

TENTATIVE DATA

Eitel-McCULLOUGH, Inc.
 SAN BRUNO, CALIFORNIA

4X5000A

**RADIAL-BEAM
 POWER TETRODE**

The Eimac 4X5000A is a compact high power forced-air-cooled tetrode of metal and ceramic construction. The 4X5000A is useful as an oscillator, amplifier or modulator at frequencies up to 30 megacycles at full ratings. Its characteristics make it particularly useful as a linear single-sideband amplifier, class AB₁ audio amplifier or as a screen-modulated radio-frequency amplifier.

A pair of these tubes will deliver 17.5 kilowatts of audio-frequency or radio-frequency power with zero driving power. The plate dissipation is rated at five kilowatts for most applications, and six kilowatts for Class-AB operation.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten		
Voltage	- - - - -	7.5 volts
Current	- - - - -	75 amperes
Grid-Screen Amplification Factor (Average) - - - - - 5		
Direct Interelectrode Capacitances (Average)		
	Grounded Cathode	Grounded Grid
Feedback	- - - - - 0.75 uuf	0.14 uuf
Input	- - - - - 106 uuf	47 uuf
Output	- - - - - 18 uuf	18 uuf
Highest Frequency for Maximum Ratings - - - - - 30 mc		



MECHANICAL

Base	- - - - -	Special, Concentric
Recommended Socket	- - - - -	Eimac SK-300
Mounting	- - - - -	Axis vertical, base down or up
Cooling	- - - - -	Forced Air
Maximum Over-all Dimensions:		
Length	- - - - -	9-1/8 inches
Diameter	- - - - -	4-15/16 inches
Net Weight	- - - - -	9 1/2 pounds
Shipping Weight (Approx.)	- - - - -	22 pounds

Note: Typical operation data are based on conditions of adjusting the r-f drive to a specified plate current, maintaining fixed conditions of grid bias and screen voltage. It will be found that if this procedure is followed, there will be little variation in power output between tubes even though there may be some variation in grid and screen currents. Where grid bias is obtained principally by means of a grid resistor, to control plate current it is necessary to make the resistor adjustable.

RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C, Key-down conditions, per tube:

MAXIMUM RATINGS	
D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	3.0 MAX. AMPERES
PLATE DISSIPATION	5000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 mc.)	
D-C Plate Voltage	7500 volts
D-C Screen Voltage	500 volts
D-C Grid Voltage	-350 volts
D-C Plate Current	2.8 amperes
D-C Screen Current	0.5 amperes
D-C Grid Current	0.25 amperes
Peak R-F Grid Voltage	590 volts
Driving Power	150 watts
Grid Dissipation	60 watts
Screen Dissipation	250 watts
Plate Dissipation	5000 watts
Plate Power Output	16,000 watts

PLATE-MODULATED RADIO-FREQUENCY POWER AMPLIFIER

Class-C Telephony, Carrier Conditions
unless otherwise specified, one tube:

MAXIMUM RATINGS

D-C PLATE VOLTAGE	5000 MAX. VOLTS
D-C SCREEN VOLTAGE	1000 MAX. VOLTS
D-C PLATE CURRENT	2.5 MAX. AMPERES
PLATE DISSIPATION*	3500 MAX. WATTS
SCREEN DISSIPATION	250 MAX. VOLTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Frequencies below 30 mc.:

D-C Plate Voltage	- - - - -	5000 volts
D-C Screen Voltage	- - - - -	500 volts
D-C Grid Voltage	- - - - -	-400 volts
D-C Plate Current	- - - - -	1.4 amperes
D-C Screen Current	- - - - -	0.26 amperes
D-C Grid Current	- - - - -	0.050 amperes
Peak R-F Grid Voltage	- - - - -	520 volts
Grid Driving Power	- - - - -	25 watts
Grid Dissipation	- - - - -	6 watts
Screen Dissipation	- - - - -	130 watts
Plate Dissipation	- - - - -	1100 watts
Peak A-F Screen Voltage for 100% modulation	- - - - -	450 volts
Plate Power Output	- - - - -	5.8 kilowatts

*Corresponds to 5 kw at 100%, sine-wave modulation.

CLASS-AB RADIO-FREQUENCY OR AUDIO POWER AMPLIFIER

MAXIMUM RATINGS per tube:

D-C PLATE VOLTAGE	7500 MAX. VOLTS
D-C SCREEN VOLTAGE	1500 MAX. VOLTS
D-C PLATE CURRENT	4.0 MAX. AMPERES
PLATE DISSIPATION	6000 MAX. WATTS
SCREEN DISSIPATION	250 MAX. WATTS
GRID DISSIPATION	75 MAX. WATTS

TYPICAL OPERATION, Class-AB₁ R-F Linear Amplifier, one tube,
Peak Envelope or Modulation Crest Conditions,
Frequencies below 30 mc.:

D-C Plate Voltage	- - - - -	7500 volts
D-C Screen Voltage	- - - - -	1250 volts
D-C Grid Voltage*	- - - - -	-300 volts
D-C Plate Current	- - - - -	1.9 amperes
Zero-Signal Plate Current	- - - - -	0.50 amperes
D-C Screen Current	- - - - -	0.20 amperes
D-C Grid Current	- - - - -	0 amperes
Driving Power	- - - - -	0 watts
Peak R-F Grid Voltage	- - - - -	300 volts
Screen Dissipation	- - - - -	250 watts
Plate Dissipation	- - - - -	4200 watts
Plate Power Output**	- - - - -	10,000 watts

*Adjust grid voltage to obtain specified Zero-signal plate current.

**Peak envelope Power Output or R-F Power Output at crest of modulation envelope.

TYPICAL OPERATION, Class-AB₁ Audio Amplifier, two tubes unless otherwise specified:

D-C Plate Voltage	- - - - -	4000	5000	6000	7000	volts
D-C Screen Voltage	- - - - -	1250	1250	1250	1250	volts
D-C Grid Voltage	- - - - -	-270	-280	-310	-325	volts
D-C Zero-Signal Plate Current	- - - - -	1.25	1.00	0.83	0.70	amperes
D-C Max.-Signal Plate Current	- - - - -	5.10	4.40	4.25	3.65	amperes
D-C Zero-Signal Screen Current	- - - - -	0	0	0	0	amperes
D-C Max.-Signal Screen Current	- - - - -	0.35	0.33	0.30	0.24	amperes
Load Resistance, P-to-P	- - - - -	1500	2370	2940	4100	ohms
Peak A-F Driving Voltage	- - - - -	250	240	270	235	volts
Driving Power	- - - - -	0	0	0	0	watts
Max.-Signal Plate Dissipation	- - - - -	4200	4200	4200	4200	watts
Max.-Signal Power Output	- - - - -	11,500	13,500	17,000	17,500	watts

APPLICATION

MECHANICAL

Mounting—The 4X5000A must be mounted 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-300 is designed especially for the concentric base terminals of the 4X5000A. 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, after which a duct guides it into the anode cooling fins.

Cooling—The maximum temperature rating for the external surfaces of the 4X5000A is 200°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 stem surfaces below 200°C.

When the tube is mounted in the Eimac SK-300 Socket, plate dissipation power of 5,000 watts requires 175 CFM air flow, corresponding to a pressure differential across tube and socket of 1.5 inches water column. Cooling at the 6,000-watt dissipation power level requires 210 CFM air flow, corresponding to a pressure

differential of 2.25 inches water column across the tube and socket.

The flow rates and pressure differentials specified above apply to air at sea level pressure and at 20°C ambient temperature.

If the 4X5000A is operated in a socket of a design different from that of the SK-300, the air-flow rates must be determined independently for each design, using the maximum rated temperature as the criterion for satisfactory cooling.

A convenient method of measuring temperatures is the use of a temperature-sensitive paint, applied sparingly to the tube surfaces. When heavy coats are applied, the air-cooled surface of the paint may not reach the tube temperature because the paint conducts heat poorly and errors can occur. One type of temperature-sensitive paint can be obtained from the Tempil Corporation, 11 West 25th Street, New York, 10, N.Y.

The air inlet to the cooling system should be equipped with an effective air filter, which should be inspected periodically to assure adequate air flow into the system.

ELECTRICAL

Filament Operation—The rated filament voltage for the 4X5000A is 7.5 volts. The actual operating voltage should be maintained within the range from 7.15 to 7.85 volts, as measured at the base of the tube.

Electrode Dissipation Ratings—The maximum dissipation ratings for the 4X5000A must be respected to avoid damage to the tube. An exception is the plate dissipation, which may be permitted to rise above the maximum rating during brief periods, such as may occur during tuning.

Grid Dissipation—The grid dissipation can be determined approximately by use of the expression:

$$P_{g1} = e_{comp} I_c$$

where: P_{g1} = Grid dissipation, watts;

e_{comp} = Peak grid-filament positive voltage, volts;

I_c = D-C grid current, amperes.

The value of the peak positive grid voltage can be measured by means of a suitable peak-reading vacuum tube voltmeter.

Screen Dissipation—The screen dissipation, in cases where there is no a-c applied to the screen, is the simple product of the screen voltage and the screen current.

In case the screen voltage is modulated, the screen dissipation will depend strongly on the loading, driving power, and carrier screen voltage.

Plate Dissipation—The plate dissipation rating for the 4X5000A is 5000 watts for most applications, but for audio and SSB amplifier applications, the maximum dissipation rating is 6000 watts.

In class-AB and class-B amplifiers, the maximum plate dissipation does not coincide with maximum power output, but occurs at some lower power level determined jointly by the bias voltage and the driving voltage applied to the tube. Accordingly, it is advisable to limit the plate dissipation under full power conditions to approximately 70% of the maximum rated plate dissipation of the tubes used.

Screen modulated operation produces maximum plate dissipation under carrier conditions. The dissipation diminishes as the modulation increases.

When the 4X5000A is operated as a plate-modulated r-f power amplifier, the power input 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.

Special Applications—If it is desired to operate this tube under conditions widely different from those given here, write to Eitel-McCullough, Inc., San Bruno, California, for information and recommendations.



