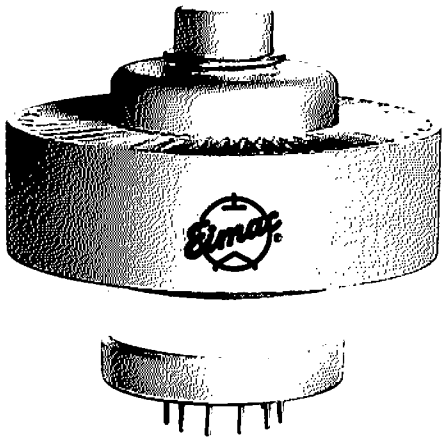
TECHNICAL DATA

3CPX800A7
HIGH-MU
POWER TRIODE



The EIMAC 3CPX800A7 is a rugged ceramic/metal high-mu power triode designed with beam-forming cathode and control-grid geometry to allow the simplicity of design and circuit advantages of a triode with the gain of a tetrode.

The 3CPX800A7 is intended for pulsed rf amplifier, pulse modulator or pulse regulator service, with a pulse plate current rating of 8 amperes, and a maximum plate voltage holdoff rating of 4500 volts.

The anode is forced-air cooled for 800 watts of dissipation.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential

Heater Voltage	13.5 ± 0.6	V
Heater Current, at 13.5 volts	1.5	A
Cathode-Heater Potential (maximum)	± 150	V
Minimum Warmup Time (before application of rf drive and/or high voltage)	3	Min
Amplification Factor (approximate)	200	
Direct Interelectrode Capacitance (grid grounded) [2] : Cin	25.5	pF
Cout	6.1	pF
Cpk	0.04	pF
Highest Frequency for Maximum Ratings	500	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	2.425 in; 61.59 mm
Diameter	2.530 in; 64.26 mm
Net Weight	12.0 oz; 340 gm
Operating Position	Any
Cooling	Forced Air
Maximum Operating Temperature: Ceramic/Metal Seals or Anode Core	250°C
Base: Large Wafer Elevenar 11-Pin with Ring	(EIA No. E11-81)
Recommended Socket	EIMAC SK-1900
Recommended Air Chimney	EIMAC SK-1906
Available Chimney Clamp for SK-1906 (needed if mounting is not vertical, anode up)	EIMAC SK-1916
Available Grid Collet with grounding flange to fit SK-1900	EIMAC P/N 720359
Available Grid Bypass Capacitor Ring (1100 pF @ 1000 DCWV)	EIMAC SK-655
Available Anode Connector Clip, for DC, Pulse and HF Applications	EIMAC ACC-1

PULSE MODULATOR OR SWITCH TUBE SERVICE

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	4.5	KILOVOLTS
PEAK PLATE CURRENT #	8	AMPERES
PULSE DURATION & DUTY #	See Derating Chart	
PLATE DISSIPATION	800	WATTS
DC GRID VOLTAGE	-150	VOLTS
DC GRID CURRENT (Average)	0.060	AMPERES
GRID DISSIPATION	4.0	WATTS
HEATER VOLTAGE	SEE HEATER/CATHODE OPERATION	

TYPICAL OPERATION - Pulse Modulator Service

Plate Voltage	4.5	kVdc
Pulse Plate Current	5.0	a
Grid Voltage	-50	Vdc
Pulse Positive Grid Voltage *	70	v
Pulse Grid Current *	200	ma
Pulse Duration	10	uSec
Duty	0.005	
Pulse Driving Power *	25	w
Pulse Output Power *	20	kw
Pulse Output Voltage *	4.0	kv

\# Pulse duration, pulse plate current and duty are interrelated; see Derating Chart.
* Approximate value.

VA4988(Effective May 1988)

Printed in U.S.A.

PULSED RADIO FREQUENCY AMPLIFIER
CATHODE DRIVEN Class AB2 - DRIVE PULSED

ABSOLUTE MAXIMUM RATINGS (to 500 MHz):

DC PLATE VOLTAGE	3500	VOLTS
PLATE CURRENT (average)	0.6	AMPERE
PEAK PLATE CURRENT #	2.5	AMPERES
PLATE DISSIPATION (average)	800	WATTS
GRID CURRENT (average)	0.06	AMPERE
GRID DISSIPATION (average)	4.0	WATTS

* Approximate value, see VHF OPERATION
\# Average during the pulse.
\## Measured at the load.

TYPICAL OPERATION - Calculated Data
Class AB2 Cathode Driven - Du = 0.01

Plate Voltage	3500	Vdc
Cathode Bias Voltage	+15.0	Vdc
Zero-Signal Plate Current	20	mAdc
Pulse Plate Current #	2.5	Adc
Pulse Power Input #	8.75	kw
Pulse Grid Current * #	105	mAdc
Peak rf Cathode Voltage *	130	v
Peak Driving Power * #	320	w
Peak (Useful) Power Output # ##	6.0	kw
Cathode Input Impedance	30	Ohms
Resonant Plate Load Impedance	660	Ohms

TYPICAL OPERATION values are obtained by actual measurement or by calculation from published characteristic curves. Adjustment of the rf drive 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 grid/cathode voltage in the presence of the current variation.

A P P L I C A T I O N

MECHANICAL

MOUNTING & SOCKETING - The tube may be mounted in any position. If operated inverted (anode down) or horizontally the SK-1916 clamp assembly should be used in conjunction with the SK-1906 chimney for reliable retention. The SK- 1906 chimney is provided with four 4-40 tapped holes at one end for chassis mounting and four more 4-40 tapped holes at the other end for optional SK-1916 mounting. The combination of the SK-1906 air chimney with the optional SK-1916 clamp makes a rigid mounting assembly for the tube. Outline drawings of the SK-1906 and the SK-1916 are shown in Fig.1.

COOLING - Forced-air cooling must be provided to maintain the anode core and seal temperatures at a safe operating temperature. Cooling data are shown for incoming cooling air at 25°C and 50°C, and represent the minimum requirements to limit tube temperatures to 225°C. The pressure drop figures are approximate and are for the mounting-plate (shown in Fig. 1), socket, tube and chimney combination as would be the case with pressurized-compartment mounting where air is required to pass through the chassis slots and and through the air chimney to reach the anode cooler.

Some air from the pressurized compartment passes by the socket for base cooling. This mounting technique is effective in the HF region but rf leakage through the slots may cause amplifier instability or degeneration in the VHF region. Screening the holes or use of "wave-guide-beyond-cutoff" (honeycomb) air vents may be required in the VHF region.

Cooling must be applied before or simultaneously with electrode voltages, including the heater, and may be removed simultaneously with them. In all cases temperature of the anode and the ceramic/metal seals is the limiting factor, and the designer is encouraged to use temperature-sensitive paint or other temperature sensing devices in connection with any equipment design before the layout is finalized. It should also be noted that it is not good practice to operate at, or close to, the absolute maximum temperature rating for the metal/ceramic seals. Where long life and consistent performance are factors cooling in excess of minimum requirements is normally beneficial.

Cooling Air at 25°C

	SEA LEVEL		5000 FEET	
Anode Diss. W	Flow Rate cfm	Press. Drop In.Water	Flow Rate cfm	Press. Drop In.Water
400	6	0.09	7	0.10
600	11	0.20	14	0.23
800	19	0.50	23	0.57

Cooling Air at 50°C

	SEA LEVEL		5000 FEET	
Anode Diss. W	Flow Rate cfm	Press. Drop In.Water	Flow Rate cfm	Press. Drop In.Water
400	8	0.10	10	0.12
600	16	0.31	19	0.35
800	27	0.79	33	0.88

ELECTRICAL

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 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.

HIGH VOLTAGE - Normal operating voltages used with this tube are deadly. Equipment must be designed properly and operating precautions must be followed. Design equipment so that no one can come in contact with high voltages. Equipment must include safety enclosures for the 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. The interlock switches must not be bypassed or "cheated" to allow operation with access doors open. Remember HIGH VOLTAGE CAN KILL.

For pulse modulator or regulator service anode voltage should not exceed 4.5 kVdc at sea level. This value assumes some safety factor and assumes a clean tube with no buildup of dirt or grime across the insulating ceramic. At higher altitudes a reduction in voltage may be required to preclude the possibility of external tube flashover.

HEATER/CATHODE OPERATION - Rated heater voltage for the 3CPX800A7 is 13.5 volts, as measured at the base of the tube, and short-term variations should be limited to plus/minus 0.6 volt for good life and consistent performance.

Pulse current capability of the 3CPX800A7 is dependent on cathode temperature, which in turn is dependent on heater voltage. For most consistent performance in switch tube or modulator service regulation of the heater voltage to limit variation to plus/minus one percent is recommended. Heater voltage should be measured with a known accurate RMS-responding meter.

The maximum heater-cathode voltage for the tube is 150 volts. Any applications which use the tube as a cathode follower or place the load between the cathode and ground may require that the heater voltage supply be insulated from ground by a voltage equal to the plate voltage plus an additional voltage if inductance is present in the load.

CATHODE WARMUP TIME - It is recommended that heater voltage be applied for a minimum of three minutes before anode voltage and/or rf drive voltage are applied, to allow for proper conditioning of the cathode surface.

INPUT CIRCUIT - When this tube is operated as a grounded-grid rf amplifier, the use of a resonant tank in the cathode circuit is recommended to obtain greatest linearity and power output. For best results with a single-ended amplifier it is suggested that the cathode tank circuit operate at a "Q" of two or more.

GRID OPERATION - The maximum rated dc grid bias voltage for the tube is -150 volts and the maximum grid dissipation is 4 watts. In normal applications the grid dissipation will not approach the maximum rating. In applications where pulse duration exceeds 100 Ms or duty factors are high, the electrode dissipation ratings may prevent attaining peak plate current substantially over the dc rating. A protective spark gap, such as a Siemens #B1-C75, should be connected between the cathode and grid to provide protection in the event of an internal tube arc.

ANODE CURRENT - For pulse service, either as a switch tube pulse modulator or voltage regulator, an anode current (during the pulse) of up to 8 amperes is available. Peak current capability, pulse duration, and duty factors are interrelated and the PULSE DERATING DATA on page 5 should be consulted. To use this chart, enter with pulse duration and note the intersection with desired pulse plate current. At this intersection read off values of maximum duty and/or pulse repetition rate.

The pulse derating chart is intended to allow selection of operating parameters which give a reasonable tube life. Operating under experimental combinations of maximum plate current and pulse duration which are outside the ranges of the chart may give useful results at low repetition rates, with a resulting tube life commensurate with that type of operation.

PLATE OPERATION - The anode of the 3CPX800A7 is nominally rated for 800 watts with forced-air cooling. In pulse service the average anode dissipation may be calculated as the product of pulse anode current, pulse tube-voltage drop during conduction, and the duty factor. Actual dissipation may often exceed the calculated value, if pulse rise and fall times are appreciable compared to pulse duration. This occurs because long rise and fall times allow plate current to flow for longer periods in the high tube-voltage drop region.

FAULT PROTECTION - All power tubes operate at voltages which can cause severe damage in the event of an arc, especially in cases where large amounts of power supply stored energy are involved. Some means of protection is advised in all cases, and it is recommended that a series resistor be used in the lead from the power supply to the anode circuit to limit peak current and help dissipate the energy in the event of a tube or circuit arc. A resistance of 10 to 50 ohms, depending on allowable voltage drop, with at least a 50W rating, in the positive plate power supply lead will help protect the tube in the event of an arc. EIMAC Application Bulletin #17, titled FAULT PROTECTION, contains additional information and is available on request.

VHF OPERATION - The base pin connections to the grid may be used at frequencies to 30 MHz. Above 30 MHz the available contact collets or grid bypass capacitor assembly (see Page 1) are recommended. VHF driving power will be greater than the typical values shown on page 2 because of higher circuit losses.

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 his application. Measurements should be taken with the mounting which represents the approximate final layout if capacitance values are highly significant in the design.

RADIO-FREQUENCY RADIATION - Exposure to strong rf fields should be avoided, 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 severe injury, including blindness. CARDIAC PACEMEAKERS MAY BE EFFECTED.

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. Remember that HIGH VOLTAGE CAN KILL.

b. 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.

c. 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.

d. 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: Varian EIMAC, Power Grid Application Engineering, 301 Industrial Way, San Carlos CA 94070.

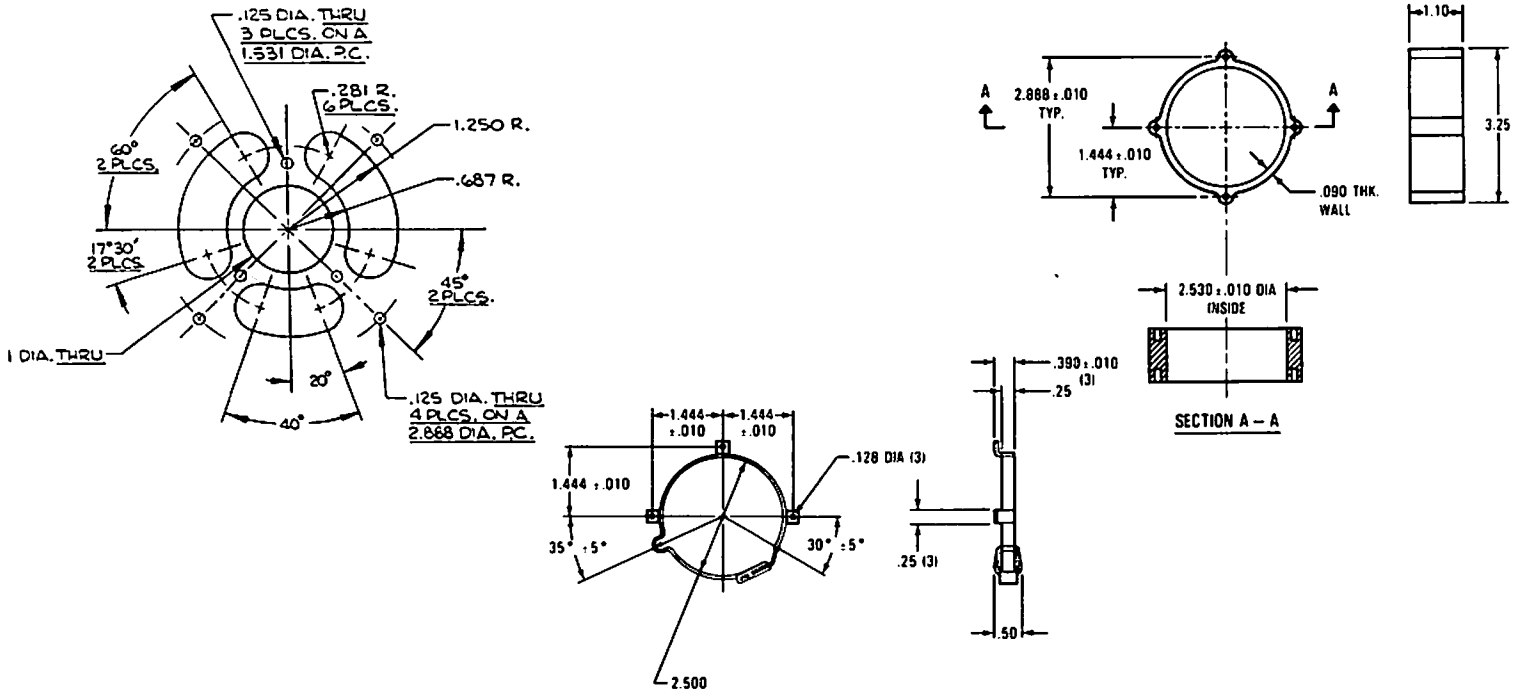


Figure 1 - Mounting Plate, Chimney SK-1906 and Clamp SK-1916, for SK-1900 Socket Assembly

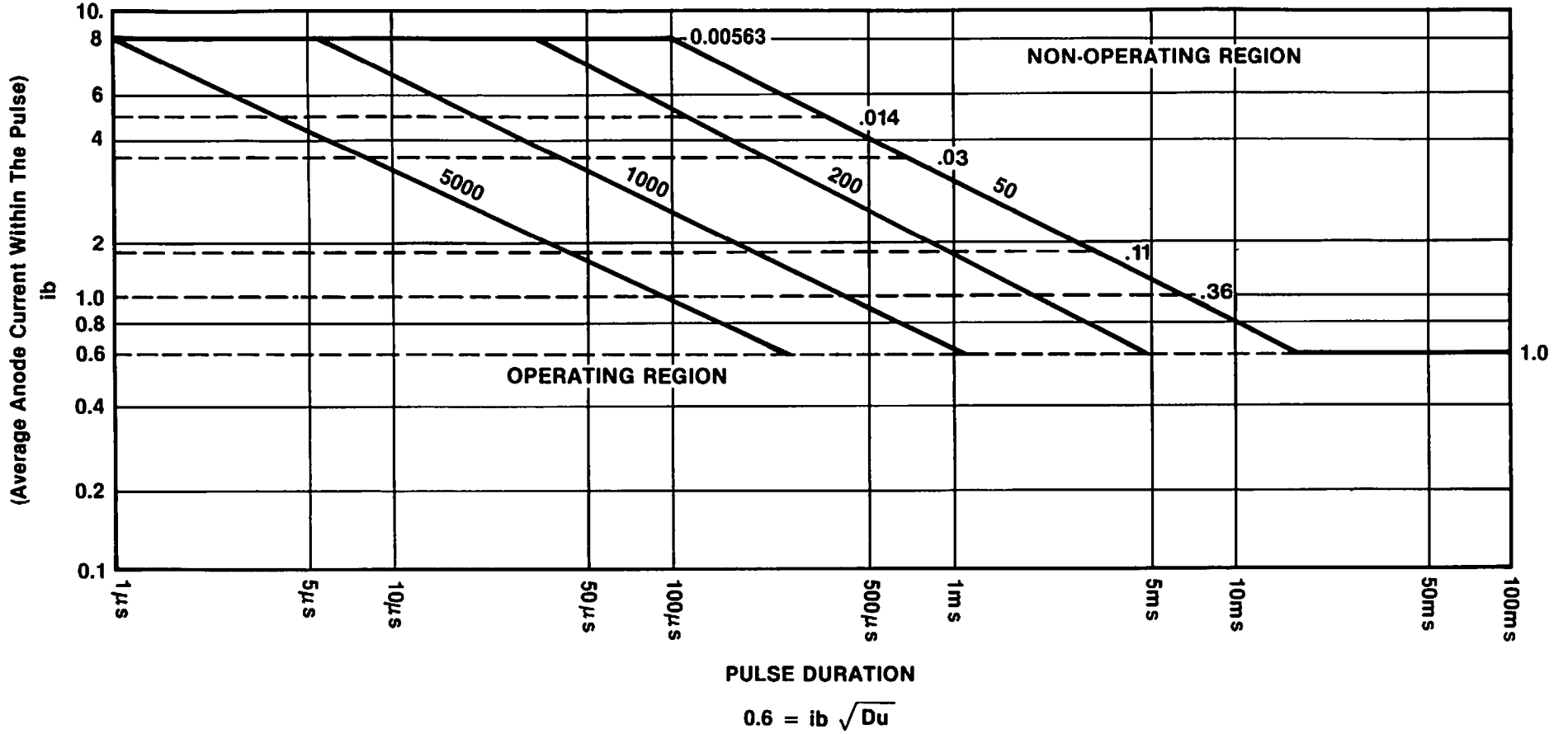


Figure 2 - Pulse Derating Chart, 3CPX800A7

Pulse Modulator or Regulator Service

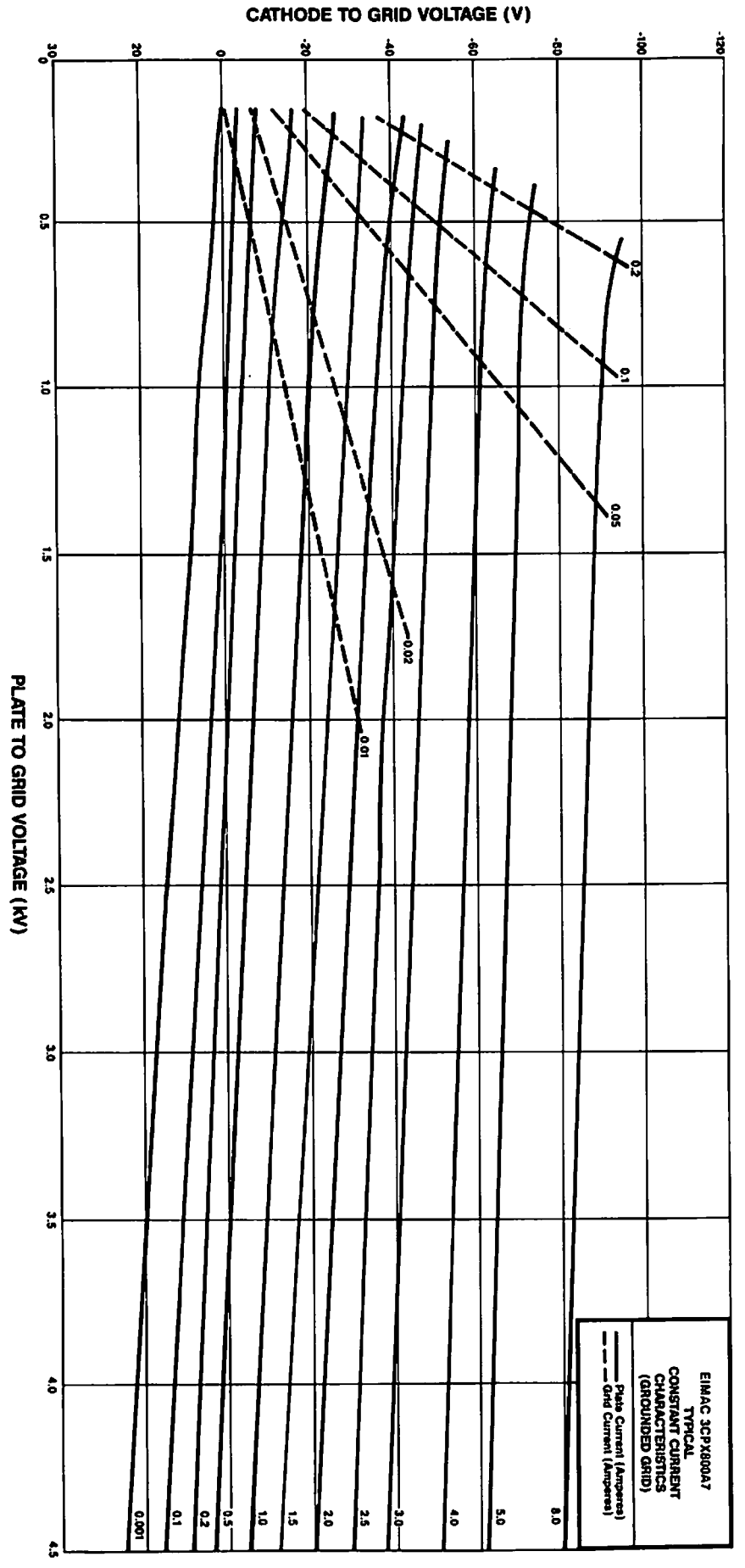
Pulse anode current (ib) capability is dependent on pulse duration (tp) and duty factor (Du). Maximum ib for a given tp is shown; maximum Du may then be derived from the relationship:

$$0.6 = ib\sqrt{Du}$$

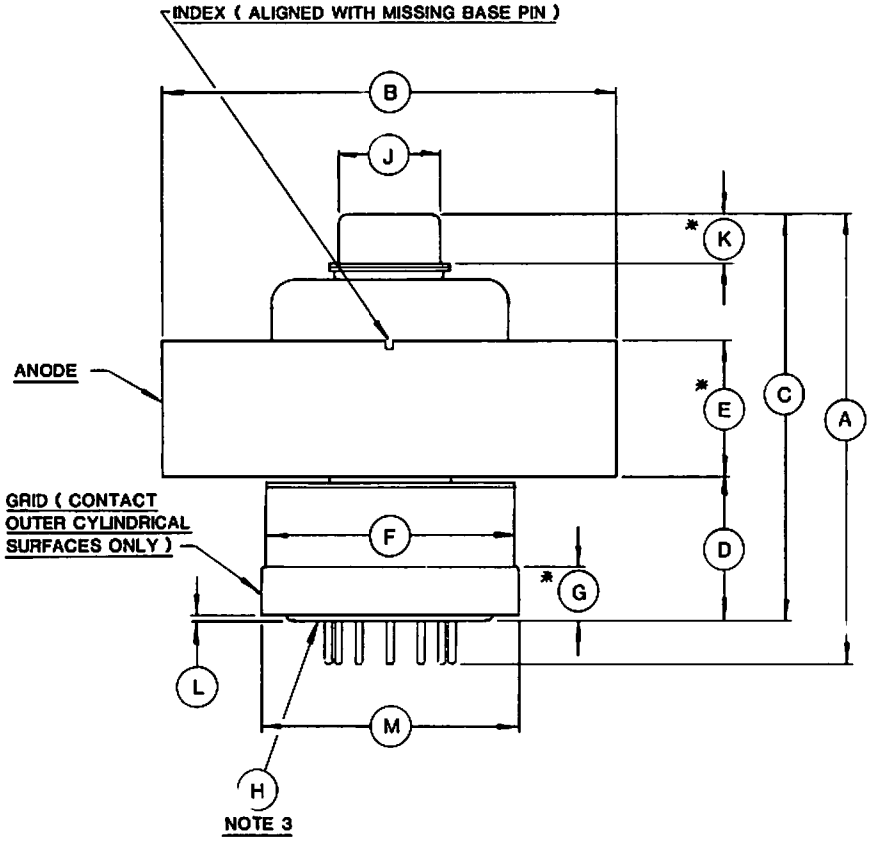
Solid lines represent constant repetition rates. Dashed lines represent constant duties.

Do not extrapolate above or to the right of the bold lines which set boundaries of maximum anode current and minimum repetition rate, respectively.

Refer to the ANODE CURRENT section on Page 3 for discussion of this chart.


CATHODE TO GRID VOLTAGE (V)
30
20
0
-20
-40
-60
-80
-100
-120
PLATE TO GRID VOLTAGE (kV)
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
0.2
0.1
0.05
0.02
0.01
EIMAC 3CPX800A7
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
(GROUNDED GRID)
Plate Current (Amperes)
Grid Current (Amperes)
8.0
5.0
4.0
3.0
2.5
2.0
1.5
1.0
0.5
0.2
0.1
0.001

DIMENSIONAL DATA						
	INCHES			MILLIMETERS		
DIM.	MIN	MAX.	REF.	MIN.	MAX	REF
A	2.340	2.633		59.44	66.88	
B	2.485	2.515		63.12	63.88	
C	2.152	2.352		54.66	59.74	
D	.786	.906		19.96	23.01	
E	.710	.790		18.03	20.07	
F		1.406			35.71	
G	.187			4.75		
H	BASE: E11-61 (JEDEC DESIGNATION)					
J	.559	.573		14.20	14.55	
K	.240			6.10		
L			.027			.69
M	1.417	1.433		35.99	36.40	



NOTES:

1. REF. DIMENSIONS ARE FOR INFO ONLY & ARE NOT REQUIRED FOR INSPECTION PURPOSES.
2. (*) CONTACT SURFACES.
3. BASE IS BASIC JEDEC EXCEPT CERAMIC WAFER IS INSIDE SHELL.

PIN No. 1 CATHODE
PIN No. 2 CATHODE
PIN No. 3 CATHODE
PIN No. 4 GRID
PIN No. 5 HEATER
PIN No. 6 HEATER
PIN No. 7 GRID
PIN No. 8 CATHODE
PIN No. 9 CATHODE
PIN No. 10 CATHODE
PIN No. 11 GRID