# 8170
# 4CX5000A

**RADIAL-BEAM POWER TETRODE**

**TECHNICAL DATA**

The EIMAC 8170/4CX5000A is a compact high-power ceramic and metal tetrode cooled by forced air. It is useful as an oscillator, amplifier, or modulator at frequencies up to 110 megahertz and is particularly suited for use as a linear single-sideband amplified, Class-$AB_1$ audio amplifier, or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The rated plate dissipation is five kilowatts for most classes of services and six kilowatts for Class-AB operation.


## GENERAL CHARACTERISTICS

### ELECTRICAL

| | Min. | Nom. | Max. | |
|---|---|---|---|---|
| Filament: Thoriated Tungsten | | | | |
| Voltage | | 7.5 | | volts |
| Current | 73 | | 78 | amperes |
| 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 and Screen: | Min. | Max. | |
|---|---|---|---|
| Input | 48 | 58 | pF |
| Output | 18 | 23 | pF |
| Feedback | | 0.16 | pF |

### MECHANICAL

| | |
|---|---|
| Base | Special concentric |
| Maximum Seal Temperature | 250°C |
| Maximum Anode-Core Temperature | 250°C |
| Recommended Socket | EIMAC SK-300A |
| Recommended Chimney | EIMAC SK-306 |
| Operating Position | Axis vertical, base up or down |
| Maximum Dimensions: | |
| Height | 9.13 inches |
| Diameter | 4.94 inches |
| Cooling | Forced air |
| Net Weight | 9.5 pounds |
| Shipping Weight (Approximate) | 22 pounds |

### RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR (Up to 30 megahertz)

Class-C Telegraphy (Key-down conditions)

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE | 7500 VOLTS |
| DC SCREEN VOLTAGE | 1500 VOLTS |
| DC PLATE CURRENT | 3 AMPS |
| PLATE DISSIPATION | 5000 WATTS |
| SCREEN DISSIPATION | 250 WATTS |
| GRID DISSIPATION | 75 WATTS |

TYPICAL OPERATION
(Frequencies below 30 megahertz)

| | |
|---|---|
| DC Plate Voltage | 7500 volts |
| DC Screen Voltage | 500 volts |
| DC Grid Voltage | —350 volts |
| DC Plate Current | 2.8 amps |
| DC Screen Current | 0.5 amp |
| DC Grid Current | 0.25 amp |
| Peak RF Grid Voltage | 590 volts |
| Driving Power | 150 watts |
| Plate Dissipation | 5000 watts |
| Plate Output Power | 16,000 watts |

(Revised 4-15-69) 

Printed in U.S.A.

## RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR
**(From 30 to 220 MHz)**

Class-C Telegraphy or FM Telephony

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE: | |
| 30 to 60 MHz | 7000 VOLTS |
| 60 to 110 MHz | 6500 VOLTS |
| 110 to 220 MHz | 5800 VOLTS |
| DC SCREEN VOLTAGE | 1500 VOLTS |
| DC PLATE CURRENT: | |
| 30 to 60 MHz | 2.8 AMPS |
| 60 to 220 MHz | 2.6 AMPS |
| PLATE DISSIPATION | 5000 WATTS |
| SCREEN DISSIPATION | 250 WATTS |
| GRID DISSIPATION | 75 WATTS |

TYPICAL OPERATION

| | 108MHz | 220MHz | |
|---|---|---|---|
| DC PLATE VOLTAGE | 6500 | 5500 | volts |
| DC SCREEN VOLTAGE | 750 | 680 | volts |
| DC GRID VOLTAGE | -350 | -140 | volts |
| DC PLATE CURRENT | 2.3 | 1.6 | amperes |
| DC SCREEN CURRENT | .2 | .034 | amperes |
| DC GRID CURRENT | .05 | .030 | amperes |
| DRIVING POWER | 100 | --- | watts |
| USEFUL OUTPUT POWER | 10,000 | 5,500 | watts |

## PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony
(Carrier conditions except where noted)

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE | 5500 VOLTS |
| DC SCREEN VOLTAGE | 1000 VOLTS |
| DC PLATE CURRENT | 2.5 AMPS |
| PLATE DISSIPATION* | 3500 WATTS |
| SCREEN DISSIPATION | 250 WATTS |
| GRID DISSIPATION | 75 WATTS |

*Corresponds to 5000 watts at 100-percent sine-wave modulation.

TYPICAL OPERATION (Frequencies below 30 megahertz)

| | |
|---|---|
| DC Plate Voltage | 5000 volts |
| DC Screen Voltage | 500 volts |
| Peak AF Screen Voltage (For 100-percent modulation) | 450 volts |
| DC Grid Voltage | —400 volts |
| DC Plate Current | 1.4 amperes |
| DC Screen Current | 0.26 ampere |
| DC Grid Current | 0.05 ampere |
| Peak RF Grid Voltage | 520 volts |
| Grid Driving Power | 25 watts |
| Plate Dissipation | 1100 watts |
| Plate Output Power | 5.8 kilowatts |

## SCREEN-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony
(Carrier conditions except where noted)

MAXIMUM RATINGS (Per Tube)

| | |
|---|---|
| DC PLATE VOLTAGE | 7500 VOLTS |
| DC SCREEN VOLTAGE | 750 VOLTS |
| DC PLATE CURRENT | 3.0 AMPS |
| PLATE DISSIPATION | 5000 WATTS |
| SCREEN DISSIPATION | 250 WATTS |
| GRID DISSIPATION | 75 WATTS |

TYPICAL OPERATION (Frequencies below 30 megahertz per tube)

| | | |
|---|---|---|
| DC Plate Voltage | 7500 | 7500 volts |
| DC Screen Voltage | 350 | 350 volts |
| Peak AF Screen Voltage (For 100-percent modulation) | 550 | 550 volts |
| DC Grid Voltage | —300 | —300 volts |
| DC Plate Current | 0.9 | 1.14 amperes |
| DC Screen Current* | —0.01 | —0.01 ampere |
| DC Grid Current | 0.015 | 0.03 ampere |
| Peak RF Grid Voltage | 350 | 375 volts |
| Grid Driving Power | 7 | 11 watts |
| RF Load Impedance | 2000 | 1600 ohms |
| Plate Dissipation | 4000 | 5000 watts |
| Useful Output Power | 2750 | 3550 watts |

*DC Screen Current is a function of loading; values of plus or minus 20 milliamperes may be considered typical at carrier level.

NOTE: Two tubes can be employed under conditions listed in the first column to obtain more than five kilowatts plate output power. Likewise, three tubes can be utilized at conditions listed in the second column to obtain better than ten kilowatts output power.

## AUDIO-FREQUENCY AMPLIFIER OR MODULATOR

Class-$AB_1$

MAXIMUM RATINGS (Per Tube)

| | |
|---|---|
| DC PLATE VOLTAGE | 7500 VOLTS |
| DC SCREEN VOLTAGE | 1500 VOLTS |
| DC PLATE CURRENT | 4.0 AMPS |
| PLATE DISSIPATION | 6000 WATTS |
| SCREEN DISSIPATION | 250 WATTS |
| GRID DISSIPATION | 75 WATTS |

TYPICAL OPERATION, two tubes

| | | | | |
|---|---|---|---|---|
| DC Plate Voltage | 4000 | 5000 | 6000 | 7000 volts |
| DC Screen Voltage | 1250 | 1250 | 1250 | 1250 volts |
| DC Grid Voltage | —270 | —280 | —310 | —325 volts |
| Max-Signal Plate Current | 5.10 | 4.40 | 4.25 | 3.65 amperes |
| Zero-Signal Plate Current | 1.25 | 1.00 | 0.83 | 0.70 amperes |
| Max-Signal Screen Current | 0.35 | 0.33 | 0.30 | 0.24 ampere |
| Zero-Signal Screen Current | 0 | 0 | 0 | 0 amperes |
| Peak AF Driving Voltage | 250 | 240 | 270 | 235 volts |
| Driving Power | 0 | 0 | 0 | 0 watts |
| Load Resistance, Plate-to-Plate | 1500 | 2370 | 2940 | 4100 ohms |
| Max-Signal Plate Dissipation* | 4200 | 4200 | 4200 | 4200 watts |
| Max-Signal Plate Output Power | 11,500 | 13,500 | 17,000 | 17,500 watts |

*Per Tube

## RADIO-FREQUENCY LINEAR AMPLIFIER

Class-$AB_1$

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE | 7500 VOLTS |
| DC SCREEN VOLTAGE | 1500 VOLTS |
| DC PLATE CURRENT | 4.0 AMPS |
| PLATE DISSIPATION | 6000 WATTS |
| SCREEN DISSIPATION | 250 WATTS |
| GRID DISSIPATION | 75 WATTS |

TYPICAL OPERATION, Peak-Envelope or modulation-Crest Conditions, (Frequencies below 30 megahertz)

| | |
|---|---|
| DC Plate Voltage | 7500 volts |
| DC Screen Voltage | 1250 volts |
| DC Grid Voltage* | —300 volts |
| Max-Signal Plate Current | 1.9 amperes |
| Zero-Signal Plate Current | 0.50 ampere |
| Max-Signal Screen Current | 0.20 ampere |
| Peak RF Grid Voltage | 300 volts |
| Driving Power | 0 watts |
| Plate Dissipation | 4200 watts |
| Plate Output Power ** | 10,000 watts |

*Adjust grid voltage to obtain specified Zero-Signal plate current.
**PEP output or rf output power at crest of modulation envelope.

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.

# APPLICATION

## MECHANICAL

*Mounting* — The 4CX5000A 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-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

*Cooling* — The maximum temperature rating for the external surfaces of the 4CX5000A 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. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megahertz).

| Plate Dissipation* (Watts) | SK-300A Socket | | SK-300 Socket | |
|---|---|---|---|---|
| | Air Flow (CFM) | Pressure Drop (Inches of water) | Air Flow (CFM) | Pressure Drop (inches of water) |
| 2000 | 75 | 0.4 | 75 | 0.4 |
| 3000 | 105 | 0.7 | 100 | 0.7 |
| 4000 | 145 | 1.1 | 135 | 1.2 |
| 5000 | 190 | 1.5 | 165 | 1.8 |
| 6000 | 230 | 2.0 | 200 | 2.5 |

***Since the power dissipated by the filament represents about 560 watts and since grid-plus-screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 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 higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling.* The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

## ELECTRICAL

*Filament Operation*—The rated filament voltage for the 4CX5000A is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

*Electrode Dissipation Ratings*—The maximum dissipation ratings for the 4CX5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

*Control Grid Operation* — The 4CX5000A control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in "Typical Operation" sections of the data sheet whenever possible.

*Screen-Grid Operation* — The power dissipated by the screen of the 4CX5000A must not exceed 250 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 loading, driving power, and carrier screen voltage.

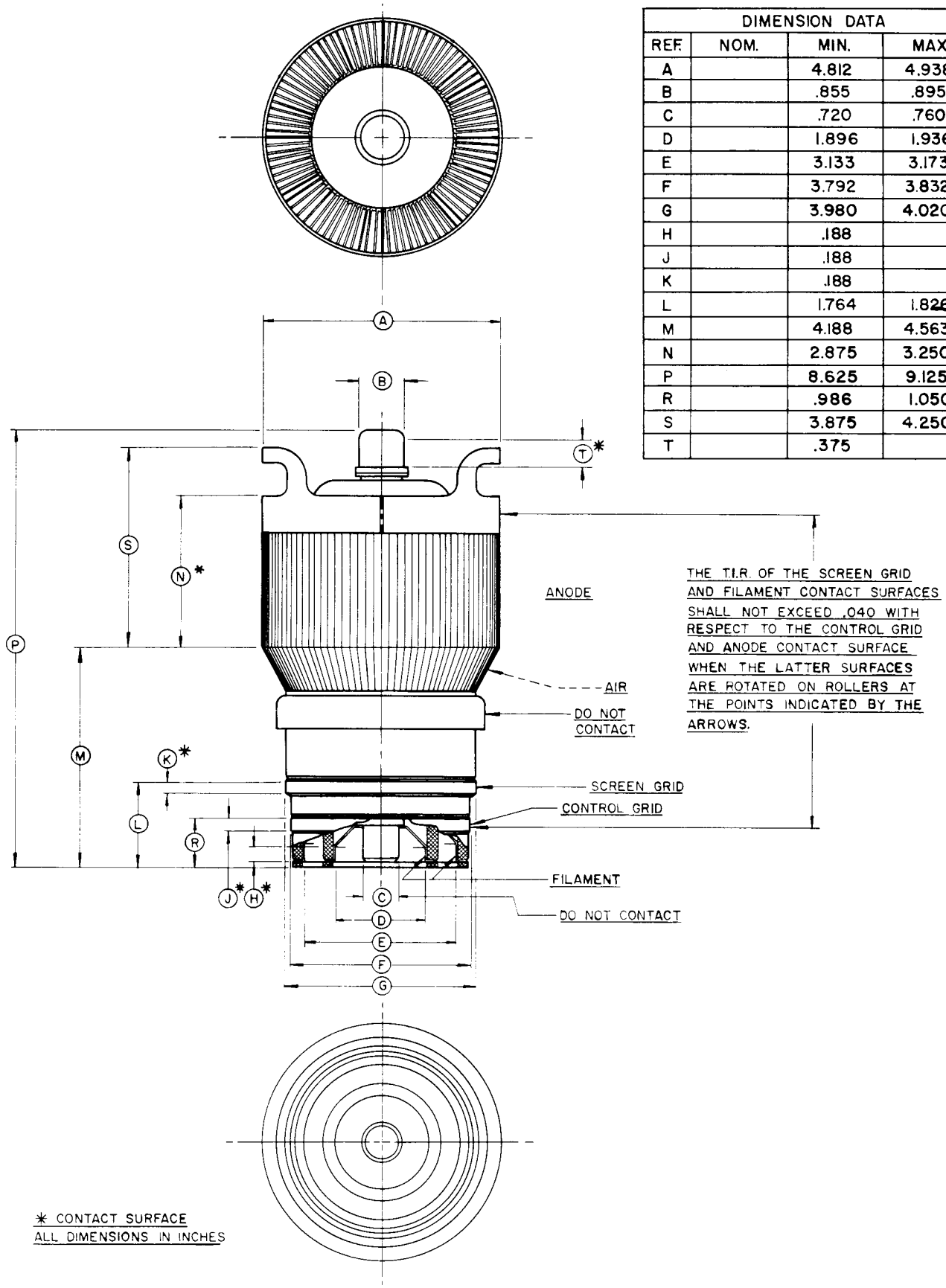
Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

*Plate Dissipation*—The plate-dissipation rating for the 4CX5000A is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts.

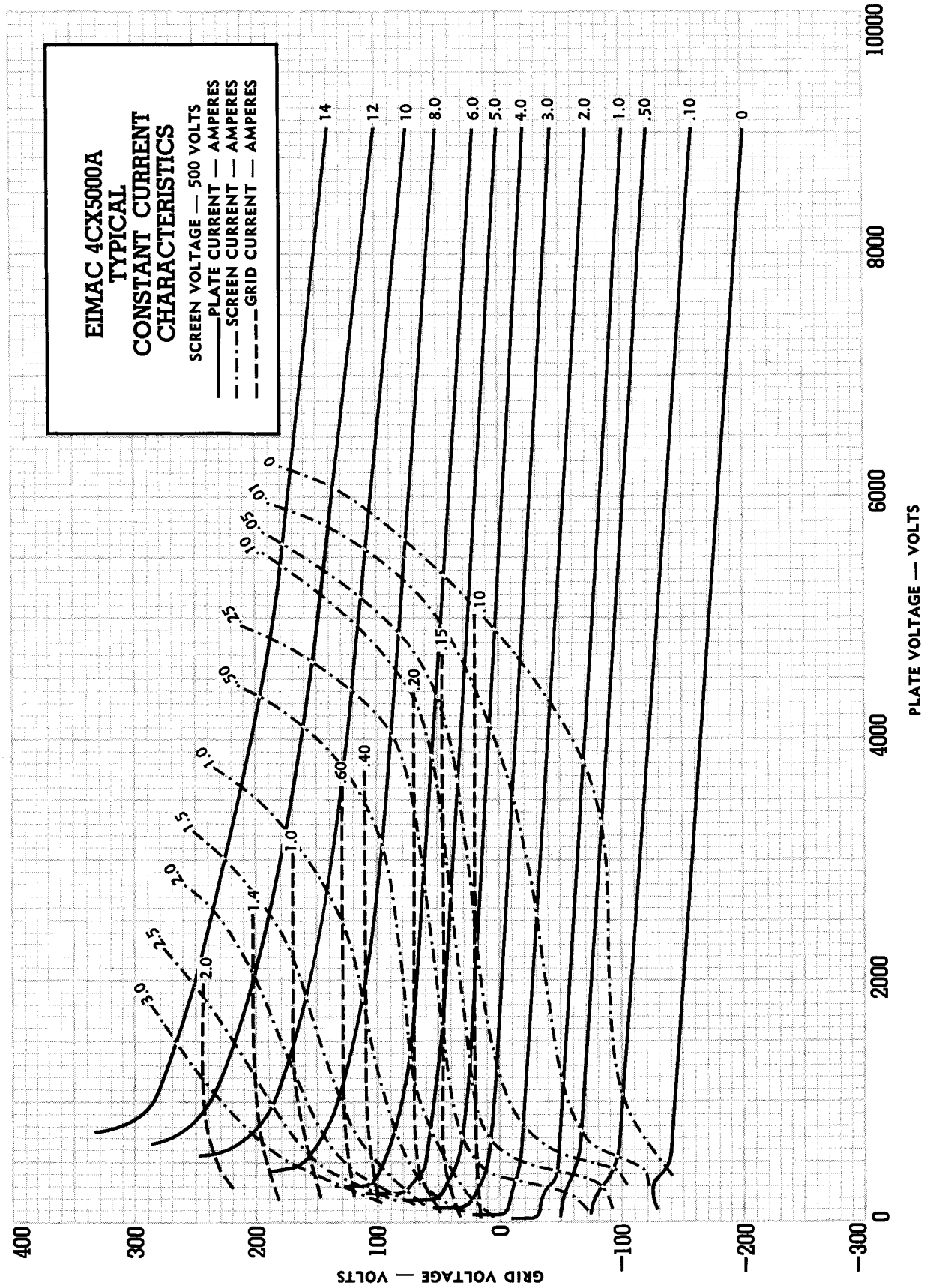
When the 4CX5000A is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

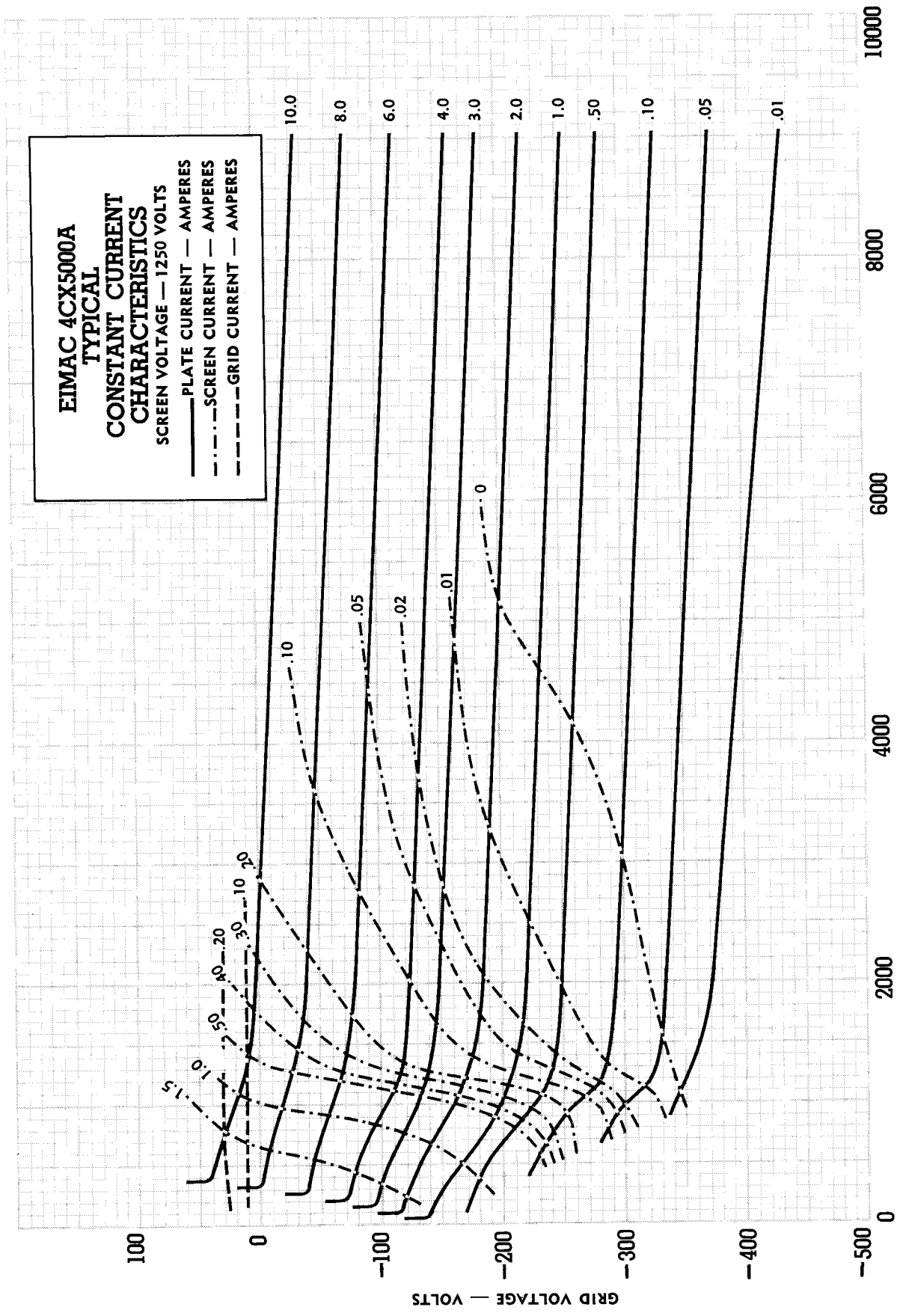
*Special Applications*—If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California, for information and recommendations.

| DIMENSION DATA | | | |
|---|---|---|---|
| REF. | NOM. | MIN. | MAX. |
| A | | 4.812 | 4.938 |
| B | | .855 | .895 |
| C | | .720 | .760 |
| D | | 1.896 | 1.936 |
| E | | 3.133 | 3.173 |
| F | | 3.792 | 3.832 |
| G | | 3.980 | 4.020 |
| H | | .188 | |
| J | | .188 | |
| K | | .188 | |
| L | | 1.764 | 1.826 |
| M | | 4.188 | 4.563 |
| N | | 2.875 | 3.250 |
| P | | 8.625 | 9.125 |
| R | | .986 | 1.050 |
| S | | 3.875 | 4.250 |
| T | | .375 | |




* CONTACT SURFACE
ALL DIMENSIONS IN INCHES


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 500 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
400
300
200
100
0
−100
−200
−300
0
2000
4000
6000
8000
10000
14
12
10
8.0
6.0
5.0
4.0
3.0
2.0
1.0
.50
.10
0
3.0
2.5
2.0
1.5
1.0
.5
0
2.5
2.0
1.4
1.0
.60
.40
.20
.15
.10


EIMAC 4CX5000A
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 1250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
10.0
8.0
6.0
4.0
3.0
2.0
1.0
.50
.10
.05
.01
0
.01
.02
.05
.10
1.5
1.0
.50
.40
.30
.20
.10
100
0
−100
−200
−300
−400
−500
0
2000
4000
6000
8000
10000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS