EIMAC
Division of Varian
SAN CARLOS
CALIFORNIA

8590
4CPX250K

RADIAL BEAM TETRODE

The EIMAC 8590/4CPX250K is a compact forced-air cooled, external anode radial beam tetrode, intended for wideband grid-pulsed radio frequency amplifier and pulse modulator service.

The 8590/4CPX250K has a maximum anode dissipation of 250 watts and is capable of delivering pulse output power in excess of 10 kW with 10 db gain when cathode driven at 450 MHz.

The tube is of coaxial construction and especially designed for cavity operation.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide Coated, Unipotential		
Heater: Voltage	6.0 ± 0.3	V
Current, at 6.0 volts	2.5	A
Amplification Factor (Average):		
Grid to Screen	5	
Direct Interelectrode Capacitances (Grounded grid)[2]		
Input	14.0	pF
Output	4.1	pF
Feedback	.006	pF
Frequency of Maximum Rating:		
CW	500	MHz
Plate or Grid-Pulsed	500	MHz

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. EIMAC Division of Varian should be consulted before using this information for final equipment design.

2. In Shielded Fixture.

MECHANICAL

Maximum Overall Dimensions:	
Length	2.81 in; 71.37 mm
Diameter	1.64 in; 41.66 mm
Net Weight	4 oz; 114 gm
Operating Position	Any

(Effective 4-1-70) Printed in U.S.A.

MECHANICAL

Maximum Operating Temperature:	
Ceramic/Metal Seals	250 °C
Anode Core	250 °C
Cooling	Forced-Air
Base	Coaxial
Socketing: EIMAC collets are available as follows:	
Heater pin connection	EIMAC Part No. 008290
Cathode connection	EIMAC Part No. 008291
Control grid connection	EIMAC Part No. 008292
Anode connection	EIMAC Part No. 008294
Screen grid connection	EIMAC Part No. 882931

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class C Telegraphy or FM Telephony
(Key-Down Conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	2500 VOLTS
DC SCREEN VOLTAGE	500 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	0.250 AMPERE
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

Plate Voltage	1000	1500	2000	2500	Vdc
Screen Voltage	250	250	250	250	Vdc
Grid Voltage	-90	-90	-90	-90	Vdc
Plate Current	250	250	250	250	mAdc
Screen Current [1]	38	21	19	16	mAdc
Grid Current [1]	31	28	26	25	mAdc
Peak rf Grid Voltage [1]	114	112	112	111	v
Calculated Driving Power [1]	3.5	3.2	2.9	2.8	W
Plate Input Power	250	375	500	625	W
Plate Output Power	190	280	390	500	W

1. Approximate value.

PULSE MODULATOR SERVICE

MAXIMUM RATINGS

DC PLATE VOLTAGE	7000 VOLTS
DC SCREEN VOLTAGE	750 VOLTS
DC GRID VOLTAGE	-400 VOLTS
PEAK PLATE CURRENT	6.0 AMPERES
PULSE DURATION	(See Derating Chart)
DUTY FACTOR	(See Derating Chart)
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

Plate Voltage	6000	Vdc
Screen Voltage	750	Vdc
Grid Voltage	-275	Vdc
Peak Drive Voltage [1]	280	v
Peak Plate Current	3.5	a
Peak Screen Current [1]	0.4	a
Peak Input Power	21.0	kW
Peak Output Power	17.5	kW
Peak Output Voltage	5000	kv
Pulse Duration	250	μs
Duty Factor	0.005	

1. Approximate value .

RF POWER AMPLIFIER

Class B or C, Grid and Screen Pulsed

MAXIMUM RATINGS

DC PLATE VOLTAGE	5500	VOLTS
PEAK DC SCREEN VOLTAGE	1000	VOLTS
DC GRID VOLTAGE	-250	VOLTS
PEAK PLATE CURRENT[1]	6.0	AMPERES
PULSE DURATION	(See Derating Chart)	
DUTY FACTOR	(See Derating Chart)	
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

1. Peak anode current may be considered as average during the pulse and should be limited to 6.0 amperes. With a pulse length longer than 80 μs, or a duty factor higher than 0.0016, peak current should be reduced in accordance with the data shown on the Derating Chart for Anode Current. For longer pulse duration or larger duty factor, consult EIMAC Division of Varian.

TYPICAL OPERATION (Frequencies to 500 MHz)
Class B, Grounded Grid (Measured Values)

Plate Voltage	5500	Vdc
Screen Voltage (Pulsed)	1000	v
Grid Voltage	-200	Vdc
Peak Grid Voltage[2]	255	v
Peak Driving Power[2]	1000	w
Peak Output Power (Useful)	10	kW
Pulse Duration	250	μs
Duty Factor	0.005	

2. Approximate value .

NOTE: TYPICAL OPERATION data are obtained by calculation from published characteristic curves. Adjustment of the rf grid voltage to obtain the specified plate current at the specified bias, screen and plate voltages is assumed. If this procedure is followed, there will be little variation in output power when the tube is changed, even though there may be some variation in grid and screen current. The grid and screen currents which result when the desired plate current is obtained are incidental and vary from tube to tube. These current variations cause no difficulty so long as the circuit maintains the correct voltage in the presence of the variations in current. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to obtain the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater: Current at 6.0 volts	2.3	3.0	A
Cathode Warmup Time	30	---	sec.
Interelectrode Capacitances[1] (Grounded Grid Connection)			
Input	12.0	16.0	pF
Output	3.90	4.35	pF
Feedback	---	0.01	pF

1. Capacitance values are for a cold tube as measured in a shielded fixture.

APPLICATION

MOUNTING - The 8590/4CPX250K may be mounted in any position. The concentric arrangement of the electrode terminals permits the use of the tube in coaxial line or cavity-type circuits to advantage. Connections to the contact surfaces should be made by means of spring finger collets which have sufficient pressure to maintain a good electrical contact at all fingers. Points of electrical contact should be kept clean and free of oxidation to minimize rf losses.

HEATER - The rated heater voltage for the 8590/4CPX250K is 6.0 volts, as measured at the base of the tube, and variations should be restricted to plus or minus 0.3 volt for long tube life and consistent performance. At frequencies above approximately 300 MHz under Class C Telegraphy conditions, it may be necessary to reduce heater voltage to compensate for rf transit-time heating of the cathode. This type of back-heating is a function of frequency, grid current, grid bias, anode current, duty cycle, and circuit design and adjustment. The following heater operation voltages are recommended for straight-through CW amplifier operation:

Frequency (MHz)	Heater Voltage
300 or lower	6.00
301 to 400	5.75
401 to 500	5.50

COOLING - Sufficient forced-air cooling must be provided to maintain the anode core and seal temperatures within maximum ratings. Special care must be observed to insure that there is adequate cooling in the area of the coaxial filament and grid terminals. With an anode dissipation of 250 watts and an incoming air temperature of 50°C at sea level, a minimum air flow of 4.8 cfm must be passed through the anode cooler, with a resultant pressure drop of approximately 0.25 inch of water. Air should normally be directed in a base-to-anode direction in order to minimize base cooling problems. In cases where long life and consistent performance are factors, cooling in excess of minimum requirements is normally beneficial. Air flow should be applied before or simultaneously with the application of electrode voltages (including heater voltage), and may be removed simultaneously with them.

CATHODE WARMUP TIME - Heater voltage should be applied for a minimum of 30 seconds before the application of other electrode voltages to allow proper conditioning of the cathode surface.

CATHODE OPERATION - The oxide-coated unipotential cathode must be protected against excessively high emission current. The DERATING CHART FOR ANODE CURRENT shows the current capability of the 8590/4CPX250K anode at various pulse durations and duty factors. To use this chart, enter with pulse duration and note the intersection with the desired peak anode current. At this intersection read off the values of maximum duty and/or pulse repetition rate.

Under a given set of operating conditions, element dissipation may limit the maximum permissible duty to a smaller value than anode current considerations alone would dictate. It will usually be found that screen grid dissipation is the limiting factor with large plate voltage swings and that plate dissipation limits the maximum duty with small plate voltage swings.

CONTROL GRID OPERATION - The average power dissipated by the control grid must not exceed two watts. The control grid dissipation can be computed as the product of average grid current, and peak positive grid to cathode voltage.

SCREEN GRID OPERATION - The average power dissipated by the screen grid must not exceed twelve watts. Screen grid dissipation is the product of dc screen voltage, average screen current during the pulse, and duty factor.

The screen grid current may reverse under certain operating conditions and produce negative current indications on the screen milliammeter. This is a normal characteristic of most tetrodes. The screen grid power supply should be designed with this characteristic in mind so that the correct operating voltage will be maintained on the screen grid under all conditions. A current path from screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator, or an electron tube shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per tube. A series pass tube regulated power supply can be used only when an adequate bleeder resistor is provided. Protection for the screen grid should be provided by an over-current relay and by interlocking the screen supply so that plate voltage must be applied before screen voltage can be applied.

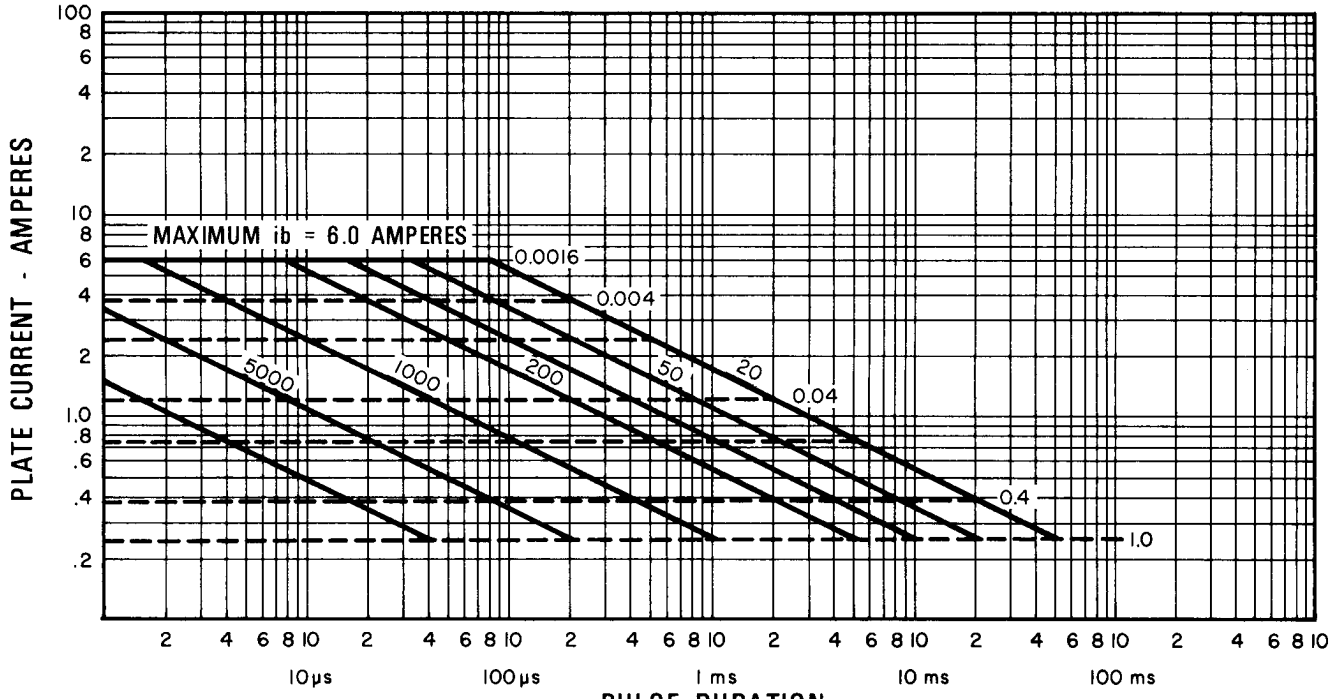
PULSE MODULATOR PLATE OPERATION - Average plate dissipation may be calculated as the product of average plate current during the pulse, minimum anode voltage, and duty factor. Excessive average dissipation is likely to occur with high values of minimum anode voltage. The calculated value of plate dissipation may well be below 250 watts based on a rectangular pulse but excessive dissipation will result if pulse rise and fall times slow down the plate voltage swing and allow plate current to flow for longer periods in the high anode voltage region.

UHF OPERATION - Such operation should be conducted with heavy plate loading, minimum bias, and the lowest driving power consistent with satisfactory performance. It is often preferable to operate at a sacrifice in efficiency to obtain increased tube life.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide individual metering and individual adjustments of bias and/or screen grid voltage to equalize the plate currents. Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that any tube fails.

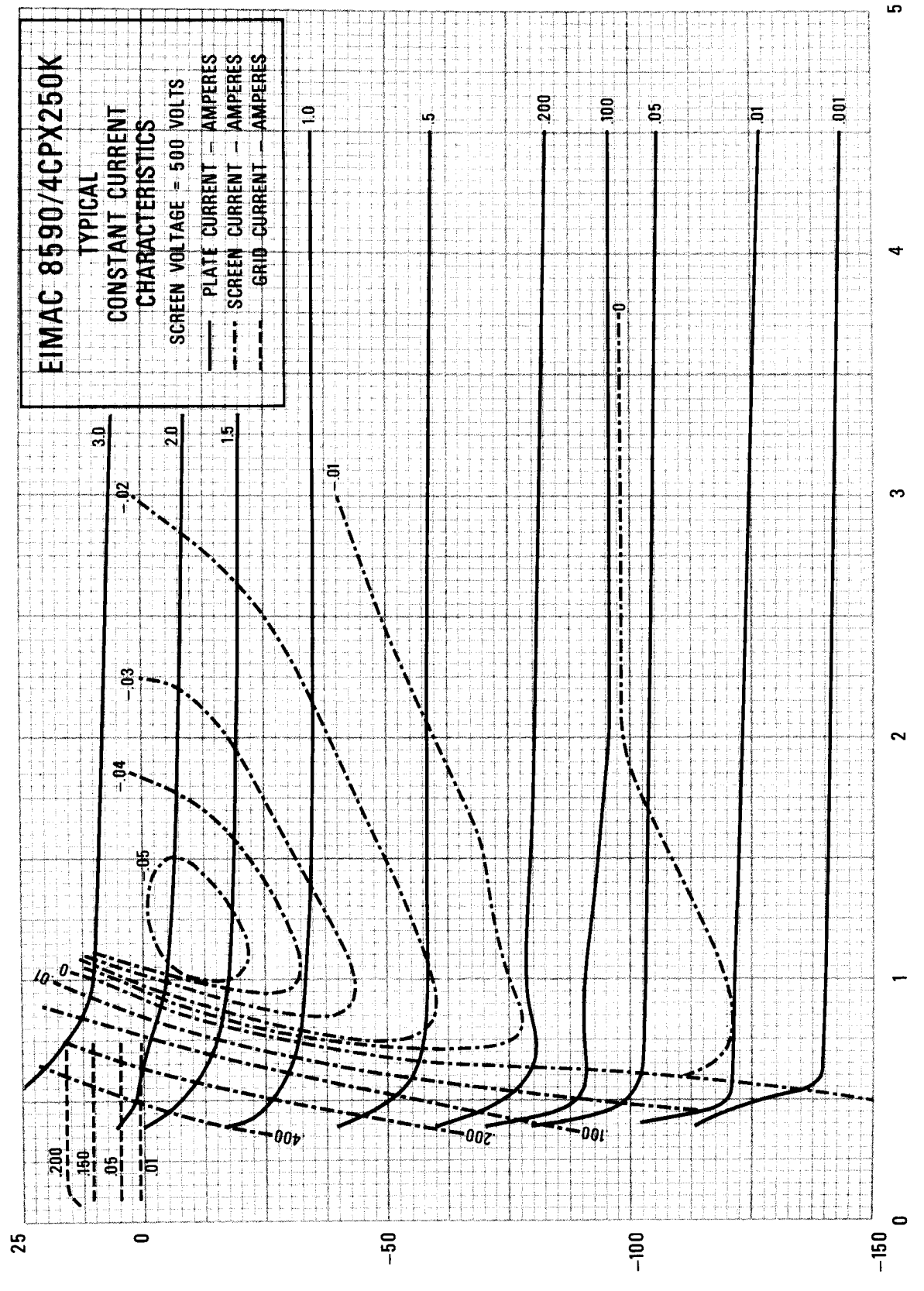
SPECIAL APPLICATION

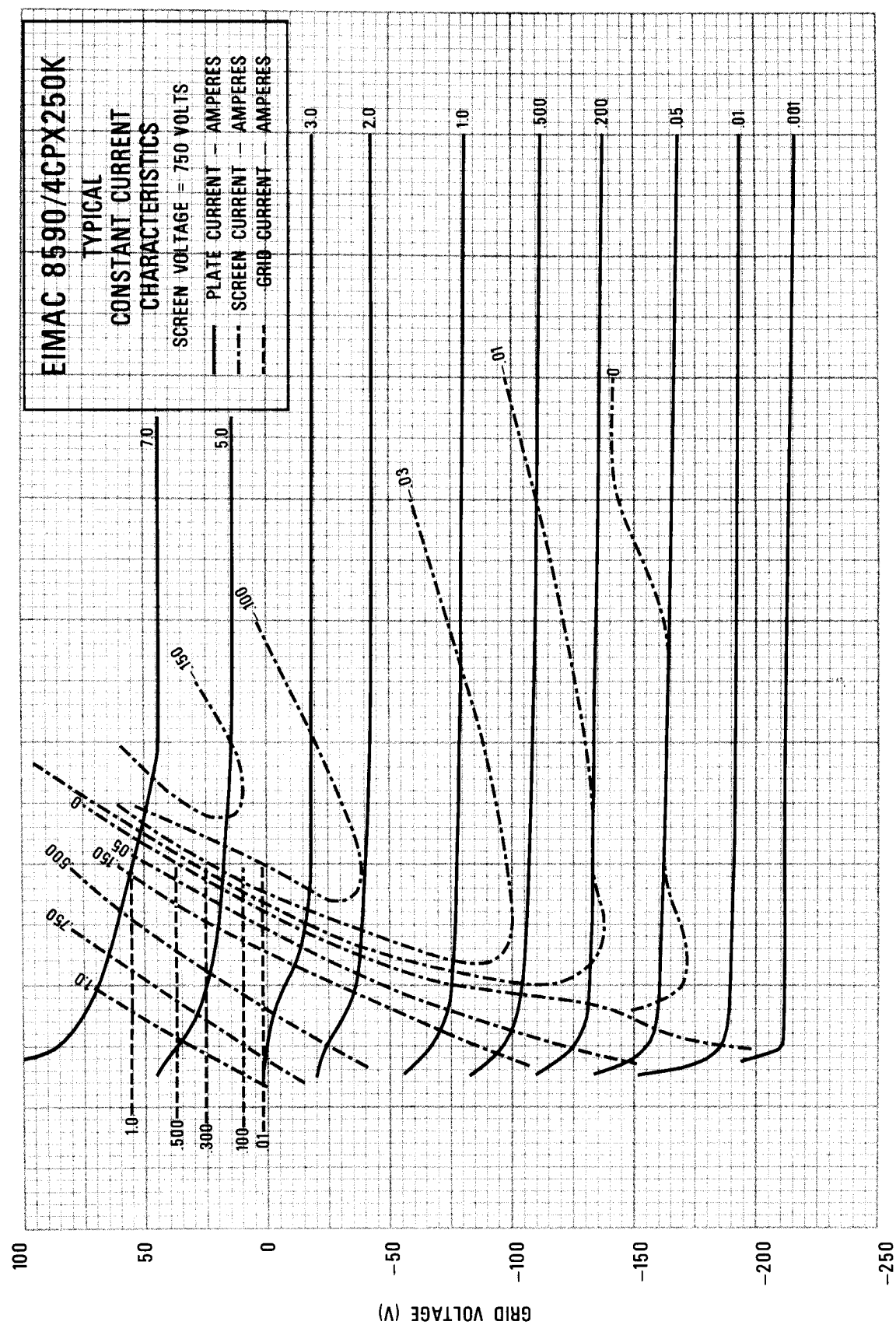
If it is desired to operate this tube under conditions widely different from those listed here, write to Power Grid Tube Division, EIMAC Division of Varian, 301 Industrial Way, San Carlos, California 94070, for information and recommendations.



TYPE 8590/4CPX250K – DERATING CHART FOR ANODE CURRENT
(AVERAGE DURING PULSE)

SOLID LINES REPRESENT CONSTANT REPETITION RATES
DASHED LINES REPRESENT CONSTANT DUTIES
DO NOT EXTRAPOLATE ABOVE OR TO THE RIGHT OF BOLD LINES


EIMAC 8590/4CPX250K
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 500 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
CURVE #3539


EIMAC 8590/4CPX250K
TYPICAL
CONSTANT CURRENT
CHARACTERISTICS
SCREEN VOLTAGE = 750 VOLTS
PLATE CURRENT – AMPERES
SCREEN CURRENT – AMPERES
GRID CURRENT – AMPERES
GRID VOLTAGE (V)
PLATE VOLTAGE (KV)
CURVE #3540

DIMENSIONAL DATA				
DIM.	INCHES		MILLIMETERS	
	MIN.	MAX.	MIN.	MAX.
A	—	2.813	—	71.45
B	1.615	1.640	41.02	41.66
C	—	1.406	—	35.71
D	1.415	1.435	35.94	36.45
E	0.588	0.597	14.94	15.16
F	0.318	0.325	8.08	8.26
G	0.091	0.095	2.31	2.41
J	0.585	0.665	14.86	16.89
K	0.900	0.950	22.86	24.13
L	0.187	—	4.75	—
M	0.520	0.560	13.21	14.22
N	0.235	0.265	5.97	6.73
P	0.032	0.082	0.83	2.08
R	—	0.040	—	0.102
S	—	0.171	—	0.434
T	0.388	—	9.86	—
U	0.406	—	10.31	—
V	0.468	—	11.89	—
W	0.559	0.573	14.20	14.55
X	0.240	—	6.10	—

NOTES:

1. * INDICATES CONTACT SURFACE.
2. THE TUBE WILL BE ROTATED ON DIAMETER D WHEN ECCENTRICITY IS BEING MEASURED.
3. SURFACE Y MUST BE PERPENDICULAR TO THE MEASURING PLATFORM WHEN ECCENTRICITY IS BEING MEASURED.
4. AVERAGE DIAMETER OF E SHALL BE AS NOTED, & MAY BE OUT OF ROUND A TOTAL OF 0.006 (0.15 mm). AVERAGE DIAMETER OF F SHALL BE AS NOTED, AND MAY BE OUT OF ROUND A TOTAL OF 0.006 (0.15 mm).