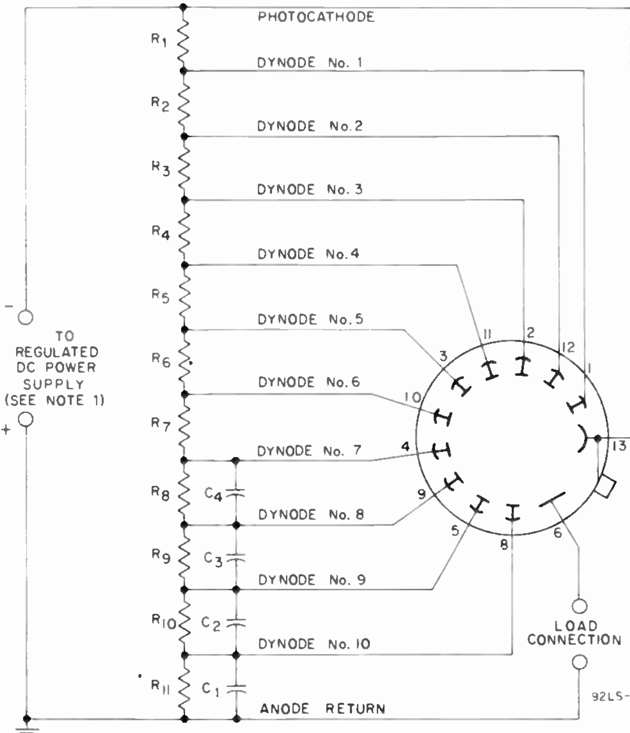


Figure 8

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

4532, 4532A

Vidicons

Silicon-Diode Array Camera Tubes for all Conventional TV Pickup Systems. Cameras Employing the 8507A or 8541A can be Readily Adapted to Use the 4532A or 4532.

- Silicon Photoconductor Having Broad Spectra Range – 380 to 1100 nm
- Extremely High Sensitivity – 4350 μA/lm
- Extremely Low Lag
- Very Low Dark Current
- Excellent Discharge Capability
- No Burn-In

ELECTRICAL

Heater Voltage:

Operational	6.3 V
For standby with no other electrode voltages applied	3.0 V
AC or DC Heater Current at 6.3 Volts (nominal value)	0.10 A
Focusing Method	Magnetic
Deflection Method	Magnetic

Direct Interelectrode Capacitance:[a]

Target to all other electrodes	4.6 pF

OPTICAL

Optical Distance	0.113 ± 0.020 in (2.87 ± 0.51 mm)
Spectral Response	RCA Type V

Target:

Maximum useful diagonal of rectangular image	0.62 in (15.7 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 target.

MECHANICAL

Overall Length	6.250 ± 0.125 in (158.7 ± 3.18 mm)
Greatest Diameter	1.125 ± 0.010 in (28.58 ± 0.25 mm)
Bulb Diameter	1.020 + 0.030 – 0.035 in (25.9 + 0.76 – 0.89 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 (See Figure 2)	Cleveland Electronics,[c,d] No.VYLFA-959, Penn Tran,[c,d] No.1465, or equivalent
Operating Position	Any
Weight (approx.)	2 oz

MAXIMUM AND MINIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

	Min.	Max.	
Heater-Voltage Tolerance	−5	+5	%
Grid-No.4 Voltage[f]	–	350	V
Grid-No.3 Voltage[f]	–	350	V
Grid-No.2 Voltage	–	350	V
Grid-No.1 Voltage	−150	0	V
Heater-Cathode Voltage	−125	10	V
Target Voltage	–	300	V
Peak Target Current	–	750	nA
Faceplate:			
Illumination[g]	–	6×10^7	lm/ft^2
	–	6×10^8	lux
Temperature:			
Operating and Storage	–	90	°C

TYPICAL OPERATION

With tube operated in a Cleveland Electronics Assembly Type VYLFA-959, or equivalent; scanned area of 1/2" x 3/8" (12.7 mm x 9.5 mm); faceplate temperature of 30° ± 3° C; and standard CCIR "M", or EIA, TV scanning rate (525 lines, interlaced 2:1, frame time 1/30 second).

Grid-No.4 (Decelerator) Voltage[f]	340	V
Grid-No.3 (Beam-Focus Electrode) Voltage[f]	290	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 Voltage[h]	8	V
Focusing-Coil Current[j]	43 ± 2	mA
Peak-to-Peak Deflecting-Coil Current:		
Horizontal	185	mA
Vertical	15	mA
Field Strength of Each Adjustable Alignment Coil[k]	0 to 3	G

TYPICAL PERFORMANCE DATA

Under the conditions shown under Typical Operation

Peak Radiant Responsivity (At 710 nanometers)	380	mA/W
Grid No.1 Voltage for Picture Cutoff[m]	60 to –100	V
Dark Current	7	nA
Average "Gamma" of Transfer Characteristic for a Signal Output Current between 4 nA and 400 nA	1	
Visual Equivalent Signal to Noise Ratio (Approx.)[n]	300:1	
Lag – Per Cent of Initial Value of Signal-Output Current 1/20 Second After Illumination is Removed[p]	8	%
Limiting Resolution:		
At center of picture	700	TV lines
At corner of picture	600	TV lines
Amplitude Response to a 400 TV Line Square-Wave Test Pattern at Center of Picture[q]	40	%

Sensitivity to Tungsten Light Source[r]

Conditions

Faceplate Illumination (Highlight)	0.1	lm/ft^2 (fc)

Performance

Sensitivity	4350	μA/lm
Typical Signal-Output Current[s,t]	565	nA

Sensitivity to Visible Light[u]

Conditions

Illumination from 2854° K Light Source Incident on Infrared Absorbing Filter (Highlight)	0.3	lm/ft^2 (fc)

Performance

Sensitivity	910	μA/lm
Typical Signal-Output Current[s,t]	350	nA

Sensitivity to Infrared Light[v]

Conditions

Illumination from 2854° K Light Source Incident on Visible Absorbing Filter (Highlight)	1.0	lm/ft^2 (fc)

Performance

Typical Signal-Output Current[s,t]	540	nA

SPURIOUS SIGNAL TEST PATTERN

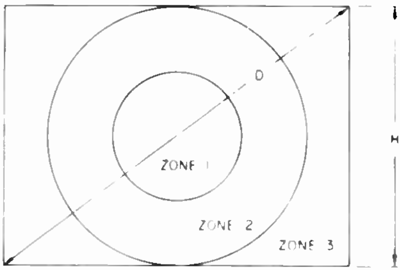


FIGURE 1

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%

SPURIOUS SIGNAL TEST

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. Allowable spot size for each zone is shown in Table I for type 4532A and in Table II for type 4532. To be classfieid 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 3% to constitute a reject item.

Table I — Type 4532A

Blemish Size (Equivalent TV Lines)	Zone 1 Allowed Spots White	Black	Zone 2 Allowed Spots White	Black	Zone 3 Allowed Spots White	Black
Over 6	0	0	0	0	0	0
Over 4	0	0	0	1	0	3
Over 1	0	2	2	7	2	9
1 or smaller	0	*	0	*	*	*

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

Table II — Type 4532

Blemish Size (Equivalent TV Lines)	Zone 1 Allowed Spots White	Black	Zone 2 Allowed Spots White	Black	Zone 3 Allowed Spots White	Black
Over 8	0	0	0	0	0	0
Over 6	0	0	0	2	0	2
Over 4	0	0	0	6	0	6
Over 1	1	5	2	16	3	21
1 or smaller	5	*	*	*	*	*

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

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 Company, 1501 Morse Avenue, Elk Grove Village, IL 60007.

c The magentic component No.VYLFA-959 is made by Cleveland Electronics Inc., 2000 Highland Road, Twinsburg, OH 44087; the magnetic component No.1465, by Penn-Tran Inc., 1155 Zion Road, Bellefonte, PA

d These components, when mounted along the tube axis as shown in **Figure 2**, will provide minimum beam landing error (maximum signal uniformity) at the recommended grid No.3/grid No.4 operating voltage ratio of 0.85. This ratio is determined by the electro-optical characteristics of the target-mesh region which are significantly different from those of the typical vidicon configuration.

f Grid-No.4 voltage must always be greater than grid-No.3 voltage. The grid-No.3/grid-No.4 ratio of 0.85 provides optimum performance with regard to dark current uniformity, signal discharge uniformity and geometrical accuracy with the recommended deflection-coil assemblies. Cameras designed for the RCA vidicon types 8507A and 8541A can be modified to operate the 4532A and 4532 by providing a fixed target voltage of the proper value and the selection of suitable electrode voltages within the maximum ratings (The 4532A and 4532 cannot be operated with conventional vidicon automatic signal control circuits operating on the target voltage.)

g The tube can withstand the illumination contained in a focused image of the sun without damage

h This target voltage provides an optimum operating point consistent with maximum target discharge capability and optimizes other performance characteristics such as dark current uniformity and lag.

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 Measured with high-gain, low-noise, cascode-input-type amplifier having bandwidth of 5 MHz and a peak signal-output current of 350 nanoamperes. 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.

p For an initial signal-output current of 200 nanoamperes and at recommended target voltage.

q Amplitude response is the signal amplitude from a given TV line number 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.

r Light source is a tungsten-filament lamp having a lime-glass envelope. The lamp is operated at a color temperature of 2854° K.

s The deflecting circuits must provide extremely linear scanning for good signal reproduction. Signal current is dependent upon the scanning velocity. Any change in scanning velocity produces a signal error in 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.

u With the same light source specified in footnote (r) except an infrared absorbing filter (Schott Jena[er] KG-3, 5.5 mm thick, available from Fish-Schurman Corporation, 70 Portland Road, New Rochelle, NY 10802) is interposed between the light source and the faceplate of the tube.

For sharper infrared cutoff, the Kodak Series 305 Infrared Rejection Filter may be used. This series is available from Eastman Kodak Co., Special Products Sales, Rochester, NY 14650.

v With the same light source specified in footnote (r) except an infrared transmitting filter (Corning C.S. No 7-56, 2540 glass available from the Corning Glass Works, Corning, NY 14830) is interposed between the light source and the faceplate of the tube.

Kodak filters Nos.87 or 87C may be preferred for some applications.

WARNING

Failure to observe the maximum dc electrode voltage ratings can drastically reduce the life expectancy of these tubes. When operated within ratings with the recommended deflection-focusing coil assemblies, the full performance capabilities of the silicon-diode array target will be easily realized. Normally, a tube life expectancy of many thousands of hours of useful service can be obtained when the tube is operated within the specified maximum ratings.

RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS TO OBTAIN MINIMUM BEAM-LANDING ERROR

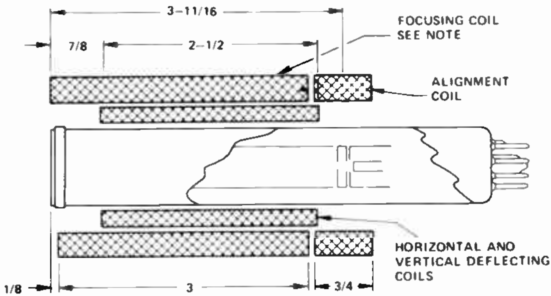
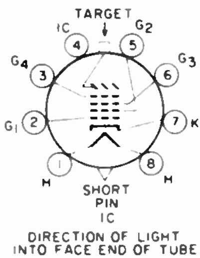


FIGURE 2

Note: Cross-hatching indicates wound portion of focusing coil.

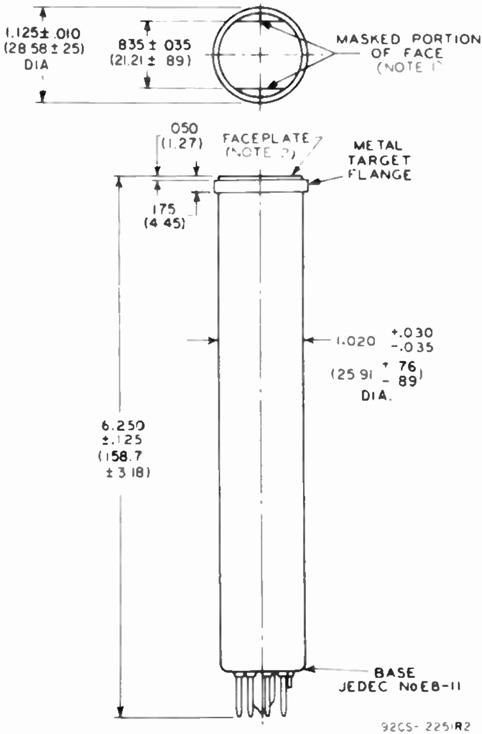
TERMINAL DIAGRAM (Bottom View)



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

DIMENSIONAL OUTLINE

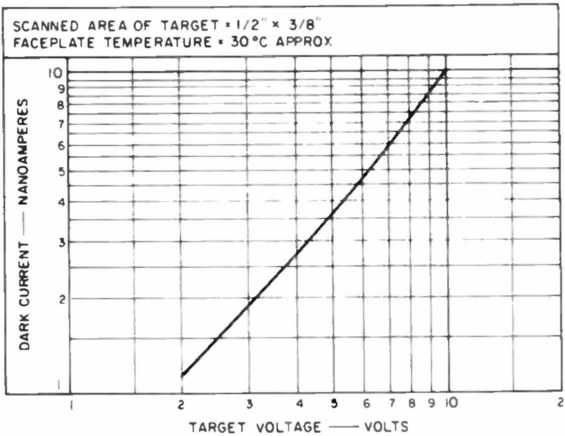


Note 1 — Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2 — Faceplate glass is Corning No 7056 having a thickness of 0.094" ± 0.012".

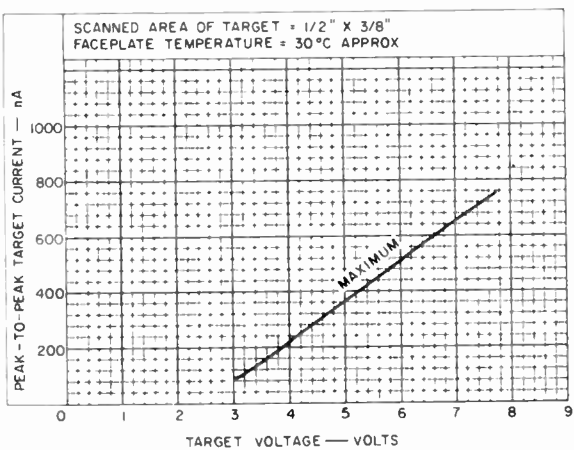
Note 3 — Optical distance (from faceplate front to target plane) = 0.113" ± 0.02". This distance is the nominal faceplate thickness of 0.94" divided by the index of refraction of Corning No.7056 glass (1.487) plus the space between the inner surface of faceplate and the nominal target focal plane (0 05").

TYPICAL DARK CURRENT CHARACTERISTIC



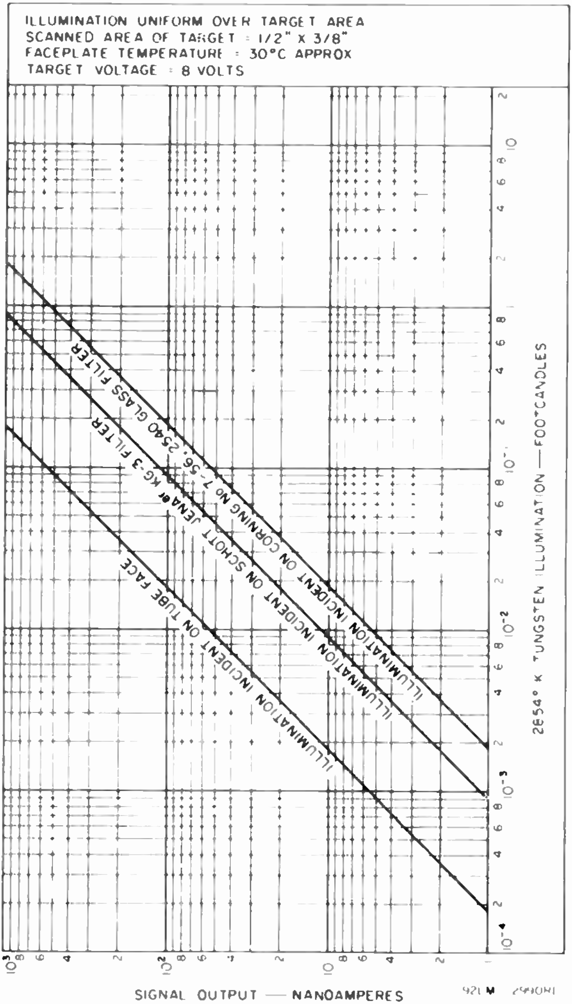
92LS-2991

TYPICAL SATURATION TARGET CURRENT CHARACTERISTIC

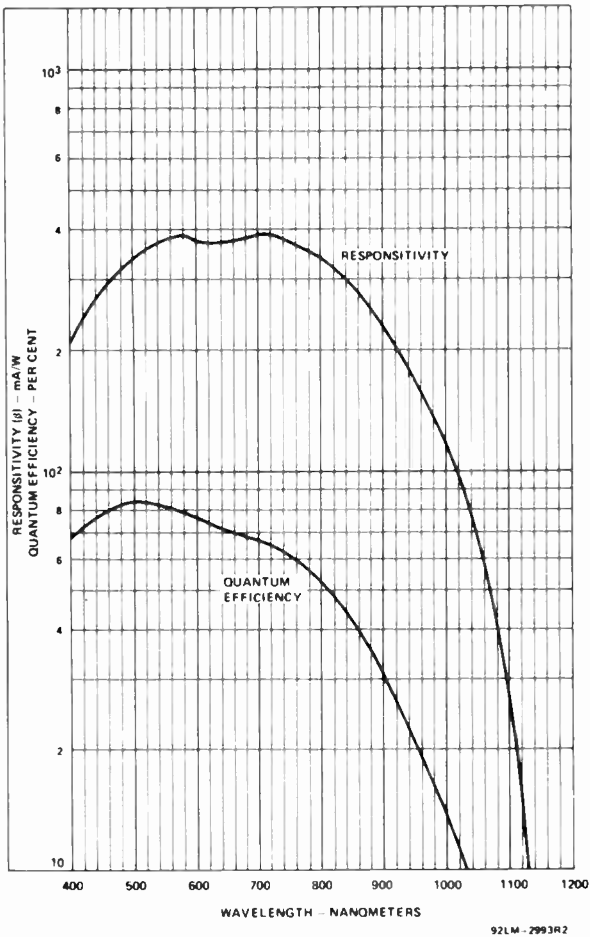


92LS-3342

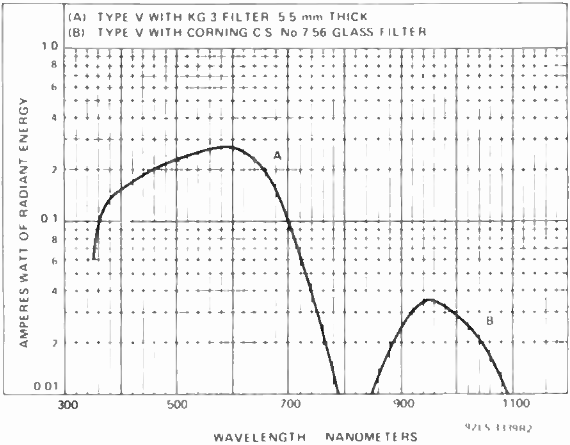
TYPICAL LIGHT TRANSFER CHARACTERISTICS



TYPICAL RCA TYPE V SPECTRAL RESPONSE CHARACTERISTICS



TYPICAL RCA TYPE V SPECTRAL RESPONSE CHARACTERISTICS AS MODIFIED BY THE FILTER CHARACTERISTICS OF FIGURES 3 AND 4



TYPICAL TRANSMISSION OF SCHOTT (JENA^{ER}) KG-3 INFRA-RED ABSORBING FILTER, THICKNESS: 5.55 MM

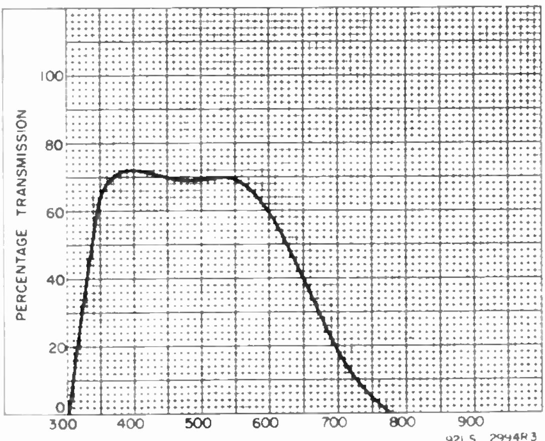
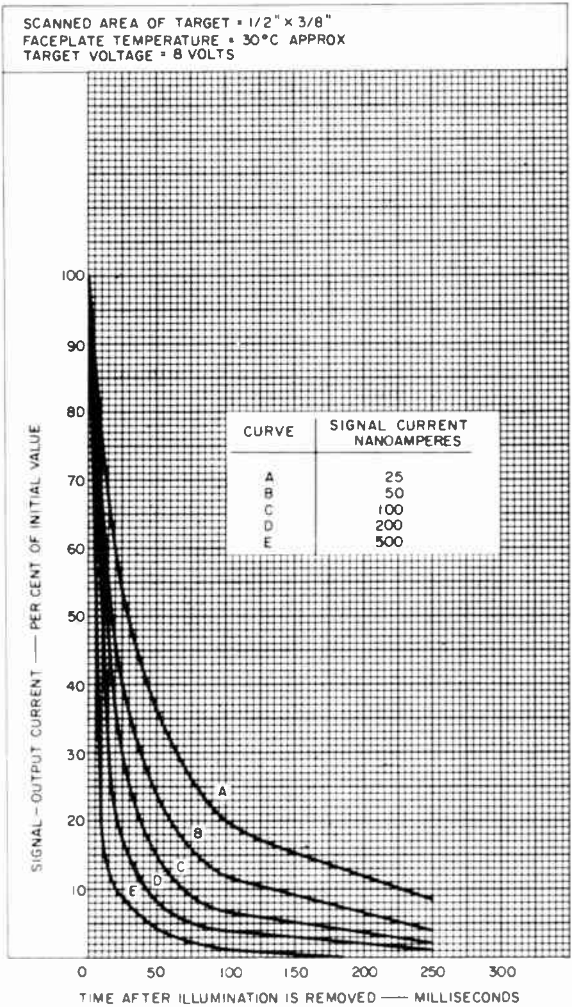
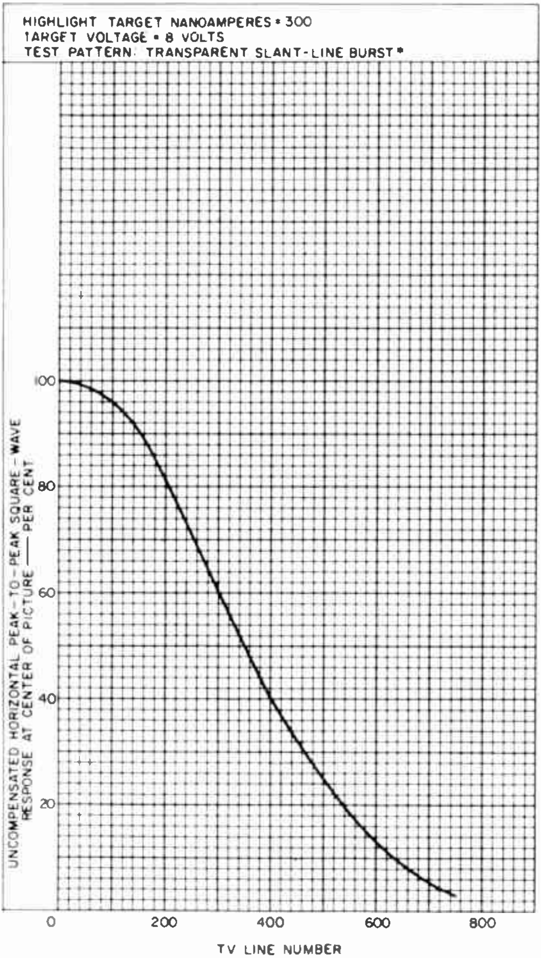


FIGURE 3

TYPICAL PERSISTENCE (LAG) CHARACTERISTICS



TYPICAL HORIZONTAL SQUARE-WAVE RESPONS



*Amplitude response measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

TYPICAL TRANSMISSION OF CORNING C.S. NO. 7-56 (2540 GLASS) VISIBLE ABSORBING FILTER

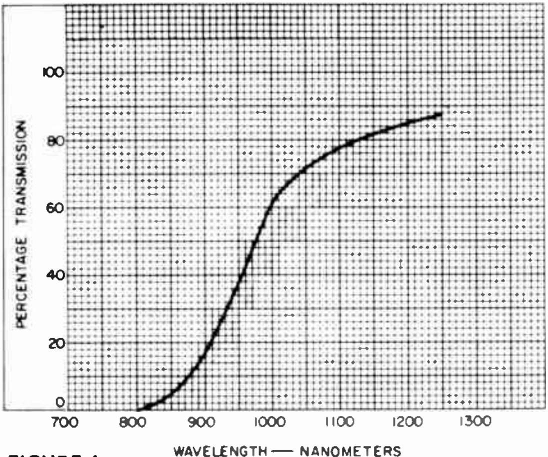


FIGURE 4

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[h]	600	V
Dynode-No.3 Voltage[h]	800	V
Dynode-No.4 Voltage[h]	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:[j]		
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/ft² (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

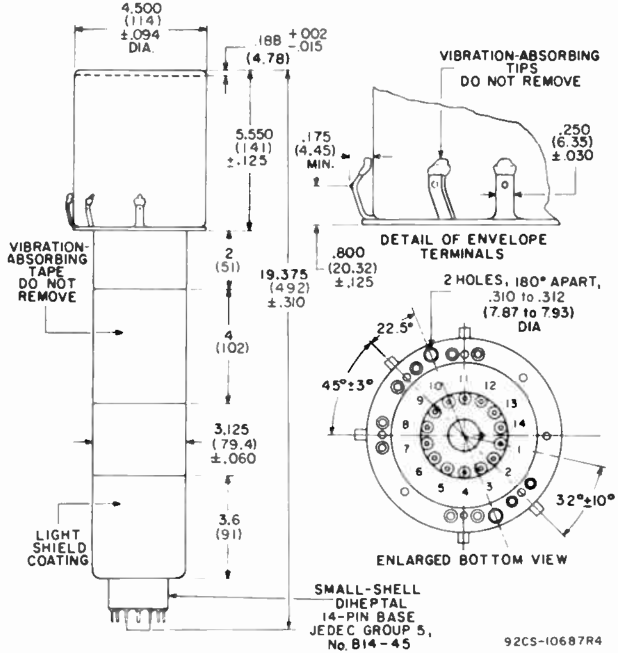
Here are the "dos" –

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).

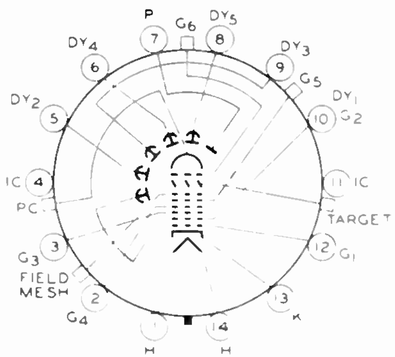
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



TERMINAL DIAGRAM (Bottom View)

DIRECTION OF LIGHT:

PERPENDICULAR TO LARGE END OF TUBE



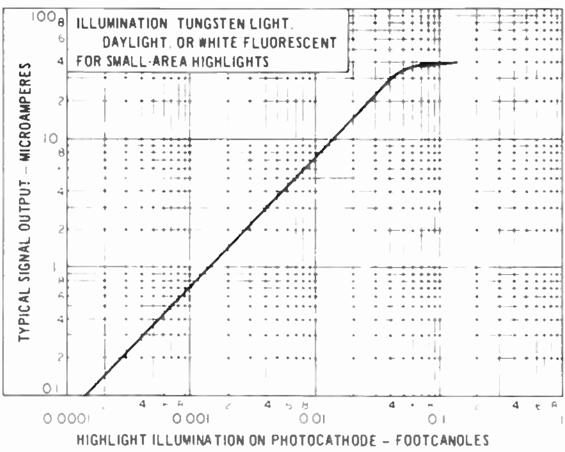
SMALL-SHELL DIHEPTAL 14-PIN BASE

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

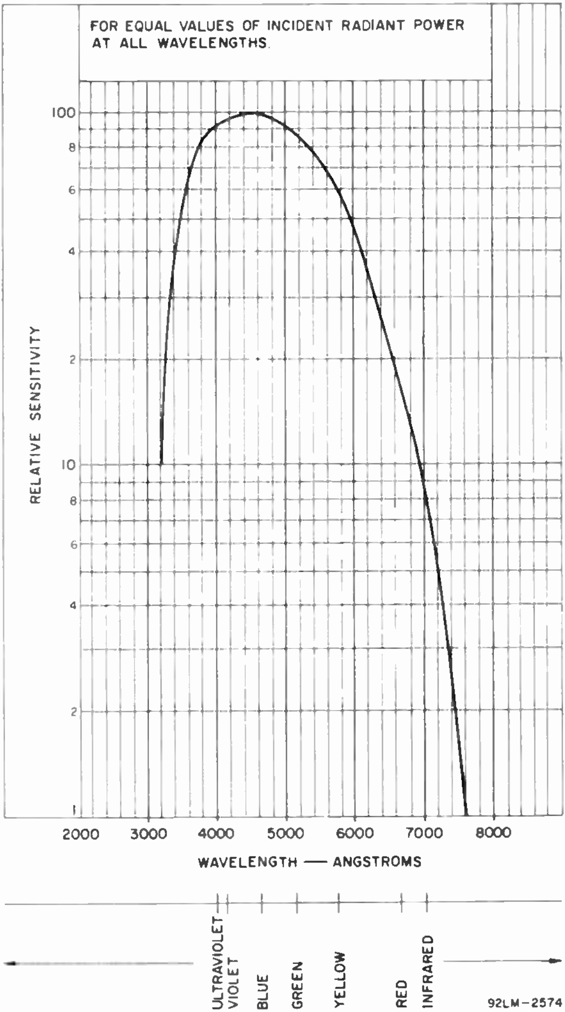
ENVELOPE TERMINALS

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.

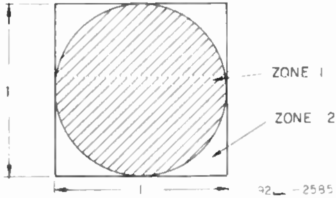
[r] The target voltage for each tube must be adjusted to that value which gives the desired operating dark current.

[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"*

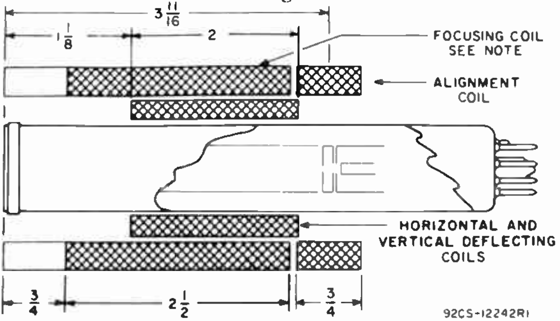
Equivalent Number of Raster Lines	Zone 1 Allowed Spots	Zone 2 Allowed Spots
over 4	0	Any Number Allowed Under 4 TV Lines (Max.)
4 but not including 3	1	
3 but not including 1	4	
1 or less	■	

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.

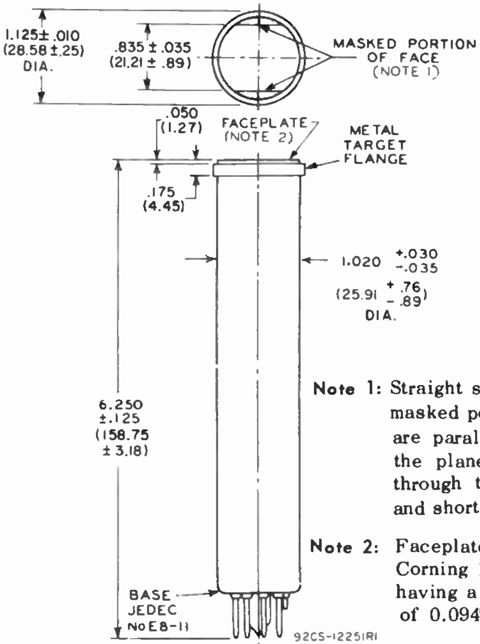
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To obtain minimum beam-landing error



Note: Cross-hatching indicates wound portion of focusing coil.

DIMENSIONAL OUTLINE-Dimensions in Inches (mm)

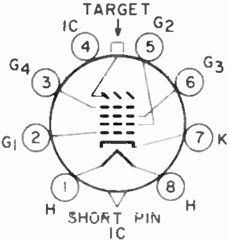


Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

TERMINAL DIAGRAM (Bottom View)

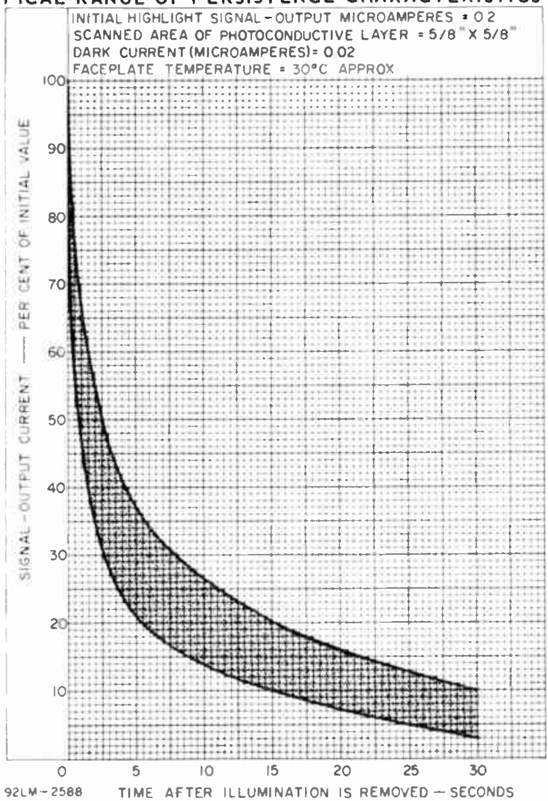
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection — Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode
Pin 8: Heater



Flange: Target
Short Index Pin — Internal Connection — Make No Connection

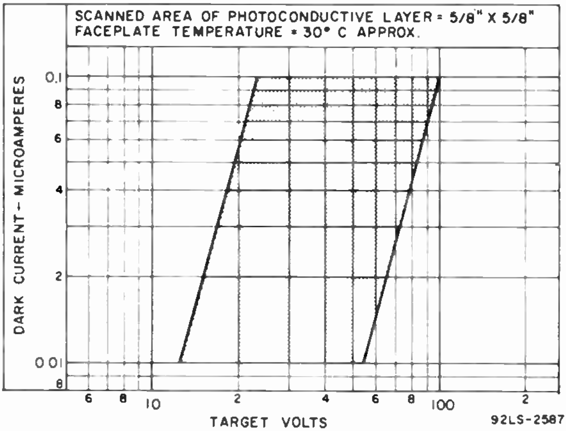
DIRECTION OF LIGHT: INTO FACE END OF TUBE

TYPICAL RANGE OF PERSISTENCE CHARACTERISTICS

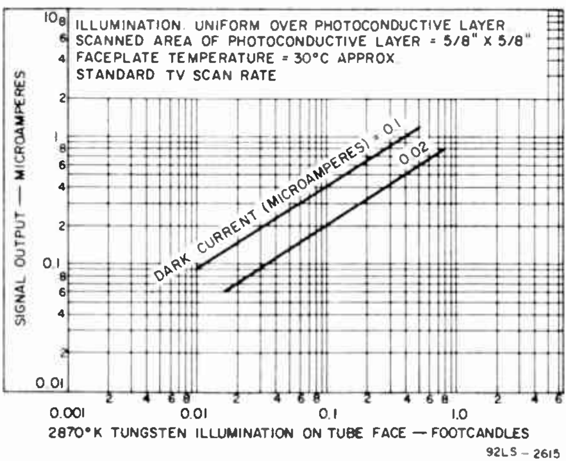


92LM-2588

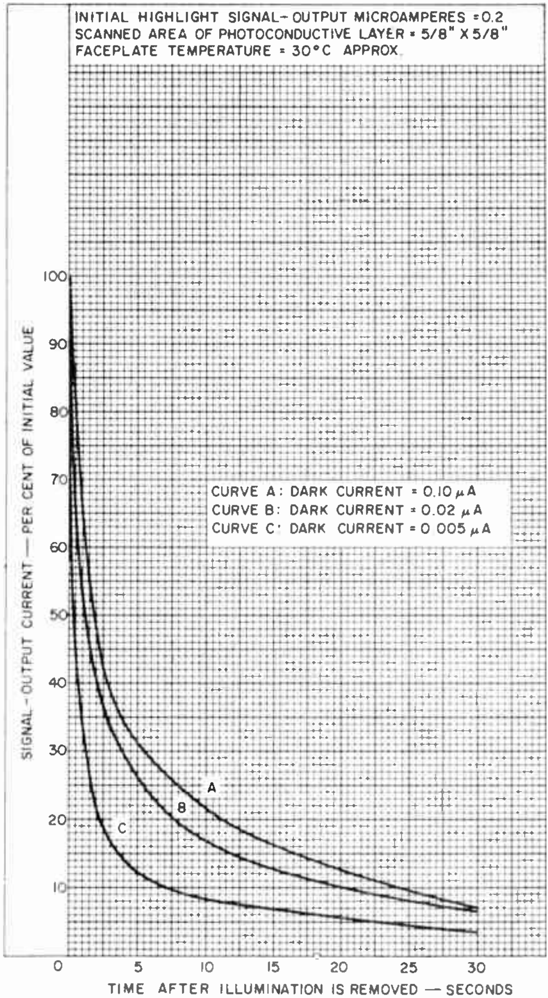
RANGE OF DARK CURRENT



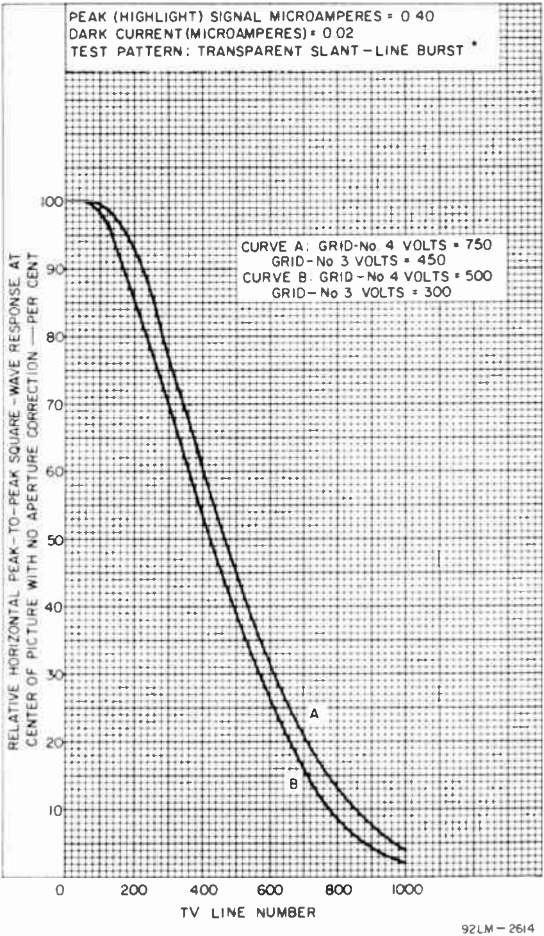
LIGHT TRANSFER CHARACTERISTICS



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° to +68° C

Operating . . . . -54° to +52° C

Typical Performance Characteristics

Under conditions with 6.75 volts dc applied and at an ambient temperature of 22° 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° C	3.5×10^4	8×10^4	–	fL/fc
At -54° 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

$$\text{Per-cent Distortion} = \frac{Emx - Cmx}{Cmx} \times 100$$

Operating Considerations

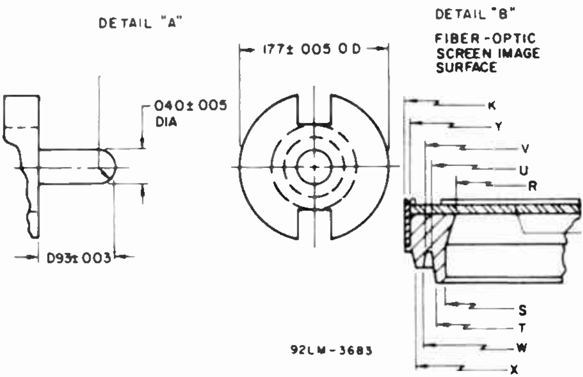
Magnetic shielding of these tubes may be required to minimize the effects of extraneous fields on tube performance. It is to be noted that ac magnetic fields are particularly objectionable in that they seriously impair tube resolution. If an iron or steel case is used, care should be taken to insure 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.

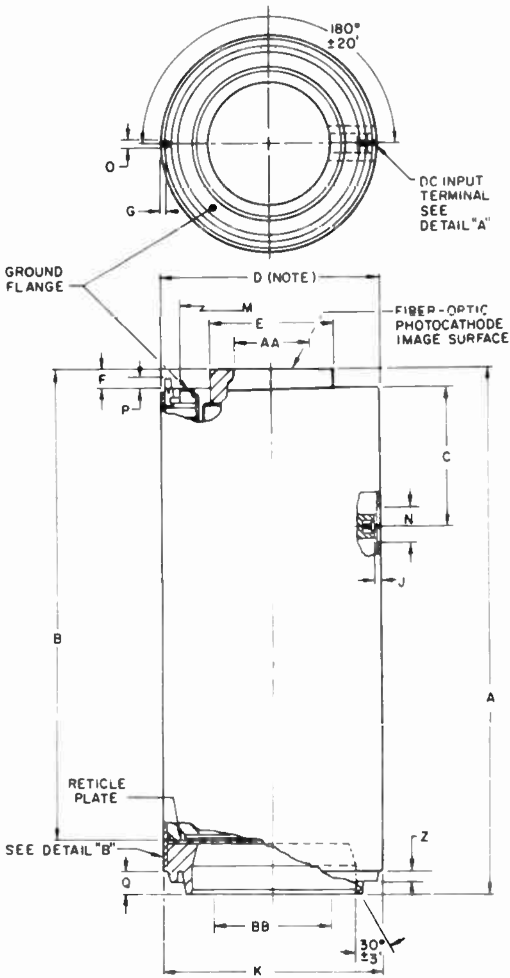
While the gain of the typical 8606 falls rapidly at input illumination levels above 10^{-3} footcandle and falls to unity at approximately 10^{-2} footcandle, the 4549 can operate at input illumination levels up to about 7 footcandles. Screen brightness as a function of incident illumination is shown 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



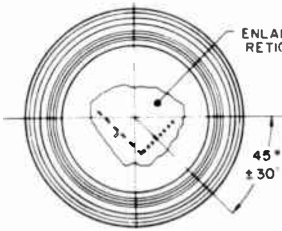
DIMENSIONAL OUTLINE



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

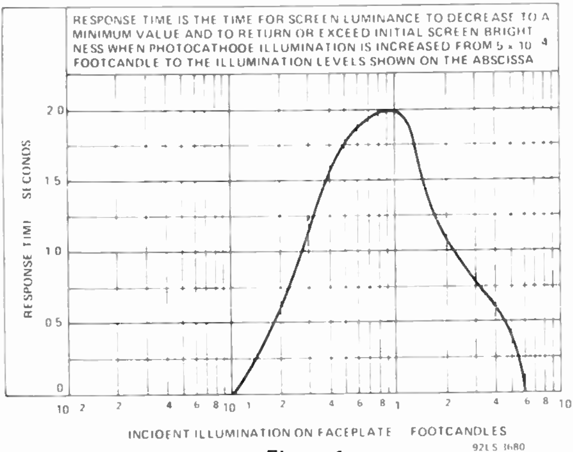


Figure 1

BATTERY CURRENT AS A FUNCTION OF INCIDENT ILLUMINATION

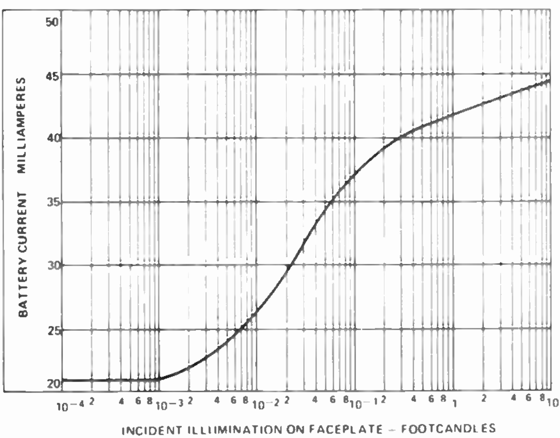
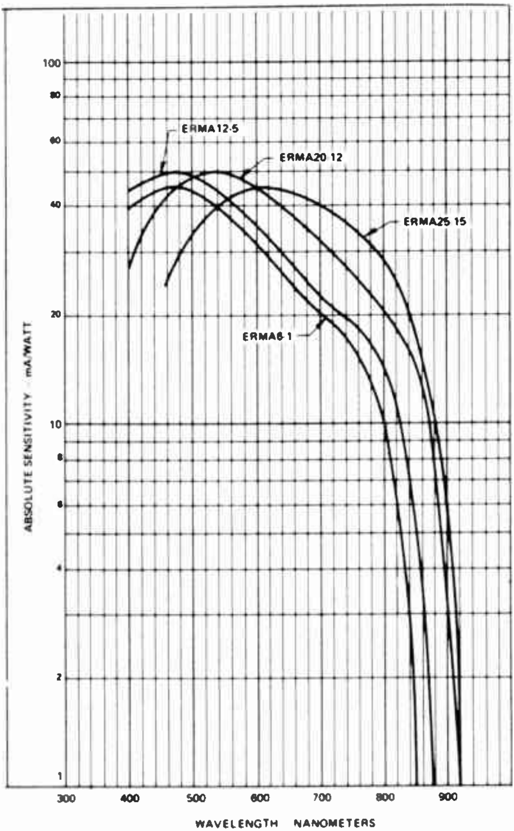


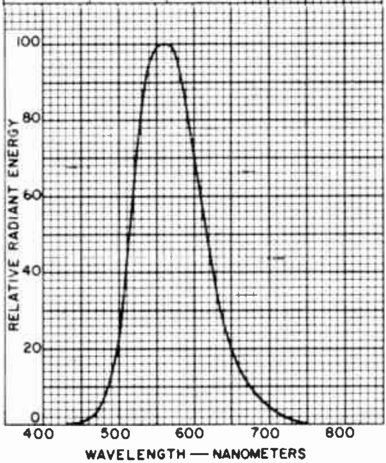
Figure 2

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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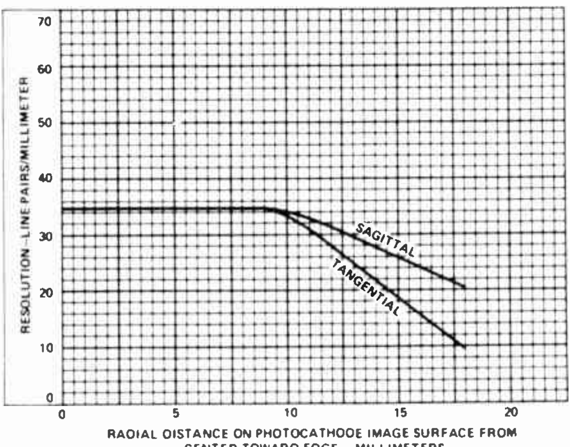
TYPICAL RESOLUTION CHARACTERISTICS



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SCREEN LUMINANCE VS. INCIDENT ILLUMINATION CHARACTERISTIC

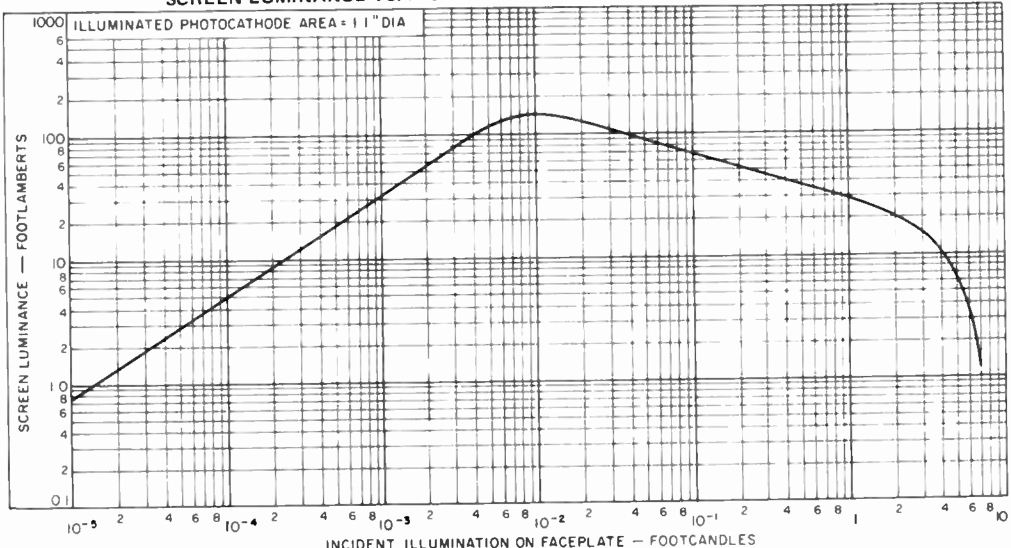

Figure 3

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TYPICAL MODULATION TRANSFER FUNCTION VS. FREQUENCY

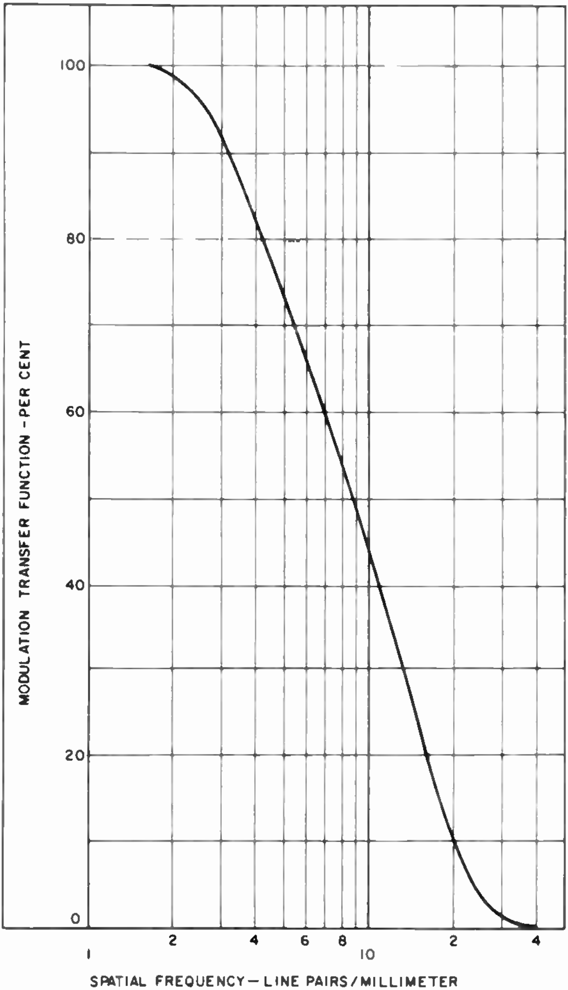
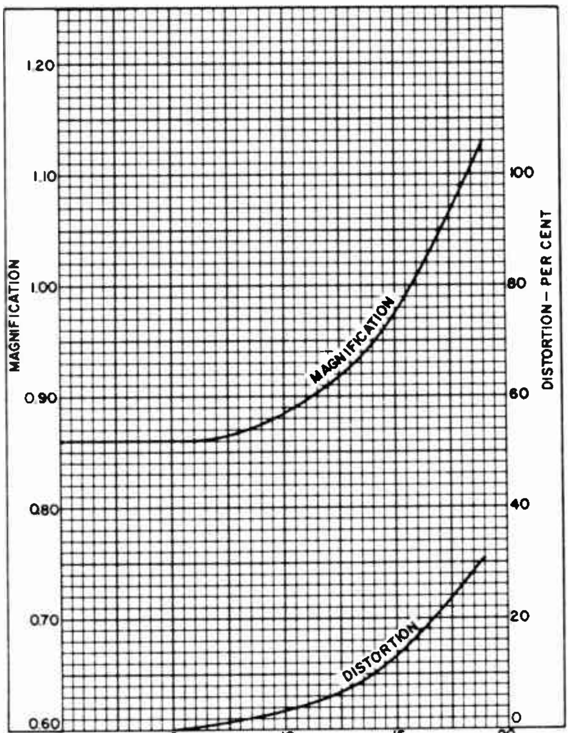


Figure 4

TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS



Photomultiplier Tube

1-1/8" Diameter, Side-On Type Having Bialkali Photocathode

GENERAL DATA

Spectral Response	See **Figure 2**
Wavelength of Maximum Response	400 ± 50 nm
Cathode, Opaque	Potassium-Cesium-Antimony (Bialkali)
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 436 nanometers	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	3.10 in (7.8 cm)
Seated Length	2.55 in (6.48 cm)
Maximum Diameter	1.18 in (3 cm)
Bulb	T9
Base	12-Pin Duodecar
Socket	Cinch-Jones[c] No.12CS-M, or equivalent
Magnetic Shield	See footnote d
Operating Position	Any
Weight (Approx.)	1 oz

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[f]	0.5 max.	mA
Ambient Temperature Range[g]	−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.	Typical	Max.	
Anode Sensitivity:				
Radiant[h] at 400 nanometers. . . .	–	8.4×10^{4}	–	A/W
Luminous[j] (2870° K)	10	100	1500	A/lm
Cathode Sensitivity:				
Radiant[k] at 400 nanometers	–	0.054	–	A/W
Luminous[m] (2870° K)	3.5×10^{-5}	6.5×10^{-5}	–	A/lm
Quantum Efficiency at 400 nanometers. . . .	–	17	–	%
Current Amplification.	–	1.5×10^{6}	–	
Anode Dark Current[n] at 20 A/lm	–	8×10^{-10}	1×10^{-8}	A
Equivalent Anode Dark Current Input[n]	–	4×10^{-11}	5×10^{-10}	lm
	–	4.8×10^{-14}[p]	6×10^{-13}[p]	W
Equivalent Noise Input[q]	–	1.5×10^{-12}	–	lm
	–	1.8×10^{-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 Cinch-Jones Distributor Division, 1501 Morse Avenue, Elk Grove Village, IL 60007.

d 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.

f Averaged over any interval of 30 seconds maximum.

g Tube operation at 22° C or below is recommended.

h This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 837 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 837 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 400 nanometers. These values are calculated from the EADCI values in lumens using a conversion factor of 837 lumens per watt.

q Under the following conditions: 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 400 nanometers. This value is calculated from the ENI value in lumens using a conversion factor of 837 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.

Operating Considerations

Operating Stability

The operating stability of the 4552 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.

Ambi ̓ent 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.

Tube Orientation

The sensitivity of the photocathode surface varies with respect to the position of the light spot on the surface. **Figure 3a** shows the variation in sensitivity of the surface as the position of a 1-mm diameter light spot is moved from one end of the photocathode to the other. Similarly, the curve in **Figure 3b** shows how the sensitivity of the photocathode surface varies across its projected width in the plane of the grill. From these curves, the equipment designer can readily determine the optimum position of any light spot on the photocathode surface to give the highest sensitivity.

When an application involves use of light flux which covers essentially the entire cathode area, consideration should be given to the effect on luminous sensitivity caused by angular position of the cathode with respect to the direction of incident light. This effect is shown in **Figure 4**. As the tube is rotated from the position of maximum sensitivity (approximately + 13° as shown in **Figure 4**), the internal structure prevents portions of a large beam of light from striking the cathode. With a light spot covering only a small portion of the cathode area, relatively minor cutoff of light occurs making the directional effect on luminous sensitivity very small.

Shielding

Electrostatic and/or magnetic shielding of the 4552 may be necessary.

An external electrostatic shield, in contact with the sides of the glass envelope and connected to a negative dc potential essentially the same as that of the photocathode, should be employed in those applications where it is desired to reduce the equivalent noise input of the 4552 to a minimum.

It is to be noted that the use of an external magnetic and/or electrostatic shield at high negative potential presents a safety hazard unless the shield is connected through a high impedance in the order of 10 megohms to the negative-potential source. 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.

Magnetic shielding of the 4552 is necessary if it is operated in the presence of strong magnetic fields. The curve in Figure 8 shows the effect on anode current of variation in magnetic field strength under the conditions indicated. With increase in supply voltage between anode and cathode, the effect of a given magnetic field will cause less decrease in anode current.

Adequate light shielding should be provided to prevent extraneous light from reaching any part of the 4552.

Dynode Modulation

Current amplification may also be controlled or the output signal may be modulated by adjustment of the voltage applied to a single or to two consecutive central dynodes with the voltages on the other stages held constant. The curve in Figure 5a shows the effect on output current as the voltage applied to dynode No.6 is varied. Similar results may be obtained by adjusting the voltage on dynodes No.2 and No. 4. Somewhat less control is obtained by adjusting the voltage on dynodes No.3, No.5, or No.7.

The curve in **Figure 5b** shows the effect on output current as dynodes No.5 and No.6 are modulated simultaneously but with a constant 100 volt difference maintained between these dynodes during modulation. Similar results may be obtained by simultaneous modulation of dynode No.3 and No.4 and dynode No.7 and No.8.

Dark Current

The use of a refrigerant, such as dry ice, to cool the 4552 is recommended in those applications where maximum current amplification with minimum dark current is required.

Typical ENI as a function of tube temperature is shown in **Figure 6.**

Typical anode dark current and EADCI as a function of luminous sensitivity at a temperature of + 22° C is shown in **Figure 7.**

The resistor values of the voltage divider should be adequate to prevent variation of dynode potentials by signal current. 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. Resistor 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.

A typical voltage divider arrangement for use with the 4552 is shown in **Figure 1.** 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 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.

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 inter-stage voltages throughout the pulse duration.

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 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:

$$C = 100 \frac{q}{V}$$

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 4552 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

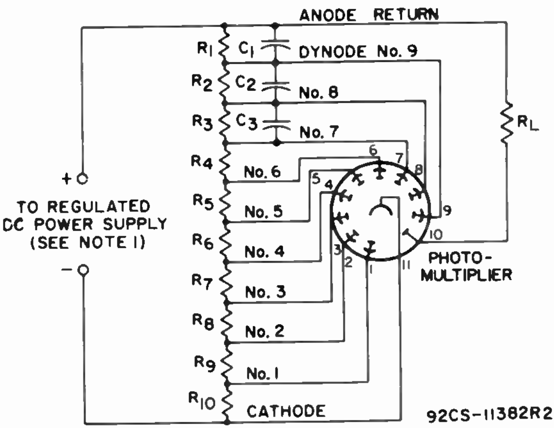


Figure 1

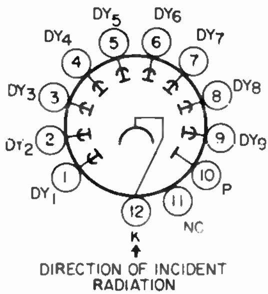
R_1 through R_{10} = 20,000 to 1,000,000 ohms

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.

BASING DIAGRAM, (Bottom View)

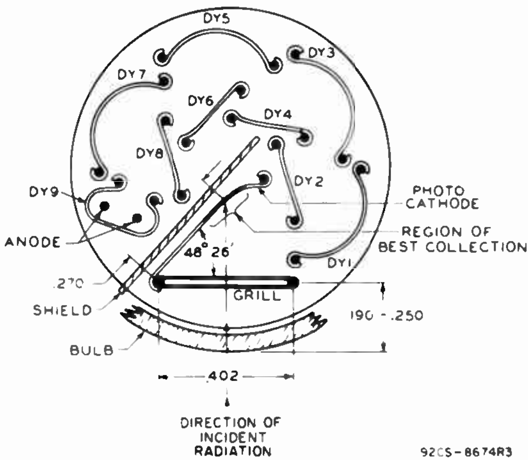
Note: The tube should be rotated about its major axis to provide maximum anode current.



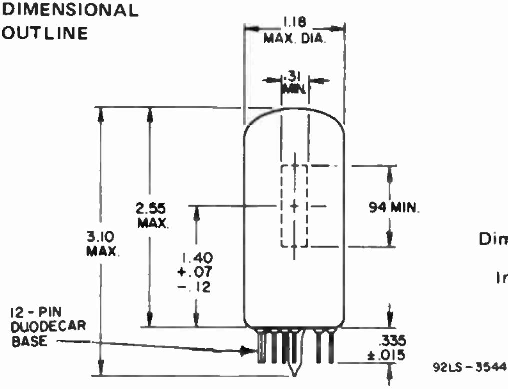
Pin 1—	Dynode No.1
Pin 2—	Dynode No.2
Pin 3—	Dynode No.3
Pin 4—	Dynode No.4
Pin 5—	Dynode No.5
Pin 6—	Dynode No.6
Pin 7—	Dynode No.7
Pin 8—	Dynode No.8
Pin 9—	Dynode No.9
Pin 10—	Anode
Pin 11—	No Internal Connection*
Pin 12—	Photocathode

* 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

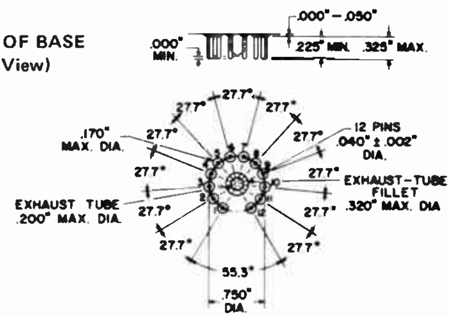


DIMENSIONAL OUTLINE

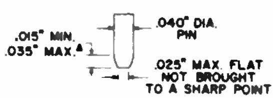


Dimensions in Inches

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.

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

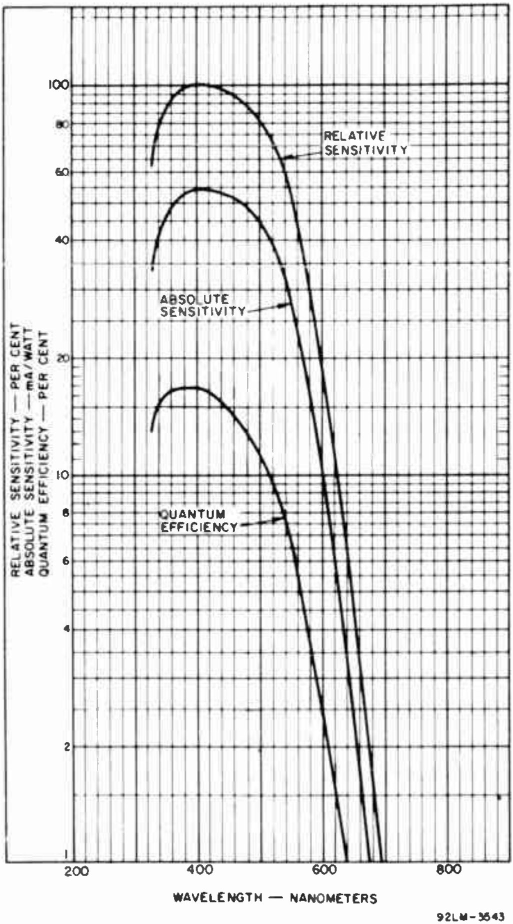


Figure 2

TYPICAL VARIATION OF PHOTOCATHODE SENSITIVITY ALONG TUBE LENGTH

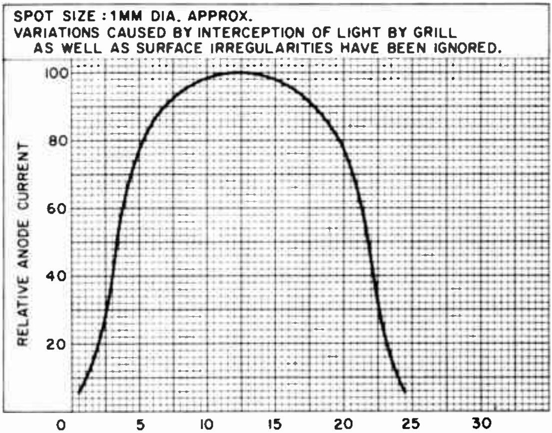


Figure 3a

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

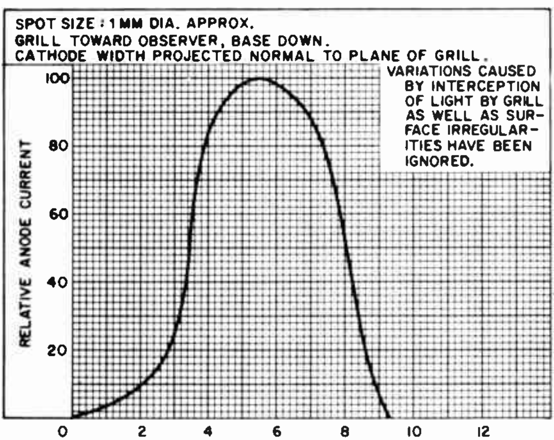


Figure 3b

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

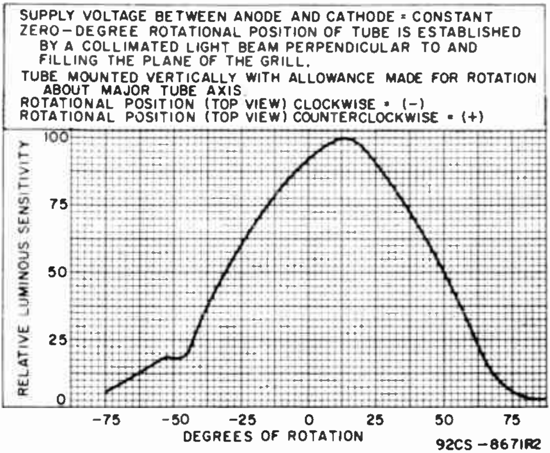


Figure 4

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

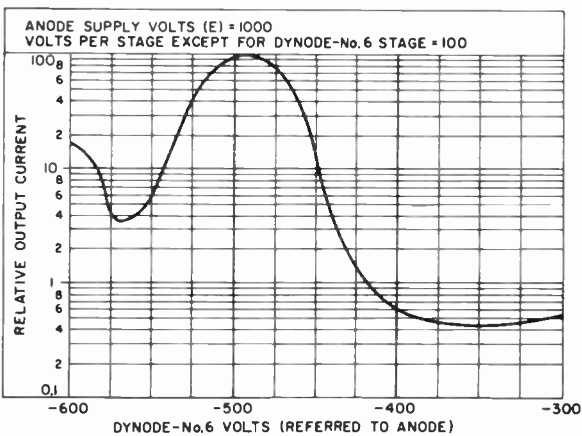


Figure 5a

92CS-8672R1

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

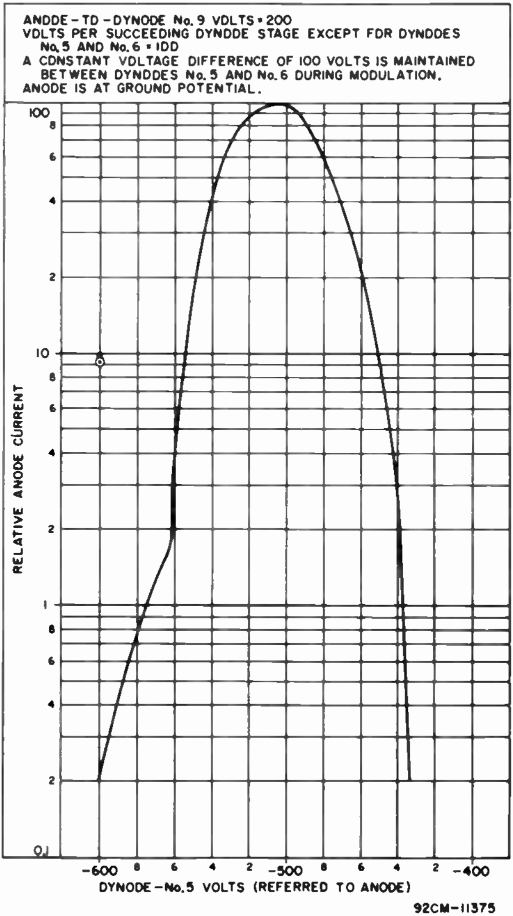
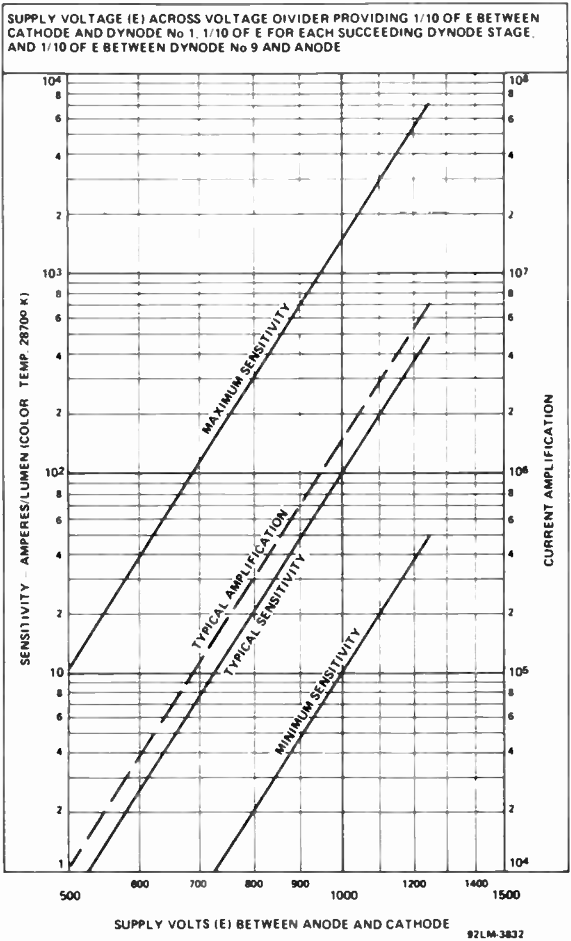


Figure 5b

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



ENI CHARACTERISTIC AS A FUNCTION OF TUBE TEMPERATURE

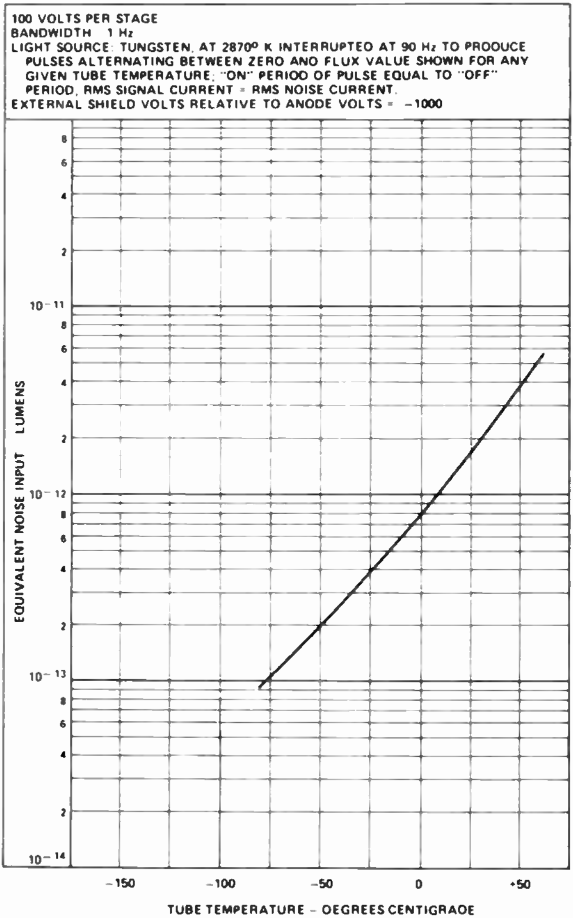


Figure 6

TYPICAL EADCI AND DARK CURRENT CHARACTERISTICS

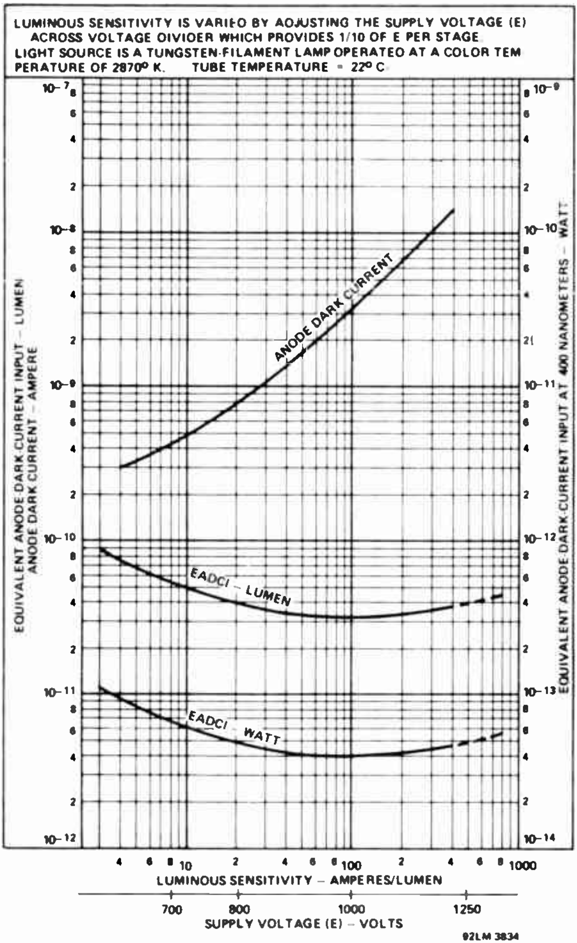


Figure 7

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

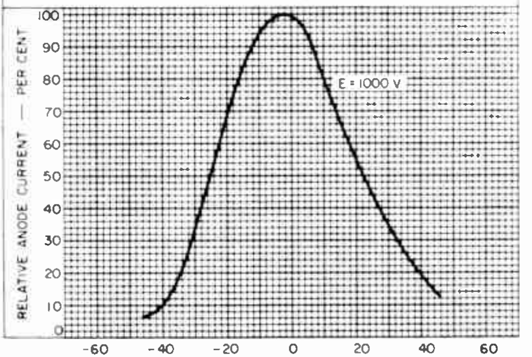
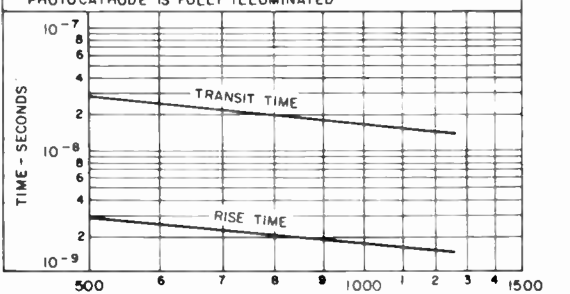


Figure 8

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



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:

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

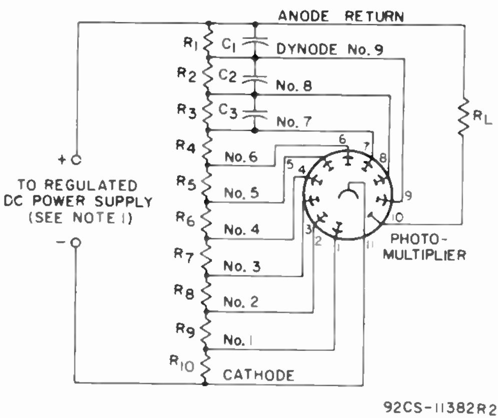
where C is in farads
i is the amplitude of anode current in amperes
V is the voltage across the capacitor in volts
and t is the time duration of the pulse in seconds

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

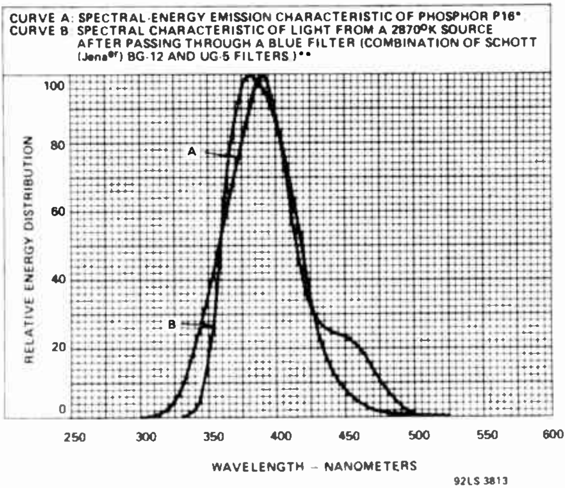


R_1 through R_{10} – 5000 to 1,000,000 ohms

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.

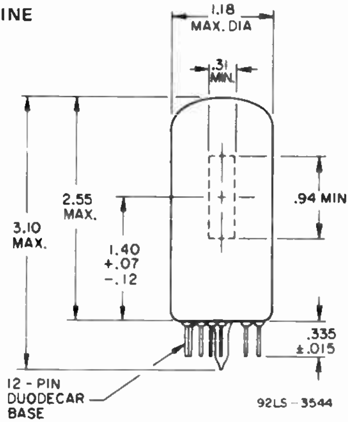
TYPICAL P16 SPECTRAL DISTRIBUTION CHARACTERISTIC AND THE SPECTRAL CHARACTERISTIC OF LIGHT FROM A 2870° K SOURCE AFTER PASSING THROUGH INDICATED FILTERS.



* JEDEC Publication 16A, January 1966.

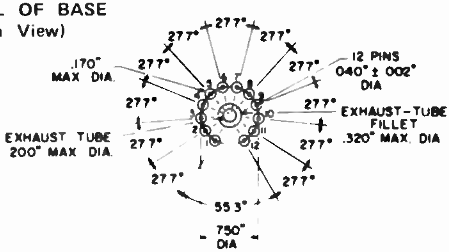
** Curve B is the product of the transmission characteristics of a combination of a BG-12 filter (1 mm thick) and a UG-5 filter (1mm thick) and the emission characteristics of a 2870° K tungsten-filament lamp. The filters are not in optical contact. The transmission characteristics of the filter combination 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

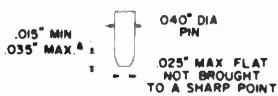


DIMENSIONS IN INCHES

DETAIL OF BASE
(Bottom View)

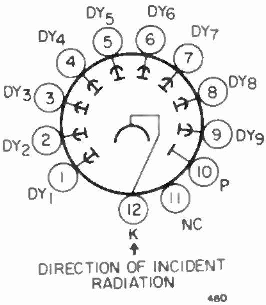


Duodecar-Base-Pin Contour



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)

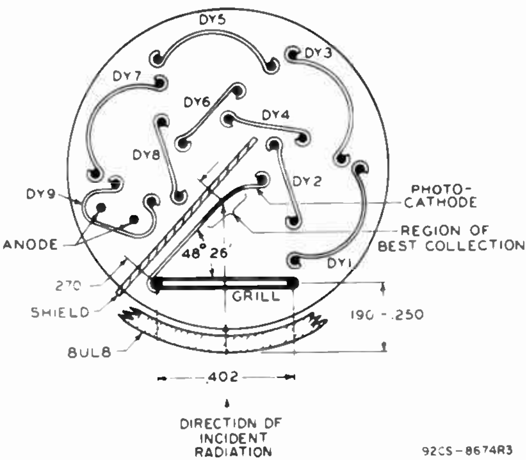


Pin 1— Dynode No.1
Pin 2— Dynode No.2
Pin 3— Dynode No.3
Pin 4— Dynode No.4
Pin 5— Dynode No.5
Pin 6— Dynode No.6
Pin 7— Dynode No.7
Pin 8— Dynode No.8
Pin 9— Dynode No.9
Pin 10— Anode
Pin 11— No Internal Connection*
Pin 12— Photocathode

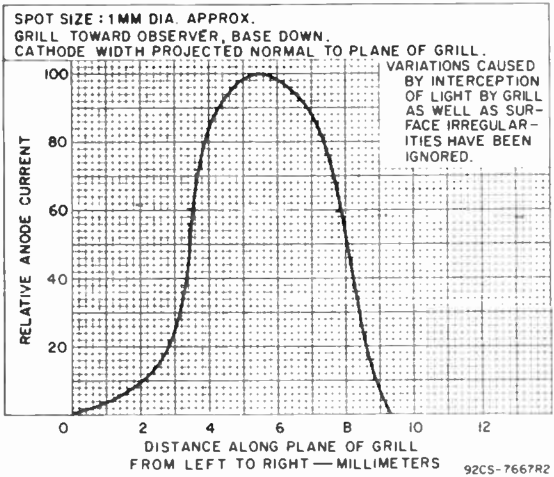
Note: The tube should be rotated about its major axis to provide maximum anode current.

* 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.

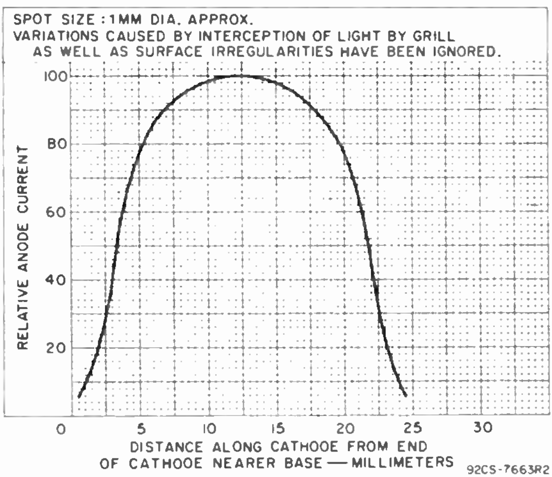
SCHEMATIC REPRESENTATION OF TUBE STRUCTURE



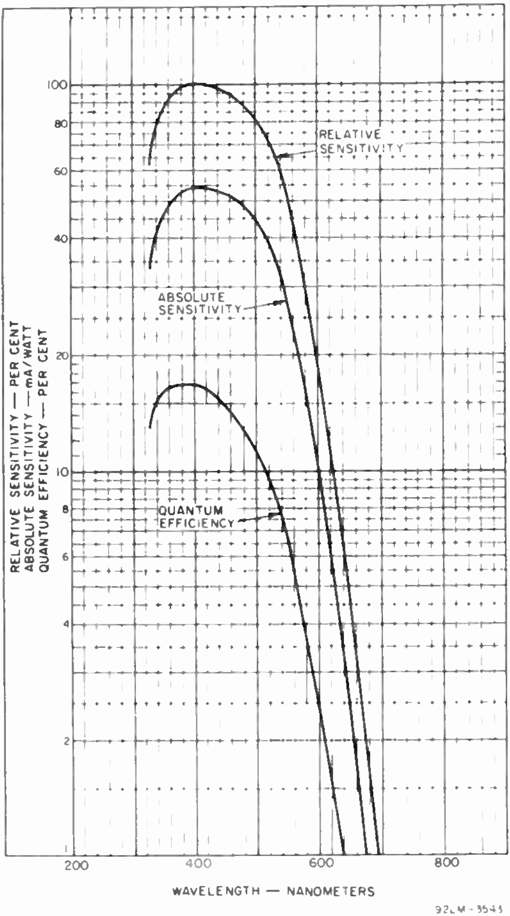
TYPICAL VARIATION OF PHOTOCATHODE SENSIVITY ACROSS PROJECTED WIDTH IN PLANE OF GRILL



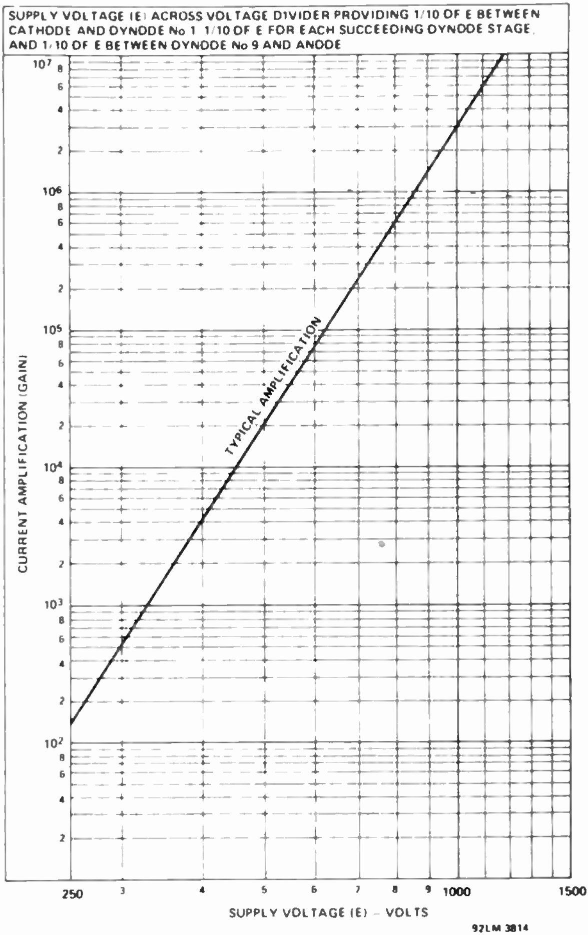
TYPICAL VARIATION OF PHOTOCATHODE SENSIVITY ALONG TUBE LENGTH



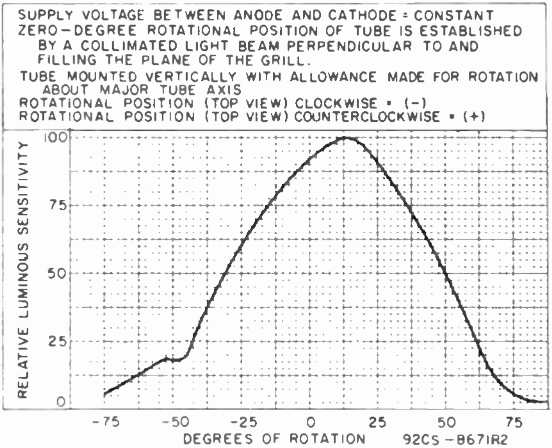
TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS



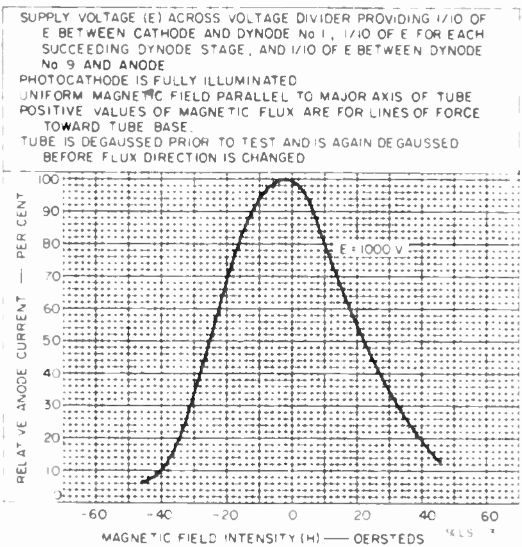
TYPICAL CURRENT AMPLIFICATION CHARACTERISTIC



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



TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



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/ft^2
	–	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.

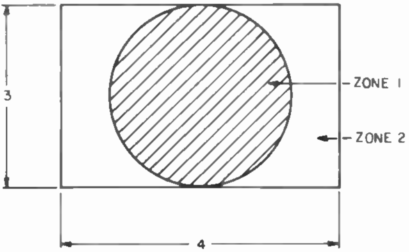
t Defined as the component of the highlight target current after the dark-current component has been subtracted.

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



92LS-1064

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	*	*

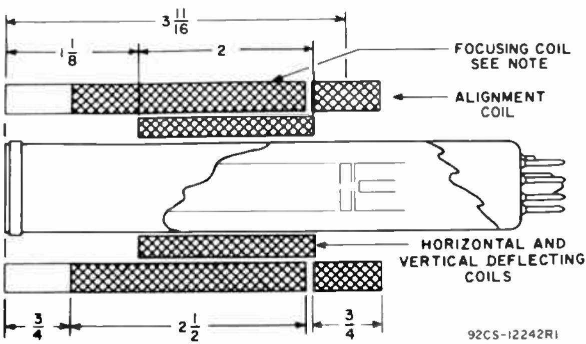
Minimum separation between any 2 spots greater than 1 raster line is limited to 16 raster lines.

*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

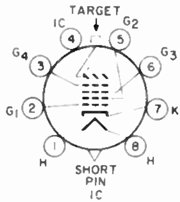
To obtain minimum beam-landing error.



Note: Cross-hatching indicates wound portion of focusing coil.

TERMINAL DIAGRAM (Bottom View)

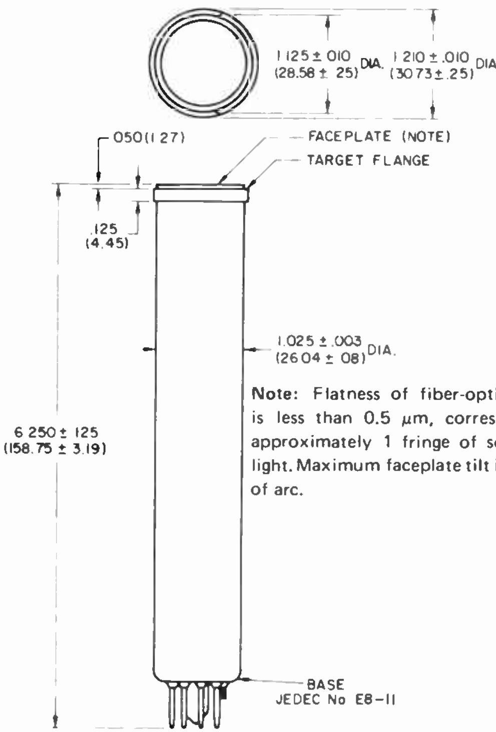
Pin 1: Heater
Pin 2: Grid No.1
Pin 3: Grid No.4
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No.2
Pin 6: Grid No.3
Pin 7: Cathode



Pin 8: Heater
Flange : Target
Short Index Pin – Internal Connection – Make No Connection

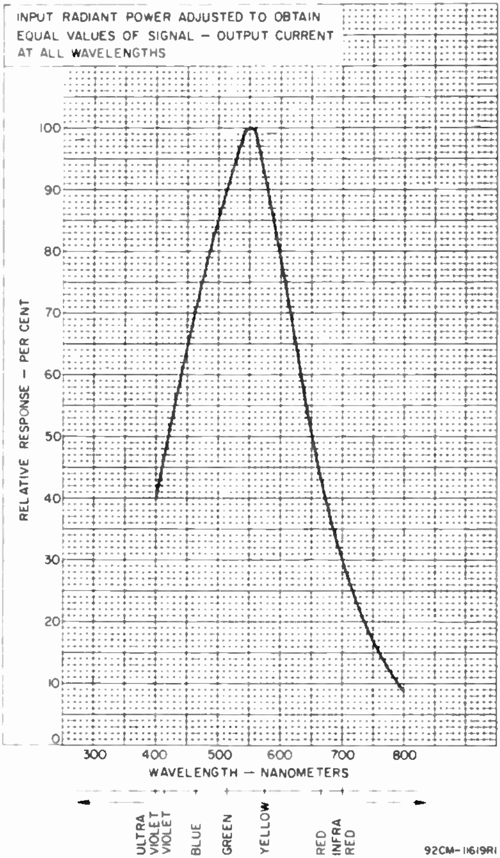
DIRECTION OF LIGHT INTO FACE END OF TUBE

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.

TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC



92CM-11619R1

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.	^{o}C

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.

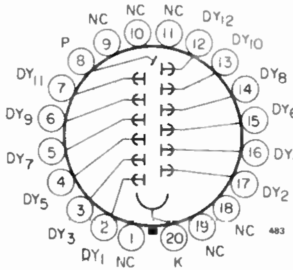
Ambient Atmosphere

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

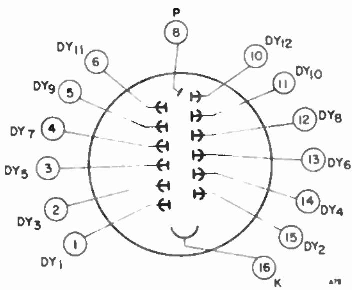
The semiflexible leads of the tube may be soldered or welded into the associated circuit. Care must be exercised when making such connections to prevent tube destruction due to thermal stress of the glass-metal seals. A heat sink placed in contact with the semiflexible leads between the point being soldered, or welded, and the protective shell is recommended. Excessive bending of the leads is to be avoided.

Basing Diagram — Bottom View (With Temporary Base)



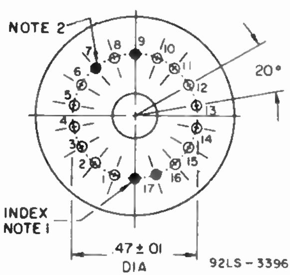
Pin 1: No Connection
Pin 2: Dynode No. 1
Pin 3: Dynode No. 3
Pin 4: Dynode No. 5
Pin 5: Dynode No. 7
Pin 6: Dynode No. 9
Pin 7: Dynode No.11
Pin 8: Anode
Pin 9: No Connection
Pin 10: No Connection
Pin 11: No Connection
Pin 12: Dynode No.12
Pin 13: Dynode No.10
Pin 14: Dynode No. 8
Pin 15: Dynode No. 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

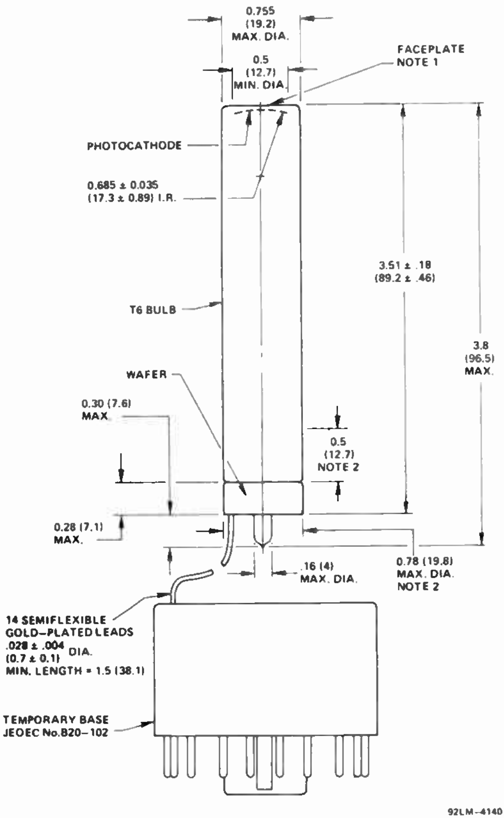
Lead Orientation, Bottom View



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

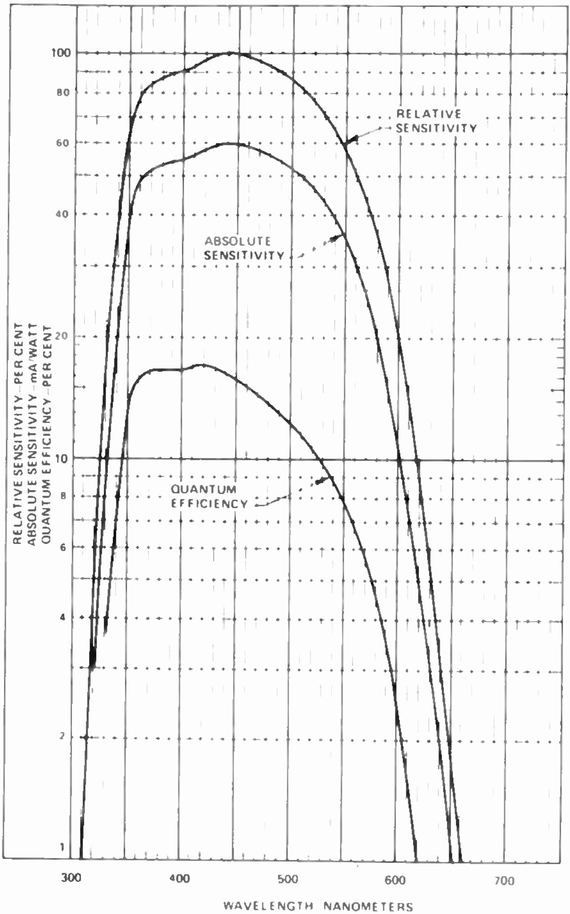


Figure 1

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

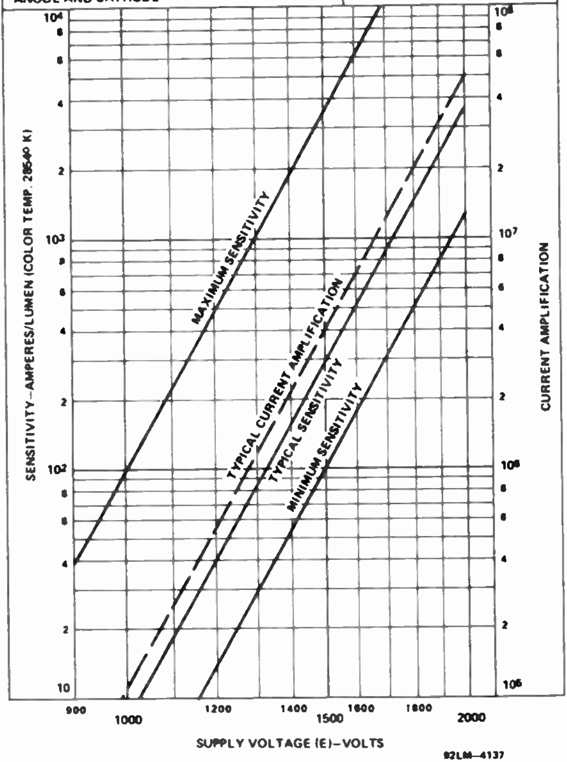


Figure 2

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

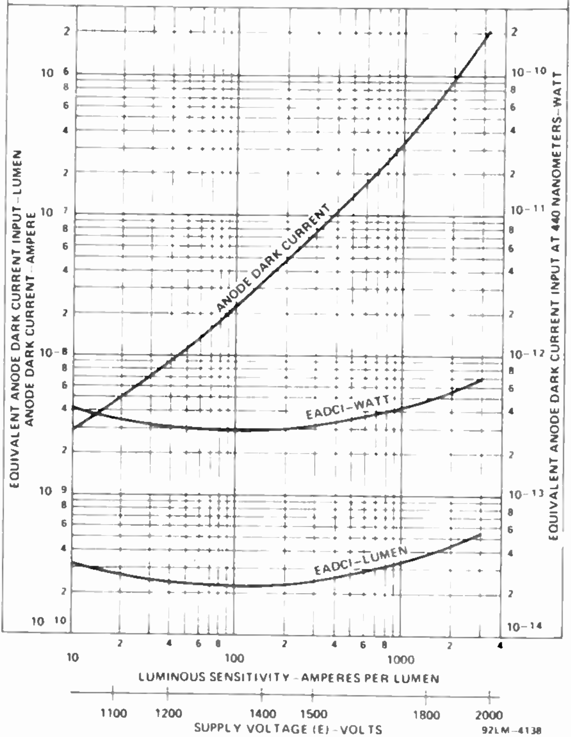
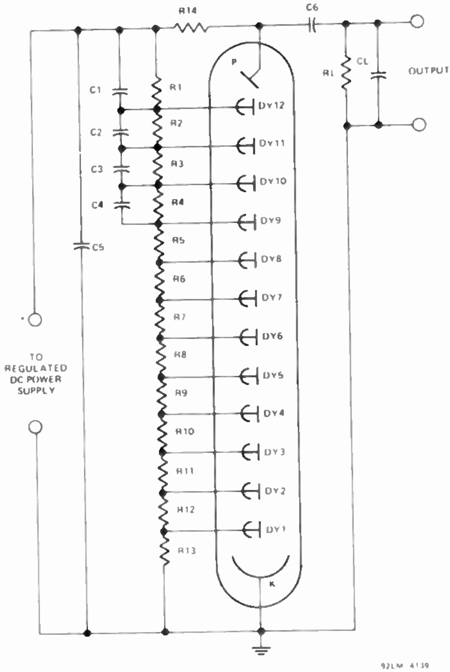


Figure 3

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:

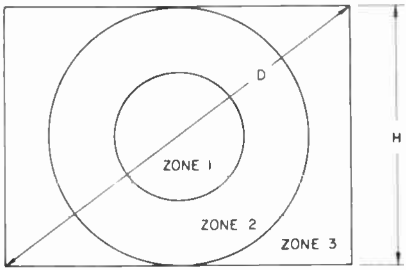
4804A/P2, 4804A	0 to 3	G
4804/P2, 4804	0 to 4	G

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	–	mA/W-2854° K
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.

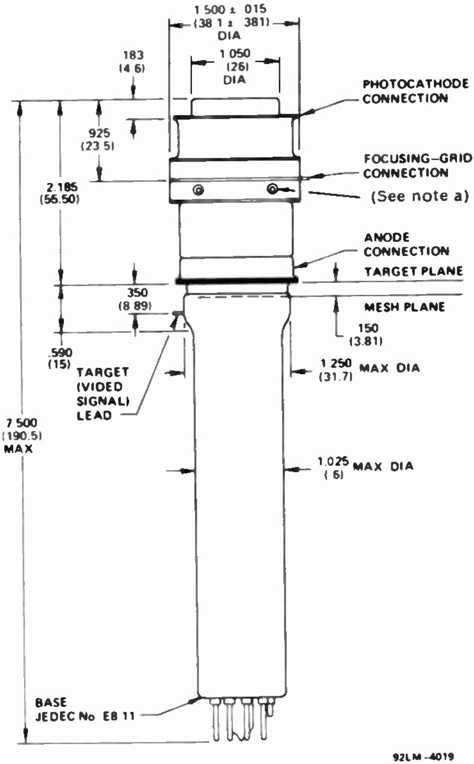
k For picture cutoff with no blanking voltage on grid No.1.

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° 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, sensitivity can be expressed in units of either amperes/lumen or amperes/watt-2854° K.

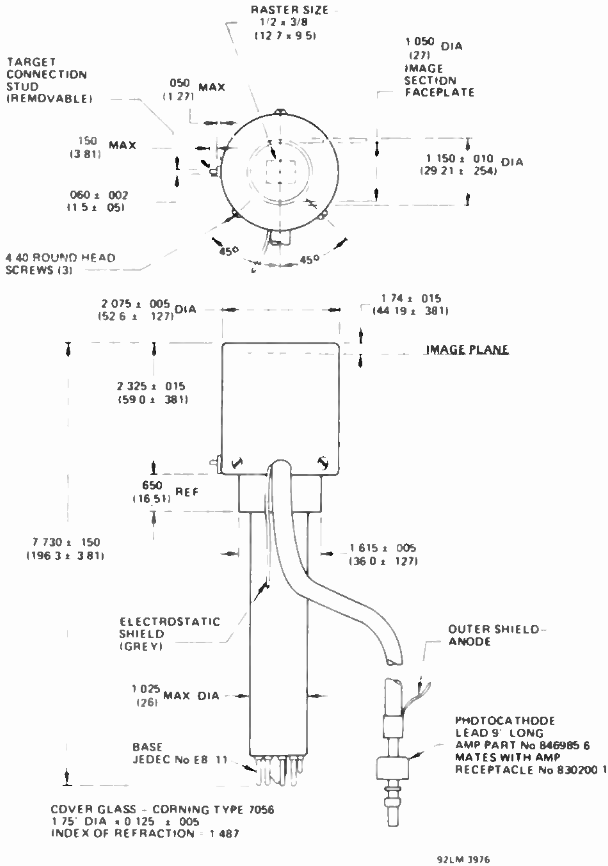
Dimensional Outline of 4804A and 4804 (Non-potted Types)



Note a — Clearance of 1.765 in (44.8) is required to pass all protrusions.

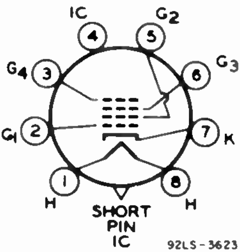
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension. (One inch = 25.4 mm)

Dimensional Outline of 4804A/P2 and 4804/P2 (Potted Types)



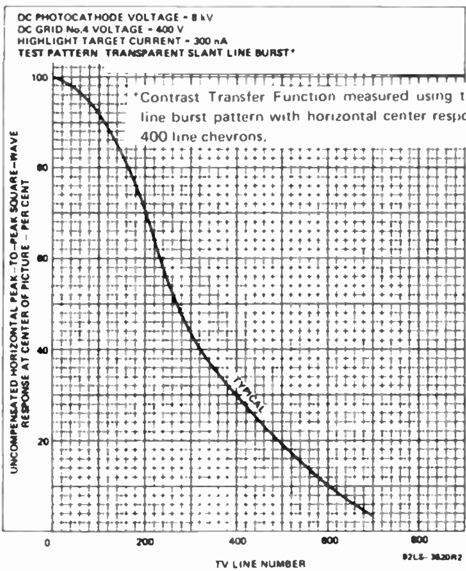
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension. (One inch = 25.4 mm).

Basing Diagram, Bottom View



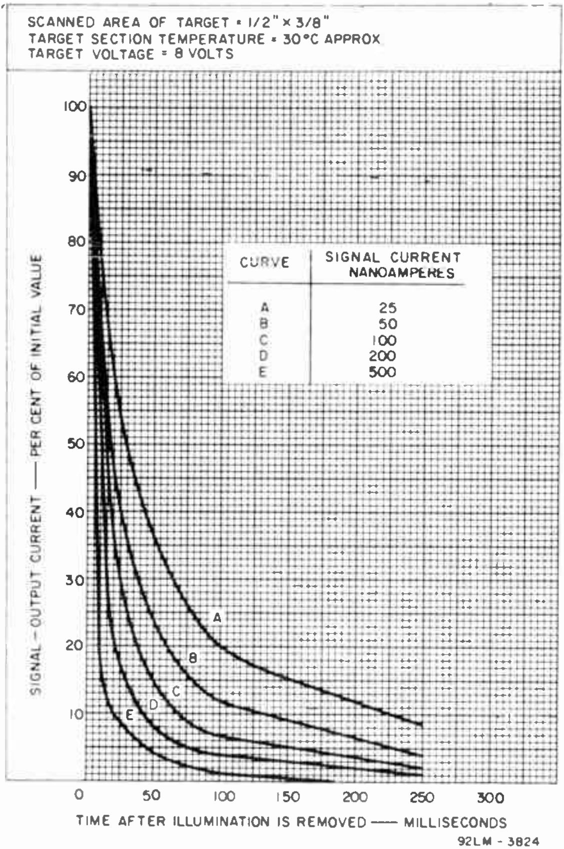
Pin 1— Heater
Pin 2— Grid No.1
Pin 3— Grid No.4
Pin 4— Internal Connection — Do not use
Pin 5— Grid No.2
Pin 6— Grid No.3
Pin 7— Cathode
Pin 8— Heater
Short Index Pin — Internal Connection— Make no connection

Horizontal Square Wave Response (Figure 2)

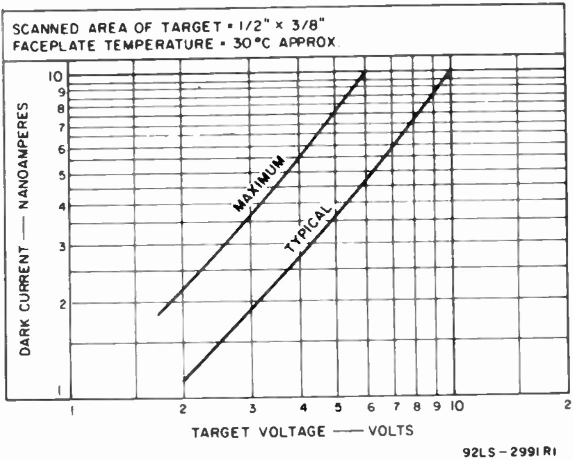


*Contrast Transfer Function measured using the RCA P200 slant-line burst pattern with horizontal center response balanced on the 400 line chevrons.

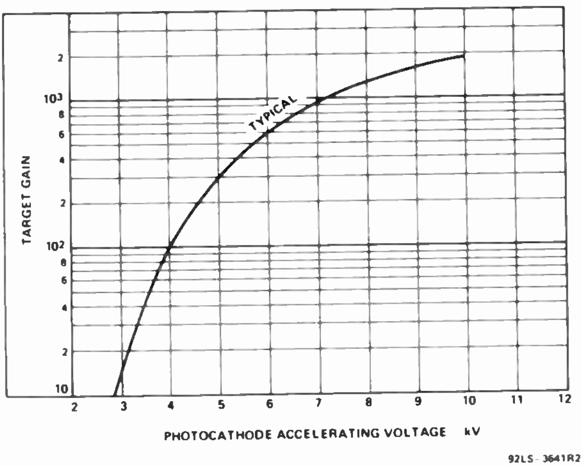
Typical Persistence Characteristics (Figure 3)



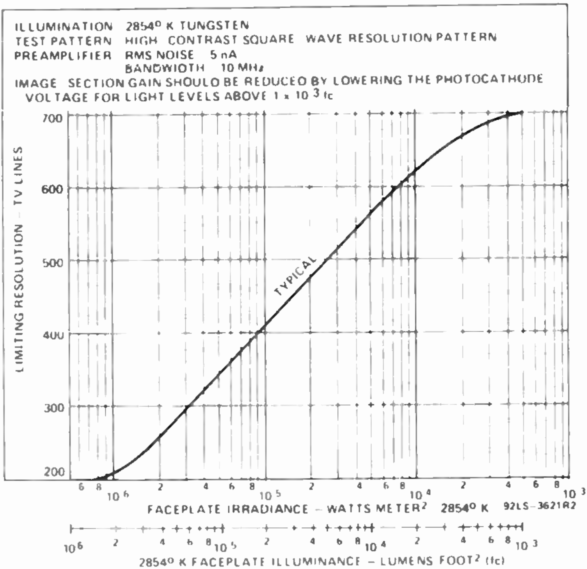
Dark Current Characteristics (Figure 4)



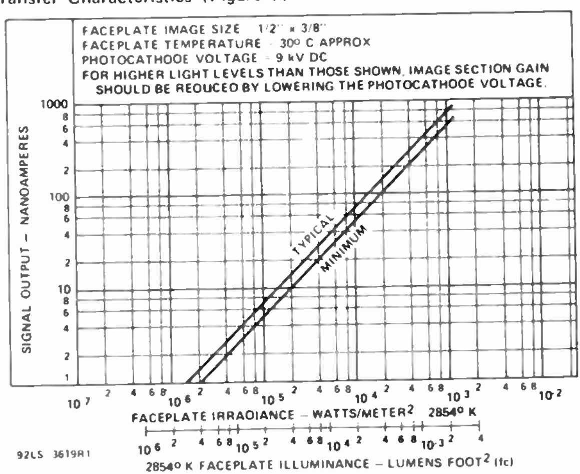
Target Gain Characteristics (Figure 5)



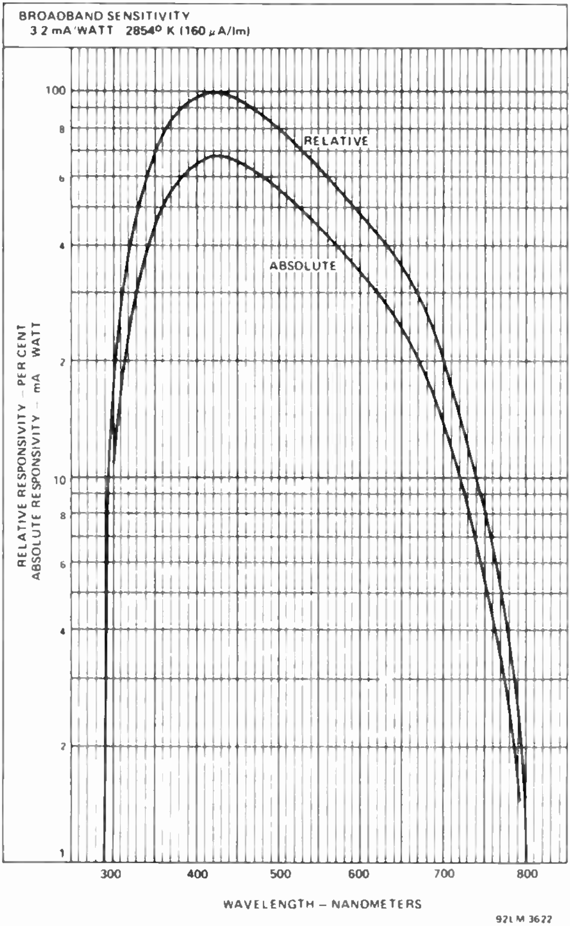
Resolution Characteristics (Figure 6)



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

$$\frac{160\ \mu\text{A}}{\text{lm}} \times \frac{20\ \text{lumens}}{\text{watt-2854}^{\circ}\text{K}} = 3.2\ \text{mA/watt-2854}^{\circ}\text{K}$$

Also an illuminance of 1 lm/ft^2 (fc) is equivalent to an irradiance of

$$\frac{1\ \text{lm}}{\text{ft}^2} \times \frac{\text{watts-2854}^{\circ}\ \text{K}}{20\ \text{lumens}} \times \frac{10\ \text{ft}^2}{\text{M}^2} = 0.5\ \text{watt-2854}^{\circ}\ \text{K/meter}^2$$

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.

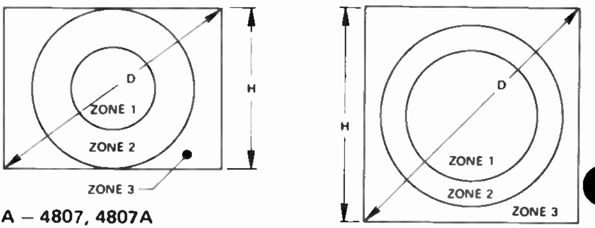
Step 6: Optical elements, photocathode voltage (image-section focus), and grid-No.4 voltage (scanning-under Typical Operating Values. The tubes are adjusted to provide maximum picture resolution. Spurious signals are evaluated by size which is represented by equivalent number of raster lines in a 525 TV line system. Allowable spots size 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

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).

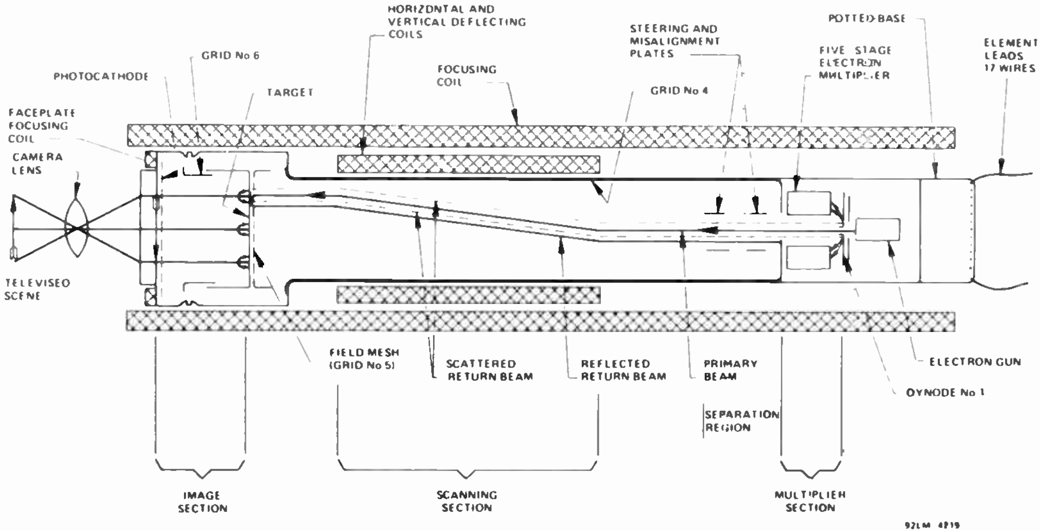
d. If several dynode voltages, including that of dynode No.5 are varied simultaneously, care should be taken to avoid allowing the voltage between dynode No.5 and anode to vary to the point where anode collection efficiency is reduced. A practical minimum voltage for $E_b - E_{dyn5}$ is 35 volts.

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.

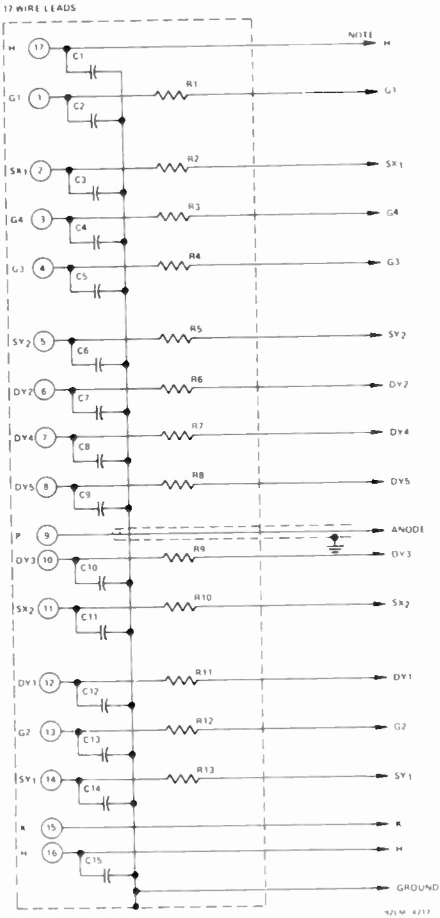
6. Scan-failure protection. Nothing elaborate is needed as long as grid No.1 voltage does not fall to zero. In this context, note that a normal shutdown of equipment could cause damage unless the coupling time constants are such that the (negative) G_1 voltage will decay more slowly than the (positive) 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

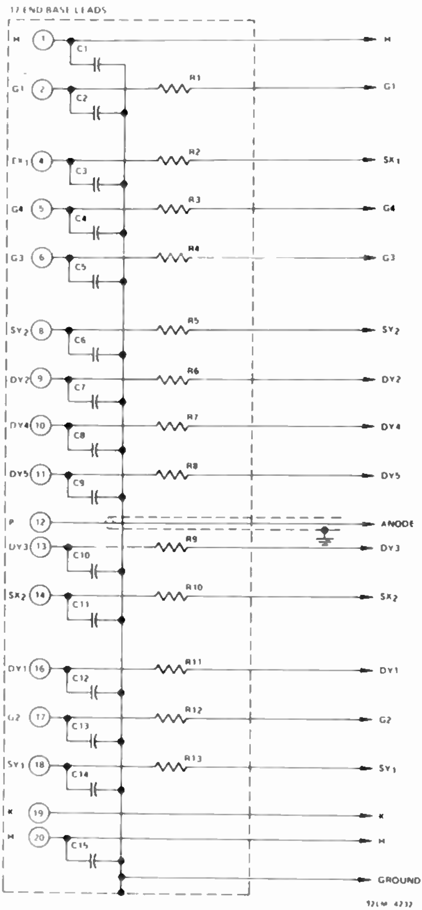
Each lead is identified. Leads are approximately 9" (230 mm) long.



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

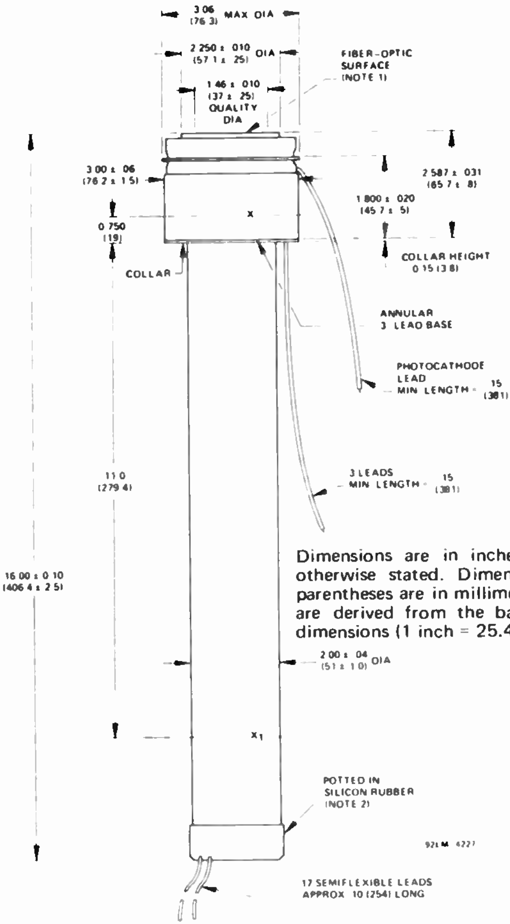
Suggested Tube End-Base Decoupling Networks For 4807/V1, 4807A/V1

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

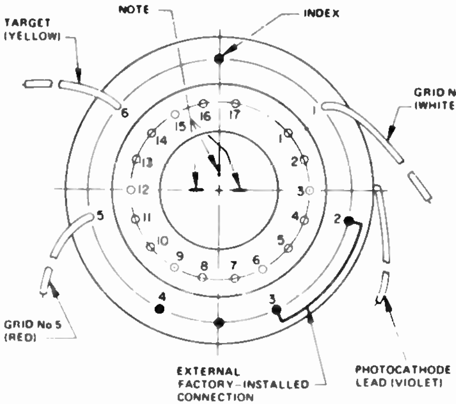
Dimensional Outline For Types 4807 And 4807A



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.

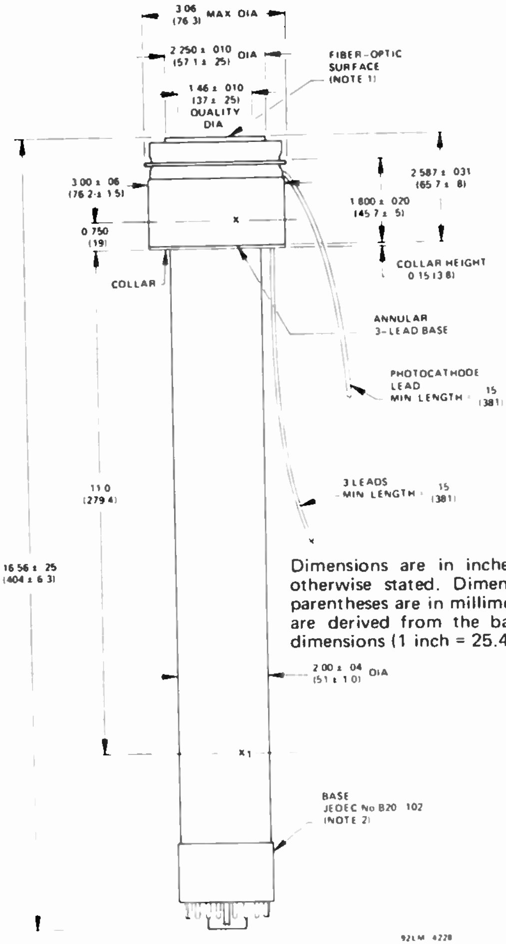
Enlarged Bottom View, Types 4807 And 4807A



Base Lead	Description	Color Code Body	Color Code 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.

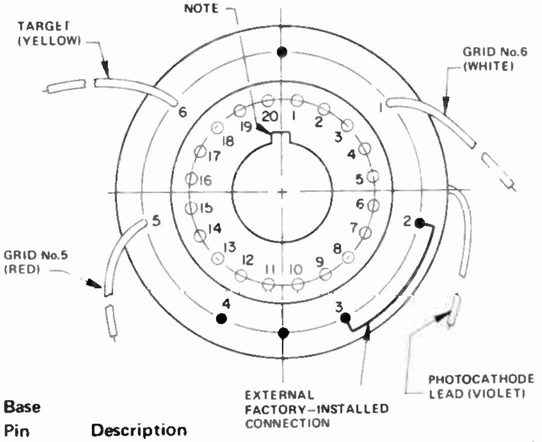
Dimensional Outline For Types 4807/V1 And 4807A/V1



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.

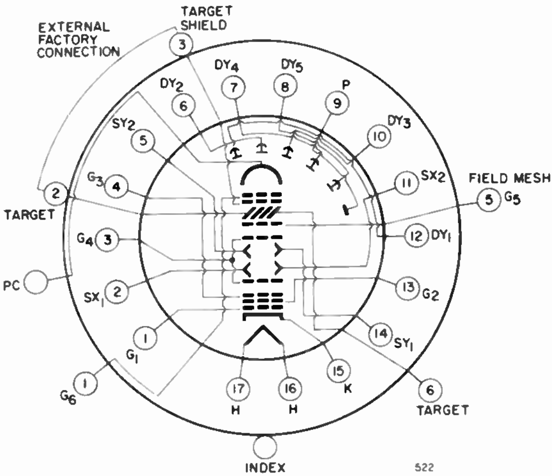
Enlarged Bottom View, Types 4807/V1 And 4807A/V1



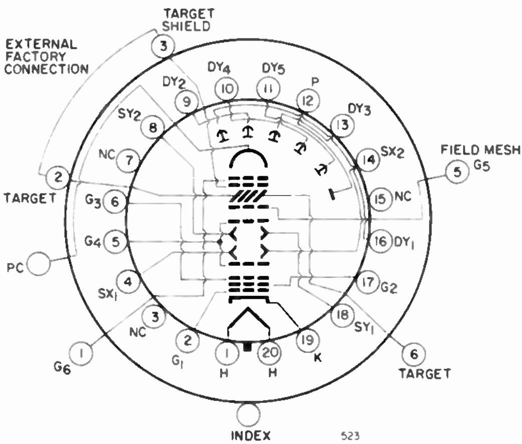
Base Pin	Description
1	Heater
2	Grid No.1
3	Internal Connection – Do Not Use
4	Steering Plate SX_1
5	Grid No.4
6	Grid No.3
7	Internal Connection – Do Not Use
8	Misalignment Plate SY_2
9	Dynode No.2
10	Dynode No.4
11	Dynode No.5
12	Anode
13	Dynode No.3
14	Steering Plate SX_2
15	Internal Connection – Do 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.

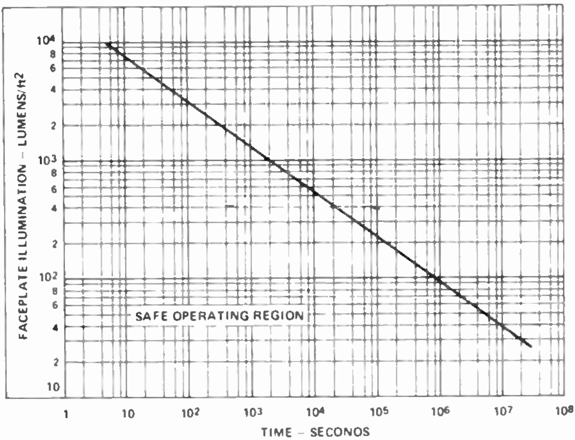
Basing Schematic For Types 4807 And 4807A



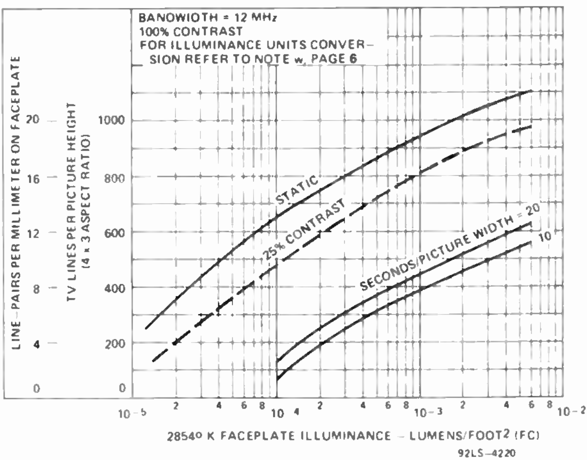
Basing Schematic For Types 4807/V1 And 4807A/V1



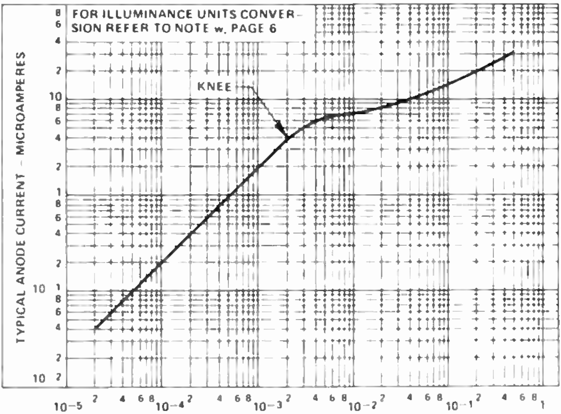
Faceplate Exposure Limit



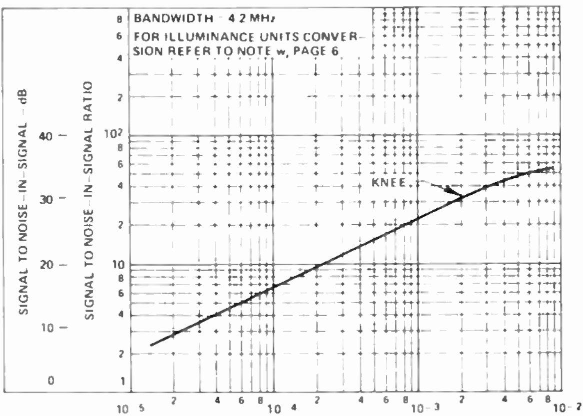
Typical Dynamic Limiting Resolution



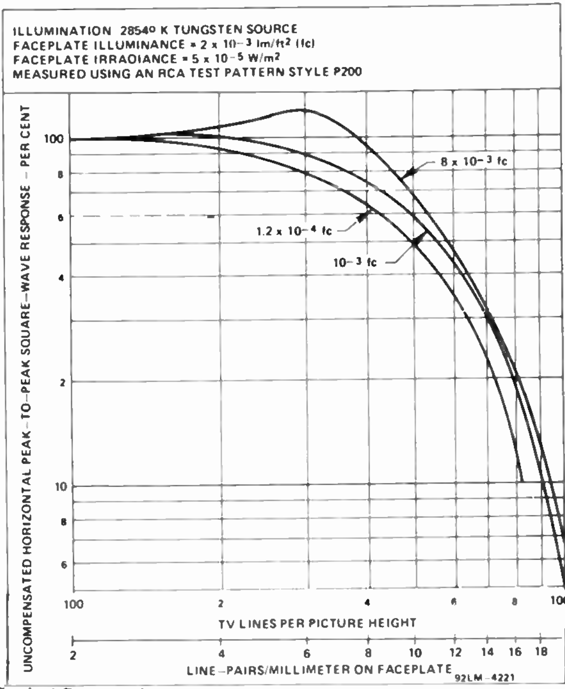
Typical Transfer Characteristic



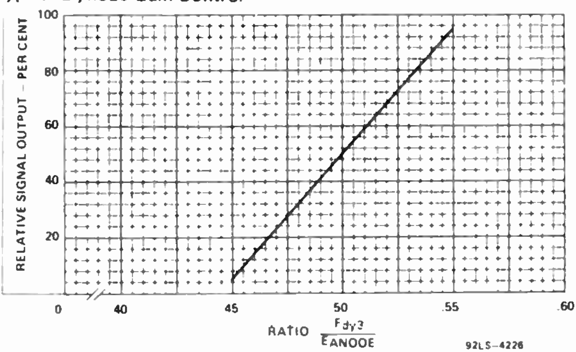
Typical Signal to Noise-In-Signal Ratio As A Function of Faceplate Illuminance or Irradiance From Flux Levels Within A Given Scene. (Beam Adjustment Fixed At 2 x Knee Setting)



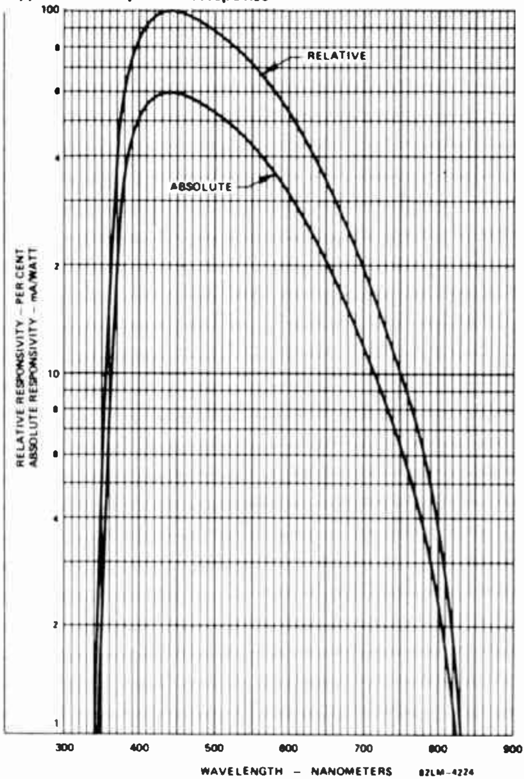
Typical Amplitude Response (CTF) Characteristic



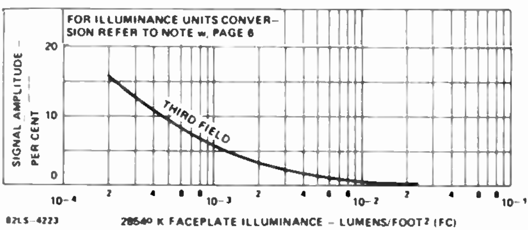
Typical Dynode Gain Control



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 1260 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:

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

where ΔI_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.

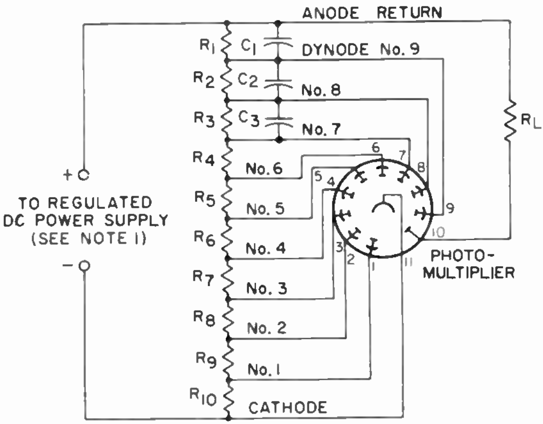
p The electron transit time is the time interval between the arrival of a delta function light pulse at the entrance window of the tube and the time at which the output pulse at the anode terminal reaches peak amplitude. The transit time is measured under conditions with the incident light fully illuminating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

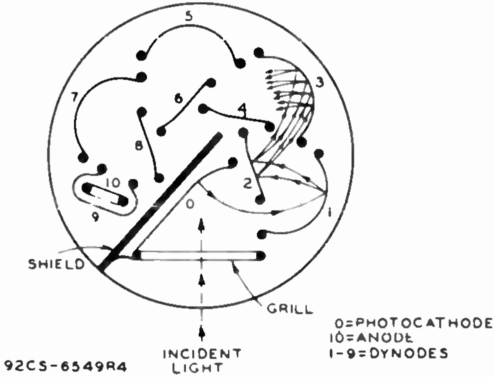


C1:	0.05 μF, 500 volts (DC working)
C2:	0.02 μF, 500 volts (DC working)
C3:	0.01 μF, 500 volts (DC working)
R1 through R10:	20,000 to 1,000,000 ohms

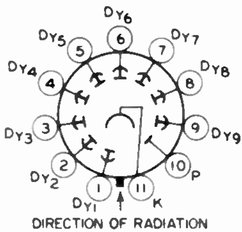
Note 1 — Adjustable between approximately 500 and 1250 volts.

Note 2 — Capacitors C1 through C3 should be connected at tube socket for optimum high-frequency performance.

Schematic Arrangement of Structure

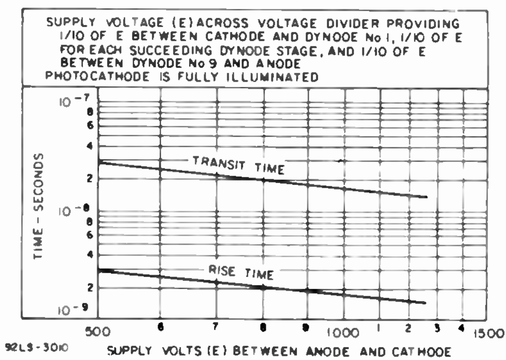


Basing Diagram — Botton View

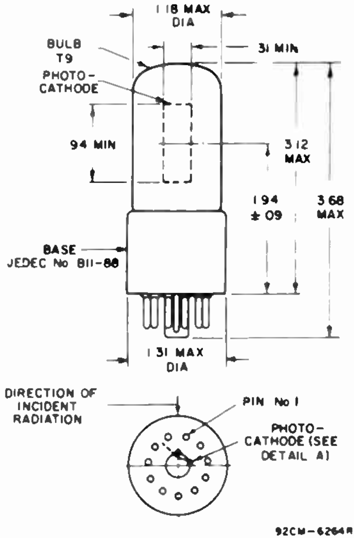


Pin 1: Dynode No.1
Pin 2: Dynode No.2
Pin 3: Dynode No.3
Pin 4: Dynode No.4
Pin 5: Dynode No.5
Pin 6: Dynode No.6
Pin 7: Dynode No.7
Pin 8: Dynode No.8
Pin 9: Dynode No.9
Pin 10 Anode
Pin 11 Photocathode

Typical Time-Resolution Characteristics

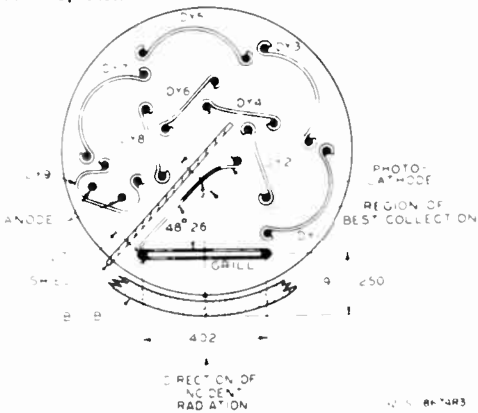


Dimensional Outline



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

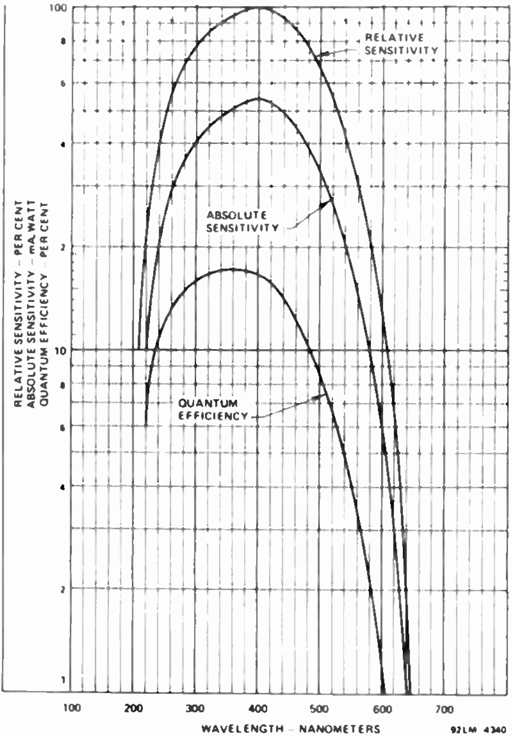
Detail A – Top View



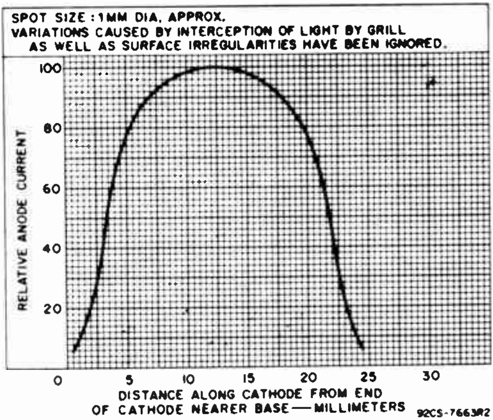
Dimensions are in inches unless otherwise stated. Dimensions tabulated below are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

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

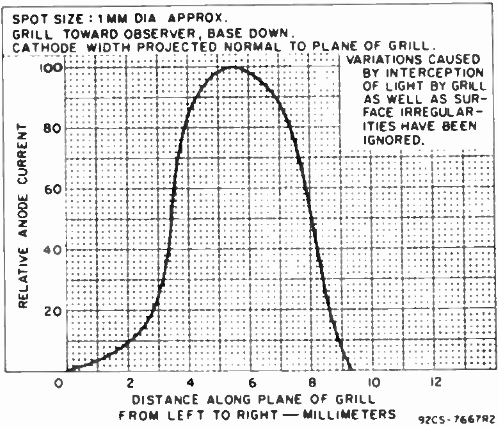
Typical Photocathode Spectral Response Characteristics



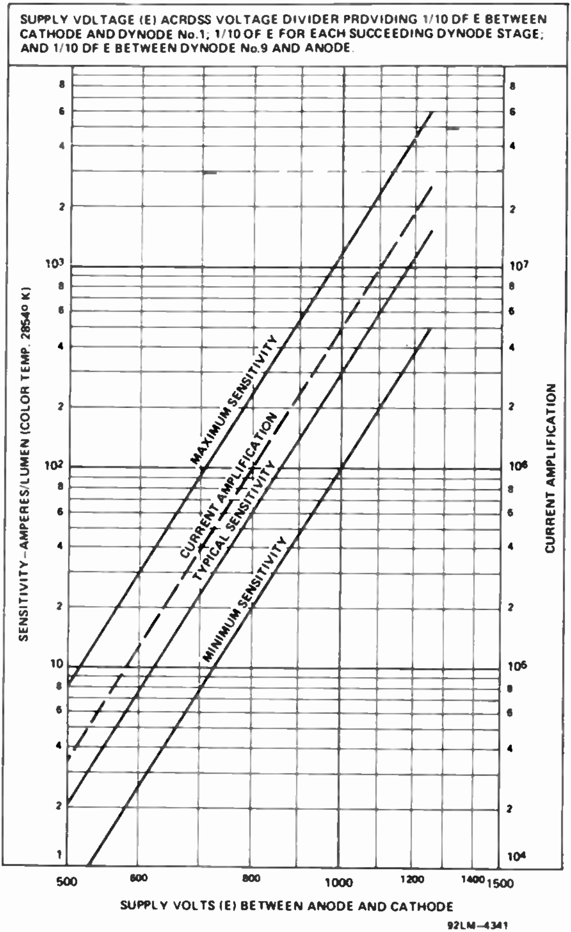
Typical Variation of Photocathode Sensitivity Along Tube Length



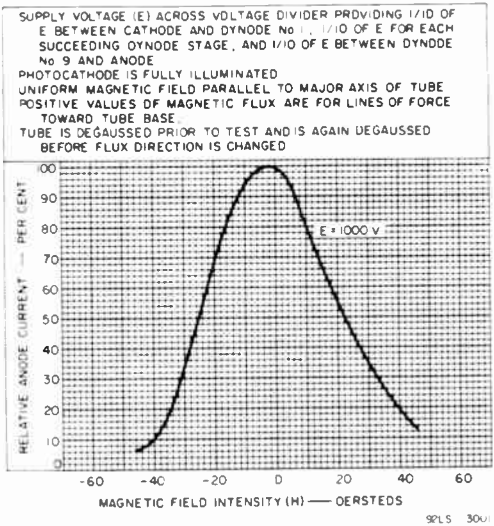
Typical Variation of Photocathode Sensitivity Across Projected Width in Plane of Grill



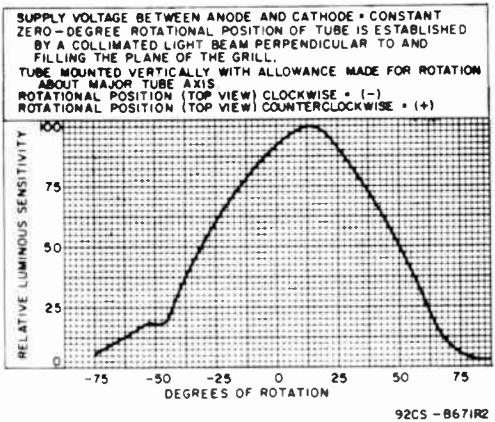
Typical Sensitivity and Current Amplification Characteristics



Typical Effect of Magnetic Field on Anode Current



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



5527

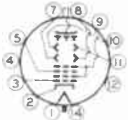
5527
ICONOSCOPE

ELECTROSTATIC FOCUS ELECTROSTATIC DEFLECTION

General:

Heater, for Unipotential Cathode:		
Voltage	6.3 ± 10% . . .	ac or dc volts
Current	0.6	amp
Direct Interelectrode Capacitances (Approx.):▲		
Grid No.1 to All Other Electrodes	7.5 . .	μμf
Signal Electrode to All Other Electrodes and External Shield	5 . .	μμf
Focusing Method		Electrostatic
Deflection Method		Electrostatic
Image Size (4 x 3 aspect ratio)		1.4" Diagonal
Overall Length.		9" ± 1/4"
Seated Length		8-1/4" ± 1/4"
Maximum Diameter.		2-1/4"
Mounting Position		Any
Cap		Recessed Small Cavity
Base		Medium-Shell Diheptal 12-Pin
Basing Designation for BOTTOM VIEW		14L

Pin 1 - Heater
Pin 2 - Cathode
Pin 3 - Grid No.1
Pin 4 - Internal Connection - Do Not Use
Pin 5 - Grid No.3
Pin 7 - Deflecting Electrode DJ3
Pin 8 - Deflecting Electrode DJ4



DIRECTION OF LIGHT INTO END OF BULB

Pin 9 - Anode No.2, Grid No.4
Pin 10 - Deflecting Electrode DJ2
Pin 11 - Deflecting Electrode DJ1
Pin 12 - Internal Connection - Do Not Use
Pin 14 - Heater
Cap - Signal Electrode

Maximum Ratings, *Design-Center Values*:

SIGNAL-ELECTRODE VOLTAGE.	900 max.	. . . volts
GRID-No.4 & GRID-No.2 VOLTAGE . . .	900 max.	. . . volts
GRID-No.3 VOLTAGE	450 max.	. . . volts
GRID-No.1 VOLTAGE:		
Negative bias value	100 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
AMBIENT TEMPERATURE	40 max.	. . . °C
MOSAIC ILLUMINATION	50 max.	foot-candles

▲ with external shield.

APRIL 15, 1947 TENTATIVE DATA

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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Typical Operation:

Signal-Electrode Voltage	800	. . . .	volts
Grid-No.4 & Grid-No.2 Voltage . . .	800	. . . .	volts
Grid-No.3 Voltage for Focus . . .	125 to 250	. . .	volts
Grid-No.1 Voltage	Adjust for best picture		
Max. Grid-No.1 Voltage for Picture Cutoff . .	-75	. . . .	volts
Max. Deflecting Voltages (Peak-to-Peak)*:			
DJ_1 & DJ_2 (Vertical)	120	. . . .	volts
DJ_3 & DJ_4 (Horizontal)	100	. . . .	volts
Min. Peak-to-Peak Blanking Voltage	30	. . . .	volts
Signal-Output Current (Approx.) . .	0.025	. . . .	μamp
Output Resistor (Approx.)	1.0	. . . .	megohm

Maximum Circuit Values:

Grid-No.1-Circuit Resistance . . .	1.0 max.	. . . .	megohm
Resistance in any Deflecting-Electrode Circuit□ . .	5.0 max.	. . . .	megohms

* To scan picture of 1.4" diagonal (4 x 3 aspect ratio).

□ It is recommended that the deflecting-electrode-circuit resistances be approximately equal.

The SPECTRAL SENSITIVITY CHARACTERISTIC curve for the 5527 is the same as that shown for Type 1850-A.

APRIL 15, 1947 TENTATIVE DATA

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5527
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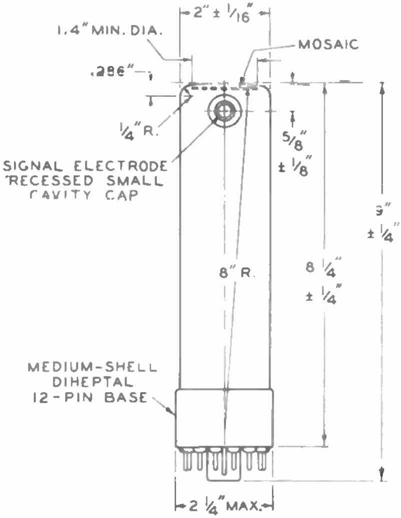


℄ OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

THE PLANE THROUGH THE TUBE AXIS AND BASE-PLUG KEY MAY VARY FROM THE PLANE THROUGH THE TUBE AXIS AND SIGNAL ELECTRODE TERMINAL BY AN ANGULAR TOLERANCE (MEASURED ABOUT THE TUBE AXIS) OF 20°. SIGNAL ELECTRODE TERMINAL IS ON SAME SIDE AS BASE-PLUG KEY.

DJ1 AND DJ2 ARE NEARER THE MOSAIC; DJ3 AND DJ4 ARE NEARER THE BASE. WITH DJ1 POSITIVE WITH RESPECT TO DJ2, THE SPOT IS DEFLECTED TOWARD PIN 5. WITH DJ3 POSITIVE WITH RESPECT TO DJ4, THE SPOT IS DEFLECTED TOWARD PINS 1 AND 2. WITH DJ1 AND DJ2 USED FOR VERTICAL DEFLECTION, THE VERTICAL AXIS OF THE SCANNED AREA OF THE MOSAIC IS PARALLEL TO VERTICAL PLANE THROUGH PINS 5 AND 12 WITHIN ±15°. THE ANGLE BETWEEN THE SCANNING DIRECTION PRODUCED BY DJ3 AND DJ4 AND THE SCANNING DIRECTION PRODUCED BY DJ1 AND DJ2 IS 90° ± 3°.

92CS-6803

Gas Phototube

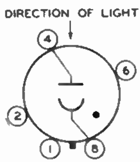
SIDE-ON TYPE HAVING S-4 RESPONSE

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 $\mu\mu$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).	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.

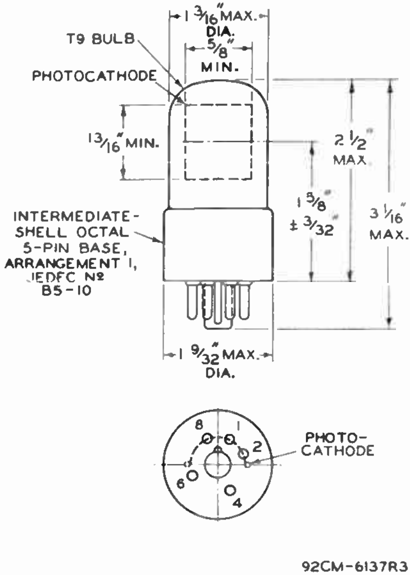
[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light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

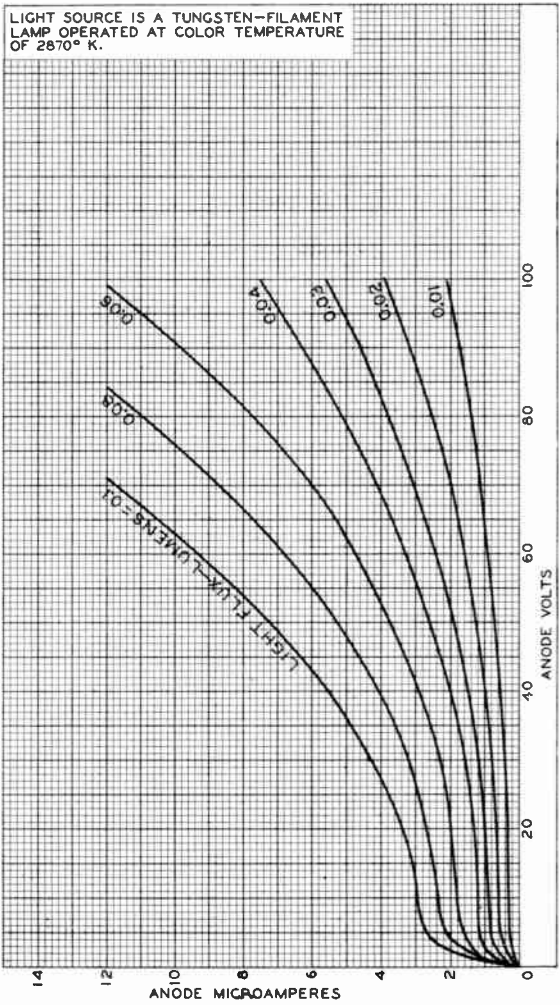
and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section


1 3/16" MAX. DIA.
T9 BULB
5/8" MIN.
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-6822R1

5582

5582
GAS PHOTOTUBE

CARTRIDGE TYPE WITH S-4 RESPONSE

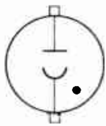
For sound reproduction involving a dye-image sound track in conjunction with an incandescent light source

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 $\mu\mu$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) .	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.

RCA

5582

GAS PHOTOTUBE

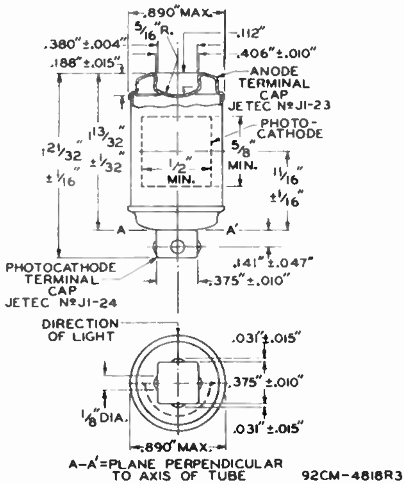
Minimum Circuit Values:

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

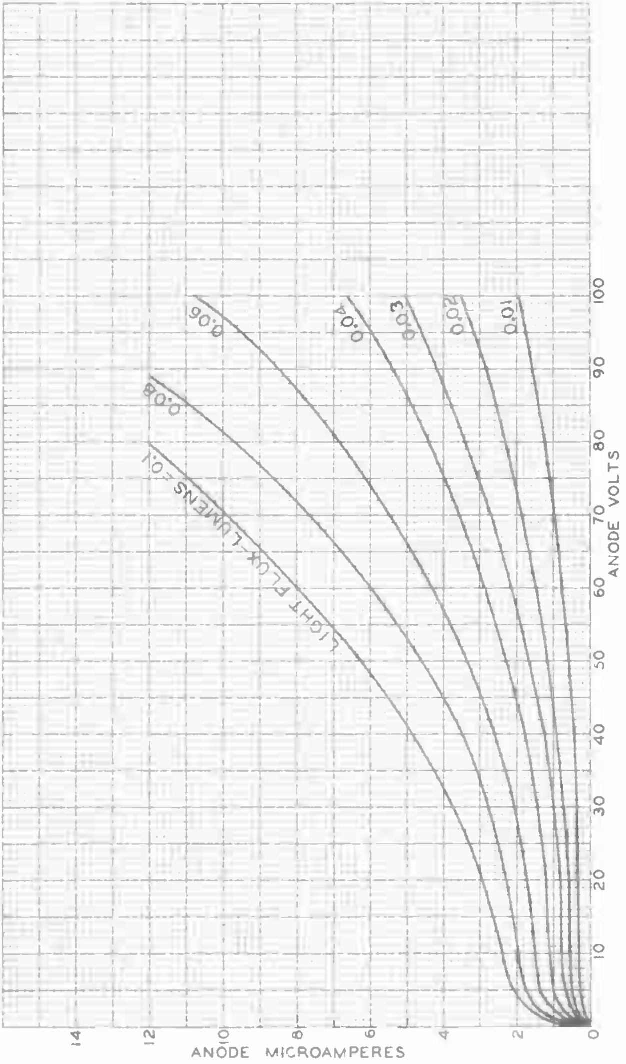


TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

5582

5582

AVERAGE ANODE CHARACTERISTICS



DEC. 27, 1946 TUBE DEPARTMENT 92CM-6823

Gas Phototube

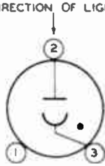
SIDE-ON TYPE HAVING S-4 RESPONSE

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

DIRECTION OF LIGHT



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.

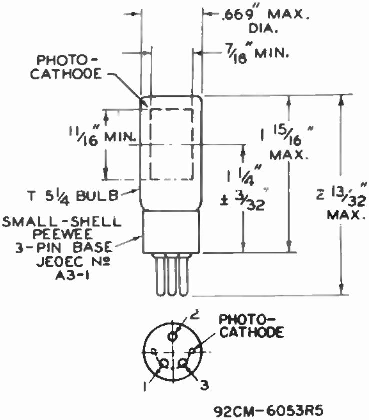
SPECTRAL-SENSITIVITY CHARACTERISTIC OF PHOTOSENSITIVE DEVICE HAVING S-4 RESPONSE

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 No
A3-1
2
PHOTO-
CATHODE
1
3
92CM-6053R5

Gas Phototube

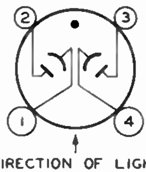
SIDE-ON, TWIN-UNIT TYPE HAVING S-4 RESPONSE

DATA

General:

Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 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 μμf
Cathode to anode[c]	1.6 μμf
Anode to anode[d]	0.4 μμf ←
Maximum Overall Length	4"
Maximum Seated Length	3-3/8"
Seated Length to Center of Cathode	2-1/8" ± 3/32"
Maximum Diameter	1-3/16"
Operating Position	Any
Weight (Approx.)	1.1 oz ←
Bulb	T9
Socket	Amphenol No.77-MIP-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



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)	80 max.	100 max.	volts
AVERAGE CATHODE-CURRENT DENSITY[e]	20 max.	10 max.	μa/sq.in.
AVERAGE CATHODE CURRENT[e]	4 max.	2 max.	μa
AMBIENT TEMPERATURE	75 max.	75 max.	°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 4000 angstroms. .	-	0.12	-	amp/watt
Luminous:[f]				
At 0 cps	80	120	17[illegible]	µa/lumen
At 5000 cps	-	110	-	µa/lumen
At 10000 cps.	-	96	-	µa/lumen
Ratio of Luminous Sensitivities				
(Unit No.1 to Unit No.2). . .	0.[illegible]	1.25	2.0	
Gas Amplification Factor[g] . . .	-	-	5.5	
Anode Dark Current at 25° C . . .	-	-	0.050	µa

Minimum Circuit Values:

Values are for Each Unit

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.	-	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 light.

[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 voltage 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-4 RESPONSE

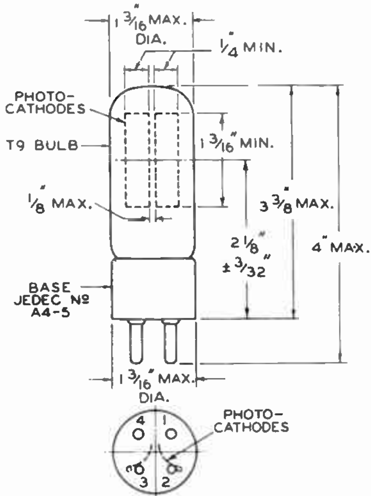
and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section

AVERAGE-ANODE-CHARACTERISTICS CURVE
shown under Type 5582 also applies to each unit of the 5584

→ Indicates a change.


1 3/16" MAX. DIA.
1/4" MIN.
PHOTO-CATHODES
T9 BULB
1 3/16" MIN.
1/8" MAX.
3 3/8" MAX.
2 1/8" ± 3/32"
4" MAX.
BASE JEDEC № A4-5
1 3/16" MAX. DIA.
PHOTO-CATHODES
4
1
3
2

92CM-4561R4

Vacuum Phototube

COMPOSITE-ANODE-CATHODE, SIDE-ON TYPE HAVING S-4 RESPONSE

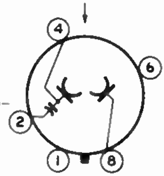
DATA

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-[illegible]/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.	$^{\circ}$C

Characteristics: ←

With an anode-supply voltage of 250 volts

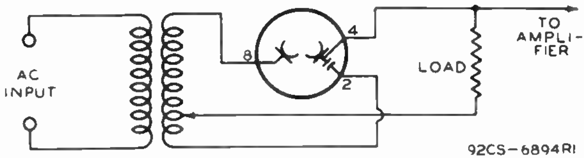
	Min.	Median	Max.	
Sensitivity:				
Radiant, at 4400 angstroms	-	0.044	-	amp/watt
Luminous[d]	19	45	70	μa/lumen
Ratio of Cathode Luminous Sensitivities	0.42	1.0	2.4	
Anode Dark Current at 25° C	-	-	0.01	μa

← Indicates a change.

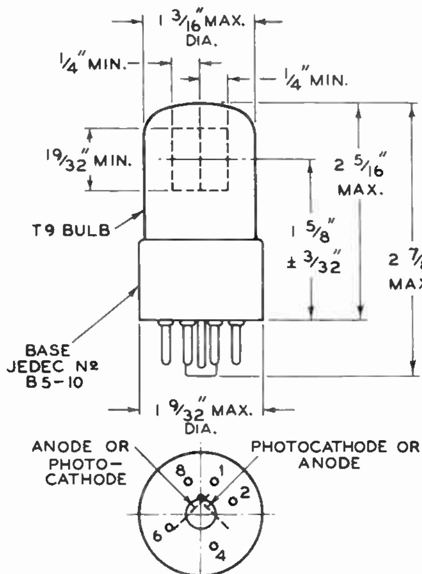
a On plane perpendicular to indicated direction of incident light.
b Measured between pins 2 and 4.
c Averaged over any interval of 30 seconds maximum.
d For conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K. A 1-megohm load resistor and a light 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

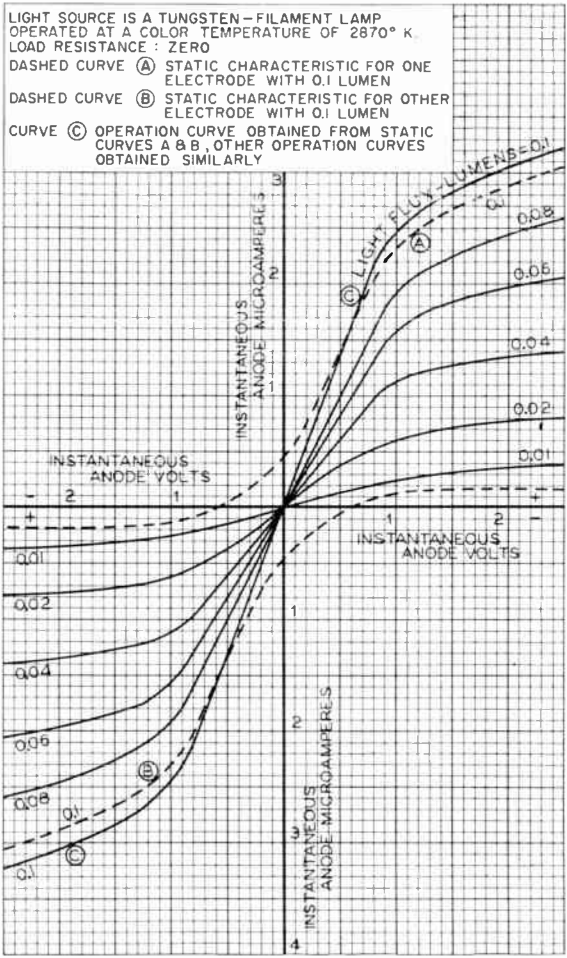


92CS-6894R1



92CS-6869R1

TYPICAL OPERATION CHARACTERISTICS
With AC Voltage Applied Between the Two Electrodes



Vacuum Phototube

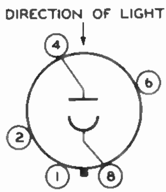
SIDE-ON TYPE HAVING S-4 RESPONSE

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] Or 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.

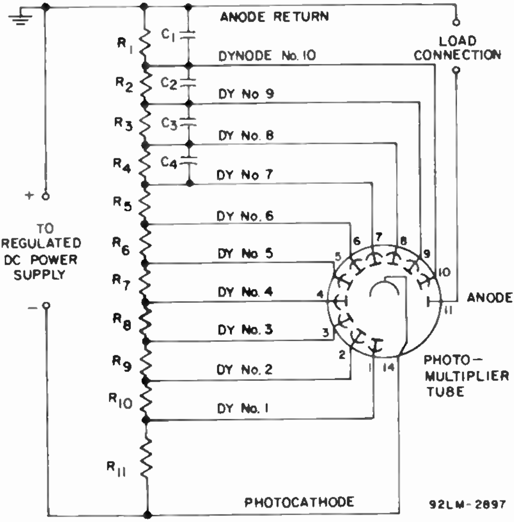
[q] Under the following conditions: Tube temperature 22° C, external shield connected to cathode, bandwidth 1 Hz, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between zero and the value stated. The "on" period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

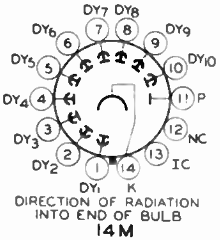


C_1: 0.05 µF, 20%, 500 volts (dc working), ceramic disc
C_2: 0.02 µF, 20%, 500 volts (dc working), ceramic disc
C_3: 0.01 µF, 20%, 500 volts (dc working), ceramic disc
C_4: 0.005 µF, 20%, 500 volts (dc working), ceramic disc
R_1 through R_{10}: 390,000 ohms, 5%, 1/2 watt
R_{11}: 910,000 ohms, 5%, 1/2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

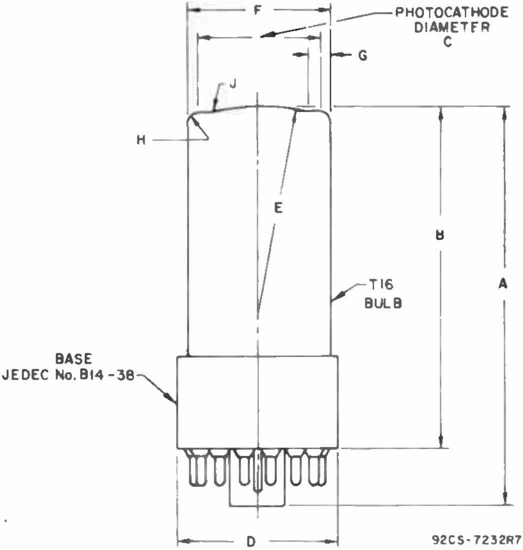
TERMINAL DIAGRAM (Bottom View)

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

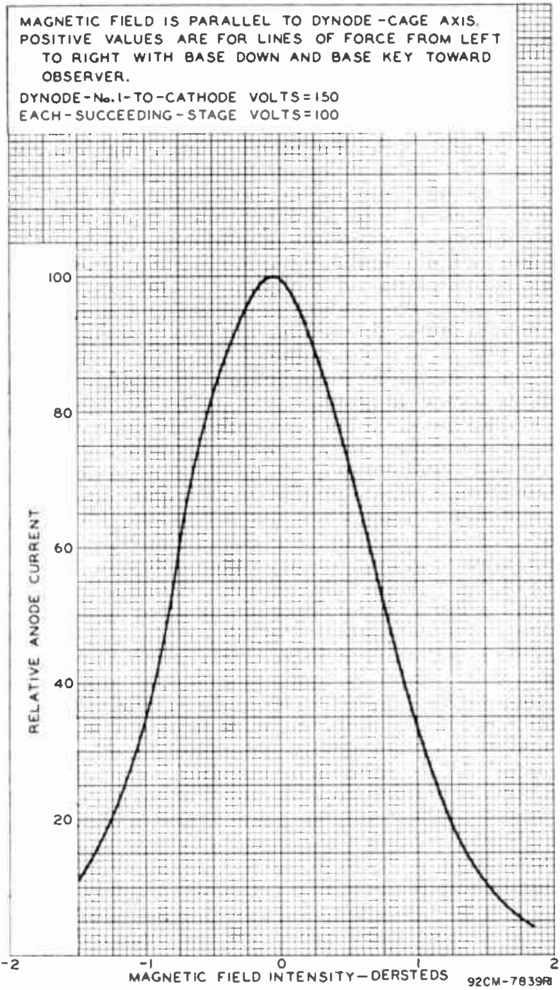


℄ of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

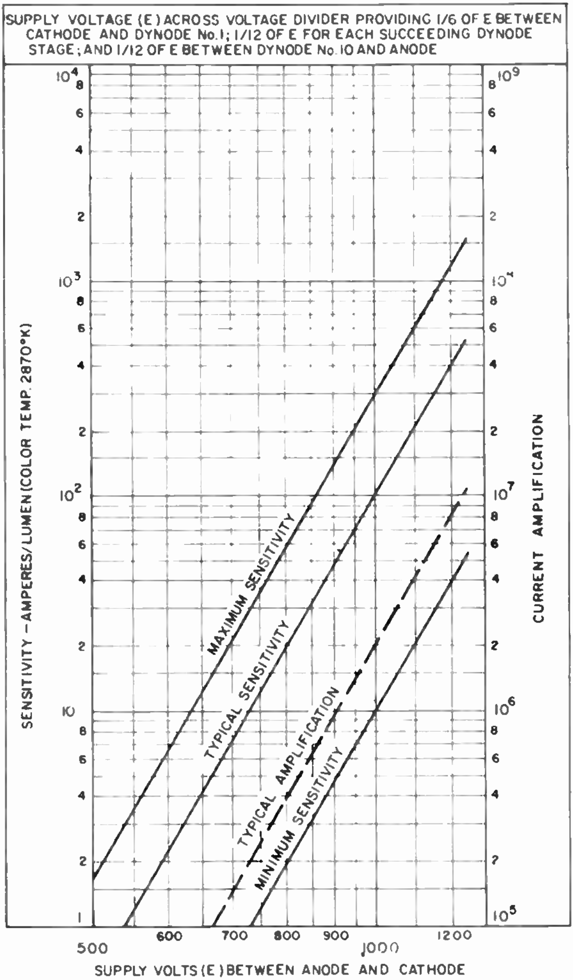
The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

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.

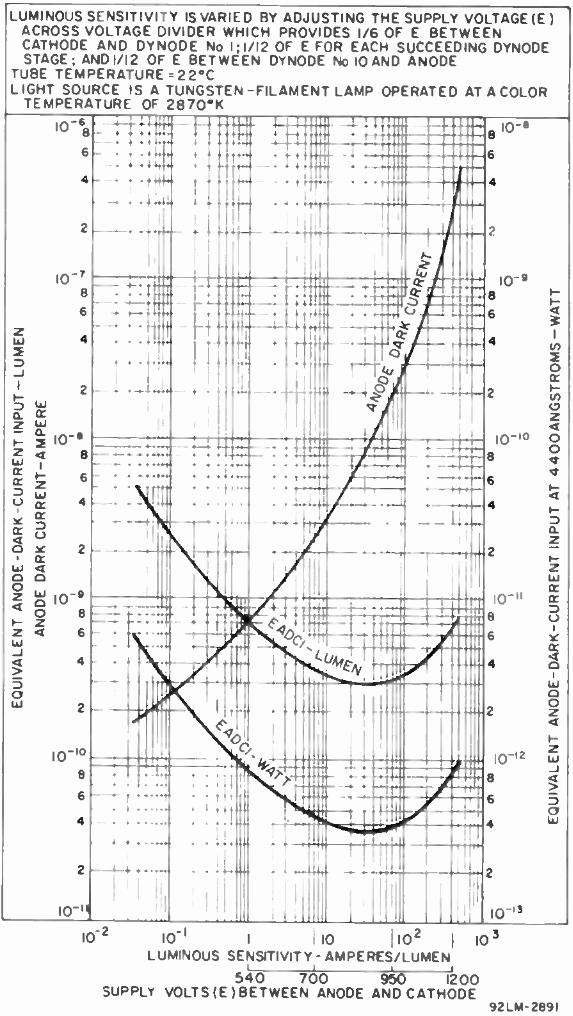
TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



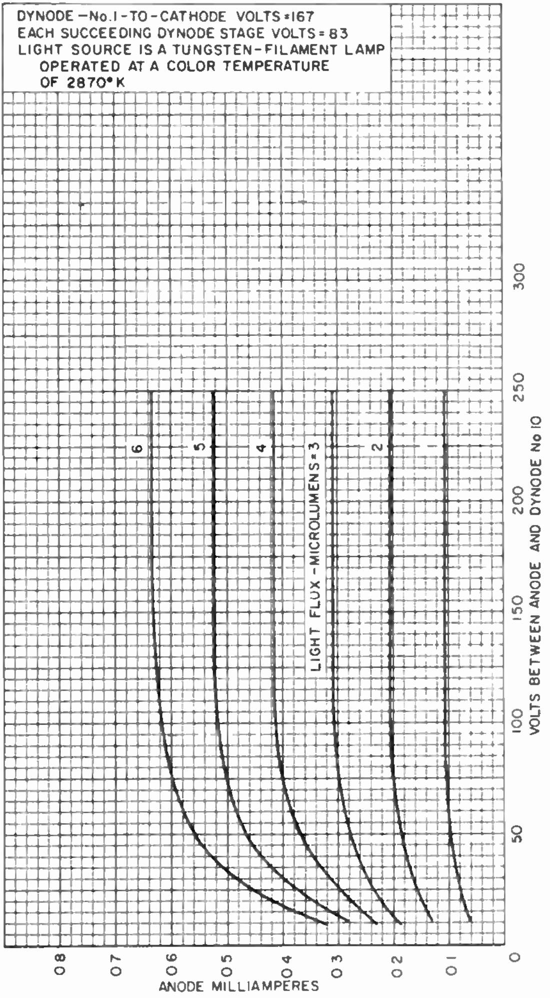
TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS

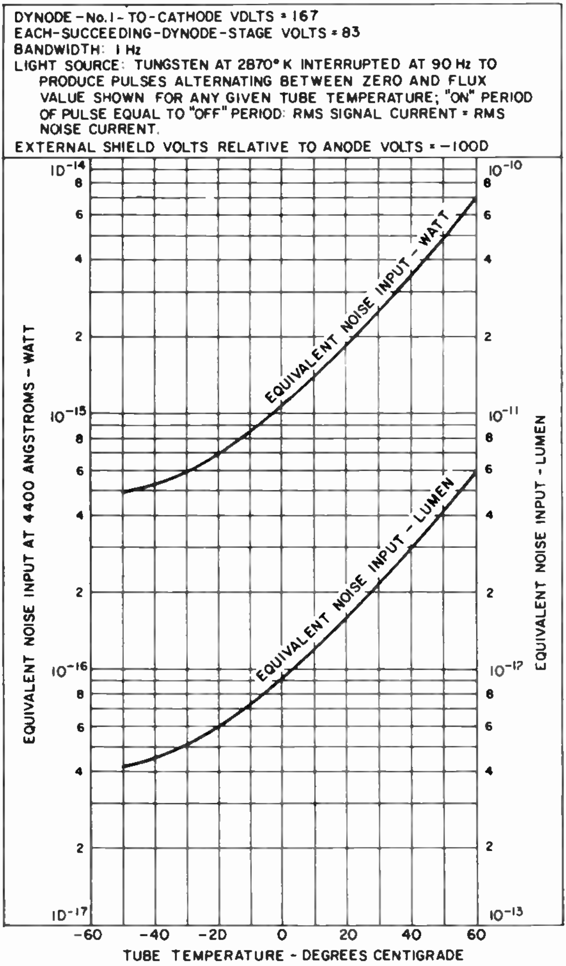


TYPICAL ANODE CHARACTERISTICS



92LM-2895

TYPICAL ENI CHARACTERISTICS



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 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 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]

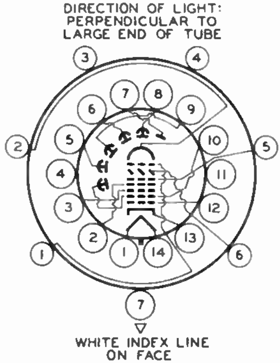
Pin 1 - Grid No.6	Pin 5 - Grid No.5
Pin 2 - Photocathode	
Pin 3 - Internal Connection—Do Not Use	Pin 6 - Target
Pin 4 - Internal Connection—Do Not Use	Pin 7 - Internal Connection—Do Not Use

[a] See basing diagram on next page.

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	[illegible]	–	
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	[illegible]	–	%
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.

[illegible]

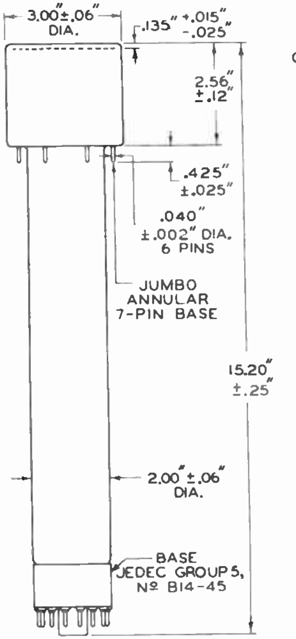
[e] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with the indicator located outside of and at the image end of the focusing coil.

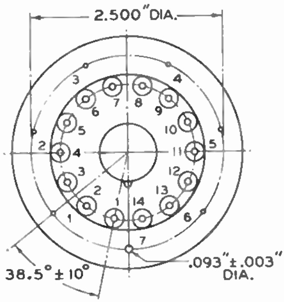
[f] With 5820A operated in properly adjusted RCA TK-31 camera.

[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

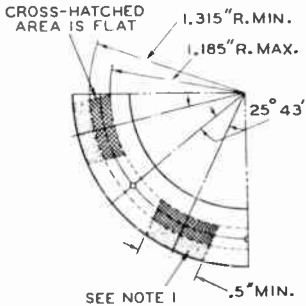




ENLARGED BOTTOM VIEW

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 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".

BASIC LIGHT-TRANSFER CHARACTERISTIC

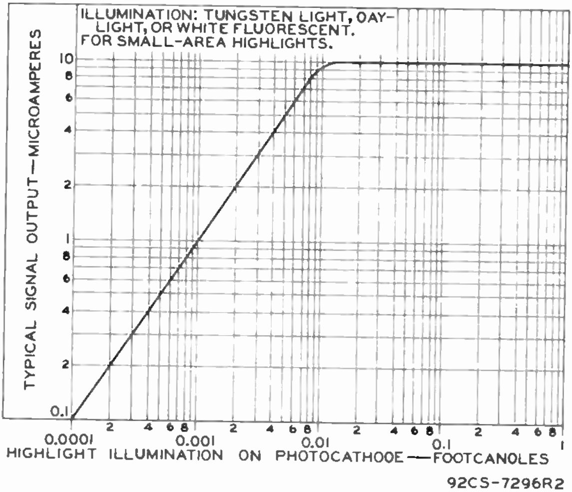


Image Orthicon

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

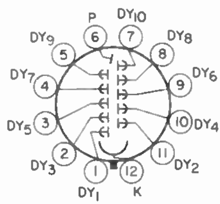
For Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources in Portable Scintillation Counters

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		
[illegible]	1250	V
[illegible]	250	V
[illegible]	200	V
[illegible]	300	V
Average Anode Current[d]	0.75	mA
Ambient Temperature[e]	75	°C

CHARACTERISTICS RANGE VALUES

[illegible]

With E – 1000 V (Except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
[illegible][f]	-	3.6×10^{4}	-	A/W
[illegible][g]				
[illegible]	-	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, 1701 Germantown Avenue, Philadelphia 44, Pennsylvania.

[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.

→ Indicates a change.

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

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.5-56, 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.

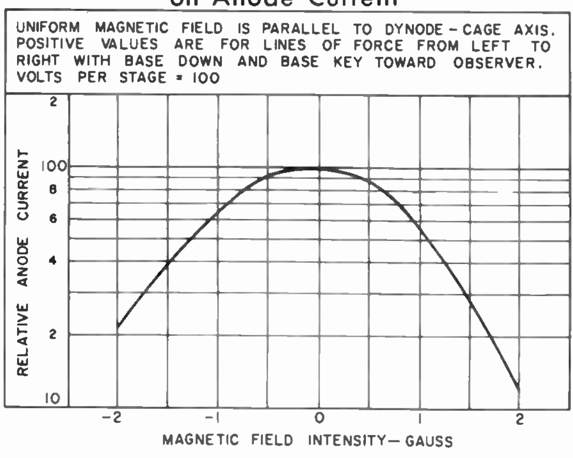
p At 4400 angstroms. This value is calculated from the rating in lumen using a conversion factor of 804 lumens per watt.

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.

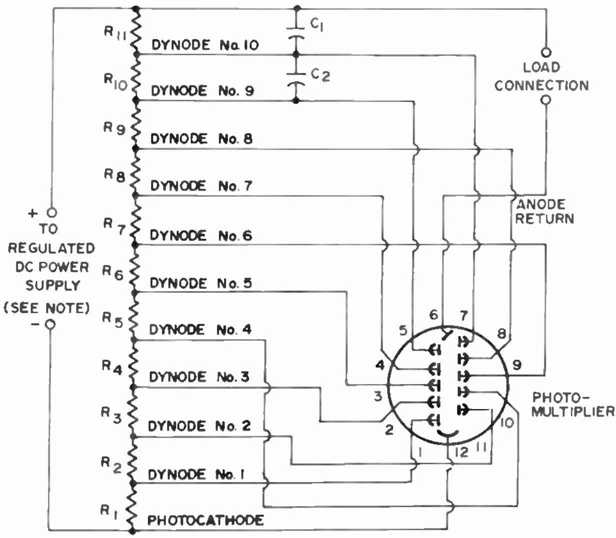
s The electron transit time is the time interval between the arrival of a delta function light pulse at the entrance window of the tube and the time at which the output pulse at the anode terminal reaches peak amplitude. The transit time is measured under conditions with the incident light fully illuminating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

Typical Effect of Magnetic Field on Anode Current



92LS-1489

TYPICAL VOLTAGE DIVIDER ARRANGEMENT



92LS-1506

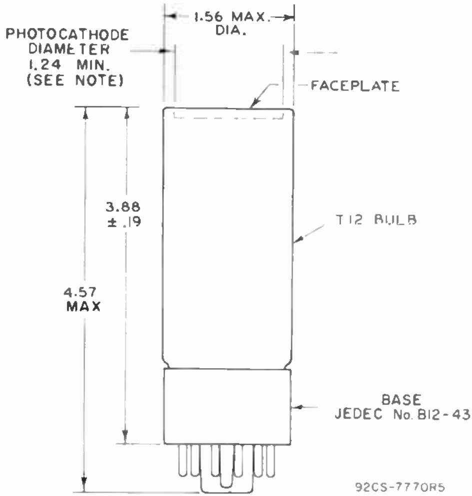
Note: Adjustable between approximately 500 and 1250 volts dc.

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

DIMENSIONAL OUTLINE

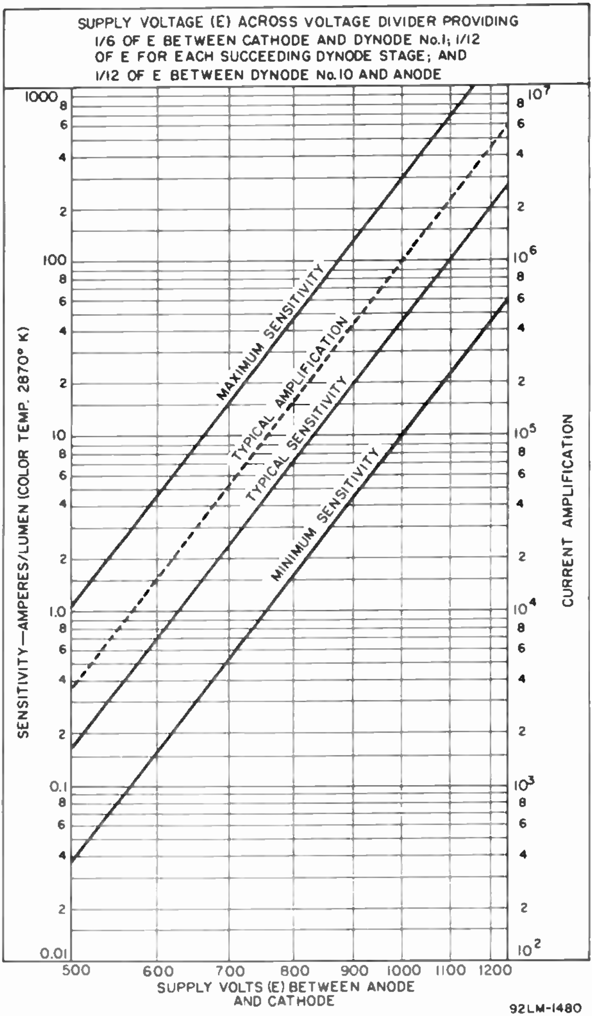


DIMENSIONS IN INCHES

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

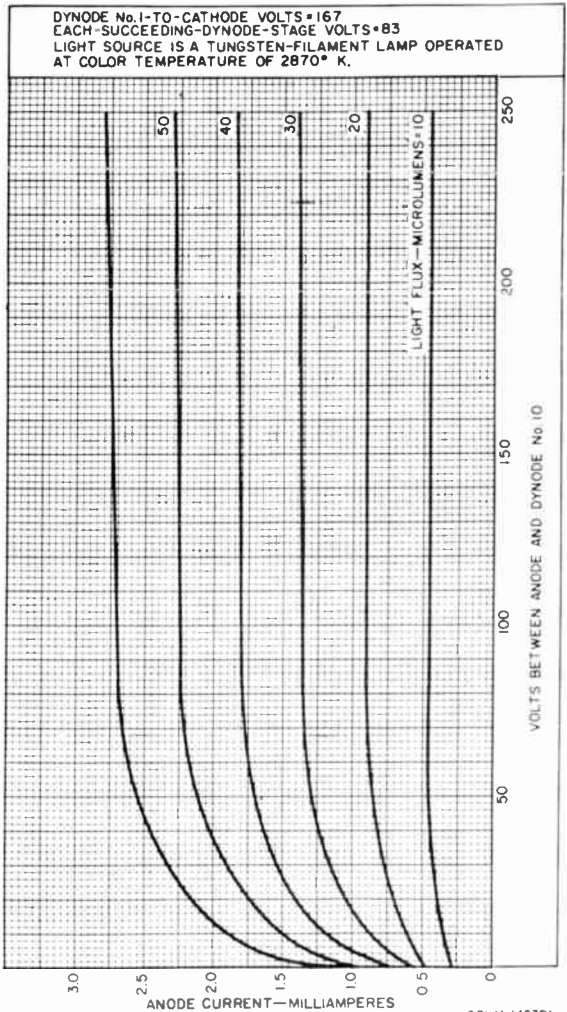
Center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

Typical Sensitivity and Current Amplification Characteristics



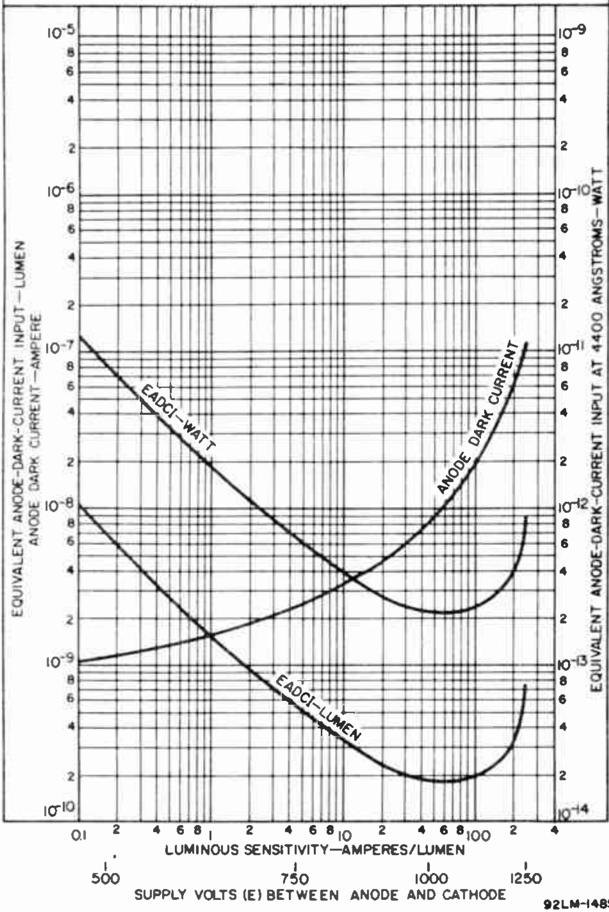
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

Typical Anode Characteristics



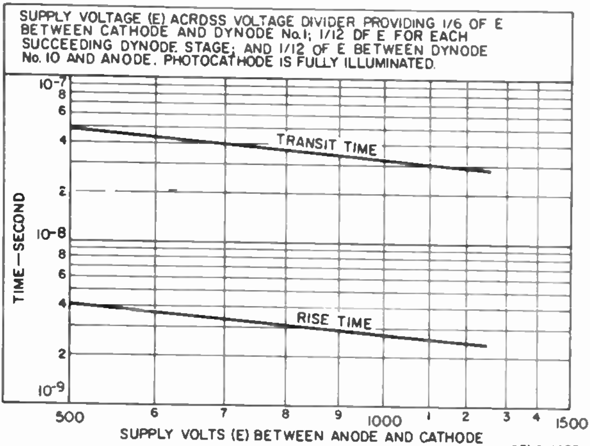
Typical Dark Current and EADCI Characteristics

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 1/2 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.



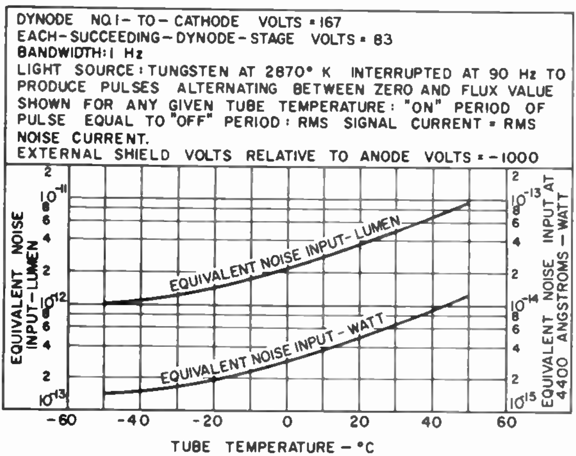
92LM-1485

Typical Time-Resolution Characteristics



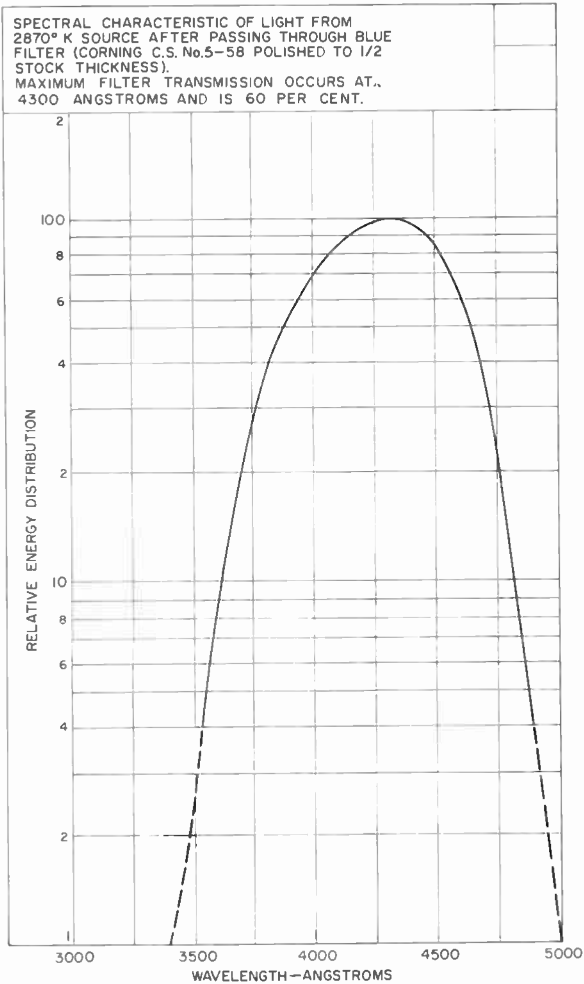
92LS-1482

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

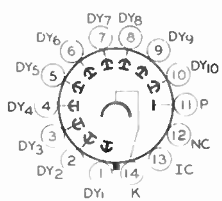
Spectral Response	S-10
Wavelength of Maximum Response	4500 ± 300 angstroms
Cathode, Semitransparent	Ag-Bi-O-Cs
Shape	Curved, Circular ←
Minimum area	2.2 sq in
Minimum diameter	1-11/16 in
Window	Lime Glass (Corning[a] No.0080), or equivalent ←
Index of refraction	1.51
Dynode Material	Cs-Sb ←
Direct Interelectrode 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 4400 angstroms	-	5.1×10^4	-	A/W
Cathode radiant, at 4400 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 100 A/lm				
Equivalent Noise Input[j]	-	4×10^{-11}	1.7×10^{-10}	lm
Dark Current	-	-	7.5×10^{-7}	A
To any electrode [illegible] anode at [illegible] °C				

With E = 750 V (Except as noted)

	Min	*Typ*	*Max*	
Sensitivity				
Radiant, at 4400 angstroms	-	5.1×10^3	-	A/W
Cathode radiant, at 4400 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 100 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

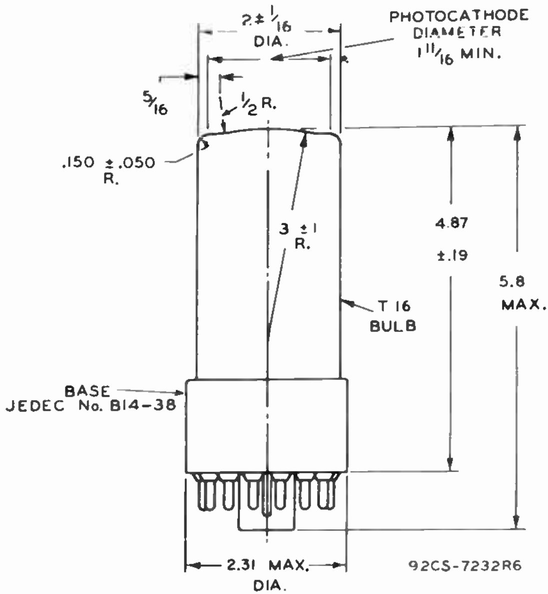
→ Indicates a change.

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



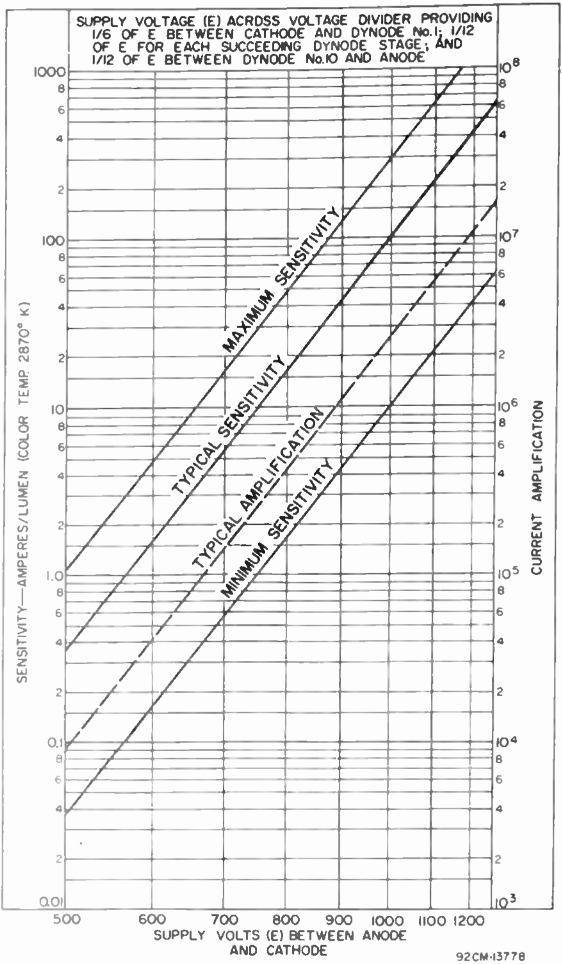
DIMENSIONS IN INCHES

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



RCA

6323

MULTIPLIER PHOTOTUBE

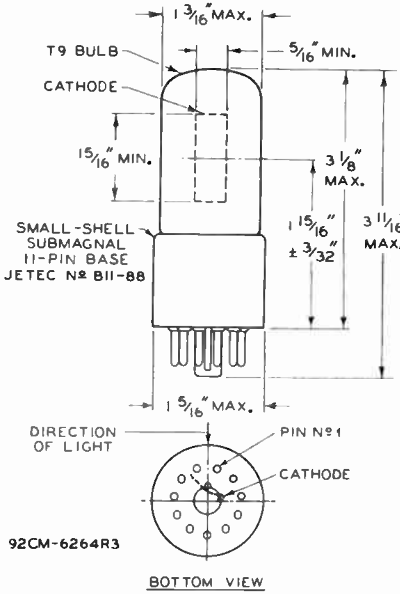
9-STAGE TYPE WITH S-4 RESPONSE

For Headlight-Control Service

The 6323 is the same as the 6328 except for the following items:

General:

Direct Interelectrode Capacitances (Approx.):	
Anode to dynode No.9	4.4 $\mu\mu f$
Anode to all other electrodes	6 $\mu\mu f$
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"
Weight (Approx.).	1.6 oz
Base. . . . . Small-Shell Submagnal 11-Pin (JETEC No.B11-88), Non hygroscopic	



℄ 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 PLANE THROUGH PINS No. 1 AND No. 11 AND THE PLANE OF THE GRILL WILL NOT EXCEED 6°.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

6326-A
VIDICON

600-LINE RESOLUTION

For live pickup with color or black-and-white TV cameras

The 6326-A is an improved version of the 6326 and is unilaterally interchangeable with it.

DATA

General:

Heater, for Unipotential Cathode:
- Voltage . . . . 6.3 ± 10% . . . . .ac or dc volts
- Current . . . . 0.6 . . . . amp

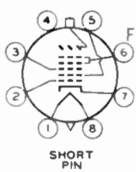
Direct Interelectrode Capacitance:♦
- Target (Signal electrode) to all other electrodes. . . . . 4.5 μμf

Spectral Response . . . .*See Curves*

Photoconductive Layer:
- Maximum useful diagonal of rectangular image (4 x 3 aspect ratio). . . . . 0.62"
- 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"
Weight (Approx.). . . . . 2 oz
Operating Position. . . . Approx. horizontal, or faceplate up
Bulb. T8
Base Connector. . . . . .Cinch No.54A18088, or equivalent
Base. . . . . . . .Small-Button Ditetrar 8-Pin (JETEC No.E8-11)
Basing Designation for BOTTOM VIEW. . . . . 8HL ←

Pin 1 - Heater
Pin 2 - Grid No.1
Pin 3 - Grid No.3
Pin 4 - Internal Connection— Do Not Use
Pin 5 - Grid No.2
Pin 6 - Grid No.4, Grid No.5



DIRECTION OF LIGHT: INTO FACE END OF TUBE

Pin 7 - Cathode
Pin 8 - Heater
Flange - Target (Signal Electrode)
Short Index Pin- Internal Connection— Do Not Use

♦: See next page.

← indicates a change.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

RCA

6326-A

VIDICON

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

For scanned area of 1/2" x 3/8"

GRID-No.5 & GRID-No.4 VOLTAGE	350 max.	volts
GRID-No.3 VOLTAGE	350 max.	volts
GRID-No.2 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
DARK CURRENT	0.12 max.	μa
PEAK TARGET (SIGNAL-ELECTRODE) CURRENT	0.5 max.	μa
FACEPLATE:		
Illumination	1000 max.	ft-c
Temperature	60 max.	°C

Typical Operation:

Grid No.3 connected to grids No.4 and No.5; scanned area of 1/2" x 3/8"; faceplate temperature of 30° to 35° C

Faceplate Illumination:		
Constant highlight, for pickup from live scenes	2 to 5	ft-c
Average highlight▲, for pickup from film	50 to 300	ft-c
Maximum Target (Signal-Electrode) Voltage required to produce dark current of 0.1 μa in any tube**	100	volts
Target (Signal-Electrode) Voltage:†		
For pickup from live scenes	60 to 80	volts
For pickup from film	20 to 40	volts
Grid-No.5 (Decelerator) and Grids-No.4 & No.3 (Beam-Focus Electrodes*) Voltage	250⊕ to 300	volts
Grid-No.2 (Accelerator) Voltage	300	volts
Grid-No.1 Voltage for picture cutoff●	-45 to -100	volts
Signal-Output Current:#		
Peak	0.3 to 0.4	μa
Average	0.1 to 0.2	μa
Dark Current:		
For pickup from live scenes	0.1	μa
For pickup from film	0.004	μa
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.)○	300:1	
Minimum Peak-to-Peak Blanking Voltage:		
When applied to grid No.1	40	volts
When applied to cathode	10	volts

♦,▲,**,†,*,⊕,●,#,○: See next page.

→ Indicates a change.

6326-A
VIDICON

Field Strength at Center of Focusing Coil (Approx.)	40	gausses
Field Strength of Adjustable Alignment Coil□	0 to 4	gausses

⍿ This capacitance, which effectively is the output impedance of the 6326-A, 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.

▲ Averaged over the time of one TV frame.

** The target (signal-electrode) voltage for each 6326-A must be adjusted to that value which gives the desired operating dark current.

† Indicated range for each type of service serves only to illustrate the operating target- (signal-electrode-) voltage range normally encountered.

* Beam focus is obtained by combined effect of grids-No.4 & No.3 voltage which should be adjustable over indicated range, and a focusing coil having an average field strength of 40 gausses. If desired, grid No.3 may be operated separately to permit vernier control of focus. Under such conditions, the instantaneous grid-No.3 voltage must always be equal to or greater than the grid-No.4 voltage.

⊕ Definition, focus uniformity, and picture quality decrease with decreasing grids-No.5 & No.4 & No.3 voltage. In general, grids No.5 & No.4 & No.3 should not be operated below 250 volts.

● With no blanking voltage on grid No.1.

Defines as the component of the target (signal-electrode) current after the dark-current component has been subtracted.

○ Measured with high-gain, low-noise, cascode-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.

□ 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.

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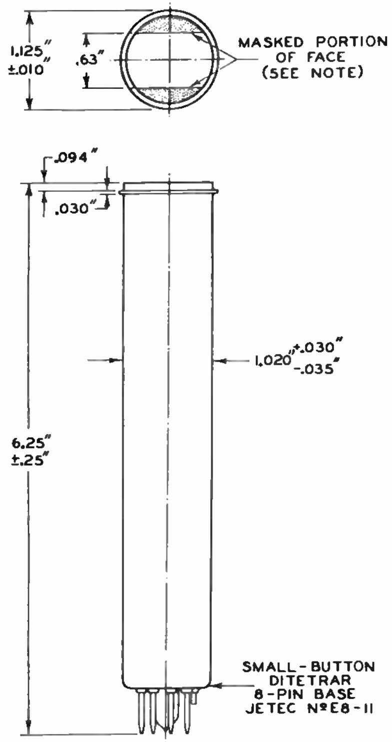
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6326-A
VIDICON



92CS-9081R1

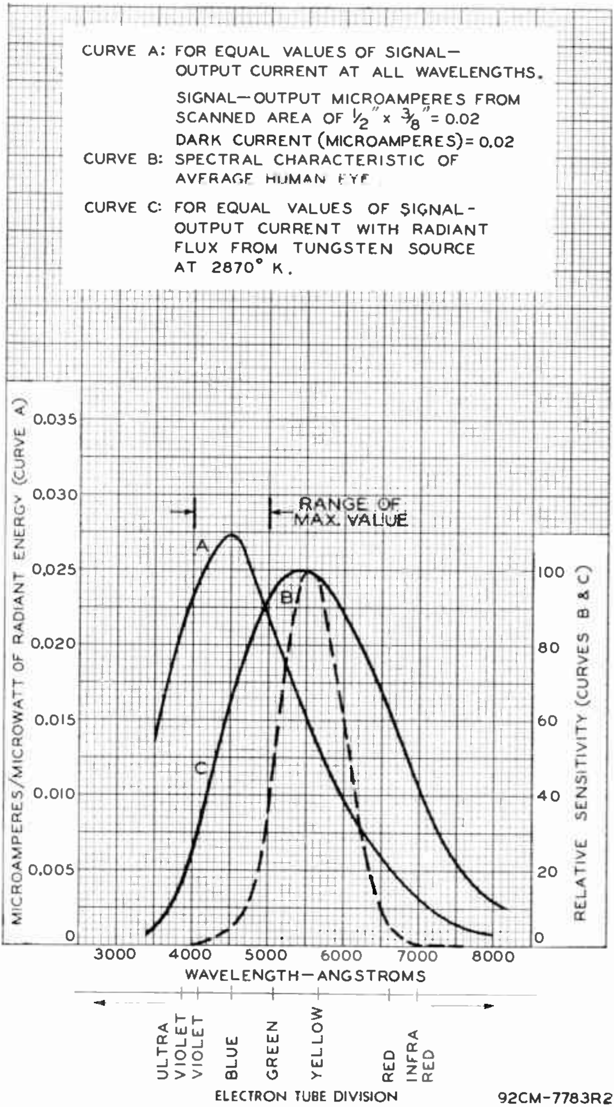
NOTE: STRAIGHT SIDES OF MASKED PORTIONS ARE PARALLEL TO THE PLANE PASSING THROUGH TUBE AXIS AND SHORT INDEX PIN.

6326-A

RCA

6326-A

SPECTRAL-SENSITIVITY CHARACTERISTICS



ELECTRON TUBE DIVISION

92CM-7783R2

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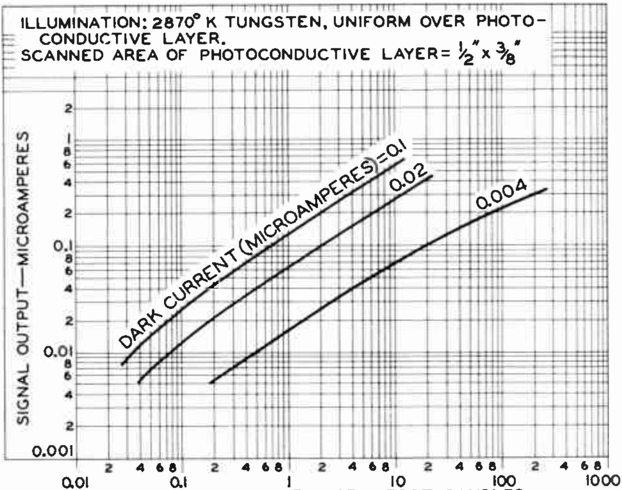
RCA

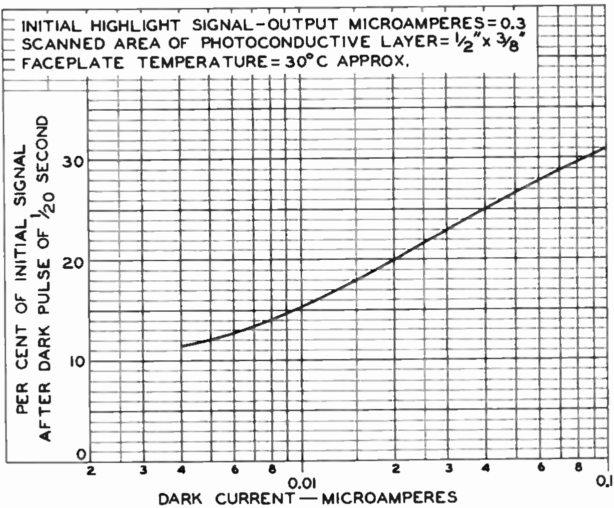
6326-A

TYPICAL LIGHT-TRANSFER CHARACTERISTICS



92CS-9546

TYPICAL PERSISTENCE CHARACTERISTIC

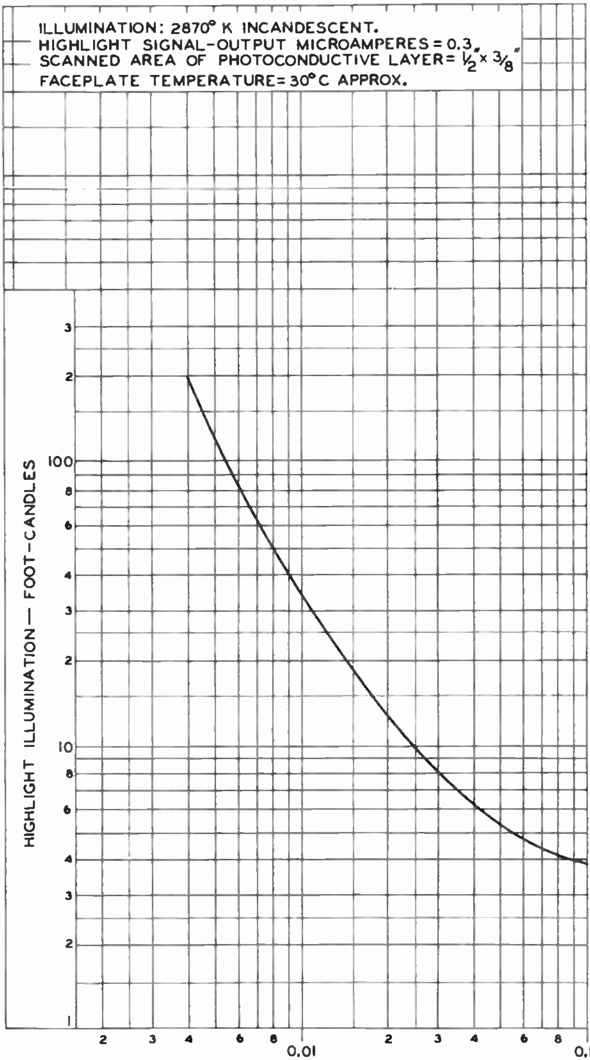


92CS—9548

RCA

6326-A

TYPICAL CHARACTERISTIC



ELECTRON TUBE DIVISION 92CM-9544

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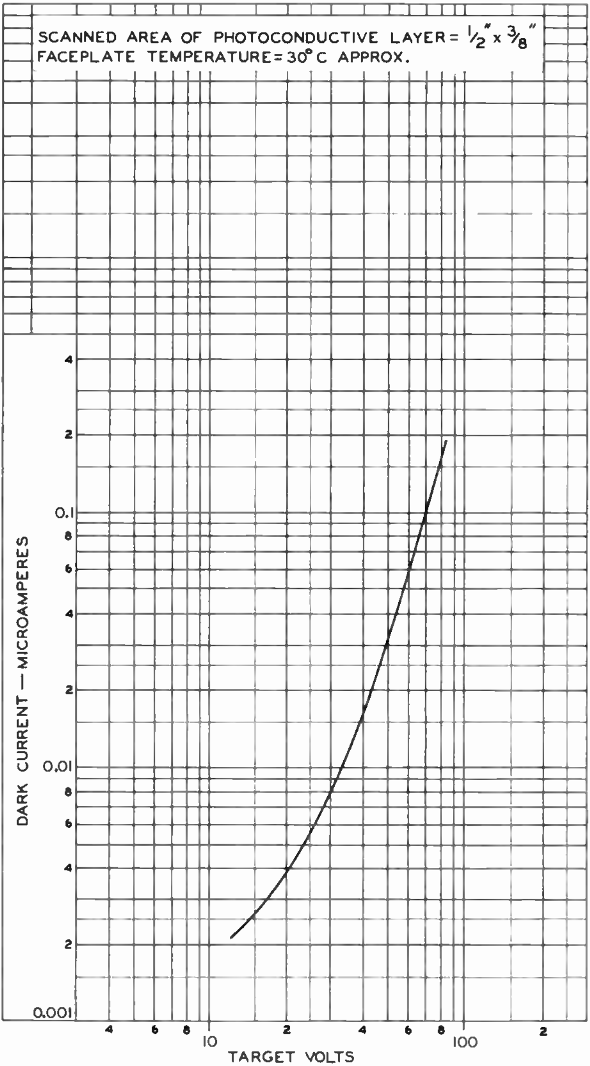
RCA

6326-A
TYPICAL DARK-CURRENT CHARACTERISTIC



92CM-9541

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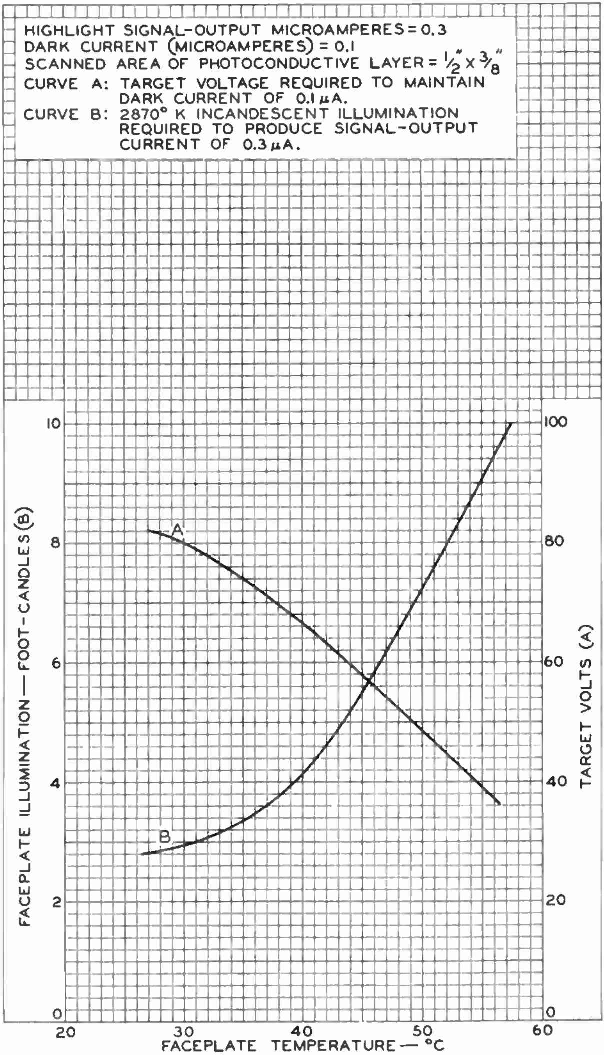
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6326-A

TYPICAL CHARACTERISTICS



ELECTRON TUBE DIVISION

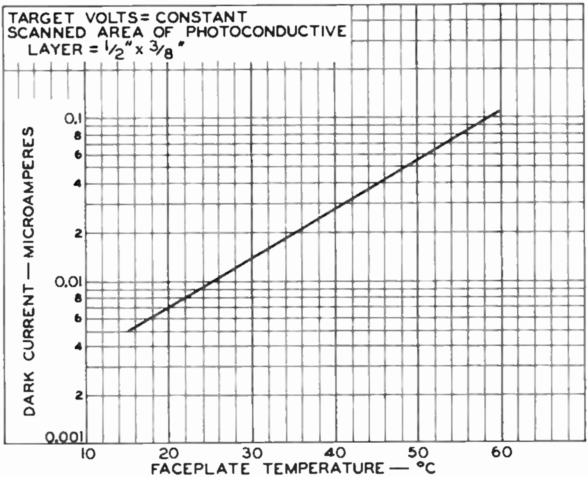
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9542

RCA

6326-A

TYPICAL CHARACTERISTIC



92CS-9539

Photomultiplier Tube

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

For AC-Operated Control Applications Such as Automobile-Headlight Control

GENERAL

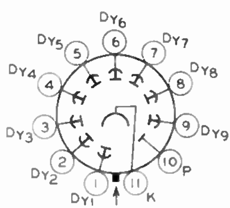
Spectral Response	S-4
Wavelength of Maximum Response	4000 ± 500 angstroms
Cathode, Opaque	Cs-Sb ←
Minimum projected length[a]	0.93 in
Minimum projected width	0.31 in
Window . . . . . Lime Glass, (Corning[b] No.0080), or equivalent ←	
Dynode Material	Cs-Sb
Direct Interelectrode Capacitances (Approx.)	
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	-	-	7.5×10^{-7}	A
At 25°C				

→ With E = Adjustable 60 c/s ac Voltage

	Min	*Typ*	*Max*	
Anode-to-Cathode Voltage[g].	525	750	990	V
RMS values				
Anode Dark Current[h].	-	-	1×10^{-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 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.

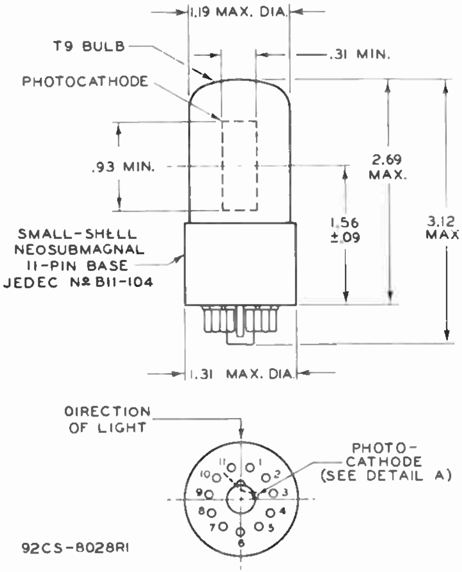
[f] Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870°K and a light input of 10 microlumens is used.

[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



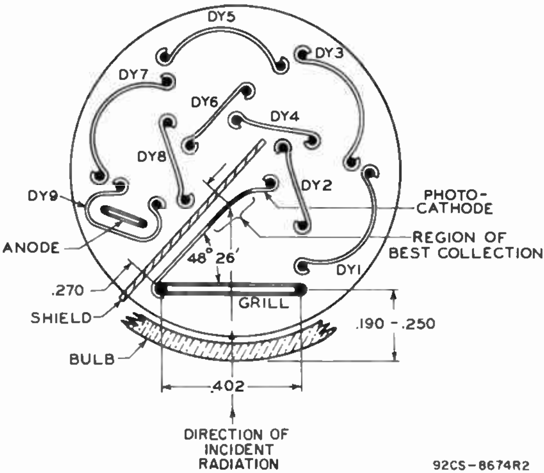
92CS-8028R1

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.

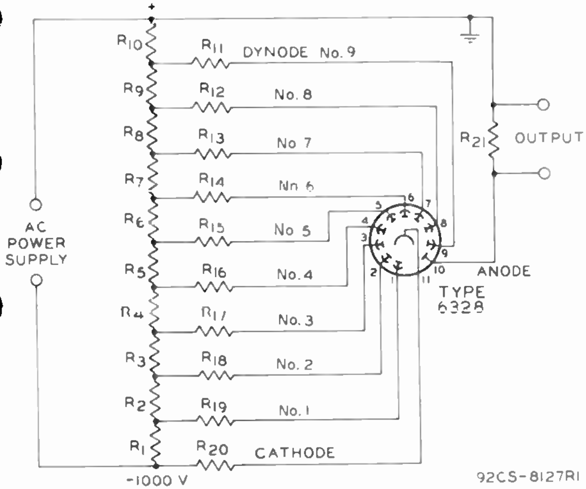
Note: The maximum angular variation between the planes through pins 1 and 11 and the plane of the grill will not exceed 6°.

DIMENSIONS IN INCHES

DETAIL A


DY5
DY3
DY7
DY6
DY4
DY8
DY2
DY9
PHOTO-CATHODE
ANODE
REGION OF BEST COLLECTION
48° 26′
DY1
.270
GRILL
SHIELD
.190 - .250
BULB
.402
DIRECTION OF INCIDENT RADIATION
92CS-8674R2

RECOMMENDED VOLTAGE-DIVIDER NETWORK FOR USE WITH TYPE 6328 IN HEADLIGHT-CONTROL SERVICE



92CS-8127R1

R1 R2 R3 R4 R5
R6 R7 R8 R9 R10: 1 megohm, 1/2 watt

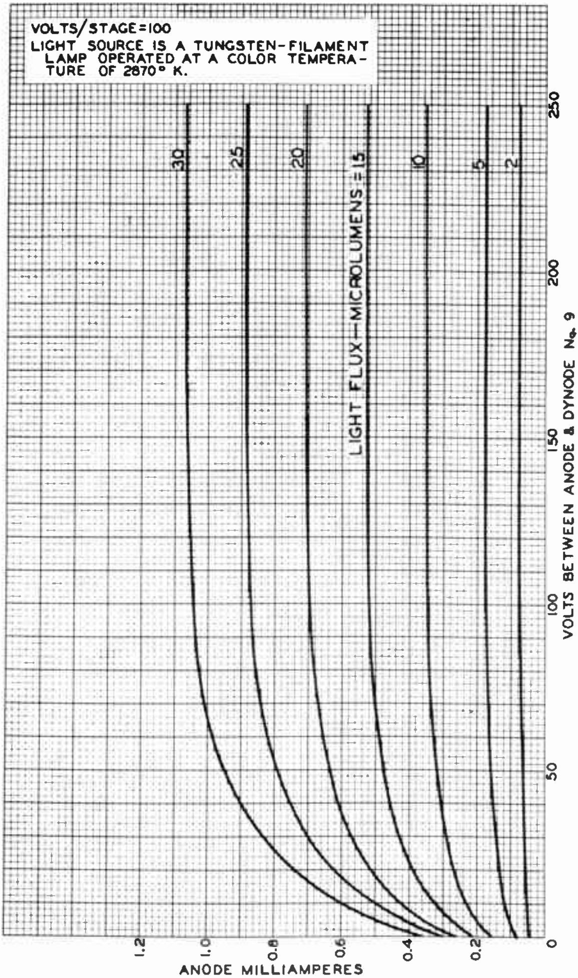
R11: 2 megohms, 1/2 watt

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

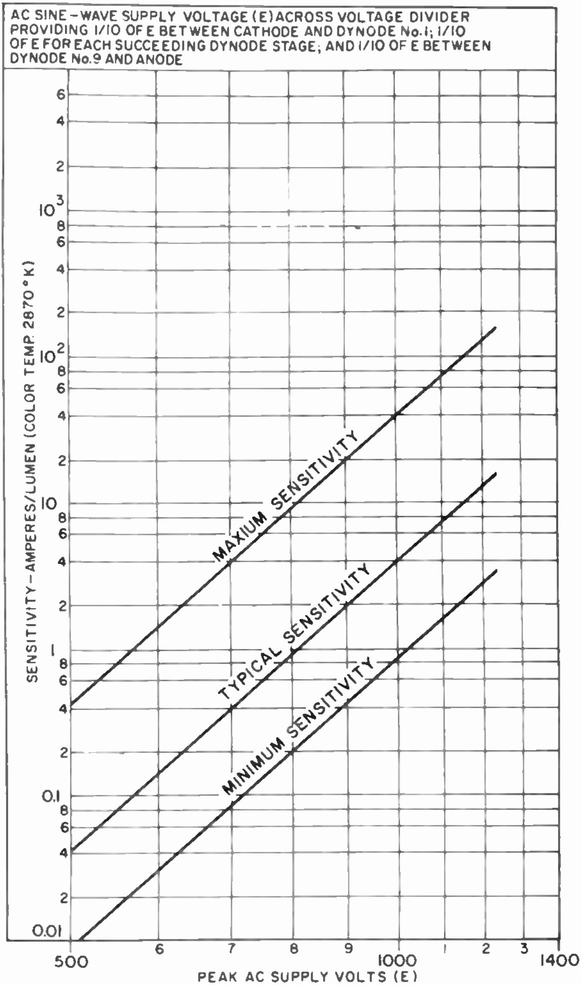
Typical Anode Characteristics



92CM-8029R2

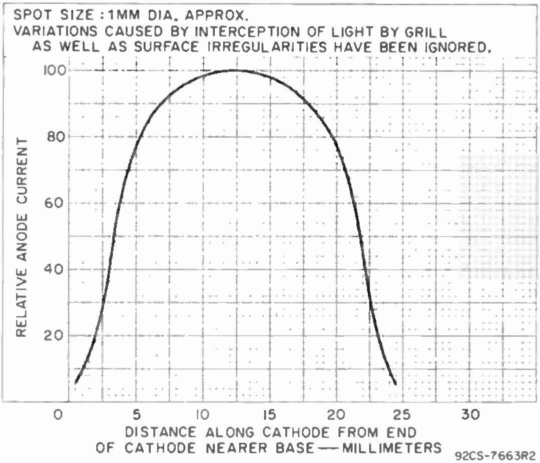
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

Sensitivity Characteristics

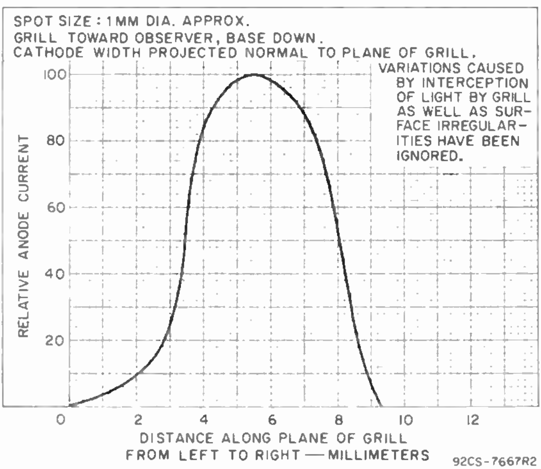


92CM-9571R1T

Variation in Photocathode Sensitivity Along Its Length



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



Multiplier Phototube

10-STAGE, HEAD-ON, FLAT-FACEPLATE

ELECTROSTATICALLY FOCUSED DYNODE STAGES

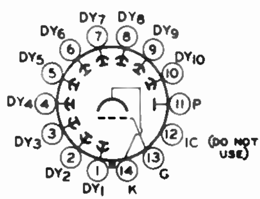
For Detection and Measurement of Nuclear Radiation and other Low-Level Light Sources in Scintillation Counters

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

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. . . .	–	$[illegible] \times 10^{4}$	–	a/w
Cathode radiant at 4400 angstroms. . . .	–	0.0[illegible]	–	a/w
Luminous:				
At 0 cps[e]	[illegible]	[illegible]	[illegible]00	a/lm
With dynode No.10 as output electrode[f] .	–	22	–	a/lm
Cathode luminous:				
With tungsten light source[g]	$[illegible] \times 10^{-[illegible]}$	$[illegible] \times 10^{-5}$	–	a/lm
With blue light source[h,s]	[illegible]	–	–	a
Current Amplification . .	–	$[illegible].9 \times 10^{5}$	–	
Equivalent Anode-Dark-Current Input[j]	–	2×10^{-10} [k]	2×10^{-9} [k]	lm
	–	$2.5 \times 10^{-1[illegible]}$ [m]	2.5×10^{-12} [m]	w
Equivalent Noise Input[n]	–	$7 \times 10^{-1[illegible]}$ [p]	1.7×10^{-11} [p]	lm
	–	$4.7 \times 10^{-1[illegible]}$ [p]	$2.[illegible] \times 10^{-14}$ [p]	w
Anode Pulse Rise Time[q] . .	–	$[illegible] \times 10^{-9}$	–	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.

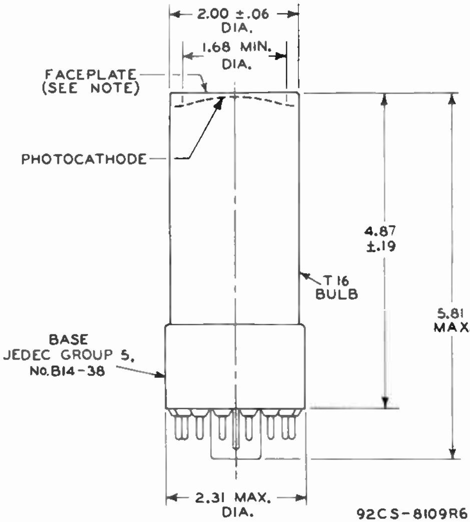
[p] Determined under the same conditions shown under (p) except that use is made of a monochromatic source having radiation at 4400 angstroms.

[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

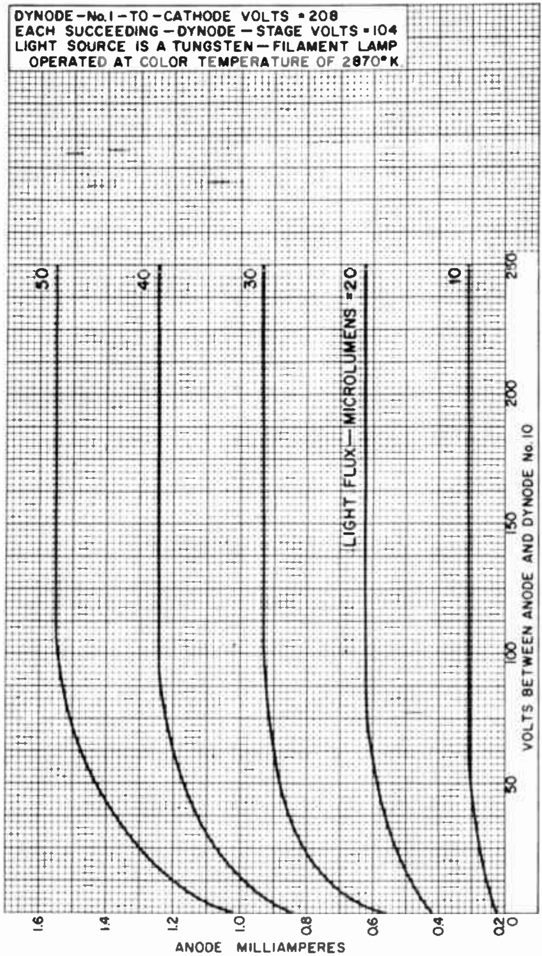


ALL DIMENSIONS IN INCHES

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.

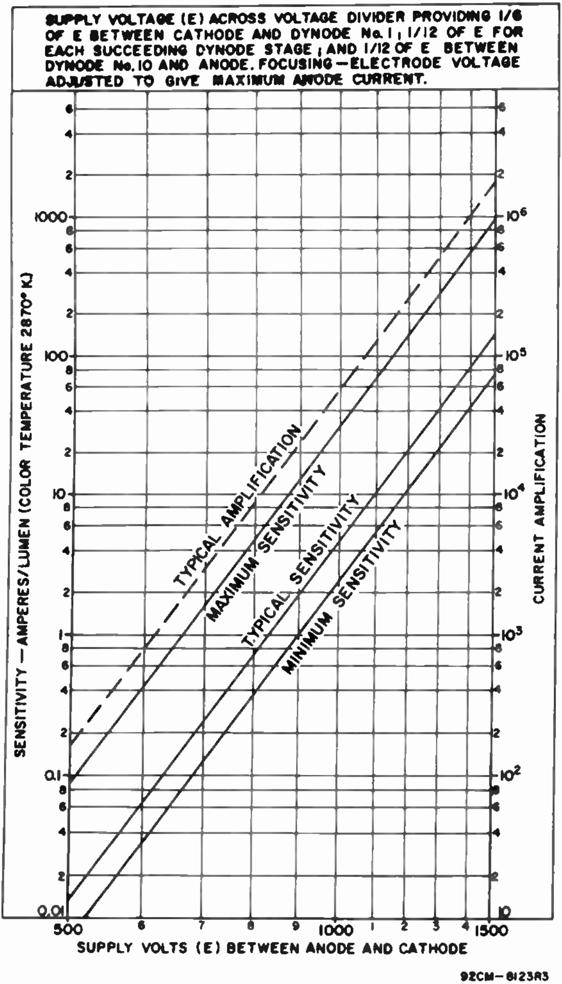
NOTE: WITHIN 1.68" DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.010" FROM PEAK TO VALLEY.

TYPICAL ANODE CHARACTERISTICS

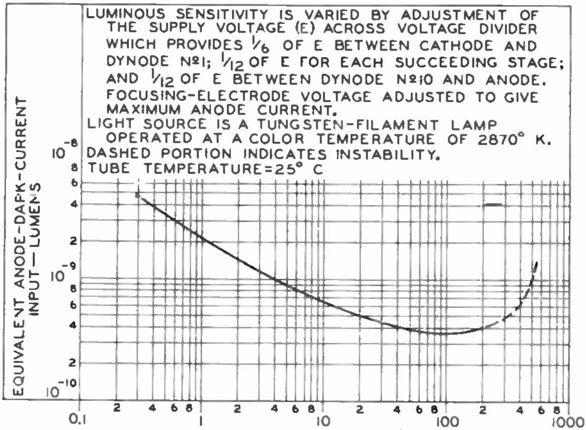


92CM-8125R4

CHARACTERISTICS



TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



RCA

6372

MULTIPLIER PHOTOTUBE

10-STAGE TYPE WITH
4-1/8" x 3" SEMITRANSPARENT CATHODE AND S-11 RESPONSE

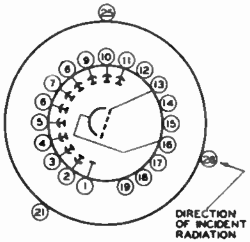
DATA

General:

Spectral Response		S-11
Wavelength of Maximum Response	4400 ± 500	angstroms
Cathode, Semitransparent:		
Shape		Semicylindrical
Window:		
Minimum length	4-1/8	in.
Minimum width (Along circumference of bulb)	3	in.
Minimum area	12-3/8	sq. in.
Index of refraction	1.48	
Direct Interelectrode Capacitances (Approx.):		
Anode to dynode No.10	5	$\mu\mu f$
Anode to all other electrodes	6.5	$\mu\mu f$
Maximum Overall Length		7-3/4"
Maximum Seated Length		7-1/4"
Length from Base Seat to Center of Useful Cathode Area		3-5/8" ± 1/8"
Maximum Diameter		2-9/16"
Mounting Position		Any
Weight (Approx.)		9 oz
Bulb		T-20
Base		Small-Button Twentyninar 22-Pin (JETEC No.E22-16)

BOTTOM VIEW

Pin 1 - Anode
Pin 2 - Dynode No.10
Pin 3 - Dynode No.9
Pin 4 - Dynode No.8
Pin 5 - Dynode No.7
Pin 6 - Dynode No.6
Pin 7 - Dynode No.5
Pin 8 - Dynode No.4
Pin 9 - Dynode No.3
Pin 10 - Dynode No.2
Pin 11 - Dynode No.1
Pin 12 - Internal Connection-Do Not Use
Pin 13 - Focusing Electrode
Pin 14 - Same as Pin 12
Pin 15 - Same as Pin 12
Pin 16 - Cathode
Pin 17 - Same as Pin 12
Pin 18 - Same as Pin 12
Pin 19 - Same as Pin 12
Pin 21 - Same as Pin 12
Pin 25 - Same as Pin 12
Pin 28 - Same as Pin 12



PINS 1-19: ON 1⅞" DIA. PIN CIRCLE
PINS 21,25,28: ON ⅞" DIA. PIN CIRCLE
PIN CIRCLES ARE CONCENTRIC

← Indicates a change.

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6372

MULTIPLIER PHOTOTUBE

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

ANODE-SUPPLY VOLTAGE (DC or Peak AC). . . .	1200 max.	volts
SUPPLY VOLTAGE BETWEEN DYNODE No.10 AND ANODE (DC or Peak AC). . . .	180 max.	volts
DYNODE-No.1 SUPPLY VOLTAGE (DC or Peak AC).	300 max.	volts
FOCUSING-ELECTRODE VOLTAGE (DC or Peak AC).	300 max.	volts
AVERAGE ANODE CURRENT●.	0.75 max.	ma
AMBIENT TEMPERATURE	75 max.	°C

Characteristics Range Values for Equipment Design:

Under conditions with supply voltage (E) across a voltage divider providing 1/12 of E between cathode and focusing electrode; 1/12 of E between focusing electrode 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.	*Median*	*Max.*	
Sensitivity:				
→ Radiant, at 4400 angstroms. .	-	16000	-	µamp/µwatt
→ Cathode radiant, at 4400 angstroms	-	0.026	-	µamp/µwatt
Luminous:♁				
At 0 cps.	5	20	-	amp/lumen
At 100 Mc	-	19	-	amp/lumen
Cathode luminous:				
With tungsten light source▲	20	33	-	µamp/lumen
With blue light source†⧫	0.026	-	-	µamp
Current Amplification	-	600000	-	
Equivalent Anode-Dark-Current Input✤	-	5×10^{-9}	1×10^{-8}	lumen
Equivalent Noise Input*■	-	1×10^{-10}	-	lumen

● Averaged over any interval of 30 seconds maximum.

♁ For conditions when 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 150 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, 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 150 volts are applied between cathode and all other electrodes connected together as anode.

⧫,✤,*,■: See next page. → Indicates a change.

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RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

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6372

MULTIPLIER PHOTOTUBE

♦ 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 20 amperes per lumen. Dark current caused by thermionic emission and ion feedback may be reduced by the use of a refrigerant.

* Under the following conditions: Supply voltage (E) is 1000 volts, 25°C tube temperature, 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.

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

OPERATING CONSIDERATIONS

The *operating stability* of the 6372 is dependent on the magnitude of the anode current and its duration. When the 6372 is operated at high 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 6372 usually recovers a substantial percentage of such loss in sensitivity.

The use of an average anode current well below the maximum rated value of 0.75 milliampere is recommended when stability of operation is important. When maximum stability is required, the anode current should not exceed 100 microamperes.

Electrostatic and/or *magnetic shielding* of the 6372 may be necessary.

SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-11 Response
is shown at the front of this Section

TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

6372

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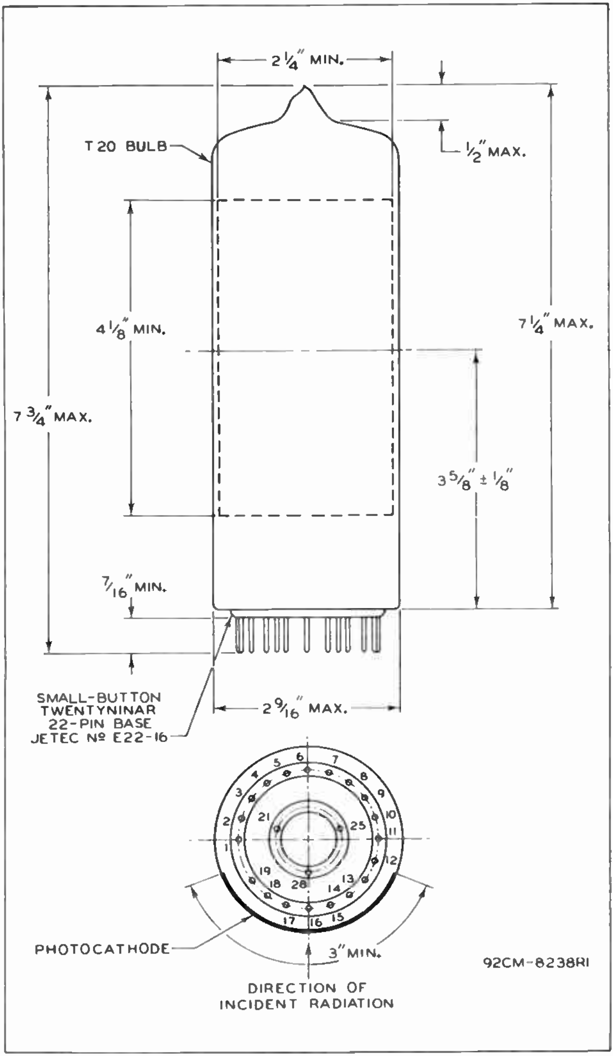
6372

MULTIPLIER PHOTOTUBE



SEPT. 1, 1955

CE-8238R1

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RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

6372

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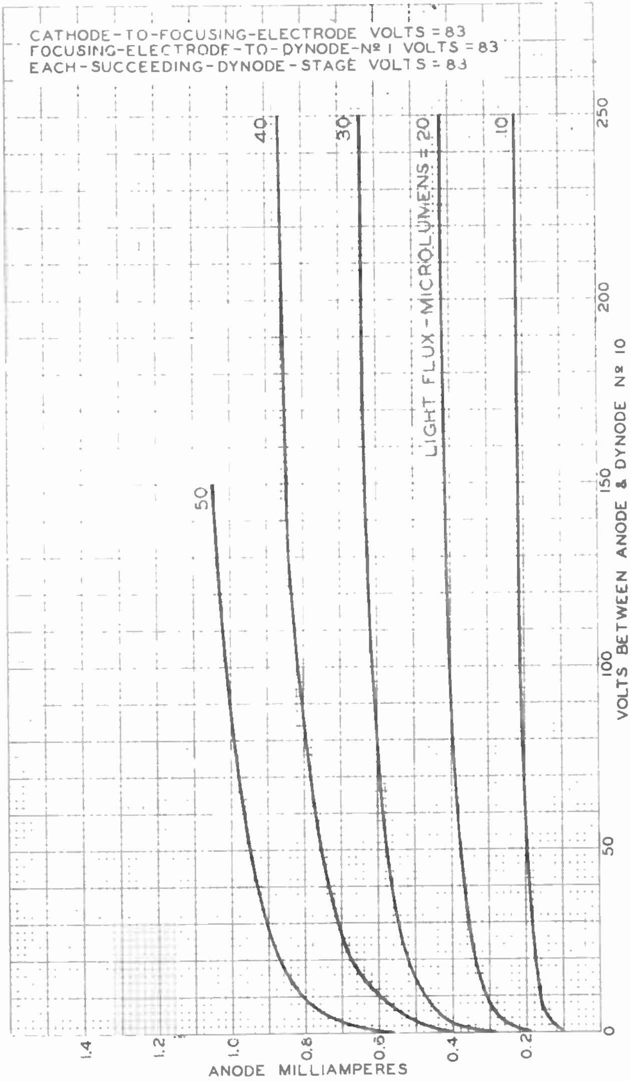
AVERAGE ANODE CHARACTERISTICS



FEB. 26, 1954

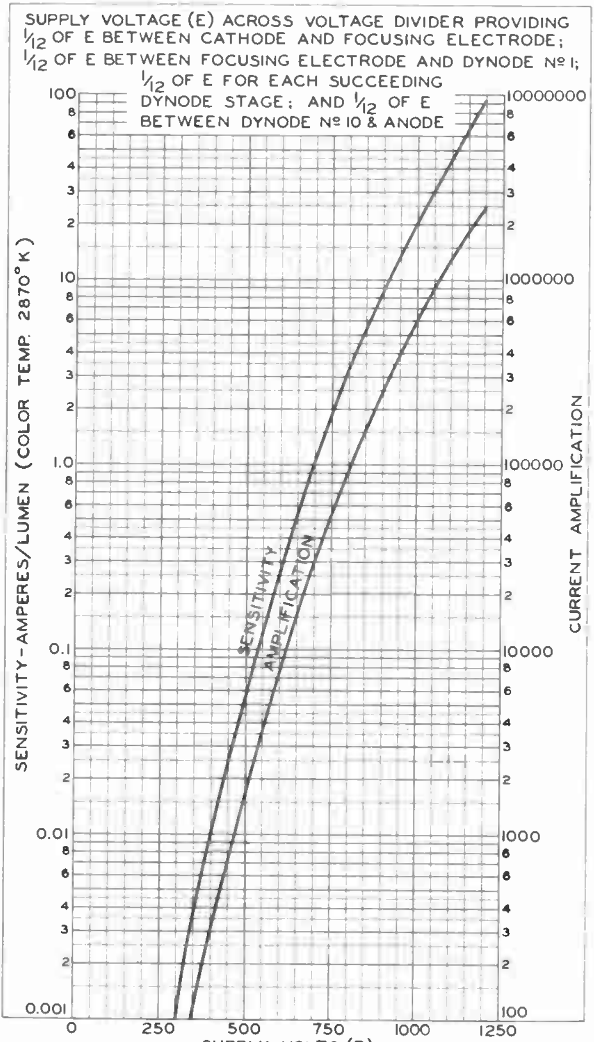
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-8258

6372

6372

AVERAGE CHARACTERISTICS



FEB. 26, 1954

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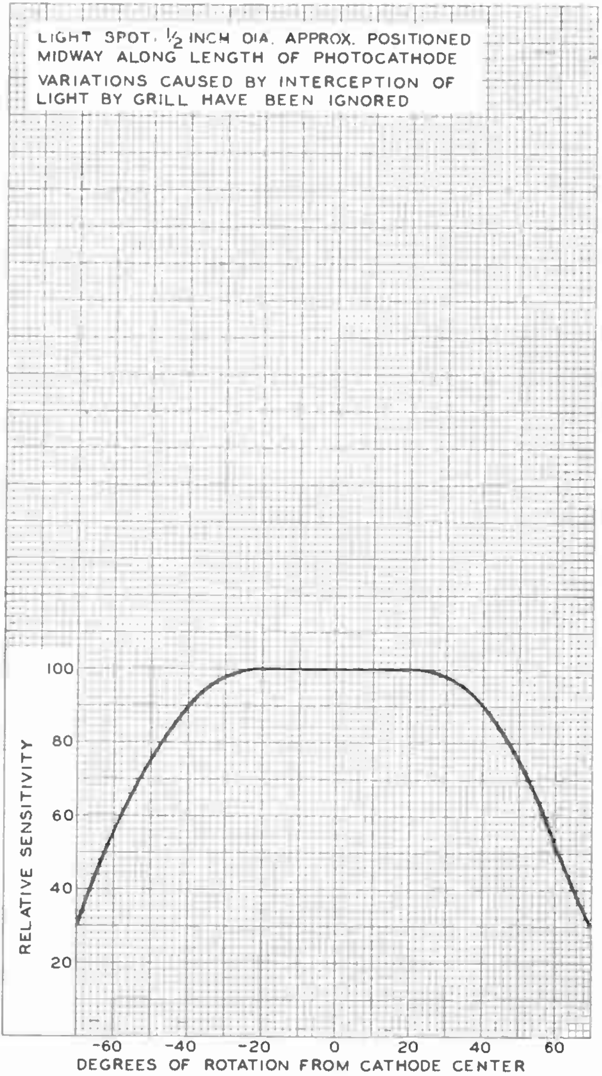
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CL-8257

6372

6372

VARIATION IN SENSITIVITY



APRIL 9, 1954

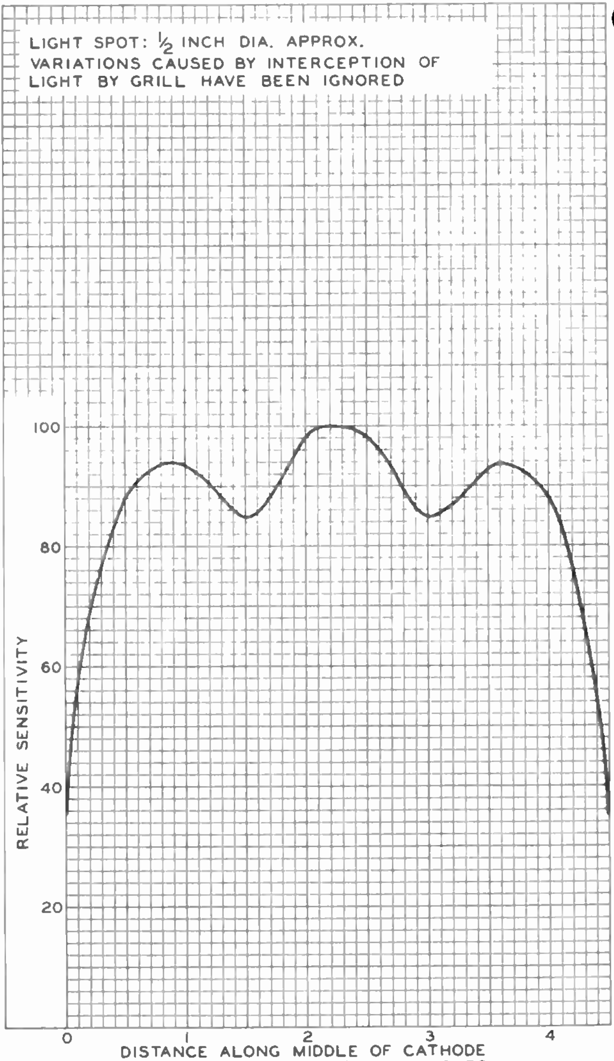
TUBE DIVISION
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-8304

RCA

6372

VARIATION IN SENSITIVITY



6405/1640

Gas Phototube

SIDE-ON TYPE | S-1 RESPONSE

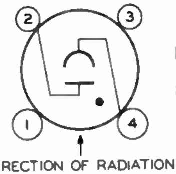
For Industrial Applications Critical as to Microphonics and Sensitivity Gradient

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]. . . . . 7/8"
Direct Interelectrode Capacitance (Approx.) . . . . [illegible]
Maximum Overall Length. . . . . 4-7/16"
Maximum Seated Length . . . . 3-15/16"
Seated Length to Center of Cathode . . . . 2-1/4" ± 3/32"
Maximum Diameter. [illegible]
Operating Position. . . . . Any
Weight (Approx.). . . . . 1.5 oz
Bulb. . . . . [illegible]
Socket. . . . . Amphenol No. [illegible], or equivalent
Base. . . . . .Dwarf-Shell Small 4-Pin (JEDEC No. [illegible]) Non-hygroscopic
  Basing Designation for BOTTOM VIEW. . . . . [illegible]

Pin 1 - No Internal Connection
Pin 2 - Anode



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.	Median	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] . . .	–	–	4.0	
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.	[illegible] min.	–	megohm
For dc currents above 3 µa.	–	2.5 min.	megohms
For dc currents below 3 µa.	–	[illegible] 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 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 measurement, 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.

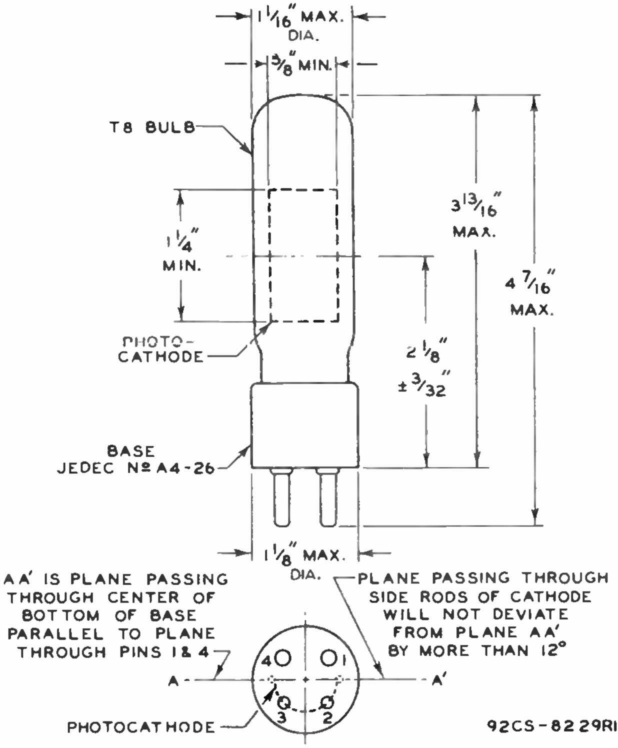
[e] The ratio of luminous sensitivity at an anode-supply voltage of 50 volts to luminous sensitivity at an anode-supply voltage of [illegible] volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the 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

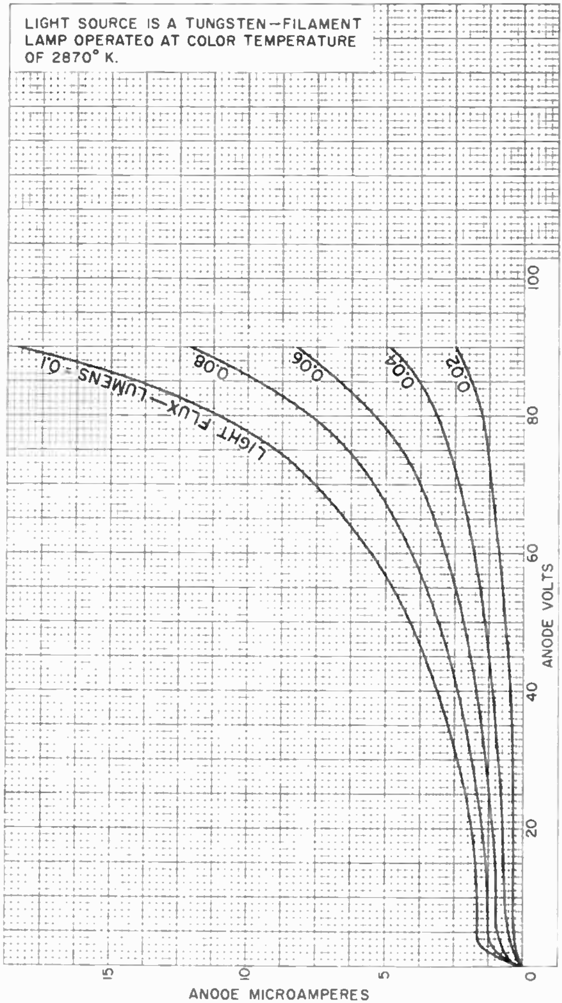
and

FREQUENCY-RESPONSE CHARACTERISTICS OF GAS PHOTOTUBES

are shown at the front of this section


1 1/16" MAX. DIA.
3/8" MIN.
T8 BULB
3 13/16" MAX.
4 7/16" MAX.
1 1/4" MIN.
PHOTO-CATHODE
2 1/8" ± 3/32"
BASE JEDEC № 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

AVERAGE ANODE CHARACTERISTICS



92CM-8227RI

Photomultiplier Tube

S-4 RESPONSE

FLEXIBLE LEADS SIDE-ON, 9-STAGE TYPE

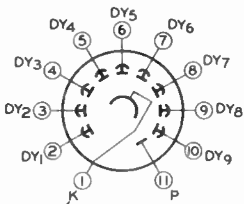
For AC- or DC-Operated Control Applications Which Require High Luminous Sensitivity

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. . . . . 2-3/4 in
  Excluding semiflexible leads
Maximum Envelope Length . . . . 2-1/4 in
  Excluding tip
Length. . . . . 1-1/4 ± 3/32 in
  From envelope seal to center of useful cathode area
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



DIRECTION OF LIGHT

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.

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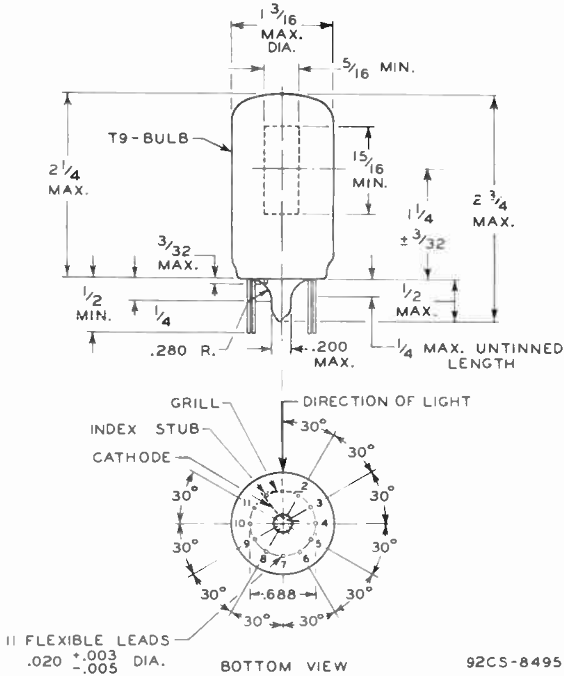
DIMENSIONAL OUTLINE

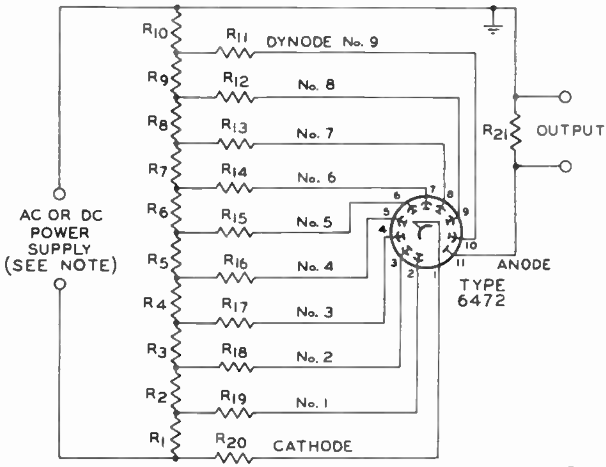


DIMENSIONS IN INCHES

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



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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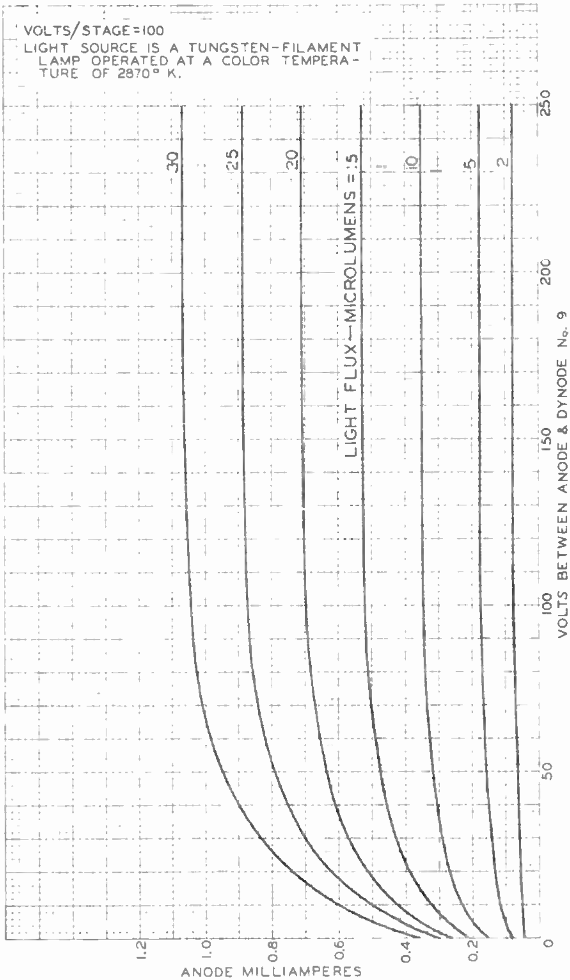
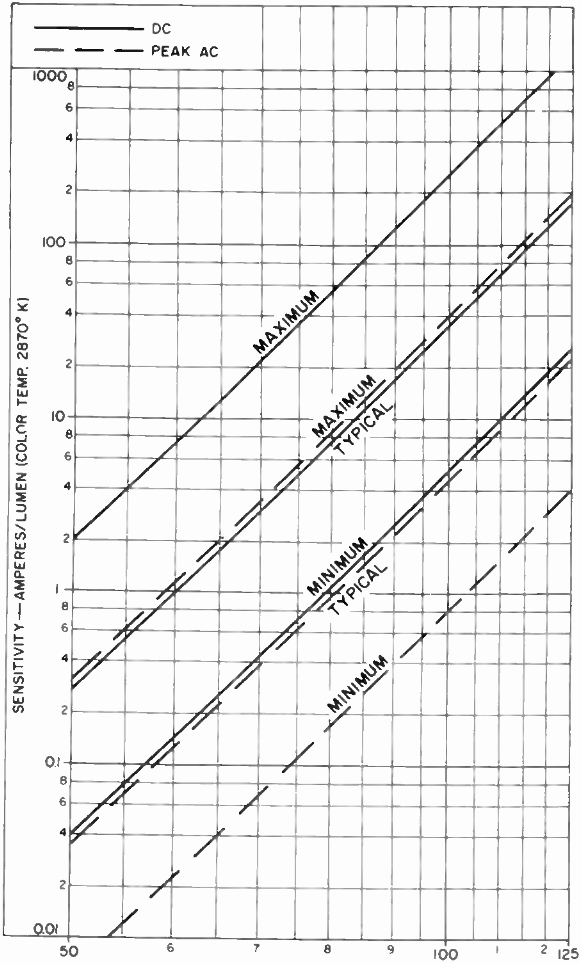
Typical Anode Characteristics



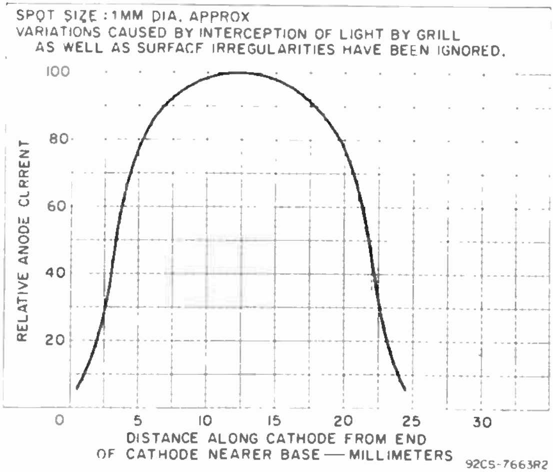
92CM-8029R2

Range of Luminous Sensitivity

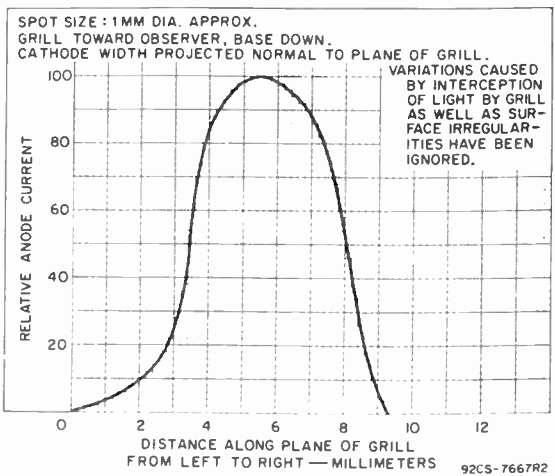


92CM-8027R2

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

DIRECTION OF LIGHT

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.

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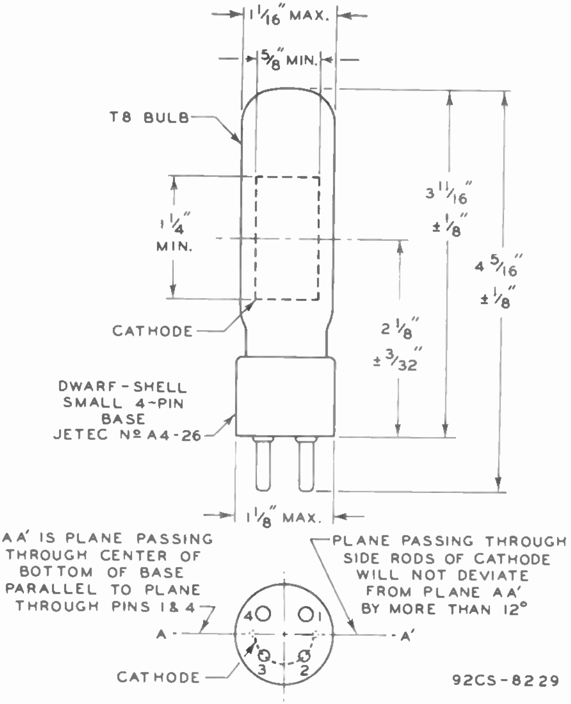
6570

VACUUM PHOTOTUBE

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



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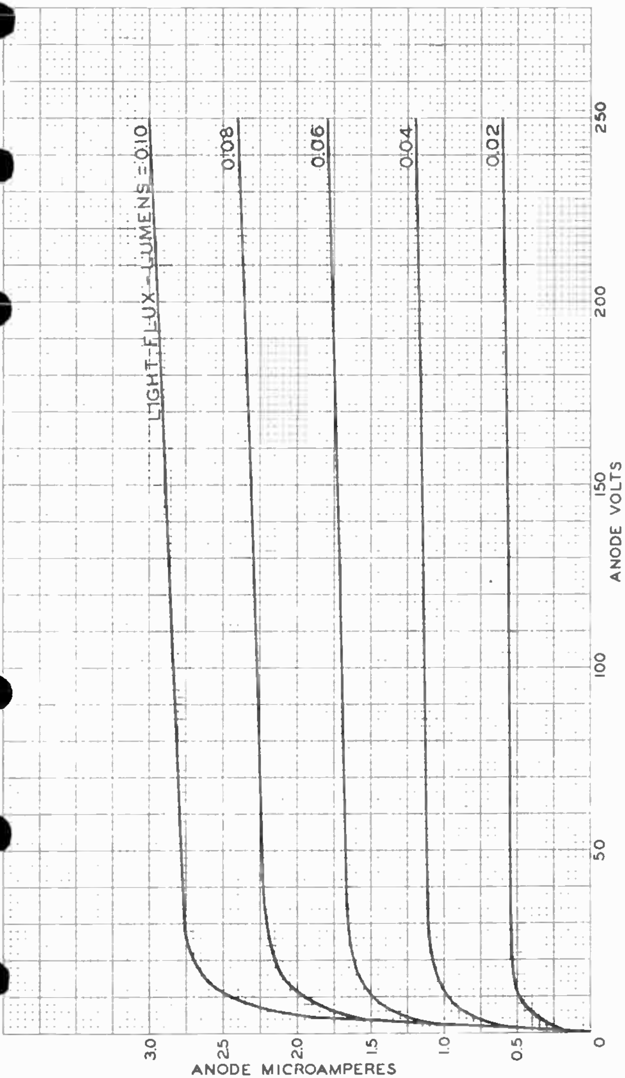
6570

AVERAGE ANODE CHARACTERISTICS



DEC. 3, 1954 | TUBE DIVISION | 92CM-8491

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6571

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6571

COMPUTER STORAGE TUBE

SINGLE-BEAM, PRIMARY-CURRENT-MODULATION TYPE

REDISTRIBUTION WRITING CAPACITANCE-DISCHARGE READING

DATA

General:

Heater, for Unipotential Cathode:

Voltage	6.3	ac or dc volts
Current	0.6	amp

Direct Interelectrode Capacitances (Approx.):

Grid No.1 to all other electrodes	6.5	µµf
Grid No.1 to deflecting electrode DJ_1	0.2	µµf
Grid No.1 to deflecting electrode DJ_2	0.2	µµf
Grid No.1 to deflecting electrode DJ_3	0.2	µµf
Grid No.1 to deflecting electrode DJ_4	0.2	µµf
Cathode to all other electrodes	5	µµf
DJ_1 to DJ_2	2.6	µµf
DJ_3 to DJ_4	2.6	µµf
DJ_1 to all other electrodes	9	µµf
DJ_2 to all other electrodes	9	µµf
DJ_3 to all other electrodes	8	µµf
DJ_4 to all other electrode	7	µµf

Focusing Method . . . . . Electrostatic

Deflection Method . . . . . Electrostatic

Deflecting-electrode arrangement . . . . . *See Dimensional Outline*

Storage Surface . . . . . On inner surface of faceplate

Signal-Output Electrode . . . . . Metal plate or 50-line (minimum) mesh covering external surface of faceplate and capacitively coupled to the storage surface. (This electrode is not supplied with the tube).

Overall Length . . . . . 11-1/2" ± 1/4"

Greatest Diameter of Bulb . . . . . 3" ± 1/16"

Weight (Approx.) . . . . . 9 oz

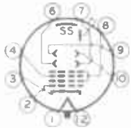
Mounting Position . . . . . Center of tube face must be at same elevation as or at higher elevation than tube base.

Cap . . . . . Recessed Small Cavity (JETEC No.J1-21)

Base . . . . . Small-Shell Duodecal 10-Pin (JETEC No.B10-75)

BOTTOM VIEW

Pin 1 - Heater
Pin 2 - Grid No.1
Pin 3 - Cathode
Pin 4 - Grid No.3
Pin 6 - Deflecting Electrode DJ_4
Pin 7 - Deflecting Electrode DJ_3
Pin 8 - Ultor (Grid No.2 & No.4)



Pin 9 - Deflecting Electrode DJ_2
Pin 10 - Deflecting Electrode DJ_1
Pin 12 - Heater
Cap - Collector
SS - Storage Surface▲

▲ The Signal-Output Electrode is capacitively coupled to the Storage Surface.

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6571

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Maximum Ratings, *Design-Center Values:*

COLLECTOR VOLTAGE:		
Difference between collector voltage and ultor voltage	150 max.	volts
ULTOR• VOLTAGE	2500 max.	volts
GRID-No.3 VOLTAGE	1000 max.	volts
GRID-No.1 VOLTAGE:		
Negative bias value	200 max.	volts
Positive bias value	0 max.	volts
Positive peak value	2 max.	volts
PEAK VOLTAGE BETWEEN ULTOR AND ANY DEFLECTING ELECTRODE	500 max.	volts
PEAK HEATER-CATHODE VOLTAGE:		
Heater negative with respect to cathode	125 max.	volts
Heater positive with respect to cathode	125 max.	volts

Equipment Design Ranges:

For any ultor voltage (E_{c_4}) between 1000 and 2500 volts

Collector Voltage	95% to 105% of E_{c4}	volts
Grid-No.3 Voltage	20% to 28% of E_{c4}	volts
Max. Grid-No.1 Voltage for Beam-Current Cutoff	2.4% of E_{c4}	volts
Max. Grid-No.3 Current Range	-15 to +10	μamp
Deflection Factors:		
DJ_1 & DJ_2	39 to 53	v dc/in./kv of E_{c4}
DJ_3 & DJ_4	35.5 to 48.5	v dc/in./kv of E_{c4}
Focused-Beam Position	##	

Examples of Use of Design Ranges:

For ultor voltage of	*1000*	*2500*	*volts*
Collector Voltage	950 to 1050	2375 to 2625	volts
Grid-No.3 Voltage	200 to 280	500 to 700	volts
Max. Grid-No.1 Voltage for Beam-Current Cutoff	-24	-60	volts
Deflection Factors:			
DJ_1 & DJ_2	39 to 53	97.5 to 133	volts dc/in.
DJ_3 & DJ_4	35.5 to 48.5	89 to 122	volts dc/in.

• The "ultor" in a storage tube is the electrode to which is applied the highest dc voltage for accelerating the electrons in the beam prior to its deflection. In the 6571, the ultor function is performed by grid No.4. Since grid No.4 and grid No.2 are connected together within the 6571, they are collectively referred to simply as "ultor" for convenience in presenting data and curves.

The center of the undeflected focused beam will fall within a circle having a 7.5-mm radius concentric with the center of the tube face.

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6571

COMPUTER STORAGE TUBE

Storage Characteristics for Ultor Voltage of 2500 Volts:

Storage-Surface Boundary (In terms of deflection voltage):		
In the DJ_1-DJ_2 direction from position of undeflected focused beam . .	±109	volts
In the DJ_3-DJ_4 direction from position of undeflected focused beam . .	±100	volts
Blemish Factor*, for storage surface within indicated boundary.	0.5 max.	
Spill (Determined for Double-Dot Pattern):**		

Under conditions involving 255 references to "spill" element and 1 reference to "test" element

Separation Between Storage Elements, in either the DJ_1-DJ_2 or DJ_3-DJ_4 direction in terms of deflection voltage:		
At center of storage surface	8 max.	volts
At midpoint on each side of storage-surface boundary	10 max.	volts

Maximum Circuit Values:

Grid-No.1-Circuit Resistance	1.5 max.	megohms
Resistance in Any Deflecting-Electrode Circuit■	1.0 max.	megohm

* Blemish factor is defined as the factor by which the normal positive signal is reduced by the blemish.

** Spill is indicative of the amount of binary information that can be stored by the tube. The storage capability is determined by the separation between two storage elements at which the signal from one element is changed by no more than a specified amount after repeated references to the other element. For the 6571, the separation is measured, in terms of deflection voltage, when the amplitude of the negative signal of the "test" element has decreased to 50% of its maximum negative amplitude. The maximum negative amplitude is determined by separating the two elements far enough to eliminate the effects of secondary electron redistribution from the "spill" element.

■ It is recommended that the deflecting-electrode-circuit resistances be approximately equal.

OPERATING CONSIDERATIONS

Shielding. In typical computer applications, the 6571 is mounted in a compartment having effective magnetic and electrostatic shielding. It is recommended that the bulb be provided with a tight-fitting electrostatic shield extending from the base to the collector coating. *(See Dimensional Outline).* This external shield supplements the shielding action of the collector in preventing cross-coupling between the electron gun and the external signal electrode.

A *signal-output electrode* shaped to conform with the external contour of the faceplate and placed in contact with the entire area of the faceplate is required. The signal-output electrode is connected to a low-noise video

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6571

COMPUTER STORAGE TUBE

amplifier having sufficient gain to amplify signals from a fraction of a millivolt to the desired level.

The *amount of information that can be stored by the 6571* is dependent on the manner in which it is operated, and is affected by the stability of the deflecting system, freedom from noise in the associated output circuit, the number of regenerations compared with the number of addresses, and the effectiveness of the electrostatic and magnetic shielding.

In general, the number of storage elements is proportional to the operating ultor voltage. For the greatest number of storage elements, the 6571 should be operated at the rated maximum ultor voltage and so that the peak grid-No.1 drive is less than that required for the maximum positive amplitude but high enough to provide a satisfactory output signal.

It is recommended that the beam current be limited to the minimum value which provides satisfactory signal amplitude.

The *storage characteristics* in the tabulated data and curve are based on the use of a double-dot pattern. In this method of storage, the positive signal is produced by adjusting the beam current and the distance between two dot storage elements so that the optimum positive signal is produced when the "test" element is addressed. Other methods of storage such as superimposed focused and defocused spots or dots and dashes may be used equally well with the 6571.

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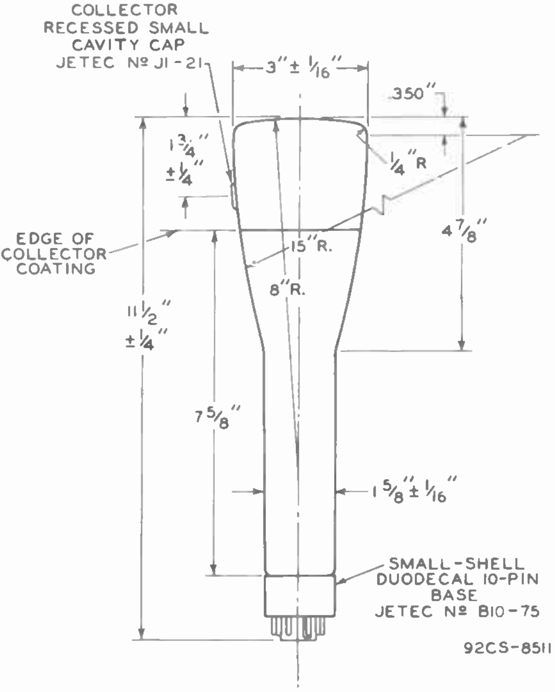
6571
COMPUTER STORAGE TUBE



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

DJ_1 AND DJ_2 ARE NEARER THE STORAGE SURFACE: DJ_3 AND DJ_4 ARE NEARER THE BASE. WITH DJ_1 POSITIVE WITH RESPECT TO DJ_2, THE BEAM WILL BE DEFLECTED TOWARD PIN 2; LIKEWISE, WITH DJ_3 POSITIVE WITH RESPECT TO DJ_4, THE BEAM WILL BE DEFLECTED TOWARD VACANT PIN POSITION 11.

THE PLANE THROUGH TUBE AXIS AND EACH OF THE FOLLOWING ITEMS MAY VARY FROM THE DEFLECTION PATH PRODUCED BY DJ_1 AND DJ_2 BY THE FOLLOWING ANGULAR TOLERANCES (MEASURED ABOUT THE TUBE AXIS): PIN 2, 10°; SIDE TERMINAL (ON SAME SIDE AS PIN 8), 10°. ANGLE BETWEEN DJ_1-DJ_2 DEFLECTION PATH AND DJ_3-DJ_4 DEFLECTION PATH IS $90^{\circ} \pm 3^{\circ}$.

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6571

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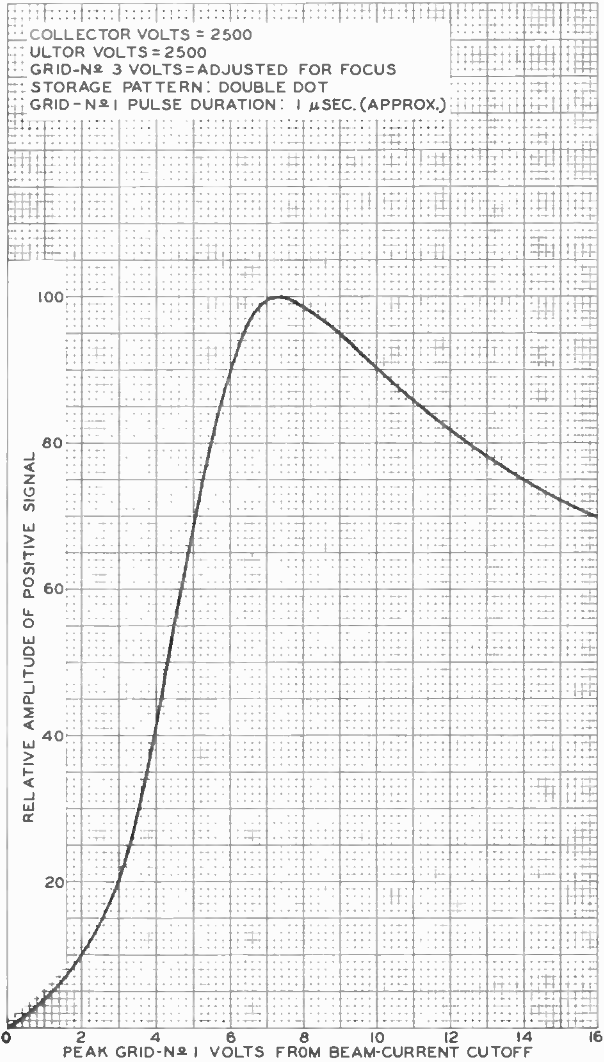
AVERAGE CHARACTERISTIC



JAN. 27, 1955 TUBE DIVISION 92CM-8510

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

Photomultiplier Tube

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

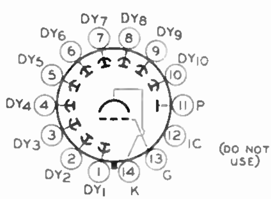
For Use in Scintillation Counters for the Detection and Measurement of Nuclear Radiation and Other Low-Level Light Sources

GENERAL

Spectral Response S-11
Wavelength of Maximum Response . . . . . . 4400 ± 500 angstroms
Cathode, Semitransparent . . . . Cs-Sb
[illegible] . . . Curved, Circular
[illegible] . . . 2.2 sq in
[illegible] . . . 1.68 in
Window . . . . . . Lime Glass, Corning[a] No.0080, or equivalent
[illegible] . . . Plano-Concave
[illegible] . . . 1.51
Dynodes
[illegible] . . . Ni
[illegible] . . . Cs-Sb
[illegible] . . . Circular-Cage
Direct Interelectrode Capacitances (Approx.)
[illegible] . . . 4.4 pF
[illegible] . . . 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.814-38), Non-hygroscopic
Socket . . . . Loranger[b] No.2274, or equivalent
Magnetic Shield . . . . Millen[c] Part No.808028, or equivalent ←

TERMINAL DIAGRAM (Bottom View)

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
[illegible]
Pin [illegible]: 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.

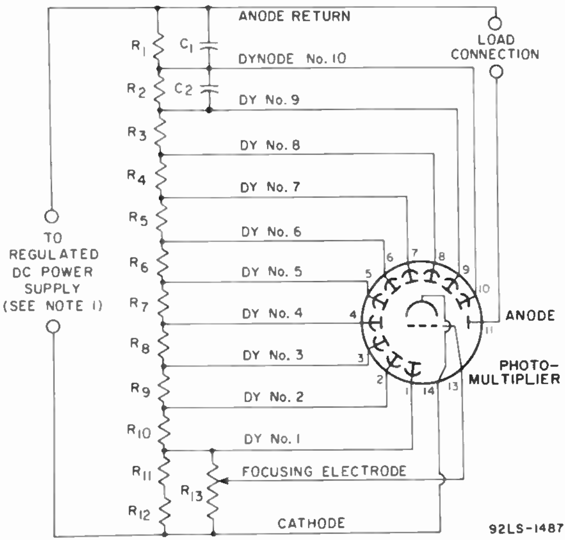
p At 4400 angstroms. This value is calculated from the rating in lumen using a conversion factor of 804 lumens per watt.

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



92LS-1487

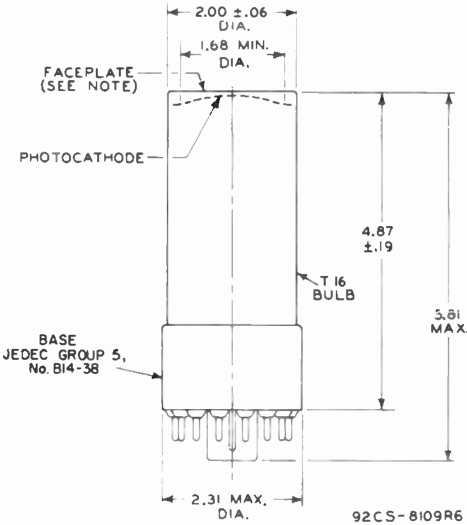
C_1, C_2: 0.01 μF non-inductive type, 400 volts (dc working). Values dependent on amplitude and duration of pulse.

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.

DIMENSIONAL OUTLINE



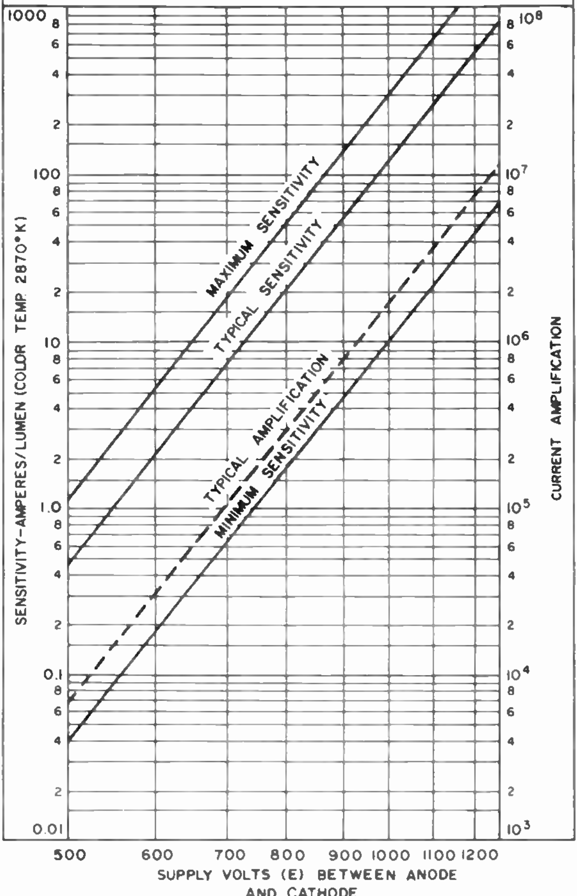
DIMENSIONS IN INCHES

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.

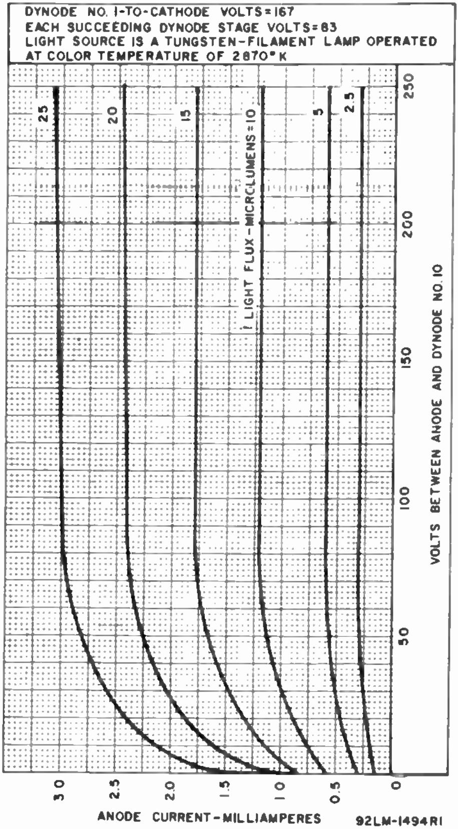
Typical Sensitivity and Current Amplification Characteristics

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

Typical Anode Characteristics



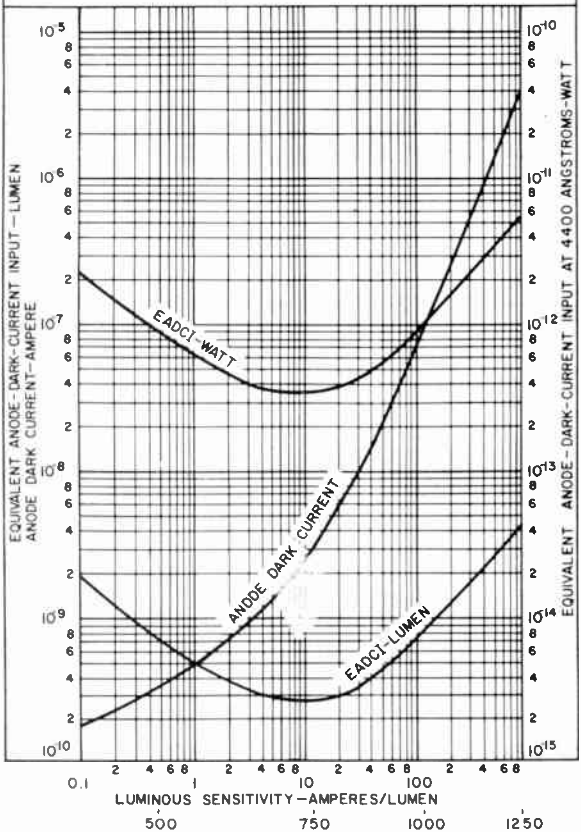
Typical Dark Current and EADCI Characteristics

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.

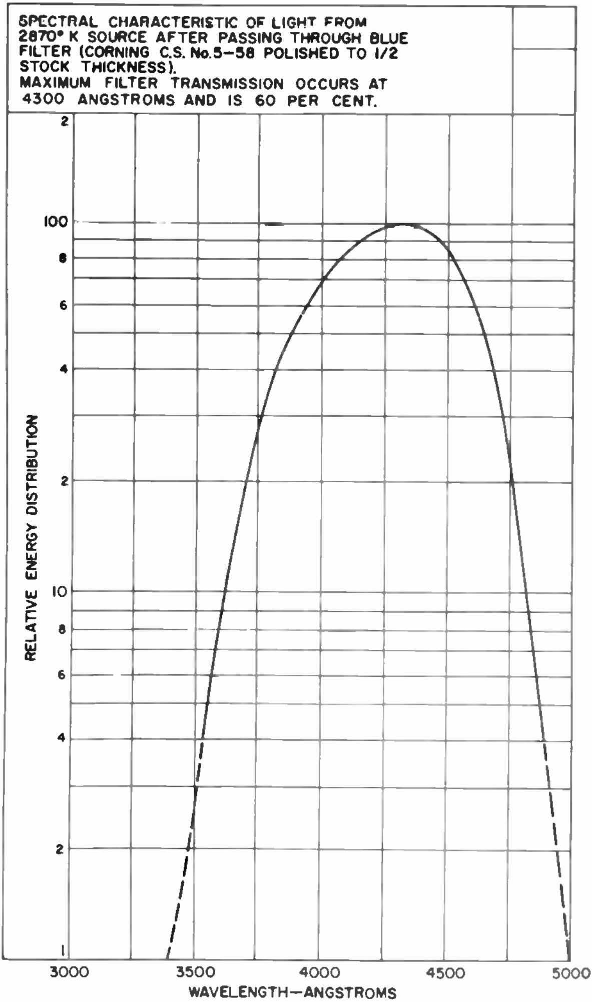
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K

TUBE TEMPERATURE = 22° C



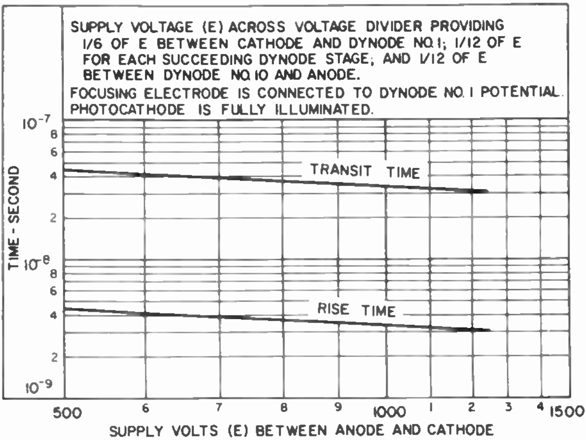
92LM-1495

Spectral Energy Distribution of 2870°K Light Source after Passing Through Blue Filter



92CM—11081R1

Typical Time-Resolution Characteristics



92LS-1476

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.	°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° 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° K).	5×10^{-5}	7×10^{-5}	–	A/lm
Current with blue light source[m] (2870° 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.

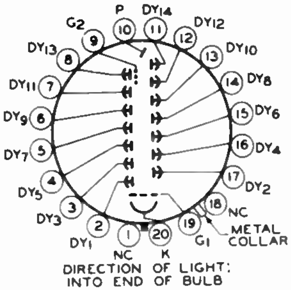
r At 4400 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 803 lumens per watt.

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.

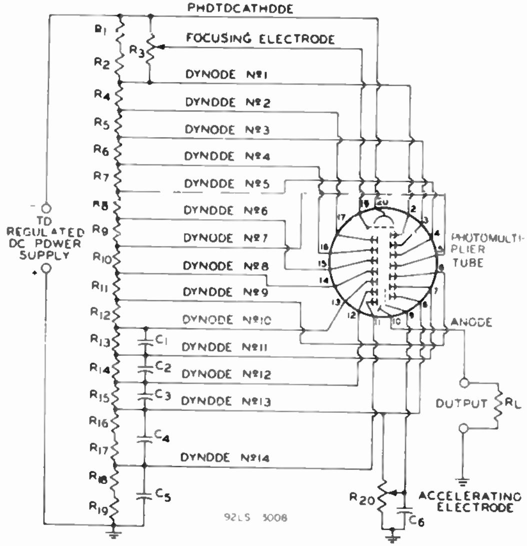
TERMINAL DIAGRAM (Bottom View)

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

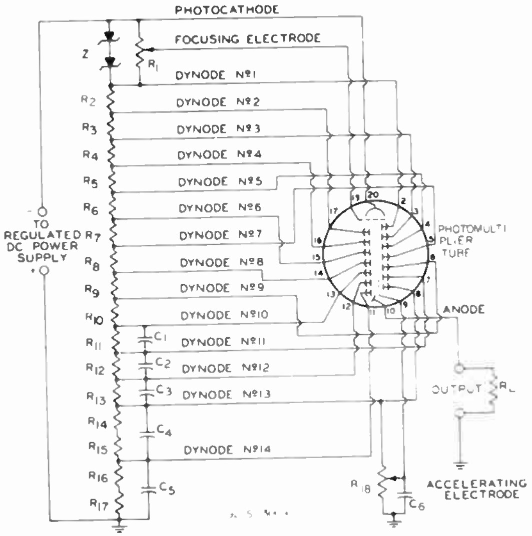


C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (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_{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 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

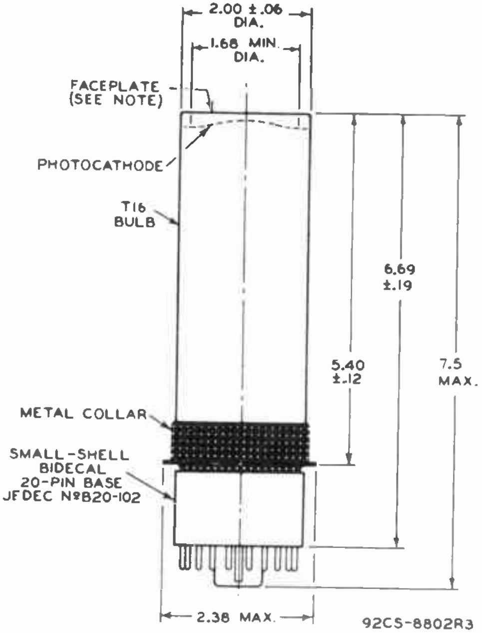


C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (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_{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: (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° 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

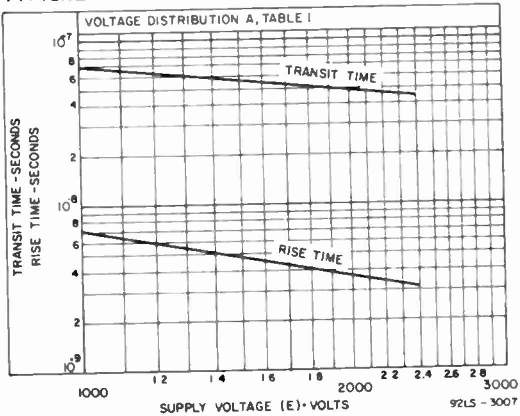
Inch	mm	Inch	mm	Inch	mm
0.06	1.5	1.68	42.6	5.40	137.1
0.12	3.0	2.00	50.8	6.69	169.9
0.19	4.8	2.38	60.4	7.5	190.5

Table 1		
Voltage Distribution		
	A	B
Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	5.4% of Supply Voltage (E) multiplied by	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	—

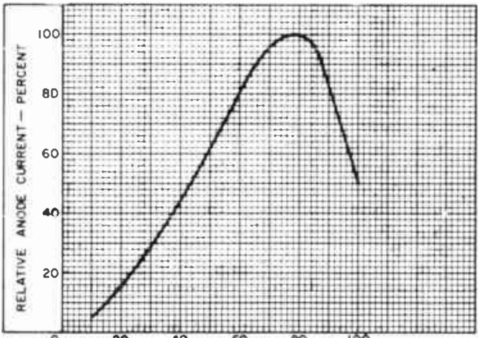
Focusing electrode is connected to arm of potentiometer between cathode and dynode No. 1; the focusing electrode voltage is varied to give maximum anode current.

♦Cathode-to-dynode No. 1 voltage is maintained at 360 volts.

TYPICAL TIME-RESOLUTION CHARACTERISTICS

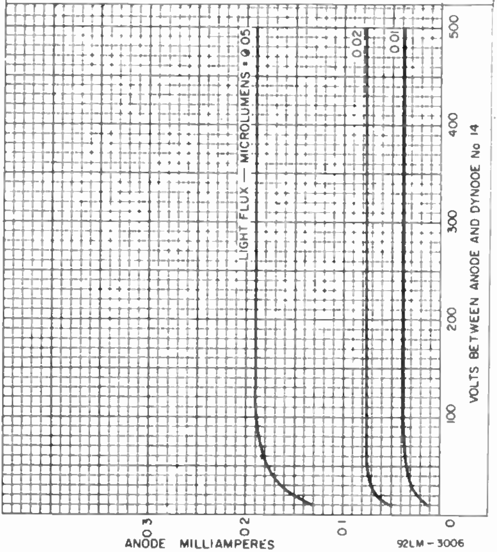


TYPICAL FOCUSING ELECTRODE CHARACTERISTIC

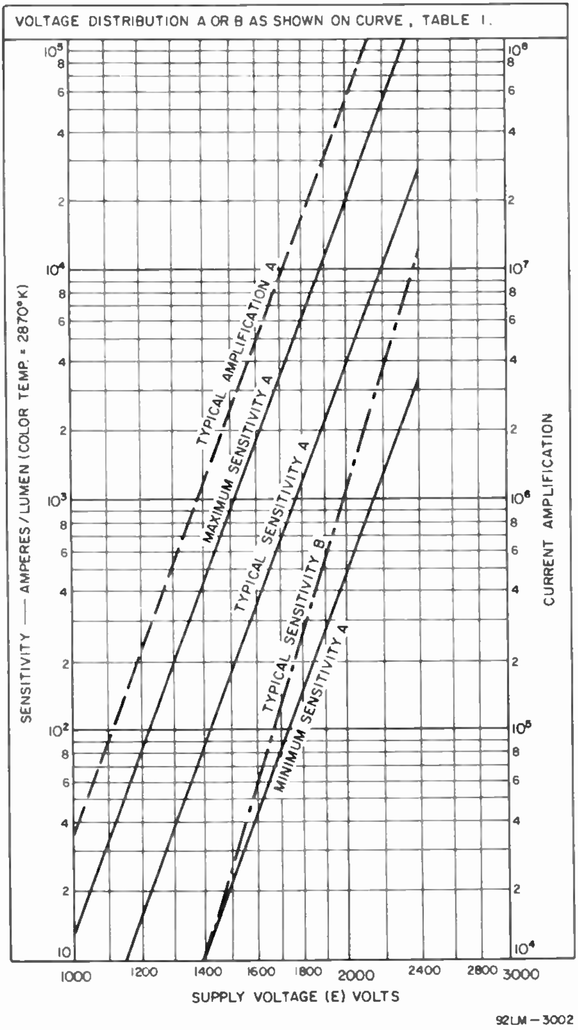


TYPICAL ANODE CHARACTERISTICS

CATHODE-TO-FOCUSING ELECTRODE VOLTS = 173
CATHODE-TO-DYNODE No I (DYI) VOLTS = 216
DYI-TO-DY2, DY2-TO-DY3 ETC TO DY10-TO-DY11 VOLTS = 108
DY11-TO-DY12 VOLTS = 135
DY12-TO-DY13 VOLTS = 160
DY13-TO-DY14 VOLTS = 189
GRID No. 2 VOLTS ADJUSTED TO GIVE MAX ANODE CURRENT
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K



SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

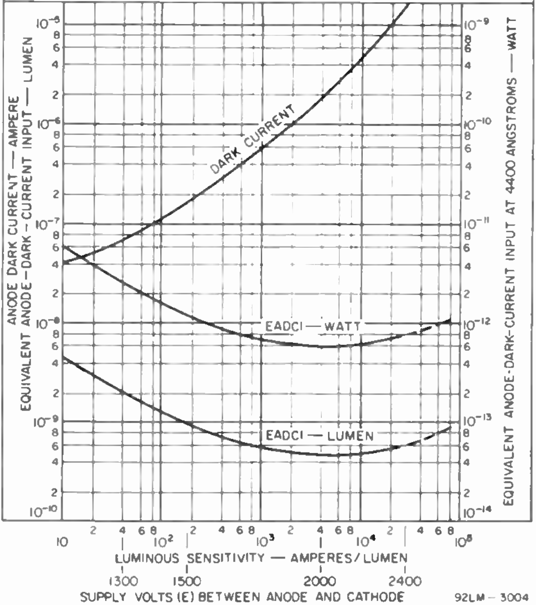


TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS

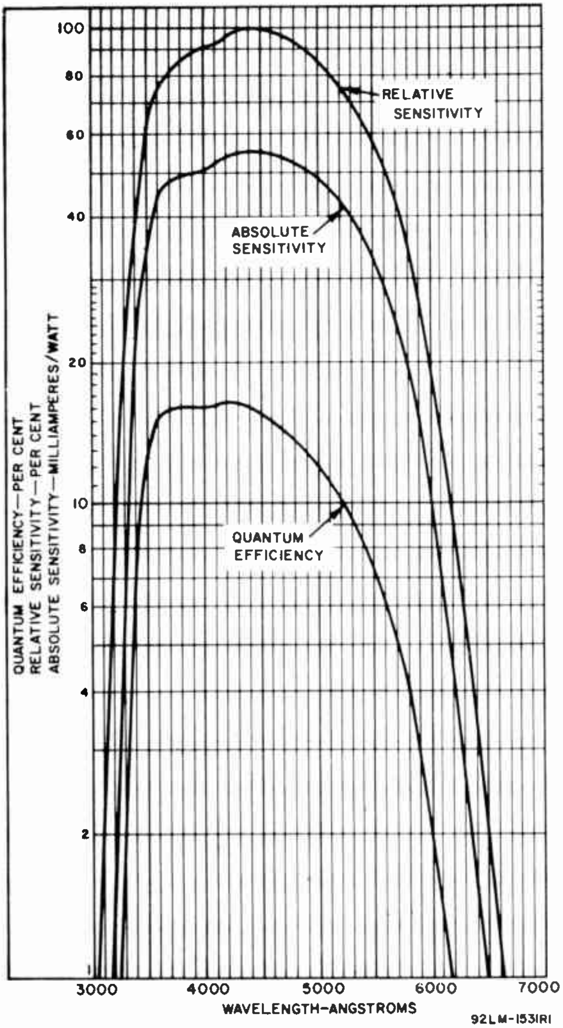
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES VOLTAGES AS FOLLOWS:

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



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



RCA

6866
DISPLAY STORAGE TUBE

DIRECT-VIEW TYPE
4"-DIAMETER DISPLAY
NON-EQUILIBRIUM WRITING   GRID-CONTROL READING (VIEWING)

DATA

General:

	Writing Section	Viewing Section	
Heater, for Unipotential Cathode:			
Voltage (AC or DC)	6.3	6.3	volts
Current	0.6	0.6	amp
Minimum Cathode Heating Time before other electrode voltages are applied	-	30	sec
Direct Interelectrode Capacitances (Approx.):°			
Grid No.1 to all other tube electrodes	6	18	μμf
Cathode to all other tube electrodes	4.2	6.5	μμf
Deflecting electrode DJ_1 to deflecting electrode DJ_2	1.8	-	μμf
Deflecting electrode DJ_3 to deflecting electrode DJ_4	1.8	-	μμf
DJ_1 to all other tube electrodes	7.5	-	μμf
DJ_2 to all other tube electrodes	8	-	μμf
DJ_3 to all other tube electrodes	6	-	μμf
DJ_4 to all other tube electrodes	7	-	μμf
Focusing Method	Electrostatic	None	
Deflection Method	Electrostatic	None	
Deflecting-Electrode Arrangement	*See Dimensional Outline*	-	
Phosphor	-	High-Visual-Efficiency Type, Aluminized	
Fluorescence	-	Yellow	
Phosphorescence	-	Yellow	

Minimum Useful Screen Diameter	4"
Maximum Overall Length	15-1/2"
Seated Length	14" ± 3/8"
Maximum Tube Radius	3-5/32"
Bulb-Flange Diameter	5-1/8" ± 1/16"
Greatest Bulb Diameter	5" ± 1/16"
Bulb Terminals:	
Caps (Two)	Recessed Small Cavity (JETEC No.J1-21)
Flange	*See Dimensional Outline*
Flexible cable	*See Dimensional Outline*
Ambient-Temperature Range	-65° to +100 °C
Mounting Position	Any
Weight (Approx.)	2 lbs
Socket	Alden Part No.435SBA, or equivalent
Base	Small-Button Thirtyfivar 31-Pin (JETEC No.E31-36)

° without external shield.

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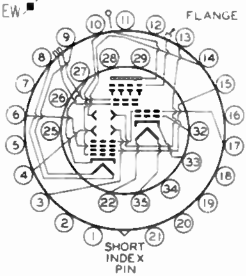
6866

6866

DISPLAY STORAGE TUBE

BOTTOM VIEW■



Pin 1 - No Connection
Pin 2 - Same as Pin 1
Pin 3 - Deflecting Electrode DJ_4 of Writing Gun
Pin 4 - Deflecting Electrode DJ_3 of Writing Gun
Pin 5 - Same as Pin 1
Pin 6 - Grid No.3 of Writing Gun
Pin 7 - Same as Pin 1
Pin 8 - Heater of Writing Gun
Pin 9 - Heater of Writing Gun
Pin 10 - Grid No.1 of Writing Gun
Pin 11 - Same as Pin 1
Pin 12 - Same as Pin 1
Pin 13 - Deflecting Electrode DJ_1 of Writing Gun
Pin 14 - Deflecting Electrode DJ_2 of Writing Gun
Pin 15 - Grid No.2 of Writing Gun
Pin 16 - Internal Connection-Do Not Use
Pin 17 - Grid No.4 of Writing Gun, Grid No.2 of Viewing Gun
Pin 18 - Same as Pin 1
Pin 19 - Same as Pin 1
Pin 20 - Same as Pin 16
Pin 21 - Same as Pin 1
Pin 22 - Heater of Viewing Gun
Pin 25 - Same as Pin 1
Pin 26 - Same as Pin 1
Pin 27 - Cathode of Writing Gun
Pin 28 - Same as Pin 1
Pin 29 - Same as Pin 1
Pin 32 - Grid No.1 of Viewing Gun
Pin 33 - Cathode of Viewing Gun
Pin 34 - Same as Pin 1
Pin 35 - Heater of Viewing Gun
Flexible Cable - Connection to Screen
Flange - Backing-Electrode
Recessed Cavity Cap -
Nearer Tube Face--Grid No.4 of Viewing Gun
Nearer Electron Guns--Grid No.3 of Viewing Gun

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

	Writing Section	Viewing Section**	
SCREEN VOLTAGE	-	11000 max.	volts
PEAK BACKING-ELECTRODE VOLTAGE.	-	20 max	volts

■ Pins 23 and 31 are not shown because they are trimmed to the same dimension as the short index pin and are not to be used.

**: See next page.

TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

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6866

DISPLAY STORAGE TUBE

	Writing Section		Viewing Section**	
		Equivalent Values		
GRID-No.4 VOLTAGE	2900 max.*	150 max.**	300 max.	volts
GRID-No.3 VOLTAGE	1000 max.*	–	300 max.	volts
GRID-No.2 VOLTAGE	2750 max.*	–	150 max.	volts
CATHODE VOLTAGE	–	-2900 max.**	–	volts
GRID-No.1 VOLTAGE:				
Negative bias value . .	200 max.*		100 max.	volts
Positive bias value . .	0 max.*		0 max.	volts
Positive peak value . .	2 max.*		0 max.	volts
PEAK VOLTAGE BETWEEN GRID No.4 AND ANY DEFLECTING ELECTRODE. .	500 max.		–	volts
PEAK HEATER-CATHODE VOLTAGE:				
Heater negative with respect to cathode. .	125 max.*		125 max.	volts
Heater positive with respect to cathode. .	125 max.*		125 max.	volts

VIEWING SECTION**

Operating Values and Typical Performance Characteristics:

Screen Voltage	5000	10000	10000	volts
DC Backing-Electrode Voltage	5	5	5	volts
Grid-No.4 Voltage	150	210	150	volts
Grid-No.3 Voltage#.	25 to 125	50 to 150	25 to 125	volts
Grid-No.2 Voltage†#	50 to 75	70 to 105	50 to 75	volts
Grid-No.1 Voltage#.	0 to -50	0 to -75	0 to -50	volts
Maximum Screen Current. . .	350	600	350	μamp
Maximum Peak Backing-Electrode Current	1.5	2	1.5	ma
Maximum Grid-No.4 Current♦.	2	3	2	ma
Maximum Grid-No.3 Current♦.	1.5	2	1.5	ma
Maximum Cathode Current♦. .	3	4	3	ma
Writing Speed††	300000	300000	300000	in./sec
Number of Half-Tone Steps□ .	5	5	5	
Viewing Duration▲	40	20	40	sec
Maximum Erasing-Uniformity Factor□□.	0.5	0.5	0.5	
Stored-Spot Diameter†† . . .	0.020	0.020	0.020	in.
Resolution⊕.	50	50	50	lines/in.
Brightness♦♦.	175	1750	950	fl

** Voltages are shown with respect to cathode of Viewing Gun.

Adjusted for brightest, most uniform pattern.

† Grid No.2 of the Viewing Gun is connected internally to grid No.4 of the writing Gun.

♦ For conditions with combined adjustment of grid-No.1 voltage, grid-No.2 voltage, and grid-No.3 voltage to give brightest, most uniform pattern.

■, ††, □, ▲, □□, ⊕, ♦♦: See next page.

TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

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6866

DISPLAY STORAGE TUBE

WRITING SECTION●

Range Values for Equipment Design:*

With any grid-No.2 voltage (E_{c_2}) between 500 and 2750 volts

Grid-No.4 Voltage (E_{c_4})	95% to 105% of E_{c_2}	volts
Grid-No.3 Voltage for Focus	14% to 28% of E_{c_2}	volts
Maximum Grid-No.1 Voltage for Cutoff of Undeflected Focused Spot.	-4.6% of E_{c_2}	volts
Maximum Grid-No.3 Current	-15 to +10	μamp
Maximum Cathode Current	*See Curve*	
Deflection Factors:		
DJ_1 and DJ_2	28 to 38	v dc/in./kv of E_{c_4}
DJ_3 and DJ_4	28 to 38	v dc/in./kv of E_{c_4}
Focused Beam Position	##	

Examples of Use of Design Ranges:*

With grid-No.2 voltage of	*1500*	*2500*	*volts*
Grid-No.4 Voltage (E_{c_4})	1425 to 1575	2375 to 2625	volts
Grid-No.3 Voltage for Focus . .	210 to 420	350 to 700	volts
Maximum Grid-No.1 Voltage for Cutoff of Undeflected Focused Spot.	-69	-115	volts
Deflection Factors when E_{c_4} = E_{c_2}:			
DJ_1 and DJ_2	42 to 57	70 to 95	v dc/in.
DJ_3 and DJ_4	42 to 57	70 to 95	v dc/in.

Equivalent Values for Examples of Writing-Gun Voltages Referred to Cathode of Viewing Gun:

Cathode Voltage	-1450 to -1395	-2450 to -2395	volts
Grid-No.2 Voltage	-25 to +180	-75 to +230	volts
Grid-No.3 Voltage for Focus . .	-1240 to -975	-2100 to -1695	volts
Grid-No.4 Voltage	50 to 105	50 to 105	volts

VIEWING SECTION and WRITING SECTION

Circuit Values:

Grid-No.1-Circuit Resistance (Either gun)	1.0 max.	megohm
Resistance in Any Deflecting-Electrode Circuit■ . . .	0.1 max.	megohm
Backing-Electrode-Circuit Resistance.	0.005 max.	megohm
Series Current-Limiting Resistance in Screen Circuit.	1.0 min.	megohm

* Voltages are shown with respect to cathode of writing Gun.

†† Measured under conditions of writing from just zero brightness (viewing-beam cutoff) to maximum brightness with grid No.1 of writing Gun at -10 volts with respect to cathode of writing Gun, and grids No.2 and No.4 of writing Gun at +2500 volts with respect to cathode of writing Gun.

□ Observed with an RCA-2F21 Monoscope display.

▲, □□, ❁, ♣♣, ●, ##, ■: See next page.

6866
DISPLAY STORAGE TUBE

▲ Expressed in terms of the time required for the brightness of the unwritten background to rise from just zero brightness (viewing-beam cutoff) to 10% of the maximum brightness.

□□ Defined as $(t_2 - t_1)/t_2$, where

t_1 = time measured from start of erasing to instant at which any screen area is reduced to zero brightness.

t_2 = time measured from start of erasing to instant at which entire screen area is reduced to zero brightness.

⊕ Measured by shrinking-raster method and with grids No.2 and No.4 of writing Gun at +2500 volts with respect to cathode of writing Gun.

♣♣ Measured with entire storage grid written to produce maximum brightness and with screen at indicated voltage.

● The cathode of the writing Gun is operated at about −2500 volts with respect to the cathode of the viewing Gun which is usually operated at ground potential.

** The center of the undeflected focused beam will fall within a circle having a 10-mm radius concentric with the center of the face under the following conditions: grids No.2 and No.4 of writing Gun at +2500 volts with respect to cathode of writing Gun, grid No.3 of writing Gun at voltage to give focus, grid No.1 of writing Gun at voltage which will permit storage of a charge just sufficient to give a barely perceptible spot on screen, viewing Section operating under normal conditions, and tube shielded against extraneous fields.

■ It is recommended that the deflecting-electrode-circuit resistances be approximately equal.

OPERATING CONSIDERATIONS

Magnetic shielding must be provided to prevent external fields from interfering with the required accurate control of the low-velocity viewing beam. A cylindrical shield of properly annealed high-permeability material about 1/16-inch thick is usually satisfactory. The screen cable should be placed outside the shield.

The *metal flange* at the face end of the tube requires the use of a spring-contact ring bearing against the edge of the flange.

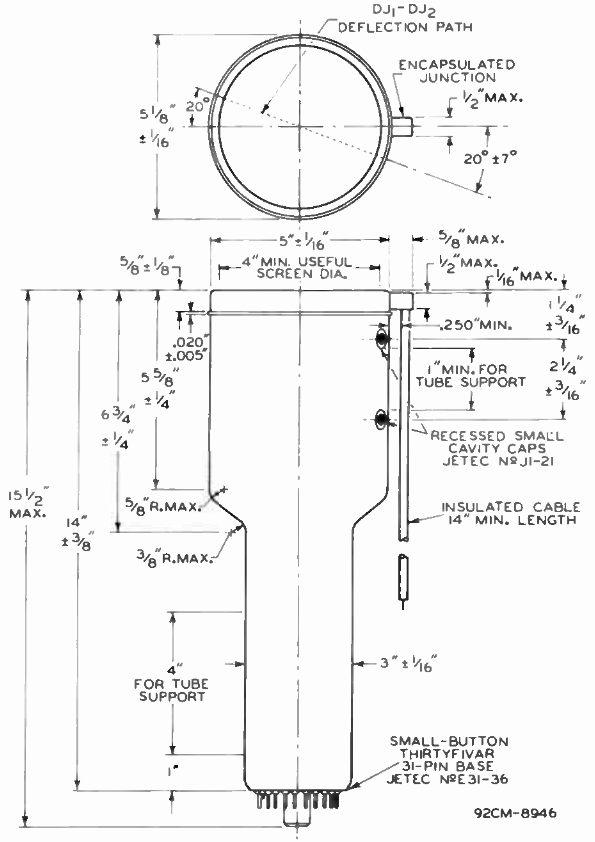
To prevent possible damage to the tube, allow the viewing-gun beam current to reach normal operating value before turning on the writing-gun beam current, and keep the viewing beam on until the writing beam is turned off.

TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

RCA

6866

DISPLAY STORAGE TUBE



CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 3° IN ANY DIRECTION FROM PERPENDICULAR ERECTED AT CENTER OF FACEPLATE.

THE PLANE THROUGH TUBE AXIS AND EACH OF THE FOLLOWING ITEMS MAY VARY FROM THE DEFLECTION PATH PRODUCED BY DJ_1 AND DJ_2 BY THE FOLLOWING ANGULAR TOLERANCES (MEASURED ABOUT THE TUBE AXIS): PIN 27, ± 10°; EACH CAVITY CAP (ON SAME SIDE AS PIN 27), ± 10°; ENCAPSULATED JUNCTION, ± 10°. ANGLE BETWEEN DJ_1 – DJ_2 DEFLECTION PATH AND DJ_3 – DJ_4 DEFLECTION PATH IS 90° ± 3°.

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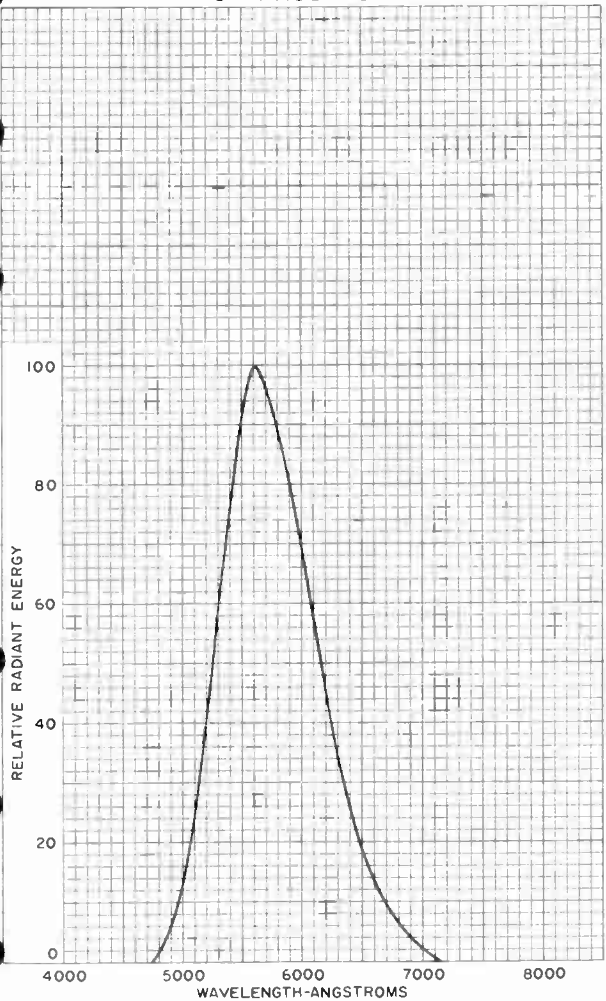
6866

6866

SPECTRAL-ENERGY EMISSION CHARACTERISTIC OF PHOSPHOR



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RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

92CM-9042

6866

AVERAGE CHARACTERISTIC

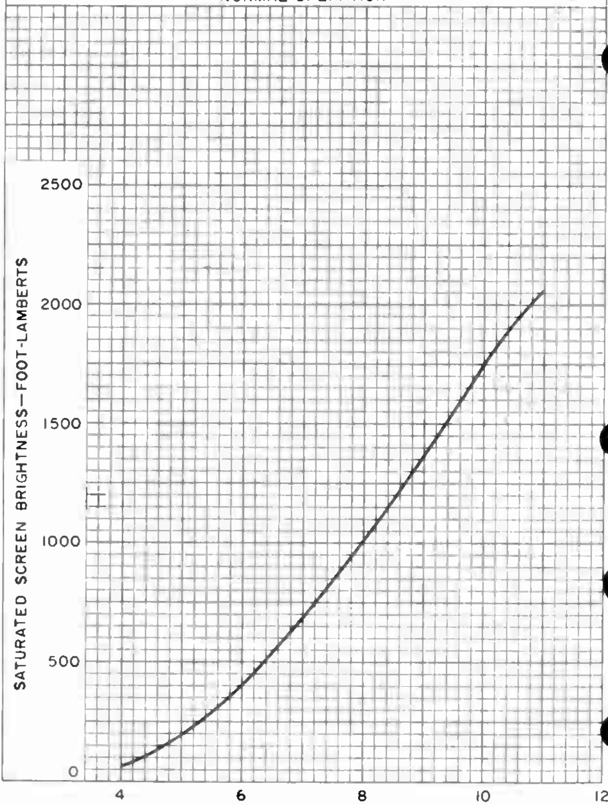
VIEWING SECTION

E_f = 6.3 VOLTS
BACKING-ELECTRODE VOLTS* = 5
GRID-No 4 VOLTS* = 210
GRID-No 2 VOLTS* = 85
GRID-No 3 VOLTS* } ADJUSTED FOR BRIGHTEST,
GRID-No 1 VOLTS* } MOST UNIFORM DISPLAY

*REFERRED TO CATHODE OF VIEWING GUN

WRITING SECTION

NORMAL OPERATION



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92CM-9043

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AVERAGE CHARACTERISTICS

VIEWING SECTION

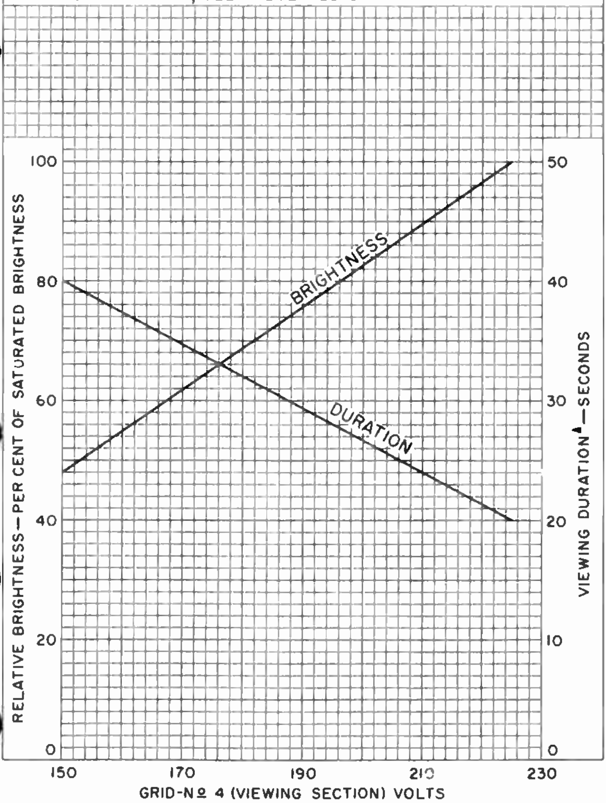
E_f = 6.3 VOLTS
SCREEN KILOVOLTS* = 5 TO 10
BACKING-ELECTRODE VOLTS* = 5
GRID-No 2 VOLTS* = 85
GRID-No 3 VOLTS* } ADJUSTED FOR BRIGHTEST,
GRID-No 1 VOLTS* } MOST UNIFORM DISPLAY

*REFERRED TO CATHODE OF VIEWING GUN

WRITING SECTION

NORMAL OPERATION

▲FOR EXPLANATION, SEE TABULATED DATA



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92CM-9044

6866

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TYPICAL ERASURE CHARACTERISTICS

VIEWING SECTION

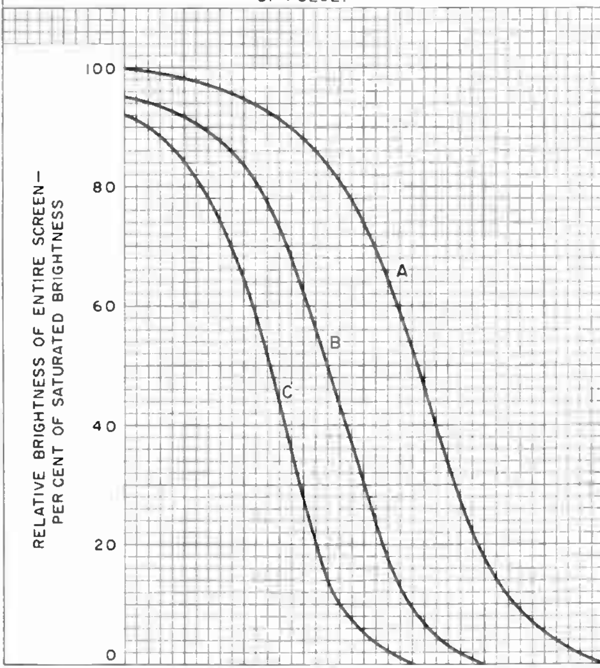
E_f = 6.3 VOLTS
GRID-Nº 4 VOLTS* = 210
GRID-Nº 3 VOLTS* } ADJUSTED FOR BRIGHTEST,
GRID-Nº 1 VOLTS* } MOST UNIFORM DISPLAY

SCREEN KILOVOLTS* = 10
GRID-Nº 2 VOLTS* = 85

*REFERRED TO CATHODE OF VIEWING GUN

CURVE	BACKING-ELECTRODE VOLTS	
	DC	POSITIVE RECTANGULAR PULSE AMPLITUDE (APPROX.)
A	10	10
B	5	8
C	2	7

ERASURE IS PRODUCED BY POSITIVE RECTANGULAR PULSE APPLIED TO BACKING-ELECTRODE. INDICATED DURATION IS SUM OF DURATIONS OF NUMBER OF PULSES OR ELAPSED TIME AFTER START OF PULSE.



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92CM-9045

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CURRENT CHARACTERISTIC
FOR WRITING GUN

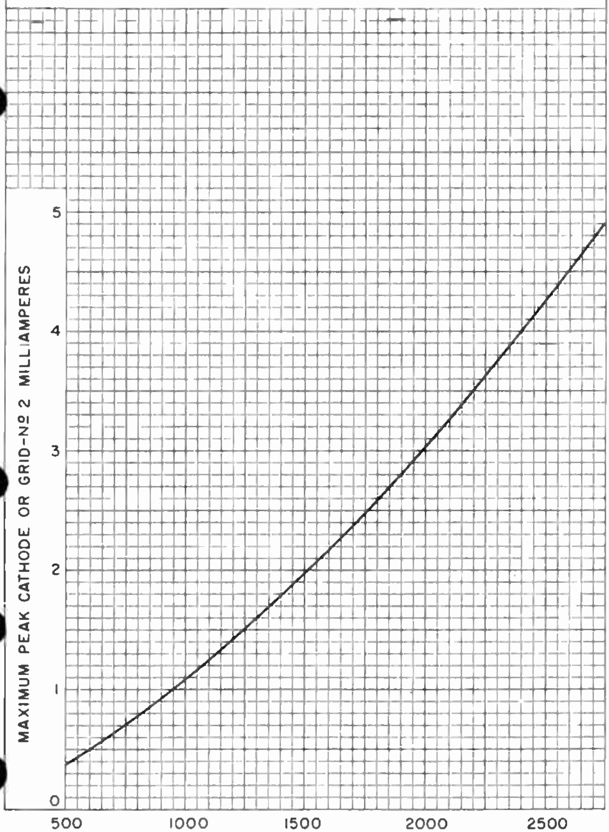
WRITING SECTION

E_f = 6.3 VOLTS
GRID-No 4 VOLTS* = GRID-NO. 2 VOLTS
GRID-No 3 VOLTS* = ADJUSTED FOR FOCUS
GRID-No 1 VOLTS* = 0

*REFERRED TO CATHODE OF WRITING GUN

VIEWING SECTION

NORMAL OPERATION



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92CM-9046

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TYPICAL DRIVE CHARACTERISTIC
FOR WRITING GUN

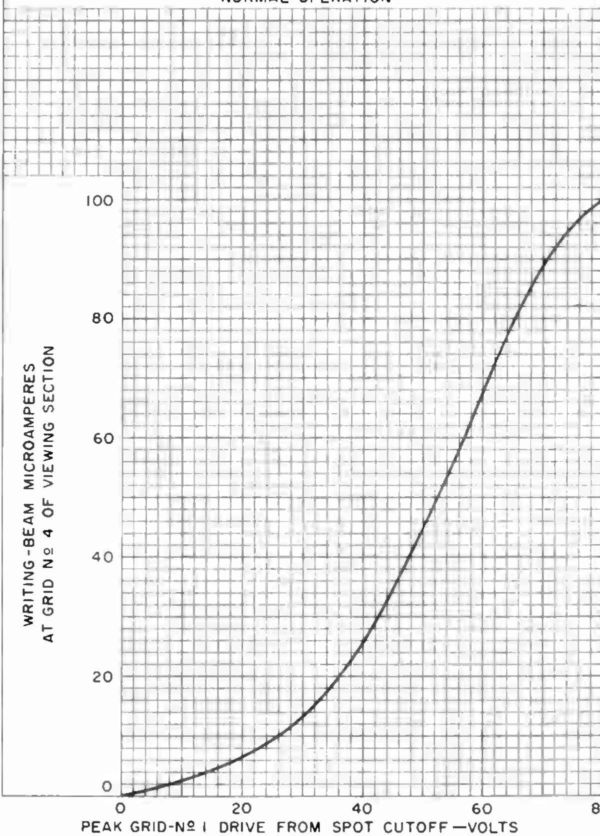
WRITING SECTION

E_f = 6.3 VOLTS
GRID-No 4 VOLTS* = 2500
GRID-No 3 VOLTS* = ADJUSTED FOR FOCUS
GRID-No 2 VOLTS* = 2500
GRID-No 1* BIASED TO SPOT CUTOFF

*REFERRED TO CATHODE OF WRITING GUN

VIEWING SECTION

NORMAL OPERATION



TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

92CM-9048

Photomultiplier Tube[a]

S-13 RESPONSE

10-STAGE, HEAD-ON, FLAT-FACEPLATE

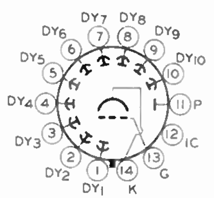
ELECTROSTATICALLY FOCUSED DYNODE STAGES

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
[illegible] . . . . .Flat, Circular
[illegible] . . . . 2 sq in
[illegible] . . . . 1-5/8 in
Window. . . . . .Fused Silica
[illegible] . . . . 0.150 in
[illegible] 1.51
Dynode Material . . . . Cesium-Antimony
Direct Interelectrode Capacitances (Approx.)
[illegible] . . . . 4.4 pF
[illegible] . . . . 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

[illegible]



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 1/ 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 angstrom	-	0.047	-	A/W
Luminous:				
At 0 c/s[e]	10	90	300	A/lm
With dynode No.10 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 angstrom	-	0.047	-	A/W

→ Indicates a change.

	Min	Typ	Max	
[illegible][e]	-	7.9	-	A/lm
[illegible][f]	-	4.6	-	A/lm
[illegible][g]	4×10^{-5}	6×10^{-5}	-	A/lm
[illegible][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 [illegible] 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 0.1 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.

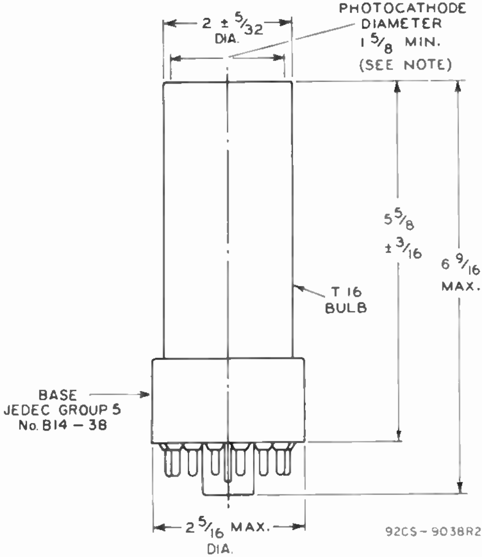
n Under the following conditions: Supply voltage (E) is as shown, 25° C tube temperature, external shield connected to cathode, bandwidth 1 cycle per second, tungsten-light source at a color temperature of 2870° K interrupted at a low audio frequency to produce incident radiation pulses alternating between 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 [illegible] 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

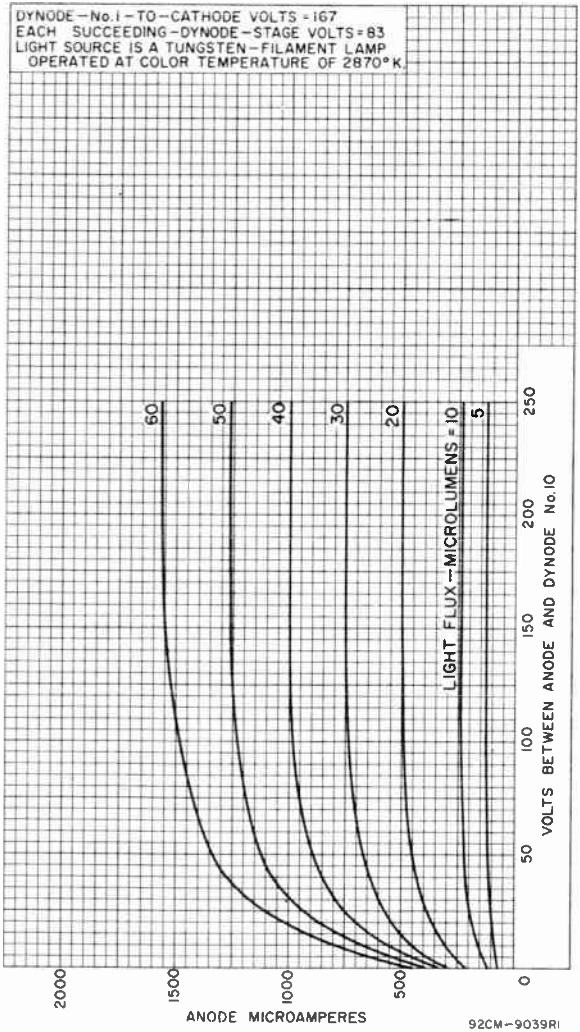


DIMENSIONS IN INCHES

Center line of bulb will not deviate more than [illegible]° 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 0.0[illegible]" from peak to valley.

TYPICAL ANODE CHARACTERISTICS



TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

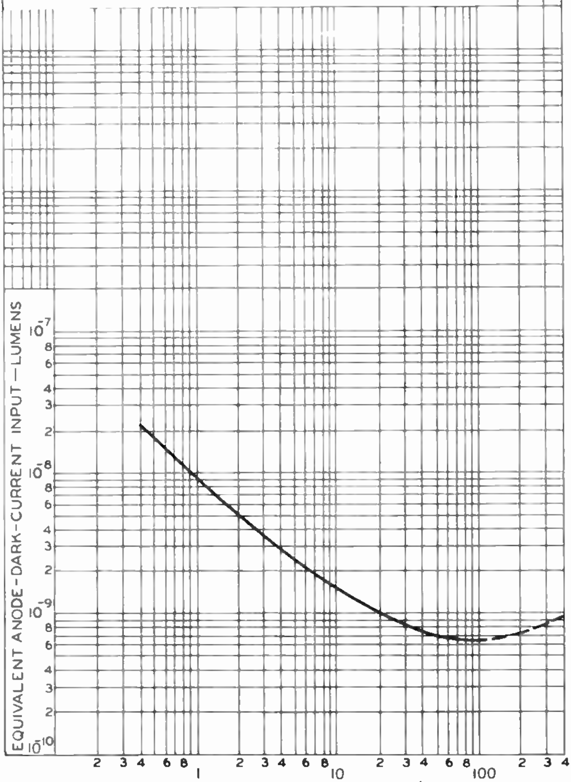
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS VOLTAGE DIVIDER WHICH PROVIDES 1/6 OF E BETWEEN CATHODE AND DYNODE No.1; 1/12 OF E FOR EACH SUCCEEDING STAGE; AND 1/12 OF E BETWEEN DYNODE No.10 AND ANODE.

FOCUSING-ELECTRODE VOLTAGE ADJUSTED TO PROVIDE MAXIMUM ANODE CURRENT.

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

DASHED PORTION INDICATES INSTABILITY.

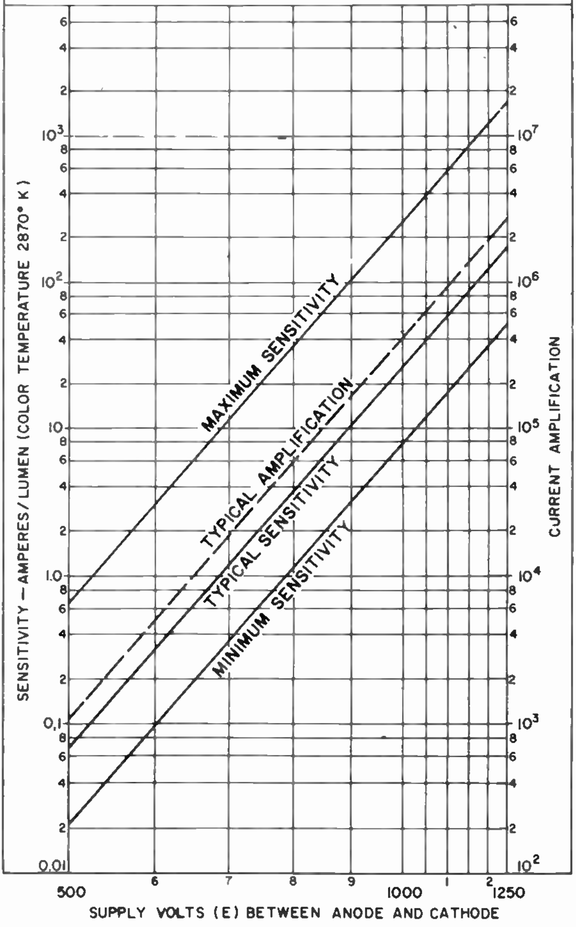
TUBE TEMPERATURE = 25°C



92CM—9032R1

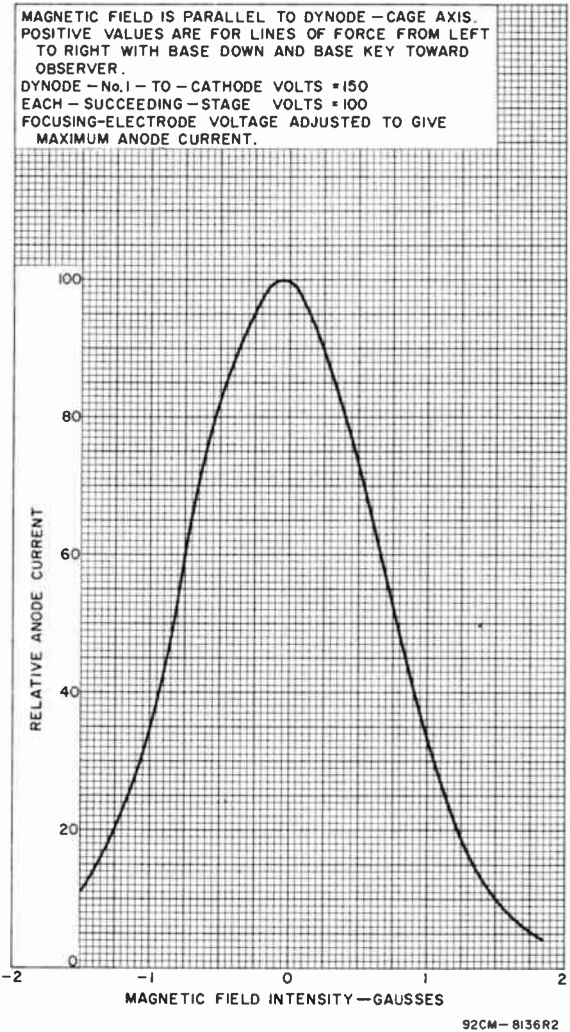
CHARACTERISTICS

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



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

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

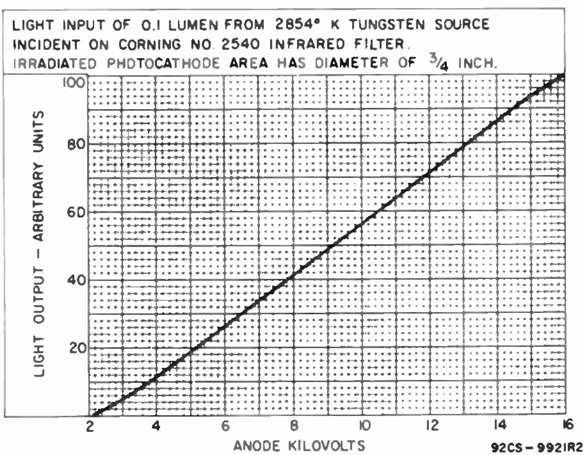
Handling. The tubes should be handled by the metal terminals. Fingerprints on the glass should be avoided since they cause leakage current, corona, and higher screen background. To minimize the possibility of leakage current and corona, the external surface of the glass side wall is coated with a transparent, 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.

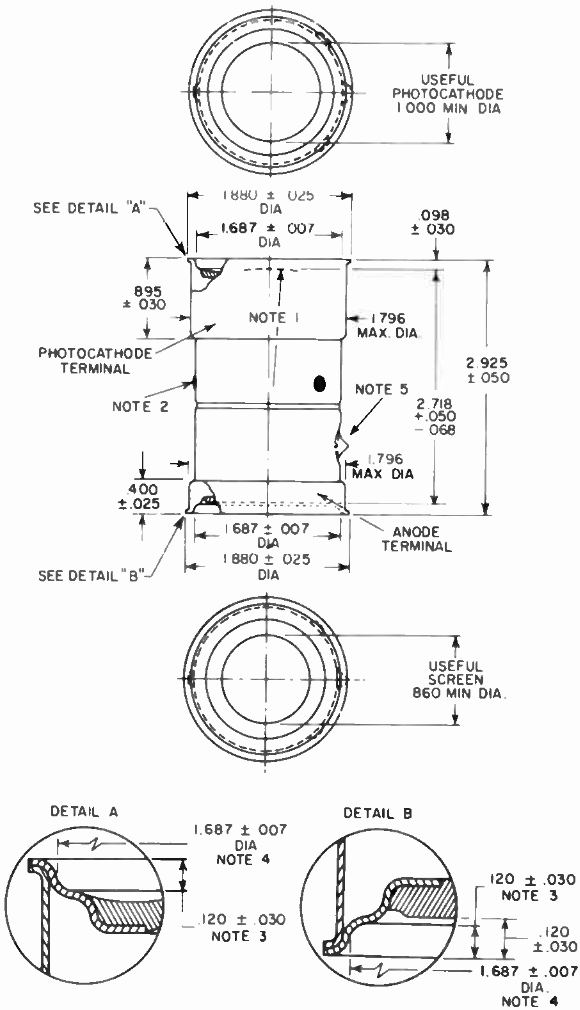
Connections to the two terminals of the tube, indicated on the Dimensional Outline, should not be soldered to the terminals. They may be made by spring fingers engaging the rim or the straight side of each terminal.

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".

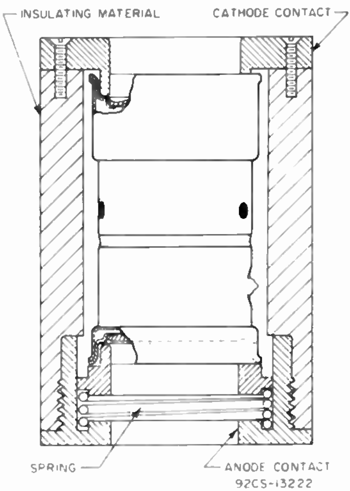
Note 2: Three insulated lead tips will not extend beyond maximum O.D. of tube. Leads are used only during tube manufacture.

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

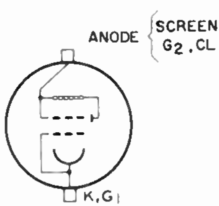
C_L: Collector

G_1: Grid No.1 (Focusing Electrode)

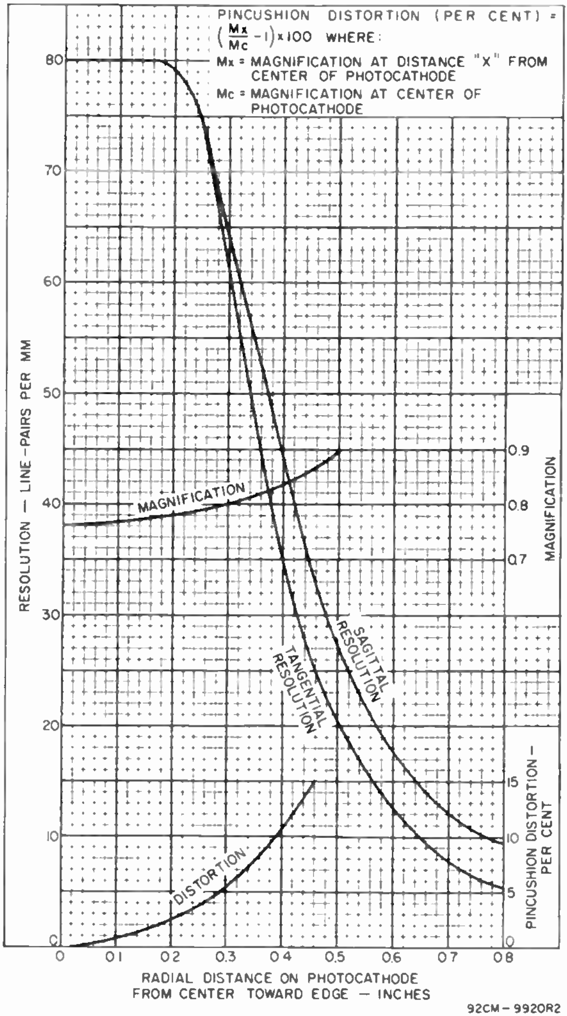
G_2: Grid No.2 (Focusing & Accelerating Electrode)

K: Photocathode

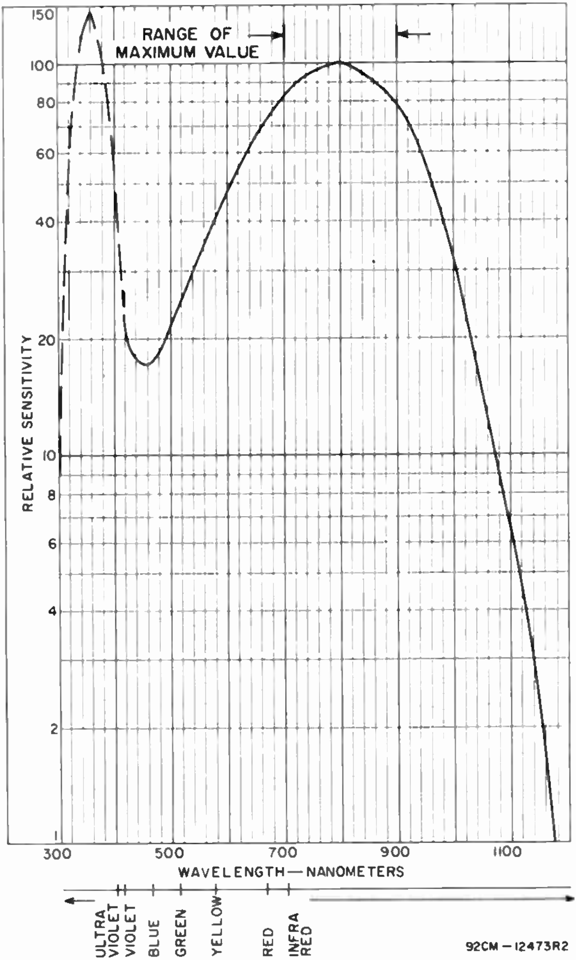
Direction of incident radiation: Perpendicular to photocathode end of tube



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° 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

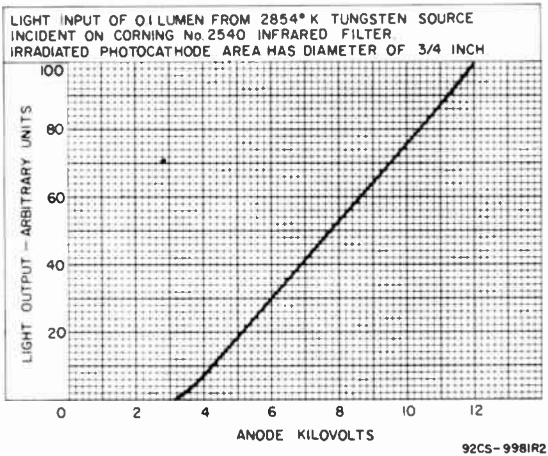
HANDLING The tubes should be handled by the metal terminals. Fingerprints on the glass should be avoided since they cause leakage current, corona, and higher screen background. To minimize the possibility of leakage current and corona, the external surface of the glass side wall is coated with a transparent, 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.

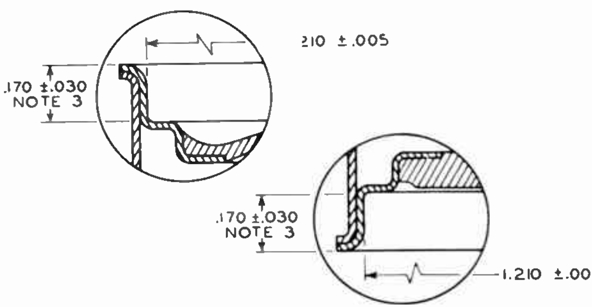
Connections to the two terminals of the tube, indicated on the Dimensional Outline, should not be soldered to the terminals. They may be made by spring fingers engaging the rim or the straight side of each terminal.

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.

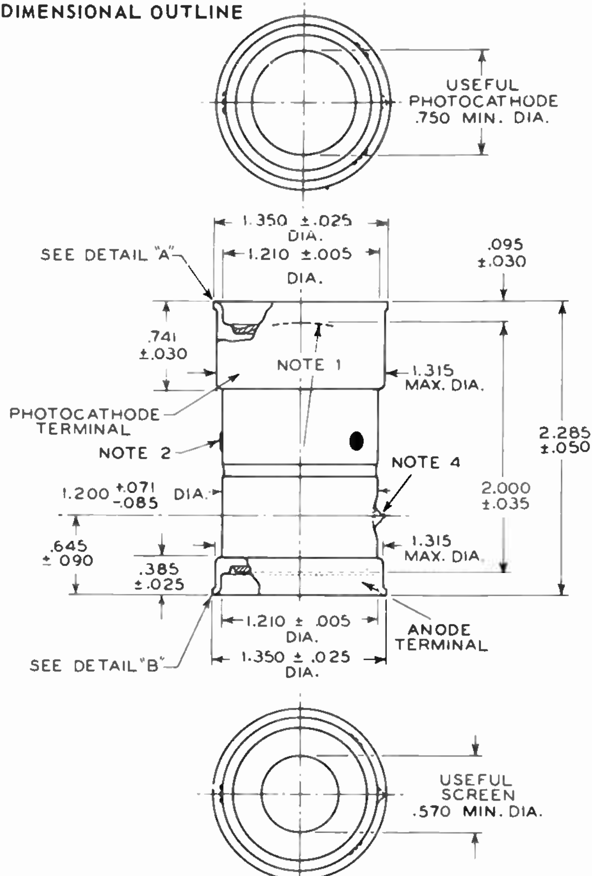
TYPICAL CHARACTERISTICS



DIMENSIONAL OUTLINE DETAILS



DIMENSIONAL OUTLINE



Dimensions in Inches

92CM-9995R2

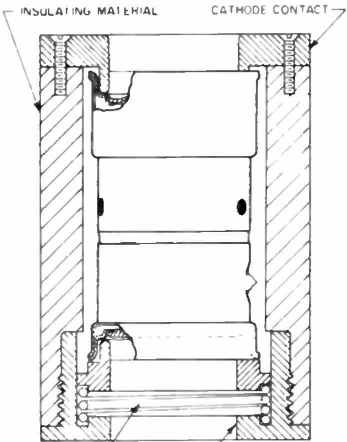
Note 1: Radius of curvature of faceplate is 1.230" ± 0.005"; faceplate thickness at center is 0.060" ± 0.004".

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



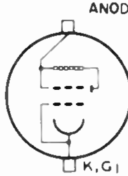
TERMINAL CONNECTIONS

C_L: Collector

G_1: Grid No.1
(Focusing Electrode)

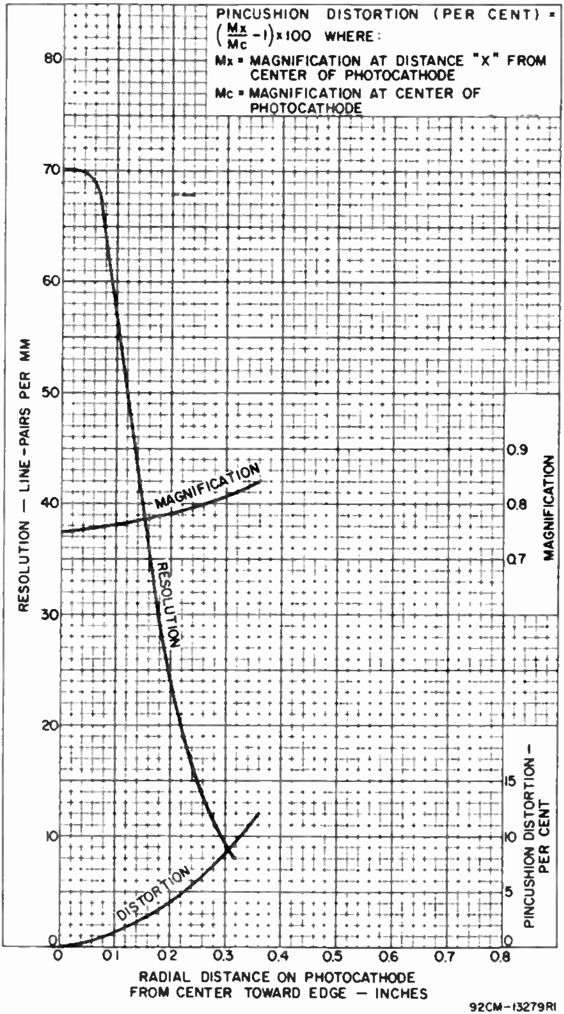
G_2: Grid No.2
(Focusing &
Accelerating Electrode)

K: Photocathode

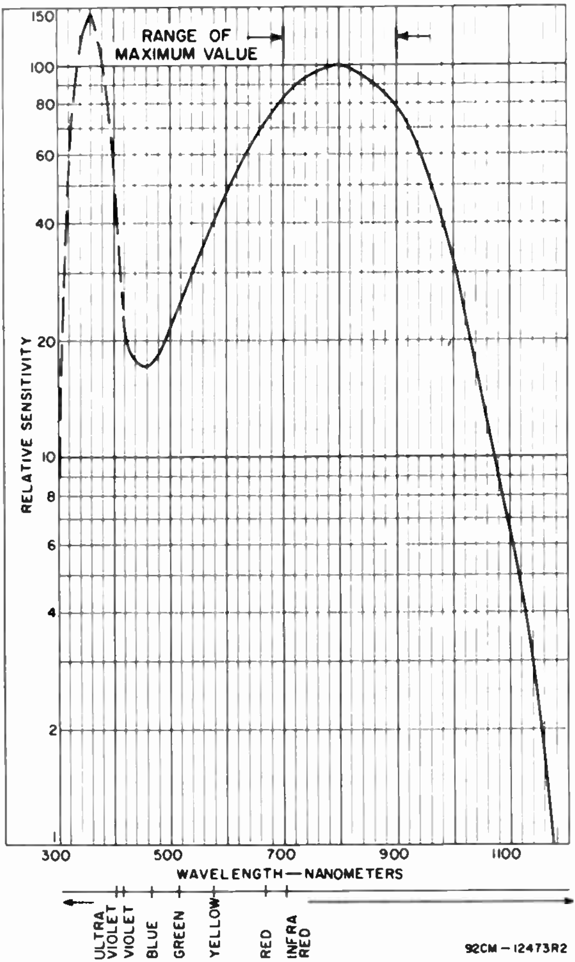


Direction of incident radiation:
Perpendicular to photocathode end of tube

TYPICAL CHARACTERISTICS



TYPICAL SPECTRAL RESPONSE CHARACTERISTIC



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

Gas Phototube

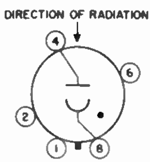
SIDE-ON TYPE HAVING UNOBSTRUCTED PHOTOCATHODE AREA AND S-1 RESPONSE

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 $\mu\mu$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	–	0.019	–	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.

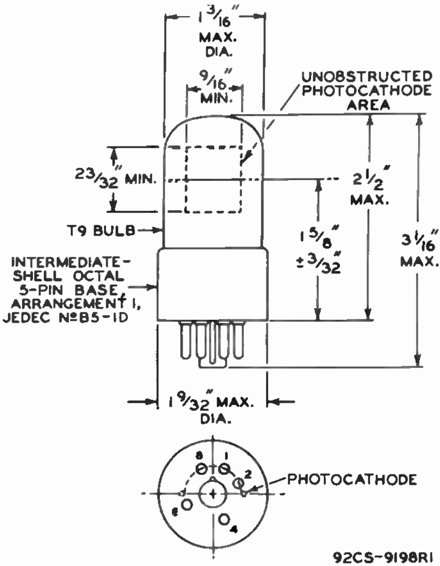
[d] The ratio of luminous sensitivity at an anode supply voltage of 90 volts to luminous sensitivity at an anode supply voltage of 25 volts. In each case, sensitivity is obtained under conditions where the light source is a tungsten-filament lamp operated at a color temperature of 2870° K, the light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

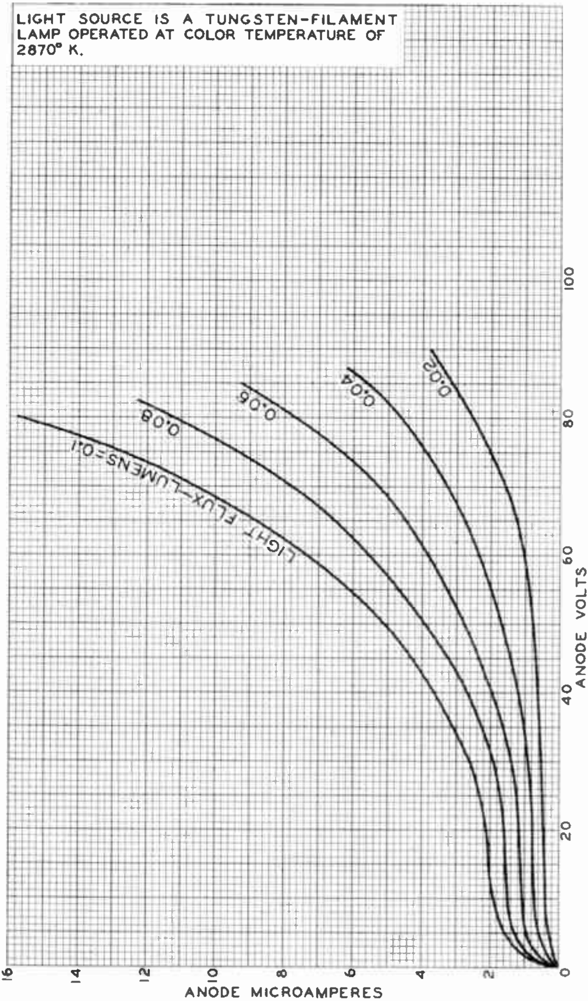
and

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 1, JEDEC No B5-1D
1 9/32" MAX. DIA.
8
1
2
6
4
PHOTOCATHODE
92CS-9198R1

AVERAGE ANODE CHARACTERISTICS



92CM-9226

7037

IMAGE ORTHICON

For simultaneous color pickup

MAGNETIC FOCUS MAGNETIC DEFLECTION

DATA

General:

Heater, for Unipotential Cathode:
- Voltage . . . . 6.3 ± 10% . . . ac or dc volts
- Current . . . . 0.6 . . . . amp

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

Photocathode, Semitransparent:
- Response. . . . . *See accompanying Spectral-Sensitivity Characteristics curve*
- 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 Length. . . . . 5"
Focusing-Coil Length. 10"
Alignment-Coil Length . . . . 15/16"
Photocathode Distance Inside End of Focusing Coil . . . . 1/2"
Operating Position. . . . . *See Operating Considerations*
Weight (Approx.). . . . . 1 lb 6 oz
End Base. . . . Small-Shell Diheptal 14-Pin (JETEC 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

■ See basing diagram on next page.

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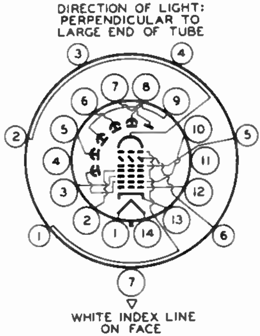
7037

IMAGE ORTHICON

Shoulder Base . . . . Keyed Jumbo Annular 7-Pi

BOTTOM VIEW



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

Maximum and Minimum Ratings, ***Absolute Values:***

PHOTOCATHODE:		
Voltage	-550 max.	volts
Illumination.	50 max.	ft-c
OPERATING TEMPERATURE:		
Of any part of bulb	50 max.	°C
Of bulb at large end of tube (Target section).	40 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*	1350 max.	volts
VOLTAGE PER MULTIPLIER STAGE.	350 max.	volts

*: See next page.

RCA

7037

IMAGE ORTHICON

Typical Operation and Characteristics Range Values:

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°	-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#	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	
Dynode-No.4 Voltage.	1000	volts
Dynode-No.5 Voltage.	1200	volts
Anode Voltage.	1250	volts
Anode Current (DC)	30	μa
Signal-Output Current (Peak to peak).	3 to 24	μa
Target-Temperature Range	40 to 45	°C
Ratio of Peak-to-Peak Highlight Video-Signal Current to RMS Noise Current (Approx.).	60	
Minimum Peak-to-Peak Blanking Voltage.	5	volts
Field Strength at Center of Focusing Coil▲	75	gausses
Field Strength of Alignment Coil (Approx.)	0 to 3	gausses

* Ratio of dynode voltages is shown under *Typical Operation*.

° Normal setting of target voltage is +2 volts from target cutoff. The target-supply voltage should be adjustable from -3 to +5 volts.

\# Adjust to give the most uniformly shaded picture near maximum signal.

▲ 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.

OPERATING CONSIDERATIONS

The *operating position* of the 7037 should preferably be such that any loose particles in the neck of the tube will not fall down and strike or become lodged on the target. Therefore, it is recommended that the tube 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.

When the equipment design or operating conditions are such that the maximum temperature rating or maximum temperature difference as given under *Maximum Ratings* will be exceeded, provision should be made to direct a blast of cooling air

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RCA

7037

IMAGE ORTHICON

from the Diheptal-base end of the tube along the entire length of the bulb surface, i.e., through the space between the bulb surface and the surrounding deflecting-coil assembly and its extension. Any attempt to effect cooling of the tube by circulating even a large amount of air around the focusing coil will do little good, but a small amount of air directly in contact with the bulb surface will effectively drop the bulb temperature. For this purpose, a small blower is satisfactory, but it should be run at low speed to prevent vibration of the 7037 and the associated amplifier equipment. Unless vibration is prevented, distortion of the picture may occur.

Ordinarily, the temperature in a camera equipped with a blower will not exceed 45° C, except in very hot weather or unless the target heater is left on accidentally for a long period.

To keep the operating temperature of the large end of the tube from falling below 45° C, some form of controlled heating should be employed. Ordinarily, adequate heat will be supplied by the focusing coil, deflecting coils, and associated amplifier tubes so that the temperature can be controlled by the amount of cooling air directed along the bulb surface. If, in special cases, a target heater is required, it should fit between the focusing coil and the bulb near the shoulder of the tube, and be non-inductively wound.

Resolution in excess of 500 lines at the center of the picture can be produced by the 7037 when operated for color reproduction.

To utilize the resolution capability of the 7037 in the horizontal direction with the standard scanning rate of 525 lines, it is necessary to use a video amplifier having a bandwidth of at least 6 megacycles.

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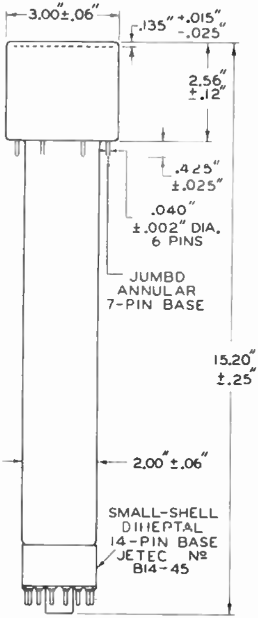
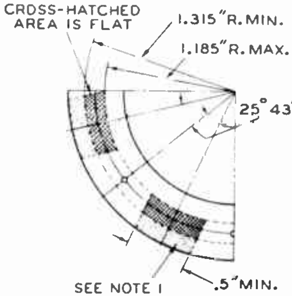
7037

IMAGE ORTHICON



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

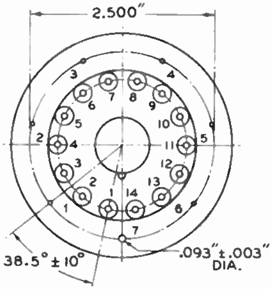
ANGULAR VARIATIONS BETWEEN PINS AS WELL AS ECCENTRICITY OF NECK CYLINDER WITH RESPECT TO PHOTOCATHODE CYLINDER ARE HELD TO TOLERANCES SUCH THAT PINS AND NECK CYLINDER WILL FIT FLAT-PLATE GAUGE WITH:

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

92CM-8293R3

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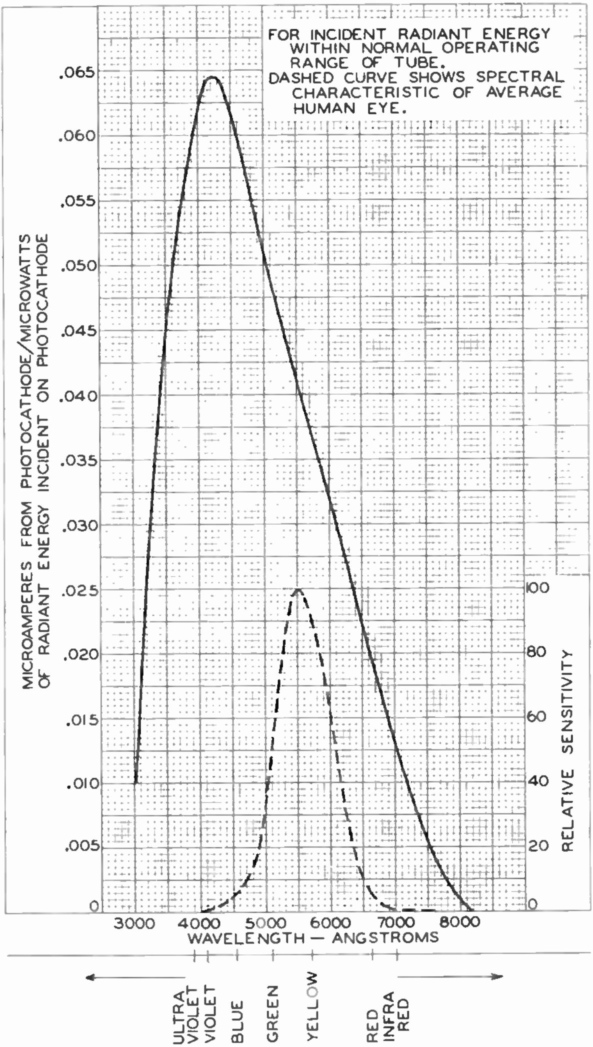
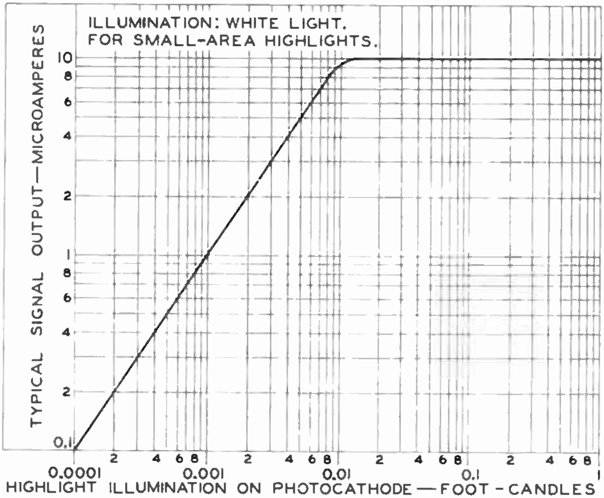
SPECTRAL-SENSITIVITY CHARACTERISTICS

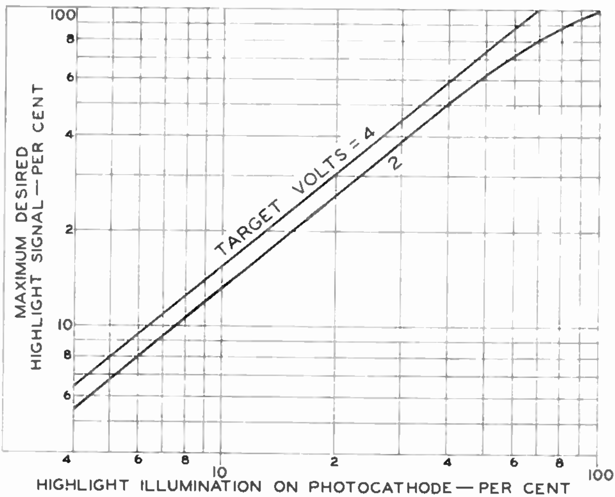


BASIC LIGHT-TRANSFER CHARACTERISTIC



92CS-9450R1

LIGHT-TRANSFER CHARACTERISTICS



92CS-9441

Vidicon

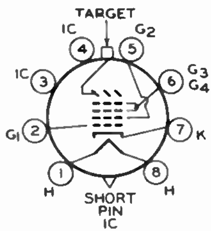
MAGNETIC FOCUS — 1" Diameter — MAGNETIC DEFLECTION

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.

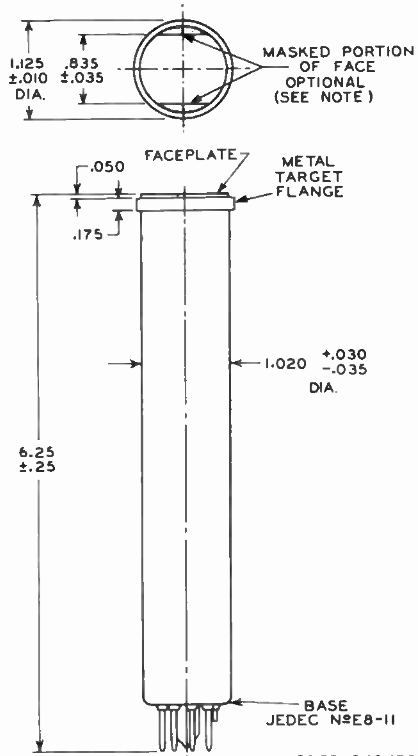
[m] The target voltage for each 7038 must be adjusted to that value which gives the desired operating dark current.

[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.

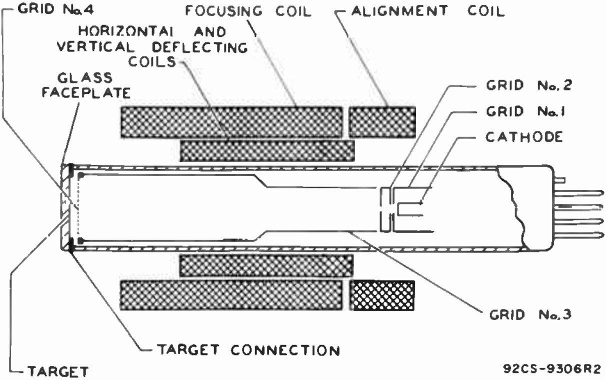


DIMENSIONS IN INCHES

Note: Straight sides of masked portions are parallel to the plate passing through tube axis and short pin.

→ Indicates a change.

SCHEMATIC ARRANGEMENT

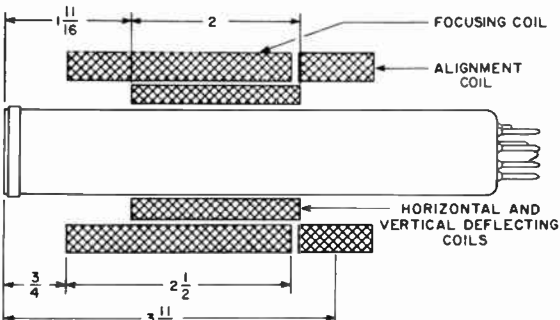


Alignment of the beam is accomplished by a transverse magnetic field produced by external coils located at the base end of the focusing coil.

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

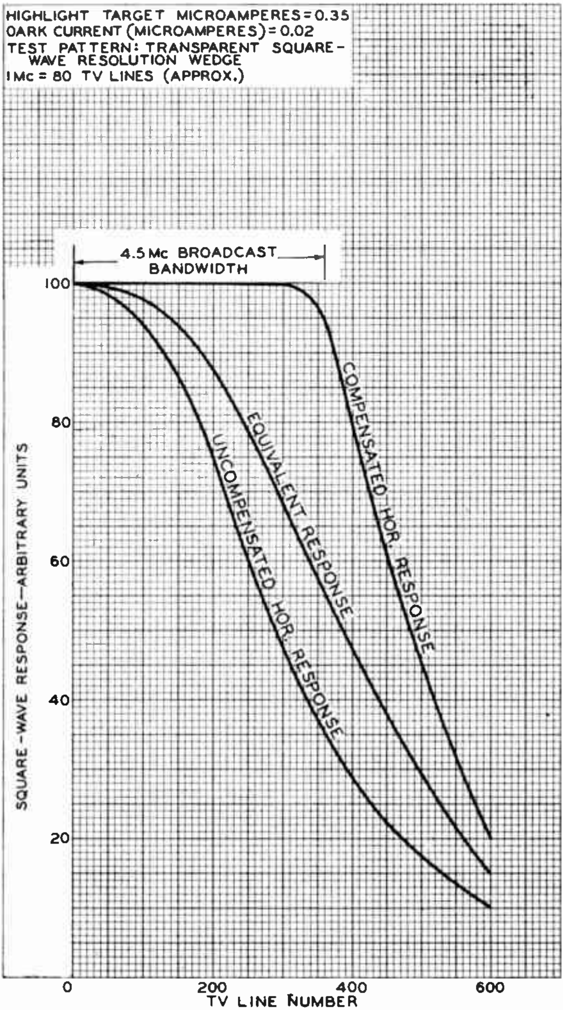
For Minimum Beam-Landing Error



DIMENSIONS IN INCHES

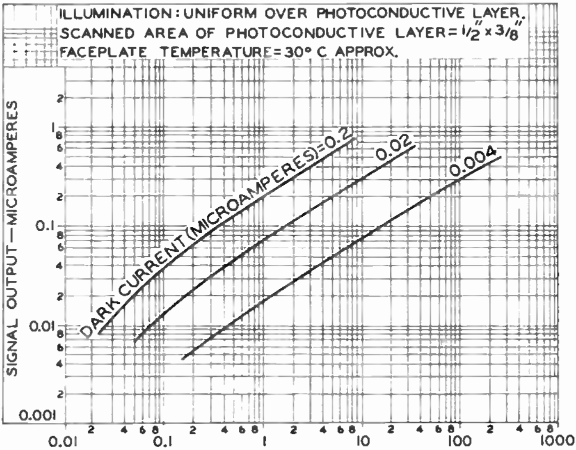
The *deflecting yoke and focusing coil* used with the 7038 are designed to cause the scanning beam to land perpendicularly to the target at all points of the scanned area with minimum beam-landing error and resultant superior uniformity of sensitivity and focus over the scanned area.

HORIZONTAL & EQUIVALENT SQUARE-WAVE RESPONSE CHARACTERISTICS



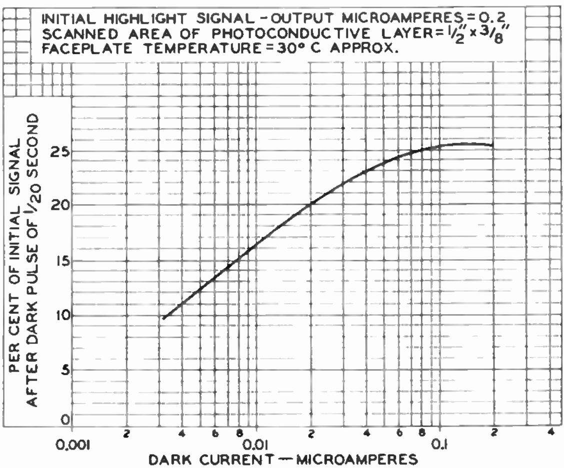
92CM-8117R1

TYPICAL LIGHT-TRANSFER CHARACTERISTICS



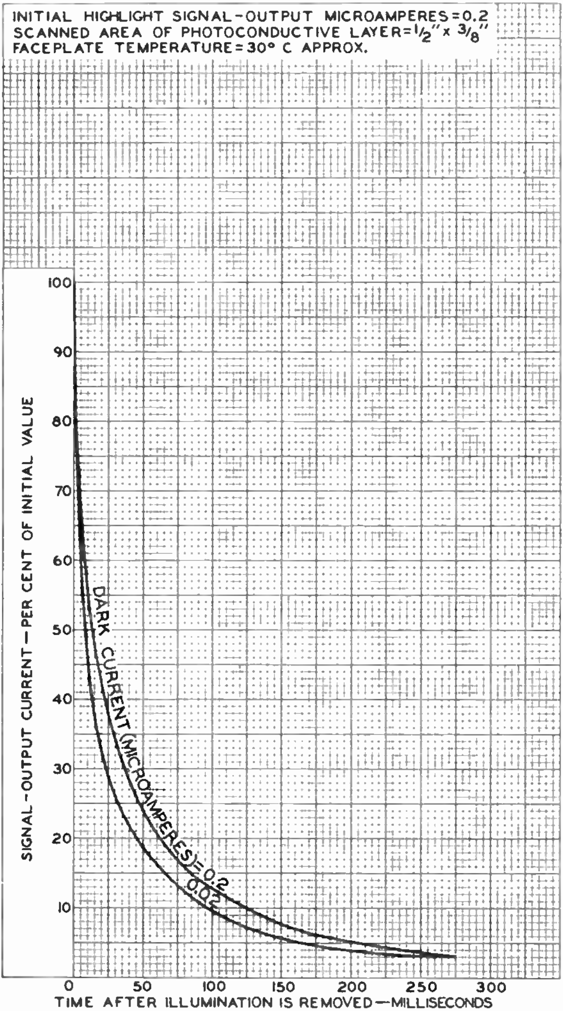
92CS-9495

TYPICAL PERSISTENCE CHARACTERISTIC



92CS-9504R1

TYPICAL PERSISTENCE CHARACTERISTICS

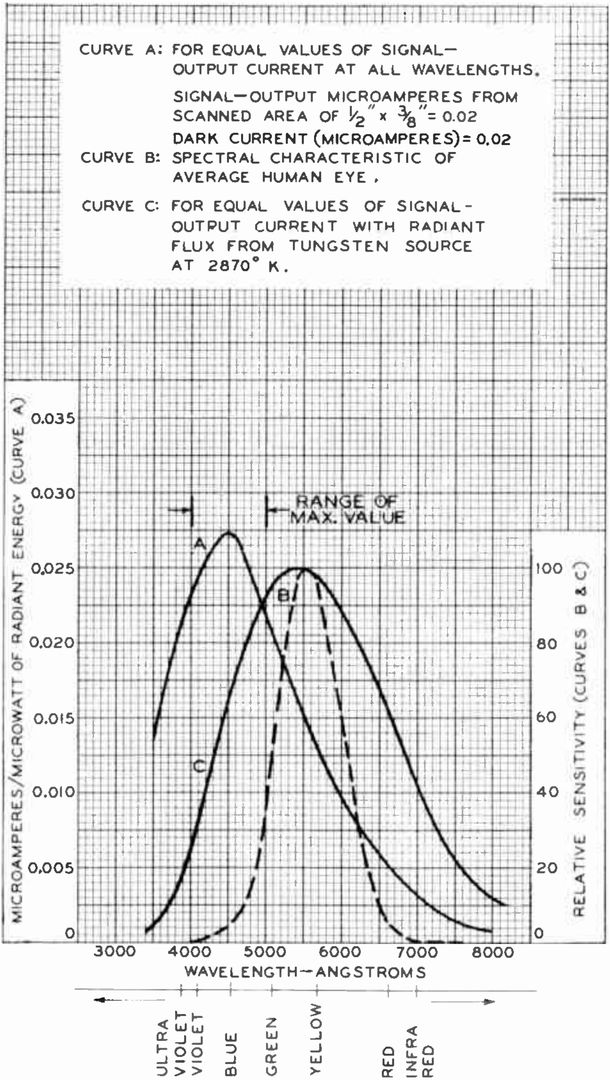


92CM-9505R1

RCA

7038

SPECTRAL-SENSITIVITY CHARACTERISTICS



ELECTRON TUBE DIVISION

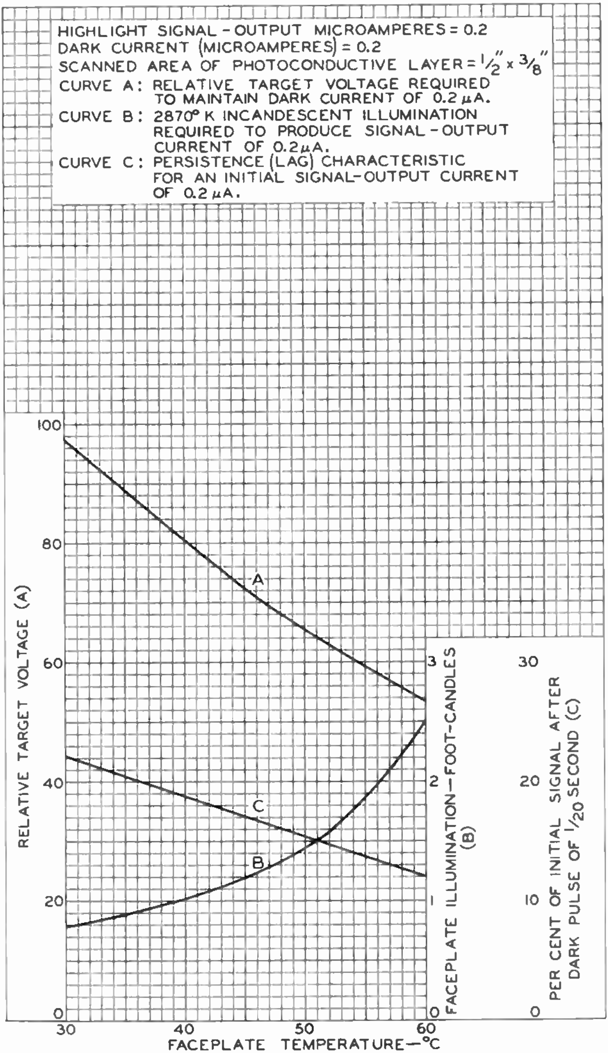
RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

92CM-7783R2

7038

7038

TYPICAL CHARACTERISTICS



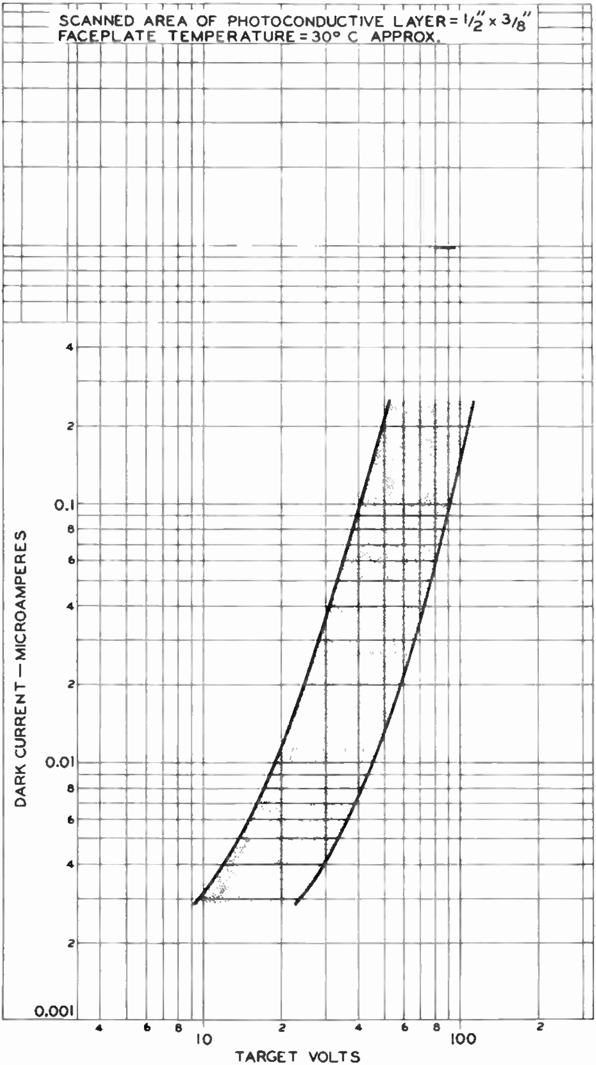
ELECTRON TUBE DIVISION 92CM-9499

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

7038

DARK-CURRENT RANGE



ELECTRON TUBE DIVISION

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

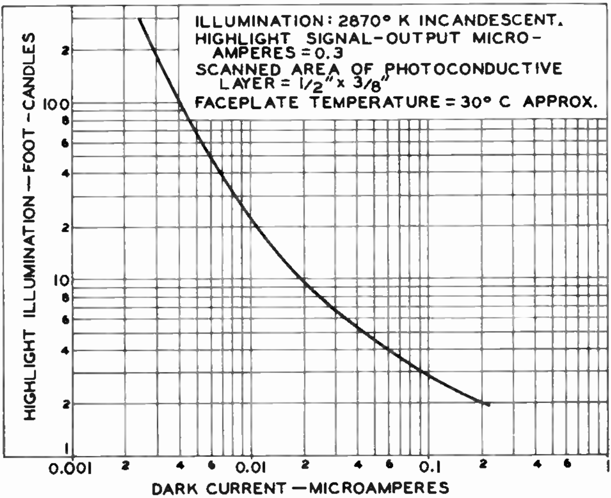
92CM-9497

7038

RCA

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.

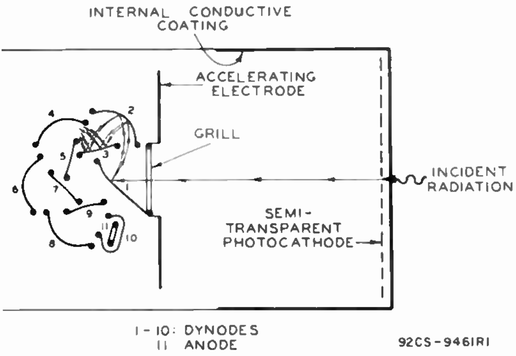
ANODE CURRENT

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.

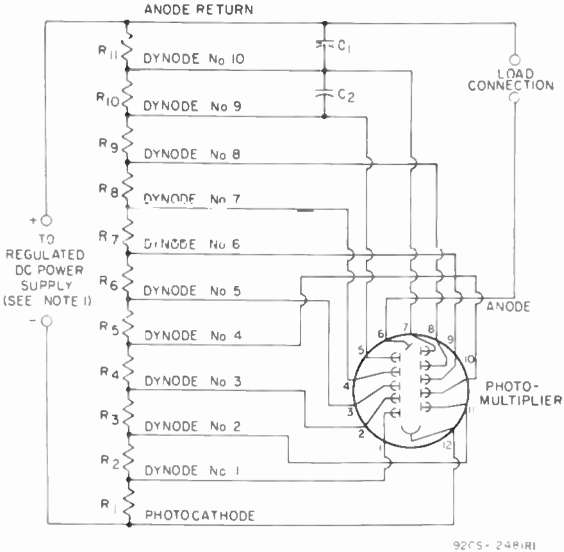
SHIELDING

Electrostatic and/or magnetic shielding of the 7102 may be necessary.

SCHEMATIC ARRANGEMENT OF STRUCTURE



TYPICAL VOLTAGE-DIVIDER ARRANGEMENT



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

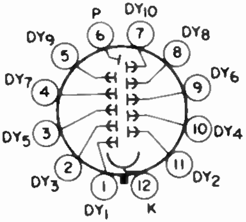
Note 1: Adjustable between approximately 500 and 1500 volts dc.

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.

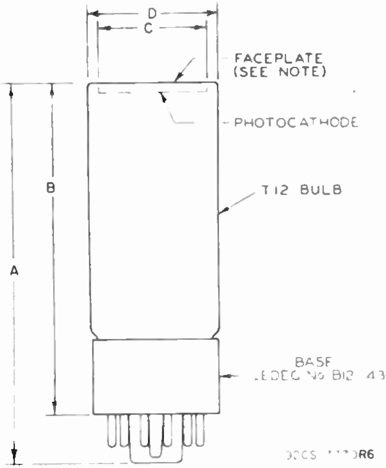
TERMINAL DIAGRAM (Bottom View)

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

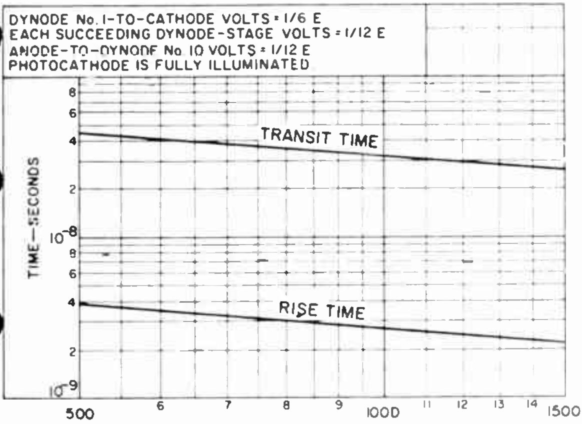
DIMENSIONAL OUTLINE



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.

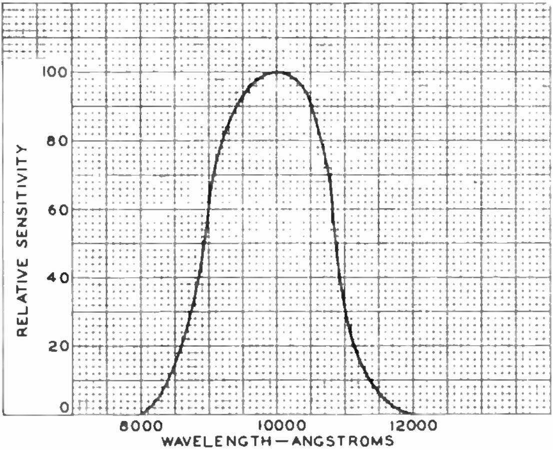
Dimensions	Inches	mm
A	4.57 max.	116.1 max.
B	3.88 ± 0.19	98.5 ± 4.8
C	1.24 min. dia.	31.4 min. dia.
D	1.56 max. dia.	39.6 max. dia.

TYPICAL TIME RESOLUTION CHARACTERISTICS



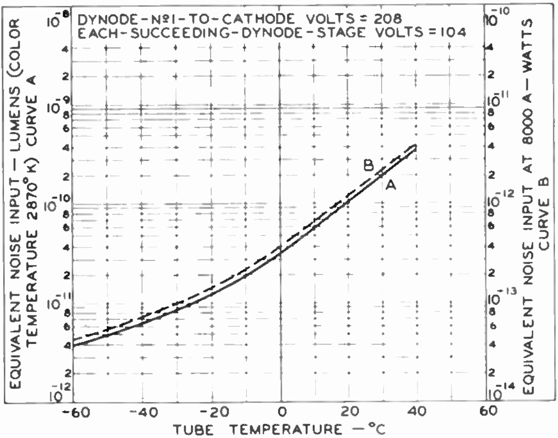
92CS-12475

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



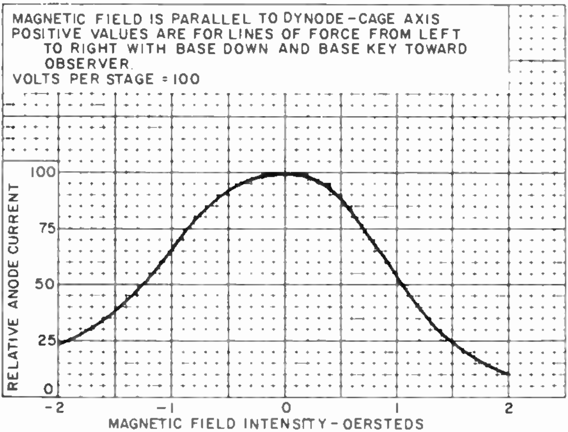
92CS-9456

EQUIVALENT NOISE-INPUT CHARACTERISTICS



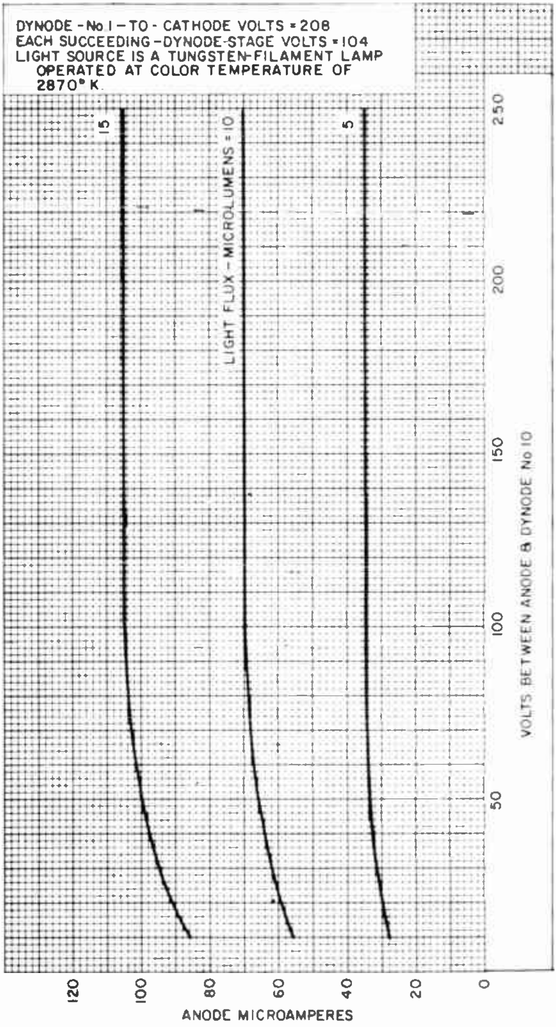
92CS-9462

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT



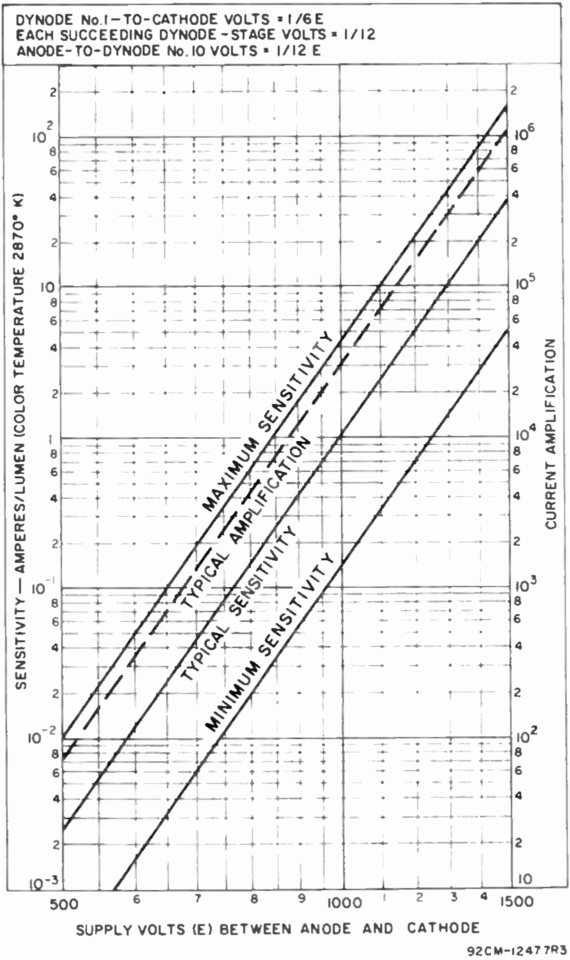
92CS-7813VI

TYPICAL ANODE CHARACTERISTICS

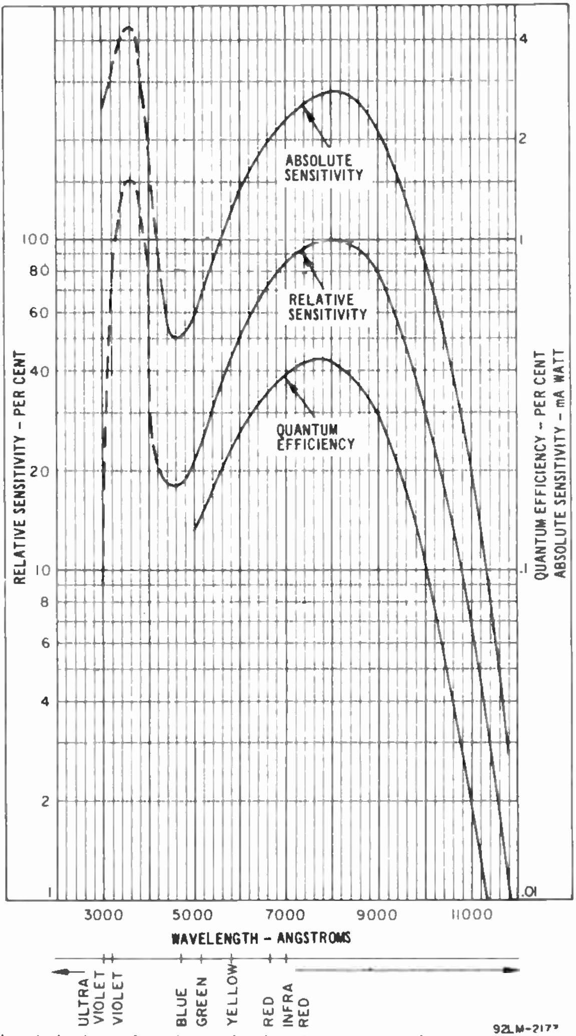


92CM-9460R3

SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



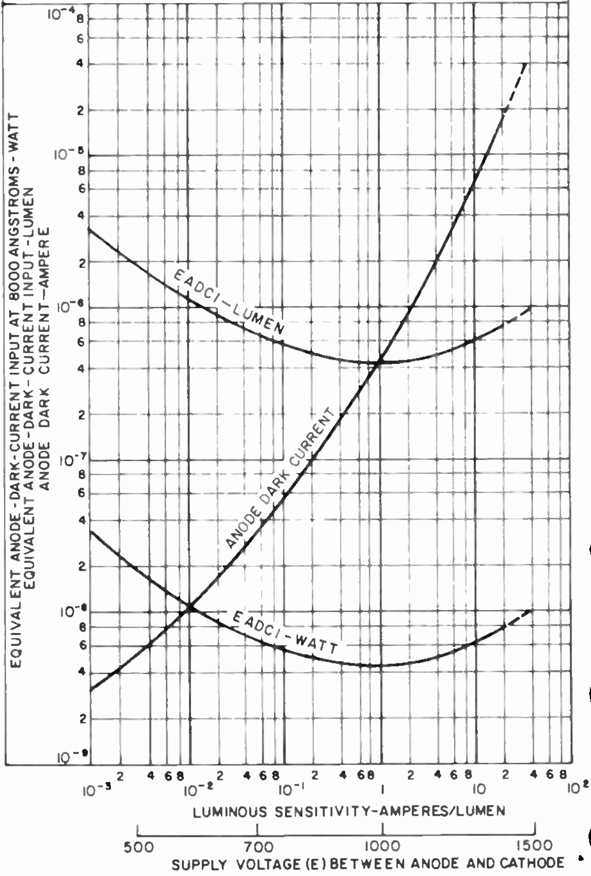
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



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

TYPICAL EADCI AND ANODE DARK CURRENT CHARACTERISTICS

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
LIGHT SOURCE IS A TUNGSTEN–FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22°C



92LM-3135

Photomultiplier Tube

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

For DC-Operated Control Applications Such as Automobile-Headlight Control

GENERAL

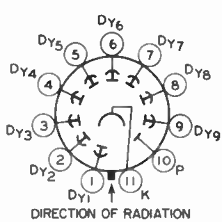
Spectral Response. S-4
Wavelength of Maximum Response . . . . . 4000 ± 500 angstroms
Cathode, Opaque. . . . . Cs-Sb ←
  Minimum projected length[a]. . . . . 0.93 in
  Minimum projected width[d] . . . . 0.31 in
Window . . . . .Lime Glass, (Corning[b] No.0080), or equivalent ←
Dynode Material. . . . . 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 cps[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.

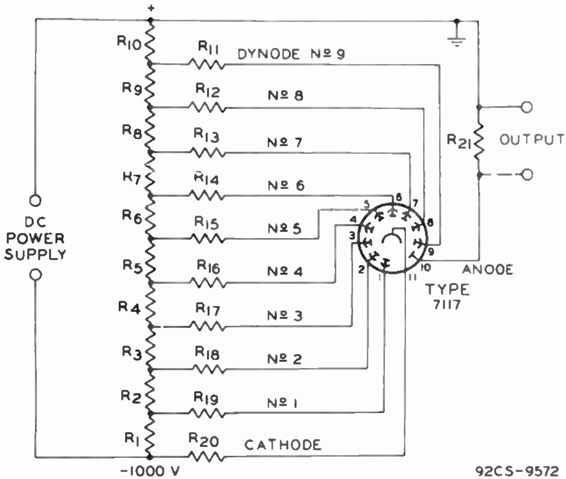
g Under the following conditions: Light incident on the cathode is transmitted through a filter (Corning C.S. No. 3-67, Glass Code No. 3482—Manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident 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



92CS-9572

R1 R2 R3 R4 R5
R6 R7 R8 R9 R10: 1 megohm, 1/2 watt

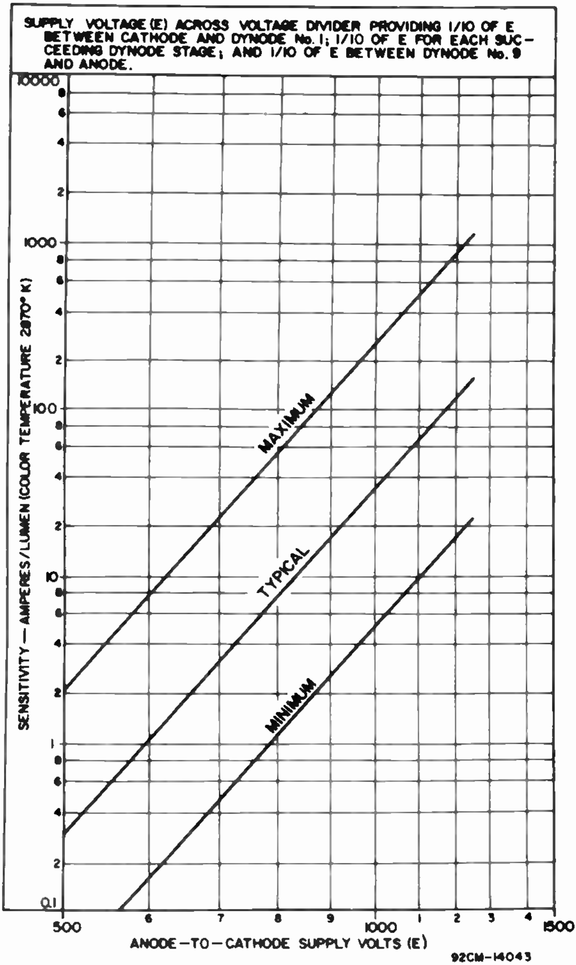
R11: 2 megohms, 1/2 watt

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

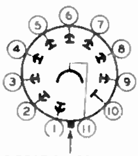
For detection and measurement of ultraviolet radiation

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



DIRECTION OF LIGHT

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

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.

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7200

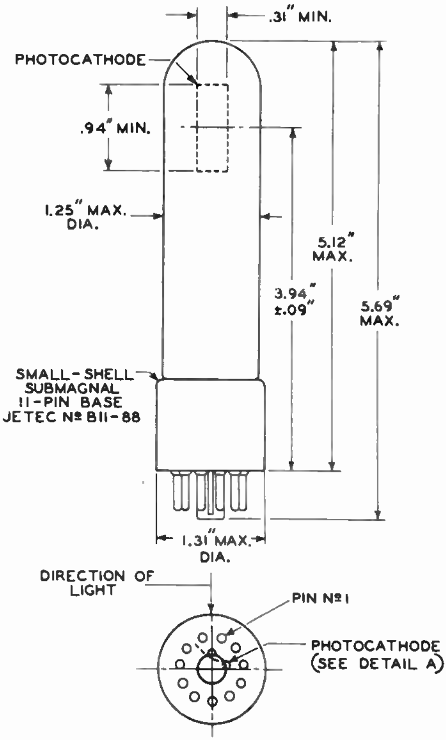
MULTIPLIER PHOTOTUBE

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



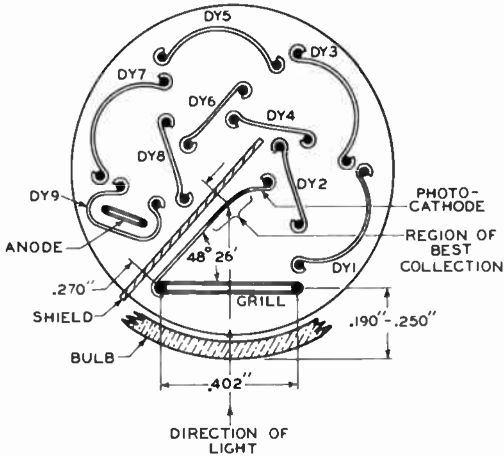
92CS-9581

RCA

7200

MULTIPLIER PHOTOTUBE

DETAIL A



92CS-8674R1

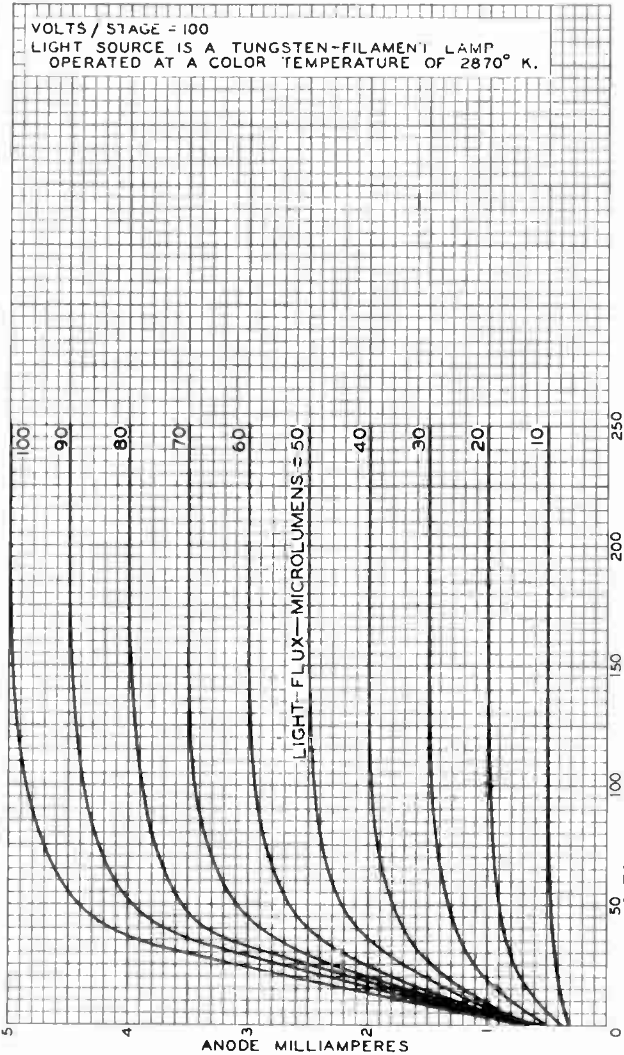
NOTE 1: CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT CENTER OF BOTTOM OF BASE.

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

7200

7200

AVERAGE ANODE CHARACTERISTICS



ELECTRON TUBE DIVISION

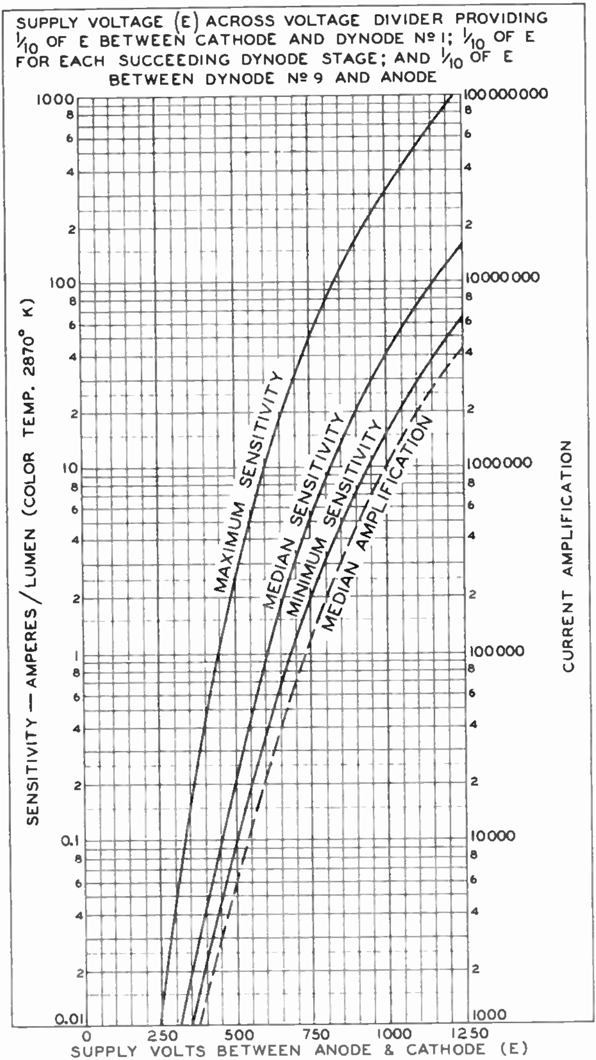
RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

92CM-9577

RCA

7200

CHARACTERISTICS



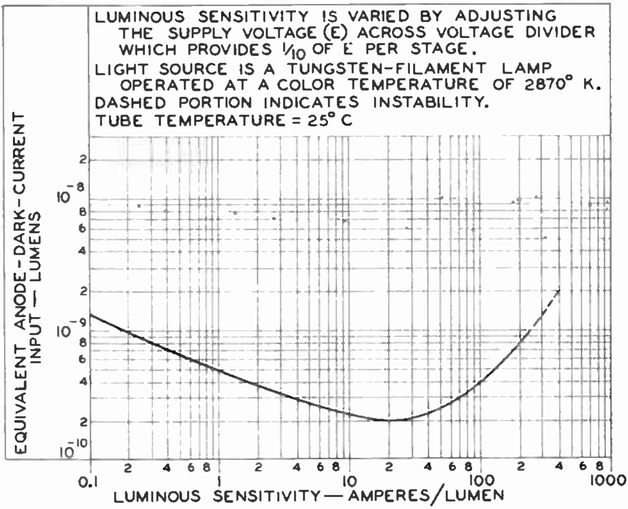
ELECTRON TUBE DIVISION 92CM-9583

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7200

7200

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



92CS-9586

7262A

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.

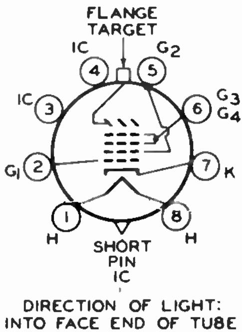
[r] The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

[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)



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

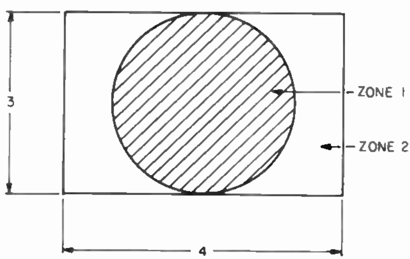


Fig.1

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

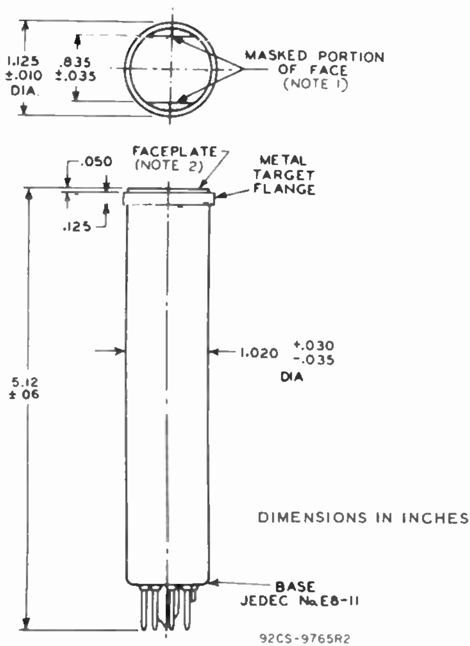
For scanned area of 1/2" x 3/8"

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.

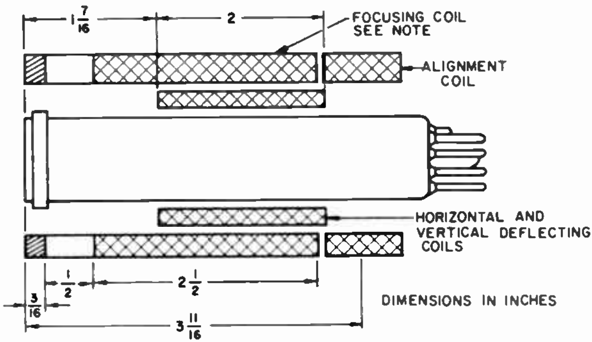
DIMENSIONAL OUTLINE



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".

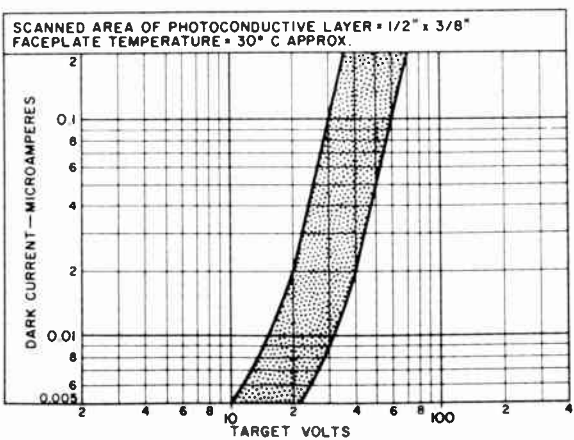
COMPONENT LOCATIONS



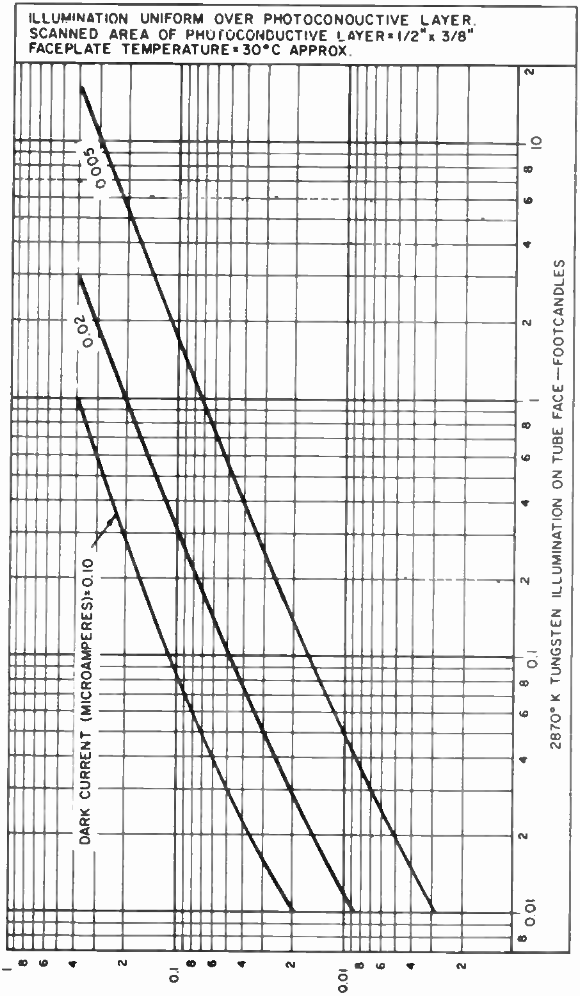
NOTE: CROSS-HATCHING INDICATES WOUND PORTION OF FOCUSING COIL.

Recommended Location and Length of Deflecting, Focusing, and Alignment Components to obtain Minimum Beam-Landing Error.

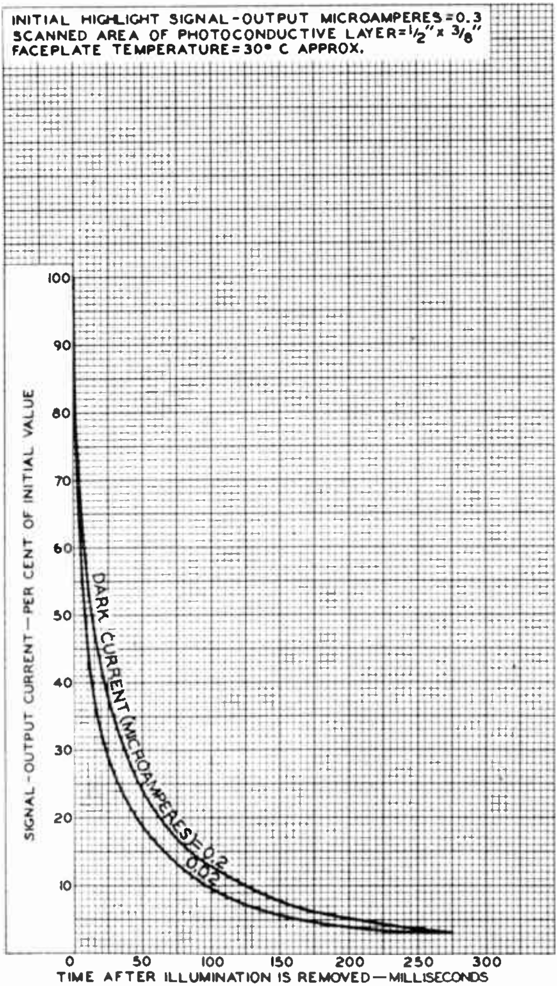
RANGE OF DARK CURRENT



LIGHT TRANSFER CHARACTERISTICS

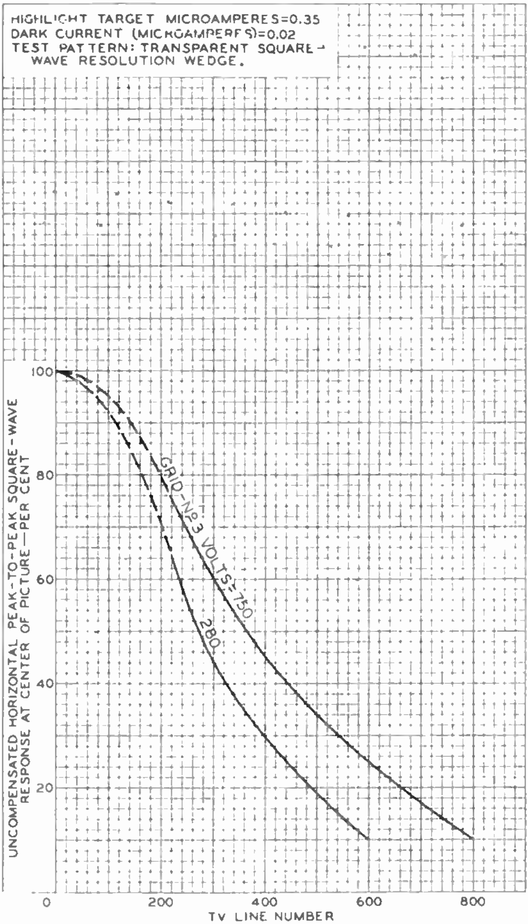


TYPICAL PERSISTENCE CHARACTERISTIC



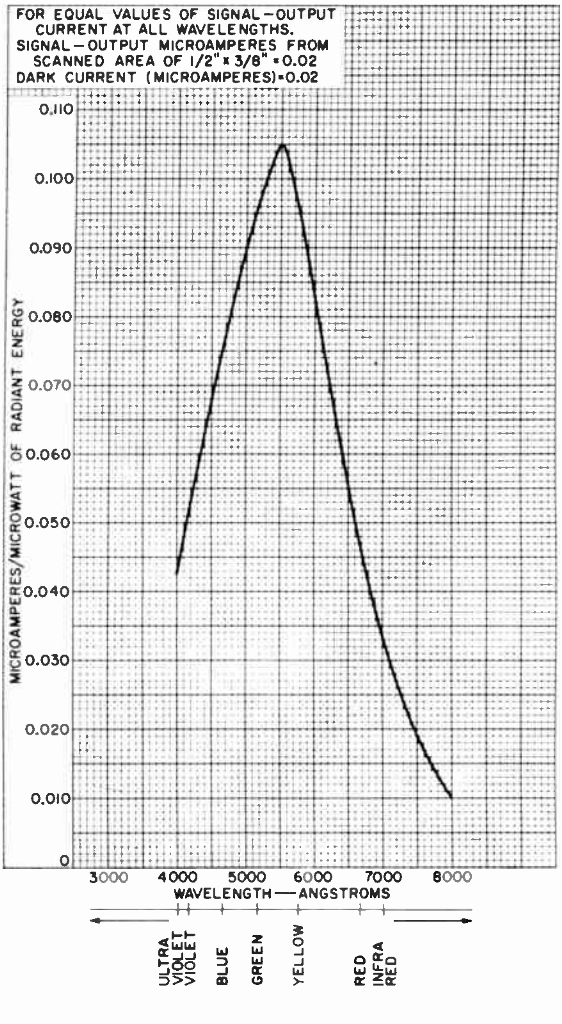
92CM-9505R1

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.

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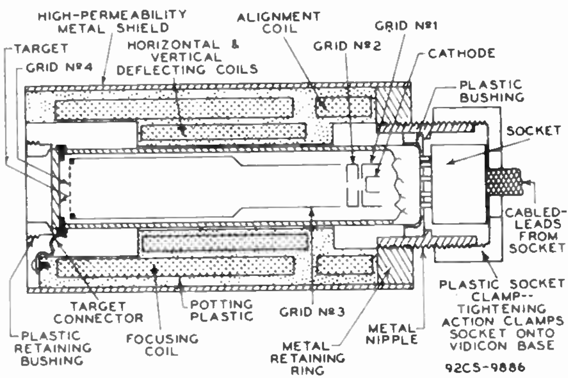
§ Tube socket such as Cinch No.54A18088 and RCA Assembly No.200SDU501, or equivalent, which consists of the deflecting coils, focusing coil, alignment coil, shield, and target connector.

♦ 5 June 1957, Procedure 1 of Military Specification.

* 1 January 1956.

TYPICAL COMPONENT ASSEMBLY FOR TUBE OPERATION UNDER SEVERE ENVIRONMENTAL CONDITIONS



7264

MULTIPLIER PHOTOTUBE

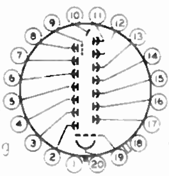
14-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE WITH 1.68"-DIA., SPHERICAL, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE
VERY SHORT TIME-RESOLUTION CAPABILITY

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	μμf
Anode to all other electrodes	5.5	μμf
Dynode No.14 to all other electrodes	7.5	μμf
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)

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON, NEW JERSEY

7264

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	-	millimicrosec

●,#,†,▲,••,♦,❂,■,★,□: See next page.

7264

RCA 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.

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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

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.

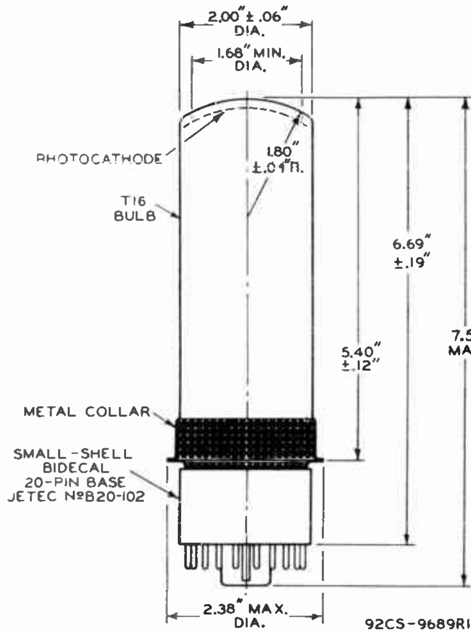
Operation at an average anode current well below the maximum rated value of 2 milliamperes is recommended when stability is important. When maximum stability is required, the anode current should not exceed 250 microamperes.

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

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7264

TYPICAL ANODE CHARACTERISTICS

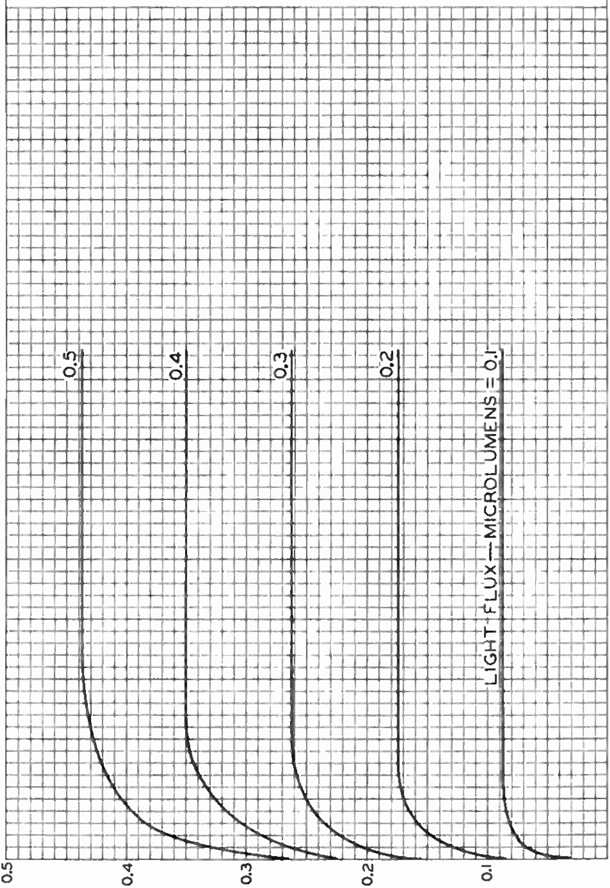
VERY-LOW-LIGHT-LEVEL, LOW-NOISE, HIGH-GAIN SERVICE

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.



92CM-9684

ELECTRON TUBE DIVISION
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7264

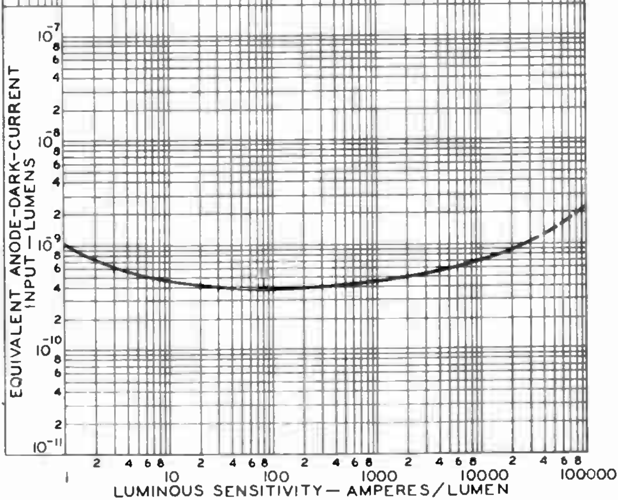
TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

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.



7264

7264

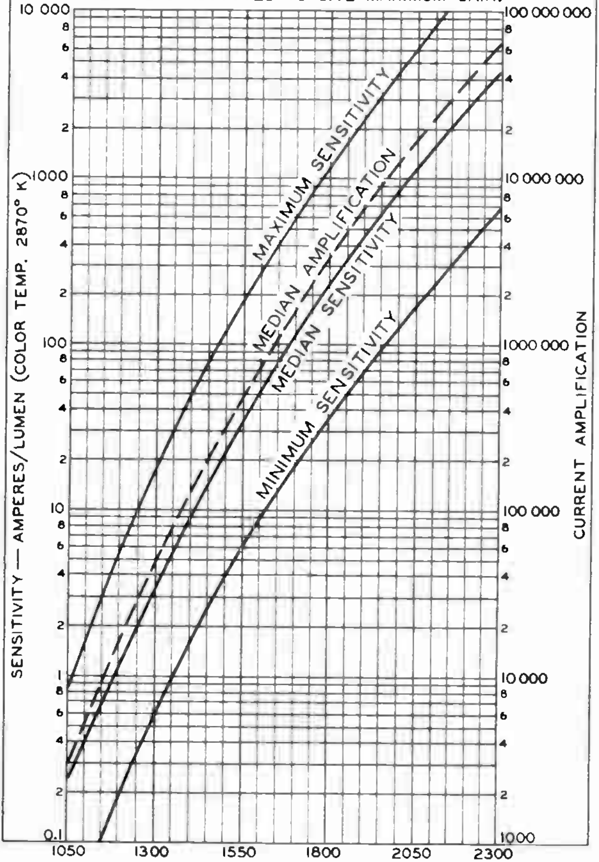
CHARACTERISTICS

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 Nº1	1	DY_{11} & DY_{12}	1.25
GRID Nº1 & DYNODE Nº1	1	DY_{12} & DY_{13}	1.5
DYNODE Nº1(DY_1) & DY_2 ETC. THRU DY_{10} & DY_{11}	1	DY_{13} & DY_{14}	1.75
		DY_{14} & ANODE	2

GRID-Nº2 VOLTS ADJUSTED TO GIVE MAXIMUM GAIN.



ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

92CM-9687

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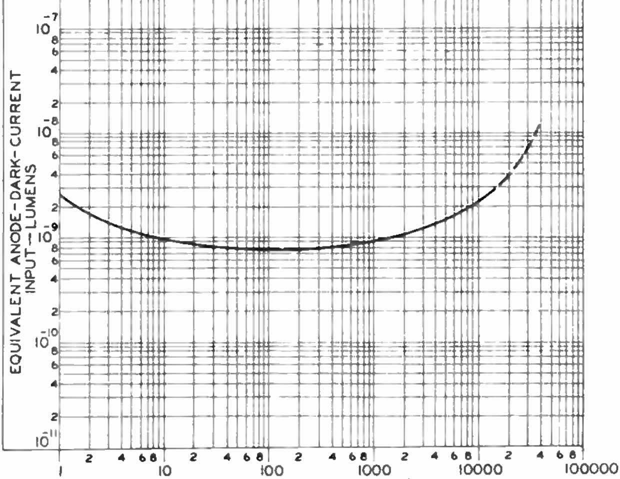
7264

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 № 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	1.2
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-№ 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

92CM-9356

RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

7264

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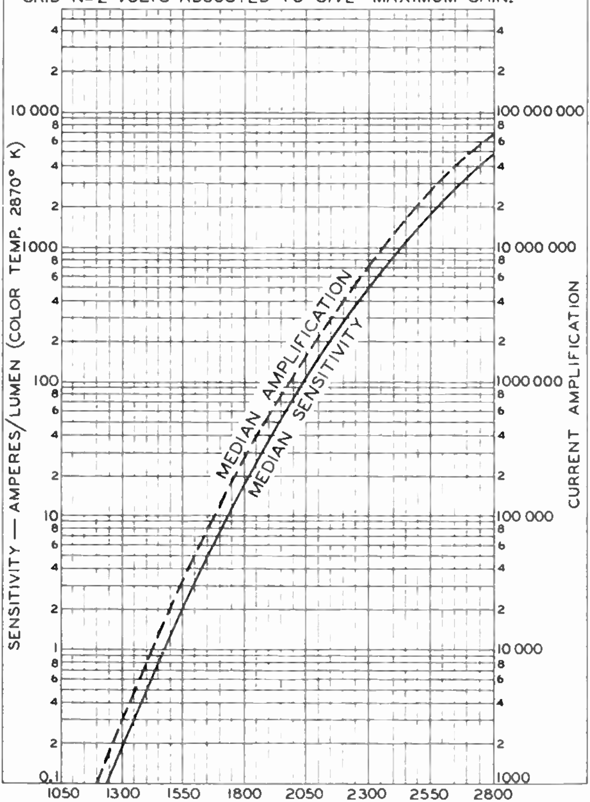
7264

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 №1	1	DY_8 & DY_9	1.9
GRID №1 & DYNODE №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_{11} & DY_{12}	3.8
		DY_{12} & DY_{13}	4.8
DY_6 & DY_7	1.2	DY_{13} & DY_{14}	6
DY_7 & DY_8	1.5	DY_{14} & ANODE	4.8

GRID-№ 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.

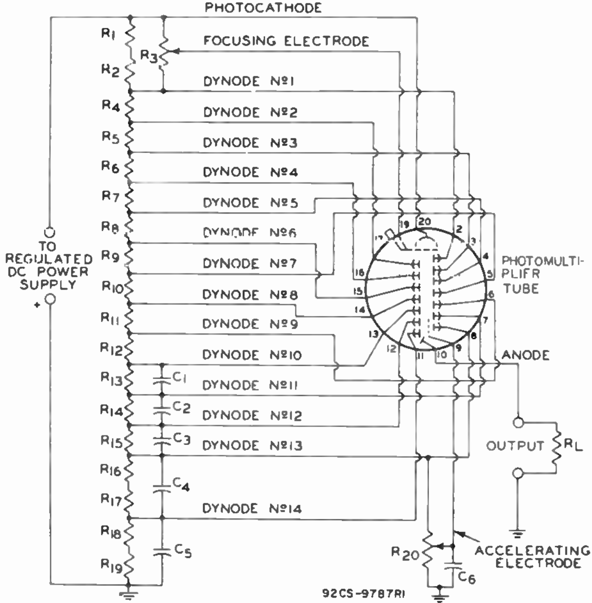
Voltage Distribution B is recommended where high dynode-No.1 gain is important, such as low light level and scintillation counting applications. Voltage Distribution B maintains the cathode to dynode-No.1 voltage constant at 330 volts; it is especially useful when the supply voltage is adjusted over 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



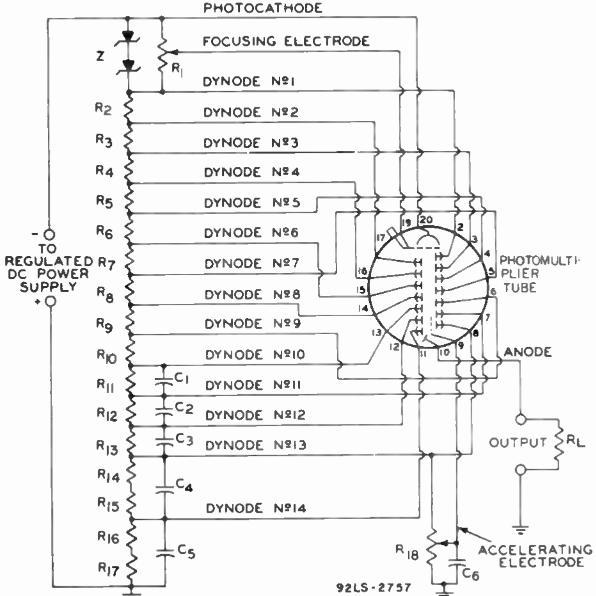
C_1: 25 pF, 20%, 600 volts (dc working), ceramic disc
C_2: 50 pF, 20%, 600 volts (dc working), ceramic disc
C_3: 100 pF, 20%, 600 volts (dc working), ceramic disc
C_4: 250 pF, 20%, 600 volts (dc working), ceramic disc
C_5: 500 pF, 20%, 600 volts (dc working), ceramic disc
C_6: 100 pF, 20%, 1000 volts (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.

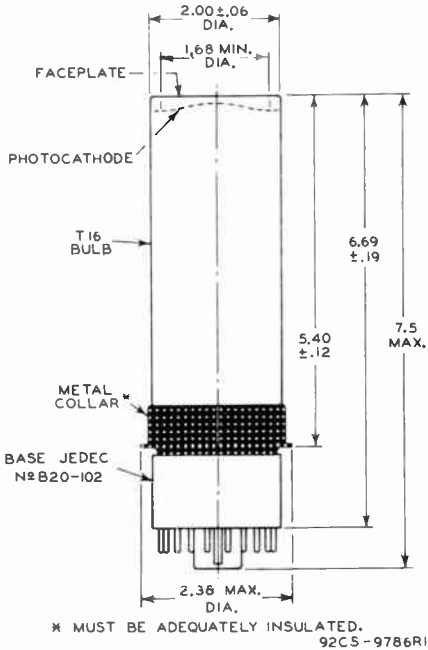
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT FOR CONSTANT VOLTAGE BETWEEN CATHODE AND DYNODE No.1



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.

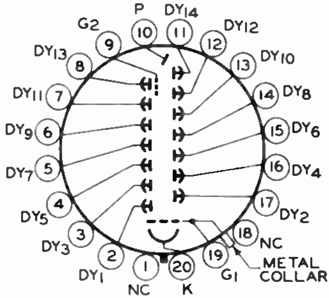
Note: Within 1.68" diameter, deviation from flatness of external surface of faceplate will not exceed 0.005" from peak to valley.

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

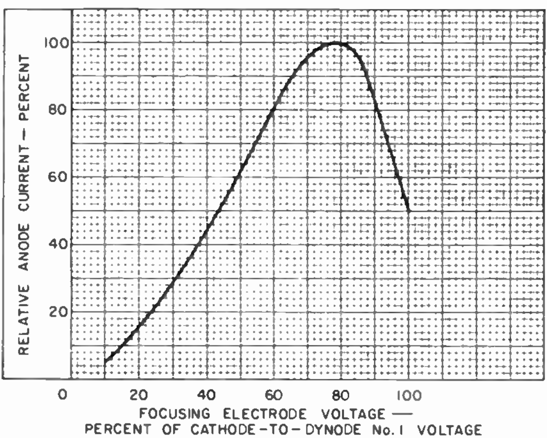


20C

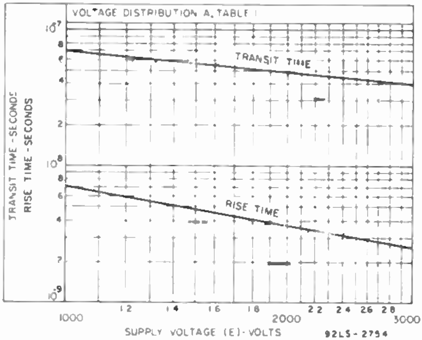
Metal Collar: Connected Internally to Focusing Electrode — Do Not Make Electrical Connection to Collar.

Note: The Metal Collar May be at High Potential Depending on the Circuit Application and Should be Insulated Accordingly.

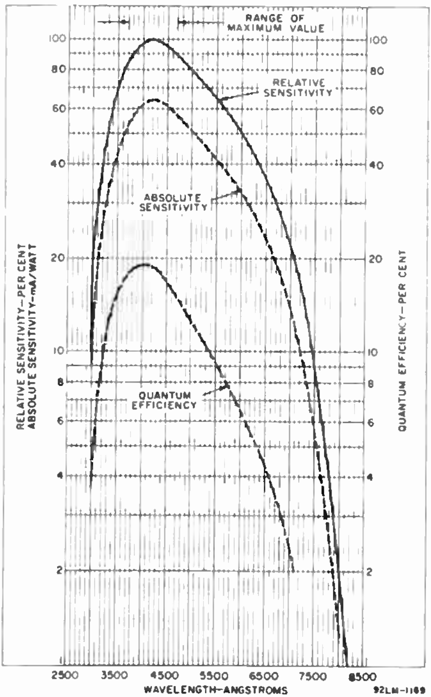
TYPICAL FOCUSING ELECTRODE CHARACTERISTIC



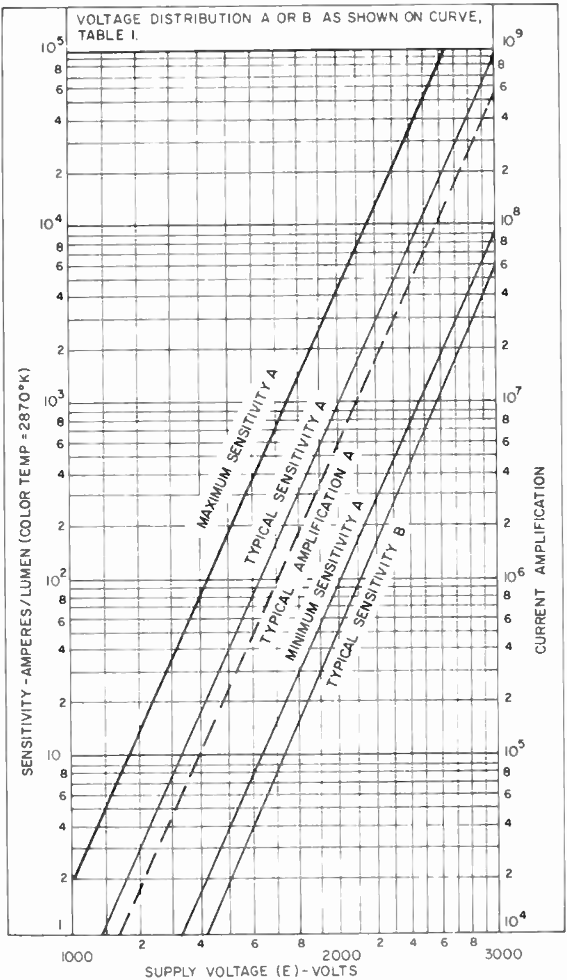
TYPICAL TIME-RESOLUTION CHARACTERISTICS



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS



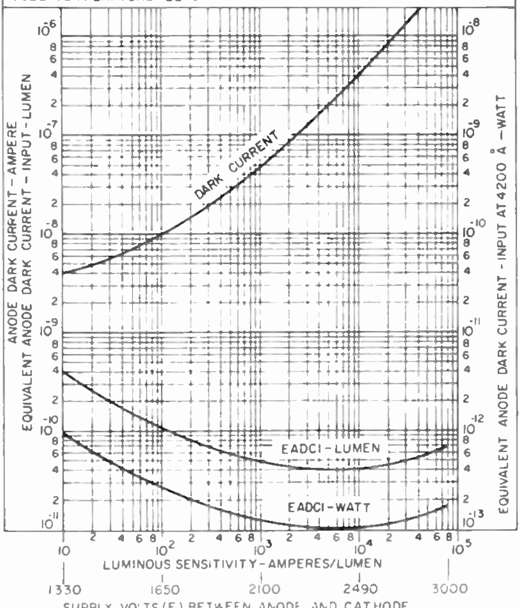
92LM-2755

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

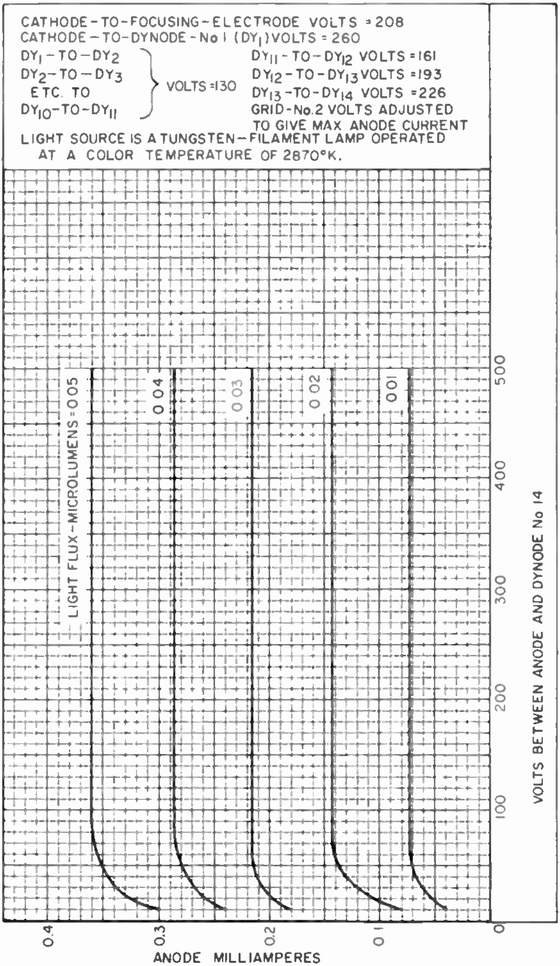
BETWEEN	5.4% OF E MULTIPLIED BY
CATHODE & FOCUSING ELECTRODE	1.6
CATHODE & DYNODE No.1 (DY_1)	2
DY_1 & DY_2	1
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1
DY_7 & DY_8	1
DY_8 & DY_9	1
DY_9 & DY_{10}	1
DY_{10} & DY_{11}	1
DY_{11} & DY_{12}	1.25
DY_{12} & DY_{13}	1.5
DY_{13} & DY_{14}	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



92CM-9780R1

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	°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° 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.

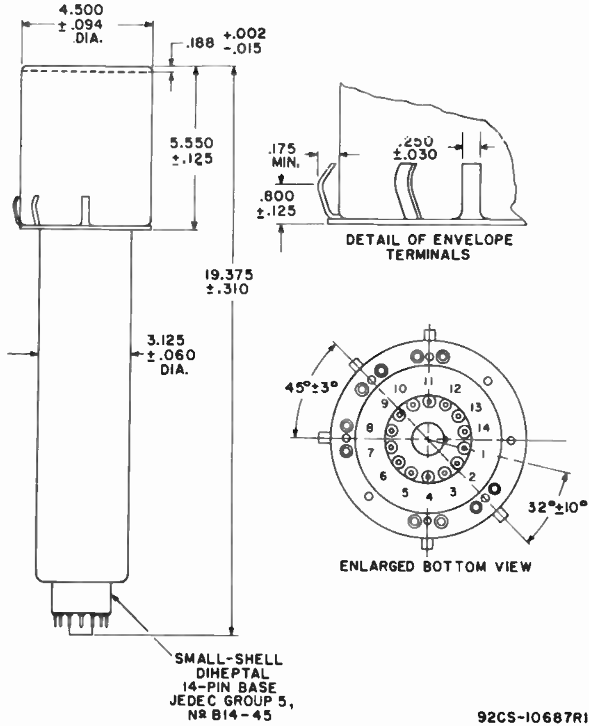
[k] Measured with amplifier having flat frequency response.

[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

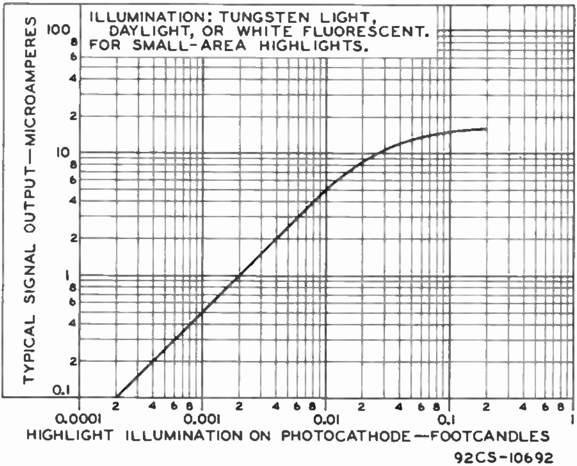


Image Orthicon

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 stand-by operation.

RCA

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	$\mu\mu f$
Anode to all other electrodes	5.5	$\mu\mu f$
Dynode No.10 to all other electrodes	6.5	$\mu\mu f$
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.

ELECTRON TUBE DIVISION
RADIO CORPORATION OF AMERICA HARRISON NEW JERSEY

7326

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.

7326

MULTIPLIER PHOTOTUBE

7326

♦ 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.

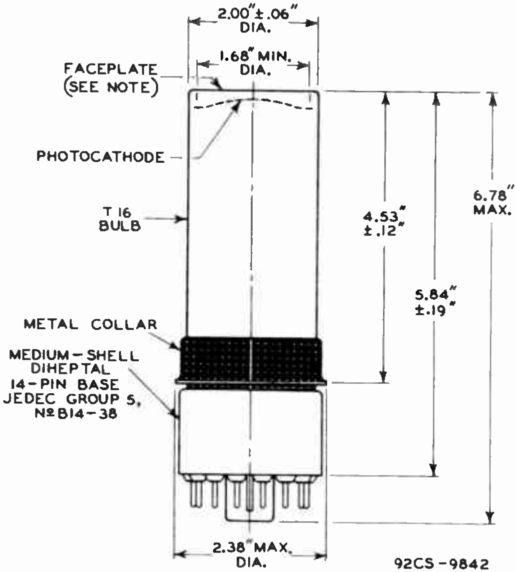
Electrostatic and/or *magnetic shielding* of the 7326 may be necessary.

SPECTRAL-SENSITIVITY CHARACTERISTIC of Phototube having S-20 Response is shown at front of this Section

RCA

7326

MULTIPLIER PHOTOTUBE



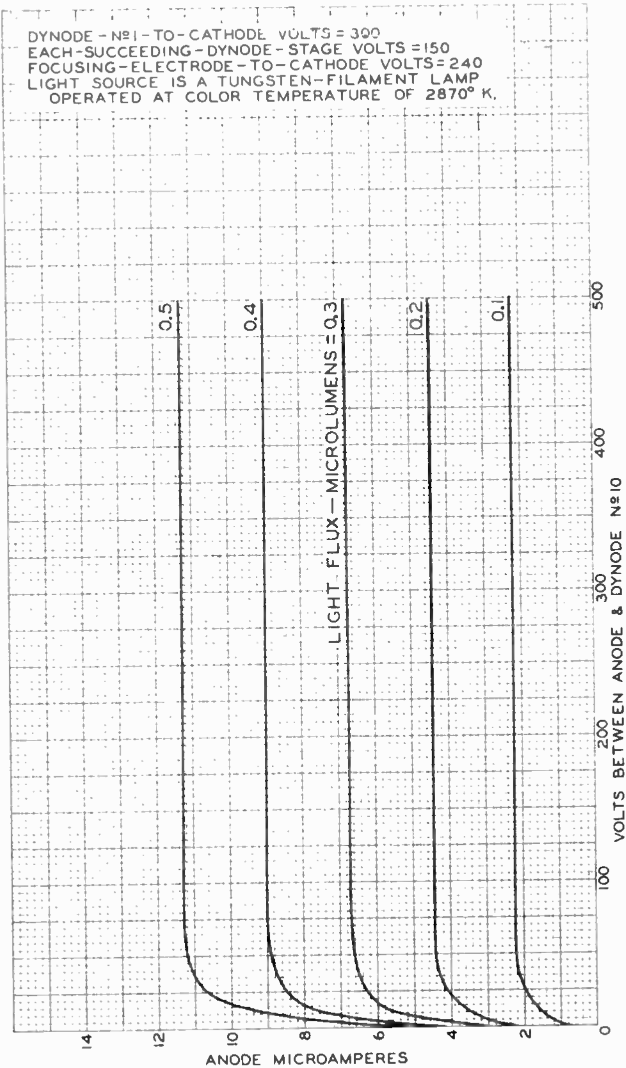
CENTER LINE OF BULB WILL NOT DEVIATE MORE THAN 2° IN ANY DIRECTION FROM THE PERPENDICULAR ERECTED AT THE CENTER OF BOTTOM OF THE BASE.

NOTE: WITHIN 1.68" DIAMETER, DEVIATION FROM FLATNESS OF EXTERNAL SURFACE OF FACEPLATE WILL NOT EXCEED 0.005" FROM PEAK TO VALLEY.

7326

7326

TYPICAL ANODE CHARACTERISTICS



ELECTRON TUBE DIVISION

92CM-9840

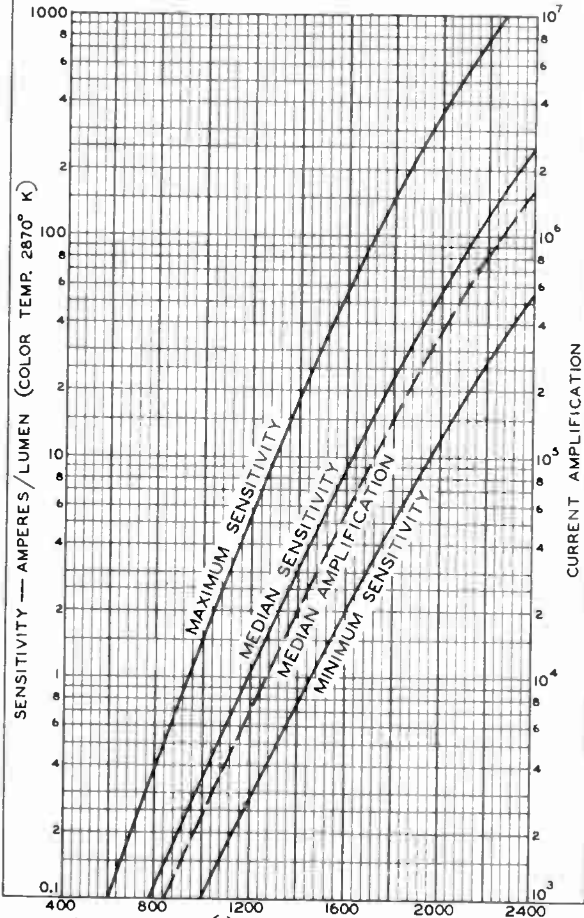
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

7326

7326

CHARACTERISTICS

SUPPLY VOLTAGE (E) ACROSS 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.



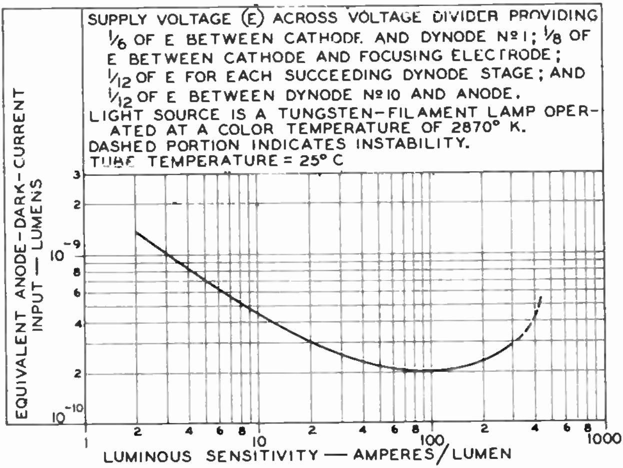
ELECTRON TUBE DIVISION 92CM-9839

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

RCA

7326

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



92CS-9841

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 × 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 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 . . . . 15.250" ± 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

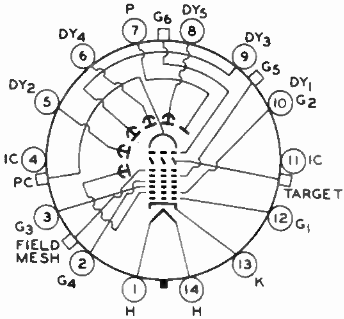
Terminal Over Pin 2 – Field Mesh
Terminal Over Pin 4 – Photocathode (PC)
Terminal On Side Of Envelope
Opposite Base Key – Grid No.6 (G_6)
Terminal Over Pin 9 – Grid No.5 (G_5)
Terminal Over Pin 11 – Target

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

BOTTOM VIEW

DIRECTION OF LIGHT: PERPENDICULAR TO LARGE END OF TUBE

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

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	200	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.

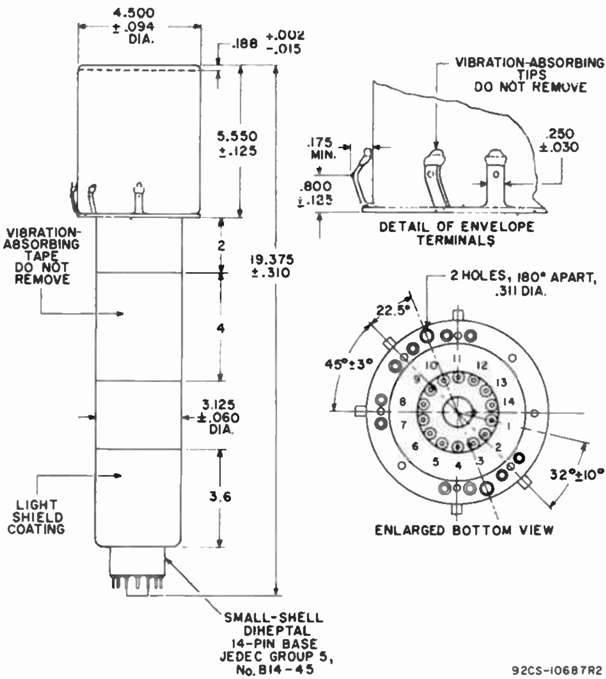
[k] Measured with amplifier having flat frequency response.

[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



DIMENSIONS IN INCHES

BASIC LIGHT-TRANSFER CHARACTERISTIC

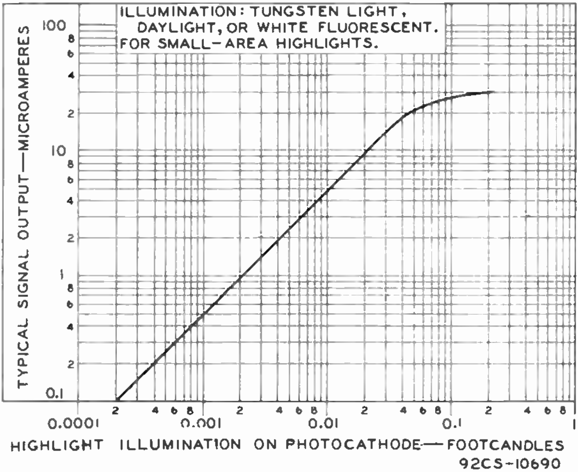


Image Orthicon

"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 7389B/L is Directly Interchangeable with the 7389, 7389A and 7389B in all cameras.

The 7389B/L *is the same as the* 7389B *except utilizes a stable, long-life glass target.*

The stable, long-life, glass target of type 7389B/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 7389B/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 7389B/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 73898/L

Dos

1. Allow the 7389B/L to warm up prior to operation.
2. Hold temperature of the 7389B/L within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control to best usable resolution.
5. Condition spare 7389B/L'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 7389B/L.

Don'ts

1. Don't force the 7389B/L into its shoulder socket.
2. Don't operate the 7389B/L without scanning.
3. Don't operate a 7389B/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.

Image Orthicon

"MICRODAMP" CONSTRUCTION FOR REDUCED MICROPHONICS
FIELD MESH FOR REDUCED "WHITE EDGE" EFFECTS

LONG-LIFE TARGET	FIELD-MESH TYPE
MAGNETIC FOCUS	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

RCA 7412

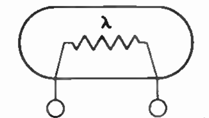
PHOTOCONDUCTIVE CELL

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



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

RCA

7412

PHOTOCONDUCTIVE CELL

♦ For conditions where the incident power is 2×10^{-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.

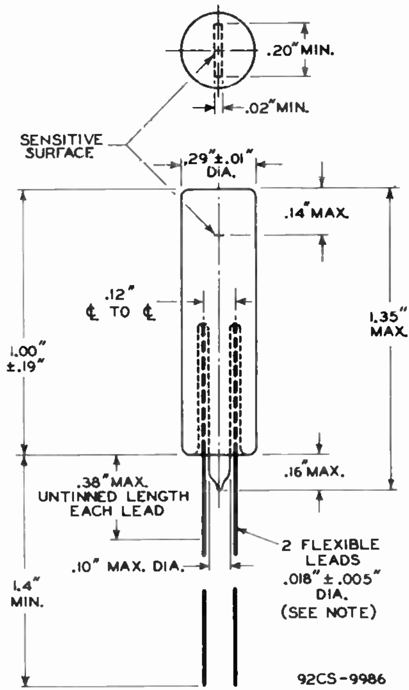
For a given illumination, the output current will have its highest value when the incident illumination is normal (angle of incidence is 90°) to the face of the cell. For smaller angles of incidence, the output current decreases. The decrease depends upon several factors including the angle of incidence 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

RCA

7412

PHOTOCONDUCTIVE CELL



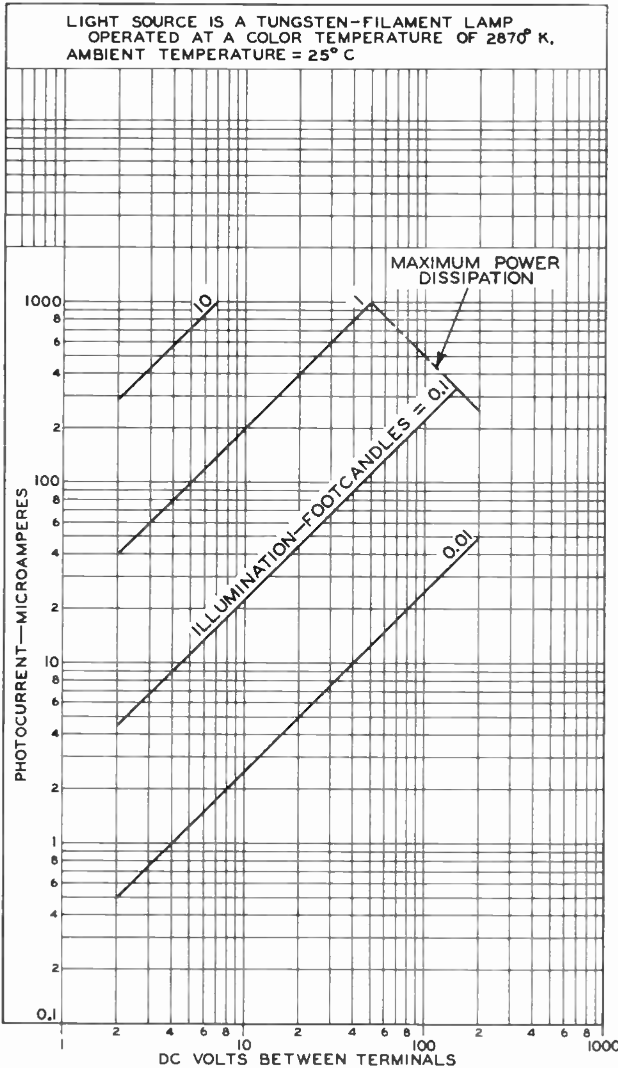
NOTE: THE SPECIFIED LEAD DIAMETER IS MAINTAINED ONLY WITHIN THE UNTINNED LENGTH.

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

7412

7412

AVERAGE CHARACTERISTICS

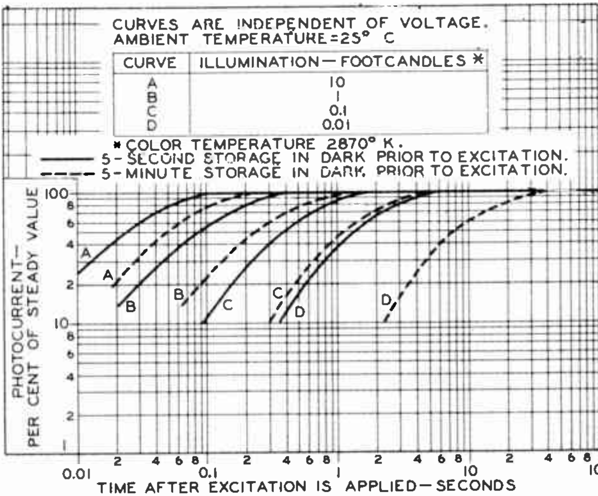


ELECTRON TUBE DIVISION 92CM-9989

RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

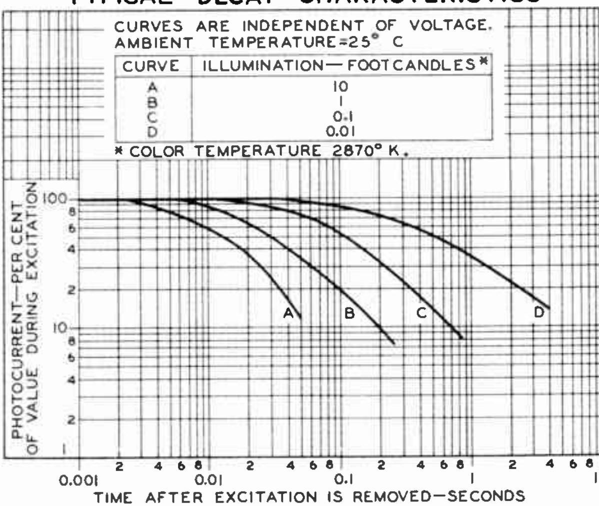
7412

TYPICAL RISE CHARACTERISTICS



92CS-9532

TYPICAL DECAY CHARACTERISTICS



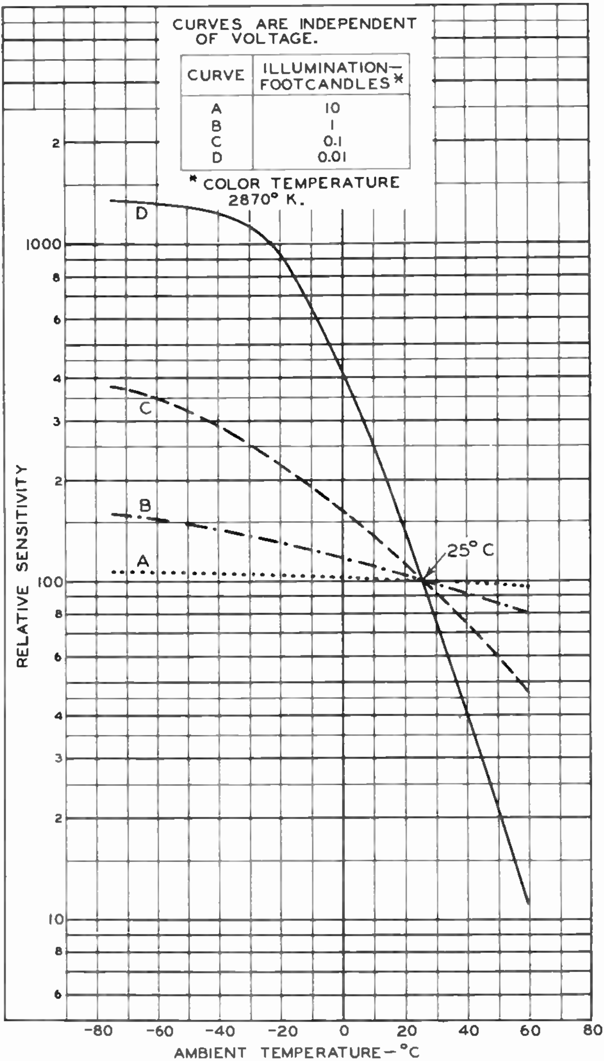
92CS-9533

7412

RCA

7412

TYPICAL CHARACTERISTICS

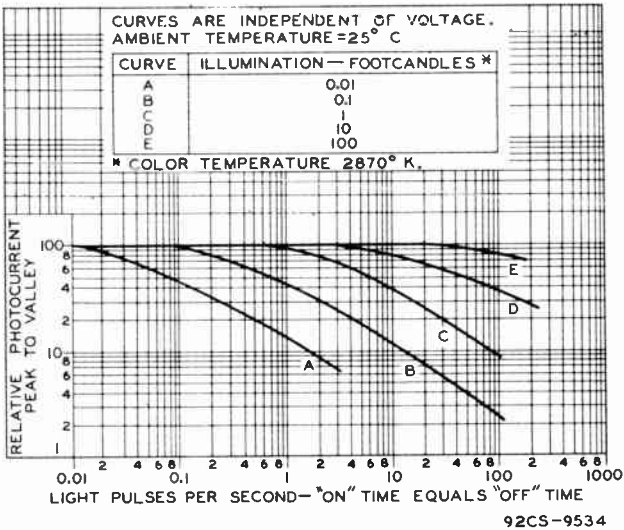


CURVE	ILLUMINATION—FOOTCANDLES*
A	10
B	1
C	0.1
D	0.01

* COLOR TEMPERATURE 2870° K.

92CM-9538

RESPONSE CHARACTERISTICS



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

Faceplate Illumination (Highlight)	1	1	fc
Target Voltage[c,d]	20 to 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 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

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.

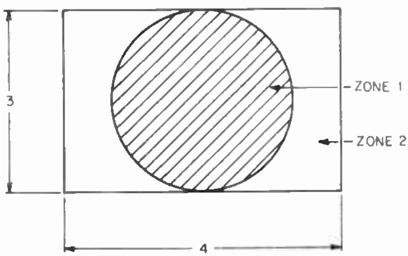
2. Don't change camera size and centering controls once the scanned area of photoconductive layer has been properly positioned.

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



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.

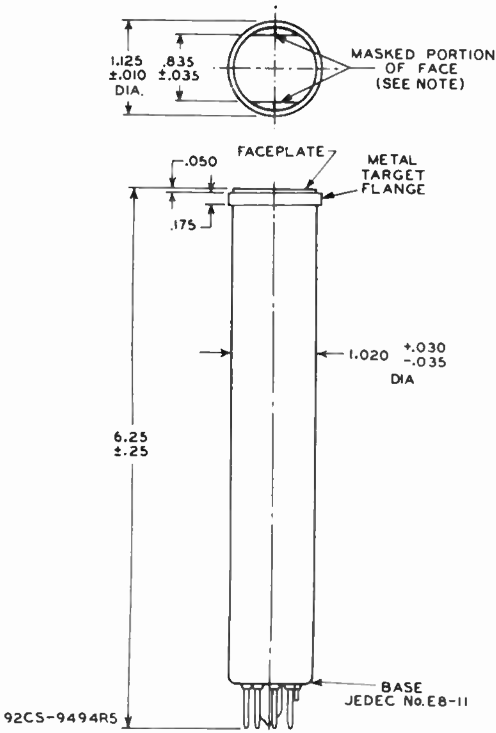
TABLE I *(For scanned area of 1/2" x 3/8")*

Equivalent Number of Raster Lines	ZONE 1 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.

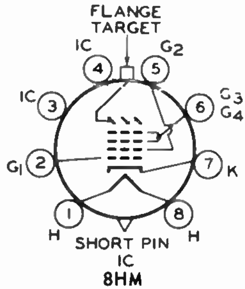
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.

ADDITIONAL DIMENSIONAL OUTLINE NOTE:

Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

TERMINAL DIAGRAM (Bottom View)

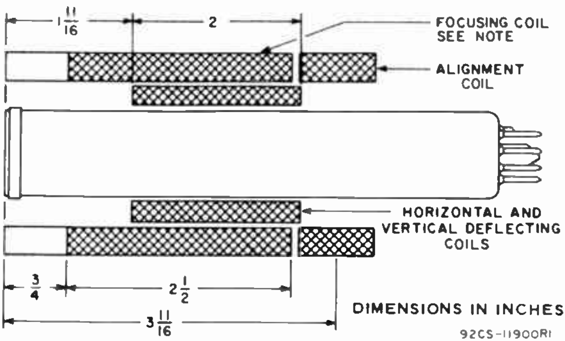
Pin 1: Heater
Pin 2: Grid No. 1
Pin 3: Internal Connection – Do Not Use
Pin 4: Internal Connection – Do Not Use
Pin 5: Grid No. 2
Pin 6: Grids No.2 and No.4
Pin 7: Cathode
Pin 8: Heater
Flange: Target
Short Index Pin: Internal Connection – Make No Connection



DIRECTION OF LIGHT: INTO FACE END OF TUBE

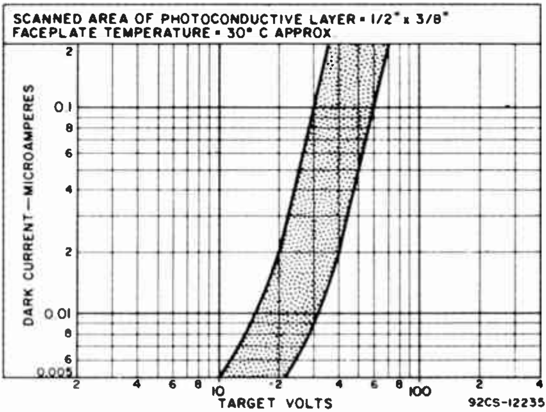
RECOMMENDED LOCATION AND LENGTH OF DEFLECTING, FOCUSING, AND ALIGNMENT COMPONENTS

To obtain minimum beam-landing error

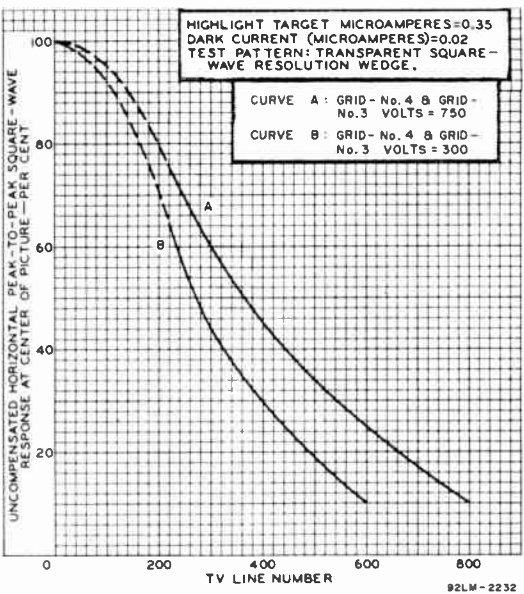


Note: Cross-hatching indicates wound position of focusing coil.

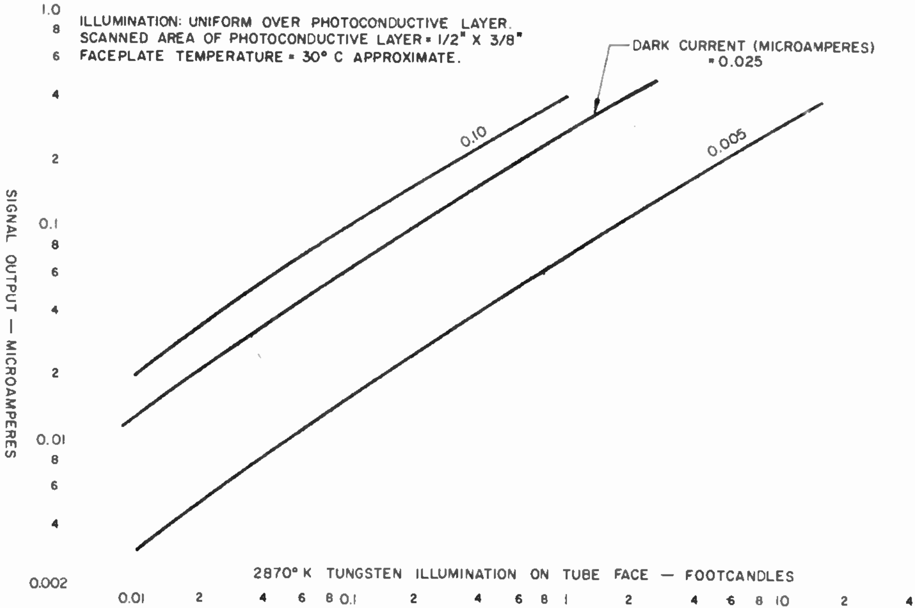
RANGE OF DARK CURRENT



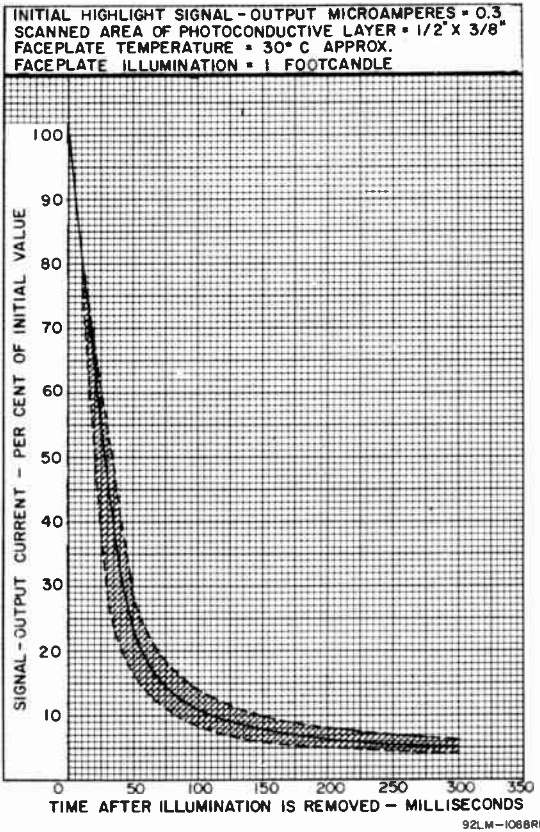
UNCOMPENSATED HORIZONTAL SQUARE-WAVE RESPONSE



LIGHT TRANSFER CHARACTERISTICS



TYPICAL PERSISTENCE CHARACTERISTIC



Multiplier Phototube

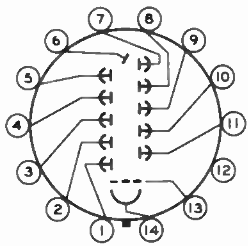
10-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE HAVING ENCLOSED, IN-LINE DYNODE STRUCTURE, 1.68"-DIAMETER, SPHERICAL, SEMITRANSPARENT PHOTOCATHODE, S-11 RESPONSE, AND VERY SHORT TIME-RESOLUTION CAPABILITY

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	μμf
Anode to all other electrodes. . . .	5	μμf
Dynode No.10 to all other electrodes.	6.5	μμf
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.	°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. I. 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.

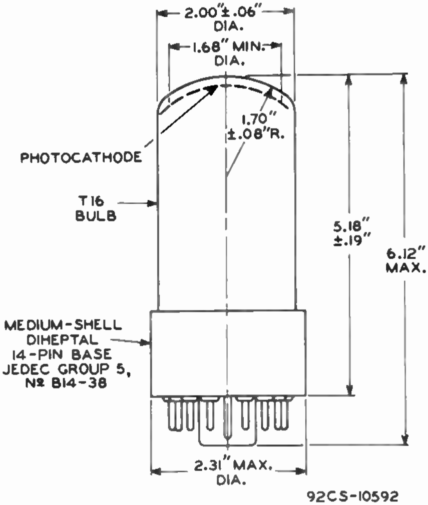
The use of an average anode current well below the maximum-rated value of 2 milliamperes is recommended when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

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.

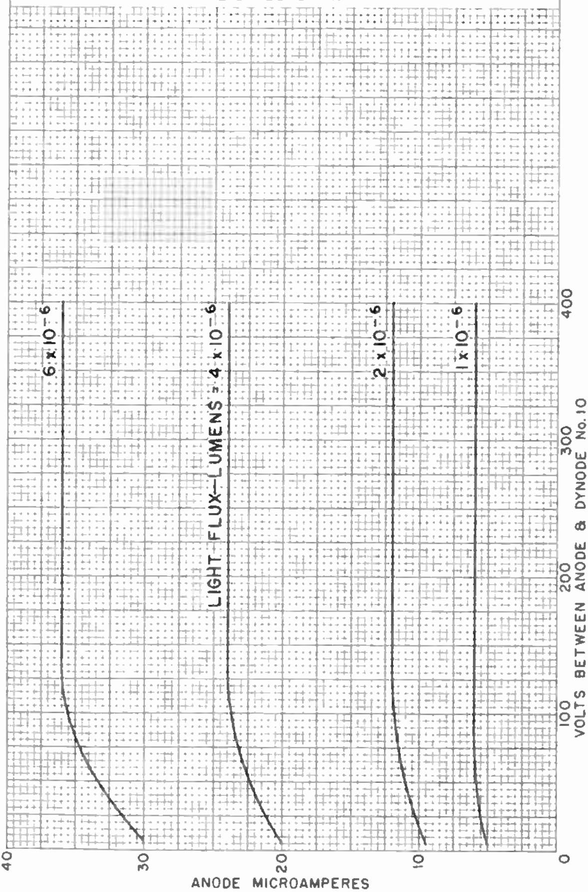
SPECTRAL-SENSITIVITY CHARACTERISTIC
of Phototube having S-11 Response
is shown at front of this Section



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.



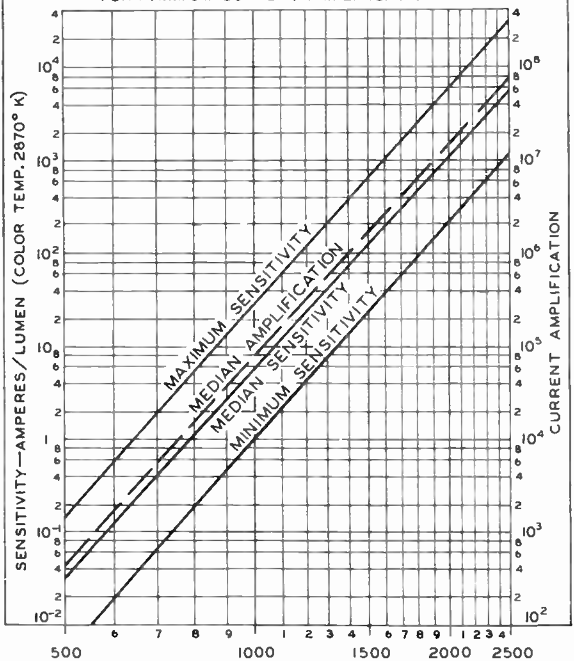
92CM – 10596R1

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.



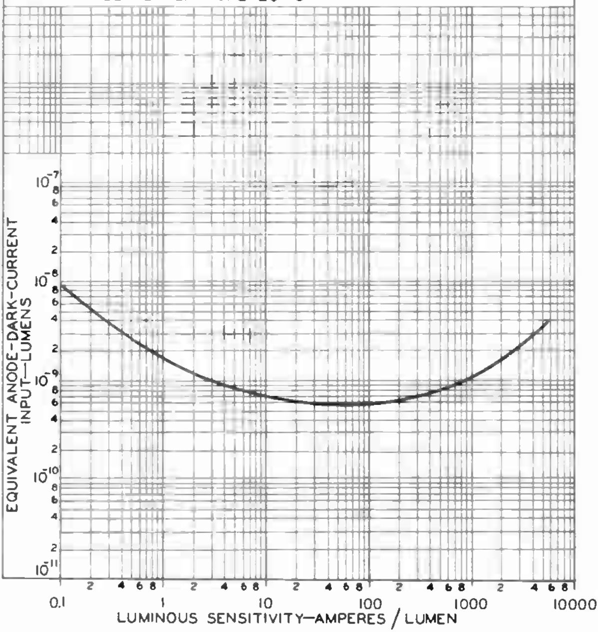
92CM-10597R1

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

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

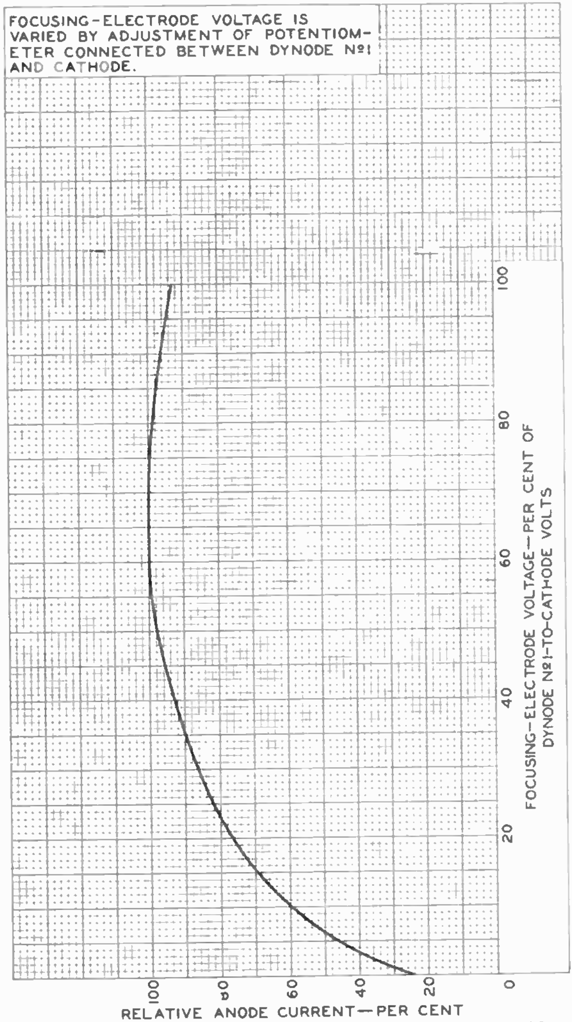
BETWEEN	8.06% OF E MULTIPLIED BY
CATHODE & DY1	2
DY1 & DY2	1.4
DY2 & DY3	1
DY3 & DY4	1
DY4 & DY5	1
DY5 & DY6	1
DY6 & DY7	1
DY7 & DY8	1
DY8 & DY9	1
DY9 & DY10	1
DY10 & ANODE	1
ANODE & CATHODE	12.4

FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM CURRENT AMPLIFICATION.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870° K.
TUBE TEMPERATURE=25° C



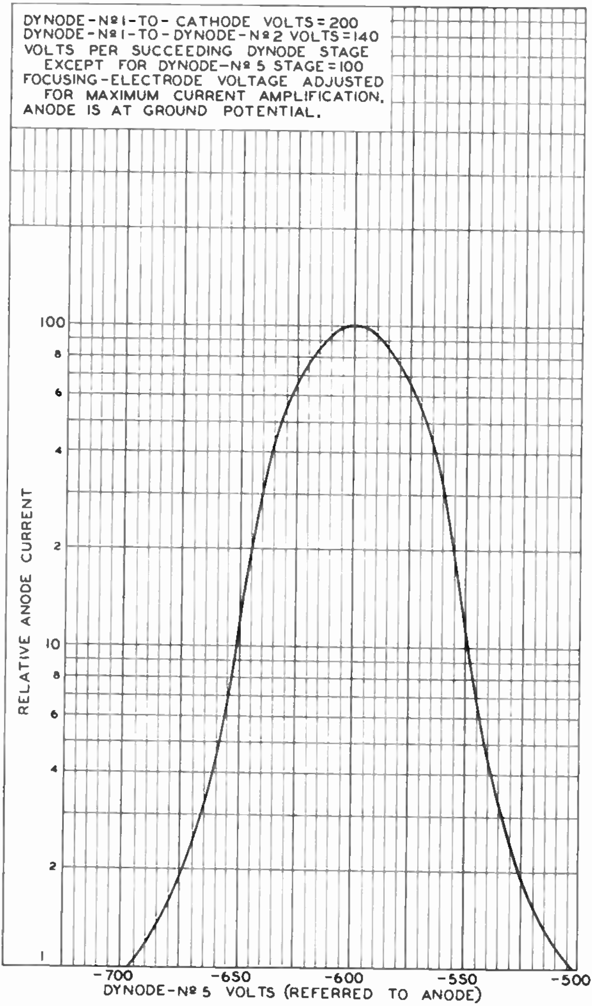
92CM-10593R1

AVERAGE FOCUSING-ELECTRODE-VOLTAGE CHARACTERISTIC



92CM-10590

TYPICAL ANODE-CURRENT CHARACTERISTIC



92CM-10598

Multiplier Phototube

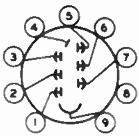
6-STAGE, HEAD-ON, FLAT-FACEPLATE, COMPACT TYPE HAVING IN-LINE DYNODE STRUCTURE, 0.5"-DIAMETER CURVED, CIRCULAR, SEMITRANSPARENT PHOTOCATHODE AND S-11 RESPONSE

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 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 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.

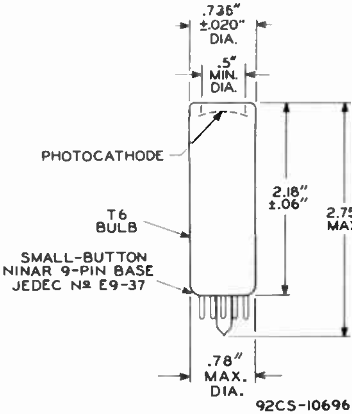
OPERATING CONSIDERATIONS

The use of an *average anode current* well below the maximum-rated value of 0.5 milliampere is recommended when stability of operation is important.

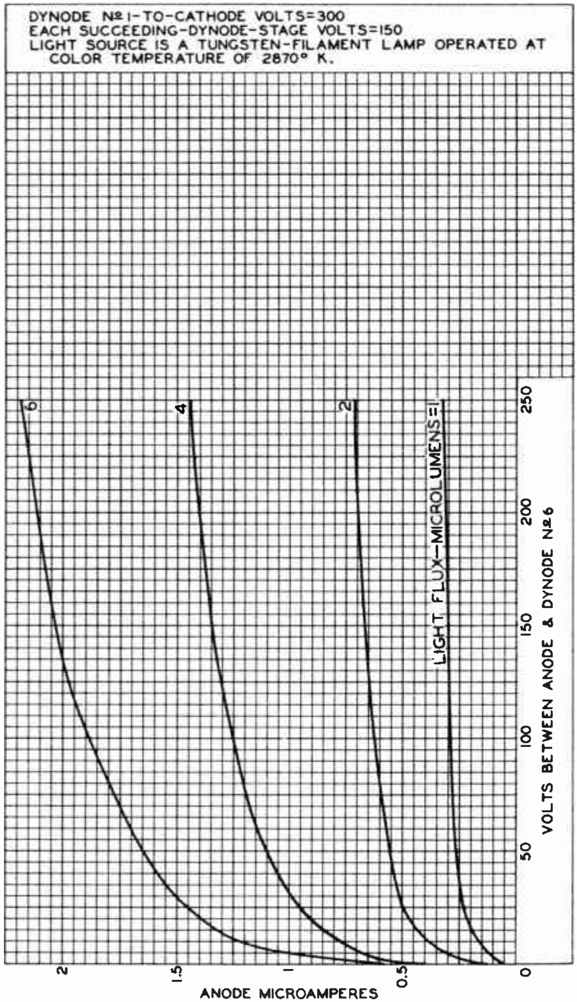
Electrostatic and/or *magnetic shielding of the 7764* may be necessary.

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

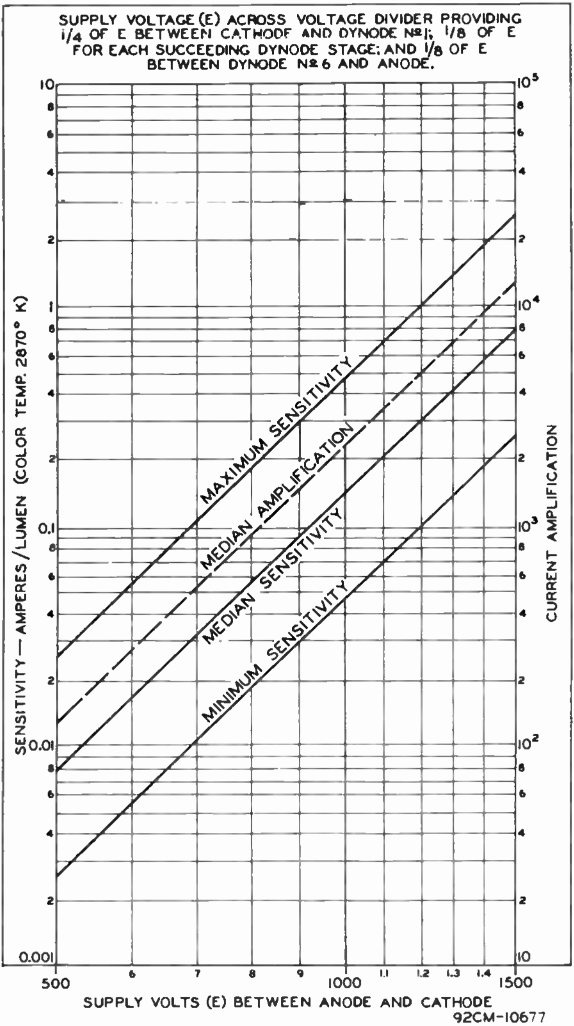


AVERAGE ANODE CHARACTERISTICS

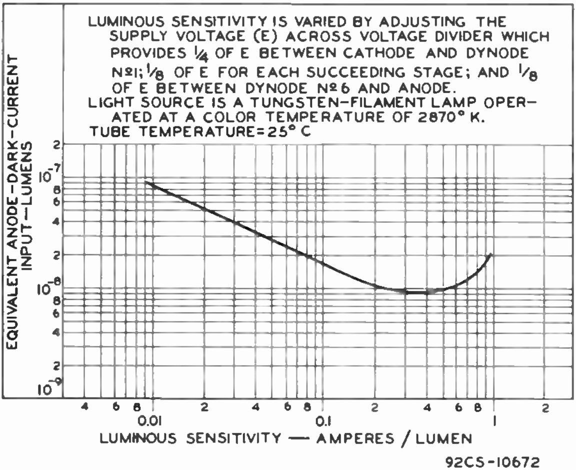


92CM-10673

CHARACTERISTICS



TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC



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.

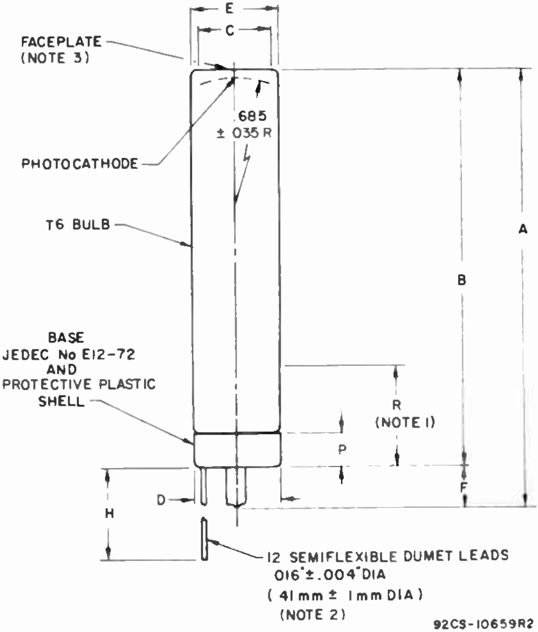
[r] Under conditions with dc supply voltage (E) across a voltage divider providing 1/6 of (E) between cathode and dynode No.1; 1/12 of (E) for each succeeding dynode stage; and 1/12 of (E) between dynode No.10 and anode..

[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



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

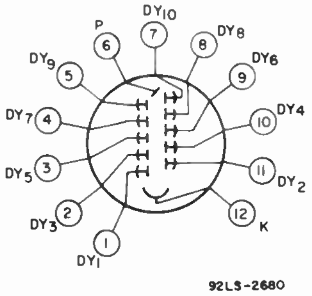
Note 1: Within this length, maximum diameter of tube is 0.78".

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 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.

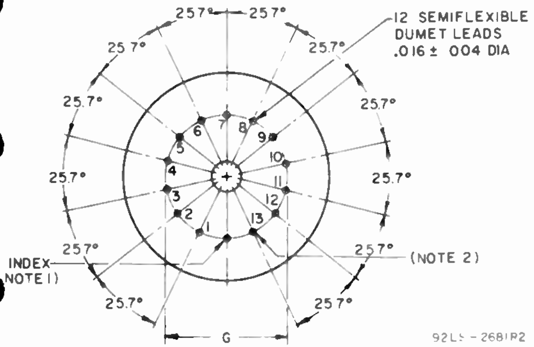
LEAD CONNECTIONS (BOTTOM VIEW)

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)

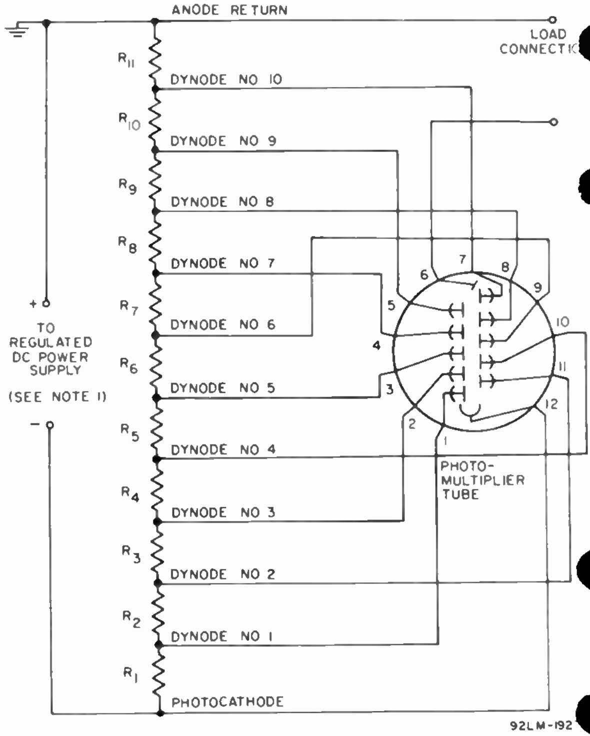


LEAD ORIENTATION NOTES

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

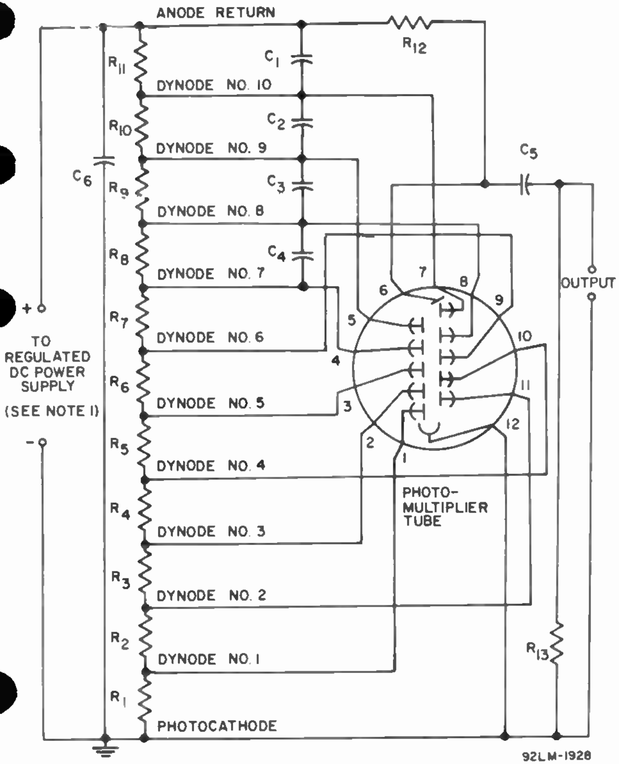


R_1 and R_2: 560,000 ohms, 1/2 watt
R_3: 820,000 ohms, 1/2 watt
R_4 through R_{11}: 470,000 ohms, 1/2 watt

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



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.

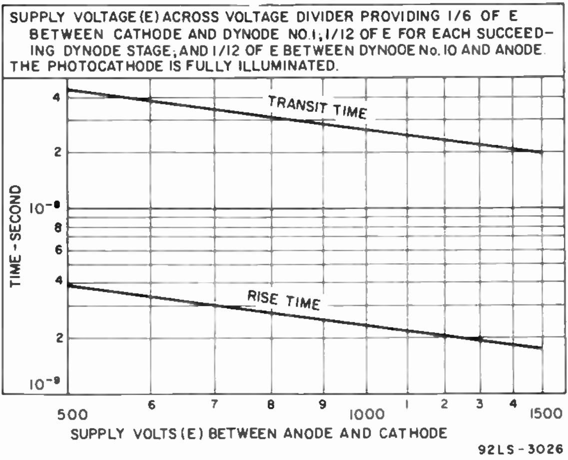
(Continued on next page)

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

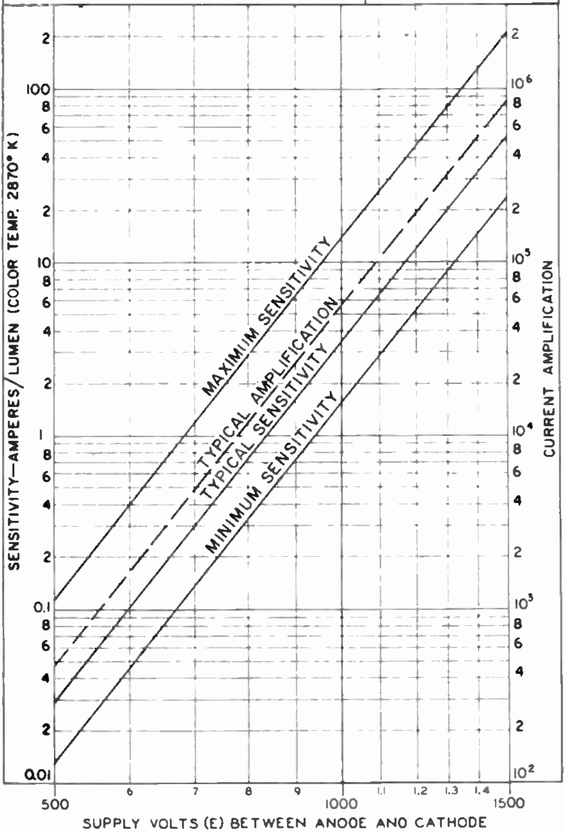
TYPICAL TIME-RESOLUTION CHARACTERISTICS



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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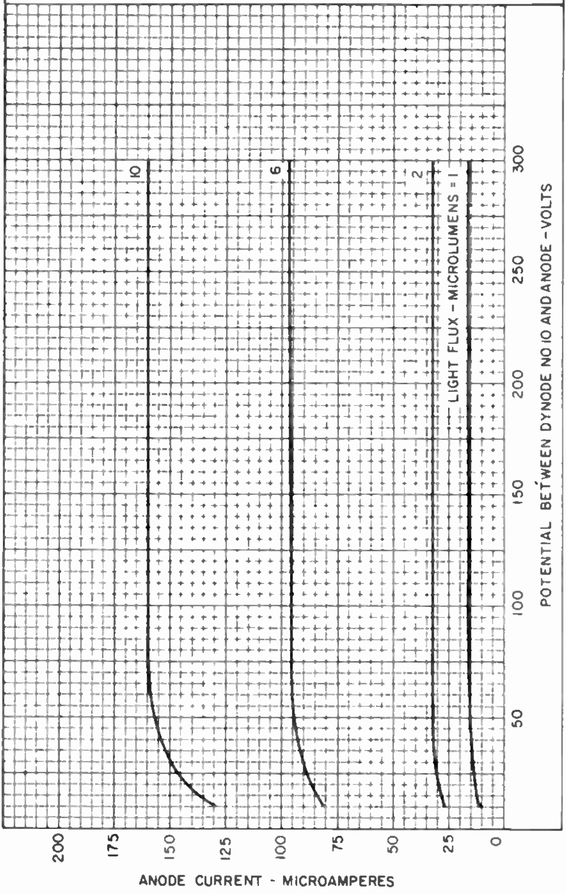
TYPICAL ANODE CHARACTERISTICS

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.



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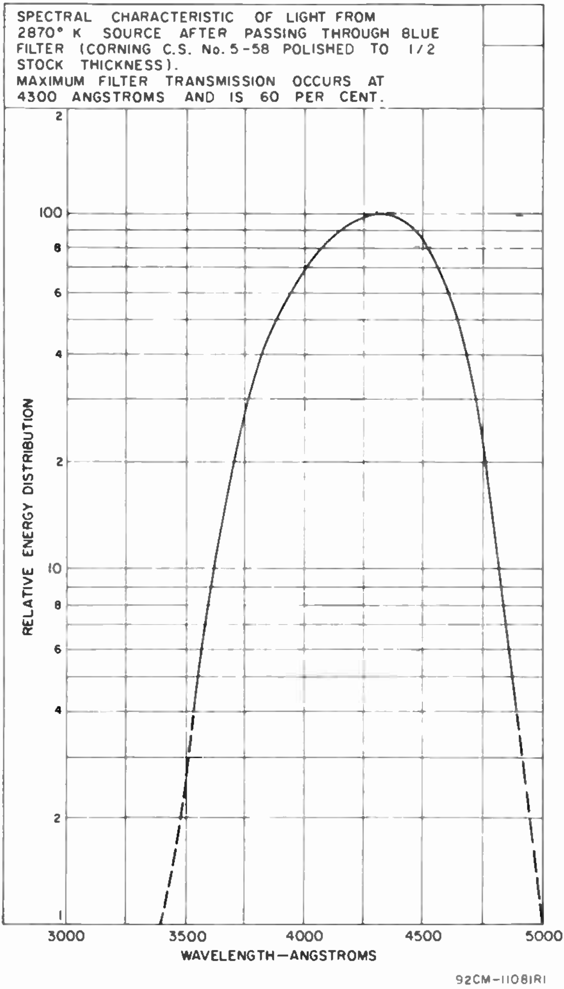
SPECTRAL ENERGY DISTRIBUTION OF 2870° K LIGHT SOURCE AFTER PASSING THROUGH INDICATED FILTER

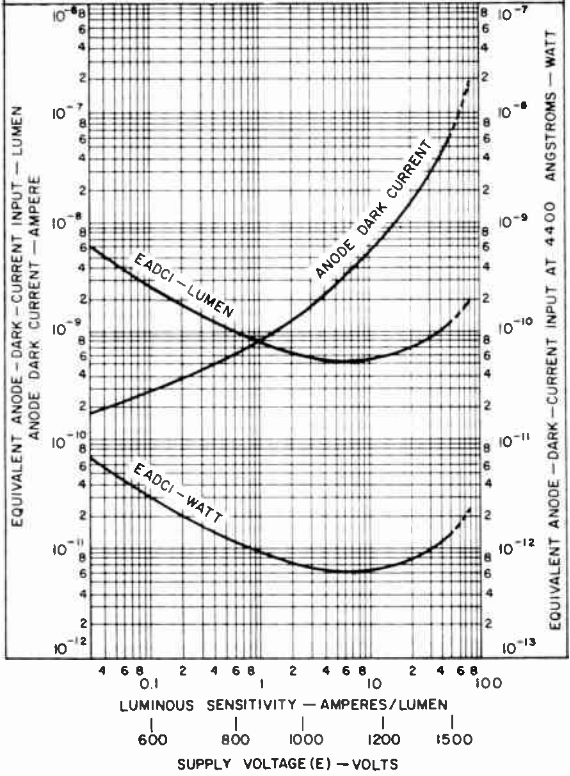


TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

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

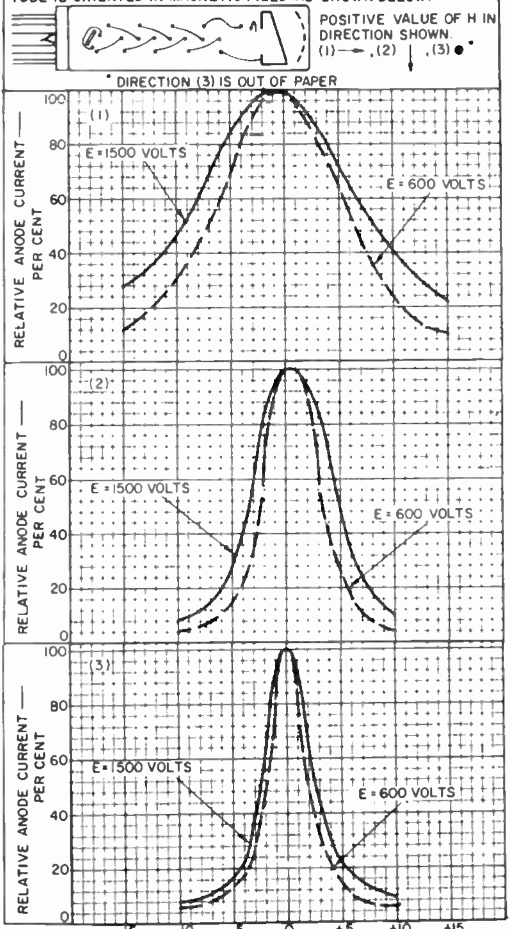
BETWEEN	8.25 % OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	1.2
DYNODE No 1 AND DYNODE No 2	1.2
DYNODE No.2 AND DYNODE No.3	1.7
EACH SUCCEEDING DYNODE-STAGE	1.0
ANODE AND CATHODE	12.1

TUBE TEMPERATURE IS 22°C

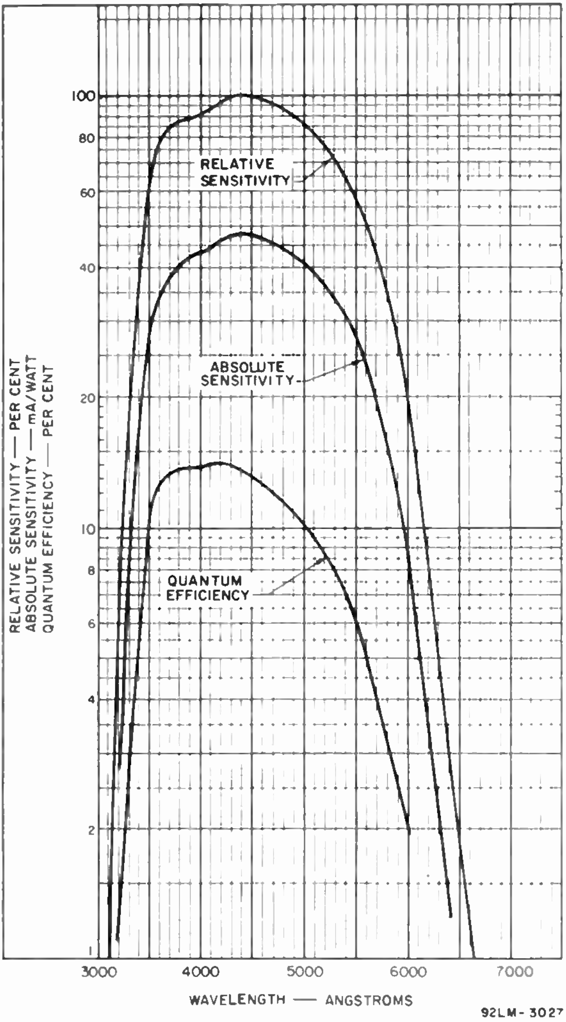


TYPICAL EFFECT OF INDICATED MAGNETIC FIELD ON ANODE CURRENT

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:



TYPICAL SPECTRAL RESPONSE CHARACTERISTICS



Multiplier Phototube

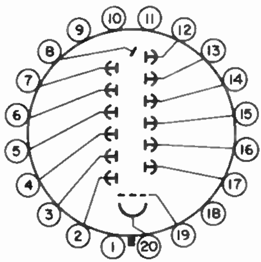
12-STAGE, HEAD-ON, SPHERICAL-FACEPLATE TYPE HAVING ENCLOSED, IN-LINE DYNODE STRUCTURE, 1.68"-DIAMETER, SPHERICAL, SEMITRANSPARENT PHOTOCATHODE, S-11 RESPONSE, HIGH CURRENT AMPLIFICATION, AND EXTREMELY SHORT RISE TIME

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 μμf
  Anode to all other electrodes. . . . . 5.7 μμf
  Dynode No.12 to all other electrodes . . . . . 6.8 μμf
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.

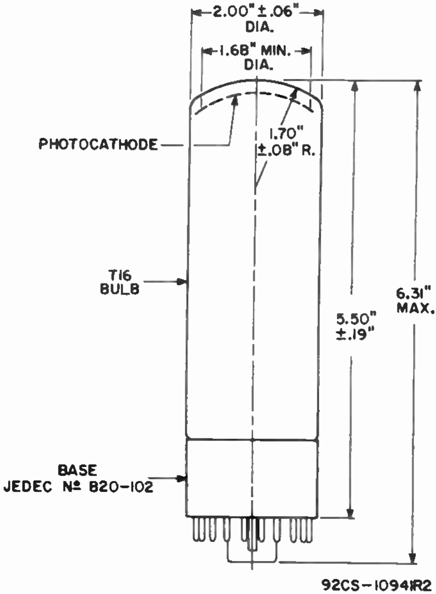
The use of an average anode current well below the maximum rated value of 2 milliamperes is recommended when stability of operation is important. When maximum stability is required, the average anode current should not exceed 10 microamperes.

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-

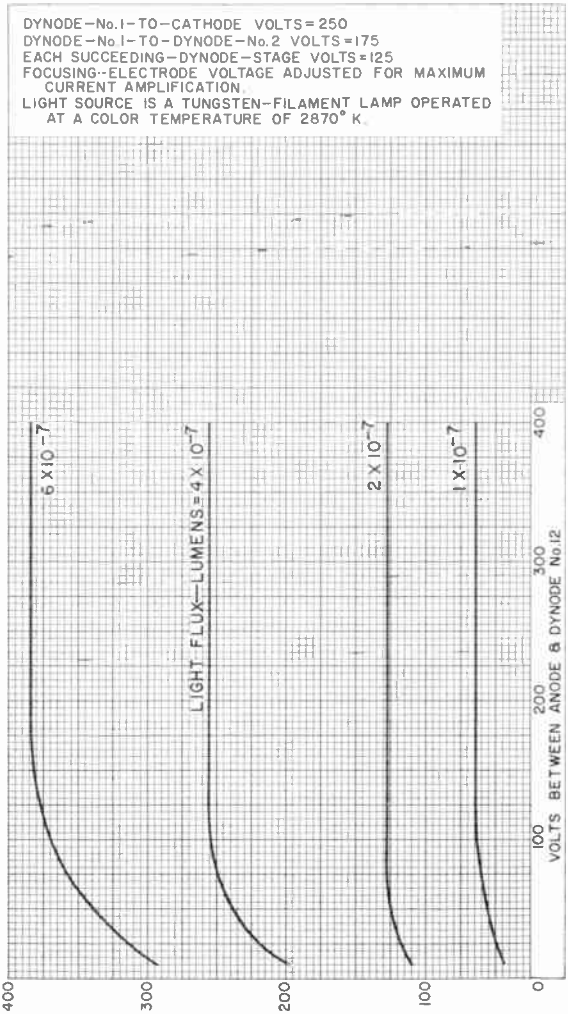
The *high voltages at which the 7850 is operated are very dangerous*. Care should be taken in the design of apparatus to prevent the operator from coming in contact with these high voltages. Precautions should include the enclosure of high-potential terminals and the use of interlock switches to break 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



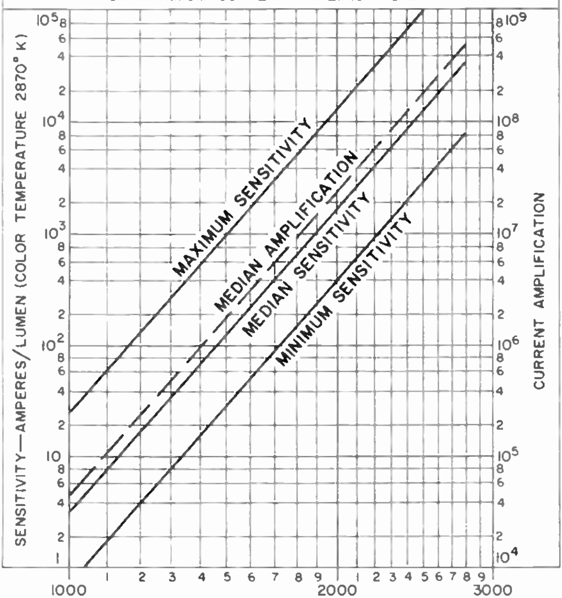
92CM—10937

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.



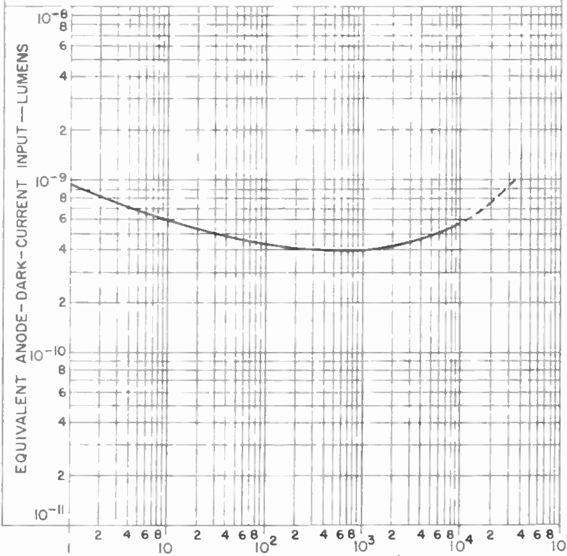
92CM-10946

TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

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

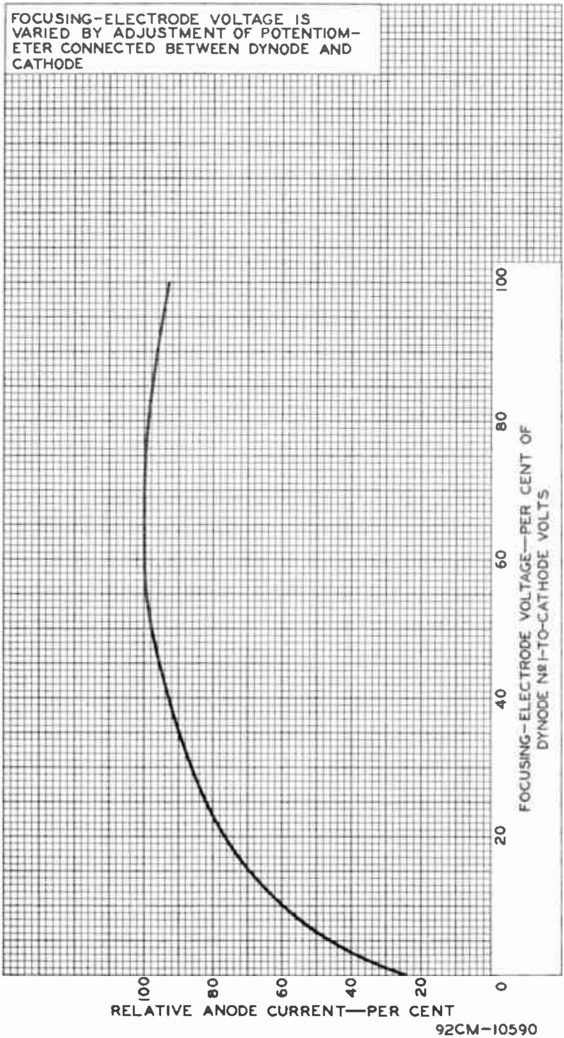
BETWEEN	6.95 % OF E MULTIPLIED BY
CATHODE & DY_1	2
DY_1 & DY_2	1.4
DY_2 & DY_3	1
DY_3 & DY_4	1
DY_4 & DY_5	1
DY_5 & DY_6	1
DY_6 & DY_7	1
DY_7 & DY_8	1
DY_8 & DY_9	1
DY_9 & DY_{10}	1
DY_{10} & DY_{11}	1
DY_{11} & DY_{12}	1
DY_{12} & ANODE	1
ANODE & CATHODE	14.4

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

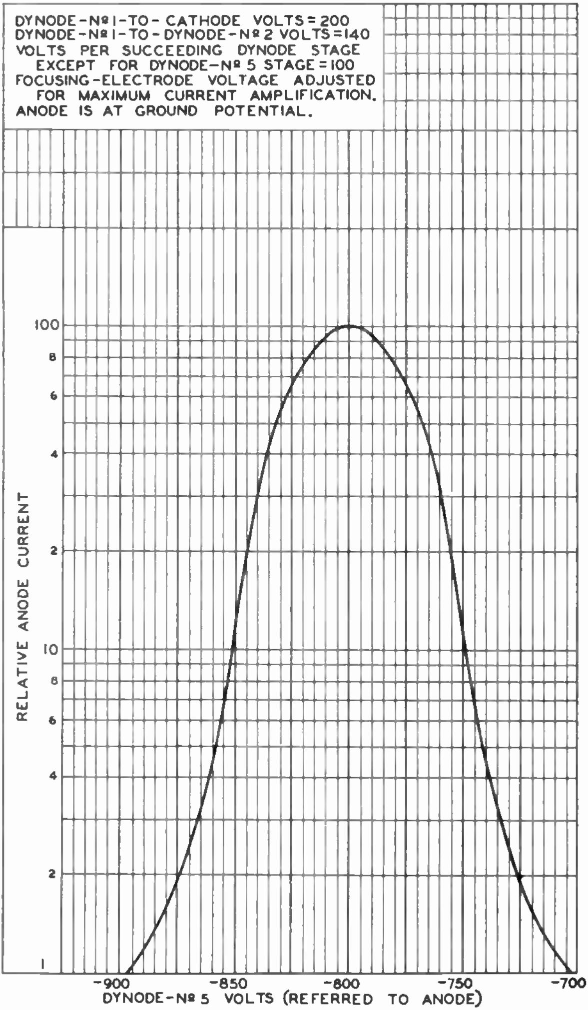


92CM-10940

AVERAGE FOCUSING-ELECTRODE-VOLTAGE CHARACTERISTIC



TYPICAL ANODE-CURRENT CHARACTERISTIC



92CM-10959

Vidicon

1-1/2" 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

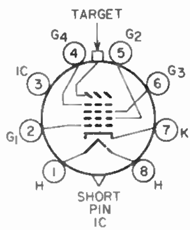
Focusing-Alignment Assembly. . . . . . . Cleveland Electronics[c] No. [illegible]-VFA-[illegible], or equivalent

Deflecting Yoke[d] . . . . Cleveland Electronics[c] No. [illegible]-VY-[illegible], 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.)	40	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)	[illegible]0	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 mask in 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.

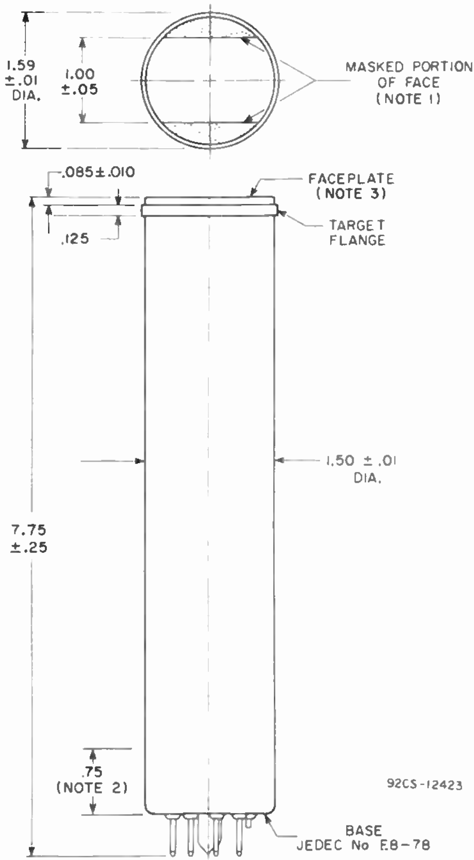
[r] Defined as the component of the highlight target current after the dark-current component has been subtracted.

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



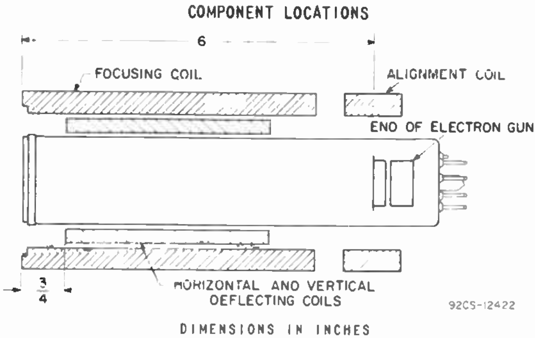
DIMENSIONS IN INCHES

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

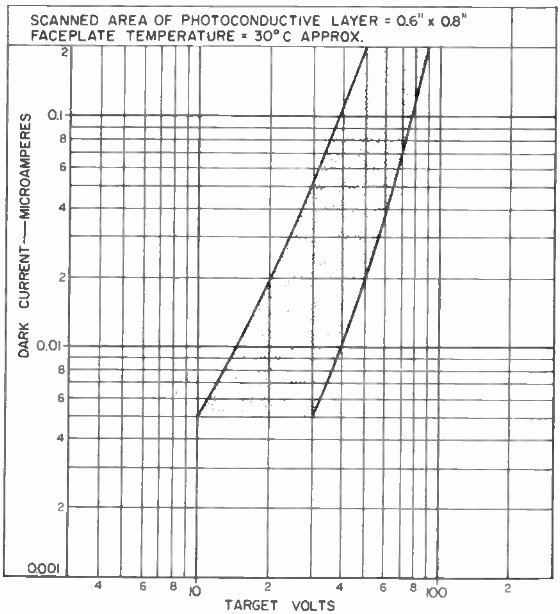
Note 2: Within this area the minimum bulb diameter dimension does not apply.

Note 3: Faceplate thickness is 0.1[illegible]" ± 0.00[illegible]".

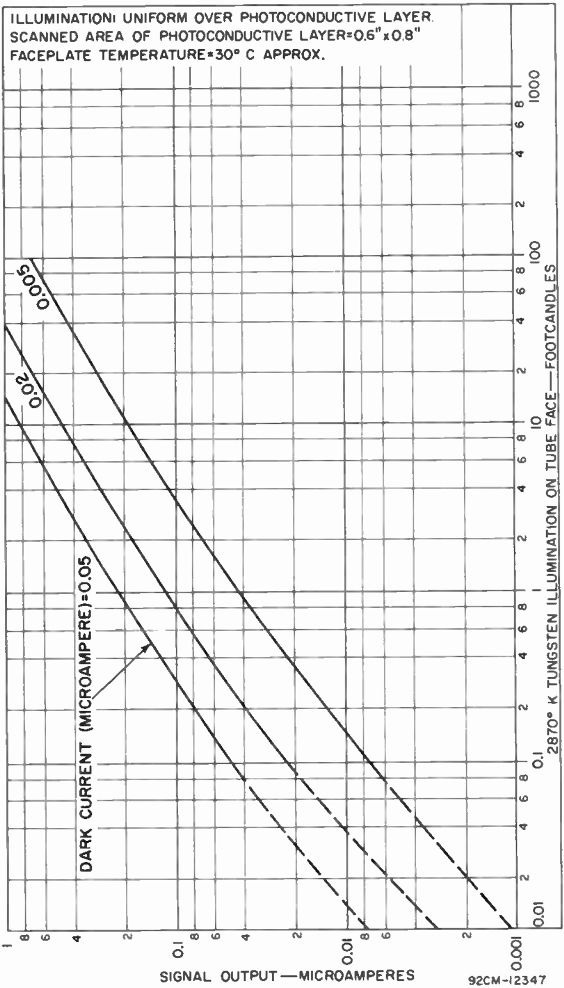
RADIO CORPORATION OF AMERICA
Electronic Components and Devices Harrison, N. J.



RANGE OF DARK CURRENT



LIGHT TRANSFER CHARACTERISTICS



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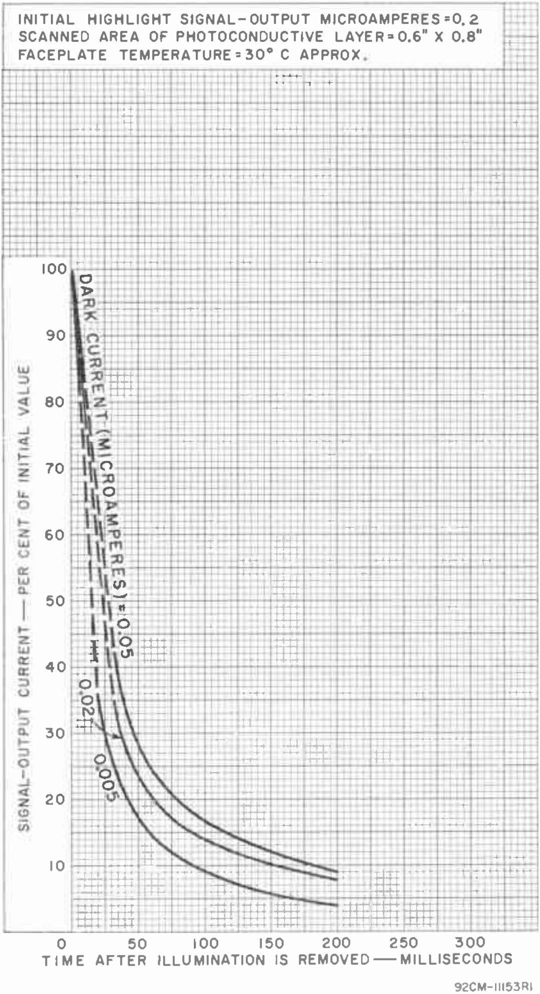
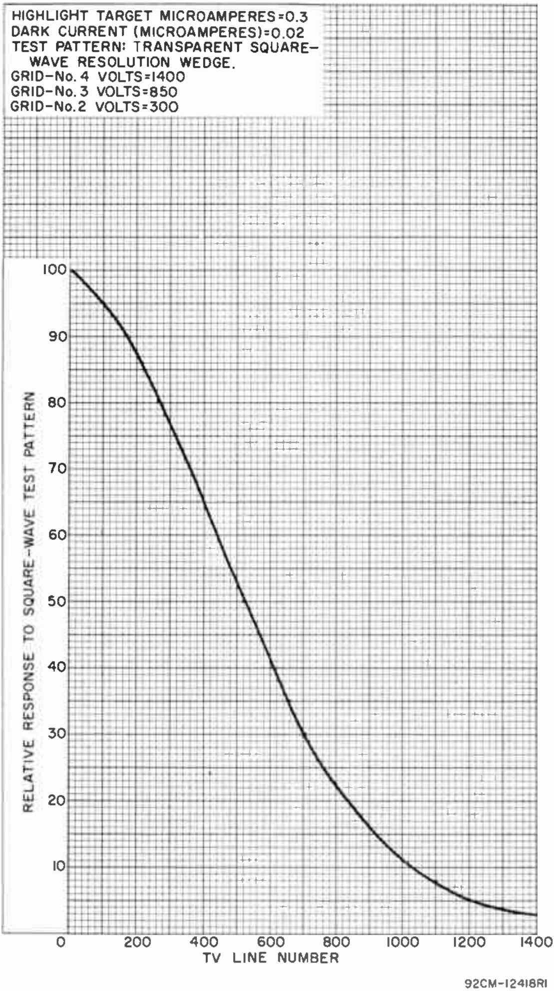
Electronic Components and Devices Harrison, N. J.

TYPICAL PERSISTENCE CHARACTERISTICS



UNCOMPENSATED HORIZONTAL RESPONSE TO A SQUARE-WAVE TEST PATTERN



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

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
[illegible]	
8053	1.68 in
8054	2.59 in
8055	4.38 in
Window	Lime glass, Corning[a] No.0080, or equivalent
[illegible]	Plano-Plano
Index of refraction at [illegible] angstroms	1.523
Dynodes	
[illegible]	Copper-Beryllium
[illegible]	Beryllium-Oxide
[illegible]	Venetian-Blind
Direct Interelectrode Capacitances (Approx.)	
[illegible]	7 pF
[illegible]	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.3M14, or equivalent
- 8055 . . . . .See footnote[d]

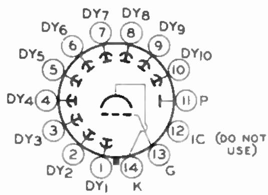
Operating Position . . . . Any

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 angstrom				
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 angstrom:				
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 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:

$$\text{Cathode Luminous Sensitivity (A/lm)} = \frac{\text{Cathode Current (with blue light source) (A)}}{0.10 \times \text{Light Flux of } 0.01\ \text{(lm)}}$$

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 (Tl) - 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 "ith" 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.

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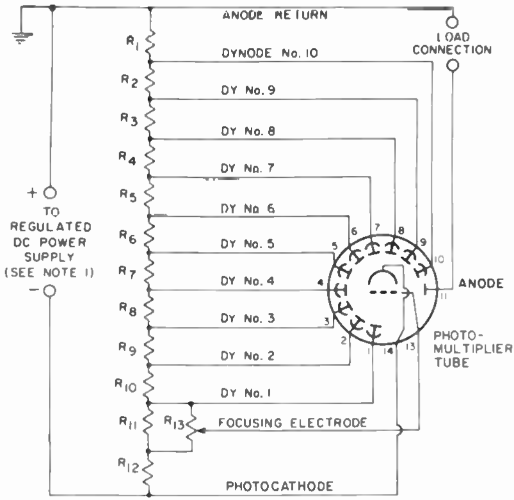
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT
FOR GENERAL PHOTOMETRIC APPLICATIONS

8053 8054 8055



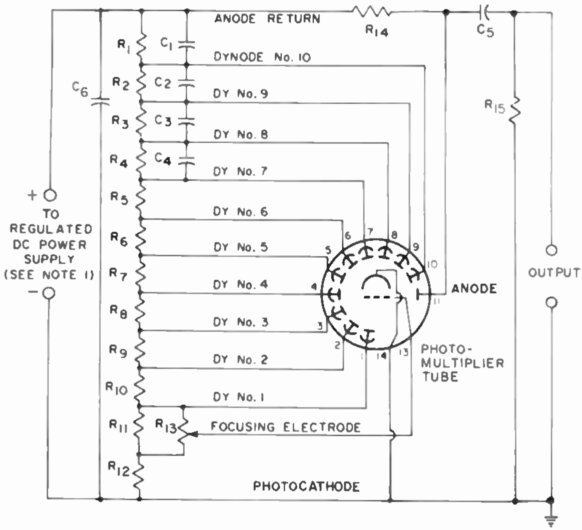
R_1 through R_{12}: 470,000 ohms, 1/2 watt

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



92LM-1612

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.

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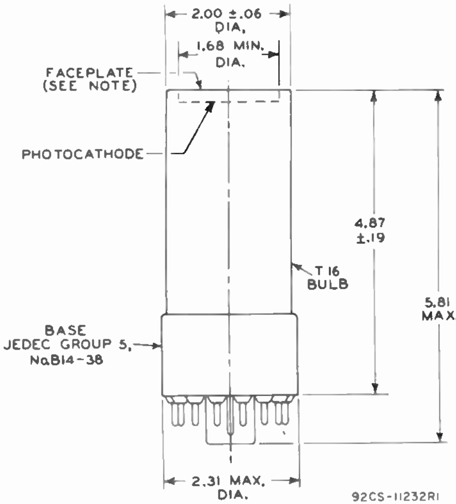
DIMENSIONAL OUTLINE

8053



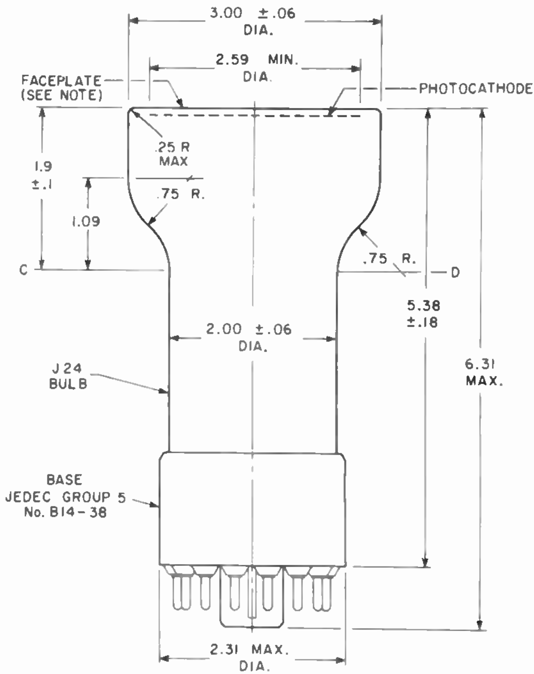
DIMENSIONS IN INCHES

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



92CM-11080R2

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.

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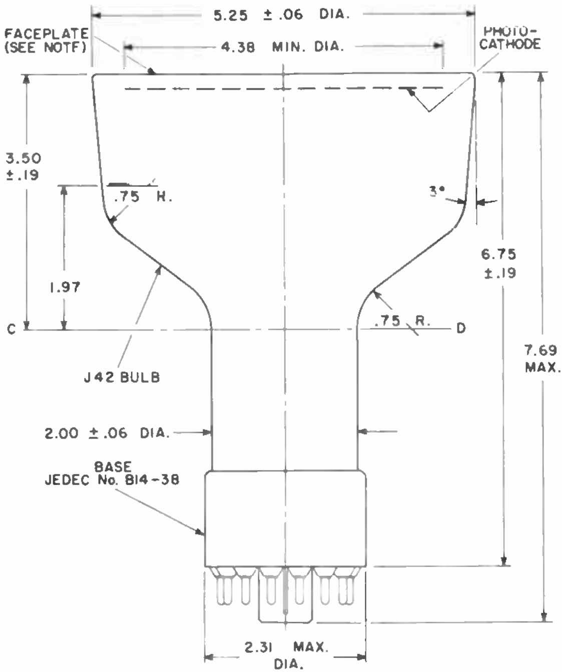
DIMENSIONAL OUTLINE
8055



92CM-11148R2

DIMENSIONS IN INCHES

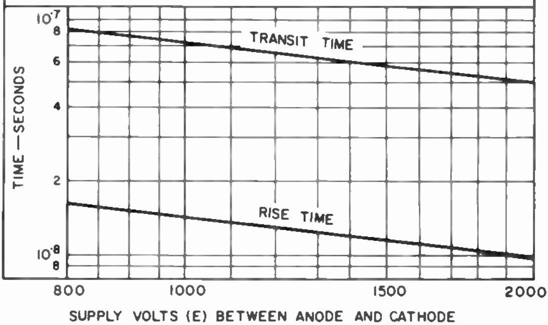
Center line of bulb will not deviate more than 2° in any direction from the perpendicular erected at the center of bottom of the base.

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

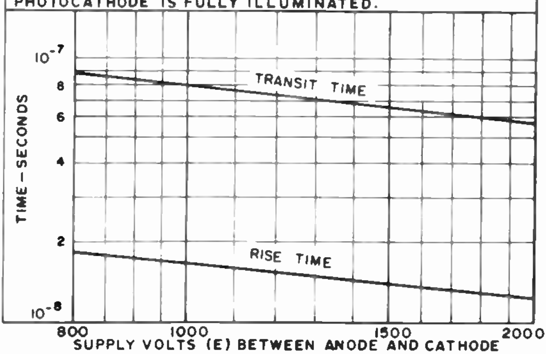
DYNODE NO. 1-TO-CATHODE VOLTS = 1/6 E
EACH SUCCEEDING DYNODE-STAGE VOLTS = 1/12 E
ANODE-TO-DYNODE NO. 10 VOLTS = 1/12 E
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE NO. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT
PHOTOCATHODE IS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



92LM-1547

8054

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-1541

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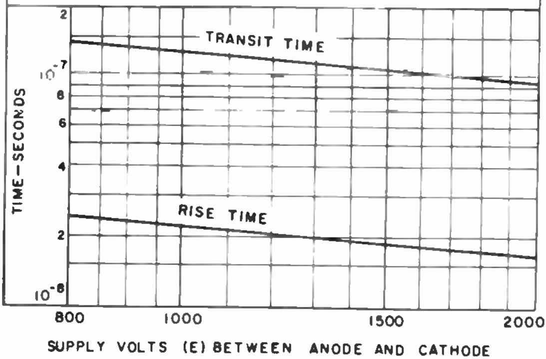
Typical Time Resolution Characteristics

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.

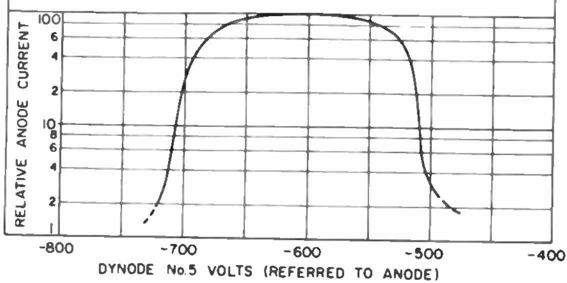


92LS-1546

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.

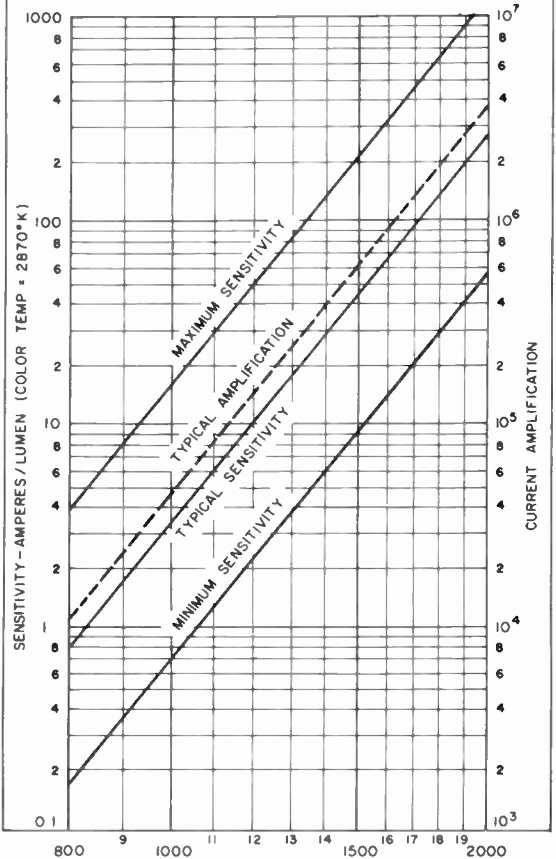


92CS-11078R1

Typical Sensitivity and Current Amplification Characteristics

8053

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.

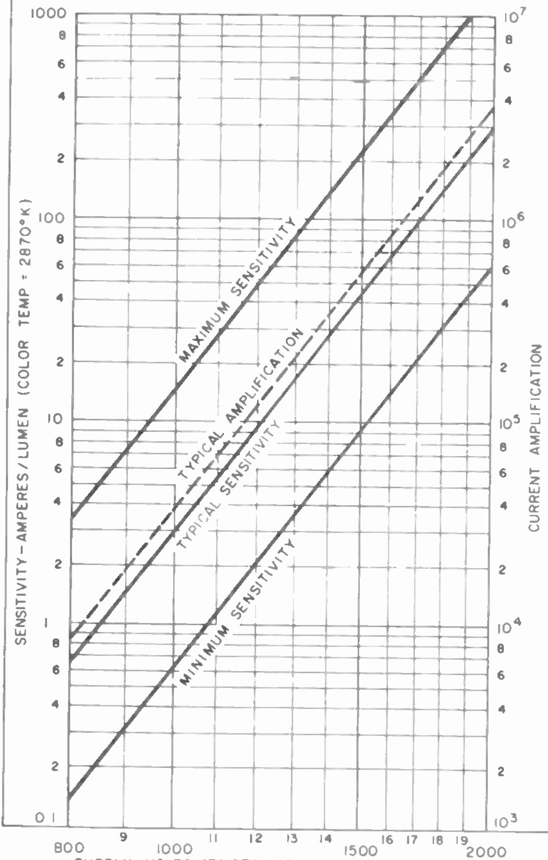


92LM-1545

Typical Sensitivity and Current Amplification Characteristics

8054

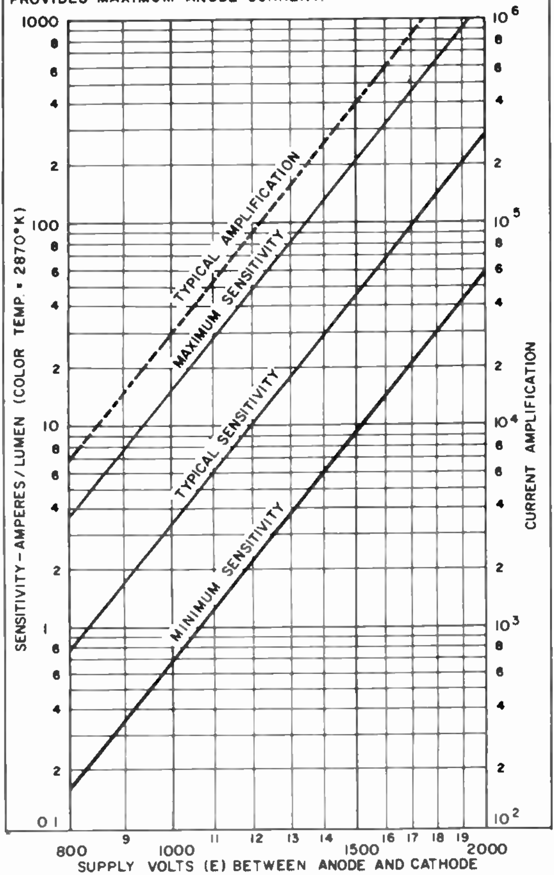
THE DC SUPPLY VOLTAGE (E) IS ACROSS A VOLTAGE DIVIDER PROVIDING 1/6 OF E BETWEEN CATHODE AND DYNODE NO.1, 1/12 OF E FOR EACH SUCCEEDING DYNODE STAGE, AND 1/12 OF E BETWEEN ANODE AND DYNODE NO.10. FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO.1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.



Typical Sensitivity and Current Amplification Characteristics

8055

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.

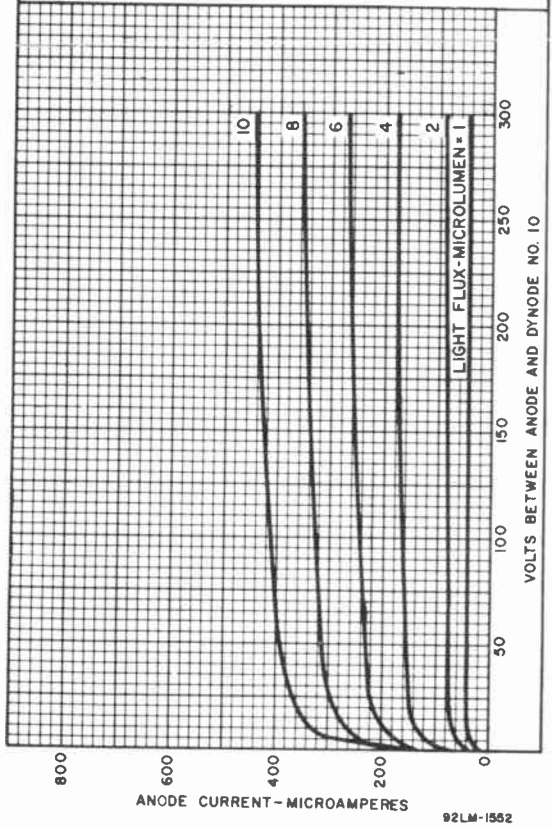


92LM-1549

Typical Anode Characteristics

8053

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.

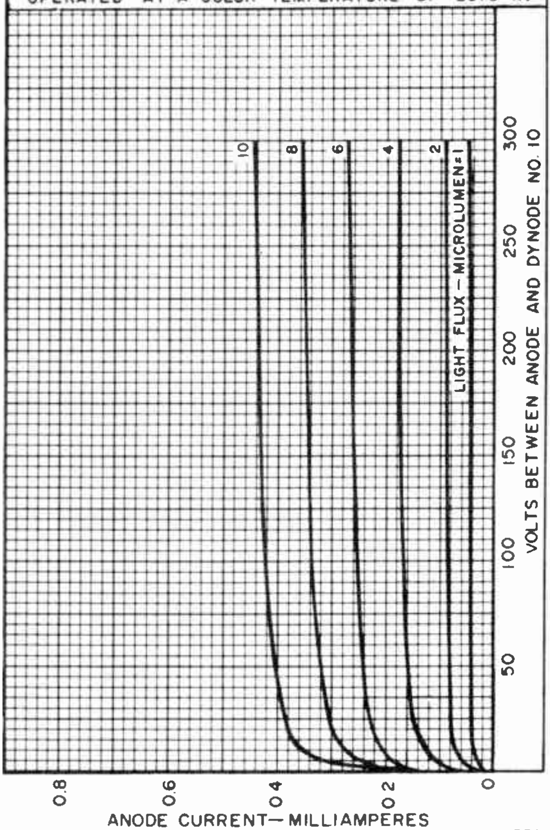


92LM-1552

Typical Anode Characteristics

8054

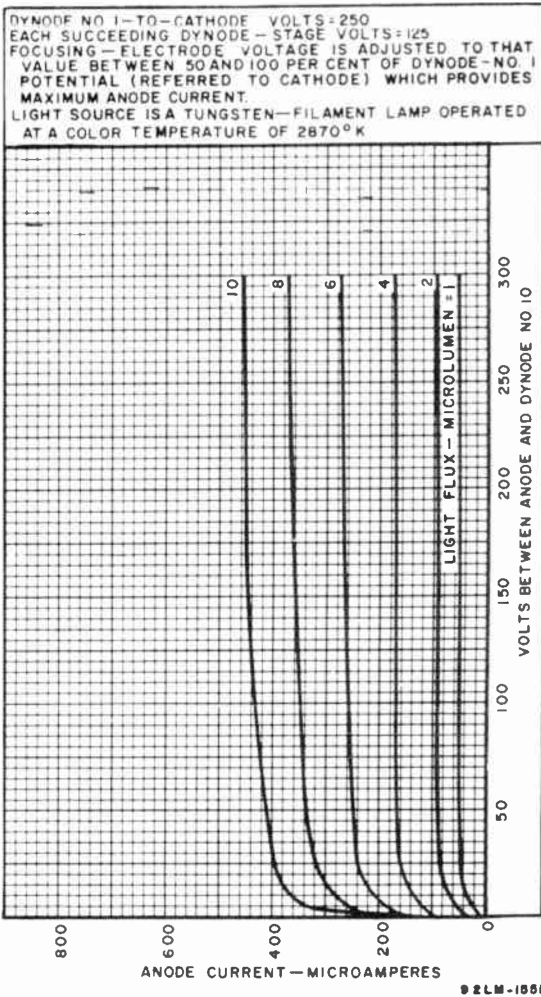
DYNODE-NO. I-TO-CATHODE VOLTS = 250
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-NO. I POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR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



92LM-1559

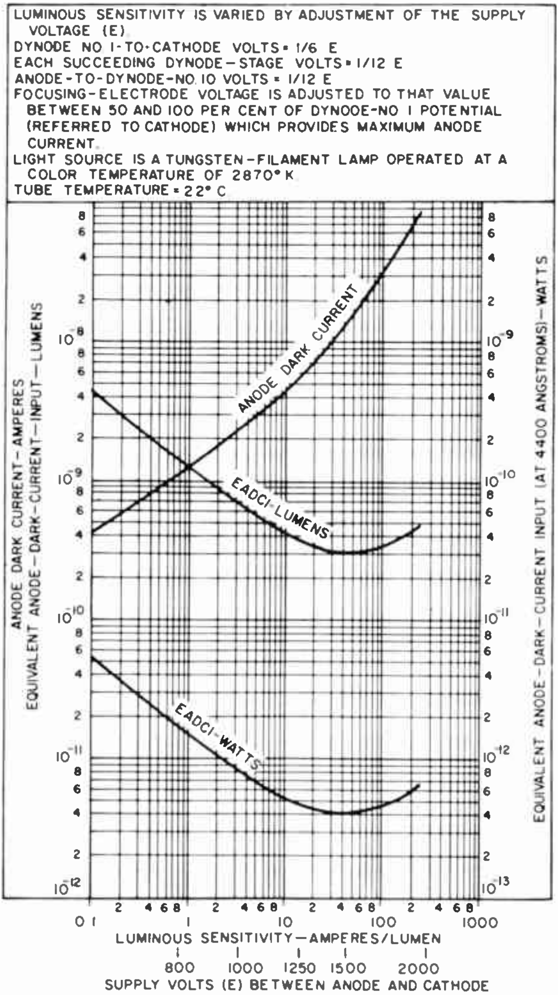
Typical Anode Characteristics

8055



Typical Dark Current and EADCI Characteristics

8053 8054 8055



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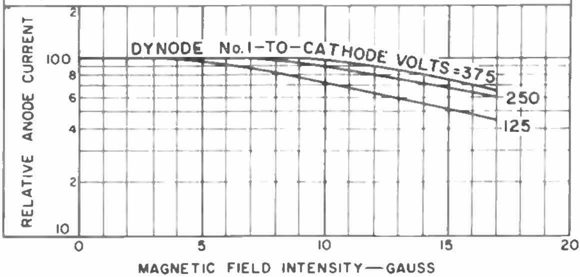
Typical Effect of Magnetic Field on Anode Current

8053

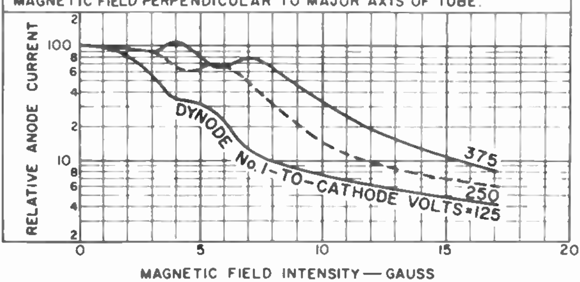
DYNODE No. 1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No. 10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE 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-11235R2

8053

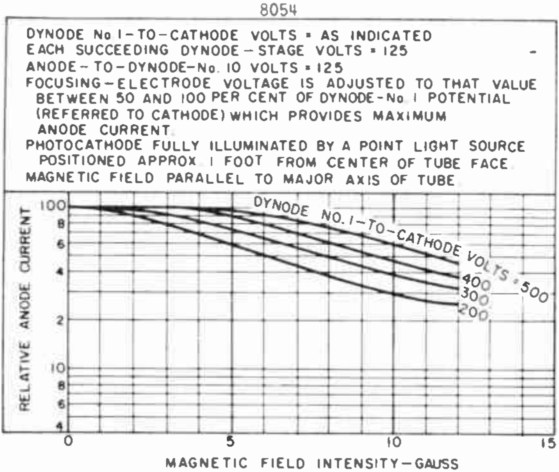
DYNODE No. 1-TO-CATHODE VOLTS = AS INDICATED
EACH SUCCEEDING DYNODE-STAGE VOLTS = 125
ANODE-TO-DYNODE No. 10 VOLTS = 125
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED TO THAT VALUE BETWEEN 50 AND 100 PER CENT OF DYNODE-No. 1 POTENTIAL (REFERRED TO CATHODE) WHICH PROVIDES MAXIMUM ANODE CURRENT.
PHOTOCATHODE 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-11236R2

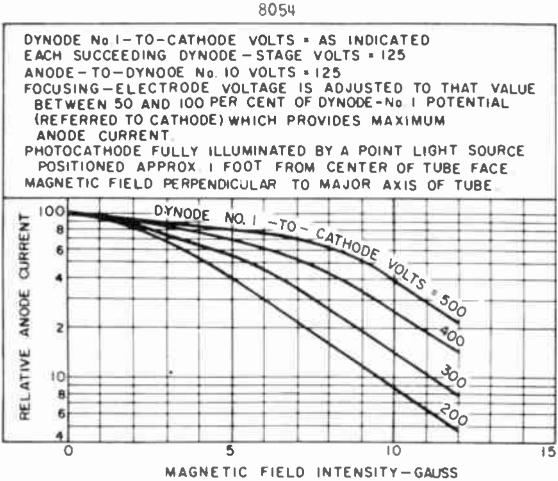
Typical Effect of Magnetic Field on Anode Current

8054



92CM-11084R3

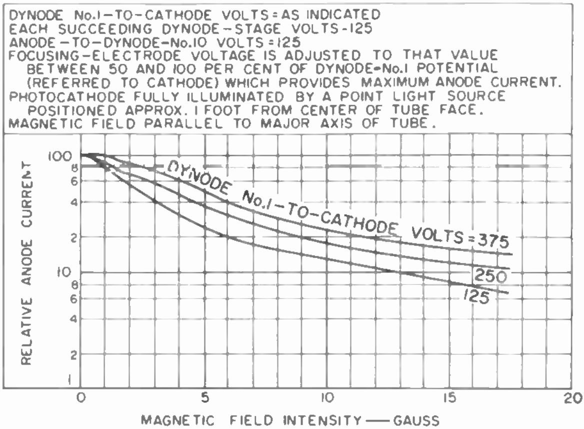
8054



92CM-11085R3

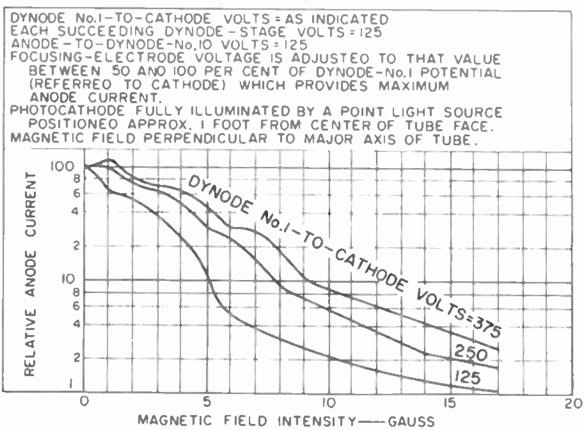
Typical Effect of Magnetic Field on Anode Current

8055



92CS-11187R2

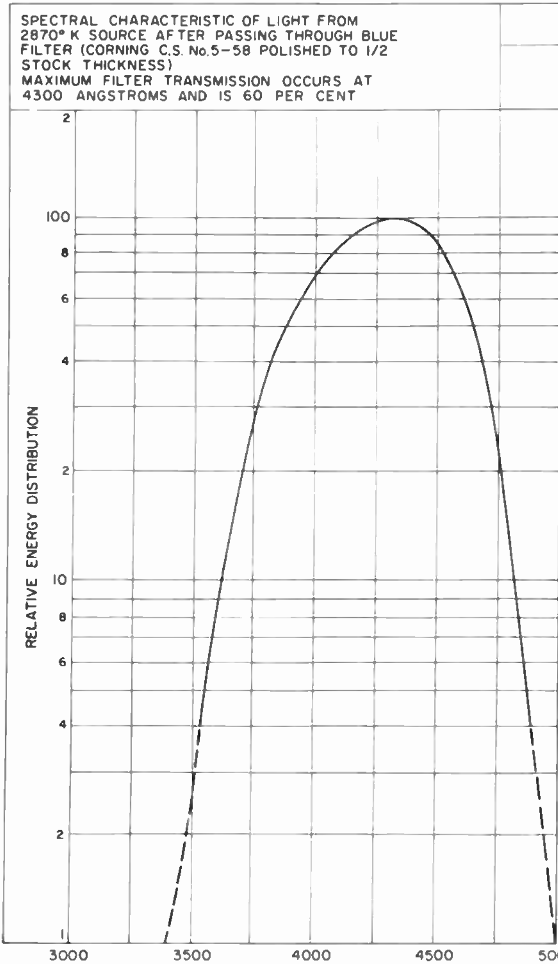
8055



92CS-11188R2

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

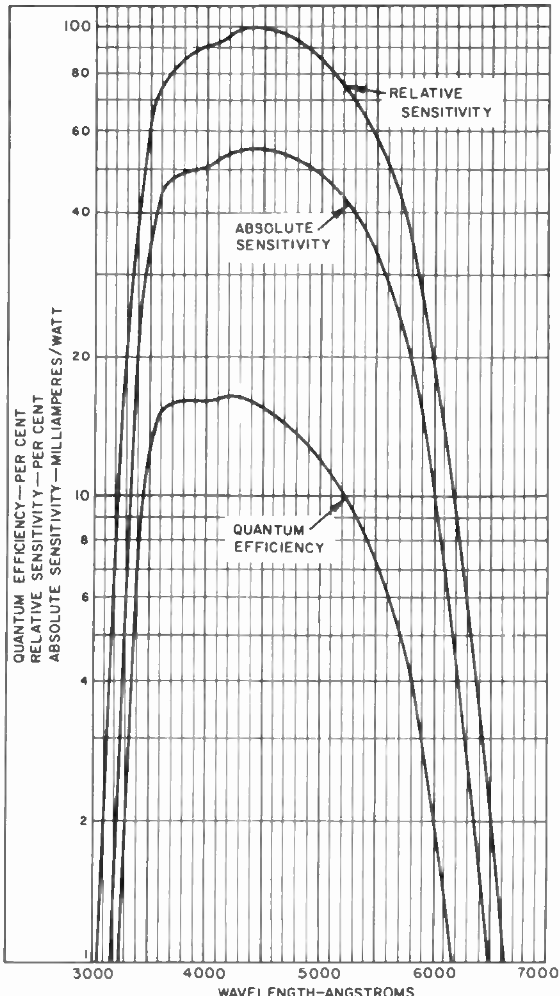
8053 8054 8055



92CM—11081R1

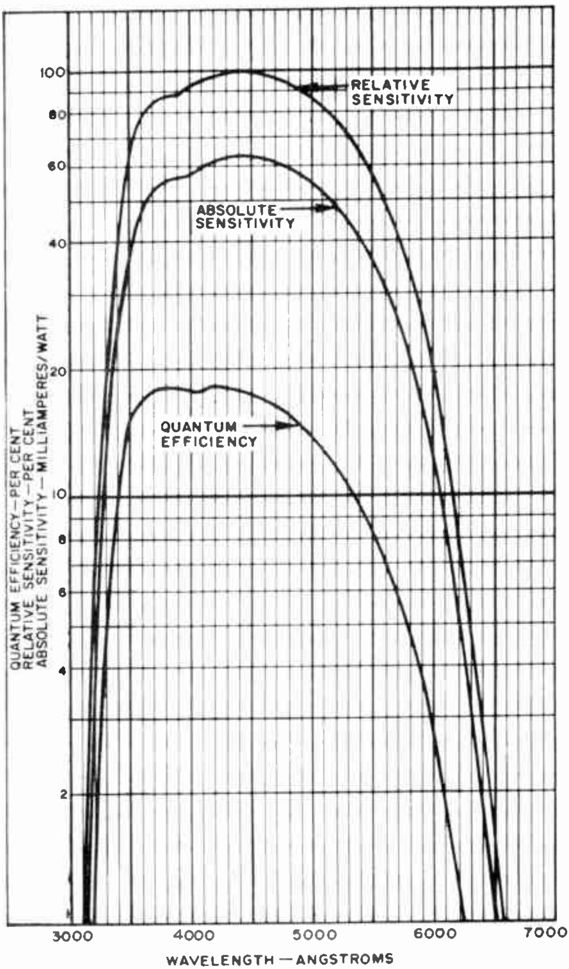
Typical Spectral Response Characteristics

8053



Typical Spectral Response Characteristics

8054



92LS-1542

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Typical Spectral Response Characteristics

8055

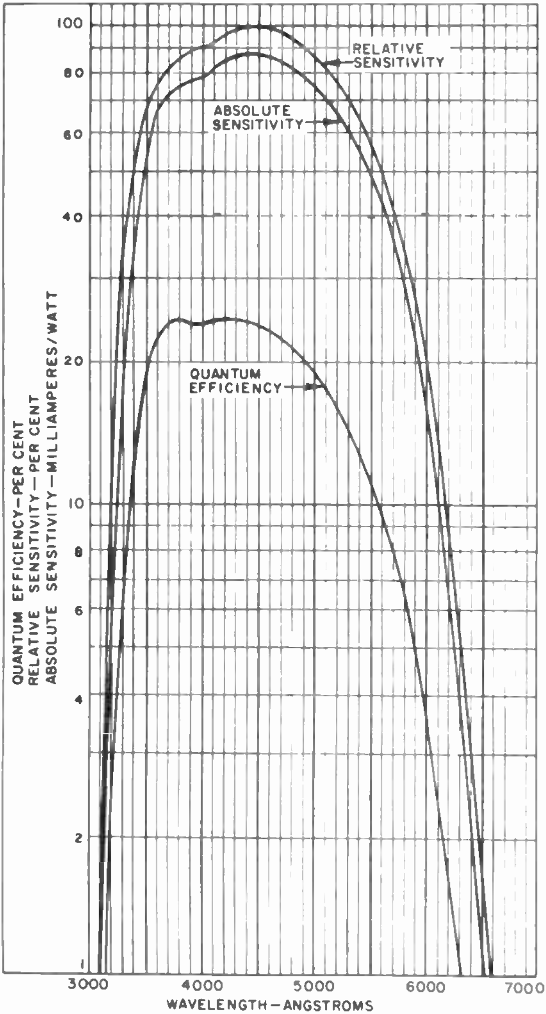


Image Orthicon

FIELD MESH
SEMICONDUCTIVE TARGET

MAGNETIC FOCUS
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

Shoulder Base. . . . . .Keyed Jumbo Annular 7-Pin

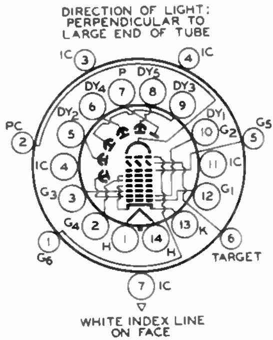
BOTTOM VIEW

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.

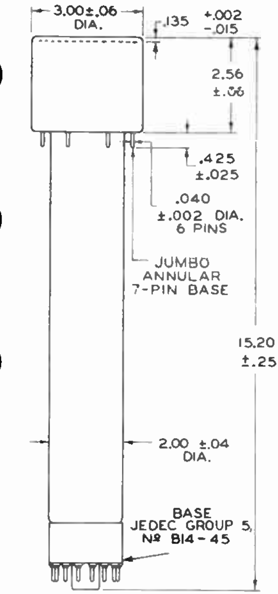
[g] Normal setting of target voltage is +2 volts from target cutoff. The target supply voltage should be adjustable from -3 to 5 volts.

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

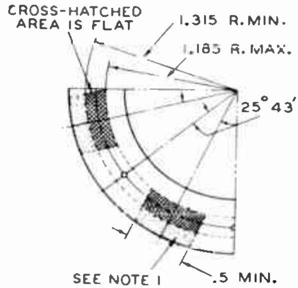
[j] Direction of current should be such that a north-seeking pole is attracted to the image end of the focusing coil, with indicator located outside of and at the image end of the focusing coil.

[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



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

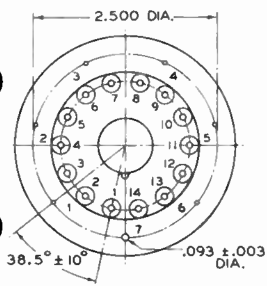
ANGULAR VARIATIONS BETWEEN PINS AS WELL AS ECCENTRICITY OF NECK CYLINDER WITH RESPECT TO PHOTOCATHODE CYLINDER ARE HELD TO TOLERANCES SUCH THAT PINS AND NECK CYLINDER WILL FIT FLAT-PLATE GAUGE WITH:

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".

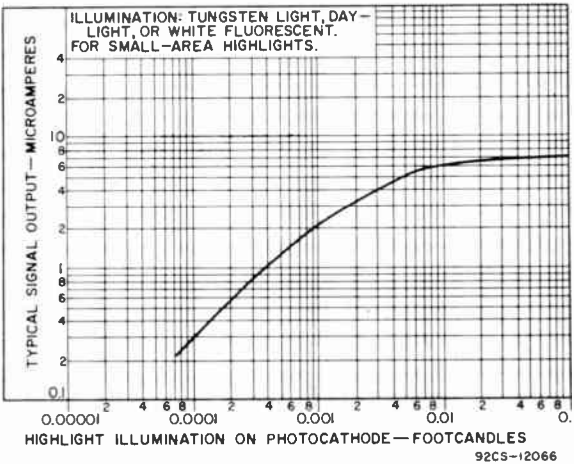


ENLARGED BOTTOM VIEW

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	0.375 x 0.5	in
Picture Size	(12.70 x 9.52 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 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.

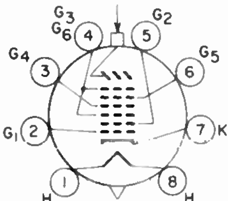
q The target voltage for each vidicon must be adjusted to that value which gives the desired operating dark current.

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.

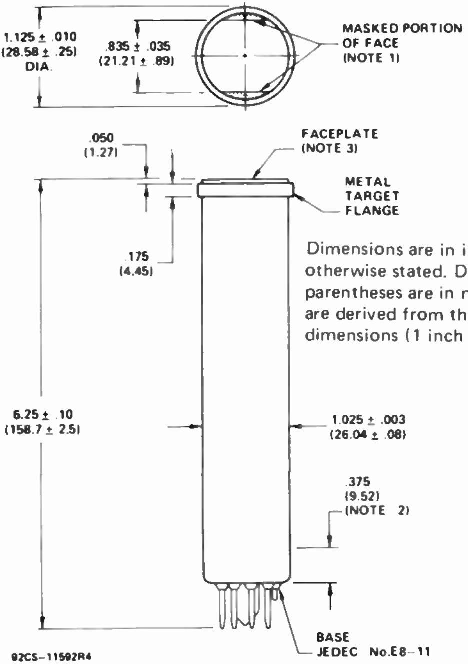
Basing Diagram (Bottom View)



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



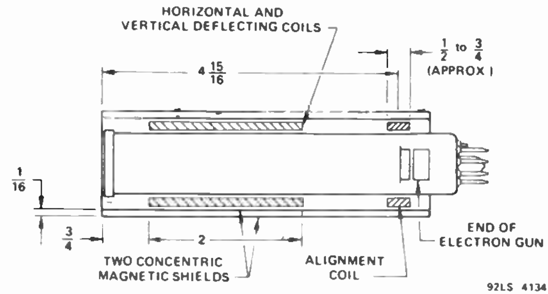
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Note 1 – Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

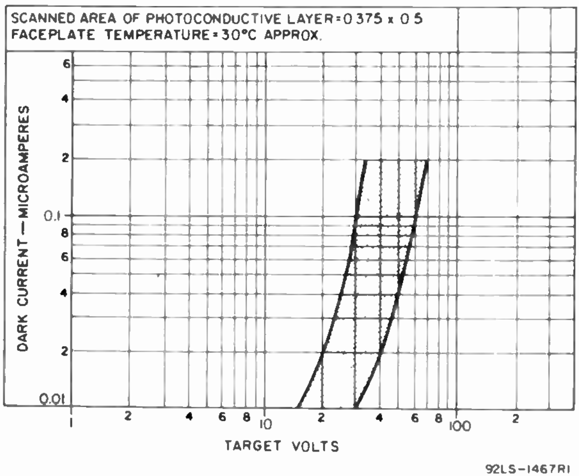
Note 2 – Within this distance, diameter of bulb is 1.025" + 0.003" – 0.030". Tube is acceptable regarding camber when it can be inserted into a 1"-long cylinder gauge which has an inner diameter of 1.0280" + 0.0011" – 0.0000". The gauge must pass along the tube length from the base to the metal target flange.

Note 3 – Faceplate is Corning No.7056 glass having a thickness of 0.094" ± 0.012".

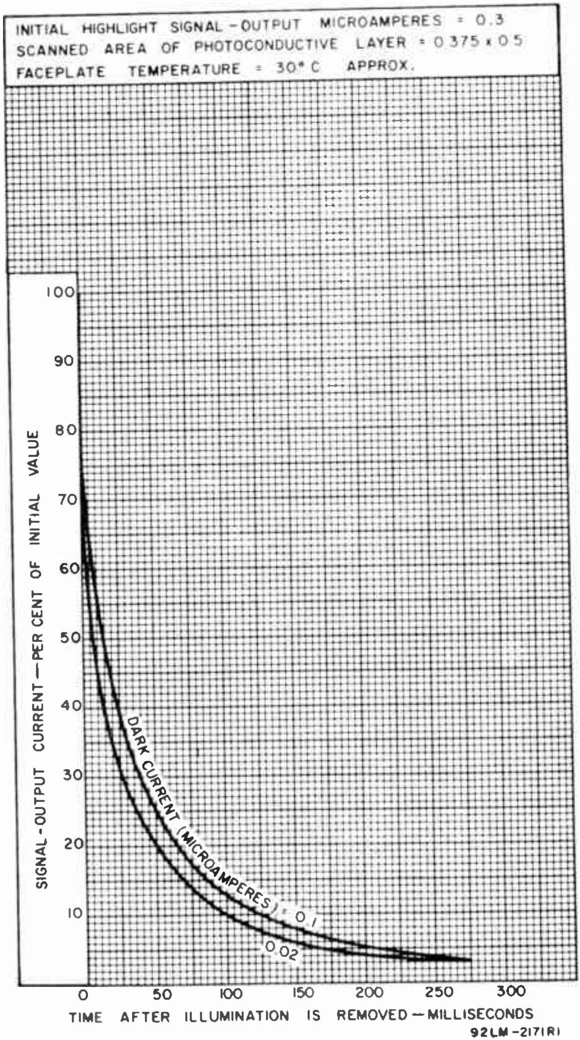
Recommended Location of Deflecting Yoke and Alignment Coil to Obtain Optimum Geometry and Optimum Output Signal Uniformity



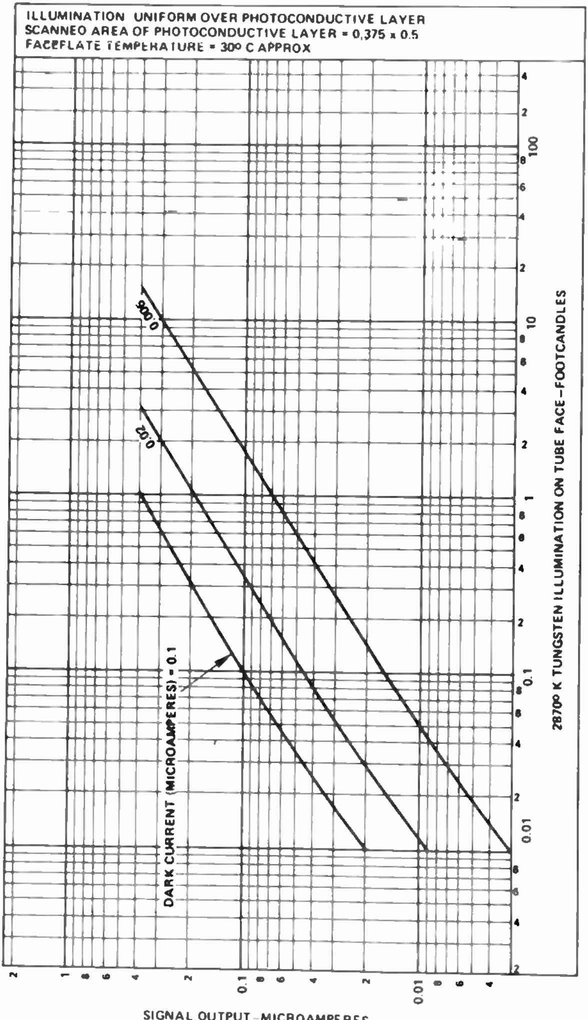
Typical Range of Dark Current



Typical Persistence Characteristics

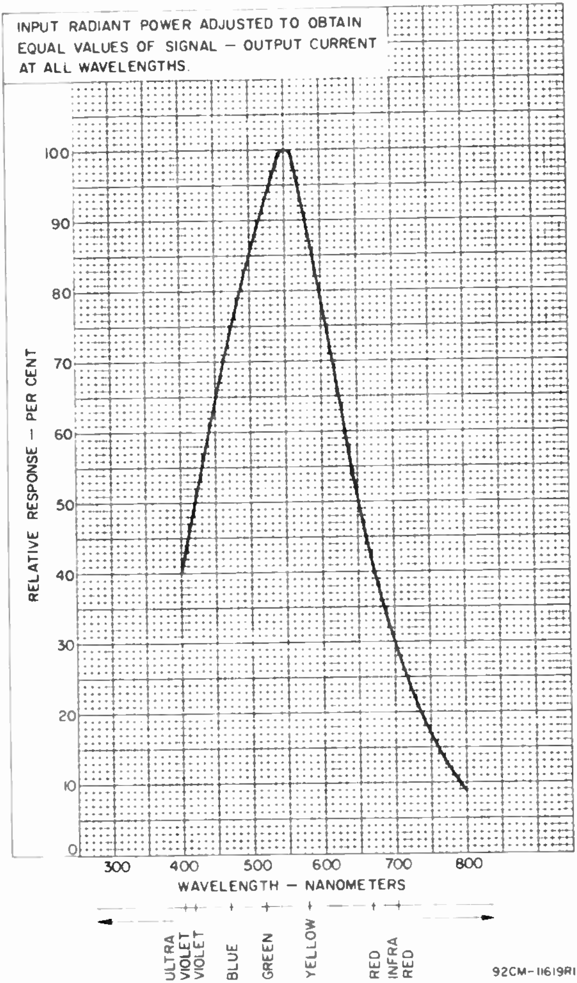


Light Transfer Characterisitcs



92CS-12245R1

Typical Spectral Sensitivity Characteristic



8480/4810

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.

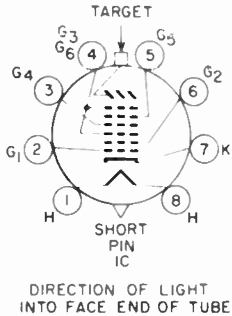
q The target voltage for each vidicon must be adjusted to that value which gives the desired operating dark current.

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.

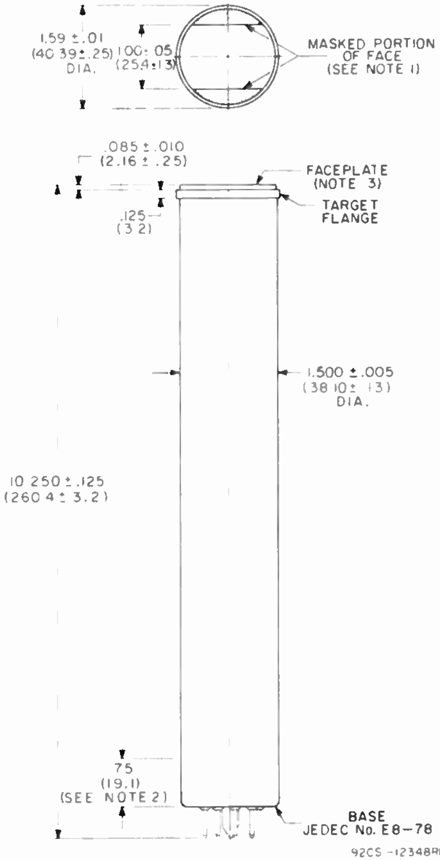
Basing Diagram (Bottom View)



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



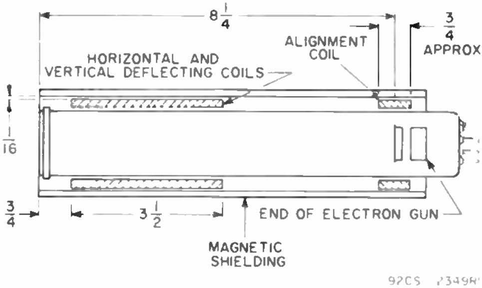
Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Note 1 — Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

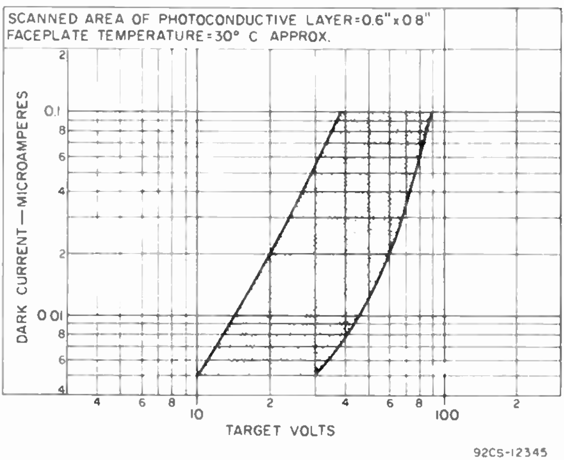
Note 2 — Within this area the minimum bulb diameter dimension does not apply.

Note 3 — Faceplate thickness is 0.135" ± 0.005".

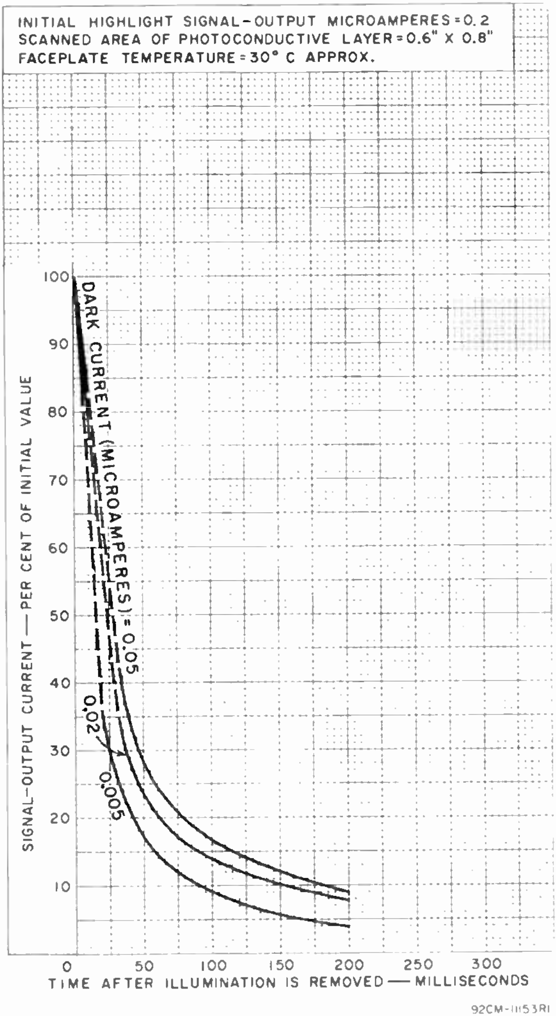
Recommended Location of Deflecting Yoke and Alignment Coil to obtain Optimum Geometry and Optimum Output Signal Uniformity



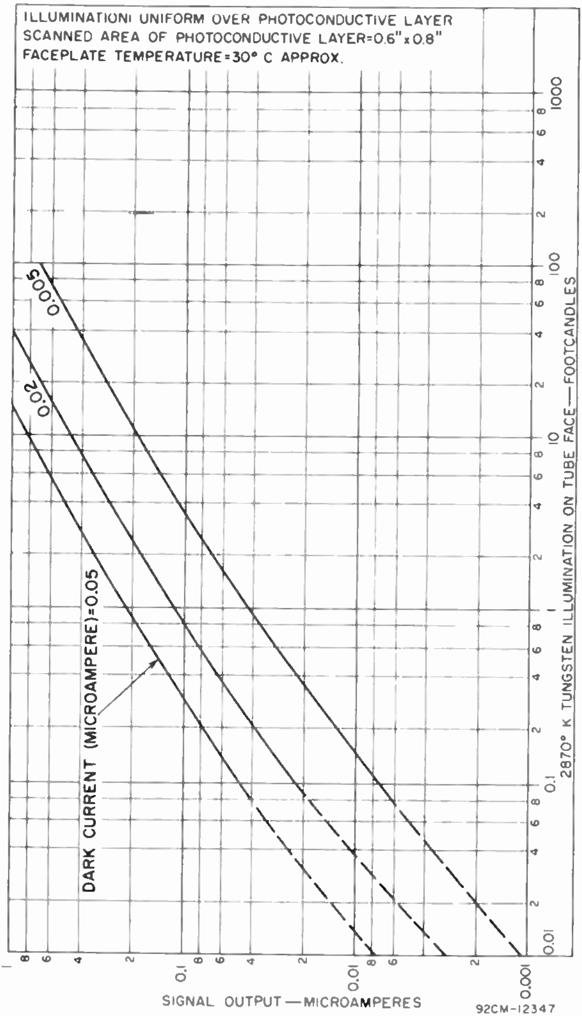
Typical Range of Dark Current



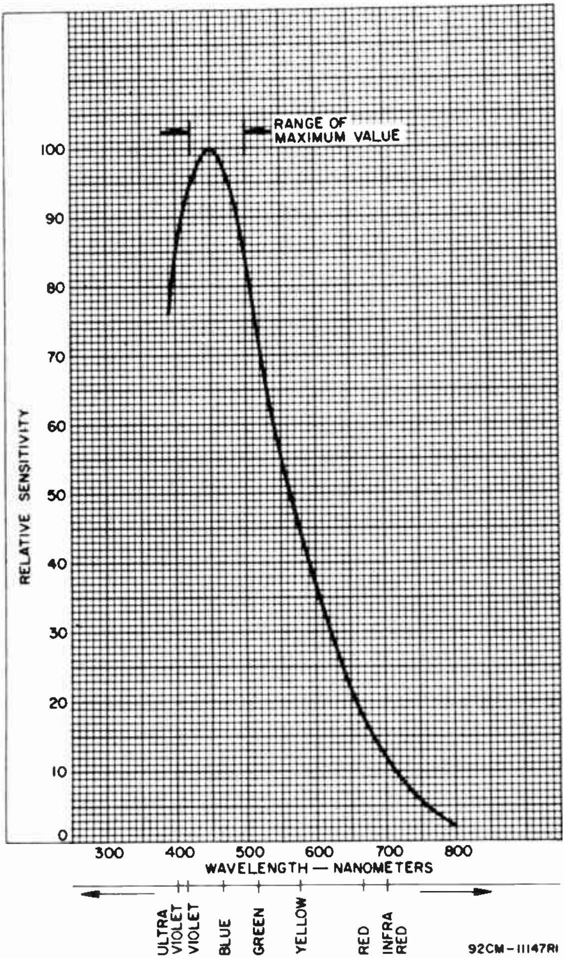
Typical Persistence Characterisitcs



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[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	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 percent 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.

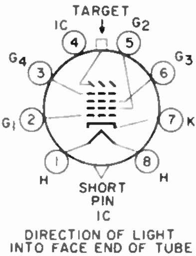
s Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

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



Spurious Signal Test

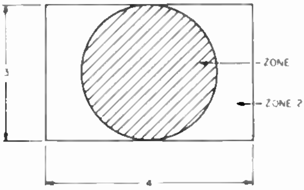


Fig.1

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.

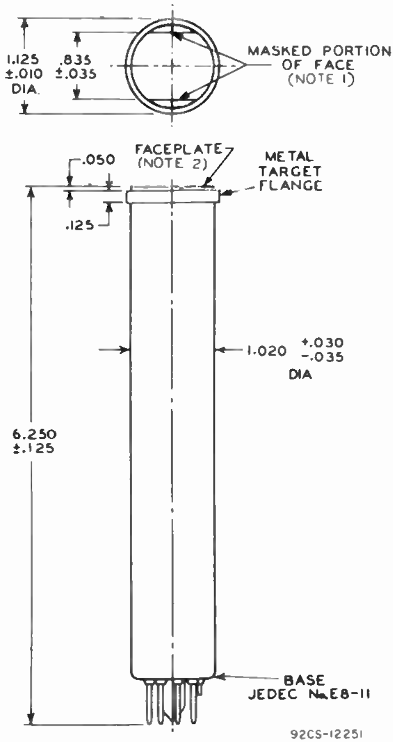
Table 1
For scanned area of 1/2" x 3/8"

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



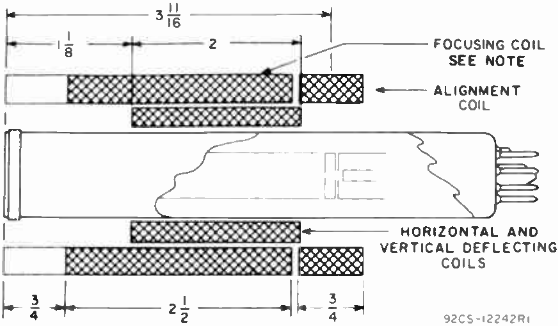
DIMENSIONS IN INCHES

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

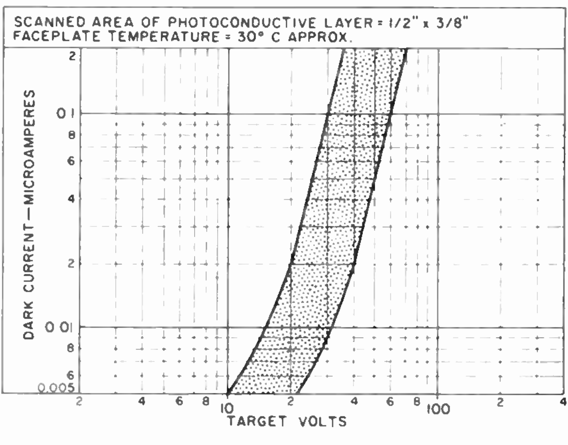
To obtain minimum beam-landing error



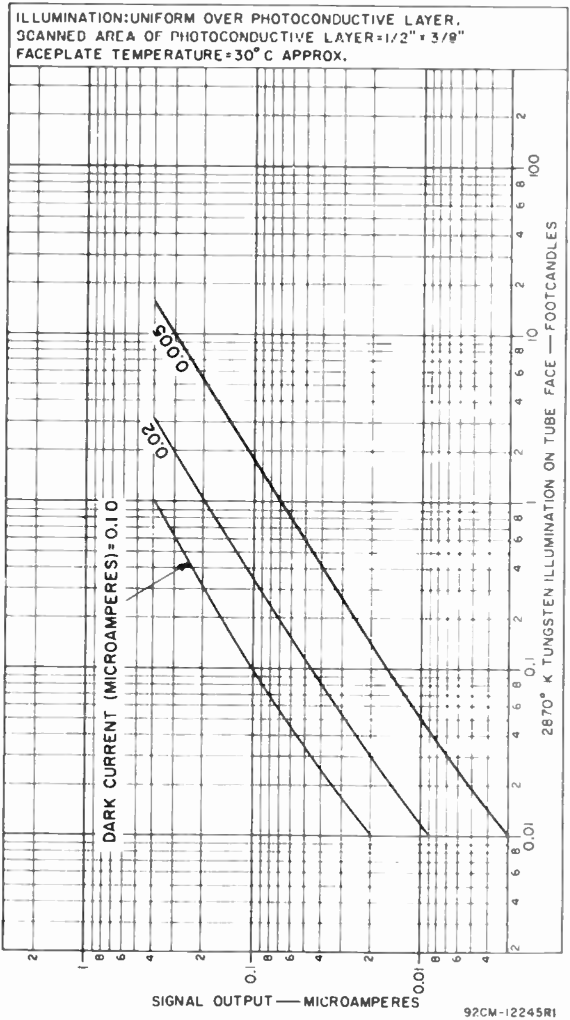
Dimensions in Inches

Note: Cross-hatching indicates wound portion of focusing coil.

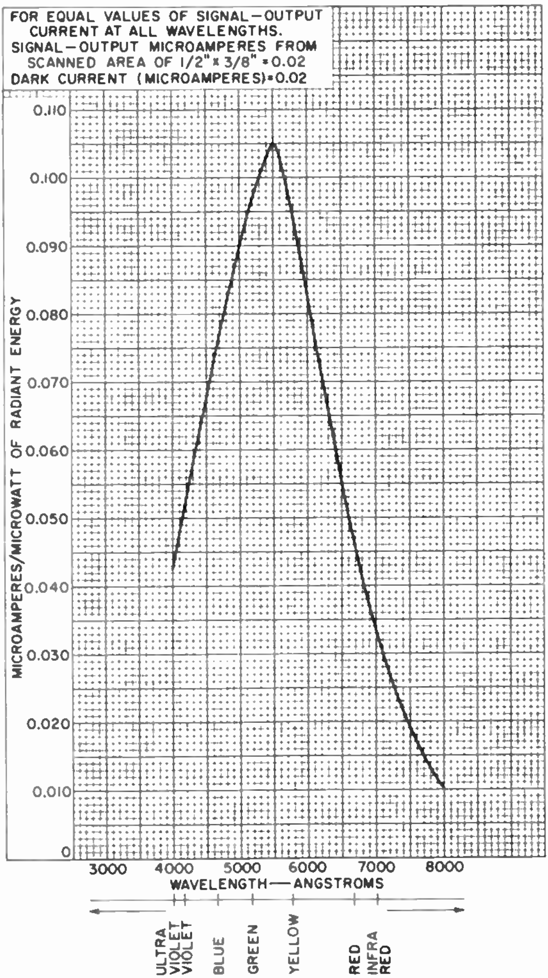
RANGE OF DARK CURRENT



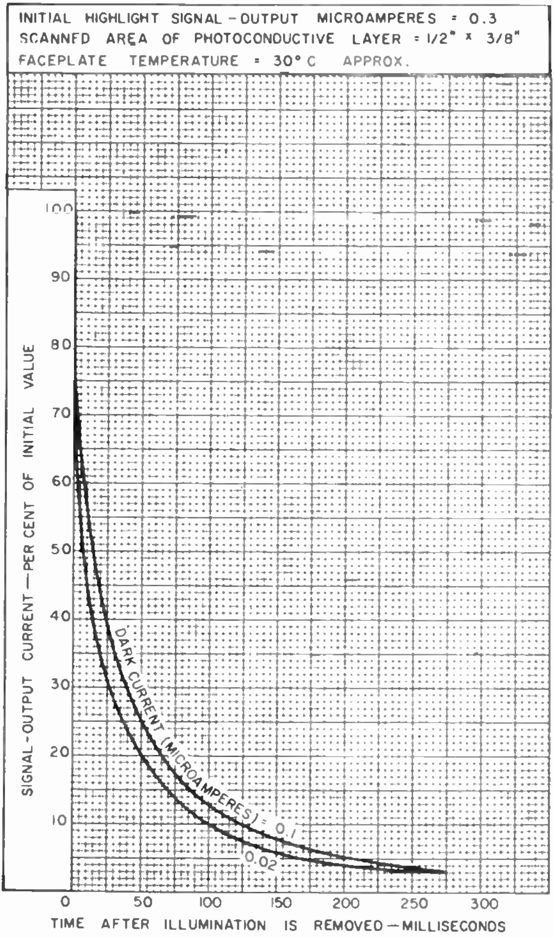
LIGHT TRANSFER CHARACTERISTICS



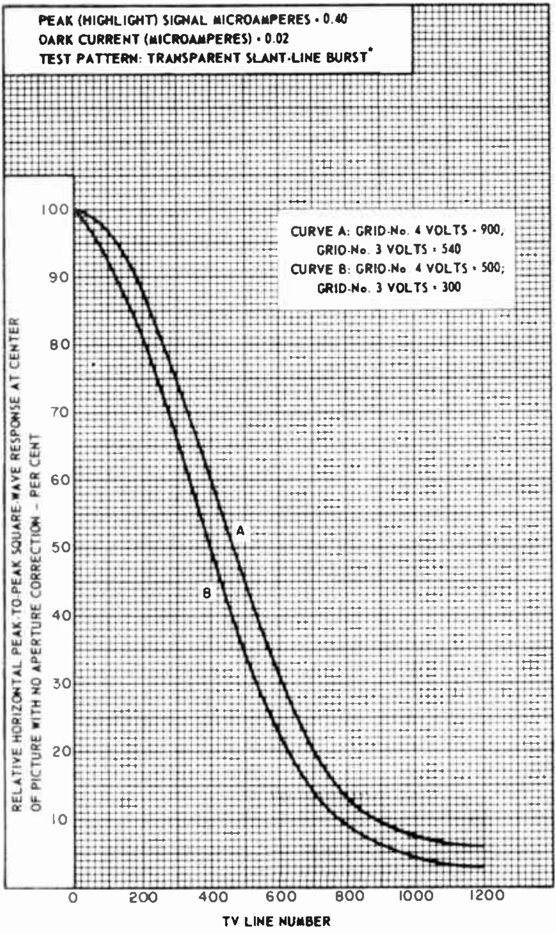
TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC



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.

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

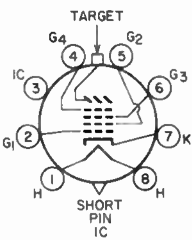
Direct Interelectrode Capacitance:[a]
- Target to all other electrodes . . . . 8.9 pf

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.

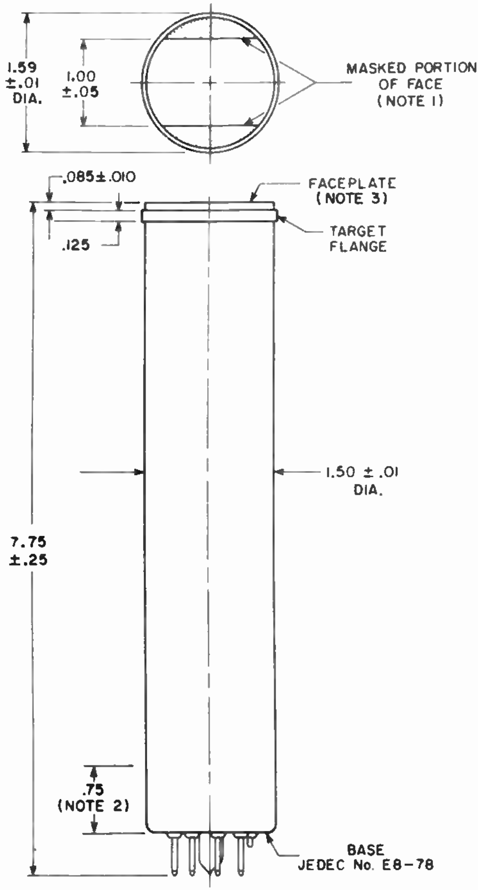
[m] The alignment coil should be located on the tube so that its center is at a distance of 6 inches from the face of the tube, and be positioned so that its axis is coincident with the axis of the tube, the deflecting yoke, and the focusing coil.

[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.



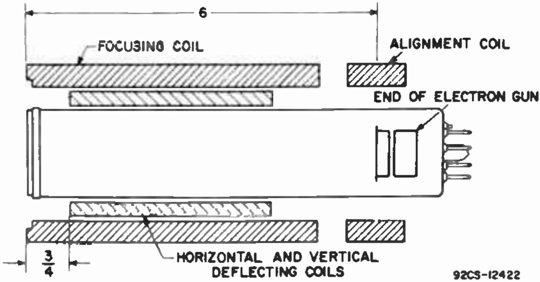
DIMENSIONS IN INCHES

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".

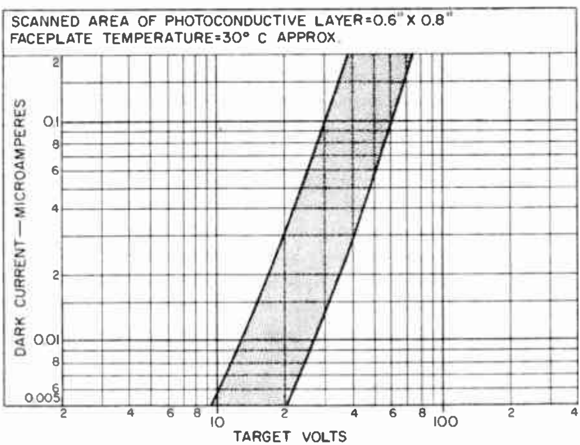
COMPONENT LOCATIONS



92CS-12422

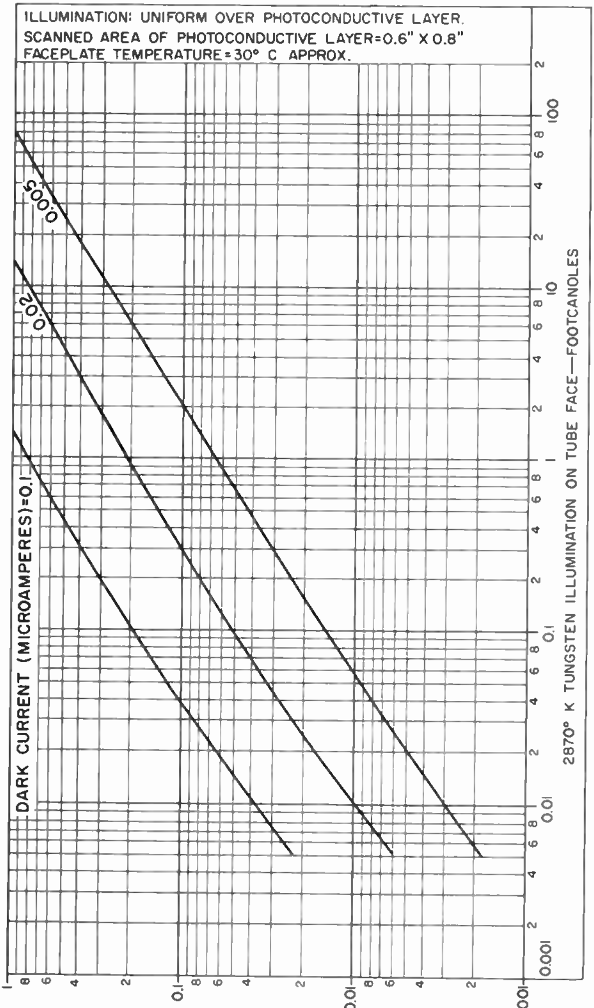
DIMENSIONS IN INCHES

RANGE OF DARK CURRENT



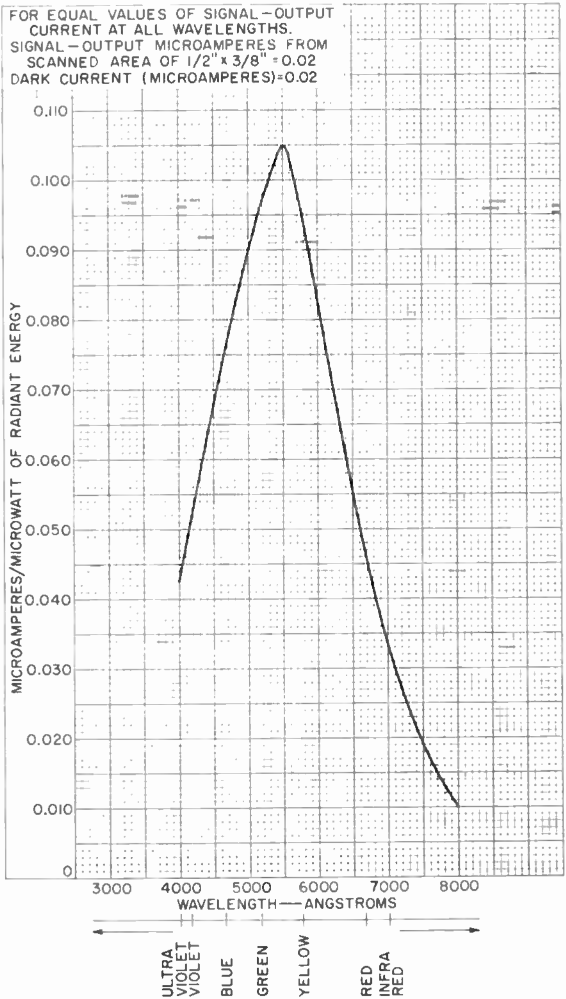
92CS-12409

LIGHT TRANSFER CHARACTERISTICS



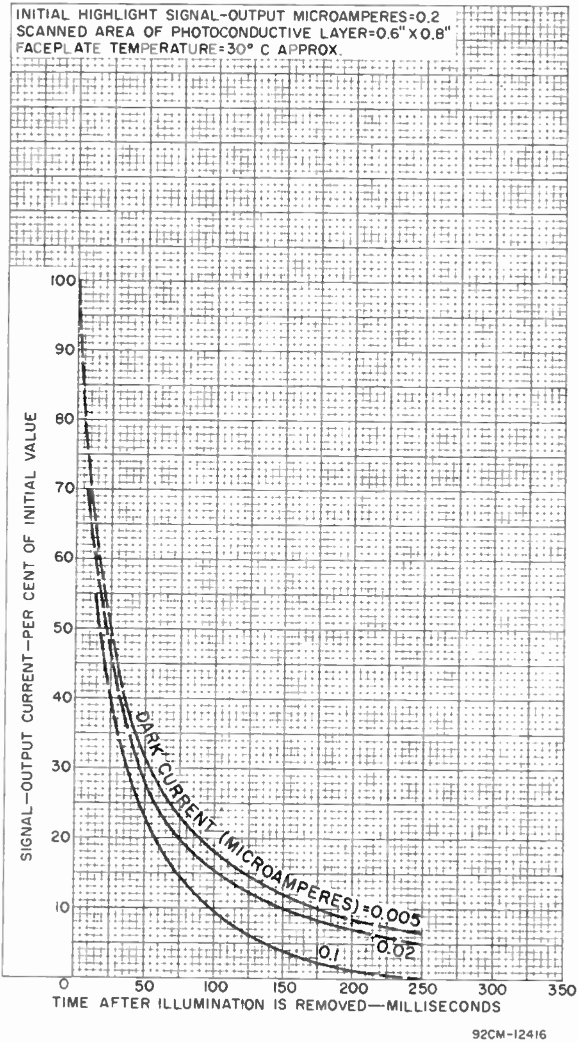
92CM-12413

TYPICAL SPECTRAL SENSITIVITY CHARACTERISTIC

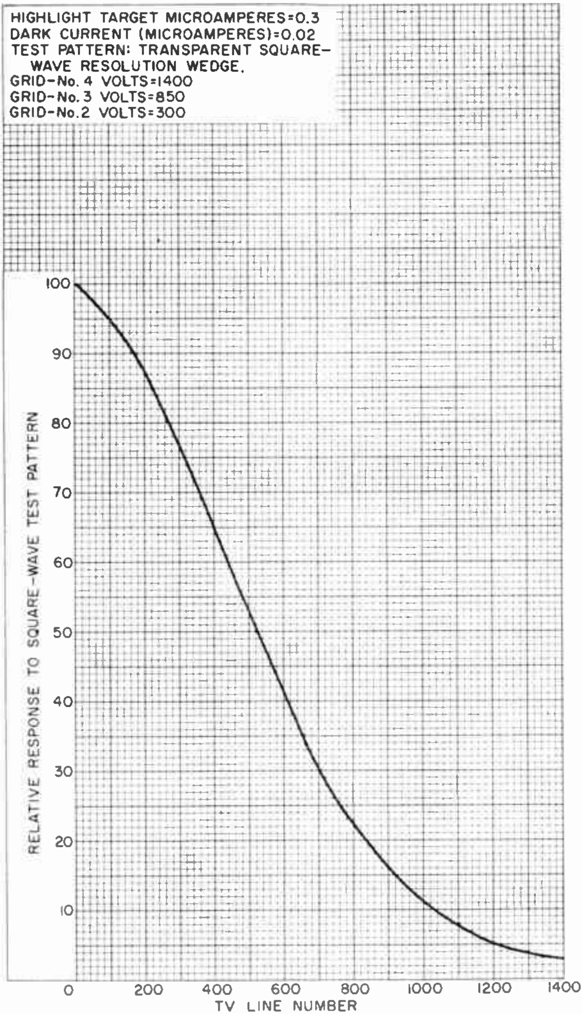


92CM-11619

TYPICAL PERSISTENCE CHARACTERISTICS



UNCOMPENSATED HORIZONTAL RESPONSE TO A SQUARE-WAVE TEST PATTERN



92CM-12418R1

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.

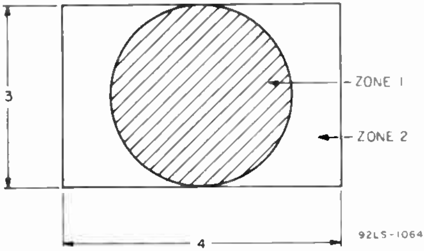
t The deflecting circuits must provide extremely linear scanning for good black-level reproduction. Dark-current signal is proportional to the scanning velocity. Any change in scanning velocity produces a black-level error in direct proportion to the change in scanning velocity.

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	■	■

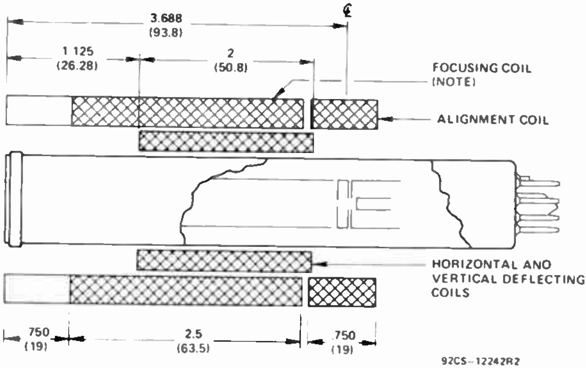
■ Spots of this size are allowed unless concentration causes a smudged appearance.

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.

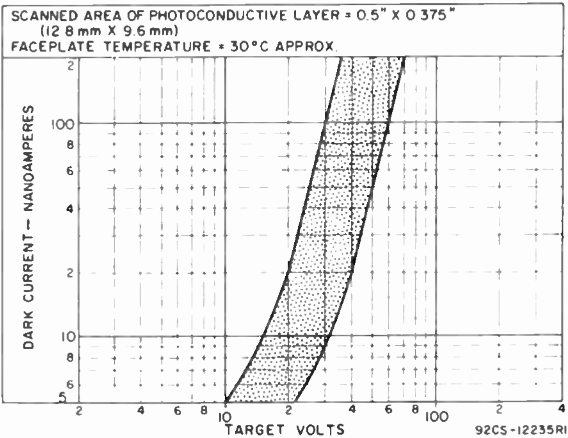
Signal-Output and Light Transfer Characteristics
Typical signal output as a function of uniform 2854° K tungsten illumination on the photoconductive layer for different values of dark current is shown in **Figure 7.**

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.

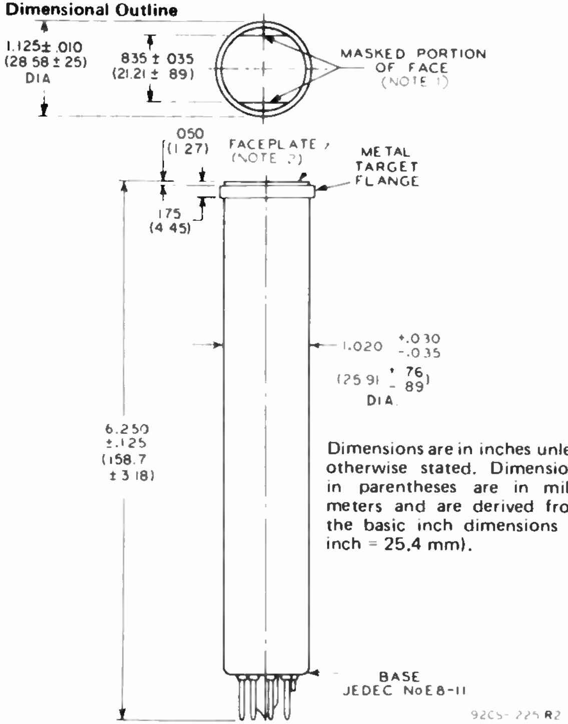
Figure 3 – Range of Dark Current



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

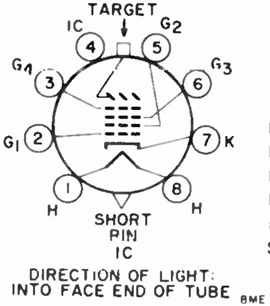


Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions (1 inch = 25.4 mm).

Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: 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

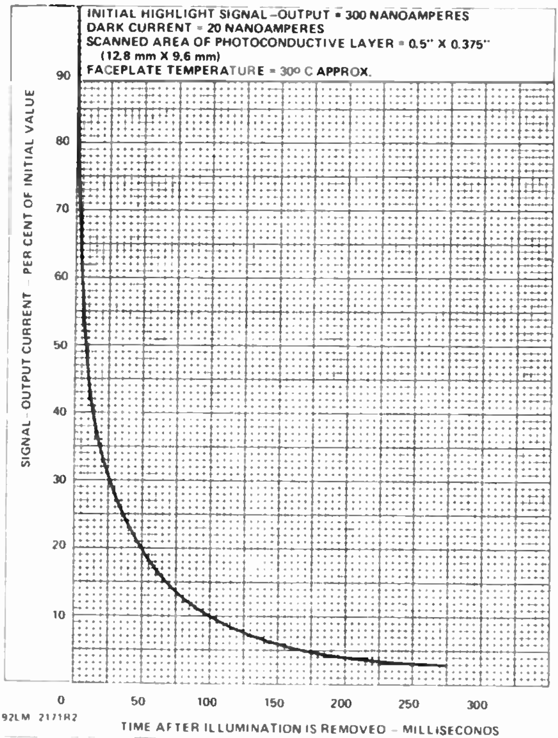


Figure 5 – Typical Spectral Response

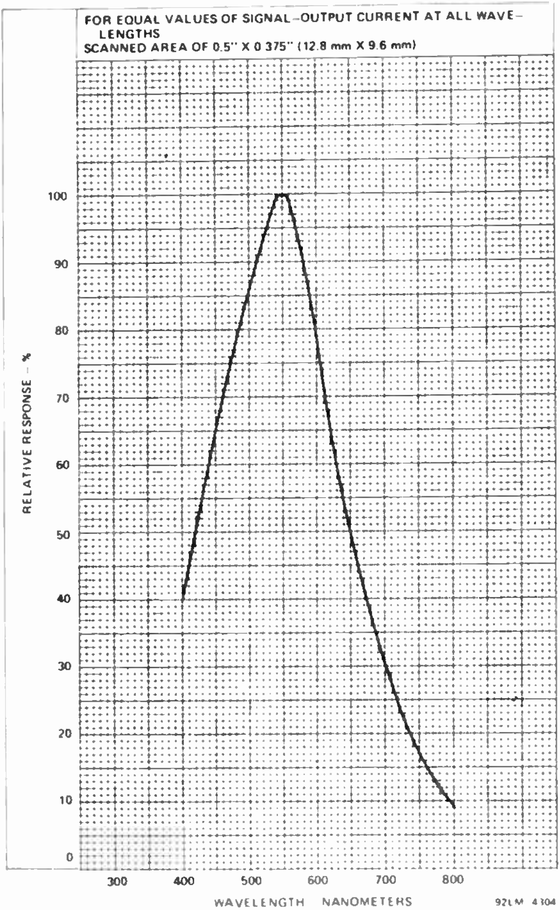
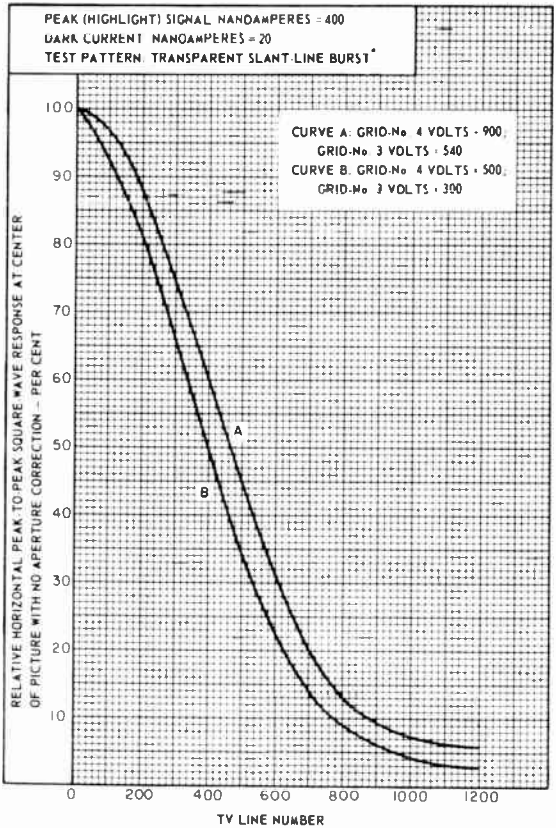
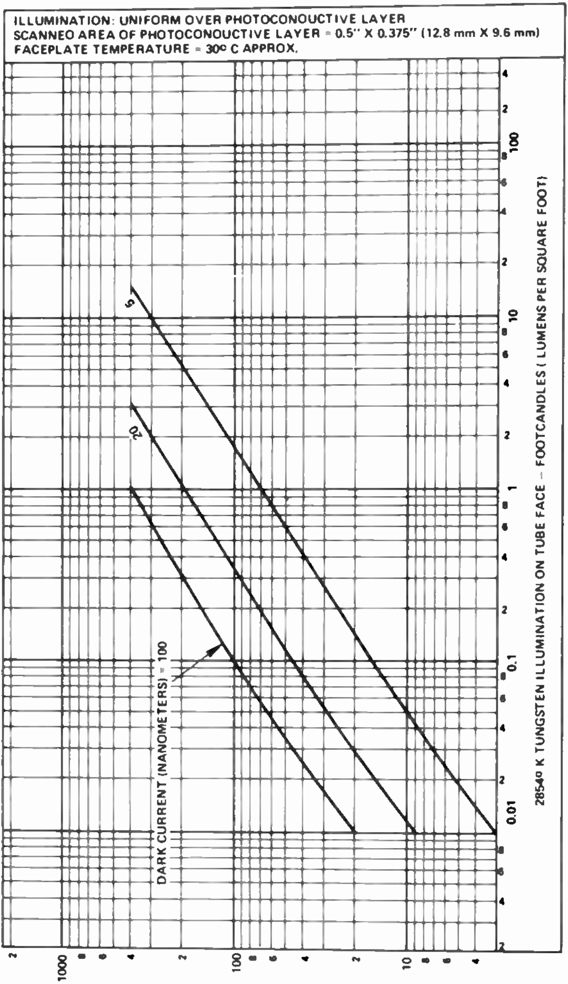


Figure 6 — Horizontal Square-Wave Response



*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



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.	^{o}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-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	–	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 $+22^{o}$ 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

Vidicon

LOW-POWER (0.6-WATT)"DARK HEATER" 1" DIAMETER PRECISION BULB[a]
ELECTROSTATIC FOCUS RUGGEDIZED MAGNETIC DEFLECTION

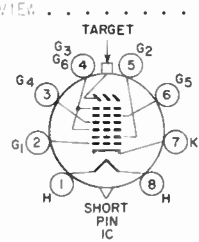
For Compact, Lightweight, Transistorized TV Cameras in Industrial and Other Closed-Circuit TV Systems Where Severe Environmental Conditions May be Encountered

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 . . . . [illegible] 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 8LK

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



DIRECTION OF LIGHT: INTO FACE END OF TUBE

Maximum Ratings, *Absolute-Maximum Values:*

For scanned area of 1/2" x 3/8"

Grid-No.6 & Grid No.3 Voltage[f] . . . . [illegible] volts
Grid-No.[illegible] Voltage[f] . . . . 1000 volts
Grid-No.4 Voltage. . . . . [illegible] volts
Grid-No.[illegible] Voltage. . . . . [illegible] 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	Intermediate-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)	[illegible]	fc
Target Voltage[m,n].	20 to 60	volts
Dark Current[p].	0.10	μa
Signal-Output Current[q]	0.10	μa

a The precision outer-diameter also permit the use of low-power, close-fitting deflecting yokes of small size and low impedance.

b This capacitance, and 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 amplifier 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 the 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 30 per cent of the maximum white-signal value and the tube must provide a resolution of at least [illegible]00 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 Amplitude 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.

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 [illegible] to 2000 and back to [illegible] 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
0.050	[illegible]	[illegible] to 20	30
–	[illegible]	20 to 2000	
–	5	2000 to 20	
0.050	[illegible]	20 to 5	

Random Vibration

The 8567 is also subjected to random vibration having a spectral density of 0.05 g²/cps in a bandwidth of [illegible]0 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

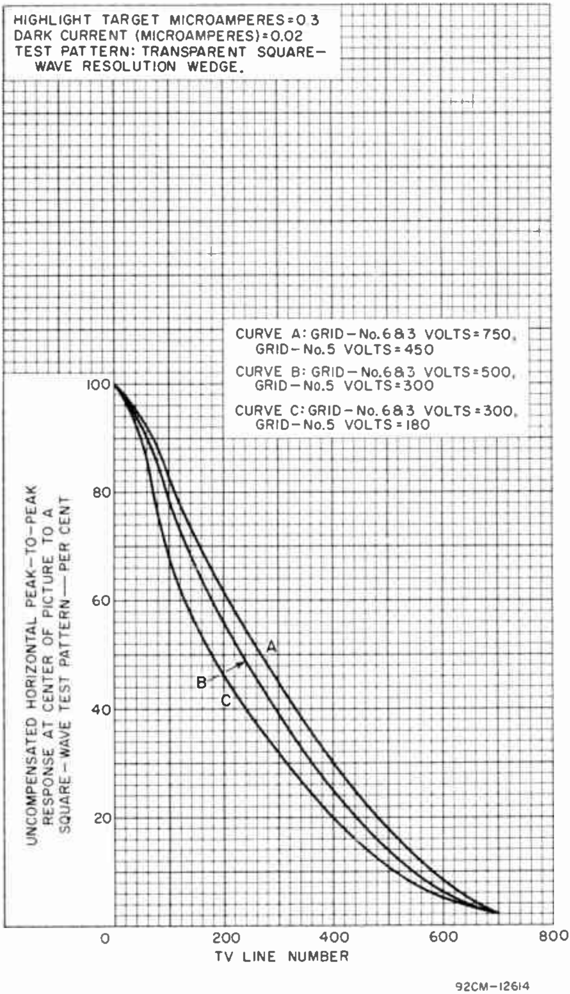
The 8567 is subjected to an overall external noise of 140 db for a period of 5 minutes.

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



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Photomultiplier Tube[a]

S-4 RESPONSE

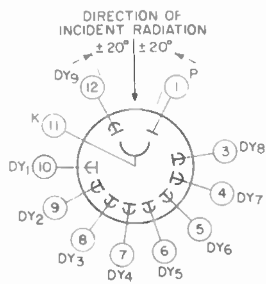
VERY SMALL, RUGGEDIZED, SIDE-ON, 9-STAGE TYPE

TESTED FOR SHOCK, VIBRATION, CONSTANT ACCELERATION, AND TEMPERATURE CYCLING

For Ultra Compact Systems in Low Light Detection and Measurement Application

GENERAL

Spectral Response	S-4
Wavelength of Maximum Response	4000 500 angstroms
Cathode	Cesium-Antimony
[illegible][b]	0.375 in
[illegible][b]	0.06 in
[illegible][b]	0.023 sq. in
Secondary-Emitting Surface	Cesium-Antimony
Window	Lime Glass, (Corning[c] No.0080), or equivalent
Direct Interelectrode Capacitances (Approx.)	
[illegible]	2.5 pF
[illegible]	3.0 pF
Maximum Overall Length	1.37 in
[illegible]	
Length	0.43 0.03 in
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



MAXIMUM RATINGS, ABSOLUTE-MAXIMUM VALUES

DC Supply Voltage

[illegible][e]	1250 V
[illegible]	250 V
[illegible]	250 V
[illegible]	250 V

Average Anode Current[f]	20	μA
Ambient Temperature.	75	°C
Lead Temperature	250	°C

[illegible]

CHARACTERISTICS RANGE VALUES

[illegible]

With E = 1000 volts (except as noted)

	Min	Typ	Max	
Sensitivity				
[illegible]	-	7.3×10^{4}	-	A/W
[illegible]	-	0.034	-	A/W
[illegible][g]. . . .	20	75	300	A/lm
[illegible][h]. . . .	2×10^{-5}	3.5×10^{-5}	-	A/lm
[illegible]	-	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				
[illegible] .	-	1×10^{4}	-	A/W
[illegible]	-	0.034	-	A/W
[illegible][g]. . . .	-	10	-	A/lm
[illegible][h]. . . .	2×10^{-5}	3.5×10^{-5}	-	A/lm
[illegible] . .	-	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 [illegible] Multiplier Phototube.

b On a plane parallel to the grill wires. See [illegible]

c Made by Corning Glass Works, Corning, N.Y.

d Magnetic shielding material in the form of foil or tape is available from the Magnetic Shield Division, Perfection 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 not usually 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 [illegible] amperes.

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

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.

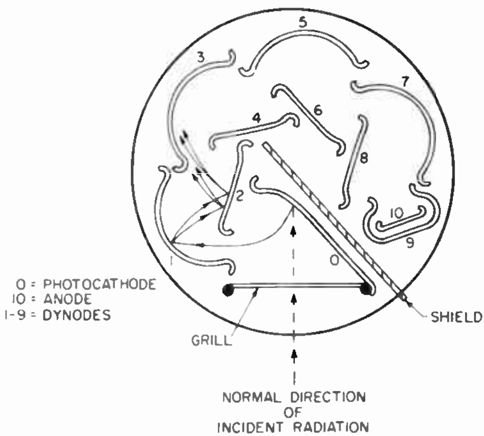
Vibration. With no voltage applied, the 8571 is vibrated, in each of the three orthogonal axes and as specified below, on apparatus which applies variable-sinusoidal frequency vibration to the tube. A vibration sweep has a duration of 5 minutes per axis in which time the frequency is varied logarithmically 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)



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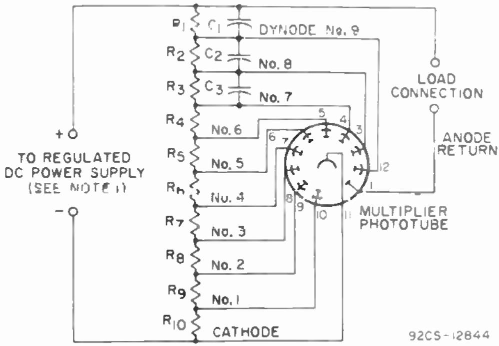
TYPICAL VOLTAGE-DIVIDER ARRANGEMENT

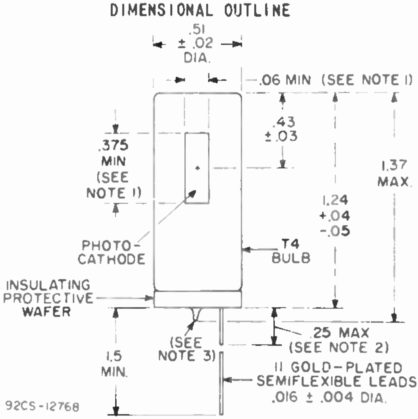


R_1 through R_{10} = 20,000 to 5,000,000 ohms.

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



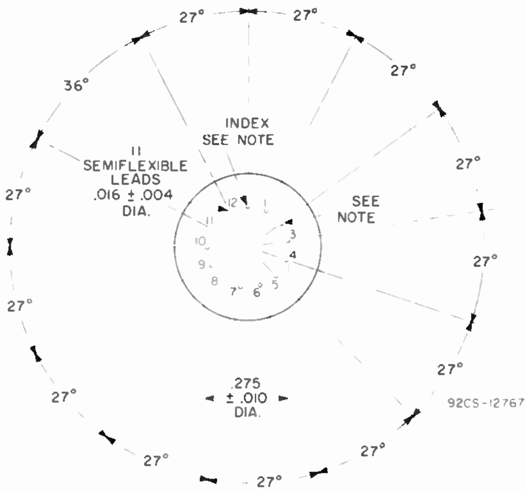
DIMENSIONS IN INCHES

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.

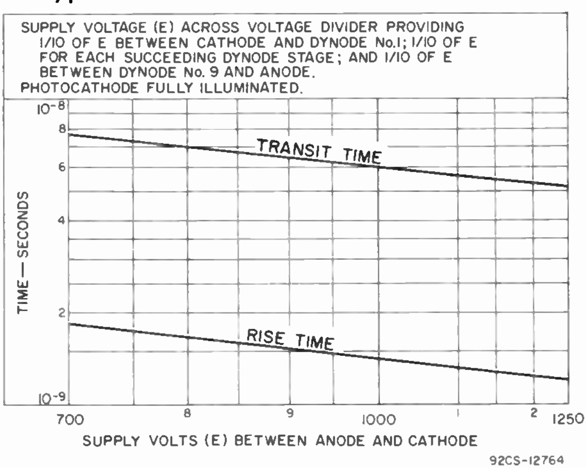
NOTE 3: A 0.15 inch minimum hole diameter should be provided in circuit boards or similar mounting arrangements to allow for clearance of the exhaust tip of the 8571.

BASE DRAWING



NOTE: Lead is cut off within 0.10 inch of the glass button for indexing.

Typical Time Resolution Characteristics



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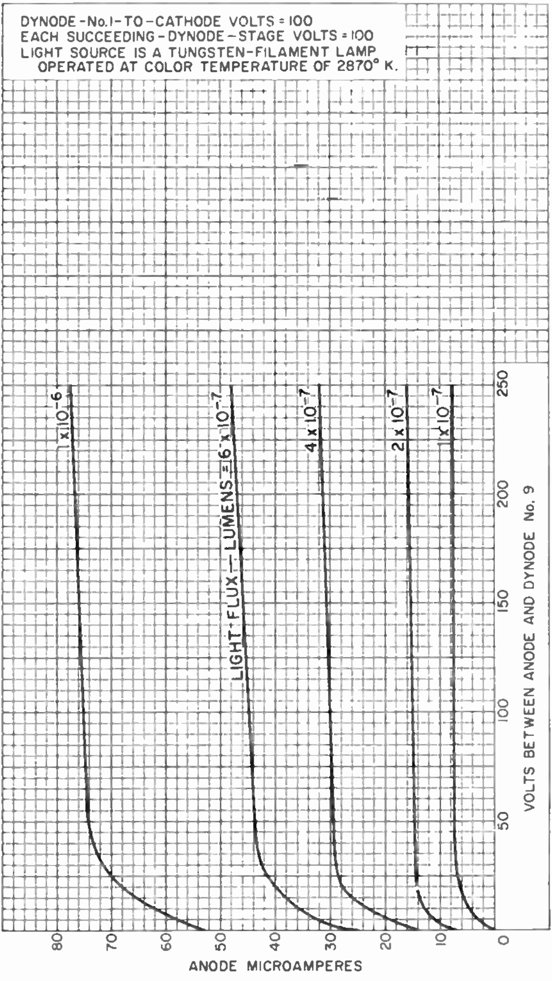
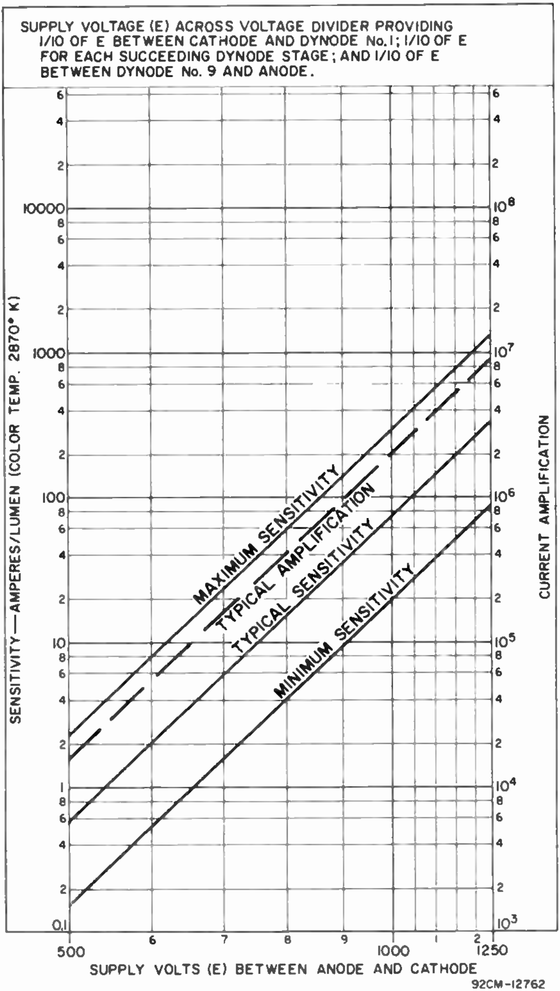
Average Anode Characteristics



Typical Sensitivity and Current Amplification Characteristics



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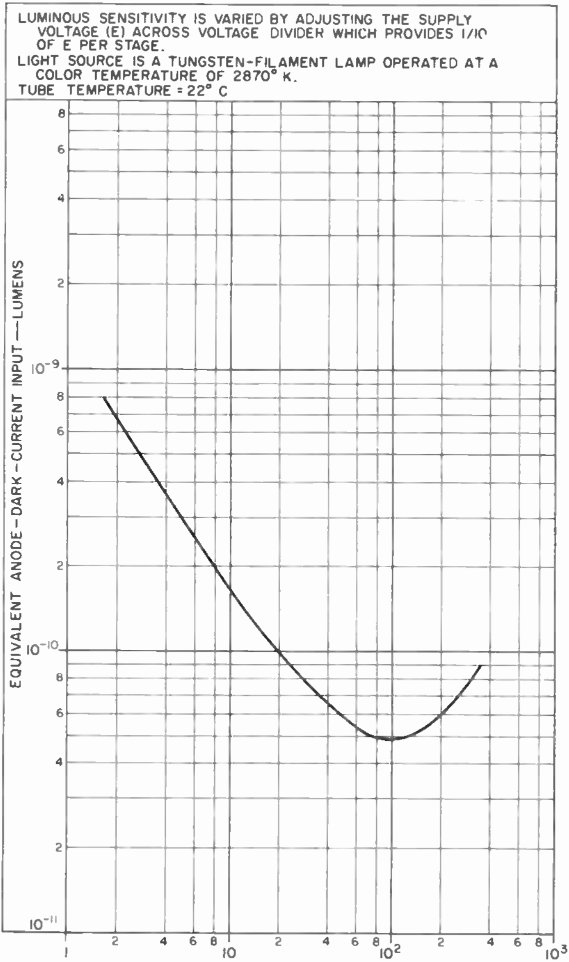
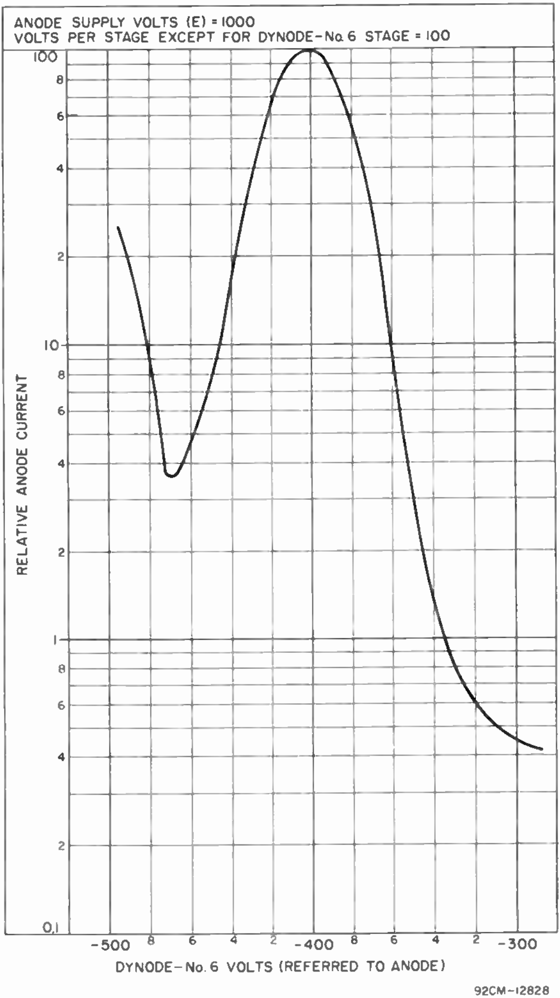
Typical Anode-Dark-Current Characteristic



Typical Anode Current Modulation Characteristic



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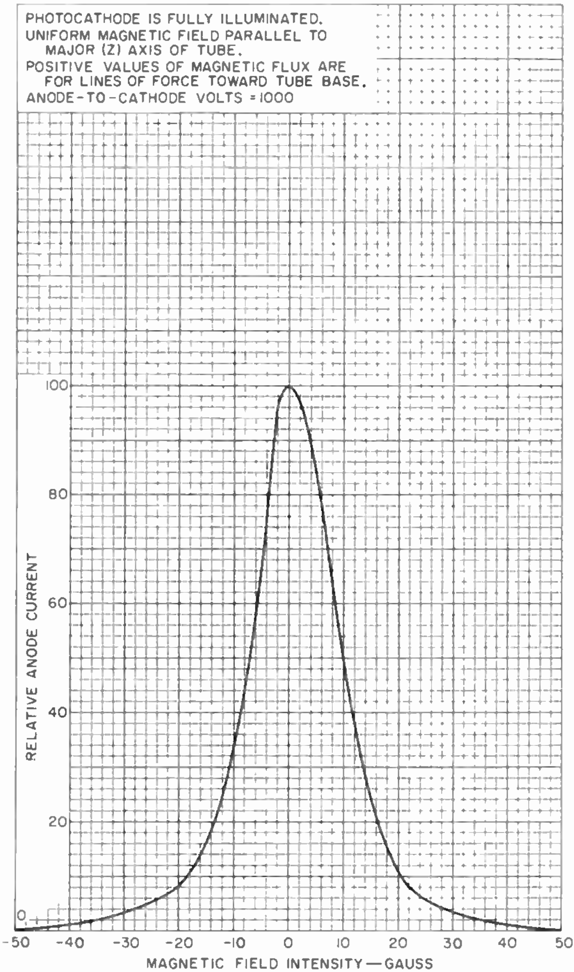
Typical Effect of Magnetic Field on Anode Current



92CM-13015

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 nnd 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[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]			
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.

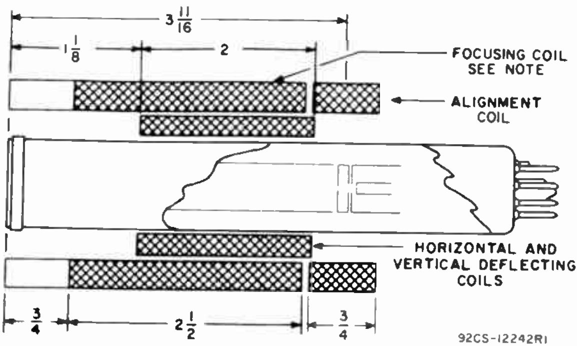
[s] Indicated range for each type of service serves only to illustrate the operating target-voltage range normally encountered.

[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

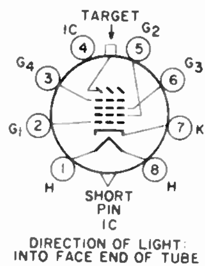


Dimensions in Inches

Note: Cross-hatching indicates wound portion of focusing coil.

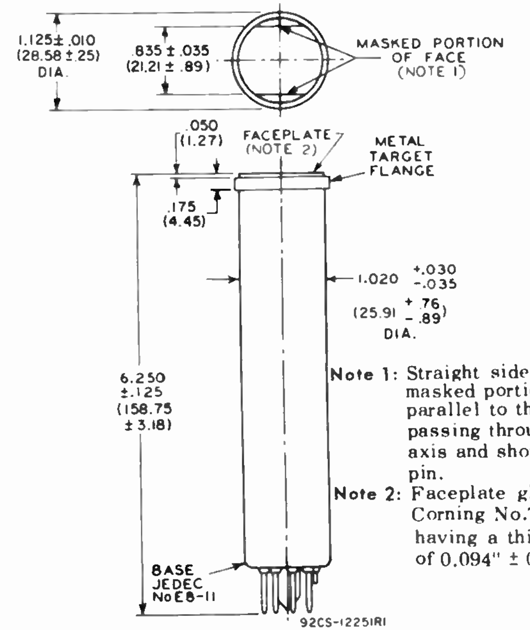
TERMINAL DIAGRAM (Bottom View)

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

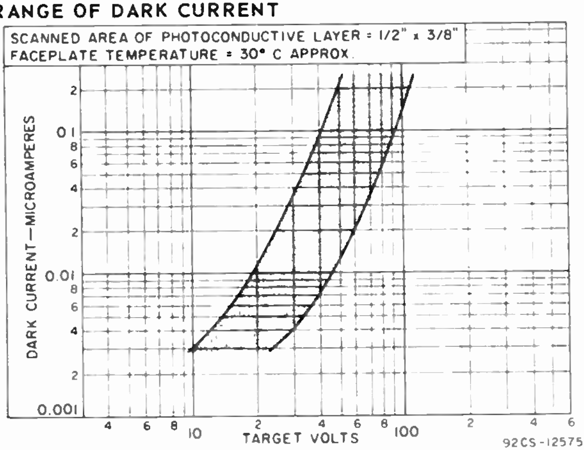
DIMENSIONAL OUTLINE - Dimensions in Inches (mm)



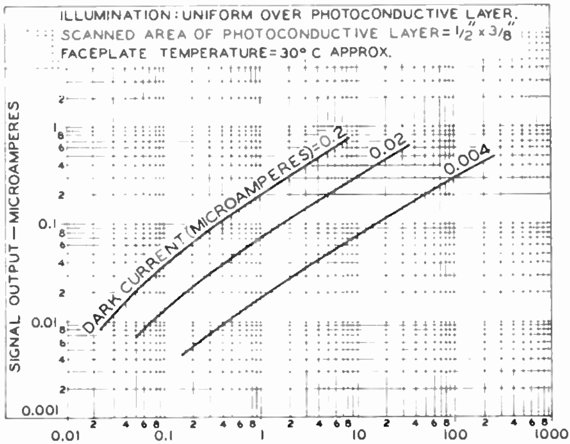
Note 1: Straight sides of masked portions are parallel to the plane passing through tube axis and short index pin.

Note 2: Faceplate glass is Corning No.7056 having a thickness of 0.094" ± 0.012".

RANGE OF DARK CURRENT

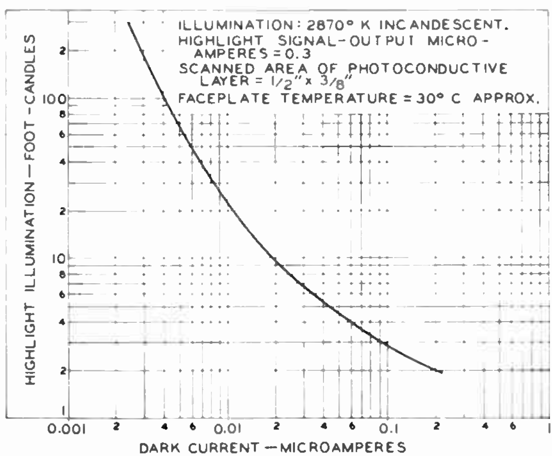


LIGHT TRANSFER CHARACTERISTICS



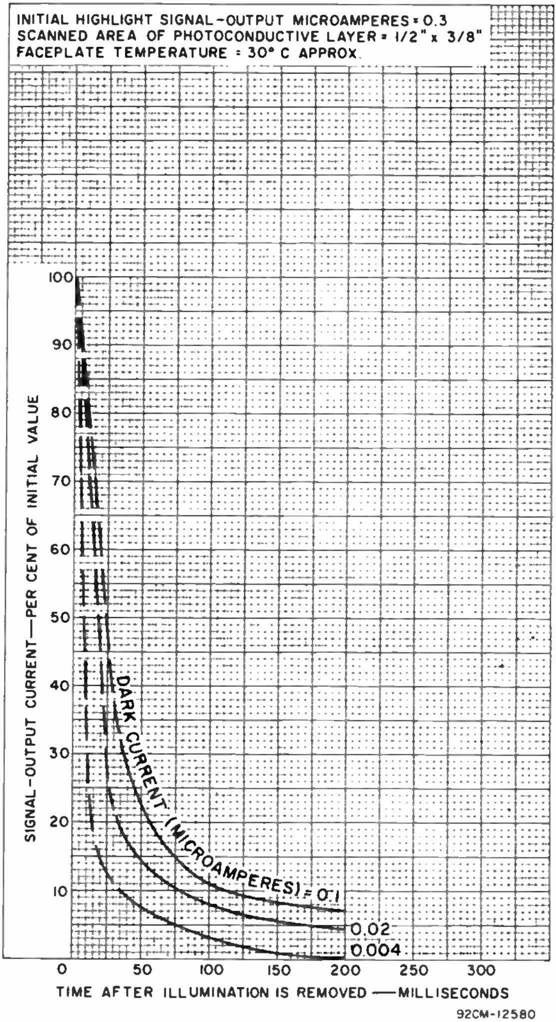
92CS-9495

TYPICAL CHARACTERISTIC

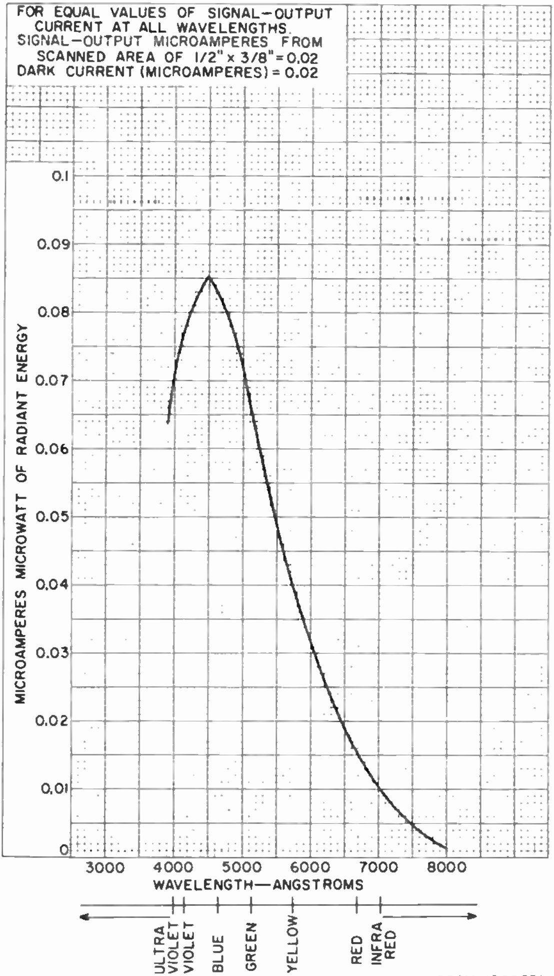


92CS-9493

TYPICAL PERSISTENCE CHARACTERISTICS

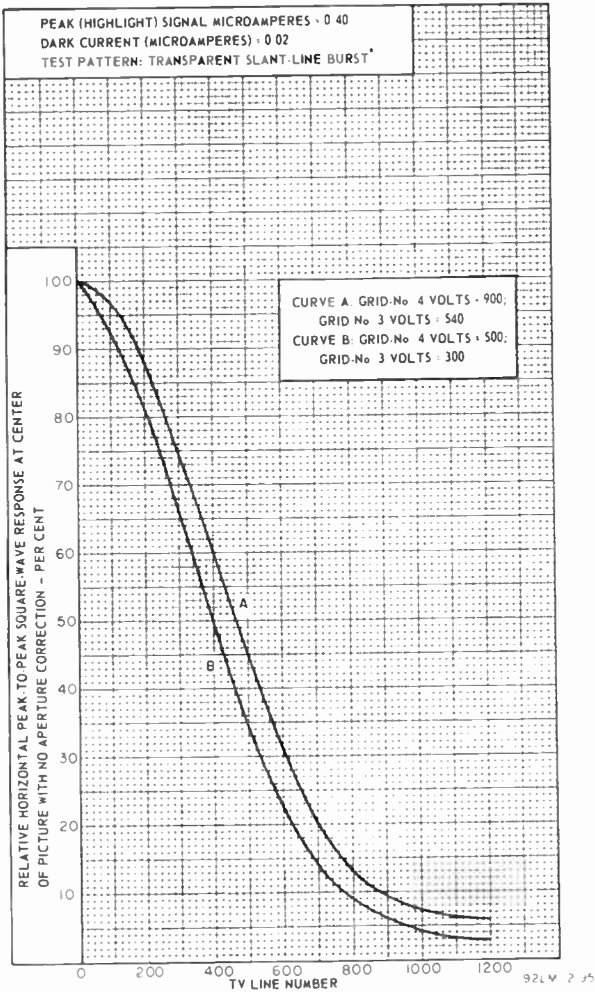


TYPICAL RCA TYPE I SPECTRAL RESPONSE



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.

8573A

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 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.

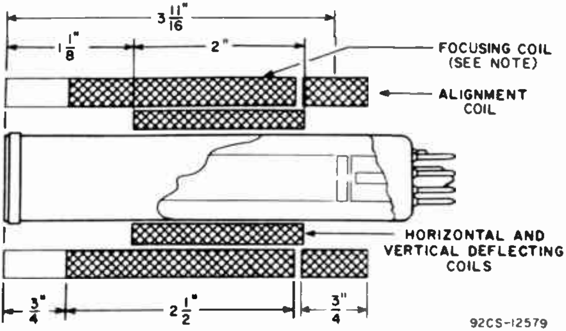
[r] The target voltage for each 8573A must be adjusted to that value which gives the desired operating dark current.

[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.

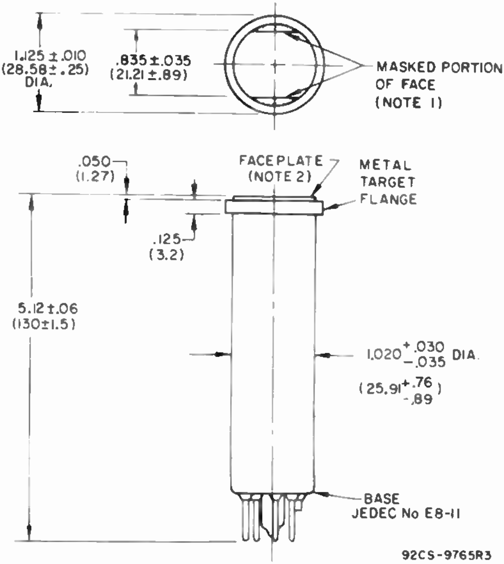
[u] Defined as the component of the highlight target current after the dark-current component has been subtracted.

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

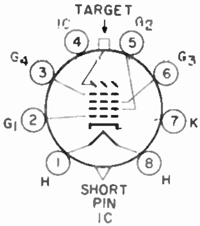
Pin 6: Grid No.3

Pin 7: Cathode

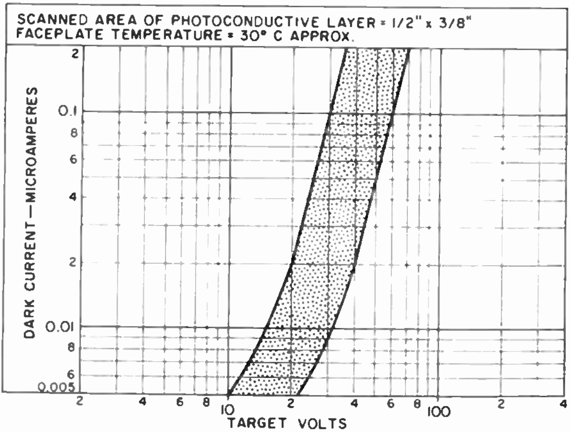
Pin 8: Heater

Flange: Target

Short Index Pin — Internal Connection — Make No Connection



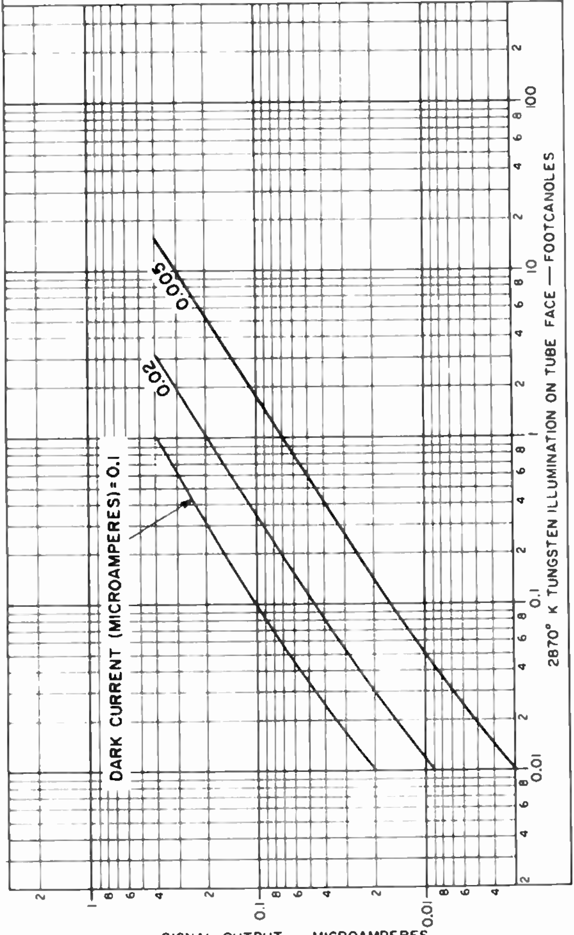
RANGE OF DARK CURRENT



92CS-12235

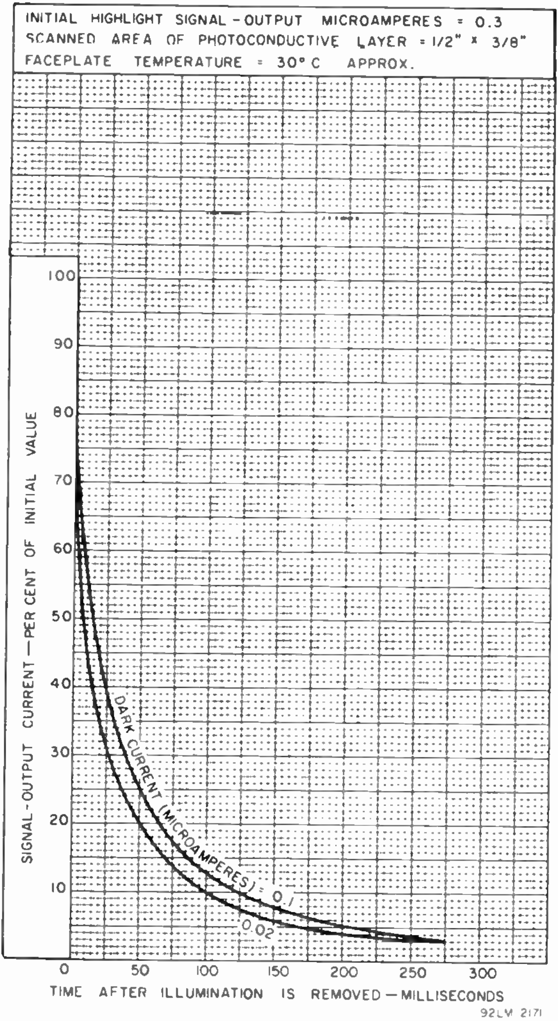
LIGHT TRANSFER CHARACTERISTICS

ILLUMINATION: UNIFORM OVER PHOTOCONDUCTIVE LAYER.
SCANNED AREA OF PHOTOCONDUCTIVE LAYER = 1/2" x 3/8"
FACEPLATE TEMPERATURE = 30° C APPROX.

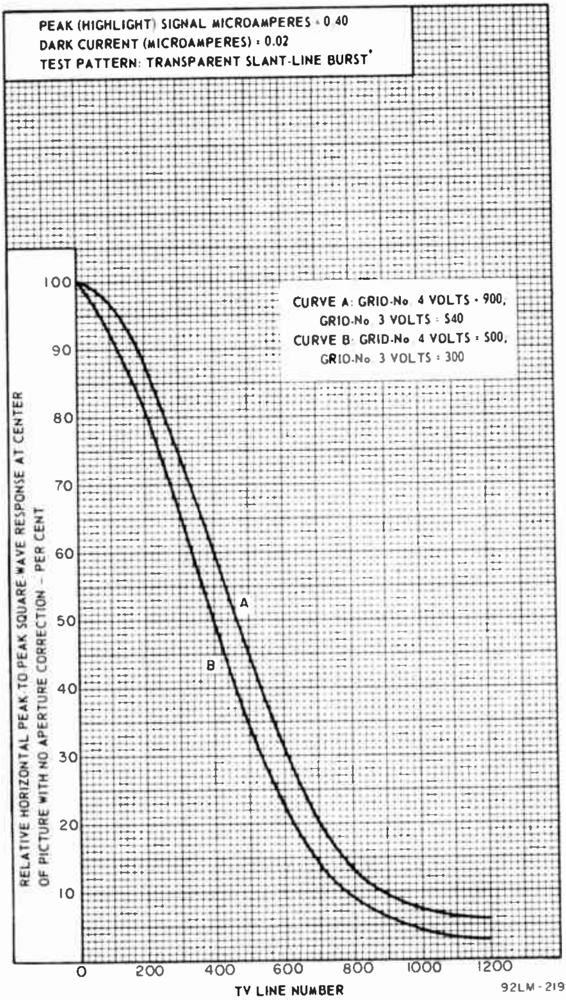


92CM-12245R1

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.

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° 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° 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.

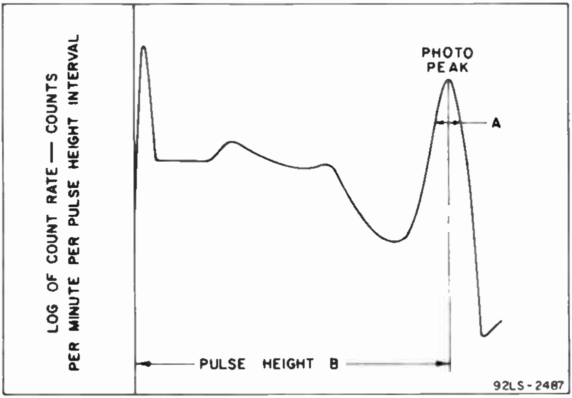
t At 3850 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1140 lumens per watt.

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:

$$MGD = \frac{\sum_{i=1}^{i=n} \left| \bar{p} - p_i \right|}{n} \cdot \frac{100}{\bar{p}}$$

where: $\bar{p}$ = mean pulse height
p_i = pulse height at the "i^{th}" reading
n = total number of readings

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.

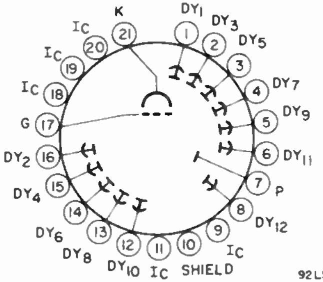
Table I			
Voltages To Be Provided By Divider			
Between the Following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	**Column A** 6.1% of Supply Voltage (E) multiplied by	**Column B** 8.06% of Dy1 – P Voltage (E) multiplied by	**Column C** 4.6% of Supply Voltage (E) multiplied by
K – Dy1	4.0	♠	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.

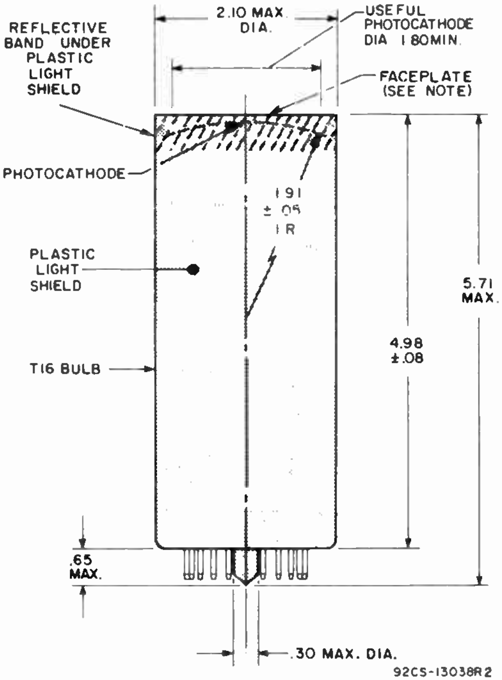
BASING DIAGRAM (BOTTOM VIEW)



DIRECTION OF RADIATION: INTO END OF BULB

92LS-2812

DIMENSIONAL OUTLINE



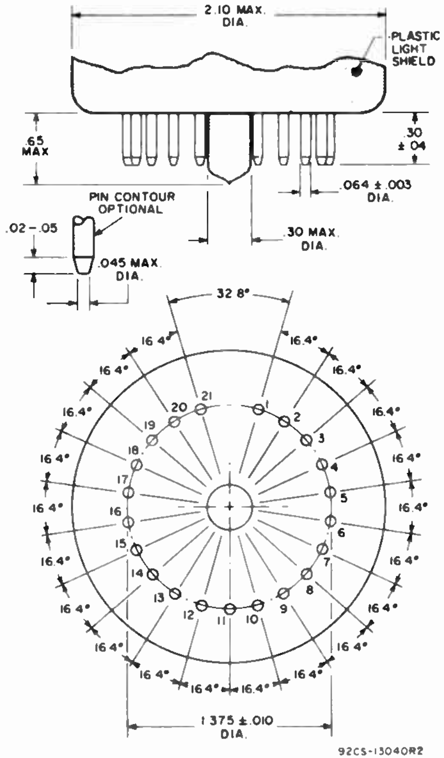
Dimensions in Inches

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).

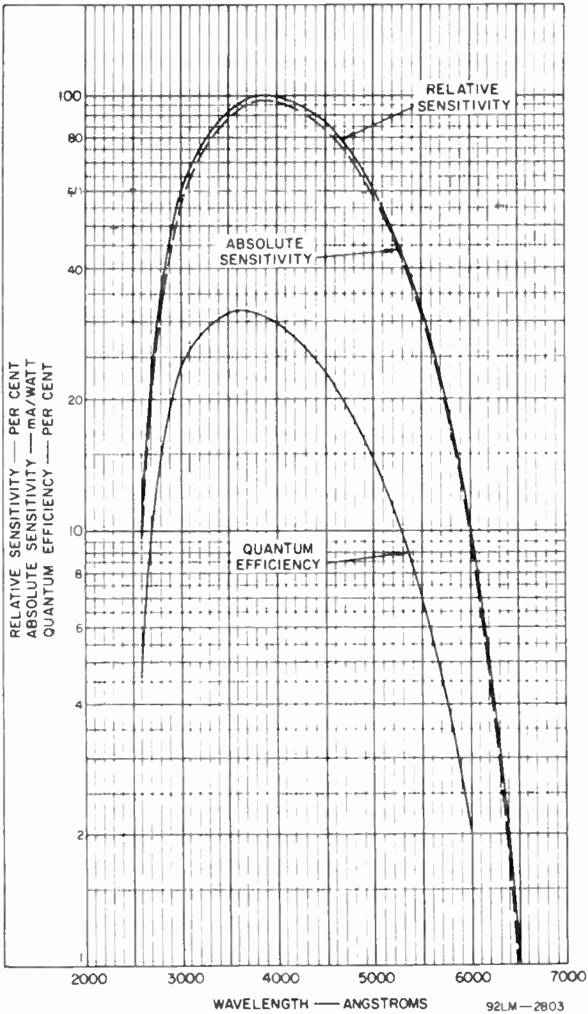
Inch	mm	Inch	mm	Inch	mm
.003	.08	.05	1.3	1.375	34.93
.010	.25	.064	1.63	1.80	45.7
.02	.5	.08	2.0	1.91	48.5
.04	1.0	.30	7.6	2.10	53.3
.045	1.14	.65	16.5	4.98	126.5
				5.71	145.0

DETAIL OF BASE ARRANGEMENT



Pin 1: Dynode No.1	Pin 12: Dynode No.10
Pin 2: Dynode No.3	Pin 13: Dynode No.8
Pin 3: Dynode No.5	Pin 14: Dynode No.6
Pin 4: Dynode No.7	Pin 15: Dynode No.4
Pin 5: Dynode No.9	Pin 16: Dynode No.2
Pin 6: Dynode No.11	Pin 17: Focusing Electrode
Pin 7: Anode	Pin 18: Internal Connection, Do not use
Pin 8: Dynode No.12	Pin 19: Internal Connection, Do not use
Pin 9: Internal Connection, Do not use	Pin 20: Internal Connection, Do not use
Pin 10: Electron Multiplier Shield	Pin 21: Photocathode
Pin 11: Internal Connection, Do not use	

TYPICAL PHOTOCATHODE SPECTRAL RESPONSE CHARACTERISTICS

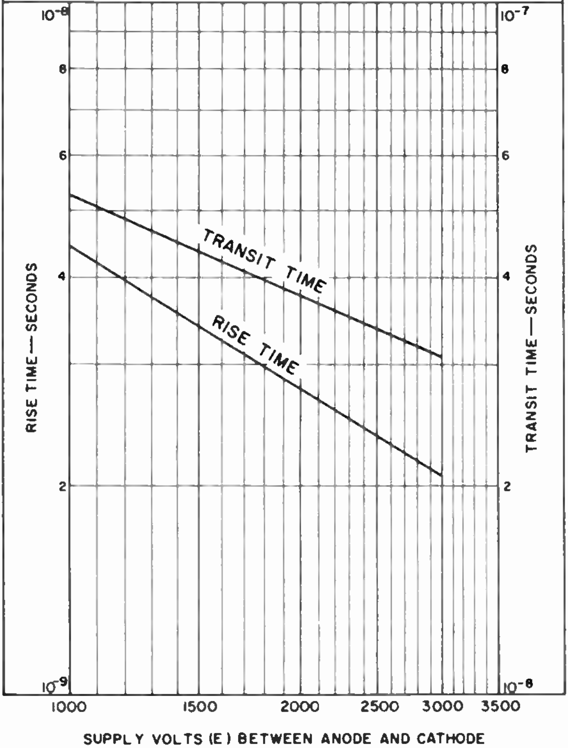


TYPICAL TIME-RESOLUTION CHARACTERISTICS

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:

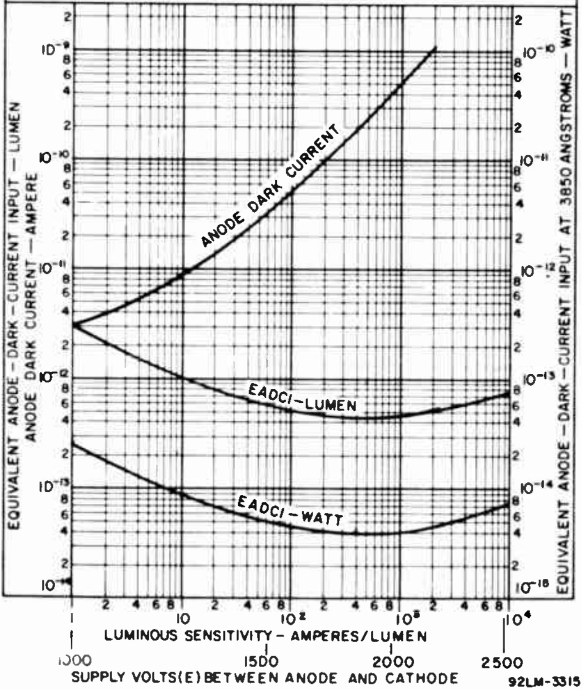
BETWEEN	6.1 % OF E MULTIPLIED BY
CATHODE AND DYNODE No. 1	4.0
DYNODE No. 1 AND DYNODE No. 2	1.0
DYNODE No. 2 AND DYNODE No. 3	1.4
EACH SUCCEEDING DYNODE-STAGE VOLTS	1.0
ANODE AND CATHODE	16.4

ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE No. 5 POTENTIAL

FOCUSING ELECTRODE IS CONNECTED TO DYNODE No. 1 POTENTIAL.

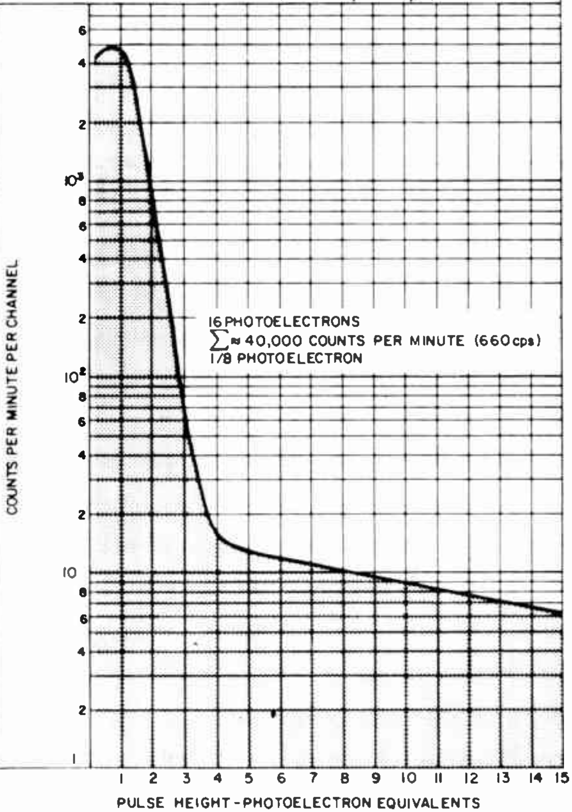
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K

TUBE TEMPERATURE = 22°C



TYPICAL DARK-PULSE SPECTRUM

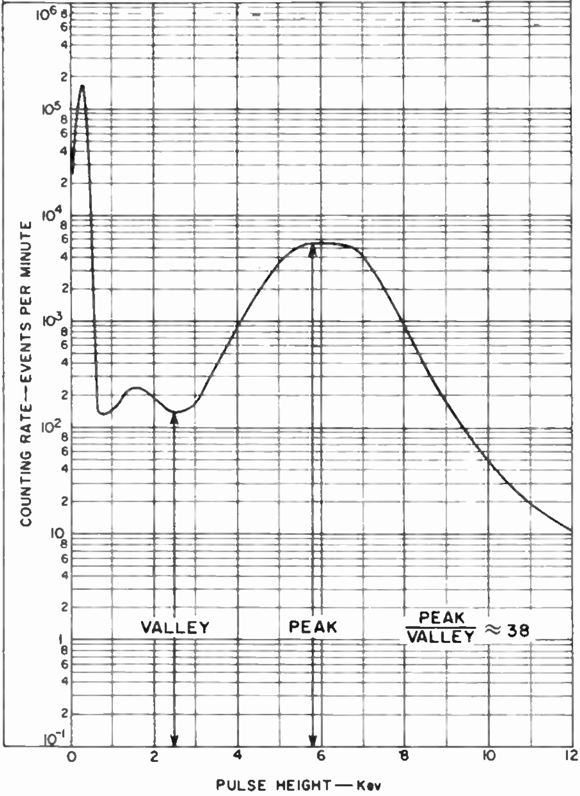
MEASURED UNDER THE FOLLOWING CONDITIONS: LIGHT ON CATHODE IS TRANSMITTED THROUGH A BLUE FILTER (CORNING CS No. 5-58, POLISHED TO 1/2 STOCK THICKNESS). LIGHT ON FILTER IS 0.1 MICROLUMEN. VOLTAGE DISTRIBUTION (A) IS USED AND SUPPLY VOLTAGE ADJUSTED TO OBTAIN AN ANODE CURRENT OF 2.6 MICROAMPERES. LIGHT 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 μs (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.



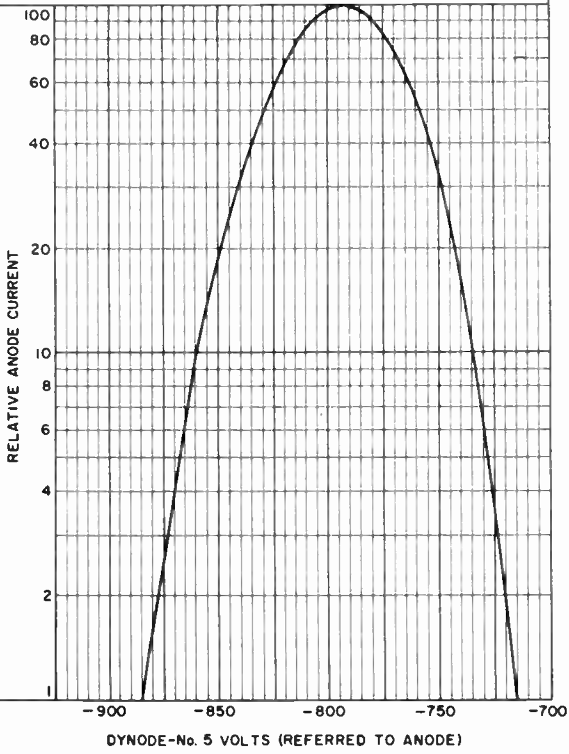
92CM-13047

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

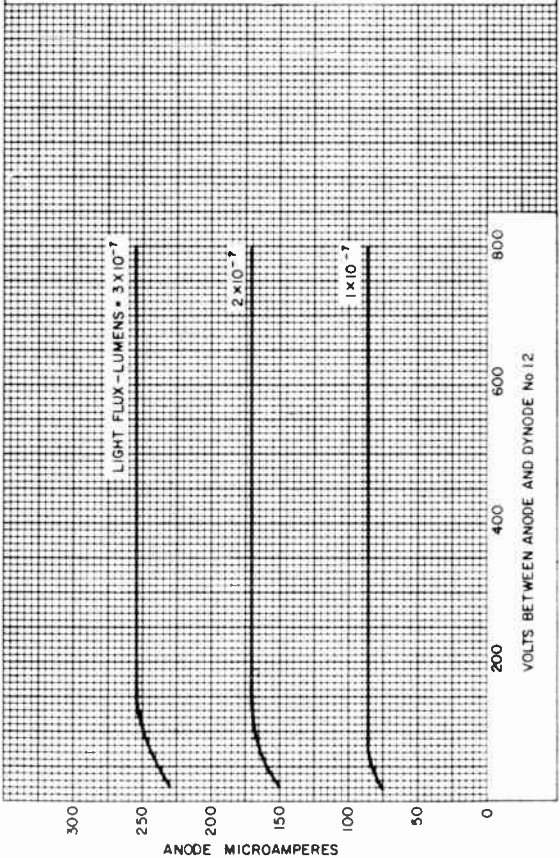
FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
CATHODE IS AT GROUND POTENTIAL.



92CM-13044

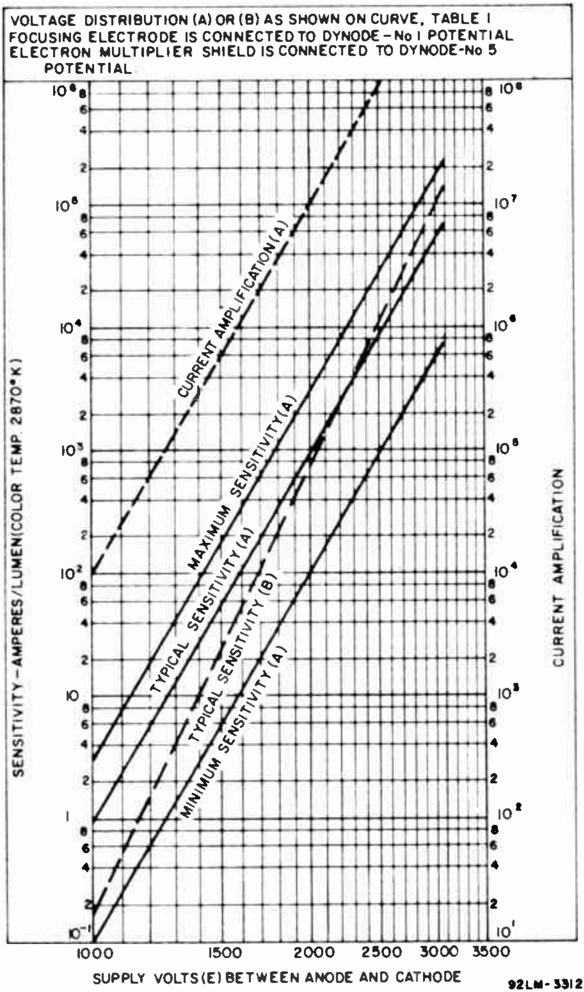
TYPICAL ANODE CHARACTERISTICS

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

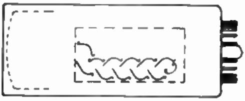


TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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

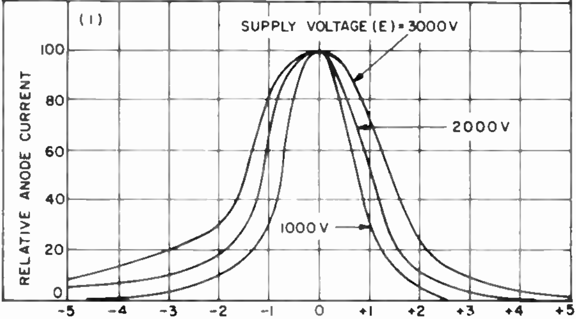
BETWEEN	6.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	4.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	16.4

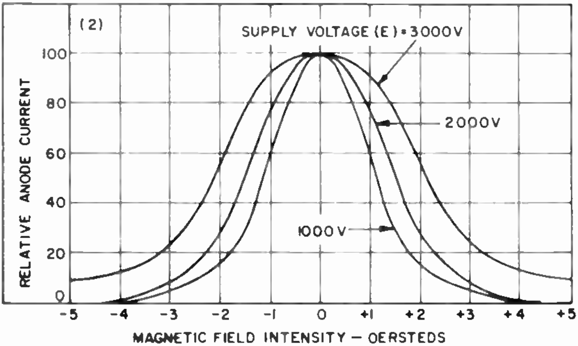
FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No.1 POTENTIAL
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No.5 POTENTIAL
PHOTOCATHODE IS FULLY ILLUMINATED.



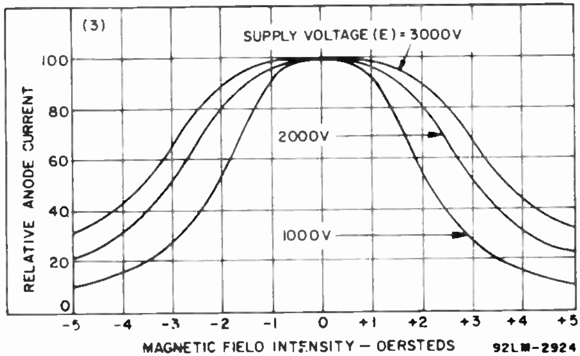
POSITIVE VALUE OF H IN DIRECTION SHOWN: (1)* •, (2) ↑ OR (3) →

* DIRECTION (1) IS OUT OF PAPER





TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)



TYPICAL FOCUSING-ELECTRODE CHARACTERISTIC

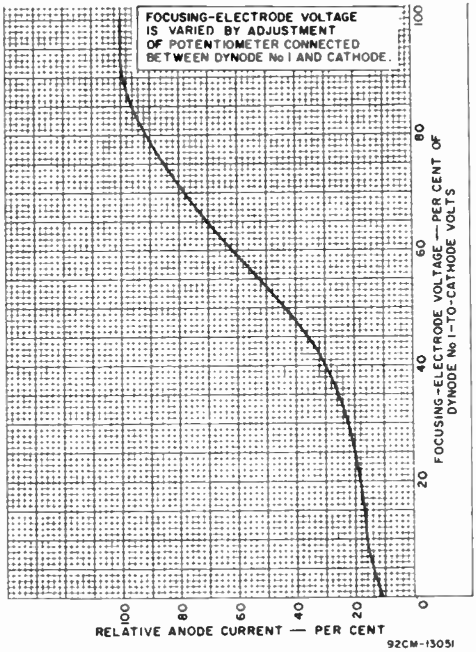


Image Intensifier Tubes

- 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 $^{+1000}_{-500}$ 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)

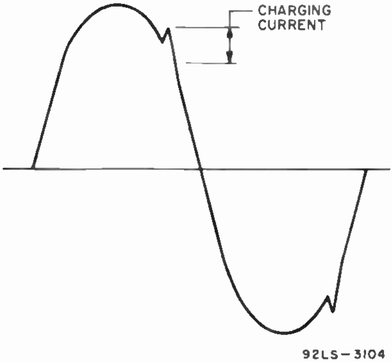
Characteristic	Type 8606 Under conditions with 2.7 ± .05 kV 1500 Hz applied and at an ambient temperature of 22° C, unless otherwise noted.			Type 8605/V1 Under conditions with a DC anode voltage of 15 kV and at an ambient temperature of 22°C, unless otherwise noted.			Type 8605/V2 Under conditions with 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] (... next 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.



[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 x 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

$$\text{Per-cent Distortion} = \frac{Emx - Cmx}{Cmx} \times 100$$

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.

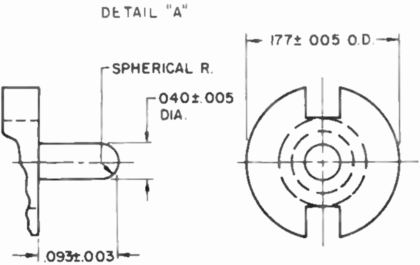
High Humidity for Types 8605/V1 and 8605/V2

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.

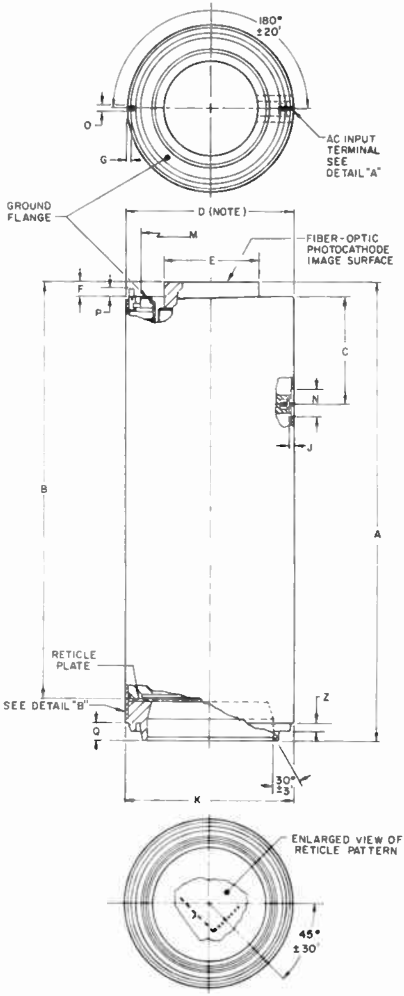
DC Power Supply for Types 8605/V1 and 8605/V2

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.

OIMENSIONAL OUTLINE
TYPE 8606

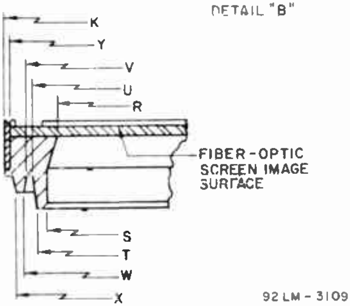


DIMENSIONAL OUTLINE
TYPE 8606



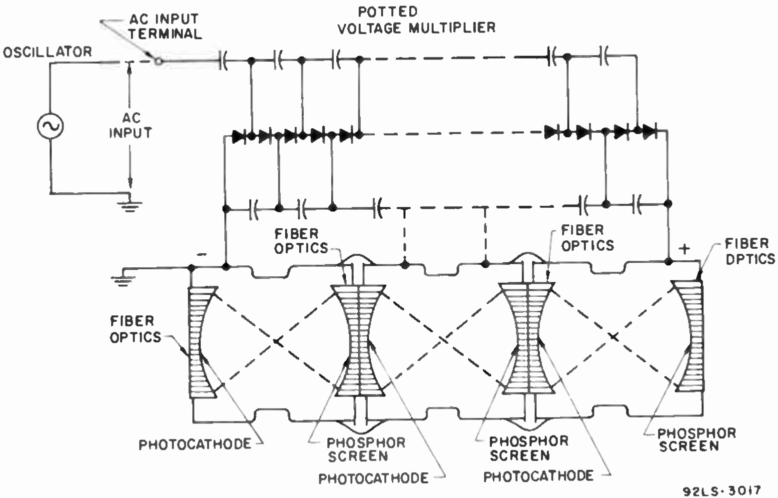
Note: Dimension applies with 1" of tube end.

DIMENSIONAL OUTLINE
TYPE 8606



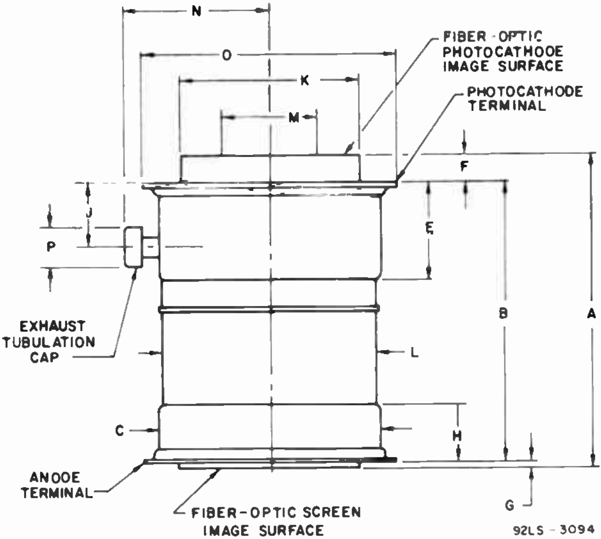
Dimensions	Inches		mm	
	Min.	Max.	Min.	Max.
A	11.906	12.028	302.512	305.511
B	11.025	11.115	280.035	282.321
C	2.372	2.398	60.249	60.909
D	3.742 Dia.	3.747 Dia.	95.047 Dia.	95.174 Dia.
E	2.095 Dia.	2.105 Dia.	53.213 Dia.	53.467 Dia.
F	.237	.243	6.020	6.172
G	.082	.092	2.082	2.336
J	.093	.113	2.362	2.870
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

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



SCHEMATIC ARRANGEMENT OF TYPE 8606

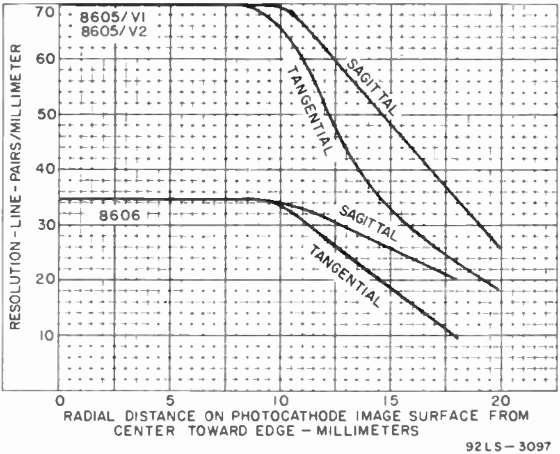
DIMENSIONAL OUTLINE
TYPES 8605/V1 AND 8605/V2



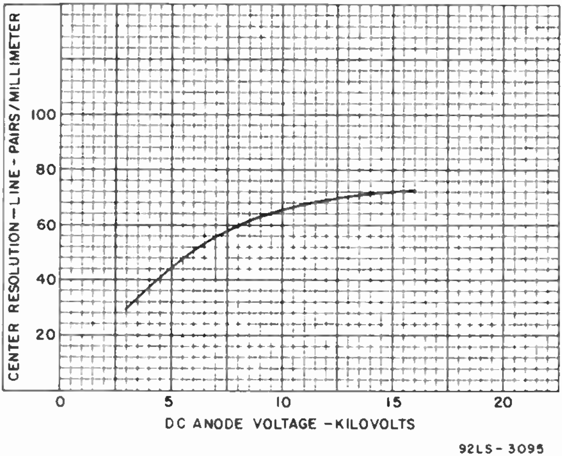
Dimensions	Inches	mm
A	3.690 ± .015	93.7 ± .4
B	3.337	84.8
C	2.600 ± .015 Dia.	66 ± .4 Dia.
D	3.00 ± .05 Dia.	76.2 ± 1.3 Dia.
E	1.15	29.2
F	.320 ± .020	8.13 ± .51
G	.042 ± .02	1.1 ± .5
H	.70	17.8
J	.77 ± .03	19.6 ± .8
K	2.100 ± .005 Dia.	53.3 ± .13 Dia.
L	2.50 Dia.	63.5 Dia.
M	1.575 Min. Dia.	40 Min. 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).

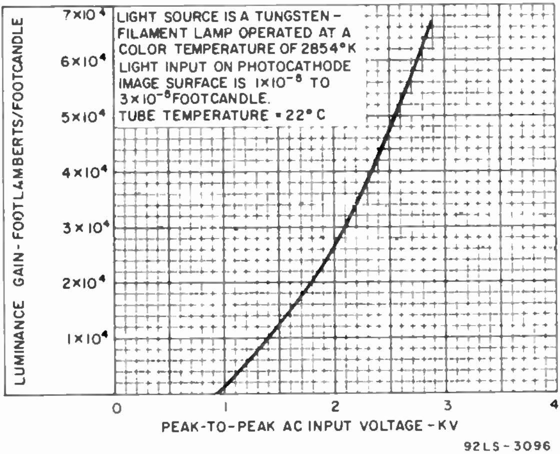
TYPICAL RESOLUTION CHARACTERISTICS FOR ALL TYPES



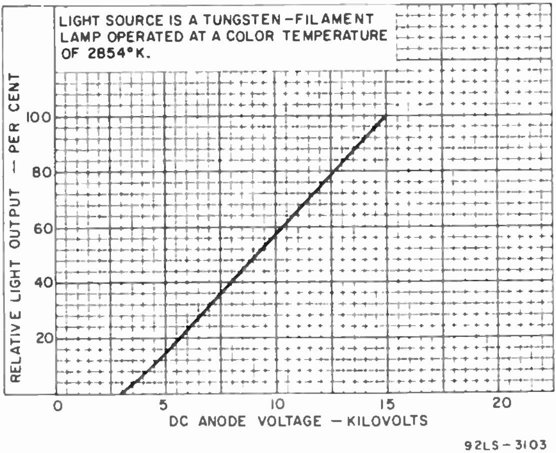
TYPICAL RESOLUTION CHARACTERISTICS FOR TYPES 8605/V1 AND 8605/V2



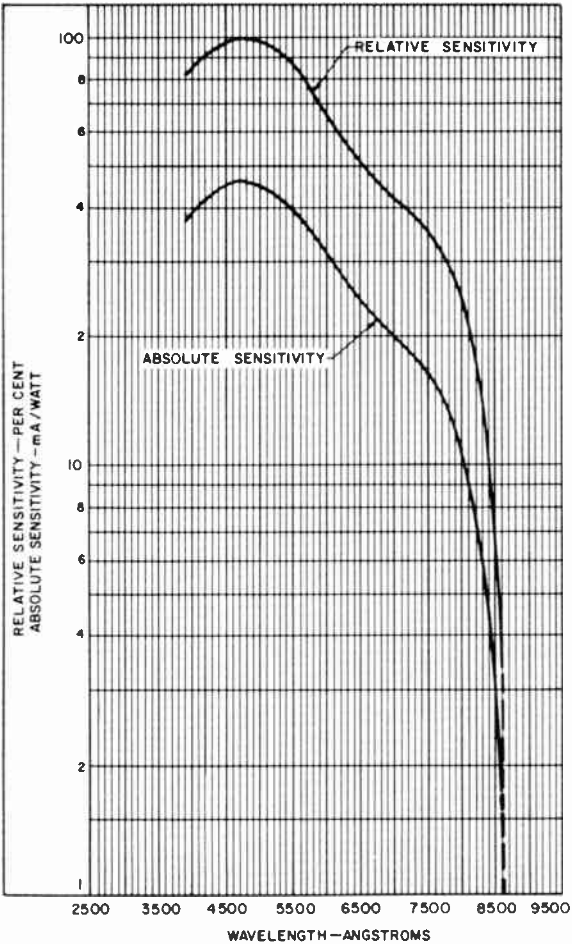
LUMINANCE GAIN AS A FUNCTION OF VOLTAGE FOR TYPE 8606



RELATIVE LIGHT OUTPUT CHARACTERISTIC FOR TYPES 8605/V1 AND 8605/V2



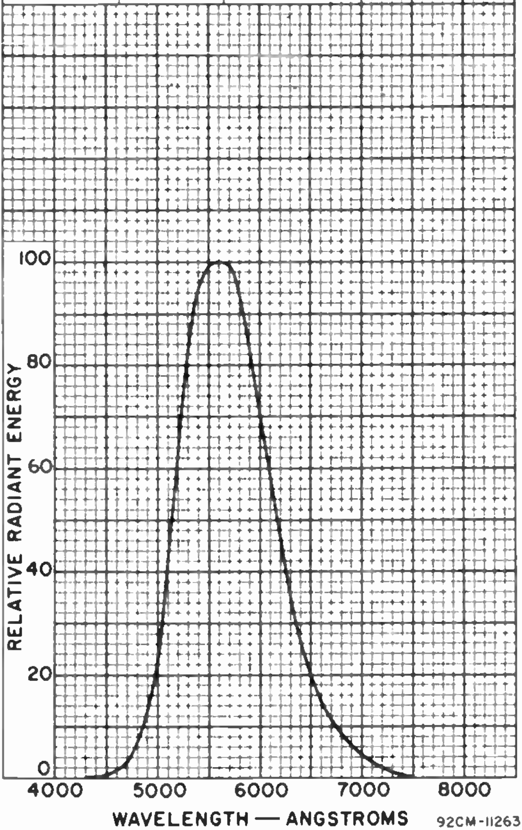
TYPICAL SPECTRAL RESPONSE CHARACTERISTIC FOR ALL TYPES



92LM-3108

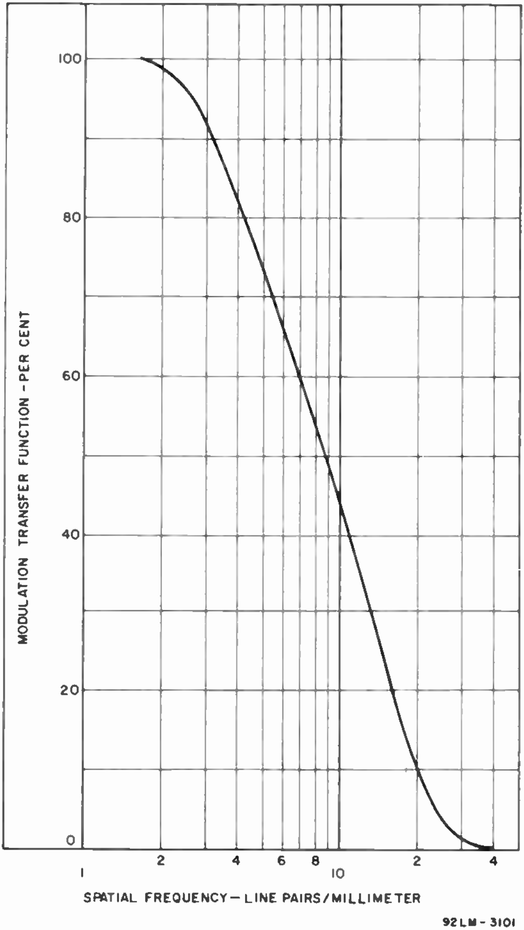
SPECTRAL ENERGY EMISSION CHARACTERISTICS
(JEDED PHOSPHOR P20) FOR ALL TYPES

COLOR	C.I.E. COORDINATES	
	X	Y
YELLOW-GREEN	0.426	0.546

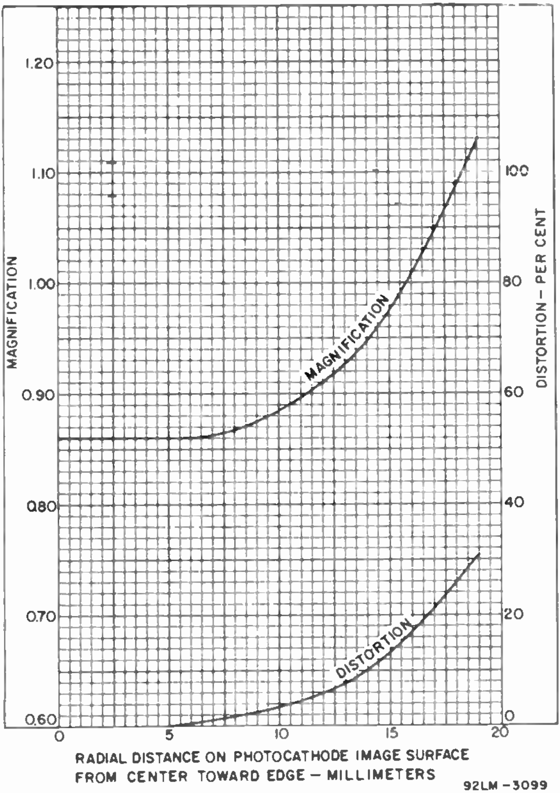


92CM-11263

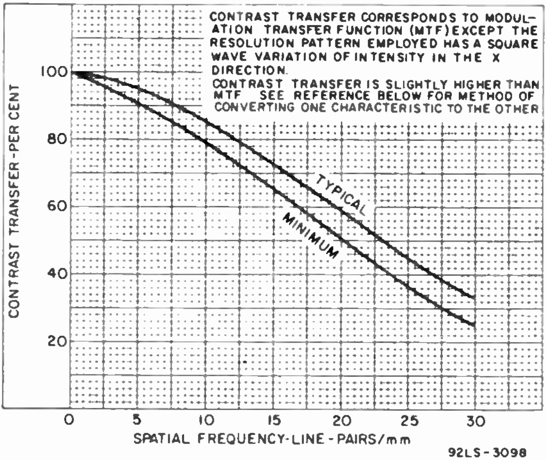
TYPICAL MODULATION TRANSFER FUNCTION VERSUS FREQUENCY FOR TYPE 8606



TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPE 8606



CONTRAST TRANSFER CHARACTERISTICS FOR TYPES 8605/V1 AND 8605/V2



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.

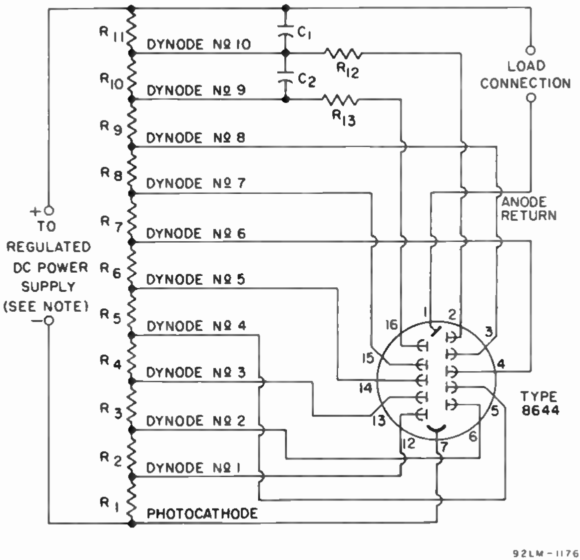
In the use of the 8644 and the 8645, as with other tubes requiring high voltages, it should always be remembered that these high voltages may appear at points in the circuit which are normally at low potential, because of defective circuit parts or incorrect circuit connections. Therefore, before any 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



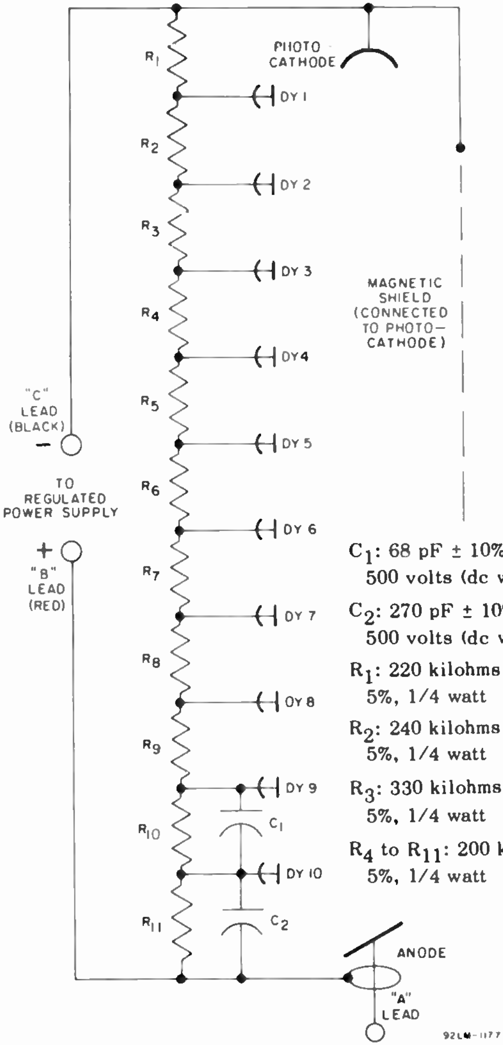
NOTE: Adjustable between approximately 500 and 2100 volts dc.

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)

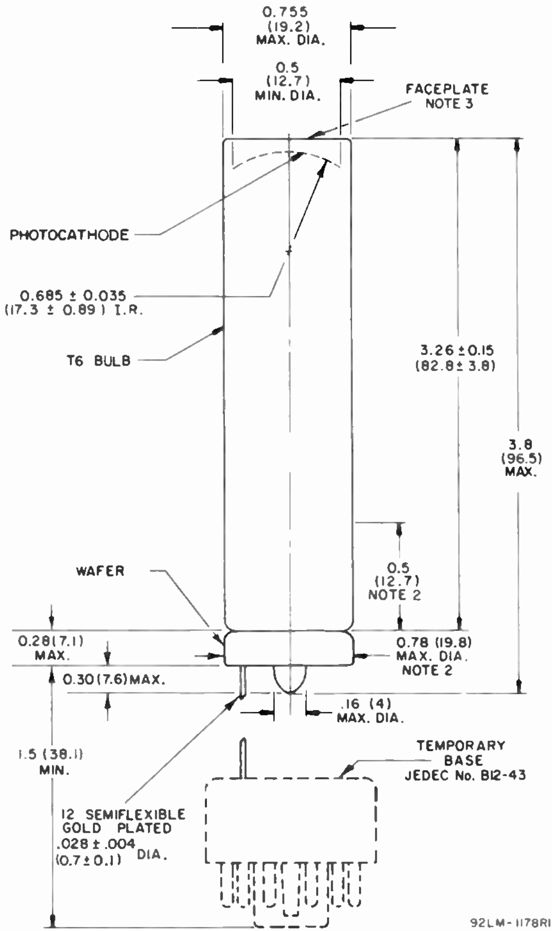
R_1: 220 kilohms, 5%, 1/4 watt

R_2: 240 kilohms, 5%, 1/4 watt

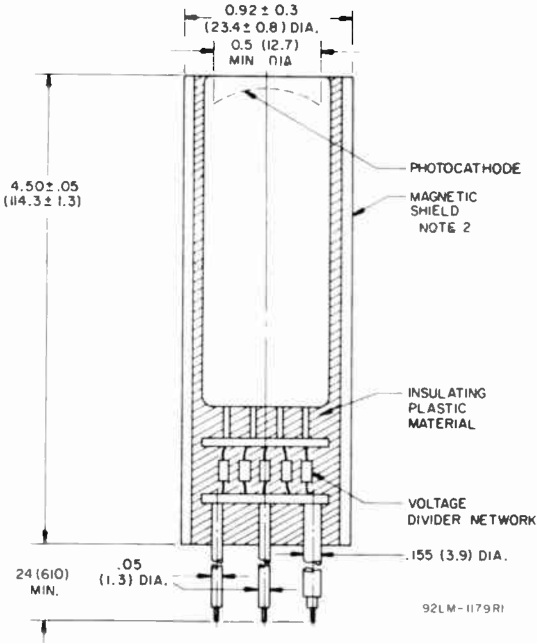
R_3: 330 kilohms, 5%, 1/4 watt

R_4 to R_{11}: 200 kilohms, 5%, 1/4 watt

DIMENSIONAL OUTLINE (TYPE 8644)

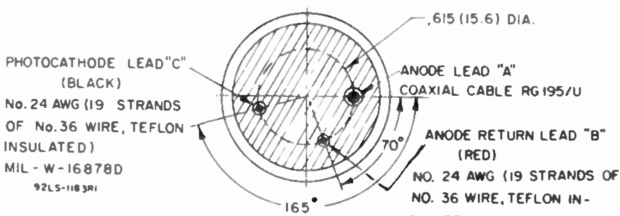


DIMENSIONAL OUTLINE (TYPE 8645)



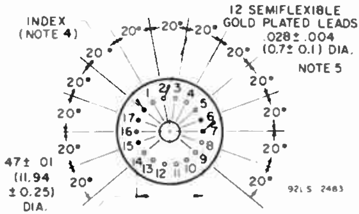
NOTE 1: Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters.

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.

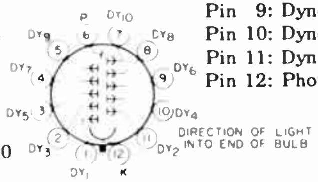
LEAD ORIENTATION (Bottom View)



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

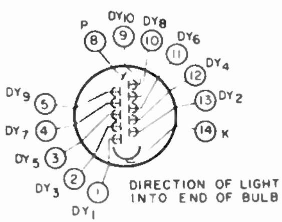
Pin 1: Dynode No.1
Pin 2: Dynode No.3
Pin 3: Dynode No.5
Pin 4: Dynode No.7
Pin 5: Dynode No.9
Pin 6: Anode
Pin 7: Dynode No.10
Pin 8: Dynode No.8



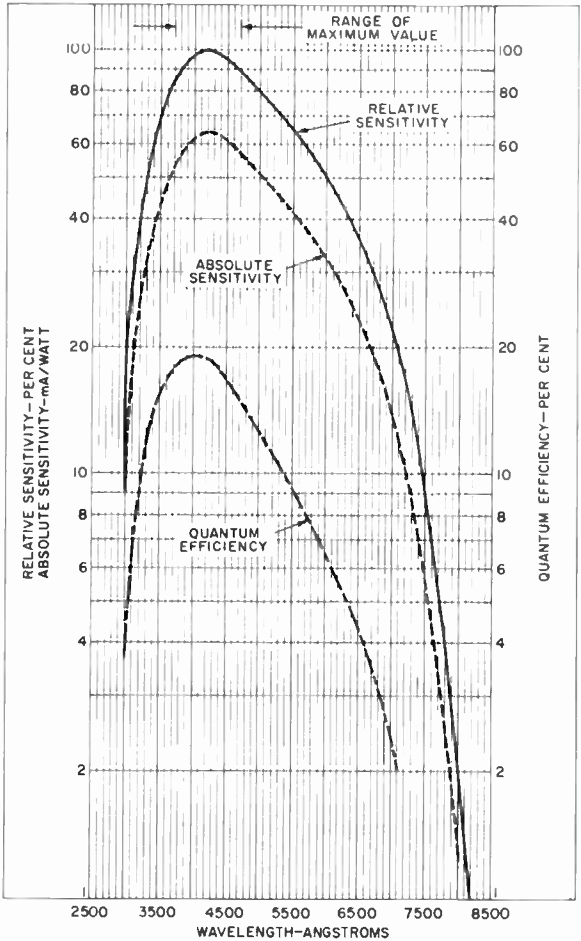
Pin 9: Dynode No.6
Pin 10: Dynode No.4
Pin 11: Dynode No.2
Pin 12: Photocathode

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

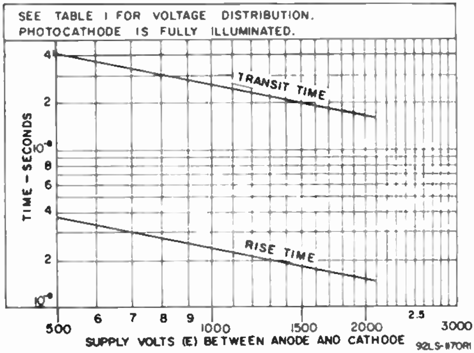


SPECTRAL RESPONSE CHARACTERISTICS

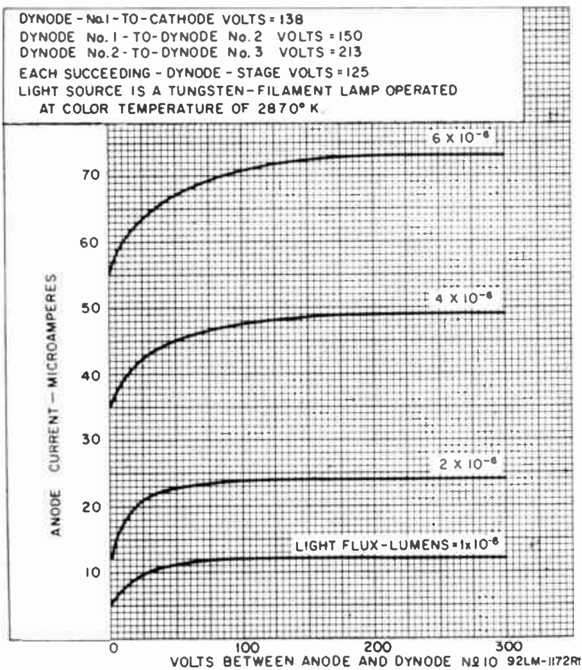


92LM-1169

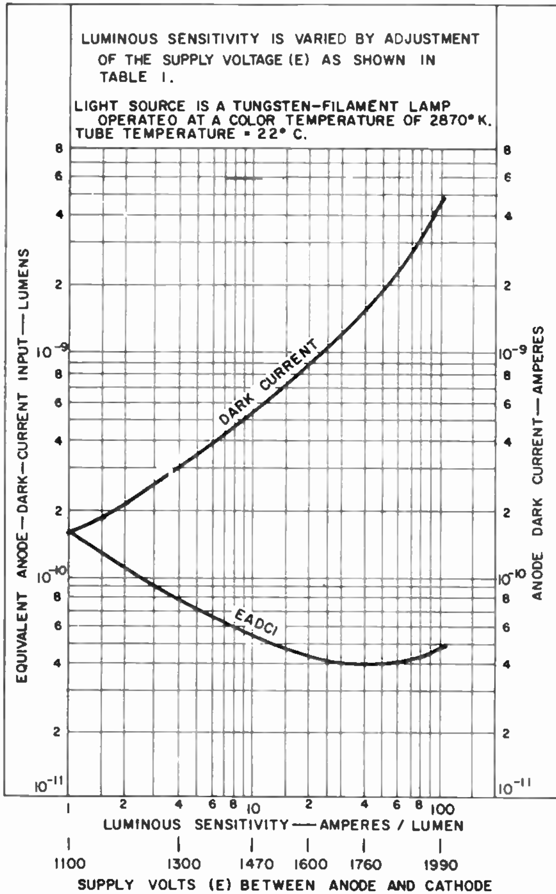
TYPICAL TIME-RESOLUTION CHARACTERISTICS



AVERAGE ANODE CHARACTERISTICS FOR TYPE 8644

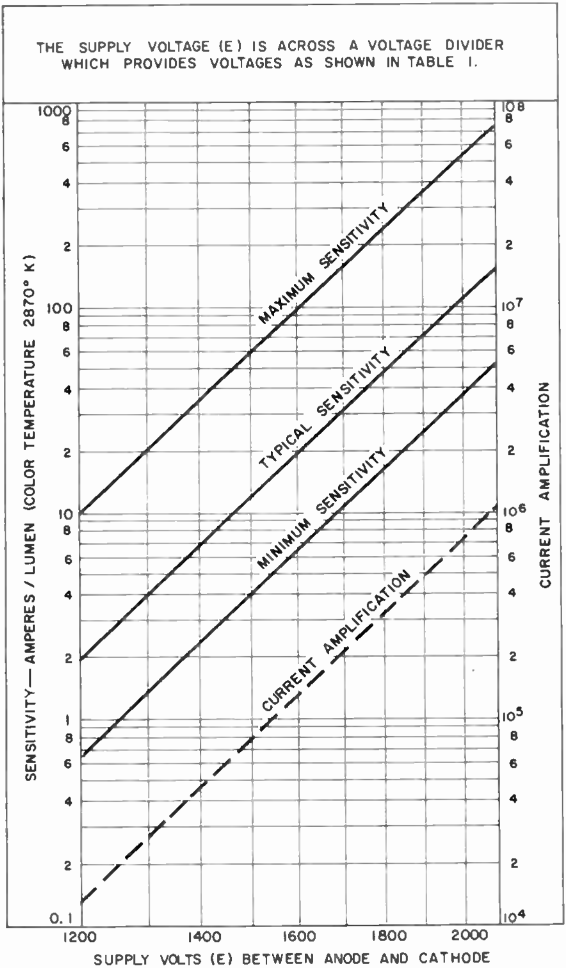


TYPICAL DARK CURRENT AND EADCI CHARACTERISTICS



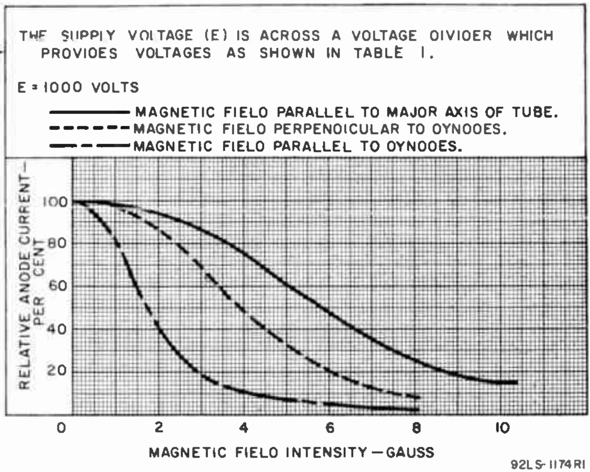
92LM-1173R1

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

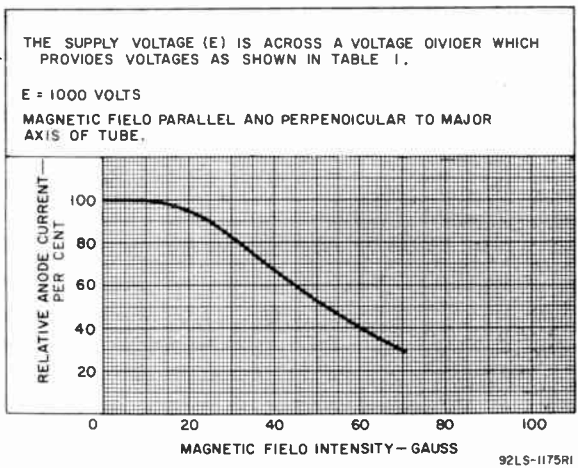


92LM-1171R1

TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT FOR TYPE 8644

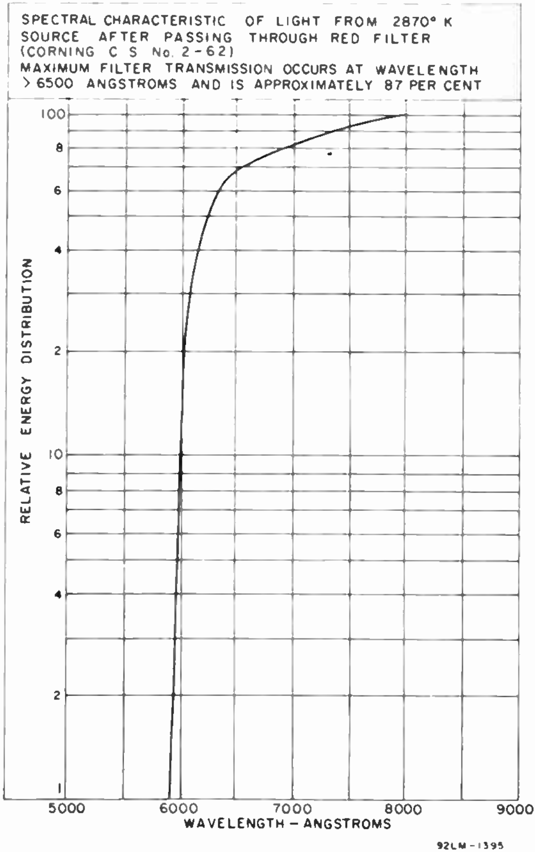


TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT FOR TYPE 8645



→ 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

	Min.	Typical	Max.	
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^{o} 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^{o} 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^{o} 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.

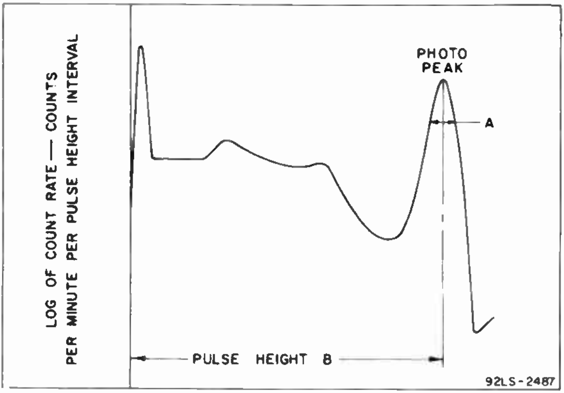
s At 4000 angstroms. This value is calculated from the ENI value in lumens using a conversion factor of 1030 lumens per watt.

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 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).



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.

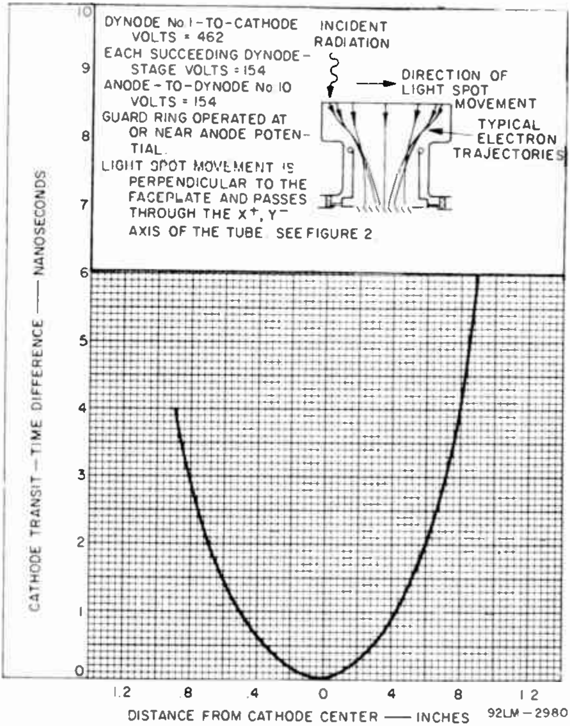
z Maximum deviation from linearity is 5 per cent.

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

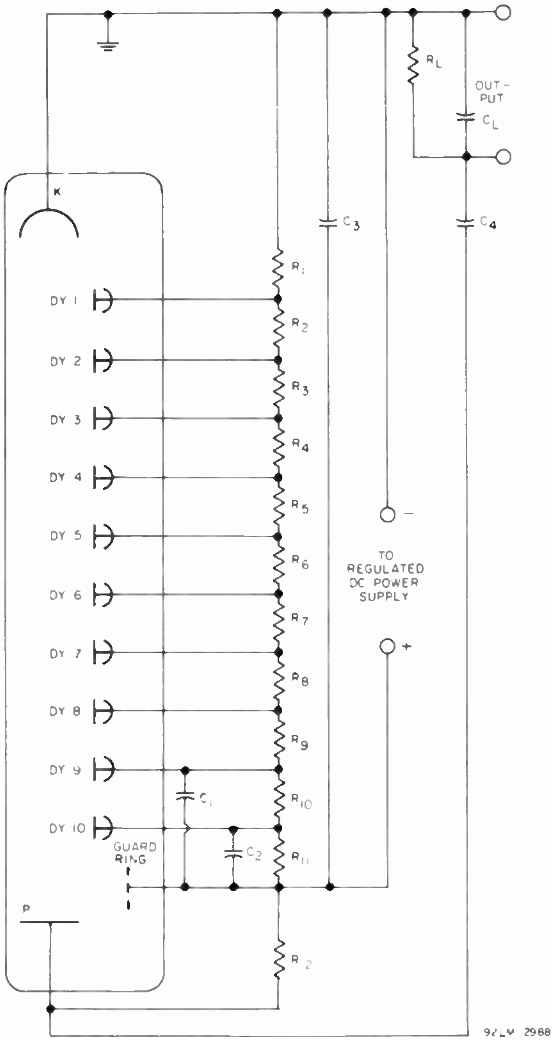
C_1: 0.005 μF, 20%, 1000 V dc, ceramic disc
C_2: 0.01 μF, 20%, 1000 V dc, ceramic disc
C_3, C_4: 0.01 μF, 20%, 3000 V dc, ceramic disc

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

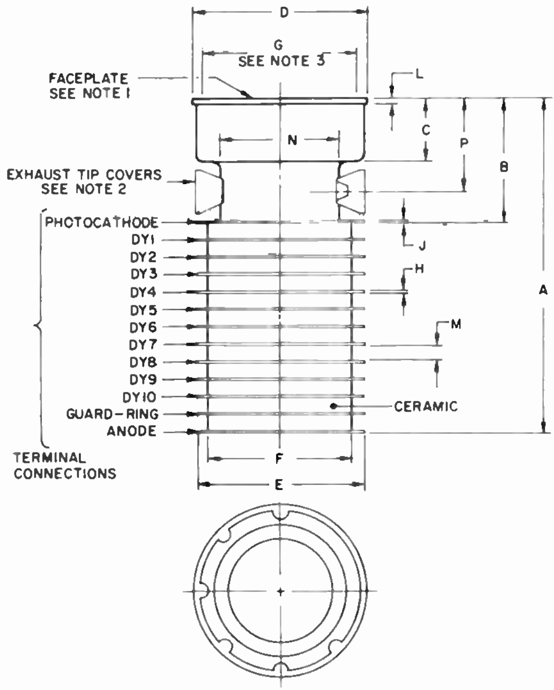
Note: The value of the load elements, R_L and C_L, depend on the application:

R_LC_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.

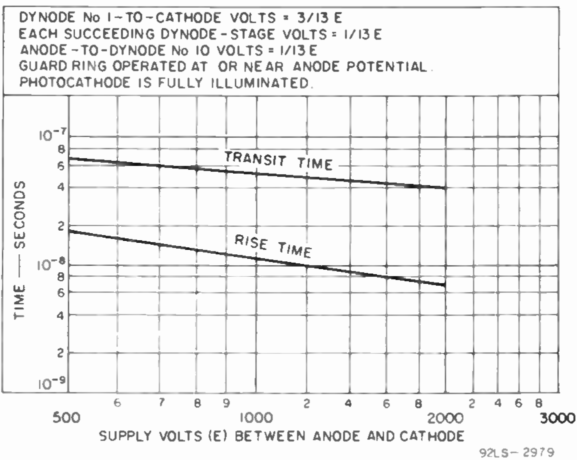
Note 2: The maximum dimension of both exhaust tip covers will not extend beyond the maximum diameter of the tube. Care should be exercised not to subject these covers to any stress or strain.

Note 3: Minimum useful photocathode diameter.

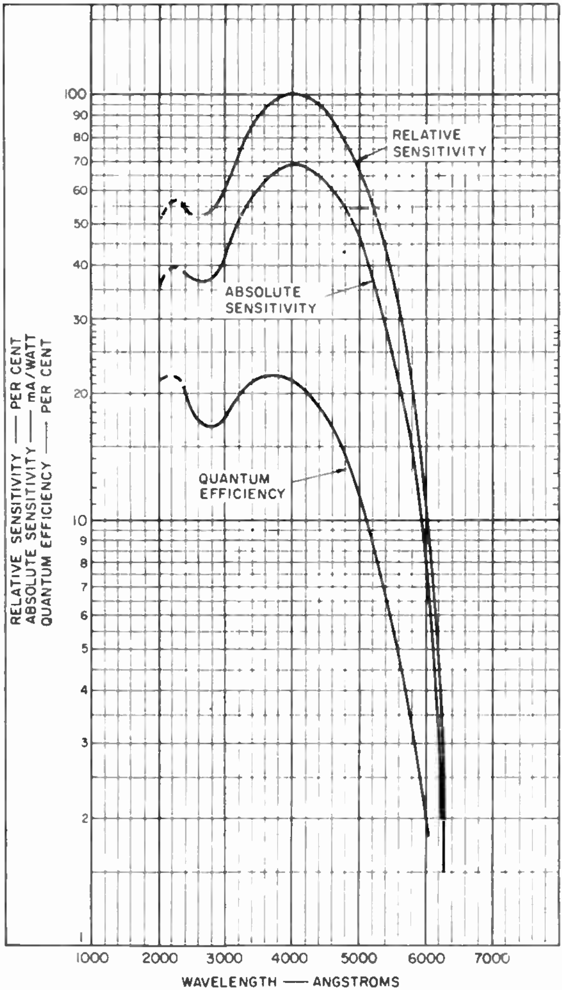
OUTLINE DIMENSIONS

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

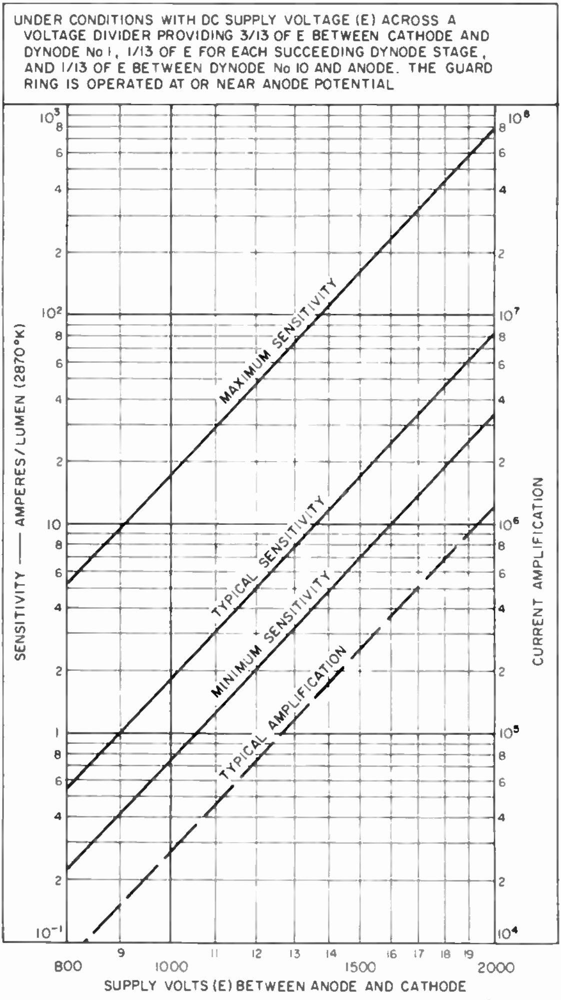


SPECTRAL RESPONSE CHARACTERISTICS



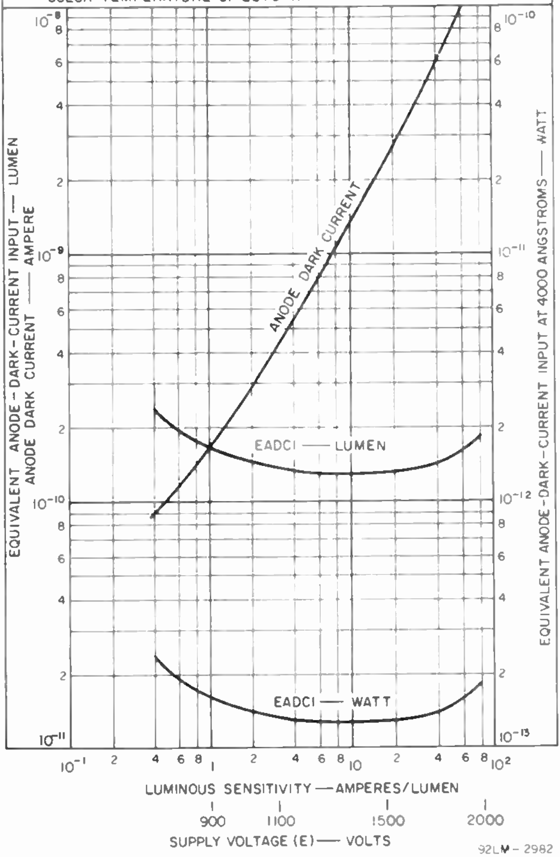
92LM-2975

TYPICAL SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

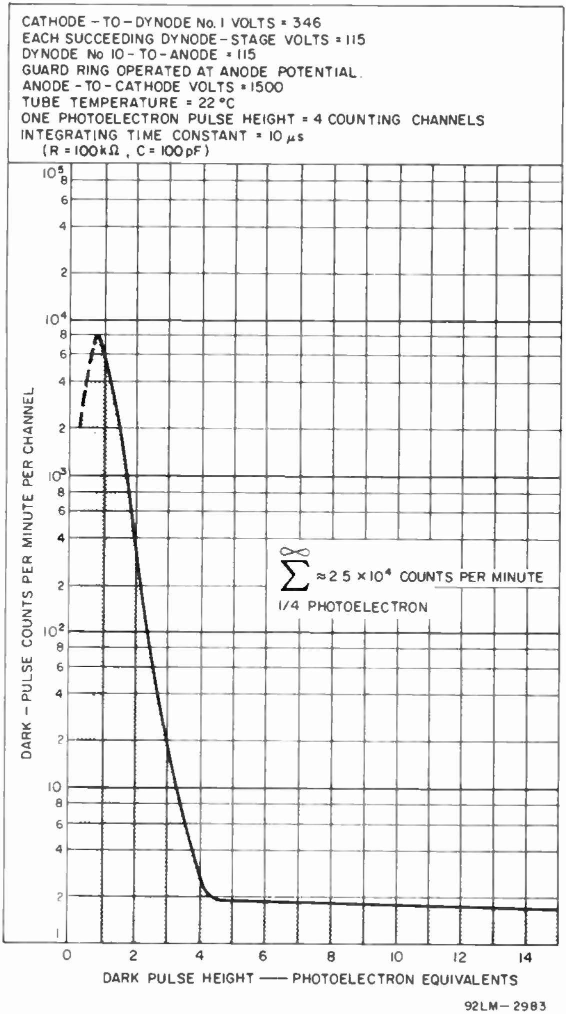


TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

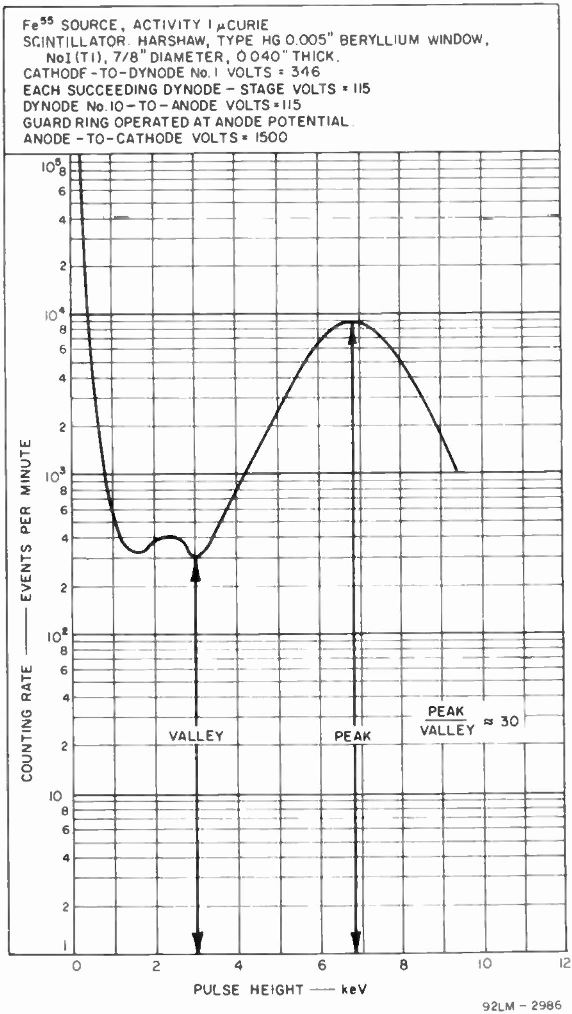
LUMINOUS SENSITIVITY IS VARIED BY ADJUSTING THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES 3/13 OF E BETWEEN CATHODE AND DYNODE No. 1, 1/13 OF E FOR EACH SUCCEEDING DYNODE STAGE; AND 1/13 OF E BETWEEN DYNODE No. 10 AND ANODE. THE GUARD RING IS OPERATED AT OR NEAR ANODE POTENTIAL.
TUBE TEMPERATURE = 22°C
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K



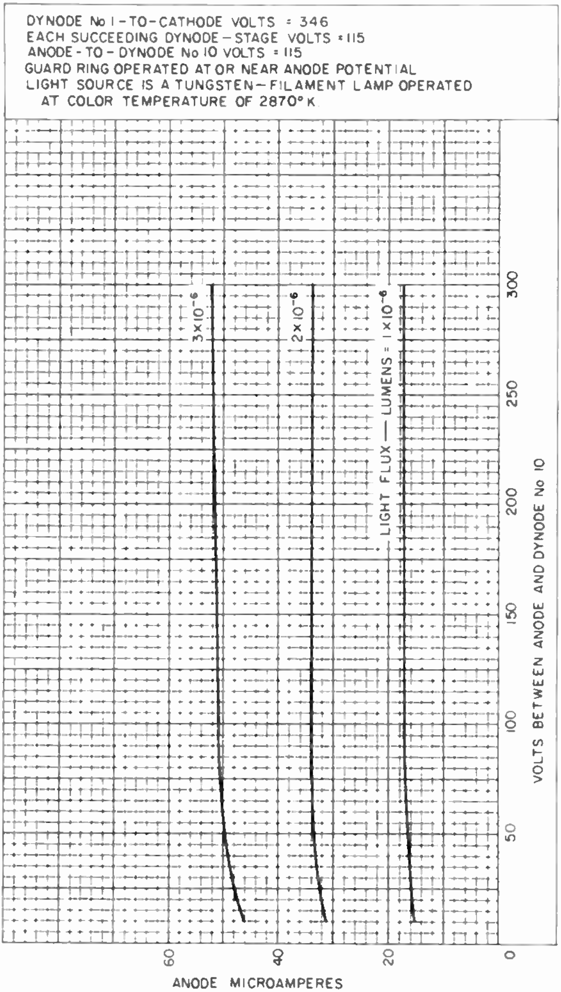
TYPICAL DARK PULSE SPECTRUM



DIFFERENTIAL Fe^{55} SPECTRUM



TYPICAL ANODE CHARACTERISTICS

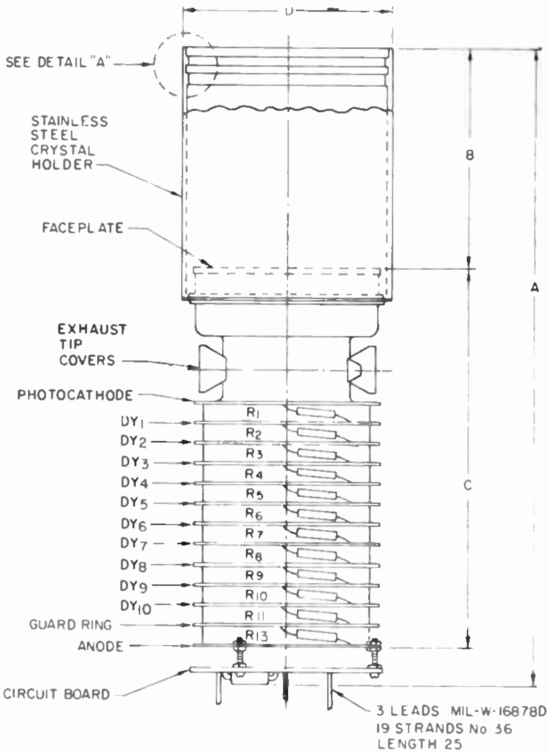


92LM-2987

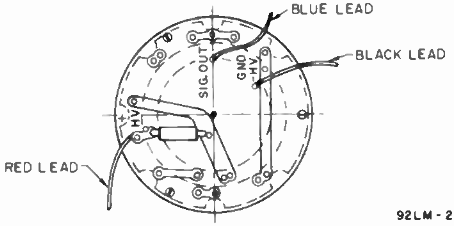
Photomultiplier Tube

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)

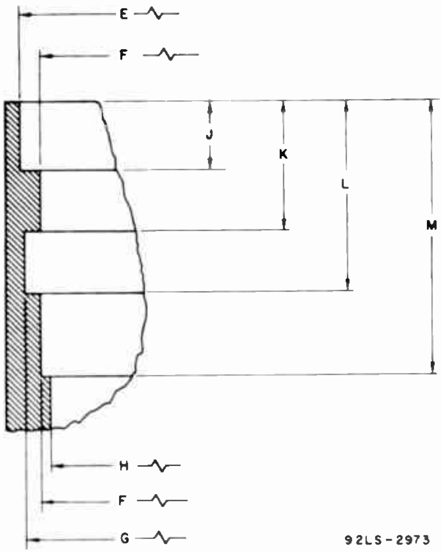


DIMENSIONAL OUTLINE (Bottom View)



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	$.406 \begin{smallmatrix} +.030 \\ -.000 \end{smallmatrix}$	$10.31 \begin{smallmatrix} +.76 \\ -.00 \end{smallmatrix}$

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

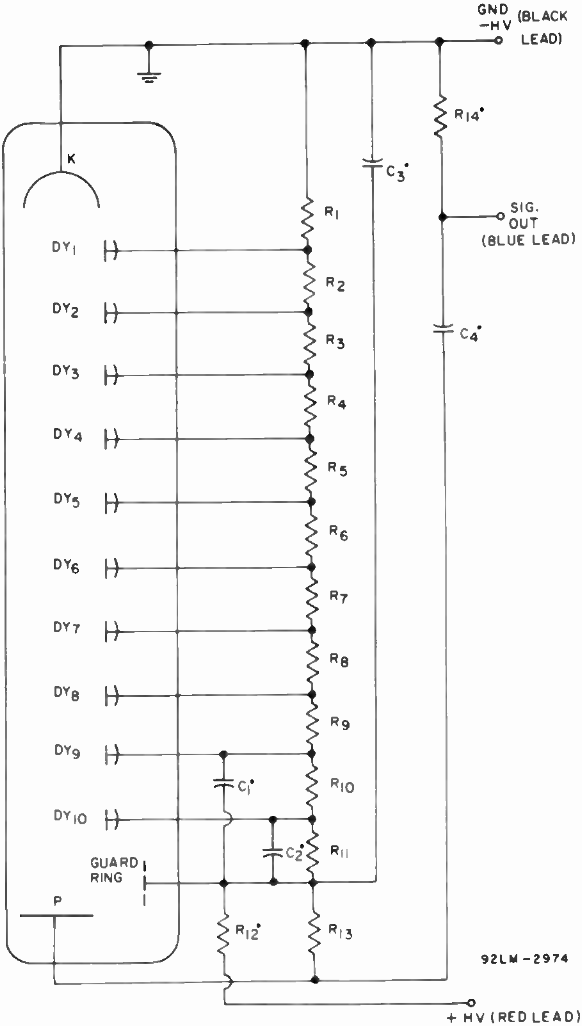


Image Orthicon

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

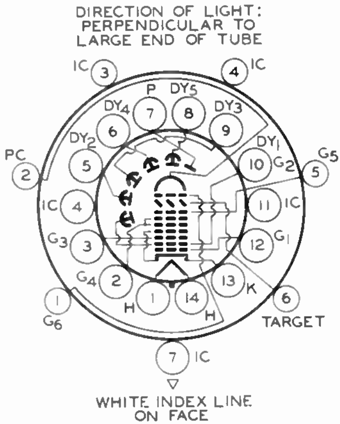
GENERAL

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 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 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 - [illegible]
Pin 2 - Photocathode
Pin 3 - [illegible]
Pin 4 - Do Not [illegible]
Pin 5 - Grid No.5
Pin 6 - [illegible]
Pin 7 - Do Not Use



End Base: Small-Shell Diheptal 14-Pin (JEDEC No.B14-45)

Pin 1 - Heater
Pin 2 - [illegible]
Pin 3 - Grid No.3
Pin 4 - [illegible]
Pin 5 - Dynode No.2
Pin 6 - Dynode No.4
Pin 7 - Anode
Pin 8 - Dynode No.[illegible]
Pin 9 - Dynode No.[illegible]
Pin 10 - Dynode No.[illegible]
Pin 11 - [illegible]
Pin 12 - Grid No.[illegible]
Pin 13 - Cathode [illegible]
Pin 14 - [illegible]

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		
[illegible] of bulb	50	°C
Of bulb at large end of [illegible]	35 min	°C
Temperature Difference	5	°C
Between [illegible]		
Grid-No.6 Voltage	-550	V

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°K Required to Reach "Knee" of Light-Transfer Characteristic.	-	-	0.035	fc(lm/ft²)
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 corresponding 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°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.

[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

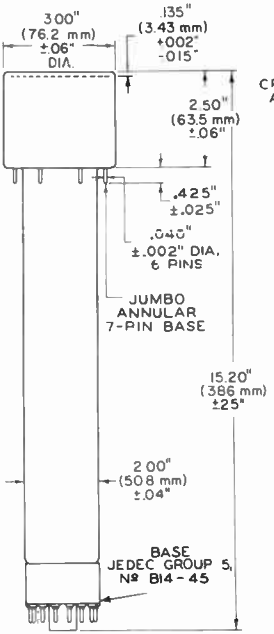
Dos

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.

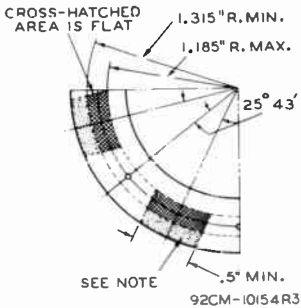
Don'ts

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.

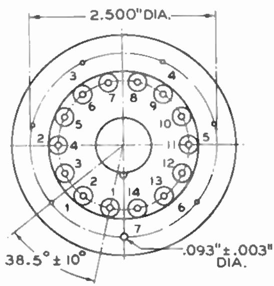
DIMENSIONAL OUTLINE



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.



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 flat-plate gauge with:

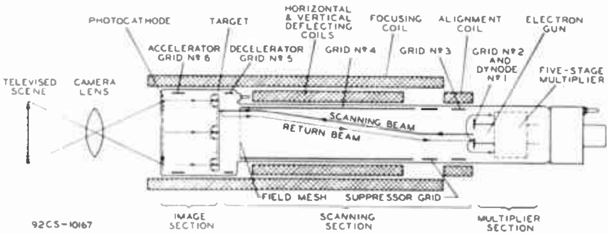
a. Six holes having diameter of 0.065 ± 0.001 inch and one hole having diameter of 0.150 ± 0.001 inch. All holes have depth of 0.265 inch ± 0.001 inch. The six 0.065 inch holes are enlarged by 45° taper to depth of 0.047 inch. All holes are spaced at angles of 51° 26' ± 5' on circle diameter of 2.500 ± 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.

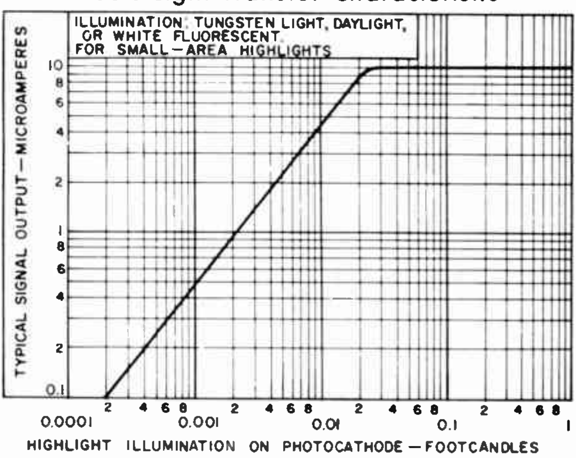
c. Rim extending out a minimum of 0.125 inch from 2.812 inch diameter and having height of 0.126 ± 0.001 inch.

d. Neck-cylinder clearance hole having diameter of 2.200 ± 0.001 inches.

SCHEMATIC ARRANGEMENT OF TYPE 8673

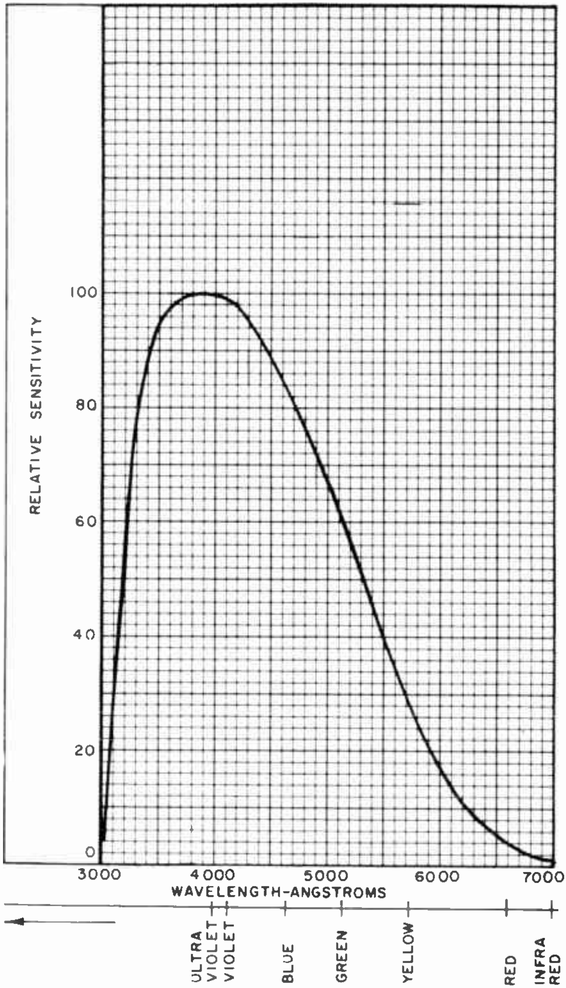


Basic Light Transfer Characteristic



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

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

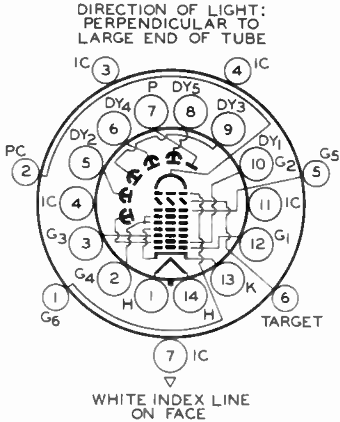
The 8674 is designed to replace types 5515, 5516, 7293, 7293A, and 7293A/L.

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 [illegible]):[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 9 - Dynode No.3
Pin 2 - Grid No.4 & Field Mesh	Pin 10 - Dynode No.1, Grid No.2
Pin 3 - Grid No.3	Pin 11 - Do Not Use
Pin 4 - Do Not Use	Pin 12 - Grid No.1
Pin 5 - Dynode No.2	Pin 13 - Cathode & Suppressor Grid
Pin 6 - Dynode No.4	Pin 14 - Heater
Pin 7 - Anode	
Pin 8 - Dynode No.5	

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/ft^2)
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 (Corner-to-Axial) 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 1×10^{-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.

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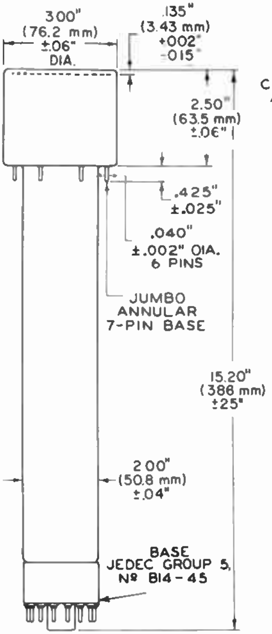
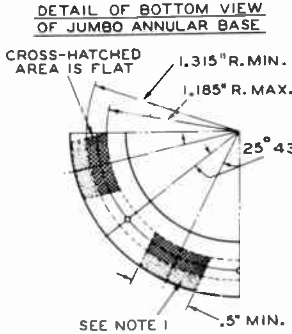
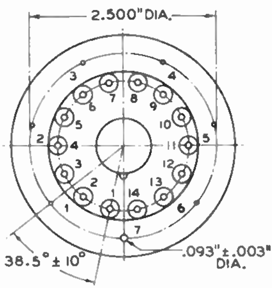
6. Don't remove the lens turret or lens when the camera is turned on, or when voltages are applied to the image section of the 8674, unless the light level incident on the tube can be reduced below 50 footcandles.





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 0.130 ± 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.

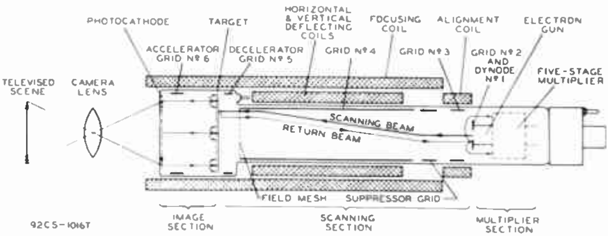
b. Seven stops having height of 0.187 ± 0.001 inch, centered between pin holes, to bear against flat areas of base.

c. Rim extending out a minimum of 0.125 inch from 2.812 inch diameter and having height of 0.126 ± 0.001 inch.

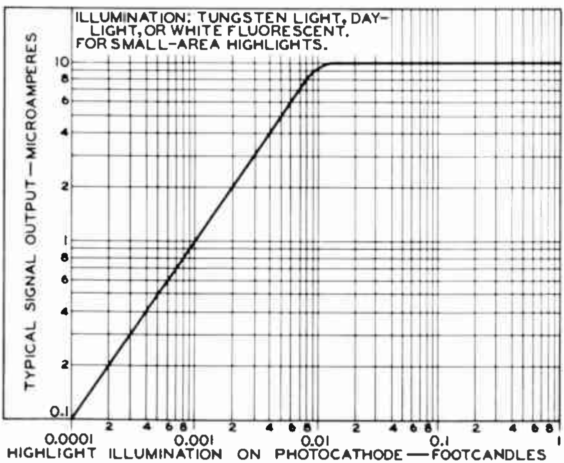
d. Neck-cylinder clearance hole having diameter of 2.200 ± 0.001 inches.

92CM-10154R3

SCHEMATIC ARRANGEMENT OF TYPE 8674



Basic Light Transfer Characteristic



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Typical Spectral Sensitivity Characteristic

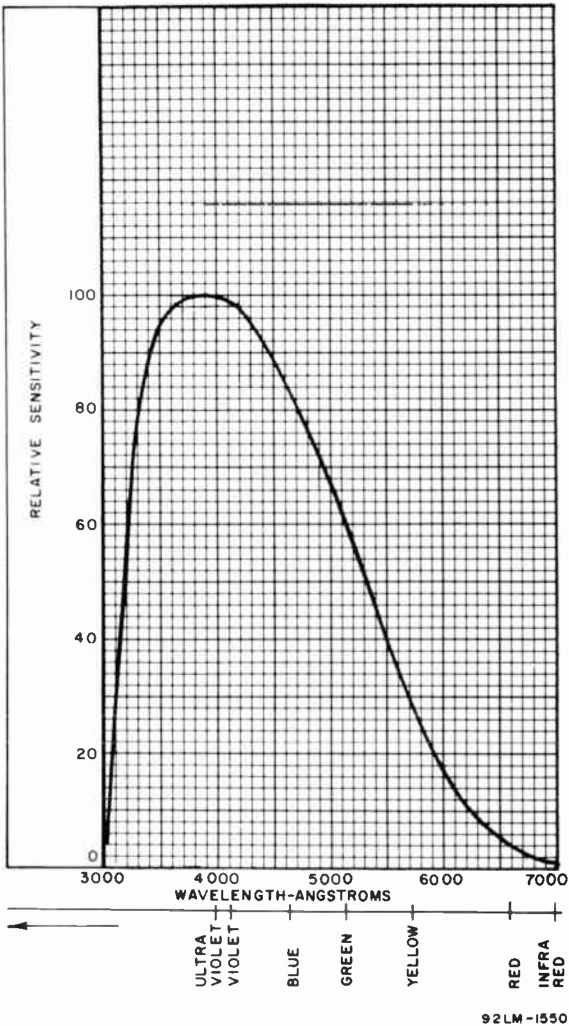

Image Orthicon

"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

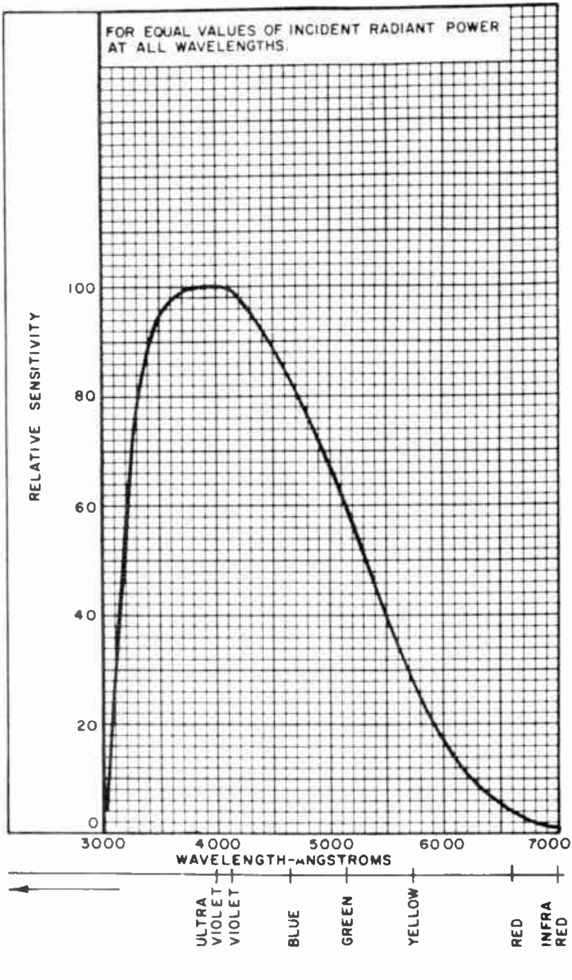

Image Orthicon

"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

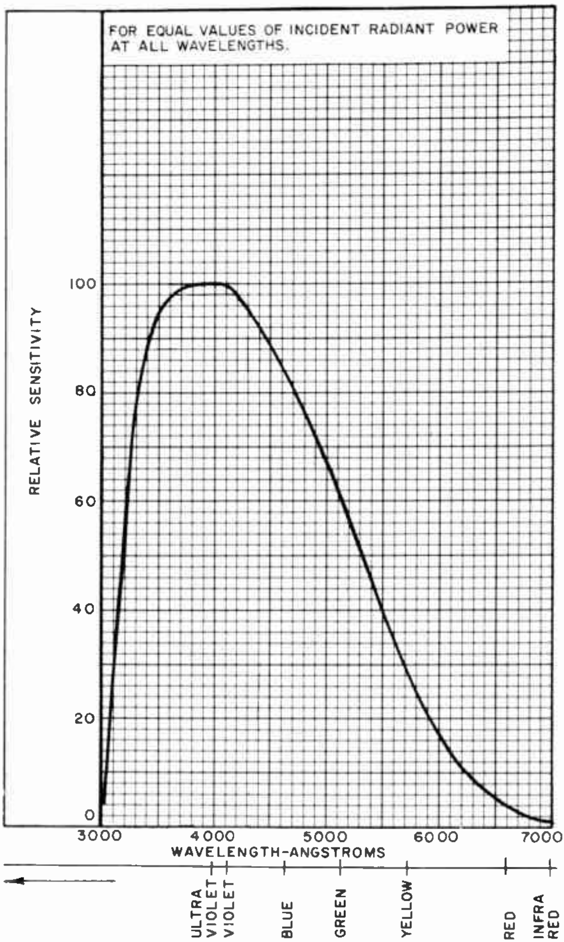

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Image Orthicon

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-cutoff. 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"

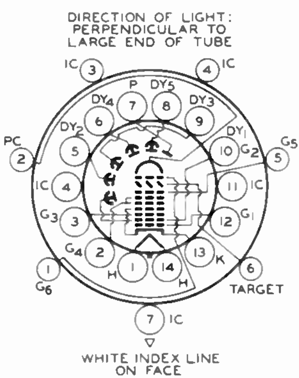
1. Allow the 8775 to warm up prior to operation.
2. Hold temperature of the 8775 within operating range.
3. Make sure alignment coil is properly adjusted.
4. Adjust beam-focus control for best usable resolution.
5. Select target voltage according to operating needs. This freedom of operation results 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:

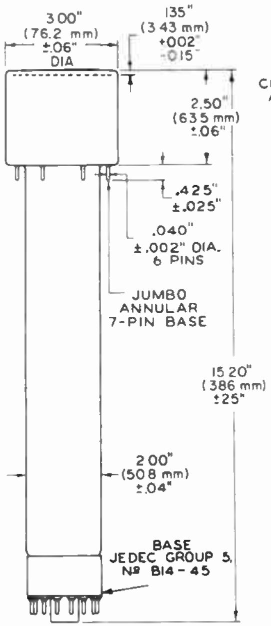
a. Six holes having diameter of 0.065" ± 0.001" and one hole having diameter of 0.150" ± 0.001". All holes have depth of 0.265" ± 0.001". The six 0.065" holes are enlarged by 45° taper to depth of 0.047". All holes are spaced at angles of 51°26' ± 5' on circle diameter of 2.500" ± 0.001).

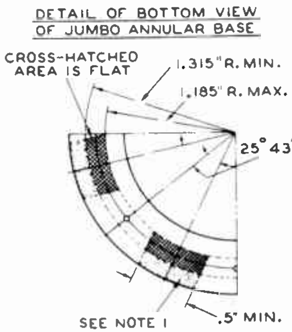
b. Seven stops having height of 0.187" ± 0.001", centered between pin holes, to bear against flat areas of base.

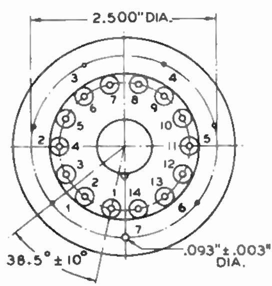
c. Rim extending out a minimum of 0.125" from 2.812" diameter and having height of 0.126" ± 0.001".

d. Neck-cylinder clearance hole having diameter of 2.200" ± 0.001".

DIMENSIONAL OUTLINE





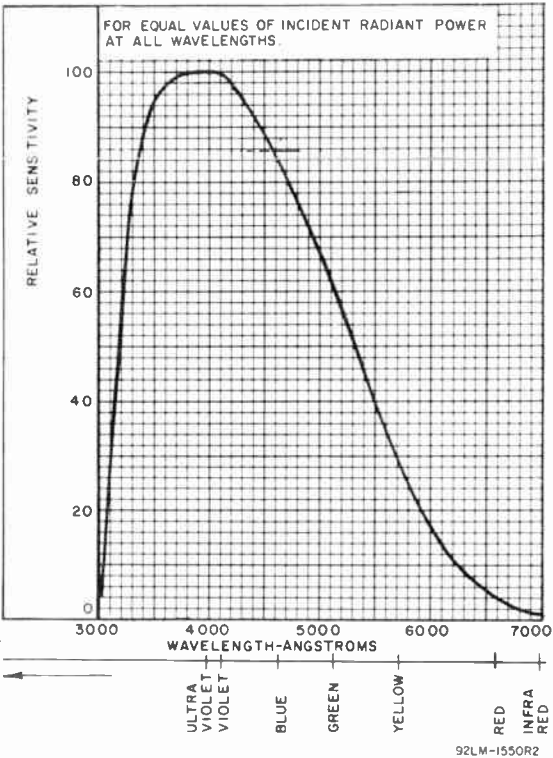


ENLARGED BOTTOM VIEW

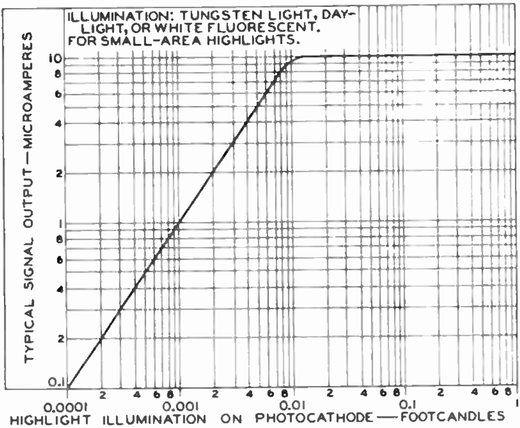
92CM-10154R3

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



92CS-7296R2

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		$^{\circ}C$

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[t]	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

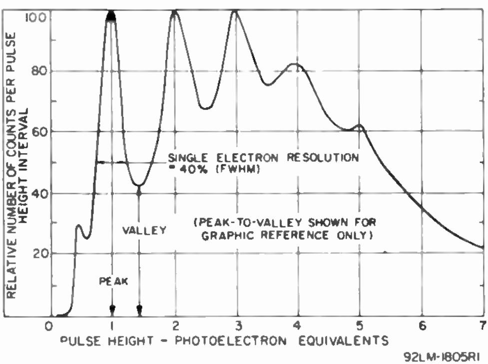
Table I		
Voltage Distribution		
Between the following Electrodes: Cathode (K), Dynode (Dy), and Anode (P)	Column A 8.06% of Dy1-P Voltage (E) Multiplied By:	Column B• 5.45% of K-P Voltage (E) Multiplied By:
K - Dy1	♠	6
Dy1 - Dy2	1	1
Dy2 - Dy3	1.4	1.4
Dy3 - Dy4	1	1
Dy4 - Dy5	1	1
Dy5 - Dy6	1	1
Dy6 - Dy7	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 ± 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.

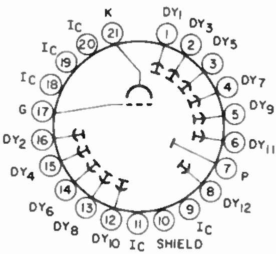
[bb] Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is primarily a function of transit time variation and is measured under conditions with the incident light fully illuminating the photocathode.

[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.

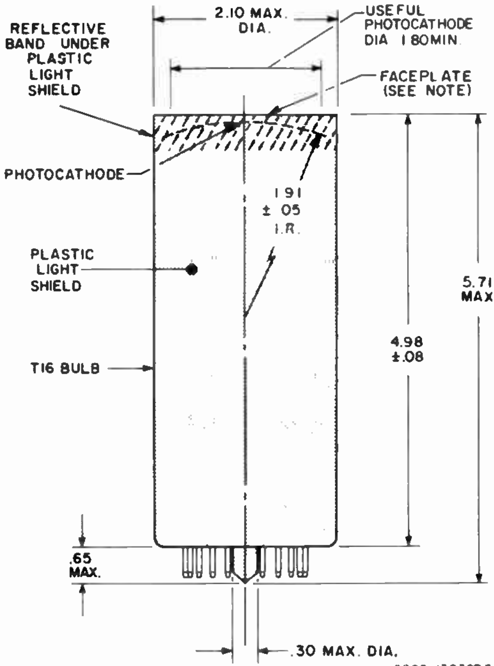
TERMINAL DIAGRAM
(Bottom View)



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



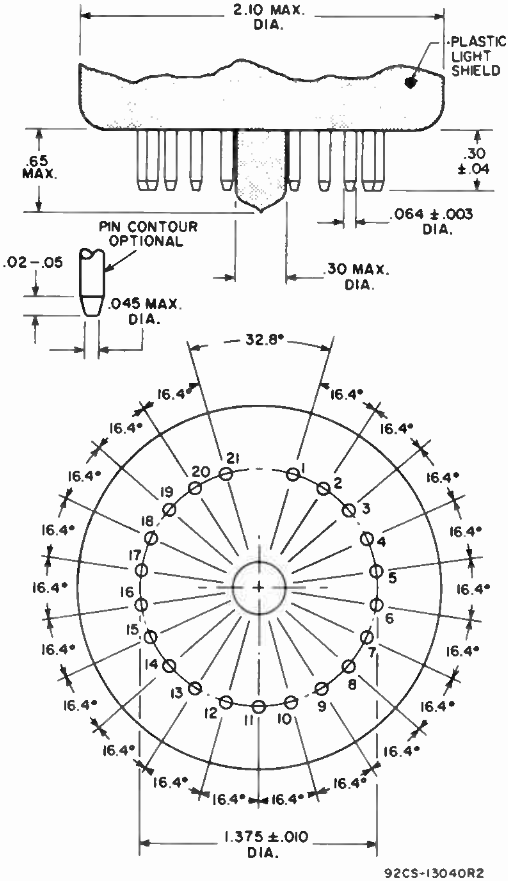
Dimensions in Inches

Note: Deviation from Flatness of External Surface of Faceplate will not exceed 0.010" from Peak to Valley.

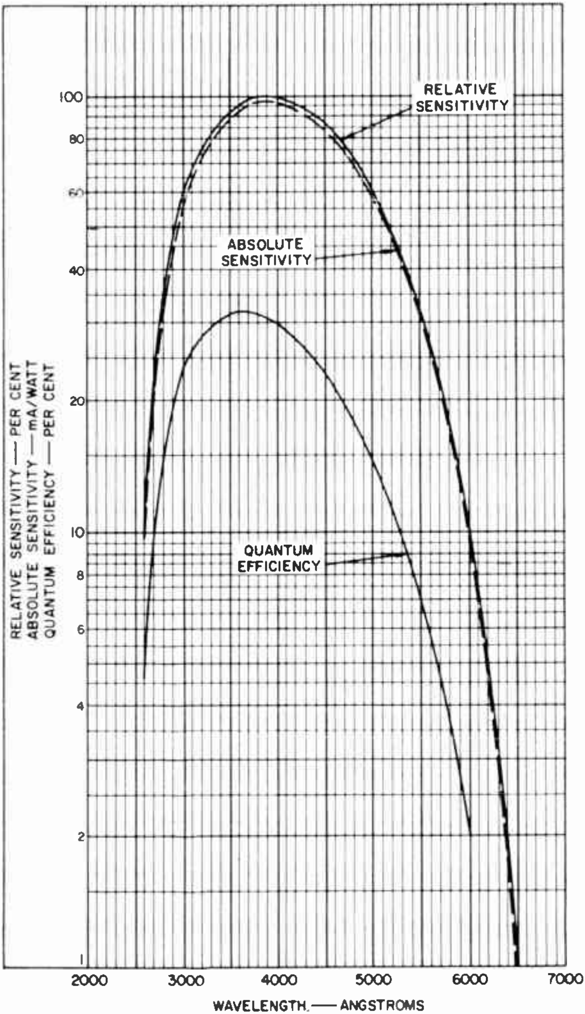
The dimensions in millimeters are derived from the basic inch dimensions (1 inch = 25.4 mm)

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



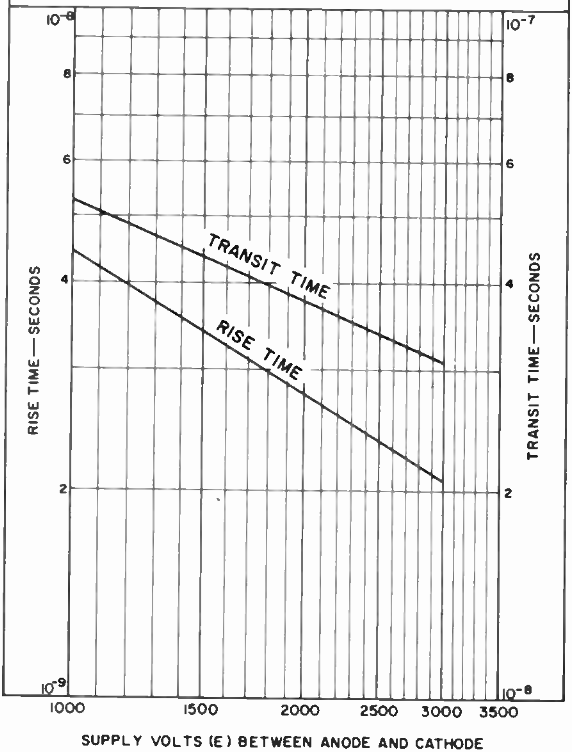
SPECTRAL RESPONSE CHARACTERISTICS



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.

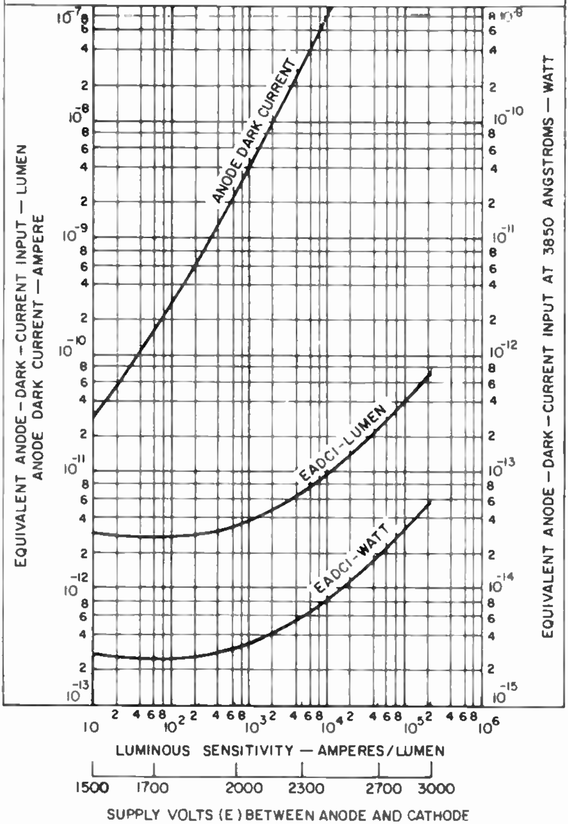


92CM-13042

TYPICAL ANODE DARK CURRENT AND EADCI CHARACTERISTICS

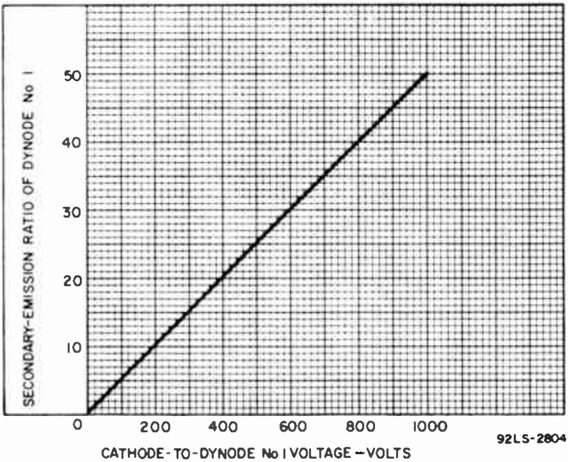
SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E) ACROSS A VOLTAGE DIVIDER WHICH PROVIDES VOLTAGE DISTRIBUTION OF COLUMN A, TABLE I.

ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
FOCUSING-ELECTRODE VOLTAGE IS ADJUSTED FOR MAXIMUM ANODE CURRENT.
LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT A COLOR TEMPERATURE OF 2870°K.
TUBE TEMPERATURE = 22° C.

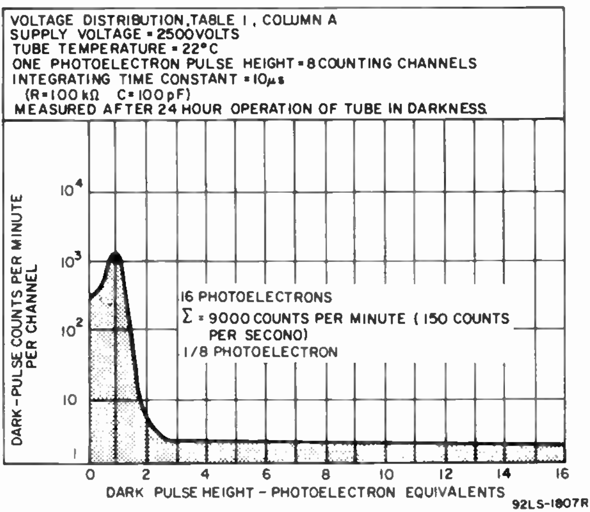


92LM-2811R1

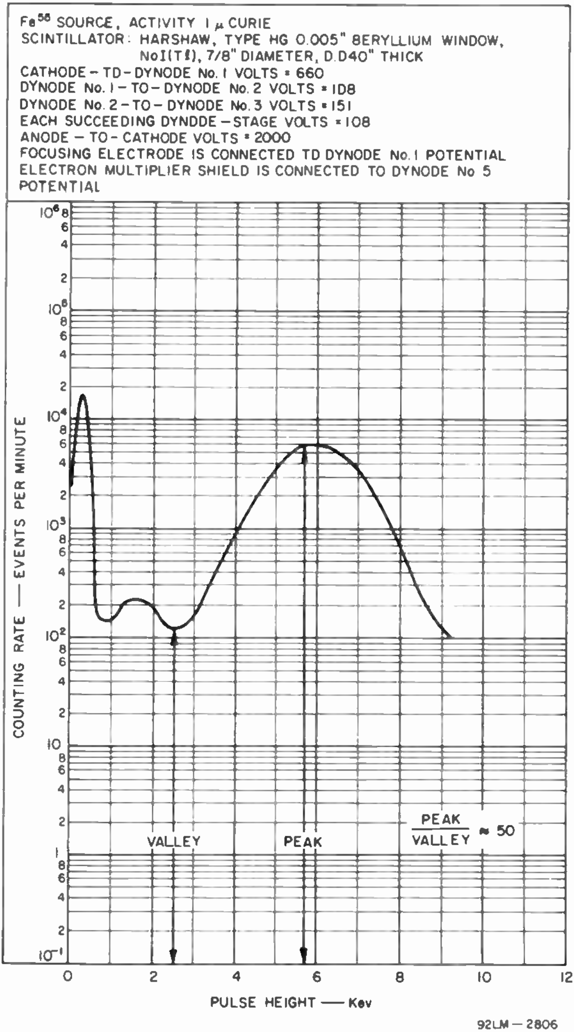
TYPICAL SECONDARY-EMISSION RATIO OF FIRST DYNODE AS A FUNCTION OF CATHODE-TO-DYNODE NO. 1 VOLTAGE



TYPICAL DARK-PULSE SPECTRUM



DIFFERENTIAL Fe^{55} SPECTRUM

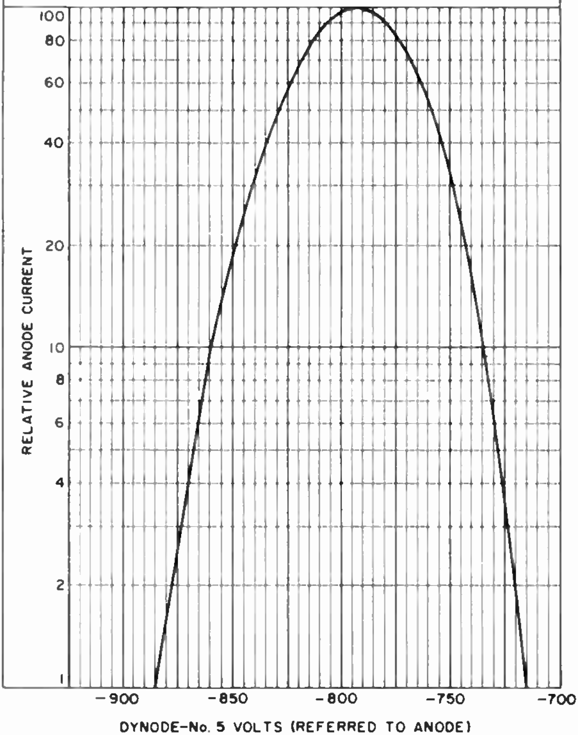


TYPICAL DYNODE MODULATION CHARACTERISTIC

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

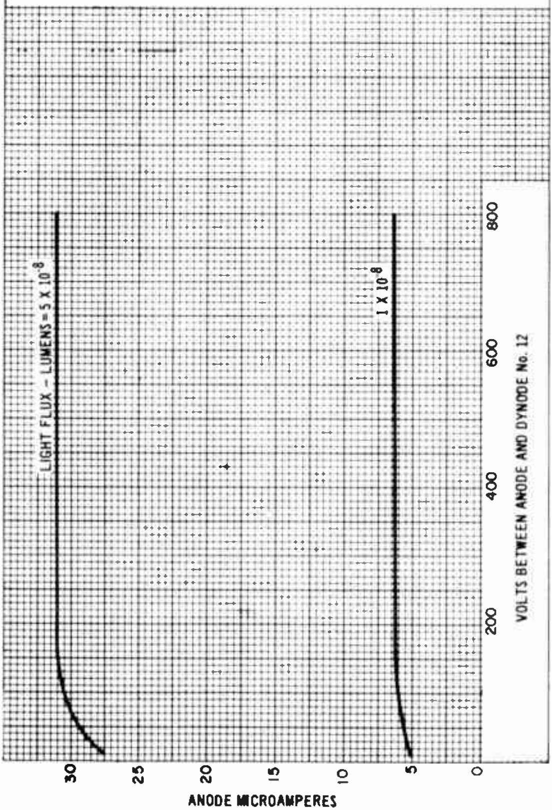
FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No. 1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No. 5 POTENTIAL.
CATHODE IS AT GROUND POTENTIAL.



92CM-13044

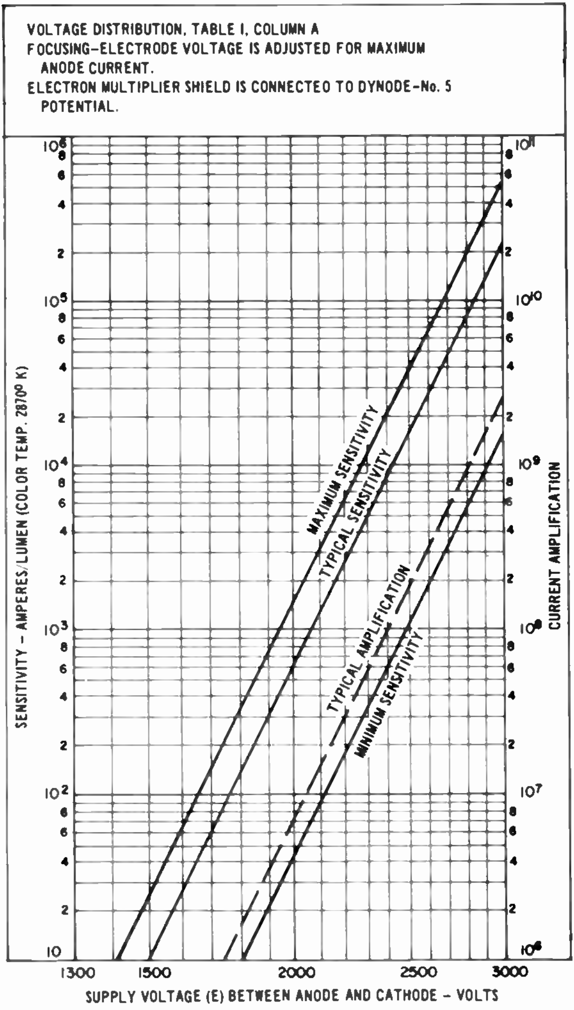
TYPICAL ANODE CHARACTERISTICS

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

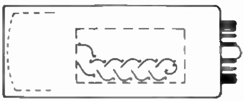


TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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

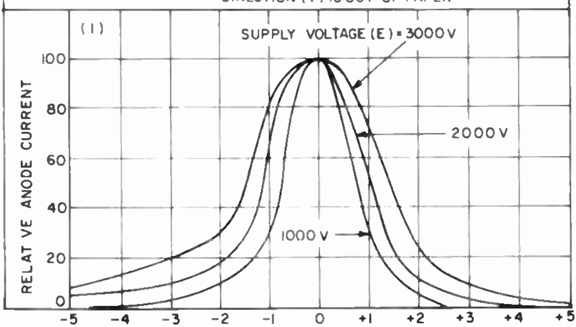
BETWEEN:	6.1% OF E MULTIPLIED BY
CATHODE AND DYNODE No.1	4.0
DYNODE No.1 AND DYNODE No.2	1.0
DYNODE No.2 AND DYNODE No.3	1.4
EACH SUCCEEDING DYNODE STAGE	1.0
ANODE AND CATHODE	16.4

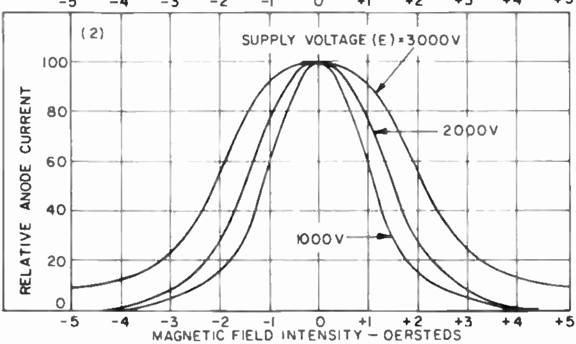
FOCUSING ELECTRODE IS CONNECTED TO DYNODE-No.1 POTENTIAL.
ELECTRON MULTIPLIER SHIELD IS CONNECTED TO DYNODE-No.5 POTENTIAL.
PHOTOCATHODE IS FULLY ILLUMINATED.



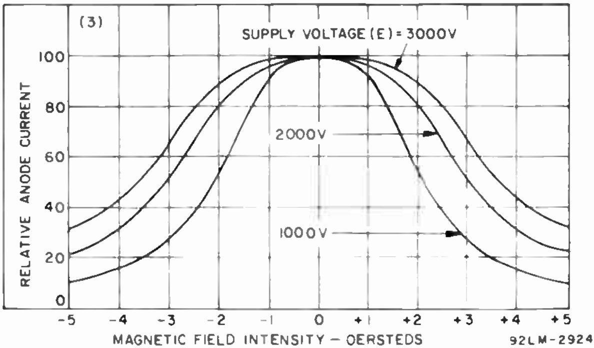
POSITIVE VALUE OF H IN DIRECTION SHOWN: (1)* •, (2) ↑ OR (3) →

* DIRECTION (1) IS OUT OF PAPER

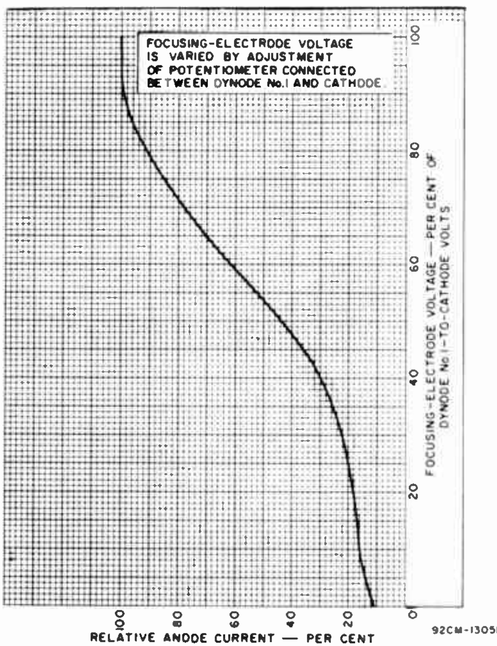




TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT (Cont'd)



TYPICAL FOCUSING-ELECTRODE CHARACTERISTIC



Photomultiplier Tube

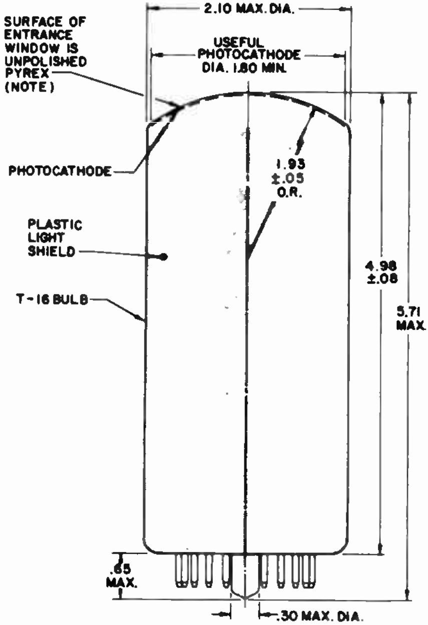
2"-Diameter Type

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

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.

	8858 Min.	8858 Typ.	8858 Max.	8857/V1 Min.	8857/V1 Typ.	8857/V1 Max.	8857/V2 Min.	8857/V2 Typ.	8857/V2 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			
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Units
Photocathode Sensitivity:										
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

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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.

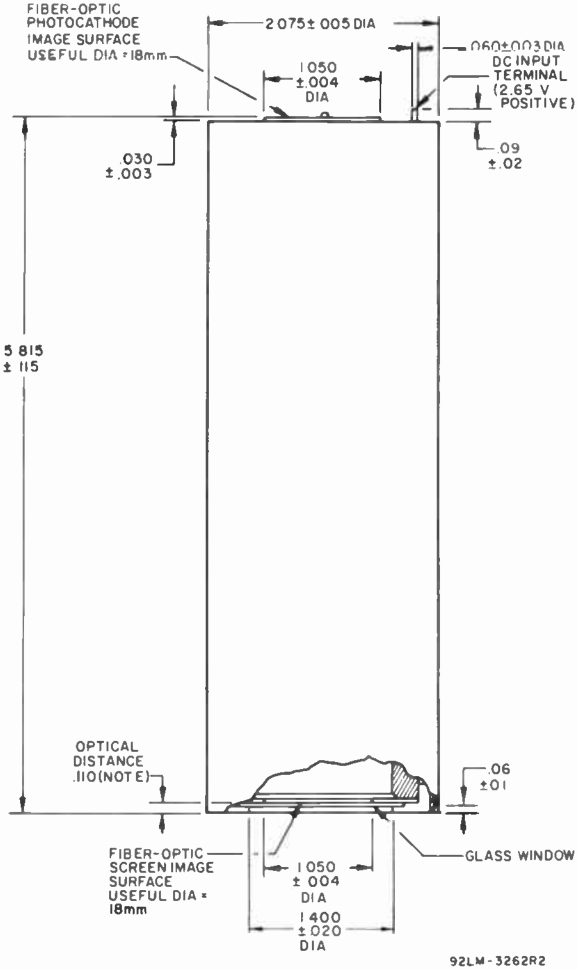
u The center of an image produced on the screen by focusing a test pattern on the optical axis of the photocathode will fall with in a circle concentric with the optical axis of the screen having the specified diameter.

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.

$$\text{Per-Cent Distortion} = \frac{\text{Emx-Cmx}}{\text{Cmx}} \times 100$$

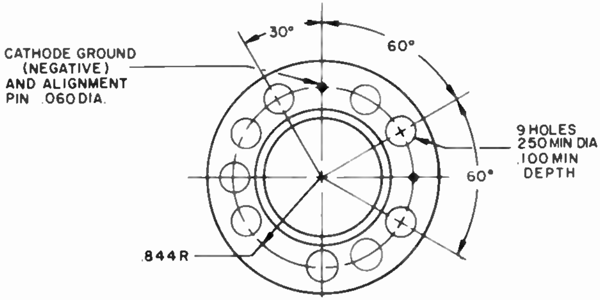
DIMENSIONAL OUTLINE FOR TYPE 8858



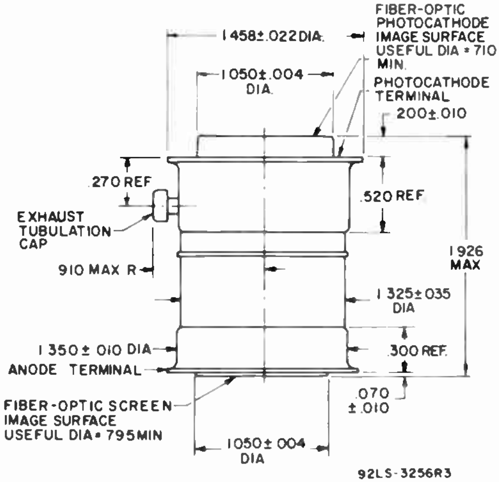
Note: This distance is measured with a depth microscope.

Dimensions in Inches

DIMENSIONAL OUTLINE FOR TYPE 8858

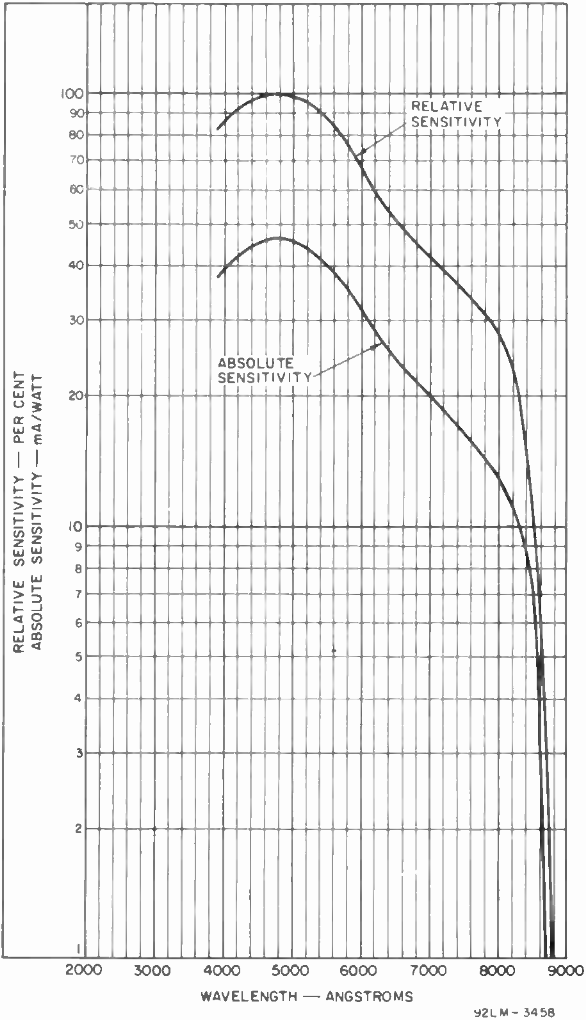


DIMENSIONAL OUTLINE FOR TYPES 8857/V1, 8857/V2

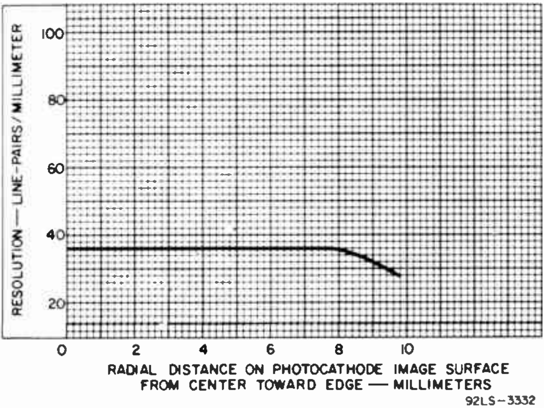


Dimensions in Inches

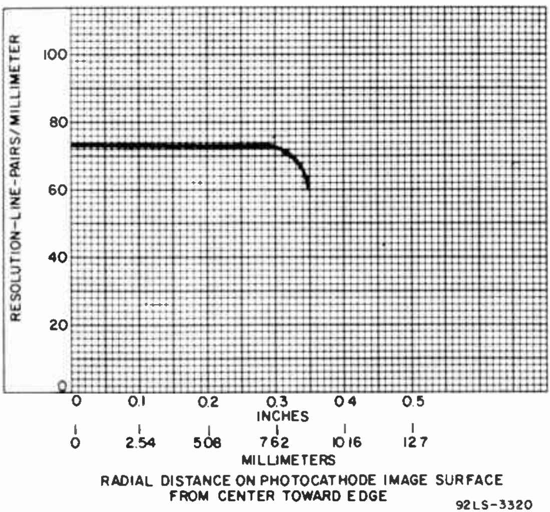
TYPICAL SPECTRAL RESPONSE CHARACTERISTICS
FOR ALL TYPES



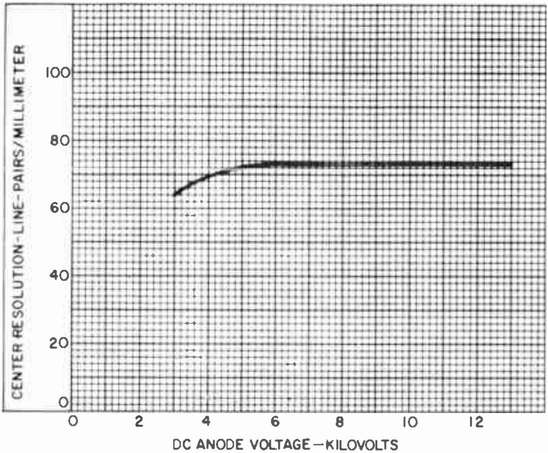
TYPICAL RESOLUTION AS A FUNCTION OF RADIAL DISTANCE ON PHOTOCATHODE FOR TYPE 8858



TYPICAL RESOLUTION AS A FUNCTION OF RADIAL DISTANCE ON PHOTOCATHODE FOR TYPES 8857/V1, 8857/V2

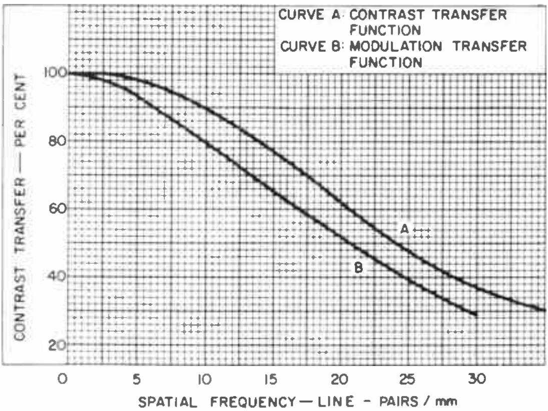


TYPICAL RESOLUTION AS A FUNCTION OF ANODE VOLTAGE FOR TYPES 8857/V1, 8857/V2



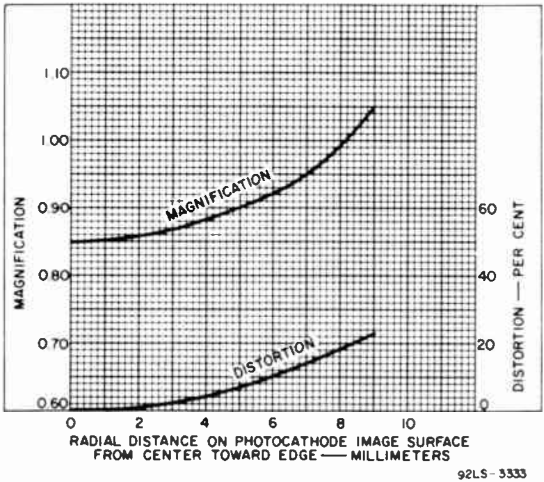
92LS-3319

TYPICAL MODULATION TRANSFER FUNCTION AND CONTRAST TRANSFER CHARACTERISTICS FOR TYPES 8857/V1, 8857/V2

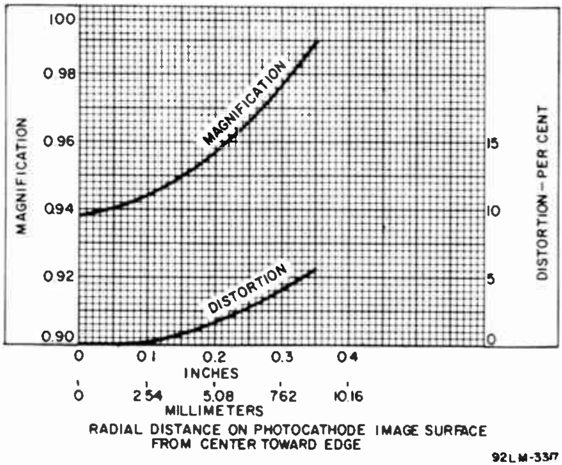


92LS-3264R1

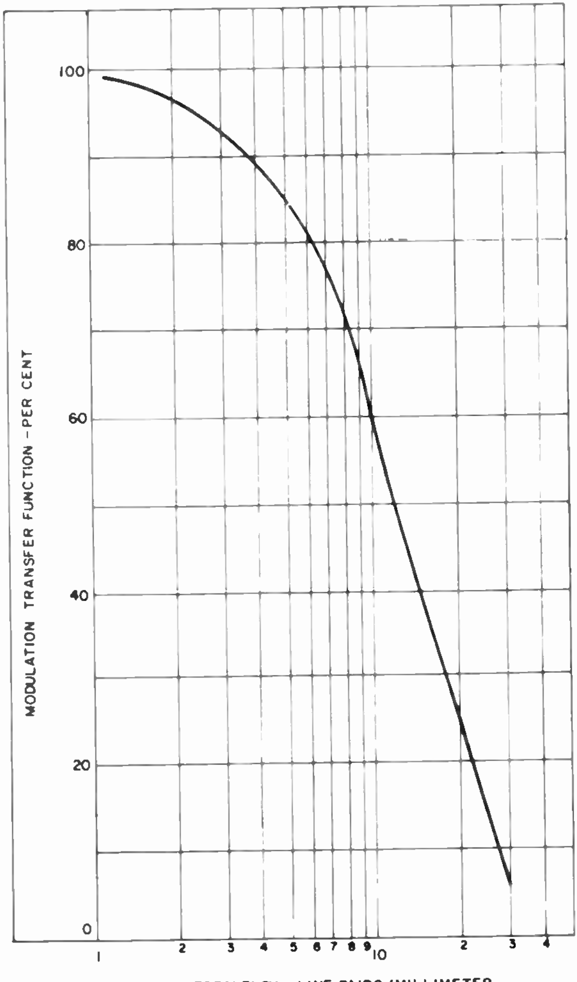
TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPE 8858



TYPICAL MAGNIFICATION AND DISTORTION CHARACTERISTICS FOR TYPES 8857/V1, 8857/V2

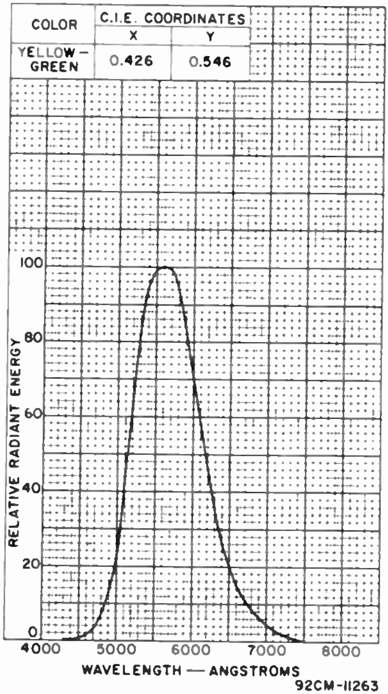


TYPICAL MODULATION TRANSFER FUNCTION FOR TYPE 8858



JEDEC PHOSPHOR P20 FOR ALL TYPES

COLOR	C.I.E. COORDINATES	
	X	Y
YELLOW-GREEN	0.426	0.546



RELATIVE LIGHT OUTPUT CHARACTERISTIC FOR TYPES 8857/V1, 8857/V2