

## TENTATIVE DATA

### MULTIPLIER PHOTOTUBE

Type F4027

#### GENERAL DESCRIPTION

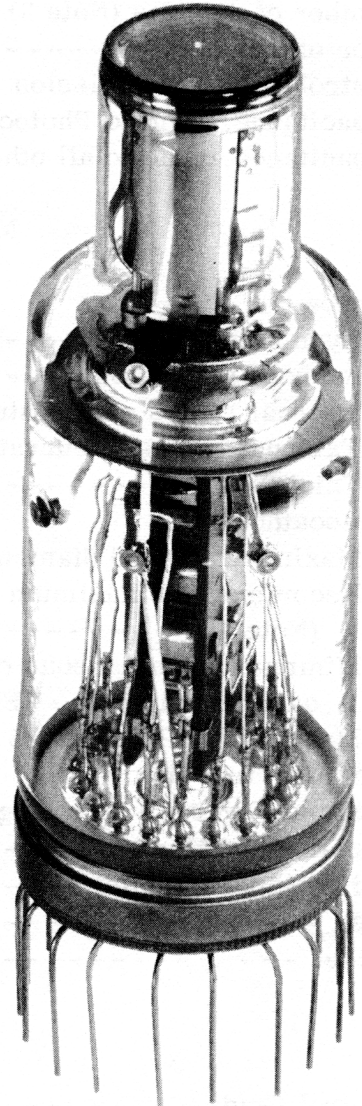
The F4027 model number refers to a series of special purpose grid controlled multiplier phototubes available with S-1, S-11, or S-20 type photocathodes. Included in the electrostatically focused image section is a high transmission mesh grid in close proximity to the photocathode surface. This grid electrically controls the number of photoelectrons emitted from the photocathode. Typical grid control characteristics are shown in Figure 3.

A defining aperture is incorporated between the photocathode and the first dynode of a 16-stage electron multiplier. It is possible to custom select the defining aperture size and shape such that the effective photocathode area conforms to the input flux area to be detected. This area-matching feature affords maximum suppression of dark noise from unused photocathode areas while at the same time yielding superior capability for detecting photoelectrons from the selected cathode area. With the addition of an external magnetic deflection coil, surrounding the image section of the tube, the effective photocathode area can be deflected to various locations on the formed photocathode surface.

Other special purpose multiplier phototubes available from ITTIL include the FW-118, FW-129, FW-130, FW-142, FW-143, FW-136, F4003 series, F4004 series, F4008 series, F4030 series, as well as many other developmental types.

#### APPLICATION

The special properties and characteristics of the F4027 make it well suited to such applications as electron energy selection, heterodyne detection, solar exposure protection, non-linear operation, fast gating, and high Gm/I amplification.



F4027

**GENERAL CHARACTERISTICS**

Photocathode response (Note 1) -----	S-1, S-11, or S-20 (See Figure 1)
Focusing method -----	Electrostatic
Deflection method (Note 2) -----	Magnetic, optional
Number of dynodes (Note 3) -----	16
Type of dynodes -----	Box and grid
Control Grid Transmission -----	80 Percent
Capacitance, Grid to Photocathode -----	12 $\mu\mu\text{f}$
Capacitance, Grid to all other electrodes ---	22 $\mu\mu\text{f}$

**MECHANICAL SPECIFICATIONS**

**Window**

Type of glass -----	Corning 7056 or equivalent
Index of refraction -----	1.5
Internal radius of curvature -----	Nominally flat
External radius of curvature -----	Nominally flat
Thickness -----	0.080 inch

**Photocathode**

Maximum formed diameter -----	0.75 inch
Recommended maximum usable diameter (Note 4) -----	0.250
Minimum instantaneous effective photo- cathode diameter - IEPD (Notes 5 & 6)-	0.005 inch
Maximum IEPD (Notes 5 & 7)-----	0.25 x 0.2 inch
Maximum tube diameter -----	2.0 inches
Maximum over-all tube length -----	6.0 inches
Mounting position -----	any
Weight (Approximate) -----	2-1/4 ounces
Base -----	The tube is normally supplied with
Socket -----	stiff flying leads (as shown in photograph). JEDEC No. B-20-102 20 pin base and associated socket are also available on request.
Control Grid -----	Flying lead, green

**TYPICAL OPERATING CONDITIONS**

Over-all voltage -----	1800 volts
Recommended voltage distribution -----	See Figure 2
Ambient temperature -----	25° C
IEPD -----	0.100 inch

TENTATIVE PERFORMANCE CHARACTERISTICS

For typical operating conditions. (Note 8)

<u>TUBE TYPE (Notes 1 and 9)</u>	<u>F4027 (S1, 100R)</u>	<u>F4027 (S11, 100R)</u>	<u>F4027 (S20, 100R)</u>
<b>Cathode luminous sensitivity</b> ( $\mu\text{a/lumen}$ )			
Minimum	12	30	80
Median	20	40	100
<b>Cathode peak radiant sensitivity</b> (amperes/watt)			
Median	0.0022	0.032	0.043
<b>Wavelength at maximum response</b> ( $\text{\AA}$ )			
Minimum	7000	3900	3700
Median	8000	4400	4200
Maximum	9000	4900	4700
<b>Anode luminous sensitivity</b> (amperes/lumen)			
Minimum	50	50	50
Median	200	200	200
Maximum (Note 13)	1000	1000	1000
<b>Anode dark current (amperes)</b>			
Median	$3 \times 10^{-6}$	$10^{-10}$	$10^{-10}$
Maximum	$2 \times 10^{-5}$	$10^{-9}$	$10^{-9}$
<b>Luminous equivalent of anode dark current (lumens) (Note 10)</b>			
Median	$1.5 \times 10^{-8}$	$10^{-12}$	$10^{-12}$
Maximum	$5 \times 10^{-8}$	$10^{-11}$	$10^{-11}$
<b>Equivalent noise input - ENI</b> (lumens) (Note 11)			
Median	$3 \times 10^{-11}$	$5 \times 10^{-13}$	$5 \times 10^{-13}$
Maximum	$1 \times 10^{-10}$	$1 \times 10^{-12}$	$1 \times 10^{-12}$
<b>Current amplification</b>			
Minimum	$5 \times 10^5$	$5 \times 10^5$	$5 \times 10^5$
Median	$5 \times 10^6$	$5 \times 10^6$	$5 \times 10^6$

## MAXIMUM RATINGS

### Absolute Maximum Values

Average photocathode current density	1.0 $\mu\text{a}/\text{cm}^2$
Average anode current	0.3 ma
Peak anode current	0.5 ma
Ambient temperature	75° C
Over-all voltage (dc or peak ac)	2250 volts

### NOTES

1. When ordering an F4027, two specifications in addition to the series designation "F4027" are required, namely: (1) the type of spectral response desired, and (2) the dimension of the defining aperture in mils, referred to the photocathode. These two numerical specifications should follow the series designation in brackets as follows:

EXAMPLE 1: An F4027 (S1, 2R). This calls for an F4027 multiplier phototube with an S-1 type photocathode and a 0.002 inch diameter round effective photocathode diameter.

EXAMPLE 2: An F4027 (S11, 1S). This calls for an F4027 multiplier phototube with an S-11 type photocathode and a 0.001 inch by 0.001 inch square effective photocathode area.

EXAMPLE 3: An F4027 (S20, 4 x 100). This calls for an F4027 multiplier phototube with an S-20 type photocathode and a 0.004 inch by 0.100 inch slit shaped effective photocathode area.

2. A suitable deflection coil unit (FW-315) is available from ITTIL. The F4027 can be operated without coils if paraxial operation only is desired.
3. For reduced gain, fewer dynodes may be used.
4. For reasons of nonuniformity and image distortion, ITTIL recommends that deflection of the small instantaneous photocathode area be confined within the area given by this dimension.

NOTES (Cont)

5. The term "IEPD" refers to the small instantaneous effective photocathode dimension established by an internal defining aperture. Dimensions in all cases are referred to the photocathode with no deflection applied and with the focus electrode voltage adjusted for optimum focus.
6. Effective photocathode sizes less than 0.005 inch in diameter are available but may result in a reduction of the effective photocathode sensitivity.
7. Defining apertures of various sizes and shapes can be supplied within this maximum size restriction at the photocathode.
8. Parameters utilized follow the recommendations of IRE Publication No. 62IRE 7. S1: "Methods of Testing, 1962".
9. Performance data is given in terms of tubes with 0.100 inch diameter round apertures.
10. Anode dark current divided by anode luminous sensitivity. This parameter cannot be used to predict dark noise behavior in tubes with S-11 or S-20 type photocathodes since the dark current in these tubes is not normally due to cathode dark emission current.
11. The tube dark noise in F4027 tubes with S-11 or S-20 type photocathodes is normally so low that no reliable dark noise measurements can be made using the recommended techniques of Note 8. Tube dark noise in these tubes may be such that the typical ENI is several orders of magnitude below the stated maximum rated value.
12. Registered JEDEC response curve. All spectral responses are normalized to 100 percent following registered JEDEC recommendations. Permissible tolerances on these various registered S-response curves have been or are being established by JEDEC.
13. A maximum sensitivity rating is given for replacement tube matching purposes.

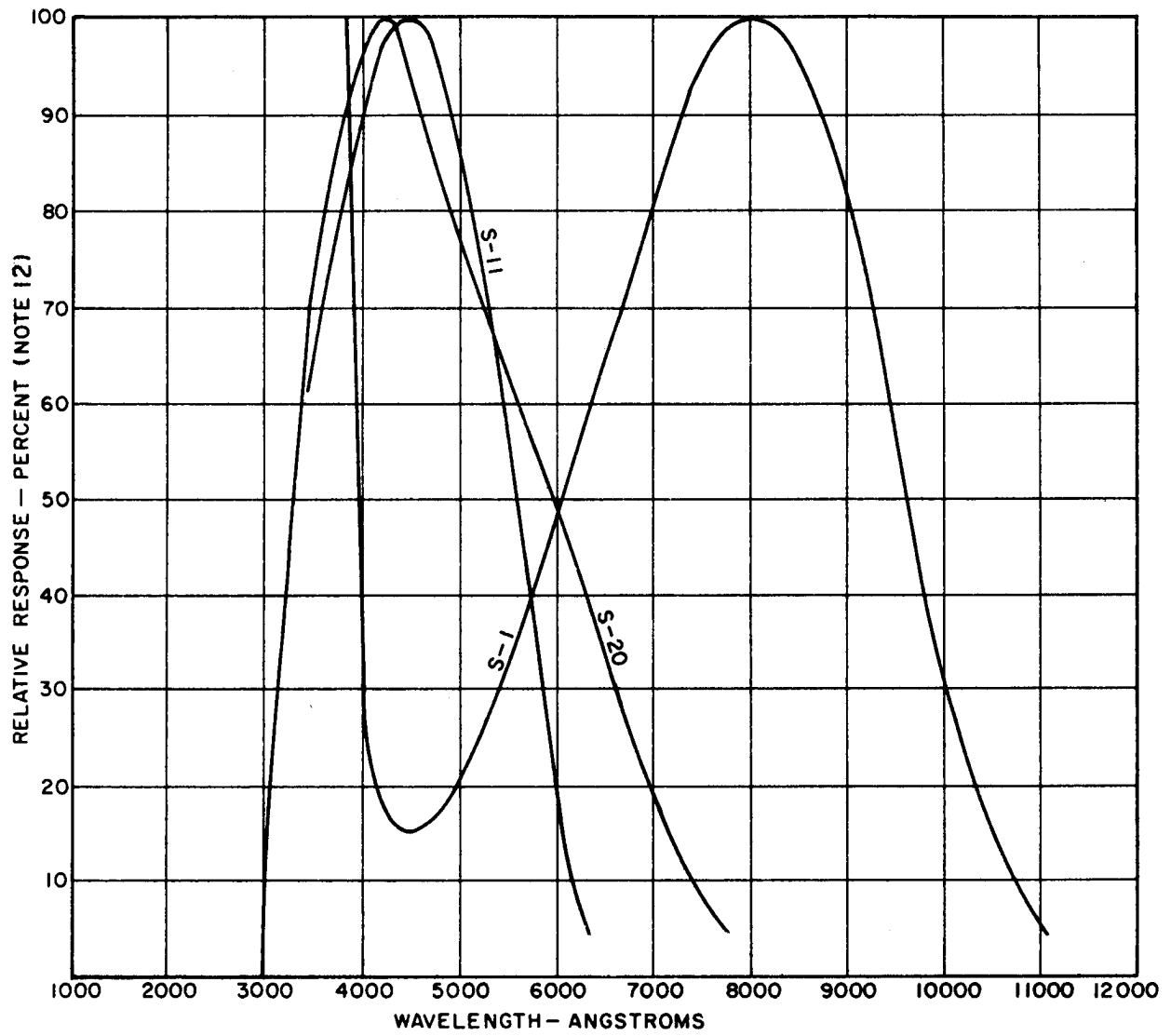
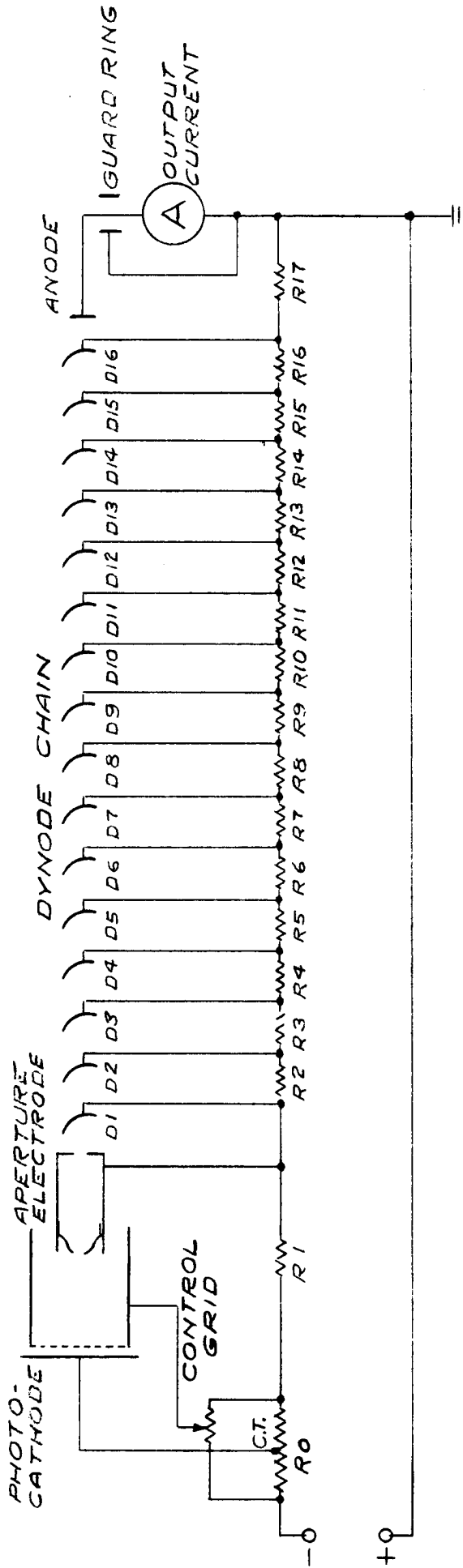


Figure 1 Spectral-Sensitivity Curves

RECOMMENDED WIRING DIAGRAM  
FOR GRID CONTROLLED MULTIPLIER  
PHOTOTUBE F4027



RESISTORS R2 THRU R15 INCLUSIVE HAVE EQUAL VALUE.

" " R0 = 9 X R2 OHMS (C.T.)

" " R1 = 2 X R2 "

" " R16 = 1.5 X R2 "

" " R17 = 3 X R2 "

NOTES:

14. CURRENT THROUGH VOLTAGE DIVIDER SHOULD EQUAL OR EXCEED 8 X THE VALUE OF THE MAXIMUM OUTPUT CURRENT FOR OPTIMUM STABILITY.

15. POWER SUPPLY SHOULD BE OF REGULATED TYPE.

16. FOR MINIMUM NOISE, MULTIPLE SHIELDING IS RECOMMENDED, WITH THE INNER SHIELD OPERATED AT PHOTOCATHODE POTENTIAL.

Figure 2

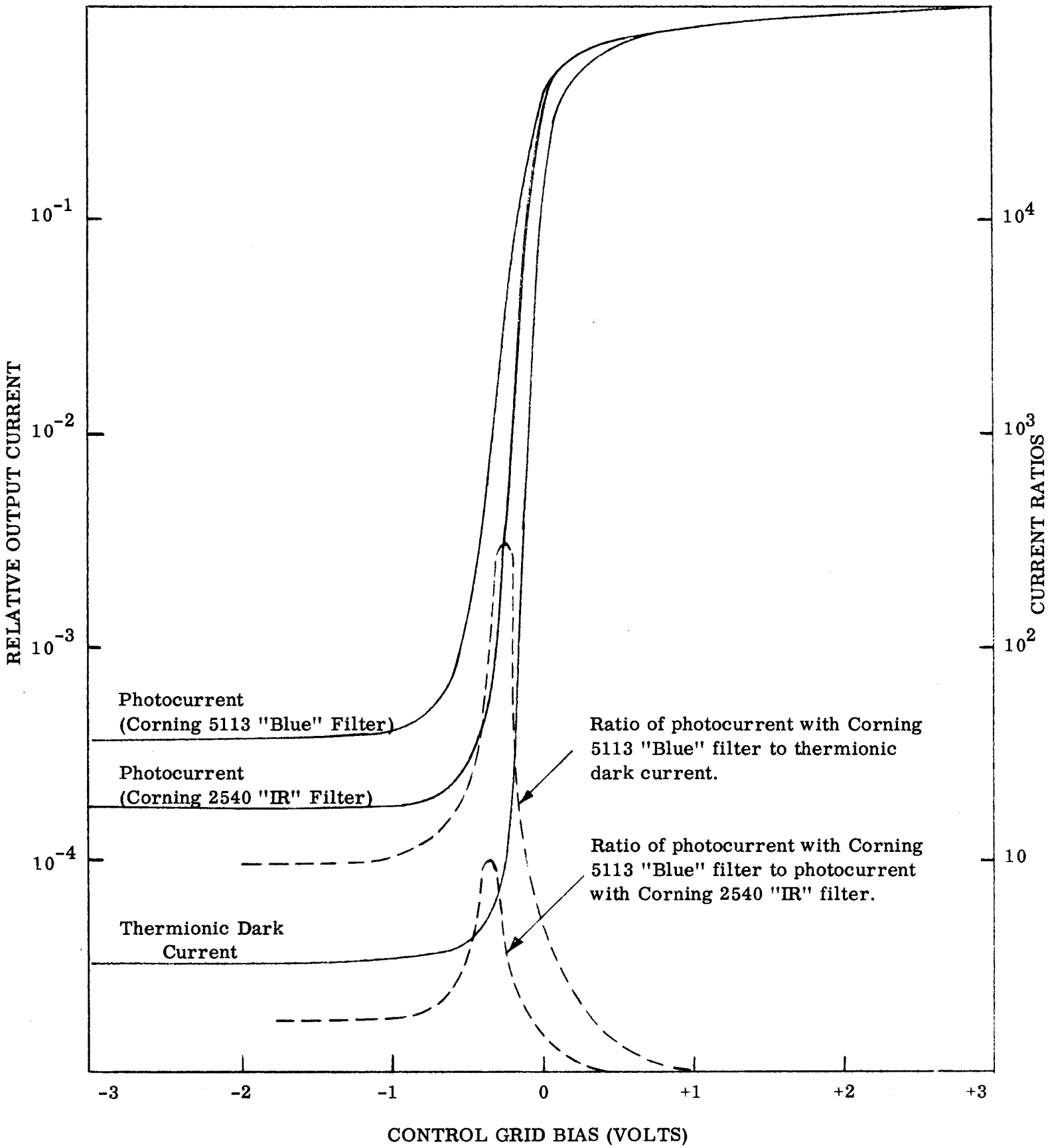
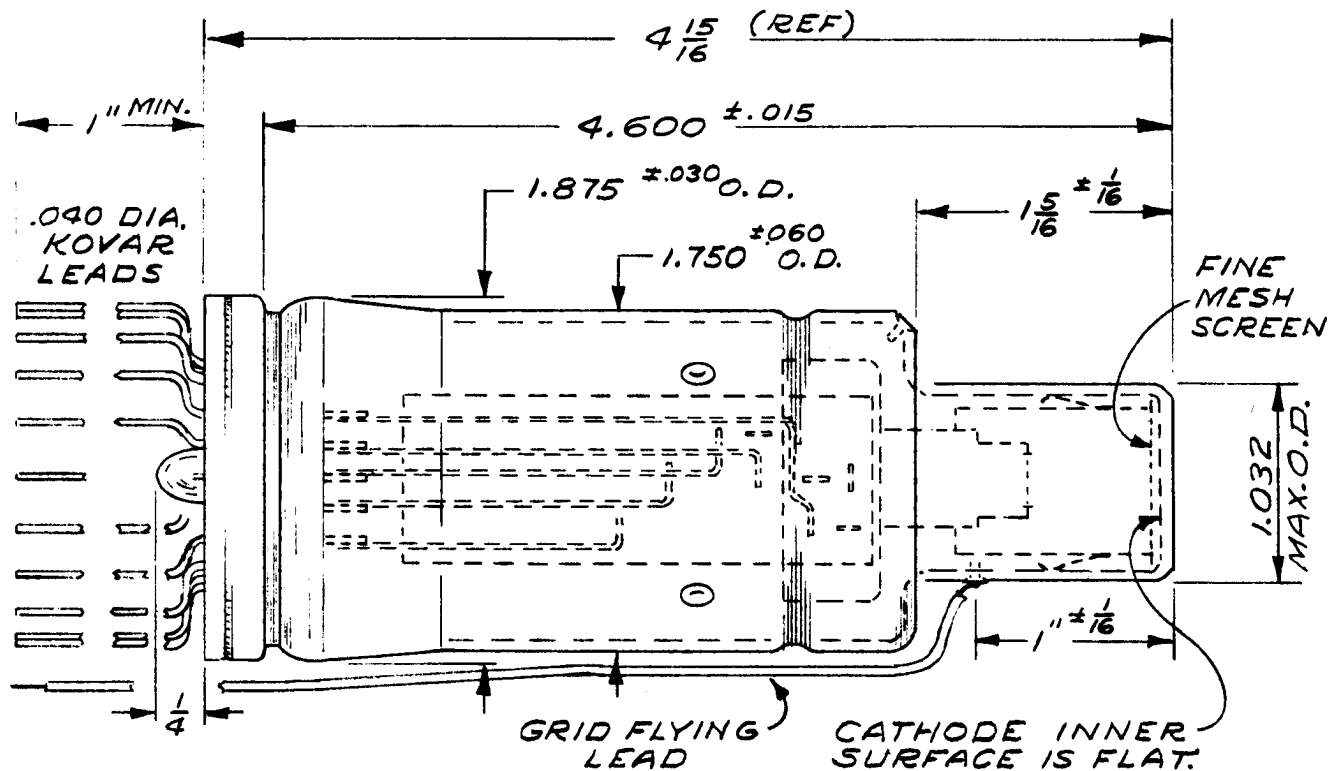


Figure 3. Typical Grid Control Characteristics



OUTLINE DRAWING



STEM CONNECTIONS

- |     |    |                    |
|-----|----|--------------------|
| Pin | 1  | Key Pin (Clipped)  |
|     | 2  | Cathode            |
|     | 3  | Dynode 1           |
|     | 4  | Dynode 3           |
|     | 5  | Dynode 5           |
|     | 6  | Dynode 7           |
|     | 7  | Dynode 9           |
|     | 8  | Dynode 11          |
|     | 9  | Dynode 13          |
|     | 10 | Dynode 15          |
|     | 11 | Anode, Multiplier  |
|     | 12 | Dynode 16          |
|     | 13 | Dynode 14          |
|     | 14 | Dynode 12          |
|     | 15 | Dynode 10          |
|     | 16 | Dynode 8           |
|     | 17 | Dynode 6           |
|     | 18 | Dynode 4           |
|     | 19 | Dynode 2           |
|     | 20 | Anode, Image Sect. |

NOTE

17. Green lead connected to control grid.
18. White lead soldered to weld ring and connected internally to the anode guard ring. It should be connected to the positive end of the voltage divider.