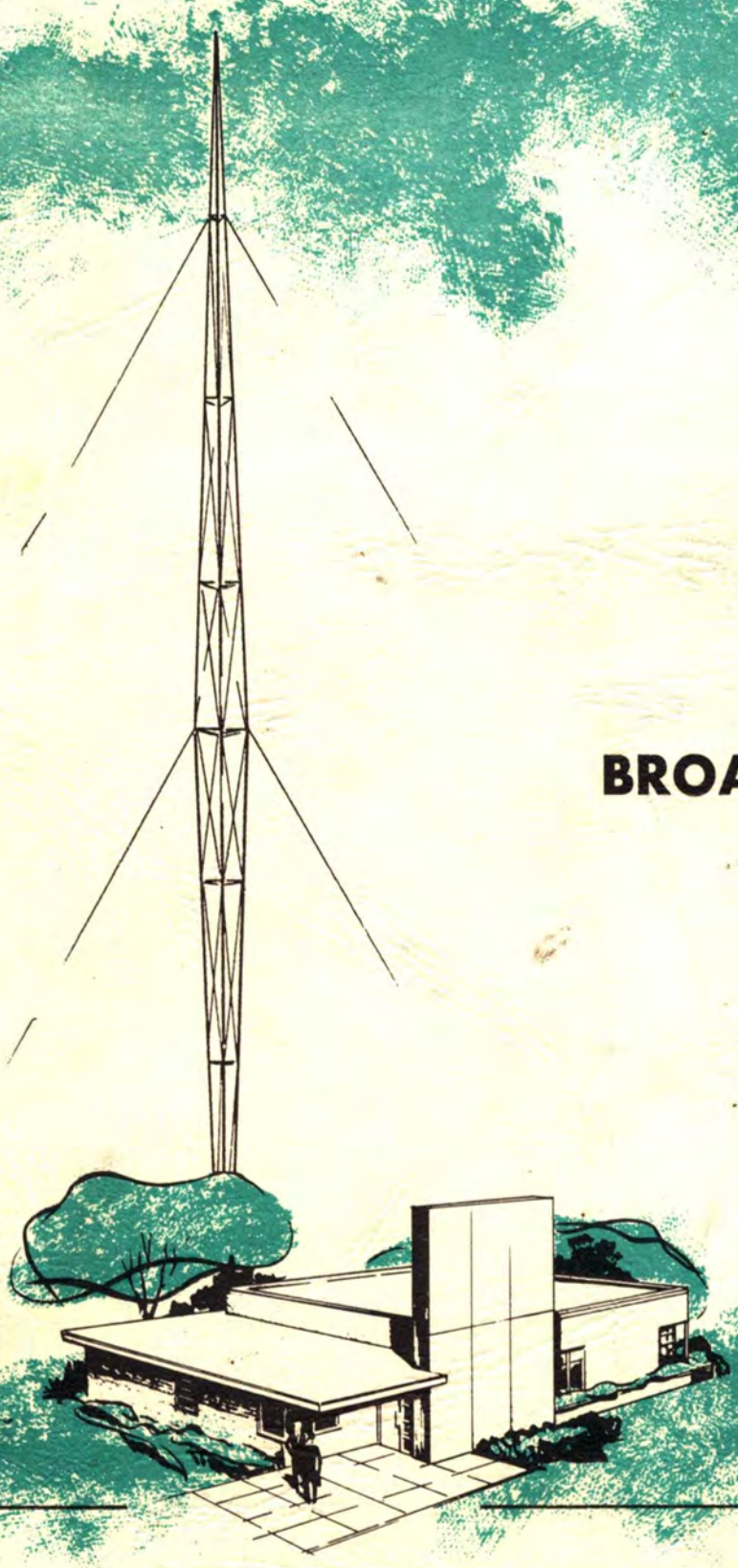
Collins

INSTRUCTION BOOK



830D-1A

1000-WATT FM

BROADCAST TRANSMITTER

COLLINS RADIO COMPANY

SYSTEM INSTRUCTION BOOK

830D-1A
1000-WATT FM BROADCAST TRANSMITTER

CONTENTS

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COLLINS

Cedar Rapids, Iowa, U.S.A.

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830D-1A
1000 WATT FM BROADCAST TRANSMITTER

COLLINS RADIO COMPANY
1962

CEDAR RAPIDS, IOWA, U.S.A.

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TD No.	Title
TD-536	A830-2 10 W Wide-Band FM Broadcast Exciter
TD-567	D830-1 1000 Watt FM Power Amplifier

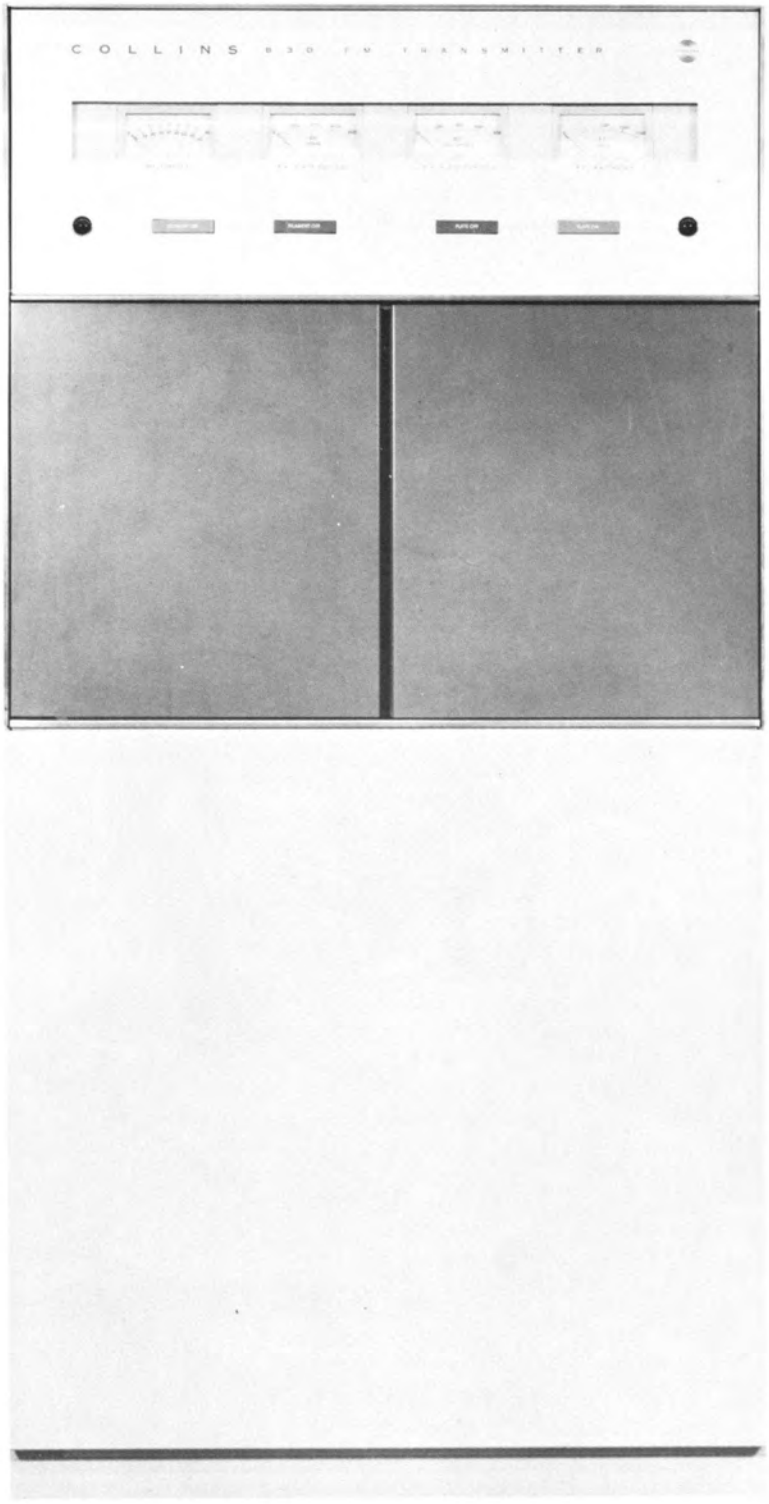


Figure 1-1. 830D-1A 1000 Watt FM Broadcast Transmitter, Over-all View

SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

This instruction book is a guide for installing, adjusting, operating, and maintaining 830D-1A 1000 Watt FM Broadcast Transmitter.

1.2 PURPOSES OF EQUIPMENT.

The 830D-1A 1000 Watt FM Broadcast Transmitter is used for continuous monophonic or optional stereophonic FM broadcast service on a single frequency in the range from 88 to 108 megacycles with an output power of 1000 watts.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The 830D-1A 1000 Watt FM Broadcast Transmitter, shown in figure 1-1, is contained in a single cabinet that is 38 inches wide, 76 inches high, 27 inches deep, and weighs approximately 776 pounds. All transmitter operating controls are located behind the doors on the front of the cabinet. The filament and plate on-off controls and four monitoring meters are located at the top front of the cabinet. The meters may be observed easily while operating the tuning controls. The transmitter uses 6 tubes and 20 transistors, all of which are accessible from the front of the transmitter. The bottom front of the transmitter cabinet is removable to allow access to components on the bottom of the inside panel.

Large doors at the upper rear of the cabinet (see figure 1-2) allow access to the upper part of the transmitter for servicing and maintenance. The lower rear half of the transmitter cabinet is covered by a removable panel that contains a ventilating fan and permanent type air filter. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panel. These interlocks ground the transmitter high-voltage circuits when the doors are opened or the panel is removed. The power amplifier plate-tuning cavity is located in an interlocked compartment at the front of the transmitter.

Inside the transmitter, heavy iron-core components are at the bottom of the cabinet. The exciter portion of the transmitter is mounted on a 19-inch rack on one side of the cabinet. A harmonic filter that is connected to the transmitter output is suspended from the top of the cabinet.

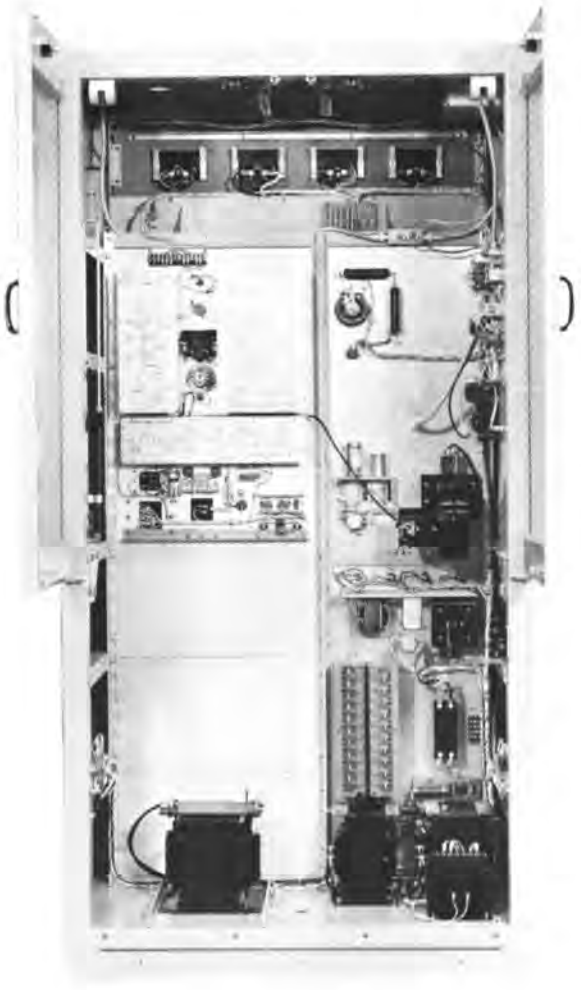


Figure 1-2. 830D-1A 1000 Watt FM Broadcast Transmitter, Rear View with Lower Panel Removed

Cooling air for the transmitter is drawn through a permanent type air filter at the rear of the cabinet by a low-speed, high-volume fan, and exhausted through a shielded opening in the top of the cabinet. An individual pressure blower supplies cooling air directly to the power amplifier tube.

1.3.2 ELECTRICAL DESCRIPTION.

The 830D-1A 1000 Watt FM Broadcast Transmitter is composed of two electrically connected subunits:

(1) a wide band exciter that furnishes a 10-watt FM output to drive (2) a 1000-watt power amplifier. Instruction books covering the exciter and power amplifier used in the transmitter are listed in table 1-1. These two books are supplied following section V of this system instruction book. The subunit instruction books contain detailed descriptions of the two transmitter subunits.

TABLE 1-1
SUBASSEMBLY INSTRUCTION BOOKS

PUBLICATION	INSTRUCTION BOOK PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
D830-1 1000 Watt FM Power Amplifier	TD-567

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of 830D-1A 1000 Watt FM Broadcast Transmitter.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NO.
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00
D830-1 1000 Watt FM Power Amplifier	522-2948-00
250 Watt/1 KW Harmonic Filter	549-2010-00

1.5 ACCESSORY EQUIPMENT.

Table 1-3 lists accessory equipment that is available for use with 830D-1A 1000 Watt FM Broadcast Transmitter. Information on the 786M-1 Stereo Generator will be found in Unit Instructions TD-537.

TABLE 1-3
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NO.
786M-1 Stereo Generator	522-2914-00

1.6 EQUIPMENT SPECIFICATIONS.

1.6.1 MECHANICAL.

Weight	776 pounds. (approximate).
Size	38 inches wide, 76 inches high, 27 inches deep.
Ventilation	One ventilating fan, one blower.
Ambient temperature range	+10°C (50°F) to +55°C (131°F).
Ambient humidity range	0 to 95 percent relative humidity.
Altitude	0 to 6000 feet.
Shock and vibration	Normal handling and transportation.

1.6.2 ELECTRICAL.

Power source	200 to 250 volts, 60 cycle, single phase.
Maximum power requirements	2200 watts.
Power output	1000 watts.
Output impedance	50 ohms, unbalanced, Maximum swr 2:1.
Frequency range	88 to 108 megacycles. Exact operating frequency determined by frequency of crystal in heterodyning oscillator.
Excitation source	Crystal-controlled high-stability oscillator using plated, nontemperature-controlled crystal, controlling an LC modulation oscillator to provide automatic frequency control. The modulation oscillator is then heterodyned up to the station operating frequency

	by a second high-stability, crystal-controlled oscillator.
Carrier-frequency stability	Within ±1000 cps of specified carrier frequency over ambient temperature range from +10°C (50°F) to +55°C (131°F) and line-voltage variations of ±5 percent.
Harmonic and spurious radiation	Any emission appearing on a frequency removed from the carrier by between 120 kc and 240 kc, inclusive, is at least 30 db below the level of the unmodulated carrier.
	Any emission appearing on a frequency removed from the carrier by more than 240 kc and up to and including 600 kc is at least 40 db below the level of the unmodulated carrier.
	Any emission appearing on a frequency removed from the carrier by more than 600 kc is at least 73 db below the level of the unmodulated carrier.
Modulation characteristics	Wide-band direct FM modulation. Standard audio pre-emphasis is incorporated in modulator.
Audio input impedance	600 ohms, balanced.
Audio input level	+10 dbm ±2 db.
Audio frequency response	Complies with standard FCC 75-microsecond pre-emphasis curve.
Audio frequency distortion	50-100 cps, 1.5 percent maximum. 100-7500 cps, 1.0 percent maximum. 7500-15,000 cps, 1.5 percent maximum.
FM noise level	Not less than 65 db below 100 percent modulation (±75 kc).
AM noise level (rms)	Not less than 55 db below equivalent 100 percent AM.

SECTION II
INSTALLATION

2.1 UNPACKING AND INSPECTING.

Be careful when uncrating the transmitter and components to avoid damaging the equipment. Inspect the transmitter carefully for scratches, dents, or other physical damage. Check for loose screws and bolts. Inspect all controls, such as switches, for proper operation as far as can be determined without applying power to the transmitter. Examine cables and wiring, making sure that all connections are tight and clear of each other and the chassis. File any damage claims promptly with the transportation company. If such claims are to filed, retain all packing material.

NOTE

Before installation, check all transistors for proper placement. The transistor location tab must be pointing to the transistor socket locating mark placed adjacent to the transistor socket.

2.2 TRANSMITTER LOCATION.

Plan transmitter and wiring placement carefully before starting installation work. Refer to figure 2-1, the transmitter installation diagram. This diagram shows the location of all wiring openings in the transmitter cabinet. As will be noted, several alternate wiring arrangements can be used. Select the combination that most nearly meets the station requirements.

Allow adequate clearance both in front and back of the transmitter. There should be a minimum of clearance of 3-1/2 feet behind the transmitter to provide sufficient room for service work.

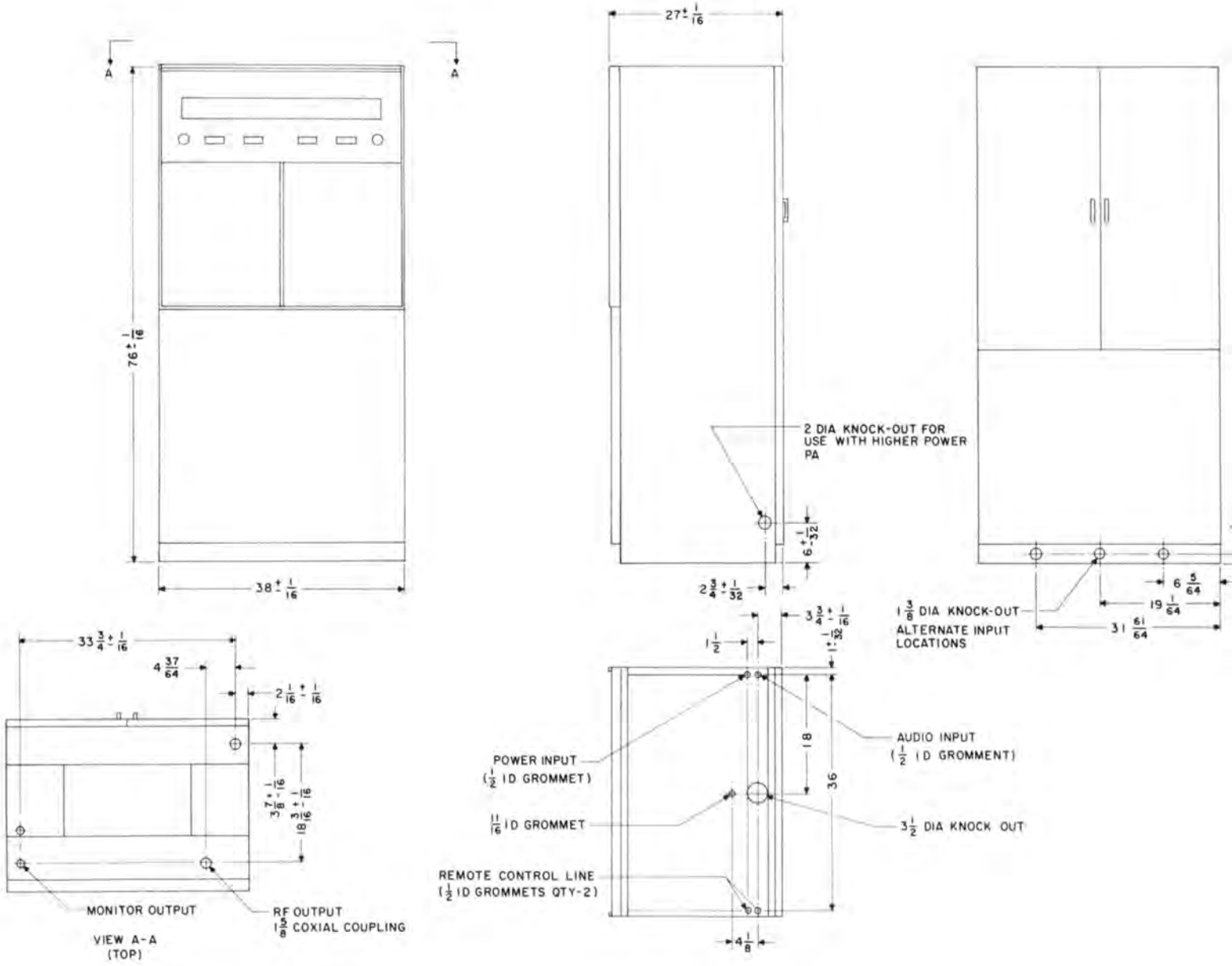


Figure 2-1. 830D-1A 1000 Watt FM Broadcast Transmitter, Outline and Installation Drawing

2.3 EXTERNAL CONNECTIONS.

Refer to figure 2-1 for assistance in making the following external connections.

WARNING

Disconnect the transmitter 230 volt ac power from the fused cutout box before making any connections to, or within, the transmitter.

a. Connect the audio input to the transmitter. Bring the audio signal through the bottom of the cabinet (or other optional input) on a shielded twisted pair. Connect the two audio leads to terminals 1 and 2 of TB305. If the optional stereophonic operation is employed, the left audio leads are connected to TB305-1 and 2 and the right audio leads to TB305-4 and 5. TB305 is located about half way up the cabinet on the left side as viewed from the rear of the cabinet. Connect the shield(s) to terminal 3 of TB305.

b. Connect the FM monitor to the monitor output on the top of the cabinet. Refer to figure 2-1. Use type RG-58U coaxial cable to make this connection.

c. Connect the antenna transmission line to the r-f output connector on top of the 830D-1A cabinet.

CAUTION

Before making this antenna connection, be sure that the transmission line and antenna present a nominal impedance of 50 ohms and an swr of not more than 2:1 at the transmitter operating frequency. If the transmitter output is improperly matched, the transmitter will not operate properly and may be damaged. THIS IS IMPORTANT.

d. Connect the power input cable to the transmitter. This power cable should be brought from an external fused cutout box rated for 12 amperes. Use number 12 wire or larger to make this connection. Connect the power leads to terminals 1 and 2 of TB301, located at the lower left corner of the transmitter cabinet as viewed from the rear. Connect the neutral wire to terminal 3 of TB301. The power cable may be brought into the transmitter through holes in either the bottom or rear of the cabinet. Make sure that the PLATE circuit breaker on the front panel is set to OFF before making these power connections.

2.4 INTERNAL CONNECTIONS.

The 830D-1A 1000 Watt FM Broadcast Transmitter 830D plate and control circuit power transformers are fitted with adjustable taps to compensate for line voltage variations. These taps compensate for line variations from 200 to 250 volts in 10-volt steps. To adjust transformer T301 and T303 for line voltage variations, perform the following steps.

a. Measure the line voltage at the transmitter fused cutout box.

b. Remove the solder lug from T301, terminal 4, and move to the transformer terminal whose input voltage is nearest to the voltage measured in step a. Do not move the solder lug from transformer termina' 5, as this terminal supplies 230 volts to the cabinet fan for all line input connections. See figure 2-2 for transformer terminal numbers versus input voltage.

c. Remove the solder lug from T303, terminal 5, and move to the transformer terminal whose input voltage is nearest to the voltage measured in step a. See figure 2-2 for transformer terminal numbers versus input voltage.

d. Tighten all transformer terminal connections.

The following connections on TB304 should be checked to ensure that the plate-on and filament-off functions will operate: TB304-1 to TB304-2, TB304-3 to TB304-4, TB304-10 to TB304-11.

If the optional stereo generator is installed any time after the initial 830D-1A installation, the 18-db audio

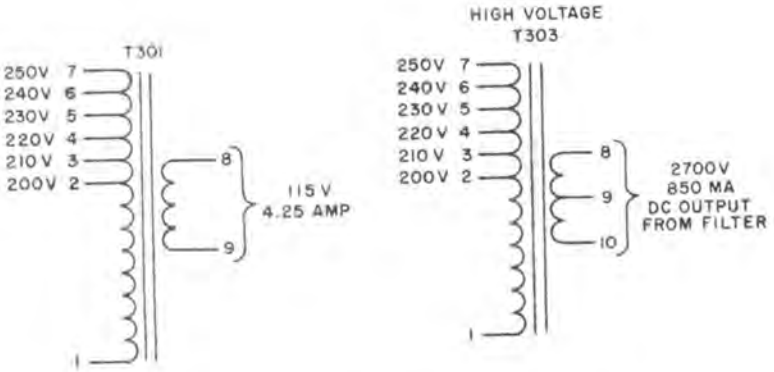


Figure 2-2. Transformer Details

pad will have to be removed from the audio circuitry of the exciter.

2.5 REMOTE CONTROL.

Remote control of 830D-1A 1000 Watt FM Broadcast Transmitter can easily be accomplished by connection to terminal boards TB302 and TB303. Table 2-1 lists the terminal board connections and the remote functions of each pair of terminals. Remote "on" switches should be the normally open momentary type. Remote "off" switches should be the normally closed momentary type. For remote operation, the LOCAL-REMOTE switch within the transmitter cabinet should be in the REMOTE position. When in the REMOTE position, it is still possible to control the transmitter from the transmitter panel switches.

For simplified operation, the FILAMENT ON and PLATE OFF switches could be eliminated. The PLATE ON switch starts a sequence of operations which turns the filaments on and the plate voltage on after the filament time delay is completed. The FILAMENT OFF switch shuts down all transmitter functions.

Equipment is available that will completely control and monitor transmitter operation from a remote location through standard telephone pairs. When such remote control equipment is used, necessary installation and connection information will be supplied with the remote equipment.

If an optional stereo generator is employed in the 830D-1A, remote control of the stereo mode may be accomplished by a ground on TB302-7. If the ground is present, the transmitter will be in the stereo mode. If the ground is removed, the transmitter will be in the monaural mode. Local control of the stereo mode is also available at the transmitter.

TABLE 2-1
REMOTE CONTROL CONNECTIONS

FUNCTION	TERMINALS	
	TB302	TB303
FILAMENT ON		1 and 2
FILAMENT OFF	8 and 9	
PLATE OFF		4 and 2
PLATE ON		3 and 2

2.6 FREQUENCY CHANGE.

If the transmitter operating frequency is changed, the following components will have to be changed or adjusted. These components are (1) exciter heterodyning oscillator crystal (2) plate cavity slider (3) grid tank inductance (4) the screen neutralization.

Table 2-2 lists the channel frequency versus crystal frequency and the Collins part number for each crystal. Figure 2-3 shows the distance the plate cavity slider should be positioned from the deck plate (tube socket mounting plate) for each frequency within the 88 to 108 megacycle range. Figure 2-3 also includes the grid inductance spacing for the same frequency range. Figure 2-4 gives the approximate positioning of the screen neutralizing inductor for the FM band. The plate cavity slider, the grid inductance, and the screen neutralizing inductor may have to be repositioned from positions shown to compensate for individual transmitter characteristics. Refer to the test procedures in paragraph 2.6.1 for tuning details.

2.6.1 NEUTRALIZATION PROCEDURE.

The 1000-watt power amplifier will have to be neutralized if the transmitter frequency is changed and may have to be neutralized if power amplifier tube V201 is replaced. If the frequency has changed, roughly adjust the neutralizing inductor to the spacing given in figure 2-4.

Neutralization is best accomplished by using the feedthrough method. As the sensitive voltmeter necessary for use with this method is normally not available at most stations, the following neutralization procedure should be substituted. Proper neutralization can be checked by tuning the plate through resonance and noting a minimum of change in control grid current.

a. Press the FILAMENT ON switch, and turn off the exciter. Allow the transmitter to warm up for at least 15 minutes. Place the WATTMETER switch in the FORWARD position.

b. Press the PLATE ON switch, and observe the R. F. WATTMETER. If there is an indication on the R. F. WATTMETER, the transmitter is not neutralized. If an indication is present, turn off the plate power, and open the plate cavity. Adjust the neutralizing inductor a SMALL AMOUNT by sliding both shorting blocks in opposite directions. This adjustment is critical. Do not move the shorting blocks a large distance.

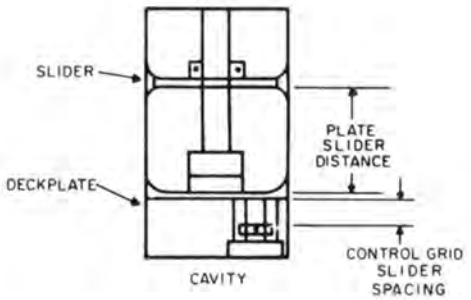
c. Turn on the transmitter, and note the new indication on the R. F. WATTMETER. If the indication has increased, readjust the shorting blocks in the opposite direction.

d. If the indication has decreased upon applying plate voltage, repeat steps b and c until the R.F. WATTMETER indication is zero.

e. With the plate voltage on, remove the grid bias fuse, F304, and watch the R. F. WATTMETER for an

TABLE 2-2. CRYSTAL PART NUMBERS

CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER	CHANNEL FREQ (mc)	CRYSTAL FREQ (mc)	COLLINS PART NUMBER
88.1	74.10000	289-2744-00	98.1	84.10000	289-2794-00
88.3	74.30000	289-2745-00	98.3	84.30000	289-2795-00
88.5	74.50000	289-2746-00	98.5	84.50000	289-2796-00
88.7	74.70000	289-2747-00	98.7	84.70000	289-2797-00
88.9	74.90000	289-2748-00	98.9	84.90000	289-2798-00
89.1	75.10000	289-2749-00	99.1	85.10000	289-2799-00
89.3	75.30000	289-2750-00	99.3	85.30000	289-2800-00
89.5	75.50000	289-2751-00	99.5	85.50000	289-2801-00
89.7	75.70000	289-2752-00	99.7	85.70000	289-2802-00
89.9	75.90000	289-2753-00	99.9	85.90000	289-2803-00
90.1	76.10000	289-2754-00	100.1	86.10000	289-2804-00
90.3	76.30000	289-2755-00	100.3	86.30000	289-2805-00
90.5	76.50000	289-2756-00	100.5	86.50000	289-2806-00
90.7	76.70000	289-2757-00	100.7	86.70000	289-2807-00
90.9	76.90000	289-2758-00	100.9	86.90000	289-2808-00
91.1	77.10000	289-2759-00	101.1	87.10000	289-2809-00
91.3	77.30000	289-2760-00	101.3	87.30000	289-2810-00
91.5	77.50000	289-2761-00	101.5	87.50000	289-2811-00
91.7	77.70000	289-2762-00	101.7	87.70000	289-2812-00
91.9	77.90000	289-2763-00	101.9	87.90000	289-2813-00
92.1	78.10000	289-2764-00	102.1	88.10000	289-2814-00
92.3	78.30000	289-2765-00	102.3	88.30000	289-2815-00
92.5	78.50000	289-2766-00	102.5	88.50000	289-2816-00
92.7	78.70000	289-2767-00	102.7	88.70000	289-2817-00
92.9	78.90000	289-2768-00	102.9	88.90000	289-2818-00
93.1	79.10000	289-2769-00	103.1	89.10000	289-2819-00
93.3	79.30000	289-2770-00	103.3	89.30000	289-2820-00
93.5	79.50000	289-2771-00	103.5	89.50000	289-2821-00
93.7	79.70000	289-2772-00	103.7	89.70000	289-2822-00
93.9	79.90000	289-2773-00	103.9	89.90000	289-2823-00
94.1	80.10000	289-2774-00	104.1	90.10000	289-2824-00
94.3	80.30000	289-2775-00	104.3	90.30000	289-2825-00
94.5	80.50000	289-2776-00	104.5	90.50000	289-2826-00
94.7	80.70000	289-2777-00	104.7	90.70000	289-2827-00
94.9	80.90000	289-2778-00	104.9	90.90000	289-2828-00
95.1	81.10000	289-2779-00	105.1	91.10000	289-2829-00
95.3	81.30000	289-2780-00	105.3	91.30000	289-2830-00
95.5	81.50000	289-2781-00	105.5	91.50000	289-2831-00
95.7	81.70000	289-2782-00	105.7	91.70000	289-2832-00
95.9	81.90000	289-2783-00	105.9	91.90000	289-2833-00
96.1	82.10000	289-2784-00	106.1	92.10000	289-2834-00
96.3	82.30000	289-2785-00	106.3	92.30000	289-2835-00
96.5	82.50000	289-2786-00	106.3	92.50000	289-2836-00
96.7	82.70000	289-2787-00	106.7	92.70000	289-2837-00
96.9	82.90000	289-2788-00	106.9	92.90000	289-2838-00
97.1	83.10000	289-2789-00	107.1	93.10000	289-2839-00
97.3	83.30000	289-2790-00	107.3	93.30000	289-2840-00
97.5	83.50000	289-2791-00	107.5	93.50000	289-2841-00
97.7	83.70000	289-2792-00	107.7	93.70000	289-2842-00
97.9	83.90000	289-2793-00	107.9	93.90000	289-2843-00



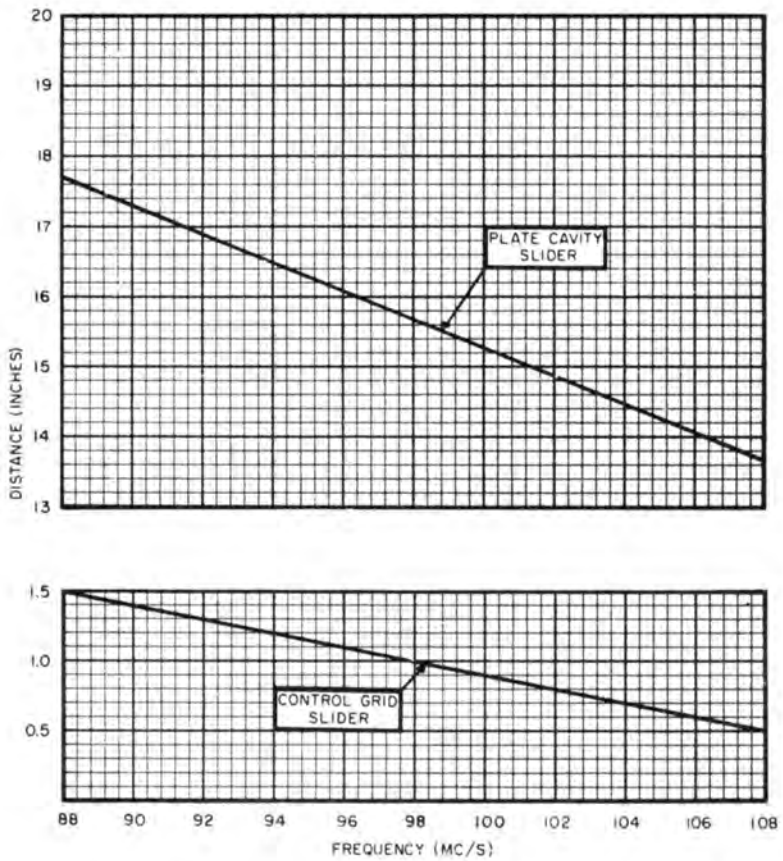
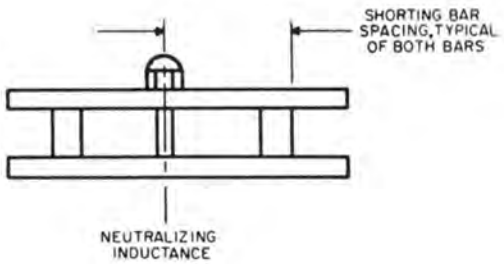


Figure 2-3. Plate Cavity Tuning Chart and Control Grid Inductor Spacing



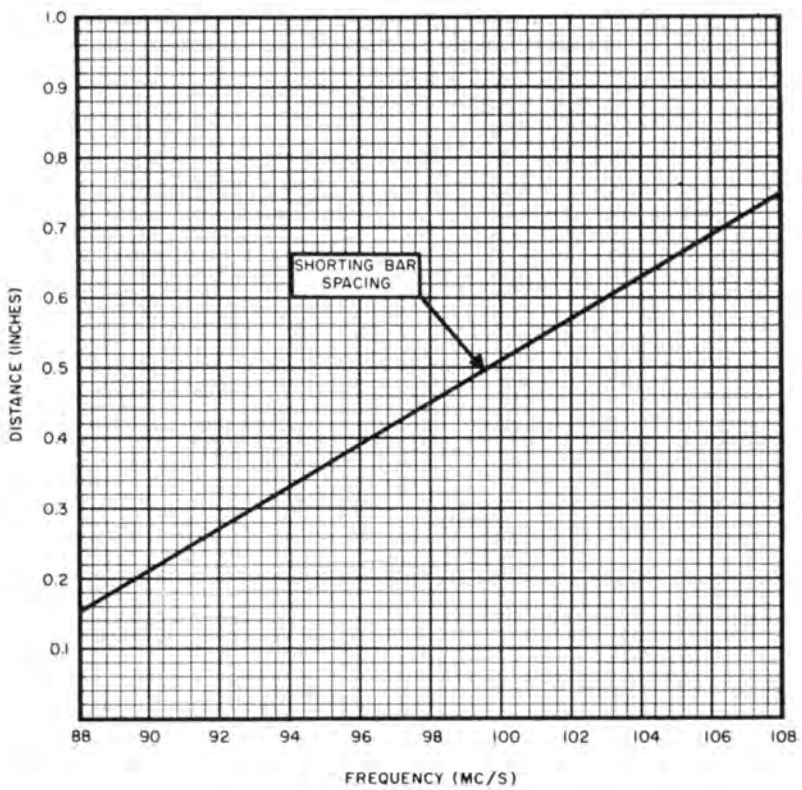


Figure 2-4. Screen Neutralization Inductor Spacing

indication. The PA plate current will start to rise immediately upon removing the grid bias fuse and will continue to rise until the overload relay trips or the plate current is shut off.

f. Repeat steps b and e until no further indication is shown on the R. F. WATTMETER.

g. Turn on the exciter, and retune the power amplifier according to the procedure given in paragraph 2.7.o.

2.7 STARTING THE TRANSMITTER IN A NEW INSTALLATION.

Before starting the transmitter for the first time, read section II of the subunit instruction books to become familiar with the location and function of the various transmitter controls. Then, perform the following procedure.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when making any transmitter adjustments. Do not reach inside the rear of the transmitter cabinet when high voltages are applied. Do not depend entirely on door interlocks. Always shut off transmitter power at the external cutout box, and ground all capacitors with the shorting stick in the transmitter cabinet before doing any work inside the rear of the cabinets. When working in the power amplifier cavity, remember that 115 volts a-c is present on one side of the cavity compartment interlock. Keep metal tools and the hands away from all transistor cases.

a. Complete the entire transmitter installation procedure as directed in this instruction book.

b. Close the doors at the rear of the cabinet. Open the doors at the front of the cabinet, and remove the lower front panel so that the entire inside panel is exposed. Check that the plate cavity slider, the grid inductor, and the screen neutralizing inductor conform approximately to the distance specified in figure 2-3 for the operating frequency. These adjustments have been set at the factory and will not normally require further adjustment. Close the cover on the plate cavity compartment.

c. Set the PLATE circuit breaker on the front panel to ON.

d. Press the FILAMENT ON switch. The green indicator lamp at the top left of the cabinet should light. This means that all transmitter tube filaments and cooling-air blowers are operating.

e. Place the proper crystals into the exciter sockets. The 14-megacycle crystal is placed into the Y501 socket. The heterodyning crystal is placed into the Y426 socket. Turn on the exciter, and allow it to warm up for at least 15 minutes.

f. Turn S101 to the 14 MC REF B position, and check M101 for an indication in the B meter range. Turn S101 to the AFC KEY B position, and check M101 for an indication in the B meter range.

NOTE

When S101 is in the AFC KEY position, the meter pointer will not hold steady but will pulse at the 5-cps keying generator rate. This pulsing is an indication of normal operation.

Turn S101 to the MOD OUTPUT B position, and check M101 for an indication in the B meter range. If all meter indications for the three S101 positions fall within the B meter range, proceed with the following power amplifier tuning procedures. If any of the meter indications fall outside of the B meter range, the modulator and afc discriminator is out of adjustment and will have to be adjusted according to the Modulator and AFC Discriminator Adjustment Procedures in the Maintenance section of this instruction book.

g. Switch S101 to the MIXER GRID A position. Set POWER OUT resistor R454 to its midposition. Using a nonmetallic screwdriver type tuning tool, adjust the BUF TUNE control for a peak indication on meter M101.

NOTE

The MIX BAL control, R438, should be placed in its midrange position. No further adjustment of this control is then necessary unless the transmitting frequency falls within the range of 97 to 100 megacycles. See step m if the transmitted frequency falls within this range.

h. Switch S101 to the V428B position. Adjust L429 and L430 for a maximum indication on M101.

i. Switch S101 to the V429B position. Adjust L431 and L432 for a maximum indication on M101.

j. Switch S101 to the V430B position. Adjust L433 and L434 for a maximum indication on M101.

k. Switch S101 to the V430C position. Adjust the PA PLATE control for a minimum indication on M101.

l. Set the MULTIMETER switch to GRID FS 4 MA. Remove the grid bias fuse F304. Adjust first the exciter PA MATCH control, then the power amplifier GRID TUNING control for a peak MULTIMETER indication. (The grid tuning capacitor should be near its center when the peak occurs. If not approximately in this position, move the grid inductance in the proper direction, and repeat the above step.) Replace the grid bias fuse and peak PA MATCH control and GRID TUNING control. Set GRID COUPLING control for 0.5 ma of grid current.

m. If the transmitter frequency falls between 97 and 100 megacycles, the following additional step will have

to be completed. Place a grid dip meter tuned to 98 megacycles near the exciter output. Adjust the MIX BAL control for a minimum output as indicated on the grid dip meter.

n. Set the POWER OUTPUT ADJUST control fully counterclockwise.

o. Press the PLATE ON switch. The red indicator lamp at the top right of the cabinet should light, and the P. A. PLATE VOLTAGE meter should indicate 2700 ±100 volts.

p. Set the MULTIMETER switch to SCREEN FS 400 VDC. The MULTIMETER should indicate 240 ±30 volts.

q. Adjust the PLATE TUNING control for a dip in the P. A. PLATE CURRENT meter indication.

r. Set the WATTMETER switch to FORWARD. Adjust the OUTPUT COUPLING control for approximately 10 ma of screen current.

s. Turn the POWER OUTPUT ADJUST control approximately two-thirds of its maximum clockwise rotation.

t. Increase the transmitter coupling a small amount by turning the OUTPUT COUPLING control clockwise until the PA screen current is reduced to approximately 10 ma. Adjust the PLATE TUNING control for a dip in the P. A. PLATE CURRENT meter indication. (The plate tuning capacitor should be near its center position when the dip in power amplifier plate current occurs. If the capacitor is not in this position, move the plate slider in the appropriate direction and repeat step t.)

u. Rotate the POWER OUTPUT ADJUST control clockwise a small amount.

v. Repeat steps t and u until the P. A. PLATE CURRENT meter indicates the transmitter output is 1000 watts as measured by the indirect method. At this time, the PA screen current should be not less than 10 ma. or more than 35 ma. The indirect method of measuring power output is:

$$\text{Power Output} = I_p E_p K$$

when K is efficiency, E_p plate voltage, and I_p plate current.

w. Check to be sure that the FM monitor that is connected to the transmitter is properly calibrated. Then, if necessary, adjust the exciter VHF OSC FREQ ADJ control until the monitor indicates that the transmitter operating frequency is within specified operating limits.

x. Apply a 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 dbm.

y. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation.

z. Replace the lower front panel on the transmitter cabinet, and close the front doors. The transmitter is now ready for standard broadcast use.

NOTE

At this point, it is suggested that a record be made of all meter readings for future maintenance and trouble shooting. These meter readings may be recorded in table 5-3.

SECTION III
OPERATION

3.1 GENERAL.

Refer to the subunit instruction books to become familiar with the operation and function of controls on both the power amplifier and the exciter.

After the transmitter has been placed in operation, it will only be necessary to check meter indications from time to time to be sure the transmitter is operating properly and occasionally to "touch-up" the power amplifier loading and tuning.

3.2 STARTING THE TRANSMITTER IN NORMAL OPERATION.

The transmitter may be put into operation by two different methods, depending upon the circumstances. For normal operation, press the FILAMENT ON switch to start the power amplifier filament and to warm up the exciter (the exciter POWER switch should be left in the ON position at all times). Check the power amplifier grid current to be sure the exciter is presenting sufficient drive to the power amplifier before applying plate power. Approximately 3 to 4 minutes after filament power is applied, the PLATE ON switch may be pressed, starting the transmitter.

The alternate method of starting the transmitter consists of pressing the PLATE ON switch only. The power amplifier filament and the exciter will immediately start to warm up. As soon as the power amplifier time delay relay has completed its cycle, the power amplifier plate voltage will come on automatically, starting the transmitter.

To shut down the transmitter it is recommended, but not necessary, to press the PLATE OFF switch, wait a few seconds, and then shut off the filament and exciter power by pressing the FILAMENT OFF switch. It is also possible to press the FILAMENT OFF switch only, which removes plate, filament, and exciter power. Pressing the PLATE OFF switch first allows the plate power supply voltage to discharge through the power amplifier while the filament is at normal operating temperature and, in addition, cools the power amplifier components.

SECTION IV
PRINCIPLES OF OPERATION

4.1 GENERAL.

Refer to figure 4-1, a block diagram of 830D-1A 1000 Watt FM Broadcast Transmitter. The transmitter can be broken down into three main subassemblies: an exciter, a power amplifier, and a harmonic filter. Refer to section II of the unit instruction books for a complete explanation of the exciter and the power amplifier.

4.2 A830-2 10 W WIDE-BAND FM EXCITER.

The baseband audio is coupled to the A830-2 through a pre-emphasis network and through an 18-db pad to J101 and two baseband amplifiers. The baseband output is coupled to voltage-sensitive capacitor C654. C654 is a diode which varies in capacity in proportion to the voltage across it. The FM oscillator is tuned to 14 megacycles. The capacity of C654 varies in proportion to the baseband audio and, therefore, the output is a 14-mc signal frequency modulated by the baseband audio. The deviation of the 14-mc signal is ±75 kc for 100 percent modulation. The oscillator output is coupled through two limiters to remove any amplitude modulation. The limited 14-mc signal is then amplified and coupled to the rate correction frequency discriminator and to the output amplifier. The output of the frequency discriminator is simply the baseband audio detected from the modulated 14-mc signal. This detected audio is coupled back to the baseband input to correct for any nonlinearity in C654.

The output amplifier amplifies the modulated 14-mc signal to a level sufficient to mix with the 74- to 94-mc signal (per customer requirement) in the balanced mixer.

A portion of the limiter output is coupled to the afc buffer stage. The afc buffer output, the modulated 14-mc signal, is coupled to the reference oscillator and afc limiters through a diode switch. The output of the 14-mc reference oscillator, is also coupled to the reference oscillator and afc limiters through a diode switch. The diode switch is operated by a 5-cps keying generator. The 5-cps generator is a unijunction transistor operating as a relaxation oscillator keying a multivibrator.

The diode switch alternately connects the modulated 14-mc signal (afc buffer output) and the 14-mc reference signal. The limiter output is coupled to the afc discriminator. The afc discriminator detects the difference between the 14-mc reference signal and the modulated 14-mc signal. The modulated 14-mc signal will cause a baseband audio output at the discriminator. This is not an error in frequency, so a portion of the baseband audio input is amplified by the baseband canceling amplifier and fed into the output of the frequency discriminator through a diode switch. This diode switch is keyed by the same 5-cps signal which switched the reference oscillator and afc limiter input. When the modulated 14-mc signal is connected to the reference oscillator and afc limiter input, the baseband canceling signal is switched into the output of the frequency discriminator to cancel the baseband output from the discriminator.

The input signal to the four error signal amplifiers is a 5-cps square wave. The amplitude of this square is proportional to the frequency error in the FM oscillator. The error signal amplifier square wave output is converted to a d-c control signal in the synchronous detector. The synchronous detector is also keyed by the 5-cps keying signal. The d-c error signal is coupled to C654 to correct the frequency modulation oscillator.

The modulated 14-mc signal from the output amplifier is heterodyned up to the operating frequency in a balanced mixer. The injection frequency is generated in a crystal oscillator. The crystal frequency is 14 mc below the customer's operating frequency. The crystal oscillator output is coupled to a buffer stage and is mixed with the modulated 14-mc signal in the balanced mixer. The balanced mixer output is limited and amplified to the 10-watt r-f output level. The output impedance of the A830-2 is between 50 and 70 ohms.

The power supply for the A830-2 is of conventional design and supplies operating voltages for the vacuum tubes and transistors in the A830-2.

The final power amplifier consists of a single ceramic-type tetrode tube. The tube is operated as a class C amplifier with a tuned-cavity plate circuit. The output from the power amplifier is fed through a harmonic filter which reduces all output harmonics.

The harmonic filter consists of two series resonant "M-derived" low pass end sections and a "constant K" "T" center section. The harmonic filter starts to attenuate above 110 megacycles and reaches maximum attenuation at the carrier second harmonic. The attenuation pattern then tapers off slowly as the frequency rises. The over-all result of the harmonic filter is in keeping the harmonics attenuated at least 73 db below the carrier frequency.

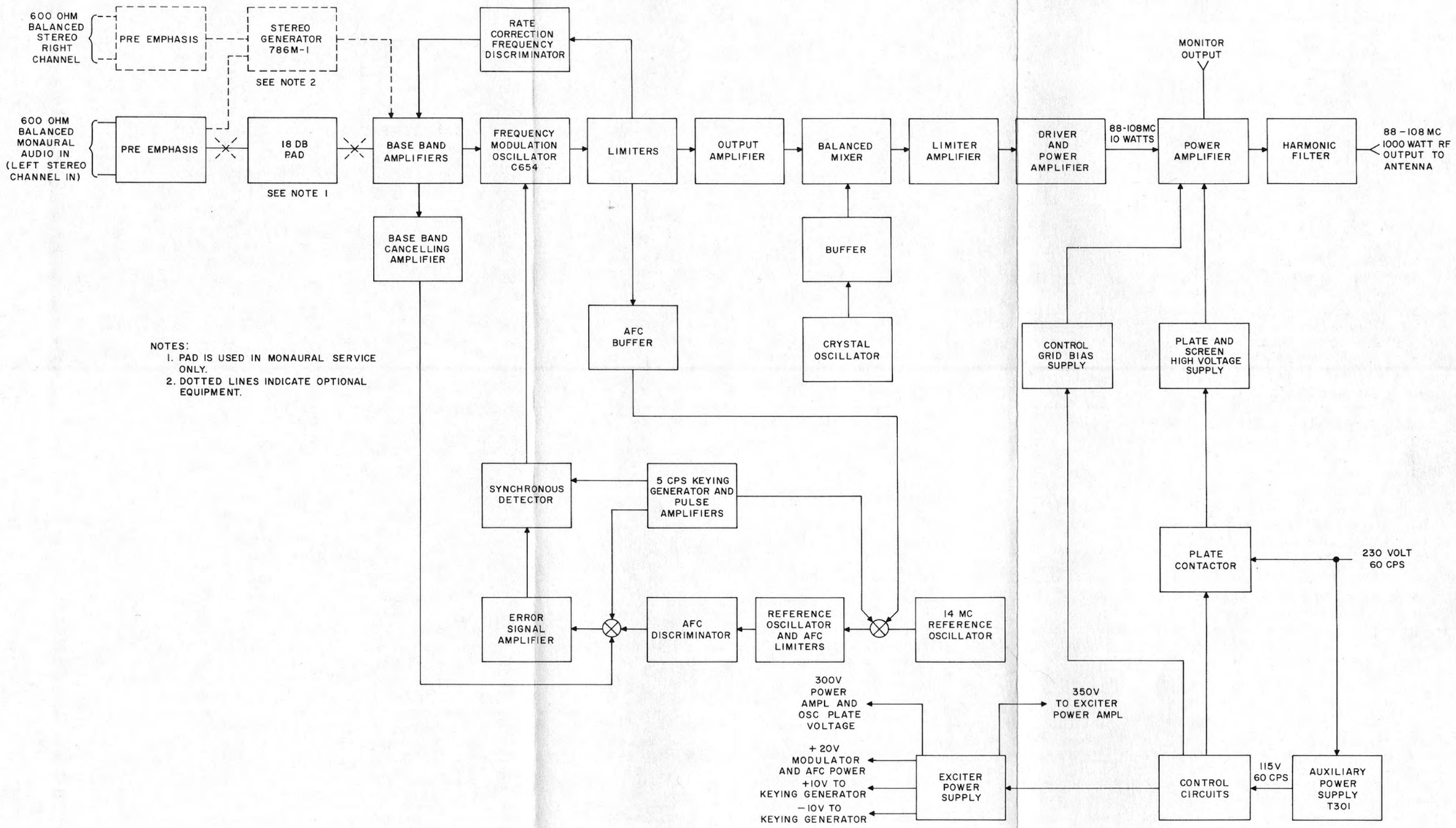


Figure 4-1. 830D-1A 1000 Watt FM Broadcast Transmitter, Block Diagram

4.3 CONTROL CIRCUITS.

The 230-volt a-c single phase power input is stepped down to 115 volts a-c by transformer T301. This lower voltage is used to activate relays in the transmitter control circuits and is also fed to the exciter as its primary power source. The control circuits allow power to be applied to the transmitter only in the proper sequency to prevent damage to the final amplifier. These circuits also contain protective devices to prevent damage to components from accidental overloads. All meter circuits are bypassed to eliminate damage from r-f energy.

4.4 PLATE CONTACTOR AND PLATE POWER SUPPLY.

The plate contactor consists of a heavy duty relay which controls the 230-volt a-c primary power to the plate power supply. The plate contactor is actuated by the PLATE ON switch through the control circuitry.

The plate power supply consists of a step-up transformer, a full wave bridge rectifier, and a filter. The power supply is capable of delivering 2,700 volts d-c at 850 ma to the power amplifier.

4.5 CONTROL GRID BIAS SUPPLY.

The control grid bias supply is a conventional half-wave type with an adjustable output. The supply is fused for protection and, in addition, is an aid in neutralization of the power amplifier. The bias supply output is approximately a negative 48 volts.

SECTION V
MAINTENANCE

5.1 GENERAL.

The following paragraphs contain information concerning maintenance of 830D-1A 1000 Watt FM Broadcast Transmitter.

WARNING

Voltages are present in this transmitter that are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the transmitter cabinet when high voltage is applied. Do not depend entirely on door interlocks. Always shut down the transmitter before doing any work inside the transmitter cabinet. Immediately upon opening the rear cabinet doors, short out capacitors C301 and C302 (located in the lower right portion of the transmitter cabinet) with the shorting stick provided with the transmitter.

Refer to the applicable unit instructions for specific maintenance procedures for each subassembly.

5.2 NORMAL TUNING PROCEDURES.

The following are tuning procedures which should be observed after the transmitter has been installed and tuned according to the installation procedures given in section II. Table 5-1 presents abbreviated tuning instructions to be used with the following procedures. Table 5-1 can be used separately when the operator becomes familiar with the transmitter.

a. Open the doors at the front of the cabinet.
b. Press the FILAMENT ON switch, and allow the exciter to warm up for 15 minutes.
c. Set S101 on the exciter to MIXER GRID A. Adjust BUF TUNE control for a peak on M101.
d. Set S101 to V428 B, and adjust L429 and L430 for a peak on M101.
e. Set S101 to V429 B, and adjust L431 and L432 for a peak on M101.
f. Set S101 to V430 B, and adjust L433 and L434 for a peak on M101.
g. Set S101 to V430C B and adjust the PA PLATE control for a minimum indication on M101.

NOTE

Convenient, marked ranges are available on the meter which correspond to switch positions. These ranges give an approximate requirement for min-max readings on the particular switch position.

h. Tune the exciter coupling by setting the MULTIMETER switch to GRID CURRENT and adjusting the exciter PA MATCH control for peak MULTIMETER

TABLE 5-1. ABBREVIATED TUNING PROCEDURES

CONTROL	POSITION	ADJUSTMENT	INDICATING METER	INDICATION	NOTES Allow transmitter to warm up at least 15 minutes before tuning.
S101	MIXER GRID	BUF TUNE	M101	Maximum	
S101	V428 B	*L429, L430	M101	Maximum	
S101	V429 B	*L431, L432	M101	Maximum	
S101	V430 B	*L433, L434	M101	Minimum	
S101	V430C B	PA (exciter) PLATE	M101	Minimum	
MULTIMETER	GRID FS 4 MA	PA MATCH GRID TUNING	MULTIMETER	Maximum	
MULTIMETER	GRID FS	GRID COUPLING	MULTIMETER	0.5 MA (approx)	
WATTMETER	FORWARD	PLATE TUNING OUTPUT COUPLING POWER OUTPUT ADJUST	P. A. PLATE CURRENT R. F. WATTMETER R.F. WATTMETER	Near min. Near 1000 watt indication Near 1000 watt indication	Repeat the adjustment of PLATE TUNING, OUTPUT COUPLING, and POWER OUTPUT ADJUST controls until 250 watts is achieved by the indirect power measuring method. $P = I_p E_p K$ **

*Use slotted nonmetallic screwdriver on these adjustments.
**Check frequency and adjust if necessary with VHF OSC FREQ ADJ control.

indication. Tune the power amplifier GRID TUNING control for a peak MULTIMETER indication. Adjust the GRID COUPLING control for approximately 0.5 ma of grid current.

i. Set the WATTMETER to FORWARD.

j. Press the PLATE ON switch. In turn, adjust the PLATE TUNING control for minimum indication, and increase the OUTPUT coupling control and the POWER OUTPUT ADJUST control, by small amounts, until the transmitter output power is 1000 watts as measured by the indirect method.

$$\text{Power Output} = I_p E_p K$$

The power amplifier screen current should be not less than 10 ma or more than 35 ma when the transmitter is properly tuned.

k. Adjust the VHF OSC FREQ ADJ control until the FM monitor indicates the transmitter is operating within the specified operating limits.

5.3 MODULATOR AND AFC DISCRIMINATOR ADJUSTMENT PROCEDURES.

The broadband exciter is designed to be exceptionally stable and will require few adjustments over a long period of time. The following adjustment procedures should be followed only if the exciter is not operating within limits upon installation, or if any of the following transistors are replaced: Q503 or Q511, Q601, or Q604. Replacement of other components should not normally require a change in the adjustments given in this section. The transmitter will have to be energized when performing steps c and e. Use an a-c vtvm such as a Ballantine Model 310A when making adjustments. A d-c vtvm such as a Heath type may be used in step f.

NOTE

When adjusting the modulator and afc section of the exciter, use a nonmetallic hex type adjusting tool. Keep all metallic tools and the hands or other parts of the body away from transistor cases. When disabling the afc, and the complete transmitter is in operation, check the station monitor to be sure the center frequency stays within the FCC requirements.

a. Remove transistor Q509, and place a vtvm from TP501 to ground. Tune L505 for a peak indication on

the vtvm, tune L504 for a peak indication. Be sure to tune the inductances in the order given to minimize the limiting effect. Check that each stage is limiting when making these adjustments. Limiting will show up as a broad flat peak on the vtvm when tuning. Set the controls midway between the limiter fall-off points shown on the vtvm. Do not replace Q509.

b. Tune the afc discriminator by placing a vtvm from TP501 to ground, and tune the DISCR PRI control, C515, for a maximum indication. Place the vtvm from TP502 to ground, and adjust the DISCR SEC control, C518, for zero on the vtvm.

c. Disable the afc by pressing the AFC DISABLE switch, and adjust the OSC FREQ control until the station monitor indicates that the exciter is on frequency. Replace Q509.

d. Remove Q607. Place a vtvm between TP602 and ground. Tune L606 and L603 for a maximum indication on the vtvm. Tune the inductors in the order shown to minimize the effects of the limiter.

e. Remove afc by holding down the AFC DISABLE switch. With the vtvm from TP602 and ground, tune the DISCR PRI control, C639, for a maximum indication on the vtvm. Move the vtvm to TP601 and tune the DISCR SEC control, C644, for a zero indication when the modulation monitor indicates the exciter is approximately on frequency. Repeat the tuning of the DISCR PRI and DISCR SEC controls. Replace Q607.

f. Place a d-c vtvm between TP603 and ground. Set the AMP BIAS control for a 7.5-volt indication on the vtvm.

g. Place a vtvm between TP504 and ground. Remove Q510. Tune L611 and L608 for a maximum indication on the vtvm. Replace Q510.

h. With a vtvm on TP504, adjust the REF LEVEL control for an equal indication on the vtvm with first Q510 removed and then Q509 removed. (This equalizes the modulator oscillator voltage and the 14-megacycle reference voltage.) Replace the transistors.

i. Place an oscilloscope between TP503 and ground. Apply a 150-cps audio signal on J601. Adjust the MOD BALANCE control for a minimum 150-cps indication as shown on the oscilloscope.

NOTE

The MOD BAL control must be adjusted slowly to allow the error signal amplifiers to stabilize between adjustments.

5.4 DISTORTION TESTING PROCEDURE.

a. Refer to figure 5-1. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to the exciter audio input, terminals 1 and 2 of TB305. (Disconnect the station console audio input leads when making this connection.) Connect a distortion and noise meter, such as a Hewlett-Packard Model 330D, to the broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Apply a 50-cps audio tone to the transmitter input. The input level should be such that the voltage at the transmitter audio input terminals is +10 ±2 dbm.

c. Adjust the exciter MOD GAIN control until the monitor indicates 100 percent modulation (±75 kilocycle deviation).

d. Measure the distortion at the frequencies and modulation levels given in table 5-2. The distortion shall be less than 1.5 percent for frequencies between 50 and 100 cps, less than 1.0 percent for frequencies between 100 and 7,500 cps, and less than 1.5 percent for frequencies between 7,500 and 15,000 cps.

5.5 AUDIO FREQUENCY RESPONSE MEASUREMENTS.

a. Refer to figure 5-2. Connect an audio frequency signal generator, such as a Hewlett-Packard Model

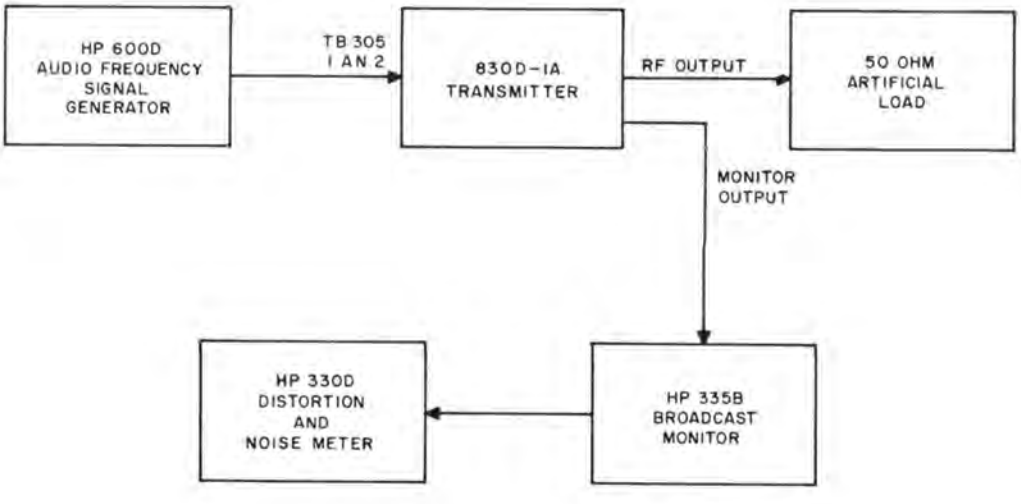


Figure 5-1. Distortion Test Setup

TABLE 5-2. DISTORTION CHECKS

FREQUENCY	DISTORTION IN PERCENT		
	25% MODULATION	50% MODULATION	100% MODULATION
50			
100			
400			
1,000			
5,000			
7,500			
10,000			
15,000			

600D, to terminals 1 and 2 of terminal board TB305. (Disconnect the station console audio input leads when making these measurements.) Connect a vacuum tube voltmeter, such as a Ballantine Model 310A, to the audio output terminals of the audio frequency generator. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Check the audio frequency response of the transmitter by modulating the transmitter at 50, 100, 400, 1,000, 5,000, 7,500, 10,000, and 15,000 cps for 25 percent, 50 percent, and 100 percent modulation. Audio frequency response is measured by keeping the percentage of modulation constant and measuring the magnitude of audio, at each frequency given, to give the desired percentage of modulation. The audio frequency response must fall within the limits given in figure 5-3.

NOTE

When taking audio frequency response measurements, a broadcast monitor, such as a Hewlett-Packard Model 335B, should be used. Do not use an instrument where audio de-emphasis might give a false indication of peak modulation.

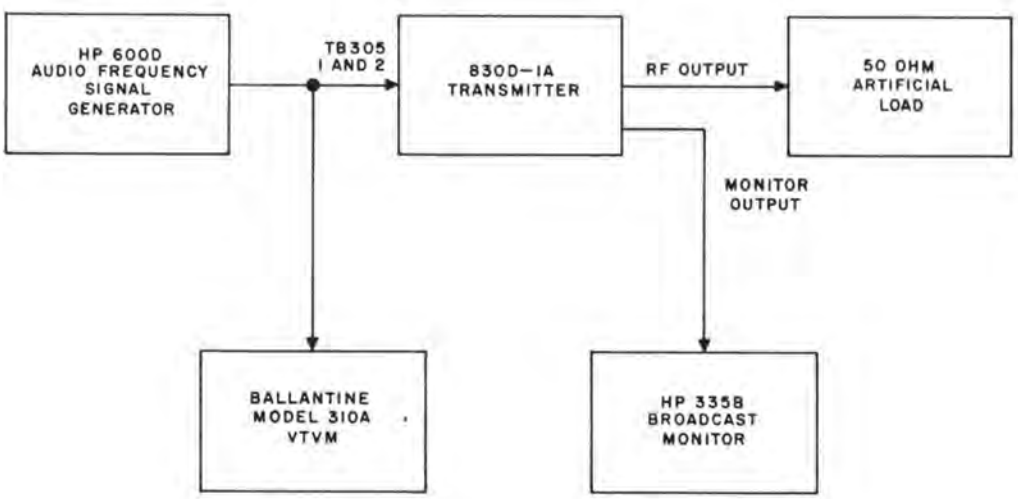


Figure 5-2. Audio Frequency Response Test Setup

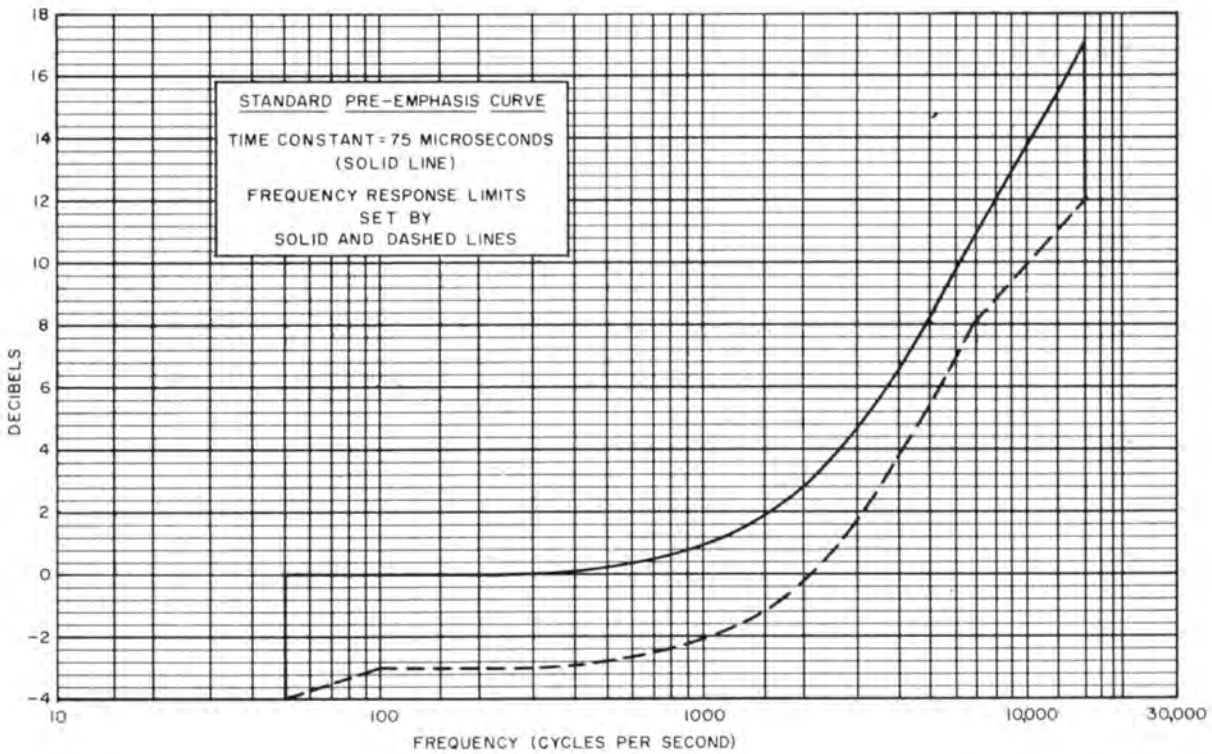


Figure 5-3. Audio Frequency Response Limits

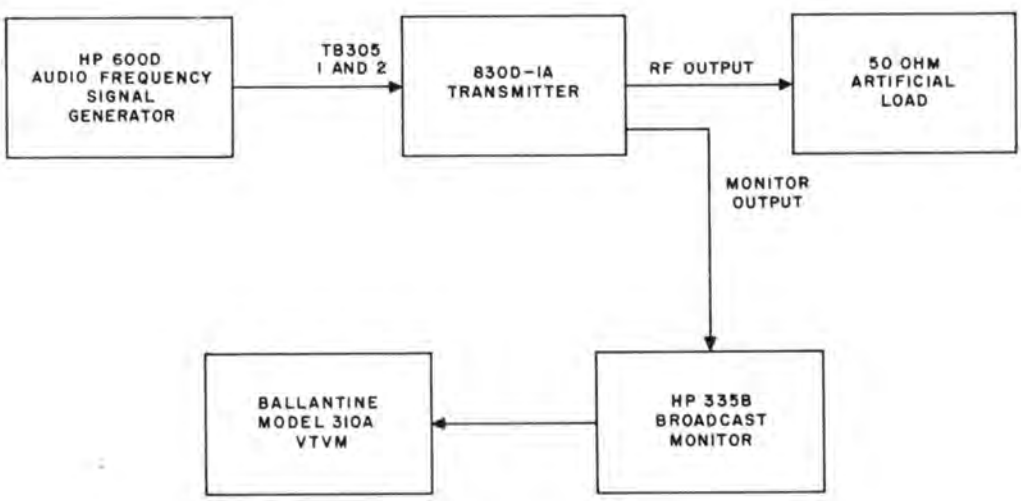


Figure 5-4. FM Noise Test Setup

5.6 FM NOISE MEASUREMENT.

a. Refer to figure 5-4. Connect an audio frequency signal generator, such as a Hewlett-Packard Model 600D, to terminals 1 and 2 of terminal board TB305. (Disconnect the station console audio input leads when making this measurement.) Connect a vacuum tube voltmeter to the output terminals of the broadcast monitor. Connect an artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Modulate the transmitter 100 percent (±75 kilocycles deviation) with 400 cps of audio.

c. Remove the modulating 400 cps, and read the residual FM noise on the vacuum tube voltmeter. The residual FM noise shall be less than -65 db below 100 percent modulation.

5.7 AM NOISE MEASUREMENTS.

a. Refer to figure 5-5. Short out terminals 1 and 2 of terminal board TB305. Connect a vacuum tube voltmeter to connector J3 of the Hewlett-Packard Model 335B broadcast monitor. Connect a 50-ohm artificial load to the r-f output connector located on top of the transmitter cabinet. Turn on the transmitter.

b. Switch the broadcast monitor to measure carrier level.

c. Measure the AM noise in db at J3 of the broadcast monitor in the following manner. Set modulation monitor to CARRIER LEVEL, and measure the d-c level on the modulation meter (100 percent on scale equals 10 volts). Connect the vacuum tube voltmeter to J3, and terminate J3 with a two-megohm resistor. Measure the a-c level on the vacuum tube voltmeter. (The input to the vacuum tube voltmeter should be a shielded cable having less than 100 uuf distributed capacitance.) The AM noise is the direct ratio of the d-c reading and the a-c level. The AM noise shall be not less than -55 db below voltage or d-c carrier level.

$$\text{AM Noise} = 20 \log \frac{\text{D-C reading}}{\text{A-C reading}}$$

5.8 TROUBLE SHOOTING.

Standard trouble-shooting procedures should be used in finding malfunctions in the transmitter. As is suggested in TD-536 and TD-538, meter indications for all functions should be recorded when the transmitter is installed and operating properly. Table 5-3 is supplied for recording these readings. If some malfunction should occur after the normal meter readings are recorded, it is a simple matter to compare the meter readings of the malfunctioning equipment with the normal meter readings. When trouble shooting and comparing the meter readings, it is advisable to start with the final stage and proceed backwards until normal readings are encountered. The malfunctioning stage will then be the one immediately ahead of the normal meter indications.

As most cases of trouble will be traced to tubes or transistors, it is advisable to first of all replace the tube (or transistor) in the stage in which the trouble is suspected. If the trouble does not clear with tube or transistor replacement, it will become necessary to take resistance or voltage measurements, within the suspected circuit, to determine which component has failed.

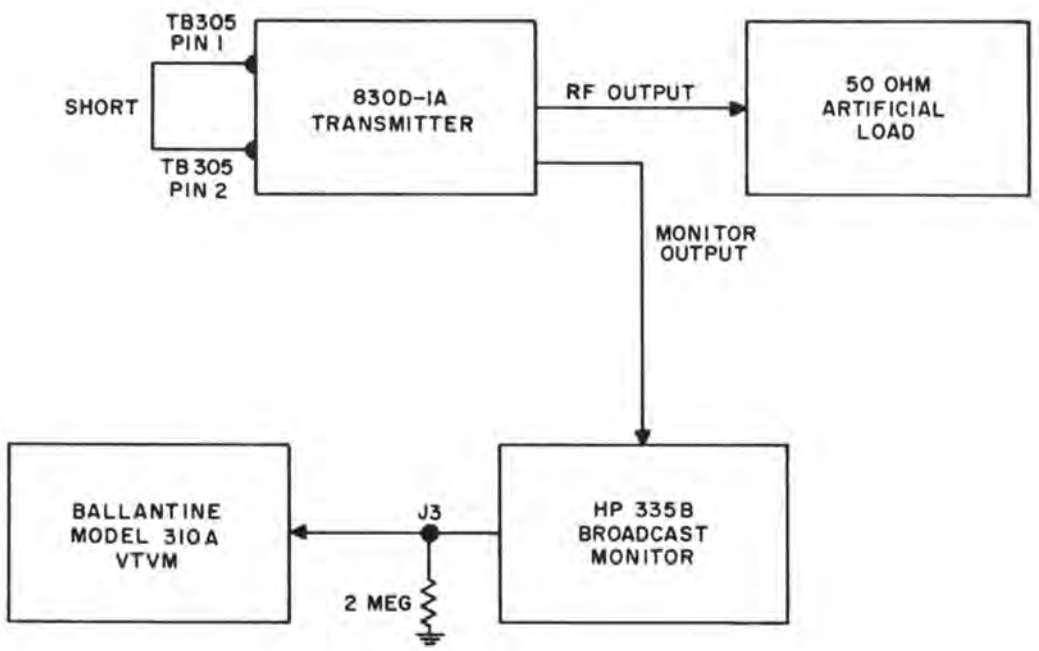


Figure 5-5. AM Noise Test Setup

When tracing trouble within the power amplifier, it will be helpful to use the "from-to" information given in unit instructions TD-538. The "from-to" information gives the actual location of the individual wires within the power amplifier cabinet. When used in conjunction with the schematic, the "from-to" information can be very helpful.

If the transmitter center frequency shifts excessively with modulation, the trouble may be isolated to either the afc circuitry or the modulator circuitry by disabling the afc and noting if the carrier shifts more than 1.8 kc with a change in modulation from zero to 100 percent. If the modulator oscillator shifts more than the 1.8 kc with the afc disabled, the trouble will be within the modulator oscillator circuits. The afc circuitry cannot shift the modulator oscillator frequency more than 1.8 kilocycles. If the carrier shift is under 1.8 kc the trouble will be in the afc circuitry.

If the power amplifier tube, V201, is replaced, the stage may no longer be neutralized. Check neutralization of the stage before going ahead with the neutralization procedure given in paragraph 2.6.1. It may not be necessary to change the neutralization adjustment.

TABLE 5-3. NORMAL TRANSMITTER METER INDICATIONS

CONTROL	POSITION	METER	INDICATION
S101	BUFFER GRID A	M101	
S101	MIXER GRID A	M101	
S101	V428 B	M101	
S101	V429 B	M101	
S101	V430 B	M101	
S101	V430C B	M101	
S101	MOD OUTPUT B	M101	
S101	AFC KEY B	M101	
S101	14 MC REF B	M101	
MULTIMETER	SCREEN FS 400 VDC	MULTIMETER	
MULTIMETER	SCREEN FS 40 MA	MULTIMETER	
MULTIMETER	GRID FS 4 MA	MULTIMETER	
		P.A. PLATE VOLTAGE	
		P.A. PLATE CURRENT	
WATTMETER	FORWARD 1.5KW	R.F. WATTMETER	
WATTMETER	REFLECTED 1.5KW	R.F. WATTMETER	

TD-567
15 FEBRUARY 1962

D830-1
1000-WATT FM POWER AMPLIFIER

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1962

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SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

Unit Instructions TD-567 provides information about D830-1 1000-Watt FM Power Amplifier. Information which is furnished covers a general description of the equipment, principles of operation, maintenance procedures, and a parts list.

1.2 PURPOSE OF EQUIPMENT.

The D830-1 1000-Watt FM Power Amplifier can be used for continuous monaural or multiplex and SCA FM broadcast service on a single frequency, in the range from 88 to 108 megacycles with an exciter input of 10 watts and an output power of 1000 watts.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The D830-1 1000-Watt FM Power Amplifier, shown in figure 1-1, is contained in a single cabinet that is 38 inches wide, 76 inches high, 27 inches deep, and weighs approximately 767 pounds. All D830-1 operating controls are located behind the doors on the front of the cabinet. The filament and plate on-off controls and four monitoring meters are located at the top front of the cabinet. The meters may be observed easily while operating the tuning controls. The D830-1 uses one tube (the power amplifier), plus semiconductors for voltage rectification and regulating. The power amplifier tube is accessible from the front of the transmitter. The bottom front of the D830-1 cabinet is removable to allow access to components on the bottom of the inside panel.

Large doors at the upper rear of the cabinet (see figure 1-2) allow access to the upper part of the D830-1 for servicing and maintenance. Operating personnel are protected by both electrical and mechanical interlocks on the rear doors and panel. These interlocks remove the D830-1 plate voltage and ground the high voltage circuits when the doors are opened or the panel is removed. The power amplifier plate-tuning cavity is located in an interlocked compartment at the front of the D830-1.

Inside the D830-1, heavy iron-core components are at the bottom of the cabinet. A standard 19-inch rack is provided for mounting the 10-watt exciter within the confines of the D830-1. Room is also provided on the standard 19-inch rack, for the mounting of SCA generators. An optional harmonic filter which can be connected to the D830-1 output is suspended from the top of the cabinet.

Figure 1-1. D830-1 1000-Watt FM Power Amplifier, Over-all View

Cooling air for the D830-1 is drawn through a permanent-type air filter at the rear of the cabinet by a low-speed, high-volume fan, and exhausted through a shielded opening in the top of the cabinet. A pressure blower supplies cooling air directly to the power amplifier tube.

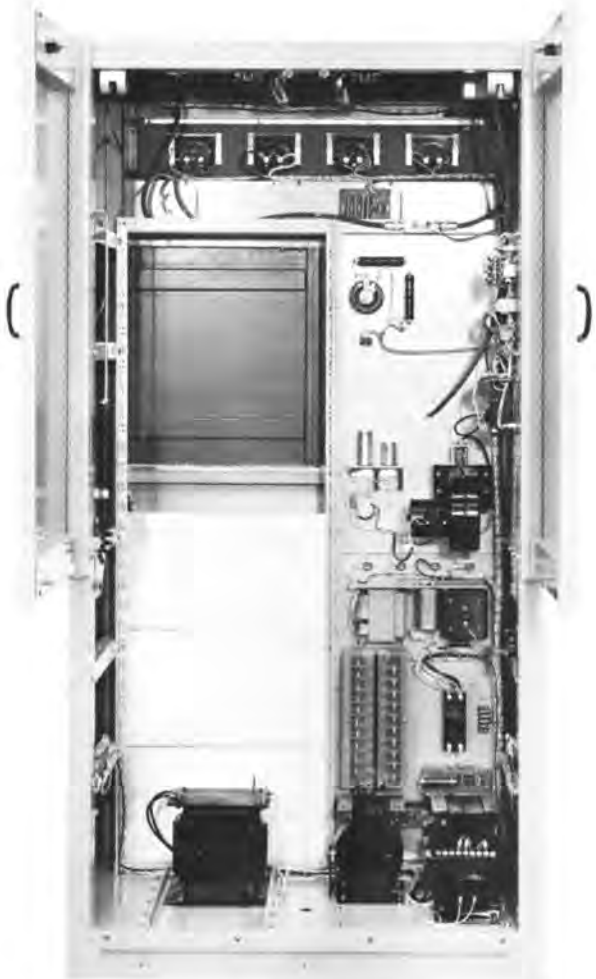


Figure 1-2. D830-1 1000-Watt FM Power Amplifier, Rear View with Bottom Panel Removed

1.3.2 ELECTRICAL DESCRIPTION.

The D830-1 1000-Watt FM Power Amplifier consists of a single air-cooled, power amplifier tube capable of being driven to full power by a 10-watt exciter. All associated power supply and control circuitry is included for operation of the D830-1. D830-1 r-f input impedance is 50 ohms nominal, unbalanced. D830-1 output power is at least 1000 watts over the frequency range of 88 to 108 mc into a 250-ohm load with an swr not exceeding 2:1.

Line power input required is 50/60-cycle, single-phase, with primary taps on all power transformers to compensate for line voltage variations from 200 to 250 volts. Circuit breakers in the input side of the line are provided for primary current overload protection. The control circuits, the final amplifier filament, and the central grid bias supply are fused. A time delay relay provides protection of the power amplifier tube during warmup. Remote control can be exercised over filament on, filament off, plate on, and plate off functions of the power amplifier. Instruction books covering the exciters used in conjunction with D830-1 1000-Watt FM Power Amplifier are listed in table 1-1.

TABLE 1-1
ASSOCIATED EQUIPMENT INSTRUCTION BOOKS

ASSOCIATED EQUIPMENT	INSTRUCTION BOOK NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
786M-1 Stero Generator	TD-537

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of D830-1 1000-Watt FM Power Amplifier.

TABLE 1-2
EQUIPMENT SUPPLIED WITH D830-1 1000-WATT FM POWER AMPLIFIER

EQUIPMENT	COLLINS PART NUMBER
D830-1 1000-Watt FM Power Amplifier	522-2948-00

1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-3 lists equipment that is required for operation of D830-1 1000-Watt FM Power Amplifier but not supplied as part of the power amplifier.

TABLE 1-3
EQUIPMENT REQUIRED BUT NOT SUPPLIED AS PART OF D830-1 1000-WATT FM POWER AMPLIFIER

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00

1.6 ACCESSORY EQUIPMENT.

Table 1-4 lists accessory equipment that is available for use with D830-1 1000-Watt FM Power Amplifier.

TABLE 1-4
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NUMBER
250-Watt/1-Kw Harmonic Filter (used only if the D830-1 is fed directly to an antenna and not to a higher power amplifier).	549-2010-00

1.7 EQUIPMENT SPECIFICATIONS.

1.7.1 MECHANICAL.

Weight . . . . . 767 pounds maximum.

Size . . . . . 38 inches wide, 76 inches high, 27 inches deep.

Ventilation . . . . . One ventilating fan, one blower.

Ambient temperature range . . . . . +10°C (50°F) to +45°C (113°F).

Ambient humidity range . . . . . 0 to 95 percent relative humidity.

Altitude . . . . . 0 to 6000 feet.

1.7.2 ELECTRICAL.

Power source . . . . . 200 to 250 volts, 50/60-cycle, single-phase.

Maximum power requirements . . . . . 3300 watts.

R-f input power . . . . 10 watts nominal.

Input impedance . . . . 50 ohms nominal, unbalanced.

Power output . . . . . 1000 watts nominal.

Output impedance . . . 50 ohms, unbalanced. Maximum swr 2:1.

Frequency range . . . . 88 to 108 mc. Exact operating frequency determined by frequency of exciter.

1.8 TUBE AND SEMICONDUCTOR COMPLEMENT.

Table 1-5 lists the tube and semiconductor complement supplied as part of the D830-1 1000-Watt FM Power Amplifier.

TABLE 1-5
TUBE AND SEMICONDUCTOR COMPLEMENT

QUANTITY	TYPE	FUNCTION
1	4CX1000A	R-f power amplifier
1	50M140ZB5	Voltage regulation
80	1N1566	H.V. rectifier diodes
1	1N1492	Bias rectifier
1	1N1492	Grid current diode
1	1N1566	Meter protection diode

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

The D830-1 1000-Watt FM Power Amplifier consists of a power amplifier and associated control circuitry, for the amplification of 10 watts of exciter drive to 1000 watts of r-f power. The D830-1 output can be used to drive a higher power amplifier or fed through a harmonic filter to an antenna.

Refer to figure 2-1, a block diagram of D830-1 1000-Watt FM Power Amplifier. The 230 volts a-c is fed to a control circuit power transformer which reduces the input voltage to 115 volts a-c for use by the power amplifier blower and control circuits. A second regulated transformer located within the control circuitry reduces the 230 volts a-c to 6.3 volts for use by the power amplifier filament. The 230 volts a-c is also fed to a transformer which supplies the power amplifier plate and screen voltages. The primary power to the plate power supply is controlled by the plate contactor. The control circuits provide cabinet interlocks for protection of personnel from all high voltage, local or remote filament on and filament off controls, local or remote plate on and plate off controls, and a time delay to prevent the application of high voltage before the power amplifier filament has heated sufficiently. Provisions are also available within the control circuitry for connection to the control circuitry of a higher power amplifier. The higher power amplifier could then control the D830-1 plate and filament power. Exciter input power is applied directly to the power amplifier where it is raised to 1000-watts of r-f power.

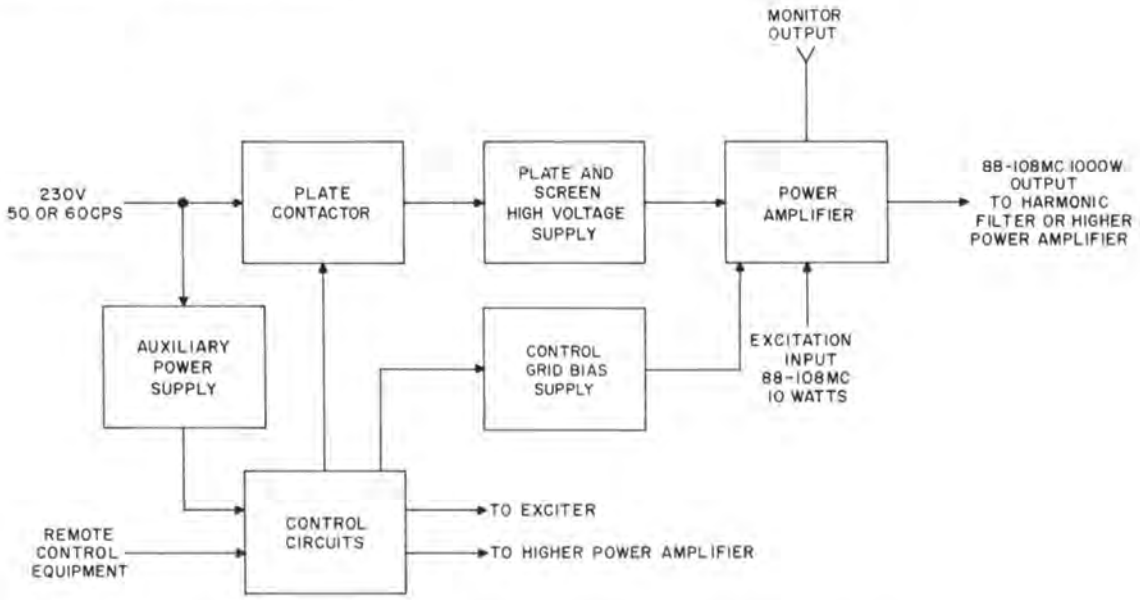


Figure 2-1. D830-1 1000-Watt FM Power Amplifier, Block Diagram

The power amplifier consists of a forced air cooled, ceramic tetrode, V201. The plate of V201 is connected to a tuned cavity (foreshortened $\frac{\lambda}{4}$ coaxial line resonator). The output from the tuned cavity can then be fed to a higher power amplifier or to a harmonic filter and antenna if high power amplification is not necessary. A sample of the power amplifier output is taken from the plate tuned cavity for monitoring purposes.

Metering circuits are provided for the power amplifier plate current and voltage, screen current and voltage, grid current, and output power.

2.1.1 CONTROL CIRCUITS.

Refer to figure 2-2, a simplified schematic diagram of the control circuits of D830-1 1000-Watt FM Power Amplifier. The primary purpose of the control circuitry is to provide filament and plate on and off control. The power amplifier filament is turned on in the following manner: When the momentary FILAMENT ON switch, S112, is pressed, a ground is placed on filament control relay K301. As 115 volts a-c is present on terminal 2 of relay K301 from 115-volt a-c supply transformer T301, the filament control relay will be energized. This closes contacts 3 and 4 holding the relay in the energized position after the momentary FILAMENT ON switch, S112, is released. The green filament indicator lamp, DS301, will light. The filament control relay, K301, when energized, will close relay contacts which will start cabinet fan B103, supply 230 volts to the regulated filament transformer, supply 115 volts a-c to the 10-watt exciter, and supply 115 volts a-c to the power amplifier bias supply. When blower B301 comes up to speed, the air interlock switch, S314, will close, applying 115 volts a-c to time delay K307. In 4 to 5 minutes (time for power amplifier filament V201 to warm up) time delay K307 will close, energizing auxiliary relay K306, which through contacts 3 and 5 supplies 115 volts a-c to plate contactor relay K304. The plate can now be turned on by pressing momentary PLATE ON switch S113 (providing all interlocks are closed). Pressing the momentary PLATE ON switch places a ground on plate control relay K302. Relay K302 will then energize, closing contacts 3 and 4 holding K302 in the energized position. Contacts 9 and 10 will also close providing a ground path energizing plate contactor K304, and lighting the red plate on indicator. When the plate contactor closes, the primary a-c supply will be applied to the plate and screen supply transformer T303. The plate power supply will then furnish approximately 2700 volts d-c to power amplifier tube V201.

The momentary FILAMENT OFF switch, S111, removes power from the control and power amplifier circuits. It accomplishes this by opening the 115-volt a-c lead to filament control relay K301 and plate control relay K302. This de-energizes plate contactor K304 and blower interlock S314, removing filament, plate, and screen voltage. The time delay relay will begin to recycle and will always cause the correct time delay necessary for proper filament heating.

The momentary PLATE OFF switch, S114, removes only plate and screen voltage from power amplifier V201. This is accomplished by momentarily opening the ground lead of plate control relay K302, which de-energizes plate contactor K304, removing 230-volt a-c power from the plate and screen supply.

Plate overload protection is provided by overload relay K305. As the plate current increases, the current through K305 will increase until overload relay K305 energizes, opening the ground lead of plate control relay K302, removing plate voltage. Potentiometer

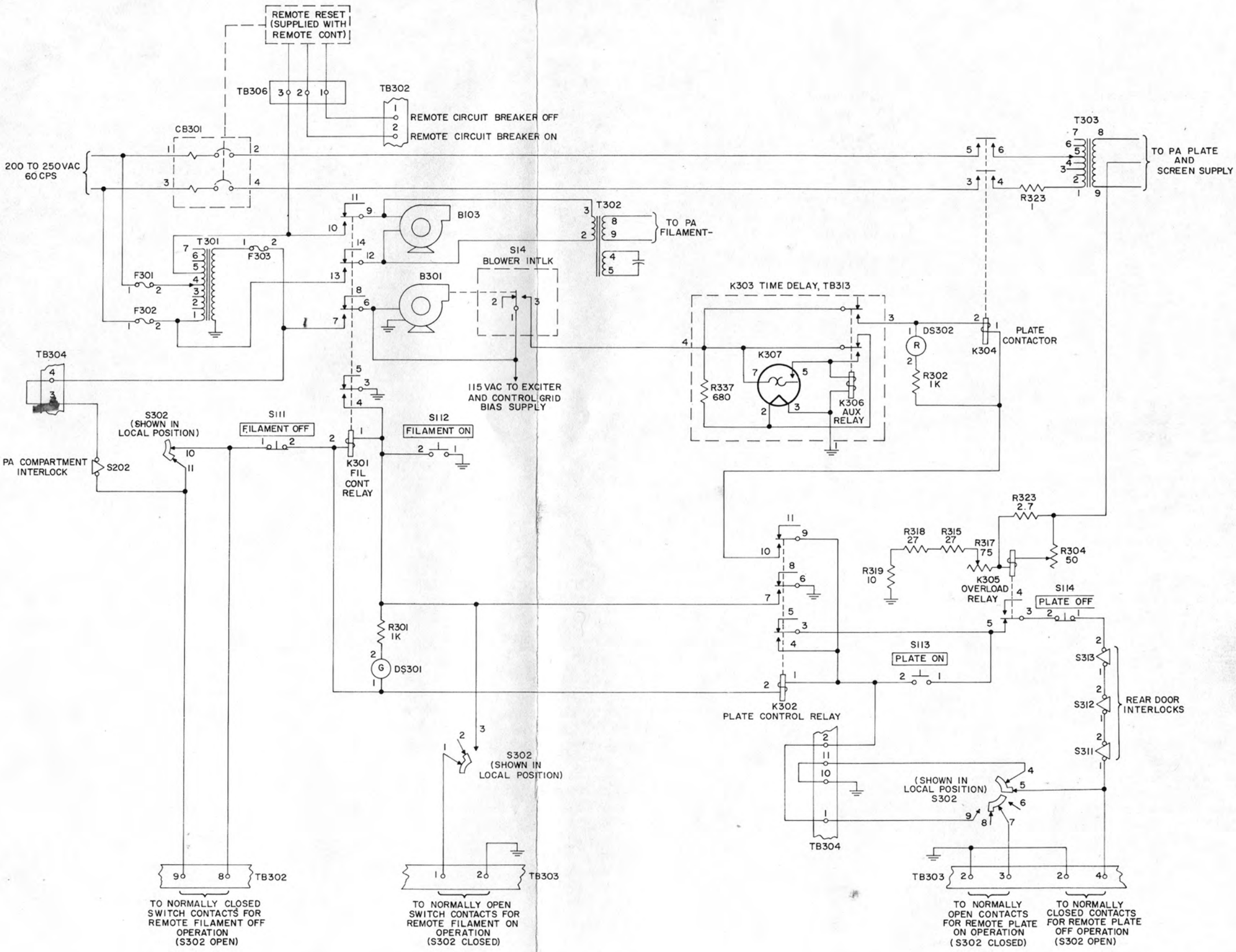
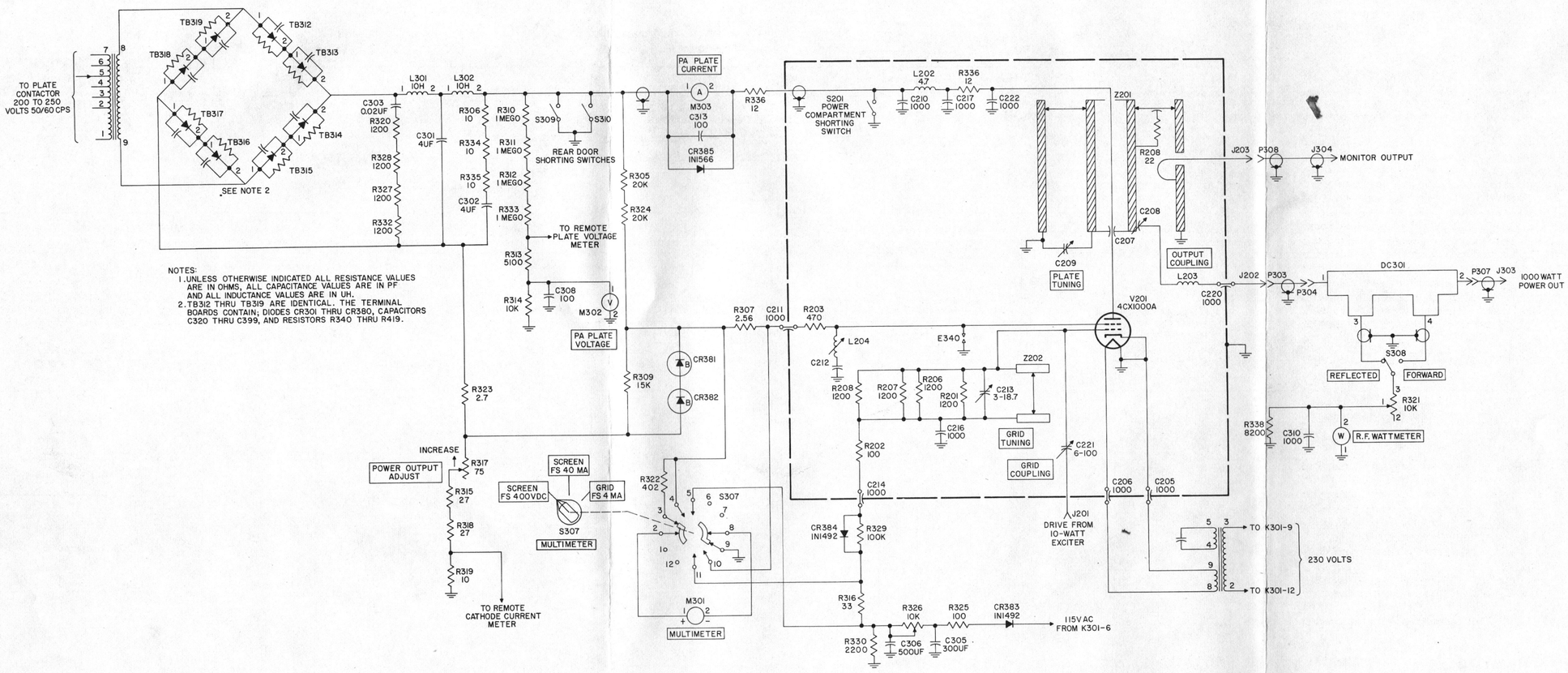


Figure 2-2. D830-1 1000-Watt FM Power Amplifier, Control Circuits, Simplified Schematic Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN PF AND ALL INDUCTANCE VALUES ARE IN UH.
2. TB312 THRU TB319 ARE IDENTICAL. THE TERMINAL BOARDS CONTAIN; DIODES CR301 THRU CR380, CAPACITORS C320 THRU C399, AND RESISTORS R340 THRU R419.

Figure 2-3. D830-1 1000-Watt FM Power Amplifier, Power Amplifier Circuits, Simplified Schematic Diagram

R304 adjusts the point at which excess plate current will activate overload relay K305.

2.1.2 POWER AMPLIFIER CIRCUITS.

Refer to figure 2-3, a simplified schematic of the power amplifier circuit of D830-1 1000-Watt FM Power Amplifier. The power amplifier consists of a forced air-cooled, tetrode amplifier, operating over the standard frequency modulated broadcast band of 88 to 108 mc.

The power amplifier plate and screen voltages are obtained from a full-wave bridge rectifier circuit. Transformer T303 increases the 230-volt single-phase 50/60-cps primary input to approximately 3000 volts rms across terminals 8 and 9 (T303 secondary) winding. The primary winding of transformer T303 has six adjustable taps to compensate for line voltages from 200 to 250 volts. The output voltage of the secondary winding of T303 is fed to a conventional full-wave bridge and filter circuit rectifier consisting of diodes CR301 through CR380, inductances L301 and L302, and capacitors C301 and C302. Resistors R340 through R419, and capacitors C320 through C399 are used to equalize the forward currents of all diodes. Resistor R320, R327, R328, R331, and R332, and capacitor C303 form a transient suppressor network which helps suppress transient voltages formed when power is first applied to transformer T303 and when power is switched off. The 2750-volt d-c output from the power supply is fed through P.A. PLATE CURRENT meter M303, through an r-f filter consisting of C210, C217, C222, L202 and R336 to the plate of V201. Plate voltage and plate current are read directly from P.A. PLATE VOLTAGE meter M302 and P.A. PLATE CURENT meter M303 respectively.

The screen voltage is obtained from the 2750-volt plate supply. The plate supply is fed to a combination bleeder resistor and voltage divider consisting of resistors R305, R324, R309, R315, R317, R318, and R319. Voltage regulation for the screen supply of V201 is accomplished by passing most of the bleeder current through two Zener diodes placed in parallel with R309. If the screen current should fluctuate, the screen voltage is held to 250 volts by the two Zener diodes, CR381 and CR382. Capacitor C212 is placed from the screen grid to ground to shunt any r-f energy present on the screen grid. Screen voltage, and thus the power output of V201, is made variable by POWER OUTPUT ADJUST control R317. A protective device consisting of two carbon blocks (which will arc over if the screen voltage exceeds 400 volts) is provided to protect the screen supply Zener diodes in the event of a screen-to-plate short.

Power amplifier V201 is a grounded cathode tetrode, using fixed and grid leak bias. The control grid circuit of V201 consists of a parallel-tuned resonant tank circuit, Z202 and C213. R201, R205, R206, and R207 placed in parallel with C213 present the proper load to the exciter and also provide a broad-band low-impedance input to the control grid. Z202 consists of two parallel rods, forming a shorted stub which is tuned by a shorting bar between the two rods. Control grid fine tuning is accomplished by capacitor C213. Negative fixed bias for the control grid is obtained from a half-wave power supply consisting of diode CR383, capacitors C383 and C384, and resistors R325, R326, and R330. The fixed bias is made adjustable by adjustable resistor R326. Power to operate the bias supply is obtained from T301 through the filament control relay, K301. Grid leak bias is obtained from the voltage drop across R329 due to grid current. Diode CR384 is placed across R329 to prevent the possibility of the grid going positive because of grid emission.

The plate cavity is formed by a short section of coaxial transmission line resonating with the plate capacity of V201 and plate tuning capacitor C209. The coaxial transmission line is roughly tuned initially by adjusting a shorting plate which lengthens or shortens the physical length of the coaxial transmission line. A resistor, R208, is attached to the tank slider to provide parasitic swamping. Fine plate tuning is accomplished by C209. The output coupling network, formed by C208 and L203, is coupled to the coaxial transmission line adjacent to the plate of V201 for correct impedance matching. Inductance L203 and capacitor C220 act as an L section low-pass filter for frequencies above 130 mc to provide a measure of harmonic suppression. A monitor output is provided in the plate cavity for use by the station program monitor.

Neutralization of V201 is accomplished by two small adjustable bars which are connected in series with the screen by-pass capacitor connected to the tube socket. These bars form two parallel inductances that adjust the over-all screen reactance, bringing the tube internal reactances into balance for neutralization.

A MULTIMETER is located on the front panel of the power amplifier to enable the station operator to monitor screen voltage, screen current, and grid current. The MULTIMETER functions are selected by the multimeter switch located within the power amplifier cabinet. Screen voltages are determined by connecting multimeter M301 and meter multiplier resistor R322 across the regulated screen supply with switch S307. Screen current is determined by placing M301 and shunt resistor R307 in series with the screen voltage line. Grid current is determined by placing M301 and shunt in series with the control grid bias input.

2.2 CONTROL FUNCTIONS.

The following paragraphs describe all the functions of controls in D830-1 1000-Watt FM Power Amplifier. Refer to figure 2-4 for control locations.

The controls located directly on the front panel under the meters include the FILAMENT ON, FILAMENT OFF, PLATE OFF, and PLATE ON controls. The filament on and plate on indicators are placed in line with the above mentioned controls. The FILAMENT ON switch, S112, energizes the power

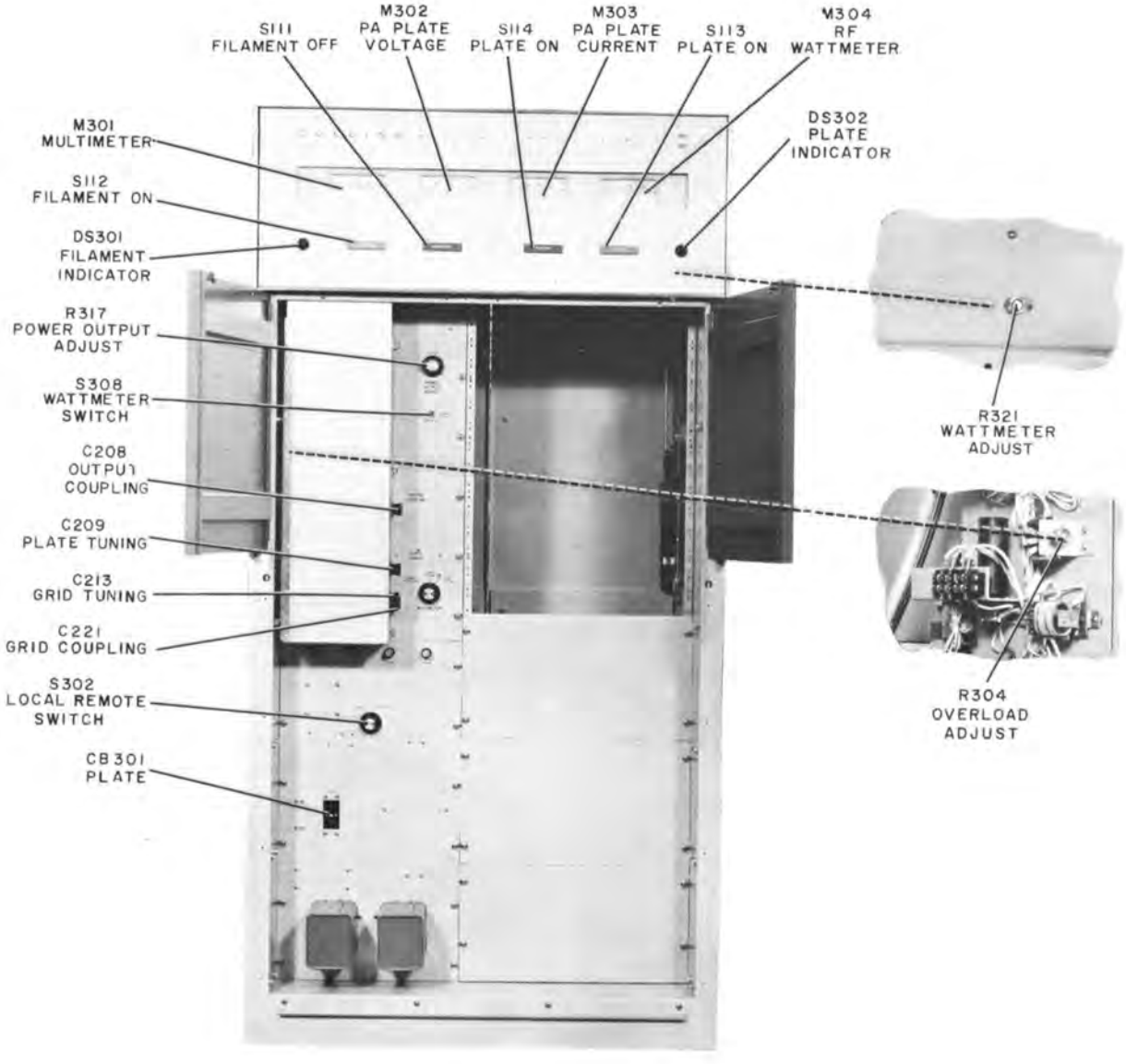


Figure 2-4. D830-1 1000-Watt FM Power Amplifier, Control Locations

amplifier filament, the power amplfier and cabinet blowers, and supplies power to the 10-watt exciter. The FILAMENT OFF switch, S111, de-energizes all transmitter circuits. The PLATE ON switch, S113, energizes the plate control relay, K302, which in turn could (if the FILAMENT ON switch has not been pressed) energize the filament control relay, K301, starting the power amplifier in sequence.

The PLATE OFF switch, S114, removes plate and screen voltage. The green filament indicator light, DS301, lights when the FILAMENT ON switch is pressed and indicates that voltage is available to the filament control relay. The filament control relay starts the PA blower which activates the PA blower interlock, energizing the power amplifier filament. The red plate on indicator light, DS302, indicates the plate contacter is receiving voltage.

The following controls are located directly under the left front door on the power amplifier panel. The POWER OUTPUT ADJUST potentiometer, R317, adjusts the power amplifier screen voltage thus changing the output power. The WATTMETER switch, S308, connects the R. F. WATTMETER to either the reflected power or forward power section of the directional coupler. The WATTMETER switch is normally left in the FORWARD position. The MULTIMETER switch, S307, selects either screen voltage, screen current or grid current for the MULTIMETER, M301. Table 3-1 lists the MULTIMETER switch positions and typical indications for each of the three meter circuits.

The following controls are located directly behind the left front door on the power amplifier compartment. The OUTPUT COUPLING control, C208, adjusts the coupling of the load to the plate cavity. The PLATE TUNING control, C209, tunes the plate cavity to resonance and is set very near the minimum indication on the P.A. PLATE CURRENT meter, M303. At this point the power output should be at the peak as indicated on the R.F. WATTMETER, M304. The GRID TUNING control, C213, tunes the grid tank and is set for maximum indication on the MULTIMETER, M301, with the MULTIMETER switch, S307, set to GRID FS 4 MA. The GRID COUPLING control, C221, adjusts the coupling of the grid tank to the exciter output and is normally set for 0.5 ma indication on the MULTIMETER. The following controls are located on the power supply panel directly behind the bottom front panel of the power amplifier cabinet. The LOCAL-REMOTE switch, S302, allows the power amplifier to be operated from a remote position or from the power amplifier. With S302 in the REMOTE position, filament on, filament off, plate on, and plate off functions may be selected from either a remote position or at the power amplifier. With S302 in the LOCAL position, filament on, filament off, plate on and plate off functions may be selected only at the power amplifier cabinet. The PLATE circuit breaker, CB301, is a protective device which monitors the plate supply transformer primary current. The circuit breaker will activate if the transformer primary current exceeds 12 amperes. The control circuit fuses protect the control circuits from overloads. The two 5-ampere fuses protect the control transformer primary while the 4-ampere fuse protects the control transformer secondary. A fourth fuse, 1/8-ampere, protects the control grid bias supply.

The wattmeter adjusting potentiometer, R321, is located directly below the R.F. WATTMETER when the upper switch and meter panel is raised. The wattmeter adjusting potentiometer is set at the factory and does not normally require adjustment.

The overload adjusting potentiometer, R304, is located inside the right rear door on the relay panel. The overload adjusting potentiometer is set at the factory and does not normally require adjustment. The bias adjust control, R326, is located on the rear of the power amplifier panel on the bias supply chassis. The bias adjusting control adjusts the fixed control grid bias. This control is set at the factory and does not normally require adjustment.

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains information concerning the maintenance of D830-1 1000-Watt FM Power Amplifier.

WARNING

Voltages present in this equipment are dangerous to life. Observe safety precautions when performing any maintenance. Do not reach inside the D830-1 cabinet whenever high voltage is applied. Do not depend entirely on door interlocks. Always shut down the D830-1 before doing any work inside the D830-1 cabinet. Immediately upon opening the rear doors short out all high-voltage points using the shorting stick located inside the left rear door.

3.2 PREVENTIVE MAINTENANCE.

Most service interruptions in equipment of this type are caused by dirt and corrosion. Corrosion is accelerated by the presence of moisture and dust. Dust should be removed periodically with a soft brush or a dry, oil-free air jet. Remove dust as often as a perceptible quantity accumulates at any point in the power amplifier.

When the D830-1 is operated near salt water or in other corrosive atmospheres, inspect and clean interlock switches, cable connectors, tube prongs, and other metal parts more frequently to keep the equipment in good operating condition.

3.2.1 AIR FILTER CLEANING.

At least once each month, or more often if needed, clean the air filter according to the following procedure.

a. Remove the air filter from the D830-1 cabinet by loosening the two thumb screws located above the air filter. Slide the air filter to the extreme right and pull the left side of the air filter out as soon as the filter clears the panel. Slide the air filter to the left and remove.

b. Mark with an arrow the direction of air flow.

c. Wash by passing a fine spray of hot water through the filter in the direction opposite that of the airflow. Gently shake the water out of the filter.

d. Dip the filter in a water-soluble oil, such as Filter-kote M available from Collins Radio Company, Service Parts Department, Cedar Rapids, Iowa (Collins part number 005-0609-00).

e. Remove the filter from the oil, lay the filter face down until oil ceases to drip from the filter.
f. Replace the filter into the lower rear panel with the air flow arrow (marked when the filter was removed) pointing in the direction of the air flow. Tighten the two thumb screws.
g. Replacement filters are Collins part number 009-1069-00.

3.2.2 PA TUBE CLEANING.

The power amplifier tube depends upon a stream of air passing through the fins to cool the anode. When these fins become dirty, the air-flow is reduced and the tube life is shortened. The radiator fins should be cleaned as follows:

a. Remove the r-f amplifier tube as described in paragraph 3.2.2.1.

CAUTION

Special care must be used in removing or installing the power amplifier tube to prevent damage to the tube.

b. Direct a low-pressure (50 psi) air stream through the fins in the direction opposite to the normal airflow until all dust is removed.
c. Replace the r-f amplifier tube as described in paragraph 3.2.2.1.

3.2.2.1 PA TUBE REMOVAL.

WARNING

Voltages present within the plate cavity are dangerous to life. Shut down the D830-1 doing any work inside the cavity. Short the plate to ground immediately on opening the plate cavity door. Do not depend entirely on the door interlock.

The power tube may be removed as follows:

a. Open the power amplifier cavity and loosen the clamp holding the coaxial transmission line and the power amplifier tube anode. Also loosen the plate slider clamp.
b. Grasp the center coaxial transmission line and lift until the center coaxial transmission line stops.
c. Turn the anode of V201 approximately 1/6 turn (counterclockwise) until the tube clears the tube socket.
d. Remove tube V201 from the socket.
e. Replacement is the reverse of the removal procedure.

NOTE

It may be necessary to move the OUTPUT COUPLING capacitor to the right so the center coaxial transmission line will clear the capacitor when the center transmission line is moved upwards.

3.2.3 INSPECTION.

Once each week check and clean the three interlock switches and the two shorting switches at the rear of the D830-1 cabinet to be sure they are in good working order.

Once each month check all connections in the D830-1. Tighten any nuts, bolts, or screws that may be loose. Check cable connections to see that they are clean and mechanically secure. Check moving parts such as tuning controls for excessive wear. Check the plate cavity for corrosion around the cavity contact strip. Check and clean (by lightly brushing) the screen grid voltage protector blocks located within the plate cavity.

3.2.4 LUBRICATION.

The PA blower is to lubricated once every six months with two drops of SAE no. 20 oil in each bearing. The cabinet fan has bearings that are lubricated for the life of the equipment. No other lubrication of the D830-1 is required.

3.2.5 TUBE MAINTENANCE.

The power amplifier, V201, should be inspected once each week to ensure that an accumulation of dust does not build up on the radiator fins. If dust is present, clean as described in paragraph 3.2.2. When tuning the D830-1, care should be taken not to exceed the maximum plate current shown in table 3-1.

3.3 TROUBLE SHOOTING.

The most common cause of trouble will probably be traced to tube failure. If the power amplifier tube is suspected of failure, replace it with a tube of known quality, retune, and note any change in performance. A small loss in emission of V201 can be compensated for by a change in the setting of the POWER OUTPUT ADJUST potentiometer. If no screen grid voltage is present, the trouble may lie in the screen grid protector blocks. These should then be cleaned or replaced.

Four meters are located on the D830-1 front panel to assist in locating any trouble which may occur. Table 3-1 contains typical meter indications. These average indications are obtained from several production power amplifiers, and the indications of some D830-1 may vary slightly outside the given limits without affecting the power amplifier performance. A list of panel meter indications for each

TABLE 3-1. TYPICAL METER INDICATIONS

METER	METER SWITCH POSITION	INDICATION
MULTIMETER	SCREEN FS 400 VDC	210 to 260
MULTIMETER	SCREEN FS 40 MA	25 ma
MULTIMETER	GRID FS 4 MA	0.5 ma
PA PLATE VOLTAGE		2650 to 2750
PA PLATE CURRENT		Approx 600 ma
RF WATTMETER	Forward	1000 watts
RF WATTMETER	Reflected	Less than 100 watts

individual power amplifier should be taken when the D830-1 is operating properly in its particular installation. Any abnormal deviation from these values will then be apparent during a check of meter indications.

3.4 CABLE CHART.

Table 3-2 contains from-to information for cables installed in D830-1 1000-Watt FM Power Amplifier. The table is useful in locating point to point wiring within the D830-1 cabinet. The FROM column is listed in alphabetical and numerical order. To find a particular wire, establish the point on the D830-1 from which wire tracing is to be initiated. Find this point in the FROM column of table 3-2 and the TO column will give the location of the other end of that particular wire. The WIRE CODE column gives the type and color of wire used in each case. Refer to the inside back cover of this manual for the wire code explanation. When the wire code CBSJ is encountered, the letters SJ mean shield with jacket.

TABLE 3-2. CABLE FROM-TO INFORMATION

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RE91	C206	T302-5	RC92	CR382-Cathode	CR381-Anode
RC4	C211	E314	CBSJ905	DC301-3	S308-2
RC93	C214	R319-2	Shield	DC301-3	E313
RC95	C218	S302-11	CBSJ903	DC301-4	S308-3
RC95	C219	TB304-3	Shield	DC301-4	E313
KEO	C301-1	L301-2	KEO	E301	L302-2
RC90	C301	TB-310-3	KEO	E301	S309
RC90	C301-2	R304-3	KEO	E301	TB308-1
RC90	C301-2	TB318-1	KEO	E301	R305-1
RC90	C301-2	C302-2	KEO	E301	M303-1
RC90	C302-2	TB312-2	RC4	E303	C211
RC90	C302-2	C301-2	RC96	E304	R308
KEO	C303	TB313-2	RC96	E304	S307-4
VG90	CB301-1	TB301-1	Shield	E306	M304-1
VG90	CB301-1	XF301-1	Shield	E306	E313
RE90	CB301-2	K304-5	RC92	E307	TB309-1
VG9	CB301-3	XF302-1	RC91	E307	XF304-1
VG9	CB301-3	TB301-2	RC91	E307	K301-6
RE95	CB301-4	K304-3	RC91	E307	S314-1
RC95	CR305-2	XF304-2	RC91	E307	TB307-1
RC-6	CR381-Cathode	R324-2	RC913	E308	S305-1
RC92	CR381-Anode	CR382-Cathode	RC913	E308	K305-5
RC90	CR382-Anode	R317-3	RC913	E308	K302-3

TABLE 3-2. CABLE FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RC913	E308	TB304-7	RC925	K304-2	TB304-5
VG9	E309	E310	RC923	K304-2	XDS302-1
RC9	E309	Power supply panel	RE95	K304-3	CB301-4
VG9	E310	E309	RE92	K304-4	T303-1
VG9	E310	TB301-3	RE90	K304-5	CB301-2
RC9	E310	E311	RE91	K304-6	T303-5
RC0	E310	E312	RC915	K305-1	R304-1
RC9	E310	M302-2	RC90	K305-2	R317-3
RC9	E310	TB303-2	RC916	K305-3	S114-2
RC9	E310	TB304-10	RC913	K305-5	E308
RC9	E310	T301-9	KEO	L301-1	TB315-2
RC9	E311	E310	KEO	L301-2	L302-1
RC0	E312	E310	KEO	L301-2	C301-1
RC9	E312	TB313-1	KEO	L302-1	L301-2
Shield	E313	DC301-3	KEO	L302-2	E301
Shield	E313	DC301-4	RC903	M301-1	S307-2
Shield	E313	E306	RC902	M301-2	S307-8
RC93	E313	R319-2	RC902	M302-1	TB308-6
RC4	E314	C211	RC9	M302-2	E310
CC1	E316	S307-10	RC9	M302-2	TB308-7
RC9	E317	TB309-2	RC9	M302-2	M304-1
RC9	E317	S307-9	KEO	M303-1	E301
RC905	E317	TB303-10	LE9	M303-2	S201
RC9	E322	K302-6	Shield	M304-1	E306
RC9	E322	K301-3	RC9	M304-1	M302-2
RC0	J305-1	K301-12	CBSJ906	M304-2	R321-1
RC0	J305-1	T302-1	RC915	R304-1	K305-1
RC90	J305-2	T302-2	RC90	R304-3	C301-2
RC90	J305-2	K301-9	KEO	R305-1	E301
RC96	K301-1	S112-2	RC96	R308	XV301-5
RC96	K301-1	S302-3	RC96	R309-1	S307-4
RC902	K301-2	S111-2	RC903	R315-1	R317-1
RC902	K301-2	K302-2	RC903	R317-1	R315-1
RC9	K301-3	E322	RC90	R317-3	K305-2
RC916	K301-4	K302-7	RC90	R317-3	CR382-Anode
RC91	K301-6	E301	RC903	R319-2	TB303-9
RC902	K301-7	XF303-2	RC93	R319-2	E313
RC90	K301-9	J305-2	CBSJ906	R321-1	M304-2
RC93	K301-10	T301-5	CBSJ902	R321-3	S308-1-Arm
RC0	K301-12	J305-1	RC6	R324-2	CR381
RC92	K301-13	T301-1	RC92	R330	S307-5
RC916	K302-1	S113-2	LE9	S201	M303-2
RC916	K302-1	K302-4	RC91	S302-1	TB303-1
RC91	K302-1	K302-9	RC96	S302-3	TB304-6
RC902	K302-2	TB304-8	RC96	S302-3	K301-1
RC902	K302-2	K301-2	RC912	S302-4	TB303-5
RC913	K302-3	E308	RC912	S302-4	TB304-11
RC916	K302-4	K302-1	RC90	S302-5	TB303-4
RC9	K302-6	E22	RC90	S302-5	S311-1
RC916	K302-7	K301-4	RC92	S302-7	TB303-3
RC923	K302-9	TB304-2	RC915	S302-9	TB304-1
RC91	K302-9	K302-1	RC93	S302-10	TB302-8
RC916	K302-10	TB308-11	RC95	S302-11	C218
RC906	K302-10	K304-1	RC95	S302-11	TB302-9
RC906	K304-1	K302-10	RC906	S111-1	TB302-8
RC925	K304-2	TB313-3	RC902	S111-2	K301-2

TABLE 3-2. CABLE FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
RC902	S111-2	XDS301-1	RC906	TB302-8	SI11-1
RC9	S112-1	TB308-6	RC95	TB302-9	S302-11
RC96	S3112-2	TB308-8	RC91	TB303-1	S302-1
RC96	S112-2	K301-1	RC9	TB303-2	E310
RC913	S113-1	E308	RC92	TB303-3	S302-7
RC916	S113-2	K302-1	RC90	TB303-4	S302-5
RC915	S114-1	S313-2	RC912	TB303-5	S302-4
RC916	S114-2	K305-2	RC913	TB303-7	TB304-7
RC903	S307-2	M301-1	RC902	TB303-8	TB308-5
RC96	S307-4	E304	KEO	TB303-8	TB312-1
RC96	S307-4	R309-1	RC903	TB303-9	R319-2
RC92	S307-5	R330	RC905	TB303-10	E317
RC902	S307-8	M301-2	RC915	TB304-1	S302-9
RC9	S307-9	E317	RC923	TB304-2	K302-9
RC1	S307-10	E303	RC95	TB304-3	C219
CC1	S307-10	E316	RC93	TB304-4	XF303-2
CBSJ902	S308-1	R321-3	RC925	TB304-5	K304-2
CBSJ905	S308-2	DC301-3	RC96	TB304-6	S302-3
DBSJ903	S308-3	DC301-4	RC913	TB304-7	E308
VD902	S309	S310	RC913	TB304-7	TB303-7
KEO	S309	E310	RC902	TB304-8	K302-2
VD02	S310	S309	RC9	TB304-10	E310
RC90	S311-1	S302-5	RC9	TB304-10	TB301-3
RC912	S311-2	S312-1	RC912	TB304-11	S302-4
RC912	S312-1	S311-2	TAS9	TB305-1	TB307-3
RC913	S312-2	S313-1	TAS0	TB305-2	TB307-4
RC913	S313-1	S312-2	Shield	TB305-3	TB307-5
RC915	S313-2	S114-1	TAS9	TB305-4	TB307-10
RC91	S314-1	E307	TAS2	TB305-5	TB307-11
RC92	S314-3	TB313-4	RC90	TB306-1	TB302-1
RC92	T301-1	TB302-3	RC91	TB306-2	TB302-2
RE92	T301-1	XF302-2	RC93	TB306-3	T301-4
RC92	T301-1	K301-13	RC91	TB307-1	E307
RE91	T301-4	XF301-2	RC9	TB307-2	TB308-7
RC93	T301-4	TB306-3	TAS9	TB307-3	TB305-1
RC93	T301-5	K301-10	TAS0	TB307-4	TB305-2
RC96	T301-8	XF303-1	Shield	TB307-5	TB305-3
RC9	T301-9	E310	RC96	TB307-9	TB302-7
RC0	T302-1	J305-1	TAS9	TB307-10	TB305-4
RC90	T302-2	J305-2	TAS2	TB307-11	TB305-5
RE91	T302-5	C206	KEO	TB308-1	E301
RE91	T302-7	XV201-Gnd	RC902	TB308-5	TB303-8
RE93	T303-1	K304-4	RC902	TB308-6	M302-1
RE91	T303-5	K304-6	RC9	TB308-6	S112-1
KEO	T303-8	TB312-1	RC9	TB308-6	M302-2
RC90	T303-9	TB317-2	RC9	TB308-7	TB307-2
KEO	T303-10	TB317-2	RC903	TB308-7	XDS301-2
VG90	TB301-1	CB301-1	RC96	TB308-8	S112-2
VG9	TB301-2	CB301-3	RC925	TB308-10	XDS302-2
RC9	TB301-3	TB304-10	RC916	TB308-11	K302-10
VG9	TB301-3	E310	RC92	TB309-1	E307
RC90	TB302-1	TB306-1	RC9	TB309-2	E317
RC91	TB302-2	TB306-2	RC90	TB310-3	C301
RC92	TD302-3	T301-1	KEO	TB312-1	T303-8
RC96	TB302-7	TB307-9	RC90	TB312-2	C302-2
RC93	TB302-8	S302-10	RC9	TB313-1	E312

TABLE 3-2. CABLE FROM-TO INFORMATION (Cont)

WIRE CODE	FROM	TO	WIRE CODE	FROM	TO
KEO	TB313-2	C303	RE91	XF301-2	T301-4
KEO	TB313-2	L301-1	VG9	XF302-1	CB301-3
RC925	TB313-3	K304-2	RE92	XF302-2	T301-1
RC92	TB313-4	S314-3	RC96	XF303-1	T301-8
KEO	TB315-2	L301-1	RC93	XF303-2	TB304-4
KEO	TB317-2	T303-10	RC902	XF303-2	K301-7
RC90	TB318-1	C301-2	RC91	XF304-1	E307
RC902	XDS301-1	S111-2	RC95	XF304-2	CR305-2
RC903	XDS301-2	TB308-7	RE91	XV201-Gnd	T302-7
RC923	XDS302-1	K304-2	RC5	XV301-5	R305-2
RC925	XDS302-2	TB308-10	RC96	XV301-5	R308
VG90	XF301-1	CB301-1			

SECTION IV
PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	D830-1 1000-Watt FM Power Amplifier	522-2948-00
B101	NOT USED	
B102	NOT USED	
B103	MOTOR, ALTERNATING CURRENT: 230 v; 50/60 cps, 6 w, 1550 rpm, ccw; 3.500 in dia by 4.343 in. lg; General Electric part no. 5KSP51CL17	230-0164-00
S101 thru S110	NOT USED	
S111	SWITCH, PUSH: dpst; 1.1875 in. by 1.562 in. by 1.905 in. overall	260-2020-00
S112	SWITCH, PUSH: same as S111	260-2020-00
S113	SWITCH, PUSH: same as S111	260-2020-00
S114	SWITCH, PUSH: same as S111	260-2020-00
C201 thru C204	NOT USED	
C205	CAPACITOR, FIXED, CERAMIC: 1000 uuf +80%, -20%, 500 vdcw; Erie Resistor Corp, part no. DA722-002	913-1292-00
C206	CAPACITOR, FIXED, CERAMIC: same as C205	913-1292-00
C207	NOT USED	
C208	PLATE, CAPACITOR: aluminum; 0.063 in. thk, 2.625 in. by 2.625 in. w/ 1.750 in. radius; Collins Radio Co.	549-2379-002
C209	CAPACITOR, VARIABLE, AIR: plate meshing type; 7.6 uf min, 10.8 uf max capacity; 7 aluminum plates; E. F. Johnson Co. part no. 165-7	922-0572-00
C210	CAPACITOR, FIXED, CERAMIC: 1000 uuf ±20%, 5000 vdcw; Centralab, Div. Globe Union Inc. part no. DA858-003	913-0101-00
C211	CAPACITOR, FIXED, CERAMIC: same as C205	913-1292-00
C212	P/O XV201	
C213	CAPACITOR, VARIABLE, AIR: plate meshing type; 3.0 uuf min, 18.7 uuf max capacity; aluminum or brass plates; E. F. Johnson Co. part no. 160-110-3	922-0033-00
C214	CAPACITOR, FIXED, CERAMIC: same as C205	913-1292-00
C215	NOT USED	
C216	CAPACITOR, FIXED, CERAMIC: same as C210	913-0101-00
C217	CAPACITOR, FIXED, CERAMIC: same as C210	913-0101-00
C218	CAPACITOR, FIXED, CERAMIC: same as C205	913-1292-00
C219	CAPACITOR, FIXED, CERAMIC: same as C205	913-1292-00
C220	CAPACITOR, FIXED, PLASTIC: 35 uuf ±10%, 1000 vdcw; Collins Radio Co.	549-2448-002
C221	CAPACITOR, VARIABLE, AIR: plate meshing type; 6 uuf min, 100.5 uuf max capacity; aluminum or brass plates	922-0024-00
J201	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 contact, straight shape, panel mtg; RF Products part no. 87075	357-9183-00
J202	CONNECTOR, RECEPTACLE, ELECTRICAL: 1 round female contact, straight shape; 1 in. by 1 in. by 1.106 in. overall	357-9003-00
J203	CONNECTOR, RECEPTACLE, ELECTRICAL; same as J202	357-9003-00
L201	NOT USED	
L202	COIL, RADIO FREQUENCY: 4.7 uh, 0.60 ohm dc resistance, 950 ma dc current, 9/32 in. dia, 15/16 in. lg; two AWG leads, #21 & #22 Jeffers Electronics, Div. Speer Carbon Co. part no. 10402-32	240-0178-00
L203	COIL, RADIO FREQUENCY: 4 turns #12 wire; 0.750 in. dia by 0.234 in. lg excl terminals; Collins Radio Co.	549-2373-002
L204	NOT USED	
R201	RESISTOR, FIXED, COMPOSITION: 1200 ohms ±10%, 2 w	745-5656-00
R202	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%, 2 w	745-5610-00
R203	RESISTOR, FIXED, WIREWOUND: 470 ohms ±5%, 6.5 w	747-5527-00
R204	RESISTOR, FIXED, COMPOSITION: same as R201	745-5656-00
R205	RESISTOR, FIXED, COMPOSITION: same as R201	745-5656-00
R206	RESISTOR, FIXED, COMPOSITION: same as R201	745-5656-00
R207	RESISTOR, FIXED, COMPOSITION: same as R201	745-5656-00
R208	RESISTOR, FIXED: globar, 22 ohms ±20%, 18 w	712-0002-00
S201	ARRESTOR, ELECTRICAL SURGE-RIVETED: 1.062 in. by 1.250 in. by 1.875 in.; Collins Radio Co.	549-2453-002
S202	SWITCH, INTERLOCK: spdt; 10 amp at 250 vac, 0.25 amp at 250 vdc, 6 amp at 30 vdc inductance; Micro Switch part no. 3AC5	266-8013-00
V201	ELECTRON TUBE: tetrode; Eimac type 4CX1000A	256-0123-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
XV201	SOCKET, ELECTRON TUBE: accommodates Eimac 4CX1000A or 4CW2000A tubes or equivalent; 5.595 in. dia by 1.990 in. lg	220-1507-00
B301	NOT USED	
B302	FAN, CENTRIFUGAL: 115 vac, 60 cps, single phase; 6.750 in. by 7.560 in. by 7.609 in.; Collins Radio Co.	009-1576-00
C301	CAPACITOR, FIXED, PAPER: 4 uf ±10%, 4000 vdcw; Sprague Electric Co. part no. S4878	930-0705-00
C302	CAPACITOR, FIXED, PAPER: same as C301	930-0705-00
C303	CAPACITOR, FIXED, PLASTIC: 20,000 uuf ±10%, 8000 vdcw; Condenser Products Div. of New Haven Clock & Watch Co. part no. ASG-203-8M; p/o TB310	933-0038-00
C304	NOT USED	
C305	CAPACITOR, FIXED, ELECTROLYTIC: 300 uf -10% +100%, 150 vdcw	183-1117-00
C306	CAPACITOR, FIXED, ELECTROLYTIC: 500 uf -10% +100%, 50 vdcw	183-1402-00
C307	P/O T302	
C308	CAPACITOR, FIXED, CERAMIC: 100 uuf ±5%, 500 vdcw; Erie Resistor Corp. part no. 308611U250101J	916-4059-00
C309	CAPACITOR, FIXED, CERAMIC: same as C308	916-4059-00
C310	CAPACITOR, FIXED, CERAMIC: same as C308	916-4059-00
C311	CAPACITOR, FIXED, CERAMIC: same as C308	916-4059-00
C312 thru C319	NOT USED	
C320	CAPACITOR, FIXED, CERAMIC: 10,000 uuf ±20%, 1000 vdcw; Centralab, Div. Globe Union, Inc. part no. DA049-182CB; p/o TB314 thru TB321	913-3183-00
C321 thru C399	CAPACITOR, FIXED, CERAMIC: same as C320; p/o TB314 thru TB321	913-3183-00
CB301	CIRCUIT BREAKER: magnetic blowout arc quenching; 50-amp contact rating; 230 vac, 125 vdc max operating; Heinemann Electric Co. part no. 2263S	260-0243-00
CR301	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; incl 2 wire lead terminals; 0.417 in. dia by 0.425 in. lg; Motorola, Inc. part no. 1N1566; p/o TB314 thru TB321	353-1736-00
CR302 thru CR380	SEMICONDUCTOR DEVICE, DIODE: same as CR301; p/o TB314 thru TB321	353-1736-00
CR381	SEMICONDUCTOR DEVICE, SET: matched pair, zener 140 v, type 50M140ZB5	353-6015-00
CR382	SEMICONDUCTOR DEVICE, SET: same as CR381	353-6015-00
CR383	SEMICONDUCTOR DEVICE, DIODE: silicon; incl 2 wire lead terminals; 0.395 in. dia by 0.636 in. lg; General Electric Co. part no. 1N1492	353-1661-00
CR384	SEMICONDUCTOR DEVICE, DIODE: same as CR383	353-1661-00
CR385	SEMICONDUCTOR DEVICE, DIODE: same as CR301	353-1736-00
DC301	DIRECTIONAL COUPLER: 1200 w; Jones Model No. 576N7	277-0165-00
F301	FUSE, CARTRIDGE: 5 amp, 250 vdc; ferrule-type terminals; ceramic body; 0.250 in. dia by 1.250 in. lg.	264-0361-00
F302	FUSE, CARTRIDGE: same as F301	264-0361-00
F303	FUSE, CARTRIDGE: 4 amp, 125 vdc; ferrule-type terminals; time delay, 1/2 sec at 500 percent load; glass body; 0.250 in. dia by 1.250 in. lg; Bussman Mfg. Co. part no. MDX-4	264-0217-00
F304	FUSE, CARTRIDGE: 0.215 amp, 250 vdc; normal instantaneous; ferrule terminal; glass covering; one time; 1/4 in. dia by 1-1/4 in. lg	264-4010-00
H301	CONTACT, ELECTRICAL: copper, 0.032 in. thk; irregular shape; Collins Radio Co.	549-2317-002
H302	WASHER, FLAT: aluminum; 0.063 in. thk by 2 in. dia; Collins Radio Co.	504-9553-001
H303	WINDOW, OBSERVATION, METERS: glass, 3/16 in. thk, 3-5/8 in. w by 32-1/8 in. lg; Collins Radio Co.	548-3567-002
H304	NUT, SPECIAL, PLATED: steel, cadmium plated; 1/8 in. by 1/4 in. by 3/8 in.; Collins Radio Co.	549-0692-002
H305	SPRING, SHORTING: copper, 0.032 in. thk; 2-11/32 in. w by 2-9/16 in. lg approx; Collins Radio Co.	549-2374-002
H306	WASHER, KNOB: CRES, 0.003 in. thk; irregular shape; Collins Radio Co.	542-7417-002
H307	WASHER, FLAT: CRES, 0.018 in. thk by 0.120 in. id by 0.375 in. od; Collins Radio Co.	504-0730-003
J301	NOT USED	
J302	NOT USED	
J303	CONNECTOR: Andrew 2261, 1-5/8 to type N RF out of Cab. connector	013-1215-00
J304	CONNECTOR, RECEPTACLE, ELECTRICAL: bulkhead mtd; brass, teflon insulation, beryllium copper contact; American Phenolic part no. 31-206	357-9248-00
J305	CONNECTOR, PLUG, ELECTRICAL: 3 female contacts; straight shape; 10 amp, 250 v; 15 amp, 125 v	368-0014-00
K301	RELAY, ARMATURE: 4C; 115 vac, 10 amp; 330 ohms resistance; Aemco, Inc. part no. 83-3544	970-1933-00
K302	RELAY, ARMATURE: same as K301	970-1933-00
K303	RECTIFIER, SEMICONDUCTOR DEVICE: 0.233 in. by 2.593 in. by 11.750 in.; Collins Radio Co.	549-2463-003
K304	RELAY, ARMATURE: spst; 600 v at 25 amp; 60 cps coil rating; 3.000 in. by 4.000 in. by 5.875 in. overall	405-0124-00
K305	RELAY, ARMATURE: 1C; 28 vdc or 115 vac at 5 amp; 1 inductive winding, 158 ma, 10 ohms; Sigma Instruments part no. 95062	408-1114-00
K306	RELAY, ARMATURE: 2C; 30 vdc or 115 vac; 1 inductive winding, 115 vac, 60 cps; Aemco, Inc. part no. 45-2446	972-1347-00
K307	RELAY, THERMAL: nominal time delay, 180 seconds; 115 vac; 4 watts	402-0387-00
L301	CHOKE: 10 h; 60 ohms, 0.850 amp	668-0022-00
L302	CHOKE: 10 h; 60 ohms, 0.850 amp	668-0022-00
M301	AMMETER: permanent magnet moving coil type dc milliammeter; 0 to 1 ma dc meter range, 100 ohms ±5% meter resistance, ±2% accuracy	458-0649-00
M302	VOLTMETER: 0 to 1 ma meter range, 50 ohms meter resistance, 0 to 4000 vdc scale markings; 2.875 in. by 3.937 in. by 5.000 in.	458-0610-00
M303	AMMETER: 0 to 800 ma meter range; 0.5 ohm meter resistance, 40 scale divisions; 2.875 in. by 3.937 in. by 5.000 in.	458-0611-00
M304	METER	458-0652-00
MP301	CONTACT ASSEMBLY: female; 15/16 in. by 2-5/16 in.; Neptune Electronics part no. F7460330G4	260-4050-00
MP302	CONTACT ASSEMBLY: same as MP301	260-4050-00
MP304	DOOR CATCH: steel, spring friction; 17/32 in. by 1 in. by 1-5/16 in.; Amerock Corp. part no. 40-F-3687-1	015-4090-00
MP305	DOOR CATCH: same as MP304	015-4090-00
MP306	LATCH, MAGNETIC: 10 lb. supplied w/ or w/o striker plate; latch, aluminum; striker plate, steel; ferrite magnet; Heppner Mfg. Co. part no. AD-PL-100 & DC-ST-1	015-0899-00
MP307	LATCH, MAGNETIC: same as MP306	015-0899-00
MP308	LATCH, TOUCH, RELEASE: steel, 3/4 in. by 1-11/32 in. by 1-3/8 in.; National Lock Co. part no. 61-380(CAD-1)	015-1398-00
MP309	LATCH, TOUCH, RELEASE: same as MP308	015-1398-00
MP310	ROD ASSEMBLY, SHORTING: c/o plastic handle, shorting rod, coiled copper coil w/ rubber jacket & hardware; approx 26-3/4 in. lg; Collins Radio Co.	549-2186-003
MP311	SLIDER, TUNING CAVITY: aluminum, 1/2 in. by 5-27/32 in. by 6-11/16 in.; Collins Radio Co.	549-2424-004
MP312	SHAFT, STRAIGHT, SHORT: glass melamine rod; 0.250 in. dia by 29/32 in. lg; Collins Radio Co.	549-2436-002
MP313	SHAFT, STRAIGHT, LONG: glass melamine rod; 0.250 in. dia by 1-1/32 in. lg; Collins Radio Co.	549-2437-002
MP314	COUPLING, SHAFT, RIGID: brass, setscrew type 7/16 in. dia by 1/2 in. lg; Collins Radio Co.	549-2435-002
MP315	SLIDER, CONTACT: brass, 3/32 in. by 1/8 in. by 3/16 in.; Collins Radio Co.	549-2413-002
MP316	SLIDER, CONTACT: same as MP315	549-2413-002
MP317	GEAR, SPUR: aluminum, 48 teeth, diametral pitch 64, 0.570 in. std pitch dia; 0.040 in. w face, 3/8 in. lg overall; Collins Radio Co.	542-7422-002
MP318	LEADSCREW: CRES, 0.249 in. dia by 2-9/16 in. lg; grooved; undercut and threaded one end 4-40 NC-2B; Collins Radio Co.	549-2365-002

ITEM	DESCRIPTION	COLLINS PART NUMBER
MP319	CONTACT, SHORTING: brass, setscrew type; spherical radius; 3/4 in. dia by 3/4 in. lg; Collins Radio Co.	542-1773-002
MP320	COUPLING: brass, rigid; 0.250 in. id, 1/2 in. od, 3/4 in. lg; James Mellon Mfg. Co., Inc. part no. 39003	015-0257-00
MP321	BEARING, SLEEVE: porous bronze, flanged; 15/32 in. dia flange, 11/64 in. lg; Oilite-Chrysler Corp. part no. F-346	309-0086-00
MP322	ARRESTOR, ELECTRICAL SURGE-RIVETED: 1.062 in. by 1.250 in. by 1.875 in.; Collins Radio Co.	549-2453-002
MP323	CONDUCTOR, ROD, LONG: aluminum, stock dia, 3-1/2 in. lg; Collins Radio Co.	549-2372-002
MP324	CONDUCTOR ROD, SHORT: aluminum, 1/2 in. dia by 3.250 in. lg; Collins Radio Co.	549-2371-002
MP325	CLAMP, HALF, ELECTRICAL, LOWER: aluminum; 3/8 in. by 1/2 in. by 7/8 in.; Collins Radio Co.	549-2367-002
MP326	CLAMP, HALF, ELECTRICAL, UPPER: aluminum, 3/8 in. by 1/2 in. by 7/8 in.; Collins Radio Co.	549-2366-002
MP327	PLATE, CAPACITOR: aluminum, 0.063 in. thk; 2-5/8 in. by 2-3/4 in.; 1-3/4 in. radius; Collins Radio Co.	549-2379-002
MP328	LEAD, ELECTRICAL, UPPER: brass, 0.147 in. by 13/32 in. by 1-15/16 in.; Collins Radio Co.	549-2415-002
MP329	LEAD, ELECTRICAL, LOWER: brass, 3/32 in. by 0.145 in. by 1.812 in.; Collins Radio Co.	549-2414-002
MP330	SLIDER, CONTACT: brass, 3/32 in. by 1/8 in. by 3/16 in.; Collins Radio Co.	549-2413-002
MP331	SLIDER, CONTACT: same as MP330	549-2413-002
MP332	HOOK: steel, 7/8 in. w by 9/16 in. lg; Corbin Cabinet & Lock Div. American Hardware Corp, part no. 15797	015-0205-00
MP333	HOOK: same as MP332	015-0205-00
MP334	HOOK: same as MP332	015-0205-00
MP335	DRAW-PULL CATCH: steel; Corbin Cabinet & Lock Div. American Hardware Corp. part no. 15797	015-0204-00
MP336	DRAW-PULL CATCH: same as MP335	015-0204-00
MP337	DRAW-PULL CATCH: same as MP335	015-0204-00
0301	KNOB: fluted; black phenolic, setscrew type; 1.242 in. dia by 0.8435 in. w; w/ skirt	546-1293-002
0302	KNOB: same as MP301	546-1293-002
0303	KNOB: same as MP301	546-1293-002
0304	KNOB: same as MP301	546-1293-002
0305	KNOB: same as MP301	546-1293-002
0306	KNOB: fluted, black phenolic, setscrew type, 1.125 in. dia by 0.750 in. thk; w/ skirt	547-8792-003
P301	NOT USED	
P302	NOT USED	
P303	CONNECTOR, PLUG, ELECTRICAL: brass body and contacts, teflon insulation; 3/4 in. dia by 1-1/2 in. lg approx; Amphenol part no. UF-1185/U	357-9326-00
P304	CONNECTOR, PLUG, ELECTRICAL: same as P303	357-9326-00
P305	NOT USED	
P306	NOT USED	
P307	CONNECTOR, PLUG, ELECTRICAL: same as P303	357-9326-00
P308	CONNECTOR, PLUG, ELECTRICAL: 1 male contact, 1 mating end	357-9292-00
P309	CONNECTOR, PLUG, ELECTRICAL: 3 wire midget, twist-lock; 10 amp, 250 v; 15 amp, 125 v	368-0013-00
P310	CONNECTOR, PLUG, ELECTRICAL: same as P303	357-9326-00
R301	RESISTOR, FIXED, COMPOSITION: 18,000 ohms ±10%, 1 w; p/o TB308	745-3405-00
R302	RESISTOR, FIXED, COMPOSITION: same as R301; p/o TB308	745-3405-00
R303	NOT USED	
R304	RESISTOR, VARIABLE: wirewound; 50 ohms ±10%, 2 w	377-0619-00
R305	RESISTOR, FIXED, WIREWOUND: 20,000 ohms ±5%, 210 w	746-6723-00
R306	RESISTOR, FIXED, COMPOSITION: 10 ohms ±10%, 2 w; p/o TB312	745-5568-00
R307	RESISTOR, FIXED, WIREWOUND: 2.56 ohms ±1%, 2.5 w	746-9448-00
R308	NOT USED	
R309	RESISTOR, FIXED, WIREWOUND: 15,000 ohms ±5%, 20 w	710-4782-00
R310	RESISTOR, FIXED, FILM: 1,000,000 ohms ±1%, 2 w; p/o TB308	705-4254-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
R311	RESISTOR, FIXED, FILM: same as R310; p/o TB308	705-4254-00
R312	RESISTOR, FIXED, FILM: same as R310; p/o TB308	705-4254-00
R313	RESISTOR, FIXED, FILM: 5,110 ohms ±1%, 1/2 w; p/o TB308	705-7630-00
R314	RESISTOR, FIXED, FILM: 10,000 ohms ±1%, 1 w, p/o TB308	705-3394-00
R315	RESISTOR, FIXED, WIREWOUND: 27.0 ohms ±5%, 55 w	747-2815-00
R316	RESISTOR, FIXED, COMPOSITION: 33 ohms ±10%, 1 w	745-3289-00
R317	RESISTOR: 75 ohms, 1100 v	735-4000-00
R318	RESISTOR, FIXED, WIREWOUND: same as R315	747-2815-00
R319	RESISTOR, FIXED, WIREWOUND: 10 ohms ±5%, 11 w	746-6040-00
R320	RESISTOR, FIXED, COMPOSITION: 1200 ohms ±10%, 2 w; p/o TB 310	745-5656-00
R321	RESISTOR, VARIABLE: wirewound; 10,000 ohms ±20%, 2.0 w	380-2757-00
R322	RESISTOR, FIXED, FILM: 402,000 ohms ±1%, 1 w	705-3287-00
R323	RESISTOR, FIXED, WIREWOUND: 3.9 ohms ±5%, 11 w	746-6115-00
R324	RESISTOR, FIXED, WIREWOUND: same as R305	746-6723-00
R325	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%, 2 w	745-5610-00
R326	RESISTOR, ADJUSTABLE: 10,000 ohms ±10%, 10 w	716-0013-00
R327	RESISTOR, FIXED, COMPOSITION: same as R320; p/o TB310	745-5656-00
R328	RESISTOR, FIXED, COMPOSITION: same as R320; p/o TB310	745-5656-00
R329	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 2 w	745-5719-00
R330	RESISTOR, FIXED, WIREWOUND: 310 ohms ±5%, 11 w	746-6087-00
R331	RESISTOR, FIXED, COMPOSITION: same as R320; p/o TB310	745-5656-00
R332	RESISTOR, FIXED, COMPOSITION: same as R320; p/o TB310	745-5656-00
R333	RESISTOR, FIXED, FILM: same as R310	705-4254-00
R334	RESISTOR, FIXED, COMPOSITION: same as R306; p/o TB312	745-5568-00
R335	RESISTOR, FIXED, COMPOSITION: same as R306; p/o TB312	745-5568-00
R336	RESISTOR, FIXED, WIREWOUND: 12 ohms ±5%, 14 w	747-0726-00
R337	RESISTOR, FIXED, COMPOSITION: 1800 ohms ±10%, 2 w	745-5663-00
R338	RESISTOR, FIXED, COMPOSITION: 8200 ohms ±10%, 1 w	745-3391-00
R339	NOT USED	
R340	RESISTOR, FIXED, COMPOSITION: 0.18 megohm ±10%, 1 w (p/o TB314 thru TB321)	745-3447-00
R341 thru R419	RESISTOR, FIXED, COMPOSITION: same as R340 (p/o TB314 thru TB321)	745-3447-00
S301	NOT USED	
S302	SWITCH, ROTARY: 1 section, 4 moving, 12 fixed contacts	259-1561-00
S303 thru S306	NOT USED	
S307	SWITCH, ROTARY: 1 section, 2 moving, 8 fixed contacts	259-1565-00
S308	SWITCH, TOGGLE: spdt; dc rating 250 v max, 0.5 amp resistive current rating; ac rating 220 v max, 6 amp resistive current rating; 60 cps	266-3075-00
S309	NOT USED	
S310	NOT USED	
S311A	CONTACT ASSEMBLY, ELECTRICAL: incls 5 female contacts; Neptune Electronics Co. part no. F-7460330G4	260-4050-00
S311B	CONTACT ASSEMBLY, ELECTRICAL: incls 2 male contacts; 0.687 in. by 1.375 in. by 1.875 in. overall; Neptune Electronics Co. part no. M-7460330G4	260-4040-00
S312A	CONTACT ASSEMBLY, ELECTRICAL: same as S311A	260-4050-00
S312B	CONTACT ASSEMBLY, ELECTRICAL: same as S311B	260-4040-00
S313A	CONTACT ASSEMBLY, ELECTRICAL: same as S311A	260-4050-00
S313B	CONTACT ASSEMBLY, ELECTRICAL: same as S311B	260-4040-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
S314	SWITCH, AIRFLOW: spdt; 5 amp at 250 vac	266-8307-00
T301	TRANSFORMER, POWER, STEP-DOWN: 1 pri winding, 250 v, tapped at 200 v, 210 v, 220 v, 230 v, 240v; 50/60 cps; 120 v at 4.25 amp sec; open frame; 5-1/8 in. by 5-1/8 in. by 5-3/8 in.; Electro Engr. Works part no. E12322	622-0043-00
T302	FIL. TRANSFORMER: incls C307	662-0053-00
T303	PLATE TRANSFORMER:	662-0054-00
TB301	TERMINAL BOARD: ceramic; incls 4 thd stud terminals; 1.312 in. h by 1.750 in. lg; Square D Co. part no. TB-4	306-0778-00
TB302	TERMINAL BOARD: bakelite; incls 10 terminals; 0.375 in. by 0.875 in. by 4.375 in. overall; Howard B. Jones, Div. Cinch Mfg. Co. part no. 140-10	367-3100-00
TB303	TERMINAL BOARD: same as TB302	367-3100-00
TB304	TERMINAL BOARD: phenolic; 12 screw-type terminals; 13/32 in. by 7/8 in. by 5-11/64 in.; Howard B. Jones, Div. Cinch Mfg. Co. part no. 140-D	367-0518-00
TB305	TERMINAL BOARD: same as TB304	367-0518-00
TB306	TERMINAL BOARD: bakelite; incls 4 screw terminals 0.500 in. by 1.125 in. by 2.500 in.; Howard B. Jones, Div. Cinch Mfg. Co. part no. 4-141	367-4040-00
TB307	FANNING STRIP: incls 12 terminals; 0.578 in. by 0.999 in. by 5.187 in. overall; Cinch Mfg. Co. part no. 12-160-AL	367-1385-00
TB308	TERMINAL BOARD: plastic; accommodates 11 terminals; 0.062 in. by 3.500 in. by 4.562 in. board; Collins Radio Co. (includes R301, R302, R308 thru R314)	549-2102-003
TB309	TERMINAL BOARD: phenolic, incls 2 solder-lug terminals; 0.625 in. by 0.375 in. by 1.125 in.; Cinch Mfg. Co. part no. 18A/18697	306-0168-00
TB310	SUPPRESSOR, TRANSIENT: 0.968 in. by 2.125 in. by 6.031 in.; Collins Radio Co. (includes C303, R320, R327, R328, R331, R332)	549-2455-003
TB311	TERMINAL BOARD: plastic; incls 10 terminals; 0.625 in. by 1.062 in. by 6.625 in.; Howard B. Jones, Div. Cinch Mfg. Co. part no. 10-142	367-5100-00
TB312	RESISTOR ASSEMBLY: 10 ohms ±10%, 2 w; 0.380 in. by 1.750 in. by 1.875 in. overall; incls one terminal board; Collins Radio Co. (includes R306, R334, R335)	549-2450-002
TB313	TERMINAL BOARD: incls 4 terminals; 0.406 in. by 0.875 in. by 2.156 in. overall; Howard B. Jones Div. Cinch Mfg. Co. part no. 4-140	367-0002-00
TB314 thru TB321	RECTIFIER, SEMICONDUCTOR DEVICE: includes C320 thru C399; CR301 thru CR380, R340 thru R419	549-2463-004
XF301	FUSEHOLDER: 250 v, 20 amp; accommodates cartridge type fuse; 0.812 in. by 0.812 in. by 2.875 in.; Bussman Fuse, Div. McGraw-Edison Co. part no. HKL-JRZ	265-1040-00
XF302 thru XF304	FUSEHOLDER: same as XF301	265-1040-00
XK307	SOCKET, ELECTRON TUBE: accommodates T-5-1/2 tube; 0.750 in. by 0.812 in. by 1.125 in.	220-1235-00

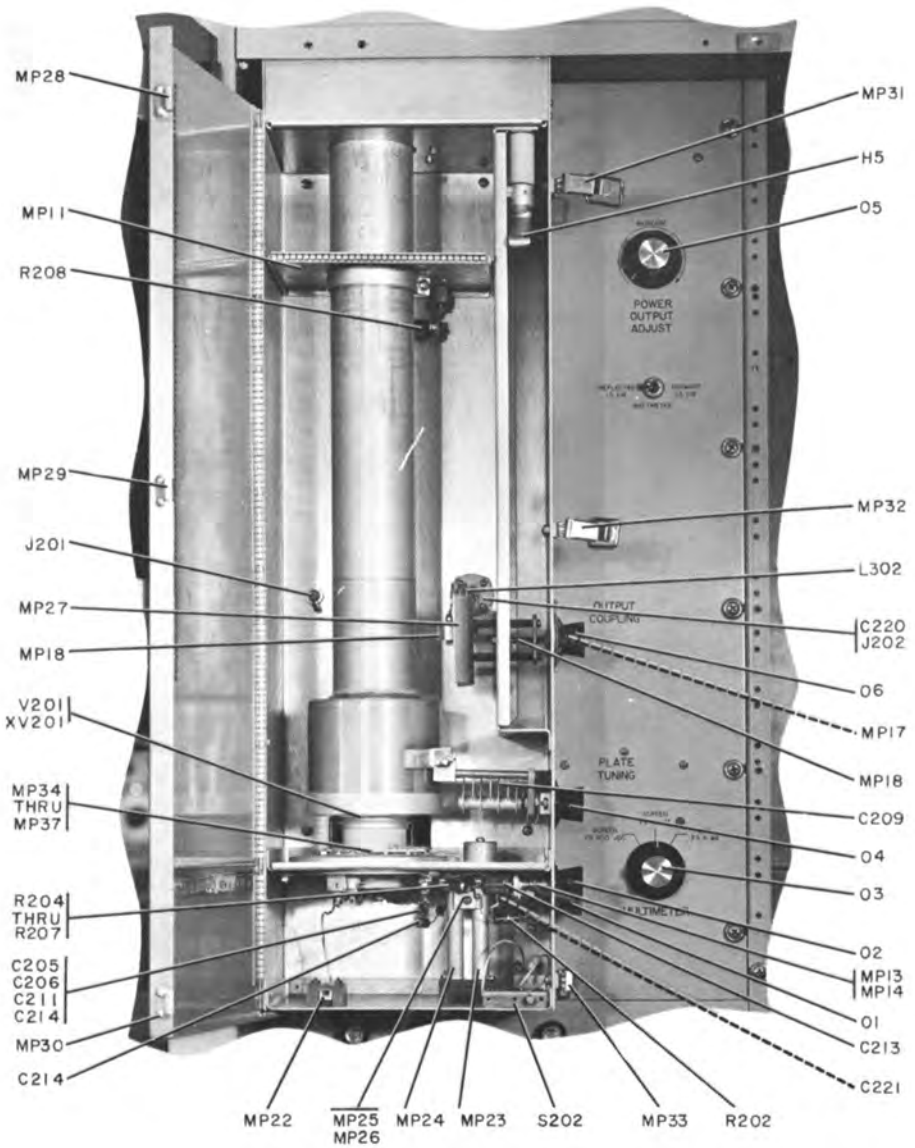


Figure 4-1. Cavity, Parts Location

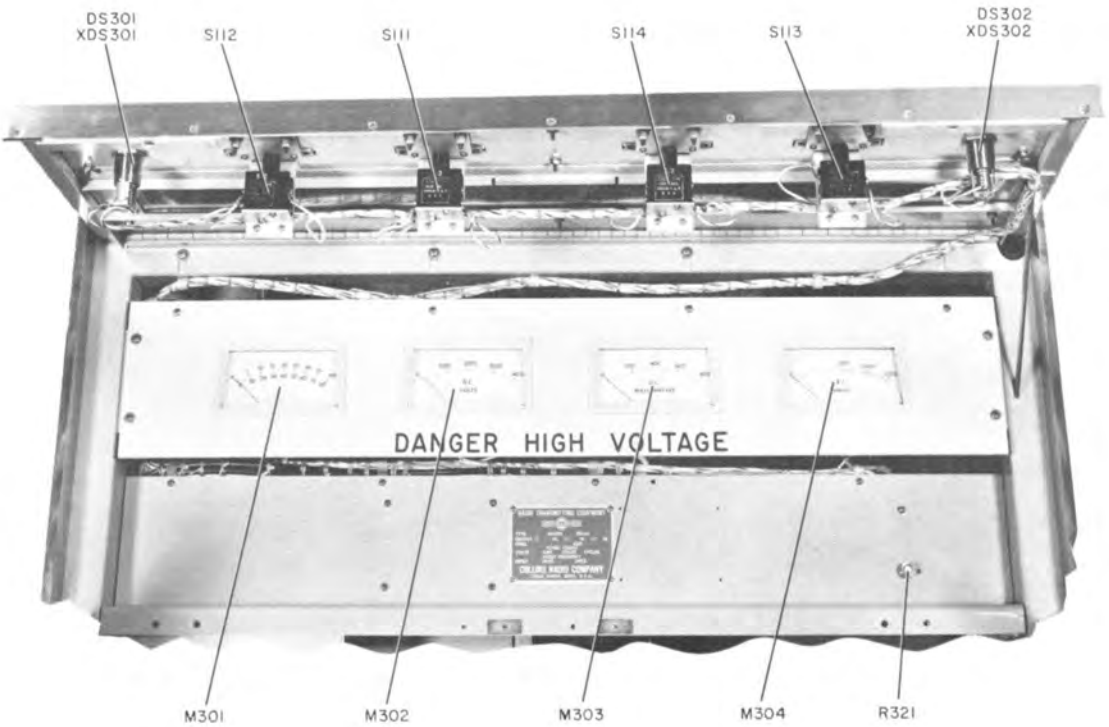


Figure 4-2. Meter Panel, Parts Location

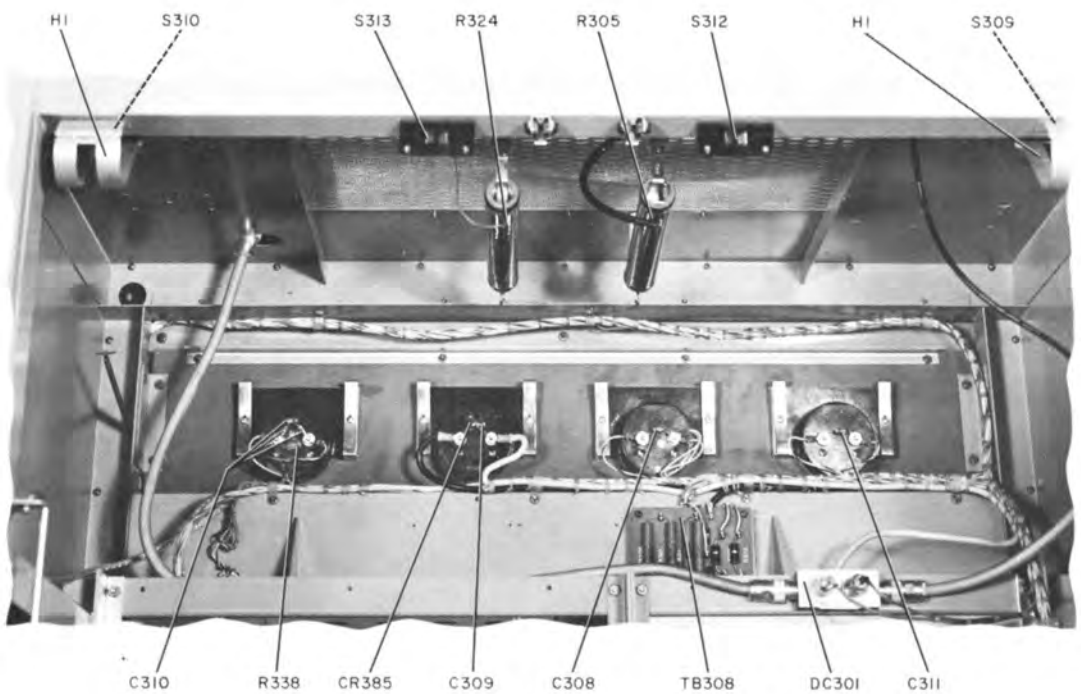


Figure 4-3. Rear View Meter Panel, Parts Location

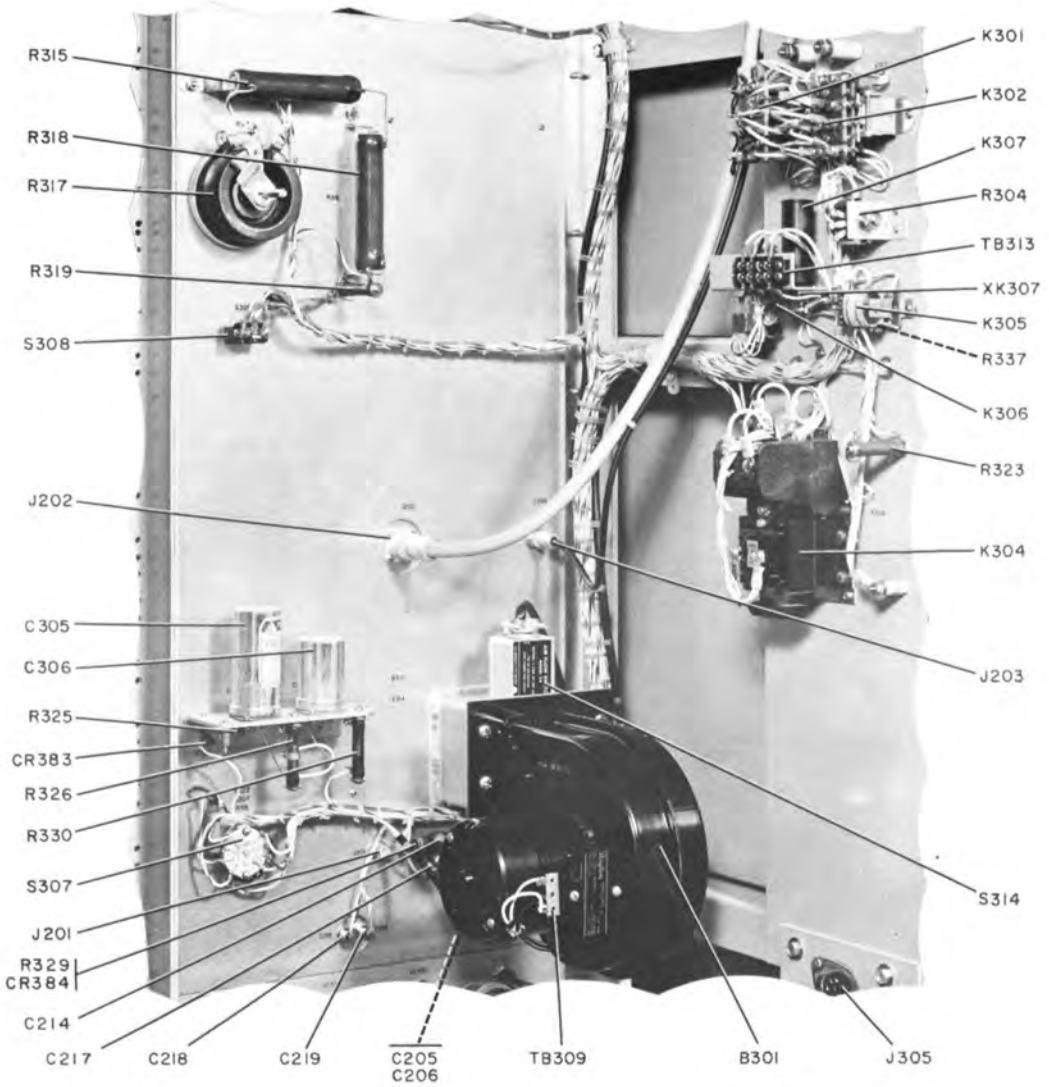


Figure 4-4. Relay and Cavity Panels, Parts Location

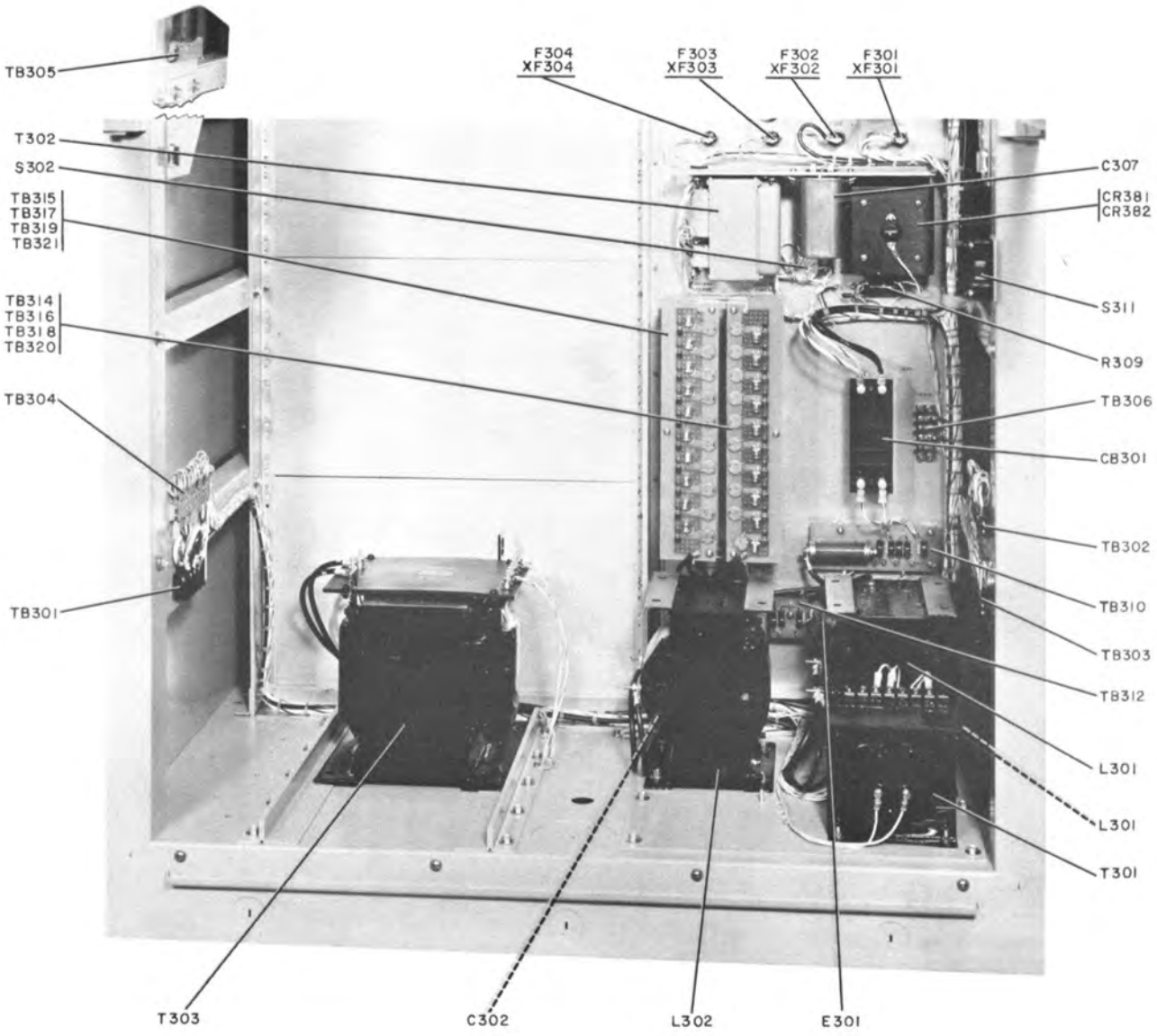
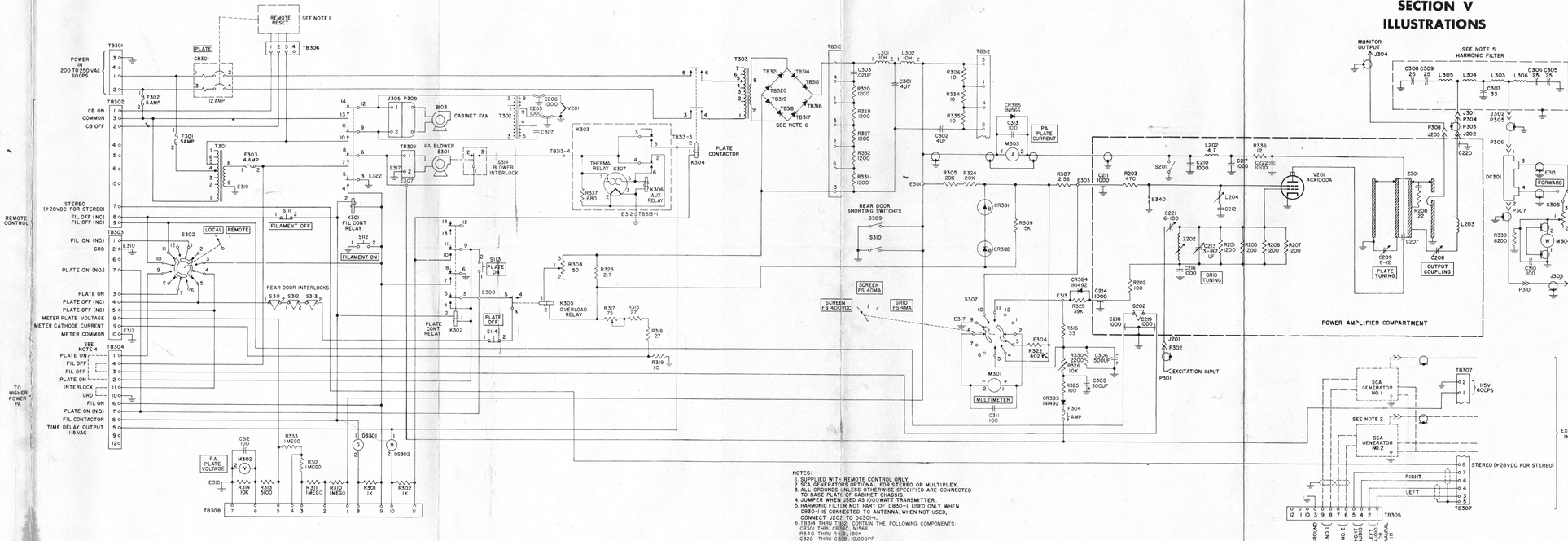


Figure 4-5. Power Panel, Parts Location

SECTION V
ILLUSTRATIONS



NOTES:
1. SUPPLIED WITH REMOTE CONTROL ONLY.
2. SCA GENERATORS OPTIONAL FOR STEREO OR MULTIPLEX.
3. SHOWN WITH CB301 IN ON POSITION AS SPECIFIED ARE CONNECTED TO BASE PLATE OF CABINET CHASSIS.
4. JUMPER WHEN USED AS 1000-WATT TRANSMITTER.
5. HARMONIC FILTER NOT PART OF D830-1, USED ONLY WHEN D830-1 IS CONNECTED TO ANTENNA. WHEN NOT USED, CONNECT J202 TO DC301.
6. TB304 THRU TB307 CONTAIN THE FOLLOWING COMPONENTS
   CR301 THRU CR380, IN1566
   R340 THRU R439, 180K
   C320 THRU C339, 10,000PF
7. UNLESS OTHERWISE INDICATED ALL CAPACITANCE VALUES ARE IN PF, ALL RESISTANCE VALUES ARE IN OHMS, AND ALL INDUCTANCE VALUES ARE IN UH.

Figure 5-1. 1000-Watt FM Power Amplifier D830-1, Schematic Diagram

TD-536
1 MAY 1962

92.7 Station Freq
78.7 Xtal Freq Y-426 Y-426
McCoy

92.7
14
78.7 MC

A830-2
10 W WIDE-BAND FM BROADCAST EXCITER

CEDAR RAPIDS, IOWA, U.S.A.

PRINTED IN THE UNITED STATES OF AMERICA

COLLINS

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SECTION I
GENERAL DESCRIPTION

1.1 GENERAL.

This instruction book contains information for operation and maintenance of A830-2 10 W Wide-Band FM Broadcast Exciter. See figure 1-1. The A830-2 is manufactured by Collins Radio Company, Cedar Rapids, Iowa.

1.2 PURPOSE OF EQUIPMENT.

The A830-2 10 W Wide-Band FM Broadcast Exciter is a direct FM exciter designed specifically to meet the stringent requirements of stereophonic FM broadcasting. The A830-2 may be used in monaural broadcasting, Storecasting (SCA), or with Collins 786M-1

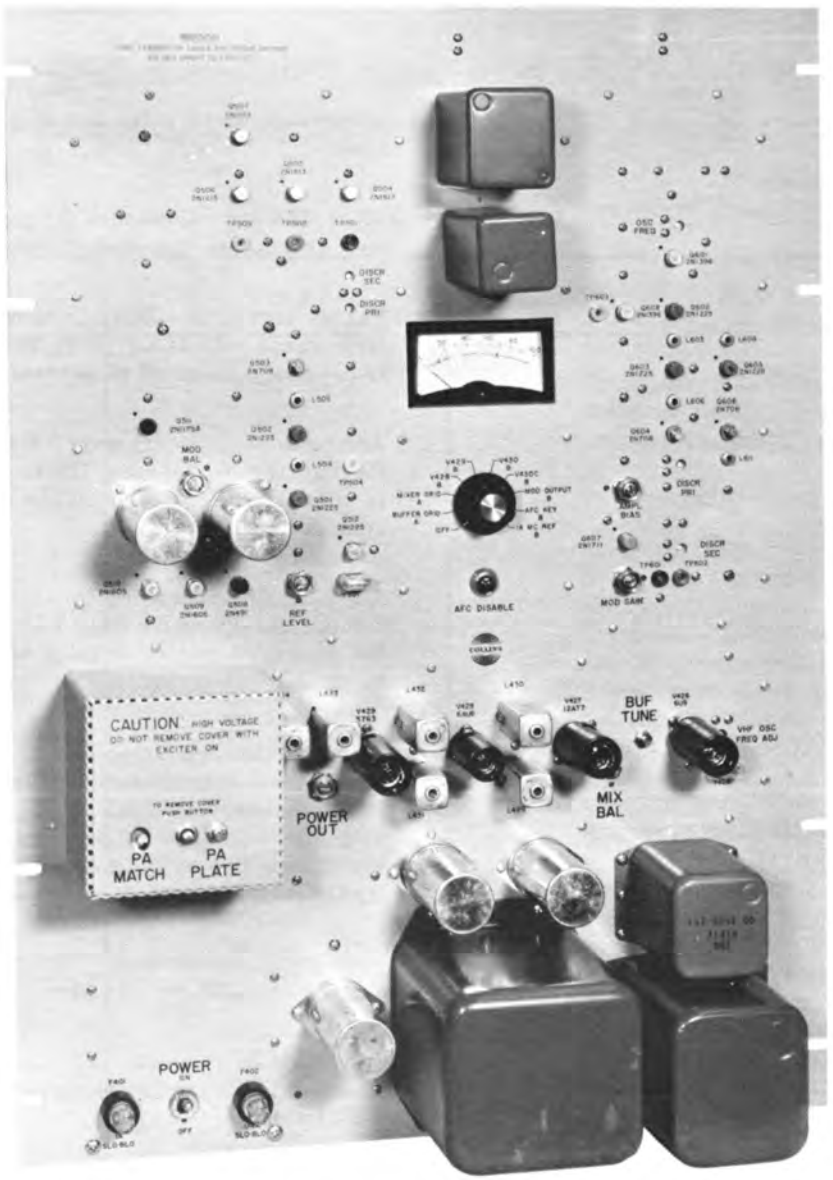


Figure 1-1. A830-2 10 W Wide-Band FM Broadcast Exciter, Over-all View

Stereo Generator (optional) for stereophonic broadcasting. The A830-2 is used to drive higher power amplifiers in the FM broadcast service.

1.3 EQUIPMENT SUPPLIED.

The A830-2 is normally supplied as a part of a Collins FM transmitter (830B-1A, 830D-1A, 830E-1A, etc.). The A830-2 mounts in the same cabinet as the first stage of amplification (250 or 1000 watts) in the transmitter. A rear view of the A830-2 is shown in figure 1-2.

1.4 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

The A830-2 is supplied with all required equipment.

1.5 TECHNICAL SUMMARY.

Ambient temperature range	+10°C(+50°F) to +55°C(+131°F).
Ambient humidity range	0 to 95 percent relative.
Altitude	7500 feet, maximum.
Shock and vibration	Normal handling and transportation.
Power source	117 volts ±5 percent, 50/60 cps, single phase.
R-f power output	Adjustable to 10 watts into a 50- to 70-ohm resistive load.
Frequency range	88 to 108 mc. Customer frequency is determined by one crystal in the heterodyning oscillator circuit.
Carrier frequency stability	Varies less than ±1000 cps with an ambient temperature range of +10°C(+50°F) to +55°C(+131°F), and a line-voltage range of ±5 percent.
Harmonic and spurious radiation	Any emission appearing on a frequency removed from the carrier by between 120 kc and 240 kc, inclusive, is attenuated at least 30 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 240 kc up to and including 600 kc is attenuated at least 40 db below the level of the unmodulated carrier. Any emission appearing on a frequency removed from the carrier by more than 600 kc is attenuated at least 80 db below the level of the unmodulated carrier, with the exception of harmonics of the r-f carrier which complies with the requirements of the particular transmitter in which the A830-2 is installed.
Type of modulation	Frequency modulation. 100 percent modulation is defined as ±75-kc deviation of the main carrier.
Exciter inputs	Stereophonic channel: 600 ohms, unbalanced. Input of 0.1 volt (approximately) required for 100 percent modulation. Monophonic channel: 600 ohms, balanced. Input of 10 dbm ±2 db (approximately 2.45 volts) required for 100 percent modulation.

SCA channel: 600 ohms, balanced. Input of 0.35 volt (approximately) required for 10 percent modulation.

Frequency and phase response . . . . . The frequency and phase response of the A830-2 is such that when used with a suitable stereophonic generator such as the 786M-1, stereophonic separation between left and right stereophonic channels shall be better than 35 db at audio modulating frequencies between 30 and 15,000 cps.

Distortion . . . . . Does not exceed 0.5 percent in the 30- to 15,000-cps frequency range and 1.0 percent in the 15,000- to 75,000-cps frequency range.

Pre-emphasis . . . . . Standard 75-microsecond pre-emphasis.

FM noise level . . . . . 65 db below 100 percent modulation.

AM noise level . . . . . 55 db below 100 percent AM level.

1.6 VACUUM-TUBE, FUSE, AND SEMICONDUCTOR COMPLEMENT.

Table 1-1 lists all of the vacuum tubes, fuses, and semiconductors used in the A830-2.

TABLE 1-1. VACUUM-TUBE, FUSE, AND SEMICONDUCTOR COMPLEMENT

SYMBOL	TYPE	FUNCTION
V426	6U8A	Oscillator and buffer
V427	12AT7	Balanced mixer
V428	6AU6	Limiter-amplifier
V429	5763	Driver
V430	2E26	Power amplifier
Q501	2N1225	First afc limiter
Q502	2N1225	Second afc limiter
Q503	2N708	Afc discriminator driver
Q504	2N1613	First error signal amplifier
Q505	2N1613	Second error signal amplifier
Q506	2N1613	Third error signal amplifier
Q507	2N1613	Fourth error signal amplifier
Q508	2N491	Keying generator
Q509	2N1605	Multivibrator
Q510	2N1605	Multivibrator
Q511	2N1175A	Baseband cancellation amplifier
Q601	2N1396	Frequency modulated oscillator
Q602	2N1225	First limiter
Q603	2N1225	Second limiter
Q604	2N708	Discriminator driver
Q605	2N1225	Afc buffer
Q606	2N708	Modulator output amplifier
Q607	2N1711	First baseband amplifier
Q608	2N1396	Second baseband amplifier
CR401	1N1492	B+ rectifier
CR402	1N1492	B+ rectifier
CR403	1N1492	B+ rectifier
CR404	1N1492	B+ rectifier
CR405	1N1492	B+ rectifier

TABLE 1-1. VACUUM-TUBE, FUSE, AND SEMICONDUCTOR COMPLEMENT (Cont)

SYMBOL	TYPE	FUNCTION
CR406	1N1492	B+ rectifier
CR407	1N1492	B+ rectifier
CR408	1N1492	B+ rectifier
CR409	1N538	+20-volt rectifier
CR410	1N538	+20-volt rectifier
CR411	10M10ZB1	+20-volt regulator
CR412	1Z10V01	+10-volt regulator
CR413	1N538	-10-volt rectifier
CR414	1N538	-10-volt rectifier
CR415	1Z10V01	-10-volt regulator
CR426	1N977A	Oscillator plate voltage regulator
CR501	1N270	Gate
CR502	1N270	Gate
CR503	1N270	Afc limiter
CR504	1N270	Afc limiter
CR505	1N270	Afc limiter
CR506	1N270	Afc limiter
CR507	1N198	Afc discriminator
CR508	1N198	Afc discriminator
CR509	FA-4000	Synchronous detector
CR510	FA-4000	Synchronous detector
CR511	FA-4000	Gate
CR512	1N198	Meter rectifier
CR513	1N198	Meter rectifier
CR514	1N718	Voltage regulator
CR601	1N626	Temperature compensation
CR602	SV3173	Voltage regulator
CR603	1N270	Limiter
CR604	1N270	Limiter
CR605	1N270	Limiter
CR606	1N270	Limiter
CR607	1N198	Modulation discriminator
CR608	1N198	Modulation discriminator
CR609	1N751A	Voltage regulator
CR610	1N198	Meter rectifier
F401	1 amp	Protect T401
F402	1/4 amp	Protect T402

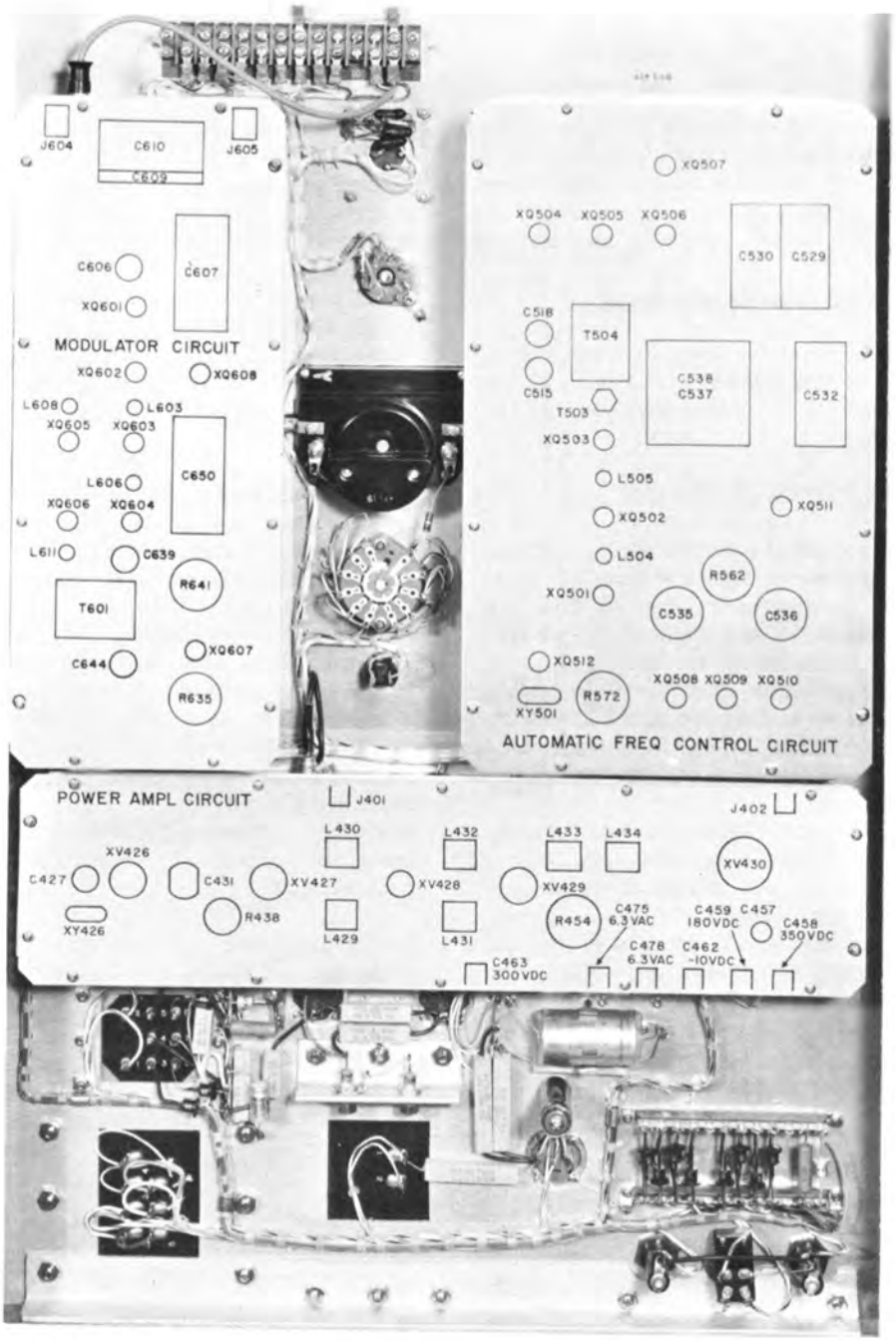


Figure 1-2. A830-2 10 W Wide-Band FM Broadcast Exciter, Rear View

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

This section describes the principles of operation of A830-2 10 W Wide-Band FM Broadcast Exciter. Figure 2-2 is a block diagram of the A830-2 and figure 5-1 is the schematic diagram of the A830-2. Refer to these figures for the following discussion.

2.2 FREQUENCY MODULATION METHODS.

There are two basic methods used to generate an FM signal, direct FM and phase modulation. There are variations of each of these two methods, but the end results are the same.

2.2.1 PHASE MODULATORS.

The phase modulation method consists of phase modulating a CW (continuous wave) signal with audio tones. The audio response is shaped to drop off 6 db per octave from the lowest to the highest frequency. The resultant signal is frequency modulated although produced by a phase modulator. The modulation index of an FM signal is defined as the ratio of the change in carrier frequency (deviation) to the modulating frequency, $\frac{\nabla f}{f_m}$. The modulation index of present phase modulators is so low that modulation is usually performed at a low frequency (approximately 100 kc) and then multiplied about 800 times to obtain the output frequency with the desired ±75-kc deviation. The outstanding advantage of this system is that the 100-kc oscillator may be crystal controlled and further frequency stabilization is not required. This system has been used widely in broadcast FM transmitters in the past.

The arrival of stereophonic FM broadcasting has caused problems in the phase modulator. A composite stereo plus SCA signal (referred to hereafter as the baseband audio signal) occupies a frequency band from 50 cps to 75 kc. The audio response shaping (6 db per octave) would require that 50-cps signals be 65.5 db above signals at 75 kc. When a signal-to-noise ratio of 65 db and a dynamic range of approximately 60 db is added to this, it is obvious that baseband amplifiers cannot be built to meet these requirements.

It is possible to split the phase modulation into two steps where one phase modulator accepts only the L + R (left and right audio signals) audio spectrum and a subsequent modulator adds the L - R double-sideband suppressed carrier signal. The audio bandwidth for each phase modulator is thereby reduced and the dynamic range of the baseband amplifiers is reduced to acceptable limits. The phase and amplitude relationships must be maintained between the two signals. These requirements are ±0.3-db gain variation and ±3-degree phase variation to meet the 30-db stereo separation requirement. These requirements would be difficult to obtain without frequent on-the-air adjustment to continually meet the stereo separation requirement.

There are other methods of splitting the signal and using more than one modulator, but all have the phase and gain stability problem.

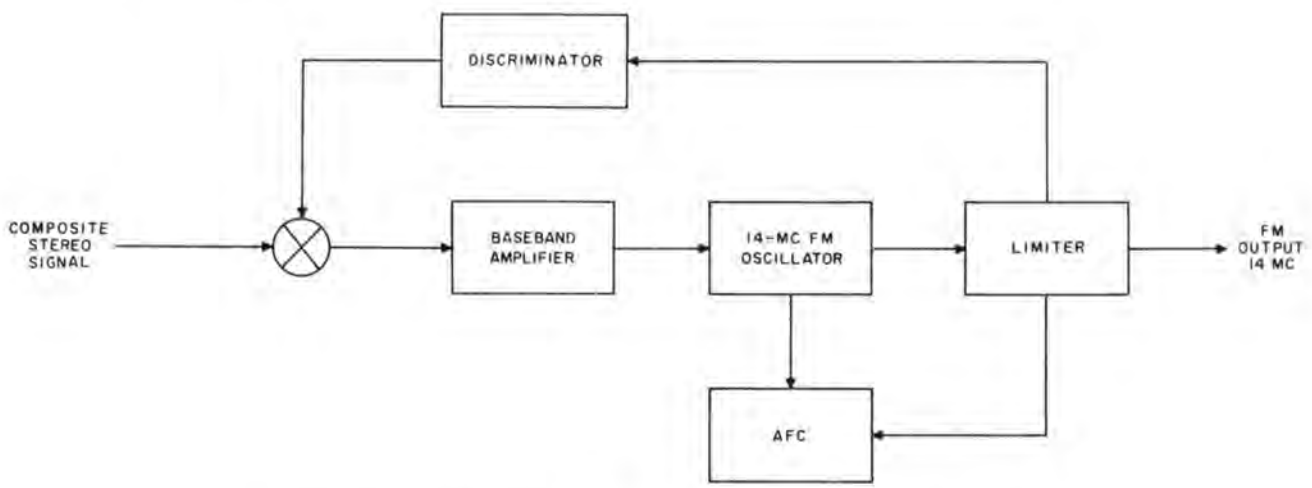


Figure 2-1. Direct FM Modulation, Simplified Block Diagram

2.2.2 DIRECT FREQUENCY MODULATION.

The direct method of generating a frequency modulated signal is shown in figure 2-1. The complete stereo signal (and SCA signal if used) is fed through a baseband amplifier to a frequency-modulated oscillator. The discriminator completes an audio feedback loop which suppresses FM oscillator distortion, incidental FM noise, transient carrier offset, and gain/phase variation in the baseband amplifier and modulator. The center frequency of the oscillator is not sufficiently stable so an automatic frequency control (afc) circuit is required to maintain frequency stability. The output of the modulator is a 14-mc FM signal with ±75-kc peak deviation. The output frequency is obtained by translating this signal with a stable vhf oscillator. The use of the direct FM system removes the requirement for double modulators, phase delay lines, and baseband amplifiers with a response which changes with frequency.

2.3 BLOCK DIAGRAM.

Refer to figure 2-2, a block diagram of the A830-2.

2.3.1 MODULATOR.

The A830-2 uses the direct FM method of generating an FM signal. The baseband input (and SCA input, if used) is connected to baseband amplifiers Q607 and Q608. The response of these amplifiers is flat.

The gain of the baseband amplifiers is adjustable with AMPL BIAS control R641. Refer to figure 5-1. The emitter voltage on Q608 is regulated to +15 volts by a silicon breakdown diode, CR609. The output of Q608 is coupled to frequency-modulated oscillator Q601. Q601 is an LC oscillator which has a center frequency of 14 mc. The tuned circuit in the base of Q601 contains a voltage-sensitive capacitor, C654. Refer to figure 5-1. The capacitance of C654 varies proportionately with the voltage across it. The change in capacity of C654 makes a corresponding change in the frequency of oscillations in Q601. Thus, the frequency deviation of the output of Q601 is directly proportional to the amplitude of the modulating signal and the peak deviation is ±75 kc.

The output of Q601 is coupled to two limiters, Q602 and Q603. The limiters remove any amplitude modulation from the FM signal. This amplitude modulation is caused by variation of the tuned circuit capacity by the baseband signal. The transistors do not do any limiting. The limiting takes place in the diodes connected to the collectors. This method provides symmetrical limiting (positive and negative) which avoids the phase modulation that occurs when unsymmetrical clipping followed by filtering is used. The limiters are set up so that as the input level is raised, the second limiter operates first; just before it becomes nonlinear, the first limiter starts limiting. The limiting range is approximately 31 db.

The output of the second limiter is coupled to discriminator driver Q604. One output of the discriminator driver is connected to modulator discriminator T601 and the other output goes to output amplifier Q606.

Modulator discriminator T601 converts the frequency-modulated 14-mc signal to an AM signal which is detected by diodes CR607 and CR608. The detected audio is mixed with the input baseband audio at the input to the baseband amplifiers. This feedback loop suppresses distortion from the FM oscillator, incidental FM noise, transient carrier offset, and gain/phase variation in the baseband amplifier and modulator.

Output amplifier Q606 provides a signal output of 1.0 volt rms for the balanced mixer in the power amplifier compartment. This output is matched to 50 ohms by an L-section impedance, L611 and C634. A low-pass filter, C632, C633, and L610, attenuates harmonics of the 14-mc signal. A portion of this output is rectified and connected to meter switch S101 for monitoring purposes.

The second output from Q606 is coupled to afc buffer amplifier Q605. This amplifier, as well as the limiters and amplifiers preceding it, reduces oscillator frequency change caused by variation of loading on the output. The output of Q605 is 0.1 volt rms across 50 ohms.

2.3.2 AUTOMATIC FREQUENCY CONTROL.

The A830-2 requires automatic frequency control to maintain the center frequency of the modulated oscillator at 14 mc. The error in frequency of this oscillator may be caused by temperature drift, carrier shift due to distortion in the modulator, etc. The afc circuits correct these errors to bring the stability of the output frequency to ±1000 cycles per second over a temperature range of +10°C(+50°F) to +55°C(+131°F) and a line voltage range of ±5 percent.

The afc correction voltage is obtained by comparing the modulator output signal with the output of a crystal-controlled reference oscillator, and deriving a d-c voltage which is proportional in magnitude and polarity to the magnitude and direction of the difference in frequency of these two signals.

The reference oscillator is a conventional crystal-controlled oscillator using a fundamental 14-mc series-resonant crystal. The temperature drift of this crystal contributes only ±70 cycles per second to the output frequency drift over temperature.

The signal from afc buffer Q605 and the output from the reference oscillator are connected to a diode switch, CR501 and CR502. The diode switch is simply two diodes which are alternately switched on and off by the 5-cps square wave. The diode switch is controlled by a signal from keying generator Q508. This

signal, a square wave with a frequency of approximately 5 cps, alternately couples the reference signal, then the modulated carrier, to the input to first limiter Q501.

The two limiters, Q501 and Q502, and discriminator driver Q503 are identical to the limiters and driver (Q602, Q603, and Q604) used in the modulator. The limiters remove any amplitude difference which might exist between the two signals. The level of the reference signal is adjustable with REF LEVEL control R572. Q503 amplifies the limited signal to a level sufficient to drive the afc discriminator. Assume that there is no modulation applied. In this case, the output from the discriminator will be a 5-cps square wave with an amplitude proportional to the frequency error in the FM oscillator.

The 5-cps error signal is amplified and applied to the synchronous detector which develops the d-c correction voltage. This d-c voltage is coupled through a low-pass filter to the voltage-sensitive capacitor in the frequency-modulated oscillator to tune the FM oscillator back on frequency.

The operation of the afc circuitry is only slightly different when modulation is applied at ±75-kc deviation. Assume now that modulation is applied and an error of 100 cps exists in the FM oscillator. The output of the afc discriminator due to the 100-cps signal would be 100 K_d where K_d is the gain of the discriminator in volts per cps. The output of the discriminator due to the modulation on the carrier would be 150,000 K_d. This means that the undesired signal is 1500 times greater than the desired signal. The undesired signal is removed by the modulation canceling circuit consisting of baseband cancel amplifier Q511 and diode switch CR511. Whenever the modulated carrier is connected to the first limiter diode switch, CR501 and CR502, the baseband audio input is connected to the discriminator output by diode switch CR511. This baseband audio is 180 degrees out of phase with the discriminator output, and when MOD BAL control R652 is properly adjusted, the output of the afc discriminator due to modulation is completely canceled. The 5-cps error signal due to the frequency error in the FM oscillator is then amplified and detected as if modulation were not applied.

Note that the afc discriminator is used as a comparator rather than as a reference. The exact center frequency of the discriminator is not important since the output voltage need only be proportional to the difference in the two frequencies rather than to the absolute value of these frequencies. Therefore, the center frequency stability of the discriminator does not effect the operation of the afc system.

The last stage of the error signal amplifiers, Q507, is a phase splitter to provide a push-pull output to the synchronous detector. The synchronous detector is keyed by the 5-cps square-wave keying signal from the keying generator.

The synchronous detector recovers the information contained in the amplitude and phase of the 5-cps error signal. The circuit used in the A830-2 is actually two synchronous detectors operating from opposite half cycles of the 5-cps square-wave keying signal so that the 5-cps square-wave keying signal is balanced out in the output. This is analogous to a double-sideband balanced modulator in which neither input signal is present in the output.

Figures 2-3 through 2-5 illustrate the operation of the two diode switches and the synchronous detector. The electronic circuit and a mechanical analog for each of the circuits is shown. The resistances marked R_f represent the forward resistance of the diodes.

The output of the synchronous detector may be disabled for test and adjustment by depressing AFC DISABLE switch S102 on the front panel.

2.3.3 POWER AMPLIFIER.

The 14-mc FM signal from the modulator is coupled to a balanced mixer, V427. The other input to V427 is the amplified output of a vhf crystal oscillator, V426A. The crystal oscillator operates with a fifth-overtone series-resonant crystal in the 74- to 94-mc frequency range. The specific frequency of the crystal is 14 mc below the station's assigned output frequency. The exact frequency is adjustable over a small range by VHF OSC FREQ ADJ control C427. This adjustment is required to compensate for the finishing tolerance and aging in crystals Y426 and Y501. The output of V426A is amplified in V426B and coupled to V427. The two input signals are balanced out of the output of V427 and the sum of the two signals is the operating frequency. The MIX BAL control compensates for unbalance between the sections of V427.

The output of V427 is coupled to limiter amplifier V428. The limiter amplifier removes any amplitude modulation resulting from mixing and couples this signal to driver stage V429. The signal is amplified by V429 to a level sufficient to drive power amplifier stage V430. The power output is adjustable with POWER OUT control R454. The tuning and loading of the output stage is accomplished with C461 and C456.

2.3.4 POWER SUPPLY.

The power supply in the A830-2 provides all operating voltages for the A830-2 and 786M-1 Stereo Generator, if used. The primary power may be 115 or 230 volts, 60 cps. The power supply is of conventional design using a bridge rectifier and a voltage divider for the high voltages. The low voltages are obtained from full-wave rectifiers. Voltage breakdown diodes are used for regulating the +20-volt, +10-volt, and -10-volt outputs to ±5 percent.

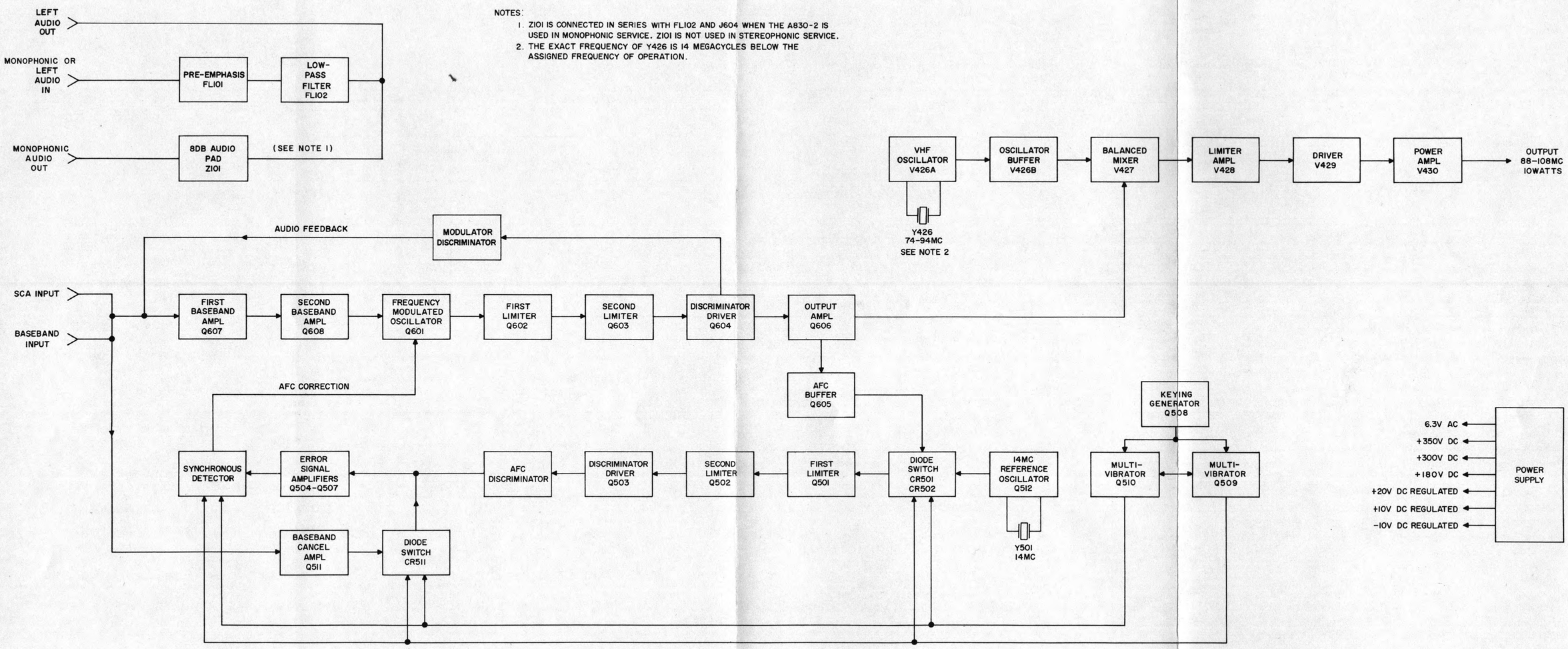


Figure 2-2. A830-2 10 W Wide-Band FM Broadcast Exciter, Block Diagram

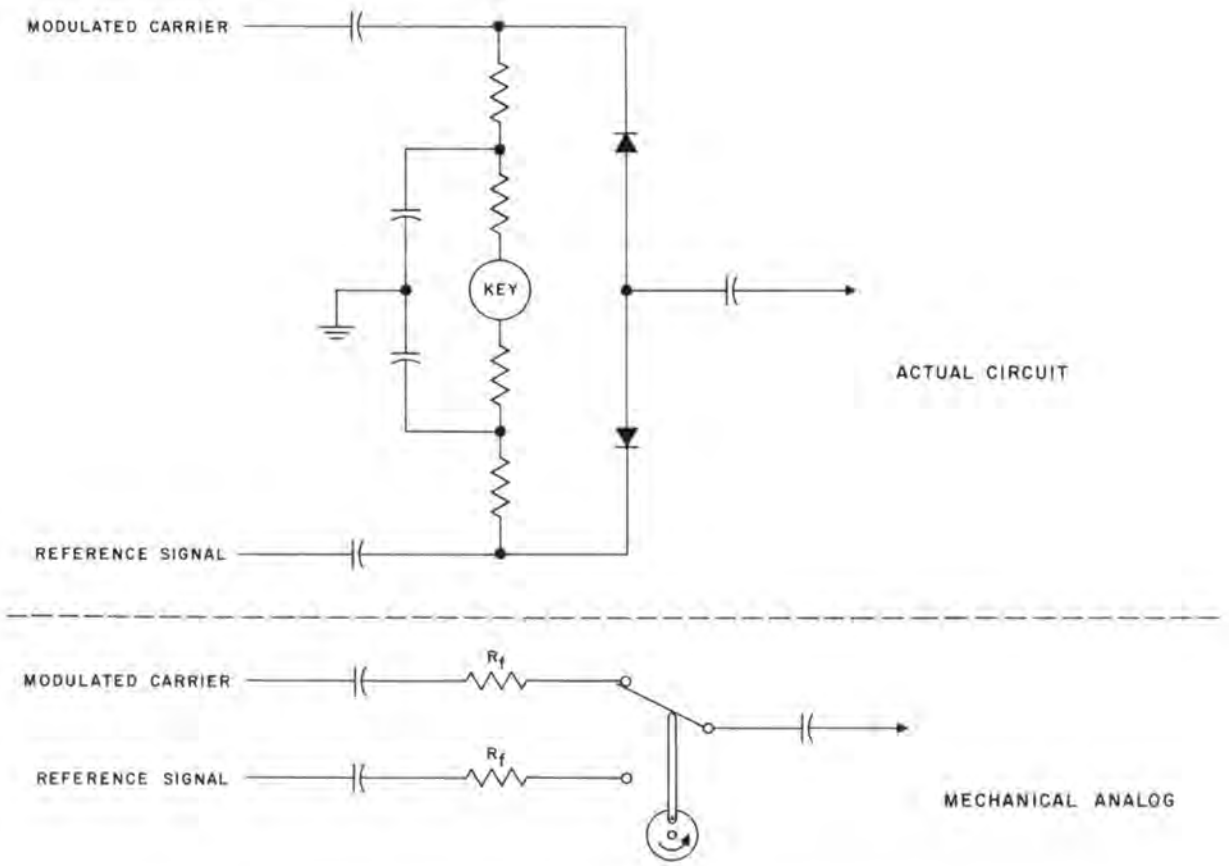


Figure 2-3. Reference Switch, Simplified Schematic and Mechanical Analog Diagram

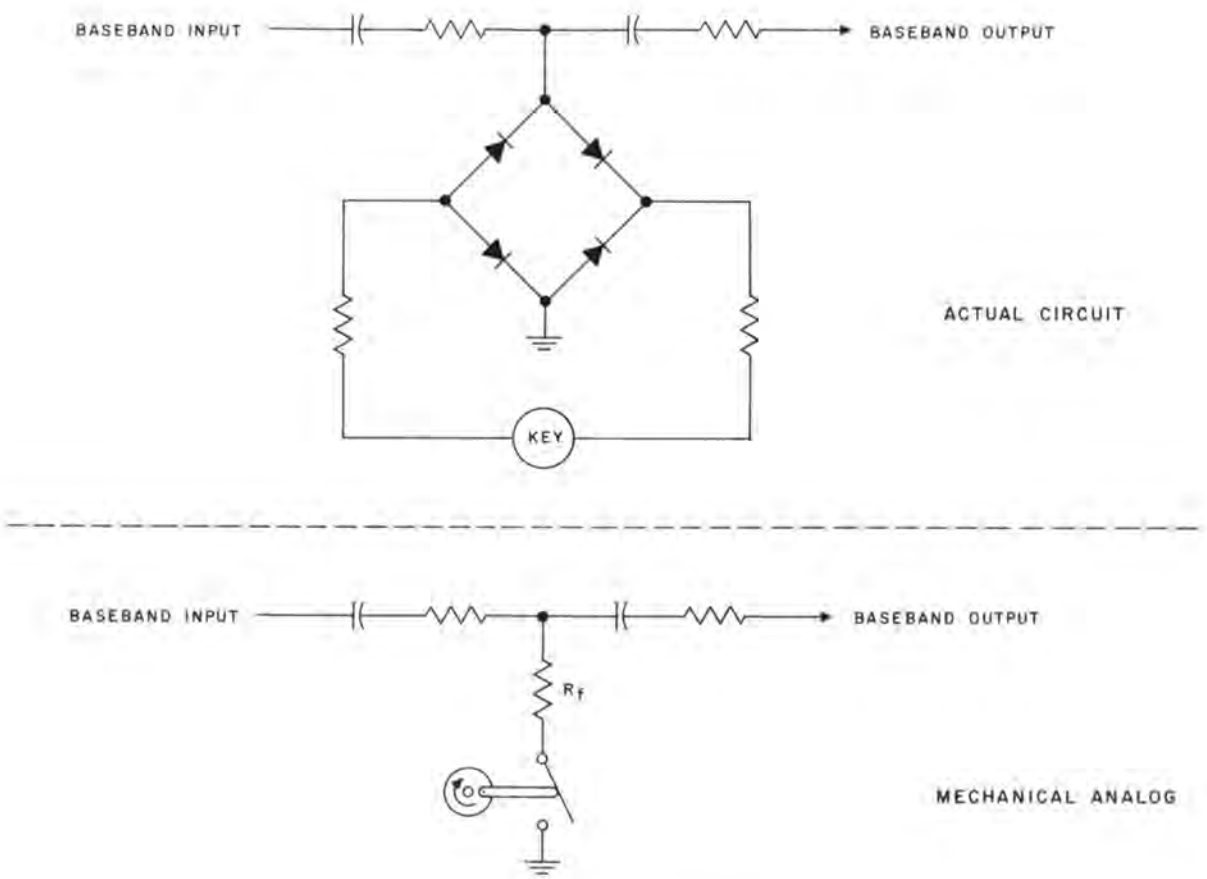


Figure 2-4. Baseband Cancel Switch, Simplified Schematic and Mechanical Analog Diagram

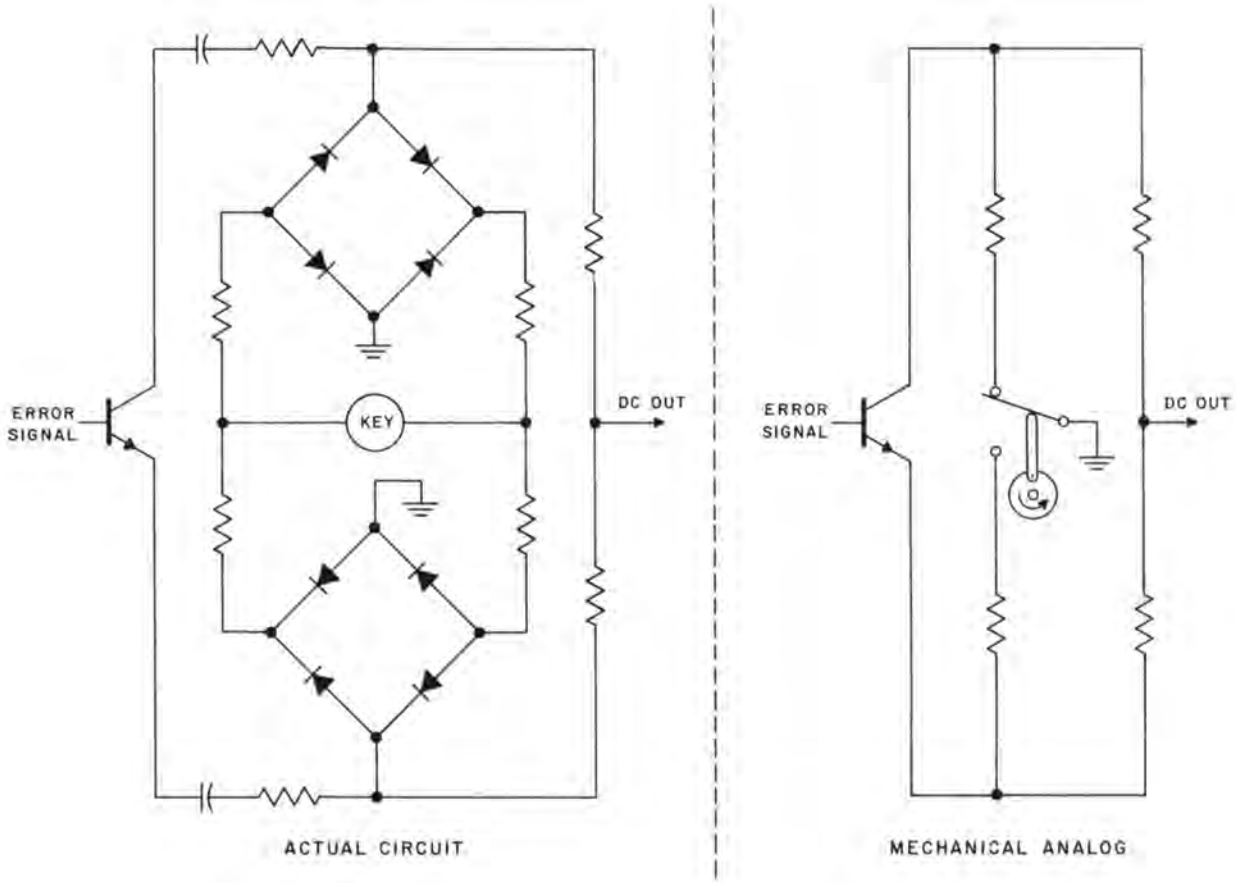


Figure 2-5. Synchronous Detector, Simplified Schematic and Mechanical Analog Diagram

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains alignment instructions, adjustment procedures, and minimum performance standards for the A830-2.

3.2 TEST EQUIPMENT REQUIRED.

The test equipment in table 3-1, or its equivalent, is required to perform the procedures given in this section.

TABLE 3-1
TEST EQUIPMENT REQUIRED

ITEM	MANUFACTURER'S DESIGNATION
Audio oscillator	Hewlett-Packard 200AB
Distortion and noise meter	Hewlett-Packard 330D
A-c vtvm	Hewlett-Packard 410B
R-f vtvm*	Bird 91C
Communications receiver	Capable of receiving 14 mc
10-db pad	Microlab AD-10N
Oscilloscope	
FM monitor	Hewlett-Packard 335B
50-ohm load	

*The 91C is not required if a Tektronix 541 oscilloscope is available. See paragraph 3.3.10.

3.3 ALIGNMENT AND ADJUSTMENT.

3.3.1 PRELIMINARY ADJUSTMENTS.

Perform the following procedure prior to performing any of the alignment procedures.

a. Set the meter switch on the A830-2 to the OFF position.
b. Short AFC DISABLE switch S102 on the A830-2 with a clip lead.
c. Connect the 50-ohm load to RF OUTPUT jack J402.
d. Operate POWER switch S401 to the ON position. Allow 10 minutes for equipment warm up.

3.3.2 MODULATOR LIMITER-DISCRIMINATOR ALIGNMENT.

a. Remove Q601 from its socket.
b. Rotate REF LEVEL control R572 fully counterclockwise.
c. Connect a 0.01-uf capacitor and clip lead between the movable arm of REF LEVEL control R572 and the emitter pin on the socket for Q601. This supplies an accurate 14-mc signal for alignment of the A830-2.
d. Connect the HP-410B to TP602 and set it to the lowest d-c scale.
e. Rotate R572 clockwise until an indication is observed on the HP-410B.

NOTE

During this adjustment, maintain the 14-mc signal at a level below limiting. Limiting causes the tuning peaks to be very broad.

f. Adjust C639, L606, and L603 for maximum indication on the HP-410B.
g. Remove the 0.01-uf capacitor and clip lead from XQ601 and R572. Replace Q601 into XQ601.
h. Connect the 91C to TP504.

NOTE

Refer to note in paragraph 3.3.10.

i. Remove Q509 from its socket.
j. Adjust R572 for an indication of 30 millivolts.
k. Replace Q509.

3.3.3 MODULATOR OUTPUT AMPLIFIER TUNING.

a. Set the meter selector switch on the front panel of the A830-2 to the MOD OUTPUT B position.
b. Tune L611 for maximum indication on the front panel meter.

3.3.4 AFC BUFFER TUNING.

a. Connect the 91C (or Tektronix oscilloscope) to TP504.
b. Remove Q510 from its socket.
c. Tune L608 for maximum indication on the 91C (or oscilloscope).
d. Replace Q510 into its socket.

3.3.5 FM OSCILLATOR ADJUSTMENT.

a. Loosely couple the communications receiver to FM oscillator Q601 and to the 14-mc reference oscillator. If the receiver has a bfo, turn it off.
b. Adjust OSC FREQ control C606 for a zero beat on the communication receiver.
c. Remove the communications receiver.

3.3.6 MODULATION DISCRIMINATOR.

a. Connect the HP-410B to TP601.
b. Adjust DISCR SEC control C644 for a zero indication on the HP-410B.
c. Check adjustment of DISCR PRI control C639. It should be set for a maximum indication, and C644 set for a minimum indication.

3.3.7 AMPLIFIER BIAS ADJUSTMENT.

a. Connect the HP-410B to TP603.
b. Adjust R641 for an indication of +7.5 volts d-c.

3.3.8 MODULATOR GAIN ADJUSTMENT.

a. Remove the 50-ohms load and connect the HP-335B to the output of the A830-2 through the 10-db pad.
b. Connect the HP-200AB to baseband input jack J604.
c. Set the output level of the HP-200AB to 0.1 volt rms at 1000 cps.
d. Adjust MOD GAIN control R635 for an indication of 100 percent modulation (±75-kc deviation) on the HP-335B.

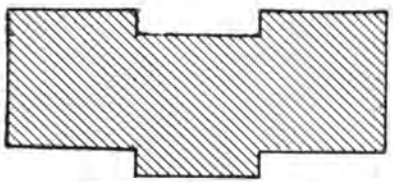
3.3.9 AFC LIMITER-DISCRIMINATOR ALIGNMENT.

a. Connect the HP-410B to TP501 and set to 10-volt scale.
b. Remove Q509 from its socket.
c. Adjust REF LEVEL control R572 fully counterclockwise.
d. Adjust L504, L505, and C515 (DISCR PRI control) for maximum indication on the HP-410B.
e. Connect the 91C to TP504.
f. Adjust R572 for an indication of 30 millivolts on the 91C.
g. Connect the HP-410B to TP502 and adjust DISCR SEC control C518 for a minimum indication on the HP-410B when set to its lowest range.
h. Replace Q509 in its socket.
i. Reset R572 as specified in paragraph 3.3.10.

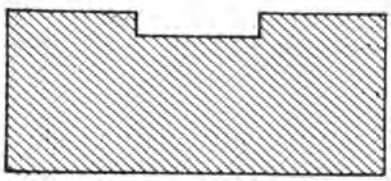
3.3.10 REFERENCE LEVEL ADJUSTMENT.

NOTE

The following procedure may be accomplished with the 91C or with a Tektronix 541 oscilloscope. Steps a through f describe the procedure for using the 91C and steps g and h describe the procedure for using the 541 oscilloscope.



IMPROPER ADJUSTMENT



PROPER ADJUSTMENT

Figure 3-1. Reference Level Adjustment, Oscilloscope Patterns

a. Connect the 91C to TP504.
b. Remove Q510 from its socket.
c. Tune L608 for maximum indication on the 91C. Record the reading on the 91C.
d. Replace Q510 and remove Q509 from its socket.
e. Adjust R572 for the same indication recorded in step c.
f. Replace Q509 in its socket.
g. Connect the Tektronix oscilloscope to TP504.
h. Adjust R572 for alignment of base lines of alternate signals. See figure 3-1.
i. Set meter switch S101 on the A830-2 front panel to the 14 MC REF B position. The meter should indicate in the B range.

3.3.11 BASEBAND CANCELING ADJUSTMENT.

a. Remove Q510 from its socket.
b. Make certain that AFC DISABLE switch S102 is still jumpered.
c. Rotate R562 to its maximum counterclockwise position.
d. Connect the oscilloscope to TP503.
e. Connect the HP-200AB to baseband input jack J604.
f. Set the HP-200AB to 50 cps.
g. Set the level of the HP-200AB to produce a 2-volt peak-to-peak waveform on the oscilloscope.
h. Adjust the oscilloscope to display the 50-cps waveform.
i. Slowly adjust R562 to cancel the signal on the oscilloscope. Gradually increase the input signal from the HP-200AB to 0.1 volt while maintaining the null by adjustment of R562. The waveform on the oscilloscope should be less than 1 volt peak-to-peak when the input signal is 0.1 volt.
j. Replace Q510.

3.3.12 AFC LOOP CHECK.

a. Remove the jumper from across AFC DISABLE SWITCH S102.
b. Observe the deviation meter on the HP-335B and depress the AFC DISABLE switch. The frequency should slowly drift off and come back quickly when the AFC DISABLE switch is released.

3.3.13 POWER AMPLIFIER ADJUSTMENT AND TUNING.

a. Set meter switch S101 on the A830-2 to the MIXER GRID A position.
b. Adjust C431 for maximum indication on front panel meter M101.
c. Adjust VHF OSC FREQ ADJ control C427 so that the HP-335B indicates on frequency.
d. Switch S101 to BUFFER GRID A and observe meter. It should indicate approximately 1 unit.
e. Switch S101 to V428 B.
f. Adjust L429, L430, and MIX BAL control R438 for maximum indication on the front panel meter.
g. Switch S101 to V429 B.
h. Adjust L431 and L432 for maximum indication on the front panel meter.
i. Remove all connections to J402 and connect the 50-ohm load to J402.
j. Connect the HP-410B across the 50-ohm load.
k. Switch S101 to V430C B.
l. Adjust PA PLATE control C461 for minimum indication on the front panel.
m. Adjust PA MATCH control C456 for a maximum indication on the HP-410B.
n. Adjust POWER OUT control R454 for an indication of 22.5 volts.

3.4 MINIMUM PERFORMANCE STANDARDS.

The A830-2 should be tested in accordance with the following procedures after alignment and adjustment. The following tests may be used to determine if the A830-2 is operating properly.

3.4.1 PRELIMINARY ADJUSTMENTS.

a. Connect the HP-200AB to J604 on the A830-2.
b. Connect the HP-335B through the 10-db pad to J402.
c. Connect the HP-330D to the modulation output of the HP-335B.

3.4.2 FREQUENCY RESPONSE.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-200AB for an output of 0.100 volt on a frequency of 400 cps.
c. Adjust the HP-330D for an indication of 0 db.
d. Set the HP-200AB to 50 cps and reset output level to 0.100 volt. The HP-330D indication should be 0 ±0.3 db.
e. Repeat step d for a frequency setting of 15,000 cps.

3.4.3 HARMONIC DISTORTION.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-200B frequency to 50 cps and the output level to 0.01 volt. Measure the harmonic distortion on the HP-330D. It should be 1.0 percent or less.
c. Repeat step b for frequencies of 400 and 15,000 cps.

3.4.4 RESIDUAL FM NOISE.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-200AB to 400 cps at an output level of 0.100 volt.
c. Measure the level across terminals 1 and 2 of the HP-335B with the HP-330D. Record the reading.
d. Turn off the HP-200AB and record the indication on the HP-330D. Record this reading.
e. Compute the s+n/n ratio using the readings recorded in steps c and d. The ratio should not be less than 60 db.

3.4.5 CARRIER FREQUENCY SHIFT.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Remove the audio input from J604.
c. Connect the output of the HP-200AB to terminals 3 and 4 of TB101.
d. Adjust the output of the HP-200AB to a frequency of 1000 cps and to a level sufficient to modulate the carrier 100 percent.
e. Remove the audio connections from terminals 3 and 4.
f. Adjust the HP-335B to indicate 0 frequency deviation.
g. Touch the audio connections from the HP-200AB to terminals 3 and 4 of TB101 and note the carrier deviation on the HP-335B. It should be less than 500 cps.

3.4.6 AM NOISE MEASUREMENT.

a. Perform the preliminary procedures of paragraph 3.4.1.
b. Set the HP-335B function switch to CARRIER LEVEL and read the carrier output voltage on the modulation meter. An indication of 100 percent modulation equals 10 volts, 90 percent modulation equals 9 volts, etc.
c. Connect the 91C to J3 on the HP-335B and measure the noise output. Compute the carrier-to-AM noise ratio using the following formula:

$$\frac{\text{Carrier}}{\text{AM Noise}} = 20 \log_{10} \frac{\text{Carrier Voltage}}{\text{AM Noise Voltage}}$$

The ratio should not be less than 50 db.

SECTION IV
PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	A830-2 10 W WIDE-BAND FM BROADCAST EXCITER	549-1588-00
	PANEL	
FL101	ATTENUATOR, FIXED: pre-emphasis network for use in FM commercial broadcast equipment; 600 ohms balanced, w/ center tap; ±1 to ±1.5 db frequency response	379-0426-00
FL102	FILTER, HIGH PASS: metal encased, hermetically sealed, input 600 ohms, output 600 ohms, 4 solder type terminals; continuous duty cycle; A. D. C. part no. D10390	673-0869-00
M101	METER, ARBITRARY SCALE: permanent magnet moving coil d-c microammeter, 500 ua, 100 ohms resistance; 2 scales, A scale, 10-90 ua, B scale, 175-500 ua; Assembly Products, Inc. part no. 361	458-0650-00
R101	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R102	RESISTOR, FIXED, FILM: 562 ohms ±1%, 1/4 w	705-7084-00
R103	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7068-00
R104	RESISTOR, FIXED, FILM: same as R103	705-7068-00
S101	SWITCH, ROTARY: 2 circuit, 2 pole, 10 position, 2 section; 2 moving, 22 fixed contacts	259-1567-00
S102	SWITCH, PUSH: spst; momentary; 125 v a-c, 0.75 amp, 250 v a-c, 0.25 amp; Cutler-Hammer part no. 8411-K6	266-6169-00
TB101	TERMINAL BOARD: barrier type w/ double row front connection of 12 screw terminals; 13/32 in. by 7/8 in. by 5-11/64 in.; Howard B. Jones, Div, Cinch Mfg. Co, part no. 12-140-D	367-0518-00
TB102	TERMINAL BOARD: Bakelite, 4 terminals, 1 grounded, 3 insulated; 21/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no. 1534-A	306-2240-00
XFL101	SOCKET, ELECTRON TUBE: 8 prong octal tube socket w/ steel mtg plate; Amphenol-Borg Electronics part no. 88-8TM	220-1005-00
	POWER AMPLIFIER AND POWER SUPPLY	
C401	CAPACITOR, FIXED, CERAMIC: 1000 uuf ±20%, 500 vdcw	913-1186-00
C402 thru C408	CAPACITOR, FIXED, CERAMIC: same as C401	913-1186-00
C409 A & B	CAPACITOR, FIXED, ELECTROLYTIC: dual section, 40 uf ea section; -10% +50%, 450 vdcw; Sprague Electric part no. Y27674	183-1259-00
C410	CAPACITOR, FIXED, ELECTROLYTIC: 1000 uf -10% +100%, 50 vdcw	183-1403-00
C411	CAPACITOR, FIXED, ELECTROLYTIC: same as C410	183-1403-00
C412	CAPACITOR, FIXED, ELECTROLYTIC: 500 uf -10% +100%, 50 vdcw	183-1575-00
C413	CAPACITOR, FIXED, ELECTROLYTIC: 4 uf -10% +100%, 50 vdcw	183-1389-00
C414 thru C425	NOT USED	
C426	CAPACITOR, FIXED, MICA: 5 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C050J01	912-2750-00
C427	CAPACITOR, VARIABLE, CERAMIC: 3.0 uuf min to 12.0 uuf max, 350 vdcw	917-1072-00
C428	CAPACITOR, FIXED, MICA: 470 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F471J01	912-2864-00
C429	CAPACITOR, FIXED, CERAMIC: 1.5 uuf ±5%, 500 vdcw; Stackpole Carbon Co, part no. GA-1.5uufPORM5	913-2981-00
C430	CAPACITOR, FIXED, CERAMIC: 4700 uuf ±20%, 500 vdcw	913-1187-00
C431	CAPACITOR, VARIABLE, AIR: 3.0-9.8 uuf, 1250 vdcw; E. F. Johnson part no. 160-211	922-0046-00
C432	CAPACITOR, FIXED, CERAMIC: 7.5 uuf ±5%, 500 vdcw; Stackpole Carbon Co, part no. GA-7.5uufPORM5	913-2997-00
C433	CAPACITOR, FIXED, MICA: same as C426	912-2774-00
C434	CAPACITOR, FIXED, MICA: same as C426	912-2774-00
C435	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C436	CAPACITOR, FIXED, MICA: 10 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C100J01	912-2753-00
C437	CAPACITOR, FIXED, MICA: same as C436	912-2753-00
C438	CAPACITOR, FIXED, CERAMIC: same as C429	913-2981-00
C439 thru C444	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C445	CAPACITOR, FIXED, CERAMIC: same as C429	913-2981-00
C446 thru C449	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C450	CAPACITOR, FIXED, CERAMIC: 1000 uuf -20% +80%, 500 vdcw; Erie Resistor part no. 327-029X5T0102Z	913-1292-00
C451	CAPACITOR, FIXED, CERAMIC: same as C429	913-2981-00
C452	CAPACITOR, FIXED, MICA: 33 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E330J01	912-2780-00
C453	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C454	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C455	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C456	CAPACITOR, VARIABLE, CERAMIC: 4.5 uuf min to 25 uuf max, 500 vdcw	917-1026-00
C457	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C458	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C459	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C460	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C461	CAPACITOR, VARIABLE, AIR: 3.0 uuf min to 18.7 uuf max; 1250 v a-c; E. F. Johnson Co. part no. 160-110-3	922-0033-00
C462	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C463	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C464	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C465 thru C468	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C469	NOT USED	
C470	NOT USED	
C471 thru C474	CAPACITOR, FIXED, CERAMIC: same as C430	913-1187-00
C475 thru C480	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C481	CAPACITOR, FIXED, CERAMIC: 1.0 uuf ±5%, 500 vdcw; Stackpole Carbon Co, part no. GA-1.0uufPORM5	913-2977-00
C482	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C483	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C484	CAPACITOR, FIXED, MICA: same as C428	912-2864-00
C485	CAPACITOR, FIXED, CERAMIC: same as C450	913-1292-00
C486	CAPACITOR, FIXED, MICA: same as C426	912-2750-00
C487	CAPACITOR, FIXED, MICA: same as C426	912-2750-00
C488	CAPACITOR, FIXED, MICA: same as C426	912-2750-00
C489	CAPACITOR, FIXED, MICA: 150 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F151J01	912-2828-00
C490	CAPACITOR, FIXED, MICA: same as C489	912-2828-00
C491	CAPACITOR, FIXED, MICA: 20 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C200J01	912-2765-00
CR401	SEMICONDUCTOR DEVICE, DIODE: silicon; Motorola part no. 1N1492	353-1661-00
CR402 thru CR408	SEMICONDUCTOR DEVICE, DIODE: same as CR401	353-1661-00
CR409	SEMICONDUCTOR DEVICE, DIODE: silicon, single phase, half-wave; General Electric part no. 1N538	353-1526-00
CR410	SEMICONDUCTOR DEVICE, DIODE: same as CR409	353-1526-00
CR411 A & B	SEMICONDUCTOR DEVICE, SET: two hermetically sealed silicon voltage reference diodes; Motorola part no. 10M10ZB1	353-1238-00
CR412	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; International Rect. Corp part no. 1Z10V01	353-1208-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
CR413	SEMICONDUCTOR DEVICE, DIODE: same as CR409	353-1526-00
CR414	SEMICONDUCTOR DEVICE, DIODE: same as CR409	353-1526-00
CR415	SEMICONDUCTOR DEVICE, DIODE: same as CR412	353-1208-00
CR416 thru CR425	NOT USED	
CR426	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed, diffused-junction type; Motorola part no. 1N977A	353-3237-00
F401	FUSE, CARTRIDGE: 1.00 amp current rating, 250 v, glass body, ferrule terminals; Bussmann part no. MDL 1	264-4280-00
F402	FUSE, CARTRIDGE: 0.250 amp current rating, 250 v d-c, glass body, ferrule terminals	264-4240-00
J401	JACK, TELEPHONE: steel, miniature, panel mtg; Switchcraft, Inc. part no. 3501FP	360-0148-00
J402	CONNECTOR, RECEPTACLE, ELECTRICAL: single round female contact, right angle shape; Amphenol part no. 31-213	357-9258-00
L401	REACTOR: 7.2 henrys min, 0.300 amp d-c; 60 ohms; 4-37/64 in. by 5-5/16 in. overall; Stancor Elec, Inc. part no. RS-8300	668-0015-00
L402 thru L425	NOT USED	
L426	COIL, RADIO FREQUENCY: 0.68 uh ±3%, 250 mc, 0.12 ohm, 1750 ma; 3/16 in. dia by 7/16 in. lg; Delevon part no. 1840	240-1844-00
L427	COIL, RADIO FREQUENCY: 0.25 uh ±3%, 400 mc, 0.04 ohm, 2850 ma; 3/16 in. dia by 7/16 in. lg	240-1843-00
L428	COIL, RADIO FREQUENCY, NO. 1: single layer wound #14 wire, 1/2 in. ID of coil, 7/8 in. lg overall	549-1605-003
L429	COIL, RADIO FREQUENCY: variable; 88 to 108 mc, -15°C to +55°C temp range; 850 v d-c dielectric strength	278-0730-00
L430 thru L434	COIL, RADIO FREQUENCY: same as L429	278-0730-00
L435	COIL, RADIO FREQUENCY, NO. 2: single layer wound #16 wire; 3/4 in. ID of coil, 2-7/8 in. lg overall	549-1606-003
L436	COIL, RADIO FREQUENCY: single layer wound; 5.6 uh, 860 ma current, 0.95 ohm; Jeffers Electronics Div. of Speer Carbon Co. part no. 10402-34	240-0179-00
L437	COIL, RADIO FREQUENCY: same as L436	240-0179-00
L438	COIL, RADIO FREQUENCY: single layer wound, 0.47 uh nom inductance, 0.09 ohm max dc resistance, 1600 ma max current rating; Jeffers Electronics, Div. of Speer Carbon Co. part no. 10100-126	240-0060-00
L439	COIL, RADIO FREQUENCY, NO. 3: single layer wound #14 wire, 3/4 in. ID of coil, 1-3/8 in. h; approx 1-11/16 in. lg overall	549-1607-003
L440	COIL, RADIO FREQUENCY: 1.00 uh ±10%, 0.30 ohm d-c resistance; 850 ma d-c; Jeffers Electronics part no. 10100-128	240-0062-00
R401	RESISTOR, FIXED, WIREWOUND: 100 ohms ±10%, 10 w	710-9053-00
R402	RESISTOR, FIXED, WIREWOUND: 16,000 ohms ±5%, 25 w	710-0369-00
R403	NOT USED	
R404	RESISTOR, FIXED, WIREWOUND: 600 ohms ±10%, 10 w	710-9081-00
R405	RESISTOR, FIXED, WIREWOUND: 12,000 ohms ±10%, 10 w	710-9070-00
R406	RESISTOR, FIXED, WIREWOUND: 25,000 ohms ±10%, 10 w	710-9068-00
R407	RESISTOR, FIXED, WIREWOUND: 5.0 ohms ±10%, 5 w	710-9105-00
R408	RESISTOR, FIXED, WIREWOUND: 25 ohms ±10%, 7 w	710-9019-00
R409	RESISTOR, FIXED, WIREWOUND: same as R408	710-9019-00
R410	RESISTOR, FIXED, COMPOSITION: 160.0 ohms ±5%, 5 w	747-5444-00
R411	RESISTOR, FIXED, COMPOSITION: same as R407	710-9105-00
R412	RESISTOR, FIXED, COMPOSITION: same as R410	747-5444-00
R413	RESISTOR, FIXED, WIREWOUND: 100 ohms ±10%, 7 w	710-9005-00
R414 thru R425	NOT USED	

ITEM	DESCRIPTION	COLLINS PART NUMBER
R426	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R427	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R428	RESISTOR, FIXED, COMPOSITION: 220 ohms ±10%, 1/2 w	745-1324-00
R429	RESISTOR, FIXED, COMPOSITION: 2700 ohms ±10%, 1/2 w	745-1370-00
R430	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
R431	RESISTOR, FIXED, COMPOSITION: 1500 ohms ±10%, 1/2 w	745-1359-00
R432	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1/2 w	745-1419-00
R433	RESISTOR, FIXED, COMPOSITION: 2200 ohms ±10%, 1/2 w	745-1366-00
R434	RESISTOR, FIXED, COMPOSITION: 0.10 megohm ±10%, 1/2 w	745-1436-00
R435	RESISTOR, FIXED, COMPOSITION: same as R434	745-1436-00
R436	RESISTOR, FIXED, COMPOSITION: same as R431	745-1359-00
R437	RESISTOR, FIXED, COMPOSITION: same as R433	745-1366-00
R438	RESISTOR, VARIABLE: COMPOSITION; 500 ohms ±20%, 0.2 w	376-0202-00
R439	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 2 w	745-5673-00
R440	RESISTOR, FIXED, COMPOSITION: same as R439	745-5673-00
R441	RESISTOR, FIXED, COMPOSITION: same as R434	745-1436-00
R442	RESISTOR, FIXED, COMPOSITION: same as R426	745-1394-00
R443	RESISTOR, FIXED, COMPOSITION: 68 ohms ±10%, 1/2 w	745-1303-00
R444	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1 w	745-3419-00
R445	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1 w	745-3380-00
R446	RESISTOR, FIXED, COMPOSITION: same as R434	745-1436-00
R447	RESISTOR, FIXED, COMPOSITION: same as R426	745-1394-00
R448	RESISTOR, FIXED, COMPOSTION: 270 ohms ±10%, 1 w	745-3328-00
R449	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1 w	745-3394-00
R450	RESISTOR, FIXED, COMPOSITION: 820 ohms ±10%, 2 w	745-5649-00
R451	RESISTOR, FIXED, COMPOSITION: 10 ohms ±10%, 1/2 w	745-1268-00
R452	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 1/2 w	745-1373-00
R453	RESISTOR, FIXED, COMPOSITION: same as R432	745-1419-00
R454	RESISTOR, VARIABLE, WIREWOUND: 250 ohms ±10%, 2 w	377-0621-00
R455	RESISTOR, FIXED, COMPOSITION: 180 ohms ±10%, 2 w	745-5621-00
R456	RESISTOR, FIXED, COMPOSITION: 8200 ohms ±10%, 1/2 w	745-1391-00
R457	RESISTOR, FIXED, COMPOSITION: 33 ohms ±10%, 1/2 w	745-1289-00
R458	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%, 1/2 w	745-1310-00
R459	RESISTOR, FIXED, COMPOSITION: same as R451	745-1268-00
R460	NOT USED	
R461	RESISTOR, FIXED, FILM: 51,000 ohms ±10%, 5 w	714-2973-00
R462	RESISTOR, FIXED, COMPOSITION: same as R443	745-1303-00
R463	RESISTOR, FIXED, COMPOSITION: 22,000 ohms ±10%, 1/2 w	745-1408-00
R464	RESISTOR, FIXED, COMPOSITION: same as R458	745-1310-00
R465	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1/2 w	745-1412-00
R466	RESISTOR, FIXED, WIREWOUND: 20,000 ohms ±10%, 10 w	710-9067-00
R467	RESISTOR, FIXED, COMPOSITION: 22,000 ohms ±10%, 2 w	745-5708-00
S401	SWITCH, TOGGLE: dpst; 125 v a-c, 15 amp, 250 v a-c, 10 amp; Cutler-Hammer, Inc. part no. 7561K4	266-0099-00
T401	TRANSFORMER, POWER, STEP-UP, STEP-DOWN: pri 120 v; sec. #1, 438 v, sec. #2, 6.3 v, ct; 50/60 cps; continuous duty cycle; Stancor Electric part no. 31215	662-0046-00
T402	TRANSFORMER, POWER, STEP-DOWN: pri 120 v rms; sec. #1, 77 v, ct; sec. #2, 41.5 ct; 50/60 cps; continuous duty cycle; Stancor Electric part no. 31214	662-0048-00
T403 thru T425	NOT USED	

ITEM	DESCRIPTION	COLLINS PART NUMBER
T426	TRANSFORMER, RADIO FREQUENCY: pri 14 turns #26 wire, close wound; sec. 13 turns #26 wire, close wound	549-1590-00
TB401	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB402	TERMINAL BOARD: Baklite, 2 terminals; 21/32 in. by 3/4 in. lg; Cinch Mfg. Co. part no. 1513-A	306-2220-00
TB403	TERMINAL BOARD: laminated phenolic w/ 4 solder-lug terminals; 27/32 in. w by 1-1/2 in. lg overall; Cinch Mfg. Co. part no. 1909	306-0838-00
TB404	TERMINAL BOARD: same as TB401	306-9033-00
TB405	TERMINAL BOARD: phenolic; steel mounting base, brass lugs, 12 terminals; H. B. Jones part no. 2012	367-0905-00
TB406	TERMINAL BOARD: same as TB405	367-0905-00
TB407 thru TB425	NOT USED	
TB426	TERMINAL BOARD: phenolic, 4 brass solder-lug terminals; 1/16 in. by 3/8 in. by 1-1/2 in.; Cinch Mfg. Corp. part no. 1532-A	306-9032-00
TB427	TERMINAL BOARD: same as TB403	306-0838-00
TB428	TERMINAL BOARD: phenolic, 5 brass solder-lug terminals; 1/16 in. by 3/8 in. by 1-7/8 in.; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB429	TERMINAL BOARD: same as TB428	306-0951-00
TB430	TERMINAL BOARD: same as TB402	306-2220-00
TB431	TERMINAL BOARD: same as TB428	306-0951-00
V401 thru V425	NOT USED	
V426	ELECTRON TUBE: triode-pentode; Radio Corp. of America part no. 6U8A	255-0328-00
V427	ELECTRON TUBE: glass envelope; twin triode; Radio Corp. of America part no. 12AT7	255-0205-00
V428	ELECTRON TUBE: pentode; Radio Corp. of America part no. 6AU6	255-0202-00
V429	ELECTRON TUBE: glass envelope; vhf beam power; Radio Corp. of America part no. 5763	257-0059-00
V430	ELECTRON TUBE: glass envelope; Radio Corp. of America part no. 2E26	256-0084-00
XF401	FUSE HOLDER: extractor post type, for use w/ 3 AG fuses; 0-20 amp, 100-125 v; clear knob; neon lamp type	265-1072-00
XF402	FUSE HOLDER: same as XF401	265-1072-00
XV401 thru XV425	NOT USED	
XV426	SOCKET, ELECTRON TUBE: 9 contact miniature; copper nonmagnetic alloy contacts; phenolic insulation; Sylvania Electric Products, Inc. part no. 7490-0100	220-1244-00
XV427	SOCKET, ELECTRON TUBE: same as XV426	220-1244-00
XV428	SOCKET, ELECTRON TUBE: 7 contact miniature for uhf application; phenolic insulation; Sylvania Electric Products, Inc, part no. 7470-0125	220-1203-00
XV429	SOCKET, ELECTRON TUBE: same as XV426	220-1244-00
XV430	SOCKET, ELECTRON TUBE: 8 prong octal tube socket w/ steel mtg plate; Amphenol-Borg Electronics part no. 78-8TM	220-1005-00
	AUTOMATIC FREQUENCY CONTROL	
C501	CAPACITOR, FIXED, CERAMIC: 1000 uuf ±20%, 500 vdcw	913-1186-00
C502	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C503	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C504	CAPACITOR, FIXED, CERAMIC: 0.01 uf -0% +100% temp range; 100 vdcw; Erie Resistor Corp. part no. 855-502-X550-103P	913-3680-00
C505	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C506	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C507	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C508	CAPACITOR, FIXED, MICA: 10 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C100J01	912-2753-00
C509	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C510	CAPACITOR, FIXED, MICA: 82 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E820J01	912-2810-00
C511	CAPACITOR, FIXED, CERAMIC: 0.1 uf -20% +80%, 50 vdcw; Sprague Electric part no. 33C41	913-3886-00
C512	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C513	CAPACITOR, FIXED, CERAMIC: same as C504	913-3680-00
C514	CAPACITOR, FIXED, MICA: same as C510	912-2810-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
C515	CAPACITOR, VARIABLE, CERAMIC: 5.0 uuf min to 37.5 uuf max, 350 vdcw; Erie Resistor part no. 557018C0P039R	917-1073-00
C516	CAPACITOR, FIXED, MICA: 220 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F221J01	912-2840-00
C517	CAPACITOR, FIXED, MICA: 30 uuf ±2%, 500 vdcw; Electro Motive part no. DM15E300G01	912-2776-00
C518	CAPACITOR, VARIABLE, CERAMIC: 3.0 uuf min to 12.0 uuf max, 350 vdcw	917-1072-00
C519	CAPACITOR, FIXED, MICA: 470 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F471J01	912-2864-00
C520	CAPACITOR, FIXED, MICA: same as C519	912-2864-00
C521	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf -10% +100%, 10 vdcw; Sprague Electric part no. S13691	183-2151-00
C522	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf -10%, +100%, 25 vdcw; Sprague Electric part no. 30D188A1	183-1192-00
C523	CAPACITOR, FIXED, CERAMIC: 0.68 uf -20% +80%, 25 vdcw; Sprague Electric part no. 5C12A	913-3809-00
C524	CAPACITOR, FIXED, ELECTROLYTIC: same as C522	183-1192-00
C525	CAPACITOR, FIXED, CERAMIC: same as C523	913-3809-00
C526	CAPACITOR, FIXED, ELECTROLYTIC: same as C522	183-1192-00
C527	CAPACITOR, FIXED, CERAMIC: same as C523	913-3809-00
C528	CAPACITOR, FIXED, ELECTROLYTIC: same as C522	183-1192-00
C529	CAPACITOR, FIXED, PAPER: 5.0 uf ±20%, 150 vdcw; Sprague Electric part no. 121P50501R5S2	931-2585-00
C530	CAPACITOR, FIXED, PAPER: same as C529	931-2585-00
C531	CAPACITOR, FIXED, PAPER: 2.0 uf ±20%, 200 vdcw; Aerovox Corp. part no. P8292ZN14	951-0670-00
C532	CAPACITOR, FIXED, PAPER: 20 uf ±20%, 150 vdcw; Sprague Electric part no. 143P101M	951-2004-00
C533	CAPACITOR, FIXED, PAPER: same as C531	951-0670-00
C534	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% +100%, 30 vdcw	183-1565-00
C535	CAPACITOR, FIXED, ELECTROLYTIC: 1000 uf -10% +100%, 50 vdcw	183-1403-00
C536	CAPACITOR, FIXED, ELECTROLYTIC: same as C535	183-1403-00
C537	CAPACITOR, FIXED, PAPER: 35 uf ±20%, 150 vdcw; Sprague Electric part no. 143P4M	951-2003-00
C538	CAPACITOR, FIXED, PAPER: same as C537	951-2003-00
C539	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% +100%, 12 vdcw; Sprague Electric Co. part no. 30D157A1	183-1190-00
C540	CAPACITOR, FIXED, CERAMIC: same as C511	913-3886-00
C541	CAPACITOR, FIXED, MICA: 180 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F181J01	912-2834-00
C542	CAPACITOR, FIXED, CERAMIC: same as C511	913-3886-00
C543	NOT USED	
C544	CAPACITOR, FIXED, MICA: 68 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E680J01	912-2804-00
C545	CAPACITOR, FIXED, MICA: 510 uuf ±5%, 300 vdcw; Electro Motive part no. DM15F511J01	912-2867-00
C546	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C547	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C548	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
C549	CAPACITOR, FIXED, CERAMIC: 3300 uuf ±20%, 500 vdcw	913-1193-00
C550	CAPACITOR, FIXED, MICA: 22 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C220J01	912-2768-00
C551	CAPACITOR, FIXED, ELECTROLYTIC: same as C534	183-1565-00
C552	CAPACITOR, FIXED, CERAMIC: same as C549	913-1193-00
C553	CAPACITOR, FIXED, CERAMIC: same as C501	913-1186-00
CR501	SEMICONDUCTOR DEVICE, DIODE: germanium; Transitron part no. 1N270	353-2018-00
CR502 thru CR506	SEMICONDUCTOR DEVICE, DIODE: same as CR501	353-2018-00
CR507	SEMICONDUCTOR DEVICE, DIODE: germanium; Erie Resistor part no. 1N198	353-0160-00
CR508	SEMICONDUCTOR DEVICE, DIODE: same as CR507	353-0160-00
CR509	SEMICONDUCTOR DEVICE, SET: four matched silicon diodes; encapsulated; Fairchild Semiconductor Corp. part no. FA-4000	353-3271-00
CR510	SEMICONDUCTOR DEVICE, SET: same as CR509	353-3271-00
CR511	SEMICONDUCTOR DEVICE, SET: same as CR509	353-3271-00
CR512	NOT USED	
CR513	SEMICONDUCTOR DEVICE, DIODE: same as CR507	353-0160-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
CR514	SEMICONDUCTOR DEVICE, DIODE: hermetically sealed, silicon; Motorola, Inc. part no. 1N718	353-2734-00
CR515	SEMICONDUCTOR DEVICE, DIODE: quick recovery silicon junction diode; Hughes Aircraft part no. 1N626	353-2857-00
CR516	SEMICONDUCTOR DEVICE, DIODE: same as CR515	353-2857-00
J501	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; brown; E. F. Johnson Co. part no. 105-208-200	360-0152-00
J502	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; red; E. F. Johnson Co. part no. 105-202-200	360-0150-00
J503	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; orange; E. F. Johnson Co. part no. 105-206-200	360-0154-00
J504	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; yellow; E. F. Johnson Co. part no. 105-207-200	360-0156-00
L501	COIL, RADIO FREQUENCY: single layer wound, 100 uh nom inductance, 3.2 ohms d-c resistance, 530 ma current rating; Jeffers Electronics, Div. of Speer Carbon Co. part no. 10404-34	240-0193-00
L502	COIL, RADIO FREQUENCY: single layer wound, 3.30 uh nom inductance, 0.15 ohm d-c resistance, 1150 ma current rating; Jeffers Electronics, Div. of Speer Carbon Co. part no. 10102-110	240-0065-00
L503	COIL, RADIO FREQUENCY: single layer wound, 4.7 uh inductance; 0.22 ohm max d-c resistance, 950 ma current rating; Jeffers Electronics, Div. of Speer Carbon Co. part no. 10102-115	240-0145-00
L504	COIL, RADIO FREQUENCY: variable; +15°C to +55°C temp range; 100 v d-c dielectric strength	278-0733-00
L505	COIL, RADIO FREQUENCY: same as L504	278-0733-00
Q501	TRANSISTOR: germanium; RCA part no. 2N1225	352-0135-00
Q502	TRANSISTOR: same as Q501	352-0135-00
Q503	TRANSISTOR: hermetically sealed, NPN silicon; Fairchild Semi Conductor Co. part no. 2N708	352-0322-00
Q504	TRANSISTOR: hermetically sealed, NPN diffused silicon planar transistor; Fairchild Semiconductor Corp. part no. 2N1613	352-0349-00
Q505	TRANSISTOR: same as Q504	352-0349-00
Q506	TRANSISTOR: same as Q504	352-0349-00
Q507	TRANSISTOR: same as Q504	352-0349-00
Q508	TRANSISTOR: silicon; General Electric part no. 2N491	352-0116-00
Q509	TRANSISTOR: germanium; hermetically sealed; Sylvania Electric part no. 2N1605	352-0348-00
Q510	TRANSISTOR: same as Q509	352-0348-00
Q511	TRANSISTOR: hermetically sealed; PNP germanium; General Electric part no. 2N1175A	352-0315-00
Q512	TRANSISTOR: same as Q501	352-0135-00
R501	RESISTOR, FIXED, COMPOSITION: 68 ohms ±10%, 1/2 w	745-1303-00
R502	RESISTOR, FIXED, COMPOSITION: 2700 ohms ±10%, 1/2 w	745-1370-00
R503	RESISTOR, FIXED, COMPOSITION: same as R502	745-1370-00
R504	RESISTOR, FIXED, COMPOSITION: 680 ohms ±10%, 1/2 w	745-1345-00
R505	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R506	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R507	RESISTOR, FIXED, COMPOSITION: same as R505	745-1380-00
R508	RESISTOR, FIXED, FILM: 42.2 ohms ±1%, 1/4 w	705-7030-00
R509	RESISTOR, FIXED, FILM: 51.1 ohms ±1%, 1/4 w	705-7034-00
R510	RESISTOR, FIXED, COMPOSITION: same as R506	745-1394-00
R511	RESISTOR, FIXED, COMPOSITION: same as R506	745-1394-00
R512	RESISTOR, FIXED, COMPOSITION: same as R505	745-1380-00
R513	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7068-00
R514	RESISTOR, FIXED, COMPOSITION: 1800 ohms ±10%, 1/2 w	745-1363-00
R515	RESISTOR, FIXED, COMPOSITION: same as R514	745-1363-00
R516	RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%, 1/2 w	745-1317-00
R517	RESISTOR, FIXED, FILM: 110 ohms ±1%, 1/4 w	705-7050-00
R518	RESISTOR, FIXED, FILM: 6810 ohms ±1%, 1/4 w	705-7136-00
R519	RESISTOR, FIXED, FILM: same as R518	705-7136-00
R520	RESISTOR, FIXED, FILM: same as R517	705-7050-00
R521	RESISTOR, FIXED, FILM: 34,800 ohms ±1%, 1/4 w	705-7170-00
R522	RESISTOR, FIXED, FILM: 10,000 ohms ±1%, 1/4 w	705-7144-00
R523	RESISTOR, FIXED, FILM: 178,000 ohms ±1%, 1/4 w	705-7204-00
R524	RESISTOR, FIXED, FILM: 14,700 ohms ±1%, 1/4 w	705-7152-00
R525	RESISTOR, FIXED, FILM: 7500 ohms ±1%, 1/4 w	705-7138-00
R526	RESISTOR, FIXED, FILM: 422 ohms ±1%, 1/4 w	705-7078-00
R527	RESISTOR, FIXED, FILM: 196,000 ohms ±1%, 1/4 w	705-7206-00
R528	RESISTOR, FIXED, FILM: same as R524	705-7152-00
R529	RESISTOR, FIXED, FILM: same as R525	705-7138-00
R530	RESISTOR, FIXED, FILM: same as R526	705-7078-00
R531	RESISTOR, FIXED, FILM: same as R527	705-7206-00
R532	RESISTOR, FIXED, FILM: same as R524	705-7152-00
R533	RESISTOR, FIXED, FILM: same as R525	705-7138-00
R534	RESISTOR, FIXED, FILM: same as R526	705-7078-00
R535	RESISTOR, FIXED, FILM: 38,300 ohms ±1%, 1/4 w	705-7172-00
R536	RESISTOR, FIXED, FILM: 19,600 ohms ±1%, 1/4 w	705-7158-00
R537	RESISTOR, FIXED, FILM: 1470 ohms ±1%, 1/4 w	705-7104-00
R538	RESISTOR, FIXED, FILM: same as R537	705-7104-00
R539	RESISTOR, FIXED, FILM: 2870 ohms ±1%, 1/4 w	705-7118-00
R540	RESISTOR, FIXED, FILM: same as R539	705-7118-00
R541	RESISTOR, FIXED, FILM: 100,000 ohms ±1%, 1/4 w	705-7192-00
R542	RESISTOR, FIXED, FILM: same as R541	705-7192-00
R543	RESISTOR, FIXED, COMPOSITION: 0.12 megohm ±10%, 1/2 w	745-1440-00
R544	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1/2 w	745-1412-00
R545	RESISTOR, FIXED, COMPOSITION: 0.18 megohm ±10%, 1/2 w	745-1447-00
R546	RESISTOR, FIXED, FILM: 5620 ohms ±1%, 1/4 w	705-7132-00
R547	RESISTOR, FIXED, FILM: 9090 ohms ±1%, 1/4 w	705-7142-00
R548	RESISTOR, FIXED, FILM: same as R547	705-7142-00
R549	RESISTOR, FIXED, FILM: 8250 ohms ±1%, 1/4 w	705-7140-00
R550	RESISTOR, FIXED, FILM: 1330 ohms ±1%, 1/4 w	705-7102-00
R551	RESISTOR, FIXED, COMPOSITION: 15,000 ohms ±10%, 1/2 w	745-1401-00
R552	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 1/2 w	745-1373-00
R553	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R554	RESISTOR, FIXED, COMPOSITION: same as R551	745-1401-00
R555	RESISTOR, FIXED, FILM: 75,000 ohms ±1%, 1/4 w	705-7186-00
R556	RESISTOR, FIXED, COMPOSITION: 10 ohms ±10%, 1/2 w	745-1268-00
R557	RESISTOR, FIXED, COMPOSITION: 220 ohms ±10%, 1/2 w	745-1324-00
R558	RESISTOR, FIXED, FILM: 56,200 ohms ±1%, 1/4 w	705-7180-00
R559	RESISTOR, FIXED, FILM: 2610 ohms ±1%, 1/4 w	705-7116-00
R560	RESISTOR, FIXED, FILM: 3160 ohms ±1%, 1/4 w	705-7120-00
R561	RESISTOR, FIXED, COMPOSITION: same as R553	745-1352-00
R562	RESISTOR, VARIABLE: COMPOSITION; 1000 ohms ±20%, 1/4 w	376-4727-00
R563	RESISTOR, FIXED, COMPOSITION: same as R506	745-1394-00
R564	RESISTOR, FIXED, FILM: 3480 ohms ±1%, 1/4 w	705-7122-00
R565	RESISTOR, FIXED, FILM: 4640 ohms ±1%, 1/4 w	705-7128-00
R566	RESISTOR, FIXED, FILM: same as R521	705-7170-00
R567	RESISTOR, FIXED, FILM: same as R521	705-7170-00
R568	RESISTOR, FIXED, COMPOSITION: 100 ohms ±10%, 1/2 w	745-1310-00
R569	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 1/2 w	745-1387-00
R570	RESISTOR, FIXED, COMPOSTION: 8200 ohms ±10%, 1/2 w	745-1391-00
R571	RESISTOR, FIXED, COMPOSITION: 18,000 ohms ±5%, 1/2 w	745-1404-00
R572	RESISTOR, VARIABLE: COMPOSITION; 500 ohms ±20%, 1/4 w	376-4726-00
R573	RESISTOR, FIXED, COMPOSITION: same as R502	745-1370-00
R574	RESISTOR, FIXED, COMPOSITION: same as R502	745-1370-00
R575	RESISTOR, FIXED, COMPOSITION: same as R505	745-1380-00
R576	RESISTOR, FIXED, COMPOSITION: 5600 ohms ±10%, 1/2 w	745-1384-00
R577	RESISTOR, FIXED, COMPOSITION: 39,000 ohms ±10%, 1/2 w	745-1419-00
R578	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
R579	RESISTOR, FIXED, COMPOSITION: 2150 ohms ±1%, 1/4 w	705-7112-00
R580	RESISTOR, FIXED, COMPOSITION: 820 ohms ±10%, 1/2 w	745-1349-00
R581	RESISTOR, FIXED, COMPOSITION: same as R552	745-1373-00
T501	NOT USED	
T502	NOT USED	
T503	TRANSFORMER, RADIO FREQUENCY: 20 turns #30 AWG, close wound tapped at 10 turns; 43.5 uh inductance; ferrite core; 0.250 in. w by 0.500 in. dia	549-1589-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
T504	TRANSFORMER, RADIO FREQUENCY: 5 terminals, primary ct; 5/8 in. h by 1-1/8 in. w by 1-1/2 in. lg	549-1617-003
TB501	TERMINAL BOARD: phenolic, 1-7/8 in. lg by 3/8 in. w by 1/16 in. thk; 5 brass solder-lug terminals; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB502	TERMINAL BOARD: same as TB501	306-0951-00
TB503	TERMINAL BOARD: same as TB501	306-0951-00
TB504	TERMINAL BOARD: Bakelite, 4 terminals, 1 grounded, 3 insulated; 21/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no. 1534-A	306-2240-00
TB505	TERMINAL BOARD: same as TB501	306-0951-00
TB506	TERMINAL BOARD: same as TB501	306-0951-00
TB507	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB508	TERMINAL BOARD: same as TB501	306-0951-00
TB509	TERMINAL BOARD: phenolic, 1/16 in. by 3/8 in. by 1-1/2 in.; 4 brass solder-lug terminals; Cinch Mfg. Corp. part no. 1532-A	306-9032-00
TB510	TERMINAL BOARD: same as TB507	306-9033-00
TB511	TERMINAL BOARD: same as TB501	306-0951-00
TB512	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals, 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1525-A	306-0001-00
TB513	TERMINAL BOARD: same as TB509	306-9032-00
TB514	TERMINAL BOARD: same as TB507	306-9033-00
TB515	TERMINAL BOARD: same as TB501	306-0951-00
TB516	TERMINAL BOARD: same as TB501	306-0951-00
TB517	TERMINAL BOARD: same as TB501	306-0951-00
TB518	TERMINAL BOARD: phenolic, 12 solder-lug terminals; Vector Mfg. Co. part no. 6H-12	306-0909-00
TB519	TERMINAL BOARD: same as TB501	306-0951-00
TB520	TERMINAL BOARD: phenolic w/ 4 solder lug terminals; 27/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no, 1909	306-0838-00
TB521	TERMINAL BOARD: phenolic, 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg	306-0587-00
Y501	CRYSTAL UNIT, QUARTZ: 14.0 mc; type HC-27/U holder	289-2743-00
	MODULATOR	
C601	CAPACITOR, FIXED, CERAMIC: 20.0 uuf ±2%, 500 vdcw	916-0362-00
C602	CAPACITOR, FIXED, CERAMIC: same as C601	916-0362-00
C603	CAPACITOR, FIXED, CERAMIC: uninsulated, 10.0 uuf ±1/2 uuf, 500 vdcw	916-0412-00
C604	CAPACITOR, FIXED, MICA: 100 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F101J01	912-2816-00
C605	CAPACITOR, FIXED, CERAMIC: 0.01 uf -0% +100%, 100 vdcw; Erie Resistor Corp. part no. 855-502-X550-103P	913-3680-00
C606	CAPACITOR, VARIABLE, CERAMIC: 5.0 uuf min to 37.5 uuf max, 350 vdcw; Erie Resistor Corp. part no. 557018C0P039R	917-1073-00
C607	CAPACITOR, FIXED, PAPER: 1.0 uf -10% +20%, 200 vdcw	931-0170-00
C608	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% +100%, 12 vdcw; Sprague Electric Co. part no. 30D157A1	183-1190-00
C609	CAPACITOR, FIXED, PAPER: 0.5 uf -10% +20%, 200 vdcw	931-0169-00
C610	CAPACITOR, FIXED, PAPER: 20 uf ±20%, 150 vdcw; Sprague Electric part no. 143P101M	951-2004-00
C611	CAPACITOR, FIXED, MICA: same as C604	912-2816-00
C612	CAPACITOR, FIXED, MICA: same as C604	912-2816-00
C613	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C614	CAPACITOR, FIXED, MICA: 330 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F331J01	912-2852-00
C615	CAPACITOR, FIXED, CERAMIC: 0.1 uf -20% +80%, 50 vdcw; Sprague Electric part no. 33C41	913-3886-00
C616	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C617	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C618	CAPACITOR, FIXED, CERAMIC: 100 uuf ±20%, 500 vdcw	913-1186-00
C619	CAPACITOR, FIXED, MICA: 10 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F100J01	912-2753-00
C620	CAPACITOR, FIXED, MICA: 82 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E820J01	912-2810-00
C621	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C622	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C623	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C624	NOT USED	
C625	CAPACITOR, FIXED, MICA: 22 uuf ±5%, 500 vdcw; Electro Motive part no. DM15C220J01	912-2768-00
C626	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C627	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C628	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C629	CAPACITOR, FIXED, MICA: same as C625	912-2768-00
C630	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C631	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C632	CAPACITOR, FIXED, MICA: 150 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F151J01	912-2828-00
C633	CAPACITOR, FIXED, MICA: same as C632	912-2828-00
C634	CAPACITOR, FIXED, MICA: 39 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E390J01	912-2786-00
C635	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C636	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C637	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C638	CAPACITOR, FIXED, CERAMIC: same as C605	913-3680-00
C639	CAPACITOR, VARIABLE, CERAMIC: same as C606	917-1073-00
C640	CAPACITOR, FIXED, CERAMIC: same as C618	913-1186-00
C641	CAPACITOR, FIXED, MICA: 68 uuf ±5%, 500 vdcw; Electro Motive part no. DM15E680J01	912-2804-00
C642	CAPACITOR, FIXED, MICA: 220 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F221J01	912-2840-00
C643	CAPACITOR, FIXED, CERAMIC: same as C601	916-0362-00
C644	CAPACITOR, VARIABLE, CERAMIC: 3.0 uuf min to 12.0 uuf max, 350 vdcw	917-1072-00
C645	CAPACITOR, FIXED, MICA: 33 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F330J01	912-2780-00
C646	CAPACITOR, FIXED, MICA: same as C645	912-2780-00
C647	CAPACITOR, FIXED, MICA: 560 uuf ±5%, 500 vdcw; Electro Motive part no. DM19F561J	912-2983-00
C648	CAPACITOR, FIXED, MICA: 1800 uuf ±5%, 500 vdcw; Electro Motive part no. DM20F182J	912-3333-00
C649	CAPACITOR, FIXED, ELECTROLYTIC: 100 uf -15% +75%, 25 vdcw; Sprague Electric part no. 109D107C7025T2	184-7802-00
C650	CAPACITOR, FIXED, PAPER: same as C607	931-0170-00
C651	CAPACITOR, FIXED, CERAMIC: same as C615	913-3886-00
C652	CAPACITOR, FIXED, CERAMIC: 10.0 uuf ±1/4 uuf, 500 vdcw	916-0203-00
C653	CAPACITOR, FIXED, MICA: 270 uuf ±5%, 500 vdcw; Electro Motive part no. DM15F271J01	912-2846-00
C654	CAPACITOR, DIODE: 35 uuf ±20%, at -4 v d-c voltage, max 130 v d-c; total capacity range 6 to 88 uuf, 130 v d-c to 0.1 v d-c	922-0002-00
CR601	SEMICONDUCTOR DEVICE, DIODE: quick recovery silicon junction diode; Hughes Aircraft part no. 1N626	353-2857-00
CR602	SEMICONDUCTOR DEVICE, DIODE: silicon, hermetically sealed; Transitron Elect. Corp. part no. SV3173	353-3304-00
CR603	SEMICONDUCTOR DEVICE, DIODE: germanium, Transitron part no. 1N270	353-2018-00
CR604	SEMICONDUCTOR DEVICE, DIODE: same as CR603	353-2018-00
CR605	SEMICONDUCTOR DEVICE, DIODE: same as CR603	353-2018-00
CR606	SEMICONDUCTOR DEVICE, DIODE: same as CR603	353-2018-00
CR607	SEMICONDUCTOR DEVICE, DIODE: germanium; Erie Resistor part no. 1N198	353-0160-00
CR608	SEMICONDUCTOR DEVICE, DIODE: same as CR607	353-0160-00
CR609	SEMICONDUCTOR DEVICE, DIODE: silicon; Texas Instruments part no. 1N751A	353-2710-00
CR610	SEMICONDUCTOR DEVICE, DIODE: same as CR607	353-0160-00
J601	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; brown; E. F. Johnson Co. part no. 105-208-200	360-0152-00
J602	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; red; E. F. Johnson Co. part no. 105-202-200	360-0150-00
J603	JACK, TIP: insulated tip u/w standard 0.080 in. test probes; orange; E. F. Johnson Co. part no. 105-206-200	360-0154-00
J604	JACK, TELEPHONE: steel, miniature; panel mtg; Switchcraft, Inc. part no. 3501FP	360-0148-00
J605	JACK, TELEPHONE: same as J604	360-0148-00
L601	COIL, RADIO FREQUENCY: 82 uh ±10%, 2.3 ohms max d-c resistance, 570 ma current rating; Jeffers Electronics part no. 10404-112	240-0192-00
L602	INDUCTOR, RADIO FREQUENCY: toroidal, single layer wound, approx 22 turns #28 double formvar; 2.4 uh ±2%, at 2.6 mc	240-1529-00
L603	COIL, RADIO FREQUENCY: variable; -15°C to +55°C temp range; 100 v d-c dielectric strength	278-0733-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
L604	COIL, RADIO FREQUENCY: universal wound, 3 pi, 72 turns ea section, #36 AWG wire; 220 uh inductance; 100 ma current; Delevan Electric part no. BS-217	240-0198-00
L605	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L606	COIL, RADIO FREQUENCY: same as L603	278-0733-00
L607	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L608	COIL, RADIO FREQUENCY: same as L603	278-0733-00
L609	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L610	COIL, RADIO FREQUENCY: 1.00 uh ±10%, 0.30 ohm d-c resistance; 850 ma dc; Jeffers Electronics part no. 10100-128	240-0062-00
L611	COIL, RADIO FREQUENCY: same as L603	278-0733-00
L612	COIL, RADIO FREQUENCY: same as L604	240-0198-00
L613	NOT USED	
L614	COIL, RADIO FREQUENCY: single layer wound, 56 uh inductance, 750 ma current; 1.30 ohms d-c; Jeffers Electronics Div. of Speer Carbon Co. part no. 10404-30	240-0191-00
L615	COIL, RADIO FREQUENCY: same as L601	240-0192-00
L616	COIL, RADIO FREQUENCY: same as L604	240-0198-00
P601	PLUG, TELEPHONE: brass; phenolic insulation, w/ solder-lug terminal; Switchcraft part no. 3501MC	361-0062-00
P602	NOT USED	
P603		
P604	PHONO, PLUG: w/ solder-lug terminals, phenolic insulation; Switchcraft, Inc. part no. 3501MC	361-0062-00
Q601	TRANSISTOR: germanium; hermetically sealed; Radio Corp. of America part no. 2N1396	352-0376-00
Q602	TRANSISTOR: germanium; Radio Corp. of America part no. 2N1225	352-0135-00
Q603	TRANSISTOR: same as Q602	352-0135-00
Q604	TRANSISTOR: hermetically sealed, NPN silicon; Fairchild Semiconductor Corp. part no. 2N708	352-0322-00
Q605	TRANSISTOR: same as Q602	352-0135-00
Q606	TRANSISTOR: same as Q604	352-0322-00
Q607	TRANSISTOR: silicon planar; hermetically sealed; Fairchild Semiconductor Corp. part no. S4639	352-0373-00
Q608	TRANSISTOR: same as Q601	352-0376-00
R601	RESISTOR, FIXED, FILM: 21,500 ohms ±1%, 1/4 w	705-7160-00
R602	RESISTOR, FIXED, FILM: 12,100 ohms ±1%, 1/4 w	705-7148-00
R603	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R604	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
*R605	RESISTOR, FIXED, FILM: 1470 ohms ±1%, 1/4 w	705-7104-00
*R605	RESISTOR, FIXED, FILM: 1960 ohms ±1%, 1/4 w	705-7110-00
*R605	RESISTOR, FIXED, FILM: 4220 ohms ±1%, 1/4 w	705-7126-00
*R605	RESISTOR, FIXED, FILM: 1000 ohms ±1%, 1/4 w	705-7096-00
R606	RESISTOR, FIXED, FILM: 19,600 ohms ±1%, 1/4 w	705-7158-00
R607	RESISTOR, FIXED, FILM: 2610 ohms ±1%, 1/4 w	705-7116-00
R608	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R609	RESISTOR, FIXED, COMPOSITION: 5600 ohms ±10%, 1/2 w	745-1384-00
R610	RESISTOR, FIXED, COMPOSITION: 27,000 ohms ±10%, 1/2 w	745-1412-00
R611	RESISTOR, FIXED, COMPOSITION: 1500 ohms ±10%, 1/2 w	745-1359-00
R612	RESISTOR, FIXED, COMPOSITION: 1800 ohms ±10%, 1/2 w	745-1363-00
R613	RESISTOR, FIXED, FILM: 42.2 ohms ±1%, 1/4 w	705-7030-00
R614	RESISTOR, FIXED, FILM: 51.1 ohms ±1%, 1/4 w	705-7034-00
R615	RESISTOR, FIXED, COMPOSITION: same as R608	745-1394-00
R616	RESISTOR, FIXED, COMPOSITION: same as R608	745-1394-00
R617	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R618	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7068-00
R619	RESISTOR, FIXED, COMPOSITION: same as R612	745-1363-00
R620	RESISTOR, FIXED, COMPOSITION: same as R612	745-1363-00
R621	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 1/2 w	745-1387-00
R622	RESISTOR, FIXED, COMPOSITION: same as R617	745-1380-00
R623	RESISTOR, FIXED, COMPOSITION: same as R621	745-1387-00
R624	RESISTOR, FIXED, COMPOSITION: 220 ohms ±10%, 1/2 w	745-1324-00
R625	RESISTOR, FIXED, COMPOSITION: same as R612	745-1363-00
R626	RESISTOR, FIXED, COMPOSITION: 2200 ohms ±10%, 1/2 w	745-1366-00
R627	RESISTOR, FIXED, COMPOSITION: 390 ohms ±10%, 1/2 w	745-1335-00
R628	RESISTOR, FIXED, FILM: 1960 ohms ±1%, 1/4 w	705-7110-00
R629	RESISTOR, FIXED, FILM: same as R628	705-7110-00
R630	RESISTOR, FIXED, FILM: 8250 ohms ±1%, 1/4 w	705-7140-00
R631	RESISTOR, FIXED, FILM: 1100 ohms ±1%, 1/4 w	705-7098-00
R632	RESISTOR, FIXED, FILM: same as R631	705-7098-00
*R633	RESISTOR, FIXED, FILM: 3480 ohms ±1%, 1/4 w	705-7122-00
*R633	RESISTOR, FIXED, FILM: 4220 ohms ±1%, 1/4 w	705-7126-00
*R633	RESISTOR, FIXED, FILM: 5110 ohms ±1%, 1/4 w	705-7130-00
*R633	RESISTOR, FIXED, FILM: 10,000 ohms ±1%, 1/4 w	705-7144-00
R634	RESISTOR, FIXED, FILM: 348 ohms ±1%, 1/4 w	705-7074-00
R635	RESISTOR, VARIABLE: COMPOSITION; 50,000 ohms ±30%, 1/4 w	376-4737-00
R636	RESISTOR, FIXED, FILM: 1000 ohms ±1%, 1/4 w	705-7096-00
R637	RESISTOR, FIXED, FILM: 7500 ohms ±1%, 1/4 w	705-7138-00
R638	RESISTOR, FIXED, FILM: 100,000 ohms ±1%, 1/4 w	705-7192-00
R639	RESISTOR, FIXED, FILM: 316 ohms ±1%, 1/4 w	705-7072-00
R640	RESISTOR, FIXED, FILM: 5110 ohms ±1%, 1/4 w	705-7130-00
R641	RESISTOR, VARIABLE: COMPOSITION; 50,000 ohms ±30%, 1/4 w	376-4732-00
R642	RESISTOR, FIXED, FILM: 13,300 ohms ±1%, 1/4 w	705-7150-00
R643	RESISTOR, FIXED, FILM: 2870 ohms ±1%, 1/4 w	705-7118-00
R644	RESISTOR, FIXED, COMPOSITION: 0.10 megohm ±10%, 1/2 w	745-1436-00
R645	RESISTOR, FIXED, COMPOSITION: same as R644	745-1436-00
R646	RESISTOR, FIXED, COMPOSITION: same as R644	745-1436-00
R647	RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%, 1/2 w	745-1317-00
R648	RESISTOR, FIXED, COMPOSITION: 680 ohms ±10%, 1/2 w	745-1345-00
R649	RESISTOR, FIXED, COMPOSITION: same as R608	745-1394-00
R650	RESISTOR, FIXED, COMPOSITION: same as R626	745-1366-00
R651	RESISTOR, FIXED, COMPOSITION: 22 ohms ±10%, 1/2 w	745-1282-00
T601	TRANSFORMER, RADIO FREQUENCY: 5 terminals primary, ct; 5/8 in. h by 1-1/8 in. w by 1-1/2 in. lg; Collins Radio Co.	549-1617-003
TB601	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB602	TERMINAL BOARD: phenolic, 1/16 in. by 3/8 in. by 1-1/2 in.; 4 brass solder lug terminals; Cinch Mfg. Corp. part no. 1532-A	306-9032-00
TB603	TERMINAL BOARD: same as TB602	306-9032-00
TB604	TERMINAL BOARD: same as TB601	306-9033-00
TB605	TERMINAL BOARD: same as TB601	306-9033-00
TB606	TERMINAL BOARD: same as TB601	306-9033-00
TB607	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg, Cinch Mfg. Corp. part no. 1525-A	306-0001-00
TB608	TERMINAL BOARD: phenolic, 1-7/8 in. by 3/8 in. by 1/16 in.; 5 brass solder-lug terminals; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB609	TERMINAL BOARD: same as TB608	306-0951-00
TB610	TERMINAL BOARD: laminated phenolic w/ 4 solder lug terminals; 27/32 in. w by 1-1/12 in. lg overall; Cinch Mfg. Corp. part no. 1909	306-0838-00
TB611	TERMINAL BOARD: same as TB610	306-0838-00
TB612	TERMINAL BOARD: same as TB601	306-9033-00
TB613	TERMINAL BOARD: same as TB601	306-9033-00
TB614	TERMINAL BOARD: phenolic, 12 solder lug terminals; Vector Mfg. Co. part no. 6H-12	306-0909-00
TB615	TERMINAL BOARD: same as TB608	306-0951-00
TB616	TERMINAL BOARD: phenolic, 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg	306-0587-00

*Chosen per operational requirement.

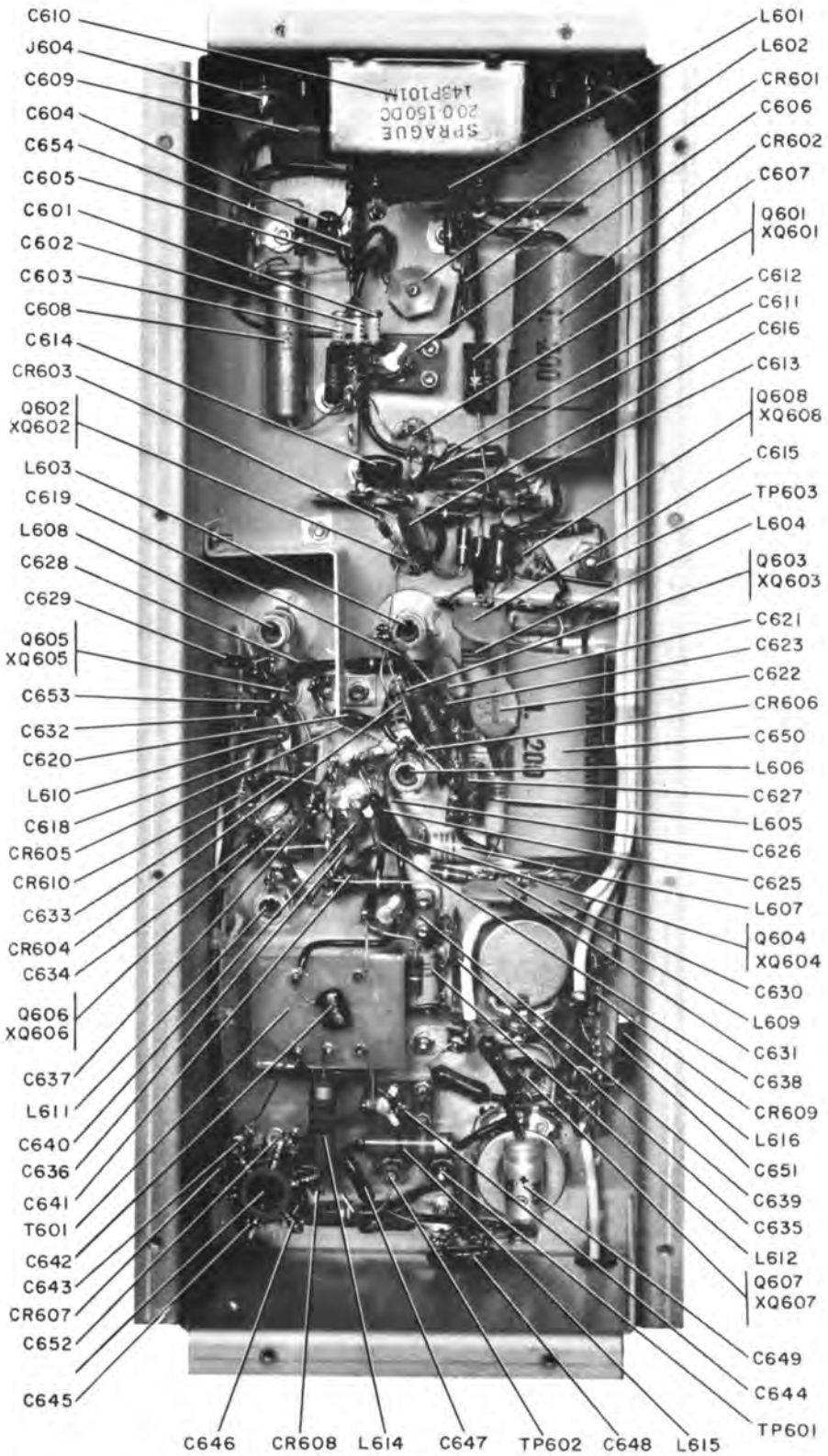


Figure 4-1. Modulator Compartment, Component (Except Resistors) Identification

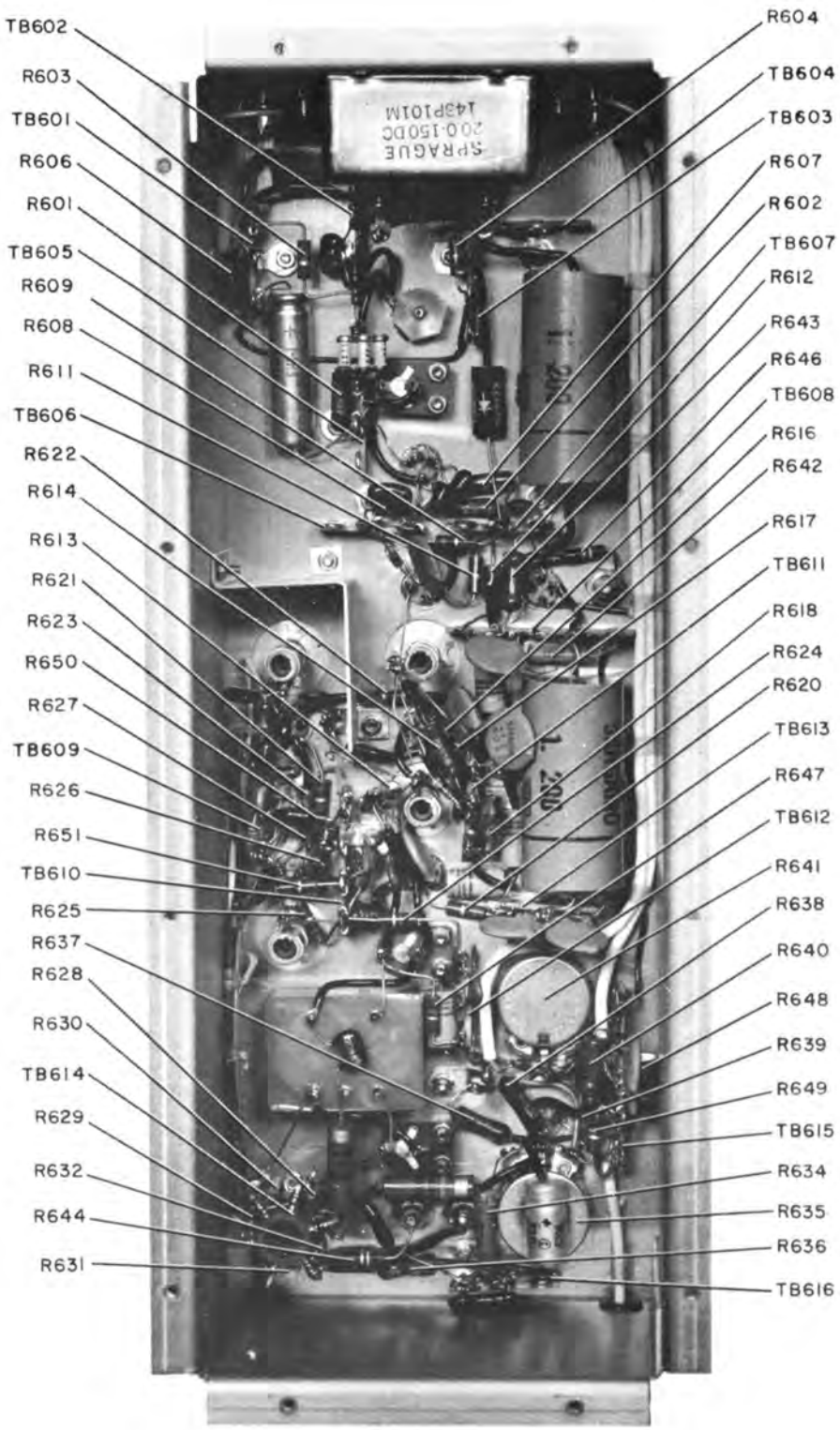


Figure 4-2. Modulator Compartment, Resistor Identification

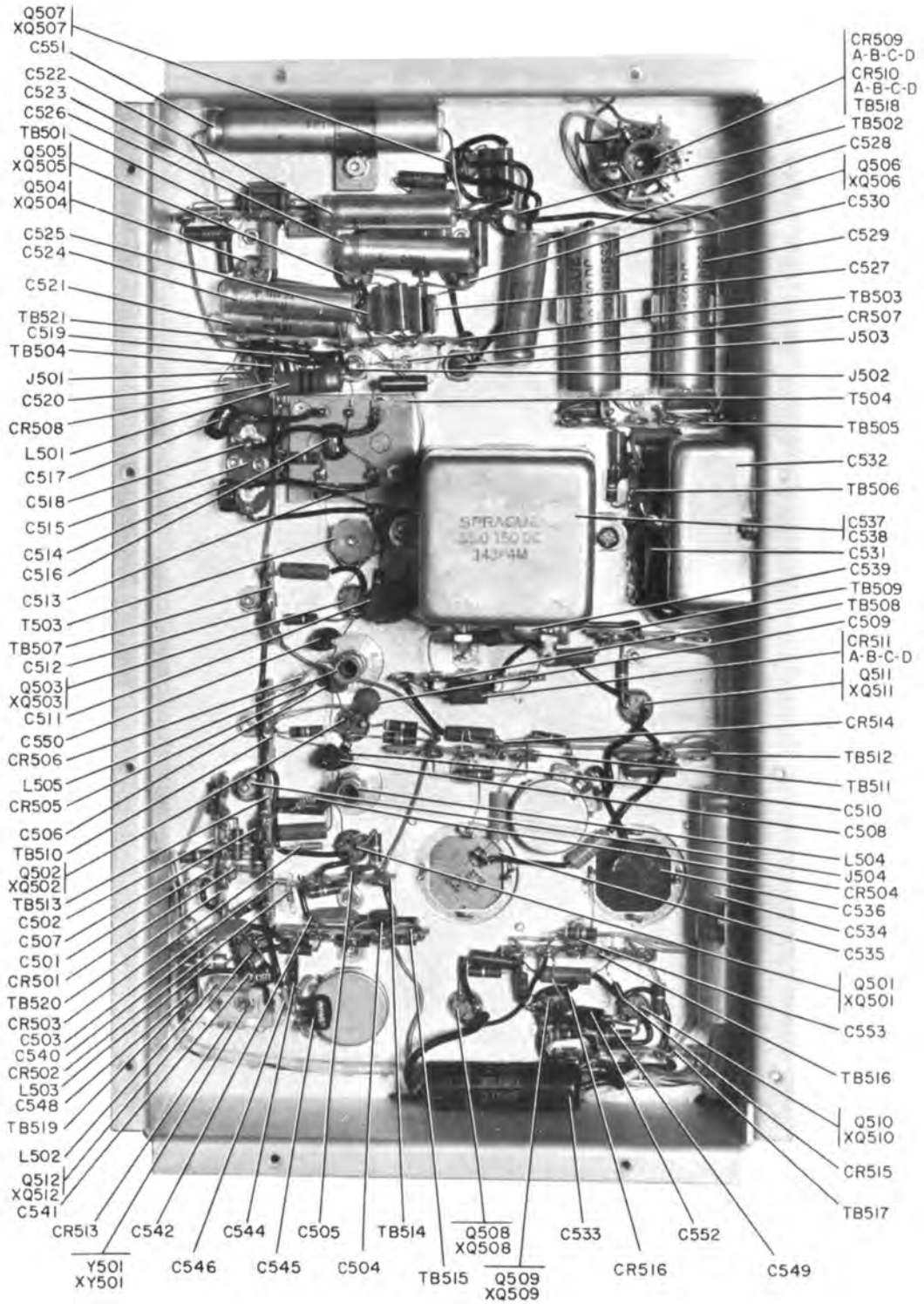


Figure 4-3. AFC Compartment, Component (Except Resistors) Identification

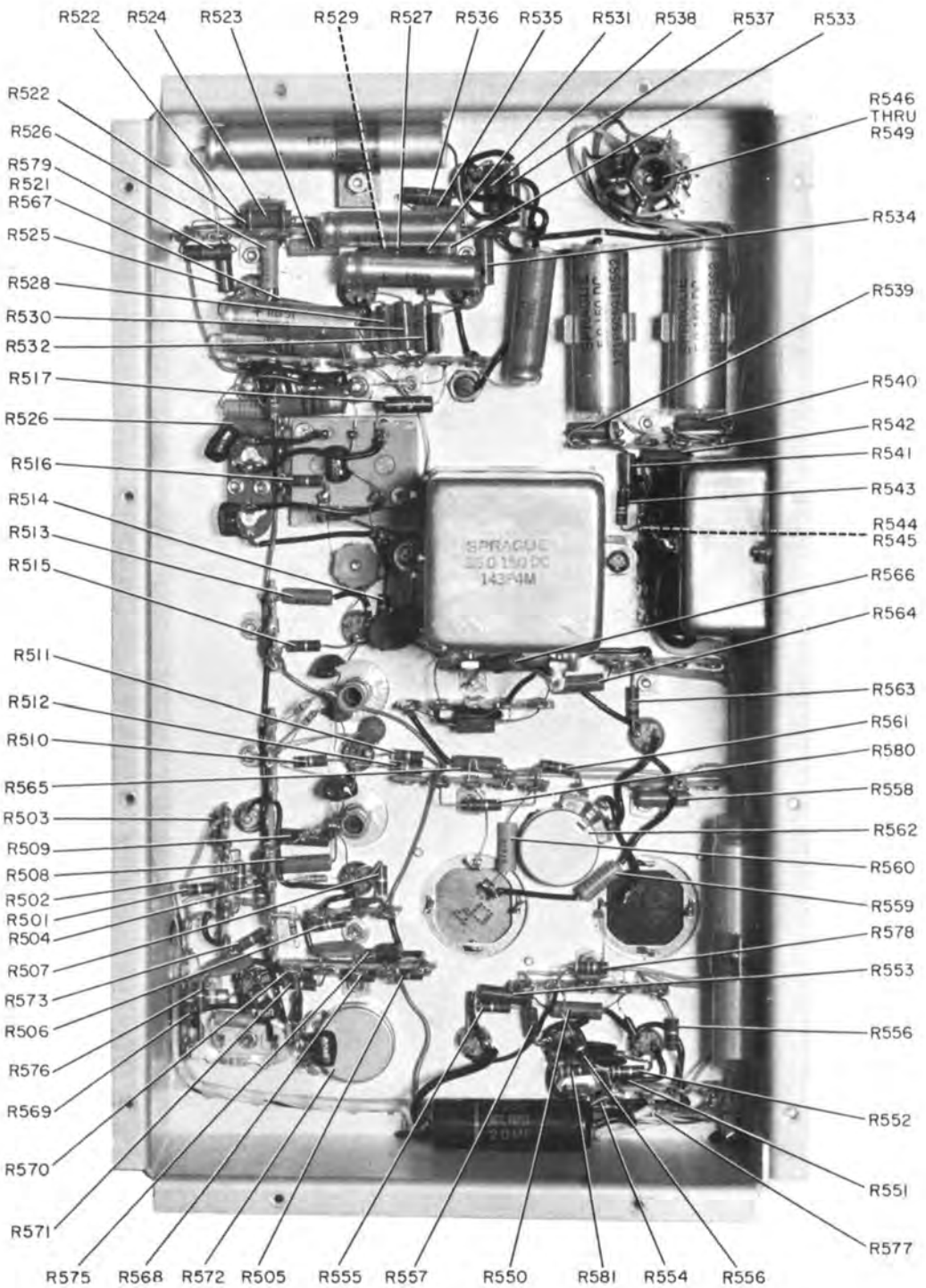


Figure 4-4. AFC Compartment, Resistor Identification

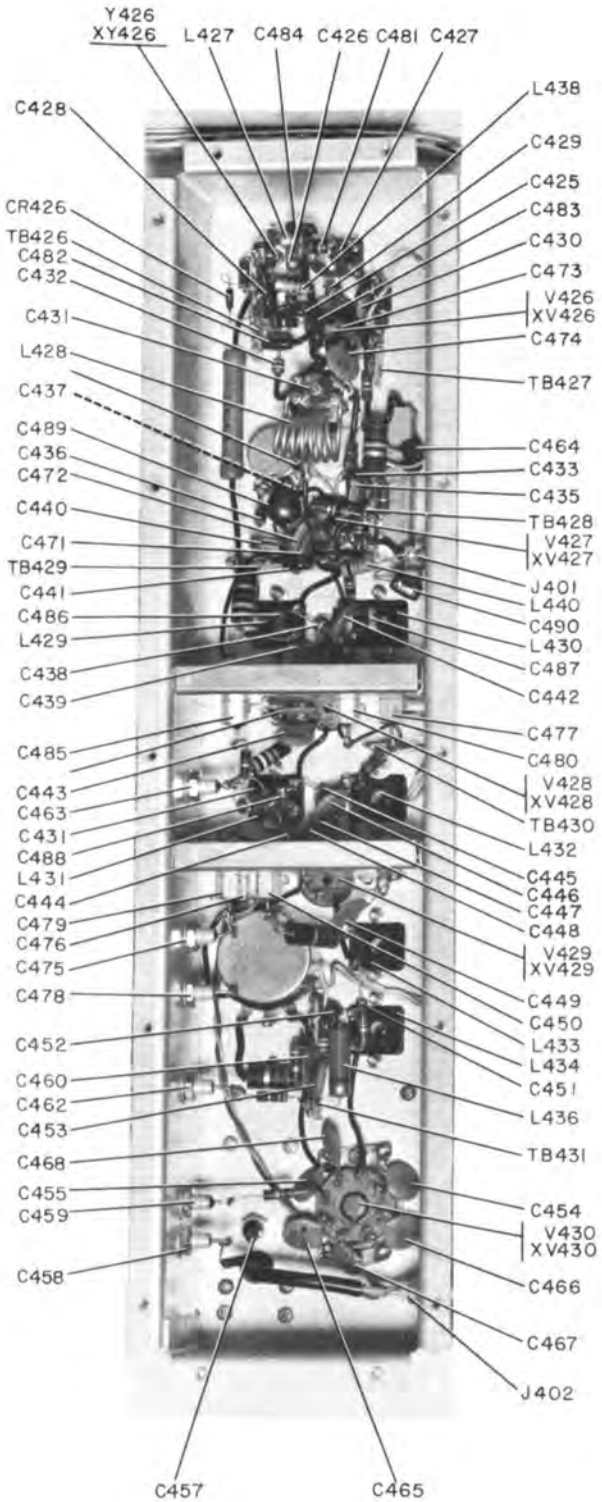


Figure 4-5. Power Amplifier Compartment, Component (Except Resistors) Identification

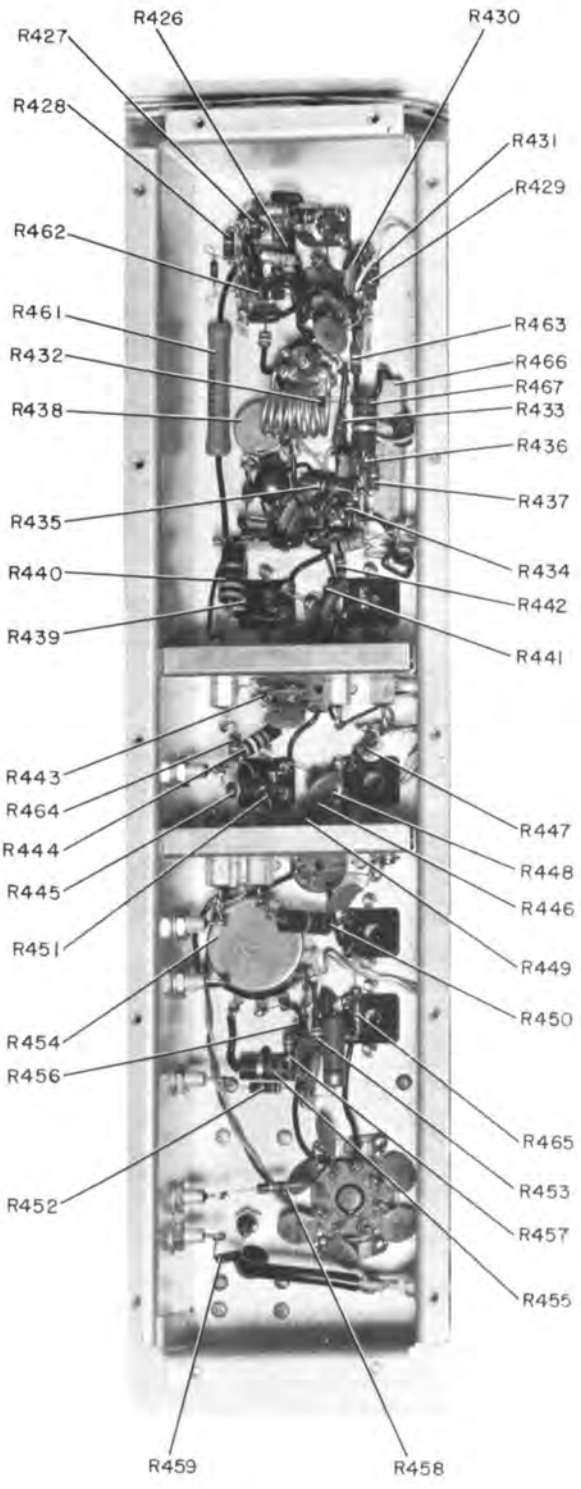


Figure 4-6. Power Amplifier Compartment, Resistor Identification

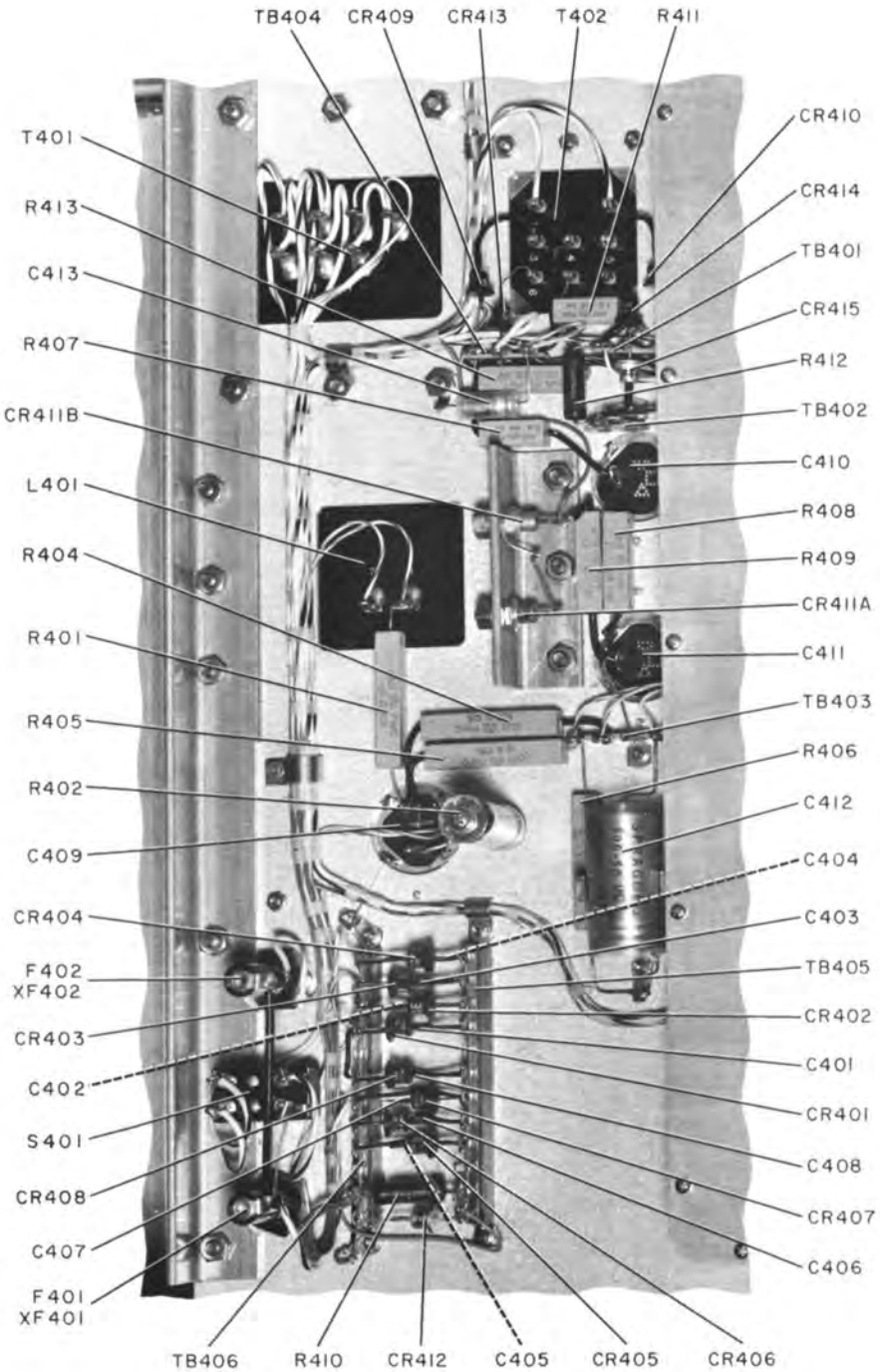


Figure 4-7. Power Supply, Component Identification

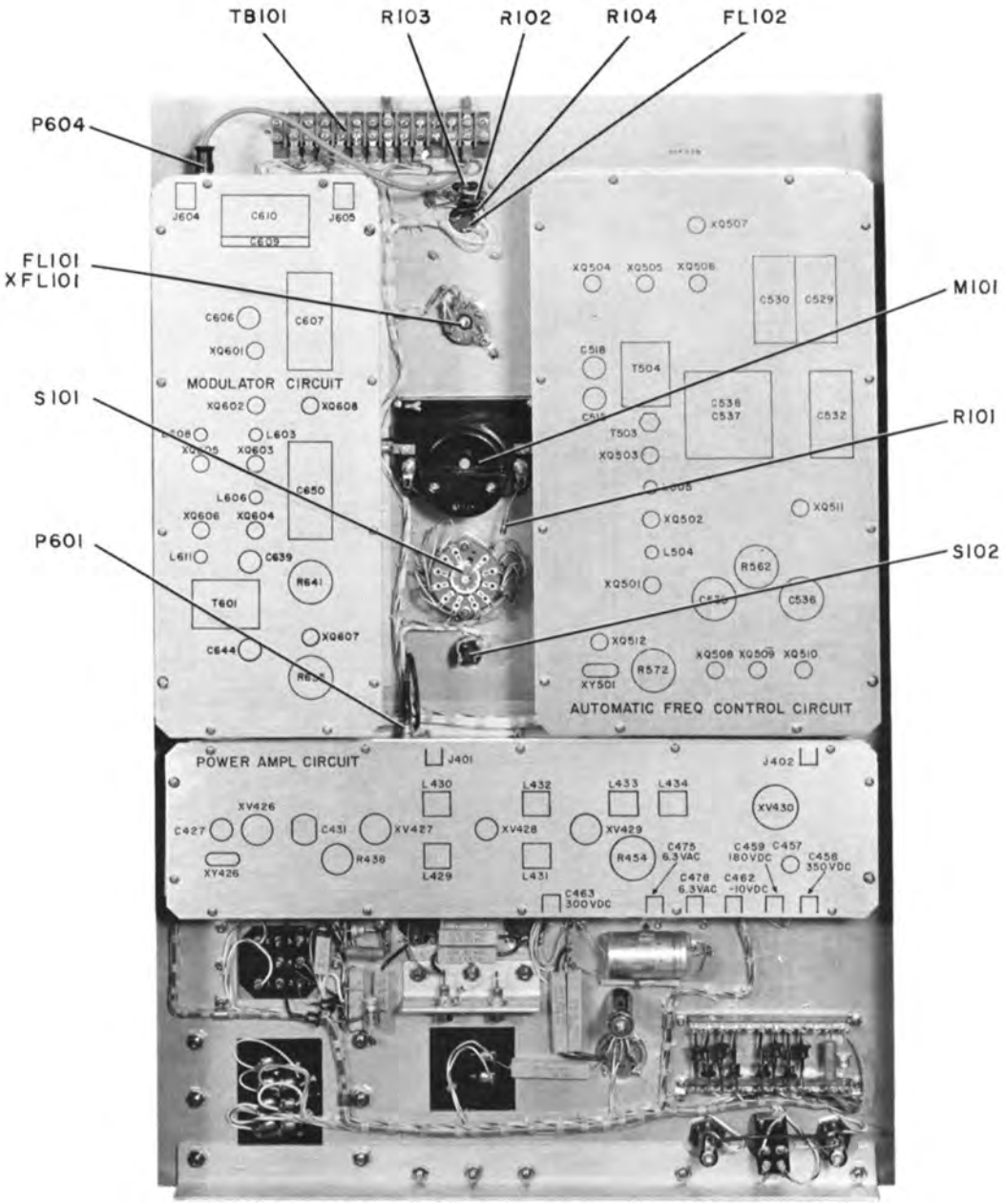


Figure 4-8. Chassis, Component Identification

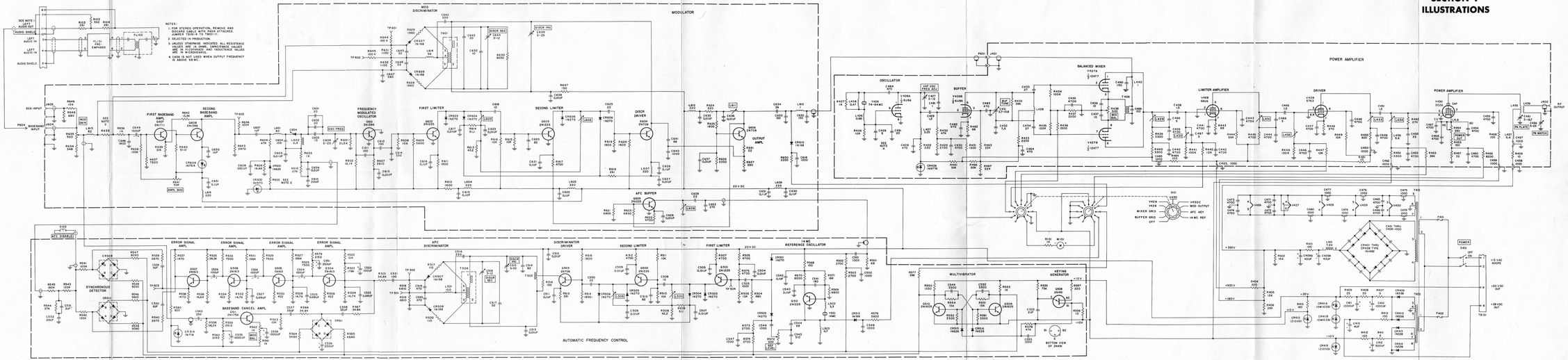


Figure 5-1. A830-2 10 W Wide-Band FM Broadcast Exciter, Schematic Diagram

786M-1
STEREO GENERATOR

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1962

CEDAR RAPIDS, IOWA, U.S.A.

PRINTED IN THE UNITED STATES OF AMERICA

COLLINS

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SECTION I
GENERAL DESCRIPTION

1.1 PURPOSE OF INSTRUCTION BOOK.

Unit Instructions TD-537 provides information about 786M-1 Stereo Generator, Collins part number 522-2914-00. Information which is furnished includes a general description of the equipment, principles of operation, maintenance procedures, and a parts list.

1.2 PURPOSE OF THE EQUIPMENT.

The 786M-1 Stereo Generator is used to convert stereophonic audio input signals into main and stereophonic subchannel signals and to generate a pilot subcarrier. The resultant signal is suitable for modulation of wideband FM broadcast exciters.

1.3 DESCRIPTION OF EQUIPMENT.

1.3.1 PHYSICAL DESCRIPTION.

The 786M-1 Stereo Generator, shown in figure 1-1, is constructed on a standard 19-inch rack-mounted panel. This panel is 19 inches wide, 10-1/2 inches high, 7 inches deep, and weighs approximately 14 pounds. All operating controls are located on the front panel with seldom-used adjustments located inside the back panel. A meter is placed conveniently on the lower left portion of the front panel for monitoring of input and output signals. All transistors and the 38-kc crystal are placed on the front panel for convenient access. Bulky components are grouped in the upper right-hand corner of the front panel leaving the remaining portion of the panel free of obstacles for ease of maintenance and adjustment. All components located in the rear of the unit are protected in a dust-resistant enclosure.

1.3.2 ELECTRICAL DESCRIPTION.

The 786M-1 Stereo Generator is an all transistorized unit consisting of the following circuits; a crystal controlled 38-kilocycle oscillator, a 19-kilocycle locked oscillator, a meter amplifier, two audio amplifiers, and a balanced modulator. All components for operation of the time division stereo generator are

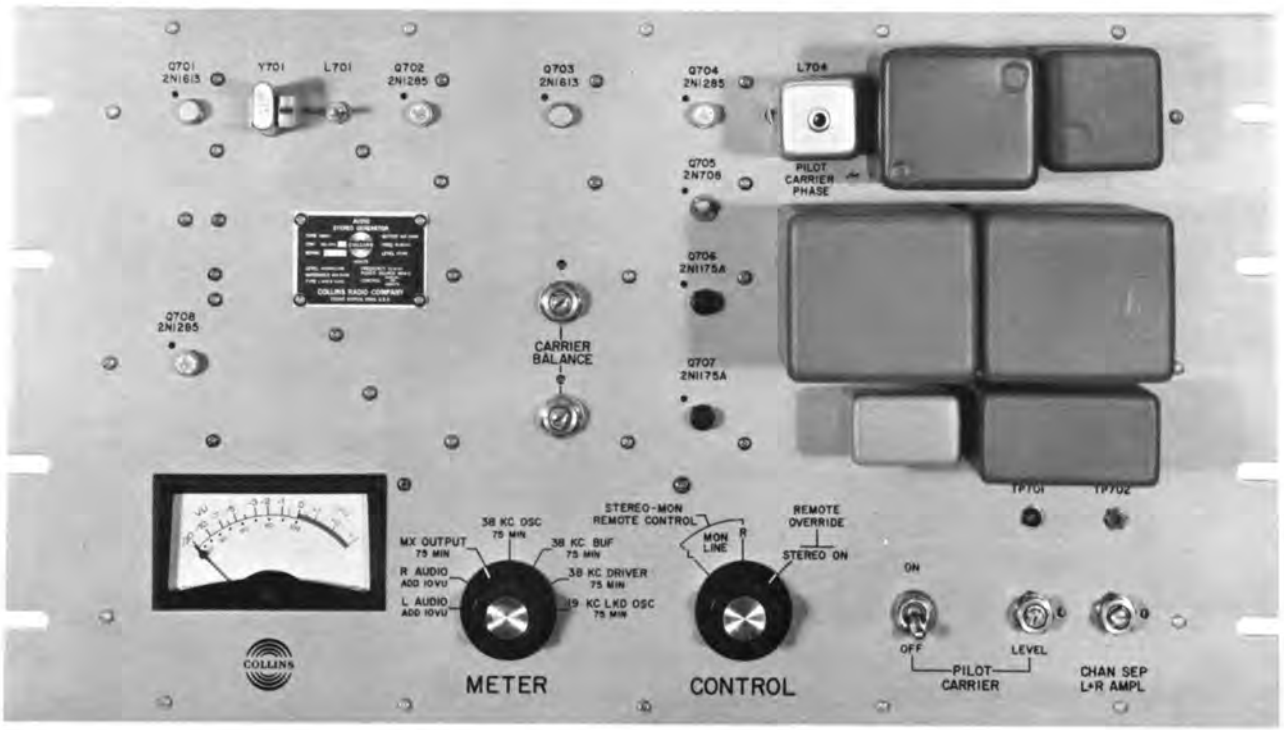


Figure 1-1. 786M-1 Stereo Generator, Over-all View

contained within the 19-inch rack-mounted panel with the exception of a left audio channel pre-emphasis network. This function must be supplied externally and is available in the Collins A830-2 10 W Wide-Band FM Broadcast Exciter.

Power input required is 20 ±0.1 volts d-c which is supplied by the A830-2. Remote control can be exercised over the stereophonic and monophonic modes. Power required for operation of remote control is 28 ±2.8 volts d-c. Instruction books covering the exciter and power amplifiers, used in conjunction with the 786M-1, are listed in table 1-1.

TABLE 1-1
ASSOCIATED EQUIPMENT INSTRUCTION BOOKS

ASSOCIATED EQUIPMENT	INSTRUCTION BOOK PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	TD-536
B830-1 250-Watt FM Power Amplifier	TD-538
D830-1 1000-Watt FM Power Amplifier	TD-567
E830-1 5-Kw FM Power Amplifier	TD-539

1.4 EQUIPMENT SUPPLIED.

Table 1-2 lists equipment that is supplied as part of the 786M-1 Stereo Generator.

TABLE 1-2
EQUIPMENT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
786M-1 Stereo Generator	522-2914-00

1.5 EQUIPMENT REQUIRED BUT NOT SUPPLIED.

Table 1-3 lists equipment that is required for operation of the 786M-1 Stereo Generator but not supplied as part of the 786M-1.

TABLE 1-3
EQUIPMENT REQUIRED BUT NOT SUPPLIED

EQUIPMENT	COLLINS PART NUMBER
A830-2 10 W Wide-Band FM Broadcast Exciter	522-2714-00

1.6 ACCESSORY EQUIPMENT.

Table 1-4 lists accessory equipment that is available for use with 786M-1 Stereo Generator.

TABLE 1-4
ACCESSORY EQUIPMENT

EQUIPMENT	COLLINS PART NUMBER
B830-1 250-Watt FM Power Amplifier	549-2008-00
D830-1 1000-Watt FM Power Amplifier	522-2948-00
E830-1 5-Kw FM Power Amplifier	549-2009-00
250-Watt/1-Kw Harmonic Filter	549-2010-00

1.7 EQUIPMENT SPECIFICATIONS.

1.7.1 MECHANICAL.

Weight	14 pounds approximately.
Size	19 inches wide, 10-1/2 inches high, 7 inches deep.
Ambient temperature range	+15°C (59°F) to 45°C (113°F).
Ambient humidity range	0 to 95% relative humidity.
Altitude	0 to 7500 feet.

1.7.2 ELECTRICAL.

Power source	20 ±0.1 volts d-c.
	28 ±2.8 volts d-c (for remote operation).

Input . . . . . Balanced 600 ohms, left and right channels.

Input level . . . . . 10 ±2 dbm for 100% composite modulation.

Frequency range . . . 30 to 15,000 cps for each channel.

Output level . . . . . 280 ±50 mv peak to peak.

Pilot carrier frequency . . . . . 19 kc ±2 cps.

Pilot carrier level . . Equivalent to 9% ±1% modulation of the main carrier.

Channel separation . . Greater than 30 db, 50 cps to 15,000 cps.

Crosstalk . . . . . More than 40 db below single channel level.

Distortion . . . . . Less than 0.5% over the frequency range of 30 to 15,000 cps.

38-kc subcarrier suppression . . . . . 40 db below output with 10-dbm input level.

Main channel and stereophonic subcarrier phase relationship. . . ±3 degrees for audio frequencies from 50 to 15,000 cps.

Audio-frequency response . . . . . Complies with FCC standard 75-microsecond pre-emphasis curve (right channel only, left channel pre-emphasis is obtained from exciter).

1.8 SEMICONDUCTOR COMPLEMENT.

Table 1-5 lists the semiconductor complement supplied as part of 786M-1 Stereo Generator.

TABLE 1-5. SEMICONDUCTOR COMPLEMENT

SYMBOL	QUANTITY	TYPE	FUNCTION
Q701	1	2N1613	38-kc oscillator
Q702	1	2N1285	38-kc buffer
Q703	1	2N1613	38-kc driver
Q704	1	2N1285	38-kc isolation amplifier
Q705	1	2N708	19-kc locked oscillator
Q706	1	2N1175A	Left audio amplifier
Q707	1	2N1175A	Right audio amplifier
Q708	1	2N1285	Meter amplifier
CR702	4	1N270	Balanced modulator diode switches

SECTION II
PRINCIPLES OF OPERATION

2.1 GENERAL.

The 786M-1 Stereo Generator provides facilities for the conversion of stereophonic input signals to an output which conforms to the standards approved by the FCC for the transmission of stereophonic signals. The following paragraphs discuss stereophonic principles and the operation of the 786M-1 Stereo Generator.

2.2 PRINCIPLES OF FM STEREO.

2.2.1 STEREOPHONIC SOUND SYSTEMS.

An elementary stereophonic sound system consists of two directional microphones placed to the right and left of a sound source. See figure 2-1. Each microphone in turn is connected to an amplifier and speaker system. When the listener is situated between the speakers, the left channel will be received by the left ear and the right channel will be received by the right ear. The effect upon the listener of such a system is to simulate placing the listener at a point midway between the two microphones and receiving a true representation of the originating sound source.

To provide a realistic stereo effect, the difference in time delay and signal amplitude from the sound source to each of the microphones must be maintained through the entire stereo system. If the time delay or amplitude difference is changed in one of the amplifier or speaker systems, the effect to the listener will be a change in direction of the sound source, when in reality no change has occurred. A change in time delay of the left or right channel is referred to as a phase relationship change. This phase relationship between the channels must be held, in stereo transmitting equipment, to within ±3 degrees.

If the amplitude difference and time delay in each system is identical (as when the sound source is centered between the microphones), the sound source will

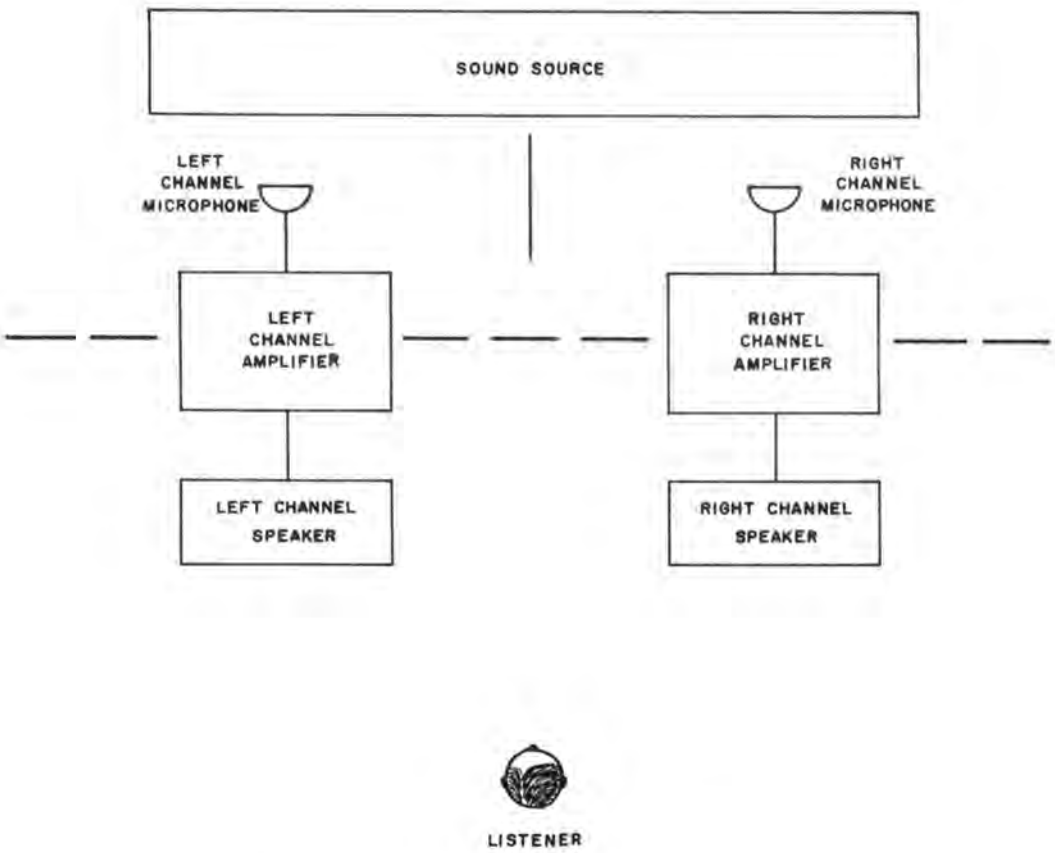


Figure 2-1. Elementary Stereophonic System

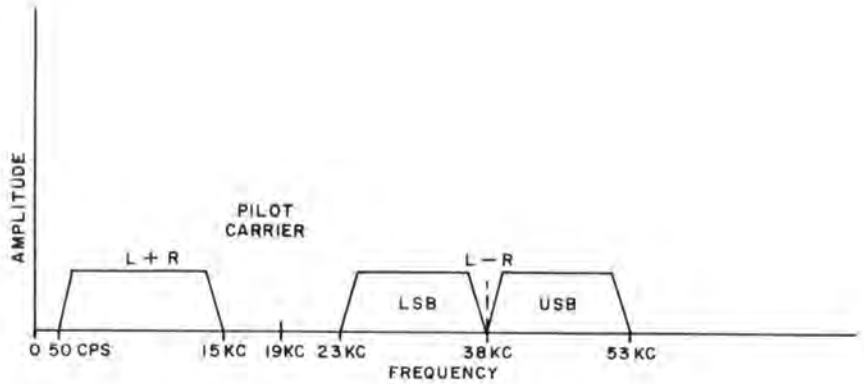


Figure 2-2. Spectrum of Signals in Baseband Audio

appear to the listener to be centered between the speakers. This is actually the true relationship of the microphones and the sound source.

To enhance the stereo effect to the listener, it is desirable for each microphone to be directional, as stated previously, so that sounds originating directly in front of the right microphone will be received by the right microphone, and as little as possible by the left microphone, and vice versa. If too much of the right sound source is picked up by the left microphone or vice versa, the effect to the listener will be to move the sound source to the center. This isolation between the two sound systems is known as channel separation and must be held greater than 29.7 db in stereo transmitting equipment.

If proper isolation of the amplifiers is not obtained, and there is an interchange of signals, the sound source will again appear to move toward the center. If the channel separation is reduced to zero, the effect would be to replace the two microphones with a single microphone feeding the same information to both amplifier and speaker systems. It is then understood that monophonic operation can be obtained by paralleling (adding) the left and right microphone outputs. This monophonic component is referred to as L+R.

An interchange of information between channels (main and subchannel) is referred to as crosstalk. Crosstalk will deteriorate the stereo signals by adding noise to the signal. In stereo transmitting systems, crosstalk must remain at least 40 db below a single channel level.

2.2.2 METHODS OF GENERATING FCC STEREO.

Signals which are prescribed by the FCC for the transmission of stereophonic intelligence is shown in figure 2-2. This band of frequencies must be generated and transmitted in order that both monaural and stereophonic receivers will be able to detect the FM signal. For monaural receivers, only the L+R (left plus right) channel is received, with the pilot carrier and L-R (left minus right) signals rejected by the pass band of the monaural receiver. Stereophonic FM receivers detect the complete band of frequencies in a discriminator and will process the signals into left and right stereophonic channels. The 19-kc pilot carrier is used in this process. The method of generating the signals shown in figure 2-2 depends upon the method chosen for modulating an FM signal.

The methods of modulating an FM signal may be broken down into two groups, a direct and an indirect method. These two general categories may be broken down further into various methods of obtaining the end result. Phase modulation is the most generally used method of generating an FM signal by the indirect method. If this system is used to modulate the composite stereo signal, various problems are encountered. The most serious problem is that of frequency response of the phase modulator. As the phase modulator audio response exhibits nonlinear modulation characteristics (rises 6 db per octave from the lowest to the highest frequency), predistortion is employed to compensate for this trait. In a stereo FM modulator this predistortion would amount to 65.5 db over the entire modulating frequency range of 50 cps to 75 kc (SCA added to stereo signal). When a 65-db signal to noise ratio and a 60-db dynamic range is added to this, it is apparent that baseband amplifiers cannot be built to give this characteristic.

It is possible to split the phase modulation into two steps and modulate one phase modulator with the L+R signal and the second phase modulator with the L-R and pilot carrier signals. This type of stereophonic phase modulation is not desirable because of the required phase linearity of ±3 degrees and the gain requirements of stereophonic transmission systems. These requirements are difficult, if not impossible, to maintain.

Another method of FM stereophonic modulation which could be employed is a combination of direct and indirect modulation. With this method the L+R signal directly FM modulates an oscillator, while the L-R signal phase modulates the signal produced in the oscillator, in a later stage. As in phase modulation of the stereophonic signal, it is difficult to maintain phase linearity and gain characteristics.

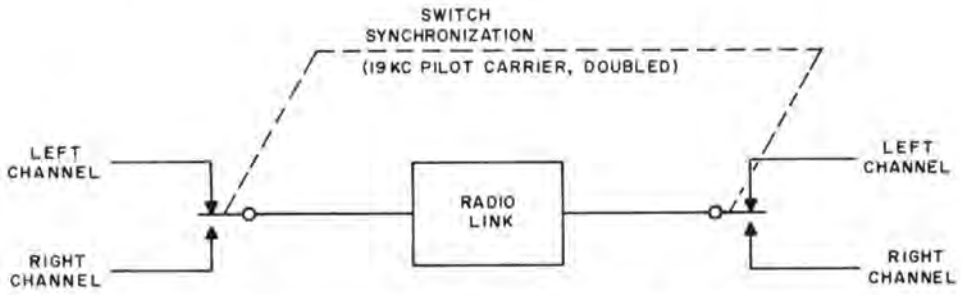


Figure 2-3. An Elementary Time Division Multiplex System

A third method of generating a stereophonic FM signal is by the use of direct modulation over the entire stereophonic generator frequency range. Phase relationship and gain characteristics are then easy to maintain because of the point input source. Until recently, it has been difficult to directly modulate an FM signal with a wide bandwidth of signals. With the advent of solid state components and specifically the production of the variable capacity diode, this wide-band type of modulation is possible. This is the type of modulation used in the Collins A830-2 10 W Wide-Band FM Broadcast Exciter. The development of the wide-band type of modulator made possible the development of 786M-1 Stereo Generator which is discussed in paragraph 2.3.

2.3 PRINCIPLES OF OPERATION OF 786M-1.

The 786M-1 Stereo Generator generates the spectrum of signals shown in figure 2-2 by the time division multiplex method. By this method, shown simplified in figure 2-3, the left and the right channels are switched alternately at a 38-kc rate. If the receiver switching rate is synchronized with the transmitter switching rate, the original left and right audio signals will be detected. In the receiver, the 19-kc pilot carrier is doubled to synchronize the receiver to the transmitter. It is important that the switching frequency in both the stereo generator and the receiver be of the same phase to retain the identity of the left and right audio signals.

The mathematical analysis of two audio signals being switched alternately by a square wave shows that the resultant signal is made up of two components. One component is directly proportional to the sum of the two audio signals (L+R) and the other is a double-sideband (DSB) signal centered on a frequency equal to the switching frequency (38 kc). The modulation appearing on this DSB signal is directly proportional to the difference of the two audio channels (L-R). If L is defined as the audio signal in the left channel, R is defined as the audio signal in the right channel, and ω_c is defined as the switching frequency, the composite signal is equal to:

$$\frac{L+R}{2} + \frac{2}{\pi} (L-R) \cos\omega_c t$$

The following is a block diagram explanation of the 786M-1 Stereo Generator which generates the signals just mentioned. Refer to figure 2-4. It is noted on the block diagram that the left audio channel is fed through the pre-emphasis network and high-pass filter of the A830-2 wide-band exciter and then to the 786M-1.

The right audio channel utilizes the pre-emphasis network and the high-pass filter located in the 786M-1. The outputs of the high-pass filters are fed through 15-kc low-pass filters where audio components above 15 kc are attenuated sharply. The 15-kc filter outputs are then fed to emitter follower amplifiers where isolation of the two channels from the balanced modulator is obtained. The two-channel audio output is then fed to a balanced modulator whose action resembled that of a switch. The balanced modulator utilizes the signal generated in the 38-kc oscillator to alternately switch on and off each audio channel. The output of the balanced modulator consists of an L+R component and an L-R DSB component. The fundamental 38-kc modulating signal and all even order harmonics are balanced out.

The balanced modulator output is mixed with a small amount of direct L+R signal (correction factor) and is fed through a 50-cps to 53-kc low-pass linear phase filter where all odd order harmonics above 53 kc are attenuated. The filter output is mixed with a 19-kc signal from the pilot carrier phase locked oscillator and is fed to the 786M-1 output. All FCC phasing, channel separation, crosstalk, and amplitude specifications are satisfied within the 786M-1 Stereo Generator.

2.3.1 DETAILED DESCRIPTION OF 786M-1 STEREO GENERATOR.

Refer to figure 5-1, a schematic diagram of the 786M-1. The right audio channel is identical to the left audio channel except that the pre-emphasis network and the 15-kc filter for the left channel are located within the A830-2 exciter. Only the right channel is discussed in the following paragraphs.

The 600-ohm balanced right audio channel is fed into a pre-emphasis network, FL701. Due to the inherently low level of high-frequency audio components in program material, pre-emphasis is employed to overcome the effects of noise which is often found in home receivers. The 786M-1 follows the standard

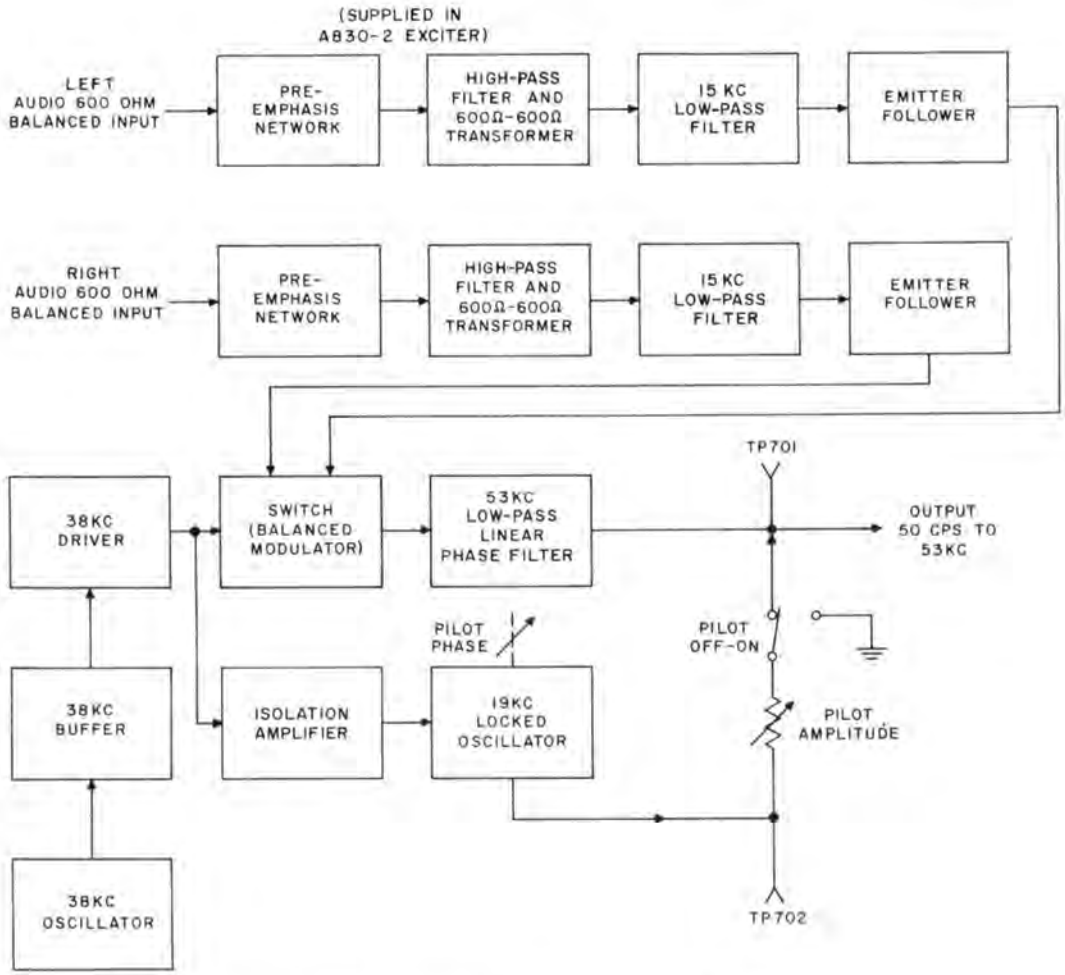


Figure 2-4. 786M-1 Stereo Generator, Block Diagram

75-microsecond pre-emphasis curve established by the FCC. The output of pre-emphasis filter FL701 is fed into a 30-cps high-pass filter, FL702, which sharply attenuates audio components below 30 cps. This is necessary to prevent 5-cps audio components from interfering with the 5-cps sampling circuits within the A830-2 exciter. Filter FL702 also transforms the 600-ohm balanced input into a 600-ohm single-ended output.

The output of FL702 is connected to relay K701 which remotely selects either the stereo mode for transmission, or the left or right audio channels for monaural operation. Relay K701 operates by applying 28 volts d-c across the solenoid. This 28-volt d-c source is supplied by the A830-2 exciter. Selection of either the left or right monaural channel is determined by the position of S701. At this point, if either the left or right channel is selected for monaural operation, the single 50-cps to 15-kc audio signal is fed through an 8-db loss pad to the output of the 786M-1 Stereo Generator. The 8-db loss pad is made up of R750, R751, and R752. The resulting audio input to the A830-2 is the same as that obtained without the stereo generator. Switch S701 will also override the remote relay if desired.

If the stereo mode is selected by S701, the audio component is fed to a 15-kc low-pass filter, FL704. FL704 attenuates all frequencies over 15 kc to prevent their interfering with adjacent channels. The output of FL704 is fed to the base of emitter follower Q707, which isolates the audio circuits from the balanced modulator.

The function of the balanced modulator is to generate the L+R and the L-R components shown in figure 2-2. The balanced modulator resembles a switch which samples the left audio channel and the right audio channel in turn. The 38-kc switching frequency and all even order harmonics are balanced out in the modulator output. The 38-kc switching frequency is obtained from the 38-kc driver and is impressed across transformer T701. If the primary switching voltage is negative, the secondary voltage will switch on diodes CR703 and CR704. Thus, right audio will appear at the secondary center tap. If the primary switching voltage is positive, the secondary voltage will switch

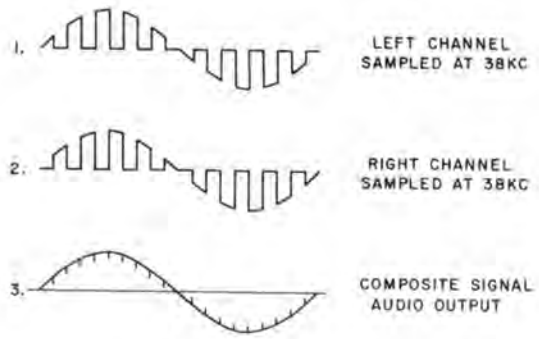


Figure 2-5. Balanced Modulator Output When L+R=2, L-R=0

on diodes CR702 and CR705. The left audio channel will then appear on the secondary of T701. A representation of a sine wave input in each channel (L=R, L+R=2, L-R=0) switched in this manner is shown in figure 2-5. It is seen in this illustration that the composite signal at the output of the balanced modulator is a sine wave of an amplitude equal to the original signal level in each channel. The spikes shown on the composite sine wave result from imperfect switching and are filtered out in FL705.

Figure 2-6 shows the balanced modulator output when R=0, L+R=1, and L-R=1. The output of the balanced modulator is an audio component plus DSB components centered on the switching frequency and odd harmonics which form the square wave shape. When the odd harmonics are filtered out by the 53-kc harmonic filter, FL705, the third waveform results. Because the fundamental component of a square wave is $\frac{4}{\pi}$ times the square wave amplitude, the DSB component is larger than the audio. The audio component is then increased by $\frac{4}{\pi}$ and the fourth illustration results. The audio component is added by resistors R724 and R730 which leak a small portion of L+R directly around the balanced modulator. Potentiometer R755 adjusts the audio component so the $\frac{4}{\pi}$ loss in filtering is exactly compensated.

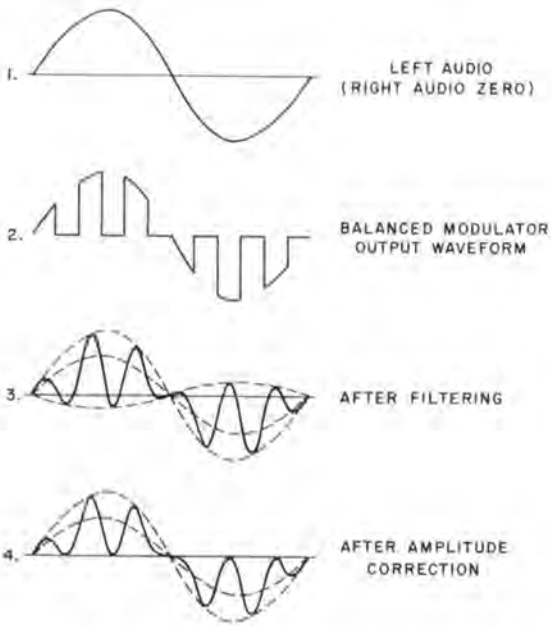


Figure 2-6. Balanced Modulator Output When L+R=1 and L-R=1

Figure 2-7 shows the time division signal when L=-R, or L+R=0, L-R=2. The composite waveform from the balanced modulator is shown in the third illustration. This waveform is composed of audio components and odd harmonics centered on the switching frequency. When the odd harmonics are removed by filtering in FL705, the waveshape in the fourth illustration results. This waveshape is a DSB signal which equals L-R as required by the matrix process.

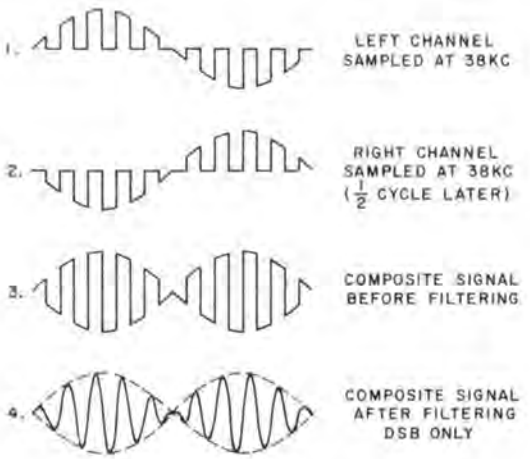


Figure 2-7. Balanced Modulator Output When L+R=0 and L-R=2

The output of the balanced modulator and L+R mixing is fed to a low-pass 53-kc filter, FL705. Filter FL705 removes all harmonics and noise above 53 kc to form the DSB waveshape as shown in figures 2-6 and 2-7. The output from FL705 is mixed with a 19-kc pilot carrier and fed to the stereo override switch, S701, and the remote relay, K701. Operation at this point is similar to audio switching which was discussed earlier. If relay K701 is energized and S701 is in the STEREO ON position, the composite stereo is fed to J701 for connection to the A830-2 10 W Wide-Band FM Exciter.

The balanced modulator switching frequency is obtained from crystal-controlled oscillator Q701. Oscillations are sustained by taking the output of L701 and feeding it into the base of Q701. The 38-kc output of L701 is also capacitively coupled into the 38-kc buffer amplifier, Q702. The output of Q702 is tuned to 38 kc by C714 and L702. The output of buffer amplifier Q702 is further amplified to approximately 4 volts peak to peak by driver amplifier Q703. The gains of Q701,

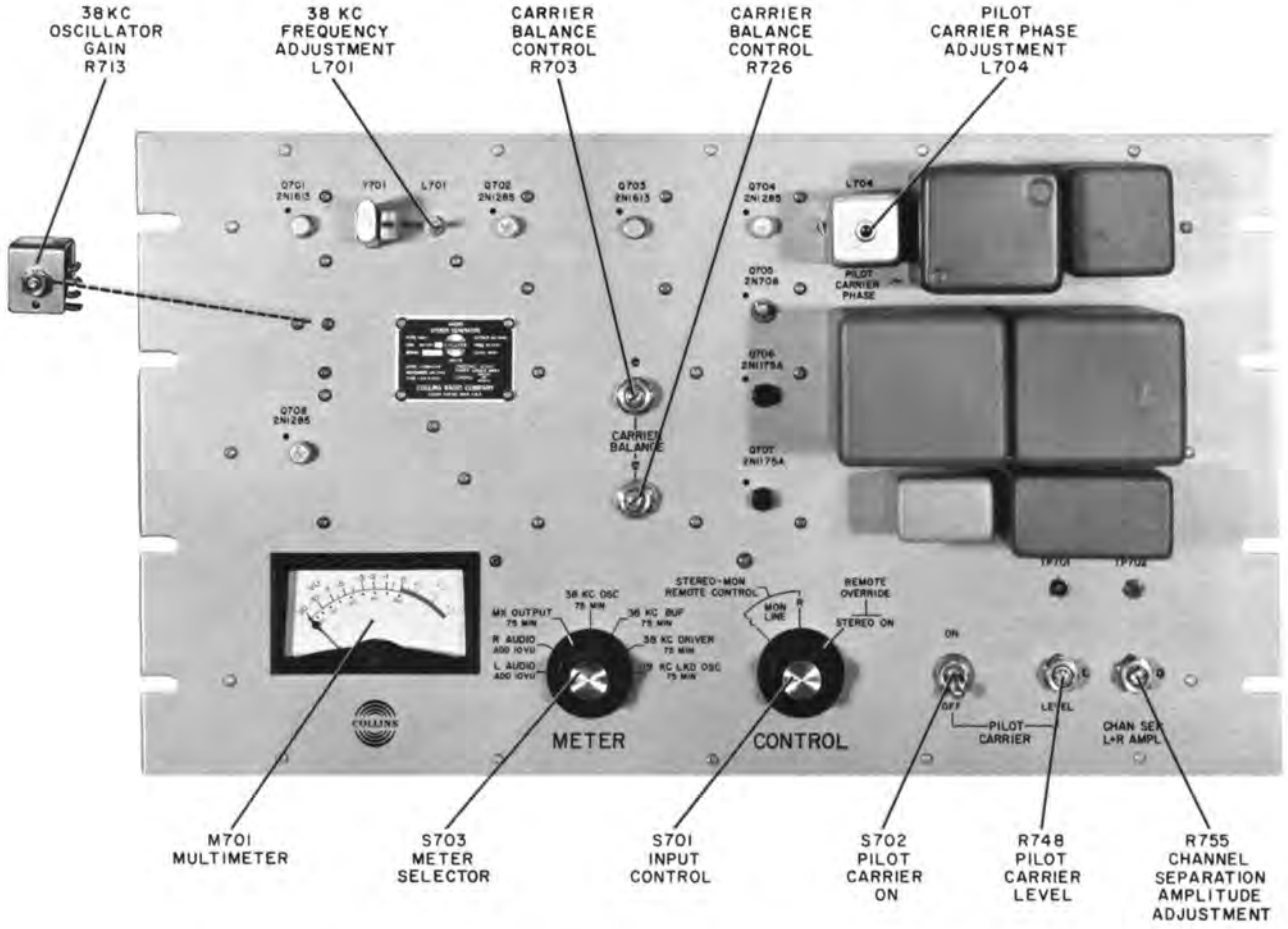


Figure 2-8. 786M-1 Control and Adjustment Locations

Q702, and Q703 are stabilized by emitter degeneration to reduce gain variations between transistors. The output of Q703 is capacitively coupled to the primary of T701 (balanced modulator switching transformer) and to the 19-kc pilot carrier locked oscillator through an isolation stage, Q704.

The pilot carrier oscillator, Q704, is basically a grounded base oscillator which is synchronized by injecting a 38-kc signal into the base. The oscillator output is a 19-kc resonant tank placed across the base to emitter junction by means of a capacity voltage divider. The 19-kc output is taken from the emitter circuit and is injected into the output of FL705. The pilot carrier phase, which must be maintained in phase with the output of FL705, is adjusted by varying the inductance of L704. Pilot carrier level is adjusted with R748.

Metering circuits are provided within the 786M-1 to assist in trouble shooting. Meter amplifier Q705 provides isolation of the matrixing and oscillator circuits from the metering circuits. The right audio and left audio channels are fed directly from the 600-ohm balanced input through meter multiplying resistors R711 and R710 to meter M701.

2.3.2 CONTROL FUNCTIONS.

The following paragraphs describe the functions of all controls in the 786M-1 Stereo Generator. Refer to figure 2-8 for control locations.

Meter selector S703 connects meter M701 into various circuits for monitoring purposes. The metering positions are as follows; L AUDIO (left audio), R AUDIO (right audio), MX OUTPUT (multiplex output), 38 KC OSC (38-kc oscillator), 38 KC BUF (38-kc buffer amplifier), 38 KC DRIVER, and 19 KC LKD OSC (19-kc locked oscillator output).

Audio input switch S701 selects one of three possible audio inputs; left audio, right audio, and stereo. If switch S701 is placed in the left audio or right audio positions, remote relay K701 is able to provide remote control over the monaural or stereo modes. When S701 is in the stereo mode, relay K701 is disabled and has no effect on stereo generator inputs.

CARRIER BALANCE controls R703 and R726 balance out the 38-kc carrier and 76-kc second harmonic in the secondary of T701. These controls are adjusted

for zero indication at TP701 with no audio in either channel.

Channel separation L+R amplitude control (CHAN SEP L+R AMPL) R755 adjusts the amount of L+R fed around the balanced modulator to raise the L+R level by $\frac{4}{\pi}$.

Inductor L701 adjusts the frequency of the 38-kc oscillator. Resistor R713 adjusts the level of the 38-kc driver output into the balanced modulator. This level is set for 6 volts peak to peak at TP701 at the factory and should never need readjustment.

PILOT CARRIER PHASE control L704 adjusts the phase of the 19-kc pilot carrier. The control is set for an in-phase condition with relation to the output of FL705. PILOT CARRIER LEVEL control R748 adjusts the level of the 19-kc pilot carrier. This control is set for 0.009 volt rms at TP701. PILOT CARRIER switch S702 turns the 19-kc pilot carrier off and on for adjustment and testing purposes.

SECTION III
MAINTENANCE

3.1 GENERAL.

This section contains information concerning the maintenance of the 786M-1 Stereo Generator.

NOTE

As some transistor cases are electrically above ground, do not short transistor cases to ground or damage to the transistor may result. Always replace transistors with the transistor locating mark placed adjacent to the transistor socket.

3.2 SERVICING TRANSISTOR CIRCUITS.

Servicing procedures and test equipments that have been used in the past with other types of electronic equipment, for the most part, may be used with transistor circuits. Some special precautions which must be used are listed below.

3.2.1 TEST EQUIPMENT.

Damage to transistors by test equipment is usually the result of accidentally applying too much voltage to the transistor elements. Common causes of damage from test equipment are as follows:

a. Test equipment with a transformerless power supply is one source of such voltage. This type of test equipment can be used by employing an isolation transformer in the power line.

b. It is still possible to damage transistors from line voltage even though the test equipment has a power transformer in the power supply, if the test equipment is equipped with a line filter. This filter may act like a voltage divider and apply 55 volts a-c to the transistor. To eliminate trouble from this situation, connect a ground wire from the chassis of the test equipment to the chassis of the equipment under test before making any other connections.

c. Another cause of transistor damage is a multimeter that requires excessive current for adequate indications. Multimeters that have sensitivities of less than 5000 ohms per volt should not be used. A multimeter with lower sensitivity will draw too much current through many types of transistors and damage them. Use of 20,000-ohm-per-volt meters or vacuum-tube volt meters is recommended. Check the ohmmeter circuits (even those in vtvm's) on all scales with an external, low-resistance milliammeter in series with the ohmmeter leads. If the ohmmeter draws more than one milliampere on any range, this range cannot be used safely on small transistors.

3.2.2 ELECTRIC SOLDERING IRONS.

The following are possible causes of transistor damage from soldering irons:

a. Electric soldering irons may damage transistors through leakage current. To check a soldering iron for leakage current, connect an a-c volt meter between the tip of the iron and a ground connection, allow the iron to heat, the check for a-c voltage with the meter. Reverse the plug in the a-c receptacle and again check for voltage. If there is any indication on the meter, isolate the iron from the a-c line with a transformer. The iron may be used without the isolation transformer if the iron is plugged in and brought to temperature then unplugged for the soldering operation. It is also possible to use a ground wire between the tip of the iron and the chassis of the equipment being repaired to prevent damage from leakage current.

b. Light-duty soldering irons of 20 to 25 watts capacity are adequate for transistor work and should be used. If it is necessary to use a heavier duty iron, wrap a piece of number 10 copper wire around the tip of the iron and make it extend beyond the tip of the iron. Tin the end of the piece of copper wire and use it as the soldering tip.

3.2.3 SERVICING PRACTICES.

a. If a transistor is to be evaluated in an external test circuit, be sure that no more voltage is applied to the transistor than normally is used in the circuit from which it came.

b. Test prods should be clean and sharp. Because many of the resistors used in transistorized equipments have low values, any additional resistance produced by a dirty test prod will make a good resistor appear to be out of tolerance.

3.2.4 TROUBLE SHOOTING.

The usual trouble-shooting practices apply to transistors. Be sure the test equipment and tools meet the requirements outlined in the above paragraphs. It is recommended that transistor testers be used to evaluate the transistor.

If a transistor tester is not available, a good ohmmeter may be used for testing. Be sure the ohmmeter meets the requirements as set forth in the paragraph on test equipment, above. To check a PNP transistor, connect the positive lead of the ohmmeter to base and the negative lead to the emitter. (The red lead is not necessarily the positive lead on all ohmmeters.) Generally, a resistance reading of 50,000 ohms or more should be obtained. Connect the negative lead to the collector; again a reading of 50,000 ohms or more should be obtained. Reconnect the circuit with the negative lead of the ohmmeter to the base. With the positive lead connected to the emitter, a value of resistance in the order of 500 ohms or less should be obtained. Likewise, with the positive lead connected to the collector, a value of 500 ohms or less should be obtained.

Similar tests made on an NPN transistor produces results as follows: With the negative ohmmeter lead connected to the base, the value of resistance between the base and the emitter and between the base and the collector should be high. With the positive lead of the ohmmeter connected to the base, the value of resistance between the base and the emitter and between the base and collector should be low. If the readings do not check out as indicated, the transistor probably is defective and should be replaced.

CAUTION

If a defective transistor is found, make sure that the circuit is in good operating order before inserting the replacement transistor.

Make sure that the value of the bias resistors in series with the various transistor elements are as shown on the schematic diagram. The transistor is very sensitive to improper bias voltages; therefore, a short or open circuit in the bias resistors may damage the transistor. For this reason, do not trouble-shoot by shorting various points in the circuit to ground and listening for clicks.

3.3 TROUBLE SHOOTING.

Trouble shooting can best be accomplished by using standard trouble-shooting techniques. Suspected troubles should be isolated to individual stages before components are replaced. The pilot carrier can be turned off with switch S702 as an aid in trouble shooting and testing.

3.4 ADJUSTMENTS AND TESTS.

The 786M-1 is fitted with adjustments which adjust 38-kc oscillator tuning, carrier balance, pilot carrier level, and pilot carrier phase.

NOTE

Do not attempt the following adjustments without using the proper test equipment as serious deterioration of the 786M-1 output quality may result from the use of inferior test equipment.

The test equipments or their equivalents required to perform the specified tests are listed in table 3-1.

TABLE 3-1
TEST EQUIPMENT REQUIRED

EQUIPMENT	MANUFACTURER AND TYPE
Oscilloscope	Tektronix Model 545A with Type 53/54C plug-in unit and a Type D plug-in unit
Oscillator	Hewlett-Packard Model 200AB
Distortion and noise meter	Hewlett-Packard Model 330D
Vtvm	Hewlett-Packard Model 400H

Figure 3-1 is a standard transistor base, viewed from the bottom, which provides a transistor element reference.

3.4.1 38-KC OSCILLATOR TUNING.

Turn on the A830-2 10 W Wide-Band FM Exciter. Connect an a-c vtvm to the collector of Q702. (See figure 3-1.) Adjust L701 for a maximum indication on the vtvm. The oscillator output at the collector of Q702 should be approximately 1.5 volts.

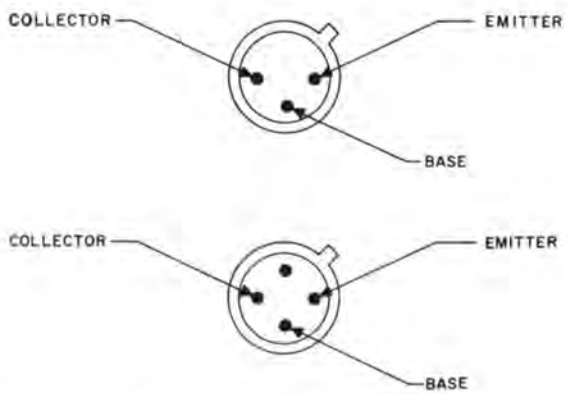


Figure 3-1. Transistor Base Configuration

3.4.2 38-KC AMPLITUDE CHECK.

Connect a calibrated Tektronix oscilloscope, provided with a Type D plug-in unit, across terminals 1 and 2 of T701. The voltage at this point should be 6 volts peak to peak as read on the oscilloscope.

3.4.3 CARRIER BALANCE.

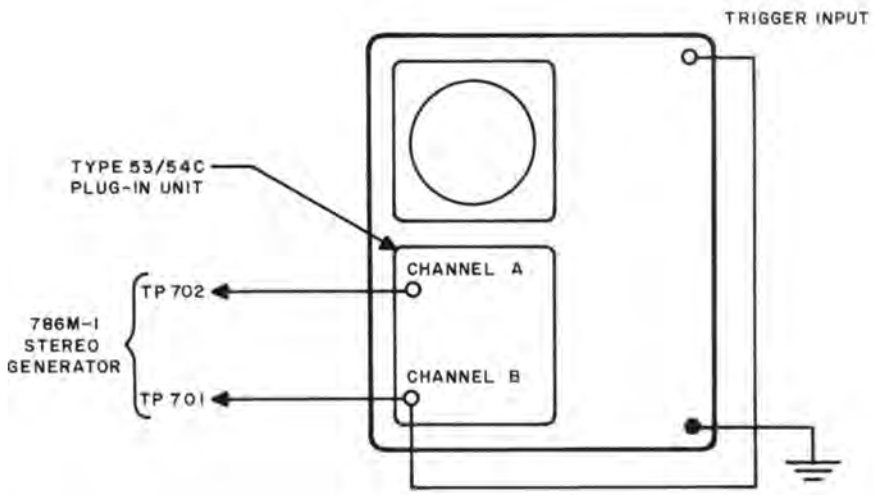
Turn the PILOT CARRIER switch to OFF. Remove any audio from the left and right audio channels. Connect the Tektronix oscilloscope with the Type D plug-in unit to TP702 and ground. Adjust in turn R703 and R726 in small steps for a minimum indication on the oscilloscope. The final indication on the oscilloscope must be more than 40 db below 100 millivolts (1 millivolt).

3.4.4 PILOT CARRIER PHASE.

Connect the Tektronix oscilloscope to the 786M-1 Stereo Generator as shown in figure 3-2. Connect the audio oscillator into the 786M-1 through 10-db pads to give an L= -R signal (right audio channel 180 degrees out of phase with the left audio channel) into the audio input terminals at a frequency of 1000 cps and a level of 7.8 volts rms. Set the PILOT CARRIER switch to OFF. Switch the CONTROL switch to STEREO ON. Adjust the PILOT CARRIER PHASE control until both traces on the oscilloscope are stationary and an exact coincidence of the zero crossings of the 19-kc pilot carrier and the L-R signal is obtained as shown in figure 3-3. Expand the sweep to 5X, and adjust the horizontal position knob to check the two points of coincident zero crossing.

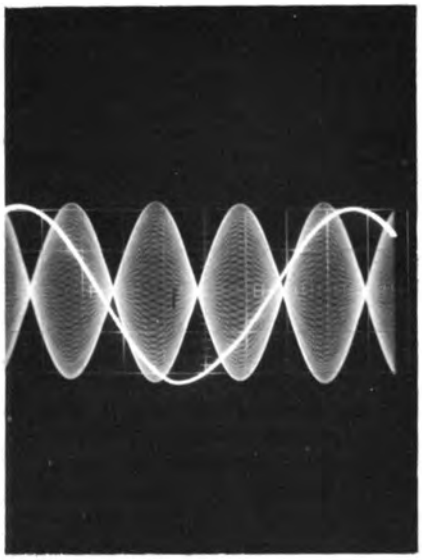
3.4.5 PILOT CARRIER LEVEL.

Remove any audio from the 786M-1 audio input channels and connect a vtvm to TP702. Set the PILOT CARRIER switch to ON, and adjust the PILOT CARRIER LEVEL control for a reading of 0.009 volt rms as read on the vtvm.

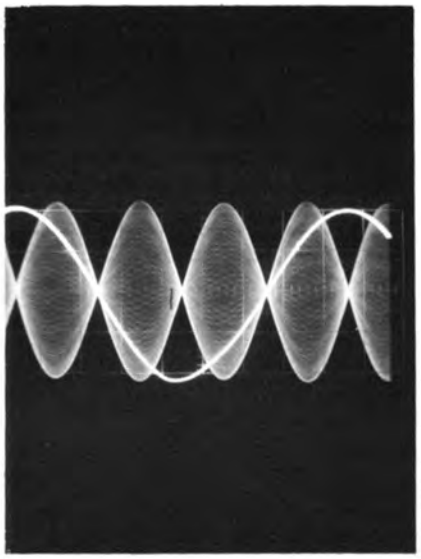


CONTROL SETTINGS	
1. CHANNEL A	0.05 V/CM, TP702
2. CHANNEL B	0.05 V/CM, TP701
3. MODE - ALTERNATE	
4. TRIGGERING MODE — AUTOMATIC TRIGGER SLOPE - + EXTERNAL	
5. SWEEP TIME/CM 5 USEC	
6. MAGNIFIER	X1, X5

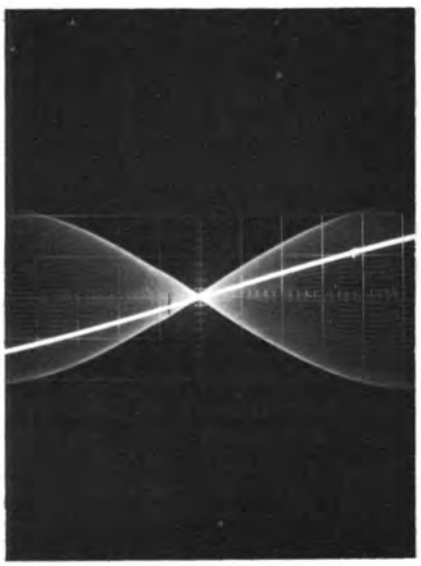
Figure 3-2. Pilot Carrier Phase Test Setup



MALADJUSTMENT OF PILOT CARRIER PHASE CONTROL.



PROPER ADJUSTMENT OF PILOT CARRIER PHASE CONTROL.



PROPER ADJUSTMENT OF PILOT CARRIER PHASE CONTROL, EXPANDED HORIZONTAL DEFLECTION.

Figure 3-3. Pilot Carrier Phase Adjustment, Oscilloscope Pattern

3.4.6 CHANNEL SEPARATION ADJUSTMENT.

Set the audio oscillator to 5000 cps, and connect it to the left audio input of the 786M-1. Connect the Tektronix oscilloscope with the type D plug-in unit to TP702 and ground, and adjust the audio oscillator for a 300-millivolt peak-to-peak indication on the oscilloscope. Adjust the CHAN SEP L+R AMPL control to produce a straight zero axis (within 4 millivolts) as shown in figure 3-4. Repeat with the audio input into the right audio channel. The final adjustment must bring the zero axis to within 4 millivolts of a straight zero axis.

3.5 MINIMUM PERFORMANCE STANDARDS.

3.5.1 OVER-ALL GAIN.

a. Connect the Tektronix oscilloscope to TP702 and ground.

b. Switch the PILOT CARRIER switch to OFF.

c. Connect the audio oscillator through 10-db pads to the 786M-1 in such a way to obtain an L=R signal (left channel equal in amplitude and phase with right channel).

d. Adjust the audio oscillator frequency to 1000 cps, and adjust the audio oscillator output to obtain 0 VU on the 786M-1 VU meter when the METER switch is set to L AUDIO or R AUDIO. The peak-to-peak indication on the oscilloscope shall be from 200 to 300 millivolts.

e. Connect the audio input so L= R- (right channel equal in amplitude but 180 degrees out of phase with the left channel). The peak-to-peak indication shall be from 200 to 300 millivolts.

3.5.2 FREQUENCY RESPONSE.

a. Connect the distortion analyzer between TP702 and ground.

b. Switch the PILOT CARRIER switch to OFF.

c. Connect the audio oscillator through 10-db pads to each channel in such a way to obtain an L=R signal (left channel equal in amplitude and in phase with right channel).

d. Adjust the audio oscillator frequency to 1000 cps, and adjust the audio oscillator output to obtain 0 VU on the 786M-1 VU meter when the METER switch is set to L AUDIO. Set the distortion analyzer to 0 db.

e. Set the audio oscillator to 50 cps, and adjust the audio level from the audio oscillator for 0 VU on the 786M-1 VU meter. The indication on the distortion analyzer shall be within ±0.5 db of the level at 1000 cps.

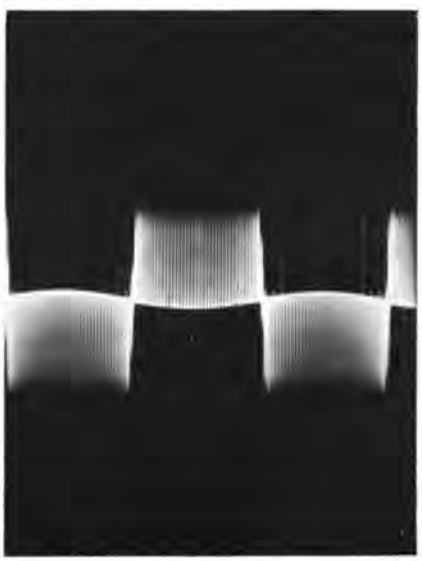
f. Repeat step e at 15,000 cps. The indication on the distortion analyzer shall be within ±1.5 db of the level at 1000 cps.

g. Repeat steps d, e, and f with the METER switch set at R AUDIO.

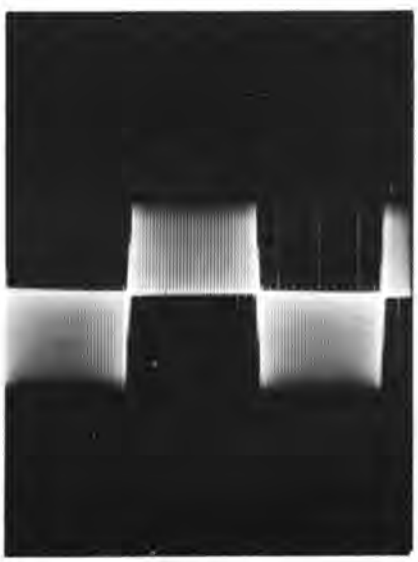
3.5.3 HARMONIC DISTORTION.

a. Connect the test setup as described in paragraph 3.5.2, steps a, b, and c.

b. The distortion at 50, 1000, and 15,000 cps should be not more than one percent.



MALADJUSTMENT OF CHANNEL SEPARATION L AND R AMPL CONTROL.



PROPER ADJUSTMENT OF CHANNEL SEPARATION L AND R AMPL CONTROL.

Figure 3-4. Channel Separation Adjustment, Oscilloscope Pattern

SECTION IV
PARTS LIST

ITEM	DESCRIPTION	COLLINS PART NUMBER
	786M-1 STEREO GENERATOR	522-2914-00
C701	CAPACITOR, FIXED, ELECTROLYTIC: 30 uf -10% +100%, 10 vdcw	183-1377-00
C702	CAPACITOR, FIXED, ELECTROLYTIC: 50 uf -10% +100%, 25 vdcw	183-1379-00
C703	CAPACITOR, FIXED, ELECTROLYTIC: same as C701	183-1377-00
C704	CAPACITOR, FIXED, ELECTROLYTIC: same as C702	183-1379-00
C705	CAPACITOR, FIXED, ELECTROLYTIC: 250 uf -10% +100%, 12 vdcw; Sprague Electric part no. 30D157A1	183-1190-00
C706	CAPACITOR, FIXED, ELECTROLYTIC: same as C705	183-1190-00
C707	CAPACITOR, FIXED, ELECTROLYTIC: 15 uf -10% +100%, 25 vdcw; Sprague Electric part no. 30D183A1	183-1164-00
C708	CAPACITOR, FIXED, MICA: 6800 uuf ±10%, 300 vdcw	935-2110-00
C709	CAPACITOR, FIXED, PAPER: 0.047 uf ±10%, 400 vdcw; Sprague Electric part no. 160P47394	931-0295-00
C710	CAPACITOR, FIXED, PAPER: 0.1 uf ±10%, 400 vdcw; Sprague Electric part no. 160P10494	931-0299-00
C711	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf -10% +100%, 25 vdcw; Sprague Electric part no. 40D181A2	183-1365-00
C712	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C713	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C714	CAPACITOR, FIXED, MICA: 1500 uuf ±5%, 500 vdcw; Electro Motive part no. DM20F152J	912-3327-00
C715	CAPACITOR, FIXED, FILM: 0.10 uf ±1%, 50 vdcw; Sprague Electric part no. 114P1041 R5S4	933-0279-00
C716 thru C719	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C720	CAPACITOR, FIXED, MICA: 510 uuf ±5%, 500 vdcw; Electro Motive part no. DM19E511J	912-2980-00
C721	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C722	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C723	CAPACITOR, FIXED, FILM: same as C715	933-0279-00
C724	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C725	CAPACITOR, FIXED, MICA: 10,000 uuf ±2%, 500 vdcw; Electro Motive part no. DM30F103G	912-2734-00
C726	CAPACITOR, FIXED, PAPER: same as C710	931-0299-00
C727	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C728	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C729	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
C730	CAPACITOR, FIXED, ELECTROLYTIC: 20 uf -10% +100%, 50 vdcw	183-1369-00
C731	CAPACITOR, FIXED, ELECTROLYTIC: same as C711	183-1365-00
CR701	NOT USED	
CR702 A, B, C, & D	SEMICONDUCTOR DEVICE, SET: four hermetically sealed matched germanium diodes; Hughes Products part no. MQ4032	353-2041-00
FL701	ATTENUATOR, FIXED: pre-emphasis network for u/in FM commercial broadcast equipment; 75 microseconds, 600 ohms input and output	379-0426-00
FL702	FILTER, HIGH PASS: metal encased, hermetically sealed, input 600 ohms, output 600 ohms, 4 solder-type terminals, continuous duty cycle; A. D. C. part no. D10390	673-0869-00
FL703	FILTER, LOW PASS: continuous duty cycle, input 600 ohms ±20%, output 600 ohms ±20%, metal encased, hermetically sealed; C. A. C. part no. 90-1015-00	673-0871-00
FL704	FILTER, LOW PASS: same as FL703	673-0871-00
FL705	FILTER, LOW PASS: linear, continuous duty cycle, input 600 ohms ±20%, output 600 ohms ±20%, metal encased, hermetically sealed; solder-type terminals; C. A. C. part no. 90-1012-00	673-0870-00
J701	JACK, TIP: insulated for u/w 0.080 in. test probes; brown; E. F. Johnson part no. 105-208-200	360-0152-00
J702	JACK, TIP: insulated for u/w 0.080 in. test probes; red; E. F. Johnson part no. 105-202-200	360-0150-00
K701	RELAY, ARMATURE: 4C contact arrangement; 0.25 amp, 300 v dc, 1 inductive winding, 250 ohms resistance, 27.5 vdc; 0.11 amp approx operating current; Aemco, Inc. part no. 94-3473	974-0127-00
L701	COIL, RADIO FREQUENCY: multilayer solenoid type winding; 2.3 ohms; -15°C to +55°C; 0.5 to 3.5 mh; Chicago Standard Transformer Corp. part no. WC-7	278-0734-00
L702	COIL, RADIO FREQUENCY: single layer wound, 10,000 uh, 66.5 ohms dc, 75 ma current rating; Delevan part no. 2500-76	240-2564-00
L703	COIL, RADIO FREQUENCY: same as L702	240-2564-00
L704	COIL, RADIO FREQUENCY: -15 to +55°C operating temp; 8 mh, 100 v rms	278-0713-00
M701	METER, AUDIO LEVEL: VU meter for use in equipments exposed to environments; background color, white	456-0056-00
O701	KNOB: setscrew type; black phenolic body; 1.125 in. dia by 0.843 in. thk; w/ skirt	546-1294-003
O702	KNOB: same as O701	546-1294-008
P701	PLUG, TELEPHONE: brass; phenolic insulation, w/ solder-lug terminal; Switchcraft part no. 3501MC	361-0062-00
Q701	TRANSISTOR: hermetically sealed NPN diffused silicon planar transistor; Fairchild Semiconductor Corp. part no. 2N1613	352-0349-00
Q702	TRANSISTOR: germanium; RCA part no. 2N1285	352-0243-00
Q703	TRANSISTOR: same as Q701	352-0349-00
Q704	TRANSISTOR: same as Q702	352-0243-00
Q705	TRANSISTOR: hermetically sealed, NPN silicon; Fairchild Semiconductor Corp. part no. 2N708	352-0322-00
Q706	TRANSISTOR: hermetically sealed, PNP germanium; General Electric part no. 2N1175A	352-0315-00
Q707	TRANSISTOR: same as Q706	352-0315-00
Q708	TRANSISTOR: same as Q702	352-0243-00
R701	RESISTOR, FIXED, FILM: 750 ohms ±1%, 1/4 w	705-7090-00
R702	RESISTOR, FIXED, FILM: same as R701	705-7090-00
R703	RESISTOR, VARIABLE, WIREWOUND: 10 ohms ±10%, 2 W	377-0113-00
R704	RESISTOR, FIXED, COMPOSITION: 3900 ohms ±10%, 1/2 w	745-1377-00
R705	RESISTOR, FIXED, COMPOSITION: 15,000 ohms ±10%, 1/2 w	745-1401-00
R706	RESISTOR, FIXED, COMPOSITION: 3300 ohms ±10%, 1/2 w	745-1373-00
R707	RESISTOR, FIXED, COMPOSITION: same as R704	745-1377-00
R708	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R709	RESISTOR, FIXED, COMPOSITION: same as R706	745-1373-00
R710	RESISTOR, FIXED, FILM: 1330 ohms ±1%, 1/4 w	705-7102-00
R711	RESISTOR, FIXED, FILM: same as R710	705-7102-00
R712	RESISTOR, FIXED, COMPOSITION: 33,000 ohms ±10%, 1/2 w	745-1415-00
R713	RESISTOR, VARIABLE, COMPOSITION: 5000 ohms ±20%, 1/2 w	376-0205-00
R714	RESISTOR, FIXED, COMPOSITION: 10,000 ohms ±10%, 1/2 w	745-1394-00
R715	RESISTOR, FIXED, COMPOSITION: 120 ohms ±10%, 1/2 w	745-1314-00
R716	RESISTOR, FIXED, COMPOSITION: 4700 ohms ±10%, 1/2 w	745-1380-00
R717	RESISTOR, FIXED, COMPOSITION: 1000 ohms ±10%, 1/2 w	745-1352-00
R718	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
R719	RESISTOR, FIXED, COMPOSITION: 47,000 ohms ±10%, 1/2 w	745-1422-00
R720	RESISTOR, FIXED, COMPOSITION: selected in production	
R721	RESISTOR, FIXED, COMPOSITION: 180 ohms ±10%, 1/2 w	745-1321-00
R722	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R723	RESISTOR, FIXED, COMPOSITION: 39 ohms ±10%, 1/2 w	745-1293-00
R724	RESISTOR, FIXED, FILM: 1,960 ohms ±1%, 1/4 w	705-7110-00
R725	RESISTOR, FIXED, FILM: 464 ohms ±1%, 1/4 w	705-7080-00
R726	RESISTOR, VARIABLE, WIREWOUND: same as R703	377-0113-00
R727	RESISTOR, FIXED, FILM: same as R725	705-7080-00
R728	RESISTOR, FIXED, FILM: same as R725	705-7080-00
R729	RESISTOR, FIXED, FILM: same as R725	705-7080-00
R730	RESISTOR, FIXED, FILM: same as R724	705-7110-00
R731	RESISTOR, FIXED, COMPOSITION: same as R706	745-1373-00
R732	RESISTOR, FIXED, COMPOSITION: 6800 ohms ±10%, 1/2 w	745-1387-00
R733	RESISTOR, FIXED, COMPOSITION: 150 ohms ±10%, 1/2 w	745-1317-00
R734	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R735	RESISTOR, FIXED, FILM: 13,300 ohms ±1%, 1/4 w	705-7150-00
R736	RESISTOR, FIXED, COMPOSITION: 560 ohms ±10%, 1/2 w	745-1342-00
R737	RESISTOR, FIXED, COMPOSITION: same as R719	745-1422-00
R738	RESISTOR, FIXED, COMPOSITION: same as R736	745-1342-00
R739	RESISTOR, FIXED, COMPOSITION: same as R719	745-1422-00
R740	RESISTOR, FIXED, COMPOSITION: same as R714	745-1394-00
R741	RESISTOR, FIXED, FILM: 287 ohms ±1%, 1/4 w	705-7070-00
R742	RESISTOR, FIXED, COMPOSITION: 8200 ohms ±10%, 1/2 w	745-1391-00
R743	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R744	RESISTOR, FIXED, COMPOSITION: same as R717	745-1352-00
R745	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R746	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R747	RESISTOR, FIXED, COMPOSITION: same as R716	745-1380-00
R748	RESISTOR, VARIABLE: composition; 10,000 ohms ±30%, 1/4 w	376-4730-00
R749	RESISTOR, FIXED, COMPOSITION: same as R712	745-1415-00
R750	RESISTOR, FIXED, FILM: 562 ohms ±1%, 1/4 w	705-7084-00
R751	RESISTOR, FIXED, FILM: 261 ohms ±1%, 1/4 w	705-7068-00
R752	RESISTOR, FIXED, FILM: same as R751	705-7068-00
R753	RESISTOR, FIXED, COMPOSITION: same as R714	745-1394-00
R754	RESISTOR, FIXED, COMPOSITION: same as R714	745-1394-00
R755	RESISTOR, VARIABLE: composition, 250 ohms ±20%, 1/4 w	376-4725-00
R756	RESISTOR, FIXED, FILM: 619 ohms ±1%, 1/4 w	705-7086-00
R757	RESISTOR, FIXED, COMPOSITION: same as R736	745-1342-00
R758	RESISTOR, FIXED, COMPOSITION: same as R736	745-1342-00
R759	RESISTOR, FIXED, COMPOSITION: same as R723	745-1293-00
R760	RESISTOR, FIXED, COMPOSITION: 12,000 ohms ±10%, 1/2 w	745-1398-00
R761	RESISTOR, FIXED, FILM: same as R724	705-7110-00
R762	RESISTOR, FIXED, COMPOSITION: same as R717	745-1352-00
R763	NOT USED	
R764	RESISTOR, FIXED, COMPOSITION: selected in production	
R765	RESISTOR, FIXED, FILM: 5110 ohms ±1%, 1/4 w	705-7130-00
R766	RESISTOR, FIXED, FILM: same as R765	705-7130-00
R767	RESISTOR, FIXED, FILM: same as R765	705-7130-00
R768	RESISTOR, FIXED, FILM: same as R765	705-7130-00
R769	RESISTOR, FIXED, COMPOSITION: same as R717	745-1352-00
R770	RESISTOR, FIXED, COMPOSITION: same as R719	745-1422-00
R771	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R772	RESISTOR, FIXED, COMPOSITION: same as R705	745-1401-00
R773	RESISTOR, FIXED, COMPOSITION: selected in production	
S701	SWITCH SECTION, ROTARY: 6 circuit, 6 pole, 3 position, 3 section, 45° detent & stops limiting rotation to 3 positions, phenolic insulation	379-1597-00

ITEM	DESCRIPTION	COLLINS PART NUMBER
S702	SWITCH, TOGGLE: spdt; 40 amp continuous; 28 v dc, 20 amp resistive, 15 amp inductance; 115 v, 400 cps, 10 amp resistance, 10 amp inductance; Hetherington, Inc. part no. T1003-AN	266-3099-00
S703	SWITCH SECTION, ROTARY: 4 circuit, 4 pole, 7 position, 4 section, 30° detent & stops limiting rotation to 7 positions, phenolic insulation	379-1596-00
T701	TRANSFORMER, RADIO FREQUENCY, BALANCED: c/o plastic fabric base phenolic board 1/16 in. by 1-3/16 in. by 1-3/16 in.; plus 3 coils, 75 turns ea; coil #1, wound ccw, coils #2 & #3, cw; plus plastic rod 0.159 in. w by 0.413 in. dia	549-1639-003
TB701	TERMINAL BOARD: phenolic, barrier type w/ lug for back connection; 12 terminals	367-0020-00
TB702	TERMINAL BOARD: bakelite, 4 terminals, 3/8 in. by 1/2 in. by 1-1/2 in.; Cinch Mfg. Corp. part no. 1534-A	306-2240-00
TB703	TERMINAL BOARD: same as TB702	306-2240-00
TB704	TERMINAL BOARD: 4 solder-lug terminals, brass; 3/8 in. by 1-1/2 in. overall	306-0698-00
TB705	TERMINAL BOARD: phenolic, 4 brass solder lug terminals; 1/16 in. by 3/8 in. by 1-1/2 in.; Cinch Mfg. Corp. part no. 1532A	306-9032-00
TB706	TERMINAL BOARD: phenolic, 3 solder-lug terminals; 11/16 in. by 1-1/8 in. lg	306-0587-00
TB707	TERMINAL BOARD: same as TB706	306-0587-00
TB708	TERMINAL BOARD: same as TB702	306-2240-00
TB709	TERMINAL BOARD: phenolic, 5 brass solder lug terminals; 1/16 in. by 3/8 in. by 1-7/8 in.; Cinch Mfg. Corp. part no. 1542-A-FV	306-0951-00
TB710	TERMINAL BOARD: same as TB702	306-2240-00
TB711	TERMINAL BOARD: laminated phenolic w/ 4 solder lug terminals; 27/32 in. w by 1-1/2 in. lg; Cinch Mfg. Corp. part no. 1909	306-0838-00
TB712	TERMINAL BOARD: same as TB702	306-2240-00
TB713	TERMINAL BOARD: same as TB706	306-0587-00
TB714	TERMINAL BOARD: same as TB711	306-0838-00
TB715	TERMINAL BOARD: same as TB711	306-0838-00
TB716	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1520-A	306-9033-00
TB717	TERMINAL BOARD: phenolic w/ 3 solder-lug terminals; 11/16 in. w by 1-1/8 in. lg; Cinch Mfg. Corp. part no. 1525A	306-0001-00
TB718	TERMINAL BOARD: same as TB704	306-0698-00
TB719	TERMINAL BOARD: same as TB702	306-2240-00
TB720	TERMINAL BOARD: same as TB717	306-0001-00
TB721	TERMINAL BOARD: same as TB704	306-0698-00
TB722	TERMINAL BOARD: 12 terminals, brass, 4.125 in. by 5.1875 in. overall; phenolic board; Cinch Mfg. Corp. part no. 12-160-AL	367-1385-00
XFL701	SOCKET, ELECTRON TUBE: 8 prong octal tube socket w/ steel mtg plate; Amphenol-Borg Electronics part no. 78-8TM	220-1005-00
XQ701	SOCKET, TRANSISTOR: 3 contacts spaced on 0.200 in. dia circle; Elco Corp. part no. 3307X	352-9903-00
XQ702	SOCKET, TRANSISTOR: 4 contacts spaced on 0.200 in. dia circle; Elco Corp. part no. 3307	352-9902-00
XQ703	SOCKET, TRANSISTOR: same as XQ701	352-9903-00
XQ704	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XQ705	SOCKET, TRANSISTOR: same as XQ701	352-9903-00
XQ706	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XQ707	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XQ708	SOCKET, TRANSISTOR: same as XQ702	352-9902-00
XY701	SOCKET, CRYSTAL: 2 regularly spaced contact positions, 0.486 in. c to c ea contact, 0.243 in. from center; cadmium plated phosphor bronze or beryllium copper; Hugh H. Eby part no. 8879	292-0082-00
Y701	CRYSTAL UNIT, QUARTZ: 38.000 kc; type CR-50/U	289-1490-00

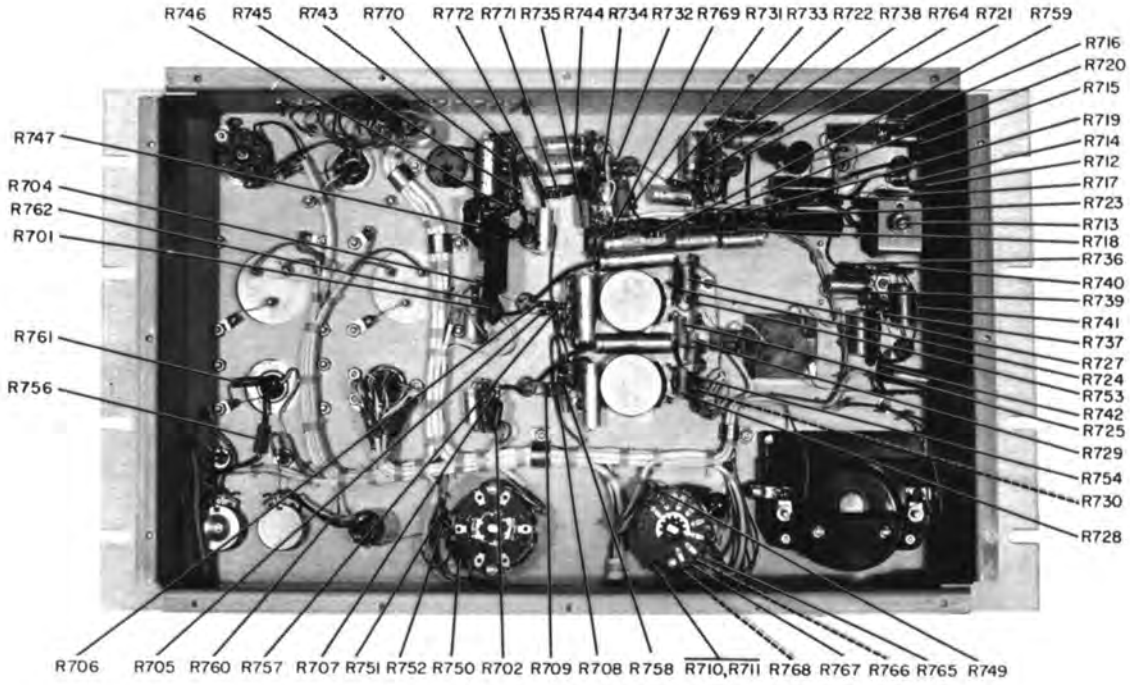


Figure 4-1. 786M-1 Stereo Generator, Rear View, Resistor Location

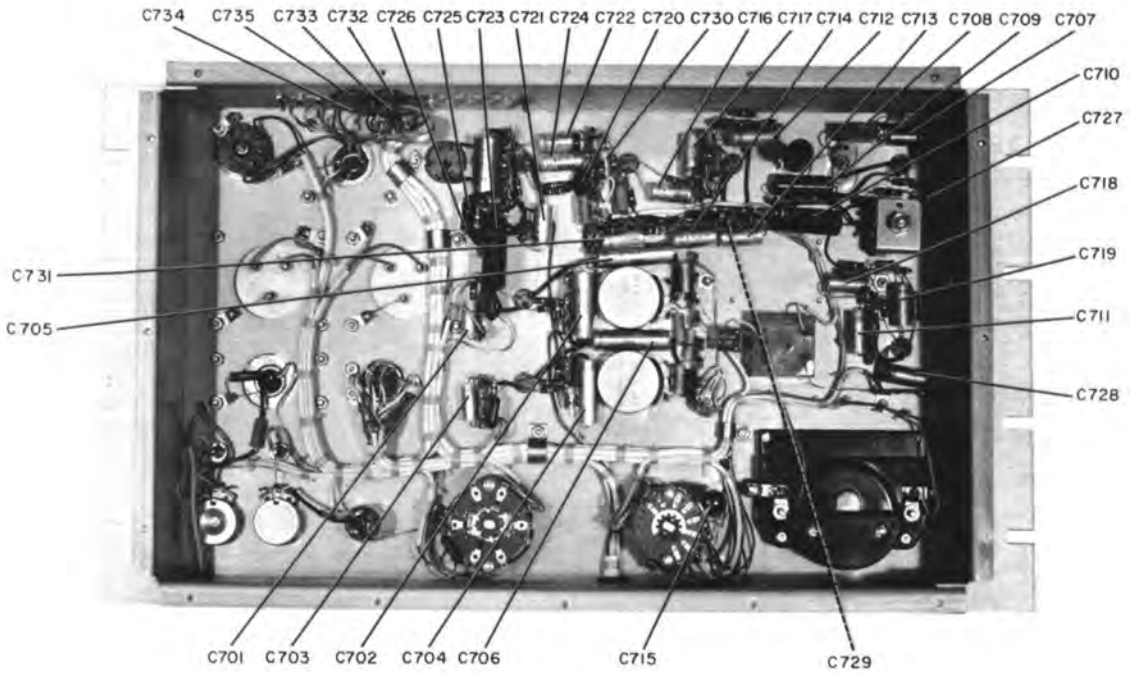


Figure 4-2. 786M-1 Stereo Generator, Rear View, Capacitor Location

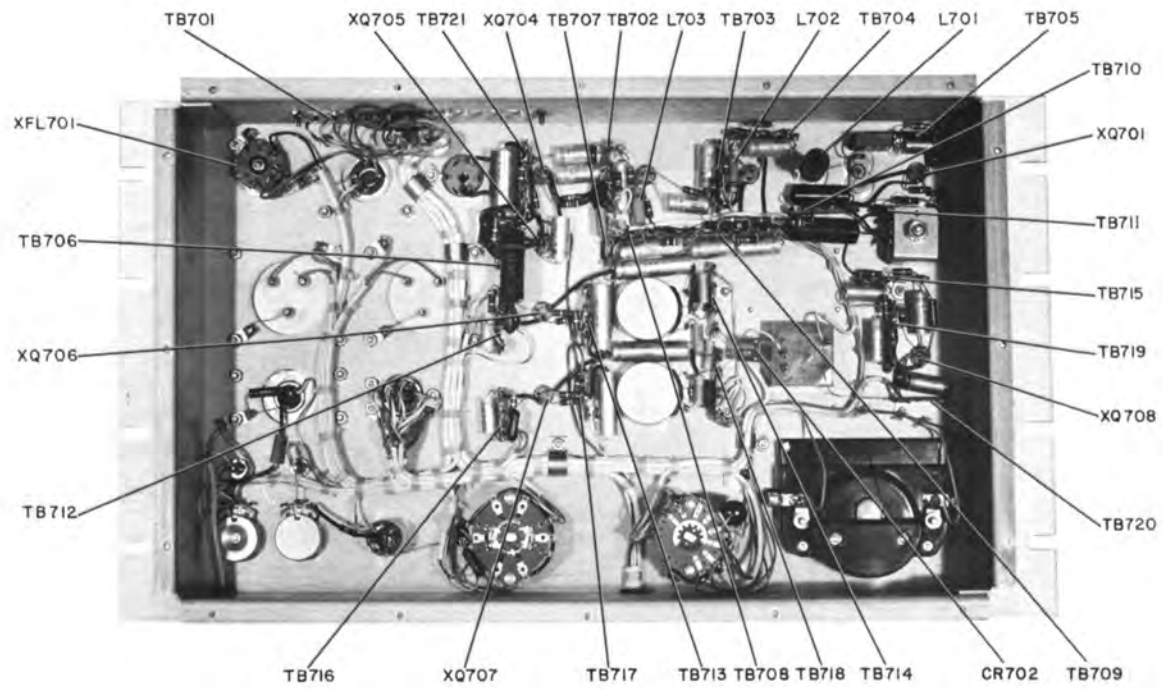


Figure 4-3. 786M-1 Stereo Generator, Rear View, Miscellaneous Parts Location

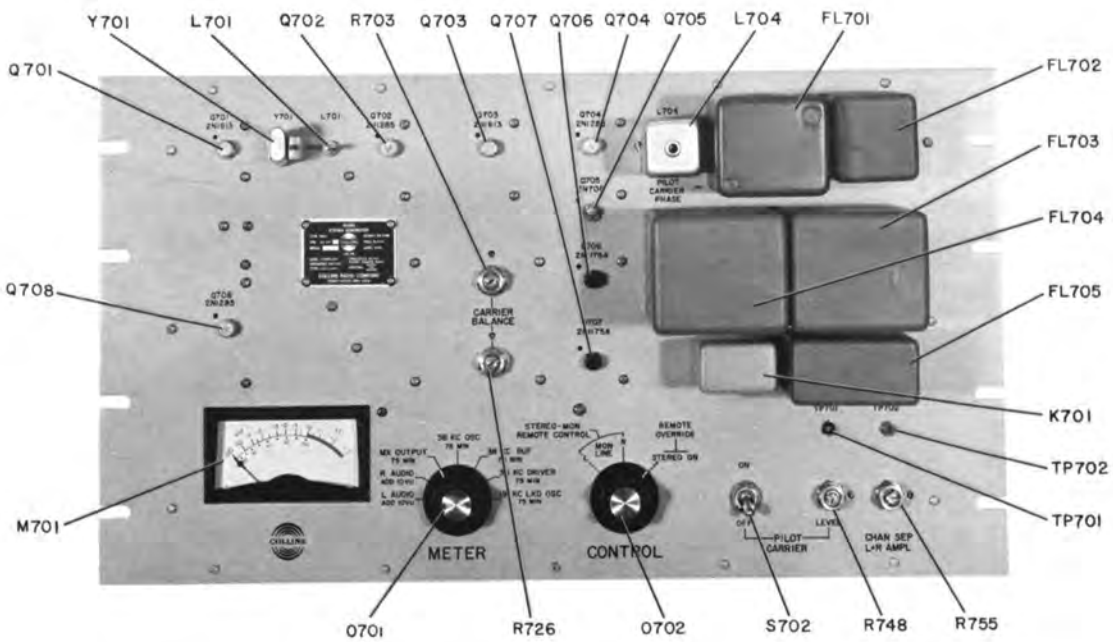
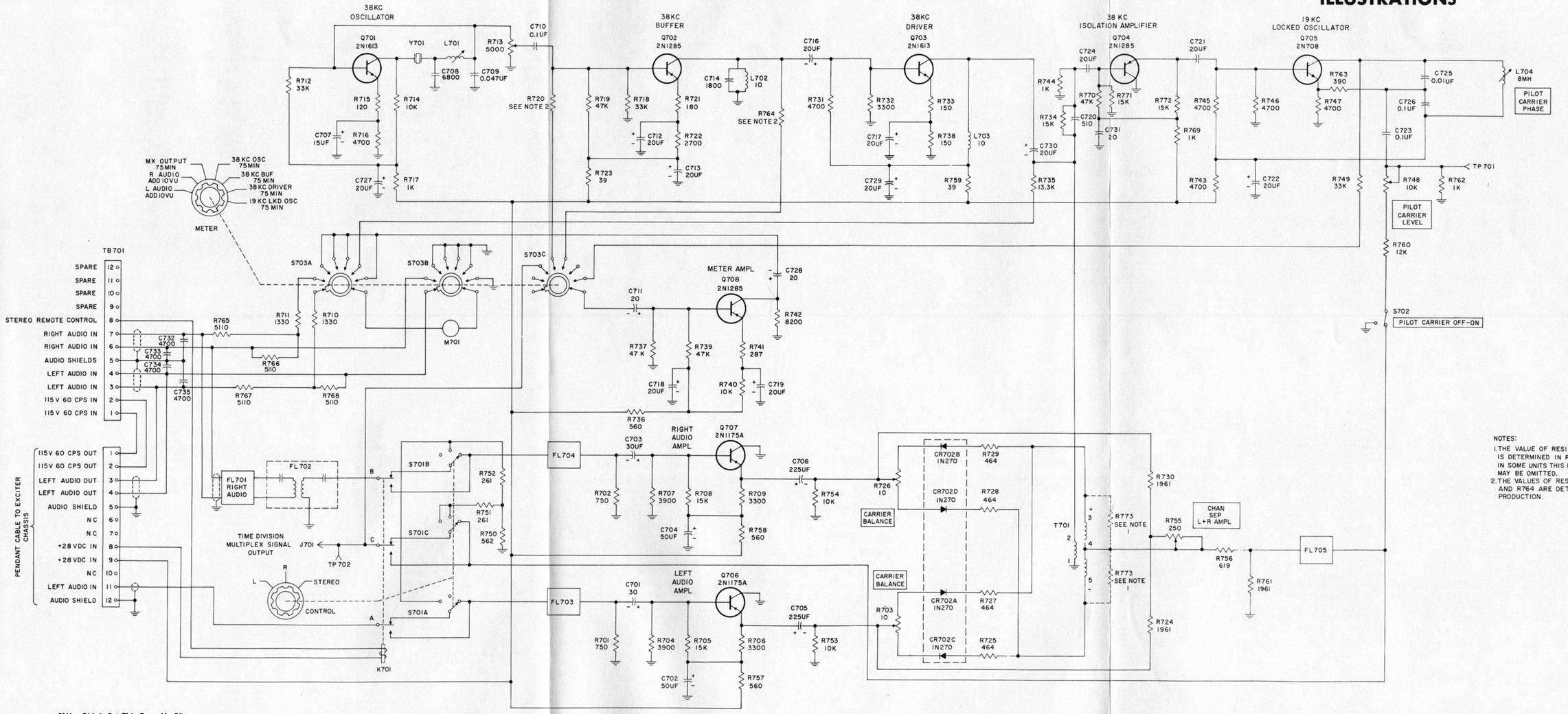


Figure 4-4. 786M-1 Stereo Generator, Front View Parts Location

SECTION V
ILLUSTRATIONS



NOTES:
1. THE VALUE OF RESISTOR R773 IS DETERMINED IN PRODUCTION. IN SOME UNITS THIS RESISTOR MAY BE OMITTED.
2. THE VALUES OF RESISTORS R720 AND R764 ARE DETERMINED IN PRODUCTION.

Figure 5-1. 786M-1 Stereo Generator, Schematic Diagram

ELECTRICAL WIRE CODE

EXAMPLES

UNSHIELDED WIRE, MIL TYPE B #22 AWG, WHITE WITH RED AND GREEN TRACERS:

D	A	9	25	—	4-1/4
Type of Wire	Size of Wire	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (SINGLE), MIL TYPE C, #15 AWG, WHITE WITH RED AND GREEN TRACERS:

R	D	S	9	25	—	4-1/4
Type of Wire	Size of Wire	Shielded	Color of Body	Color of Tracers		Length of Wire in Inches (Includes Stripping & Tinning)

SHIELDED WIRE (MULTIPLE), MIL TYPE B, #22 AWG, WHITE, AND WHITE WITH RED TRACER:

D	A	S	(9)	(92)	—	4-1/4
Type of Wire	Size of Wire	Shielded	First Conductor	Second Conductor		Length of Wire in Inches (Includes Stripping & Tinning)

TYPE OF WIRE CODE		
LETTER	TYPE OF WIRE	FAMILY USUALLY FOUND IN
A	Cotton Braid Over Plastic (Formerly AN-J-C-48)	440 Plain 443 Shielded
B	Busbar, Round Tinned	421
C	MIL-W-16878 Type B (#20 and Larger) (600 Volts)	439
D	Miniature Wire, MIL-W-16878 Type B (#22 & Smaller)	439-7000 Series
E		
F	Extra Flexible Varnished Cambric	423
G		
H	Kel-F (Monochloro-trifluoroethylene)	422
J		
K	Neon Sign Cable (15,000 Volts)	423 0004 00
L	Silicone	425 0942 00
M		
N	Single Conductor Stranded (Not Rubber Covered)	422
.P	Single Conductor Stranded (Rubber Covered)	423
Q		
R	MIL-W-16878 Type C (1000 Volts)	439 1000 Series
T	Teflon, MIL-W-16878 Type E (600 Volts)	439 4000 Series
V	MIL-W-16878 Type D (3000 Volts)	439 3000 Series
W	Teflon, MIL-W-16878 Type EE (1000 Volts)	439 0000 Series
X		
Y		
Z	Acetate Yarn Telephone Type	428

SIZE OF WIRE CODE	
LETTER	SIZE
A	#22 AWG
B	#20
C	#18
D	#16
E	#14
F	#12
G	#10
H	#8
J	#6
K	#4
L	#2
M	#1
N	#0
P	#00
Q	#000
R	#0000
T	#28
V	#26
W	#24
X	#19
Y	#30
Z	

COLOR CODE	
NUMBER OR LETTER	COLOR
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray (Slate)
9	White
a	Clear
b	Tan
c	Pink
d	Maroon
e	Light Green
i	Light Blue

2800
460
0000
16800
11200
1288.0000

$360 = X\ 2750 \times .65$

$X = \frac{2755 \cdot 65}{360}$

2750
.65
13750
16500
1787.50

4.90
360) 1787.5
1360
1440
3475

$360 = .490\ 2.750 \times .65$

2750
.490
0000
24050
11000
1340.500

1340
.65
6700
8040
875.00