



E I M A C
Division of Varian
SAN CARLOS
CALIFORNIA

**8245
4CX250K**

**8246
4CX250M**

**RADIAL-BEAM
POWER TETRODE**

The 8245/4CX250K and 8246/4CX250M are compact, forced-air cooled, external-anode radial-beam tetrodes with a maximum plate dissipation rating of 250 watts and a maximum input-power rating of 500 watts. The 8245/4CX250K is designed to operate with a heater voltage of 6.0 volts, while the 8246/4CX-250M is designed for operation at a heater voltage of 26.5 volts. Otherwise, the two tube types have identical characteristics.

These tubes are of coaxial construction and are especially designed for cavity operation.

GENERAL CHARACTERISTICS

ELECTRICAL

	Min.	Nom.	Max.	
Cathode: Oxide-Coated, Unipotential				
Heating Time	30	60		s
Cathode-to-heater Potential			±150	V
Heater: Voltage 4CX250K		6.0		V
Current 4CX250K	2.30		3.0	A
Voltage 4CX250M		26.5		V
Current 4CX250M	0.35		0.68	A
Amplification Factor (Grid-to-Screen)		5		
Direct Interelectrode Capacitances, Grounded Cathode:				
Input	25.0		29.0	pF
Output	4.2		5.2	pF
Feedback			0.05	pF
Direct Interelectrode Capacitances, Grounded Grid and Screen				
Input				
Output				
Feedback				
Frequency for Maximum Ratings (CW)				500 MHz
(Pulsed)				1500 MHz



MECHANICAL

Base	Coaxial
Maximum Operating Temperatures:	
Ceramic-to-Metal-Seals	250° C
Anode Core	250° C
Operating Position	Any
Maximum Dimensions:	
Height	2.813 in
Diameter	1.640 in
Cooling	Forced Air
Net Weight	4.6 oz
Shipping Weight (Approximate)	1.6 lbs

RADIO-FREQUENCY POWER AMPLIFIER OR OSCILLATOR

Class-C Telephony or FM Telephony
(Key-down conditions)

MAXIMUM RATINGS	
DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION

	Frequencies up to 175 MHz				500 MHz
DC Plate Voltage	500	1000	1500	2000	2000 volts
DC Screen Voltage	250	250	250	250	300 volts
DC Grid Voltage	-90	-90	-90	-90	-90 volts
DC Plate Current	250	250	250	250	250 mA
DC Screen Current*	45	38	21	19	10* mA
DC Grid Current*	35	31	28	26	25* mA
Peak RF Grid Voltage*	114	114	112	112	— volts
Driving Power*	4.0	3.5	3.2	2.9	— watts
Plate Input Power	125	250	375	500	500 watts
Plate Output Power	70	190	280	390	225* watts
Heater Voltage	6.0	6.0	6.0	6.0	5.5 volts

* Approximate values.

** Measured Values for a typical cavity amplifier circuit.

**PLATE-MODULATED RADIO-FREQUENCY
AMPLIFIER**

Class-C Telephony (Carrier conditions)

MAXIMUM RATINGS

DC PLATE VOLTAGE	1500 VOLTS
DC SCREEN VOLTAGE	300 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT	200 MA
PLATE DISSIPATION	165 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 175 MHz)

DC Plate Voltage	500	1000	1500 volts
DC Screen Voltage	250	250	250 volts
DC Grid Voltage	-100	-100	-100 volts
DC Plate Current	200	200	200 mA
DC Screen Current*	31	22	20 mA
DC Grid Current*	15	14	14 mA
Peak RF Grid Input Voltage*	118	117	117 volts
Driving Power*	1.8	1.7	1.7 watts
Plate Input Power	100	200	300 watts
Plate Output Power	60	145	235 watts

* Approximate values.

RADIO-FREQUENCY POWER AMPLIFIER

Class-B Linear, Television Visual Service (per tube)

DC PLATE VOLTAGE	1250 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC GRID VOLTAGE	-250 VOLTS
DC PLATE CURRENT (AVERAGE)	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 216 MHz, 5 MHz bandwidth)

DC Plate Voltage	750	1000	2000 volts
DC Screen Voltage	300	300	350 volts
DC Grid Voltage	-60	-65	-70 volts

During Sync-Pulse Peak:

DC Plate Current	335	330	360 mA
DC Screen Current	50	45	29 mA
DC Grid Current	15	20	25 mA
Peak RF Grid Voltage	85	95	100 volts
RF Driver Power (approx.)	7	8	9 watts
Useful Power Output	135	200	440 watts

Black Level:

DC Plate Current	245	240	250 mA
DC Screen Current	20	15	0 mA
DC Grid Current	4	4	4 mA
Peak RF Grid Voltage (approx.)	65	70	75 volts
RF Driver Power (approx.)	4.25	4.7	5.5 watts
Plate Power Input	185	240	500 watts
Useful Power Output	75	110	250 watts

**PLATE PULSED RADIO FREQUENCY
AMPLIFIER OR OSCILLATOR****MAXIMUM RATINGS**

PULSED PLATE VOLTAGE	7000 VOLTS
PULSED SCREEN VOLTAGE	1500 VOLTS
DC GRID VOLTAGE	-500 VOLTS
MAXIMUM PULSE DURATION	5 μ S
PULSED CATHODE CURRENT	7 AMPS
AVERAGE POWER INPUT	250 WATTS
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL PULSE OPERATION

Single tube oscillator, 1200 MHz

Pulsed Plate Voltage	5	7 kV
Pulsed Plate Current	4.0	6.0 amps
Pulsed Screen Voltage	800	1200 volts
Pulsed Screen Current	0.3	0.4 amps
DC Grid Voltage	-200	-250 volts
Pulsed Grid Current	0.5	0.6 amps
Pulse Duration	4	5 μ sec
Pulse Repetition Rate	2500	1000 pps
Peak Power Output	7	17 kW

RADIO-FREQUENCY LINEAR AMPLIFIERClass-AB₁ (Single-Sideband Suppressed-Carrier Operation)**MAXIMUM RATINGS**

DC PLATE VOLTAGE	2000 VOLTS
DC SCREEN VOLTAGE	400 VOLTS
DC PLATE CURRENT	250 MA
PLATE DISSIPATION	250 WATTS
SCREEN DISSIPATION	12 WATTS
GRID DISSIPATION	2 WATTS

TYPICAL OPERATION (Frequencies up to 175 MHz, peak-envelope conditions except where noted)

DC Plate Voltage	1000	1500	2000 volts
DC Screen Voltage	350	350	350 volts
DC Grid Voltage*	-55	-55	-55 volts
Zero-Signal DC Plate Current	100	100	100 mA
Peak RF Grid Voltage**	50	50	50 volts
DC Plate Current	250	250	250 mA
DC Screen Current**	10	8	5 mA
Plate Input Power	250	375	500 watts
Plate Output Power	120	215	300 watts
Two-Tone Average DC Plate Current	190	190	190 mA
Two-Tone Average DC Screen Current**	2	-1	-2 mA

* Approximate values.

** Adjust grid bias to obtain listed zero-signal plate current.

NOTE: "TYPICAL OPERATION" data are obtained by calculation from published characteristic curves and confirmed by direct tests. Adjustment of the r-f grid drive to obtain the specified plate current at the specified grid bias, screen voltage, and plate voltage is assumed. If this procedure is followed, there will be little variation in output power when tubes are changed, even though there may be some variations in grid and screen currents. 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 r-f driving voltage is applied.



APPLICATION

MECHANICAL

Mounting The 4CX250K and 4CX250M may be mounted in any position. The concentric arrangements 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.

Cooling Sufficient forced-air cooling must be provided to maintain the anode core and seal temperatures below 250°C. Special care must be observed to insure that there is adequate cooling in the area of the coaxial filament and grid terminals.

The table below lists the minimum cooling requirements at sea level with 50°C ambient air to maintain 225°C on the anode. For operation at 10,000 feet, the air-flow values should be multiplied by 1.46.

Plate Dissipation (Watts)	BASE-TO-ANODE FLOW		ANODE-TO-BASE FLOW	
	Air Flow (CFM)	Static Pressure (inches of water)	Air Flow (CFM)	Static Pressure (inches of water)
150	3.5	0.3	3.1	0.2
200	4.3	0.4	4.6	0.4
250	5.5	0.7	6.1	0.7

ELECTRICAL

Heater The rated heater voltages for the 4CX-250K and 4CX250M are 6.0 and 26.5 volts, respectively and should be maintained at these values plus or minus five percent. At frequencies above 300 megahertz, transit time effects begin to influence the cathode temperature. The amount of driving power diverted to cathode heating will depend on frequency, plate current and driving power. When the tube is driven to maximum input as a class-C amplifier, the heater voltage should be reduced according to the following table. Further reduction in filament voltage may be needed in pulse service above 500 MHz.

Frequency, MHz	4CX250K	4CX250M
301 to 400	5.75 volts	25.5 volts
401 to 500	5.50 volts	24.3 volts

Cathode The oxide-coated unipotential cathode must be protected against excessively high emission currents. The maximum dc plate current must be limited to 250 mA under CW conditions. Pulse current must never exceed 6.0 amperes.

Where it is necessary to operate with some heater-to-cathode potential, the maximum heater-to-cathode voltage is 150 volts regardless of polarity.

Grid Dissipation Maximum grid dissipation is 2.0 watts. In ordinary af and rf amplifiers the grid dissipation usually will not reach this level. Above 100 MHz, drive power requirements increase, but most of this increase is absorbed in circuit losses rather than in grid dissipation. Satisfactory operation at 500 MHz in a "straight through" amplifier is indicated by grid currents below approximately 15 milliamperes. Grid circuit resistance should not exceed 100,000 ohms per tube.

Screen-Grid Operation The maximum rated power dissipation for the screen grid is 12 watts, and the screen input power should be kept below that level. The product of the peak screen voltage and the indicated dc screen current approximates the screen input power except when the screen current indication is near zero or negative.

In the usual tetrode amplifier, where no signal voltage appears between cathode and screen, the peak screen voltage is equal to the dc screen voltage.

When screen voltages appear between screen and cathode, as in the case of screen-modulated amplifiers or cathode-driven tetrode amplifiers, the peak screen-to-cathode voltage is the sum of the dc screen voltage and the peak ac or rf signal voltage applied to screen or cathode.

Protection for the screen 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.

The screen current may reverse under certain conditions and produce negative current indications on the screen milliammeter. 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 screen to cathode must be provided by a bleeder resistor, gaseous voltage regulator tubes or an electron tube shunt regulator connected between screen and cathode and arranged to pass approximately 15 milliamperes per connected screen. An electron tube series regulator can be used only when an adequate bleeder resistor is provided.

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 or by means of a small separate modulator tube will usually be more satisfactory. Screen-voltage modulation factors between 0.75 and 1.0 will result in 100% modulation for plate-modulated rf amplifiers using the 4CX250K or 4CX250M.

Plate Operation The maximum rated plate-dissipation power is 250 watts. In plate-modulated applications the carrier plate-dissipation power must be limited to 165 watts to avoid exceeding the plate dissipation rating with 100% sine wave modulation. The maximum dissipation rating may be exceeded for brief periods during circuit adjustment without damage to the tube.

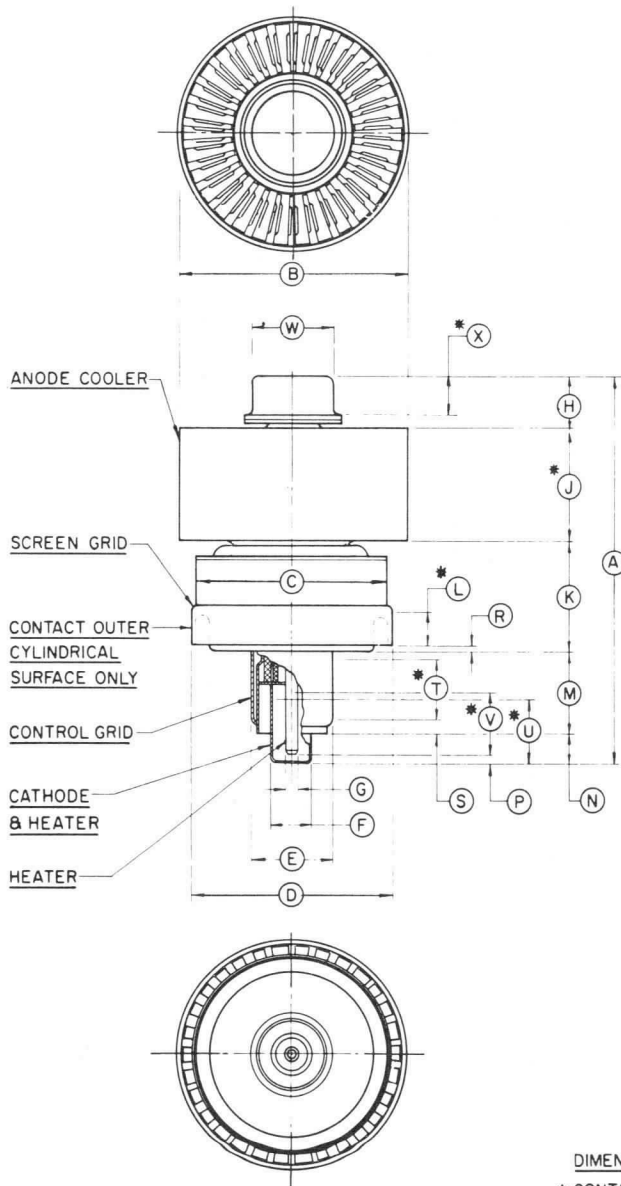
UHF Operation The 4CX250K and 4CX250M are suitable for use in the UHF region. Such operation

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 or screen voltage to equalize the inputs.

Where overload protection is provided, it should be capable of protecting the surviving tube(s) in the event that one tube fails.

Special Applications If it is desired to operate these tubes under conditions widely different from those given here, write to Product Manager, Eimac Division of Varian, San Carlos, California, for information and recommendations.



DIMENSIONS		
REF.	MIN.	MAX.
A		2.813
B	1.610 DIA.	1.640 DIA.
C		1.406 DIA.
D	1.410 DIA.	1.440 DIA.
E	.587 DIA.	.597 DIA.
F	.317 DIA.	.327 DIA.
G	.088 DIA.	.098 DIA.
H		.358
J	.710	.790
K	.740	.820
L	.187	
M	.500	.580
N	.235	.265
P	.032	.062
R	.020 NOM.	
S	.125 NOM.	
T	$\frac{11}{32}$	
U	$\frac{13}{32}$	
V	$\frac{15}{32}$	
W	.559	.573
X	.240	.280

DIMENSIONS IN INCHES

* CONTACT SURFACE

