



EITEL-McCULLOUGH, INC.
SAN CARLOS · CALIFORNIA

4-250A

(5D22)
**RADIAL-BEAM
POWER TETRODE**

**MODULATOR
OSCILLATOR
AMPLIFIER**

The Eimac 4-250A is a compact, ruggedly constructed power tetrode having a maximum plate dissipation rating of 250 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 4-250A is cooled by radiation from the plate and by circulation of forced-air through the base and around the envelope.

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 $\mu\mu\text{f}$
Input	12.7 $\mu\mu\text{f}$
Output	4.5 $\mu\mu\text{f}$
Transconductance ($I_b = 100 \text{ ma.}$, $E_b = 2500\text{V.}$, $E_{c2} = 500\text{V.}$)	4000 μmhos
Frequency for Maximum Ratings	110 Mc.

MECHANICAL

Base	5-pin metal shell
Recommended Socket	E. F. Johnson Co. socket No. 122-275, National Co. No. HX-100, or equivalent.
Basing	See drawing
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat Dissipating Plate Connector	Eimac HR-6
Maximum Temperature of Base and Plate Seals	Base Seals 200° C. Plate Seal 170° C.
Maximum Over-all Dimensions	Length 6.38 inches Diameter 3.56 inches
Net Weight	8.0 ounces
Shipping Weight	2.0 pounds

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 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	10 MAX. WATTS

PLATE-MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony

(Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

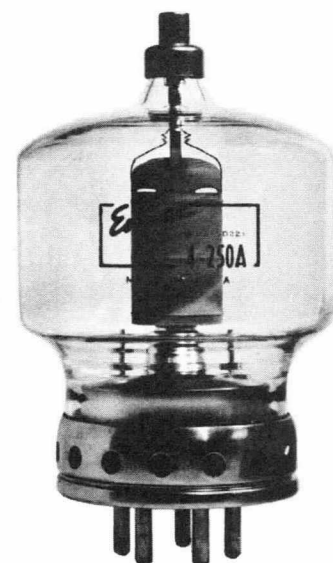
D-C PLATE VOLTAGE ¹	3200 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	275 MAX. MA
PLATE DISSIPATION	165 MAX. WATTS
SCREEN DISSIPATION	35 MAX. WATTS
GRID DISSIPATION	10 MAX. WATTS

TYPICAL OPERATION (Frequencies below 110 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

TYPICAL OPERATION (Frequencies below 110 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
Peak A-F Screen Voltage (100% modulation)	350	350	volts
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



AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR—CLASS AB

MAXIMUM RATINGS (PER TUBE)

[illegible]

TYPICAL OPERATION CLASS AB.

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	-	-	1500	2000	2500	3000	volts
D-C Screen Voltage	-	-	600	600	600	600	volts
D-C Grid Voltage ^{1, 2}	-	-	-95	-104	-110	-116	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	watts
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

¹Adjust for stated zero-signal plate current.

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

TYPICAL OPERATION CLASS AB₂

(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	-	-	-	1500	2000	2500	3000	volts
D-C Screen Voltage	-	-	-	300	300	300	300	volts
D-C Grid Voltage ¹	-	-	-	-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

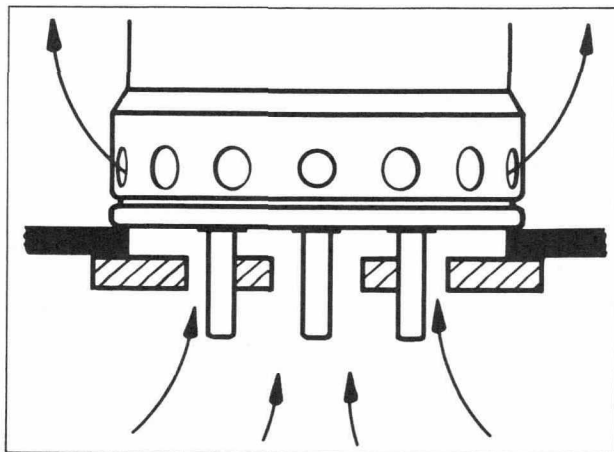
IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION", POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE WRITE EITEL-McCULLOUGH, INC., FOR INFORMATION AND RECOMMENDATIONS.

APPLICATION

Mechanical

Mounting—The 4-250A must be mounted vertically, base down or base up. 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 tube should be mounted above the chassis deck to allow free circulation of air in the manner shown in the mounting diagram below. The above requirements are met by the E. F. Johnson Co. socket No. 122-275, the National Co. socket No. HX-100, or a similar socket.

A flexible connecting strap should be provided between the HR-6 Heat Dissipating Plate Connector on the plate terminal and the external circuit. The tube must be protected from severe vibration and shock.



4-250A mounting providing base cooling, shielding and isolation of output and input compartments.

► **Cooling**—Adequate cooling must be provided for the seals and envelope of the 4-250A. At frequencies above 30Mc, cooling air in the amount of five cubic feet per minute through the base of the tube is required. This quantity is obtained when the pressure drop across the base of the tube is equal to 0.20 inch of water column. At frequencies below 30Mc the volume may be reduced to two cubic feet per minute. At this reduced air flow, the pressure drop is equal to 0.10 inch of water column. Base-cooling 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 the maximum rating 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. (The Eimac SK-400 Air-System Socket provides a convenient method of mounting and cooling the 4-250A at VHF, should the user desire to use it. Full information is available on the SK-400 Air-System Socket data sheet, or it will be sent from the factory on request.)

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 provide 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. The five cubic feet per minute base-cooling requirement must be observed in intermittent service.

Electrical

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

► Indicates change from sheet dated 8-24-53.

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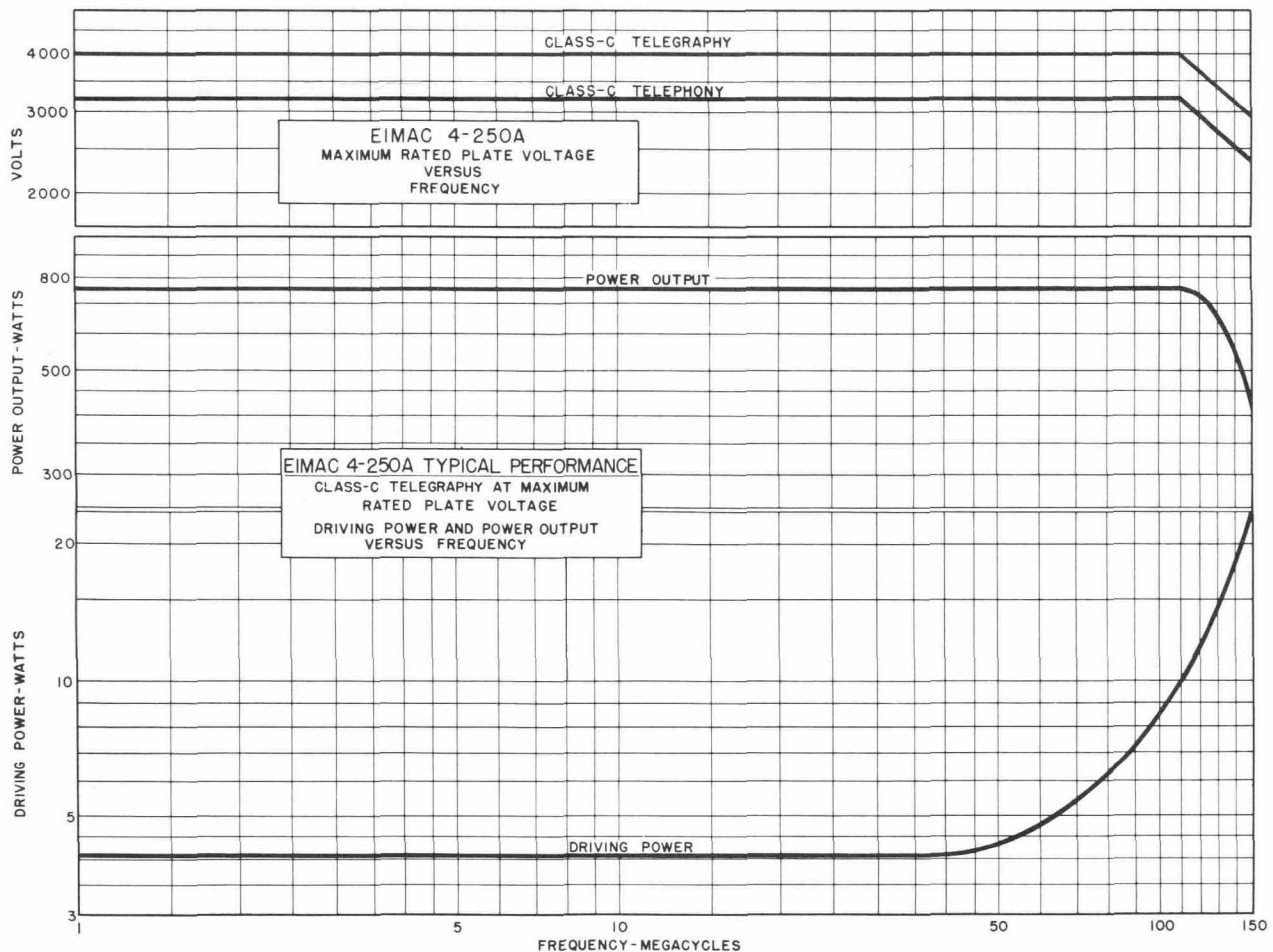
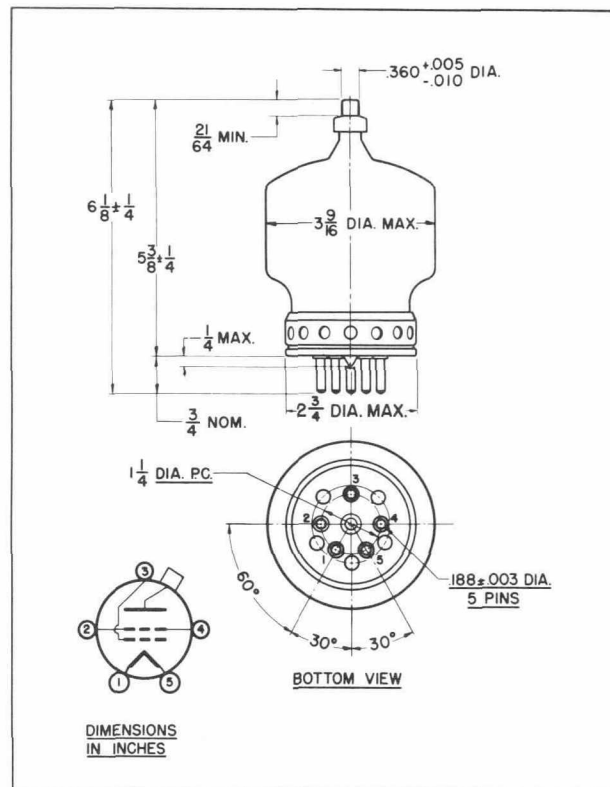


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The peak driving power figures given in the class-AB₂ tabulated data are included to make possible an accurate determination of the required driver output power. The driver amplifier must be capable of supplying the peak driving power without distortion. 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.

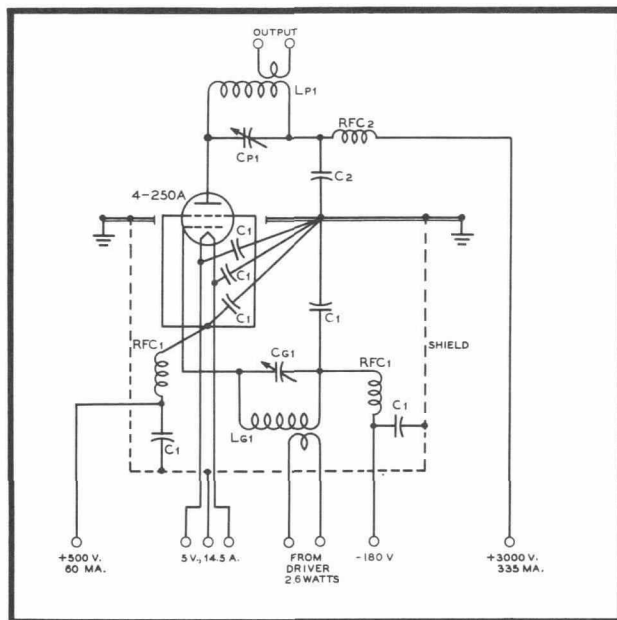
The power output figures given in the tabulated data refer to the total power output from the amplifier tubes. The useful power output will be from 5 to 15 per cent less than the figures shown, due to losses in the output transformer.



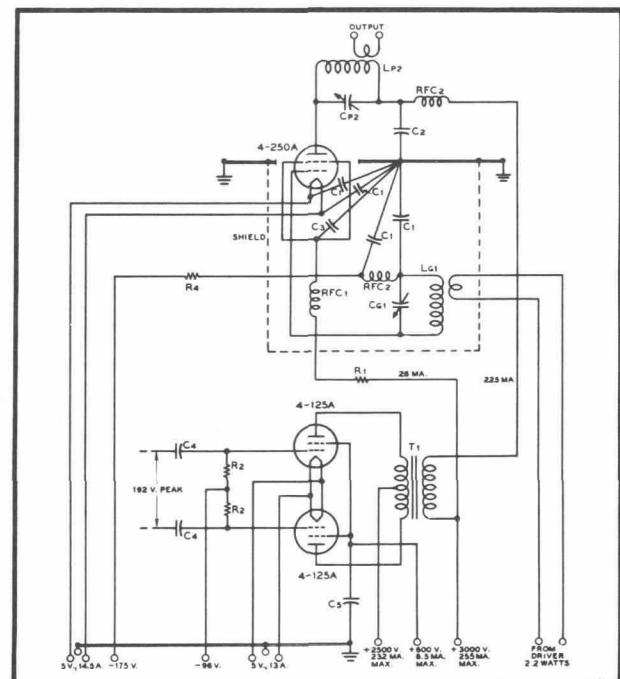


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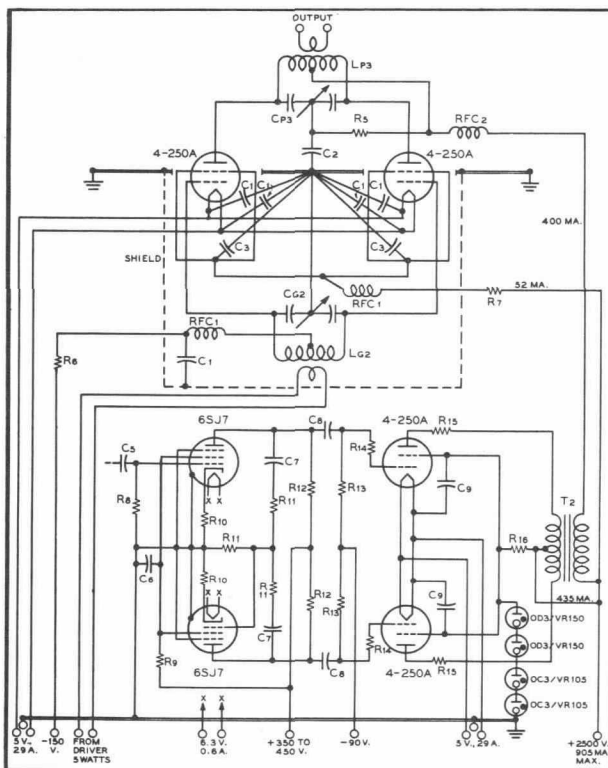
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Typical radio frequency power amplifier circuit, Class-C telegraphy, 1000 watts input.



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.

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.
- C₁ — .002-ufd., 500-v. mica
- C₂ — .002-ufd., 5000-v. mica
- C₃ — .001-ufd., 2500-v. mica
- C₄ — .1-ufd., 1000-v. paper
- C₅ — .1-ufd., 600-v. paper
- C₆ — .5-ufd., 600-v. paper
- C₇ — .03-ufd., 600-v. paper
- C₈ — .1-ufd., 1000-v. paper
- C₉ — .25-ufd., 1000-v. paper
- R₁ — 86,700 ohms, adjustable 100,000 ohms, 100 watts
- R₂ — 250,000 ohms, 1/2 watt
- R₃ — 15,000 ohms, 5 watts
- R₄ — 25,000 ohms, 2 watts
- R₅ — 2,500 ohms, 5 watts
- R₆ — 35,000 ohms, 160 watts
- R₇ — 250,000 ohms, 1/2 watt
- R₈ — 200,000 ohms, 2 watts
- R₉ — 500 ohms, 1/2 watt
- R₁₀ — 1 megohm, 1/2 watt
- R₁₁ — 100,000 ohms, 1 watt
- R₁₂ — 200,000 ohms, 1/2 watt
- R₁₃ — 10,000 ohms, 1/2 watt
- R₁₄ — 50 ohms, 10 watts
- R₁₅ — 100,000 ohms, 100 watts
- R₁₆ — 2.5-mhy., 125-ma. r-f choke
- RFC₁ — 1-mhy., 500-ma. r-f choke
- T₁ — 350-watt modulation transformer; ratio pri. to sec. approx. 1.5 : 1; pri. impedance 20,300 ohms, sec. impedance 13,300 ohms.
- T₂ — 600-watt modulation transformer; ratio pri. to sec. approx. 1.8 : 1; pri. impedance 11,400 ohms, sec. impedance 6,250 ohms.



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