

Eitel-McCullough, Inc.

SAN BRUNO, CALIFORNIA

4-400A

RADIAL-BEAM
POWER TETRODE
•
MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 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 associated circuit and driver stage.

The 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 ($I_b = 100\text{ma.}$, $E_s = 2500\text{V.}$, $E_{cr} = 500\text{V.}$)	4,000 μmhos
Frequency for Maximum Ratings	110 Mc.

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 r-f 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.

RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony

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

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA
PLATE DISSIPATION	400 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc., one tube)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	-200	-220	-220	volts
D-C Plate Current	350	350	350	ma
D-C Screen Current	46	46	40	ma
D-C Grid Current	18	19	18	ma
Screen Dissipation	23	23	20	watts
Grid Dissipation	1.8	1.9	1.8	watts
Peak R-F Grid Input Voltage	300	320	320	volts
Driving Power*	5.4	6.1	5.8	watts
Plate Power Input	875	1050	1400	watts
Plate Dissipation	235	250	300	watts
Plate Power Output	640	800	1100	watts

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

TYPICAL OPERATION (110 Mc., two tubes)

D-C Plate Voltage	3500	4000	volts
D-C Screen Voltage	500	500	volts
D-C Grid Voltage	-170	-170	volts
D-C Plate Current	500	540	ma
D-C Screen Current	34	31	ma
D-C Grid Current	20	20	ma
Driving Power (approx.)	20	20	watts
Plate Power Output (approx.)	1300	1600	watts
Useful Power Output	1160	1440	watts

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

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▶ Indicates change from sheet dated 1-30-53.

PLATE MODULATED RADIO FREQUENCY AMPLIFIER

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

MAXIMUM RATINGS (Frequencies below 75 Mc. Continuous Service)

D-C PLATE VOLTAGE	- - -	3200 MAX. VOLTS
D-C SCREEN VOLTAGE	- - -	600 MAX. VOLTS
D-C GRID VOLTAGE	- - -	-500 MAX. VOLTS
D-C PLATE CURRENT	- - -	275 MAX. MA
PLATE DISSIPATION	- - -	270 MAX. WATTS
SCREEN DISSIPATION	- - -	35 MAX. WATTS
GRID DISSIPATION	- - -	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc. Continuous Service)

D-C Plate Voltage	- - -	2000	2500	3000	volts
D-C Screen Voltage	- - -	500	500	500	volts
D-C Grid Voltage	- - -	-220	-220	-220	volts
D-C Plate Current	- - -	275	275	275	ma
D-C Screen Current	- - -	30	28	26	ma
D-C Grid Current	- - -	12	12	12	ma
Screen Dissipation	- - -	15	14	13	watts
Grid Dissipation	- - -	1.1	1.1	1.1	watts
Peak A-F Screen Voltage (100% modulation)	- - -	350	350	350	volts
Peak R-F Grid Input Voltage	- - -	290	290	290	volts
Driving Power	- - -	3.5	3.5	3.5	watts
Plate Power Input	- - -	550	688	825	watts
Plate Dissipation	- - -	170	178	195	watts
Plate Power Output	- - -	380	510	630	watts

MAXIMUM RATINGS (Frequencies below 30 Mc., Intermittent Service)

D-C Plate Voltage	- - -	4000 MAX. VOLTS
D-C Screen Voltage	- - -	600 MAX. VOLTS
D-C Grid Voltage	- - -	-500 MAX. VOLTS
D-C Plate Current	- - -	275 MAX. MA
Plate Dissipation	- - -	270 MAX. WATTS
Screen Dissipation	- - -	35 MAX. WATTS
Grid Dissipation	- - -	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 30 Mc., Intermittent Service)

D-C Plate Voltage	- - -	2000	2500	3000	3650	volts
D-C Screen Voltage	- - -	500	500	500	500	volts
D-C Grid Voltage	- - -	-220	-220	-220	-220	volts
D-C Plate Current	- - -	275	275	275	275	ma
D-C Screen Current	- - -	30	28	26	23	ma
D-C Grid Current	- - -	12	12	12	13	ma
Screen Dissipation	- - -	15	14	13	12	watts
Grid Dissipation	- - -	1.1	1.1	1.1	1.2	watts
Peak A-F Screen Voltage (100% modulation)	- - -	350	350	350	350	volts
Peak R-F Grid Input Voltage	- - -	290	290	290	315	volts
Driving Power	- - -	3.5	3.5	3.5	4.0	watts
Plate Power Input	- - -	550	688	825	1000	watts
Plate Dissipation	- - -	170	178	195	235	watts
Plate Power Output	- - -	380	510	630	765	watts

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR—CLASS AB

MAXIMUM RATINGS (PER TUBE)

D-C PLATE VOLTAGE	- - -	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	- - -	800 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT	- - -	350 MAX. MA.
PLATE DISSIPATION	- - -	400 MAX. WATTS
SCREEN DISSIPATION	- - -	35 MAX. WATTS
GRID DISSIPATION	- - -	10 MAX. WATTS

TYPICAL OPERATION CLASS AB₁

(Sinusoidal wave, two tubes unless otherwise specified)

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

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

TYPICAL OPERATION CLASS AB₂

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	- - -	2500	3000	3500	4000	volts
D-C Screen Voltage	- - -	500	500	500	500	volts
D-C Grid Voltage (approx.)*	- - -	-75	-80	-85	-90	volts
Zero-Signal D-C Plate Current	- - -	190	160	140	120	ma
Max-Signal D-C Plate Current	- - -	700	700	700	638	ma
Zero-Signal D-C Screen Current	- - -	0	0	0	0	ma
Max-Signal D-C Screen Current	- - -	50	40	38	32	ma
Effective Load, Plate-to-Plate	- - -	7200	9100	10,800	14,000	ohms
Peak A-F Grid Input Voltage (per tube)	- - -	133	140	145	140	volts
Max-Signal Peak Driving Power	- - -	8.6	9.0	10.2	7.0	watts
Max-Signal Nominal Driving Power	- - -	4.3	4.5	5.1	3.5	watts
Max-Signal Plate Dissipation (per tube)	- - -	320	363	400	400	watts
Max-Signal Plate Power Output	- - -	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 EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

MECHANICAL

Mounting—The 4-400A must be mounted vertically, base up or base 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, pro-

vision 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, 11 West 25th Street, New York 10, 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 d-c 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 Mc., it is advisable to keep the bias voltage as low as is practicable.

Screen Voltage—The d-c screen voltage for the 4-400A should not exceed 600 volts in r-f applications. In audio applications a maximum d-c 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 d-c plate-supply voltage should not exceed 3200 volts, ex-

cept below 30 Mc., 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,

$$P_g = e_{cmp} I_c$$

where P_g = Grid Dissipation

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

I_c = D-c 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.)

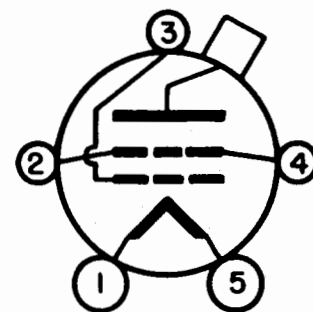
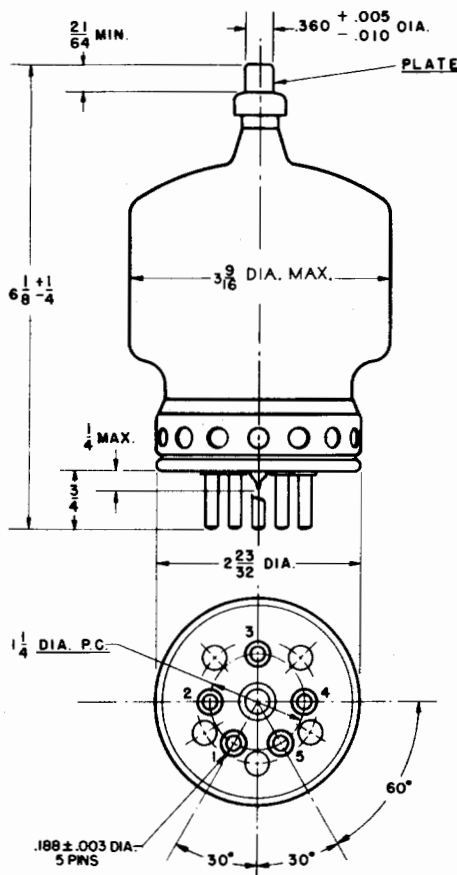
Screen Dissipation—The power dissipated by the screen of the 4-400A must not exceed 35 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to 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.

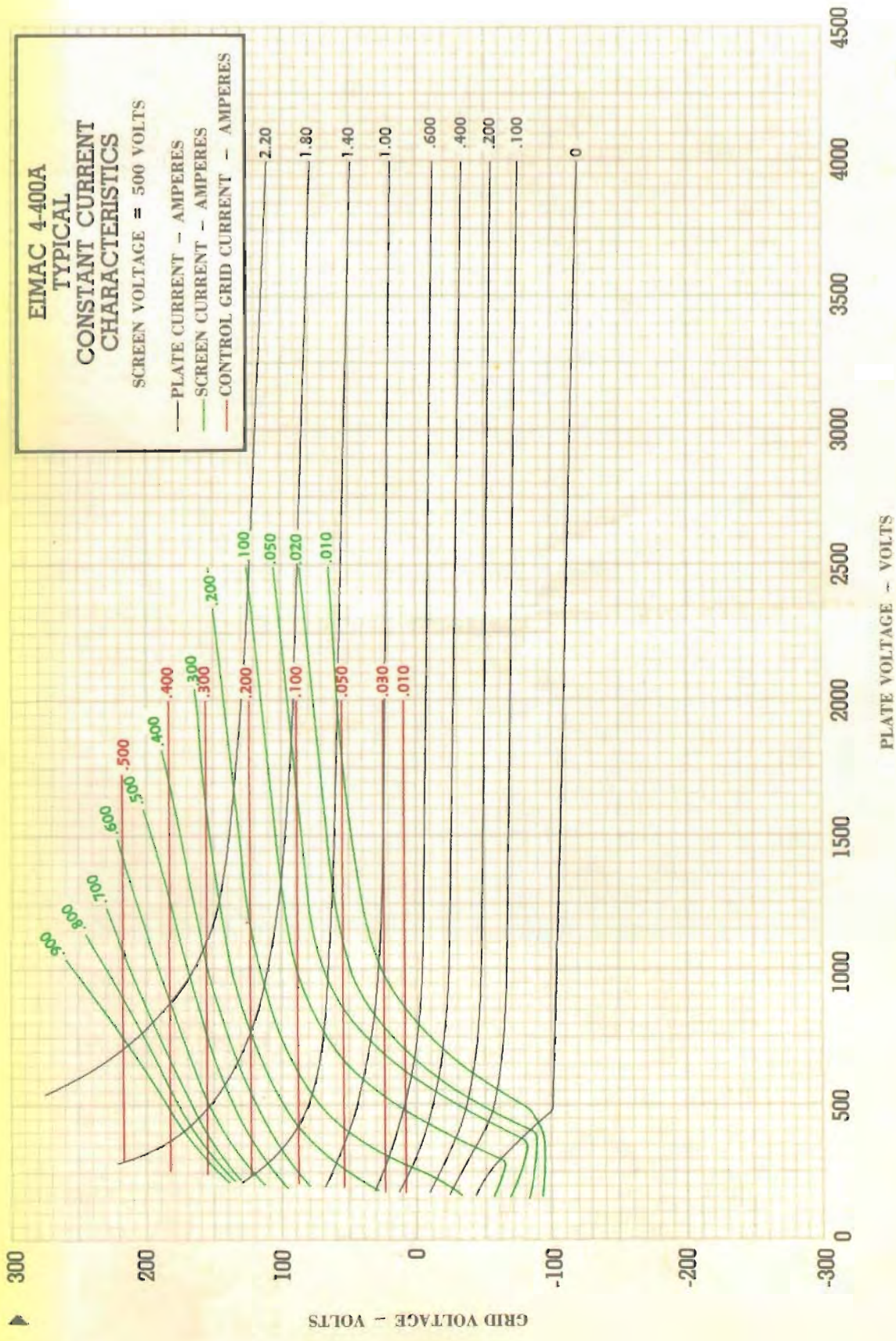
In plate modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 270 watts. The plate dissipation will rise to 400 watts under 100% sinusoidal modulation.

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

GENERAL INFORMATION PERTAINING TO THE OPERATION OF THE 4-400A MAY BE FOUND IN APPLICATION BULLETIN NO. 8, "THE CARE AND FEEDING OF POWER TETRODES." THIS BULLETIN IS AVAILABLE UPON REQUEST.



▶ Indicates change from sheet dated 1-30-53.



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