

**E I M A C**  
Division of Varian  
SAN CARLOS  
CALIFORNIA

**4CV20,000A**

VAPOR-COOLED

RADIAL-BEAM  
POWER-TETRODE

The Eimac 4CV20,000A is a vapor-cooled, ceramic-metal, power tetrode designed for use as an oscillator, modulator, or amplifier in audio and radio-frequency applications. The vapor-cooled anode is conservatively rated at 20 kilowatts of plate dissipation when mounted in an Eimac BR-200 boiler.

A pair of these tubes in class AB<sub>1</sub> audio frequency or radio frequency linear amplifier service will deliver 35 kilowatts output. The frequency for maximum ratings is 30 megacycles; operation to 110 megacycles is possible at reduced input.

### GENERAL CHARACTERISTICS

#### ELECTRICAL

|                                                       |                    |      |      |      |     |
|-------------------------------------------------------|--------------------|------|------|------|-----|
| Filament:                                             | Thoriated Tungsten | Min. | Nom. | Max. |     |
| Voltage                                               | - - - - -          | -    | 7.5  |      | V   |
| Current                                               | - - - - -          | 73   |      | 78   | A   |
| Amplification Factor (Grid-Screen)                    | - - - - -          | -    | 4.5  |      |     |
| Direct Interelectrode Capacitances, Grounded Cathode: |                    |      |      |      |     |
| Input                                                 | - - - - -          | 108  |      | 122  | pF  |
| Output                                                | - - - - -          | 18   |      | 23   | pF  |
| Feedback                                              | - - - - -          | -    | -    | 1.0  | pF  |
| Direct Interelectrode Capacitances, Grounded Grid:    |                    |      |      |      |     |
| Input                                                 | - - - - -          | 48   |      | 58   | pF  |
| Output                                                | - - - - -          | 18   |      | 23   | pF  |
| Feedback                                              | - - - - -          | -    | -    | 1.0  | pF  |
| Frequency for Maximum Ratings                         | - - - - -          | -    | -    | 30   | MHz |

#### MECHANICAL

|                                |           |                        |
|--------------------------------|-----------|------------------------|
| Base                           | - - - - - | Special, Concentric    |
| Recommended Socket             | - - - - - | Eimac, SK-300A         |
| Recommended Boiler             | - - - - - | Eimac, BR-200          |
| Operating Position             | - - - - - | Axis vertical, base up |
| Cooling                        | - - - - - | Vapor & Forced air     |
| Maximum Seal Temperature       | - - - - - | 250° C                 |
| Maximum Anode Core Temperature | - - - - - | 250° C                 |
| Maximum Over-all Dimensions:   |           |                        |
| Height                         | - - - - - | 9.13 in                |
| Diameter                       | - - - - - | 7.75 in                |
| Net Weight                     | - - - - - | 21 lbs                 |

#### RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telephony or FM Telephony

##### MAXIMUM RATINGS

|                             |       |              |
|-----------------------------|-------|--------------|
| DC PLATE VOLTAGE (to 30 Mc) | - -   | 7500 VOLTS   |
| (30-60 Mc)                  | - -   | 7000 VOLTS   |
| (60-110 Mc)                 | - -   | 6500 VOLTS   |
| DC SCREEN VOLTAGE           | - -   | 1500 VOLTS   |
| DC PLATE CURRENT (to 30 Mc) | - -   | 3.0 AMPS     |
| (30-60 Mc)                  | - -   | 2.8 AMPS     |
| (60-110 Mc)                 | - -   | 2.6 AMPS     |
| PLATE DISSIPATION           | - - - | 20,000 WATTS |
| SCREEN DISSIPATION          | - - - | 250 WATTS    |
| GRID DISSIPATION            | - - - | 75 WATTS     |

##### TYPICAL OPERATION (Below 30 Mc)

|                       |       |        |              |
|-----------------------|-------|--------|--------------|
| DC Plate Voltage      | - - - | 6000   | 7500 volts   |
| DC Screen Voltage     | - - - | 500    | 500 volts    |
| DC Grid Voltage       | - - - | -290   | -300 volts   |
| DC Plate Current      | - - - | 3.0    | 3.0 amps     |
| DC Screen Current*    | - - - | 500    | 500 mA       |
| DC Grid Current       | - - - | 290    | 290 mA       |
| Peak RF Grid Voltage* | - - - | 520    | 530 volts    |
| Driving Power         | - - - | 150    | 155 watts    |
| Plate Output Power    | - - - | 12,900 | 17,000 watts |

\*Approximate Values





4CV20,000A

## PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony (Carrier conditions except where noted)

### MAXIMUM RATINGS

|                    |         |              |
|--------------------|---------|--------------|
| DC PLATE VOLTAGE   | - - - - | 5000 VOLTS   |
| DC SCREEN VOLTAGE  | - - -   | 1000 VOLTS   |
| DC PLATE CURRENT   | - - - - | 2.5 AMPS     |
| PLATE DISSIPATION* | - - - - | 13,500 WATTS |
| SCREEN DISSIPATION | - - - - | 250 WATTS    |
| GRID DISSIPATION   | - - - - | 75 WATTS     |

\* Corresponds to 20,000 watts at 100-percent sine-wave modulation.

\*\* Approximate values.

### TYPICAL OPERATION

(Frequencies below 30 megacycles)

|                        |         |      |      |       |
|------------------------|---------|------|------|-------|
| DC Plate Voltage       | - - - - | 4000 | 5000 | volts |
| DC Screen Voltage      | - - - - | 500  | 500  | volts |
| Peak AF Screen Voltage |         |      |      |       |
| (For 100% modulation)  | - - -   | 470  | 490  | volts |
| DC Grid Voltage        | - - - - | -320 | -340 | volts |
| DC Plate Current       | - - - - | 2.2  | 2.2  | amps  |
| DC Screen Current**    | - - - - | 335  | 330  | mA    |
| DC Grid Current**      | - - - - | 160  | 150  | mA    |
| Peak RF Grid Voltage** | - - -   | 490  | 510  | volts |
| Grid Driving Power     | - - - - | 78.5 | 76.5 | watts |
| Plate Dissipation      | - - - - | 3050 | 3250 | watts |
| Plate Output Power     | - - - - | 5750 | 7750 | watts |

## RADIO-FREQUENCY LINEAR AMPLIFIER

Class AB<sub>1</sub>

### MAXIMUM RATINGS (per tube)

|                    |         |              |
|--------------------|---------|--------------|
| DC PLATE VOLTAGE   | - - - - | 7500 VOLTS   |
| DC SCREEN VOLTAGE  | - - -   | 1500 VOLTS   |
| DC PLATE CURRENT   | - - - - | 4.0 AMPS     |
| PLATE DISSIPATION  | - - - - | 20,000 WATTS |
| SCREEN DISSIPATION | - - - - | 250 WATTS    |
| GRID DISSIPATION   | - - - - | 75 WATTS     |

\* Per Tube

\*\* Approximate values.

### TYPICAL OPERATION (Peak-Envelope or Modulation-Crest Conditions)

|                            |           |        |        |       |
|----------------------------|-----------|--------|--------|-------|
| DC Plate Voltage           | - - - - - | 5000   | 7500   | volts |
| DC Screen Voltage          | - - - - - | 1500   | 1500   | volts |
| DC Grid Voltage            | - - - - - | -250   | -260   | volts |
| Max-Signal Plate Current   |           |        |        |       |
| Max-Signal Plate Current   | - - -     | 4.0    | 4.0    | amps  |
| Zero-Signal Plate Current  | - - -     | 2.0    | 2.0    | amps  |
| Max-Signal Screen Current* | - - -     | 165    | 150    | mA    |
| Peak RF Grid Voltage*      | - - - -   | 240    | 250    | volts |
| Driving Power              | - - - - - | 0      | 0      | watts |
| Plate Dissipation          | - - - - - | 9700   | 12,500 | watts |
| Plate Output Power         | - - - - - | 10,300 | 17,500 | watts |
| Resonant Load Impedance    | - -       | 590    | 1030   | ohms  |

## AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-AB<sub>1</sub>

### MAXIMUM RATINGS

|                    |         |              |
|--------------------|---------|--------------|
| DC PLATE VOLTAGE   | - - - - | 7500 VOLTS   |
| DC SCREEN VOLTAGE  | - - -   | 1500 VOLTS   |
| DC PLATE CURRENT   | - - - - | 4.0 AMPS     |
| PLATE DISSIPATION  | - - - - | 20,000 WATTS |
| SCREEN DISSIPATION | - - - - | 250 WATTS    |
| GRID DISSIPATION   | - - - - | 75 WATTS     |

\* Approximate values

### TYPICAL OPERATION (Two Tubes)

|                                 |           |        |        |       |
|---------------------------------|-----------|--------|--------|-------|
| DC Plate Voltage                | - - - - - | 5000   | 7500   | volts |
| DC Screen Voltage               | - - - - - | 1500   | 1500   | volts |
| DC Grid Voltage                 | - - - - - | -250   | -260   | volts |
| Max-Signal Plate Current        | - - -     | 8.0    | 8.0    | amps  |
| Zero-Signal Plate Current       | - - -     | 4.0    | 4.0    | amps  |
| Max-Signal Screen Current**     | - - -     | 330    | 300    | mA    |
| Peak RF Driving Voltage**       | - - -     | 240    | 250    | volts |
| Driving Power                   | - - - - - | 0      | 0      | watts |
| Load Resistance, Plate-to-Plate |           | 1180   | 2060   | ohms  |
| Max-Signal Plate Dissipation*   | -         | 9700   | 12,500 | watts |
| Max-Signal Plate Output Power   |           | 20,600 | 35,000 | watts |

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves. No allowance is made for circuit losses of any kind. Adjustment of the rf grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. 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. 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 driving voltage is applied.

## APPLICATION

### MECHANICAL

**MOUNTING** — The 4CV20,000A must be operated with its axis vertical, base up in an Eimac BR-200 boiler. Care must be exercised when installing to insure that the boiler is level, the water is at the proper level and that the flange of the tube makes a vapor tight seal against the rubber "O" ring and boiler. A typical vapor cooling system is shown below.

**SOCKET** — The Eimac SK-300A socket is available for use with the 4CV20,000A. Filament, control grid and screen grid connections are made to this socket.

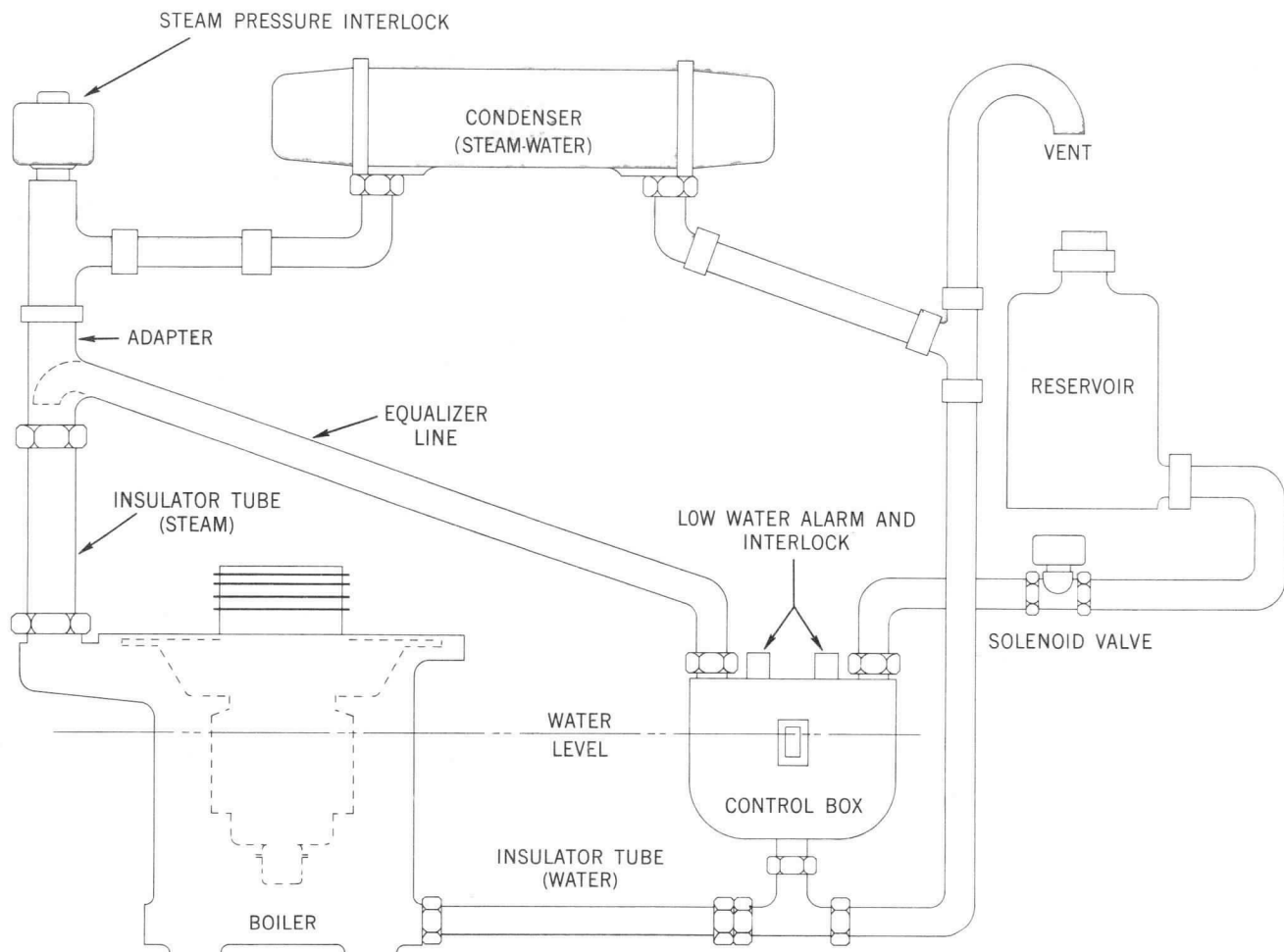
**COOLING** — Cooling is accomplished by immersing the anode in the distilled water filled BR-200 boiler. The energy dissipated at the anode causes the water to boil at the surfaces of the anode, be converted into steam and be carried away to the condenser. The boiling action keeps the anode surfaces at approximately 100°C. In a properly designed boiler-tube system (such as the 4CV20,000A and BR-200), it is extremely unlikely that the anode surfaces will ever exceed 110°C - well below the 250°C maximum rating - at full dissipation ratings.

The water in the boiler must be maintained at a constant level as indicated by the mark on the boiler, just below the top of the fins on the anode cooler. This is accomplished automatically in the vapor cooling system shown. Condensate from the condenser is returned to the boiler to maintain this constant fluid level. Any losses or drops in liquid level are sensed by the control box, CB-202. A low water level in the control box activates the solenoid water valve, allowing make-up water from the reservoir to enter the boiler. When the proper level is reached, the control box de-energizes the solenoid, stopping the flow from the reservoir. A second switch in the control box is energized if the water level drops to a lower level because of an empty reservoir or a constriction in the line. This switch may be used to shut down the equipment or activate an alarm.

For reliable operation, it is important that the control box and boiler be mounted so that the level sensed by the control box is exactly the same as the level in the boiler.

Cooling of the tube base is accomplished by blowing 25-50 CFM of air into the socket in the area of the filament seals.

VAPOR COOLING SYSTEM



## ELECTRICAL

**FILAMENT OPERATION** — The rated filament voltage for the 4CV20,000A is 7.5 volts. Filament voltage, as measured at the socket, must be maintained at 7.5 volts plus or minus five percent to obtain maximum tube life. The use of a constant voltage filament transformer is recommended.

**CONTROL-GRID OPERATION** — The 4CV20,000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. Grid dissipation is the product of the dc grid current and the peak positive grid voltage swing.

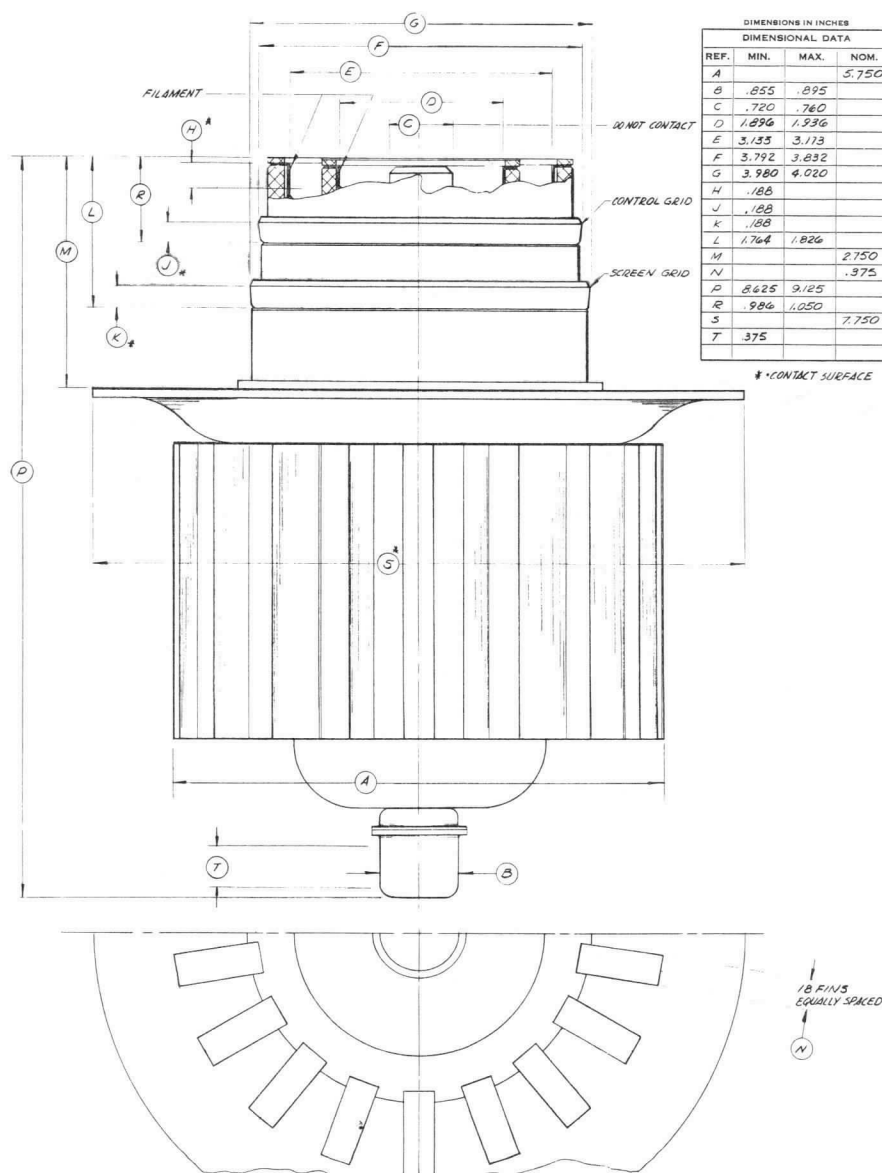
**SCREEN-GRID OPERATION** — The power dissipated by the screen must not exceed 250 watts. Screen dissipation, in cases where no ac is applied to the screen is the product of screen voltage and screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power and screen voltage.

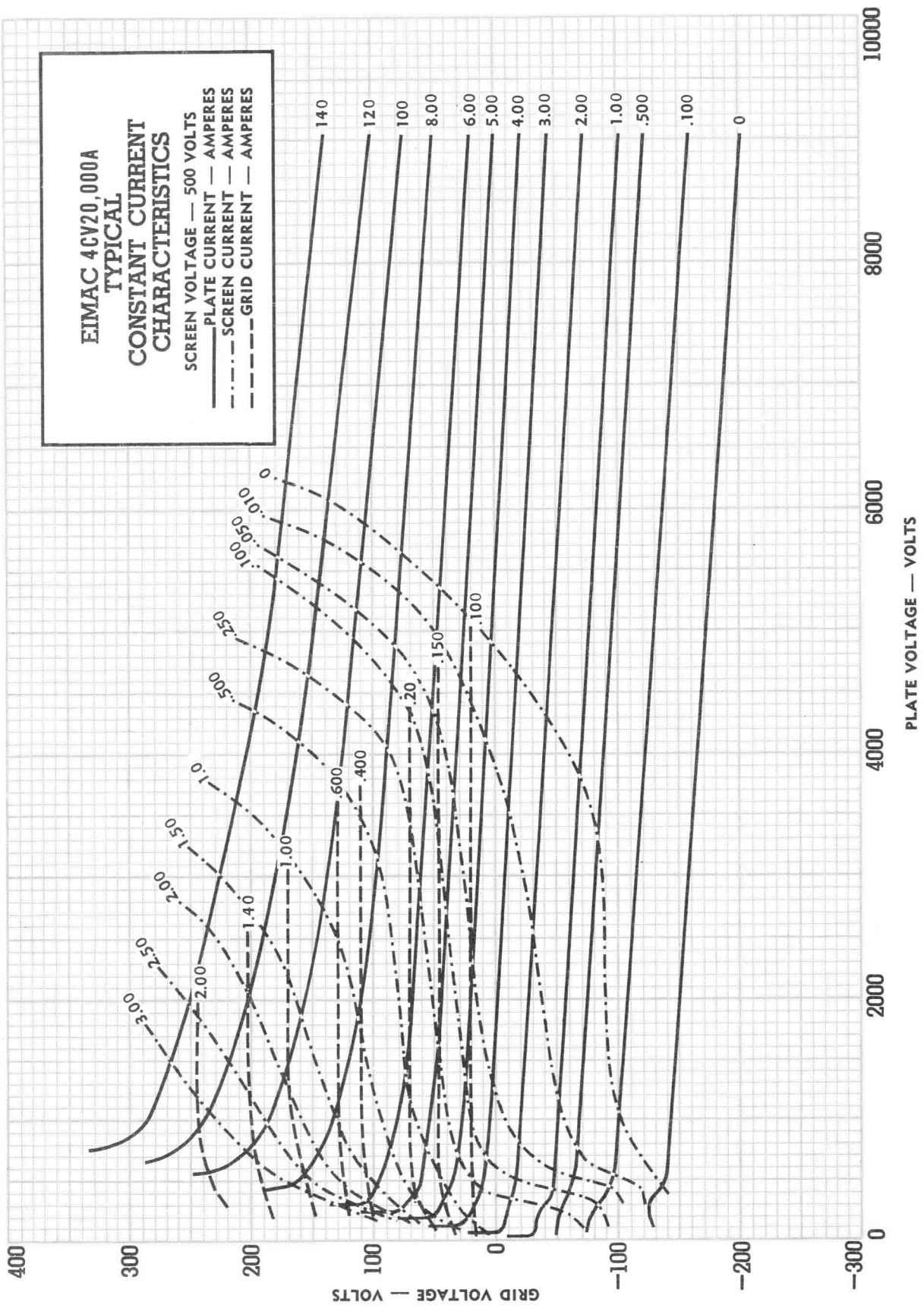
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation in the event of these failures.

**PLATE DISSIPATION** — The plate dissipation rating of 20,000 watts attainable through vapor cooling provides a large margin of safety. It is unlikely that this rating will be exceeded, even during tuning periods.

When the 4CV20,000A is used as a plate-modulated rf amplifier, this rating is reduced to 13,500 watts with a reduced plate input rating of 5000 volts and 2.5 amps.

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







4CV20,000A

