



TECHNICAL DATA

8170W
4CX5000R

RADIAL-BEAM
POWER TETRODE

The EIMAC 8170W/4CX5000R is a compact, high-power, ceramic/metal tetrode. It is directly interchangeable with the 8170/4CX5000A but incorporates more rugged internal construction features, including a sturdy mesh cathode, which allows it to meet demanding vibration and shock specifications.

The 8170W/4CX5000R is useful up to 110 Mc and is recommended for use as a radio-frequency linear amplifier, a Class-AB audio amplifier, or a Class-C power amplifier or plate-modulated amplifier.



GENERAL CHARACTERISTICS¹

ELECTRICAL

Filament: Thoriated Tungsten

Voltage 7.5 ± 0.37 V

Current, at 7.5 volts 75 A

Amplification Factor (Average):

Grid to Screen 4.5

Direct Interelectrode Capacitance (grounded filament)²

Cin 115 pF

Cout 20 pF

Cgp 0.7 pF

Direct Interelectrode Capacitance (grounded grid)²

Cin 53 pF

Cout 22.5 pF

Cpk 0.10 pF

Frequency of Maximum Rating:

C W 100 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. 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 9.125 in; 231.77 mm

Diameter 4.938 in; 125.43 mm

Net Weight 9.5 lb; 4.31 kg

Operating Position Axis vertical, base up or down

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Maximum Operating Temperature:

Ceramic/Metal Seals or Anode Core	250°C
Cooling	Forced Air
Base	Special concentric
Recommended Air System Socket	SK-300 or SK-300A
Recommended (Air) Chimney	SK-306

RADIO FREQUENCY LINEAR AMPLIFIER GRID DRIVEN

Class AB₁

ABSOLUTE MAXIMUM RATINGS

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPERES
PLATE DISSIPATION	6000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION (Frequencies to 100 MHz) Class AB₁, Grid Driven, Peak Envelope or Modulation Crest Conditions

Plate Voltage	7500 Vdc
Screen Voltage	1250 Vdc
Grid Voltage ¹	-300 Vdc
Zero-Signal Plate Current	0.50 Adc
Single-Tone Plate Current	1.90 Adc
Single-Tone Screen Current ²	0.20 Adc
Peak rf Grid Voltage ²	300 v
Plate Dissipation	4200 W
Single-Tone Plate Output Power	10,000 W

1. Adjust to specified zero-signal dc plate current.

2. Approximate value.

RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR

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

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	3.0 AMPERES
PLATE DISSIPATION	5000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION (Frequencies to 100 MHz)

Plate Voltage	6500 Vdc
Screen Voltage	750 Vdc
Grid Voltage	-350 Vdc
Plate Current	2.30 Adc
Screen Current ¹	0.20 Adc
Grid Current ¹	0.05 Adc
Measured Driving Power ¹	100 W
Useful Output Power	10,000 W

1. Approximate value.

PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER-GRID DRIVEN

Class C Telephony (Carrier Conditions)

ABSOLUTE MAXIMUM RATINGS:

DC PLATE VOLTAGE	5000 VOLTS
DC SCREEN VOLTAGE	1000 VOLTS
DC PLATE CURRENT	2.5 AMPERES
PLATE DISSIPATION ¹	3500 WATTS
SCREEN DISSIPATION ²	250 WATTS
GRID DISSIPATION ²	75 WATTS

1. Corresponds to 5000 watts at 100% sine-wave modulation.

2. Average, with or without modulation.

TYPICAL OPERATION (Frequencies to 100 MHz)

Plate Voltage	5000 Vdc
Screen Voltage	500 Vdc
Grid Voltage	-400 Vdc
Plate Current	1.40 Adc
Screen Current ¹	0.26 Adc
Grid Current ¹	0.05 Adc
Peak af Screen Voltage ¹ (100% modulation)	450 v
Peak rf Grid Voltage ¹	520 v
Calculated Driving Power	25 W
Plate Dissipation	1200 W
Plate Output Power	5800 W

1. Approximate value

AUDIO FREQUENCY POWER AMPLIFIER OR MODULATORClass AB₁, Grid Driven (Sinusoidal Wave)**ABSOLUTE MAXIMUM RATINGS (per tube)**

DC PLATE VOLTAGE	7500 VOLTS
DC SCREEN VOLTAGE	1500 VOLTS
DC PLATE CURRENT	4.0 AMPERES
PLATE DISSIPATION	6000 WATTS
SCREEN DISSIPATION	250 WATTS
GRID DISSIPATION	75 WATTS

TYPICAL OPERATION (Two Tubes)

Plate Voltage	4000	5000	6000	7000	Vdc
Screen Voltage	1250	1250	1250	1250	Vdc
Grid Voltage 1/4	-270	-280	-310	-325	Vdc
Zero-Signal Plate Current	1.25	1.00	0.83	0.70	Adc
Max. Signal Plate Current	5.10	4.40	4.25	3.65	Adc
Max. Signal Screen Current ¹	0.35	0.33	0.30	0.24	Adc
Peak af Grid Voltage ²	250	240	270	235	v
Max. Signal Plate Dissipation ¹	4200	4200	4200	4200	W
Plate Output Power	11,500	13,500	17,000	17,500	W
Load Resistance (plate to plate)	1500	2370	2940	4100	Ω

1. Approximate value.

2. Per Tube.

3. Nominal drive power is one-half peak power.

4. Adjust to give stated zero-signal plate current.

NOTE: TYPICAL OPERATION data are obtained from direct measurement or 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. In the case of Class C Service, 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

	<u>Min.</u>	<u>Max.</u>	
Filament: Current at 7.5 volts	73	78	A
Interelectrode Capacitances ¹ (grounded filament connection)			
Cin	108	122	pF
Cout	18	23	pF
Cgp	---	1.0	pF
Interelectrode Capacitances ¹ (grounded grid connection)			
Cin	48	58	pF
Cout	19	24	pF
Cpk	---	0.16	pF

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 - The 4CX5000R must be operated with its axis vertical. The base of the tube may be down or up at the convenience of the circuit designer.

SOCKET - The EIMAC SK-300A Air-System Socket is designed especially for the concentric base terminals of the 4CX5000R. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the

tube. Air forced into the bottom of the socket passes over the tube terminals and through an Air Chimney, the SK-306, into the anode cooling fins. The SK-300 socket may be used instead of the SK-300A, but its use will result in a slightly less efficient cooling system at high dissipation levels.

COOLING - The maximum temperature rating for the external surfaces of the 4CX5000R is 250°C. Sufficient forced-air circulation must be

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provided to keep the temperature of the anode at the base of the cooling fins and the temperature of the ceramic/metal seals below 250°C. Sea level air-flow requirements to maintain seal temperatures at 200°C in 50°C ambient air are tabulated below (for operation below 30 megacycles).

Plate Dissipation (Watts)	SK-300A Socket		SK-300 Socket	
	Air Flow (CFM)	Pressure Drop (Inches of water)	Air Flow (CFM)	Pressure Drop (Inches of water)
2000	75	0.4	75	0.4
3000	105	0.7	100	0.7
4000	145	1.1	135	1.2
5000	190	1.5	165	1.8
6000	230	2.0	200	2.5

Since the power dissipated by the filament represents about 560 watts and since grid-plus screen dissipation can, under some conditions, represent another 200 to 300 watts, allowance has been made in preparing this tabulation for an additional 1000 watts dissipation

At higher altitudes, higher frequencies, or higher ambient temperatures the flow rate must be increased to obtain equivalent cooling. The flow rate and corresponding pressure differential must be determined individually in such cases, using maximum rated temperatures as the criteria for satisfactory cooling.

IMPACT AND VIBRATION - The 4CX5000R is designed to operate under shock and vibration that might disable a less rugged tube. Up to 50 g of impact of 11 millisecond duration can be sustained and vibratory acceleration up to 5 g from 14 to 200 Hz and 2 g from 200 to 500 Hz will not ordinarily injure the tube unless prolonged. Production tubes are subjected to testing to insure this ruggedness.

ELECTRICAL

FILAMENT VOLTAGE - The rated filament voltage for the 4CX5000R is 7.5 volts. Filament voltage, as measured at the socket, should be maintained at this value to obtain maximum tube life. In no case should it be allowed to deviate by more than 5 percent from the rated value.

GRID DISSIPATION - The 4CX5000R control grid has a maximum dissipation rating of 75 watts. Precautions should be observed to avoid exceeding this rating. Grid Dissipation is approximately the product of dc grid current and

peak positive grid voltage. The grid bias and driving power should be kept near the values shown in the "Typical Operation" sections of the data sheet whenever possible.

SCREEN DISSIPATION - The power dissipated by the screen of the 4CX5000R must not exceed 250 watts.

Screen dissipation, in cases where there is no ac applied to the screen, is the simple product of the screen voltage and the screen current. If the screen voltage is modulated, the screen dissipation will depend upon loading, driving power, and carrier screen voltage.

Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage, or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit the screen dissipation to 250 watts in the event of circuit failure.

PLATE DISSIPATION - The plate-dissipation rating for the 4CX5000R is 5000 watts for most applications but for audio and SSB amplifier applications, the maximum allowable dissipation is 6000 watts. Plate dissipation may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

When the 4CX5000R is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

HIGH VOLTAGE - The 4CX5000R 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 condensers 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**.

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





