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3-500ZG™

High Mu Power Triode

TECHNICAL DATA

The RF Parts 3-500ZG™ is a compact power triode intended to be used as a zero-bias Class AB_2 amplifier in audio or radio-frequency applications. Operation with zero grid bias simplifiers assocated circuitry by eliminating the bias supply. In addition, grounded-grid operation is attractive since power gain as high as twenty can be obtained with the 3-500ZG™ in a cathode-driven circuit. Characteristics of the RF Parts 3-500ZG™ is patterened after the late production Eimac® 3-500Z.

General Characteristics[1]

Electrical

Filament: Thoriated Tungsten

Voltage	5.0 ± 0.25 Volts
Current @ 5.0 Volts	14.6 Amperes
Amplification Factor (Average)	130

Direct Interelectrode Capacitance (Grounded Filament)

Cin	8.3 pF
Cout	0.07 pF
Cgp	4.7 pf

Direct Interelectrode Capacitance (Grounded Circuit)

Cin	8.3 pF
Cout	4.7 pF
Cgp	0.07 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.

RF PARTS™ COMPANY

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Electrical

Maximum Overall Dimensions:

Length ..... 6.10 in; 154.94 mm
Diameter ..... 3.44 in; 87.33 mm
Net Weight ..... 7 oz; 198.5 gm
Operating Position ..... Vertical, base up or down

Maximum Operating Temperature:

Plate Seals ..... 225°C
Base Seals ..... 200°C
Cooling ..... Radiation and Forced Air
Base ..... 5 Pin Special
Recommended Socket ..... Taylor 275, RFP SK410S, SK410 or Johnson 275
Recommended Chimney ..... RFP SK406A, RFP SK406B, SK406

Recommended Heat-Dissipating Connector:

Plate ..... RFP HR6-short, RFP HR6-tall, HR-6

Radio Frequency Linear Amplifier Cathode Driven

(Frequencies to 110 MHz)

Class AB_2

Maximum Ratings:

DC Plate Voltage ..... 4000 Volts
DC Plate Current ..... 0.4 Ampere
Plate Dissipation ..... 500 Watts
Grid Dissipation ..... 20 Watts

Typical Operation

Class AB_2, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	2500	3000	3500	Vdc
Cathode Voltage[1]	0	0	0	+10	+15	Vdc
Zero Signal Plate Current[2]	65	95	130	62	53	mAdc
Single-Tone Plate Current, CW[4]	400	400	400	400	400	mAdc
Two-Tone Plate Current[3]	260	270	280	268	262	mAdc
Single-Tone Grid Current[2]	130	130	120	108	108	mAdc
Two-Tone Grid Current[2]	80	80	70	60	58	mAdc
Single-Tone Power Input	600	800	1000	1200	1400	W
Useful Output Power, CW or PEP	330	500	600	740	890	W
Resonant Load Impedance	1600	2750	3450	4200	5000	
Intermodulation Distortion Products[5]						
3rd Order	-46	-38	-33	-40	-40	db
5th Order	—	—	—	-46	-45	db
Driving Impedance	94	102	100	115	115	
Maximum Signal Driving Power[2]	49	49	46	46	46	W

1. Zener diode bias used at plate potentials of 3 kV and above.
2. Approximate value.
3. Currents listed correspond to SSB, or "Two-tone" average current at peak of signal envelope.
4. Single-tone current for 3500 Vdc operation may reach this value during short periods of circuit adjustment only.
5. Intermodulation distortion products are referenced against one tone of a two tone signal.

Audio Frequency Power Amplifier or Modulator

Class AB_2, Grid Driven (Sinusoidal Wave)

Maximum Ratings (Per Tube):

DC Plate Voltage[1]	4000 Volts
DC Plate Current	0.4 Ampere
Plate Dissipation	500 Watts
Grid Dissipation	20 Watts

Typical Operation (Two Tubes)

Plate Voltage	3000 Vdc
Grid Voltage	0 Vdc
Zero-Signal Plate Current[2]	300 mAdc
Maximum Signal Plate Current	770 mAdc
Max. Signal Grid Current[2]	244 mAdc
Peak at Grid Voltage[3]	100 V
Peak Driving Power[4]	25 W
Plate Input Power	2310 W
Maximum Signal Plate Dissipation	890 W
Plate Output Power	1420 W
Loud Resistance (plate to plate)	8600 Ohms

1. See zero-bias operation in Application Section.
2. Approximate value.
3. Per tube.
4. Nominal drive power is one-half peak power.

High-Level Modulated Radio Frequency Amplifier
Pulse-Width Modulation – Grid Driven

Absolute Maximum Ratings:	RF Amplifier	Switching Modulator	
DC Plate Voltage	4	10	Kilovolts
DC Plate Current	0.4	0.4	Amperes
DC Grid Voltage	-200	-200	Volts
Plate Dissipation	500	500	Watts
Grid Dissipation	20	20	Watts

Typical Operation (Carrier Conditions)	RF Amplifier	Switching Modulator	
Plate Voltage	3.0	9.0	kVdc
Plate Current	250	180	mAdc
Grid Voltage	-85	-120	Vdc
Grid Current[2]	170	125	mAdc
Useful Power Output[2]	550	1500	W

1. These conditions assume rectangular drive waveform and a third harmonic, high-efficiency "Tyler" circuit.
2. Approximate value.

Note: TYPICAL OPERATION data are obtained by calculation from published characteristic curves or actual measurement. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid current. The grid current which results when the desired plate current is obtained is incidental and varies from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

Radio Frequency Power Amplifier or Oscillator
Grid Driven, Cathode Driven

(Frequencies to 110 MHz)

Class AB_2 and C Telegraphy or FM (Key-Down Conditions)

Maximum Ratings:

DC Plate Voltage ..... 4000 Volts
DC Plate Current ..... 0.35 Ampere
Plate Dissipation ..... 500 Watts
Grid Dissipation ..... 20 Watts

Typical Operation	Grid Driven		Cathode Driven		
Plate Voltage	3000	3500	3000	3500	Vdc
Grid Voltage	-10	-75	-10	-75	Vdc
Plate Current	350	300	333	350	mAdc
Grid Current	115	115	108	118	mAdc
Peak rf (Cathode) (Grid) Voltage	110	187	95	200	V
Approximate Driving Power	14	22	35	81	W
Plate Input Power	1050	1050	1000	1225	W
Plate Dissipation	330	200	300	305	W
Useful Output Power	720	850	700	920	W
Resonant Load Impedance	4200	5700	4800	5500	Ohms

Application

Mechanical

Mounting – The 3-500ZG must be operated vertically, base up or down. A flexible connecting strap should be provided between the heat dissipating plate connector and the external plate circuit. The tube must be protected from severe vibration and shock.

Socket – The SK-410 air system socket and the SK-406 chimney are recommended for use with the 3-500ZG. When a socket other than the SK-410 is used, provisions must be made for equivalent cooling of the base, the envelope, and the plate lead.

If a socket other than the SK-410 is employed, the user should assure himself that strong lateral pressure is not applied to the tube base pins. Otherwise, even though the base of the tube is reinforced, damage to the base seals may result.

Caution–Glass Implosion – The RF Parts 3-500ZG is pumped to a very high vacuum, which is contained by a glass envelope. When handling a glass tube, remember that glass is a relatively fragile material, and accidental breakage can result at any time. Breakage will result in flying glass fragments, so safety glasses, heavy clothing, and leather gloves are recommended for protection.

Cooling – Forced-air cooling is required to maintain the base seals at a temperature below 200°C. Air flow requirements to maintain the above maximum temperatures are tabulated below. (For operation below 30 MHz.)

Base-to-Anode Air Flow		
Anode Dissipation (Watts)	Air Flow (CFM)	Pressure Drop (inches–H_2O)
300	6.6	0.023
400	10.3	0.052
500	13.0	0.082

The anode of the 3-500ZG operates at a visibly red color at its maximum rated dissipation of 500 Watts.

In all cases, air flow rates in excess of the minimum requirements will prolong tube life. NOTE: Two 3-500ZG tubes in a single amplifier, chassis mounted, may be adequately cooled by use of a fan so mounted as to pressurize the space below the sockets. Fans suitable for use at or near sea level are Pamotor Model 2000, or Model 6500. The Rotron "Spartan" fan (3200 rpm) is also suitable, as is a #3, 3 inch squirrel cage blower (3100 rpm).

In all cases, the only criteria of proper cooling is the temperature of the tube seals. Tube temperatures may be measured with the aid of temperature sensitive paint, spray, or crayon.

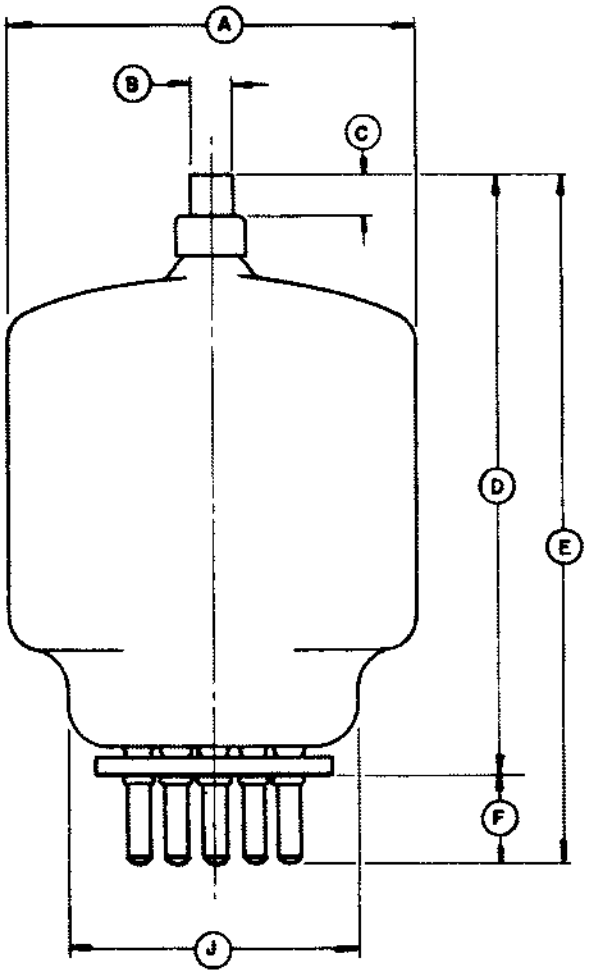
Electrical

Filament Operation – The rated filament voltage for the 3-500ZG is 5.0 volts. Filament voltage, as measured at the socket, should be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

For best tube life, the inrush current to the filament should be limited to two times normal current during turn-on. This will minimize thermal stress on the thoriated-tungsten filament wire, which can cause internal tube geometry changes with repeated cycling.

High Voltage – Operating voltage for this tube can be deadly, so the equipment must be designed properly and operating procedures must be followed. Design 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 the 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.**

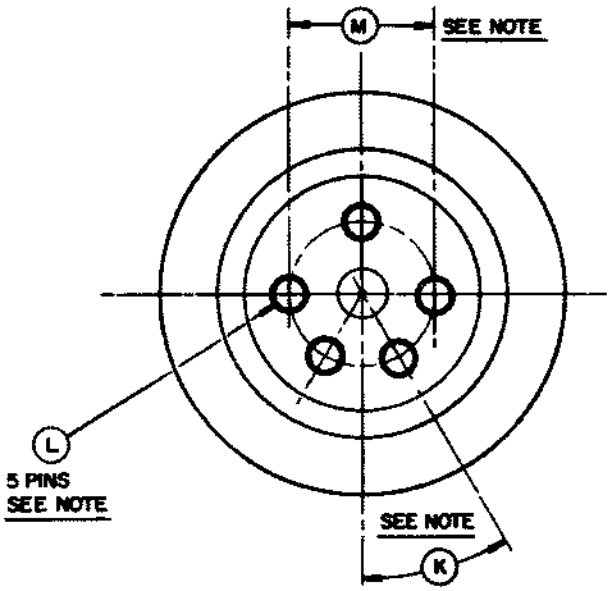
Input Circuit – When the 3-500ZG is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier, it is suggested that the cathode tank circuit operate at a Q of two or more.

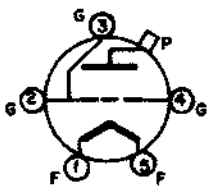


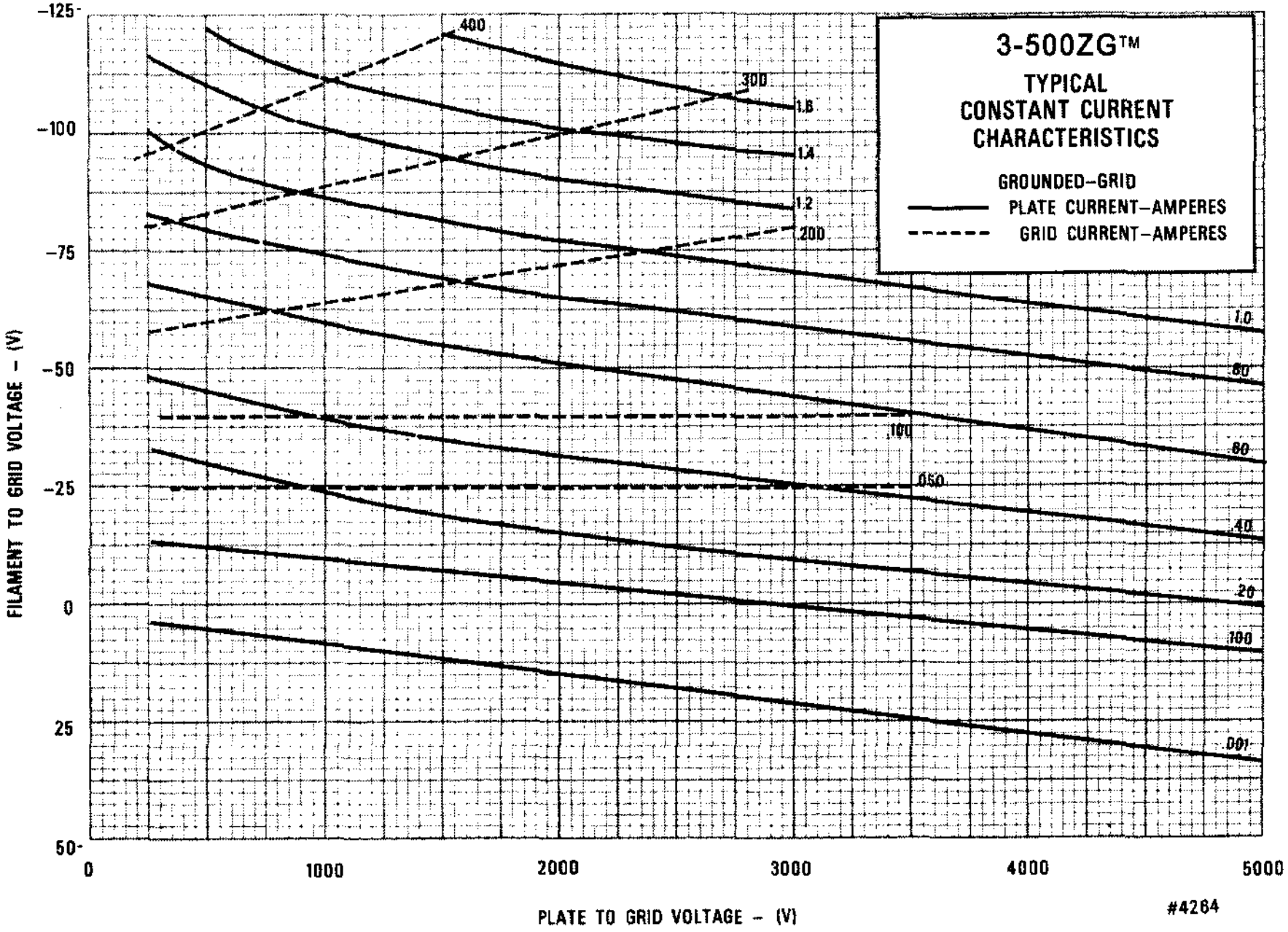
DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A		3.438			87.33	
B	.350	.365		8.89	9.27	
C	.328	.359		8.33	9.12	
D		5.200			132.1	
E	5.500	6.100		139.7	154.94	
F	.700			17.78		
G						
H						
I						
J		2.500			63.5	
K			30°			
L	.185	.191		4.7	4.85	
M			1.250			31.75

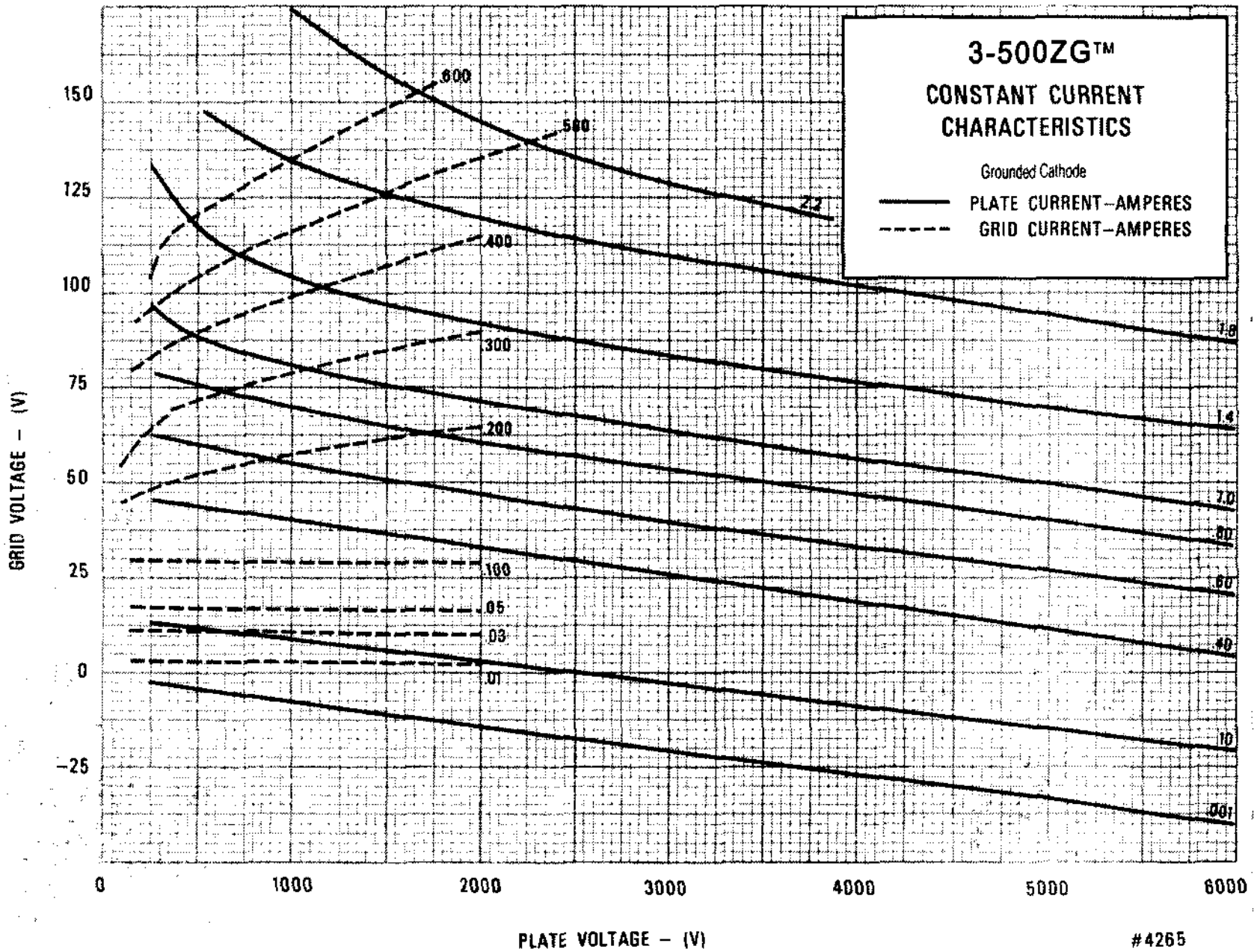
NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. METRIC EQUIVALENTS TO THE NEAREST .01mm, ARE GIVEN FOR GENERAL INFO ONLY & ARE BASED ON 1 INCH=25.4mm.
3. BASE PINS (L) ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4" THK. WITH HOLE DIAS. OF .204 LOCATED ON TRUE CENTERS BY THE GIVEN DIMS. (K) & (M)






3-500ZG™
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
GROUNDED–GRID
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
400
300
1.8
1.4
1.2
200
1.0
.80
.100
.60
.050
.40
.20
.100
.001
–125
–100
–75
–50
–25
0
25
50
0
1000
2000
3000
4000
5000
FILAMENT TO GRID VOLTAGE – (V)
PLATE TO GRID VOLTAGE – (V)
#4264


3-500ZG™
CONSTANT CURRENT CHARACTERISTICS
Grounded Cathode
PLATE CURRENT–AMPERES
GRID CURRENT–AMPERES
600
500
400
300
200
100
.05
.03
.01
2.2
1.8
1.4
1.0
.80
.60
.40
.10
.001
150
125
100
75
50
25
0
−25
0
1000
2000
3000
4000
5000
6000
GRID VOLTAGE – (V)
PLATE VOLTAGE – (V)
#4265