



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 CHARACTERISTICS<sup>1</sup>

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)<sup>2</sup>

Cin . . . . . 115 pF  
Cout . . . . . 20 pF  
Cgp . . . . . 0.7 pF

Direct Interelectrode Capacitance (grounded grid)<sup>2</sup>

Cin . . . . . 53 pF  
Cout . . . . . 22.5 pF  
Cpk . . . . . 0.10 pF

Frequency of Maximum Rating:

CW . . . . . 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

**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 AB<sub>1</sub>

**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 AB<sub>1</sub>, Grid Driven, Peak Envelope or Modulation  
Crest Conditions**

|   |          |
|---|----------|
| Plate Voltage .....                           | 7500 Vdc |
| Screen Voltage .....                          | 1250 Vdc |
| Grid Voltage <sup>1</sup> .....               | -300 Vdc |
| Zero-Signal Plate Current .....               | 0.50 Adc |
| Single-Tone Plate Current .....               | 1.90 Adc |
| Single-Tone Screen Current <sup>2</sup> ..... | 0.20 Adc |
| Peak rf Grid Voltage <sup>2</sup> .....       | 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 <sup>1</sup> .....         | 0.20 Adc |
| Grid Current <sup>1</sup> .....           | 0.05 Adc |
| Measured Driving Power <sup>1</sup> ..... | 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 <sup>1</sup> .....  | 3500 WATTS  |
| SCREEN DISSIPATION <sup>2</sup> ..... | 250 WATTS   |
| GRID DISSIPATION <sup>2</sup> .....   | 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 <sup>1</sup> .....                              | 0.26 Adc |
| Grid Current <sup>1</sup> .....                                | 0.05 Adc |
| Peak of Screen Voltage <sup>1</sup><br>(100% modulation) ..... | 450 v    |
| Peak rf Grid Voltage <sup>1</sup> .....                        | 520 v    |
| Calculated Driving Power .....                                 | 25 W     |
| Plate Dissipation .....  | 1200 W   |
| Plate Output Power .....                                       | 5800 W   |

1. Approximate value

**AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR**

Class AB<sub>1</sub>, 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 <sup>1</sup> . . . . .    | 0.35   | 0.33   | 0.30   | 0.24   | Adc |
| Peak of Grid Voltage <sup>2</sup> . . . . .          | 250    | 240    | 270    | 235    | v   |
| Max. Signal Plate Dissipation <sup>1</sup> . . . . . | 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  |
| <b>Interelectrode Capacitances<sup>1</sup> (grounded filament connection)</b> |             |             |    |
| Cin . . . . .   | 108         | 122         | pF |
| Cout . . . . .  | 18          | 23          | pF |
| Cgp . . . . .   | ---         | 1.0         | pF |
| <b>Interelectrode Capacitances<sup>1</sup> (grounded grid connection)</b>     |             |             |    |
| 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

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.

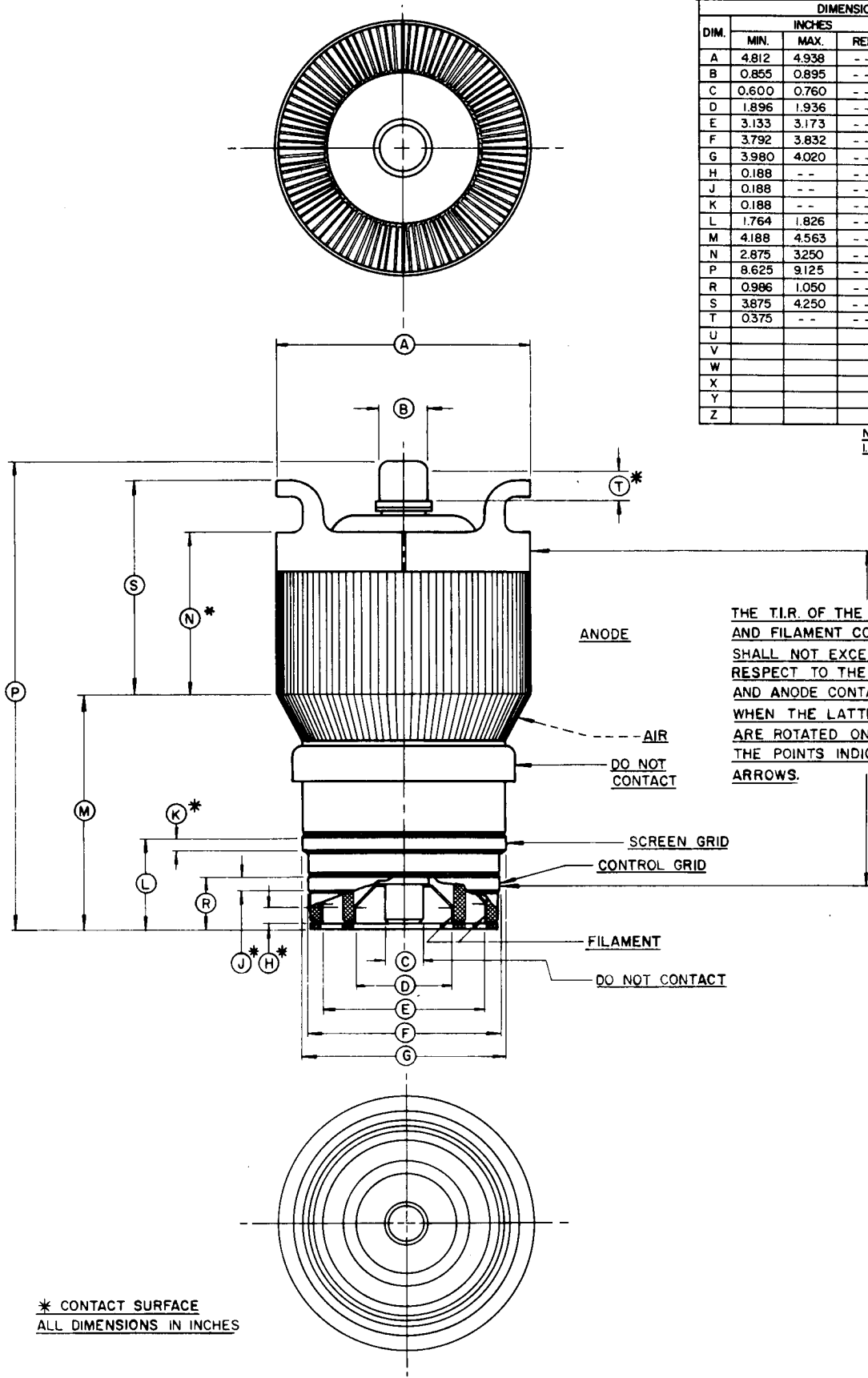
When the 4CX5000R is operated as a plate-modulated rf power amplifier, the input power is limited by conditions not connected with the plate efficiency, which is quite high. Therefore, except during tuning there is little possibility that the 3500-watt maximum plate dissipation rating will be exceeded.

**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.

| DIM. | DIMENSIONAL DATA |       |      |             |        |      |
|------|------------------|-------|------|-------------|--------|------|
|      | INCHES           |       |      | MILLIMETERS |        |      |
|      | MIN.             | MAX.  | REF. | MIN.        | MAX.   | REF. |
| A    | 4.812            | 4.938 | --   | 122.22      | 125.43 | --   |
| B    | 0.855            | 0.895 | --   | 21.72       | 22.73  | --   |
| C    | 0.600            | 0.760 | --   | 15.24       | 19.30  | --   |
| D    | 1.896            | 1.936 | --   | 48.16       | 49.17  | --   |
| E    | 3.133            | 3.173 | --   | 79.58       | 80.59  | --   |
| F    | 3.792            | 3.832 | --   | 96.32       | 97.33  | --   |
| G    | 3.980            | 4.020 | --   | 101.09      | 102.11 | --   |
| H    | 0.188            | --    | --   | 4.78        | --     | --   |
| J    | 0.188            | --    | --   | 4.78        | --     | --   |
| K    | 0.188            | --    | --   | 4.78        | --     | --   |
| L    | 1.764            | 1.826 | --   | 44.81       | 46.38  | --   |
| M    | 4.188            | 4.563 | --   | 106.38      | 115.90 | --   |
| N    | 2.875            | 3.250 | --   | 73.03       | 82.55  | --   |
| P    | 8.625            | 9.125 | --   | 219.08      | 231.78 | --   |
| R    | 0.986            | 1.050 | --   | 25.04       | 26.67  | --   |
| S    | 3.875            | 4.250 | --   | 98.43       | 107.95 | --   |
| T    | 0.375            | --    | --   | 9.53        | --     | --   |
| U    |                  |       |      |             |        |      |
| V    |                  |       |      |             |        |      |
| W    |                  |       |      |             |        |      |
| X    |                  |       |      |             |        |      |
| Y    |                  |       |      |             |        |      |
| Z    |                  |       |      |             |        |      |

NOTES:  
 1. REF. DIMENSIONS ARE FOR INFO.  
 ONLY & ARE NOT REQUIRED FOR  
 INSPECTION PURPOSES.



THE T.I.R. OF THE SCREEN GRID  
 AND FILAMENT CONTACT SURFACES  
 SHALL NOT EXCEED .040 WITH  
 RESPECT TO THE CONTROL GRID  
 AND ANODE CONTACT SURFACE  
 WHEN THE LATTER SURFACES  
 ARE ROTATED ON ROLLERS AT  
 THE POINTS INDICATED BY THE  
 ARROWS.

\* CONTACT SURFACE  
 ALL DIMENSIONS IN INCHES

