



E I M A C
 Division of Varian
 SAN CARLOS
 CALIFORNIA

8438
4-400A
 RADIAL-BEAM
 POWER TETRODE
 •
 MODULATOR
 OSCILLATOR
 AMPLIFIER

The EIMAC 8438/4-400A is a compact, ruggedly constructed power tetrode having a maximum plate dissipation rating of 400 watts. It is intended for use as an amplifier, oscillator or modulator. The low grid-plate capacitance of this tetrode coupled with its low driving-power requirement allows considerable simplification of the association circuit and driver stage.

The 8438/4-400A is cooled by radiation from the plate and by circulation of forced-air through the base, around the envelope, and over the plate seal. Cooling can be greatly simplified by using an EIMAC SK-400 Air-System Socket and its accompanying glass chimney. This socket is designed to maintain the correct balance of cooling air between the component parts of the tube.†



GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	14.5 amperes
Grid-Screen Amplification Factor (Average)	5.1
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.12 μmfd
Input	12.5 μmfd
Output	4.7 μmfd
Transconductance ($I_b=100\text{ma.}$, $E_b=2500\text{V.}$, $E_{c2}=500\text{V.}$)	4,000 μmhos
Frequency for Maximum Ratings	110 MHz

MECHANICAL

Base	See drawing
Basing	See drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat Dissipating Plate Connector	EIMAC HR-6
Recommended Socket	EIMAC SK-400 Air System Socket
Maximum Over-all Dimensions	
Length	6.38 inches
Diameter	3.56 inches
Net Weight	9 ounces
Shipping Weight	2.5 pounds
If an Air-System Socket is used, mounted on a 1/4 inch deck, the over-all dimensions of the system including chimney and HR-6 Heat Dissipating Plate Connector are:	
Length	8.0 inches
Diameter	5.5 inches

Note: Typical operation data are based on conditions of adjusting the rf grid 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.

†Guarantee applies only when the 4-400A is used as specified with adequate air in the SK-400 Air-System Socket or equivalent.



RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telephony or FM Telephony

MAXIMUM RATINGS (Key-down conditions, per tube to 110 MHz)

Table with 2 columns: Parameter (DC PLATE VOLTAGE, DC SCREEN VOLTAGE, DC PLATE CURRENT, PLATE DISSIPATION, SCREEN DISSIPATION, GRID DISSIPATION) and Rating (4000 VOLTS, 600 VOLTS, 350 MA, 400 WATTS, 35 WATTS, 10 WATTS).

TYPICAL OPERATION (Frequencies below 75 MHz, one tube)

Table with 2 columns: Parameter (DC Plate Voltage, DC Screen Voltage, DC Grid Voltage, DC Plate Current, DC Screen Current, DC Grid Current, Screen Dissipation, Grid Dissipation, Peak RF Grid Input Voltage, Driving Power*, Plate Power Input, Plate Dissipation, Plate Power Output) and Rating (2500 3000 4000 volts, 500 500 500 volts, -200 -220 -220 volts, 350 350 350 ma, 46 46 40 ma, 18 19 18 ma, 23 23 20 watts, 1.8 1.9 1.8 watts, 300 320 320 volts, 5.4 6.1 5.8 watts, 875 1050 1400 watts, 235 250 300 watts, 640 800 1100 watts).

TYPICAL OPERATION (110 MHz, two tubes)

Table with 2 columns: Parameter (DC Plate Voltage, DC Screen Voltage, DC Grid Voltage, DC Plate Current, DC Screen Current, DC Grid Current, Driving Power (approx.), Plate Power Output (approx.), Useful Power Output) and Rating (3500 4000 volts, 500 500 volts, -170 -170 volts, 500 540 ma, 34 31 ma, 20 20 ma, 20 20 watts, 1300 1600 watts, 1160 1440 watts).

*Driving Power increases as frequency is increased. At 75 MHz the driving power required is approximately 12 watts.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions unless otherwise specified. One tube)

MAXIMUM RATINGS

Table with 2 columns: Parameter (DC PLATE VOLTAGE, DC SCREEN VOLTAGE, DC GRID VOLTAGE, DC PLATE CURRENT, PLATE DISSIPATION, SCREEN DISSIPATION, GRID DISSIPATION) and Rating (3200 VOLTS, 600 VOLTS, -500 VOLTS, 275 MA, 270 WATTS, 35 WATTS, 10 WATTS).

MAXIMUM RATINGS (Frequencies below 30 MHz, Intermittent Service)

Table with 2 columns: Parameter (DC PLATE VOLTAGE, DC SCREEN VOLTAGE, DC GRID VOLTAGE, DC PLATE CURRENT, PLATE DISSIPATION, SCREEN DISSIPATION, GRID DISSIPATION) and Rating (4000 VOLTS, 600 VOLTS, -500 VOLTS, 275 MA, 270 WATTS, 35 WATTS, 10 WATTS).

TYPICAL OPERATION (Frequencies below 75 MHz, Continuous Service)

Table with 2 columns: Parameter (DC Plate Voltage, DC Screen Voltage, DC Grid Voltage, DC Plate Current, DC Screen Current, DC Grid Current, Screen Dissipation, Grid Dissipation, Peak AF Screen Voltage (100% modulation), Peak RF Grid Input Voltage, Driving Power, Plate Power Input, Plate Dissipation, Plate Power Output) and Rating (2000 2500 3000 volts, 500 500 500 volts, -220 -220 -220 volts, 275 275 275 ma, 30 28 26 ma, 12 12 12 ma, 15 14 13 watts, 1.1 1.1 1.1 watts, 350 350 350 volts, 290 290 290 volts, 3.5 3.5 3.5 watts, 550 688 825 watts, 170 178 195 watts, 380 510 630 watts).

TYPICAL OPERATION (Frequencies below 30 MHz, Intermittent Service)

Table with 2 columns: Parameter (DC Plate Voltage, DC Screen Voltage, DC Grid Voltage, DC Plate Current, DC Screen Current, DC Grid Current, Screen Dissipation, Grid Dissipation, Peak AF Screen Voltage (100% modulation), Peak RF Grid Input Voltage, Driving Power, Plate Power Input, Plate Dissipation, Plate Power Output) and Rating (2000 2500 3000 3650 volts, 500 500 500 500 volts, -220 -220 -220 -220 volts, 275 275 275 275 ma, 30 28 26 23 ma, 12 12 12 13 ma, 15 14 13 12 watts, 1.1 1.1 1.1 1.2 watts, 350 350 350 350 volts, 290 290 290 315 volts, 3.5 3.5 3.5 4.0 watts, 550 688 825 1000 watts, 170 178 195 235 watts, 380 510 630 765 watts).

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB

MAXIMUM RATINGS (per tube)

Table with 2 columns: Parameter (DC PLATE VOLTAGE, DC SCREEN VOLTAGE, MAX-SIGNAL DC PLATE CURRENT, PLATE DISSIPATION, SCREEN DISSIPATION, GRID DISSIPATION) and Rating (4000 VOLTS, 800 VOLTS, 350 MA, 400 WATTS, 35 WATTS, 10 WATTS).

TYPICAL OPERATION CLASS AB₁

Table with 2 columns: Parameter (DC Plate Voltage, DC Screen Voltage, DC Grid Voltage (approx.), Zero-Signal DC Plate Current, Max-Signal DC Plate Current, Zero-Signal DC Screen Current, Max-Signal DC Screen Current, Effective Load, Plate-to-Plate, Peak AF Grid Input Voltage (per tube), Driving Power, Max-Signal Plate Dissipation (per tube), Max-Signal Plate Power Output) and Rating (2500 3000 3500 4000 volts, 750 750 750 750 volts, -130 -137 -145 -150 volts, 190 160 140 120 ma, 635 635 610 585 ma, 0 0 0 0 ma, 28 26 32 40 ma, 6800 8900 11,500 14,500 ohms, 130 137 145 150 volts, 0 0 0 0 watts, 370 400 400 400 watts, 850 1110 1330 1540 watts).

*Adjust to give stated zero-signal plate current. The DC resistance in series with the control grid of each tube should not exceed 250,000 ohms.

TYPICAL OPERATION CLASS AB₂

Table with 2 columns: Parameter (DC Plate Voltage, DC Screen Voltage, DC Grid Voltage (approx.), Zero-Signal DC Plate Current, Max-Signal DC Plate Current, Zero-Signal DC Screen Current, Max-Signal DC Screen Current, Effective Load, Plate-to-Plate, Peak AF Grid Input Voltage (per tube), Max-Signal Peak Driving Power, Max-Signal Nominal Driving Power, Max-Signal Plate Dissipation (per tube), Max-Signal Plate Power Output) and Rating (2500 3000 3500 4000 volts, 500 500 500 500 volts, -75 -80 -85 -90 volts, 190 160 140 120 ma, 700 700 700 638 ma, 0 0 0 0 ma, 50 40 38 32 ma, 7200 9100 10,800 14,000 ohms, 133 140 145 140 volts, 8.6 9.0 10.2 7.0 watts, 4.3 4.5 5.1 3.5 watts, 320 363 400 400 watts, 1110 1375 1650 1750 watts).

*Adjust for stated zero-signal plate current.

PULSE SERVICE — For information on Pulse Service Ratings, "Application Bulletin No. 3, Pulse Service Notes", will be furnished free on request.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION," POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC, DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

MECHANICAL

Mounting — The 4-400A must be mounted vertically, base up or down. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The metal tube-base shell should be grounded by means of suitable spring fingers. The above requirements are met by the EIMAC SK-400 Air-System Socket. A flexible connecting strap should be provided between the EIMAC HR-6 cooler on the plate terminal and the external plate circuit. The tube must be protected from severe vibration and shock.

Cooling — Adequate forced-air cooling must be provided to maintain the base seals at a temperature below 200°C., and the plate seal at a temperature below 225°C.

When the EIMAC SK-400 Air-System Socket is used, a minimum air flow of 14 cubic feet per minute at a static pressure of 0.25 inches of water, as measured in the socket at sea level, is required to provide adequate cooling under all conditions of operation. Seal temperature limitations may require that cooling air be supplied to the tube even when the filament alone is on during standby periods.

In the event an Air-System Socket is not used, provision must be made to supply equivalent cooling of the base, the envelope, and the plate lead.

Tube temperatures may be measured with the aid of "Tempilaq," a temperature-sensitive lacquer manufactured by the Tempil Corporation, 132 West 22nd Street, New York 11, N.Y.

ELECTRICAL

Filament Voltage — For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated voltage of 5.0 volts. Variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage — The dc bias voltage for the 4-400A should not exceed 500 volts. If grid leak bias is used, suitable means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation, and the grid-leak resistor should be made adjustable to facilitate maintaining the bias voltage and plate current at the desired values from tube to tube. In operation above 50 MHz, it is advisable to keep the bias voltage as low as is practicable.

Screen Voltage — The dc screen voltage for the 4-400A should not exceed 600 volts in rf applications. In audio applications a maximum dc screen voltage of 800 volts may be used. The screen voltages shown under "Typical Operation" are representative voltages for the type of operation involved.

Plate Voltage — The plate-supply voltage for the 4-400A should not exceed 4000 volts in CW and audio applications. In plate-modulated telephony service the dc plate-supply voltage should not exceed 3200 volts, except below 30 MHz, intermittent service, where 4000 volts may be used.

Grid Dissipation — Grid dissipation for the 4-400A should not be allowed to exceed 10 watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{\text{cmp}} I_c$$

where P_g = Grid dissipation

e_{cmp} = Peak positive grid to cathode voltage, and

I_c = dc grid current

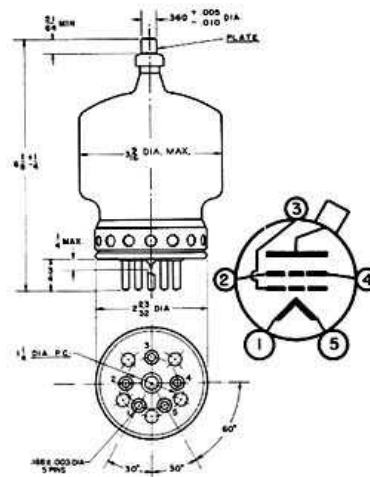
e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid. (For suitable peak v.t.v.m. circuits see EIMAC Application Bulletin Number 6, "Vacuum Tube Ratings." This bulletin is available on request.)

Screen Dissipation — The power dissipated by the screen of the 4-400A must not exceed 35 watts. 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 screen dissipation to 35 watts in event of circuit failure.

Plate Dissipation — Under normal operating conditions, the plate dissipation of the 4-400A should not be allowed to exceed 400 watts.

In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.





4-400A

