TECHNICAL DATA

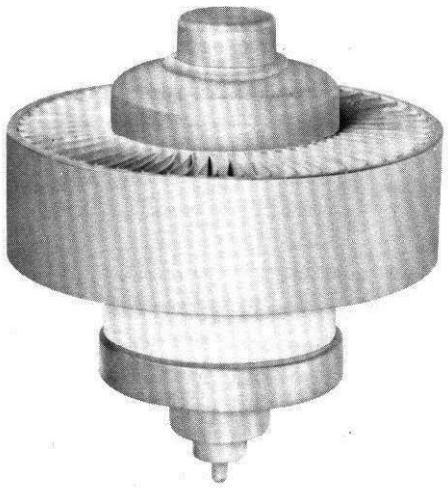
3CX800U7 HIGH-MU UHF TRANSMITTING TRIODE

The EIMAC 3CX800U7 is designed for use up to 1000 MHz as a CW, pulse or linear amplifier, particularly in the 806 to 970 MHz portion of the spectrum allocated to land mobile, paging and Amateur Radio services.

The 3CX800U7 is a ceramic/metal high-mu triode designed with beam-forming cathode and control-grid geometry, having an external anode rating of 800 watts of dissipation with forced-air cooling.

The combination of an amplification factor of 200 and minimum control-grid current interception provides high power gain in cathode-driven (grounded grid) amplifiers. Coaxial terminals and continuous cone-shaped conductors for the grid and cathode allow the lowest possible inductance between these tube elements and the cavity. The heater terminals are separate from the cathode.

Over 300 watts of useful CW rf power at 880 MHz may be obtained with better than 33% efficiency and more than 10 dB of gain. Cavity assemblies are available from Varian EIMAC for operation in the range from 820 MHz to 932 MHz. Tube terminal collets are also available.



GENERAL CHARACTERISTICS[1]

ELECTRICAL

Cathode: Oxide-coated, Unipotential		
Heater Voltage, Nominal (see derating data for UHF use)	13.5 ± 0.6	V
Heater Current, at 13.5 volts	1.5	A
Minimum Cathode Warmup Time (before application of high voltage and rf drive)	3	Min
Cathode-Heater Potential, Maximum	± 150	V
Amplification Factor (Approximate)	200	
Direct Interelectrode Capacitances (grid grounded)[2]		
Cin	23.3	pF
Cout	6.2	pF
Cpk	0.04	pF
Ck-htr	6.0	pF
Maximum Frequency for Full Ratings:		
CW	1000	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.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.8 In; 71.12 mm
Diameter	2.51 In; 63.80 mm

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VA4669

Net Weight (approximate)	11.2 Oz; 318 gms
Operating Position	Any
Cooling	Forced Air
Maximum Operating Temperature:	
Ceramic/Metal Seals and Anode Core	250 °C
Base	Special Coaxial

Recommended Contact Collets:

Tube Element	EIMAC Part No.
Inner Heater	008290
Outer Heater	008291
Cathode	008292
Grid	882931
Anode	720829

Cavity Assemblies Available from Varian EIMAC:

Frequency 825 to 880 MHz; Nominal Useful Power Output = 350 Watts	CV-2801
Frequency 915 to 932 MHz; Nominal Useful Power Output = 350 Watts	CV-2811

RADIO FREQUENCY POWER AMPLIFIER
CLASS C CW, FM OR SSB SERVICE

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE **	1800	VOLTS
DC GRID BIAS VOLTAGE	-100	VOLTS
DC PLATE CURRENT	0.5	AMPERES
PLATE DISSIPATION	800	WATTS
GRID DISSIPATION	4	WATTS
DC GRID CURRENT	0.05	AMPERE

* Will vary with installation or tube.
\# Measured at the load.
§ Intermittent keyed operation.
** May be 2000 volts under low duty intermittent keyed operation or SSB conditions. May be 2250 volts under no-signal conditions.

TYPICAL OPERATION - Class AB2 Cathode Driven
Measured Data in EIMAC CV-2801 Cavity at 850 MHz (FM/CW Service)

	FM	CW§	
Heater Voltage (warmup or standby)	13.5	13.5	Vac
Heater Voltage (during operation)	12.0	13.5	Vac
Heater Current (at 13.5 volts) *	1.5	1.5	Aac
Plate Voltage	1500	2000	Vdc
Cathode Bias Voltage *	+10.0	+8.2	Vdc
Plate Current	500	500	mAdc
Grid Current *	5	0	mAdc
Driving Power *	25	25	W
Useful Power Output #	260	325	W
Power Gain *	10.9	11.2	dB

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater Current, at 13.5 volts	1.40	1.53	Aac
Cathode Warmup Time, at 13.5 volts	3	---	Min
Interelectrode Capacitance (grounded grid)[1]			
Cin	23.0	23.6	pF
Cout	6.1	6.3	pF
Cpk	---	0.04	pF

1 Capacitance values are for a cold tube as measured in a special shielded fixture in accord with Electronic Industries Association Standard RS-191.

TYPICAL OPERATION values are obtained by measurement. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias and plate 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 current. The grid current which occurs when the desired plate current is obtained is incidental and may vary from tube to tube. This current variation causes no performance degradation providing the circuit maintains the correct voltage in the presence of the current variation.

APPLICATION

MECHANICAL

MOUNTING & SOCKETING - The 3CX800U7 may be mounted and operated in any position. Part numbers of collets available from EIMAC are listed on page 2. These collets may be soft-soldered to appropriate UHF line or cavity elements. The collets provide low-inductance connections between tube and circuitry and also serve to draw off a portion of the heat released during normal operation.
When collets are assembled in a cavity configuration, the tube should be inserted with care, making sure it is well aligned with the various collets before pressure is applied to force it into place. When the tube is removed for any reason it should be pulled straight out with a slow but steady pressure in order to avoid sudden release which might result in uneven tube movement and consequent damage to the contact collets. The EIMAC SK-605 tube extractor is recommended for cavity applicatitons to facilitate tube removal.
An air-system chimney, the EIMAC SK-1906, and anode clamp assembly SK-1916 are available for applications where the tube is used at VHF or below.

FORCED-AIR COOLING - For operation at full power input, and assuming full-power output, the anode dissipation of the 3CX800U7 tube will approach 800 watts. A minimum of 27 cfm of clean filtered air must pass through the tube cooling fins to maintain tube temperatures within ratings. Air flow must be in the base-to-anode direction. The pressure drop across the tube only with a flow of 27 cfm, will be approximately 0.6 inch of water. The cooling data above is based on an incoming air temperature of 50°C maximum at sea level and a maximum tube temperature of 225°C. If the base contacting arrangement does not restrict flow around the base seals, additional base cooling provisions may not be required, but the designer is cautioned to verify this before a circuit design is finalized, by means of temperature sensitive paints which are available for this purpose, or other equivalent means.
Depending on the circuit or cavity design, allowances must also be made for other losses in the air system, in order to assure sufficient air flow for tube cooling. The designer is also cautioned that it is not good practice to operate at, or very close to, the absolute maximum temperature ratings for the metal/ceramic seals. Where long life and consistent performance are factors, cooling in excess of the minimum requirements is normally beneficial.

INTERLOCKING PROTECTION - Protective interlocking should be provided so that if forced-air cooling fails for any reason, or falls below the minimum allowable, all voltages will be removed from the tube, including rf drive and the heater supply. Conversely, it should not be possible to apply any voltages to the tube, including its heater, unless an adequate supply of forced air is flowing through the cavity.

ELECTRICAL

CATHODE WARMUP TIME - In normal service it is recommended the heater voltage be applied for a minimum of three minutes before anode voltage and rf drive voltage are applied, to allow for proper conditioning of the cathode surface. A timer which interlocks with the plate supply is recommended.

HEATER VOLTAGE - The recommended nominal heater voltage of 13.5 $\pm$ 0.6 volts (as measured at the tube base) should be applied for a minimum of 3 minutes before operation commences. After operation has started (in UHF full-power FM or key-down CW service), where long life and consistent performance are factors,the voltage should be reduced to prevent cathode overheating due to rf transit-time effects in the tube. This reduction

in heater voltage should preferably be made automatically with the application of the rf drive voltage to the cavity. The optimum value for the reduced heater voltage is dependent on a number of factors, predominantly frequency and the power level of operation. The optimum value may also vary from tube-to-tube and normally is determined empirically for the particular application. Typical values are shown in the table.

Frequency	Heater Voltage
Below 300 MHz	13.5
300 - 500 MHz	12.75
500 - 700 MHz	12.0
700 - 800 MHz	11.25
800 - 900 MHz	10.5
900 - 1000 MHz	9.75

Heater voltage should be returned to 13.5 volts simultaneously with the removal of rf drive.
In low duty factor applications such as CW telegraphy and voice SSB, heater voltage should be maintained at 13.5 volts.

GENERAL OPERATION - For efficient operation at most power levels, bias voltage is required. A convenient means of obtaining bias voltage is with a cathode resistor, which may be a fixed value, or a wire-wound variable if a simple power-output control is desirable. For linear amplifier service, zener diode(s) should be used.
For monitoring of operating conditions, and especially during tuning of a cavity, grid and plate-current meters should be used. For grid current, a plus and minus 50 mAdc zero-center meter is desirable. The plate current meter should be 1.0 Adc full scale. The dc connection is most easily made to the center cap of the anode.
If the tube is used with an EIMAC cavity assembly, technical data, which includes detailed tuning instructions, is available on request.

GRID OPERATION - The maximum control grid dissipation is 4 watts and the maximum grid current is 50 mAdc. These ratings should not be exceeded, as this could cause vaporization of the grid-coating material and resultant poisoning of emission from the tube's oxide cathode.
The use of a zero-center grid current meter (for tuning and monitoring) is recommended since normal grid current can be negative. This negative current does not indicate any circuit or tube malfunction and is the result of tube characteristics and transit-time effects during UHF operation.

GRID AND PLATE CURRENT LIMITATIONS - Note that grid current is a function of drive power and amplifier loading and can vary widely during tuning and loading. Under no circumstances should grid current exceed 50 mAdc during tuning or operation of the tube.
The maximum plate current rating is 500 mAdc. Drive level should be restricted during tuning periods so this rating is not exceeded. For monitoring purposes, peak meter readings on voice (taking into account inertia of the meter) will be approximately 200 mAdc. Under no circumstances is the plate current meter reading to exceed the maximum plate current rating of 500 mAdc.

UHF OPERATION - Operation in the UHF range should be conducted with heavy plate loading and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency for increased tube life.

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 to limit peak current and help dissipate the energy in the event of a tube or circuit arc. A resistance of 50 ohms in the positive plate power supply lead will help protect the tube in the event of an internal arc. The resistor must be rated for at least 50 watts as it must dissipate the energy surge in the event of an arc.

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 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 period of time. The capacitance values shown in the manufacturer's technical data 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 appliction. Measurements should be taken with the mounting which represent approximate final layout if capacitance values are highly significant in the design.

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.

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, especially at frequencies above 300 MHz, where energy absorption by the human body is significant. The human eye is particularly sensitive. Prolonged exposure to rf radiation should be limited to 10 milliwatts per square centimeter (Occupational Safety & Health Administration (OSHA) standard). It is generally accepted that exposure to "high levels" of rf radiation can result in bodily injury, including blindness. CARDIAC PACEMEAKERS MAY BE AFFECTED.

SPECIAL APPLICATIONS - When it is desired to operate this tube under conditions widely different from those listed here, write to Varian EIMAC; attn: Product Manager; 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.

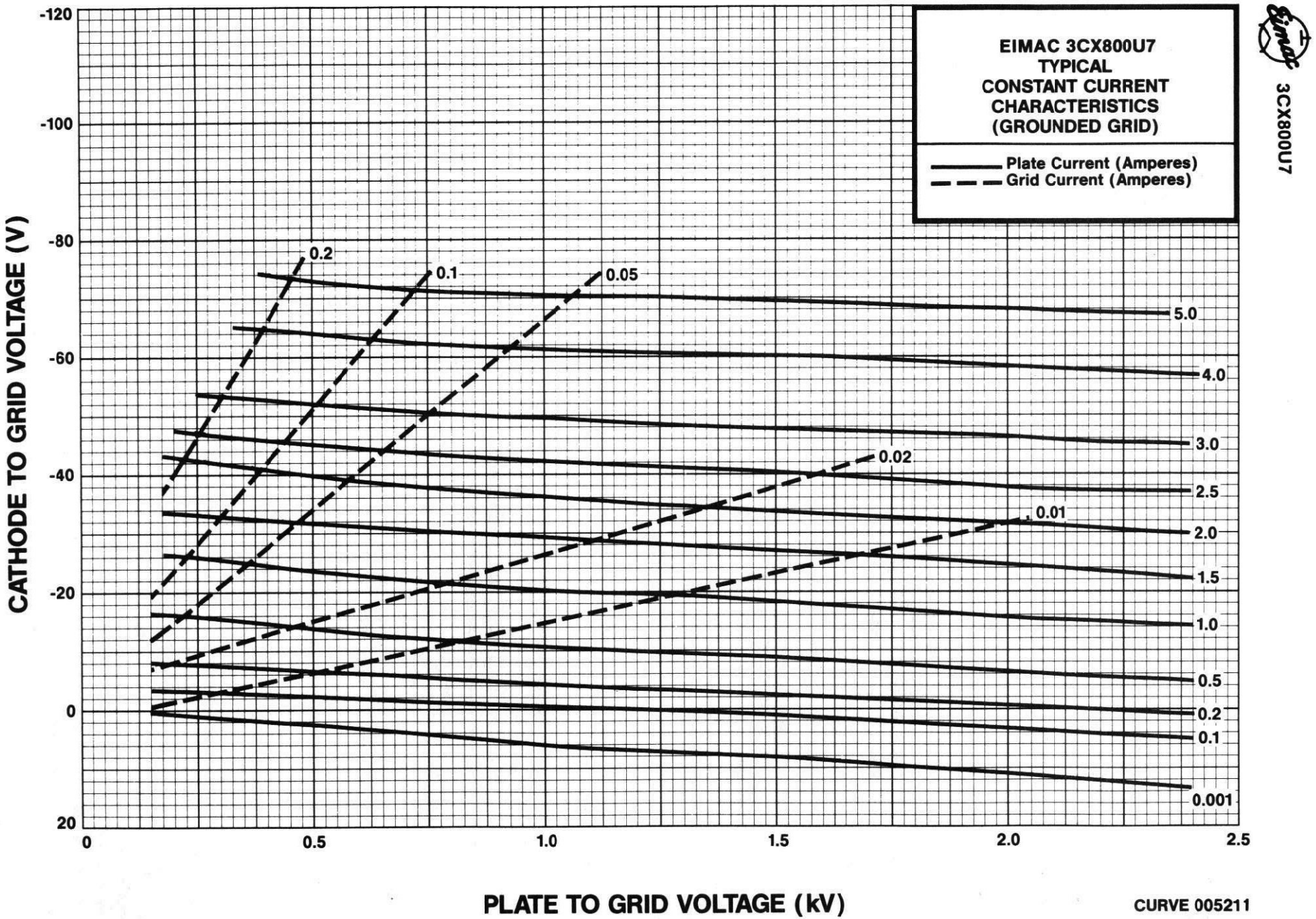
The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

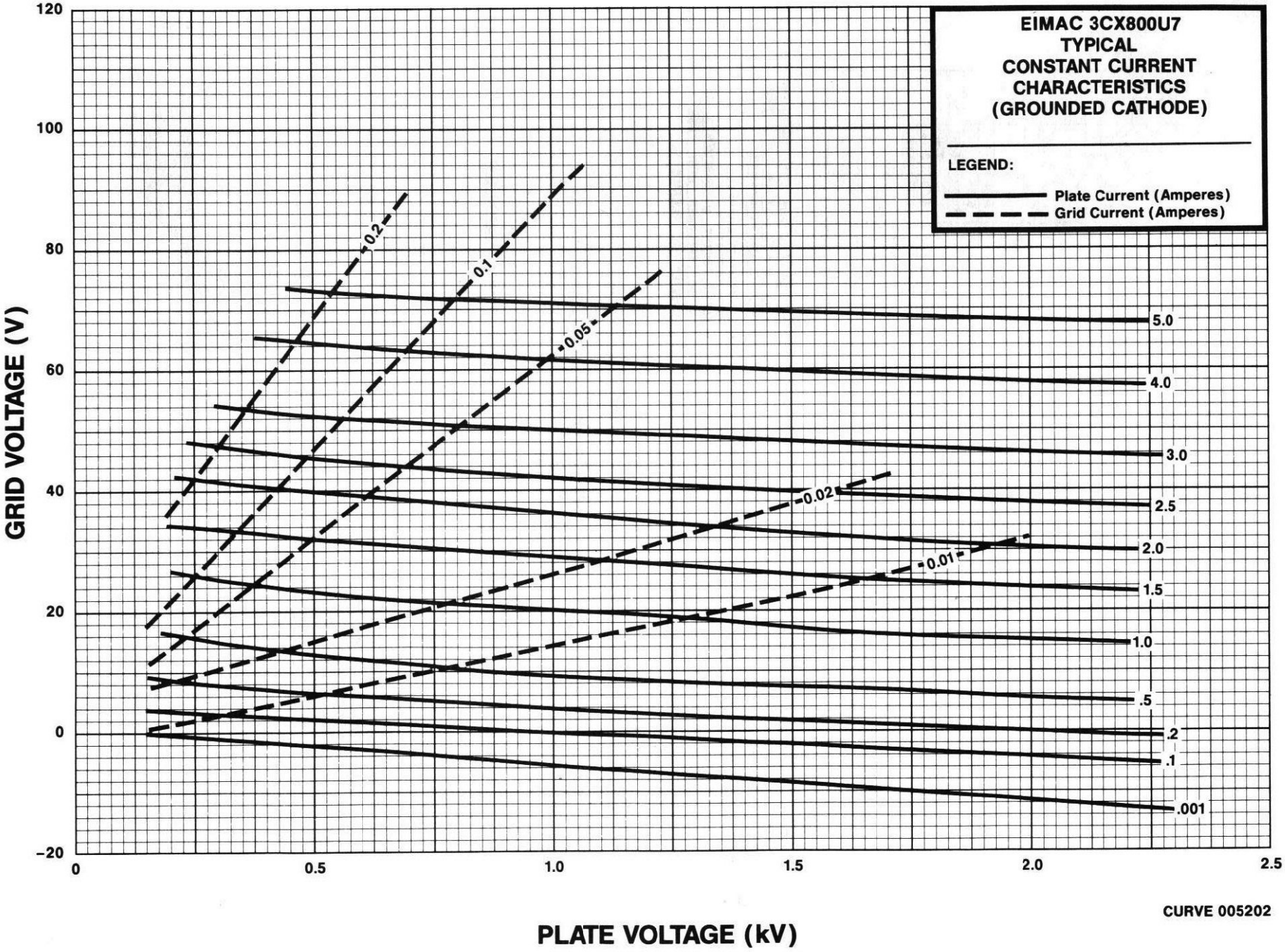
a. HIGH VOLTAGE - Normal operating voltages can be deadly. Always remember that HIGH VOLTAGE CAN KILL.

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.


EIMAC 3CX800U7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED GRID)
Plate Current (Amperes)
Grid Current (Amperes)
3CX800U7
CATHODE TO GRID VOLTAGE (V)
-120
-100
-80
-60
-40
-20
0
20
0
0.5
1.0
1.5
2.0
2.5
PLATE TO GRID VOLTAGE (kV)
0.2
0.1
0.05
0.02
0.01
5.0
4.0
3.0
2.5
2.0
1.5
1.0
0.5
0.2
0.1
0.001
CURVE 005211


EIMAC 3CX800U7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED CATHODE)
LEGEND:
Plate Current (Amperes)
Grid Current (Amperes)
GRID VOLTAGE (V)
120
100
80
60
40
20
0
-20
0
0.5
1.0
1.5
2.0
2.5
PLATE VOLTAGE (kV)
0.2
0.1
0.05
0.02
0.01
5.0
4.0
3.0
2.5
2.0
1.5
1.0
.5
.2
.1
.001
CURVE 005202

DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A			2.850			72.39
B	2.485	2.515		63.12	63.88	
C			2.188			55.58
D	.750	.810		19.05	20.57	
E	.710	.790		18.03	20.07	
F		1.406			35.71	
G	.187			4.75		
H	.200			5.08		
J	.559	.573		14.20	14.55	
K	.240			6.10		
L			.505			12.83
M			.157			3.99
N	.330			8.38		
P	.230			5.84		
R	1.417	1.433		35.99	36.40	
T	.091	.095		2.31	2.41	
U	.318	.325		8.08	8.26	
V	.588	.597		14.93	15.16	
W			.325			8.26
X	.025			.635		

NOTES:

1. REF DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACE.
3. CONCENTRICITY MEASUREMENTS ARE TO BE PERFORMED WITH TUBE MOUNTED ON SURFACE Y.