EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8187 / 4PR65A

RADIAL-BEAM PULSE TETRODE

MODULATOR OSCILLATOR AMPLIFIER

The Eimac 8187/4PR65A 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.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Filament: Thoriated tungsten				
Voltage	-	6.0		volts
Current	3.2		3.8	amperes
Amplification Factor (Grid to Screen)	-	6.0		
Direct Interelectrode Capacitances, Grounded Cathode:†				
Grid-Plate	-	-	0.12	uuf
Input	6.0		8.3	uuf
Output	1.9		2.6	uuf
Highest Frequency for Maximum Ratings	-	-	150	mc

MECHANICAL

Base	5-pin
Basing	See drawing
Recommend Socket	National HX-29 or Johnson 122-101
Operating Position	Vertical, base down or up
Maximum Operating Temperatures:	
Base Seals	200°C
Plate Seal	225°C
Cooling	Radiation and forced-air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	4.19 inches
Diameter	2.38 inches
Net Weight (tube only)	3 ounces
Shipping Weight	1.5 pounds

†In Shielded Fixture

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

DC PLATE VOLTAGE	15	MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0	MAX. KILOVOLTS
DC GRID VOLTAGE	—1.0	MAX. KILOVOLT
PEAK PLATE CURRENT	1.0	MAX. AMPERES
PLATE DISSIPATION (AVG.)	65	MAX. WATTS
SCREEN DISSIPATION (AVG.)	10	MAX. WATTS
GRID DISSIPATION (AVG.)	5	MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	5	10	15 kilovolts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—180	—225	—270 volts
Pulse Plate Voltage	4.35	9.35	14.35 kilovolts
Peak Plate Current	0.95	0.95	0.95 amperes
Pulse Screen Current	0.20	0.20	0.20 ampere
Pulse Grid Current	0.12	0.12	0.12 ampere
Pulse Pos. Grid Voltage	100	100	100 volts
Pulse Drive Power	33.6	39.0	44.5 watts
Pulse Plate Input Power	4.75	9.50	14.25 kilowatts
Pulse Plate Output Power	4.10	8.85	13.60 kilowatts
Duty	10	10	10 percent

(Effective 2-15-63) c 1968 by Varian

Printed in U.S.A.

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

MAXIMUM RATINGS

PEAK DC PLATE VOLTAGE	10 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
D-C GRID VOLTAGE	—1.0 MAX. KOLOVOLT
PEAK CATHODE CURRENT (Note 1)	1.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	65 MAX. WATTS
SCREEN DISSIPATION (AVG.)	10 MAX. WATTS
GRID DISSIPATION (AVG.)	5 MAX. WATTS

*When used as a RF 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	5	7.5	10 kilovolts
Pulse Screen Voltage	500	500	500 volts
DC Grid Voltage	—265	—300	—335 volts
Pulse Plate Current (Note 1)	200	200	200 mA
Pulse Screen Current	20	20	20 mA
Pulse Grid Current	12	12	12 mA
Peak RF Grid Voltage	370	405	440 volts
Pulse Drive Power	4.5	4.85	5.3 watts
Pulse Plate Input Power	1000	1500	2000 watts
Pulse Plate Output Power	815	1270	1720 watts
Duty	35	28	23 percent

RADIO-FREQUENCY GRID-PULSED AMPLIFIER AND OSCILLATOR

MAXIMUM RATINGS

DC PLATE VOLTAGE	7.5 MAX. KILOVOLTS
DC SCREEN VOLTAGE	2.0 MAX. KILOVOLTS
DC GRID VOLTAGE	—1.0 MAX. KILOVOLT
PEAK CATHODE CURRENT (Note 1)	1.5 MAX. AMPERES
PLATE DISSIPATION (AVG.)	65 MAX. WATTS
SCREEN DISSIPATION (AVG.)	10 MAX. WATTS
GRID DISSIPATION (AVG.)	25 MAX. WATTS

TYPICAL OPERATION

DC Plate Voltage	4.5	6.0	7.5 kilovolts
DC Screen Voltage	500	500	500 volts
DC Grid Voltage	—260	—280	—300 volts
Pulse Plate Current (Note 1)	200	200	200 mA
Pulse Screen Current	20	20	20 mA
Pulse Grid Current	12	12	12 mA
Peak RF Grid Voltage	365	385	405 volts
Pulse Drive Power	4.4	4.6	4.9 watts
Pulse Plate Input Power	900	1200	1500 watts
Pulse Plate Output Power	725	1000	1265 watts
Duty	37	32	27 percent

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

APPLICATION

MECHANICAL

Mounting—The 8187/4PR65A must be operated vertically, base up or down. The socket must provide clearance for the glass tip-off which extends from the center of the base. A flexible connecting strap should be provided between the plate terminal and the external plate circuit, and the Eimac HR-6 connector (or equivalent) used on the tube plate lead. The socket must not apply lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Cooling—When the inlet air temperature does not exceed 30° C it will not ordinarily be necessary to provide forced-air cooling of the envelope or the plate seal at frequencies below 30 Mc. provided the HR-6 Heat-Radiating plate connector is used and the tube is so located that normal circulation of air past the envelope is not impeded.

In the event the inlet air temperature is expected to be greater than 30° C, adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200° C and 225° C, respectively. In all classes of operation it is recommended that a heat radiating connector, the Eimac HR-6 or equivalent, be installed on the anode terminal, and that a socket be employed which provides for proper seal cooling. When the Eimac 8187/4PR65A, utilizing an HR-6 heat radiator, is operated at dc or low frequencies in a Johnson 122-101 socket, the minimum airflow requirements to maintain seal temperatures at 200° C in 50° C inlet air are tabulated below:

	Sea Level		10,000 Feet	
Avg. Plate Dissipation (watts)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)	Air Flow (CFM)	Plenum Pressure Drop. (Inches of Water)
40	1.7	0.013	2.5	0.02
50	2.4	0.024	3.5	0.04
65	3.3	0.036	4.8	0.06

When the Eimac 8187/4PR65A 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 rf 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 6.0 volts. Variations in filament voltage must

be kept within the range of 5.7 to 6.3 volts.

When the 8187/4PR65A 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 8187/4PR65A should not be allowed to exceed 65 watts. Dissipation in excess of this maximum rating is permissable for short periods of time, such as during tuning procedures.

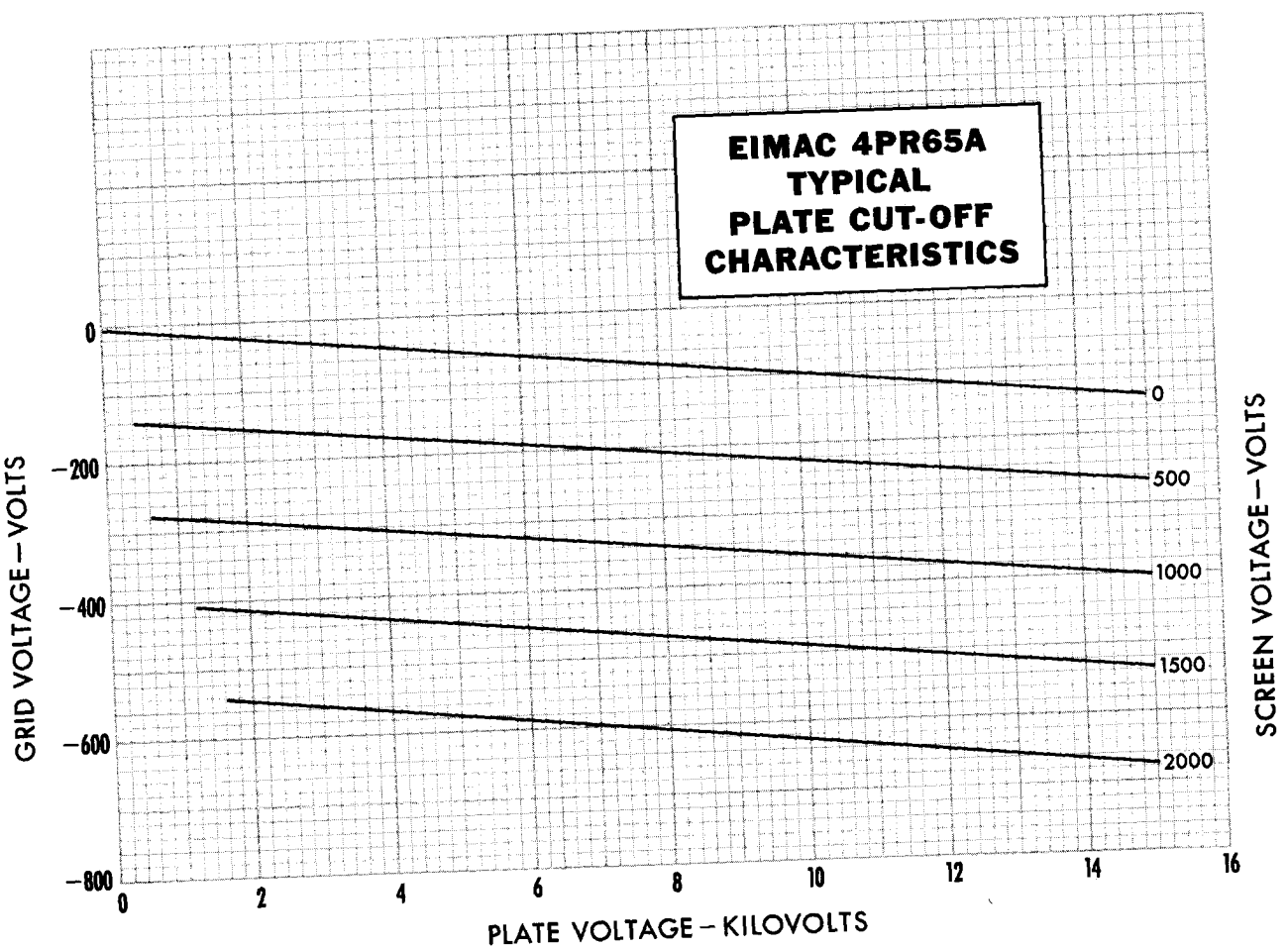
The average power dissipated by the screen-grid and the control-grid must not exceed 10 watts and 5 watts, respectively.

Cut-Off Characteristics—The Plate Current Cut-Off Characteristics of the 8187/4PR65A 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.

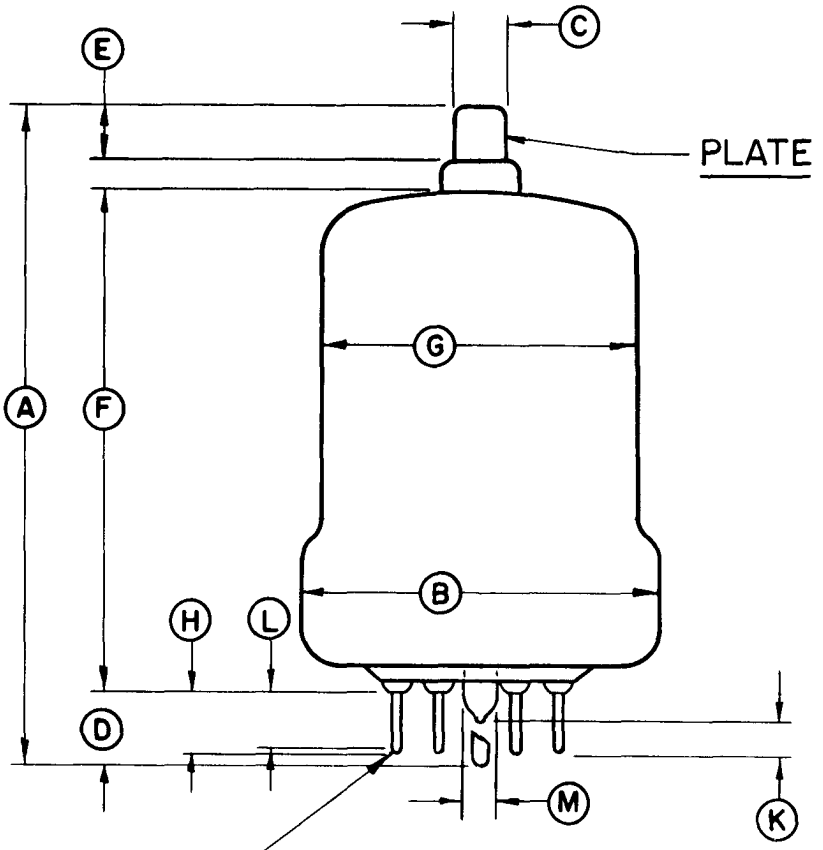
Each 8187/4PR65A is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 15 KV, a screen voltage of 1.5 KV with the grid voltage adjusted to maintain a plate current of 10 microamperes. Under these test conditions the negative grid bias must not exceed 575 volts. Due to tube-to-tube variations this cut-off point will vary and the typical range can be expected to be between 350 volts and 500 volts.

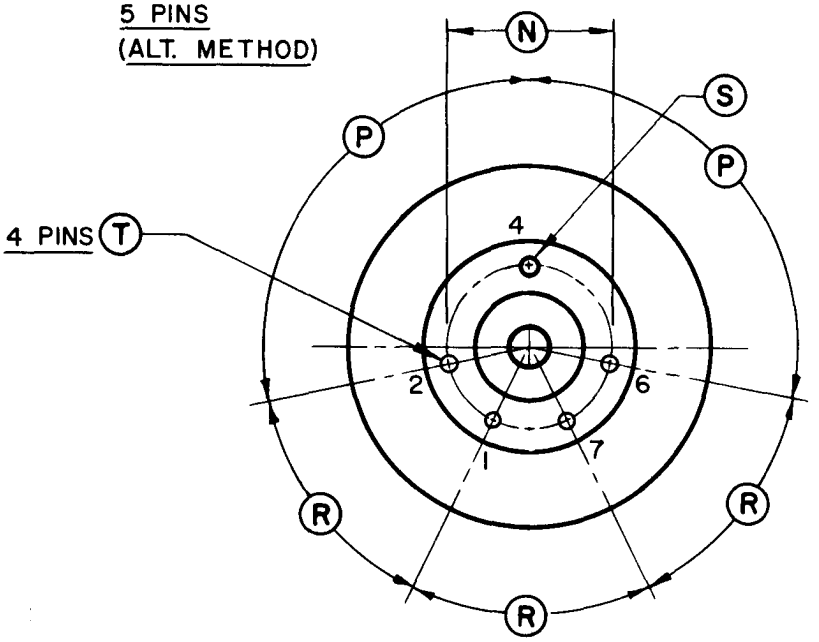
Pulse-Modulator Service—The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, 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.

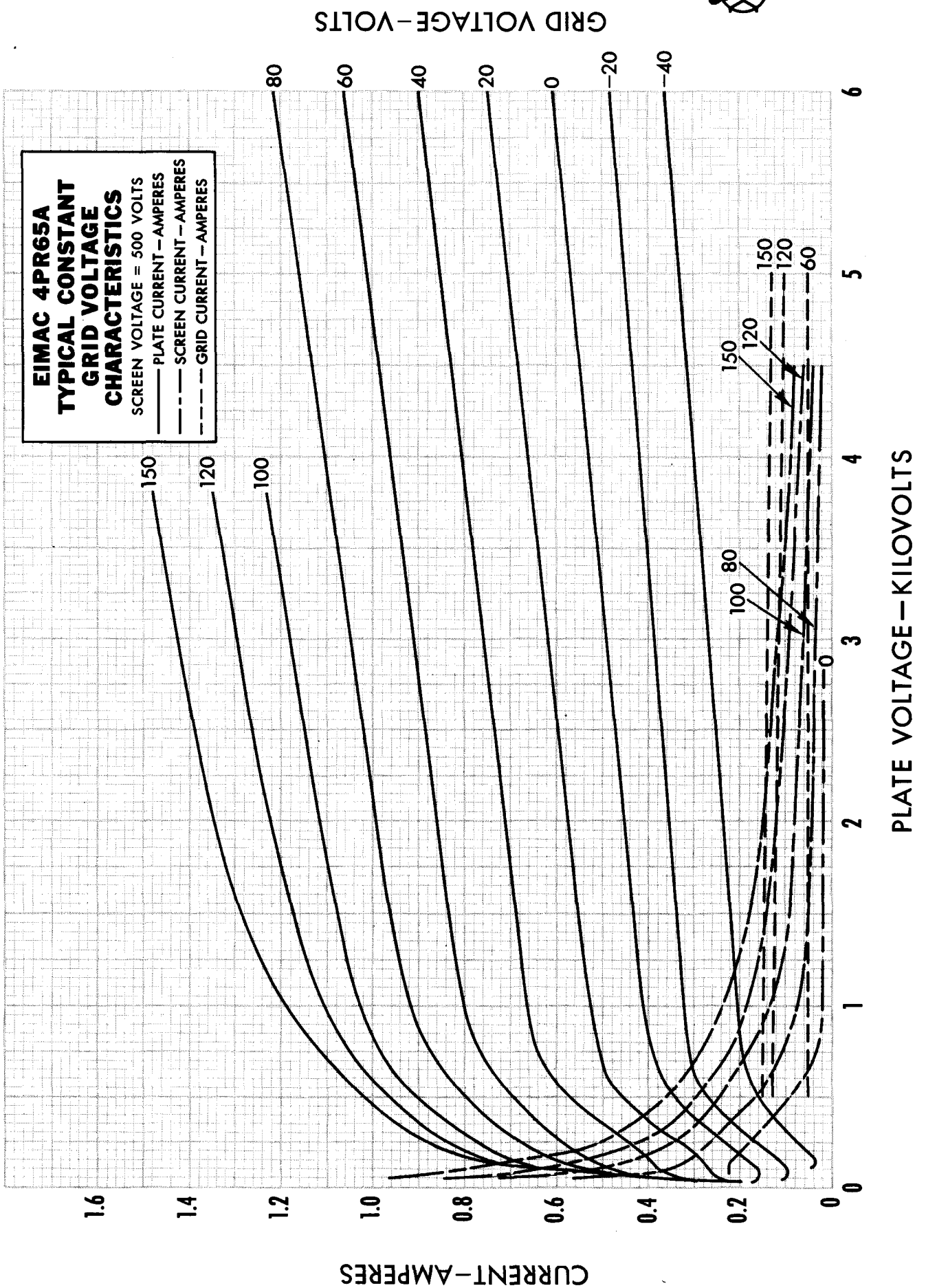
Special Applications—If it is desired to operate this tube under conditions widely different from those given here, please write to Power Grid Tube Marketing, Eimac, Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

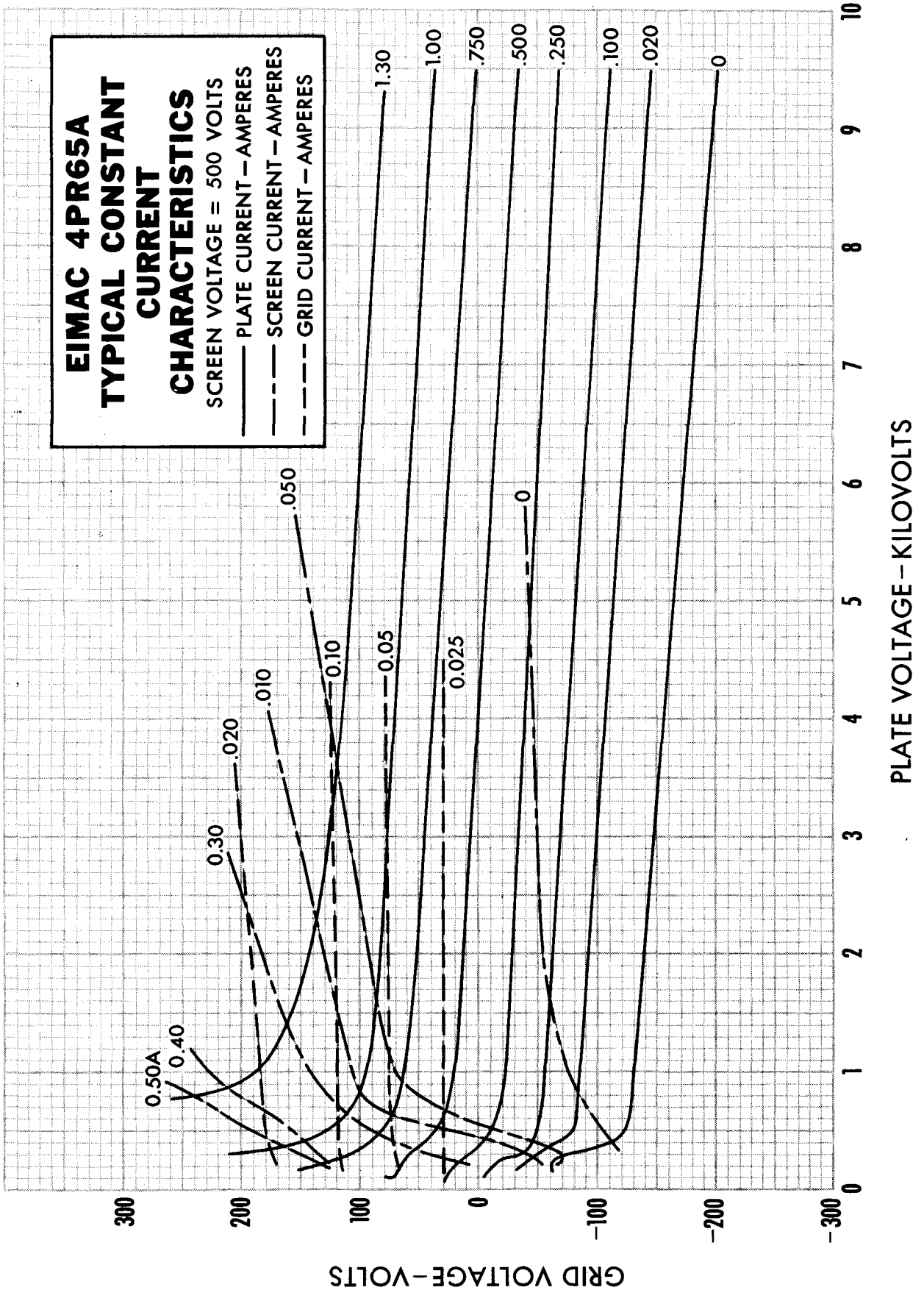


DIMENSIONS IN INCHES			
DIMENSIONAL DATA			
REF.	MIN.	MAX.	NOM.
A	4	4-3/16	
B		2-3/8	
C	.350	.365	
D	7/16	9/16	
E	21/64		
F	2-15/16	3-5/16	
G		2-1/8	
H	3/8	1/2	
K	.000		
L	5/16		
M		3/8	
N			1.000
P			102°
R			52°
S	.122 DIA.	.128 DIA.	
T	.055 DIA.	.061 DIA.	






EIMAC 4PR65A
TYPICAL CONSTANT
GRID VOLTAGE
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
80
60
40
20
0
−20
−40
150
120
100
80
60
0
PLATE VOLTAGE—KILOVOLTS
0
1
2
3
4
5
6
CURRENT—AMPERES
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6


EIMAC 4PR65A
TYPICAL CONSTANT
CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
1.30
1.00
.750
.500
.250
.100
.020
0
.050
0
0.10
0.05
0.025
.010
.020
0.30
0.40
0.50A
300
200
100
0
-100
-200
-300
0
1
2
3
4
5
6
7
8
9
10
PLATE VOLTAGE—KILOVOLTS
GRID VOLTAGE—VOLTS