

Multiplier Phototube

S-20 RESPONSE

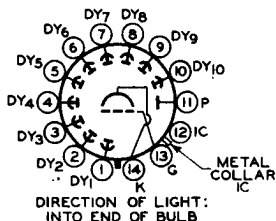
10-STAGE, HEAD-ON,
FLAT-FACEPLATE TYPEVENETIAN-BLIND-TYPE
DYNODE STRUCTURE

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



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 Roman Avenue, Chicago 24, Illinois.

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

^d Averaged over any interval of 30 seconds maximum.

^e Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870° K and a light input of 1 microlumen is used.

^f Under the following conditions: The light source is a tungsten-filament lamp having a lime-glass envelope. It is operated at a color temperature of 2870° K. The value of light flux is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

^g Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning[®] C.S. No.5-58 polished to 1/2 stock thickness—manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

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

^j Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No.2-62, manufactured by the Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2870° K. The value of light flux incident on the filter is 0.01 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.

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

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

ⁿ Measured between 10 per cent and 90 per cent of maximum anode-pulse height. This anode-pulse rise time is primarily a function of transit-time variation and is measured under conditions with the incident light fully illuminating the photocathode.

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

OPERATING CONSIDERATIONS

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

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

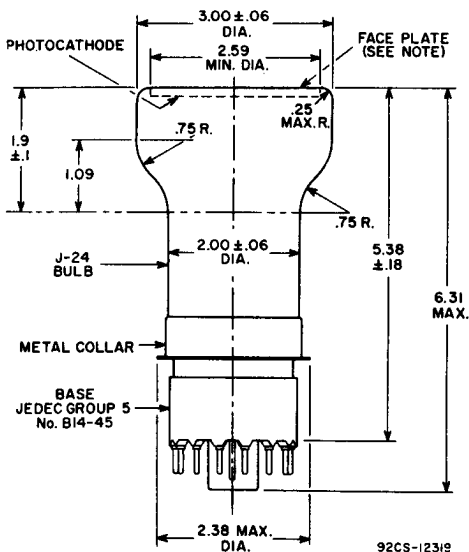


Adequate *shielding* should be provided to prevent extraneous radiation from reaching any part of 4464.

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

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

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



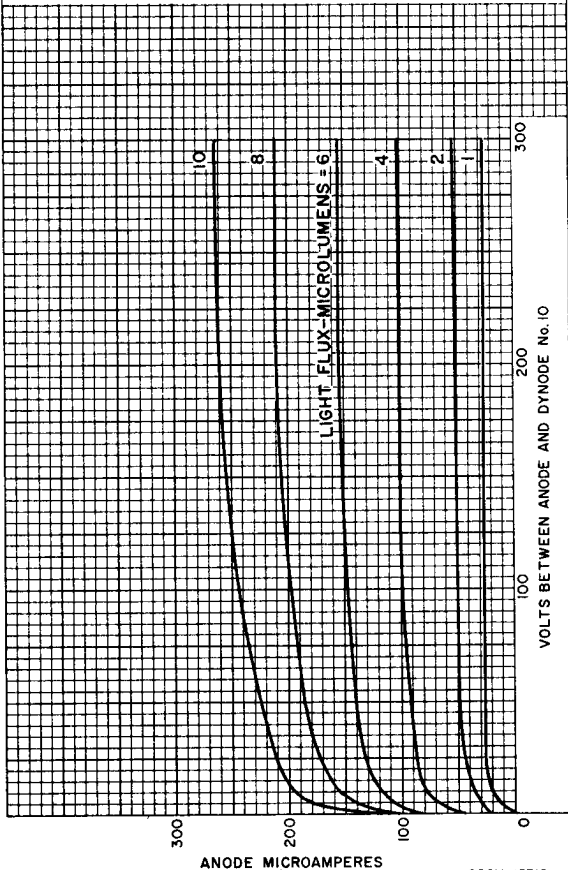
DIMENSIONS IN INCHES

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

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

TYPICAL ANODE CHARACTERISTICS

DYNODE No.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.

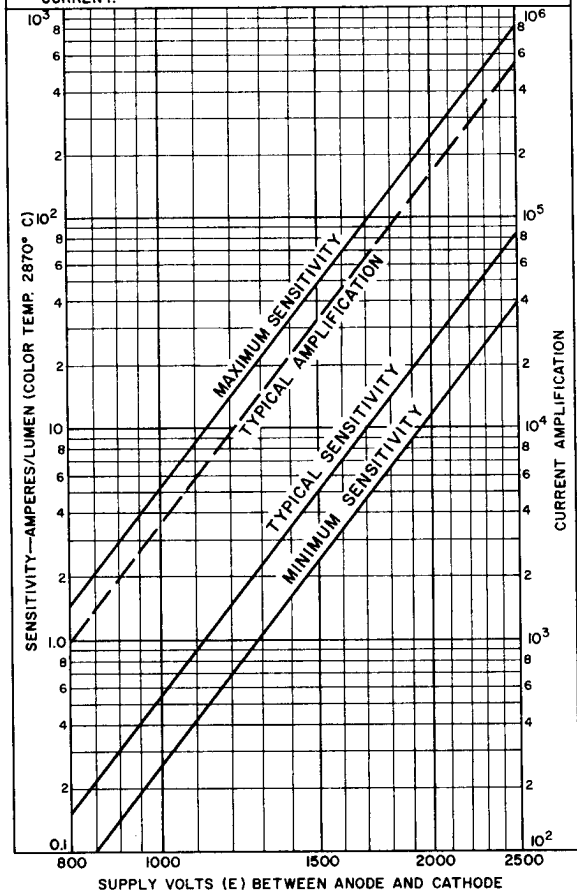


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SENSITIVITY AND CURRENT AMPLIFICATION CHARACTERISTICS

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.



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TYPICAL ANODE-DARK-CURRENT CHARACTERISTIC

LUMINOUS SENSITIVITY IS VARIED BY ADJUSTMENT OF THE SUPPLY VOLTAGE (E).

DYNODE No. 1-TO-CATHODE VOLTS = $1/6 E$

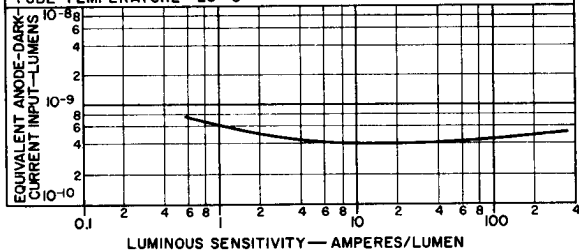
EACH SUCCEEDING DYNODE-STAGE VOLTS = $1/12 E$

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 $2870^{\circ} K$.

TUBE TEMPERATURE = $25^{\circ} C$



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TYPICAL TIME RESOLUTION CHARACTERISTICS

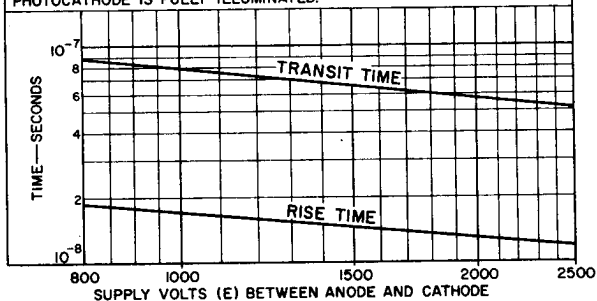
DYNODE No. 1-TO-CATHODE VOLTS= $1/6 E$

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.

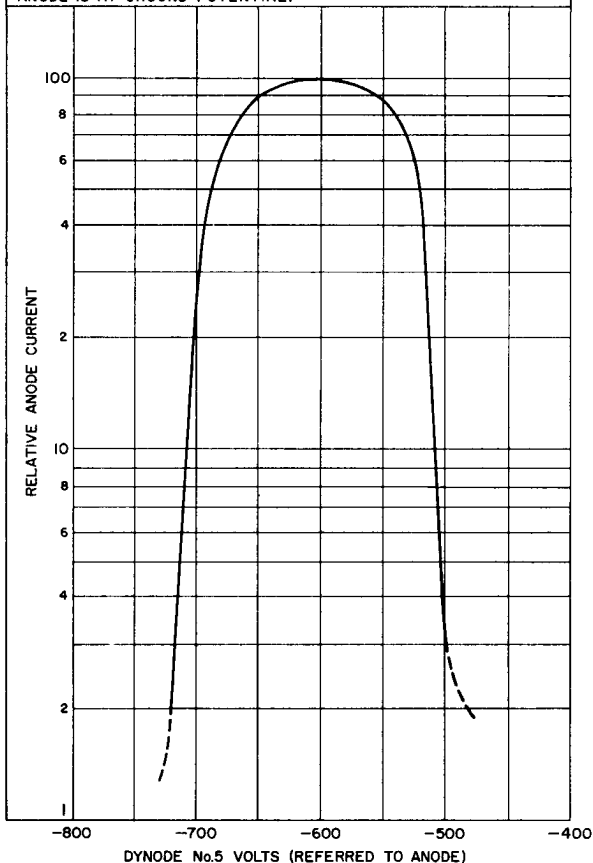


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TYPICAL CHARACTERISTIC OF OUTPUT CURRENT AS A FUNCTION OF DYNODE-No.5 VOLTS

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.

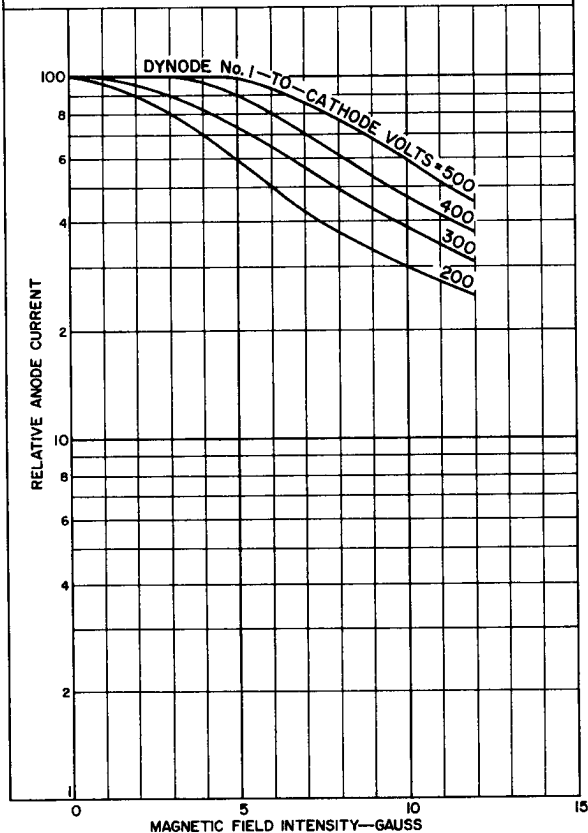


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TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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.

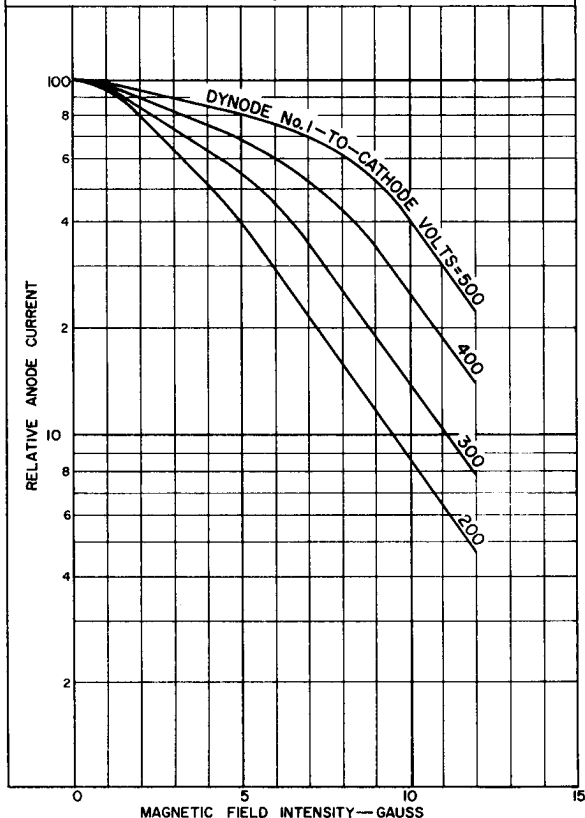


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TYPICAL EFFECT OF MAGNETIC FIELD ON ANODE CURRENT

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.



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