TECHNICAL DATA

HIGH-MU AIR-COOLED POWER TRIODE 3CX3000A7

The Eimac 3CX3000A7 is an air-cooled high-Mu power triode. This tube features high gain and ruggedness. This tube is intended for use in grounded-grid configuration It may be used in class B or AB_2 linear amplifier service with zero bias, and it may also be used in class C with cathode bias in FM broadcast or industrial amplifier service. The coaxial base on this tube readily interfaces with external VHF circuitry.

GENERAL CHARACTERISTICS[1]

ELECTRICAL

Filament: Thoriated Tungsten
- Voltage ..... 7.5 ± 0.37 V
- Current @ 7.5 Volts ..... 51.5 A

Direct Interelectrode Capacitances (grounded grid)[2]
- Cin ..... 38 pF
- Cout ..... 24 pF
- Cgp ..... 0.6 pF

Amplification Factor (average) 165
Frequency for Maximum Rating (CW) ..... 110 MHz
Frequency for Reduced Output Rating ..... 220 MHz

MECHANICAL

Overall Dimensions:
- Length ..... 9.00 in; 228.60 mm
- Diameter ..... 4.156 in; 105.56 mm

Net Weight ..... 6.2 lb; 2.8 kg
Operating Position ..... Vertical, base up or down
Maximum Operating Temperature:
- Ceramic/Metal Seals & Envelope ..... 250°C
- Plate Core ..... 250°C

Cooling ..... Forced Air
Base ..... Special, Coaxial

[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. CPI Eimac Division 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.

RADIO FREQUENCY POWER AMPLIFIER
Class C Telegraphy or FM, Cathode Driven

ABSOLUTE MAXIMUM RATINGS:

Plate Voltage	6.0	Kilovolts dc
Plate Current	2.5	Amperes dc
Grid Voltage	-1.0	Kilovolt dc
Plate Dissipation	4.0	Kilowatts
Grid Dissipation	225	Watts

TYPICAL OPERATION, at 108 MHz:

Plate Voltage	4.8	kVdc
Plate Current	1.54	Adc
Cathode Bias Voltage	60	Vdc
Grid Current*	0.48	Adc
Peak Cathode Voltage*	267	V
Driving Power*	435	W
Plate Dissipation*	1.4	kW
Plate Output Power*	5.5	kW
Input Impedance*	60	Ohms
Resonant Plate Load Impedance	1200	Ohms

*Approximate Values

RADIO FREQUENCY LINEAR AMPLIFIER
Class AB2 Cathode Driven

ABSOLUTE MAXIMUM RATINGS:

Plate Voltage	7.0	Kilovolts dc
Plate Current	2.5	Amperes dc
Grid Voltage	-1.0	Kilovolt dc
Plate Dissipation	4.0	Kilowatts
Grid Dissipation	225	Watts

TYPICAL OPERATION, below 30 MHz

Plate Voltage	4.0	kVdc
Zero-Signal Plate Current	0.35	Adc
Single-Tone Plate Current	2.0	Adc
Peak Driving Power*	410	W
Grid Voltage	0	V
Plate Dissipation*	2.78	kW
Single-Tone Plate Output Power	7.27	kW
Single Tone Grid Current*	0.6	Adc
Input Impedance*	46	Ohms
Resonant Plate Load Impedance*	1425	Ohms

*Approximate Values

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 plate current at the specified bias and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Filament Current @ 7.5 Volts	48	54	A
Interelectrode Capacitances[1] (grounded grid)			
Cin	30.0	45.0	pF
Cout	20.0	28.0	pF
Cpk	---	1.0	pF
Zero Signal Plate Current (Ec=0, Eb = 5 kV)	0.36	0.52	A
Cut-off Bias (Eb = 5 kV, Ib = 1.0 mA)	---	-45.0	V

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

APPLICATION

MOUNTING & SOCKETING – The tube must be operated with its axis vertical. The base of the tube may be up or down at the option of the equipment designer. This product contains a thoriated-tungsten filament and should be protected from shock and vibration. Any connection to the filament and grid contact surfaces should be designed to prevent extreme pressure, to avoid damaging the ceramic-to-metal seals. Never drill or solder to tube contact surfaces. Air flow should be provided into the recessed area of the inner filament contact on the base to cool the tube seals and contact fingers.

STORAGE – If a tube is to be stored as a spare it should be kept in its original shipping carton with the original packing material, to minimize the possibility of handling damage. Before storage a new tube should be operated in the equipment for 100 to 200 hours to establish that it has not been damaged and operates properly. If the tube is still in storage 6 months later it should be operated in the equipment for 100 to 200 hours to make sure there has been no degradation. If operation is satisfactory the tube can again be stored with great assurance of being a known-good spare.

COOLING - The maximum temperature rating for the plate core and the ceramic/metal seals of this tube is 250°C and sufficient forced-air cooling must be provided to assure operation at safe tube temperatures. Tube life is usually prolonged if cooling in excess of the absolute minimum requirements is provided.

The cooling table shows minimum airflow rates for two values of dissipation, 2500 W and 4000 W with air-flow in two directions. The data reflects an inlet air temperature of 40°C at sea level and at 5000 ft. ASL and applies to operation below 30 MHz. If the tube is used above this frequency additional cooling may be required because of increased rf losses that occur at VHF.

At an altitude of 10,000 feet greatly increased airflow is required; in this case both the airflow and pressure drop values for sea level must be increased by the following factor: x 1.46. Additional cooling of the tube base may be required especially if the plate cooling air is not directed past the base first; the preferred configuration is for air flow in the base-to-plate direction, although cooling air supplied in the alternate direction is permissible if of the proper flow rate.

Cooling air should be filtered to remove particles of foreign matter that may become embedded in the plate cooling fins and impair cooling efficiency.

The designer is cautioned that the cooling recommendations shown are absolute values for inlet air and temperature rise conditions shown with no safety factor and to maintain temperature at the metal/ceramic seals and at the plate core less than 225°C. It is considered good engineering practice to allow additional air flow for conservatism and to make allowance for variables such as dirty air filters, dirty plate cooling fins, pressure losses in air ducting, etc.

Base-to-Plate Air Flow				
Plate dissipation (Watts	SEA LEVEL		5,000 FEET	
	Air Flow (CFM)	Pressure Drop (In. of Water)	Air Flow (CFM)	Pressure Drop (In. of Water)
2500	36	0.60	43	0.72
4000	67	1.20	80	1.45
Plate-to-Base Air Flow				
2500	42	0.70	50	0.84
4000	84	1.70	101	2.00

Temperature-sensitive paints are available which will allow a check of temperatures before any design is finalized. EIMAC Application Bulletin AB-20, TEMPERATURE MEASUREMENTS WITH EIMAC POWER TUBES, covers this subject in detail and is available on request.

ABSOLUTE MAXIMUM RATINGS - 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 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, load variation, or manufacturing variation in the equipment itself. It does not necessarily follow that combinations of absolute maximum ratings can be attained simultaneously.

FILAMENT OPERATION - With a new tube, or one that has been in storage for some period of time, operation with filament voltage only applied for a period of 30 to 60 minutes is recommended before full operation begins. This allows the active getter material mounted within the filament structure to absorb any residual gas molecules which have accumulated during storage. Once normal operation has been established a minimum filament warm-up time of five seconds is normally sufficient before commencing operation at full power.

Eimac Application Bulletin #18, EXTENDING TRANSMITTER TUBE LIFE, gives information on the effect of filament voltage on life expectancy.

Filament voltage should be measured at the tube base, using a known-accurate (preferably plus or minus one percent) rms-responding meter. Variation in filament voltage should be limited to no more than +/- five percent for consistent tube performance.

INPUT CIRCUIT – When operated as a grounded-grid rf amplifier, the use of a matching network in the cathode circuit is recommended. For best results with a single ended amplifier, and depending on the application it is suggested the network have a "Q" of at least 5, and higher if possible.

FAULT PROTECTION - In addition to normal cooling interlocks and a plate over-current interlock, it is good practice to protect the tube from internal damage which could result from occasional arcing at high plate voltage. In all cases some protective resistance, at least 10 Ohms, should be used in series with the tube plate to absorb power supply stored energy in case an arc should occur. An electronic crowbar, which will discharge power supply capacitors in a few microseconds after the start of an arc, may be required. The test 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 AGW copper wire. The wire will remain intact if protection is adequate. Eimac Application Bulletin #17, FAULT PROTECTION, contains considerable detail and is available upon request.

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 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 period of time, even with tubes made by different manufacturers. 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 mounting that represents approximate final layout if capacitance values are highly significant in the design.

HIGH VOLTAGE - The 3CX3000A7 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 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 effect. Public health agencies are concerned with the hazard, and the published OSHA (Occupational Safety and Health Administration) or other local recommendations to limit prolonged exposure of rf radiation should be followed.

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.

SPECIAL APPLICATIONS - If it is desired to operate this tube under conditions widely different from those given here, contact the Application Engineering Dept., CPI Eimac Division, San Carlos, CA 94070 U.S.A. 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.

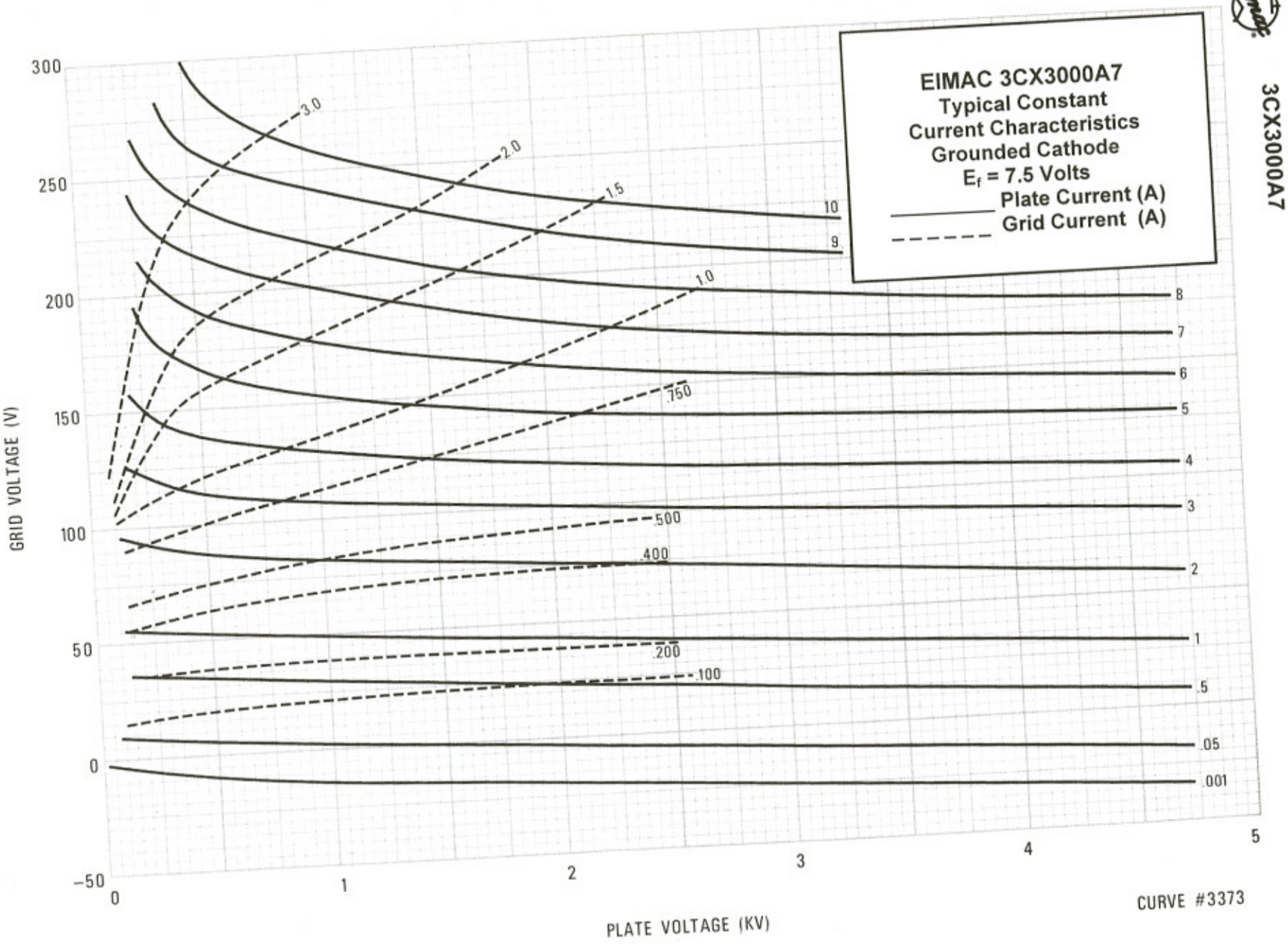
HIGH VOLTAGE – Normal operating voltages can be deadly. Remember that HIGH VOLTAGE CAN KILL.

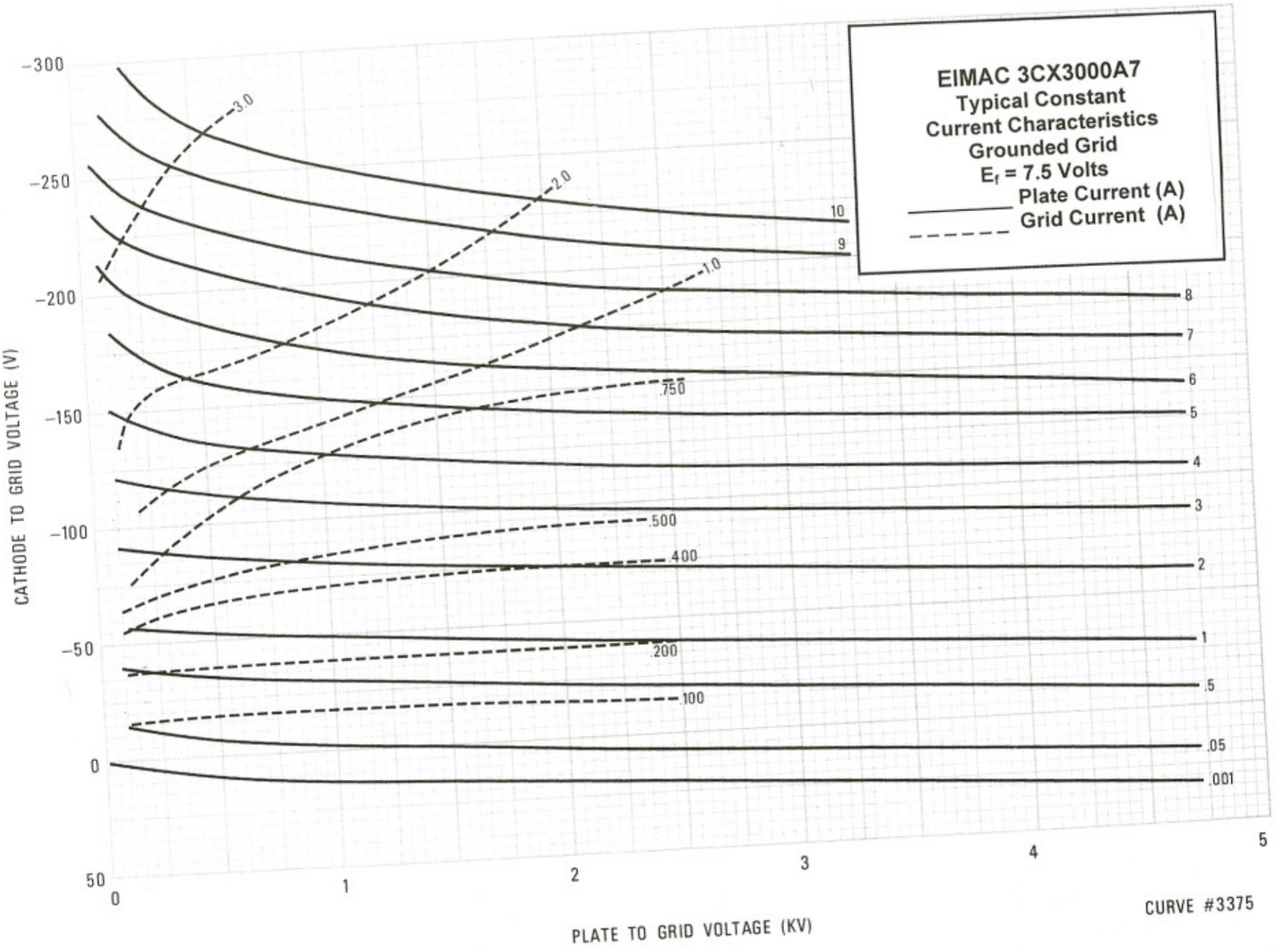
LOW-VOLTAGE HIGH-CURRENT CIRCUITS - Personal jewelry, such as rings, should not be worn when working with filament contacts or connectors as a short circuit can produce very high current and melting, resulting in severe burns.

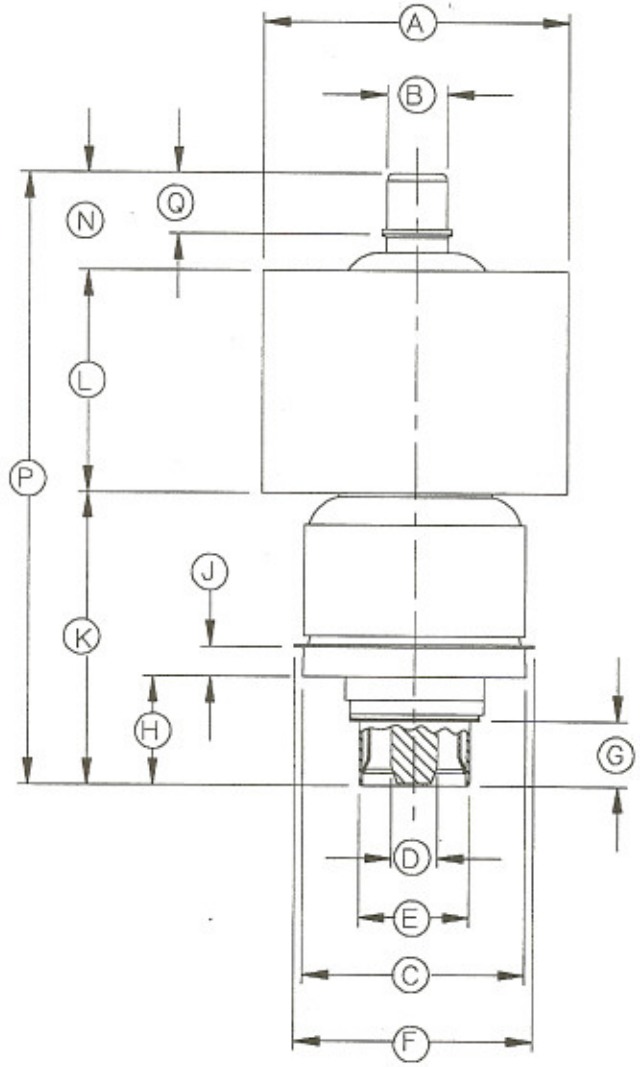
RF RADIATION – Exposure to strong rf fields should be avoided, even at relatively low frequencies. CARDIAC PACEMAKERS MAY BE AFFECTED.

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.

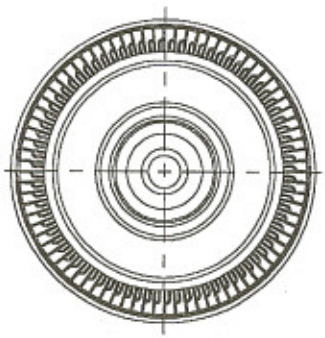
Please review the detailed Operating Hazards sheet enclosed with each tube, or request a copy from CPI, Eimac Division, Application Engineering at 650-592-1221.


EIMAC 3CX3000A7
Typical Constant
Current Characteristics
Grounded Cathode
E_f = 7.5 Volts
Plate Current (A)
Grid Current (A)
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
300
250
200
150
100
50
0
−50
0
1
2
3
4
5
3.0
2.0
1.5
1.0
.750
.500
.400
.200
.100
10
9
8
7
6
5
4
3
2
1
.5
.05
.001
CURVE #3373


EIMAC 3CX3000A7
Typical Constant
Current Characteristics
Grounded Grid
E_f = 7.5 Volts
Plate Current (A)
Grid Current (A)
CATHODE TO GRID VOLTAGE (V)
PLATE TO GRID VOLTAGE (KV)
CURVE #3375
-300
-250
-200
-150
-100
-50
0
50
0
1
2
3
4
5
10
9
8
7
6
5
4
3
2
1
.5
.05
.001
3.0
2.0
1.0
.750
.500
.400
.200
.100



DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.094	4.156		103.99	105.56	
B	.781	.844		19.83	21.44	
C	2.990	3.025		75.95	76.84	
D	.615	.635		15.62	16.13	
E	1.490	1.510		37.85	38.35	
F		3.625			92.08	
G	.813	.937		20.65	23.80	
H	1.375	1.625		34.92	41.27	
J	.375	.438		9.52	11.12	
K	3.875	4.250		98.43	107.95	
L	2.937	3.063		74.60	77.80	
N	1.187	1.687		30.15	42.85	
P	8.000	9.000		203.20	228.60	
Q	.775	.875		19.68	22.23	



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