PRELIMINARY PRODUCT ANNOUNCEMENT

4CX30,000G AIR-COOLED VHF POWER TETRODE

The EIMAC 4CX30,000G is a ceramic/metal power tetrode intended for use in audio or rf applications. It features high-stability pyrolytic graphite grids and a type of internal mechanical structure which results in high rf operating efficiency. The tube may be operated to 110 MHz in CW service, and to 230 MHz in VHF-TV service.

The 4CX30,000G is also recommended for FM broadcast and general rf amplifier service. The anode will safely dissipate up to 30 kilowatts with forced-air cooling.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated-tungsten Mesh	
Voltage	10.5 ± 0.5 V
Current, at 10.5 V	175 A
Warmup: See FILAMENT WARMUP Page 3	
Amplification Factor (average), Grid to Screen, @ Ib = 10 Adc	8
Transconductance, average, @ Ib = 10 Adc	180,000 uMhos
Direct Interelectrode Capacitance (grounded cathode)[2]	
Cin	360 pF
Cout	26 pF
Cgp	1.0 pF
Direct Interelectrode Capacitance (grounded grid)[2]	
Cin	136 pF
Cout	27 pF
Cpk	0.09 pF
Maximum Frequency for Full Ratings (CW)[3]	110 MHz
Maximum Frequency for Full Ratings (TV)	230 MHz

1. Characteristics and operating values are based on performance tests. These figures may change without notice as the result of additional data or product refinement. Varian EIMAC should be consulted before using this information for final equipment design.
2. Capacitance values are for a cold tube as measured in a special shielded fixture in accordance with Electronic Industries Association Standard RS-191.
3. For operation at CW conditions in the range of 110-230 MHz contact Varian EIMAC Application Engineering.

MECHANICAL

Maximum Overall Dimensions:	
Length	11.85 in; 30.1 cm
Diameter	10.08 in; 25.6 cm
Net Weight	55 Lb; 25 kg
Operating Position	Axis Vertical, Base Up or Down
Cooling	Forced Air
Maximum Operating Temperature:	
Ceramic/Metal Seals and Anode Core	250°C
Base	Special Coaxial
Recommended Air-System Socket (dc, LF, HF Applications)	EIMAC SK-2400
Recommended Air-System Socket (VHF Applications)	EIMAC SK-2410
Recommended Air Chimney	EIMAC SK-2406

395090 (Effective April 1984)
VA4640

Printed in U.S.A.

Varian EIMAC / 301 Industrial Way / San Carlos, CA 94070 / U.S.A.

RADIO FREQUENCY POWER AMPLIFIER

Class C Telegraphy or FM

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE . .	12	KILOVOLTS
DC SCREEN VOLTAGE .	2000	VOLTS
DC GRID VOLTAGE . .	-1000	VOLTS
DC PLATE CURRENT . .	12.5	AMPERES
PLATE DISSIPATION .	30	KILOWATTS
SCREEN DISSIPATION .	1000	WATTS
GRID DISSIPATION . .	600	WATTS

* Approximate

TYPICAL OPERATION, GRID DRIVEN

Class C rf Amplifier

Plate Voltage	11.25	kVdc
Screen Voltage	1000	Vdc
Grid Voltage	-460	Vdc
Plate Current	5.8	Adc
Screen Current *	0.55	Adc
Grid Current *	170	mAdc
Load Impedance	950	Ohms
Driving Power *	550	W
Useful Power Output	55	kW

TELEVISION LINEAR AMPLIFIER
CHANNELS 7-13
Cathode Driven

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE . .	12	KILOVOLTS
DC SCREEN VOLTAGE .	2000	VOLTS
DC GRID VOLTAGE . .	-1000	VOLTS
DC PLATE CURRENT . .	12.5	AMPERES
PLATE DISSIPATION .	30	KILOWATTS
SCREEN DISSIPATION .	1000	WATTS
GRID DISSIPATION . .	600	WATTS

* Approximate
# Calculated; including circuit losses gain will be 1 to 2 dB lower

TYPICAL OPERATION, Composite Signal Black Level unless otherwise stated

Plate Voltage	8000	10,000	Vdc
Screen Voltage	750	750	Vdc
Cathode Bias Voltage *	+95	+95	Vdc
Zero-Signal Plate Current	1.5	1.5	Adc
Plate Current	6.0	5.2	Adc
Grid Current *	0.13	---	Adc
Screen Current *	0.23	0.23	Adc
Peak Cath.Voltage (peak sync) . . .	115	95	v
Cathode Driving Power (peak sync) #	580	380	w
Plate Output Power (peak sync) . . .	33	33	kw
Plate Load Resistance	740	1230	Ohms
Cathode Load Resistance	11	12	Ohms
Gain #	17.6	19.5	dB

TYPICAL OPERATION values are obtained by calculation from published characteristic curves. To obtain the specified plate current at the specified bias, screen, and plate voltages, adjustment of the rf grid voltage is assumed. If this procedure is followed, there will be little variation in output power when the tube is replaced, even though there may be some variation in grid and screen currents. The grid and screen currents which occur when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no performance degradation providing the circuit maintains the correct voltage in the presence of the current variations.

APPLICATION

MECHANICAL

MOUNTING - The 4CX30,000G must be operated with its axis vertical. The base may be up or down at the convenience of the circuit designer.

SOCKETS - The EIMAC SK-2400 socket is available for dc, LF or HF applications. For VHF applications the SK-2410 socket is available, which is designed especially for this frequency range.

COOLING - The maximum temperature rating for the external surfaces of the tube is 250°C. Sufficient forced-air cooling must be provided to maintain the anode at the base of the cooling fins, and the ceramic/metal seals, below 250°C.

Air flow requirements to maintain anode core temperature at 250°C with 35°C ambient cooling air are tabulated below (for operation below 30 MHz). This data is for air flowing in the base-to-anode direction, and the pressure drop figures are for the anode cooler only and are approximate.

	SEA LEVEL		10,000 FEET	
Plate Diss. (watts)	Air Flow (cfm)	Press. Drop (In.water)	Air Flow (cfm)	Press. Drop (In.water)
10,000	190	0.6	275	0.7
20,000	385	1.8	560	2.1
30,000	850	6.1	1250	7.6

The blower selected in any 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(s) encountered in ducts and filters.

Separate cooling of the tube base is required and is accomplished by directing approximately 100 cfm of air horizontally through the socket from the side. It is preferable to direct this air through three equally spaced ducts.

The designer is reminded that the data shown represents minimum cooling requirements and cooling in excess of minimum requirements is normally beneficial. Temperature sensitive paints are commercially available for testing before any equipment design is finalized.

Air flow must be applied before or simultaneously with the application of power, including the tube filament, and should normally be maintained for a short period of time after power is removed to allow for tube cooldown.

ELECTRICAL

ABSOLUTE MAXIMUM RATINGS - The values shown for each type of service are based on the "absolute system" and are not to be exceeded under any service conditions. These ratings are limiting values outside which the serviceability of the tube may be impaired. In order not to exceed absolute ratings the equipment designer has the responsibility of determining an average design value for each rating below the absolute value of that rating by a safety factor so that the absolute values will never be exceeded under any usual conditions of supply voltage variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

FILAMENT WARMUP - Filament inrush surge current must be limited to 300 amperes. For best reliability, experience has shown that the filament and its internal supporting structure should be raised to operating temperature over a two-minute period. This may be accomplished by a linear increase in voltage to the operating value over 120 seconds. This mode could be implemented by a motor-driven variable transformer or an equivalent solid-state device. If the designer wishes a step-start sequence, the following program produces equivalent reliability:

1/ turn on at 40% to 50% of operating voltage and maintain this value for 120 seconds.

2/ increase voltage to full operating voltage.

In the event of a power failure not exceeding 60 seconds full operating voltage may be reapplied instantaneously. If the power failure exceeds 60 seconds, the programmed warmup procedure should be used. In case of emergency the turn-on program may be bypassed with no serious effect on reliability but normal start-up should be programmed.

FILAMENT OPERATION - At rated (nominal) filament voltage the peak emission capability of the tube is many times that needed for communication service. A reduction in voltage will lower the filament temperature, which will substantially increase life expectancy. The correct value of filament voltage should be determined for the particular application. It is recommended the tube be operated at full nominal voltage for an initial stabilization period of 100 to 200 hours before any action is taken to operate at reduced voltage. The voltage should gradually be reduced until there is a slight degradation in performance (such as power output or distortion). The filament voltage should then be increased a few tenths of a volt above the value where performance degradation was noted for operation. The operating point should be rechecked after 24 hours. Filament voltage should be closely regulated when voltage is to be reduced below nominal in this manner, to avoid any adverse influence by normal line voltage variations.

Filament voltage should be measured at the tube base or socket, using an accurate rms-responding meter. Periodically throughout the life of the tube the procedure outlined above for reduction of voltage should be repeated, with voltage reset as required, to assure best tube life.

FILAMENT CYCLING - This tube is designed for commercial service, with only one off/on filament cycle per day. If additional cycling is anticipated it is recommended the user contact Application Engineering at Varian EIMAC for more information.

GRID OPERATION - The maximum control grid dissipation is 600 watts, determined approximately by the product of the dc grid current and the peak positive grid voltage. A protective spark-gap device should be connected between the grid and the cathode to guard against excessive voltage.

SCREEN OPERATION - The maximum screen grid dissipation is 1000 watts. With no ac applied to the screen grid, dissipation is simply the product of dc screen voltage and the dc screen current. With screen modulation, dissipation is dependent on rms screen voltage and rms screen current. Plate voltage, plate loading, or bias voltage must never be removed while filament and screen voltages are present, since screen dissipation ratings will be exceeded. A protective spark-gap device should be connected between the screen grid and the cathode to guard against excessive voltage.

PLATE DISSIPATION - The nominal plate dissipation rating of the tube is 30 kilowatts, but up to 40 kilowatts can be safely sustained with the recommended forced-air cooling. When used as a plate-modulated rf amplifier, dissipation under carrier conditions should be limited to 20 kilowatts.

FAULT PROTECTION - In addition to the normal plate over-current interlock, screen current interlock, and coolant interlock, the tube must be protected from internal damage caused by an internal plate arc which may occur at high plate voltage. A protective resistance should always be connected in series with each tube anode, to help absorb power supply stored energy if an internal arc should occur. An electronic crowbar, which will discharge power supply capacitors in a few microseconds after the start of an arc, is recommended. The protection criteria for each electrode supply is to short each electrode to ground, one at a time, through a vacuum relay switch and a 6-inch length of #30 AWG copper wire. The wire will remain intact if the criteria is met.

EIMAC Application Bulletin #17 titled FAULT PROTECTION contains considerable detail, and is available on request.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly, and the equipment must be designed properly and operating precautions must be followed. Design all equipment 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 primary circuits of the power supply and to discharge high-voltage capacitors 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.

RADIO-FREQUENCY 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 the 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 interelectrode 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 Military Services use a standard test procedure as described in Electronic Industries

Association Standard RS-191. This requires the use of a specially constructed test fixture which shields all external tube leads or contacts 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 period of time. The capacitance values shown in the technical data 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 the application. Measurements should be taken with the mounting which represents approximate final layout if capacitance values are highly significant in the design.

SPECIAL APPLICATIONS - When it is desired to operate this tube under conditions widely different from those listed here, write to Varian EIMAC; attn: Applications Engineering; 301 Industrial Way; San Carlos, CA 94070 U.S.A.

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 OR ARE EXPOSED TO POWER TUBES OR EQUIPMENT WHICH 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:

a. HIGH VOLTAGE - Normal operating voltages can be deadly. Always remember that HIGH VOLTAGE CAN KILL.

b. RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies and can cause serious bodily and eye injuries. CARDIAC PACEMAKERS MAY BE EFFECTED.

c. HOT SURFACES - Surfaces of air-cooled radiators 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.

Please review the detailed operating hazards sheet enclosed with each tube, or request a copy from: Varian EIMAC, Power Grid Tube Division, 301 Industrial Way, San Carlos CA 94070.

GROUNDED GRID
CONSTANT CURRENT CHARACTERISTICS

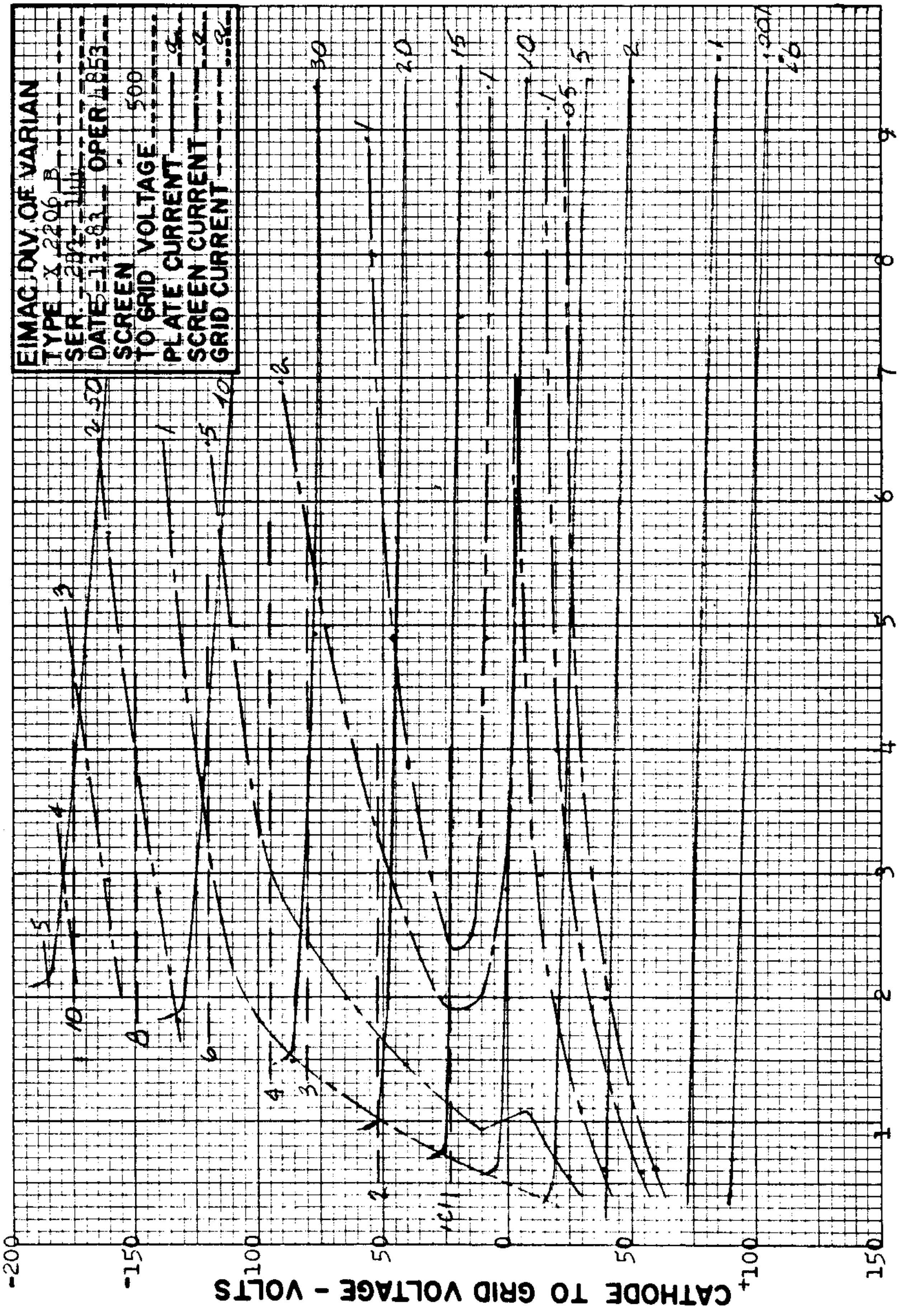
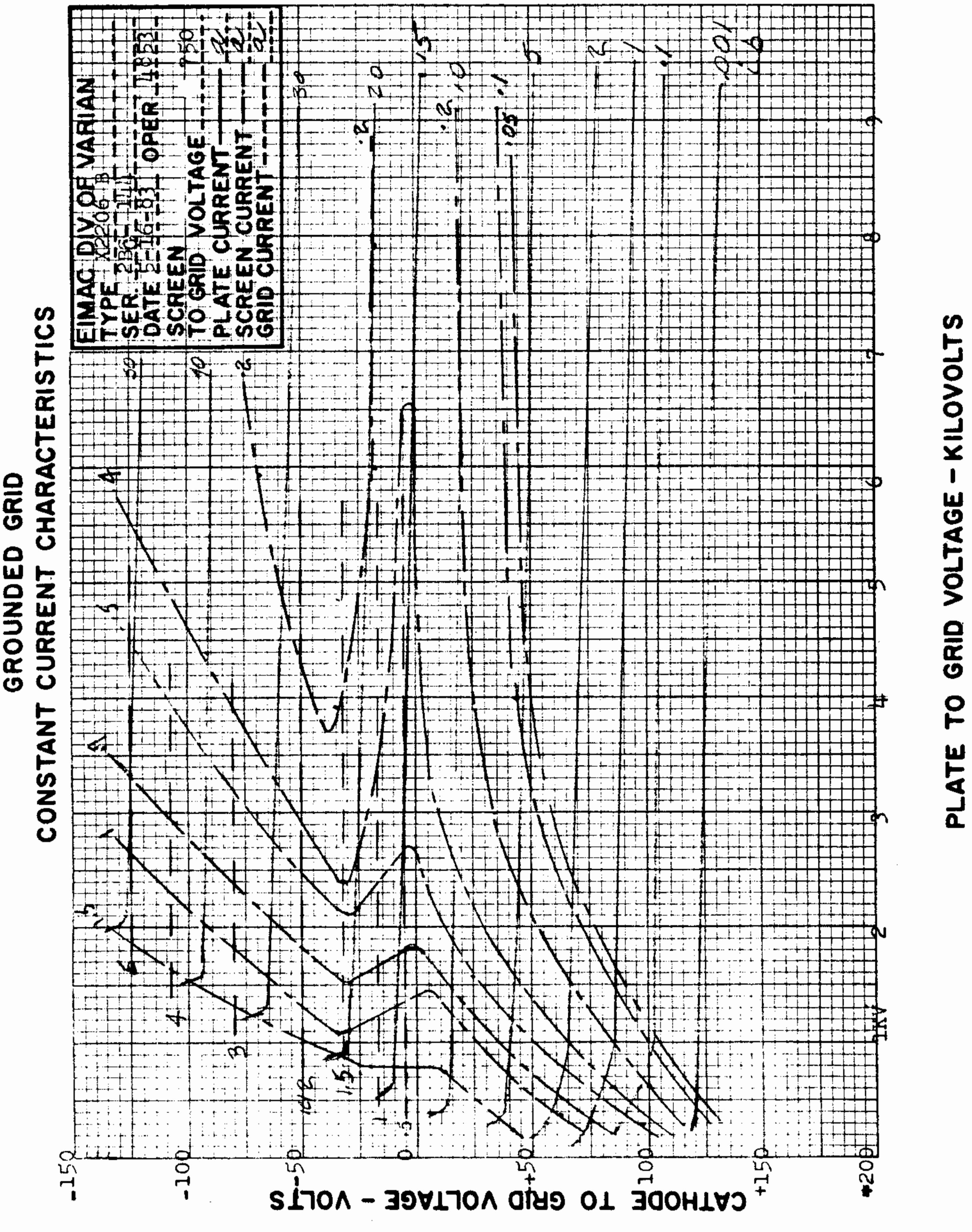


PLATE TO GRID VOLTAGE - KILOVOLTS


GROUNDED GRID
CONSTANT CURRENT CHARACTERISTICS
EIMAC DIV OF VARIAN
TYPE X2206 B
SER. 2BG 1
DATE 5-16-83 OPER 4823
SCREEN TO GRID VOLTAGE 750
PLATE CURRENT
SCREEN CURRENT
GRID CURRENT
PLATE TO GRID VOLTAGE - KILOVOLTS
CATHODE TO GRID VOLTAGE - VOLTS
-150
-100
-50
0
+50
100
+150
+200
1KV
2
3
4
5
6
7
8
9

Eimac 4CX30,000G

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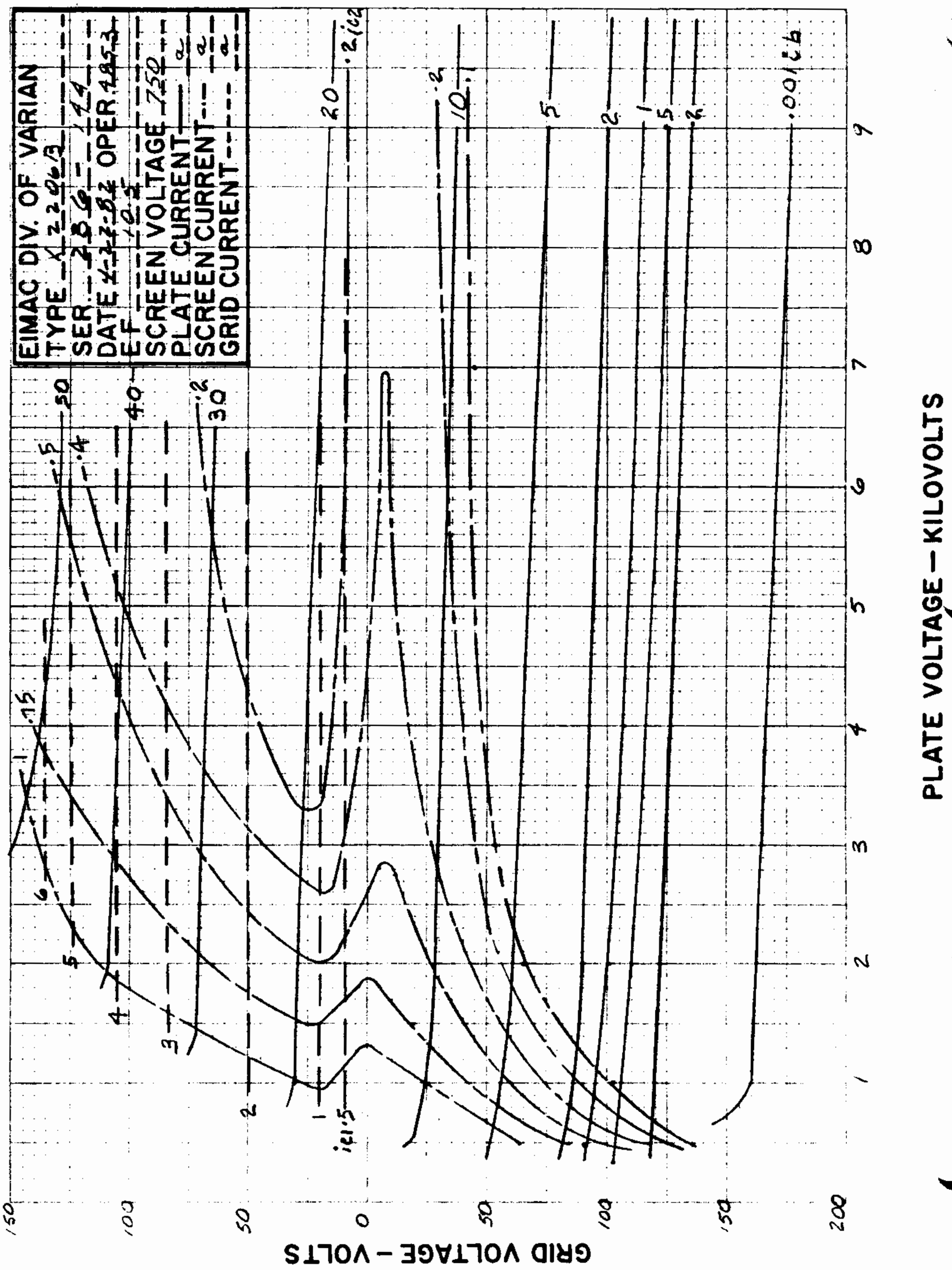
GROUNDED CATHODE
CONSTANT CURRENT CHARACTERISTICS



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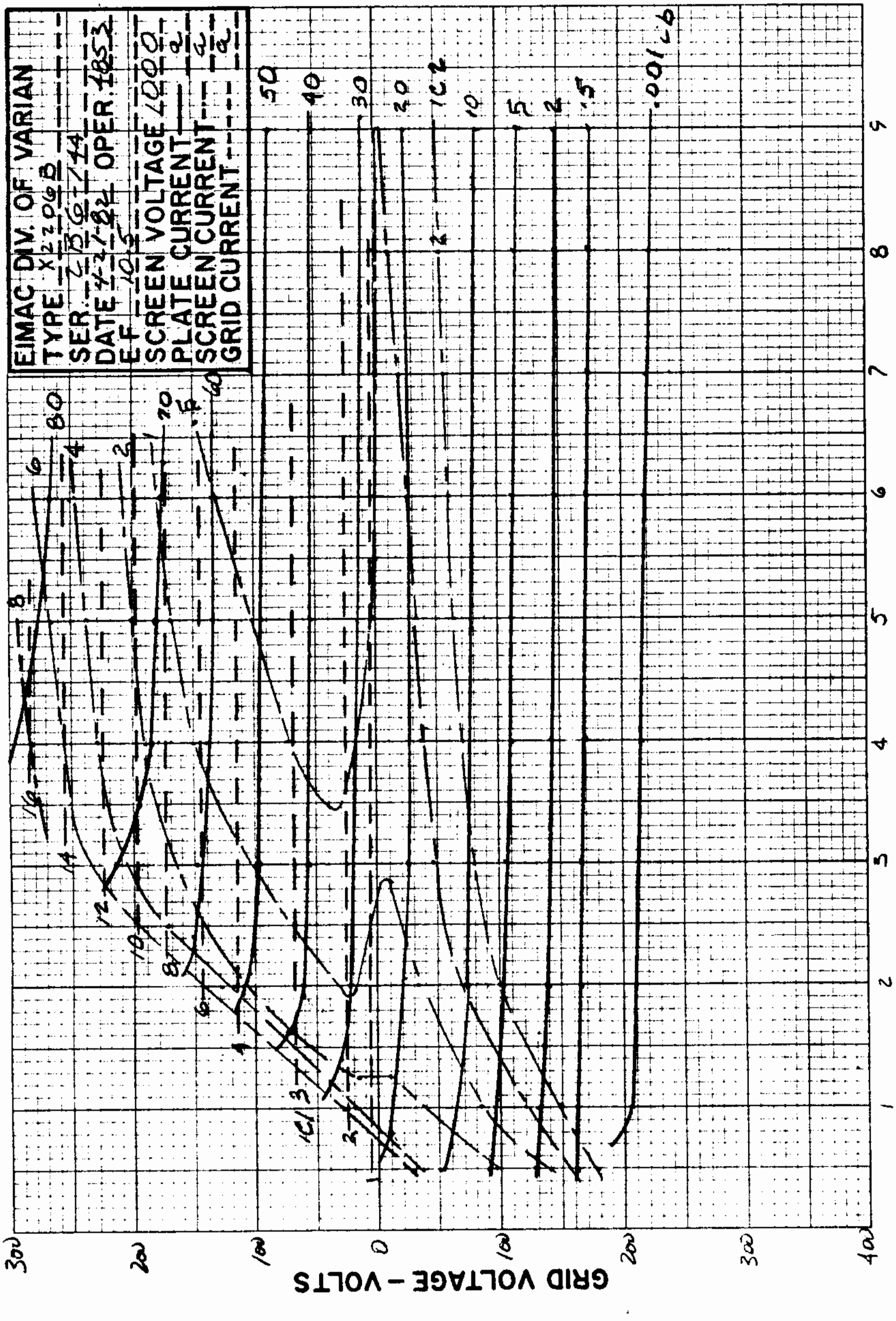
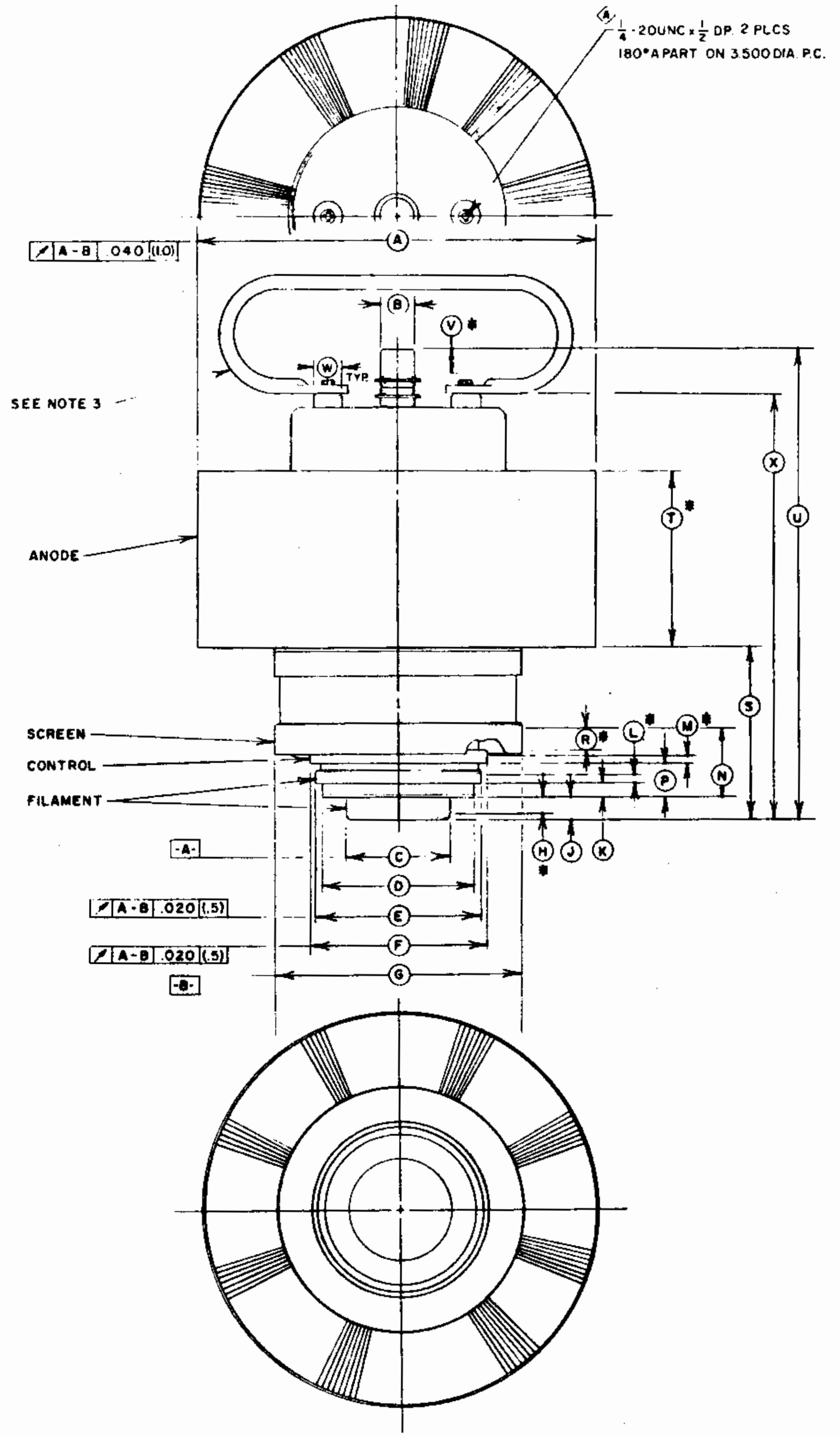
4CX30,000G Eimac

GROUNDED CATHODE CONSTANT CURRENT CHARACTERISTICS



TUBE NO. ______ PLOTTED BY ______ DATE ______

Eimac 4CX30,000G



DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM	MIN	MAX	REF	MIN	MAX	REF
A	9.960	10.080		253.0	256.0	
B	.880	.890		21.8	22.6	
C	2.615	2.625		66.42	66.68	
D			3.825			97.2
E	4.245	4.265		107.80	108.30	
F	4.490	4.520		114.05	114.81	
G	6.360	6.405		161.5	162.7	
H	.440			11.2		
J	.640	680		16.2	17.3	
K	.260	.290		6.6	7.4	
L	.250			6.3		
M	.150			3.8		
N	1.600			40.6		
P	.790	.830		20.1	21.1	
R	.350			8.9		
S	4.170	4.400		106.0	111.81	
T	4.400	4.600		112.0	117.0	
U	11.550	11.850		293.0	301.0	
V	.500			12.7		
W			.750			19.1
X	10.500	10.850		267.0	276.0	

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. * CONTACT SURFACE
3. SHIPPED WITH HANDLE ATTACHED. REMOVE BEFORE OPERATION.