TECHNICAL DATA

8807/4CX16,000A
VHF POWER TETRODE

The EIMAC 8807/4CX16,000A is a ceramic/metal power tetrode intended for use in VHF linear amplifier service. This product is an exact replacement for the 8807 in VHF-TV transmitters, delivering up to 17.6 kW peak-sync in visual service. The anode is rated for 16 kW dissipation with forced-air cooling.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten Mesh
- Voltage .... 9.5 ±0.5 V
- Current at 9.5 Volts .... 136 A
- Maximum Cold Start Inrush Current .... 300 A

Amplification Factor (average) Grid to Screen 12

Direct Interelectrode Capacitances (cathode grounded)[2]
- C_{in} .... 154.5 pF
- C_{out} .... 16.5 pF
- C_{gp} .... .39 pF

Direct Interelectrode Capacitances (grids grounded)2
- C_{in} .... 79.2 pF
- C_{out} .... 16.8 pF
- C_{pk} .... .0055 pF

Maximum Frequency for Full Ratings (CW) .... 400 MHz

[1]Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. Varian Power Grid Tube Products should be consulted before using this information for final equipment design.

MECHANICAL

Maximum Overall Dimensions:
- Length .... 6.7 in; 170.2 cm
- Diameter .... 7.085 in; 18.0 cm

Net Weight (approximate) .... 13 lbs; 5.9 kg
- Operating Position ... Axis Vertical, Base Up or Down
- Cooling .... Forced Air

Operating Temperature, Absolute Maximum
- Ceramic/Metal Seals and Anode Core .... 250°C
- Base .... Special, Coaxial

RANGE VALUES FOR EQUIPMENT DESIGN

Filament Current, at 9.5 Volts
- Minimum .... 135 A
- Maximum .... 156 A

[2]Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with the Electronic Industries Association Standard RS-191.

60 Years of Excellence
Eimac®
1934-1994

CPI
Communications & Power Industries
Eimac division

RF POWER AMPLIFIER - CLASS B TELEVISION SERVICE

Channels 7 - 13, Cathode Driven

ABSOLUTE MAXIMUM RATINGS

DC Plate Voltage	10.0 kV
DC Screen Voltage	1.65 kV
DC Grid Voltage	-600 V
DC Plate Current	6.0 A
Plate Dissipation	16 kW
Screen Dissipation	250 W
Grid Dissipation	150 W

TYPICAL OPERATION

In a cathode-driven circuit at 216 MHz and bandwidth of 6.3 MHz.

DC Plate Voltage	7.5 kV
DC Screen Voltage	1.5 kV
DC Grid Voltage	-220 V
Zero-Signal DC Plate Current	500 mA
DC Plate Current:	
Synchronizing Level	4.40 A
Blanking Level	3.30 A
DC Screen Current:	
Synchronizing Level	62 mA
Blanking Level	45 mA
DC Grid Current:	
Synchronizing Level	70 mA
Blanking Level	55 mA
Driver Power Output:	
Synchronizing Level	770 W
Blanking Level	435 W
Output Circuit Efficiency (Approx.)	90 %
Useful Power Output:	
Synchronizing Level	17.6 kW
Blanking Level	9.85 kW
Typical Linearity, at 8 kW (Approx.)	-52 dB
Power Gain	13 dB

CLASS AB OR B CW RF AMPLIFIER

Grid Driven

ABSOLUTE MAXIMUM RATINGS

DC Plate Voltage	10.0 kV
DC Screen Voltage	1.65 kV
DC Grid Voltage	-500 V
DC Plate Current	5.0 A
Plate Dissipation	16 kW
Screen Dissipation	250 W
Grid Dissipation	150 W

TYPICAL OPERATION

Class AB

DC Plate Voltage	7.5 kV
DC Screen Voltage	1.0 kV
DC Grid Voltage	-145 V
Zero-Signal DC Plate Current	500 mA
DC Plate Current	3.7 A
DC Screen Current	115 mA
DC Grid Current	250 mA
Driver Power Output (Approx.)	125 W
Grid Loading Resistance	1000 Ohms
Useful Power Output	20 kW

"Typical Operation" values are obtained by measurement or by calculation from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations.

MECHANICAL

STORAGE - If a tube is to be stored as a spare, it should be kept in the original packing material and in its original shipping carton to minimize the possibility of handling damage.

Before storage, a new tube should be operated in the equipment for 100 - 200 hours to ensure that it operates properly. See the "Filament Operation" section for recommendations on the filament voltage during this initial operation period. After 6 months of storage, the tube should be operated again for 100 - 200 hours to make sure there has been no degradation.

MOUNTING - The 8807 must be operated with its axis vertical. The base of the tube may be up or down according to the designer's convenience.

COOLING - The maximum temperature rating for the external surfaces of the tube is 250° C, and sufficient forced air cooling must be used in all applications to keep the temperature of the anode (at the base of the cooling fins) and the ceramic/metal seals comfortably below this rated maximum. It is considered good *engineering* practice to design for a maximum anode core temperature of 225° C. Temperature-sensitive paints are available for checking base and seal temperatures before any design is finalized. For more details, EIMAC application bulletin #20 titled "Temperature Measurements With EIMAC Tubes" is available on request.

The following cooling guidelines should also be noted and followed.

- It is also good practice to allow for variables such as dirty air filters, rf seal heating, and the fact that the anode cooling fins may not be clean if the tube has been in service for some length of time.
- Special attention, by means of special directors or some other provision is required in cooling the center of the stem (base).
- An air interlock system should be incorporated in the design to automatically remove all voltages from the tube in case of even partial failure of the tube cooling air.
- The contact fingers used in the contact collet assemblies (inner and outer filament, control grid and screen grid) are made of beryllium copper. If operated above 150° C for any appreciable length of time, this material will lose its temper or springy characteristic, and then it will no longer make good contact with the base contact areas of the tube. This can lead to arcing which can melt metal in a contact area, primarily the inner or outer filament contacts, and the tube's vacuum integrity will be destroyed.
- Movement of cooling air around the base of the tube keeps both the tube base and the socket contact fingers at a safe operating temperature. If all cooling air is not passed around the base of the tube and through the socket, then arrangements for adequate cooling of these areas must be made.
- Air flow must be applied before or simultaneously with the application of power, including the tube filament, and should normally be maintained for a short period of time after all power is removed to allow for a tube cooldown.
- For longer life and consistent performance, cooling in excess of the minimum requirements is normally beneficial.

Minimum air flow requirements for a maximum anode temperature of 225°C at various altitudes and dissipation levels are listed below. The pressure drop values are approximate and are for the tube anode cooler only. Pressure drop in a typical installation will be higher due to system loss.

Anode at 225° C, sea level						
Plate Diss.	25°C		35°C		50°C	
kW	CFM	in H_2O	CFM	in H_2O	CFM	in H_2O
7.5	206	1.5	213	1.5	224	1.6
10.0	324	1.8	335	2.0	352	2.1
12.5	560	3.5	579	3.6	608	3.8
15.0	688	4.7	711	4.9	746	5.2
16.0	747	5.3	772	5.5	810	5.8

Anode at 225°C, 5,000 feet						
Plate Diss.	25°C		35°C		50°C	
kW	CFM	in H_2O	CFM	in H_2O	CFM	in H_2O
7.5	250	1.8	259	1.8	271	1.9
10.0	393	2.4	406	2.5	426	2.6
12.5	678	4.3	702	4.4	735	4.6
15.0	833	5.7	862	5.9	903	6.2
16.0	905	6.4	936	6.6	981	7.0

Anode at 225°C, 10,000 feet						
Plate Diss.	25°C		35°C		50°C	
kW	CFM	in H_2O	CFM	in H_2O	CFM	in H_2O
7.5	302	2.2	308	2.2	328	2.3
10.0	475	2.9	484	2.9	516	3.1
12.5	821	5.2	836	5.3	890	5.6
15.0	1009	6.9	1026	7.0	1094	7.5
16.0	1095	7.8	1114	7.9	1188	8.4

ELECTRICAL

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open primary circuits of the power supply and to discharge high-voltage capacitors whenever access doors are opened. Interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Always remember that high voltage can kill.

ABSOLUTE MAXIMUM RATINGS - Values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service condition. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed these ratings, it is the responsibility of the equipment designer to determine, for each rating, an average design value below the absolute value by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply voltage variation, load variation, or manufacturing variation in the equipment itself. **It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.**

FILAMENT WARM-UP - The filament inrush current should be limited to 300 amperes. A suitable step-start procedure can accomplish this, or an impedance-limited transformer designed for this purpose can be used. The filament should be allowed to heat for a minimum of 15 seconds before any high voltage is applied, including the grid bias voltage.

In case of a power failure of under 15 seconds, filament warm-up can be as short as 5 seconds, but the inrush current limitation must be observed.

FILAMENT OPERATION - This tube is designed for commercial service with no more than one normal off/on filament cycle per day. If additional cycling is anticipated, the Varian Application Engineering department should be contacted for additonal information.

New tubes and tubes that have been in storage should be operated with filament voltage applied only for a period of 30 to 60 minutes before full operation begins. This allows the active getter material mounted within the filament structure to absorb any residual gas molecules which might have accumulated during storage.

At rated or nominal filament voltage, the tube's peak emission capability is many times that needed for communication service. A reduction in filament voltage will lower the filament temperature and substantially increase life expectancy. The correct value of filament voltage should be determined for the particular application.

It is recommended that the tube be operated at full nominal voltage for an initial stabilization period of 100 to 200 hours before any action is taken to operate at reduced voltage. The voltage should gradually be reduced until there is a slight degradation in performance such as power output or distortion. The voltage should then be increased a few tenths of a volt above the value where perfomance degradation was noted for operation. The operating point should be rechecked after 24 hours. Filament voltage should be closely regulated when voltage is reduced below nominal to avoid any adverse influence by nominal line voltage variations.

Filament voltage should always be measured at the tube base or socket using an accurate rms-responding meter.

Periodically, throughout the life of the tube, the procedure for voltage reduction described in Application Bulletin #18 should be repeated to reset voltage as required and assure maximum tube life. Application Bulletin #18, "Extending Transmitter Tube Life," contains detailed information and is available upon request.

DISSIPATION RATINGS - Maximum dissipation ratings must be respected to avoid tube damage. An exception is plate dissipation which may be permitted to rise above the rated maximum for up to 10 seconds such as during tuning.

GRID OPERATION - The maximum control grid dissipation is 150 Watts which is approximately determined by the product of the dc grid current and the peak positive grid voltage. A protective spark-gap device should be connected between the control grid and the cathode to guard against excessive voltage.

SCREEN OPERATION - The maximum screen grid dissipation is 250 Watts. With no ac applied to the screen grid, dissipation is simply the product of dc screen voltage and dc screen current.

Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, since screen dissipation ratings will be exceeded. Energy limiting circuitry which will activate if there is a fault condition and spark-gap over-voltage protection are recommended as good engineering practices.

Screen supply voltage must be maintained constant for any values of negative and positive screen current which may be encountered. Dangerously high plate current may flow if the screen power supply exhibits a rising voltage characteristic with negative screen current. Stabilization with a bleeder resistor connected from screen to cathode assures that net screen supply current is always positive. This is essential if a series electronic regulator is used.

FAULT PROTECTION - In addition to the normal plate over-current interlock, screen current interlock, and coolant interlock, the tube must be protected from damage caused by an internal arc which may occur at high plate voltage. A protective resistance of 10 ohms should be connected in series with the tube anode (in the B+ lines) to absorb power supply stored energy if an internal arc occurs. If power supply stored energy is high, an electronic crowbar is recommended. It will discharge power supply capacitors in a few microseconds after the start of an arc. To conduct a protection test for each electrode supply, short each electrode to ground, one at a time, through a vacuum relay switch and a 6-inch length of #30 AWG copper wire. The wire will remain in contact if protection is adequate.

For more details, Application Bulletin #17, "Fault Protection," is available upon request.

RADIO-FREQUENCY RADIATION - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz, most of the energy will pass completely through the human body with little attenuation or heating affect, however, public health agencies are concerned with the hazard even at these frequencies. OSHA (Occupational Safety and Health Administration) recommends that prolonged exposure to rf radiation should be limited to 10 milliWatts per square centimeter.

INTERELECTRODE CAPACITANCE - In most applications, the actual internal interelectrode capacitance of a tube is influenced by many variables, such as stray capacitance to the chassis, stray capacitance added by the socket, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and military services use a standard test procedure that is described in Electronic Industries Association Standard RS-191.

The test is performed on a cold tube, and requires a specially contructed test fixture that shields all external tube leads or contacts from each other and eliminates any capacitance reading to "ground." Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time.

The capacitance values shown in the technical data are taken in accordance with Standard RS-191. The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in the application. Measurements should be taken with the mounting which represents approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - When it is desired to operate this tube under conditions widely different from those listed here, contact the Power Grid Tube Marketing Department at Varian in San Carlos, (415) 592-1221.

OPERATING HAZARDS

Proper use and safe operating practices with respect to power tubes are the responsibility of equipment manufacturers and users of such tubes. All persons who work with or are exposed to power tubes or equipment which utilizes such tubes must take precautions to protect themselves against possible serious bodily injury. Do not be careless around such products.

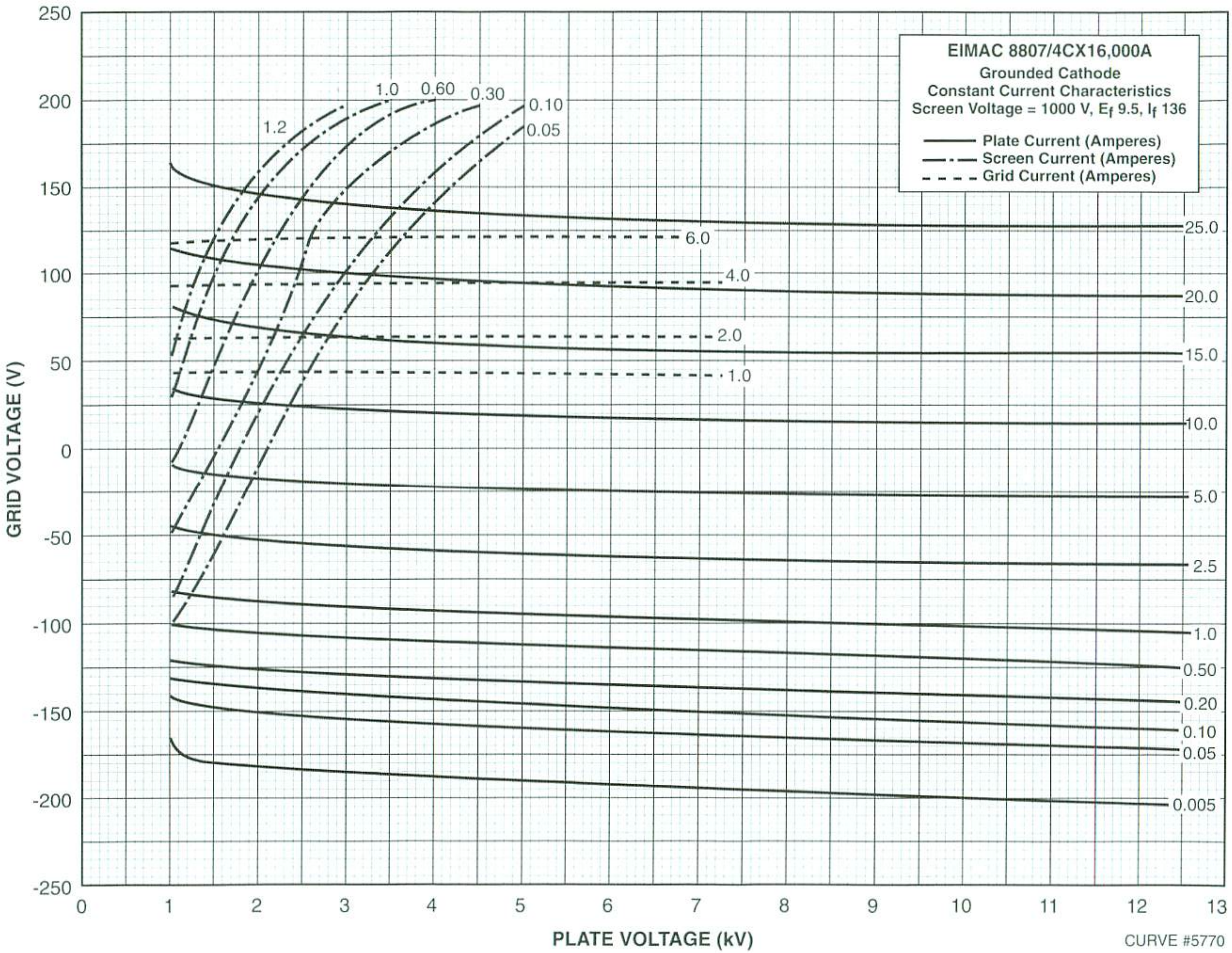
The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel. Please review the following hazards as well as the detailed operating hazards sheet enclosed with each tube or request a copy from Varian.

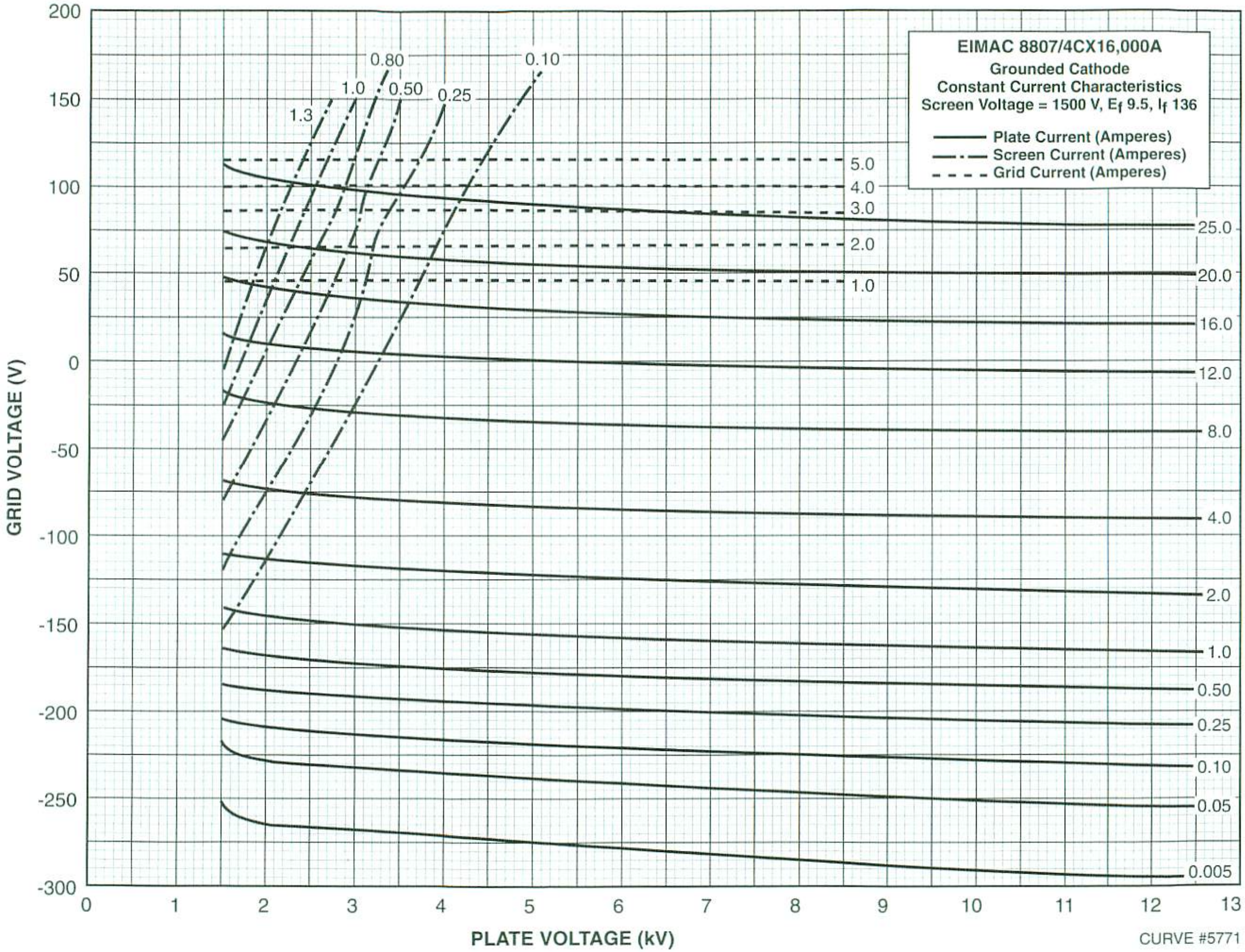
HIGH VOLTAGE - Normal operating voltages can be deadly. Remember that **high voltage can kill.**

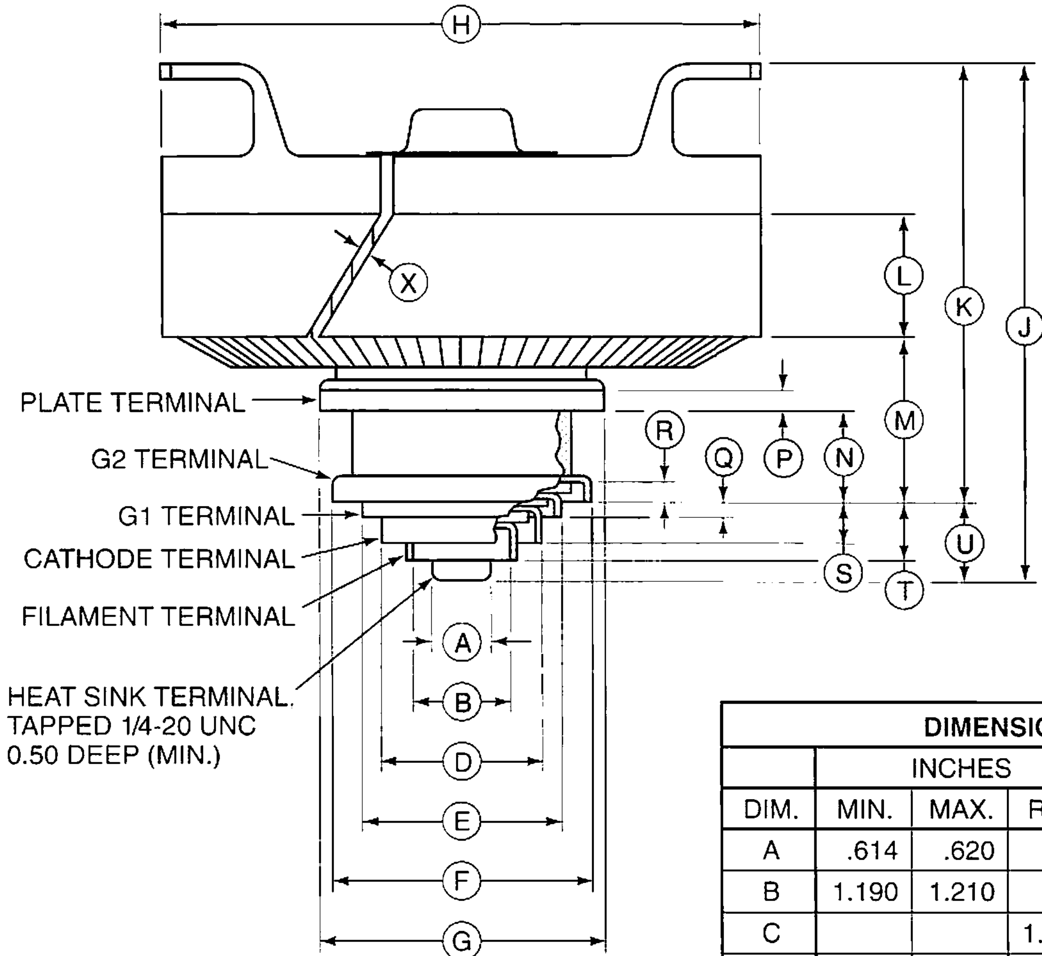
LOW VOLTAGE, HIGH CURRENT CIRCUITS - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

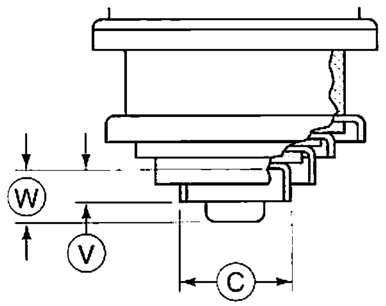
RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. **Cardiac pacemakers may be affected.**

HOT SURFACES - Surfaces of tubes can reach temperatures of several hundred °C, and they can cause serious burns if touched even several minutes after all power is removed.


EIMAC 8807/4CX16,000A
Grounded Cathode
Constant Current Characteristics
Screen Voltage = 1000 V, E_f 9.5, I_f 136
Plate Current (Amperes)
Screen Current (Amperes)
Grid Current (Amperes)
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
250
200
150
100
50
0
-50
-100
-150
-200
-250
0
1
2
3
4
5
6
7
8
9
10
11
12
13
1.2
1.0
0.60
0.30
0.10
0.05
6.0
4.0
2.0
1.0
25.0
20.0
15.0
10.0
5.0
2.5
1.0
0.50
0.20
0.10
0.05
0.005
CURVE #5770


EIMAC 8807/4CX16,000A
Grounded Cathode
Constant Current Characteristics
Screen Voltage = 1500 V, E_f 9.5, I_f 136
Plate Current (Amperes)
Screen Current (Amperes)
Grid Current (Amperes)
GRID VOLTAGE (V)
PLATE VOLTAGE (kV)
200
150
100
50
0
-50
-100
-150
-200
-250
-300
0
1
2
3
4
5
6
7
8
9
10
11
12
13
1.3
1.0
0.80
0.50
0.25
0.10
5.0
4.0
3.0
2.0
1.0
25.0
20.0
16.0
12.0
8.0
4.0
2.0
1.0
0.50
0.25
0.10
0.05
0.005
CURVE #5771





CONTACT AREAS INDICATED:
A, B, D, E, F, G, L, P, R, V, W.

DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	.614	.620		15.59	15.75	
B	1.190	1.210		30.23	30.73	
C			1.320			33.53
D	1.840	1.860		46.74	47.24	
E	2.307	2.331		58.60	59.20	
F	3.014	3.042		76.55	77.27	
G	3.230	3.250		82.05	82.55	
H	7.025	7.085		178.44	179.96	
J		6.500			165.10	
K		5.50			139.70	
L	1.480	1.520		37.59	38.61	
M	2.040	1.960		49.80	51.80	
N	1.080	1.130		27.43	28.70	
P	.160	.250		4.06	6.35	
Q	.175	.225		4.45	5.71	
R	.220			5.59		
S	.470	.530		11.9	13.5	
T	.685	.765		17.41	19.43	
U	.950	1.050		24.10	26.70	
V	.250			6.35		
W	.375			9.52		
X			.062			1.58

1. Reference dimensions are for information only and are not required for inspection.

Varian Power Grid Tube Products / 301 Industrial Way / San Carlos, CA 94070 / (415) 592-1221 Fax: (415) 592-9988

EDB 2336/185 3/93

Printed in U.S.A.