



E I M A C
Division of Varian
S A N C A R L O S
C A L I F O R N I A

8248
4PR250C

**RADIAL-BEAM
PULSE TETRODE**

The EIMAC 8248/4PR250C is a pulse tetrode intended for use in pulse-modulator, switch tube, pulsed-amplifier, and pulsed-oscillator service. This compact, high vacuum, radial-beam tetrode, incorporating a tantalum plate and non-emitting grids, is recommended for use in new equipments where voltages to 50 kilovolts are required.

Cooling of the tube is accomplished by radiation from the plate and by circulation of forced-air through the base and around the envelope. Cooling can be simplified by the use of the EIMAC SK-410 Air-System Socket.

GENERAL CHARACTERISTICS ¹

ELECTRICAL

Filament: Thoriated Tungsten

Voltage 5.0 ± 0.25 V

Current, at 5.0 volts 14 A

Amplification Factor (Average):

Grid to Screen 5.2

Direct Interelectrode Capacitances (grounded cathode)²

Input 13.0 pF

Output 3.3 pF

Feedback 0.10 pF

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. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:

Length 7.63 in; 191.8 mm

Diameter 3.60 in; 91.3 mm

Net Weight 12.5 oz; 355 gm

Operating Position Vertical, base down or up

Maximum Operating Temperature:

Plate and Base Seals 200 °C

Cooling Radiation and forced-air

Base 5-pin metal shell

Recommended Socket EIMAC SK-410

Recommended Heat-Dissipating Connector :

Plate EIMAC HR-8



**PULSE MODULATOR SERVICE****MAXIMUM RATINGS:**

DC PLATE VOLTAGE	50 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	-1.0 KILOVOLT
PEAK PLATE CURRENT ¹	4.0 AMPERES
PLATE DISSIPATION ²	250 WATTS
SCREEN DISSIPATION ²	25 WATTS
GRID DISSIPATION ²	5 WATTS

1. In switch tube applications with capacitive loads, plate current may be increased to 6.0 amperes.

2. Average value.

TYPICAL OPERATION

Plate Voltage	30	40	50 kVdc
Screen Voltage	1.5	1.5	1.5 kVdc
Grid Voltage	-600	-650	-700 Vdc
Pulse Plate Voltage	28	38	48 kv
Peak Pulse Current	4.0	4.0	4.0 a
Pulse Screen Current	0.5	0.5	0.5 a
Pulse Grid Current	0.03	0.03	0.03 a
Pulse Input Power	120	160	200 kw
Pulse Output Power	112	152	192 kw
Pulse Drive Power	25	25	25 w
Pulse Positive Grid Voltage	130	130	130 v
Duty	3	3	3 %

RF POWER AMPLIFIER AND OSCILLATOR*Plate and Screen Pulsed***MAXIMUM RATINGS:**

PEAK DC PLATE VOLTAGE	35 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	-1.0 KILOVOLT
PEAK CATHODE CURRENT ¹	5.5 AMPERES
PLATE DISSIPATION ²	250 WATTS
SCREEN DISSIPATION ²	25 WATTS
GRID DISSIPATION ²	5 WATTS

1. The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the dc plate current component during the pulse.

TYPICAL OPERATION*Class C, Grounded filament*

Plate Voltage (Pulsed)	25	30	35 kv
Screen Voltage (Pulsed)	1.5	1.5	1.5 kv
Grid Voltage	-650	-675	-700 Vdc
Pulse Plate Current ¹	940	925	900 ma
Pulse Screen Current	30	30	30 ma
Pulse Grid Current	6	6	6 ma
Peak Grid Voltage ³	780	805	830 v
Pulse Driving Power ³	4.7	5.0	4.5 w
Pulse Input Power	23.5	27.7	31.5 kw
Pulse Output Power	19.0	23.0	26.5 kw
Duty	5.5	5	5 %

2. Average value.

3. When used as a rf plate and screen-pulsed amplifier, the grid drive must also be pulsed to avoid overheating this element during the interpulse period.

RF POWER AMPLIFIER AND OSCILLATOR*Grid Pulsed***MAXIMUM RATINGS:**

DC PLATE VOLTAGE	25 KILOVOLTS
DC SCREEN VOLTAGE	2.0 KILOVOLTS
DC GRID VOLTAGE	-1.0 KILOVOLTS
PEAK CATHODE CURRENT ¹	5.5 AMPERES
PLATE DISSIPATION ²	250 WATTS
SCREEN DISSIPATION ²	25 WATTS
GRID DISSIPATION ²	10 WATTS

1. The maximum peak cathode current rating refers to the instantaneous peak cathode current available. This rating is based on available emission throughout life of 80 milliamperes per watt of filament power. The pulse plate current data shown under the Typical Operation section refers to the dc plate current component during the pulse.

TYPICAL OPERATION

Plate Voltage	20	25 kVdc
Screen Voltage	1.5	1.5 kVdc
Grid Voltage	-600	-650 Vdc
Peak Grid Voltage (Pulsed)	730	780 v
Pulse Plate Current ¹	940	940 ma
Pulse Screen Current	30	30 ma
Pulse Grid Current	6	6 ma
Pulse Driving Power	4.4	4.7 w
Pulse Input Power	18.8	23.5 kw
Pulse Output Power	15.0	19.0 kw
Duty	6	5.5 %

2. Average Value.

3. When used as a rf plate and screen-pulsed amplifier, the grid drive must also be pulsed to avoid overheating this element during the interpulse period.

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves. Adjustment of the 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.



RANGE VALUES FOR EQUIPMENT DESIGN

	<u>Min.</u>	<u>Max.</u>
Filament: Current at 5.0 volts	13.5	14.7 A
Interelectrode Capacitances ¹ (grounded filament connection)		
Input	11.0	15.0 pF
Output	2.5	4.0 pF
Feedback		0.15 pF

1. In shielded fixture.

APPLICATION

MECHANICAL

MOUNTING - The 4PR250C must be operated vertically base up or down. The SK-410 Air-System Socket may be used to aid in directing air to the metal base shell.

In the event the SK-410 Air-System Socket is not used, the socket must provide clearance for the glass tip-off which extends from the center of the tube. The metal tube-base shell should be grounded by means of suitable spring fingers. The tube must be protected from severe shock and vibration.

COOLING - Adequate forced-air cooling must be provided to maintain base-seal and plate-seal temperatures below 200°C. In all classes of operation it is recommended that a heat-radiating connector, the EIMAC HR-8 or equivalent, be installed on the anode terminal, and that a socket be employed which provides for proper base seal cooling. When the EIMAC 4PR250C is operated at dc or low frequencies in an EIMAC SK-410 Air System Socket, the minimum air-flow requirements to maintain seal temperatures at 200°C in 25°C inlet air are approximately 2 to 5 cfm.

When the EIMAC 4PR250C is used as a pulsed-amplifier or oscillator at frequencies above 30 MHz, additional cooling may be required to compensate for the effects of plate and base-seal heating caused by rf charging currents and dielectric losses. Since the amount of seal heating varies with the particular application, it is suggested that the user monitor the seal temperatures to determine the adequacy of the cooling air.

Cooling air should be applied before or simultaneously with the application of filament voltage and may be removed simultaneously with filament voltage. In any questionable situation, the only criterion for adequate cooling is temperature. Tube temperature may be measured

by using a temperature-sensitive paint.

ELECTRICAL

FILAMENT VOLTAGE - For maximum tube life the filament voltage, as measured directly at the filament pins, should be 5.0 volts. Variations in filament voltage must be kept within the range of 4.75 to 5.25 volts.

When the 4PR250C is used in pulse applications where high peak currents are demanded, filament voltage must be maintained at the rated value; the normally allowable five-percent variation in this voltage cannot be tolerated if the tube's peak-current capabilities are to be realized.

ELEMENT DISSIPATION - Under normal operating conditions, the average plate dissipation of the 4PR250C should not be allowed to exceed 250 watts. Dissipation in excess of this maximum rating is permissible for short periods of time, such as during tuning procedures.

The average power dissipated by the screen-grid and the control-grid must not exceed 25 watts and 5 watts, respectively.

CUT-OFF CHARACTERISTICS - The plate current cut-off characteristics of the 4PR250C are shown in the following graph. These curves indicate the value of negative grid voltage required to maintain a plate-current flow of 50 microamperes or less at the various plate and screen voltages noted. These curves were plotted from a "typical" tube whose electrical characteristic closely approximate the mean value in the tube test specification.

Each 4PR250C is tested to insure proper cut-off characteristics at maximum ratings. This cut-off test is made with a plate voltage of 50 kV, a screen voltage of 1.5 kV, with the grid voltage adjusted to maintain a plate current of



10 microamperes. Under these test conditions the negative grid bias must not exceed 675 volts. Due to tube-to-tube variation this cut-off point will vary and the typical range can be expected to be between -500 volts and -650 volts.

PULSE-MODULATOR SERVICE-The data shown in the "Typical Operating" section of Pulse-Modulator Service was calculated assuming a rectangular plate voltage wave-form, ignoring the effects of shunt capacity. In reality, the total shunt capacitance (including the output capacity of the tube, stray capacitance, etc.) affects the output wave form and can have considerable effect on plate dissipation. Since the actual plate wave form is not rectangular, even though the grid pulse is, additional power will be dissipated during the rise time and can, under some circumstances, be much greater than that dissipated during the remainder of the pulse. The total power dissipated is then the sum of the power dissipated during the rise time and the power dissipated during the remainder of the pulse.

As a switch tube with capacitive loading, as in a floating deck modulator, the peak plate current during the pulse may reach 6.0 amperes. This can be tolerated since under capacitive load conditions the plate voltage at the beginning of the pulse is equal to applied dc voltage, with high plate current and low screen grid current. As the load is charged, plate current falls while screen current rises. Protection for the screen must be provided to limit dissipation at the end of the pulse.

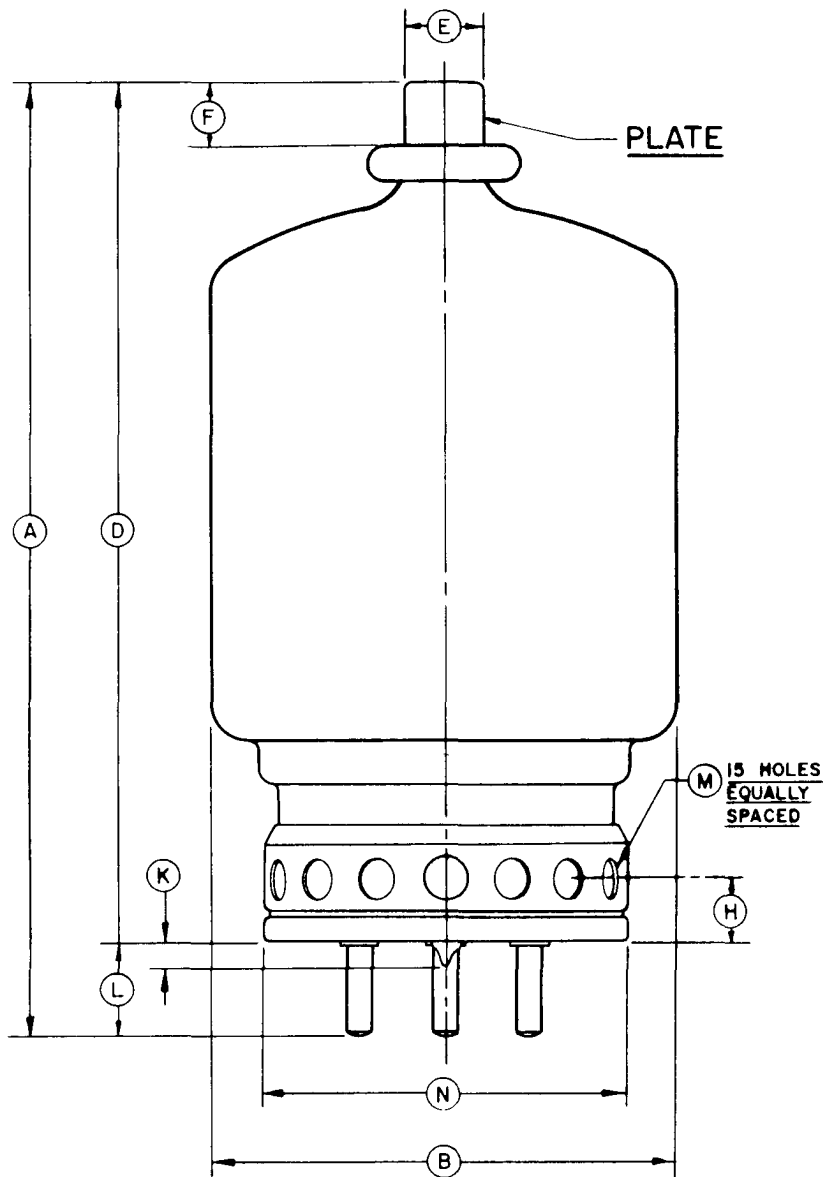
X-RADIATION - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased, and are therefore potential X-ray hazards. Very little shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly on older tubes with aging and gradual deterioration, due to leakage paths or emission characteristics as they are effected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. When pulse

transformers are involved, shielding may also be required for these. Periodic checks on the X-ray level should be made, and such tubes must never be operated without shielding in place. Lead glass which attenuates X-rays is available for viewing windows. If there is any doubt as to the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment. Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

Reference: MEDICAL X-RAY PROTECTION UP TO THREE MILLION VOLTS, National Bureau of Standards Handbook 76. Available from Superintendent of Documents, Washington, DC 20402. Price: 25 cents.
NCRP REPORT #33-MEDICAL X-RAY AND GAMMA RAY PROTECTION FOR ENERGIES UP TO 10 MEV. Available from N.C.R.P. Publications, P.O. Box 4867, Washington, DC 20008. Price: 75 cents.

HIGH VOLTAGE - The 4PR250C 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.

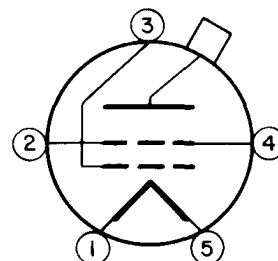
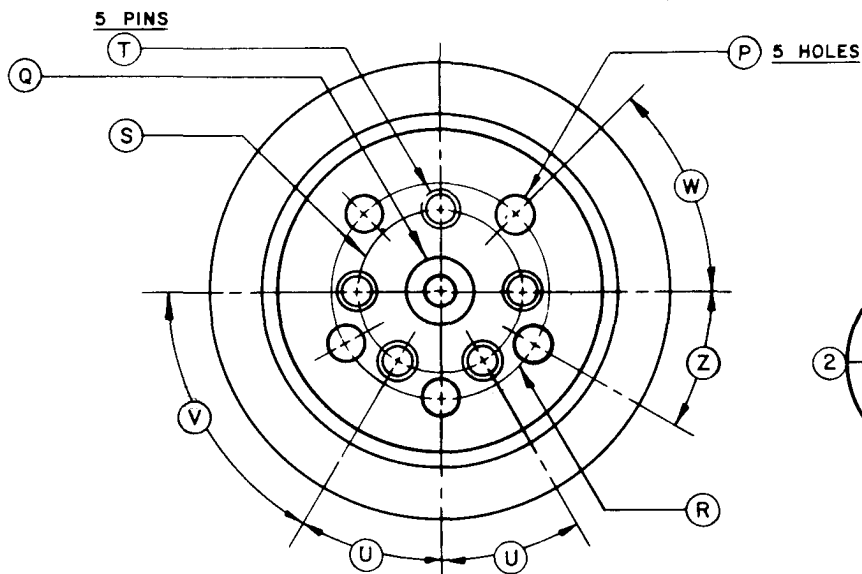
SPECIAL APPLICATIONS-If it is desired to operate this tube under conditions widely different from those given here, write to Power Grid Tube Marketing, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070 for information and recommendations.



DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	7.062	7.625	179.37	193.68
B	3.406	3.594	86.51	91.29
D	6.313	6.813	160.35	173.05
E	0.557D	0.567D	14.15	14.40
F	0.469	0.531	11.91	13.49
H	0.375	0.500	9.53	12.70
K	0.250 (NOTE 1)		6.35 (NOTE 1)	
L	0.688	0.875	17.48	22.23
M	0.219D	0.281D	5.57	7.14
N	--	2.750	--	69.86
P	0.281	0.344	7.14	8.74
Q	0.469	0.531	12.60	13.49
R	1.594	1.656	40.49	42.06
S	0.250 (NOTE 1)		6.35 (NOTE 1)	
T	0.185D	0.191D (1)	4.70D	4.85 (1)
U	30° (NOTE 1)		30° (NOTE 1)	
V	60° (NOTE 1)		60° (NOTE 1)	
W	45° (NOTE 1)		45° (NOTE 1)	
Z	30° (NOTE 1)		30° (NOTE 1)	

NOTES:

BASE PINS (T) AND TUBULATION (K) MUST BE ALIGNED SO THAT THEY CAN BE FREELY INSERTED IN A GAUGE 1/4" THICK WITH HOLE DIAMETERS OF .204 & .500 FOR PINS AND TUBULATION RESPECTIVELY LOCATED ON TRUE CENTERS DEFINED BY (S) (U) (V).

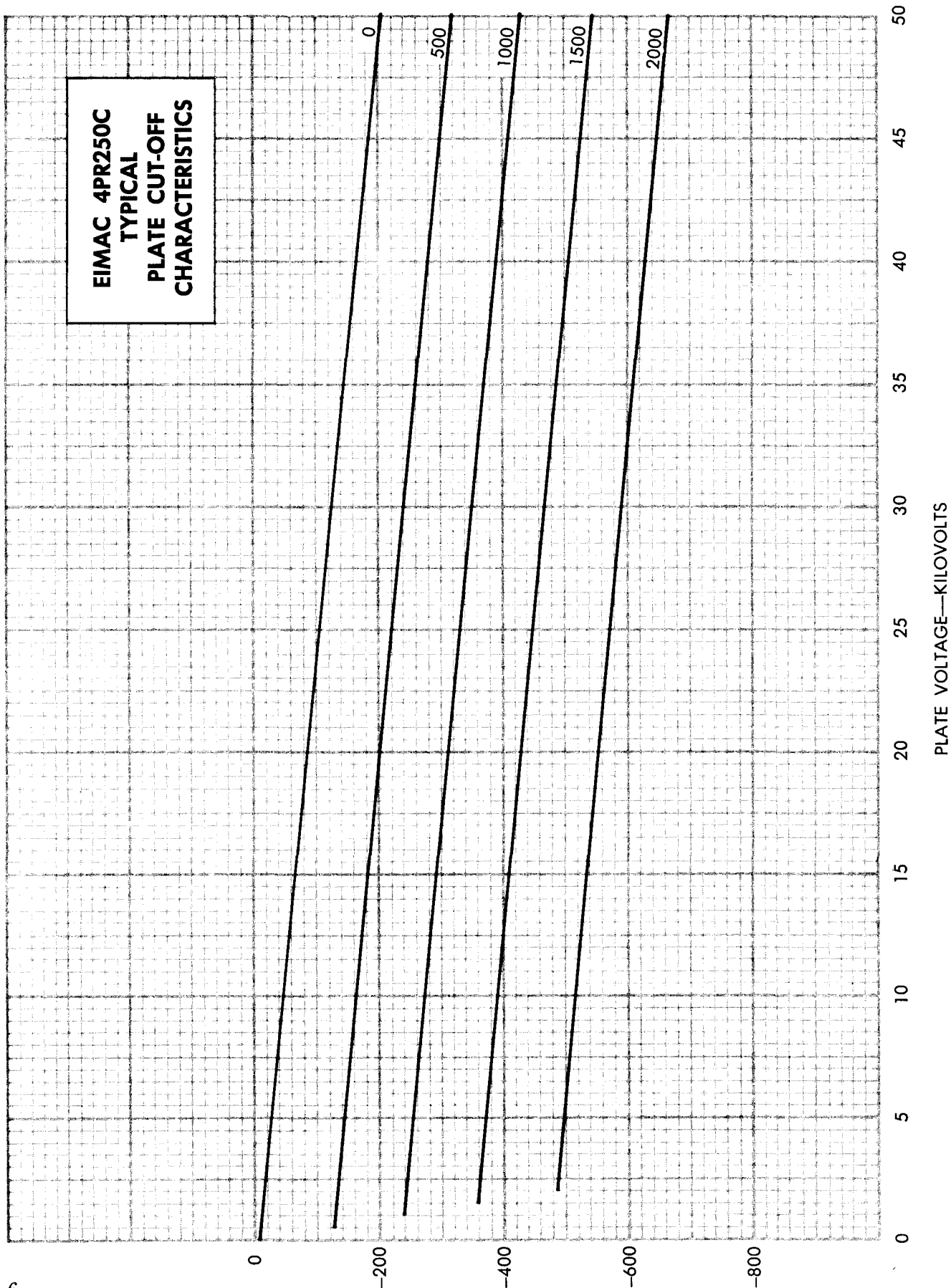


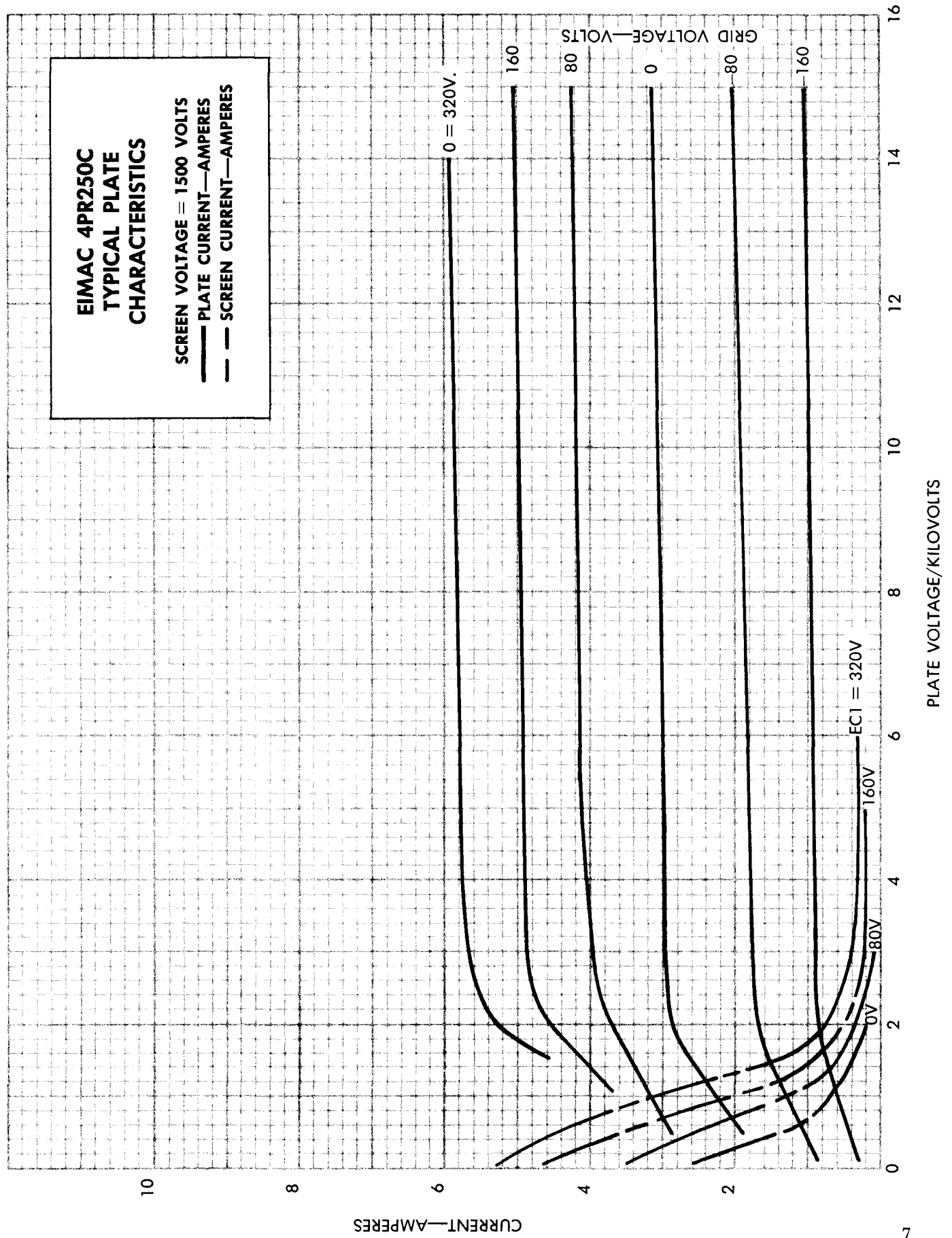
**EIMAC 4PR250C
TYPICAL
PLATE CUT-OFF
CHARACTERISTICS**

GRID VOLTAGE—VOLTS

SCREEN VOLTAGE—VOLTS

4PR250C







4PR250C

EIMAC 4PR250C

TYPICAL

CONSTANT CURRENT CHARACTERISTICS

SCREEN VOLTAGE = 1500 VOLTS

- PLATE CURRENT—AMPERES
- - - SCREEN CURRENT—AMPERES
- - - GRID CURRENT—AMPERES

