TECHNICAL DATA

8163
3-400Z

HIGH-MU
POWER TRIODE

The EIMAC 8163/3-400Z 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 8163/3-400Z in a cathode-driven circuit.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	5.0	V
Current	14.1	A
Amplification Factor (Average)	200	
Interelectrode Capacitances (Average),[2] Grounded-Grid Connection:		
Cin	7.1	pF
Cout	4.1	pF
Cpk	0.1	pF
Frequency for Maximum Ratings	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
Basing	See Drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and Forced Air
Heat-Dissipating Plate Connector	Supplied mounted on tube
Recommended Socket	EIMAC SK-410
Recommended Chimney	EIMAC SK-416
Maximum Operating Temperatures:	
Plate Seal	225°C
Base Seals	200°C
Maximum Over-All Dimensions:	
Height	5.375 In; 136.5 mm
Diameter	3.562 In; 90.47 mm
Net Weight (approximate)	7 Oz; 198 gm

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RADIO FREQUENCY LINEAR AMPLIFIER GROUNDED-GRID, Class B

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.40	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

TYPICAL OPERATION (Single-Tone Conditions)

Plate Voltage	3000	Vdc
Zero Sig. Plate Current[1]	100	mAdc
Max. Sig. Plate Current	333	mAdc
Max. Sig. Grid Current[1]	120	mAdc
Driving Impedance	122	Ω
Resonant Load Impedance	4750	Ω
Max. Sig. Driving Power[1]	32	W
Peak Envelope Plate Output Power	655	W

TYPICAL OPERATION (Minimum Distortion Products)

Plate Voltage	2000	Vdc
Zero Sig. Plate Current[1]	62	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current[1]	148	mAdc
Two Tone Plate Current	265	mAdc
Two Tone Grid Current[1]	87	mAdc
Driving Impedance	112	Ω
Resonant Load Impedance	2750	Ω
Max. Sig. Driving Power[1]	45	W
Peak Envelope Useful Output Power[1]	445	W
Intermodulation Distortion Products[2]	-40	dB

TYPICAL OPERATION (Minimum Distortion Products at 1 kW PEP Input)

Plate Voltage	2500	Vdc
Zero Sig. Plate Current[1]	73	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current[1]	142	mAdc
Two Tone Plate Current	274	mAdc
Two Tone Grid Current[1]	82	mAdc
Driving Impedance	114	Ω
Resonant Load Impedance	3450	Ω
Peak Envelope Useful Output Power[1]	560	W
Max. Sig. Driving Power[1]	44	W
Intermodulation Distortion Products[2]	-35	dB

TYPICAL OPERATION (Minimum Distortion Products with E_b = 1500 Vdc)

Plate Voltage	1500	Vdc
Zero Sig. Plate Current[1]	46	mAdc
Single Tone Plate Current	400	mAdc
Single Tone Grid Current[1]	163	mAdc
Two Tone Plate Current	265	mAdc
Two Tone Grid Current[1]	92	mAdc
Driving Impedance	109	Ω
Resonant Load Impedance	1620	Ω
Peak Envelope Useful Output Power[1]	300	W
Max. Sig. Driving Power[1]	46	W
Intermodulation Distortion Products[2]	-37	dB

1. Approximate value.

2. Approximate value; referenced against one tone of a two equal-tone signal.

AUDIO FREQUENCY AMPLIFIER OR MODULATOR
Class B

MAXIMUM RATINGS (PER TUBE):

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.40	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

1. Approximate value.

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

Plate Voltage	3000	Vdc
Grid Voltage	0	Vdc
Zero Sig. Plate Current[1]	200	mAdc
Max. Sig. Plate Current	666	mAdc
Max. Sig. Grid Current[1]	240	mAdc
Driving Power[1]	26	W
Peak af Driving Voltage(per tube)[1]	88	v
Load Resistance, Plate/Plate	9500	Ω
Max. Sig. Plate Output Power[1]	1310	W

RADIO FREQUENCY AMPLIFIER OR OSCILLATOR
Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	4000	VOLTS
DC PLATE CURRENT	0.35	AMPERE
PLATE DISSIPATION	400	WATTS
GRID DISSIPATION	20	WATTS

1. Approximate value.

TYPICAL OPERATION

Plate Voltage	3000	Vdc
Plate Current	333	mAdc
Grid Voltage	-75	Vdc
Grid Current[1]	130	mAdc
Peak rf Grid Voltage[1]	187	v
Grid Driving Power[1]	25	W
Plate Output Power[1]	730	W

RADIO FREQUENCY AMPLIFIER[1]
Plate Modulated, Class C

MAXIMUM RATINGS:

DC PLATE VOLTAGE	3000	VOLTS
DC PLATE CURRENT	0.275	AMPERE
PLATE DISSIPATION	270	WATTS
GRID DISSIPATION	20	WATTS

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

TYPICAL OPERATION

Plate Voltage	3000	Vdc
Plate Current	245	mAdc
Grid Voltage	-90	Vdc
Grid Current[2]	100	mAdc
Peak rf Grid Voltage[2]	185	v
Grid Driving Power[2]	18	W
Plate Output Power[2]	550	W

NOTE: In most cases, "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. No allowance for circuit losses, either input or output, has been made. Exceptions are distinguished by a listing of "Useful" output power as opposed to "Plate" output power. Values appearing in these groups have been obtained from existing equipment(s) and the output power is that measured at the load.

RANGE VALUES FOR EQUIPMENT DESIGN:

	Min.	Max.	
Filament Current, at 5.0 volts	13.5	14.7	A
Zero Bias Plate Current (E_b = 3000 Vdc)	80	115	mAdc
Cut-Off Voltage (E_b = 3000 Vdc, I_b = 1.0 mAdc)	---	-25	Vdc
Interelectrode Capacitance (Grounded Cathode Connection)[1]			
Cin	6.0	9.0	pF
Cout	---	0.15	pF
Cgp	3.4	4.8	pF
Interelectrode Capacitance (Grounded Grid Connection)[1]			
Cin	6.0	9.0	pF
Cout	3.4	4.8	pF
Cpk	---	0.15	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 3-400Z 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, and the tube should be protected from severe vibration and shock.

The EIMAC SK-410 Air-System Socket is especially recommended for mounting, as the contacting clips are made with considerable flexibility in order to avoid applying undue lateral pressure on the tube pins, to avoid the possibility of damage to the base of the tube. The tube should always be inserted or removed from the socket with a straight-in or straight-out motion, and "rocking" the tube in or out of the socket should be avoided.

If a socket other than the EIMAC SK-410 is used, it should be ascertained that the contacts are flexible enough so they do not apply any significant lateral force against the tube base pins, as installed or during insertion or removal, to avoid the possibility of catastrophic damage to the glass tube base.

COOLING - Forced-air cooling is required to maintain the base seals at a temperature below 200°C. When using the EIMAC SK-410 Air-System Socket and SK-416 Chimney, a minimum air flow rate of 13 cubic feet per minute at a static pressure of approximately 0.13 inch of water at sea level is required to provide adequate cooling at an air temperature of 55°C. At higher inlet air

temperatures, higher altitudes, or at frequencies above 30 MHz,the air flow rate must be increased to give equivalent cooling. Cooling air must be supplied to the tube even when the filament alone is on during standby periods.

CLASS-C OPERATION - Although specifically designed for class-B service, the 3-400Z may be operated as a class-C power amplifier or oscillator or as a plate-modulated radio-frequency power amplifier. The zero-bias characteristic of the 3-400Z can be used to advantage in class-C amplifiers operating at plate voltages of 3000 volts or below by employing only grid-leak bias. If driving power fails, plate dissipation is then kept to a low value because the tube will be operating at the normal static zero-bias conditions.

FILAMENT OPERATION - The rated filament voltage for the 3-400Z is 5.0 volts. Filament voltage as measured at the socket, must be maintained within the range of 4.75 to 5.25 volts to obtain maximum tube life.

INTERMODULATION DISTORTION - Typical Operating conditions with distortion values included are the result of data taken during actual operation at 2 megahertz. Intermodulation values listed are those measured at the full peak envelope power noted. As the driving signal level is reduced, distortion products remain at the listed value, or better, below original peak envelope power level.

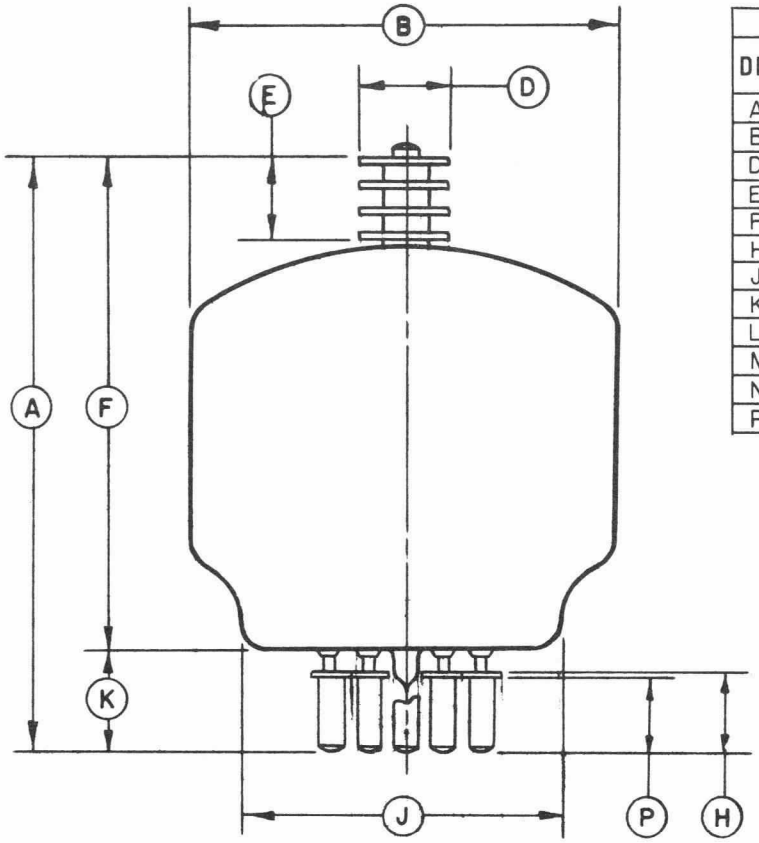
INPUT CIRCUIT - When the 3-400Z is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended in order to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of five or more.

HIGH VOLTAGE - Normal operating voltages used with the 8163/3-400Z 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.

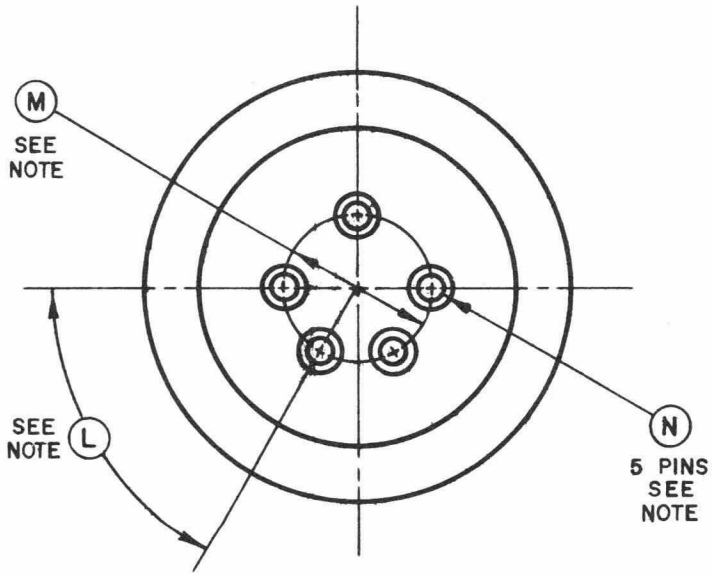


DIMENSIONAL DATA						
DIM	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.875	5.375	- -	123.8	136.5	- -
B	- -	3.562	- -	- -	90.47	- -
D	0.740	0.760	- -	18.80	19.30	- -
E	0.635	0.665	- -	16.13	16.89	- -
F	3.937	4.437	- -	100.0	112.7	- -
H	0.688	0.813	- -	17.47	20.65	- -
J	- -	2.500	- -	- -	63.50	- -
K	- -	- -	0.937	- -	- -	23.80
L	- -	- -	60°	- -	- -	60°
M	- -	- -	1.250	- -	- -	31.75
N	0.185	0.191	- -	4.70	4.85	- -
P	0.625	0.750	- -	15.87	19.05	- -

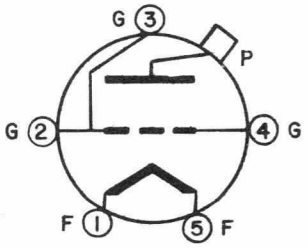
NOTES:

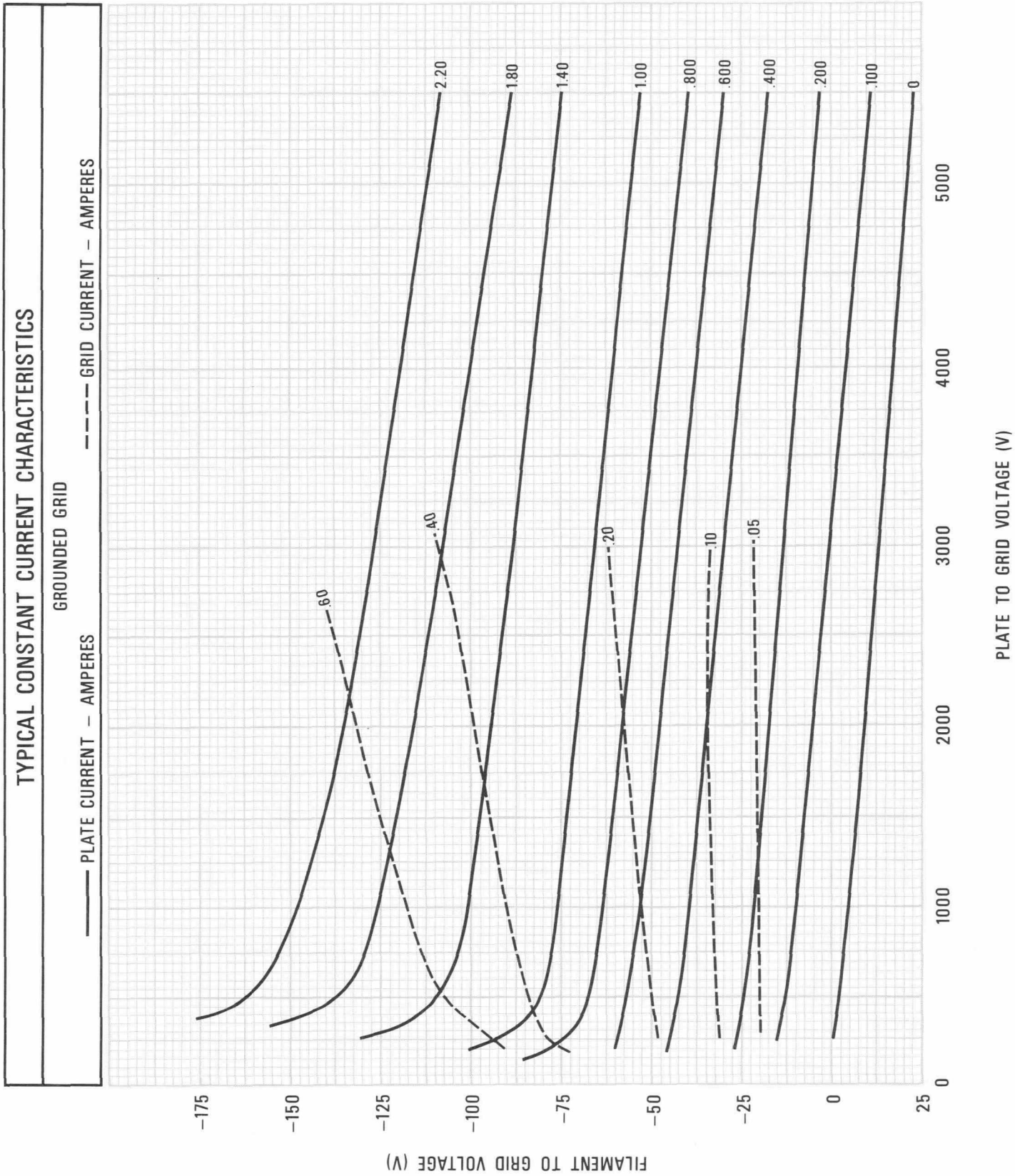
1. BASE PINS N ARE SO ALIGNED THAT THEY CAN BE FREELY INSERTED INTO A GAGE 1/4" THICK WITH HOLE DIAMETERS OF 0.204 LOCATED ON THE TRUE CENTERS BY THE GIVEN DIMENSIONS L & M.

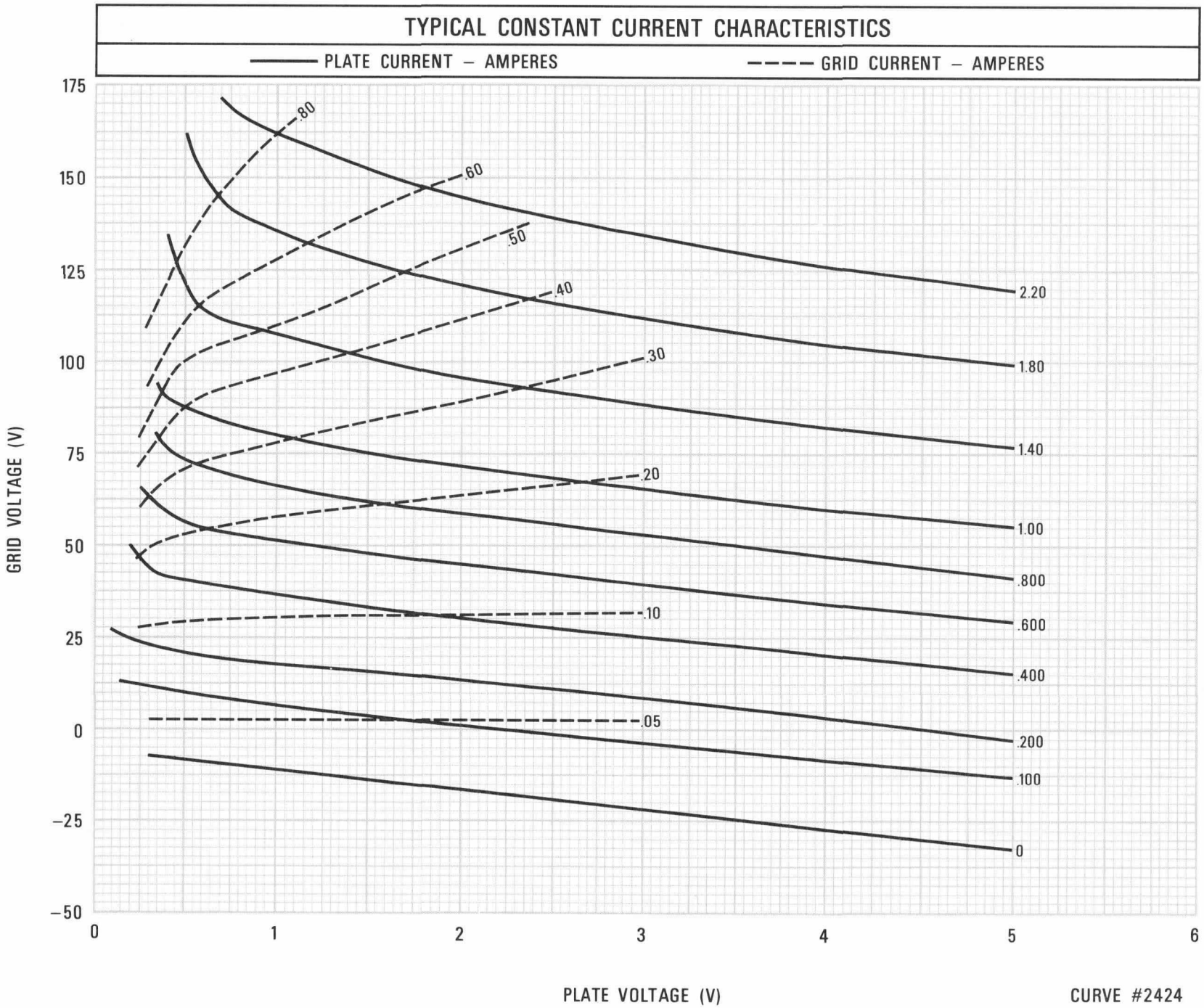
2. REFERENCE DIMENSIONS ARE FOR INFO ONLY AND ARE NOT REQUIRED FOR INSPECTION PURPOSES.



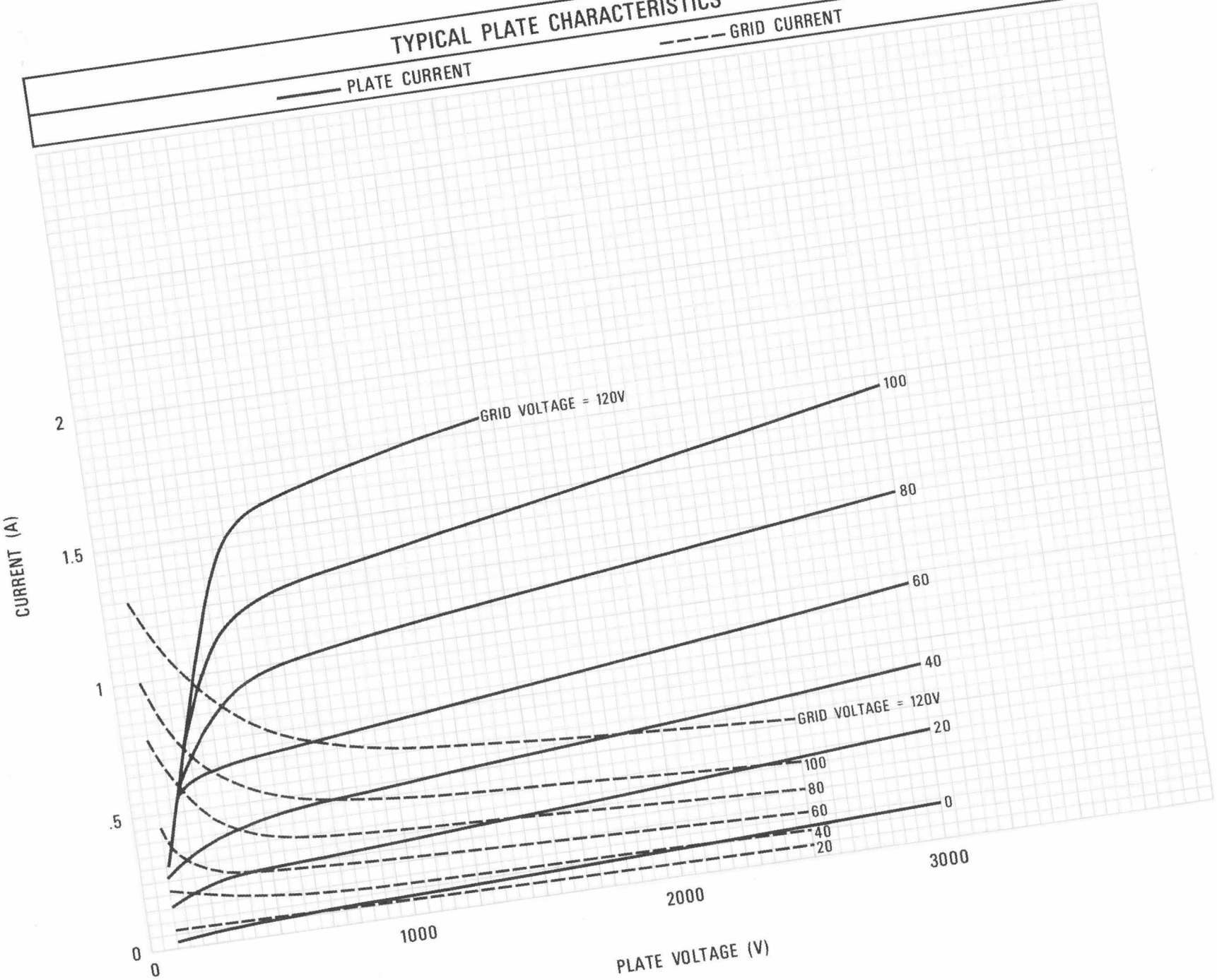
BOTTOM VIEW




TYPICAL CONSTANT CURRENT CHARACTERISTICS
GROUNDED GRID
PLATE CURRENT – AMPERES
GRID CURRENT – AMPERES
2.20
1.80
1.40
1.00
.800
.600
.400
.200
.100
0
.60
.40
.20
.10
.05
0
1000
2000
3000
4000
5000
PLATE TO GRID VOLTAGE (V)
-175
-150
-125
-100
-75
-50
-25
0
25
FILAMENT TO GRID VOLTAGE (V)



CURVE #2424

8163/3-400Z

TYPICAL PLATE CHARACTERISTICS