EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8189
4PR1000A
RADIAL-BEAM PULSE TETRODE
•
MODULATOR OSCILLATOR AMPLIFIER

The Eimac 8189/4PR1000A is a pulse tetrode intended for use in pulse-modulator, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a Pyrovac plate and non-emitting grids, is recommended for use in new equipments where high voltage, high current, or high duty factor is encountered.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the Eimac SK-510 Air-System Socket and the SK-506 Air Chimney.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage	-	7.5		volts
Current	20.0		22.7	amperes
Amplification Factor (Grid to Screen)	-	6.9		
Direct Interelectrode Capacitances, Grounded Cathode:†				
Grid-Plate	-	-	0.35	uuf
Input	23.8		32.4	uuf
Output	6.8		9.4	uuf
Transconductance (I_b=300 ma)	-	10,000		umhos
Highest Frequency for Maximum Ratings	-	-	110	mc

MECHANICAL

Base	5-pin metal shell
Basing	See drawing
Recommend Socket	Eimac SK-510 Air-System Socket
Operating Position	Vertcial, base down or up
Maximum Operating Temperatures:	
Base Seals	150°C
Plate Seal	200°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-8
Maximum Over-all Dimensions:	
Length	9.63 inches
Diameter	5.25 inches
Net Weight (tube only)	1.5 pounds
Shipping Weight	12 pounds

†In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

D-C PLATE VOLTAGE	30 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK PLATE CURRENT	8.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	20	25	30 Kilovolts
D-C Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—335	—360	—380 Volts
Pulse Plate Voltage	17.7	22.7	27.7 Kilovolts
Peak Plate Current	8.0	8.0	8.0 Amperes
Pulse Screen Current	1.25	1.25	1.25 Amperes
Pulse Grid Current	0.2	0.2	0.2 Ampere
Pulse Pos. Grid Voltage	200	200	200 Volts
Pulse Drive Power	107	112	116 Watts
Pulse Plate Input Power	160	200	240 Kilowatts
Pulse Plate Output Power	140	180	220 Kilowatts
Duty	4.0	4.0	4.0 Percent

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RADIO-FREQUENCY PLATE AND SCREEN-PULSED AMPLIFIER AND OSCILLATOR*

MAXIMUM RATINGS

PEAK D-C PLATE VOLTAGE	20 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK CATHODE CURRENT (Note 1)	12.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

*When used as a R-F Plate and Screen-Pulsed Amplifier, the grid drive must also be pulsed to avoid overheating this element during the inter-pulse periods.

TYPICAL OPERATION

Pulse Plate Voltage	10	15	20 Kilovolts
Pulse Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—480	—510	—535 Volts
Pulse Plate Current (Note 1)	1.95	1.95	1.95 Amperes
Pulse Screen Current	0.32	0.32	0.32 Ampere
Pulse Grid Current	0.02	0.02	0.02 Ampere
Peak R-F Grid Voltage	735	760	785 Volts
Pulse Drive Power	14.7	15.2	15.7 Watts
Pulse Plate Input Power	19.5	29.3	39.0 Kilowatts
Pulse Plate Output Power	17.0	23.0	31.5 Kilowatts
Duty	15.0	15.0	12.0 Percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS

D-C PLATE VOLTAGE	15 MAX. KILOVOLTS
D-C SCREEN VOLTAGE	2.5 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KILOVOLTS
PEAK CATHODE CURRENT (Note 1)	12.0 MAX. AMPERES
PLATE DISSIPATION (AVE.)	1000 MAX. WATTS
SCREEN DISSIPATION (AVE.)	75 MAX. WATTS
GRID DISSIPATION (AVE.)	25 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	10	12.5	15 Kilovolts
D-C Screen Voltage	1.5	1.5	1.5 Kilovolts
D-C Grid Voltage	—480	—495	—510 Volts
Pulse Plate Current (Note 1)	1.95	1.95	1.95 Amperes
Pulse Screen Current	0.32	0.32	0.32 Ampere
Pulse Grid Current	0.02	0.02	0.02 Ampere
Peak R-F Grid Voltage	735	745	760 Volts
Pulse Drive Power	14.7	15.0	15.2 Watts
Pulse Plate Input Power	19.5	24.4	29.3 Kilowatts
Pulse Plate Output Power	17.0	18.6	23.0 Kilowatts
Duty	15.0	15.0	15.0 Percent

Note 1: The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on an available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation sections refers to the d-c plate current component during the pulse.

APPLICATION

MECHANICAL

Mounting—The 4PR1000A must be operated vertically, base up or down. When the SK-510 Air-System Socket is used in conjunction with the SK-506 Air Chimney, the socket must be mounted to the under surface of the chassis to maintain proper air space between the plate seal and the chimney opening, otherwise plate seal cooling will be seriously impaired.

In the event the SK-510 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers.

COOLING—Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 150° C and 200° C, respectively. In all classes of operation it is recommended that a heat-radiating connector, the Eimac HR-8 or equivalent, be installed on the anode terminal, and that a socket and chimney be employed which provides for proper seal cooling. When the Eimac 4PR1000A is operated at d-c or low frequencies in an Eimac SK-510 Air System Socket, complete with SK-506 Air Chimney and HR-8 Heat Radiator, the minimum airflow requirements to maintain seal temperatures at 150° C in 50° C inlet air are tabulated below:

	Sea Level		10,000 Feet	
Ave. Plate Dissipation (watts)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)
600	17.0	0.30	24.0	0.45
800	20.0	0.40	28.0	0.56
1000	25.0	0.55	36.0	0.80

When the Eimac 4PR1000A is used as a pulsed-amplifier or oscillator at frequencies above 30 Mc, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by r-f charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured conveniently by using a temperature-sensitive paint.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins,

should be 7.5 volts. Variations in filament voltage must be kept within the range of 7.13 to 7.87 volts.

When the 4PR1000A is utilized in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

Element Dissipation—Under normal operating conditions, the average plate dissipation of the 4PR1000A should not be allowed to exceed 1000 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

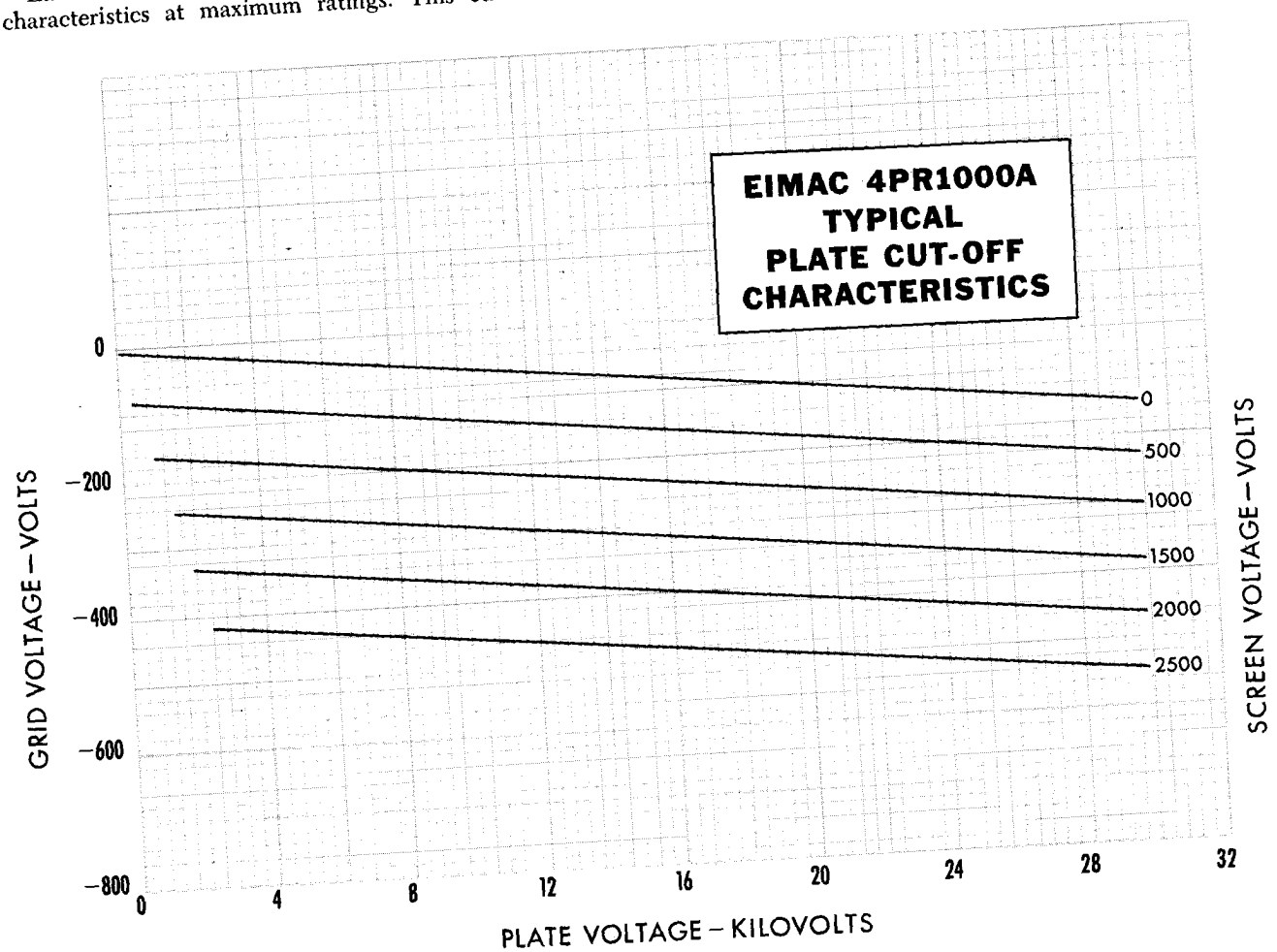
The average power dissipated by the screen-grid and the control-grid must not exceed 75 watts and 25 watts, respectively.

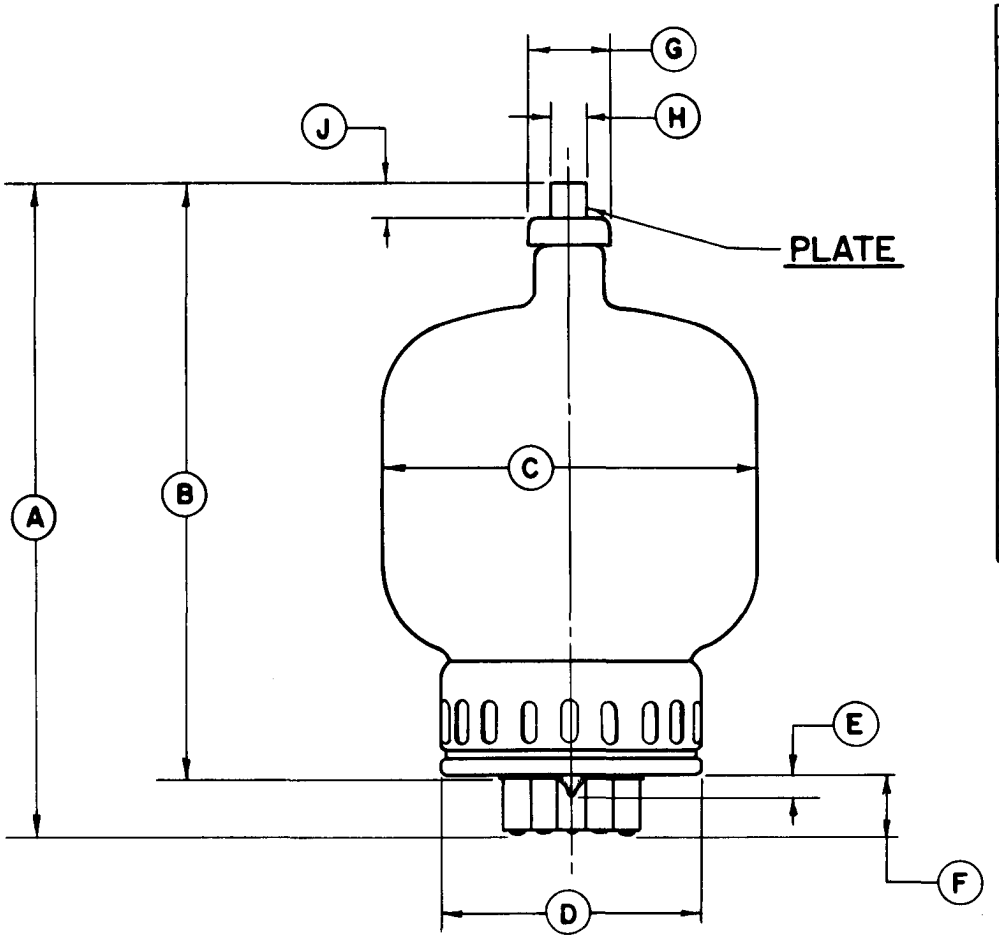
Cut-Off Characteristics—The Plate Current Cut-Off Characteristics of the 4PR1000A are shown in the graph below. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristics closely approximate the mean value in the tube test specification.

Each 4PR1000A is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 30 KV, a screen voltage of 2.5 KV with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 600 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between −470 volts and −585 volts.

Pulse-Modulator Service—The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate waveform is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

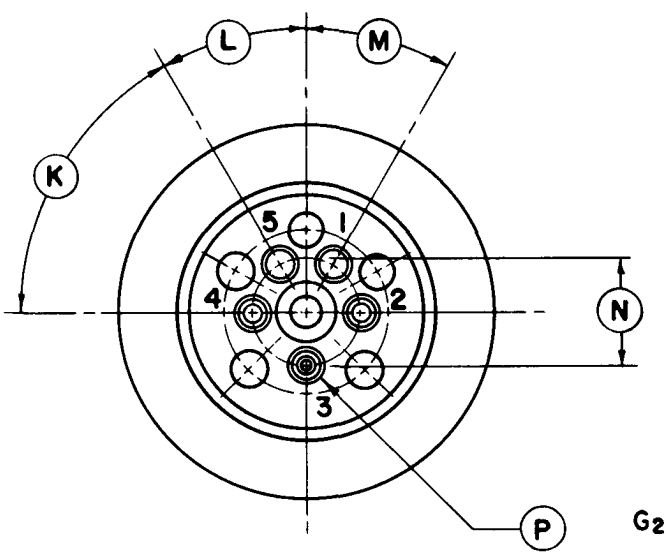
Special Applications — If it is desired to operate this tube under conditions widely different from those given here, please write to Power Grid Tube Marketing, Eimac, a division of Varian Associates, 301 Industrial way, San Carlos, California, for information and recommendations.



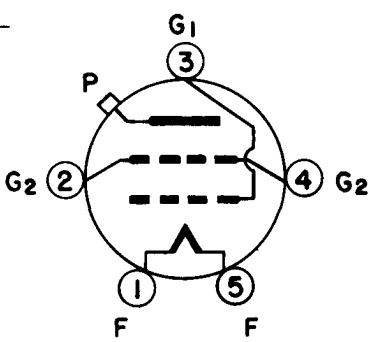


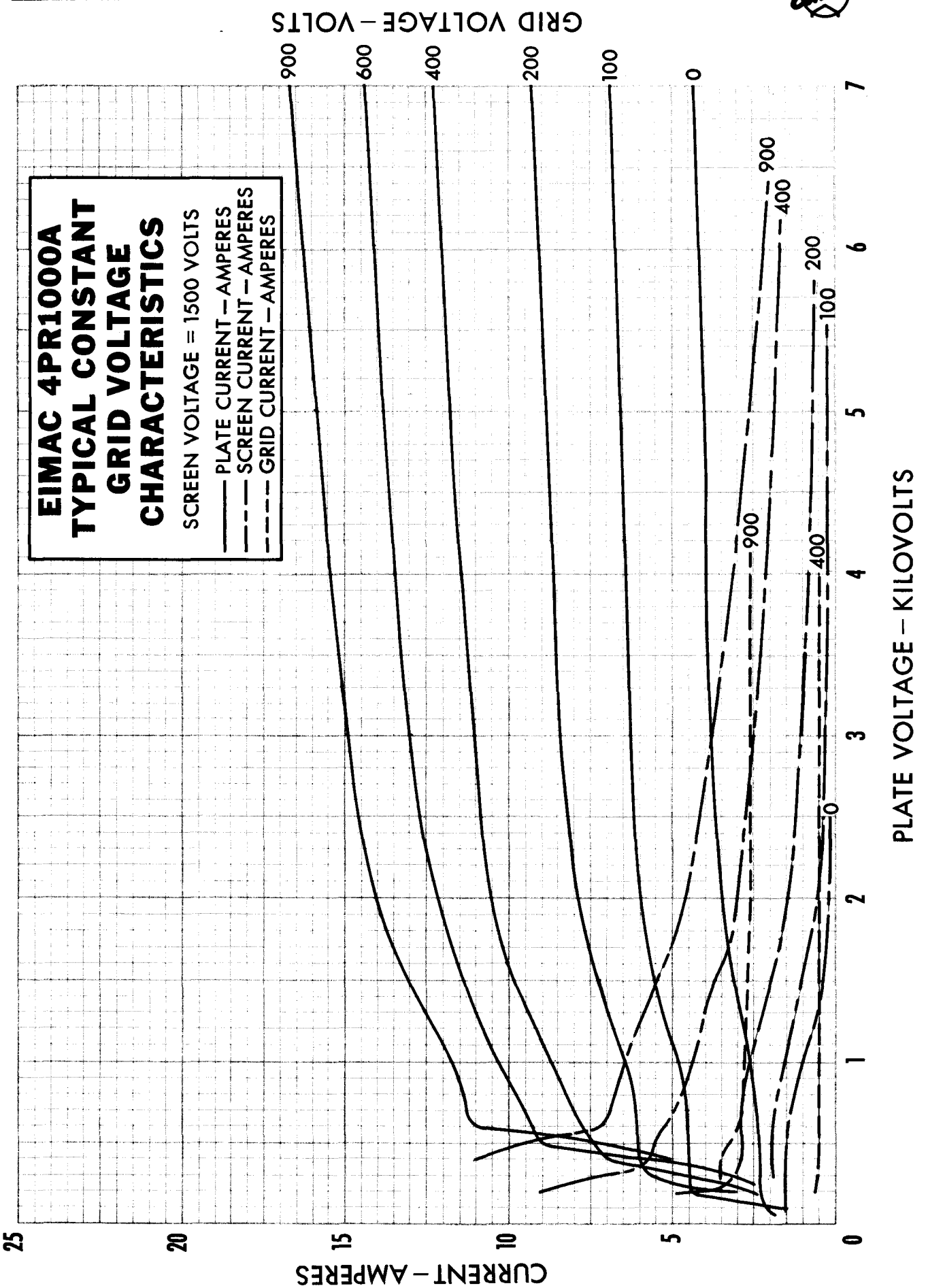
DIMENSIONS IN INCHES

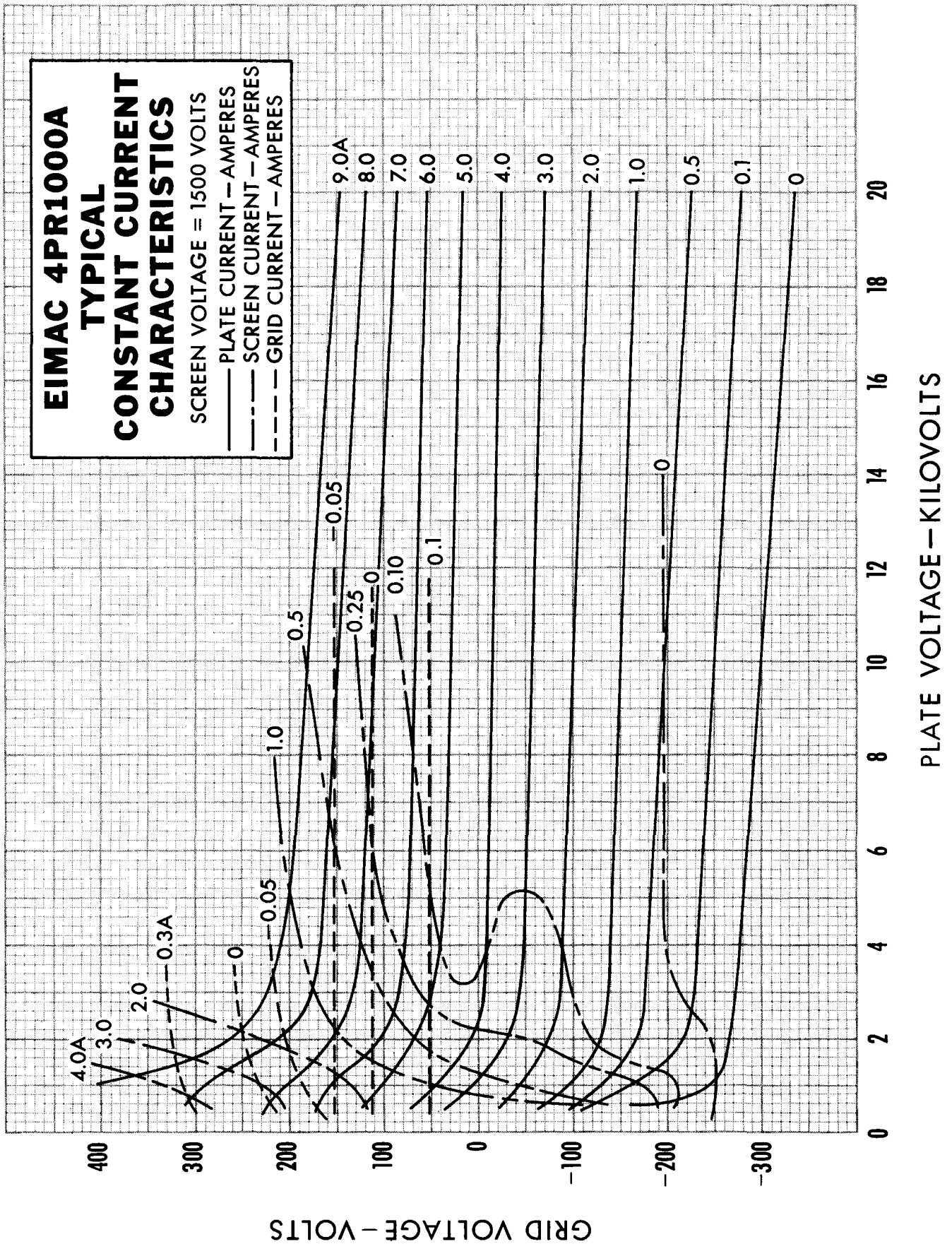
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	8.875	9.625	9.250
B	8.000	8.750	8.375
C		5.250	
D		3.625	
E		.313	
F	.825	.925	.875
G	1.110	1.140	1.250
H	.559	.573	.566
J	.484		
K			60°
L			30°
M			30°
N	1.495	1.505	1.500
P	.371	.377	.374



BOTTOM VIEW




EIMAC 4PR1000A
TYPICAL CONSTANT
GRID VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE – VOLTS
900
600
400
200
100
0
CURRENT – AMPERES
25
20
15
10
5
0
PLATE VOLTAGE – KILOVOLTS
1
2
3
4
5
6
7


EIMAC 4PR1000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 1500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
9.0A
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.1
0
0.05
0.10
0.25
0.3A
GRID VOLTAGE – VOLTS
400
300
200
100
0
-100
-200
-300
PLATE VOLTAGE – KILOVOLTS
0
2
4
6
8
10
12
14
16
18
20