TECHNICAL DATA

7580W
4CX250R

RADIAL-BEAM POWER TETRODE

The EIMAC 7580W/4CX250R is a compact, high-perveance radial-beam tetrode of ceramic/metal construction, rated for 250 watts anode dissipation with forced-air cooling. The maximum input power rating of 500 watts applies to 500 MHz.

The 7580W/4CX250R is intended for applications where significant shock and/or vibration preclude the use of other non-rugged tubes in this family of small tetrodes.

It can be used to replace the 4CX250B in equipment where the range of bias adjustment will tolerate the higher perveance and where tuning range can compensate for the small differences in input and output capacitance.

Special air-system sockets, with an integral screen grid bypass capacitor, and a special clamping-type air chimney, are available for use where severe environmental conditions are expected.

GENERAL CHARACTERISTICS [1]

ELECTRICAL

Cathode: Oxide-Coated Unipotential

Heater Voltage	6.0 ± 0.3	V
Heater Current at 6.0 volts (nominal)	2.6	A
Cathode-Heater Potential, maximum	±150	V
Warmup Time, before application of high voltage (minimum)	30	Sec
Amplification Factor, grid to screen (average)	5	
Frequency of Maximum Rating (CW)	500	MHz

Direct Interelectrode Capacitances (grounded cathode) [2]

Cin	17.3	pF
Cout	4.7	pF
Cgp	0.04	pF

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	2.46 In; 62.5 mm
Diameter	1.64 In; 41.7 mm
Net Weight	4 Oz; 113 gms
Operating Position	Any

393200 (Effective 15 Sept 82; supersedes 16 June 61)
VA4563

Printed in U.S.A.

Cooling	Forced Air
Base	Special 9-pin EIA B8-236
Maximum Operating Temperature, ceramic/metal seals or anode core	250°C
Recommended General Purpose Air-System Socket (includes integral screen grid bypass capacitor)	EIMAC SK-600A or SK-610A
Recommended General Purpose Air Chimney, for use with SK-600A or SK-610A socket	EIMAC SK-606
Recommended Air-System Socket for environmental applications (includes integral screen grid bypass capacitor)	EIMAC SK-620A or SK-630A
Recommended General Purpose Air Chimney, for use with SK-620A or SK-630A	EIMAC SK-626
Recommended Clamping Type Air Chimney, for use with SK-620A or SK-630A	EIMAC SK-636B

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN (SSB)

Class AB1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	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

* May vary with installation & tube.
** Briefly, for tuneup purposes only.
\# Adjust for specified zero-signal plate current.

TYPICAL OPERATION (Frequencies to 175 MHz)
Class AB1, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	1500	2000	Vdc
Screen Voltage	350	400	Vdc
Grid Voltage #	-62	-80	Vdc
Zero-Signal Plate Current	133	70	mAdc
Single-Tone Plate Current **	385	375	mAdc
Two-Tone Plate Current *	250	245	mAdc
Single-Tone Screen Current *	-5	+3	mAdc
Two-Tone Screen Current *	-10	+1	mAdc
Peak rf Grid Driving Voltage *	56	80	v
Plate Output Power *	262	470	W
Resonant Load Impedance	2160	2840	Ohms
Intermodulation Distortion * ##			
3rd Order	-30	-23	dB
5th Order	-35	-27	dB

Referenced against one tone of a two-equal tone signal.

RADIO FREQUENCY LINEAR AMPLIFIER
GRID DRIVEN, CARRIER CONDITIONS
Class AB1

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	2000	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 (Frequencies to 175 MHz)
Class AB1, Grid Driven

Plate Voltage	1500	2000	Vdc
Screen Voltage	350	400	Vdc
Grid Bias Voltage #	-58	-76	Vdc
Carrier Plate Current	172	172	mAdc
Carrier Screen Current *	-3	-5	mAdc
Peak rf Driving Voltage *	30	39	v
Plate Output Power *	58	105	W
Plate Load Resistance	2320	3150	Ohms

* Will vary with installation and tube.
\# Adjust for specified zero-signal plate current.

AUDIO FREQUENCY POWER AMPLIFIER
OR MODULATOR
Class AB1 - Grid Driven (Sinusoidal Wave)

DC PLATE VOLTAGE	2000	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 (Two Tubes)

Plate Voltage	1500	2000	Vdc
Screen Voltage	300	350	Vdc
Grid Bias Voltage #	-48	-66	Vdc
Zero-Signal Plate Current	200	140	mAdc
Max-Signal Plate Current	490	500	mAdc
Max-Signal Screen Current *	0	+4	mAdc
Max-Signal Grid Current *	0	0	mAdc
Peak Driving Power	0	0	W
Plate/Plate Load Resistance	5920	8016	Ohms
Plate Power Output *	410	625	W

* Will vary with installation and tube.
\# Adjust for specified zero-signal plate current.

ABSOLUTE MAXIMUM RATINGS FOR OTHER CLASSES OF SERVICE

Radio Frequency Power Amplifer,
Class C Telegraphy or FM

DC PLATE VOLTAGE	2000	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.250	AMPERE
PLATE DISSIPATION	250	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

Plate Modulated Radio Frequency Amplifier,
Class C Telephony (Carrier Conditions)

DC PLATE VOLTAGE	1500	VOLTS
DC SCREEN VOLTAGE	300	VOLTS
DC GRID VOLTAGE	-250	VOLTS
DC PLATE CURRENT	0.200	AMPERE
PLATE DISSIPATION	165	WATTS
SCREEN DISSIPATION	12	WATTS
GRID DISSIPATION	2	WATTS

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.

RANGE VALUES FOR EQUIPMENT DESIGN	Min.	Max.	
Heater Current, at 6.0 volts	2.3	2.9	A
Cathode Warmup Time (before any high voltage is applied)	30	---	Sec
Interelectrode Capacitance (grounded cathode connection)[1]			
Cin	16.0	18.5	pF
Cout	4.2	5.2	pF
Cgp	---	0.06	pF
Grid Voltage Test Characteristic:			
Ef = 6.0 Vac; Eb = 2000 Vdc; Ec2 = 400 Vdc; Ec1 = adjust for Ib = 67 mAdc	-70	-100	Vdc
Screen Current Test Characteristic:			
Ef = 6.0 Vac; Eb = 1000 Vdc; Ec2 = 300 Vdc; Ec1 = adjust for Ib = 150 mAdc	-7.0	+3.0	mAdc

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

APPLICATION

MECHANICAL

MOUNTING - Operation may be in any position. In all cases an air-system socket and chimney should be used to allow for effective cooling of the base and the anode during operation. If the tube is to be mounted other than vertical with the anode up, socket SK-620A or SK-630A should be used with the chimney SK-636B for effective tube retention.

COOLING - Sufficient forced-air cooling must be provided for the anode, base seals, and body seals to maintain operating temperatures below the rated maximum values. Air requirements to maintain anode core temperature at 200°C with an inlet air temperature of 50°C are tabulated. These requirements apply when an EIMAC SK-600 series socket and chimney are used with air flow in the base-to-anode direction.

	SEA LEVEL		10,000 FEET	
Plate Diss. (watts)	Air Flow (CFM)	Approx. Press.Drop (In.Water)	Air Flow (CFM	Approx. Press.Drop (In.Water)
200	5.0	0.52	7.3	0.76
250	6.4	0.82	9.3	1.20

The blower selected for a given application must be capable of supplying the desired airflow at a back pressure equal to the value shown above plus any drop encountered in ducts and filters. The blower must be able to deliver the air at the desired altitude.

Base cooling air requirements are satisfied automatically when the tube is operated in an EIMAC SK-600 series socket and the recommended airflow rates are used. Experience has shown that if long life and reliable operation is to be obtained, the cooling airflow must be maintained during standby periods when only heater voltage is applied to the tube. The anode cooler should be inspected periodically and cleaned when necessary to remove any dirt which might interfere with effective cooling.

SHOCK AND VIBRATION - The 4CX250R incorporates a rugged type of internal construction to allow operation under environmental stress conditions. The recommended air-system socket and clamping air chimney should be used for effective retention of the tube under such conditions.

When effectively retained the tube is rated to withstand 90G of shock (11 millisecond half-sine shock wave configuration) and 10G sinusoidal vibration to 2000 Hz. Periodic testing is performed to verify environmental capability with full operating voltages applied.

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.

HEATER OPERATION - The rated heater voltage is 6.0 volts and should be maintained as closely as practical, with the value checked with a known accurate rms-responding meter. Short-time changes of plus or minus 10% will not damage the tube but variations in performance should be expected. To minimize such variations and obtain good life the voltage should be held to plus or minus 5%.

At frequencies above approximately 300 MHz transit time effects begin to influence the temperature of the cathode. The amount of driving power diverted to heating the cathode by back-bombardment will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a Class C amplifier, heater voltage should be reduced as follows: 300-400 MHz 5.75 volts; 400-500 MHz 5.50 volts

CATHODE OPERATION - The oxide coated unipotential cathode must be protected against excessively high emission currents. The maximum rated dc plate current is 200 mAdc for plate-modulated amplfier operation and 250 mAdc for all other types of operation except pulse.

The cathode is internally connected to the four even-numbered base pins and all four of the corresponding socket terminals should be used to make connection to external circuits. At radio frequencies it is important to keep the cathode leads short and direct and to use conductors with large areas to minimize the inductive reactances in series with the cathode leads.

GRID OPERATION - The maximum control grid dissipation is 2.0 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 cathode to guard against excessive voltage.

At operating frequencies above the 100 MHz region driving power requirements for amplifiers increase noticeably. At 500 MHz as much as 20 watts of driving power may have to be supplied. However, most of the driving power is absorbed in circuit losses other than grid dissipation, so that grid dissipation is increased only slightly. Satisfactory 500 MHz operation of the tube in a stable amplifier is indicated by grid current values below approximately 15 mAdc.

The grid voltage required by different tubes may vary between limits approximately 20% above and below the center (mean) value, and means should be provided in the equipment to accommodate such variation. It is especially important that variations between individual tubes be compensated when tubes are operated in parallel or push-pull circuits, to assure equal load sharing.

SCREEN OPERATION - The maximum screen grid dissipation is 12 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.

Self-modulation of the screen in plate-modulated tetrode amplifiers using these tubes may not be satisfactory because of the screen-voltage screen-current characteristics. Screen modulation from a tertiary winding on the modulation transformer will usually be satisfactory. Screen voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250R.

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

UHF OPERATION - This tube is useful in the UHF region. Operation at these frequencies 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 to obtain increased life.

MULTIPLE OPERATION - Tubes operating in parallel or push-pull must share the load equally. It is good engineering practice to provide for individual metering and individual adjustment of the bias or screen voltage to equalize inputs. Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event one tube should fail.

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 10 to 25 ohms in the positive plate power supply lead, together with a protective spark gap such as the Siemens #B1-C145 connected between cathode and grid, will help protect the tube in the event of an internal arc. A maximum of four (4) joules total energy may be permitted to dissipate into an internal grid-to-cathode arc. Amounts in excess of this will permanently damage the cathode or the grid structure. Additional information is found in EIMAC Application Bulletin #17 "FAULT PROTECTION". Copies are available on request.

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 severe bodily injury, including blindness. **CARDIAC PACEMEAKERS MAY BE AFFECTED.**

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.**

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.

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.

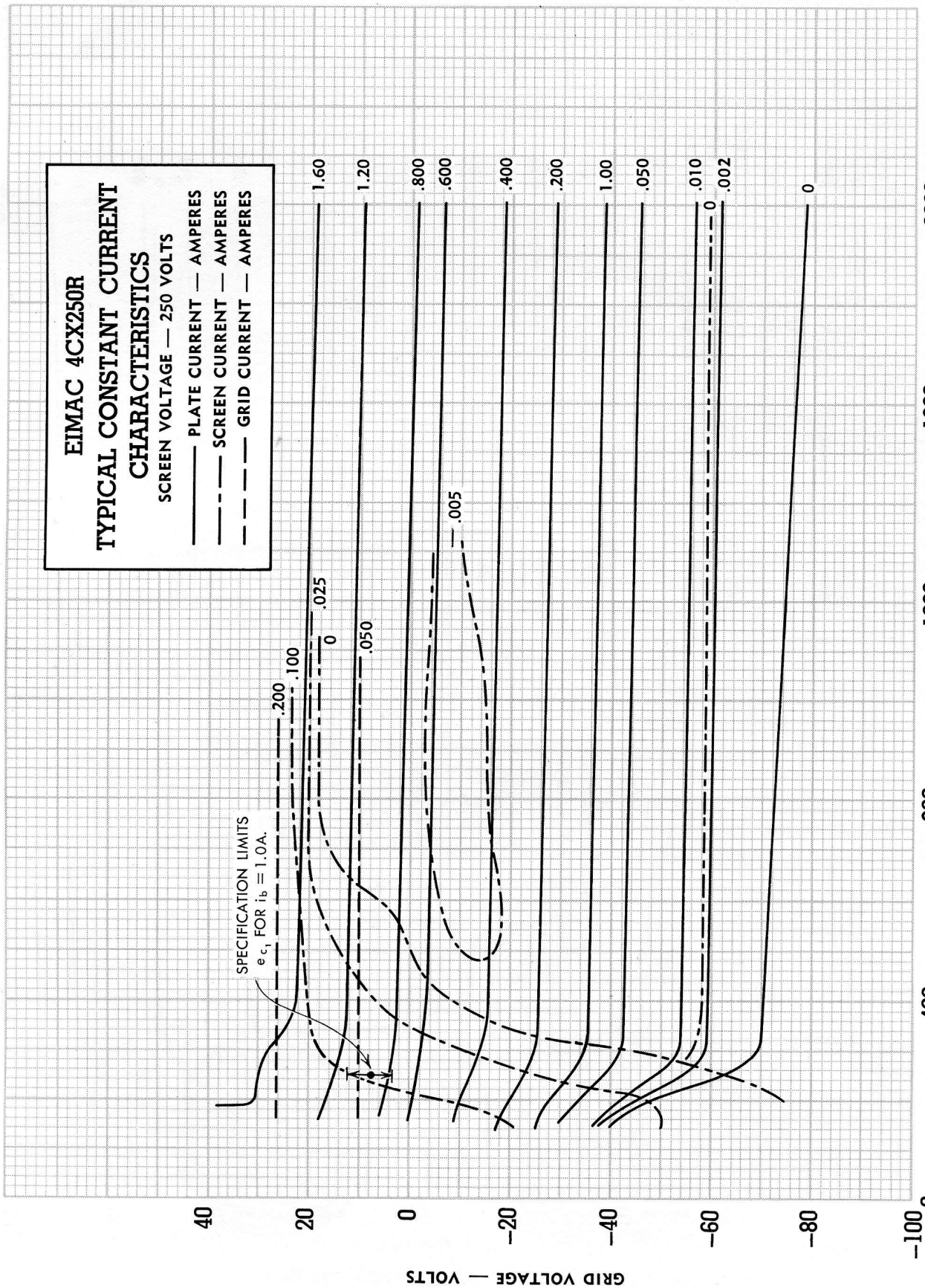
The operation of this tube may involve the following hazards, any one of which, in the absence of safe operating practices and precautions, could result in serious harm to personnel:

a. HIGH VOLTAGE - Normal operating voltages can be deadly.

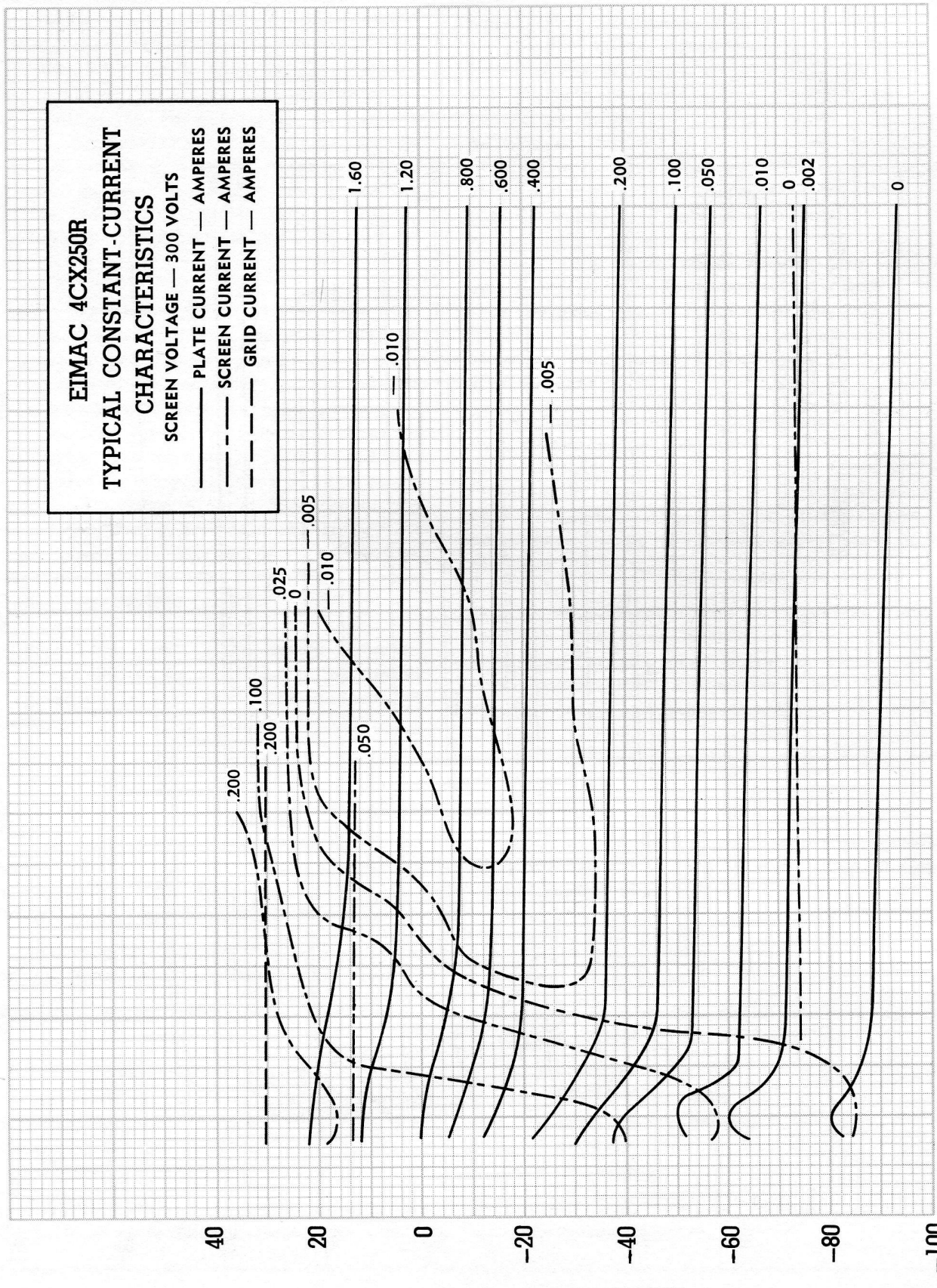
b. RF RADIATION - Exposure to strong rf fields should be avoided, even at relatively low frequencies. The dangers of rf radiation are more severe at UHF and microwave frequencies.

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.

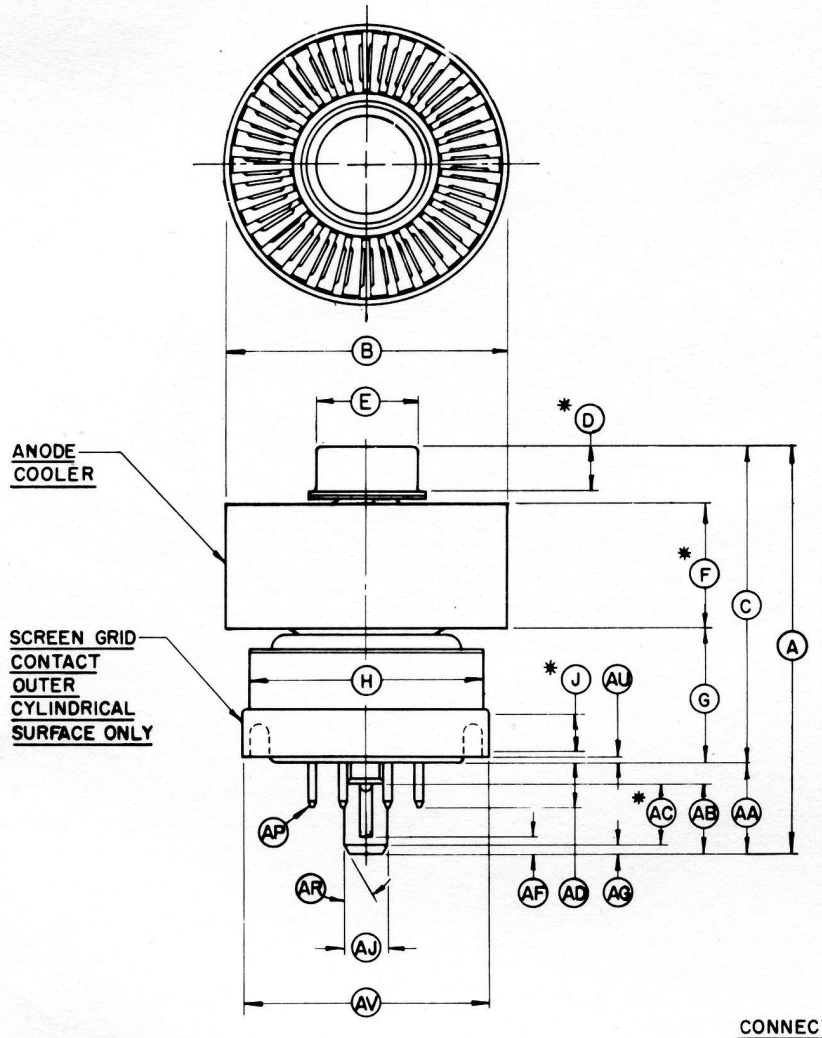
Please review the detailed operating hazards sheet enclosed with each tube, or request a copy from: VARIAN EIMAC, Power Grid Tube Division, 301 Industrial Way, San Carlos CA 94070.

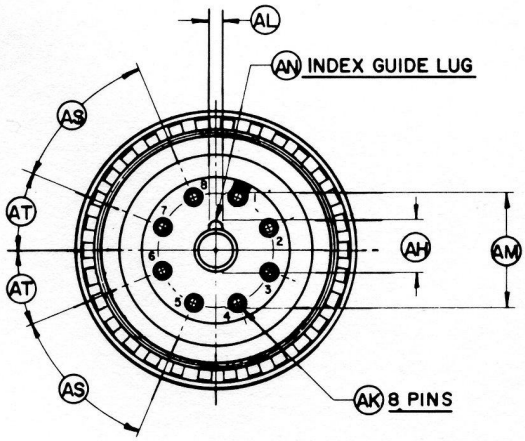

EIMAC 4CX250R
TYPICAL CONSTANT CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 250 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
SPECIFICATION LIMITS
e_{c_1} FOR i_b = 1.0A.
1.60
1.20
.800
.600
.400
.200
1.00
.050
.010
.002
0
.005
.200
.100
.025
0
.050
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS
40
20
0
−20
−40
−60
−80
−100
0
400
800
1200
1600
2000

EIMAC 7580


EIMAC 4CX250R
TYPICAL CONSTANT-CURRENT CHARACTERISTICS
SCREEN VOLTAGE — 300 VOLTS
PLATE CURRENT — AMPERES
SCREEN CURRENT — AMPERES
GRID CURRENT — AMPERES
1.60
1.20
.800
.600
.400
.200
.100
.050
.010
0
.002
.200
.100
.200
.025
0
.005
.010
.050
.005
.010
40
20
0
-20
-40
-60
-80
-100
0
400
800
1200
1600
2000
GRID VOLTAGE — VOLTS
PLATE VOLTAGE — VOLTS

DIMENSION DATA		
REF.	MIN.	MAX.
A	2.324	2.464
B	1.610 DIA.	1.640 DIA.
C	1.810	1.910
D	.240	.280
E	.559 DIA.	.573 DIA.
F	.710	.790
G	.750	.810
H		1.406 DIA.
J	.187	
AA	.514	.554
AB		.456
AC	.360	
AD		.250
AF	.068	.108
AG	.031 NOM.	
AH	.298	.308
AJ	.255 DIA.	.265 DIA.
AK	.045 DIA.	.053 DIA.
AL	.078	.086
AM	.680 DIA.	.694 DIA.
AN		.043 R.
AP	.005 R. MIN. OR	
	.035 X 22.5°	
AR	30° NOM.	
AS	45° NOM.	
AT	22.5° NOM.	
AU	.080 NOM.	
AV	1.417 DIA.	1.433 DIA.





CONNECTIONS

PIN NO. 1 : SCREEN GRID
PIN NO. 2: CATHODE
PIN NO. 3: HEATER
PIN NO. 4: CATHODE
PIN NO. 5: DO NOT USE FOR EXTERNAL CONN.
PIN NO. 6: CATHODE
PIN NO. 7: HEATER
PIN NO. 8: CATHODE
CENTER PIN : CONTROL GRID

NOTES:
1. DIMENSIONS IN INCHES.
2. CONTACT SURFACE (*)