The EIMAC 4CW25,000A is a ceramic/metal power tetrode intended for use in audio or radio frequency applications. It features a new type of internal mechanical structure which results in higher rf operating efficiency. Low rf losses in this mechanical structure permit operation of the 4CW25,000A at full ratings up to 110 MHz, and at reduced ratings, to 225 MHz.

The 4CW25,000A is recommended for radio-frequency linear power amplifier service, for television linear amplifier service, and as a switch tube for pulsed regulator service.

**GENERAL CHARACTERISTICS**

**ELECTRICAL**

Filament: Thoriated Tungsten

Voltage ........................................... 6.3 ± 0.3 V  
Current, at 6.3 volts .......................... 160 A  

Amplification Factor, average

Grid to Screen ..................................... 4.5  

Direct Interelectrode Capacitances (cathode grounded): 2

C_in ........................................ 160.0 pF  
C_out ....................................... 24.5 pF  
C_p ........................................ 1.5 pF  

Direct Interelectrode Capacitances (grid and screen grounded): 2

C_in ........................................ 67.0 pF  
C_out ....................................... 25.5 pF  
C_p ........................................ 0.2 pF  

Maximum Frequency Ratings

CW ...................................................... 110 MHz

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. 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 ........................................... 12.69 in; 322.33 mm  
Diameter ........................................ 4.750 in; 120.65 mm  
Net Weight ..................................... 13.5 lb; 6.10 kg  

Operating Position ........................ Axis vertical, base up or down  
Cooling .......................................... Water and Forced Air

(Effective 2-1-72) © by Varian  
Printed in U.S.A.
Operating Temperature, maximum  
Ceramic/Metal Seals and Anode Core .......................... 250°C  
Base .............................................. Special, concentric  
Recommended Air System Socket ............................ SK-300A

## RADIO FREQUENCY LINEAR AMPLIFIER  
**GRID DRIVEN, Class AB₁**

<table>
<thead>
<tr>
<th>Absolute Maximum Ratings</th>
</tr>
</thead>
</table>
| **PLATE VOLTAGE**       | 10.0 kVdc  
| **SCREEN VOLTAGE**      | 2.0 kVdc  
| **PLATE CURRENT**       | 6.0 Adc  
| **PLATE DISSIPATION**   | 25.0 kW  
| **SCREEN DISSIPATION**  | 450 W  
| **GRID DISSIPATION**    | 200 W  

1. Adjust for specified zero-signal plate current.  
2. Approximate value.

**Typical Operation**  
(Frequencies to 110 MHz)  
Peak Envelope or Modulation Crest Conditions  
Plate Voltage .......... 7,500 10,000 Vdc  
Screen Voltage .......... 1,500 1,800 Vdc  
Grid Voltage¹ .......... -360 -370 Vdc  
Zero-Signal Plate Current 1.0 1.0 Adc  
Single-Tone Plate Current 4.0 4.25 Adc  
Single-Tone Screen Current² | 170 | 150 mAdc  
Peak rf Grid Voltage² | 330 | 340 v  
Plate Dissipation .......... 12.2 14.0 kW  
Single-Tone Plate Output Power 20.8 28.5 kW  
Resonant Load Impedance .... 865 1,260 Ω

## RADIO FREQUENCY POWER AMPLIFIER OR OSCILLATOR  
**Class C Telegraphy or FM Telephony**  
(Key-Down Conditions)

<table>
<thead>
<tr>
<th>Absolute Maximum Ratings</th>
</tr>
</thead>
</table>
| **PLATE VOLTAGE**       | 10.0 kVdc  
| **SCREEN VOLTAGE**      | 2.0 kVdc  
| **PLATE CURRENT**       | 5.0 Adc  
| **PLATE DISSIPATION**   | 25.0 kW  
| **SCREEN DISSIPATION**  | 450 W  
| **GRID DISSIPATION**    | 200 W  

1. Approximate value.

**Typical Operation**  
(Frequencies to 110 MHz)  
Plate Voltage .......... 7,500 10,000 Vdc  
Screen Voltage .......... 750 750 Vdc  
Grid Voltage .......... -510 -550 Vdc  
Plate Current .......... 4.45 5.5 Adc  
Screen Current¹ .......... 0.69 0.64 Adc  
Grid Current¹ .......... 0.30 0.27 Adc  
Peak rf Grid Voltage¹ | 730 | 790 v  
Calculated Driving Power .......... 220 220 W  
Plate Dissipation .......... 8.1 9.0 kW  
Plate Output Power .......... 26.7 36.5 kW

## PLATE MODULATED RADIO FREQUENCY POWER AMPLIFIER, **GRID DRIVEN**, Class C Telegraphy  
(Carrier Conditions)

<table>
<thead>
<tr>
<th>Absolute Maximum Ratings</th>
</tr>
</thead>
</table>
| **PLATE VOLTAGE**       | 8.0 kVdc  
| **SCREEN VOLTAGE**      | 1.5 kVdc  
| **PLATE CURRENT**       | 4.0 Adc  
| **PLATE DISSIPATION**   | 16.4 kW  
| **SCREEN DISSIPATION**  | 450 W  
| **GRID DISSIPATION**    | 200 W  

1. Approximate value.

**Typical Operation**  
(Frequencies to 110 MHz)  
Plate Voltage .......... 6,000 8,000 Vdc  
Screen Voltage .......... 750 750 Vdc  
Grid Voltage .......... -600 -640 Vdc  
Plate Current .......... 3.75 3.65 Adc  
Screen Current¹ .......... 0.45 0.43 Adc  
Grid Current¹ .......... 0.18 0.18 Adc  
Peak af Screen Voltage¹ | 740 | 710 v  
100% modulation .......... 740 710 v  
Peak rf Grid Voltage¹ | 800 | 840 v  
Calculated Driving Power .......... 150 150 W  
Plate Dissipation .......... 5.1 5.8 kW  
Plate Output Power .......... 17.4 23.5 kW

## AUDIO FREQUENCY POWER AMPLIFIER OR MODULATOR, **GRID DRIVEN**, Class AB₁  
(Sinusoidal Wave)

<table>
<thead>
<tr>
<th>Absolute Maximum Ratings (per tube)</th>
</tr>
</thead>
</table>
| **PLATE VOLTAGE**                  | 10.0 kVdc  
| **SCREEN VOLTAGE**                 | 2.0 kVdc  
| **PLATE CURRENT**                  | 6.0 Adc  
| **PLATE DISSIPATION**              | 25.0 kW  
| **SCREEN DISSIPATION**             | 450 W  
| **GRID DISSIPATION**               | 200 W  

1. Adjust for specified zero-signal plate current.  
2. Approximate value.

**Typical Operation**  
(Two tubes)  
Plate Voltage .......... 7.500 10.000 Vdc  
Screen Voltage .......... 1.500 1.800 Vdc  
Grid Voltage¹ .......... -360 -370 Vdc  
Zero-Signal Plate Current 1.0 1.0 Adc  
Maximum Signal Plate Current 8.80 9.65 Adc  
Maximum Signal Screen Current² | 0.34 | 0.30 Adc  
Peak af Grid Voltage² | 330 | 340 v  
Maximum Signal Plate Dissipation 12.2 14.0 kW  
Plate Output Power .......... 41.6 57.0 kW  
Load Resistance (plate to plate) .......... 1.730 2.520 Ω
SWITCH TUBE OR PULSED REGULATOR SERVICE

ABSOLUTE MAXIMUM RATINGS:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLATE VOLTAGE</td>
<td>20.0 kVdc</td>
</tr>
<tr>
<td>SCREEN VOLTAGE</td>
<td>3.0 kVdc</td>
</tr>
<tr>
<td>GRID VOLTAGE</td>
<td>-1.5 kVdc</td>
</tr>
<tr>
<td>PEAK CATHODE CURRENT</td>
<td>80 A</td>
</tr>
<tr>
<td>PEAK ANODE CURRENT</td>
<td>60 A</td>
</tr>
<tr>
<td>GRID DISSIPATION(^1)</td>
<td>200 W</td>
</tr>
<tr>
<td>SCREEN DISSIPATION(^1)</td>
<td>450 W</td>
</tr>
</tbody>
</table>

PLATE DISSIPATION \(^1\) \(=\) 25.0 kW
PULSE LENGTH \(\) \(\) See Note 2
DUTY FACTOR \(\) \(\) See Note 2

1. Dissipation values shown are average.
2. Duty must be maintained at a low enough level that average tube dissipation ratings are not exceeded. For pulse lengths in excess of 0.1 second, some reduction of electrode dissipation ratings will be required.

TYPICAL OPERATION values are obtained by calculations 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. If grid bias is obtained principally by means of a grid resistor, the resistor must be adjustable to produce the required bias voltage when the correct rf grid voltage is applied.

RANGE VALUES FOR EQUIPMENT DESIGN

Heater Current, at 6.3 volts \(\) \(\) 152 \(\) \(\) 168 A

Inter-electrode Capacitances, cathode grounded\(^1\)

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cin</td>
<td>154.0</td>
<td>167.0 pF</td>
</tr>
<tr>
<td>Cout</td>
<td>22.0</td>
<td>27.0 pF</td>
</tr>
<tr>
<td>Cgp</td>
<td>(-)</td>
<td>2.0 pF</td>
</tr>
</tbody>
</table>

Inter-electrode Capacitances, grid and screen grounded\(^1\)

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cin</td>
<td>62.0</td>
<td>72.0 pF</td>
</tr>
<tr>
<td>Cout</td>
<td>23.0</td>
<td>28.0 pF</td>
</tr>
<tr>
<td>Cpk</td>
<td>(-)</td>
<td>0.3 pF</td>
</tr>
</tbody>
</table>

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 4CW25,000A 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 Air-System Socket Type SK-300A is designed especially for the concentric base terminals of the 4CW25,000A. The use of recommended air-flow rates through this socket provides effective forced-air cooling of the tube base seal areas.

COOLING - Anode cooling is accomplished by circulating water through the integral anode water jacket. The table below lists the minimum cooling water requirements at various dissipation levels.

<table>
<thead>
<tr>
<th>Plate Dissipation (kilowatts)</th>
<th>Water Flow GPM</th>
<th>Approx. Pressure Drop PSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2.2</td>
<td>3.3</td>
</tr>
<tr>
<td>15</td>
<td>3.0</td>
<td>5.0</td>
</tr>
<tr>
<td>20</td>
<td>4.0</td>
<td>8.0</td>
</tr>
<tr>
<td>25</td>
<td>5.0</td>
<td>11.5</td>
</tr>
</tbody>
</table>

*Since the power dissipated by the filament represents about 1000 watts and since grid-plus-screen dissipation can, under some conditions, represent another 600 watts, allowance has been made in preparing this tabulation for an additional 1600 watts dissipation.
The cooling table assumes a water temperature rise of 20° C. Under no circumstances should the outlet water temperature exceed 70° C. Inlet water pressure should not exceed 50 PSI.

A major factor effecting long life of water cooled tubes is the condition of the cooling water.

A simple method of determining the condition of the water is to measure the resistance across a measured amount. This can be accomplished by inserting two electrodes into the water through an insulated section of water line and measuring the resistance between the two electrodes with a sensitive meter. The resistance of the water should be maintained above 50 kohms/cm³.

Separate cooling of the tube base is required and is accomplished by directing approximately 50 cfm of air at sea level through the socket.

**ELECTRICAL**

**FILAMENT OPERATION** - The rated filament voltage for the 4CW25,000A is 6.3 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 plus or minus five percent from the rated value.

**ELECTRODE DISSIPATION RATINGs** - The maximum dissipation ratings for the 4CW25,000A must be respected to avoid damage to the tube. An exception is the plate dissipation which may be permitted to rise above the rated maximum during brief periods, such as may occur during tuning.

**GRID OPERATION** - The 4CW25,000A control grid has a maximum dissipation rating of 200 watts. Precautions should be observed to avoid exceeding this rating. The grid bias and driving power should be kept near the values shown in the “Typical Operation” sections of the data sheet whenever possible. The maximum grid circuit resistance should not exceed 100,000 ohms per tube.

**SCREEN OPERATION** - The power dissipated by the screen of the 4CW25,000A must not exceed 450 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 measures must be provided to limit the screen dissipation to 450 watts in the event of circuit failure.

**PLATE DISSIPATION** - The plate-dissipation rating for the 4CW25,000A is 25,000 watts.

When the 4CW25,000A 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 25,000 watt maximum plate dissipation rating will be exceeded.

**HIGH VOLTAGE** - Normal operating voltages used with the 4CW25,000A 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 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.

**X-RADIATION** - High-vacuum tubes operating at voltages higher than 10 kilovolts produce progressively more dangerous X-ray radiation as the voltage is increased. The 4CW25,000A, operating at its rated voltages and currents, is a potential X-ray hazard. Only limited shielding is afforded by the tube envelope. Moreover, the X-ray radiation level can increase significantly with aging and gradual deterioration, due to leakage paths or emission characteristics as they are affected by the high voltage. X-ray shielding must be provided on all sides of tubes operating at these voltages to provide adequate protection throughout the tube's life. Periodic checks on the X-ray level should be made, and the tube should never be operated without adequate shielding in place when voltages above 10 kilovolts are in use. Lead glass, which attenuates X-rays, is available for viewing windows. If there is any doubt as to the requirement for or the adequacy of shielding, an expert in this field should be contacted to perform an X-ray survey of the equipment.
Operation of high-voltage equipment with interlock switches "cheated" and cabinet doors open in order to be better able to locate an equipment malfunction can result in serious X-ray exposure.

**RADIO FREQUENCY RADIATION** - Avoid exposure to strong rf fields even at relatively low frequency. Absorption of rf energy by human tissue is dependent on frequency. Under 30 MHz, most of the energy will pass completely through the human body with little attenuation or heating effect. Public health agencies are concerned with the hazard, however, even at these frequencies, and it is worth noting that some commercial dielectric heating units actually operate at frequencies as low as the 13 and 27 MHz bands.

Many EIMAC power tubes, such as the 4CW-25,000A, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure design and efficient coupling of rf energy to the load will minimize the rf field in the vicinity of the power amplifier unit itself.

**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 the 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, even when the tube may be made by different manufacturers. The capacitance values shown in the manufacturer's technical data, or test specifications, 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 application. Measurements should be taken with the socket and mounting which represent approximate final layout if capacitance values are highly significant in the design.

**SPECIAL APPLICATIONS** - If it is desired to operate this tube under conditions widely different from those given here, write to the Application Engineering Dept., Power Grid Tube Division, EIMAC, Division of Varian, 301 Industrial Way, San Carlos, California, 94070 for information and recommendations.
5/8" SHORT FLARED TUBE COUPLING NUT
(WS-39264-8 OR EQUIVALENT)
7/8"-14 UWF-2B THD.

<table>
<thead>
<tr>
<th>DIM.</th>
<th>MIN.</th>
<th>MAX.</th>
<th>REF.</th>
<th>MIN.</th>
<th>MAX.</th>
<th>REF.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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<td>117.60</td>
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</tr>
<tr>
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<td>73.02</td>
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<td>1.760</td>
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<tr>
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<tr>
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<tr>
<td>J</td>
<td>0.188</td>
<td>-</td>
<td></td>
<td>4.77</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>K</td>
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<td>L</td>
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<tr>
<td>T</td>
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<tr>
<td>V</td>
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<td>3.675</td>
<td></td>
<td>92.07</td>
<td>93.54</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1. (x) CONTACT SURFACE
2. REF. DIMENSIONS ARE FOR INFORMATION ONLY & ARE NOT REQ'D FOR INSPECTION PURPOSES.

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

DO NOT CONTACT THIS AREA

SCREEN GRID

CONTROL GRID

FILAMENT

DO NOT CONTACT

ANODE

T