



TECHNICAL DATA

4CW25,000A

RADIAL BEAM
POWER TETRODE

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 CHARACTERISTICS¹

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

Cin 160.0 pF

Cout 24.5 pF

Cgp 1.5 pF

Direct Interelectrode Capacitances (grid and screen grounded):²

Cin 67.0 pF

Cout 25.5 pF

Cpk 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

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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**TYPICAL OPERATION (Frequencies to 110 MHz)
Peak Envelope or Modulation Crest Conditions

ABSOLUTE MAXIMUM RATINGS:

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.

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage ¹	-350	-370	Vdc
Zero-Signal Plate Current . . .	1.0	1.0	Adc
Single-Tone Plate Current . . .	4.0	4.25	Adc
Single-Tone Screen Current ² .	170	150	mAdc
Peak rf Grid Voltage ²	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 Telephony of FM Telephony
(Key-Down Conditions)

TYPICAL OPERATION (Frequencies to 110 MHz)

ABSOLUTE MAXIMUM RATINGS:

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

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	750	750	Vdc
Grid Voltage	-510	-550	Vdc
Plate Current	4.65	4.55	Adc
Screen Current ¹	0.59	0.54	Adc
Grid Current ¹	0.30	0.27	Adc
Peak rf Grid Voltage ¹	730	790	v
Calculated Driving Power	220	220	W
Plate Dissipation	8.1	9.0	kW
Plate Output Power	26.7	36.5	kW

1. Approximate value.

**PLATE MODULATED RADIO FREQUENCY POWER
AMPLIFIER, GRID DRIVEN, Class C Telephony**

(Carrier Conditions)

TYPICAL OPERATION (Frequencies to 110 MHz)

ABSOLUTE MAXIMUM RATINGS:

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.

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 Current ¹	0.45	0.43	Adc
Grid Current ¹	0.18	0.18	Adc
Peak af Screen Voltage ¹			
100% modulation	740	710	v
Peak rf Grid Voltage ¹	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)

TYPICAL OPERATION (Two tubes)

ABSOLUTE MAXIMUM RATINGS (per tube)

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.

Plate Voltage	7,500	10,000	Vdc
Screen Voltage	1,500	1,500	Vdc
Grid Voltage ¹	-350	-370	Vdc
Zero-Signal Plate Current	1.00	1.00	Adc
Maximum Signal Plate Current . .	8.80	8.50	Adc
Maximum Signal Screen Current ²	0.34	0.30	Adc
Peak af Grid Voltage ²	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

2. Approximate value.

SWITCH TUBE OR PULSED REGULATOR SERVICE**ABSOLUTE MAXIMUM RATINGS:**

PLATE VOLTAGE	20.0 kVdc
SCREEN VOLTAGE	3.0 kVdc
GRID VOLTAGE	-1.5 kVdc
PEAK CATHODE CURRENT	80 a
PEAK ANODE CURRENT	60 a
GRID DISSIPATION ¹	200 W
SCREEN DISSIPATION ¹	450 W

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

	Min.	Max.
Heater Current, at 6.3 volts	152	168 A
Interelectrode Capacitances, cathode grounded ¹		
Cin	154.0	167.0 pF
Cout	22.0	27.0 pF
Cgp	----	2.0 pF
Interelectrode Capacitances, grid and screen grounded ¹		
Cin	62.0	72.0 pF
Cout	23.0	28.0 pF
Cpk	----	0.3 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 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.

Plate *Dissipation (kilowatts)	Water Flow GPM	Approx. Pressure Drop PSI
10	2.2	3.3
15	3.0	5.0
20	4.0	8.0
25	5.0	11.5

*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.

4CW25,000A

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 means 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.

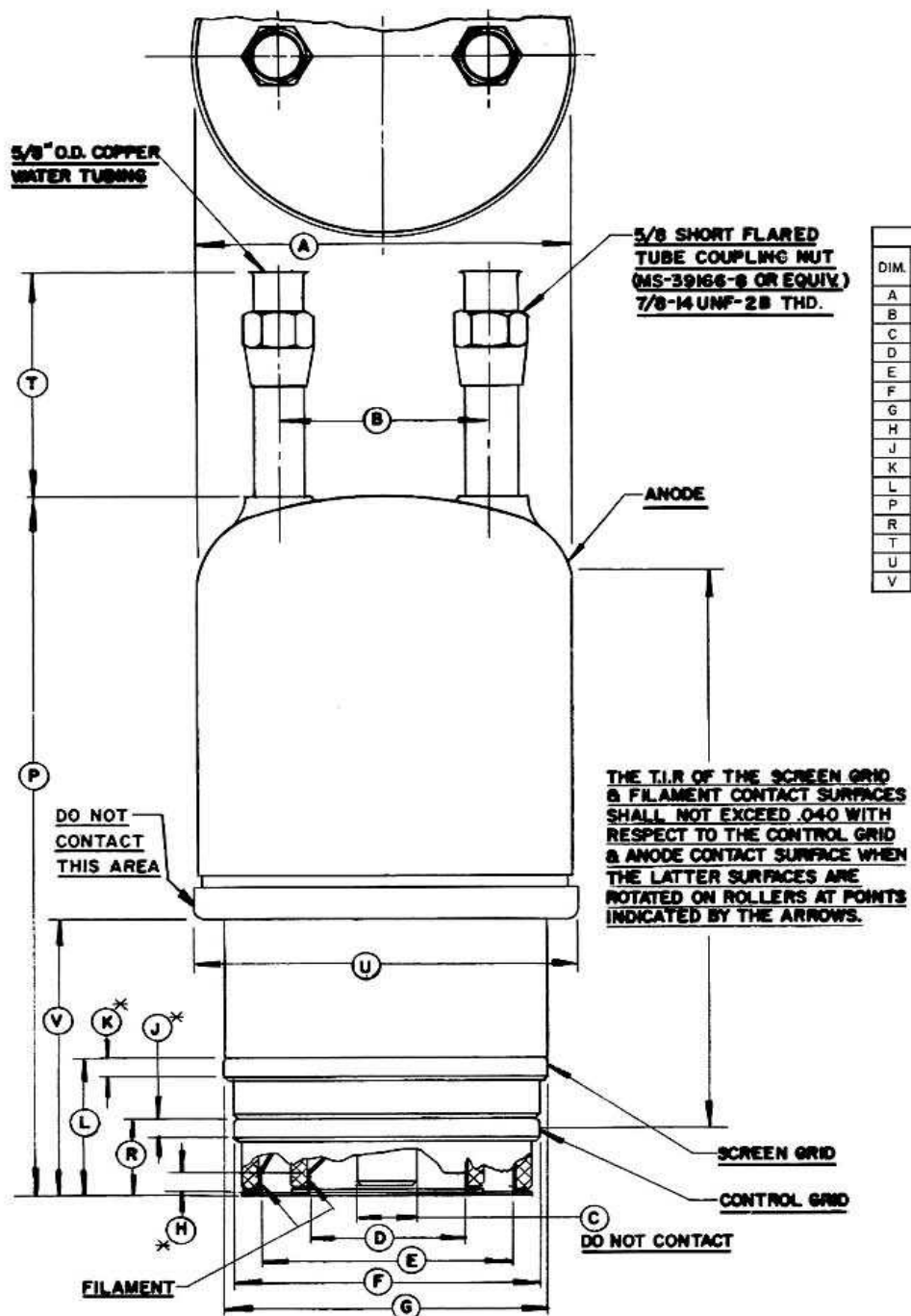
Many EIMAC power tubes, such as the 4CW-25,000A, are specifically designed to generate or amplify radio frequency power. There may be a relatively strong rf field in the general proximity of the power tube and its associated circuitry---the more power involved, the stronger the rf field. Proper enclosure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



DIM.	INCHES			MILLIMETERS		
	MIN.	MAX.	REF.	MIN.	MAX.	REF.
A	4.570	4.630	--	116.08	117.60	--
B	2.625	2.875	--	66.67	73.02	--
C	.720	.760	--	18.29	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	.188	--	--	4.77	--	--
J	.188	--	--	4.77	--	--
K	.188	--	--	4.77	--	--
L	1.764	1.826	--	44.80	46.38	--
P	9.065	9.565	--	230.25	242.95	--
R	.986	1.050	--	25.04	26.67	--
T	2.875	3.125	--	73.02	79.37	--
U	--	4.750	--	--	120.65	--
V	3.625	3.675	--	92.07	93.34	--

NOTES:

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

