

4526A

Photomultiplier

10-Stage Dormer-Window Type Having Multialkali Photocathode Deposited on a Reflective Substrate

- **High Cathode Sensitivity (Typical):**
Radiant at 530 nm: 70×10^{-3} A/W
Luminous: 315×10^{-6} A/lm
- **Quantum Efficiency (Typical):**
at 530 nm: 16.4%
- **Time Resolution Characteristics (Typical):**
Anode Pulse Rise Time:
 2×10^{-9} s @ 1500 V
Electron Transit Time:
 2×10^{-8} s @ 1500 V

BURLE 4526A is a sturdy, 10-stage dormer-window type photomultiplier tube designed for use in the detection of low-level light signals in the presence of relatively high background illumination. It is highly suitable for such applications as star-tracking and laser detection systems to approximately 800 nanometers.

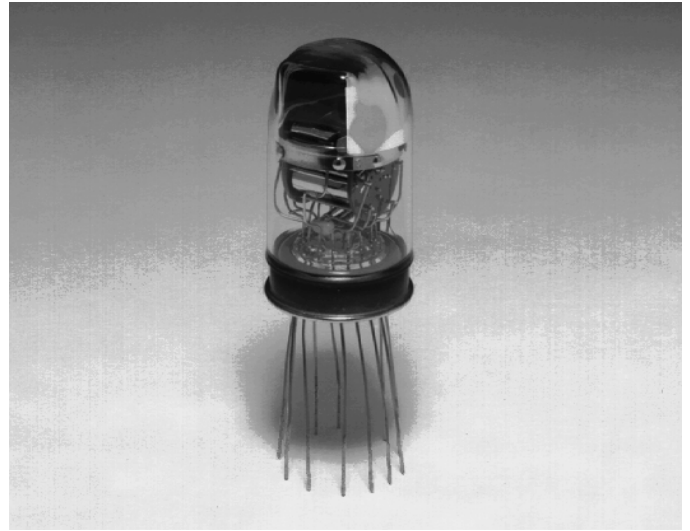
The 4526A employs a multialkali photocathode deposited on a reflective substrate. This substrate serves to increase the inherently high sensitivity of the multialkali photocathode by reflecting back through the semi-transparent photocathode that portion of the incident light signal that is not initially absorbed. Quantum efficiency of the 4526A at 694 nanometers is typically double that available from standard S-20 photomultiplier tubes.

The 4526A is supplied with semiflexible leads. The tube can also be supplied with the small-shell duodecal base permanently attached (type 4526AV1), or, with a temporary small-shell duodecal base attached to facilitate testing prior to installation.

Specifications

General Data

Spectral Response: See Figure 1.



Cathode, Semitransparent on Reflective Substrate:
K-Na-Cs-Sb (multialkali)

Shape: Concave Spherical Surface.

Minimum projected length on plane of window: 16.5 mm (0.65 in).

Minimum projected width on plane of window: 12.7 mm (0.50 in).

Window: Corning No. 0080¹, or equivalent.

Shape: Rectangular

Index of Refraction @ 589 nm: 1.51

Dynodes:

Secondary Emitting Surface: Alkali-Antimonide.

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): 76.4 mm (3.01 in).

Maximum Diameter: 39.6 mm (1.56 in).

Base (temporary, upon request): Small-shell Duodecal 12-pin JEDEC No. B12-43

Socket (for JEDEC No. B12-43 base): BURLE AJ2259.

Magnetic Shielding: BURLE AJ2243.

Operating Position: Any.

Weight (approx.):

With base attached: 85.1 g (3 oz).

Without base: 56.7 g (2 oz).



Absolute Maximum Ratings²

DC Supply Voltage:

Between anode and cathode: 2000 V.
 Between anode and dynode No. 10: 250 V.
 Between consecutive dynodes: 300 V.
 Between dynode No. 1 and cathode: 400 V.

Average Anode Current³: 100 μ A.

Ambient Temperature: 85 °C.

Performance Data

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	
Anode Sensitivity:				
Radiant at 530 nm ⁴	--	6.9x10 ³	--	A/W
Luminous ⁵	15	30	150	A/lm
Cathode Sensitivity:				
Radiant at 530 nm ⁶	--	7.3x10 ⁻²	--	A/W
Luminous ⁷	150	315	--	μ A/lm
Red Filter ⁸	80	140	--	μ A/inc. lm
Blue Filter ⁹	6	8.4	--	μ A/inc. lm
Current Amplification.....	--	9.5x10 ⁴	--	
Anode Dark Current ¹⁰	--	1	10	nA
Anode Dark Current @ 2000V--	--	20	100	nA
Equivalent Anode-Dark--				
Current Input.....	--	33 ¹⁰	333 ¹⁰	plm
	--	0.14 ¹¹	1.4 ¹¹	pW
Equivalent Noise Input ¹²	--	1.8x10 ⁻¹³	--	lm
	--	8x10 ⁻¹⁶ 13	--	W
With E = 1500 Volts:				
Anode Pulse Rise Time ¹⁴	--	2x10 ⁻⁹	--	s
Electron Transit Time ¹⁵	--	2x10 ⁻⁸	--	s

- Made by Corning Glass Works, Corning, New York.
- In accordance with the Absolute Maximum rating system as defined by the Electronic Industries Association Standard RS-239A, formulated by the JEDEC Electron Tube Council.
- Averaged over any interval of 30 seconds maximum.
- This value is calculated from the typical anode luminous sensitivity rating using a conversion factor of 230 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 2856 K and a light input of 1 microlumen is used.
- This value is calculated from the typical cathode luminous sensitivity rating using a conversion factor of 230 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 2856 K. The value of light flux is 0.001 lumen and 200 volts are applied between cathode and all other electrodes connected as anode.
- Under the following conditions: Light incident on the cathode is transmitted through a red filter (Corning C.S. No. 2-62, manufactured by Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2856 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.

- Under the following conditions: Light incident on the cathode is transmitted through a blue filter (Corning C.S. 5-58, polished to 1/2-stock thickness, manufactured by Corning Glass Works, Corning, New York) from a tungsten-filament lamp operated at a color temperature of 2856 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.
- At a tube temperature of 22 °C. With the supply voltage at 1250 volts.
- At 530 nm. This value is calculated from the EADCI value in lumens using a conversion factor of 230 lumens per watt.
- Under the following conditions: Supply voltage (E) is 1250 volts, 22 °C tube temperature, external shield connected to cathode, bandwidth 1 Hz, tungsten light source at a color temperature of 2856 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 530 nm. This value is calculated from the ENI value in lumens using a conversion factor of 230 lumens per watt.
- Measured between 10 percent 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.

Operating Considerations

Terminal Connections

The 4526A can be 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 4526A in a given system. The tube can also be supplied with the small-shell duodecal base permanently attached (type 4526AV1).

The semiflexible leads of the 4526A 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.

The leads are semiflexible and can be broken. Excessive bending of the leads--especially in the region close to the glass button--is to be avoided.

Mounting and Potting Considerations

Use of the flange for mounting purposes is not recommended. Not only is this flange internally connected to photocathode and operates at that potential, but it is also a part of the tube's vacuum enclosure. Accordingly, any undue force or stress applied to the flange can damage the glass-to-metal seal and destroy the tube.

If a "potting" compound is used, its characteristics-over the temperature range in which the tube is to be operated-must be such that its resilience is maintained at low temperature and its expansion. in a confined space, is not excessive at high temperature. Dow Corning potting compound RTV3110, or equivalent, is satisfactory for use with the 4526A over a temperature range of -40 °C to +55 °C.

Operating Stability

The operating stability of the 4526A is dependent on the magnitude of the anode current. The use of an average anode current well below the maximum rated value of 100 microamperes 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.

Dark Current

Anode dark current and Equivalent Anode Dark Current Input (EADCI) at a temperature of 22 °C as a function of luminous sensitivity is shown in Figure 4. Dark current can be reduced by use of a refrigerant.

A temporary increase in anode dark current by as much as 3 orders of magnitude may occur if the tube is exposed momentarily to a high-intensity ultraviolet radiation from sources such as fluorescent room lighting even though voltage is not applied to the tube. For optimum dark noise, it may be necessary to wait 6 to 24 hours after such irradiation.

A typical tube with high voltage applied in total darkness for a period of 24 hours often exhibits a lower value of anode dark current than that shown under Characteristics Range Values.

Operating Voltages

In general, the operating potential between anode and cathode should not be less than 500 volts.

A typical voltage-divider arrangement for use with the 4526A is shown in Figure 8. Recommended resistance values for the voltage divider ranges from 10 kilohms per stage to 1 megohm 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 nonlinearity and pulse-limiting effects, the use of resistance values exceeding 10 megohms per stage make the 4526A more susceptible to leakage effects between terminals with possible resulting deviation in interstage voltage leading to a loss of current amplification.

The operating voltage between dynode No. 10 and anode should be kept as low as will permit operation over the knee of the anode characteristic curves shown in Figure 6. 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 10 to 25 volts for the light level range shown in Figure 6. However, when high pulse currents are drawn, saturation due to space-charge limitations will occur and higher voltage will be required. To assure operation above the knee, it is necessary to increase the supply voltage between these electrodes by an amount equal to the voltage drop across a particular load.

The high voltages at which the 4526A 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.

Shielding

Electrostatic and magnetic shielding of the 4526A is ordinarily required. When a shield is in contact with the glass bulb of the 4526A, it must be at cathode potential. The application of high voltage, with respect to cathode, to any insulating or other materials supporting or shielding the 4526A 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.

Magnetic shielding of the 4526A is ordinarily required. The curve of Figure 7 shows the effect of variation in magnetic-field intensity on the anode current for a tube with no magnetic shielding.

It is to be noted that the use of an external shield at high negative potential presents a safety hazard.

Extreme care should be observed in providing adequate safeguards to prevent personnel from coming in contact with the high potential of the tube.

Warning - Personal Safety Hazards

Electrical Shock - Operating voltages applied to these devices present a shock hazard. Appropriate precautions should be taken.

Hazardous Material Content - Exposure to hazardous material would normally not occur in the ordinary use of this product. However, certain parts and components in this product may contain small amounts of materials that are considered by certain governmental bodies as having potential harmful effects. Therefore, please follow manufacturer's instructions in handling and using this product; refer servicing to an authorized service representative; and dispose of this product in accordance with all applicable environmental laws and regulations.

High Voltage - Although the user of this product is normally protected from the high voltage hazard by the equipment design, the voltages applied to this unit in normal operation are hazardous. High voltage safety precautions must be followed. Equipment caution labels and safety features must not be disregarded.

Implosion - Breaking this high vacuum device, whether or not in operation, can cause injury due to flying glass or toxic fragments.

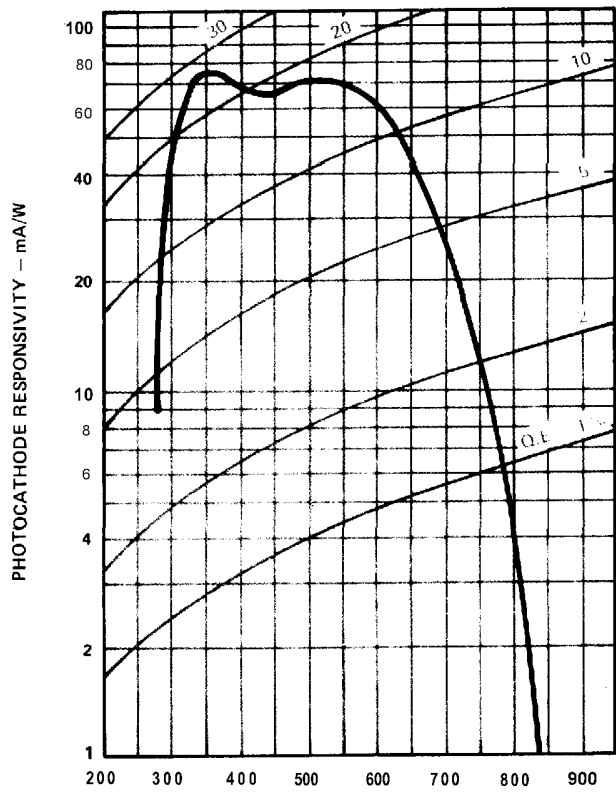


Figure 1: Spectral Response Characteristics

Figure 3: Typical Time-Resolution Characteristics

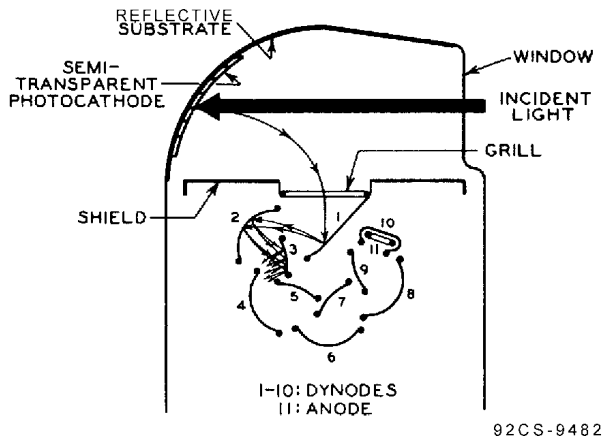


Figure 2: Schematic Arrangement of Type 4526A

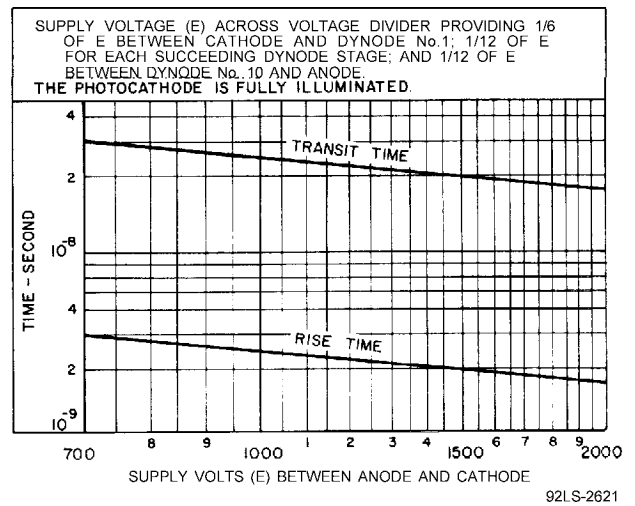


Figure 3: Typical Time-Resolution Characteristics

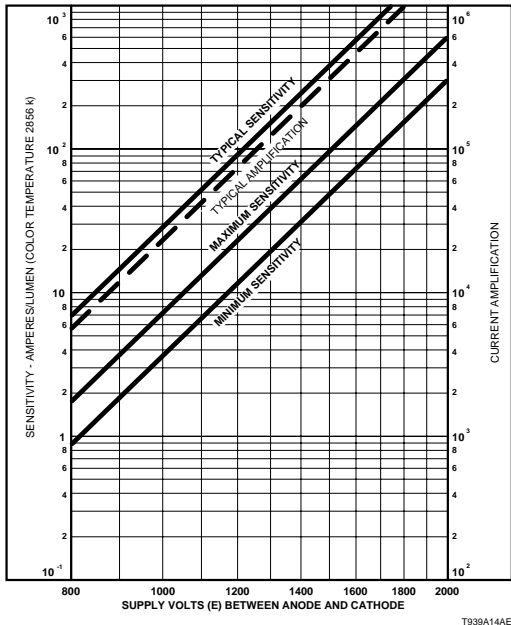


Figure 4: Typical Dark Current and EADCi Characteristics

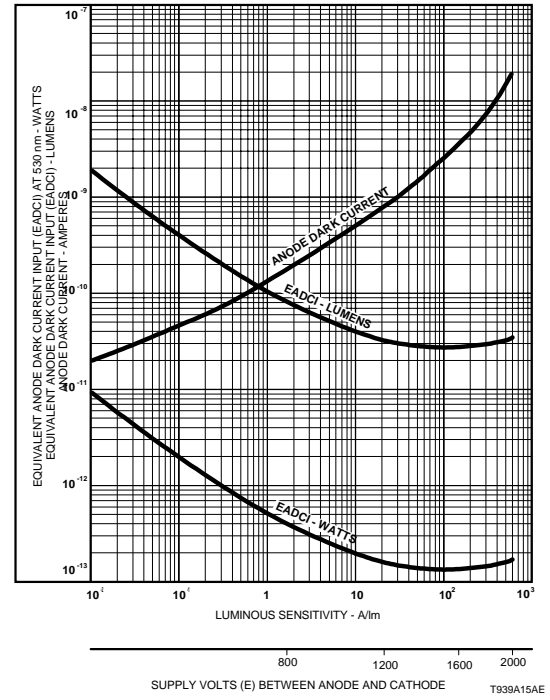
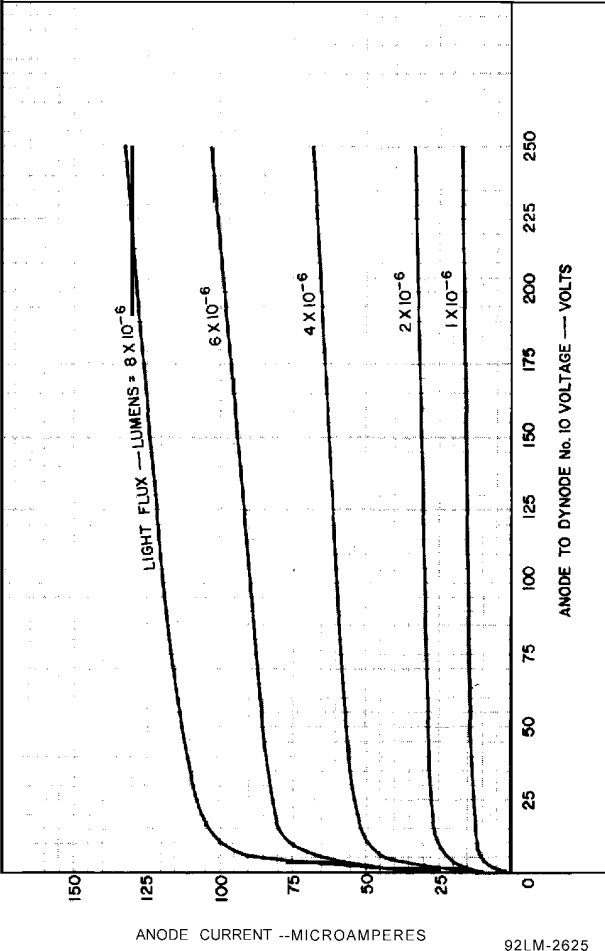


Figure 5: Typical Sensitivity and Current Amplification Characteristics

DYNODE No. 1 -TO- CATHODE VOLTS = 208
 E&CM SUCCEEDING -DYNODE-STAGE VOLTS = 104
 LIGHT SOURCE IS A TUNGSTEN-FILAMENT LAMP OPERATED AT
 COLOR TEMPERATURE OF 2856 K.



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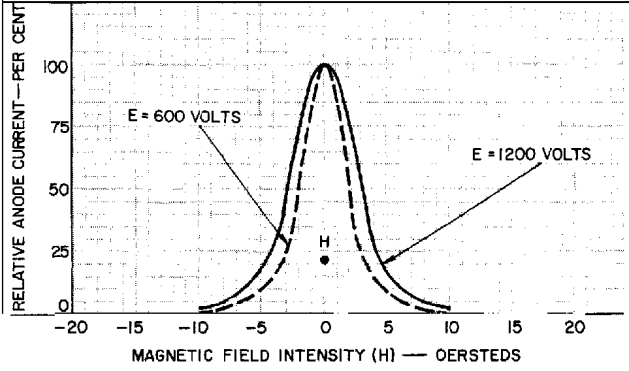
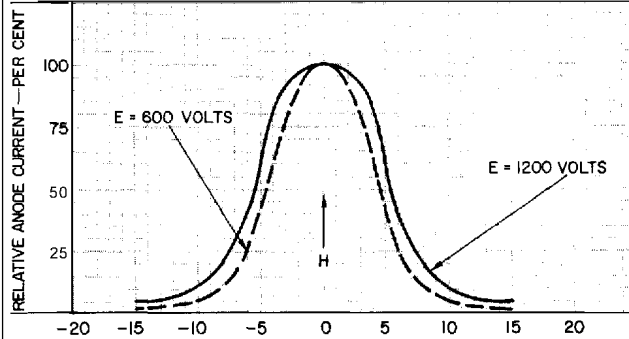
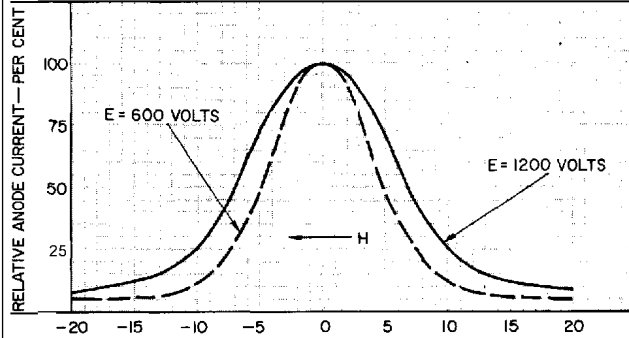
Figure 6: Typical Anode Characteristics

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.

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

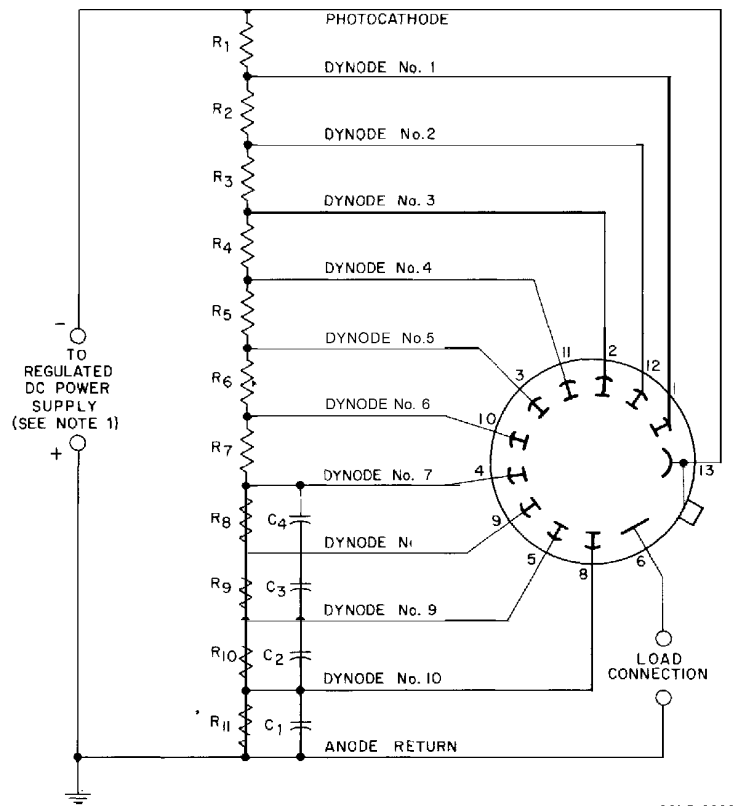


POSITIVE VALUES OF MAGNETIC FIELD INTENSITY (H) ARE FOR LINES OF FLUX (1) AND (2) IN INDICATED DIRECTION AND (3) OUT OF THE PAPER.



92LL-2626

Figure 7: Typical Effect of Indicated Magnetic Field on Anode Current



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 k ohms \pm 5% 1W
 R_2 through R_{11} : 160 k ohms \pm 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 3.

Figure 8: Typical Voltage-Divider Arrangement

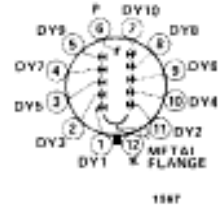
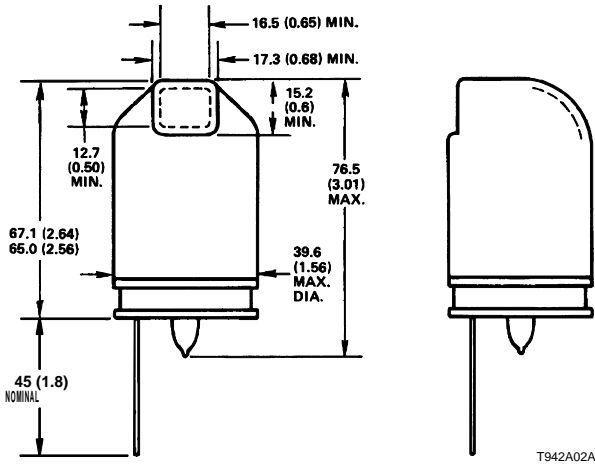
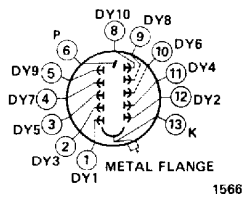


Figure 10: Basing Diagram with 12-Pin Temporary Base Attached

Dimensions in millimeters. Dimensions in parentheses are in inches.



Lead Orientation - Bottom View

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

Lead is cut off within 4 mm (0.16 in) of the glass button for indexing.

Note 1: Projected area lies between dashed lines.

Note 2: The semiflexible leads of the 4526A 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.

Figure 9: Dimensional Outline and Basing Diagrams

For additional information call 1-800-366-2875. In Europe call 44-93-276-5666.

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