



## TECHNICAL DATA

# 5CX1500A

### RADIAL BEAM POWER PENTODE

The EIMAC 5CX1500A is a ceramic/metal power pentode designed for use as a Class AB<sub>1</sub> linear amplifier in audio or radio frequency applications. Its characteristic low intermodulation distortion makes it especially suitable for single sideband service. The filament is a rugged mesh type.

The tube is also recommended for use as a Class C rf power amplifier in CW, FM and AM service.

## GENERAL CHARACTERISTICS<sup>1</sup>

### ELECTRICAL

Filament: Thoriated Tungsten

Voltage . . . . . 5.0 ± 0.25 V

Current, at 5.0 volts . . . . . 40 A

Transconductance (Average):

I<sub>b</sub> = 1.0 Adc, E<sub>c2</sub> = 500 Vdc . . . . . 24,000 μmhos

Amplification Factor (Average):

Grid to Screen . . . . . 5.5

Direct Interelectrode Capacitance (grounded cathode)<sup>2</sup>

Input . . . . . 75 pF

Output . . . . . 16.5 pF

Feedback . . . . . 0.20 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.

### MECHANICAL

Maximum Overall Dimensions:

Length . . . . . 4.950 in; 125.73 mm

Diameter . . . . . 3.370 in; 85.60 mm

Net Weight . . . . . 30 oz; 850.5 gm

Operating Position . . . . . Axis vertical, base down or up

Maximum Operating Temperature:

Ceramic/Metal Seals . . . . . 250°C

Anode Core . . . . . 250°C

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Cooling ..... Forced Air  
 Base ..... Special ring and breechblock terminal surfaces  
 Recommended Air System Socket ..... EIMAC SK-840 series  
 Recommended (Air) Chimney ..... EIMAC SK-806

**RADIO FREQUENCY LINEAR AMPLIFIER****GRID DRIVEN**Class AB<sub>1</sub>

## ABSOLUTE MAXIMUM RATINGS:

|                              |            |
|------------------------------|------------|
| DC PLATE VOLTAGE .....       | 4000 VOLTS |
| DC SCREEN VOLTAGE .....      | 750 VOLTS  |
| DC PLATE CURRENT .....       | 1.0 AMPERE |
| PLATE DISSIPATION .....      | 1500 WATTS |
| SUPPRESSOR DISSIPATION ..... | 25 WATTS   |
| SCREEN DISSIPATION .....     | 75 WATTS   |
| GRID DISSIPATION .....       | 25 WATTS   |

1. Adjust to specified zero-signal dc plate current.
2. The intermodulation distortion products are referenced against one tone of a two equal tone signal.
3. Approximate values.

## TYPICAL OPERATION (Frequencies to 30 MHz)

Class AB<sub>1</sub>, Grid Driven, Peak Envelope or Modulation Crest Conditions

|                                                  |      |      |      |      |
|--------------------------------------------------|------|------|------|------|
| Plate Voltage .....                              | 2500 | 3000 | 4000 | Vdc  |
| Suppressor Voltage .....                         | 0    | 0    | 0    | Vdc  |
| Screen Voltage .....                             | 500  | 500  | 500  | Vdc  |
| Grid Voltage <sup>1</sup> .....                  | -87  | -89  | -90  | Vdc  |
| Zero-Signal Plate Current .....                  | 250  | 250  | 250  | mAdc |
| Single-Tone Plate Current .....                  | 660  | 690  | 690  | mAdc |
| Two-Tone Plate Current .....                     | 470  | 480  | 485  | mAdc |
| Single-Tone Screen Current <sup>3</sup> ..       | 79   | 71   | 59   | mAdc |
| Two-Tone Screen Current <sup>3</sup> .....       | 36   | 32   | 25   | mAdc |
| Peak rf Grid Voltage <sup>3</sup> .....          | 87   | 89   | 90   | v    |
| Peak Driving Power <sup>3</sup> .....            | 0    | 0    | 0    | w    |
| Single-Tone Useful<br>Output Power .....         | 1090 | 1330 | 1785 | W    |
| Resonant Load Impedance .....                    | 2340 | 2680 | 3500 | Ω    |
| Intermodulation Distortion Products <sup>2</sup> |      |      |      |      |
| 3rd Order .....                                  | -38  | -36  | -33  | db   |
| 5th Order .....                                  | -39  | -41  | -42  | db   |

**RADIO FREQUENCY POWER AMPLIFIER OR****OSCILLATOR** Class C Telephony or FM Telephony

(Key-Down Conditions)

## ABSOLUTE MAXIMUM RATINGS

|                              |            |
|------------------------------|------------|
| DC PLATE VOLTAGE .....       | 5000 VOLTS |
| DC SCREEN VOLTAGE .....      | 750 VOLTS  |
| DC PLATE CURRENT .....       | 1.0 AMPERE |
| PLATE DISSIPATION .....      | 1500 WATTS |
| SUPPRESSOR DISSIPATION ..... | 25 WATTS   |
| SCREEN DISSIPATION .....     | 75 WATTS   |
| GRID DISSIPATION .....       | 25 WATTS   |

## TYPICAL OPERATION (Frequencies to 30 MHz)

|                                         |      |      |      |      |
|-----------------------------------------|------|------|------|------|
| Plate Voltage .....                     | 3000 | 4000 | 4500 | Vdc  |
| Suppressor Voltage .....                | 0    | 0    | 0    | Vdc  |
| Screen Voltage .....                    | 500  | 500  | 500  | Vdc  |
| Grid Voltage .....                      | -200 | -200 | -200 | Vdc  |
| Plate Current .....                     | 900  | 800  | 900  | mAdc |
| Screen Current <sup>1</sup> .....       | 94   | 66   | 88   | mAdc |
| Grid Current <sup>1</sup> .....         | 35   | 25   | 34   | mAdc |
| Peak rf Grid Voltage <sup>1</sup> ..... | 255  | 245  | 255  | v    |
| Calculated Driving Power .....          | 9.0  | 6.5  | 9.0  | W    |
| Plate Input Power .....                 | 2700 | 3200 | 4050 | W    |
| Plate Dissipation .....                 | 720  | 850  | 870  | W    |
| Plate Output Power .....                | 1980 | 2350 | 3180 | W    |
| Resonant Load Impedance .....           | 1570 | 2240 | 2520 | Ω    |

1. Approximate value.

**PLATE MODULATED RADIO FREQUENCY POWER****AMPLIFIER-GRID DRIVEN** Class C Telephony

(Carrier Conditions)

## ABSOLUTE MAXIMUM RATINGS

|                                       |            |
|---------------------------------------|------------|
| DC PLATE VOLTAGE .....                | 3500 VOLTS |
| DC SCREEN VOLTAGE .....               | 550 VOLTS  |
| DC PLATE CURRENT .....                | 0.8 AMPERE |
| PLATE DISSIPATION <sup>1</sup> .....  | 1000 WATTS |
| SUPPRESSOR DISSIPATION .....          | 25 WATTS   |
| SCREEN DISSIPATION <sup>2</sup> ..... | 75 WATTS   |
| GRID DISSIPATION <sup>2</sup> .....   | 25 WATTS   |

1. Corresponds to 1500 watts at 100% sine-wave modulation.
2. Average, with or without modulation.

## TYPICAL OPERATION (Frequencies to 30 MHz)

|                                                                |      |      |      |
|----------------------------------------------------------------|------|------|------|
| Plate Voltage .....                                            | 2500 | 3200 | Vdc  |
| Suppressor Voltage .....                                       | 0    | 0    | Vdc  |
| Screen Voltage .....                                           | 500  | 500  | Vdc  |
| Grid Voltage .....                                             | -260 | -260 | Vdc  |
| Plate Current .....                                            | 800  | 800  | mAdc |
| Screen Current <sup>1</sup> .....                              | 90   | 86   | mAdc |
| Grid Current <sup>1</sup> .....                                | 32   | 32   | mAdc |
| Peak af Screen Voltage <sup>1</sup><br>(100% modulation) ..... | 500  | 500  | v    |
| Peak rf Grid Voltage <sup>1</sup> .....                        | 315  | 315  | v    |
| Calculated Driving Power .....                                 | 10   | 10   | W    |
| Plate Input Power .....                                        | 2000 | 2560 | W    |
| Plate Dissipation .....                                        | 530  | 576  | W    |
| Plate Output Power .....                                       | 1470 | 1958 | W    |
| Resonant Load Impedance .....                                  | 1360 | 1863 | Ω    |

1. Approximate value.



## AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR Class AB, Grid Driven (Sinusoidal Wave)

### ABSOLUTE MAXIMUM RATINGS (per tube)

|                              |            |
|------------------------------|------------|
| DC PLATE VOLTAGE .....       | 4000 VOLTS |
| DC SCREEN VOLTAGE .....      | 750 VOLTS  |
| DC PLATE CURRENT .....       | 1.0 AMPERE |
| PLATE DISSIPATION .....      | 1500 WATTS |
| SUPPRESSOR DISSIPATION ..... | 25 WATTS   |
| SCREEN DISSIPATION .....     | 75 WATTS   |
| GRID DISSIPATION .....       | 25 WATTS   |

### TYPICAL OPERATION (Two Tubes)

|                                     |      |      |          |
|-------------------------------------|------|------|----------|
| Plate Voltage .....                 | 2800 | 3800 | Vdc      |
| Suppressor Voltage .....            | 0    | 0    | Vdc      |
| Screen Voltage .....                | 500  | 500  | Vdc      |
| Grid Voltage .....                  | -81  | -83  | Vdc      |
| Zero-Signal Plate Current .....     | 0.50 | 1.50 | Adc      |
| Max. Signal Plate Current .....     | 1.30 | 1.33 | Adc      |
| Zero-Signal Plate Current .....     | 20   | 20   | mAdc     |
| Max. Signal Screen Current .....    | 110  | 106  | mAdc     |
| Peak af Grid Voltage .....          | 81   | 83   | v        |
| Peak Driving Power .....            | 0    | 0    | w        |
| Max. Signal Plate Dissipation ..... | 720  | 1130 | W        |
| Plate Output Power .....            | 2200 | 3220 | W        |
| Load Resistance(plate to plate).... | 4800 | 6720 | $\Omega$ |

1. Approximate value.
2. Per tube .
3. Nominal drive power is one-half peak power.
4. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen 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 and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary 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. In the case of Class C Service, 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.

## RANGE VALUES FOR EQUIPMENT DESIGN

|                                                                        | Min. | Max.    |
|------------------------------------------------------------------------|------|---------|
| Filament: Current at 5.0 volts .....                                   | 38   | 43 A    |
| Interelectrode Capacitances <sup>1</sup> (grounded cathode connection) |      |         |
| Input .....                                                            | 70   | 80 pF   |
| Output .....                                                           | 14.5 | 18.5 pF |
| Feedback .....                                                         | ---  | 0.25 pF |
| Interelectrode Capacitances <sup>1</sup> (grounded grid connection)    |      |         |
| Input .....                                                            | 32   | 37 pF   |
| Output .....                                                           | 14.5 | 18.5 pF |
| Feedback .....                                                         | ---  | 0.05 pF |

## APPLICATION

### MECHANICAL

**MOUNTING** - The 5CX1500A must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

**SOCKET** - The EIMAC SK-840 socket and SK-806 chimney have been designed especially

for the 5CX1500A. The use of recommended air-flow rates through these sockets provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals through the Air Chimney, and exits through the anode cooling fins.



**COOLING** - The maximum temperature rating for the anode core of the 5CX1500A is 250°C. Sufficient forced-air circulation must be provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Air-flow requirements to maintain seal temperature at 225°C in 50°C ambient air are tabulated below (for operation below 30 MHz).

| PLATE<br>DISSIPATION<br>(WATTS) | SEA LEVEL         |                                          | 6000 FEET         |                                          |
|---------------------------------|-------------------|------------------------------------------|-------------------|------------------------------------------|
|                                 | AIR FLOW<br>(CFM) | PRESSURE<br>DROP<br>(INCHES<br>of WATER) | AIR FLOW<br>(CFM) | PRESSURE<br>DROP<br>(INCHES<br>of WATER) |
| 1000                            | 27                | .33                                      | 33                | .40                                      |
| 1500                            | 47                | .76                                      | 58                | .95                                      |

\* Since the power dissipated by the filament represents about 200 watts and since grid-plus-screen-plus-suppressor dissipation can, under some conditions, represent another 125 watts, allowance has been made in preparing this tabulation for an additional 325 watts dissipation.

The blower selected in a given application must be capable of supplying the desired air flow at a back pressure equal to the pressure drop shown above plus any drop encountered in ducts and filters.

*At other altitudes and ambient temperatures the flow rate must be modified to obtain equivalent cooling.* The flow rate and corresponding pressure differential must be determined individually in such cases, using rated maximum temperatures as the criteria for satisfactory cooling.

## ELECTRICAL

**FILAMENT OPERATION** - The rated filament voltage for the 5CX1500A is 5.0 volts. Filament voltage, as measured at the socket, should be maintained within  $\pm 5\%$  of this value or below to obtain maximum tube life.

**INTERMODULATION DISTORTION** - The Radio Frequency Linear Amplifier operating conditions including distortion data are the results of operation in a neutralized, grid-driven amplifier. Plots of IM distortion versus power output under two-tone condition for a typical tube are shown on next page.

**GRID OPERATION** - The rated dissipation of the grid is 25 watts. This is approximately the

product of dc grid current and peak positive grid voltage. Operation at bias and drive levels near those listed will insure safe operation.

**SCREEN OPERATION** - The power dissipated by the screen of the 5CX1500A must not exceed 75 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon rms screen current and voltage.

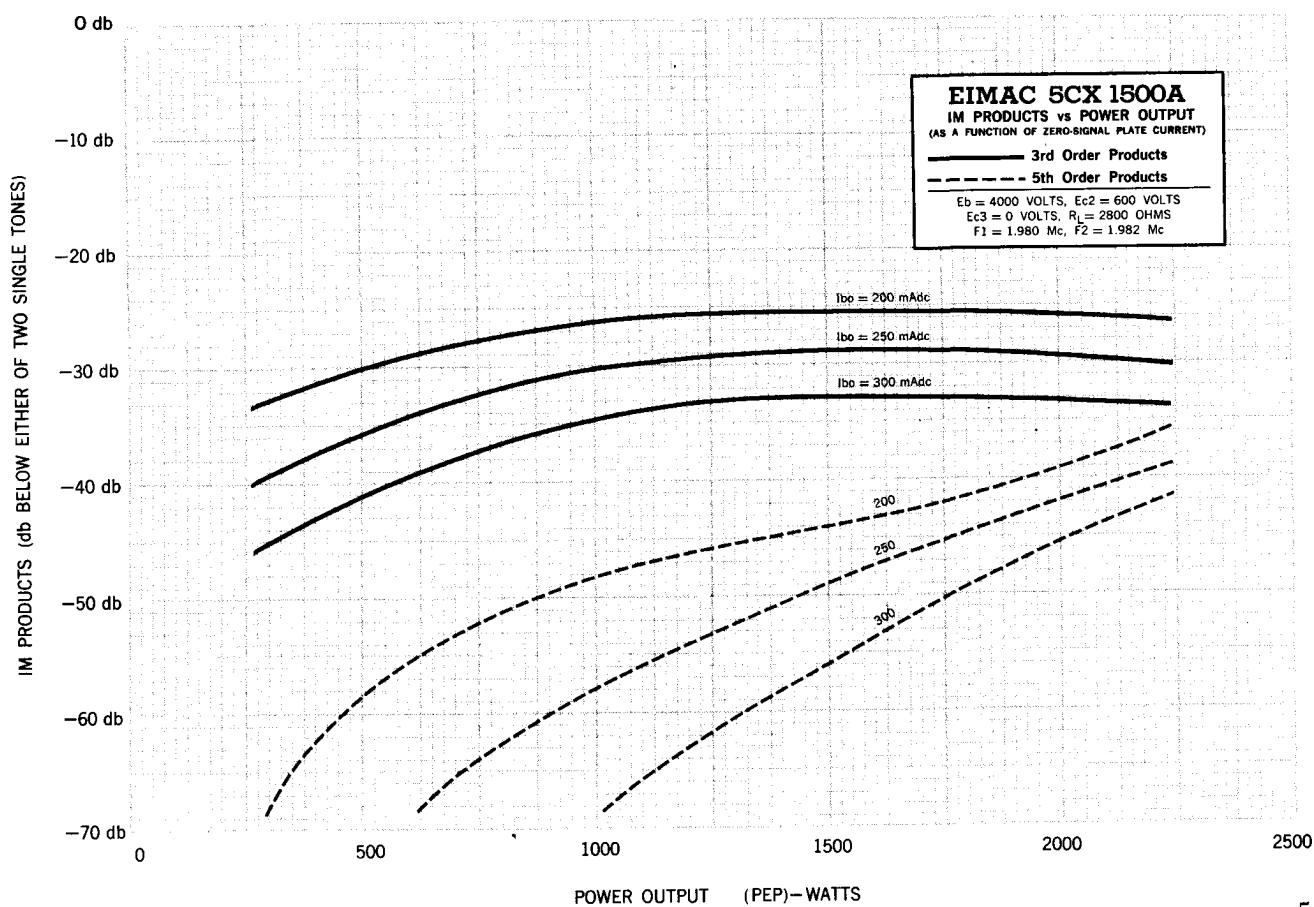
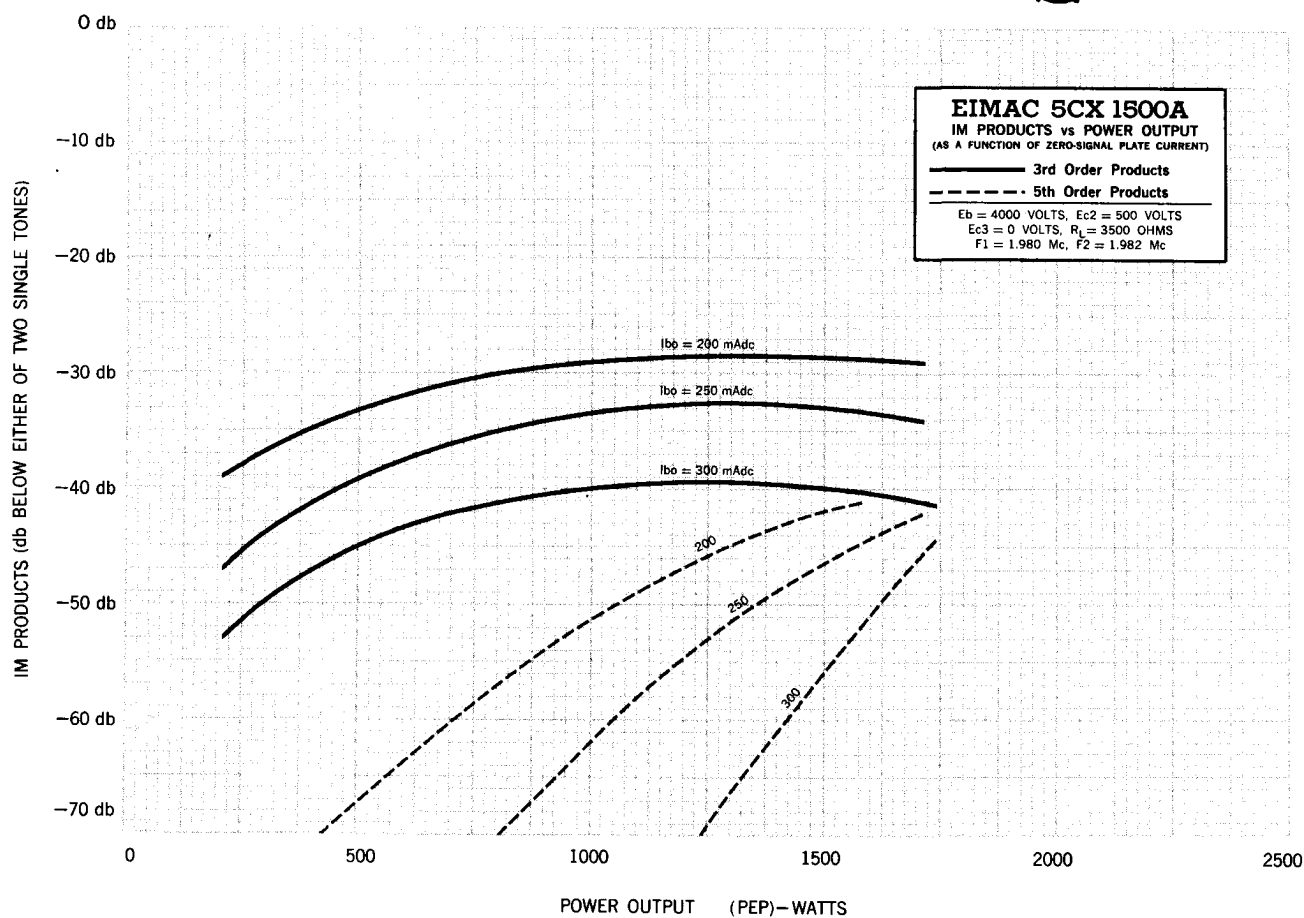
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 75 watts in the event of circuit failure.

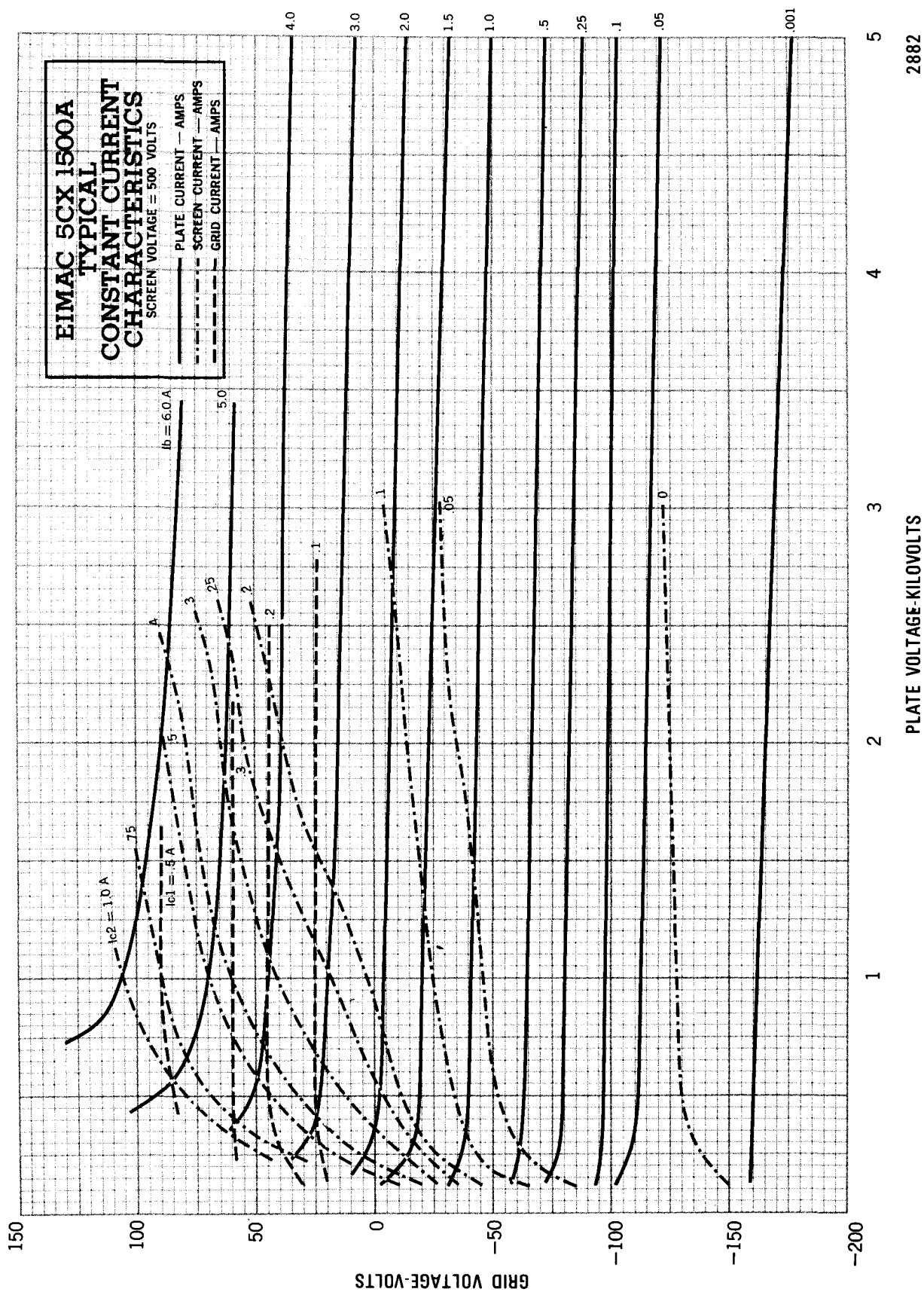
**SUPPRESSOR OPERATION** - The rated dissipation of the suppressor is 25 watts. Suppressor current will be zero or very nearly zero for all typical operating conditions specified. The 5CX1500A has been designed for zero voltage operation of the suppressor grid for most applications.

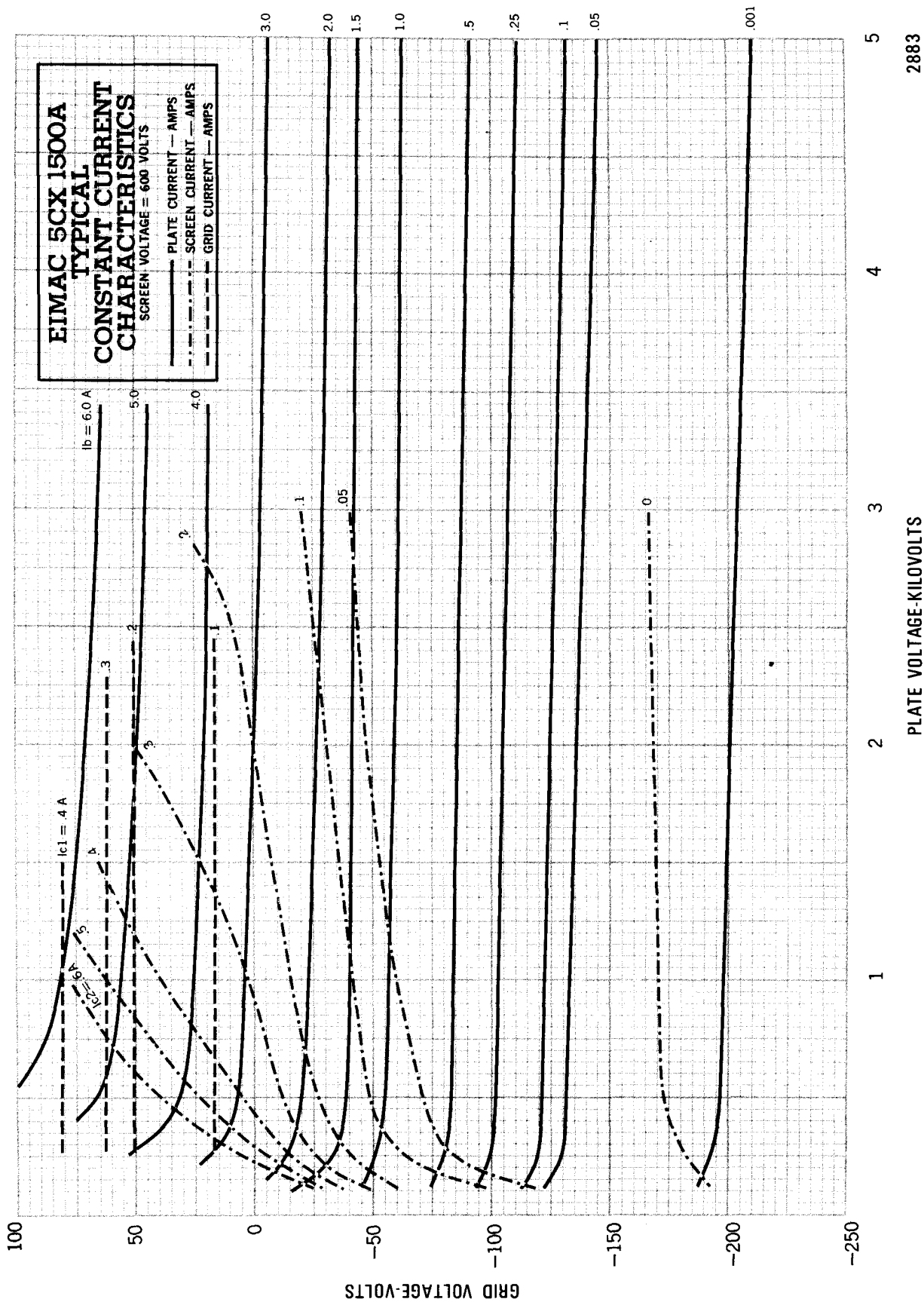
**PLATE DISSIPATION** - The plate-dissipation ratings for the 5CX1500A is 1000 watts for Class-C plate-modulated service and 1500 watts for Class-C telegraphy. In Class-AB service the plate dissipation rating is 1500 watts.

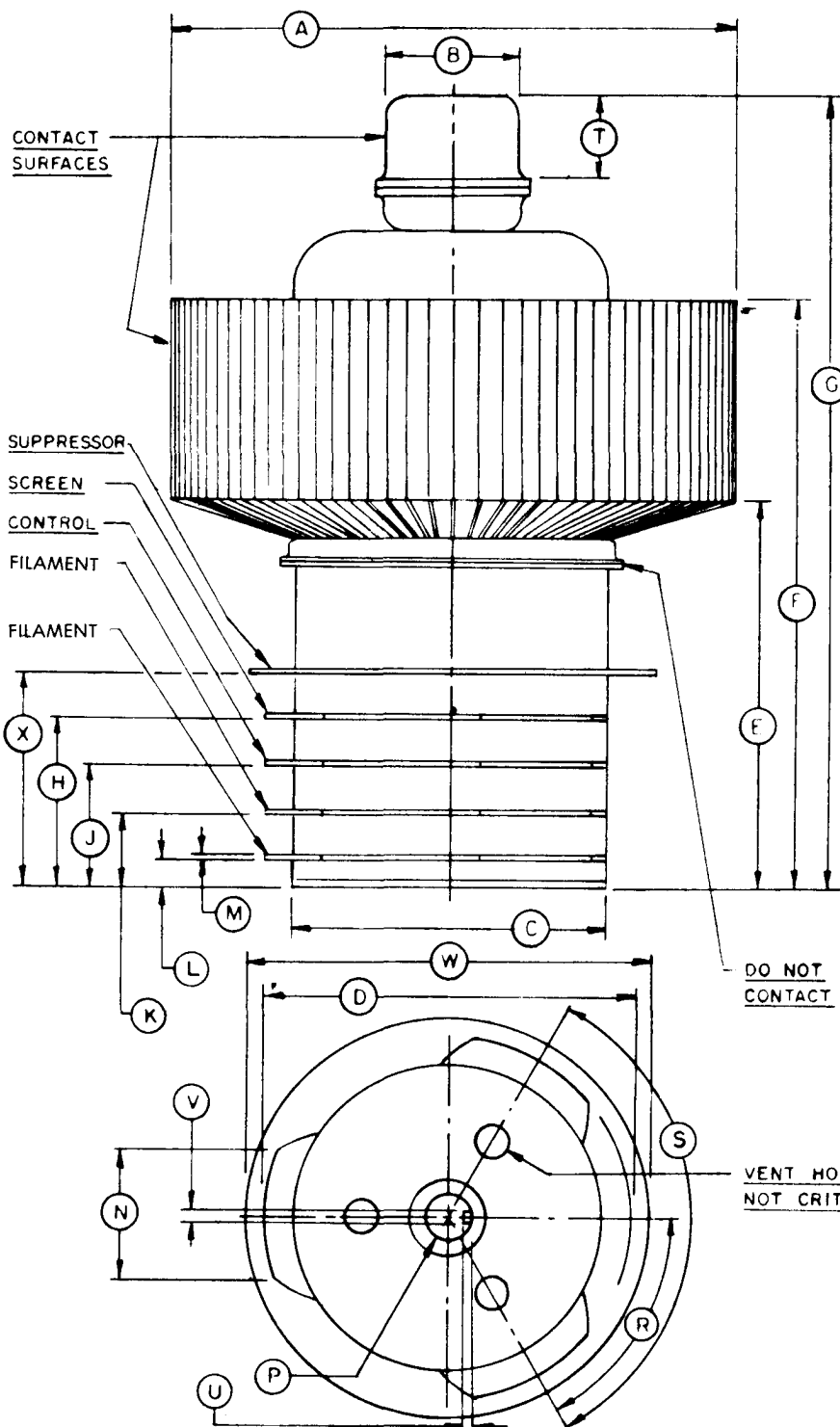
**HIGH VOLTAGE** - The 5CX1500A operates at voltages which can be deadly, and the equipment must be designed properly and operating precautions must be followed. Equipment must be designed so that no one can come in contact with high voltages. All equipment must include safety enclosures for high-voltage circuits and terminals, with interlock switches to open the primary circuits of the power supplies 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**.

**SPECIAL APPLICATIONS** - If it is desired to operate this tube under conditions widely different from those given here write to the Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.









| DIMENSIONAL DATA |        |        |             |        |
|------------------|--------|--------|-------------|--------|
| DIM.             | INCHES |        | MILLIMETERS |        |
|                  | MIN.   | MAX.   | MIN.        | MAX.   |
| A                | 3.335  | 3.370  | 84.71       | 85.60  |
| B                | 0.807  | 0.820  | 20.50       | 20.83  |
| C                | 1.870  | 1.900  | 47.50       | 48.26  |
| D                | 2.2500 | 2.3000 | 57.150      | 58.420 |
| E                | 2.335  | 2.535  | 59.31       | 64.39  |
| F                | 3.530  | 3.730  | 89.66       | 94.74  |
| G                | 4.800  | 4.950  | 121.92      | 125.73 |
| H                | 0.950  | 1.000  | 24.13       | 25.40  |
| J                | 0.675  | 0.725  | 17.15       | 18.42  |
| K                | 0.400  | 0.450  | 10.16       | 11.43  |
| L                | 0.140  | 0.170  | 3.56        | 4.32   |
| M                | 0.020  | 0.030  | 0.51        | 0.76   |
| N                | 0.700  | 0.800  | 17.78       | 20.32  |
| P                | 0.3140 | 0.3260 | 7.980       | 8.280  |
| R                | 55°    | 65°    | 55°         | 65°    |
| S                | 115°   | 125°   | 115°        | 125°   |
| T                | 0.470  | 0.530  | 11.94       | 13.46  |
| U                | 0.025  | 0.048  | 0.63        | 1.22   |
| V                | 0.0450 | 0.0700 | 1.140       | 1.780  |
| W                | 2.468  | 2.531  | 62.69       | 64.29  |
| X                | 1.225  | 1.275  | 31.12       | 32.39  |

NOTE:  
REFERENCE DIMENSIONS ARE FOR  
INFORMATION ONLY & ARE NOT  
REQUIRED FOR INSPECTION PURPOSES