

# RADIAL BEAM POWER TETRODE 4CX250B/M 7203A

The Eimac 4CX250B/M is a ceramic/metal, forced-air cooled external-anode tetrode with a maximum anode dissipation rating of 250 Watts. The 4CX250B/M is intended for use in applications where tight control of electrical specifications is required and replaces the 4CX250B in all applications. This tube utilizes a ruggedized internal structure and utilizes a welded anode cap for improved reliability.



## CHARACTERISTICS<sup>1</sup>

### ELECTRICAL

Cathode: Oxide coated, Unipotential	
Filament Voltage	6.0± 0.3 V
Current at 6.0 Volts	2.6 A
Direct Interelectrode Capacitances (grounded cathode) <sup>2</sup>	
Cin	15.7 pF
Cout	4.5 pF
Cgp	0.04 pF
Amplification Factor, Average (screen-grid)	5
Frequency of Maximum Ratings (CW)	500 MHz

### MECHANICAL:

#### Overall Dimensions:

Length	2.46 in; 62.5 mm
Diameter	1.64 in; 41.7 mm
Weight (approx.)	4 oz; 113 gm
Operating Postition	Any
Maximum Operating Temperature:	
Ceramic/Metal Seals & Envelope	250° C
Anode Core	250° C
Cooling	Forced Air
Base	Special, 9-pin Jedec-B8-236
Recommended Air System Socket	SK-600 Series
Recommended Air Chimney	SK-606

<sup>1</sup> Characteristics and operating values are based upon performance tests. These figures may change without notice as the result of additional data or product refinement.

CPI MPP, Eimac Operation should be consulted before using this information for final equipment design.

<sup>2</sup> Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.

## RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Nom.	Max.	
<b>Filament Current @ 6.0 Volts</b>	<b>2.3</b>	<b>--</b>	<b>2.9</b>	<b>Amperes</b>
<b>Cathode Warm-up Time</b>	<b>30</b>	<b>60</b>	<b>--</b>	<b>Seconds</b>
<b>Interelectrode Capacitance <sup>1</sup> (grounded cathode circuit)</b>				
Cin	14.2	--	17.2	pF
Cout	4.0	--	5.0	pF
Cgp	--	--	0.06	pF
<b>Interelectrode Capacitance <sup>1</sup> (grounded grid circuit)</b>				
Cin	--	13.0	--	pF
Cout	4.0	--	5.0	pF
Cpk	--	0.01	--	pF

<sup>1</sup> Capacitance values are for a cold tube as measured in a shielded fixture in accordance with Electronic Industries Association Standard RS-191.

The values listed above represent specified limits for the product and are subject to change. The data should be used for basic information only. Formal, controlled specifications may be obtained from CPI for use in equipment design.



**For information** on this and other CPI products, visit our website at: [www.cpii.com](http://www.cpii.com), or contact: CPI MPP, Eimac Operation, 607 Hansen Way, Palo Alto, CA 94303

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## RADIO FREQUENCY AMPLIFIER Class C, CW Operation

### ABSOLUTE MAXIMUM RATINGS:

ANODE VOLTAGE	2000	Vdc
SCREEN VOLTAGE	300	Vdc
ANODE CURRENT	0.250	Adc
PLATE DISSIPATION	250	Watts
SCREEN DISSIPATION	12	Watts
GRID DISSIPATION	2	Watts
HEATER-TO-GRID VOLTAGE	150	Volts

## TYPICAL OPERATION

### Measured Values, Grid-Driven

ANODE VOLTAGE	500	1000	1500	2000	Vdc
SCREEN VOLTAGE	250	250	250	250	Vdc
GRID VOLTAGE	-90	-90	-90	-90	Vdc
ANODE CURRENT	250	250	250	250	mAdc
SCREEN CURRENT	45	38	21	19	mAdc
GRID CURRENT <sup>1</sup>	35	31	28	26	mAdc
DRIVING POWER <sup>2</sup>	4.0	3.5	3.2	2.9	Watts
USEFUL OUTPUT <sup>3,4</sup>	70	190	280	390	Watts

<sup>1</sup> Approximate Values

<sup>2</sup> Approximate, measured in VHF service

<sup>3</sup> Approximate, delivered to the load

<sup>4</sup> For measured case; may vary from tube to tube

NOTE: TYPICAL OPERATION data are obtained from direct measurement or by calculation from published characteristic curves. Adjustment of the rf grid voltage (feedback) to obtain the specified anode current at the specified bias and anode voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed.

## APPLICATION

### MECHANICAL

**MOUNTING** - The 4CX250B/M may be mounted in any position.

**SOCKETING** - The Eimac SK-600 series air system sockets or a socket having equivalent characteristics is required. Sockets are available with or without built-in screen capacitors and may be obtained with either grounded or ungrounded cathode terminals.

**COOLING** - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperatures at 200°C with an inlet air temperature of 50°C are tabulated below. These requirements apply when a socket of the Eimac SK-600 series and an Eimac SK-606 chimney are used with an air flow in the base-to-anode direction. Tube life is prolonged if the anode temperature is maintained at values lower than the maximum rating.

The blower selected in a given application must be capable of supplying the desired airflow at a back pressure equal to the pressure drop shown in the chart plus any drop encountered in ducts and filters. The blower must be designed to deliver necessary airflow at the desired altitude.

Anode Dissipation (Watts)	SEA LEVEL		10,000 FEET	
	Air Flow (CFM)	Pressure Drop (In. of Water)	Air Flow (CFM)	Pressure Drop (In. of Water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1.20

At 500 MHz or below base cooling air requirements are satisfied automatically when the tube is used in an EIMAC Air-System socket and the recommended air flow rates are used. Experience has shown that if reliable long life operation is to be obtained, the cooling air flow must be maintained during standby periods when only the heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

**VIBRATION** - The 4CX250B/M is capable of withstanding shock and vibration, such as encountered in shipment and normal handling. The tubes will function well in environments where shock and vibration are anticipated.



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## ELECTRICAL

**HEATER OPERATION** - The rated heater voltage for the 4CX250B/M, 6.0 volts as measured at the socket, should be maintained at this value to obtain optimum performance and maximum tube life. In no case should the voltage be allowed to deviate from 6.0 volts by more than plus or minus five percent (5%). Short-time changes of +/- 10% will not damage the tube, but variations in performance must be expected. The heater voltage must be maintained within +/- 5% to minimize these variations and to obtain maximum tube life.

At frequencies above approx. 300 MHz transit-time effects begin to influence the cathode temperature. The amount of driving power diverted to heating the cathode by back-bombardment will depend upon frequency, anode current, and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the table below:

<b>Frequency MHz</b>	<b>Heater Voltage</b>
300 and lower	6.00 Volts
301 to 400	5.76 Volts
401 to 500	5.50 Volts

**CATHODE OPERATION** - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc input current is 200 mA for plate modulated operation and 250 mA for all other types of operation with the exception of pulsed applications.

The cathode is connected internally to four pins and all four should be used to make connection to external circuits to lower inductance. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

It is recommended that the rated nominal heater voltage be applied for a minimum of 30 seconds before other operating voltages are applied. Where the circuit design requires the cathode and heater to be operated at different potentials, the rated maximum heater-to-cathode voltage of 150 voltage should be observed, regardless of polarity.

**GRID OPERATION** - The maximum rated dc grid bias voltage is -250 volts and the maximum grid dissipation rating is 2.0 Watts. In ordinary audio and rf amplifiers the grid dissipation usually will not approach the maximum rating. At operating frequencies above the 100 MHz region, driving power requirements for amplifiers increase noticeably. At 500 MHz as much as 20 Watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is only increased slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is

indicated by grid-current values below approx. 15 mA. The maximum permissible grid-circuit resistance per tube is 100K Ohms.

**SCREEN OPERATION** - The maximum rated dissipation for the screen grid is 12 Watts and the screen input power must be kept below that level. The product of peak screen current and peak screen voltage approximates the screen input power when amplitude modulation is used. In some cases screen current may tend to be negative. The 4CX250B/M shows reduced screen current, compared to the 4CX250B, and is therefore preferred for use in amplifiers where screen supply voltage regulation is poor or where an increase in screen current above the normal value will cause a significant reduction in voltage. At UHF increased output (cavity) loading is recommended to reduce screen current even if the overall tube efficiency is reduced somewhat.

**FAULT PROTECTION** - All power tubes operate at voltages which can cause severe damage in the event of an internal arc, especially in those cases where large amounts of stored energy or follow-on current are involved. Some means of protection is advised in all cases, and it is recommended that a series resistor be used in the anode circuit (20 to 50 ohms) to limit peak current and provide a means of dissipating the energy in the event of a tube or circuit arc. For an oxide-cathode tube such as the 4CX250B/M a maximum of 4 joules total energy may be permitted to be dumped into an internal arc. Amounts in excess of this may permanently damage the cathode or the tube grids. Additional information is found Eimac's Application Bulletin #17 titled "FAULT PROTECTION," available on request.

**RF RADIATION** - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 300 MHz most of the energy will pass completely through the human body with little attenuation or heating affect. Public health agencies are concerned with hazard even at these frequencies. OSHA (Occupational Safety and Health Administration) recommends that prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter.

**INTERELECTRODE CAPACITANCE** - The actual internal inter-electrode capacitance of a tube is influenced by many variables in most applications, such as stray capacitance to the chassis, capacitance added by the socket used, stray capacitance between tube terminals, and wiring effects. To control the actual capacitance values within the tube, as the key component involved, the industry and the Military Services use a standard test procedure as described in Electronic Industries Association Standard RS-191. This requires the use of specially constructed test fixtures which effectively shield all external tube leads from each other and eliminates any capacitance reading to "ground". The test is performed on a cold tube. Other factors being equal, controlling internal tube capacitance in this way normally assures good interchangeability of tubes over a

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period of time, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, normally are taken in accordance with Standard RS-191.

The equipment designer is therefore cautioned to make allowance for the actual capacitance values which will exist in any normal application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

**HOT SURFACES** - Air-cooled surfaces and other parts of tubes can reach temperatures of several hundred degrees C and cause serious burns if touched for several minutes after all power is removed.

**HIGH VOLTAGE** - The 4CX250B/M 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, contact the Application Engineering Dept., CPI MPP Eimac Operation, Palo Alto, Calif. 94304 for information and recommendations.

## OPERATING HAZARDS

Proper use and safe operating practices with respect to power tubes are the responsibility of equipment manufacturers and users of such tubes. All persons who work with and are exposed to power tubes, or equipment that utilizes such tubes, must take precautions to protect themselves against possible serious bodily injury. **DO NOT BE CARELESS AROUND SUCH PRODUCTS.**

The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel.

**HIGH VOLTAGE** – Normal operating voltages can be deadly. Remember the **HIGH VOLTAGE CAN KILL**.

**LOW-VOLTAGE HIGH-CURRENT CIRCUITS** - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

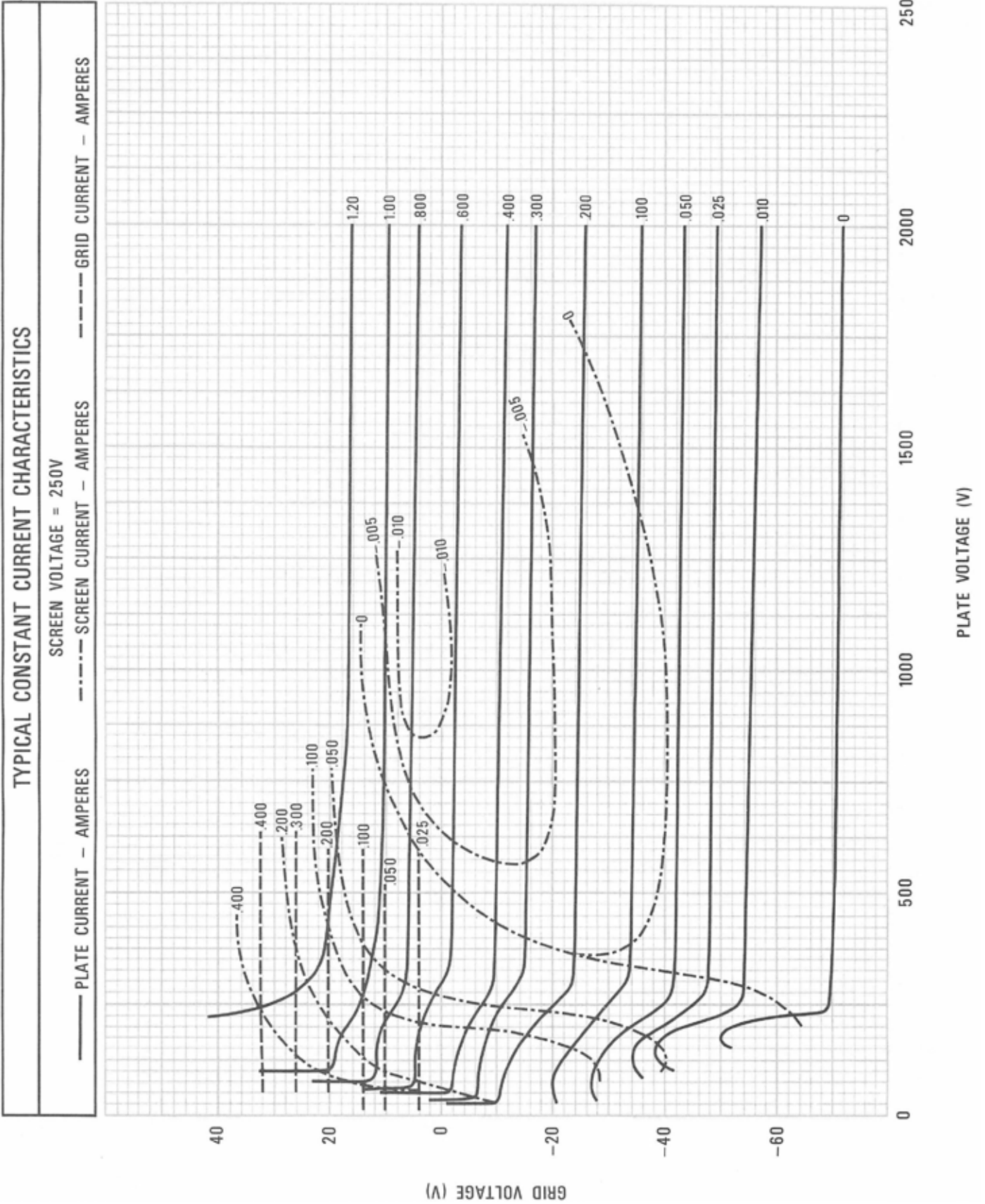
**RF RADIATION** – Exposure to strong rf fields should be avoided, even at relatively low frequencies. **CARDIAC PACEMAKERS MAY BE AFFECTED.**

**HOT SURFACES** – Surfaces of tubes can reach temperatures of several hundred °C and cause serious burns if touched for several minutes after all power is removed.

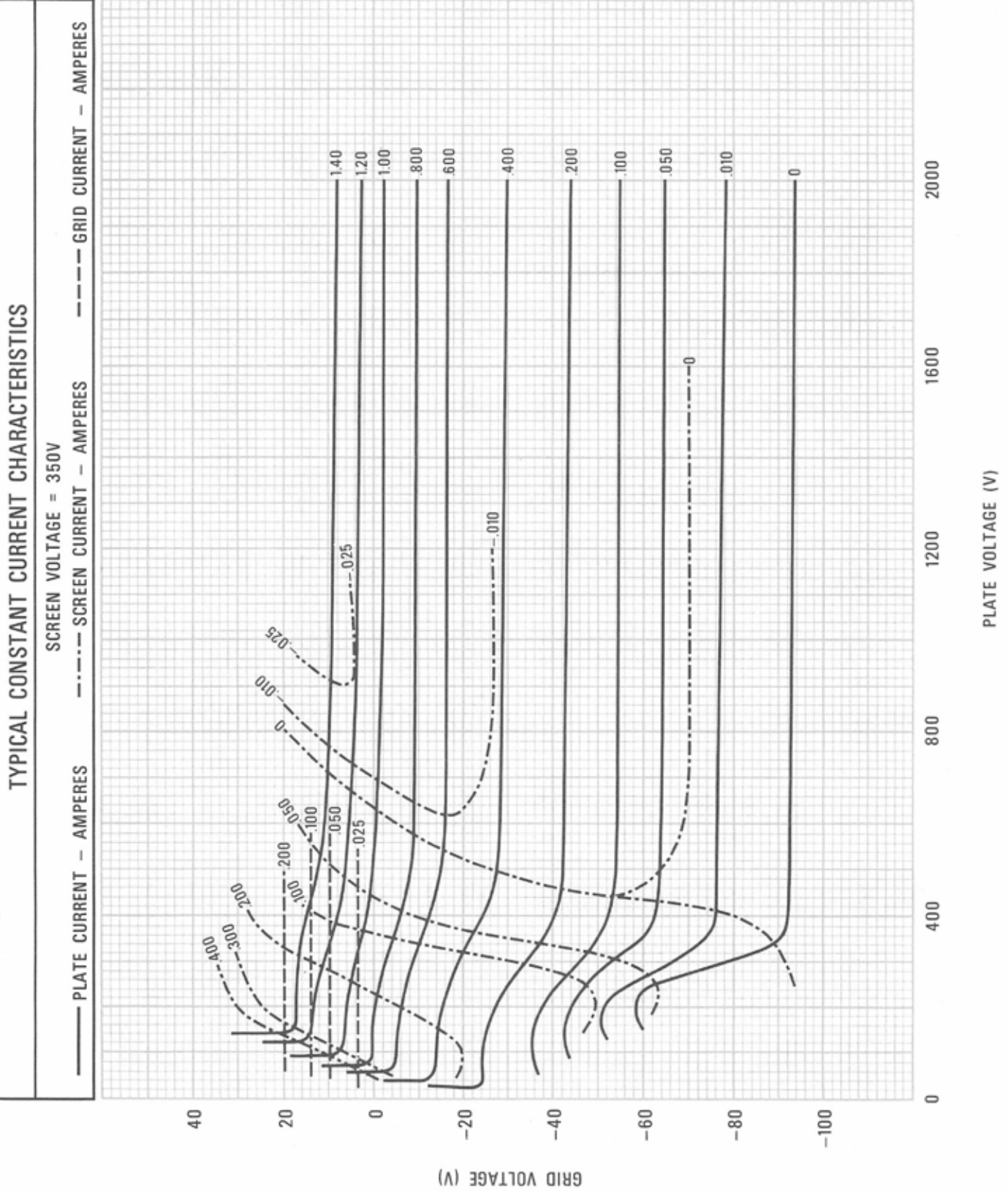
**MATERIAL COMPLIANCE** - This product and package conforms to the conditions and limitations specified in 49CFR 173.424 for radioactive material, excepted package-instruments or articles, UN2910. In addition, this product and package contains no beryllium oxide (BeO).

Please review the detailed Operating Hazards sheet enclosed with each tube, or request a copy from CPI MPP, Eimac Operation Application Engineering at 1-650-592-1221.

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