

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4-250A

(RMA 5D22)

POWER TETRODE
•
MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 4-250A is a high-vacuum power tetrode having a maximum plate dissipation rating of 250 watts. It is intended for amplifier, oscillator and modulator service. Cooling of the 4-250A is accomplished by radiation from the plate, which operates at a visibly red temperature at maximum dissipation, and by forced air circulation through the base and around the envelope.

The low driving power required by the 4-250A, together with its low grid-plate capacitance and compact and rugged construction, allows considerable simplification of the associated circuits and the driver stage.

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 (without shielding, base grounded)	0.12 μ fd.
Input	12.7 μ fd.
Output	4.5 μ fd.
Transconductance ($i_b = 100$ ma., $E_b = 2500$ v., $E_{c2} = 500$ v.)	4000 μ mhos

MECHANICAL

Base	5-pin metal shell, No. 5008B
Basing	RMA type 5BK
Cooling	Radiation and forced air
Maximum Overall Dimensions:	
Length	6.38 inches
Diameter	3.56 inches
Net Weight	8.0 ounces
Shipping Weight (Average)	2.5 pounds



RADIO FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C FM or Telegraphy (Key-down conditions, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE ¹	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C GRID VOLTAGE	-500 MAX. VOLTS
D-C PLATE CURRENT	350 MAX. MA.
PLATE DISSIPATION	250 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc.)

D-C Plate Voltage	2500	3000	4000	volts
D-C Screen Voltage	500	500	500	volts
D-C Grid Voltage	-150	-180	-225	volts
D-C Plate Current	300	345	312	ma.
D-C Screen Current	60	60	45	ma.
D-C Grid Current	9	10	9	ma.
Screen Dissipation	30	30	22.5	watts
Grid Dissipation	0.35	0.8	0.46	watts
Peak R-F Grid Input Voltage (approx.)	220	265	303	volts
Driving Power (approx.) ²	1.70	2.6	2.46	watts
Plate Power Input	750	1035	1250	watts
Plate Dissipation	175	235	250	watts
Plate Power Output	575	800	1000	watts

¹ Indicates change from sheet dated 9-1-46.

(Effective 4-15-47) Copyright, 1947 by Eitel-McCullough, Inc.

HIGH-LEVEL-MODULATED RADIO FREQUENCY AMPLIFIER

Class-C Telephony (Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE ¹	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	165 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION (Frequencies below 75 Mc.)

D-C Plate Voltage	2500	3000	volts
D-C Screen Voltage	400	400	volts
D-C Grid Voltage	-200	-310	volts
D-C Plate Current	200	225	ma.
D-C Screen Current	30	30	ma.
D-C Grid Current	9	9	ma.
Screen Dissipation	12	12	watts
Grid Dissipation	1.8	2.7	watts
Peak R-F Grid Input Voltage (approx.)	255	365	volts
Driving Power (approx.)	2.2	3.2	watts
Plate Power Input	500	675	watts
Plate Dissipation	125	165	watts
Plate Power Output	375	510	watts

¹ Above 75 Mc. the maximum plate voltage rating depends upon frequency, see page six.

² Driving power increases above 40 Mc. See Page Six.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB₁ (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	350 MAX. MA.
PLATE DISSIPATION, PER TUBE	250 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	35 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	2500	3000	volts
D-C Screen Voltage	500	500	500	500	volts
D-C Grid Voltage ²	-64	-88	-90	-93	volts
Zero-Signal D-C Plate Current	120	110	120	120	ma.
Max-Signal D-C Plate Current	400	405	430	417	ma.
Zero-Signal D-C Screen Current	-0.4	-0.3	-0.3	-0.2	ma.
Max-Signal D-C Screen Current	23	22	13	10.5	ma.
Effective Load, Plate-to-Plate	6250	9170	11,400	15,000	ohms
Peak A-F Grid Input Voltage (per tube)	64	88	90	93	volts
Driving Power	0	0	0	0	watt
Max-Signal Plate Dissipation (per tube)	145	175	225	250	watts
Max-Signal Plate Power Output	310	460	625	750	watts
Total Harmonic Distortion	4	2.5	2	2.5	per cent

² The effective grid-circuit resistance must not exceed 250,000 ohms.

AUDIO FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB₂ (Sinusoidal wave, two tubes unless otherwise specified)

MAXIMUM RATINGS

D-C PLATE VOLTAGE	4000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	350 MAX. MA.
PLATE DISSIPATION, PER TUBE	250 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	35 MAX. WATTS

TYPICAL OPERATION

D-C Plate Voltage	1500	2000	2500	3000	volts
D-C Screen Voltage	300	300	300	300	volts
D-C Grid Voltage	-48	-48	-51	-53	volts
Zero-Signal D-C Plate Current	100	120	120	125	ma.
Max-Signal D-C Plate Current	485	510	500	473	ma.
Zero-Signal D-C Screen Current	0	0	0	0	ma.
Max-Signal D-C Screen Current	34	26	23	33	ma.
Effective Load, Plate-to-Plate	5400	8000	10,900	16,000	ohms
Peak A-F Grid Input Voltage (per tube)	96	99	100	99	volts
Max-Signal Avg. Driving Power (approx.)	2.1	2.3	2.2	1.9	watts
Max-Signal Peak Driving Power	4.7	5.5	4.8	4.6	watts
Max-Signal Plate Dissipation (per tube)	150	185	205	190	watts
Max-Signal Plate Power Output	428	650	840	1040	watts
Total Harmonic Distortion	3	4	4	4.5	per cent

APPLICATION

MECHANICAL

Mounting—The 4-250A must be mounted vertically, base up or base down. The socket must provide clearance for the glass tip-off which extends through the center of the base. The metal base shell should be grounded by means of suitable spring fingers. A flexible connecting strap should be provided between the plate terminal and the external plate circuit. The socket must not apply excessive lateral pressure against the base pins. The tube must be protected from severe vibration and shock.

Adequate cooling must be provided for the seals and envelope of the 4-250A. Forced-air circulation in the amount of five cubic feet per minute through the base of the tube is required. This air should be applied simultaneously with filament power. The temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C in continuous-service applications.

A relatively slow movement of air past the tube is sufficient to prevent a plate seal temperature in excess of maximum at frequencies below 30 Mc. At frequencies above 30 Mc., radio-frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to bulb and plate seal cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc., however.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C are permissible. When the ambient temperature does not exceed 30° C it will not ordinarily be necessary to pro-

vide forced cooling of the bulb and plate seal to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-radiating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

ELECTRICAL

Filament Voltage—The filament voltage, as measured directly at the filament pins, should be between 4.75 and 5.25 volts.

Bias Voltage—D-c bias voltage for the 4-250A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Grid Dissipation—Grid dissipation for the 4-250A should not be allowed to exceed five 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 voltage, and

I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid³.

Screen Voltage—The d-c screen voltage for the 4-250A should not exceed 600 volts.

Screen Dissipation—The power dissipated by the screen of the 4-250A must not exceed 35 watts. Screen dissipa-

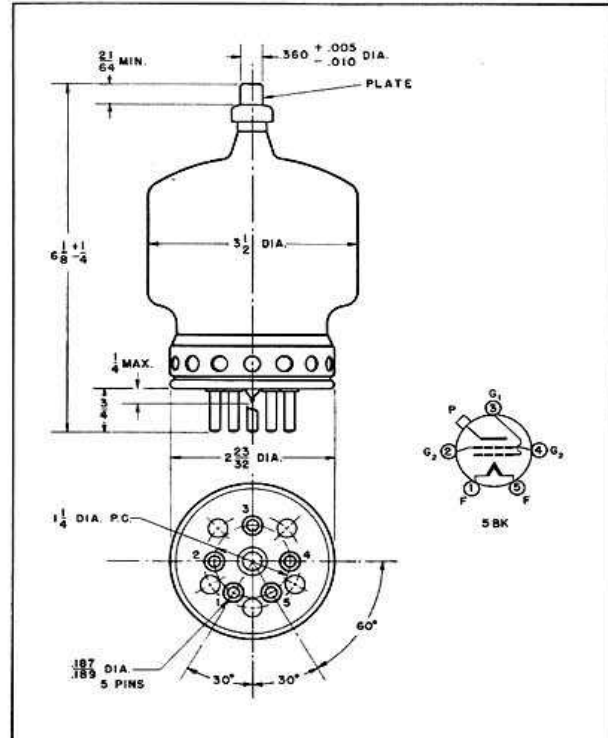
³ For suitable peak v.t.v.m. circuits see, for instance, "Vacuum Tube Ratings," Eimac News, January, 1945. This article is available in reprint form on request.

Grid bias voltage for class-AB₂ service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB₁ conditions the effective grid-circuit resistance should not exceed 250,000 ohms.

The peak driving power figures given in the class-AB₂ tabulated data are included to make possible an accurate determination of the required driver output power. The driver amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

In some cases the maximum-signal plate dissipation shown under "Typical Operation" is less than the maximum rated plate dissipation of the 4-250A. In these cases, the plate dissipation reaches a maximum value, equal to the maximum rating, at a point somewhat below maximum-signal conditions.

The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.



COMPONENTS FOR TYPICAL CIRCUITS

L_{p1} - C_{p1} — Tank circuit appropriate for operating frequency;
 $Q = 12$. Capacitor plate spacing = .200".

L_{p2} - C_{p2} — Tank circuit appropriate for operating frequency;
 $Q = 12$. Capacitor plate spacing = .200".

L_{p3} - C_{p3} — Tank circuit appropriate for operating frequency;
 $Q = 12$. Capacitor plate spacing = .375".

L_{g1} - C_{g1} — Tuned circuit appropriate for operating frequency.

L_{g2} - C_{g2} — Tuned circuit appropriate for operating frequency.

C_1 — .002-ufd., 500-v. mica

C_2 — .002-ufd., 5000-v. mica

C_3 — .001-ufd., 2500-v. mica

C_4 — .1-ufd., 1000-v. paper

C_5 — .1-ufd., 600-v. paper

C_6 — .5-ufd., 600-v. paper

C_7 — .03-ufd., 600-v. paper

C_8 — .1-ufd., 1000-v. paper

C_9 — .25-ufd., 1000-v. paper

R_1 — 86,700 ohms, adjustable 100,000 ohms, 100 watts

R_2 — 250,000 ohms, 1/2 watt

R_4 — 15,000 ohms, 5 watts

R_5 — 25,000 ohms, 2 watts

R_6 — 2,500 ohms, 5 watts

R_7 — 35,000 ohms, 160 watts

R_8 — 250,000 ohms, 1/2 watt

R_9 — 200,000 ohms, 2 watts

R_{10} — 500 ohms, 1/2 watt

R_{11} — 1 megohm, 1/2 watt

R_{12} — 100,000 ohms, 1 watt

R_{13} — 200,000 ohms, 1/2 watt

R_{14} — 10,000 ohms, 1/2 watt

R_{15} — 50 ohms, 10 watts

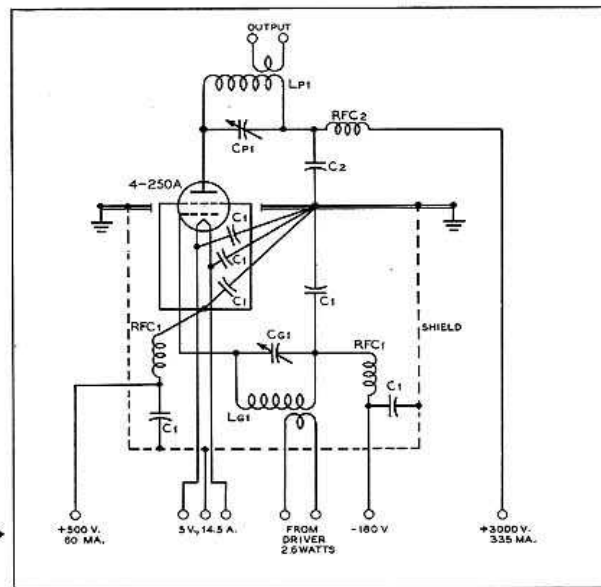
R_{16} — 100,000 ohms, 100 watts

RFC_1 — 2.5-mhy., 125-ma. r-f choke

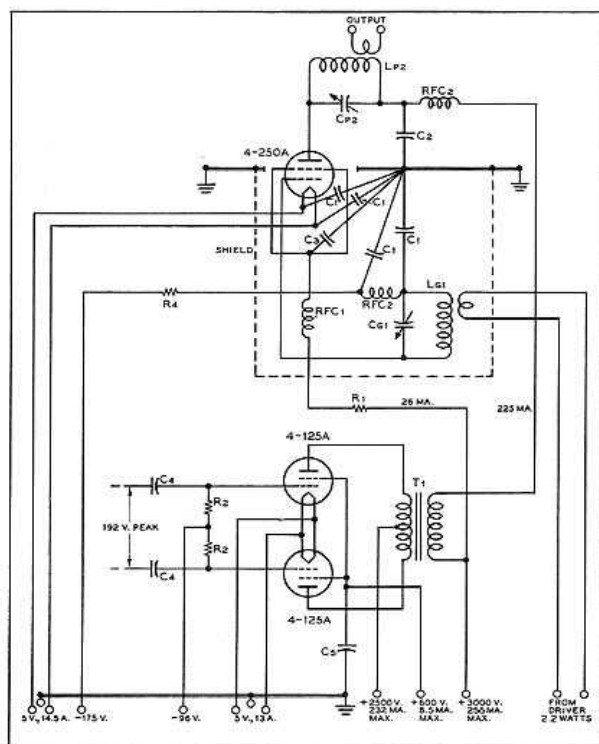
RFC_2 — 1-mhy., 500-ma. r-f choke

T_1 — 350-watt modulation transformer; ratio pri. to sec. approx. 1.5 : 1; pri. impedance 20,300 ohms, sec. impedance 13,300 ohms.

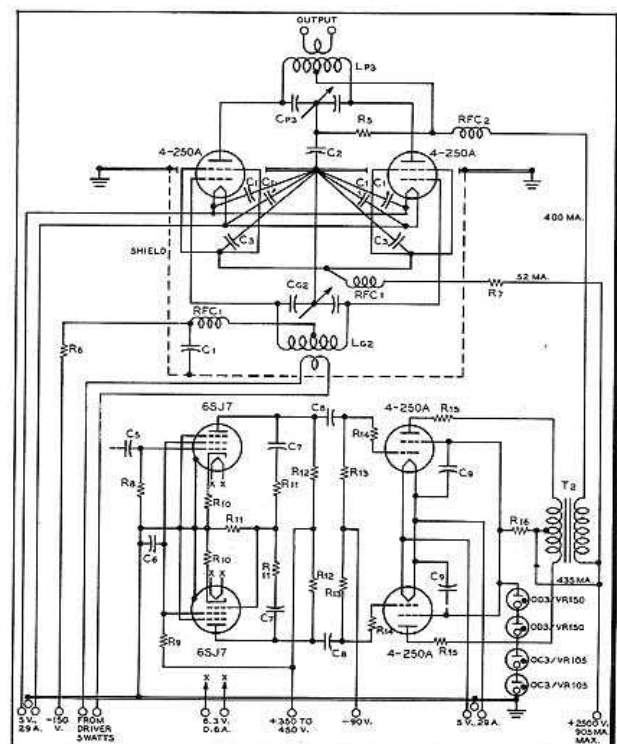
T_2 — 600-watt modulation transformer; ratio pri. to sec. approx. 1.8 : 1; pri. impedance 11,400 ohms, sec. impedance 6,250 ohms.



Typical radio frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.



Typical high-level-modulated r-f amplifier circuit, with modulator stage, 675 watts input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 1000 watts input.

