# 8172
# 4X150G

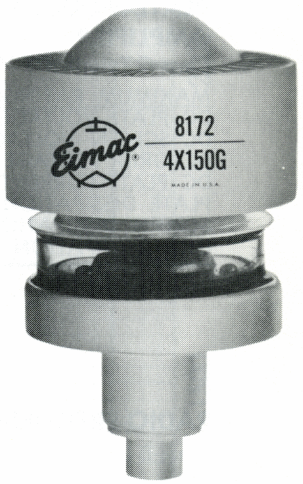
**RADIAL-BEAM POWER TETRODE**

**TECHNICAL DATA**

The EIMAC 8172/4X150G is an extremely compact external-anode tetrode intended for use as a radio-frequency amplifier, frequency multiplier, or oscillator at frequencies well into the UHF region or as an amplifier in any service requiring a high-gain tube capable of delivering high power-output at low plate-voltage. The combination of a high ratio of transconductance to capacitance and a plate dissipation capability of 250 watts makes the tube an excellent wide-band amplifier for video applications.

The cathode, grid and screen electrodes are mounted on conical and cylindrical supports giving a minimum of circuit discontinuities and lead inductance. The rugged cylindrical terminals, progressively larger in size, allow the tube to be inserted in coaxial line cavities. The screen support and terminal provide maximum isolation between the grid-cathode terminals and the plate circuit.

In amplifier service at 500 megahertz, output power of 140 watts per tube, with a stage power-gain of 14, can be obtained. At 1000 megahertz an output power of 50 watts per tube is obtained with a power-gain of five.




## GENERAL CHARACTERISTICS

### ELECTRICAL

| | *Min.* | *Nom.* | *Max.* | |
|---|---|---|---|---|
| Cathode: Oxide-Coated, Unipotential | | | | |
| Heating Time | 30 | 60 | | seconds |
| Cathode-to-heater Potential | | | 150 | volts |
| Heater: Voltage | | 2.5 | | volts |
| Current | 6.2 | | 7.3 | amperes |
| Amplification Factor (Grid-to-Screen) | | 5 | | |

| Direct Interelectrode Capacitances, Grounded Cathode: | *Min.* | *Max.* | |
|---|---|---|---|
| Input | 25.0 | 29.0 | pf |
| Output | 4.0 | 4.9 | pf |
| Feedback | | 0.05 | pf |
| **Direct Interelectrode Capacitances, Grounded Grid and Screen** | ***Min.*** | ***Max.*** | |
| Input | 14.5 | 19 | pf |
| Output | 4.0 | 4.9 | pf |
| Feedback | | 0.01 | pf |

| | |
|---|---|
| Frequency for Maximum Ratings (CW) | 500 MHz |
| (pulsed) | 1500 MHz |

### MECHANICAL

| | |
|---|---|
| Base | Coaxial |
| Maximum Operating Temperatures: | |
| Glass-to-Metal Seals | 175°C |
| Ceramic-to-Metal Seals | 250°C |
| Anode Core | 250°C |
| Operating Position | Any |
| Maximum Dimensions: | |
| Height | 2.75 inches |
| Diameter | 1.635 inches |
| Cooling | Forced Air |
| Net Weight | 6 ounces |
| Shipping Weight (Approximate) | 1.6 pounds |



Printed in U.S.A.

## RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down Conditions)

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE | 1250 VOLTS |
| DC SCREEN VOLTAGE | 300 VOLTS |
| DC GRID VOLTAGE | —250 VOLTS |
| DC PLATE CURRENT | 250 MA |
| PLATE DISSIPATION | 250 WATTS |
| SCREEN DISSIPATION | 12 WATTS |
| GRID DISSIPATION | 2 WATTS |

TYPICAL OPERATION (Frequencies up to 165 MHz)

| | | | | | | |
|---|---|---|---|---|---|---|
| DC Plate Voltage | 600 | 750 | 1000 | 1250 | 1250 | volts |
| DC Screen Voltage | 250 | 250 | 250 | 250 | 250 | volts |
| DC Grid Voltage | —75 | —80 | —80 | —90 | —80 | volts |
| DC Plate Current | 200 | 200 | 200 | 200 | 200 | mA |
| DC Screen Current* | 37 | 37 | 30 | 20 | 7 | mA† |
| DC Grid Current* | 10 | 10 | 10 | 10 | 10 | mA† |
| Peak RF Grid Voltage* | 90 | 95 | 95 | 105 | — | volts |
| Driving Power* | 0.7 | 0.7 | 0.7 | 0.8 | 10 | watts† |
| Plate Input Power | 120 | 150 | 200 | 250 | 250 | watts |
| Plate Output Power | 85 | 110 | 150 | 195 | 140 | watts† |

*Approximate values.
†Measured values for a typical cavity amplifier circuit.

## PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE | 1000 VOLTS |
| DC SCREEN VOLTAGE | 300 VOLTS |
| DC GRID VOLTAGE | —250 VOLTS |
| DC PLATE CURRENT | 200 MA |
| PLATE DISSIPATION | 165 WATTS |
| SCREEN DISSIPATION | 12 WATTS |
| GRID DISSIPATION | 2 WATTS |

TYPICAL OPERATION (Frequencies up to 165 MHz)

| | | | | |
|---|---|---|---|---|
| DC Plate Voltage | 600 | 800 | 1000 | volts |
| DC Screen Voltage | 250 | 250 | 250 | volts |
| DC Grid Voltage | —95 | —100 | —105 | volts |
| DC Plate Current | 200 | 200 | 200 | mA |
| DC Screen Current* | 35 | 25 | 20 | mA |
| DC Grid Current* | 8 | 10 | 15 | mA |
| Peak RF Grid Input Voltage* | 120 | 120 | 125 | volts |
| Driving Power* | 1 | 1.5 | 2 | watts |
| Plate Input Power | 40 | 60 | 60 | watts |
| Plate Output Power | 120 | 160 | 200 | watts |

*Approximate values.

## RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE | 1250 VOLTS |
| DC SCREEN VOLTAGE | 400 VOLTS |
| DC GRID VOLTAGE | 250 VOLTS |
| DC PLATE CURRENT (Average) | 250 MA |
| PLATE DISSIPATION | 250 WATTS |
| SCREEN DISSIPATION | 12 WATTS |
| GRID DISSIPATION | 2 WATTS |

TYPICAL OPERATION
(Frequencies up to 216 MHz, 5-MHz bandwidth)

| | | | |
|---|---|---|---|
| DC Plate Voltage | 750 | 1000 | 1250 volts |
| DC Screen Voltage | 300 | 300 | 300 volts |
| DC Grid Voltage | —60 | —65 | —70 volts |
| During Sync-Pulse Peak: | | | |
| DC Plate Current | 335 | 330 | 305 mA |
| DC Screen Current | 50 | 45 | 45 mA |
| DC Grid Current | 15 | 20 | 25 mA |
| Peak RF Grid Voltage | 85 | 95 | 100 volts |
| RF Driving Power (approx.) | 7 | 8 | 9 watts |
| Useful Power Output | 135 | 200 | 250 watts |
| Black Level: | | | |
| DC Plate Current | 245 | 240 | 230 mA |
| DC Screen Current | 20 | 15 | 10 mA |
| DC Grid Current | 4 | 4 | 4 mA |
| Peak RF Grid Voltage (approx.) | 65 | 70 | 75 volts |
| RF Driver Power (approx.) | 4.25 | 4.7 | 5.5 watts |
| Plate Power Input | 185 | 240 | 290 watts |
| Useful Power Output | 75 | 110 | 140 watts |

## PLATE PULSED RADIO FREQUENCY AMPLIFIER OR OSCILLATOR

MAXIMUM RATINGS

| | |
|---|---|
| PULSED PLATE VOLTAGE | 7000 VOLTS |
| PULSED SCREEN VOLTAGE | 1500 VOLTS |
| DC GRID VOLTAGE | —500 VOLTS |
| PULSE DURATION | 5 USEC |
| PULSED CATHODE CURRENT | 7 AMPS |
| AVERAGE POWER INPUT | 250 WATTS |
| PLATE DISSIPATION | 250 WATTS |
| SCREEN DISSIPATION | 12 WATTS |
| GRID DISSIPATION | 2 WATTS |

TYPICAL PULSE OPERATION
Single tube oscillator, 1200-MHz

| | | | |
|---|---|---|---|
| Pulsed Plate Voltage | 5 | 7 | kV |
| Pulsed Plate Current | 4.0 | 6.0 | amps |
| Pulsed Screen Voltage | 800 | 1200 | volts |
| Pulsed Screen Current | 0.3 | 0.4 | amps |
| DC Grid Voltage | —200 | —250 | volts |
| Pulsed Grid Current | 0.5 | 0.6 | amps |
| Pulse Duration | 4 | 5 | μsec |
| Pulse Repetition Rate | 2500 | 1000 | pps |
| Peak Power Output | 7 | 17 | kW |

## RADIO-FREQUENCY LINEAR AMPLIFIER

Class-$AB_1$ (Single-Sideband Suppressed-Carrier Operation)

MAXIMUM RATINGS

| | |
|---|---|
| DC PLATE VOLTAGE | 2000 VOLTS |
| DC SCREEN VOLTAGE | 400 VOLTS |
| DC PLATE CURRENT | 250 MA |
| PLATE DISSIPATION | 250 WATTS |
| SCREEN DISSIPATION | 12 WATTS |
| GRID DISSIPATION | 2 WATTS |

TYPICAL OPERATION (Frequencies up to 165 MHz
peak-envelope conditions except where noted)

| | | | |
|---|---|---|---|
| DC Plate Voltage | 1000 | 1250 | volts |
| DC Screen Voltage | 350 | 350 | volts |
| DC Grid Voltage* | —55 | —55 | volts |
| Zero-Signal DC Plate Current | 100 | 100 | mA |
| Peak RF Grid Voltage** | 50 | 50 | volts |
| DC Plate Current | 250 | 250 | mA |
| DC Screen Current** | 10 | 9 | mA |
| Plate Input Power | 250 | 310 | watts |
| Plate Output Power | 120 | 170 | watts |
| Two-Tone Average DC Plate Current | 190 | 190 | mA |
| Two-Tone Average DC Screen Current** | 2 | —1 | mA |

*Approximate values.
**Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. 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 4X150G may be mounted in any position. The concentric arrangements of the electrode terminals permits the use of the tube in coaxial line or cavity type circuits to advantage.

Connections to the contact surfaces should be made by means of spring-finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

*Cooling* — The 4X150G requires sufficient forced air to keep the glass-to-metal seals below 175°C and the ceramic-metal seals and anode core below 250°C. The air flow must be started when power is applied to the heater and must continue without interruption until all electrode voltages have been removed from the tube.

Effective cooling of the anode is accomplished by directing six cubic feet per minute of air through the anode cooler. This flow is obtained at a pressure drop across the cooler of approximately 0.25 inch of water column. The grid, cathode and heater terminals are cooled by high velocity air directed at the terminals and the connecting collets which aid in the removal of heat from the terminals by conduction. The volume required will depend upon the socket arrangement and should be adequate to keep the metal-to-glass seals below 175°C and the center heater terminal below 250°C.

The air requirements stated above are based on operation at sea level an ambient temperature of 20°C. Operation at high altitudes or at high ambient temperatures requires a greater volume of air flow.

Temperature of the external parts of a tube may be measured with the aid of a temperature-sensitive lacquer.

## ELECTRICAL

*Heater* — The rated heater voltage for the 4X150G is 2.5 volts, and should be maintained at this value plus or minus five percent. At frequencies above 300 megahertz, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C CW amplifier, the heater voltage should be reduced according to the following table.

| Frequency | Heater Voltage |
|---|---|
| 301 to 400 MHz | 2.4 volts |
| 401 to 500 MHz | 2.3 volts |

At low duty, in pulse service, no reduction in heater voltage is normally required up to 1500 MHz.

*Cathode* — The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

*Grid Dissipation*—Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 MHz drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 MHz in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

*Screen-Grid Operation* — The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected

between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4X150G.

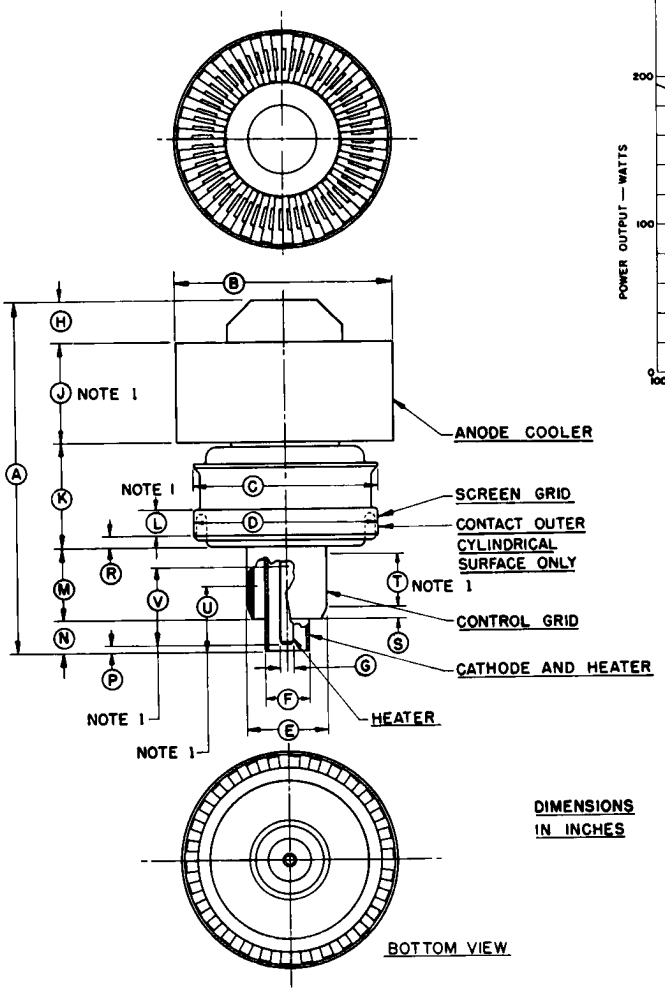
*Plate Operation* — The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate-dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

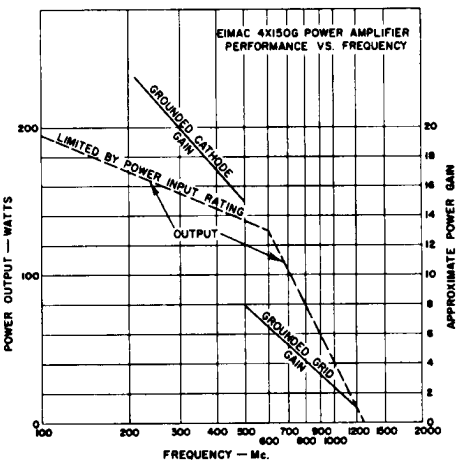
*UHF Operation* — The 4X150G is suitable use in the UHF region. Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

*Multiple Operation*—Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

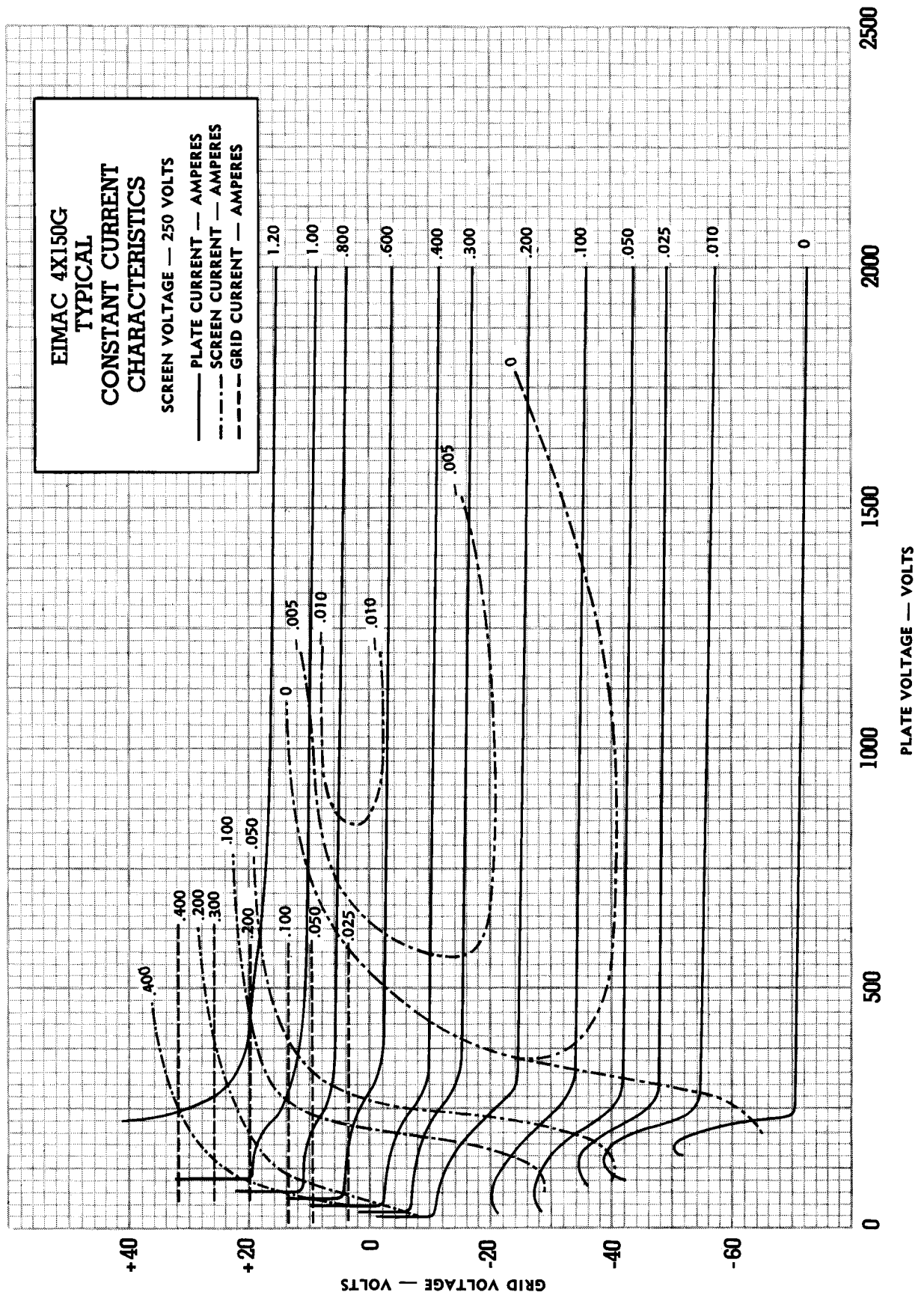
*Special Applications*—If it is desired to operate these tubes under conditions widely different from those given here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, CA 94070, for information and recommendations.

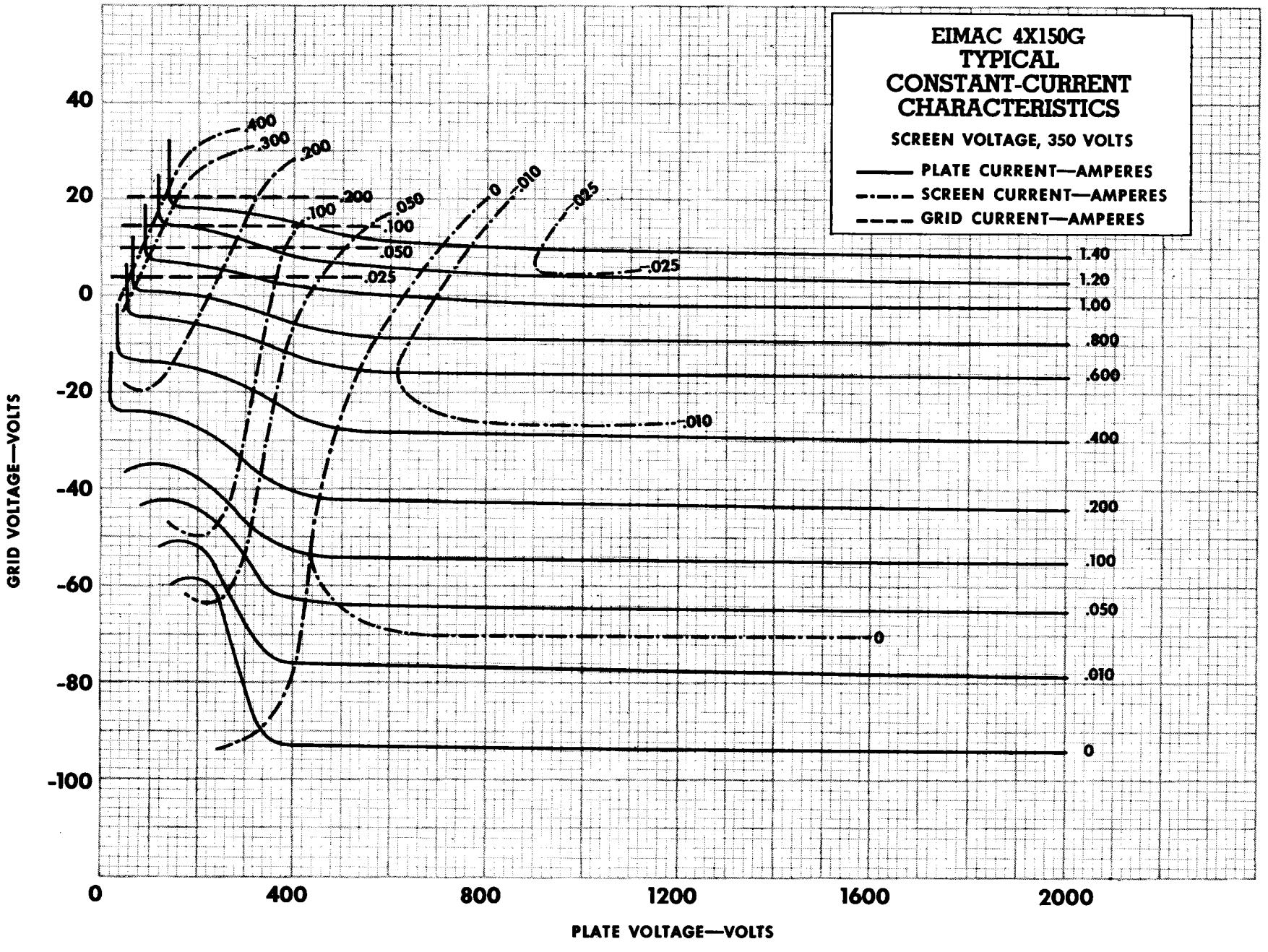



| DIMENSION | | | |
|---|---|---|---|
| REF | NOMINAL | MINIMUM | MAXIMUM |
| A | | | 2 3/4 |
| B | | 1.615 | 1.635 |
| C | | | 1.406 |
| D | | 1.417 | 1.433 |
| E | | .587 | .597 |
| F | | .317 | .327 |
| G | | .088 | .098 |
| H | | | 5/16 |
| J | | 23/32 | 25/32 |
| K | | 3/4 | 13/16 |
| L | | 3/16 | |
| M | | .500 | .578 |
| N | | 15/64 | 17/64 |
| P | | 1/32 | 1/16 |
| R | 3/32 | | |
| S | 1/8 | | |
| T | | 11/32 | |
| U | | 13/32 | |
| V | | 15/32 | |

NOTE 1. LENGTH AVAILABLE FOR CONTACT.


EIMAC 4X150G
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
1.20
1.00
.800
.600
.400
.300
.200
.100
.050
.025
.010
0
.005
GRID VOLTAGE — VOLTS
+40
+20
0
-20
-40
-60
PLATE VOLTAGE — VOLTS
0
500
1000
1500
2000
2500


EIMAC 4X150G
TYPICAL
CONSTANT-CURRENT
CHARACTERISTICS
SCREEN VOLTAGE, 350 VOLTS
PLATE CURRENT—AMPERES
SCREEN CURRENT—AMPERES
GRID CURRENT—AMPERES
GRID VOLTAGE—VOLTS
PLATE VOLTAGE—VOLTS
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
1.40
1.20
1.00
.800
.600
.400
.200
.100
.050
.010
0
.400
.300
.200
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