EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

# 7580W
# 4CX250R

## RADIAL-BEAM POWER TETRODE

The 4CX250R is a compact, high-perveance radial-beam tetrode designed specifically for use in class-$AB_1$ linear amplifiers where shock and/or vibration preclude the use of non-ruggedized tube types. The 4CX250R will replace the 7580 in almost all applications since it is electrically identical except for a minute (0.2 uuf) increase in output-capacitance limits. Further, it will replace the 4X250B or 4CX250B in equipments where the range of bias adjustment will tolerate this higher perveance tube and where tuning range can compensate for the small differences in input and output capacitances.

The 4CX250R will deliver more output power in most linear amplifiers which presently employ the 4X250B or 4CX250B and it will operate with maximum rated plate and screen voltages applied in equipments where shock and/or vibration is experienced. See **Shock and Vibration** section on page two for details.

## GENERAL CHARACTERISTICS

### ELECTRICAL

| | Min. | Nom. | Max. | |
|---|---|---|---|---|
| Cathode: Oxide-Coated, Unipotential | | | | |
| Heating Time | 30 | 60 | | seconds |
| Cathode-to-Heater Potential | — | | ±150 | volts |
| Heater: Voltage | | 6.0 | | volts |
| Current | 2.3 | | 2.9 | amperes |
| Direct Interelectrode Capacitances, Grounded Cathode: | | | | |
| Input | 16.0 | | 18.5 | uuf |
| Output | 4.2 | | 5.2 | uuf |
| Grid-to-Plate | | | 0.06 | uuf |
| Frequency for Maximum Ratings | | | 500 | Mc |

### MECHANICAL

| | | |
|---|---|---|
| Base | Special 9-pin | |
| Maximum Operating Temperatures: | | |
| Ceramic-to-Metal Seals | 250°C | |
| Anode Core | 250°C | |
| Recommended Socket | Eimac SK-600 Series | |
| Operating Position | Any | |
| Maximum Dimensions: | | |
| Height | 2.464 | inches |
| Seated Height | 1.910 | inches |
| Diameter | 1.640 | inches |
| Cooling | Forced Air | |
| Net Weight | 4 | ounces |
| Shipping Weight (Approximate) | 1.6 | pounds |

### RADIO-FREQUENCY LINEAR AMPLIFIER

Class-$AB_1$ - Single Sideband

MAXIMUM RATINGS

| | |
|---|---|
| D-C PLATE VOLTAGE | 2000 MAX. VOLTS |
| D-C SCREEN VOLTAGE | 500 MAX. VOLTS |
| D-C GRID VOLTAGE | —250 MAX. VOLTS |
| D-C PLATE CURRENT | 250 MAX. MA |
| PLATE DISSIPATION | 250 MAX. WATTS |
| SCREEN DISSIPATION | 12 MAX. WATTS |

TYPICAL OPERATION

Two-Tone where peak envelope power is at least twice the average power output—Actual measurements—Tank-circuit efficiency estimated at 95%.

| | | | |
|---|---|---|---|
| D-C Plate Voltage | 1500 | 2000 | volts |
| Zero-Signal D-C Plate Current | 133 | 070 | ma |
| Two-Tone D-C Plate Current | 250 | 245 | ma |
| D-C Screen Voltage | 350 | 400 | volts |
| Two-Tone D-C Screen Current | —10 | +1 | ma |
| D-C Grid-Bias Voltage | —62 | —80 | volts |
| Peak Signal Voltage | 56 | 80 | volts |
| 3rd Order Intermodulation products referred to signal level | —30 | —23 | db |
| 5th Order Intermodulation products referred to signal level | —35 | —27 | db |
| Worst 3rd Order Intermodulation as drive signal is reduced | —29 | —21 | db |
| Load Resistance | 2160 | 2840 | ohms |
| Peak Envelope Power, Useful | 262 | 470 | watts |

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## RADIO-FREQUENCY LINEAR AMPLIFIER

Class-$AB_1$ (Carrier with Double Sidebands)

MAXIMUM RATINGS

| | |
|---|---|
| D-C PLATE VOLTAGE | 2000 MAX. VOLTS |
| D-C SCREEN VOLTAGE | 500 MAX. VOLTS |
| D-C GRID VOLTAGE | —250 MAX. VOLTS |
| D-C PLATE CURRENT | 250 MAX. MA |
| PLATE DISSIPATION | 250 MAX. WATTS |
| SCREEN DISSIPATION | 12 MAX. WATTS |

TYPICAL OPERATION—Single Tube

(Quantities shown for carrier conditions, no modulation)

| | | | |
|---|---|---|---|
| D-C Plate Voltage | 1500 | 2000 | volts |
| D-C Plate Current | 172 | 172 | ma |
| D-C Screen Voltage | 350 | 400 | volts |
| D-C Screen Current (Approx) | —3 | —5 | ma |
| D-C Grid-Bias Voltage | —58 | —76 | volts |
| Peak Grid-Signal Voltage | 30 | 39 | volts |
| Plate-Load Resistance | 2320 | 3150 | ohms |
| Power Output for Tank Circuit Efficiency of 95% | 55 | 100 | watts |

## AUDIO-FREQUENCY LINEAR AMPLIFIER

Class-$AB_1$

MAXIMUM RATINGS (Per Tube)

| | |
|---|---|
| D-C PLATE VOLTAGE | 2000 MAX. VOLTS |
| D-C SCREEN VOLTAGE | 500 MAX. VOLTS |
| D-C GRID VOLTAGE | —250 MAX. VOLTS |
| D-C PLATE CURRENT | 250 MAX. MA |
| PLATE DISSIPATION | 250 MAX. WATTS |
| SCREEN DISSIPATION | 12 MAX. WATTS |

TYPICAL OPERATION (Two Tubes Push-Pull)

| | | | |
|---|---|---|---|
| D-C Plate Voltage | 1500 | 2000 | volts |
| D-C Plate Current No Signal | 200 | 140 | ma |
| D-C Plate Current at Full Signal | 490 | 500 | ma |
| D-C Screen Voltage | 300 | 350 | volts |
| D-C Screen Current No Signal | —2 | —4 | ma |
| D-C Screen Current at Full Signal | 0 | +4 | ma |
| D-C Grid-Bias Voltage (Approx) | —48 | —66 | volts |
| Plate-to-Plate Load Resistance | 5920 | 8016 | ohms |
| Power Output for Transformer Efficiency of 95% | 390 | 595 | watts |

## MAXIMUM RATINGS FOR OTHER TYPES OF OPERATION

Class-C Telegraphy or FM

| | |
|---|---|
| D-C PLATE VOLTAGE | 2000 MAX. VOLTS |
| D-C SCREEN VOLTAGE | 300 MAX. VOLTS |
| D-C GRID VOLTAGE | —250 MAX. VOLTS |
| D-C PLATE CURRENT | 250 MAX. MA |
| PLATE DISSIPATION | 250 MAX. WATTS |
| SCREEN DISSIPATION | 12 MAX. WATTS |
| GRID DISSIPATION | 2 MAX. WATTS |

Class-C, Plate Modulated

| | |
|---|---|
| D-C PLATE VOLTAGE | 1500 MAX. VOLTS |
| D-C SCREEN VOLTAGE | 300 MAX. VOLTS |
| D-C GRID VOLTAGE | —250 MAX. VOLTS |
| D-C PLATE CURRENT | 200 MAX. MA |
| PLATE DISSIPATION | 165 MAX. WATTS |
| SCREEN DISSIPATION | 12 MAX. WATTS |
| GRID DISSIPATION | 2 MAX. WATTS |

# APPLICATION

## MECHANICAL

**Mounting**—The 4CX250R may be mounted in any position. An Eimac Air-System Socket of the SK-600 series or equivalent is recommended. These sockets may be obtained with or without the r-f screen by-pass capacitor, and with or without the four cathode terminals grounded to the socket shell. A simple Lock-in socket restricts the flow of cooling air and is not recommended.

**Cooling**—The 4CX250R has an efficient louvered anode cooler. The maximum allowable temperature for any external surface is 250°C.

For long service life at sea level, at an ambient temperature of 25°C and maximum rated anode dissipation of 250 watts, a *minimum* of 4.6 cfm air should flow from tube base through the anode cooler. The corresponding pressure drop with the recommended socket and chimney will be approximately 0.32 inch water column. See table for other dissipation levels and conditions.

4.6 cfm of air at 25°C is the same as a mass air flow of 18 pounds per hour. Higher ambient temperature requires greater air mass and volume. Higher altitude requires equivalent mass air flow for a given ambient temperature and therefore requires greater volume at increased back pressure.

The use of temperature-sensitive laquer is recommended to determine the effectiveness of a cooling system under operating conditions.

| Plate Dissipation (Watts) | 55°C AMBIENT | | | |
|---|---|---|---|---|
| | SEA LEVEL | | 10,000 FEET ALTITUDE | |
| | Air Flow (CFM) | Pressure Drop (Inches of Water) | Air Flow (CFM) | Pressure Drop (Inches of Water) |
| 75 | 1.15 | 0.025 | 1.8 | 0.036 |
| 125 | 2.3 | 0.09 | 3.35 | 0.13 |
| 250 | 6.4 | 0.59 | 9.3 | 0.86 |

**Shock and Vibration**—The 4CX250R is one of the Eimac tube types which is unique in that shock and vibration testing is performed with *maximum rated plate and screen voltages* applied. Two samples of production tubes are randomly selected periodically and tested under the conditions outlined below.

With *maximum rated plate and screen voltages* applied, each of the tubes in this sample is subjected to six shocks of 90 G (minimum) half-sine-wave motion, with a duration of 11±2 milliseconds, in each of the three major axes (X1, X2, and Y1).

With *maximum rated plate and screen voltages* applied and with control-grid voltage adjusted to allow the flow of 100 ma through a plate load resistor of 4900 ohms, each of the tubes in this sample is vibrated in the three major axes throughout the range of 5-750-5 cps in a minimum time of six minutes per axis. The vibration level is maintained at 10 G from 28 cps to 750 cps and at 0.25 inch D.A. from 5 cps to 28 cps. During this test, noise voltage developed across the plate load resistor cannot exceed 30 volts rms. Sufficient plate power-supply voltage (2500 volts) is em-

ployed to assure that a minimum of 2000 volts appears at the plate of the tube under test even though 490 volts drop across the plate load resistor results from d-c plate-current flow.

The equipment designer is cautioned to provide adequate tube support to prevent relative motion between tube and socket in equipments where shock and/or vibration are anticipated.

## ELECTRICAL

**Heater**—For maximum life and uniform performance, the heater voltage should be maintained within plus or minus 5% of the rated 6.0 volts at operating frequencies up to 300 Mc. For CW use between 300 and 400 Mc, 5.75 volts is recommended. For CW use, 400 to 500 Mc, 5.5 volts is recommended.

**Cathode**—The cathode is connected to the four even-numbered base pins to provide a low-inductance path, or permit separation of input and output circuits if required.

Rated heater voltage should be applied for 30 seconds before other operating voltages are applied.

Heater-to-cathode maximum voltage is ±150 volts.

**Control Grid**—Maximum rated d-c bias voltage is −250 volts. D-C resistance, grid to cathode, should be no more than 100,000 ohms.

**Screen Grid**—Maximum screen dissipation is 12 watts, normally computed by multiplying d-c screen voltage by the average screen current. This computation is essentially correct except in the case of heavy plate loading when secondary-emission current may mask the normal screen current.

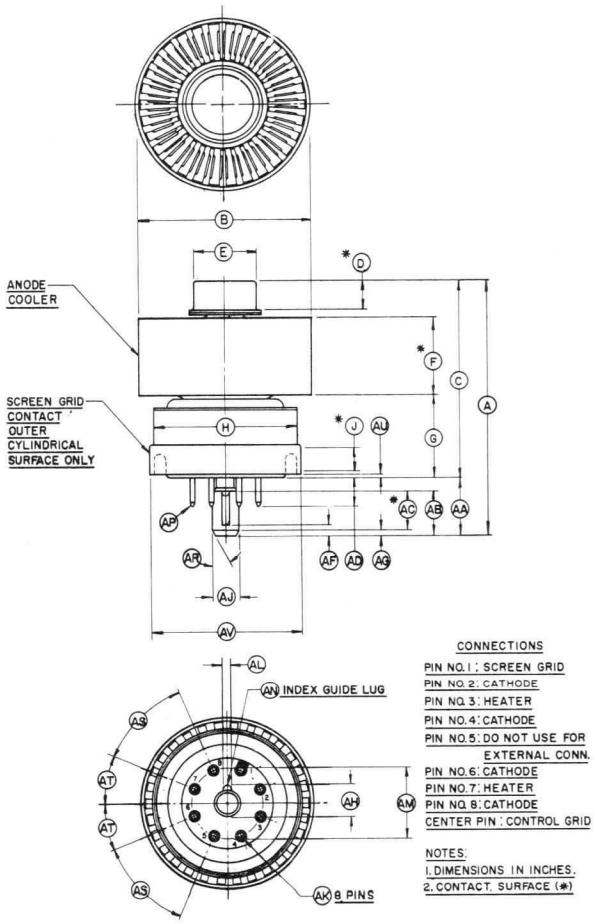
All tetrodes, under some conditions of loading and drive, will exhibit secondary emission from the screen which changes the net current to the screen and may even cause the screen meter to reverse. Normally, secondary emission is harmless provided the screen voltage is stable. To insure stable screen voltage, it is recommended that a bleeder resistor calculated to pass 15 ma from screen to ground be used.

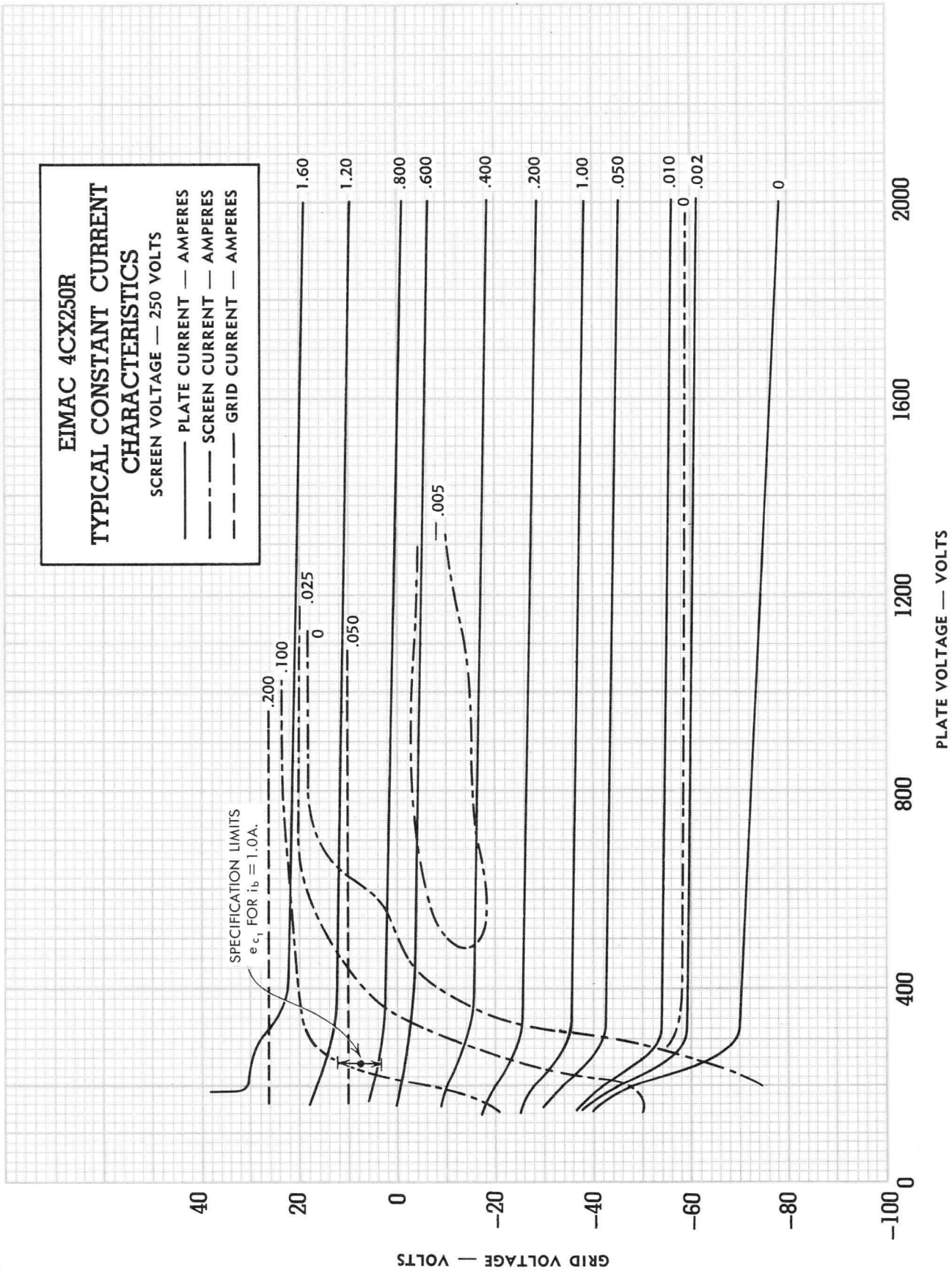
**Plate Dissipation**—The maximum plate dissipation is 250 watts. The usual single-sideband voice signal is complex and full peak envelope power shown in Typical Operating Conditions, may be developed without exceeding this plate dissipation. Single-tone testing for short periods with greater than 250 watts plate dissipation is permissible.

**Multiple Operation** — To obtain maximum power with minimum distortion from tubes operated in multiple it is desirable to adjust individual screen or grid-bias voltages so the peak plate current for each tube is equal at the crest of the exciting voltage. Under these conditions, individual d-c plate currents will be approximately equal for full input signal for class-$AB_1$ operation.

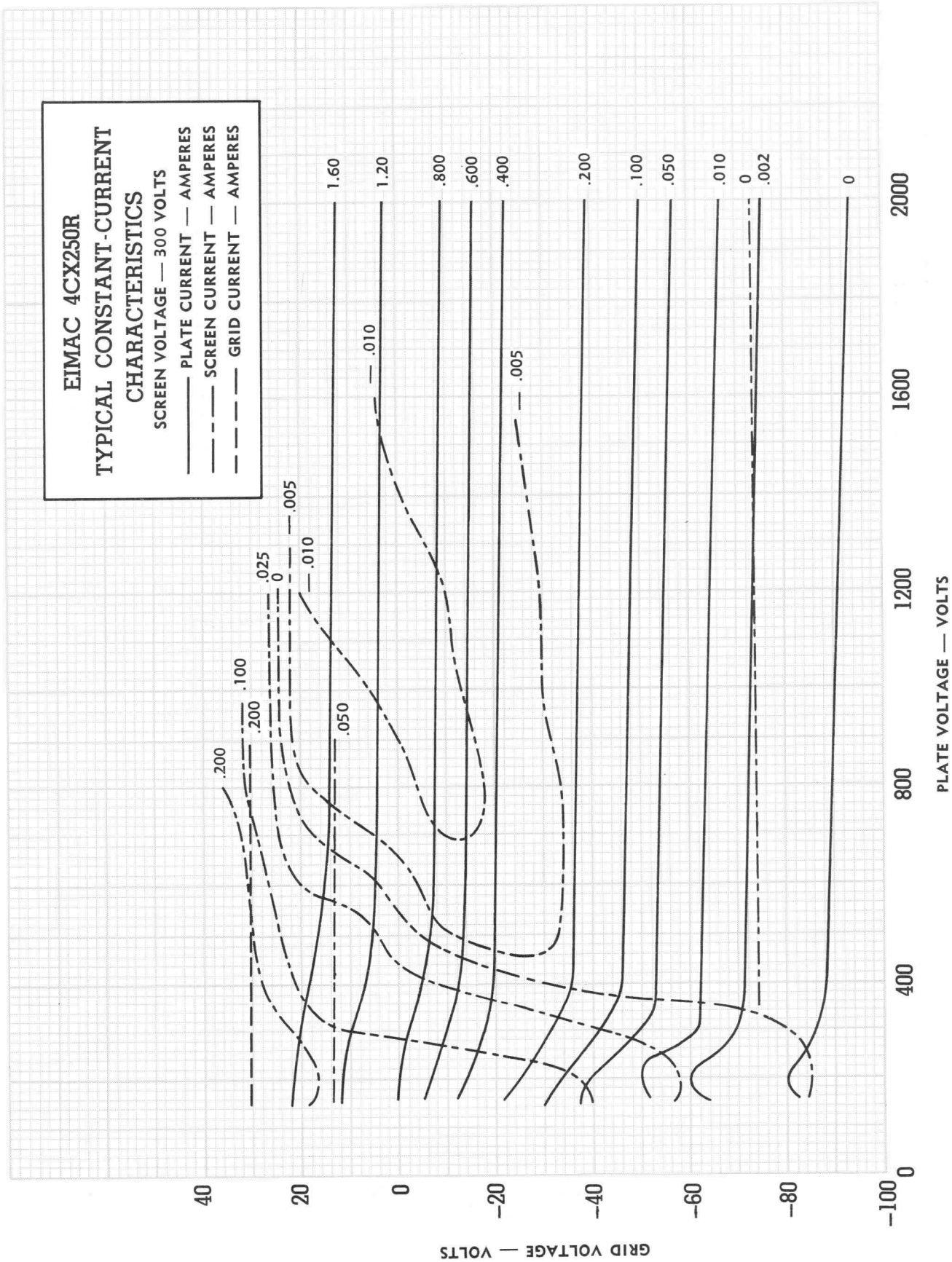
**Special Application**—If it is desired to use the 4CX250R under conditions widely different from those given here, consult the Power Grid Tube Marketing Department, EIMAC Division of Varian, San Carlos, California.

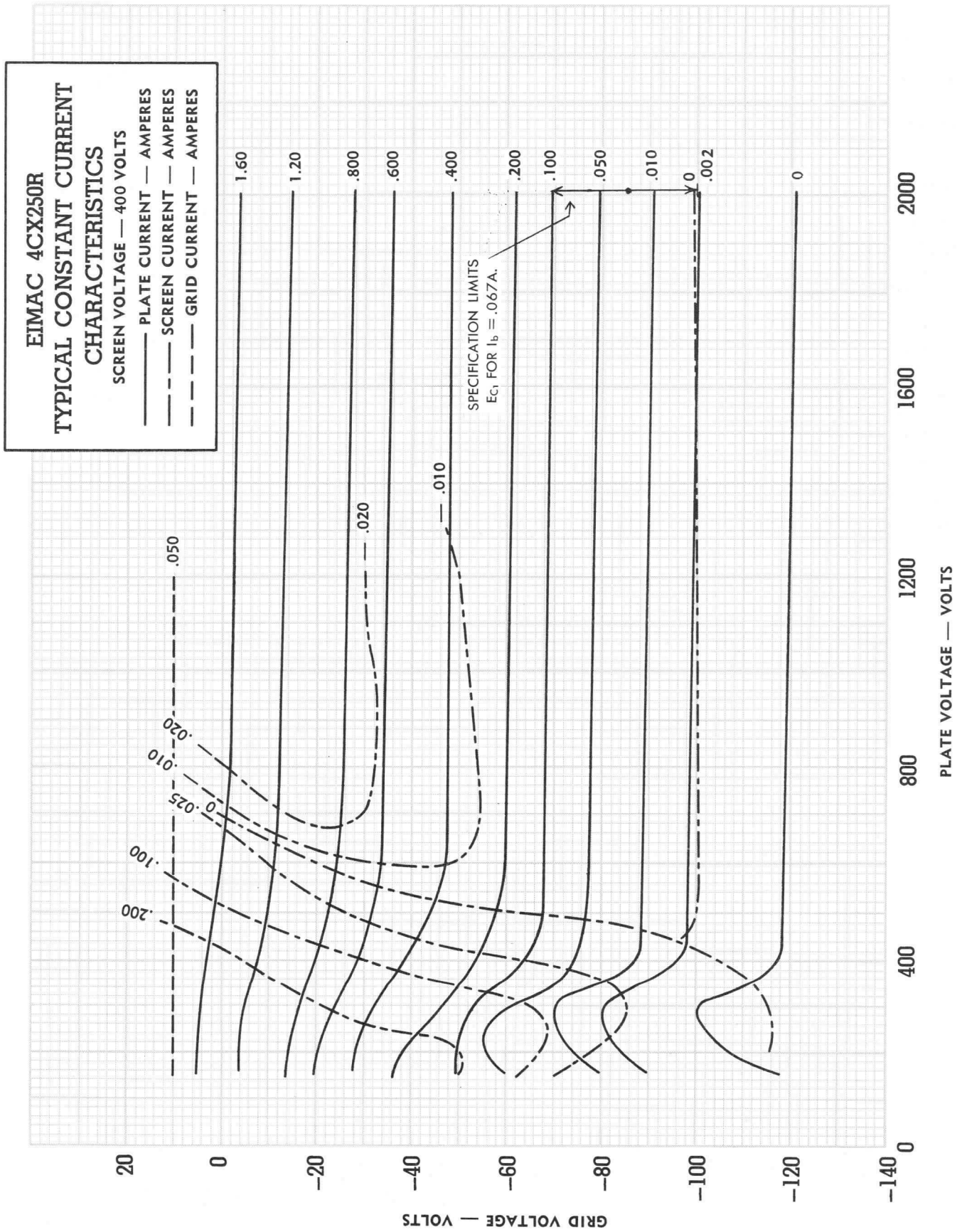
| DIMENSION DATA | | |
|---|---|---|
| REF. | MIN. | MAX. |
| A | 2.324 | 2.464 |
| B | 1.610 DIA. | 1.640 DIA. |
| C | 1.810 | 1.910 |
| D | .240 | .280 |
| E | .559 DIA. | .573 DIA. |
| F | .710 | .790 |
| G | .750 | .810 |
| H | | 1.406 DIA. |
| J | .187 | |
| AA | .514 | .554 |
| AB | | .456 |
| AC | .360 | |
| AD | | .250 |
| AF | .068 | .108 |
| AG | .031 NOM. | |
| AH | .298 | .308 |
| AJ | .255 DIA. | .265 DIA. |
| AK | .045 DIA. | .053 DIA. |
| AL | .078 | .086 |
| AM | .680 DIA. | .694 DIA. |
| AN | | .043 R. |
| AP | .005 R. MIN. OR | |
| | .035 X 22.5° | |
| AR | 30° NOM. | |
| AS | 45° NOM. | |
| AT | 22.5° NOM. | |
| AU | .080 NOM. | |
| AV | 1.417 DIA. | 1.433 DIA. |




EIMAC 4CX250R
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
SPECIFICATION LIMITS
$e_{c_1}$ FOR $i_b$ = 1.0A.
1.60
1.20
.800
.600
.400
.200
1.00
.050
.010
.002
0
.005
.025
.050
.100
.200
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000
PLATE VOLTAGE — VOLTS
GRID VOLTAGE — VOLTS

EIMAC 7580


EIMAC 4CX250R
TYPICAL CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
0
.005
.010
.025
0
.005
.010
.100
.200
.200
.050
PLATE VOLTAGE — VOLTS
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
40
20
0
−20
−40
−60
−80
−100


EIMAC 4CX250R
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 400 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
SPECIFICATION LIMITS
$E_{C_1}$ FOR $I_b$ = .067A.
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
0
.050
.020
.010
.020
.010
0
.025
.100
.200
20
0
-20
-40
-60
-80
-100
-120
-140
0
400
800
1200
1600
2000
PLATE VOLTAGE — VOLTS
GRID VOLTAGE — VOLTS