TECHNICAL DATA

8164
3-1000Z

HIGH-MU
POWER TRIODE

The EIMAC 8164/3-1000Z is a compact power triode intended to be used as a zero-bias Class-B amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifies associated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since a power gain as high as twenty times can be obtained with the 8164/3-1000Z in a cathode driven circuit.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	7.5 ± 0.37 V
Current	20 A
Amplification Factor (Average)	200
Interelectrode Capacitance (Grounded Cathode)[2]	
Cin	17.0 pF
Cout	0.2 pF
Cgp	7.5 pF
Interelectrode Capacitance (Grounded Grid)[2]	
Cin	17.0 pF
Cout	7.5 pF
Cpk	0.2 pF
Frequency of Maximum Rating (CW)	110 MHz

1. Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement. EIMAC Division of Varian should be consulted before using this information for final equipment design.

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

MECHANICAL

Base	5-Pin Special
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Recommended Heat-Dissipating Plate Connector	EIMAC HR-8
Recommended Air-System Socket	EIMAC SK-510
Recommended Air-System Chimney	EIMAC SK-516
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C

Maximum Overall Dimensions:

Height	7.875 In;	200.02 mm
Diameter	5.250 In;	133.35 mm
Net Weight	1.2 lb;	0.55 kg

RADIO FREQUENCY POWER AMPLIFIER

Class C, Grid Driven

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	700	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	1000	WATTS

TYPICAL OPERATION

Plate Voltage	3000	4500	6000	Vdc
Grid Voltage	-30[1]	-75	-100	Vdc
Plate Current	700	700	700	mAdc
Grid Current[2]	230	240	250	mAdc
Peak RF Grid Voltage[2]	107	200	230	v
Grid Driving Power[2]	27	48	57	W
Output Power[2]	1300	2250	3200	W

1. Operating bias may be wholly derived from grid current flowing through 130 ohm, 25 watt resistor.
2. Approximate value.

PLATE MODULATED RF AMPLIFIER

Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4500	VOLTS
DC PLATE CURRENT	550	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	670	WATTS

1. Drive modulation is required with a high-mu triode.
2. Approximate value.

TYPICAL OPERATION[1]

Plate Voltage	4500	Vdc
Grid Voltage	-100	Vdc
Plate Current	500	mAdc
Grid Current[2]	170	mAdc
Drive Power[2]	35	W
Output Power (carrier)[2]	1765	W

RADIO-FREQUENCY LINEAR AMPLIFIER

Class B, Zero Bias, Cathode Driven

MAXIMUM RATINGS:

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	800	MA
GRID DISSIPATION	50	WATTS
PLATE DISSIPATION	1000	WATTS

1. Approximate value.
2. Referenced against one tone of a two-equal tone signal.

TYPICAL OPERATION

Plate Voltage	2500	3000	Vdc
Zero-Signal Plate Current[1]	162	240	mAdc
Max. Signal Plate Current	800	670	mAdc
Max. Signal Grid Current[1]	260	220	mAdc
Max. Signal Drive Power[1]	100	47	W
Plate Load Impedance	1760	2650	ohms
Nominal Cathode Impedance	65	67	ohms
Plate Output Power[1]	1050	1080	W
Intermodulation Distortion[2]			
Products: 3rd Order	-32	-29	dB
5th Order	-39	-37	dB

AUDIO FREQUENCY AMPLIFIER OR MODULATOR

Class B

MAXIMUM RATINGS (per tube):

DC PLATE VOLTAGE	6000	VOLTS
DC PLATE CURRENT	800	MA
PLATE DISSIPATION	1000	WATTS
GRID DISSIPATION	50	WATTS

1. Approximate Value. Adjust to provide stated zero-signal plate current.
2. Approximate value.

TYPICAL OPERATION
(Sinusoidal Wave, Two Tubes, Grid Driven)

Plate Voltage	3000	5000	Vdc
Grid Voltage[1]	0	-13	Vdc
Zero-Signal Plate Current	350	200	mAdc
Max. Signal Plate Current	1450	1000	mAdc
Max. Signal Grid Current[2]	485	310	mAdc
Driving Power[2]	48	28	W
Peak AF Driving Voltage[2]	100	90	v
Load Resistance Plate to Plate	3940	10,200	ohms
Max. Sig. Plate Output Power[2]	2540	3560	W

RANGE VALUES FOR EQUIPMENT DESIGN:	Min.	Max.	
Filament Current, at 7.5 volts	20.0	22.7	A
Zero Bias Plate Current (E_b = 3000 Vdc)	160	260	mAdc
Cut-Off Voltage (Eb = 3000 Vdc; Ib = 1.0 mAdc)	---	-24.0	Vdc
Interelectrode Capacitance (Grounded Cathode Connection)[1]			
Cin	15.0	19.0	pF
Cout	---	0.30	pF
Cgp	6.0	9.0	pF
Interelectrode Capacitance (Grounded Grid Connection) [1]			
Cin	15.0	19.0	pF
Cout	6.0	9.0	pF
Cpk	---	0.30	pF

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

APPLICATION

MOUNTING - The 3-1000Z must be operated vertically, base up or base down. A flexible connecting strap should be provided between the EIMAC HR-8 Heat Dissipating Connector on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock. The EIMAC SK-510 socket or equivalent must be employed to prevent excess lateral pressure on base pins and seal of the tube.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C, and the plate seal at a temperature below 225°C. When using the EIMAC SK-510 Air-System Socket and SK-516 Chimney, a minimum air flow rate of 25 cubic feet per minute at a static pressure of approximately 0.43 inch of water, as measured at the socket at sea level, is required to provide adequate cooling at an inlet air temperature of 50°C. Above 30 megahertz the required air flow is increased to 35 cubic feet per minute at a static pressure of approximately 0.8 inch of water, as measured at the SK-510 socket. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

When a socket other than the SK-510 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate seal. In all cases air flow rates in excess of the minimum requirements will prolong tube life.

FILAMENT OPERATION - The rated filament voltage for the 3-1000Z is 7.5 volts. Filament voltage, as measured at the socket, must be maintained within the range of 7.13 to 7.87 volts to obtain maximum tube life. Operation at reduced voltage decreases emission capability, but increases life expectancy.

INTERMODULATION DISTORTION - Typical Operating Conditions and Intermodulation Distortion Product values are derived from measurements made at 2 MHz and are referred to one tone of a two-tone test signal. As the driving signal is reduced below full peak envelope power, distortion products remain at, or better than, the indicated value.

CLASS C OPERATION - Although designed for Class B service, the 3-1000Z may be operated as a Class-C power amplifier or oscillator, or as a plate-modulated rf amplifier. The zero-bias characteristics can be used to advantage in Class C amplifiers by employing only grid leak bias. If driving power fails, plate dissipation is kept to a low level since the tube will operate at normal, static zero-bias conditions.

ZERO-BIAS OPERATION - Operating at zero-bias is not recommended with plate voltages over 3500 volts since plate dissipation may be exceeded. Similarly, the safety of zero-bias opera-

tion as mentioned above under "Class-C Operation" is not available at plate voltages above 3500 volts. Straight Class-C or Class-B operation is, of course, permissible up to 6000 volts where other ratings are not exceeded.

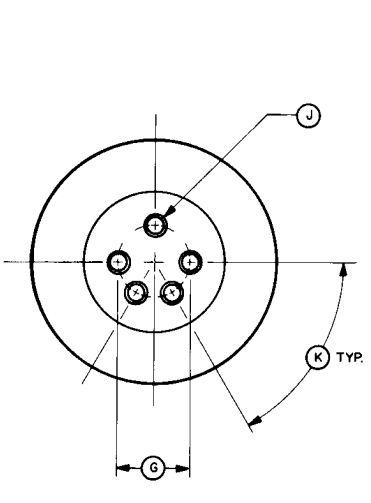
INPUT CIRCUIT - When the 3-1000Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

HIGH VOLTAGE - Normal operating voltages used with the 3-1000Z are deadly, and the equipment must be designed properly 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 condensers 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.

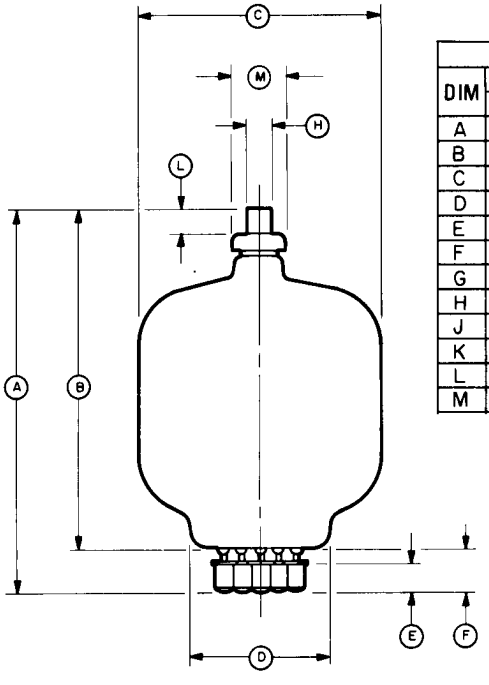
INTERELECTRODE CAPACITANCE - The actual internal interelectrode capacitance of a tube is influenced by many variables in most applications; such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a period of time, even when the tube may be made by different manufacturers The capacitance values shown in the manufacturer's technical data, or test specifications, normally 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 any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

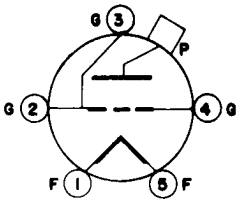
SPECIAL APPLICATIONS - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.

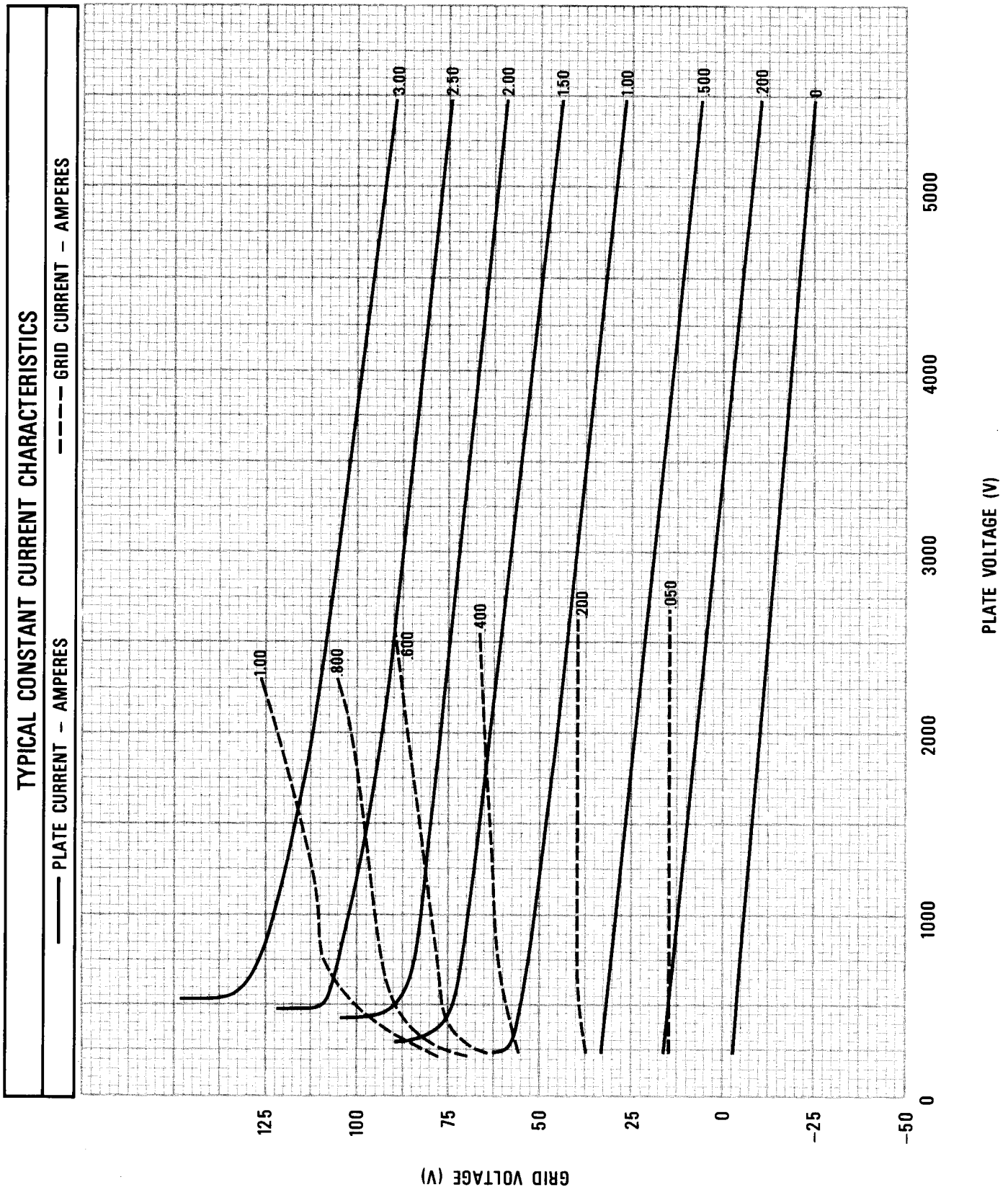


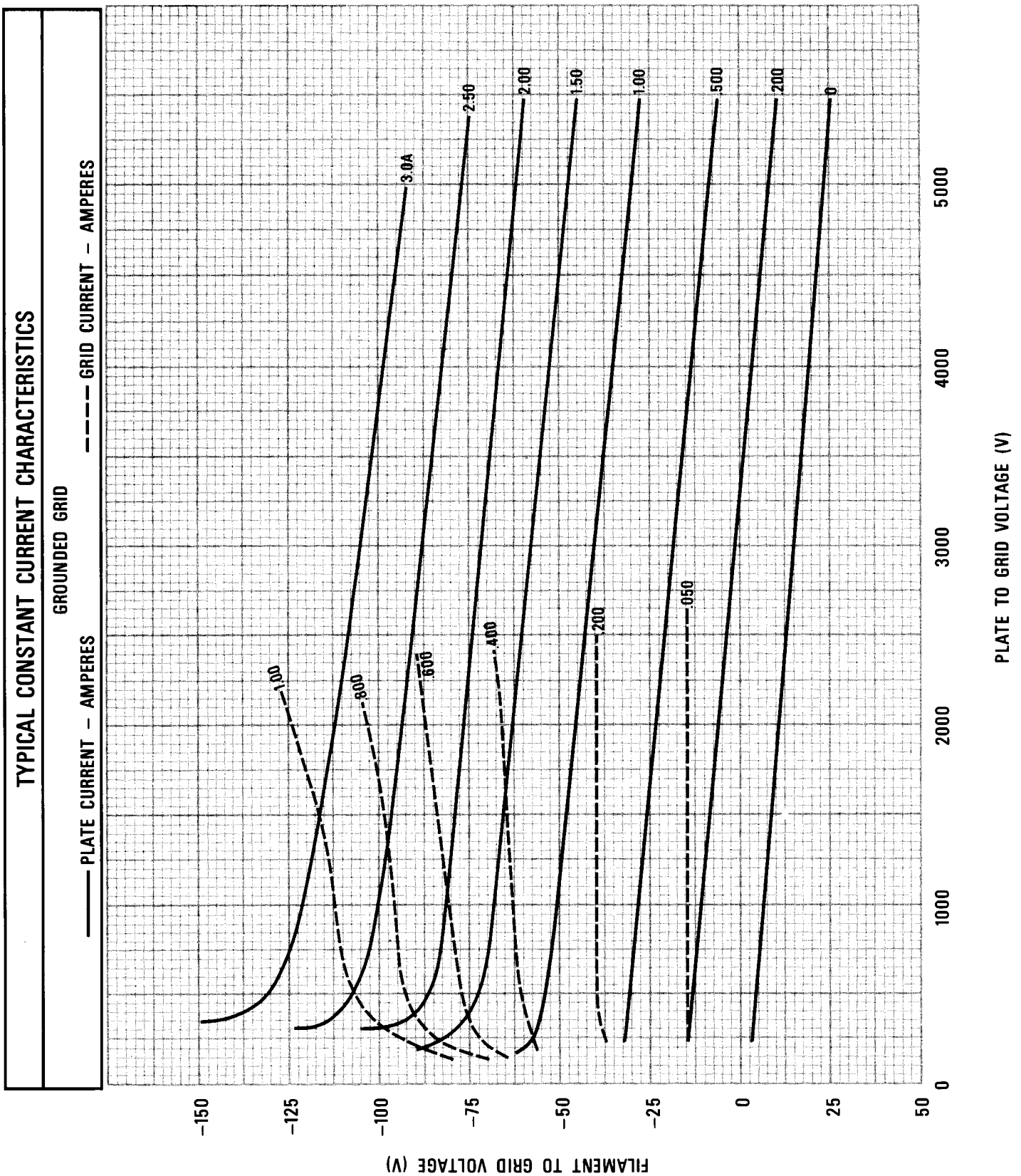
BOTTOM VIEW



DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	7.500	7.875	- -	190.5	200.0	- -
B	6.812	7.187	- -	173.0	182.5	- -
C	- -	5.250	- -	- -	133.3	- -
D	3.062	3.187	- -	77.77	80.95	- -
E	0.531	0.656	- -	13.49	16.66	- -
F	0.718	0.843	- -	18.24	21.41	- -
G	- -	- -	1.500	- -	- -	38.10
H	0.559	0.573	- -	14.20	14.55	- -
J	0.371	0.377	- -	9.42	9.57	- -
K	- -	- -	60°	- -	- -	60°
L	0.484	- -	- -	12.29	- -	- -
M	- -	- -	1.125	- -	- -	28.57




TYPICAL CONSTANT CURRENT CHARACTERISTICS
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
3.00
2.50
2.00
1.50
1.00
.500
.200
0
1.00
.800
.600
.400
.200
.050
125
100
75
50
25
0
−25
−50
0
1000
2000
3000
4000
5000
GRID VOLTAGE (V)
PLATE VOLTAGE (V)


TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
3.0A
2.50
2.00
1.50
1.00
500
200
0
1.00
800
600
400
200
050
FILAMENT TO GRID VOLTAGE (V)
–150
–125
–100
–75
–50
–25
0
25
50
0
1000
2000
3000
4000
5000
PLATE TO GRID VOLTAGE (V)