



## 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<sup>1</sup>

#### ELECTRICAL

Filament: Thoriated Tungsten

|                                      |        |
|--------------------------------------|--------|
| Voltage .....                        | 5.0 V  |
| Current .....                        | 14.1 A |
| Amplification Factor (Average) ..... | 200    |

Interelectrode Capacitances (Average),<sup>2</sup> 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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8163/3-400Z

**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 <sup>1</sup> | 100 mAdc      |
| Max. Sig. Plate Current              | 333 mAdc      |
| Max. Sig. Grid Current <sup>1</sup>  | 120 mAdc      |
| Driving Impedance                    | 122 $\Omega$  |
| Resonant Load Impedance              | 4750 $\Omega$ |
| Max. Sig. Driving Power <sup>1</sup> | 32 W          |
| Peak Envelope Plate Output Power     | 655 W         |

**TYPICAL OPERATION (Minimum Distortion Products)**

|                                                  |               |
|--------------------------------------------------|---------------|
| Plate Voltage                                    | 2000 Vdc      |
| Zero Sig. Plate Current <sup>1</sup>             | 62 mAdc       |
| Single Tone Plate Current                        | 400 mAdc      |
| Single Tone Grid Current <sup>1</sup>            | 148 mAdc      |
| Two Tone Plate Current                           | 265 mAdc      |
| Two Tone Grid Current <sup>1</sup>               | 87 mAdc       |
| Driving Impedance                                | 112 $\Omega$  |
| Resonant Load Impedance                          | 2750 $\Omega$ |
| Max. Sig. Driving Power <sup>1</sup>             | 45 W          |
| Peak Envelope Useful Output Power <sup>1</sup>   | 445 W         |
| Intermodulation Distortion Products <sup>2</sup> | -40 dB        |

**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.

**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 (Minimum Distortion Products at  
1 kW PEP Input)**

|                                                  |               |
|--------------------------------------------------|---------------|
| Plate Voltage                                    | 2500 Vdc      |
| Zero Sig. Plate Current <sup>1</sup>             | 73 mAdc       |
| Single Tone Plate Current                        | 400 mAdc      |
| Single Tone Grid Current <sup>1</sup>            | 142 mAdc      |
| Two Tone Plate Current                           | 274 mAdc      |
| Two Tone Grid Current <sup>1</sup>               | 82 mAdc       |
| Driving Impedance                                | 114 $\Omega$  |
| Resonant Load Impedance                          | 3450 $\Omega$ |
| Peak Envelope Useful Output Power <sup>1</sup>   | 560 W         |
| Max. Sig. Driving Power <sup>1</sup>             | 44 W          |
| Intermodulation Distortion Products <sup>2</sup> | -35 dB        |

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

|                                                  |               |
|--------------------------------------------------|---------------|
| Plate Voltage                                    | 1500 Vdc      |
| Zero Sig. Plate Current <sup>1</sup>             | 46 mAdc       |
| Single Tone Plate Current                        | 400 mAdc      |
| Single Tone Grid Current <sup>1</sup>            | 163 mAdc      |
| Two Tone Plate Current                           | 265 mAdc      |
| Two Tone Grid Current <sup>1</sup>               | 92 mAdc       |
| Driving Impedance                                | 109 $\Omega$  |
| Resonant Load Impedance                          | 1620 $\Omega$ |
| Peak Envelope Useful Output Power <sup>1</sup>   | 300 W         |
| Max. Sig. Driving Power <sup>1</sup>             | 46 W          |
| Intermodulation Distortion Products <sup>2</sup> | -37 dB        |

1. Approximate value.

2. Approximate value; referenced against one tone of  
a two equal-tone signal.**TYPICAL OPERATION (Sinusoidal Wave, Two Tubes,  
Grid Driven)**

|                                                |               |
|------------------------------------------------|---------------|
| Plate Voltage                                  | 3000 Vdc      |
| Grid Voltage                                   | 0 Vdc         |
| Zero Sig. Plate Current <sup>1</sup>           | 200 mAdc      |
| Max. Sig. Plate Current                        | 666 mAdc      |
| Max. Sig. Grid Current <sup>1</sup>            | 240 mAdc      |
| Driving Power <sup>1</sup>                     | 26 W          |
| Peak af Driving Voltage(per tube) <sup>1</sup> | 88 v          |
| Load Resistance, Plate/Plate                   | 9500 $\Omega$ |
| Max. Sig. Plate Output Power <sup>1</sup>      | 1310 W        |

**TYPICAL OPERATION**

|                                   |          |
|-----------------------------------|----------|
| Plate Voltage                     | 3000 Vdc |
| Plate Current                     | 333 mAdc |
| Grid Voltage                      | -75 Vdc  |
| Grid Current <sup>1</sup>         | 130 mAdc |
| Peak rf Grid Voltage <sup>1</sup> | 187 v    |
| Grid Driving Power <sup>1</sup>   | 25 W     |
| Plate Output Power <sup>1</sup>   | 730 W    |

**RADIO FREQUENCY AMPLIFIER<sup>1</sup>**

Plate Modulated, Class C

**TYPICAL OPERATION****MAXIMUM RATINGS:**

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

|                                   |          |
|-----------------------------------|----------|
| Plate Voltage                     | 3000 Vdc |
| Plate Current                     | 245 mAdc |
| Grid Voltage                      | -90 Vdc  |
| Grid Current <sup>2</sup>         | 100 mAdc |
| Peak rf Grid Voltage <sup>2</sup> | 185 v    |
| Grid Driving Power <sup>2</sup>   | 18 W     |
| Plate Output Power <sup>2</sup>   | 550 W    |

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

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) <sup>1</sup> |      |      |      |
| Cin                                                                   | 6.0  | 9.0  | pF   |
| Cout                                                                  | ---  | 0.15 | pF   |
| Cgp                                                                   | 3.4  | 4.8  | pF   |
| Interelectrode Capacitance (Grounded Grid Connection) <sup>1</sup>    |      |      |      |
| 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.

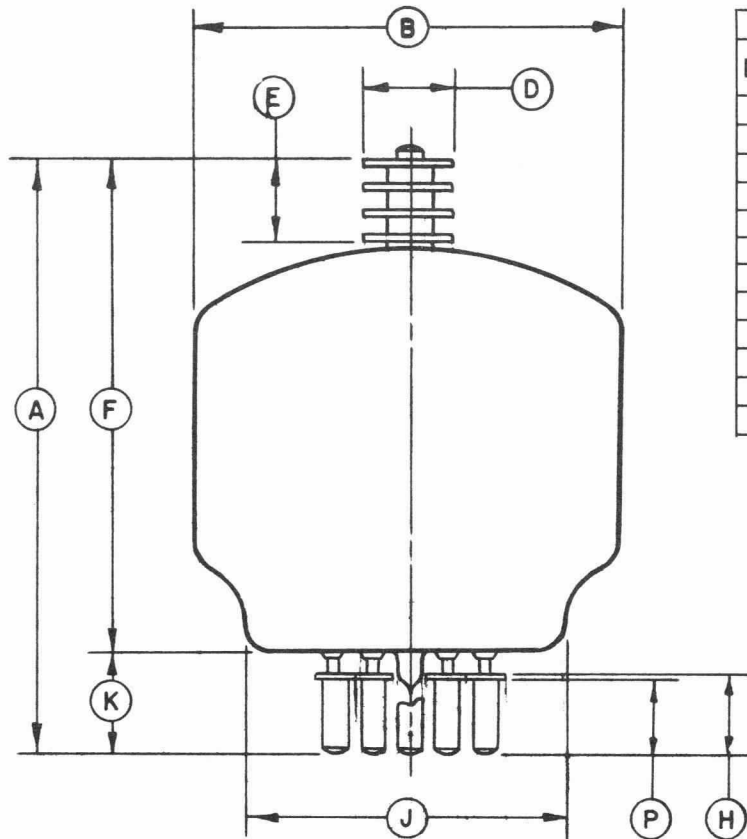
**HIGH VOLTAGE** - Normal operating voltages used with the 8163/3-400Z are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment so that no one can come in contact with high voltages. All equipment must include

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.

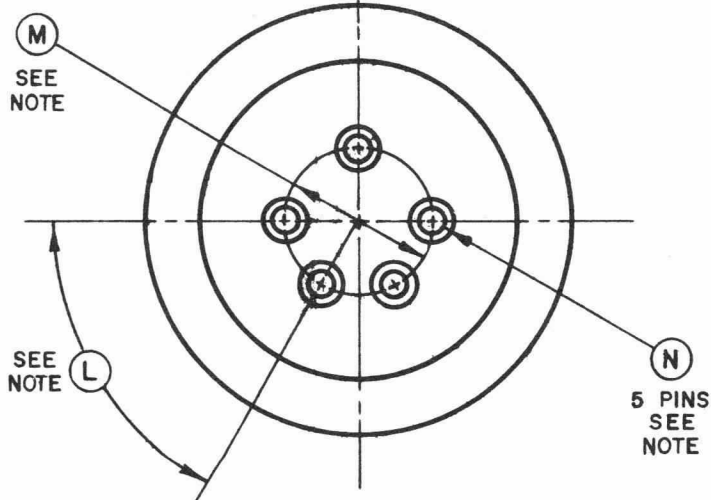
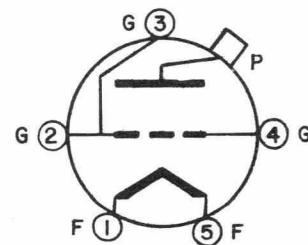
**SPECIAL APPLICATIONS** - If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, San Carlos, Calif. 94070 for information and recommendations.



| 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 | - -   |

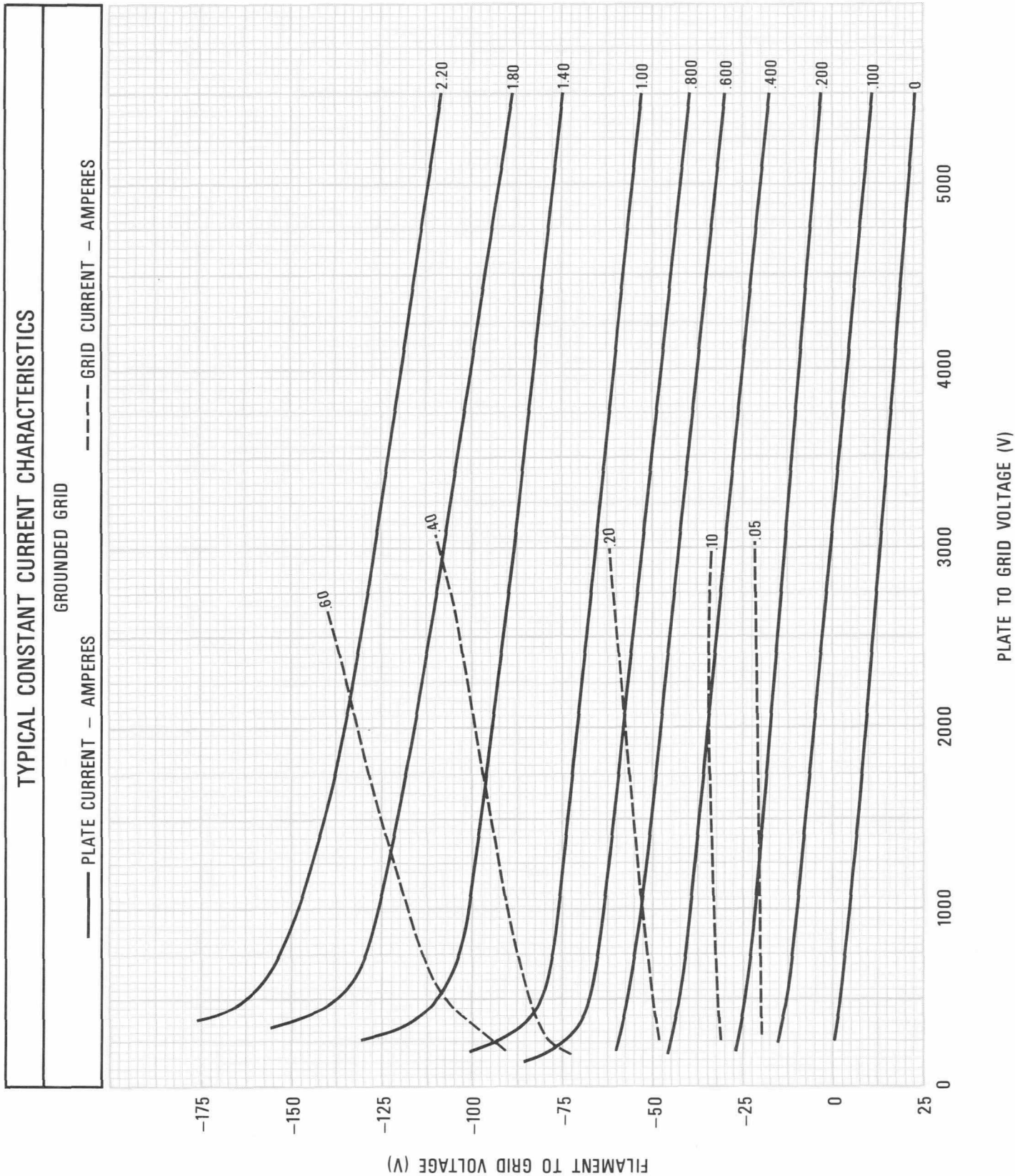
## NOTES:

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



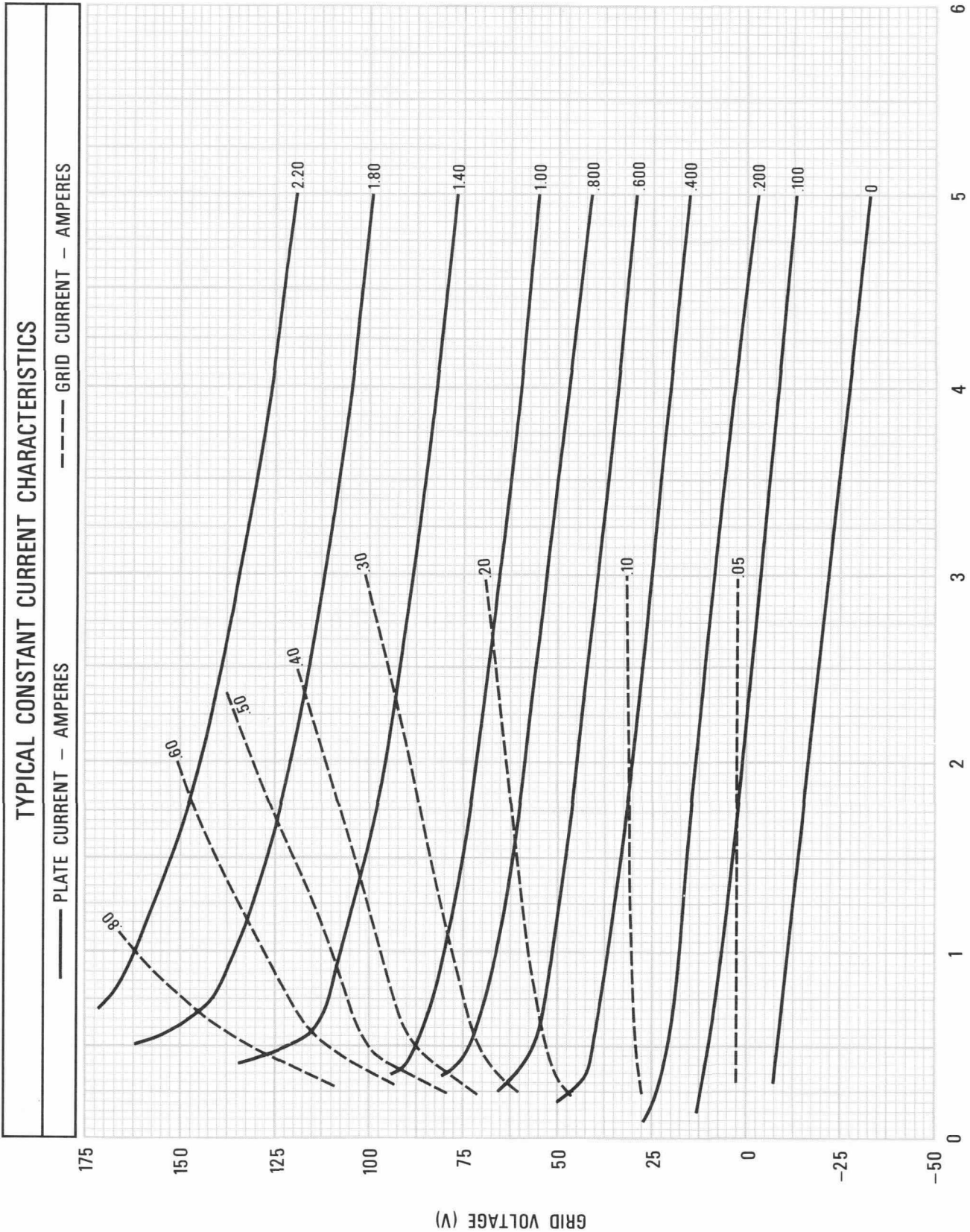
8163/3-400Z

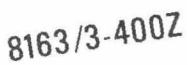




CURVE #2424

PLATE VOLTAGE (V)





## CHARACTERISTICS

GRID CURRENT

PLATE CURRENT

