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instruction book

21E/M
Broadcast Transmitter

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Figure 1-1. 21E, Front View

section 1

general description

1.1 General Description.

1.1.1 INSTRUCTION BOOK. This instruction book covers both the 5KW, 21E, and the 10KW, 21M broadcast transmitters. The detailed description covers the 21E. Significant differences in circuitry and components between the 21E and 21M are pointed out as they appear.

1.1.2 GENERAL DESCRIPTION. These transmitters are the medium power versions of a line of high fidelity broadcast transmitters which feature advanced engineering techniques, new high quality components, flexibility, and economical operation.

The 5KW, 21E transmitter includes all the facilities, except actual components, to change to a 10KW, 21M transmitter in the shortest possible time (about 12 man-hours, estimated).

These transmitters consist of a modified 300J-250-watt transmitter used as an audio and radio frequency driver unit followed by a high level modulated power amplifier with suitable plate and bias supplies.

The normal frequency range is 540 to 1600 kc but can be extended to 15 megacycles on special order.

1.1.3 PHYSICAL DESCRIPTION. With the exception of the plate transformer and in certain models the modulation transformer and modulation choke, all components are housed within an assembly of three main bays. The two end bays are complete cabinets, and the middle bay is a complete frame assembly with front and rear enclosures which, when bolted between the two end cabinets, completes the sturdy, neatly styled assembly that has the appearance of one large cabinet.

The exterior of the equipment is finished in high gloss, two-toned gray enamel. Streamlined polished chrome styling strips separate the two color areas.

1.1.3.1 MECHANICAL FEATURES. All tubes are visible through the front windows.

Tuning and metering controls are located behind four access doors on the front of the transmitter. Filament and plate power pushbuttons are located below these doors on the front panel.

Control relays are accessible through identical removable insert panels located on the lower front panel of each of the three cabinets.

1.1.4 ELECTRICAL DESCRIPTION. See figure 1-1. The radio-frequency portion consists of 6AU6 crystal oscillator, a 6SJ7 isolation buffer, an 807 r-f amplifier, followed by a pair of 4-125A tetrode driver amplifiers. These excite a 3X2500A-3 triode power amplifier in the 21E or two parallel 3X2500A-3 triodes in the 21M.

The audio lineup is push-pull all the way with 6SJ7 tubes in the first audio stage followed by a pair of 4-125A tetrode audio drivers and a pair of 3X3000A-1 triode class AB-1 modulators.

For personnel protection, each rear door is equipped with a control circuit interlock and an HV and bias supply shorting device to discharge large filter capacitors. In addition, the power cabinet rear doors employ spring operated shorting switches to ground the plate transformer secondary terminals when the rear doors are opened.

Overload protection is afforded by magnetic circuit breakers and fuses in transformer primaries and overload relays in the power amplifier and modulator plate circuits.

1.2 Specifications.

Frequency range	540 to 1600-kc standard. Frequencies to 15 mc available.
Power output	21E - 5,500 watts. 21M - 10,600 watts.
Frequency stability	540 kc to 1605 kc ±10 cps 10°C to 50°C ±20 cps 0°C to 60°C.
	1605 kc to 15,000 kc ±0.002 percent +20°C to +45°C.

Audio frequency response	Within ±2 db from 50 to 10,000 cps measured at 75 percent modulation.
Residual noise level	60 db below 100 percent modulation from 150 cycles to 7500 cps.
Carrier shift	Less than 3 percent.
R-f output impedance	75/50 ohms standard. Other impedances available on special order.
Audio input impedance	600/150 ohms.
Audio input level	+10 dbm, ±2 db, 600 ohms input with built-in input pad. With the input pad removed, -5 dbm is sufficient for 100 percent modulation. 150-ohm connection of input transformer is possible when desired.
Distortion	Less than 3 percent over the range 50 to 7500 cps, measured at 95 percent modulation.
Temperature range	+15°C to +45°C ambient.
Altitude range	Sea level to 3300 feet. Higher altitude on special order.
Power source	208/230 v 3-phase 60 cps. 50 cps on special order.
Weight	Approximately 2700 lb for 21E. Approximately 3000 lb for 21M.
Dimensions	105-1/4 inches wide, 76 inches high, 28 inches deep. (Plate transformer extra.)

Power Demand

	Power (KW)	Power Factor (%)
*5000-watt output		
Filaments and blower only 5000 watts	2.64	75.7
Output - No modulation	12.8	90.0
- 30% modulation	13.8	90.0
- 100% modulation	18.5	90.0
*10,000-watt output		
Filaments and blowers only 10,000 watts	3.28	76.5
Output - No modulation	21.2	90.5
- 30% modulation	23.6	91.0
- 100% modulation	32.8	91.5

*21E capable of 5500-watt output; 21M capable of 10,600 watt-output.

Table 1-1 is a tube complement of the 21E/M Broadcast Transmitter.

TABLE 1-1
TUBE COMPLEMENT

QUANTITY		TUBE TYPE	FUNCTION
21E	21M		
1	1	6AU6	Crystal Oscillator
1	1	6SJ7	Buffer or Multiplier
1	1	807	Amplifier
2	2	4-125A	Driver
1	2	3X2500A3	Final Amplifier
2	2	6SJ7	Audio Amplifier
2	2	4-125A	Driver Amplifier
2	2	3X3000A1	Modulator
1	1	5U4G	Exciter Bias
2	2	866A	Final Amplifier Bias
2	2	866A	Low Voltage Plate
2	2	872A	Intermediate Plate
6	6	575A	High Voltage Plate

section 2

installation

2.1 General.

Inspect the shipping crates for evidence of possible damage to the equipment within. If damage is found, save the shipping crates, read the back of the bill of lading for further instructions, and report the damage to the transportation company.

2.2 Unpacking.

The cabinets and power transformer are shipped in skid-type crates with the unpacking instructions stenciled on the sides. In general, cut and remove the steel straps from around the crates. Then remove the row of nails from the side near the bottom of the crate using a nail puller to pull the nails. Lift the whole crate assembly (top and four sides) from the base. Remove any protective material, and unbolt the equipment from the base of the crate.

Smaller assemblies are packed in regular boxes from which the top has to be removed. Use a nail puller here.

Small, loose parts are placed in sacks or small boxes and shipped in the larger boxes to prevent parts being lost. Search all packing material to be sure that no parts are discarded with the packing material.

2.3 Preinstallation.

2.3.1 MOUNTING POSITION. The important consideration in selecting a mounting position is to provide adequate room for operating and servicing the equipment. Figure 2-1 shows over-all dimensions and clearance dimensions as well as all other pertinent data concerning the mounting of the transmitter.

Increased over-all trouble-free operation will be realized if the transmitter room is air-conditioned and pressurized to control dust, insects, and excessive changes in humidity and air temperature. The heat generated by the equipment can be used to heat the building in cold climates, providing the exhaust ducts are arranged so that, under all circumstances, the heat is removed from the transmitter, and no back pressure is allowed within any cabinet. Maximum tube and component life will be obtained if duct work is equipped with an additional exhaust fan.

2.3.2 MOUNTING FRAME. A mounting frame under the transmitter will greatly facilitate the installation of power leads. The mounting frame shown in figure 2-1 is adequate and recommended.

2.3.3 ELECTRICAL DUCTS. Provide a duct in the floor, as shown in figure 2-1, in which to run the power leads. This duct should be clean and dry with provisions to maintain these conditions.

2.3.4 GROUND STRAP. See figure 2-1. Install a heavy copper strap along the front edge of the duct that is under the transmitter. Attach this ground strap to the building and antenna ground system. Attach adequate length (for instance, 5 feet) of no. 6 copper wire to the ground strap at points underneath each cabinet, and coil neatly preparatory to setting the cabinets on the frame. Run a no. 4 ground wire from the ground strap back to the plate transformer position for transformer grounding.

2.3.5 POWER SOURCE. For the 21E, provide a 230-volt, 3-phase power source capable of 20 kw (35w for 21M) for the transmitter alone, with all other sources of load extra. Install a 3-phase, metal cutout box, independent of other loads, with 100-ampere fuses for the 21E and 125-ampere fuses for the 21M, and connect it to the transmitter/plate transformer duct with a metal conduit of 2-inch minimum diameter. Observe standard electrical conduit grounding practices, but be sure that the conduit is grounded with no. 4 wire to the transmitter ground strap, too. See figure 2-1 for primary wire sizes.

2.3.6 DUCT WIRING. The wires shown in table 2-1 should be placed in the duct and arranged so that they can be pulled through the proper holes in the cabinet bases. (See figure 2-1 for suggested minimum wire sizes.)

2.3.7 OUTPUT CONNECTION. Normally, the transmitter output connection is to a feedthrough on the roof of the power amplifier cabinet. See figure 2-1. If it is desired to route the transmitter output from the base of the cabinet and into the duct, a hole that will pass the transmission line will have to be drilled into the base of the power amplifier cabinet. This must be done before mounting any heavy components in the cabinet. A ground lug is provided adjacent to the output feedthrough in the roof of the power amplifier cabinet to ground the outer conductor of the rigid transmission line. Use a 7/8-inch or 1-5/8-inch line for the 21E and a 1-5/8-inch line for the 21M of the impedance value established in the sales contract (either 50 or 72 ohms).

TABLE 2-1. DUCT CABLING

*WIRES	FROM	TO
Main power feed (3 wires plus copper ground)	Line cutout box mounted on transmitter room wall.	Power cabinet E201.
Plate transformer primary (9 wires plus transformer frame ground)	Power cabinet E202, E203, and E211.	Plate transformer primary terminals.
Plate transformer secondary (3 wires, with 5 to 6 ft extra at cabinet end)	Plate transformer secondary terminals.	Power cabinet E212, E213, E214.
Cabinet ground wires (See paragraph 2.3.4)	Duct ground strap.	Each cabinet ground connection. (See paragraph 2.6.)
Audio input	Line amplifier (not furnished).	E103 of driver cabinet 6SJ7 tube chassis. (See paragraph 2.9.)
Frequency monitor connections	Frequency monitor (not furnished).	J104 on the bottom of the driver cabinet r-f chassis. (See paragraph 2.11.)
Modulation monitor	Modulation monitor (not furnished).	J302 at the top rear of the PA r-f network box in the PA cabinet. (See paragraph 2.12.)
Audio monitor (not for audio measurements)	Audio monitor input (speaker or amplifier not furnished).	E301 on the right-hand sidewall (viewed from rear) of the PA cabinet. Watch voltage clearance.

*In some cases, L309 and T211 must be mounted externally because of the inductor and transformer sizes. If this is necessary, allow adequate room in the duct for 5 additional wires.

2.4 Reassembly.

NOTE

All parts that have been removed, and all cabling that has been disconnected, are marked by sticker tags. When reassembling, match the tag letter or number on the part with the tag number or letter on the chassis or cabinet. Match the tag letter or number on the cabling with the tag letter or number on the chassis, cabinet, or other cabling. (These numbers do not correspond to the labeling in any of the diagrams of this book.)

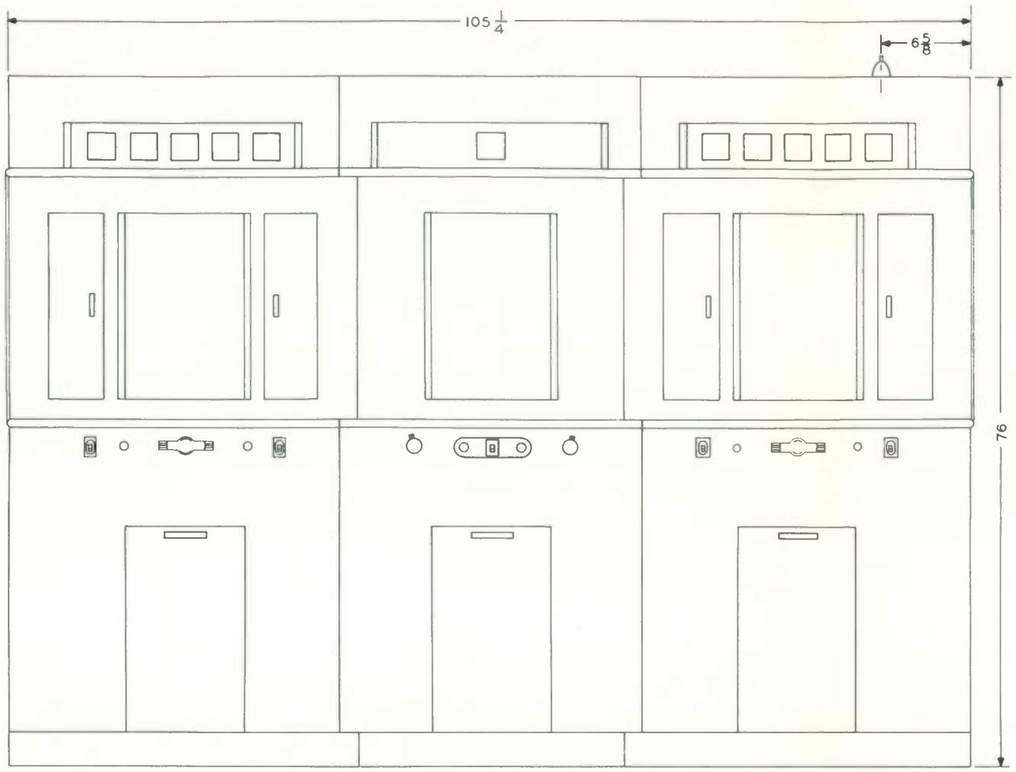
2.4.1 GENERAL. The parts should be replaced after the cabinets are set up on the mounting frame, but leave the large transformers, reactors, and the PA blower until the interconnecting cables have been pulled through the sidewalls. Remove the bottom rear panels from the three cabinets.

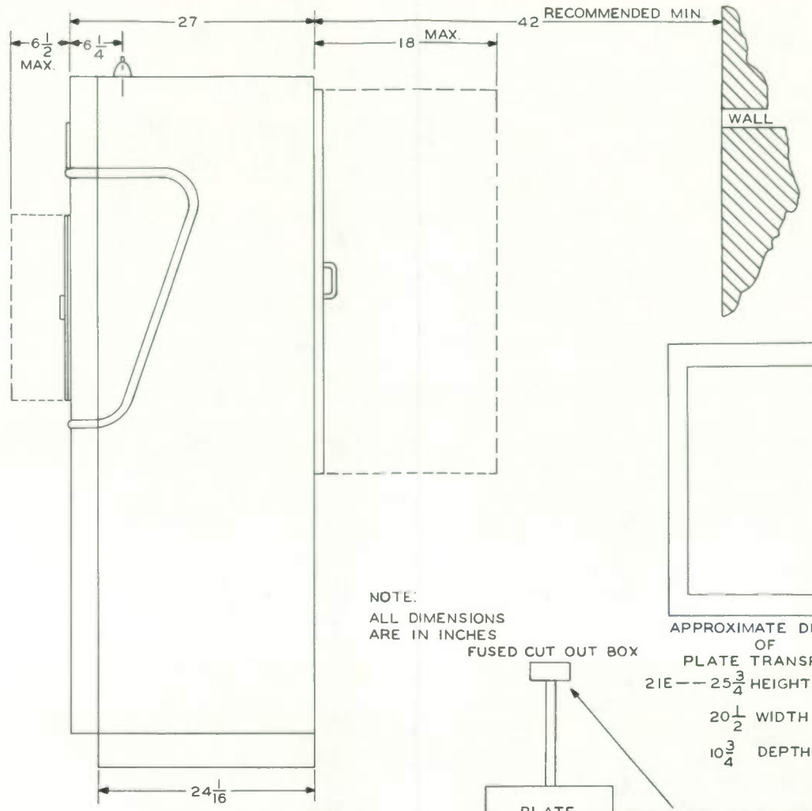
2.4.2 ORDER OF REASSEMBLY. After the preinstallation procedures have been completed, reassemble the transmitter in the following order:

WARNING

Be sure the cutout box switch is open and the fuses are removed.

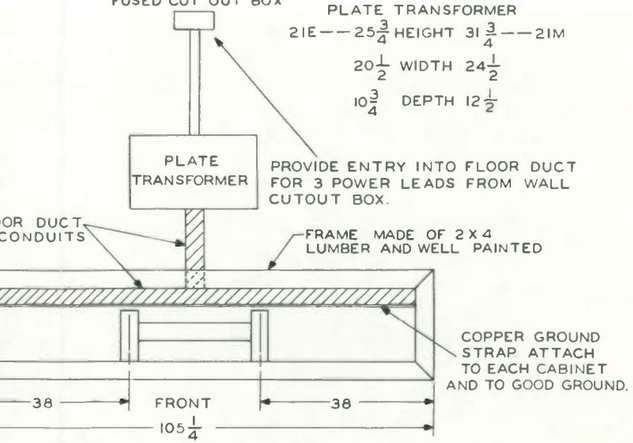
a. Place the power cabinet frame in the center position on the mounting frame; place the associated



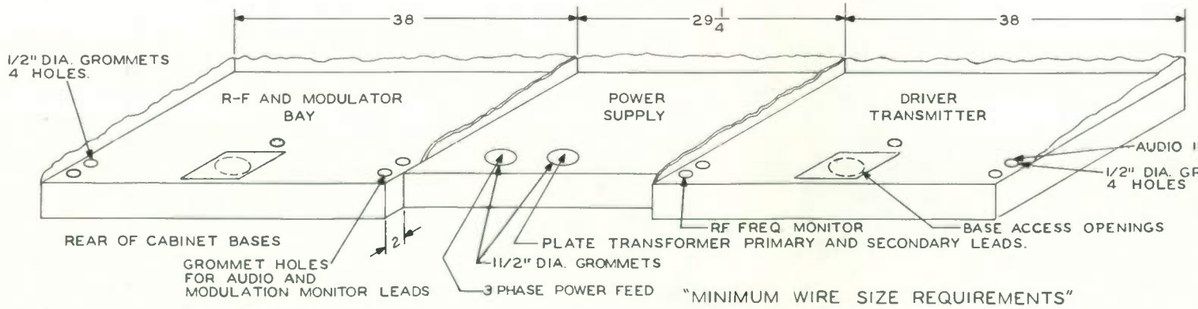


APPROXIMATE DIMENSIONS OF PLATE TRANSFORMER
21E — 25 3/4 HEIGHT 31 3/4 — 21M
20 1/2 WIDTH 24 1/2
10 3/4 DEPTH 12 1/2

NOTE:
ALL DIMENSIONS ARE IN INCHES



SUGGESTED MOUNTING FRAME



"MINIMUM WIRE SIZE REQUIREMENTS"

CONNECTION	SIZE OF WIRE
POWER LINE FEED FROM FUSED WALL CUTOUT BOX FOR 208/230 VOLT THREE PHASE 50/60 CPS POWER SOURCE	THREE NO. 2 RUBBER COVERED BUILDING WIRE FOR THE 21E. THREE NO. 0 RUBBER COVERED BUILDING WIRE FOR THE 21M. ONE GROUND AT LEAST NO. 4 WIRE. FUSE THE 21M AT 125 AMPERES, THE 21E AT 100 AMPERES.
TRANSFORMER PRIMARY LEADS	NINE NO. 6 RUBBER COVERED BUILDING WIRE FOR THE 21E. NINE NO. 4 RUBBER COVERED BUILDING WIRE FOR THE 21M.
TRANSFORMER SECONDARY LEADS	THREE NO. 12 OR 14 10,000 VOLT INSULATION.
TRANSFORMER FRAME	ONE NO. 4 BARE WIRE TO CABINET GROUND.

CONNECTION	SIZE OF WIRE
R-F FREQUENCY MONITOR FEED	RG/8U COAXIAL CABLE.
MODULATION MONITOR FEED	RG/8U COAXIAL CABLE.
INPUT AUDIO LEAD	SHIELDED PAIR
AUDIO MONITOR LEAD	SHIELDED PAIR
R-F TRANSMISSION LINE	7/8 OR 1-5/8 50 OR 72 OHM RIGID COAXIAL CABLE FOR THE 21E. 1-5/8 50 OR 72 OHM RIGID COAXIAL CABLE FOR THE 21M.

NOTE
IF A DUCT IS USED TO REMOVE THE WARM AIR, EMPLOY AN EXHAUST BLOWER OF AT LEAST 1500 CFM CAPACITY. ALLOW NO BACK PRESSURE WITHIN ANY CABINET.

Figure 2-1. Installation Details

power wires and ground wire through the base holes progressively as the power cabinet frame is shoved into position. See figure 2-2.

b. Slide the power amplifier cabinet into position. At the same time, feed the associated ground wire, modulation monitor and audio monitor wires through their base holes.

c. Slide the driver cabinet into position, at the same time feeding the r-f monitor, audio input leads, and ground wire up through the base.

d. Align the cabinets, and bolt together with the 16 self-tapping screws provided. Insert the screws from the power cabinet.

e. Feed the interconnecting cables from the power cabinet through the side-walls of the amplifier and driver cabinets. See figure 2-2.

f. Remove the top panels from all three cabinets, the middle cabinet first. This top panel is held on by two large screws through keyhole shaped holes. Loosen the screws from the rear, and lift up on the front panel. The outside cabinets are equipped with shakeproof fasteners which must be turned counter-clockwise a portion of a turn. Support the panels from the front to prevent them from falling.

g. Mount and connect the r-f tank compartment into the driver cabinet; details in paragraph 2.4.5.

h. Mount the vacuum variable capacitor C313 into the PA tank compartment with the four screws provided. Slide the circular clamp over the rear of the capacitor and tighten the clamp screw.

i. Mount and connect the PA tank compartment into the amplifier cabinet; details in paragraph 2.4.4.

j. Make all connections possible at this time. See paragraphs 2.5, 2.6, 2.7, 2.8, and their subparagraphs.

k. Install the heavy components in the base of the driver cabinet, and make connections. See figure 6-3 and paragraph 2.4.5.

l. Install the heavy components into the base of the power cabinet, and make connections. See figure 6-2 and paragraph 2.4.3.

m. Install the heavy components (except blower) into the base of the amplifier cabinet, and make connections. See figure 6-1 and paragraph 2.4.4.

n. Install the blower into the base of the amplifier cabinet.

o. Attach the r-f output line.

p. Mount the front panels on the power bay if these were removed for shipping.

q. Install the tubes.

CAUTION

Install the PA and modulator tubes by gently pressing down the tubes while rotating the tubes with a reciprocating motion not to exceed 1/2-inch excursion. Be sure the tubes seat properly to prevent air leaks. Pull the snap spring in place to ensure a good electrical contact. Check the filament air hoses to see that they are not plugged and are not disconnected or up against the panel.

r. Install the crystals; see figure 6-12 for crystal location.

CAUTION

Extreme care should be exercised when handling the crystals. This new type of crystal is extremely fragile. Following rough handling the crystals may still oscillate, but their temperature coefficient may be altered.

2.4.3 REASSEMBLY DETAILS OF POWER CABINET.

a. Perform step a of paragraph 2.4.2.

b. Set the modulation transformer in place. See figure 6-2.

c. Set the filter choke (or chokes) in place as shown in figure 6-2. The 21E takes one choke and the 21M two chokes (L202 and L203).

d. Install and connect the audio compensating board as shown in figures 2-2 and 6-2.

e. Connect all the base components and side-mounted filter capacitors. (See figure 7-4.)

f. Install surge resistors R205, R206, and R207. (See figure 2-2.)

g. After all other cabinets have been assembled and interconnecting wires installed, connect the rear fan to the powerstat, T201. One lead goes to the powerstat terminal that has a white wire and the other to the powerstat terminal that has a red wire.

2.4.4 REASSEMBLY DETAILS OF POWER AMPLIFIER CABINET.

a. Perform step b of paragraph 2.4.2.

b. The r-f tank box (see figure 6-1) was removed for shipment. This box is suspended from the roof of the cabinet by 2 metal standoffs and 3 ceramic standoffs. Carefully hold the box in position, and replace the mounting screws. Use caution in tightening the screws in the ceramic standoffs to prevent breakage.

c. Assemble the air duct (two L-shaped pieces of aluminum) between the PA chassis and the r-f tank box with the self-tapping screws provided (14 screws), see figure 6-1.

d. Turn the vacuum variable capacitor shaft C313 toward the high capacity direction (counterclockwise) until the protective disengagement starts to take place. Then rotate the shaft of C313 clockwise just until threads have engaged and the front end of capacitor is held firmly against the brushing cap. Leave the capacitor at this setting.

Rotate the dial independently counterclockwise until the stop is reached. This will be at a reading of approximately zero or minus 10 or 20 divisions. Leave the dial in this position against the dial stop, and install the drive chains keeping these relative settings the same.

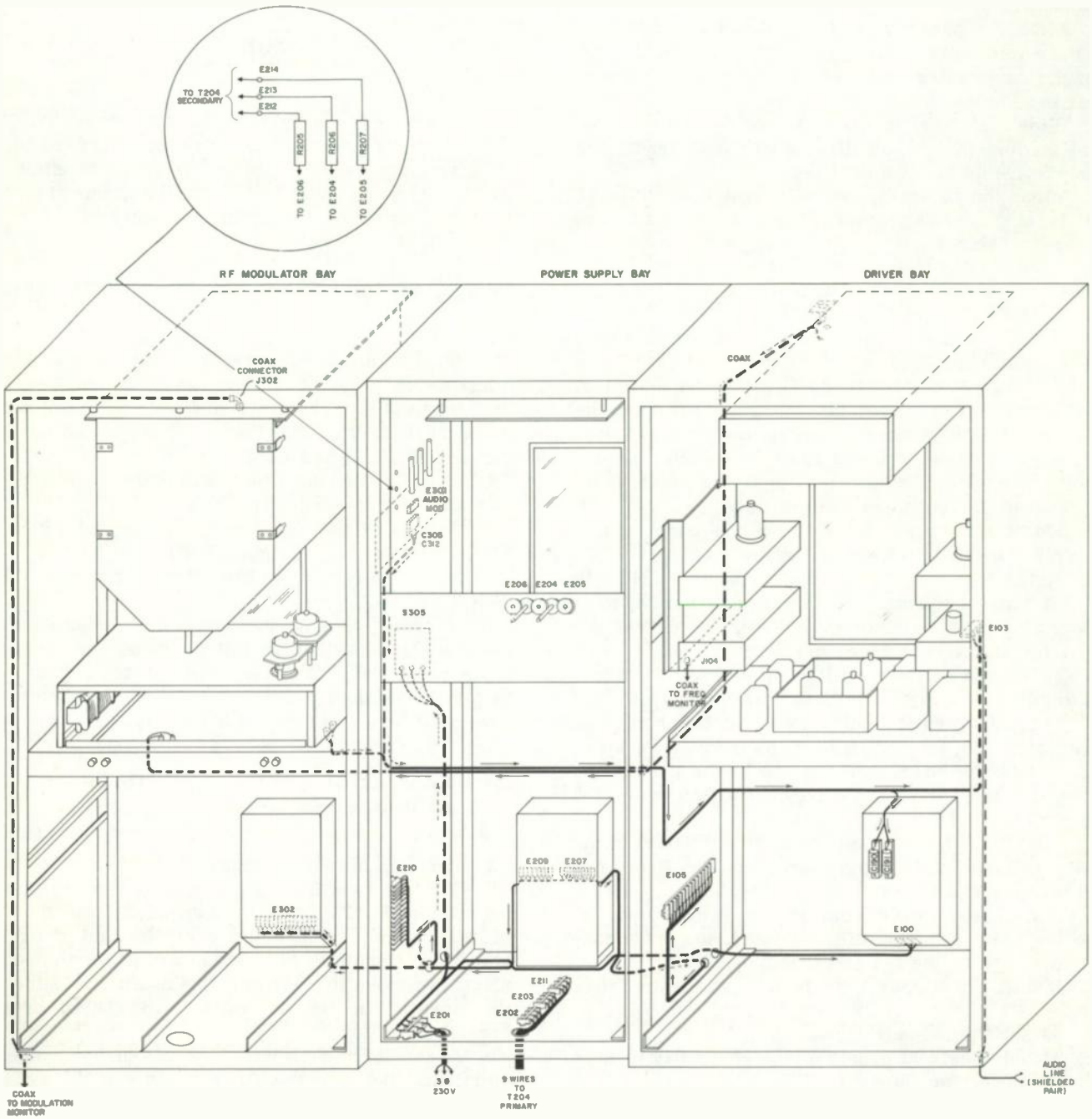


Figure 2-2. Cabling Details

Check operation by rotating dial clockwise to the point where the internal protective stop in the capacitor engages. This is toward the low capacity direction of the capacitor and will occur at a dial reading of somewhat less than the full range of the dial in the increasing number direction. Recheck by counterclockwise rotation to assure that the counterclockwise stop of the dial engages before the capacitor shaft begins to loosen up.

e. Set power amplifier variable loading capacitor C320 to minimum capacity. Turn the PA LOADING control to 0. Slide the flexible coupler head onto the dial shaft. Insert the two mounting screws, and

tighten the head to the panel. Tighten the shaft setscrew.

f. Attach the output strap to r-f line meter M301.

NOTE

The power amplifier arc suppression circuit capacitor and arc gap can be moved to gain protection over more of the transmission line, if desired. It can be placed any place in the transmission line between the static drain choke at the tower and the static drain choke at the transmitter. A d-c path to ground must be maintained. See figure 2-5 for possible insertion points along the transmission line. If the capacitor and gap are removed from the PA cabinet, jumper the loading coil to the r-f feedthrough insulator with a heavy copper strap.

g. If the PA grid coil was removed, replace it on the four metal standoffs protruding from the bottom of the PA chassis. See figure 6-5.

h. Connect the input wires to filament breaker S305. To do this, remove the breaker mounting screws from the front panel, lower the breaker, attach the wires, shove the breaker back in place, and replace the mounting screws. Phasing is important, so be sure tags agree.

i. Mount the filament transformers on the left-hand sidewall (viewed from rear) with T304 next to the front panel followed by T303, then T302. Notice the arrangement of the lugs and the form of the connecting wires, and mount the transformers to match.

j. The 21M requires an additional transformer T301 which should be installed in the front-center position of the cabinet base.

k. Install L309 in the front right-hand corner of the base.

l. Install C350 on the bracket which extends into the power supply cabinet (see figure 7-2).

m. For the 21M, put C351, C354, C355, and C356 in the shelf over L309.

n. Make all other base connections at this time. See figures 2-2 and 7-5.

o. Install the blower. See figure 7-1. Slide the canvas air duct down over the blower output opening, under the split clamp; then tighten the two screws of the split clamp.

CAUTION

Be absolutely sure this canvas is well clamped. The air force will exert some pressure against it, and tube damage will result if it comes loose at any point.

p. Set the clips on the PA grid, PA plate, and PA loading coils as indicated in the test sheet.

2.4.5 REASSEMBLY DETAILS OF DRIVER CABINET.

a. Perform step c of paragraph 2.4.2.

b. Replace the tank box in the top of the driver cabinet similar to steps b and f of paragraph 2.4.4. In this case, attach the HV strap to M102 also.

c. Set the PA TUNING and PA LOADING variable capacitors at minimum capacity. Turn the associated dials to 0. Slide the flexible coupler heads on their respective dial shafts, bolt the heads to the front panel, and tighten the setscrews. Refer to paragraph 2.4.2.f for instructions on gaining access to the front of the compartment.

d. Mount the heavy components in the base of the cabinet as shown in figure 6-3.

e. Refer to figures 6-3 and 2-2 as well as the tags on the cables in order to make all possible connections at this time.

f. Install and secure the large filter capacitors in their proper positions, as shown in figure 6-3, and make all connections to these units.

g. Remove the rear cover from the r-f output network, and set the taps on tuning coil L108 and loading coil L109 to the position shown in the test data. The Collins test department data sheet included with the transmitter contains a record of the driver network setup used for testing the driver at the factory. These conditions may not hold exactly under actual operating conditions.

h. Three r-f tank cans are associated with the oscillator, buffer, and r-f driver plate circuits. Refer to figure 3-1, and install the cans in their proper sockets.

i. Complete all internal connections, including interchassis cables and connections, to terminal boards E101 and E102 on the rear of the low voltage power shelf. Refer to installation connections diagram figure 2-2, to interunit cable diagram figure 7-3, and to tags on the wires for assistance in making the proper connections.

j. In order to extend the life of tubes and other components in the driver cabinet, an 8-inch ventilating fan is included with each unit. The fan mounts at the top of the ventilation screen on the inside of the rear panel. The two motor wires connect to terminals 12 and 13 on terminal board E102. As seen from the rear, these terminals are the two right-hand connections on the terminal board that is located near the left end of the low voltage power supply chassis. The fan is now connected across the 230-volt line to the filament transformers and will be energized when the filament circuits are energized.

2.5 Power Connections.

2.5.1 PRIMARY. The 230-volt 3-phase power connections connect to terminal block E201 in the base of the power cabinet. These wires were pulled through the left-hand grommet hole in step a of paragraph 2.4.2. Cut the wires to length, and attach to the terminals of E201 with the soldering lugs provided. The primary wires going to the exciter cabinet are cabled and enter the exciter cabinet from the power cabinet through the sidewall. These are already lugged and

tagged. Connect these two wires to terminals 1 and 3 of E100. Observe polarity. Terminal 2 of E100 is at ground potential.

Nine wires connect the high voltage power transformer T204 to connector blocks E202, E203, and E211. See figure 2-2. These wires enter the power cabinet through the right-hand 1-1/2-inch grommet. Cut these to length, and connect them to their terminations with solder lugs. Be very careful to observe correct phasing here. See cabling schematic, figure 7-4, and pictorial diagram, figures 2-2 and 2-3, for proper transformer connections. Incorrect phasing will result in shortened rectifier tube life.

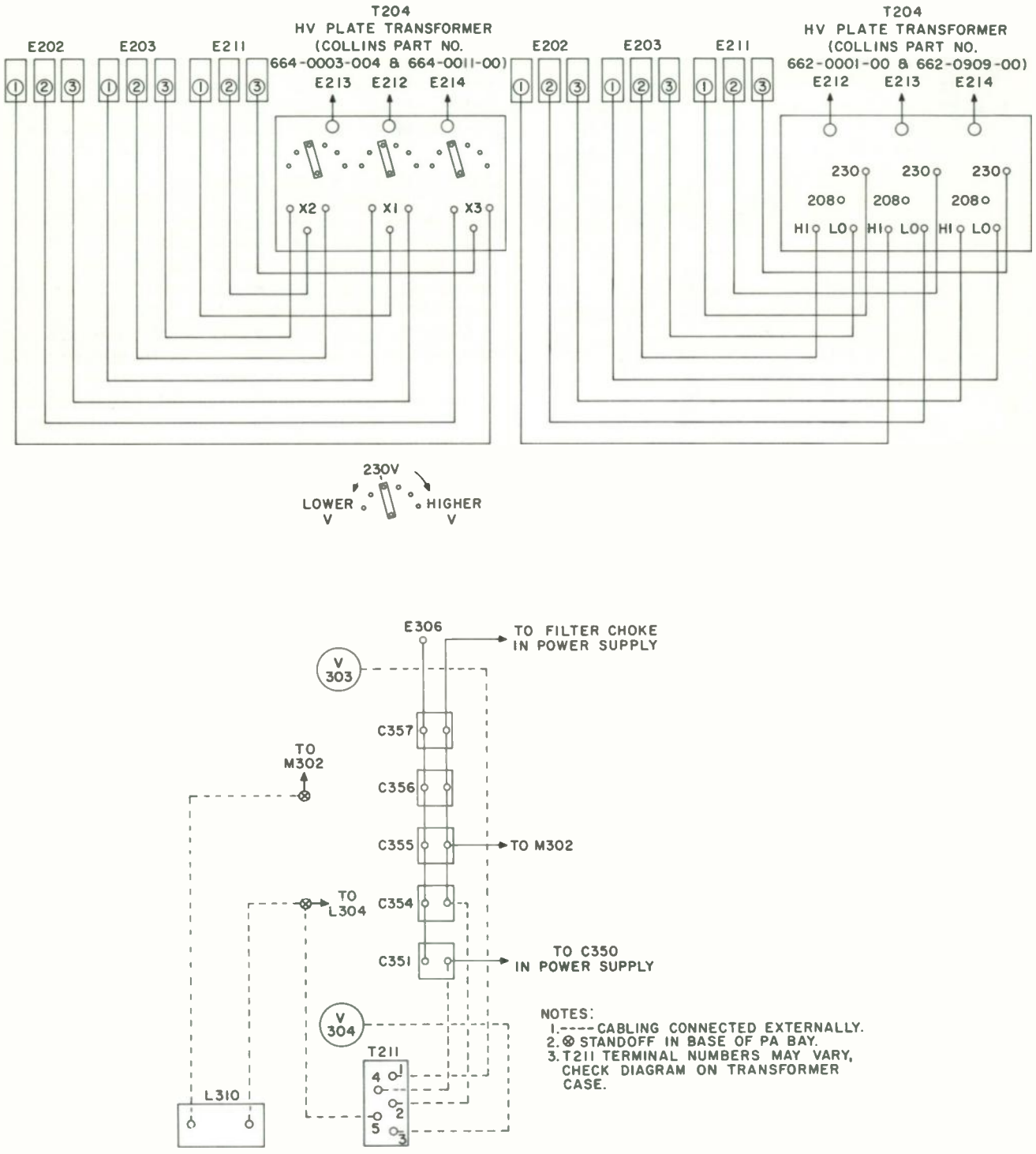


Figure 2-3. Cabling Details for HV Plate Transformer T204, and Cabling Connections to L310 and T211

2.5.2 HIGH VOLTAGE. The high voltage wires are the three long wires protruding through the right-hand grommet of the power cabinet. Cable these together, and run them up the rear of the cabinet next to the door to E212, E213, and E214. Connect these wires with soldering lugs.

CAUTION

Phasing of primary and secondary leads of high voltage transformer T204 is very important. Connect as shown by tags and schematic.

2.6 Ground Connections.

2.6.1 TRANSMITTER CABINETS. Each cabinet has a ground terminal to which the ground wire from the duct ground strap must be attached. In the exciter cabinet, use the center terminal (2) of E100.

In the power cabinet, the ground wire connects to E208, a stud in the bottom of the cabinet near the rear. In the amplifier cabinet, the ground wire attaches to any convenient choke or blower mounting screw.

2.6.2 POWER TRANSFORMER GROUND. Connect the ground wire provided in paragraph 2.3.4 to the frame of the power transformer.

2.7 Special Cabling.

2.7.1 PA GRID DRIVE. A long piece of RG-8/U cable carries the r-f from the output terminal of the driver cabinet through the sidewalls of the power cabinet, up through the rear edge of the blower pan, to standoffs E304 and E305 at the rear of the PA grid coil. The cable must be grounded at the tank box and at the ground connection on the upper supporting member on the inside of the driver cabinet.

2.7.2 MODULATOR GRID AND FEEDBACK. These wires, consisting of a shielded pair of high tension wires and a shielded pair of audio type wires pulled into a large insulating tubing, are coiled in the amplifier cabinet. They should be pulled through the sidewalls into the driver cabinet and routed to their terminations. Connect the audio type shielded pair to terminals 3, 4, and 5 of E103 (the shield to terminal number 3). (See figure 6-16.) Observe polarity as indicated by the attached tags. If the tags are missing, use a continuity meter to identify the wires. Connect one high tension wire to C190 and the other to C191 located on the rear of the front panel (orange-colored tubular capacitors). Observe polarity. Connect the shield of this pair to the ground screw on the side stiffener on the right-hand side (viewed from rear).

2.8 Inter-Unit Cabling Diagram.

The interunit cabling diagrams, figures 7-3, 7-4, and 7-5, show the parts of the transmitter in their general locations as viewed from the rear. Each section of these diagrams is enclosed by broken lines. These sections have been given section designation letters that appear in the upper right-hand corner of each dotted enclosure. Although wiring between transmitter units is not shown on the diagram, the destination of this wiring is indicated by numbers and letters that appear directly below the arrow heads as shown in figure 2-4. The numbers to the right of the lines above the arrow heads represent the type of wires used. The number directly to the right of each arrow head is the number of that point on the diagram and does not necessarily indicate that there is a terminal bearing that number at that point in the equipment. Where there are terminal boards with numbered terminals in the equipment, the terminals are represented on the diagram by small circles enclosing the number of the terminal. The terminal board is represented by a dotted line around all terminals on that board. Some sections of the diagram, such as section F, require that the terminal board in the diagram be broken to allow lines that do not terminate

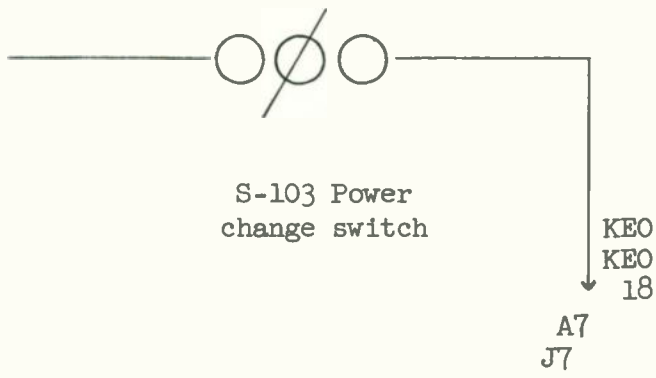


Figure 2-4. Interunit Cabling Example

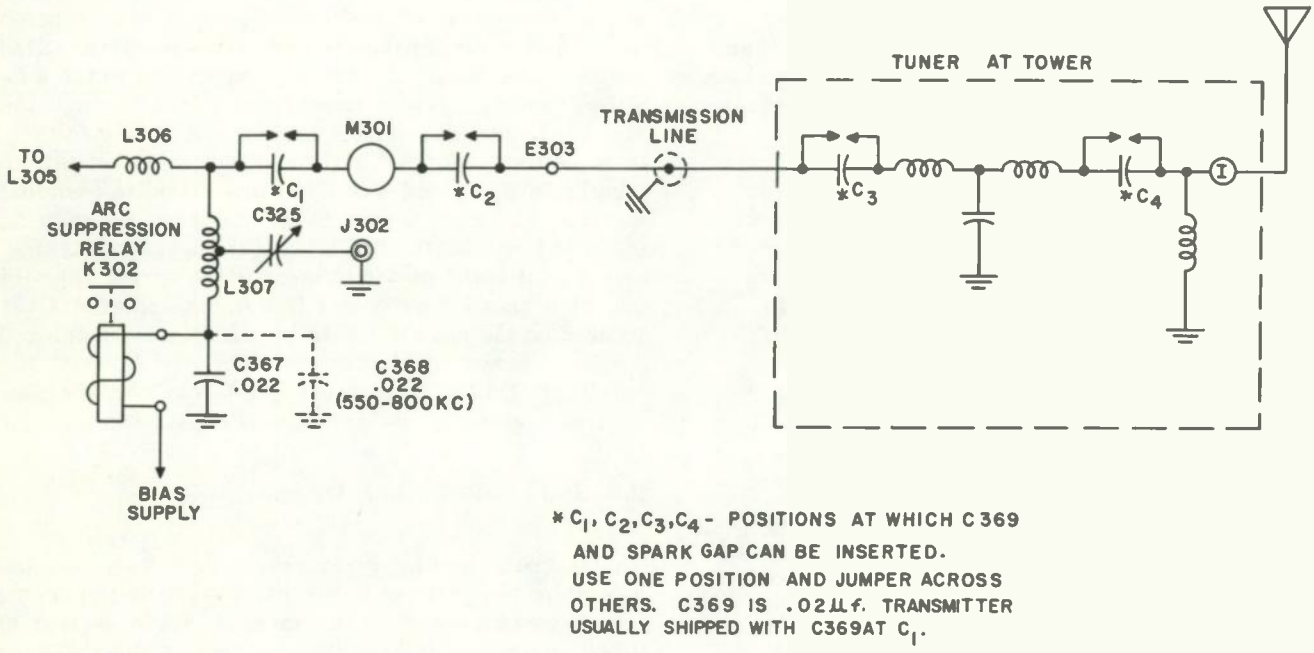


Figure 2-5. Arc Suppression Circuit

on that board to pass through the area on the diagram where the board is drawn.

A small portion of unit F from the interunit cabling diagram, figure 7-3, is shown in figure 2-4. The two KE0 designations indicate that two type KE0 wires leave this point. The K in KE0 indicates the type of wire (high voltage insulated cable). E indicates size of wire (#14). 0 indicates color of wire (black). If a tracer were used on this wire, an additional number would be added to indicate the color of the tracer. For example, if this wire were black with a red tracer, the designation would have been KE02. If a shield were used, the wire would be called KES02, the S indicating a shield. The color code used for wires and tracers is the same as that used for resistors and condensers. See tables 2-2 and 2-3 for list of wire types and wire sizes and color codes.

The number 18 shown beside the arrow head indicates that this is point number 18 on the schematic.

A7 indicates that one of the wires leaving this point on the diagram goes to point 7 on unit A of the diagram. J7 indicates that one of the wires leaving this point on the diagram goes to point 7 on unit J of the diagram.

When coaxial cable, copper straps, and other types of connecting materials except wires are used, the type of wire code is not used. Instead of using a code, the connecting material is specified by name on the diagram as in the case of the copper strap shown at point 1, unit C, of the interunit cabling diagram, figure 7-3.

Cable Identification Example:

A JAN Type WL, #22 AWG, shielded white wire with red Tracer would be labeled CAS92. A black #14 AWG neon sign cable would be labeled KE0. A breakdown of these two descriptions is shown below.

C	A	S
Type of Wire Jan Type WL	Size of Wire #22 AWG	Shielded
K	E	
Type of Wire Neon Sign Cable	Size of Wire #14 AWG	
9	2	
Color of Body White	Color of Tracer Red	
0		
Color of Body Black		

2.9 Audio Input Connections.

The audio signal should be brought into the transmitter cabinet on a shielded twisted pair. Use the audio input hole illustrated in figure 2-1 for these wires. The wires may be run up the rear corner channel, avoiding the hinges to prevent damage to the wires. The audio input connections are made to terminal board

TABLE 2-2
LIST OF WIRE TYPES

LETTER	TYPE OF WIRE
A	AN-J-C-48
B	Busbar, round tinned copper
C	JAN Type WL (600 volts)
D	Miniature
F	Extra-flexible varnished cambric
G	General Electric Deltabeston
K	Neon sign cable (15,000 volts)
N	Single conductor stranded (not rubber)
P	Single conductor stranded (rubber covered)
R	JAN Type SRIR (1000 volts)
V	JAN Type SRRV (2500 volts)

E103 located inside the lower shelf of the driver cabinet audio chassis. The location of this terminal board can be seen in figure 6-16. Connect the two leads of the twisted pair to terminals 1 and 2 of E103. Connect the shield to terminal 3 of E103.

2.10 R-F Output Connections.

See paragraph 2.3.6.

2.11 Frequency Monitor Connections.

Coaxial frequency monitor connector J104 is located on the bottom of the r-f chassis as shown in figure 2-2. The transmitter is shipped with a mating plug connected to J104. Bring a piece of RG-8/U coaxial cable through the proper hole in the floor of the cabinet as shown in figure 2-1. Connect the coax to the plug associated with connector J104.

2.12 Modulation Monitor Connections.

Coaxial modulation monitor connector J302 is supplied with the proper mating plug. Figure 2-2 shows this connector located on the top of the r-f output network box. Thread a piece of RG-8/U coaxial cable through the proper hole in the floor of the cabinet as shown in figure 2-2. Connect the coax to the plug associated with connector J302.

2.13 Audio Monitor Connections.

A shielded, twisted pair should be used for the audio monitor connections. Bring this wire through one of the monitoring lead holes in the bottom of the cabinet. These holes are indicated in figure 2-1. The audio monitor terminal board, E301, is located on the right-hand (viewed from rear) side wall of the amplifier cabinet about halfway up from the base. Connect one wire of the shielded twisted pair to the high terminal on E301. Connect the remaining wire and the grounded shield to the grounded terminal. Use extreme care in the routing of this wire to clear high voltage points associated with the modulator and feedback divider.

TABLE 2-3
LIST OF WIRE SIZES AND COLOR CODES

LETTER	SIZE OF WIRE (AWG)	NO.	COLOR OF WIRE OR TRACER
A	22	0	Black
B	20	1	Brown
C	18	2	Red
D	16	3	Orange
E	14	4	Yellow
F	12	5	Green
G	10	6	Blue
H	8	7	Violet
J	6	8	Grey
K	4	9	White
L	2		
M	1		
N	0		
P	00		
Q	000		
R	0000		

2.14 Over-All Inspection.

Before applying power to the transmitter, go over all connections, and see that they are tight. Check to see that cables clear high voltage conductors or points that may produce feedback. See that the tubes are seated firmly in their sockets and that all air seals are adequate. Be sure that phasing of power leads, filament transformers, and plate transformer are correct. Check fans and blowers to see that they rotate freely. Remove and inspect all fuses. Replace the top front panels to the three bays. See paragraph 2.4.2, step f.

2.14.1 ARC GAPS.

Inspect the arc gaps listed below for burrs, scratches, or sharp edges. If found, remove them with crocus cloth. Set gaps as follows:

a. Driver Bay

Plate tuning capacitor gap 5/16 to 21/64 inch.
Loading capacitor gap 1/16 to 5/64 inch.
Ant. coupling capacitor gap 1/32 to 3/64 inch.

b. PA Bay

Loading capacitor gap 9/64 to 5/32 inch.
Ant. coupling capacitor gap 1/16 to 5/64 inch.
Mod transformer primary gap 1/16 to 5/64 inch.
Mod transformer secondary gap 1/16 to 5/64 inch.

2.15 Initial Adjustment.

2.15.1 PREADJUSTMENT INSPECTION. (See paragraph 3.3 for control functions.)

a. Before starting the equipment for the first time, inspect it carefully to see that all filament and plate breakers are in the OFF positions and the power change switches are in the LOW position. Turn the FILAMENT powerstat to the counterclockwise position.

WARNING

Operation of this equipment involves the use of high voltages which are dangerous to life. Operating personnel should observe at all times proper safety precautions. Do not make adjustments inside the equipment with high voltage applied. Do not depend upon door interlocks for protection. Always shut down the equipment when making adjustments.

b. Remove the plate caps from the two 866A and two 872A mercury-vapor rectifier tubes, V113 through V116, in the driver cabinet and from the two 866A and the six 757A tubes in the power cabinet. Make sure that the plate caps hang free and are not near any metal parts, since large voltages are present.

c. Inspect all door interlocks. Press on the contact block until the spring is completely compressed. Release the pressure. If the contact block does not spring out to its original position, check the interlock carefully, and adjust it until it operates properly.

2.15.2 CONTROL CIRCUIT AND FILAMENT CHECK.

a. Prior to application of any plate voltage to the driver or power amplifier stages, a thorough check should be made on the control circuit and on the filament voltages.

b. Check the blower and filament breakers located in the PA bay and the filament breaker in the driver bay. No power should be applied as yet to the blower or the filaments. Now, pressing a FILAMENT button should immediately turn on the meter panel lights and blower B301. As the blower comes up to speed, filament contactor K303 should close, applying voltage to the filament transformer primary, illuminating the green panel light located next to the FILAMENT breaker in the power amplifier bay, and starting circulating fans B101 and B201. Assuming the filaments are all lighted, the next step is to adjust the filament voltage. This is done by rotating the 3-phase Variac T201 (see power supply bay, figure 3-1) clockwise to increase the voltage or counterclockwise to reduce it. Apply a voltmeter across a modulator filament, and adjust T201 for a 7.5-volt reading on this meter. The voltage on M201 should be approximately 230 volts; record the exact value for subsequent settings. (If any of the filaments are not lighted, check the fuses first when looking for the trouble.)

c. Having adjusted the filament primary voltage to approximately 230 volts, the filament voltages of all the tubes should be checked at the tube socket. In the event that any of the tube voltages vary by more than five per cent of the rated value, check the voltage between phases at the input of the transmitter. These voltages should be balanced as nearly as possible. Phase voltage unbalance will be the major cause of abnormal filament voltage.

d. Upon completion of the filament voltage adjustment, blower hold relay K305 should be adjusted to give a delay of three to five minutes from the time the FILAMENT OFF button is opened until the blower shuts off. The blower hold relay is the type in which air entering a bellows through a small adjustable orifice produces the time delay. The adjustment screw is on top of the relay which is located approximately in center of the PA cabinet relay enclosure. In adjusting the time of the delay, turn the adjustment screw in a clockwise direction to increase the time. At this point, a check should also be made in the operation of air interlock switch S304. This switch is located in the rear of the power amplifier bay. The best check is to open the blower breaker. When the air pressure in the tube chamber drops to the danger point, the switch should open, and filament contactor should drop out removing power to the filaments. As soon as the action has been checked, power should immediately be restored to the blower. When the blower is back up to speed, the air interlock switch will be closed again restoring voltage to the filaments. In the event that the air interlock switch does not operate properly, make a check on the air hose connections. One end of a hose must be firmly attached to the relay and the other forced through a hole in the air duct frame below the tube chassis.

e. The plate voltage time delay relay, K101, should be adjusted to give a delay of approximately 30 seconds. The delay time is controlled by potentiometer R171 located just below K101. Turning this control in a clockwise direction increases the length of time delay.

f. With all filament controls working properly and all doors closed, pressing driver plate ON button should energize K104 and K102 and light I104 providing time delay relay K101 has operated and I101 is lighted. Pressing plate ON button on final bay should then energize plate hold relay K206 and plate contactors K204 in middle bay. Red indicator light I304 on final bay should light.

g. At this point, a check should be made on the interlock system. Each door should be opened individually, and a check should be made to see that the high voltage final and drive plate contactors drop out. A similar check should be made on filament interlock relay K203 by operating this relay manually. After each check, it will be necessary to press plate ON button to restore contactors.

h. At this stage, a check can be made also on the overload circuit by operating the d-c overload relays K105, K106, K304 and K306 manually. Overload relays K304 and K306 should drop out only plate contactor K204. K105 and K106 should drop out both contactors

K102 and K204. Refer to paragraph 4.4.4 for details of overload circuit operation. Operation of arc-suppression circuits may be checked by manually operating K107 and K302. K302 should momentarily interrupt K204 (plate contactor); K107 should momentarily interrupt both K102 and K204.

i. This completes the check of the power circuit. Press the filament OFF button.

NOTE

Leave the filament and blower breakers ON. See note after step w.

j. Replace the plate caps on the 866A voltage rectifier tubes V113 and V114 (driver cabinet).

k. Rotate crystal selector switch S101 to the desired position. The location of this switch is shown in figure 3-1.

l. Press a FILAMENT ON push button (the filament and blower breakers must be ON first), and allow the transmitter to run for 20 minutes with only the filaments lighted. This operation is necessary in order to age the mercury vapor rectifier tubes properly. Aging is required for all new mercury vapor tubes and for old tubes that have been agitated or inverted.

m. Press the driver cabinet PLATE switch.

n. Rotate the driver multimeter switch through the first three positions, and check the readings with those given in table 3-1. The full-scale reading of the multimeter is indicated for each position of the multimeter switch.

o. Rotate the multimeter switch to the position designated 807 grid, 25 ma. It may be necessary to adjust C114 and C115, the first buffer tank circuit trimmers. The location of screwdriver adjustment for these two trimmers is shown in figure 3-1. They should be adjusted for maximum 807 grid current. These two trimmers are connected as shown in figure 7-2 for standard broadcast band. One of the trimmers should be adjusted to give a good tuning range with the second trimmer, and all adjustments made with the second trimmer.

p. Rotate the multimeter switch to the first buffer cathode position, and check the reading against table 3-1.

q. Rotate the multimeter switch to the PA grid position to check the adjustment of the 807 r-f driver plate trimmer capacitors, C125 and C126. The screwdriver adjustments for these trimmers are shown in figure 3-1. They should be adjusted for maximum power amplifier grid current. These two trimmers are connected in parallel as shown in figure 7-2 for the standard broadcast band. One of the trimmers should be adjusted to give a good tuning range with the second trimmer, and adjustments made with the second trimmer.

r. Turn off the plate and filament power and replace the plate caps on the 872A high voltage rectifier tubes, V111 and V112, in the driver cabinet and on the 866A and 575A tubes in the power cabinet.

s. Turn the two driver cabinet bias adjustment controls, R162 and R163, to the maximum counterclockwise position. This adjustment results in maximum bias and minimum audio driver tube plate current.

t. Turn driver cabinet power change switch S103 to the low position.

u. Set the driver amplifier loading to minimum by turning driver cabinet PA loading control C147 to 100 on the dial.

v. Close the transmitter rear doors.

w. Turn the blower and the filament breakers to ON.

NOTE

Leave the blower and filament breakers on hereafter. Use them as breakers and not as switches. Use the FILAMENT pushbuttons to turn the blower and filaments on and off. This is necessary to get the proper time delay and blower hold-on.

x. Press a FILAMENT pushbutton. After the warmup cycle (control circuit lamp lights) press the driver PLATE ON button.

NOTE

Look through the power cabinet window and see if there is a blue glow in the bias supply 866A rectifier tubes indicating the PA bias supply is working.

y. Adjust driver amplifier tuning control C146 for minimum driver amplifier plate current.

z. Tune the PA grid circuit to resonance as indicated by a rise in PA GRID CURRENT. Adjust the clips of L301 if necessary.

aa. Turn driver cabinet power change switch S102 to the high position.

ab. Increase the LOADING of the driver cabinet until the PA grid current reads approximately 160 ma for the 21E, or 220 ma for the 21M on the standard broadcast band, or 130 ma (21E) and 150 ma (21M) for the short wave broadcast. Try to duplicate the test data furnished with the transmitter. Retune the driver plate circuit each time a LOADING or GRID TUNING adjustment is made.

ac. Adjust audio driver bias controls R162 and R163 until 100 ma of audio driver plate current is drawn and the plates of two 4-125A audio driver tubes, V110 and V111, appear to be dissipating equal amounts of power.

ad. Turn off the driver plate current. (Press driver plate off button.)

ae. Turn the MODULATOR BIAS ADJUSTMENT controls to full counterclockwise position (highest bias).

af. Turn the PA LOADING dial to full capacity (100 on the dial). Set taps on L305 and L306 to position indicated on the test data sheet.

ag. Connect a sensitive oscilloscope to the transmitter output terminal or couple the oscilloscope to the PA tank coil with a loop.

ah. Turn the neutralizing capacitor two turns to allow r-f feedthrough. Remember in which direction the capacitor was turned.

CAUTION

Be sure the PA plate breaker is OFF, and not ON.

ai. Press the driver PLATE ON pushbutton.

aj. While observing the r-f pattern on the oscilloscope, adjust the PA PLATE tuning condenser for maximum r-f amplitude.

ak. By small steps, return the neutralizing capacitor toward the position from which it was turned in step ah. Watch the height of the pattern in the oscilloscope and adjust the neutralizing capacitor for minimum amplitude. The power amplifier is now tuned to resonance and neutralized.

NOTE

After transmitter is tuned up and operating, recheck neutralization by seeing if grid current peak occurs at plate current dip. Touch up neutralizing if necessary.

al. Turn the driver off, and remove the oscilloscope connection from the transmitter.

am. See that the transmission line with properly terminated antenna is connected to the output terminal.

an. With the power change switch in the low position, turn the power amplifier PLATE breaker to ON, press the PLATE ON pushbutton, (driver stage first and then final), and immediately re-establish plate circuit resonance as indicated by a dip on the PA PLATE current meter.

ao. Check the resonance of the grid circuit, and make a quick reading of all meters. If reasonably close to those in table 3-1, start loading the power amplifier by manipulation of the LOADING control with the taps of coil L306 set as indicated in the test data sheet. Changes in these two components will usually necessitate a readjustment of the PA TUNING control.

ap. Load the PA tubes to the values indicated in the test data sheets for low power. Adjust the PA grid current to the values shown in the test data sheets. This value is different for standard broadcast and short-wave bands.

aq. Turn the PA POWER LEVEL switch to the HIGH POWER position, and load the power amplifier to the values indicated on the test data sheet for high power.

ar. Adjust the two MODULATOR BIAS ADJUSTMENT controls, R335 and R336, until 200-ma cathode current is obtained on each tube as indicated by the PA cabinet multimeter.

WARNING

For proper operation and long life of the modulator tubes, do not run the static modulator plate current of each tube over 250 ma maximum.

as. Connect an oscilloscope to modulation monitoring jack J302, and obtain a workable pattern by adjusting the taps and condenser associated with L307, starting in a minimum position.

at. Gradually introduce (see warning below) a 1000-cps audio signal to the transmitter audio input terminals, and watch the modulator plate current indication. 100 percent modulation should occur at about 0.8-ampere plate current per tube for the 21E and 1.3 ampere for the 21M.

WARNING

When modulating the transmitter with test tones, do not run modulation levels over 50 percent modulation for longer periods of time than necessary to obtain data required. Prolonged periods of operating with test tones may damage or reduce the useful life of the modulator tubes. This is particularly true when modulating with tones of 5000 cps or higher or with tones of 100 cps or lower.

au. Remove the audio signal, and turn the POWER LEVEL switch to LOW.

av. Adjust R208 until 200-ma average static cathode current per tube is obtained on the modulator tubes.

aw. To change the setting of the r-f circuits overload relays, (see figures 6-8 and 6-19) remove the relay covers, turn the transmitter on, and load it to operating values. Gradually change the setting of the thumb screw in the driver relay K105, and momentarily run the driver amplifier off tune and watch the DRIVER PA plate current meter. Set the thumb screw at the desired drop-out point, retune to resonance, and replace the relay cover. Reset the flag by pressing the plunger at the bottom of the relay. Adjust PA overload relay K306 in a similar manner, but watch PA plate current.

ax. To change the setting of the audio driver and modulator overload relays, remove the relay covers, turn the transmitter on, and load it to operating values. Set the thumb screw in the same manner as for power amplifier overload adjustment (above), except introduce an audio sine wave at 3000 cps into the audio input, and run the gain up until proper overload drop out is established.

section 3

operation

3.1 Starting the Equipment.

3.1.1 ROUTINE. (See paragraph 3.3 for description of controls.)

a. Check to see that station exhaust fans (if used) are turned on.
b. Check to see that transmitter rear doors are closed.
c. Check to see that breakers are ON.

CAUTION

Leave the BLOWER and PA FILAMENT breakers in the ON position; this ensures full warmup cycle and cooling cycle. Use a FILAMENT pushbutton to turn the blower and filaments off.

d. Press a FILAMENT ON pushbutton.
e. Adjust FILAMENT PRIMARY to the voltage determined in paragraph 2.15.2.b.
f. Turn the POWER LEVEL control on the middle cabinet (right-hand control) to desired power level (dial pointer up or down for high power, to either side for low power).
g. Check to see that the desired crystal is in use. The right-hand crystal is selected when the switch is thrown to the right.
h. Press the driver PLATE ON pushbutton. Observe meter readings.
i. Press the power amplifier PLATE ON pushbutton.
j. Check all meter readings including all of the circuits that are read on the multimeter switches. Typical meter readings are listed in table 3-1.
k. Make all possible monitoring operations.
l. If adjustments are required, read paragraph 3.3.16 through 3.3.31.

3.1.2 TEST PERIODS.

During test periods, the equipment can be turned on by first following paragraph 3.1.1 to get the equipment operating, then by merely pressing the PA PLATE ON pushbutton; a sequence start will result. The time delay circuit will automatically allow proper filament heating and then automatically turn on the plate supplies without manipulation of any other control.

3.2 Stopping the Equipment.

3.2.1 EMERGENCY.

a. Press a FILAMENT OFF button.
b. Let the PA cabinet blower run for 2 to 5 minutes as controlled by the delay relay, except in most serious emergencies.
c. Open the power feed cutout, external to the transmitter, before entering to repair the circuit.

3.2.2 ROUTINE.

a. Press plate off buttons and, after short interval, press filament stop button. (The blower will continue to run from 2 to 5 minutes.)

3.3 Description of Operating Controls. (See figure 3-1.)

3.3.1 BLOWER BREAKER S303 (FAR RIGHT).

This breaker protects the tube cooling blower. This breaker is normally left on from day to day but is capable of automatically breaking the blower motor circuit if a heavy load is placed on this line. Never turn it off, especially if the blower is still running.

3.3.2 FILAMENT BREAKER S106 (FAR LEFT).

This is a magnetic type circuit breaker used to break the driver filament and control primary supply in case of a severe overload in these circuits. It also protects the control circuit.

3.3.3 FILAMENT BREAKER S305 (PA CABINET LEFT).

This breaker protects the filament circuits of the transmitter. When the blower is up to speed, air interlock switch S304 turns on the filaments of the power amplifier and modulator tubes. An overload in the filament circuits will automatically open this breaker or blow one of the filament protection fuses. Turning this breaker off will also turn off the plate supply of the PA, modulators, and bias supply as well as the plate supply of the driver. This circuit breaker should normally be left in the ON position to ensure proper warm up.

TABLE 3-1. TYPICAL METER READINGS, BROADCAST BAND

SWITCH	SWITCH POSITION	METER	METER READING
	21E and 21M Driver		
Multimeter	1ST AUDIO CATH. 25 MA.	Multimeter	4 ma
Multimeter	OSC. CATH. 25 MA.	Multimeter	5 ma
Multimeter	1ST BUFF. GRID. 2.5 MA.	Multimeter	0.2 ma
Multimeter	1ST BUFF. CATH. 25 MA.	Multimeter	7.5 ma
Multimeter	807 GRID 25 MA.	Multimeter	2 ma
Multimeter	807 CATH. 250 MA.	Multimeter	45 ma
Multimeter	P.A. GRID 25 MA.	Multimeter	17 ma
Driver Power Change	HIGH	Mod plate current (driver)	120 ma
Driver Power Change	HIGH	PA plate voltage	2700 volts
Driver Power Change	HIGH	PA plate current (driver)	65 ma
Multimeter	P.A. GRID CURRENT 250 MA. (low power) (high power)	Multimeter	 155 ma 150 ma
Multimeter	REAR MODULATOR CATHODE 2.5 AMP. (low power, no signal) (low power, 100% mod at 1000 cps) (high power, no signal) (high power, 100% mod. at 1000 cps)	Multimeter	 0.2 amp 0.390 amp 0.200 amp 0.725 amp
Multimeter	FRONT MODULATOR CATHODE 2.5 AMP. (all values identical to the rear mod cathode values)	Multimeter	
	21E		
Multimeter	FRONT PA CATHODE 2.5 AMP (low power) (high power)	Multimeter	 0.55 amp 1.3 amp
Power Change	LOW (no signal) HIGH (no signal) LOW (100% Mod 1000 cps) HIGH (100% Mod 1000 cps)	Mod plate current	0.4 amp 0.4 amp 0.78 amp 1.45 amp
Power Change	LOW HIGH	PA plate voltage	2300 volts 5100 volts
Power Change	LOW HIGH	PA plate current	0.55 amp 1.3 amp
	21M		
Multimeter	PA GRID CURRENT, 250 MA (low power) (high power)	Multimeter	 210 ma 200 ma

TABLE 3-1. TYPICAL METER READINGS, BROADCAST BAND (Cont)

SWITCH	SWITCH POSITION	METER	METER READING
	21M (Cont)		
Multimeter	REAR MOD CATHODE, 2.5 AMP (low power, no signal) (low power, 100% mod 1000 cps) (high power, no mod) (high power, 100% mod 1000 cps)	Multimeter	 0.2 amp 0.8 amp 0.2 amp 1.25 amp
Multimeter	FRONT MOD CATHODE 2.5 AMP (all values indentical to the rear mod cathode values)	Multimeter	
Multimeter	FRONT PA CATHODE 2.5 AMP (low power) (high power)	Multimeter	 1.0 amp 1.3 amp
Multimeter	REAR PA CATHODE 2.5 AMP (same as front PA cathode)		
Power Change	LOW (no signal) HIGH (no signal) LOW (100% mod 1000 cps) HIGH (100% mod 1000 cps)	Mod plate current	0.4 amp 0.4 amp 1.2 amp 2.5 amp
Power Change	LOW HIGH	PA plate voltage	3600 volts 5100 volts
Power Change	LOW HIGH	PA plate current	2.0 amp 2.6 amp

3.3.4 FILAMENT ON PUSHBUTTONS.

The FILAMENT ON pushbuttons normally are open, spring-return switches. As shown in the control circuit diagram, figure 4-2, operation of a FILAMENT ON pushbutton energizes the filament contactor to energize the meter lights and control circuit for the transmitter. When the BLOWER and PA FILAMENT circuit breakers are ON, the FILAMENT ON pushbutton will also energize all filaments, low voltage bias, fans, blower, and start the plate delay cycle.

3.3.5 FILAMENT PILOT LIGHT I304 (ADJACENT TO PA BREAKER).

This green lamp indicates when power is being applied to the primaries of the PA filament transformer.

3.3.6 FILAMENT VOLTAGE CONTROL T201 (POWER CABINET LEFT).

Controls the primary voltage of all filament transformers in the power and power amplifier cabinets. This primary voltage, indicated on FILAMENT PRIMARY METER, should be 230 volts.

3.3.7 THERMAL TIME DELAY ADJUSTMENT R171 (DRIVER RELAY ACCESS).

The thermal time delay relay contains a heating element, a bimetallic strip, and a set of contacts. As shown in figure 4-3, the time delay relay contacts are in series with the plate hold contacts K104, K105, and K106 and the coil of plate relay K102. The temperature within the relay affects the bimetallic element and causes the contacts to open or close. Thermal inertia of the heating element and bimetallic strip causes the time delay relay to select automatically the proper time delay interval after power interruptions. If the power is removed for an instant and then returned, there will be no delay period as the bimetallic element will not have cooled sufficiently to open the contacts. Also, the filaments will not have cooled to the point where a warm up period is necessary. This is a distinct advantage over the more common time delay systems which provide a set delay period regardless of the temperature of the tube filaments, and therefore prevent operation of the transmitter until the standard time delay has passed, even though the power interruption was momentary and the filaments remain at operating temperature.

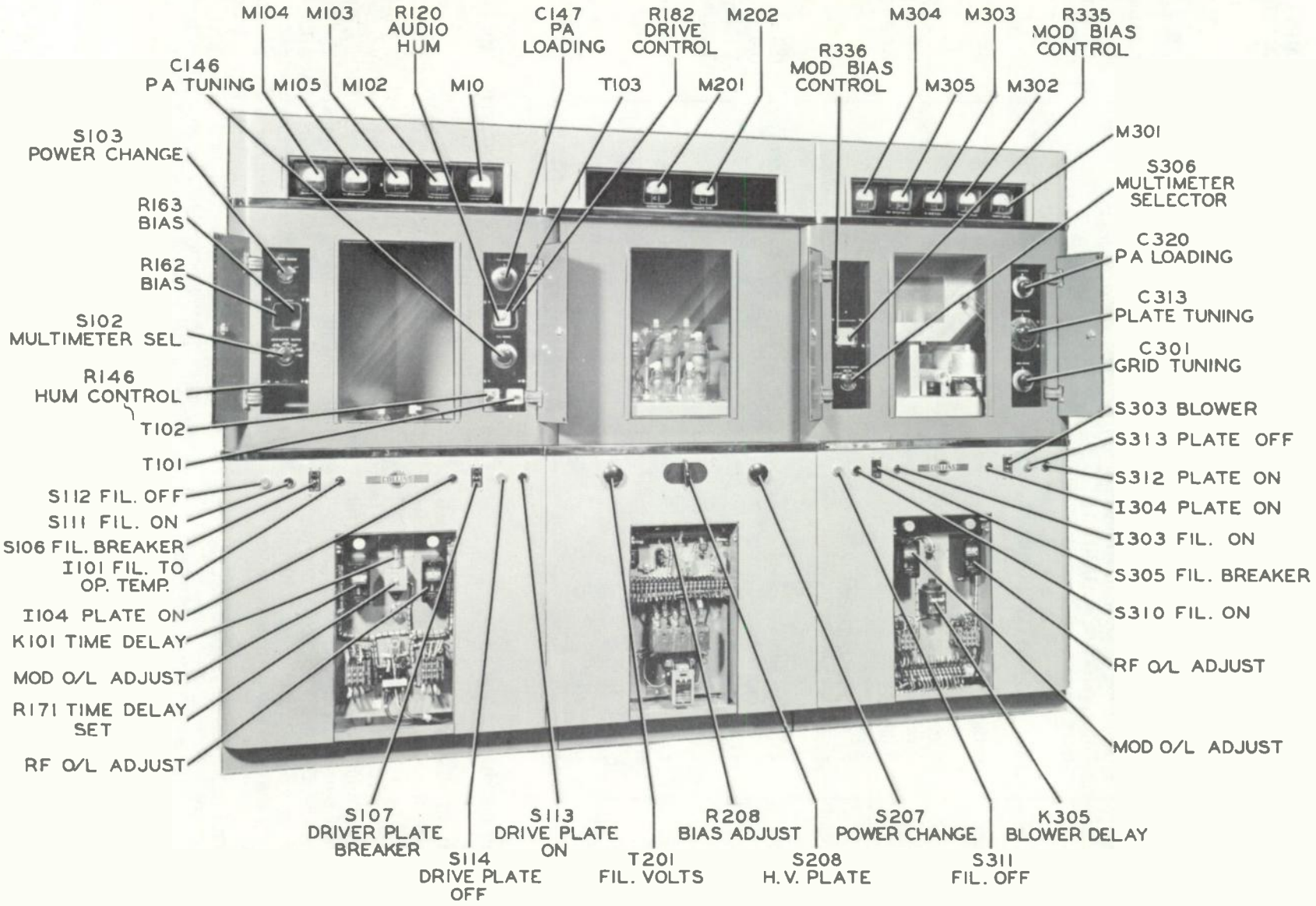


Figure 3-1. 21M Operating Controls and Parts Arrangement, Front View

The thermal time delay relay provides the quickest possible return to the air after a power interruption. When the plate contractor contacts close, they place resistor R172 in shunt with the relay heater element and relay adjustment R171 to reduce the current through the heater while the transmitter is on the air.

3.3.8 FILAMENT CIRCUIT PILOT LIGHT I101 (DRIVER CABINET LEFT).

This green pilot light is energized when the filament time delay cycle is finished. It indicates that the tubes are ready for application of plate voltage.

3.3.9 DRIVER PLATE BREAKER S107 (DRIVER CABINET RIGHT).

The driver plate breaker, S107, is a magnetic-type breaker similar to the filament and blower breakers. It protects the power transformers in case of severe overload in these circuits.

3.3.10 DRIVER PLATE ON PUSHBUTTON S114.

Pressing this normally open switch will energize the driver plate contactor, K102, providing the filament circuit has been energized long enough to actuate the time delay relay, K101. When plate contactor K102 operates, the driver plate and PA bias supplies are turned on, and plate pilot lamp I104 is illuminated.

3.3.11 DRIVER PLATE PILOT LIGHT I104 (DRIVER CABINET RIGHT).

The driver plate pilot light (red) is energized upon application of primary voltage to the driver plate transformer, HV bias transformer, and PA plate contactor K204.

3.3.12 PA PLATE PUSHBUTTON S312.

This pushbutton has a triple function. First, it is used to turn on the PA plate supply only (when the driver has been turned on by means of the filament and plate pushbuttons). Second, it can be used to orignate a sequence start, in which case the driver FILAMENT and PLATE pushbutton need not be pressed, but the entire transmitter will turn on automatically with the proper circuits being energized at the proper intervals. Third, this pushbutton is also used as an overload reset button in case an overload in the PA or modulator plate circuits turns off the transmitter.

3.3.13 MULTIMETER SWITCH S102 (DRIVER).

Multimeter switch S102 is a two-pole, eight-position switch located behind the left door on the front of the driver cabinet as shown in figure 3-1. This switch inserts multimeter M104 into any one of eight driver circuits. Table 3-1 lists the multimeter switch positions and typical readings for these circuits. The full scale reading of the multimeter is indicated for each switch position.

3.3.14 MULTIMETER SELECTOR SWITCH S306.

This switch is located inside the left-hand enclosure of the power amplifier front panel. It selects the circuit to be metered by MULTIMETER M304. Circuits metered are PA GRID CURRENT, REAR MODULATOR CATHODE, FRONT MODULATOR CATHODE, FRONT PA CATHODE, and REAR PA CATHODE (position 5 is used in the 21M only).

3.3.15 HIGH POWER-LOW POWER S207 (POWER CABINET, RIGHT).

This switch selects high power or low power operation by changing taps on the plate transformer. High power is selected when the knob points straight up or down; low power is selected when the knob points to either side.

3.3.16 HIGH VOLTAGE BREAKER S208 (POWER CABINET CENTER).

This breaker is in the primary circuit of the HV plate transformer. Upon a heavy overload in the transformer primary circuit, it removes the primary voltage automatically. This is a magnetic circuit breaker and can be reset immediately after the overload is cleared.

3.3.17 HIGH VOLTAGE PILOT LIGHT I304 (PA CABINET, RIGHT SIDE).

This pilot lamp lights when primary voltage is being applied to plate contactor K204.

3.3.18 MODULATOR BIAS ADJUST R335, R336.

These adjustments are located inside the left-hand enclosure of the power amplifier front panel. They consist of two identical variable potentiometers which individually adjust the bias of each modulator tube. Adjust for static cathode current balance of the modulator tubes as indicated on MULTIMETER M304. Static cathode current of each tube for 5 kw should be 200 ma (adjust for high power operation) and for 10 kw should be 200 ma (adjust for high power operation).

3.3.19 BIAS ADJUST R208.

This resistor, a wire-wound semi-adjustable resistor, is located at the top of the power cabinet relay enclosure. R208 is in the primary circuit of the PA and modulator bias supply transformer. Adjust this resistor when on low power for approximately 200 ma per tube modulator static plate current.

3.3.20 POWER CHANGE SWITCH S103.

Power change switch S103 is located behind the left door on the front of the cabinet as shown in figure 3-1. A resistor is connected in series with the high voltage to the r-f driver amplifier plate circuit. Power change switch S103 is connected to short this

resistor for high power operation, and remove the short for tuning operation. This switch is for initial tuning and may be used when large corrections of tuning are necessary; otherwise, it is always used in the HIGH power position.

3.3.21 FIRST R-F BUFFER TANK CIRCUIT TRIMMERS C114, C115.

The first buffer tank circuit trimmers, C114 and C115, are screwdriver adjustments located behind the lower right inspection plate. The location of these two trimmers is shown in figure 3-1. They should be adjusted for maximum grid drive to the 807 r-f driver stage. The trimmers are connected in parallel as shown in figure 7-2. One of the trimmers should be adjusted to give a good tuning range with the second trimmer.

3.3.22 807 TANK TRIMMERS C125, C126.

C125 and C126, the 807 plate circuit trimmers, are screwdriver adjustments located behind the upper right inspection plate. The location of these two trimmers is shown in figure 3-1. They should be adjusted for maximum grid drive to the driver amplifier. The trimmers are connected in parallel as shown in figure 7-2. One of the trimmers should be adjusted to give a good tuning range with the second trimmer, and all adjustments made with the second trimmer.

3.3.23 R-F DRIVE CONTROL R182.

R-f drive control R182 is a screwdriver adjustment located behind the upper right-hand inspection plate as shown in figure 3-1. It is used to vary the 807 screen voltage in order to regulate the grid drive applied to the r-f driver amplifier. Drive control R182 should be adjusted to hold the 4-125A grid current to below 20 ma.

3.3.24 DRIVER CABINET POWER AMPLIFIER TUNING AND LOADING C146 and C147.

The driver amplifier plate circuit tuning and loading controls C146 and C147 are located behind the right-hand door on the front of the driver cabinet as shown in figure 3-1. The PA TUNING control is used to resonate the power amplifier plate circuit. An increase in PA grid current, once the PA grid circuit is resonated, is obtained by reducing the capacity of PA LOADING capacitor, C147, while simultaneously returning the power amplifier plate circuit to resonance by means of the PA TUNING control. Initial tuning should be done with the driver cabinet POWER CHANGE switch in the LOW position. Recheck these controls for possible reaction after the PA GRID has been tuned.

3.3.25 GRID TUNING C301.

This control is the bottom knob inside the right-hand enclosure of the power amplifier cabinet front panel. This control tunes the grid circuit of the power amplifier. Tune for maximum indication on the MULTIMETER with the switch in the PA GRID CURRENT position. PA grid current should be approximately 150 ma for 21E and 200 ma for the 21M in the broadcast band. See test data sheets for short-wave band.

3.3.26 POWER AMPLIFIER PLATE TUNING AND LOADING CONTROLS C313, C320.

The power amplifier plate circuit tuning and loading controls, C313 and C320, are located behind the right-hand door on the front of the transmitter cabinet as shown in figure 3-1. The PA tuning controls are used to resonate the power amplifier plate circuit. An increase in loading is obtained by reducing the capacity of the power amplifier loading capacitor, C320, while simultaneously returning the power amplifier plate circuit to resonance by means of the PA tuning control. With a pi-L output network of the type used in the 21E/M transmitter, any adjustment of the PA loading control will detune the output network and cause the plate current to soar. Care must be exercised to keep the power amplifier tuning at resonance when the PA loading control is adjusted. The loading should be increased until the r-f line current is slightly less than the desired value. The PA tuning control should then be adjusted slightly to the side of resonance that gives an increase in r-f line current. The power amplifier plate current will also increase; however, the increase in power to the r-f line constitutes a large proportion of the increase in power to the power amplifier circuit, thus yielding a higher plate efficiency. Adjust the PA tuning and PA loading controls to the point where the desired amount of r-f line current is obtained with the highest operating efficiency. The highest efficiency will always be obtained with the power amplifier plate circuit slightly detuned. Neutralizing capacitor C310, located between the two power amplifier tubes, does not require readjustment.

3.3.27 CRYSTAL SELECTOR SWITCH S101.

Crystal selector switch S101 is located in the center of the area behind the lower right inspection plate as indicated in figure 3-1. The switch shaft is slotted for screwdriver operation. When the switch is turned clockwise, the crystal toward the right side of the chassis (as viewed from the front of the transmitter as in figure 6-12) is selected.

3.3.28 CRYSTAL FREQUENCY TRIMMER CONTROLS C101, C102.

Crystal frequency trimmer controls C101 and C102 are located behind the lower right inspection plate as indicated in figure 3-1. These two controls provide for small adjustments in the crystal frequency. C101, the upper control, adjusts the frequency of Y101 the left-hand crystal as seen from the front of the transmitter.

3.3.29 AUDIO DRIVER BIAS ADJUSTMENTS R162, AND R163.

Audio driver bias adjustments R162 and R163 are located behind the upper left inspection plate as indicated in figure 3-1. These two screwdriver adjustments control the amount of negative bias applied to the grids of the individual driver tubes. Turning the controls clockwise increases the amount of bias applied to the tubes. To adjust these two controls, first turn them completely clockwise; then turn on the driver plate supply, and alternately adjust one control and then the other 30 ma at a time until 130 ma MODULATOR PLATE CURRENT (driver cabinet) is obtained. Then adjust these controls for minimum distortion when adjusting the transmitter for minimum distortion. The audio driver plate current will normally be 125 to 150 ma. R149 may be adjusted to give good range with R162 and R163.

3.3.30 AUDIO HUM CONTROLS, R120 AND R146.

Audio hum controls R120 and R146 are screwdriver adjustments. R120 is located behind the upper right inspection plate of the driver cabinet as shown in figure 3-1. R146 is located behind the lower left inspection plate. They are variable resistors used to shift the ground point of the driver amplifier filament circuit and the audio driver filament circuit to points which will minimize the hum caused by the a-c filament voltages.

In order to adjust audio hum controls R120 and R146, inject a 1000-cycle audio signal of sufficient amplitude to modulate the carrier 100 percent. Calibrate a noise meter, remove the modulation, and read the noise level. Adjust audio hum control R146 first; then adjust R120 to reduce the noise level.

3.3.31 OVERLOAD ADJUST K105, K106 (DRIVER CABINET RELAY ENCLOSURE).

The value of overload dropout is adjusted by the thumbscrews within the relay front covers. The flags show that the relays have been operated. The relays do not lock out but the flags do. Press the push-rods to reset the flags.

3.3.32 OVERLOAD ADJUST K304, K306 (PA CABINET RELAY ENCLOSURE).

These relays are adjusted similarly to K105 and K106, see paragraph 3.3.31 above.

section 4

theory of operation

4.1 R-F Section.

As a result of major advances in crystal stability and oscillator design, the use of a crystal oven and its associated thermostats, relays, and other controls is no longer necessary. A highly perfected oscillator design in conjunction with extremely stable, low temperature coefficient crystals has resulted in exceptionally good frequency stability. There are provisions for mounting two crystals on the r-f chassis, with one of the two always available in a standby condition. Crystals are easily selected by means of the crystal selector switch located behind the right-hand control panel.

All r-f circuits of the 21E/M are extremely straightforward and trouble free. A 6AU6 oscillator and 6SJ7 buffer are followed by an 807 amplifier which drives parallel 4-125A tubes in the driver amplifier. The driver amplifiers excite a pair of parallel 3X2500A3 power amplifier tubes in the 21M. The oscillator, buffer and r-f driver plate circuits are contained within shielded plug-in units located behind the right front access door of the driver cabinet. For frequencies in the AM broadcast band, the oscillator employs a resistive load. As the 21E/M is also available for high frequency applications, provisions are included for replacing the resistor with a tuned tank circuit for frequency doubling. A frequency monitor connection is brought out from the grid circuit of the driver amplifier.

The r-f output network consists of a pi-section followed by an L-section and is designed to feed into impedances between *50 and 72 ohms. Harmonics are greatly attenuated in this network. There is a minimum of fundamental frequency loss between the power amplifier and transmission line. Coil L307 acts as a static drain and as a voltage source for feeding the modulation monitor.

4.2 Audio Section.

The first audio stage employs pentode-connected 6SJ7 tubes in push-pull class A amplifiers. The input to the audio system consists of a terminating pad that feeds the primary of the audio input transformer. Type 4-125A tubes are used in the push-pull class A audio driver. The 4-125A audio drivers are resistance coupled to the grids of a pair of 3X3000A-1, push-pull, class AB_1 modulator tubes. Approximately 12 db of feedback is provided from plates of the modulator tubes of grids of the first audio stage.

*Other impedances are available on special order.

4.3 Power Supplies.

The driver unit has separate power supplies for high voltage, low voltage, and bias. The high voltage supply employs two type 872A half-wave mercury vapor rectifiers in a single-phase, full-wave circuit. It supplies d-c voltage for the plates of the audio drivers and the plates and screens of the r-f driver tubes. The low voltage supply uses two type 866A half-wave mercury vapor rectifiers in a single-phase, full-wave circuit to provide d-c voltage for plates and screens of the low power stages and for screens of the audio driver tubes. The bias supply employs a 5U4G high vacuum rectifier in a single-phase, full-wave circuit. It supplies bias to the 807 amplifier audio driver and r-f driver amplifier tubes, and d-c voltage for arc-suppression circuit.

Overload protection is provided by magnetically operated circuit breakers and by fuses in the primaries of the filament, low voltage, and bias transformers. Opening of any of the above-mentioned magnetic circuit breakers will result in the plate power being removed from the power amplifier and modulation stage.

A thermal time delay is included in the control circuit to prevent application of plate voltage before the filaments reach operating temperature. A unique feature of this circuit is its ability to select automatically the proper time delay interval after short power interruptions. Instantaneous interruptions cause no delay in returning to the air.

Dual interlocks, both electrical and mechanical in nature, are incorporated on each of the rear doors to provide double protection to personnel. The electrical interlocks, which are of the split-V type, open primary circuits of the high and low voltage transformers when the rear doors are opened. The mechanical interlocks close after the electrical interlocks have opened the primary circuits. The power supplies essential for operation of the r-f power amplifier and modulator stages consist of a bias supply and a high voltage plate supply.

The bias supply consists of a rectifier filament transformer, T202, which is excited simultaneously with application of transmitter filament power; a full-wave

plate transformer, T203, which is excited upon application of plate power to the driver cabinet; a pair of 866A rectifiers; and a suitable chock input filter. Variable resistor R208 in the primary lead of T203 is shorted out by contacts of bias change relay K205, when the transmitter is operating high power. K307 inserts additional bleeder resistor R339 to reduce modulator bias on low power. R335 and R336 are individual bias controls for modulator tubes in both high and low power positions. (See figure 4-1.) The value of bias for the r-f power amplifier tubes is predetermined by voltage dividers R338 and R339. The output voltage of this supply is minus approximately 1200 volts.

The high voltage supply employs a 3-phase bridge rectifier arrangement with the primary and secondary of the high voltage transformer connected in a delta configuration. High-power to low-power change is accomplished through selection of primary taps with HIGH-LOW POWER switch S207. Six 575A mercury vapor rectifier tubes are used in the bridge circuit. A choke input filter consisting of L202, C201, C202, C203, and C204 is used in the 21E. In the 21M, choke L203 is paralleled with L202 and capacitors C354, C355, and C356 are added.

When the rear doors of the power cabinet are opened, the high voltage and bias supplies are disabled by interlock switch S201, and the high voltage leads from plate transformer T204 are shorted to ground by S204 and S205; also, the filter capacitors are shorted by S203, and the bias supply filter is shorted by S202. When the PA cabinet rear doors are opened, the high voltage supply is disabled by S301 and S302; the high voltage filter capacitors are shorted by S308 and S309; and the bias supply filter is shorted by S307 and S310. These interlocks and shorting switches are similar in construction to those on the driver cabinet.

Overload protection is provided by magnetically operated circuit breakers in the filament, blower, and plate input lines. In addition, each filament transformer and the bias plate transformer is protected by a suitable fuse. The power amplifier and modulator tubes and circuits are also protected by means of individual plate current overload relays.

4.3.1 PRIMARY CIRCUITS.

4.3.1.1 FILAMENT. (See figure 4-1.) T201, FILAMENT ADJUST, is a 3-phase, 230-volt, adjustable autotransformer used to adjust the primary voltage to all the filament transformers in the power and final bay.

The filament transformers of the driver cabinet are excited from phase 1 and 2 of the line. The filament transformers of the remainder of the 21E/M are excited from the three phases of T201, the load being equally divided between each phase as nearly as possible. The secondary of T201 connects to the primaries of the filament transformers through suitable protective fuses. The primary of T201 connects to the 230-volt phase input line through filament relay K303 and FILAMENT breaker switch S305. Filament relay K303 closes after FILAMENT breaker S106 of the driver cabinet and BLOWER switch S303 have been thrown ON and a FILAMENT ON pushbutton has been pressed to start tube cooling blower B301. Blower B301 actuates air interlock switch S304 which closes the relay coil circuit to energize filament relay K303. (See figure 4-2.) The contacts of K305 keep the blower turned on during the time the filament contactor is energized, and, because of the time delay feature of this relay, these contacts keep the blower turned on for 3 to 5 minutes after the filament contactor is de-energized. This ensures that the tubes will not be damaged because of a delayed rise in temperature when the transmitter is shut down.

4.3.1.2 PLATE. (See figure 4-1.) The 3-phase, 230-volt current to excite plate transformer T204 flows first through HV BREAKER switch S208, then through high voltage contactor K204 and through HV-LV switch S207. S207 is connected to select primary taps for power-change. Paragraph 4.4.3 explains the circuit to get high voltage contactor K204 energized.

Plate transformers T108 and T110 of the driver cabinet are excited by 230-volt, single-phase current from the power source (terminals 1 and 2 of E201) through PLATE breaker switch S107 (driver cabinet) and plate relay K102. Paragraph 4.4.3 explains how K102 is energized.

4.4 Control Circuits.

4.4.1 GENERAL.

Two types of circuit control are available; namely, the usual step-by-step manual start and a semi-automatic sequence start. The control circuits may be interrupted by any of the methods listed below with the results indicated.

a. Pressing either FILAMENT OFF button drops all holding circuits and turns off all circuits except the PA blower. Opening filament breaker S106 drops all holding circuits and turns off all circuits including the PA blower.

b. Pressing DRIVER PLATE OFF button, opening any door interlock, or experiencing an overload in the driver modulator (audio driver) or PA (r-f driver) stage will permanently open all plate relays.

c. Pressing FINAL PA PLATE button S313 opens final plate relay only.

d. Arc suppression relay K107 in driver r-f circuit opens driver plate relay K102 and final plate relay K204. The driver relay resets immediately, the PA relay after a very short interval because a turn-on cycle is initiated at relay K202.

e. Arc suppression relay K302 in the final r-f circuit opens only the final plate relay, K204. This relay resets after a short interval because a turn-on cycle is initiated at relay K202.

f. An overload in the driver plate circuits opens all plate relays and requires manual reset. The fastest reset would be pressing the PA PLATE ON button.

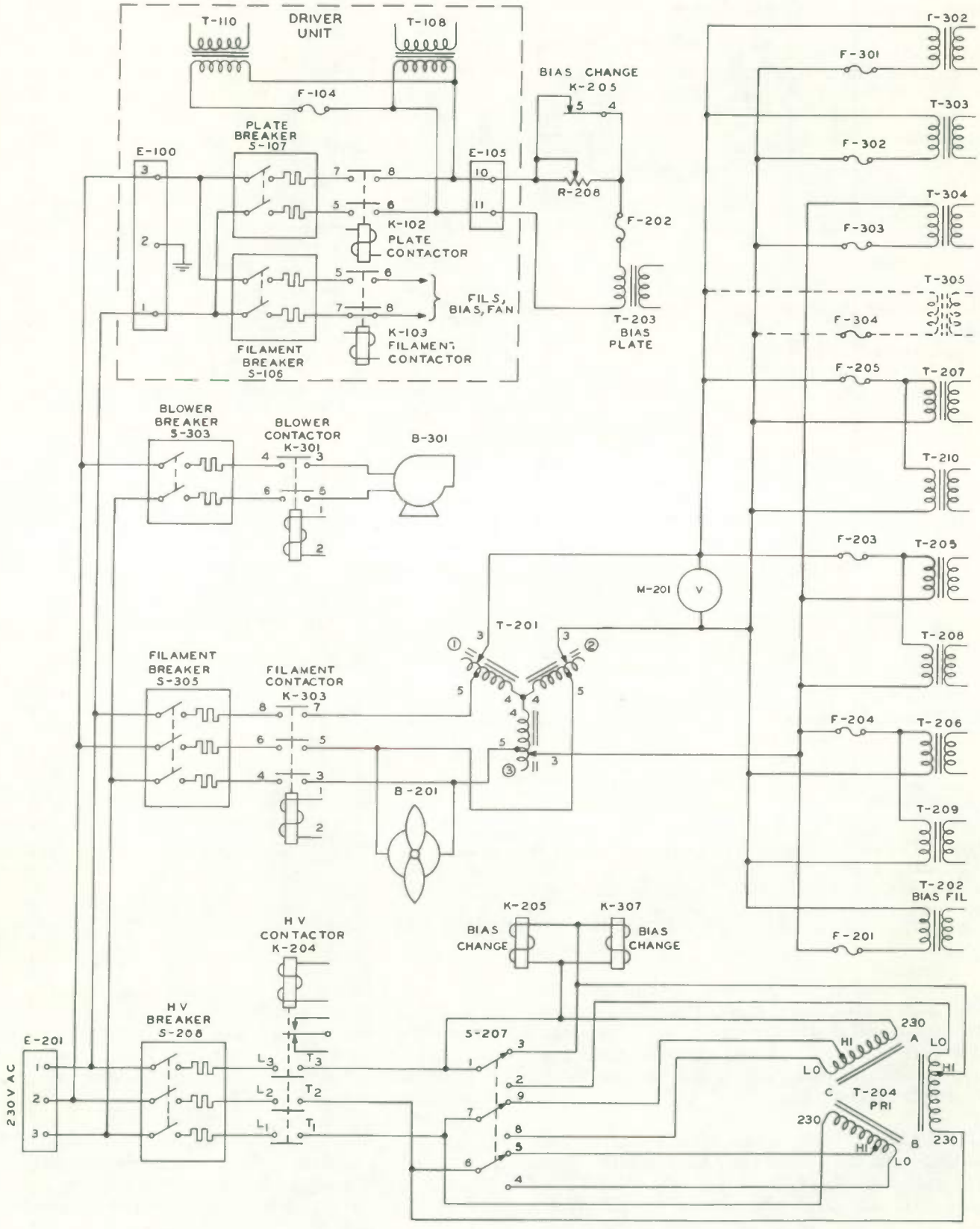


Figure 4-1. Primary Power Circuits

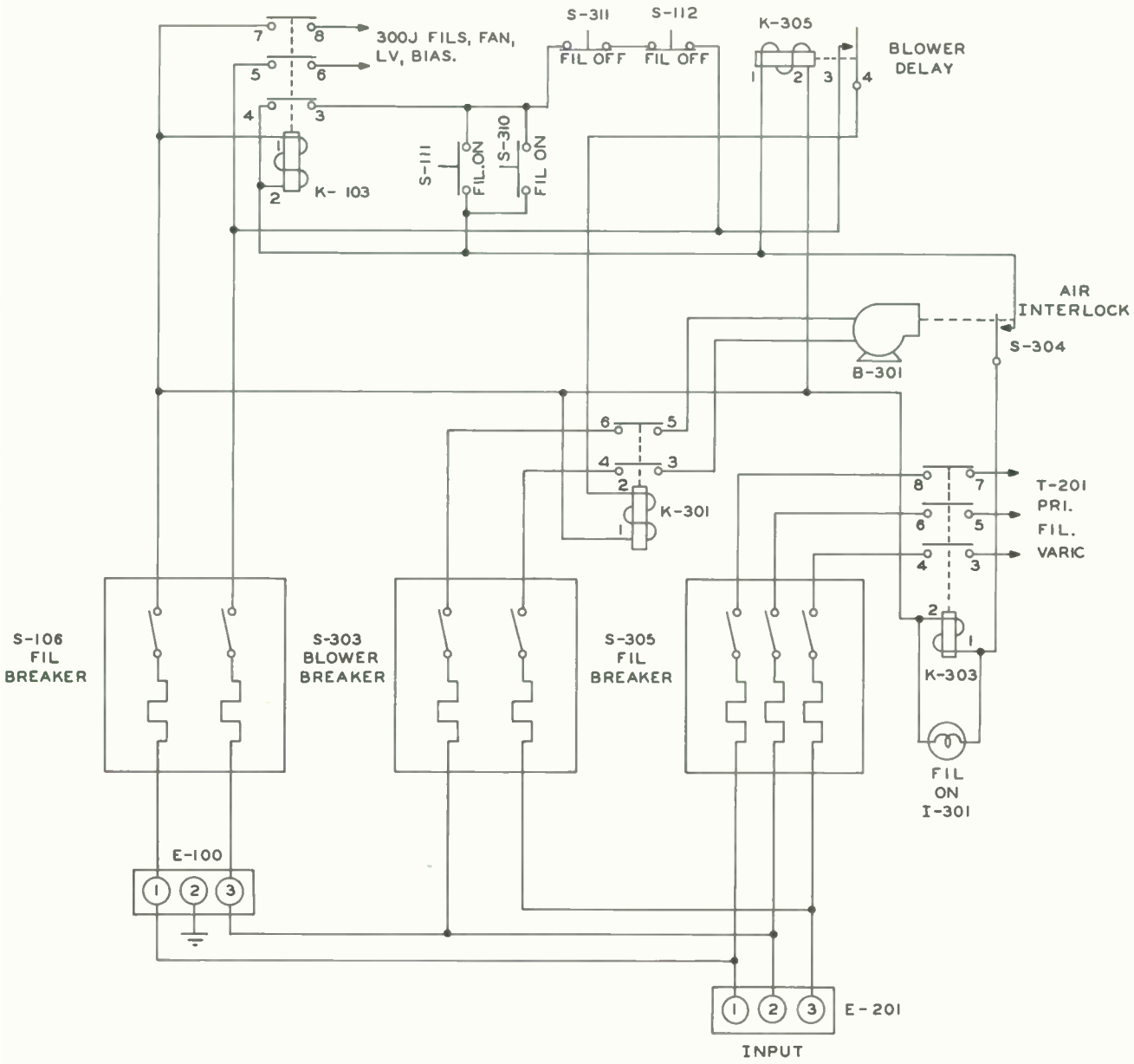


Figure 4-2. Filament Control Circuits

g. An overload in the PA plate circuits opens just the PA plate relay, and if of short duration, an automatic circuit will return the plate power. If of permanent nature, the overload will again open the plate relay, remove its hold circuit, and turn off the PA plate supply permanently.

4.4.2 FILAMENT. (See figure 4-4.) Phase A is applied to the coil of filament relay K103 directly. Phase B is applied to the coil through FILAMENT OFF buttons S112 and S113 when either FILAMENT ON button S111 or S310 is pressed. When filament relay K103 closes, contacts K103-3 and 4 bridge the FILAMENT ON buttons and hold the filament relay. The filaments of the driver stages immediately light, and the blower hold relay K305 is energized to apply power to blower contactor K301. When the air stream is at nearly full pressure, air interlock switch S304 closes to energize PA filament contactor K303. Blower hold relay K305 is a bellows type in which air, entering a bellows through a small orifice, creates the time lag which keeps the blower operating for a short period after the PA filaments have been turned off to ensure complete cooling of the tubes. Simultaneously with the application of driver filament power, time delay relay K101 begins to heat by virtue of phase A being directly applied to pin 3 of K101 and phase B being applied to pin 2 from K103-3 through R173 and R171. When K101-5 and 7 close, filament-at-operating-temperature lamp I101 lights, and plate

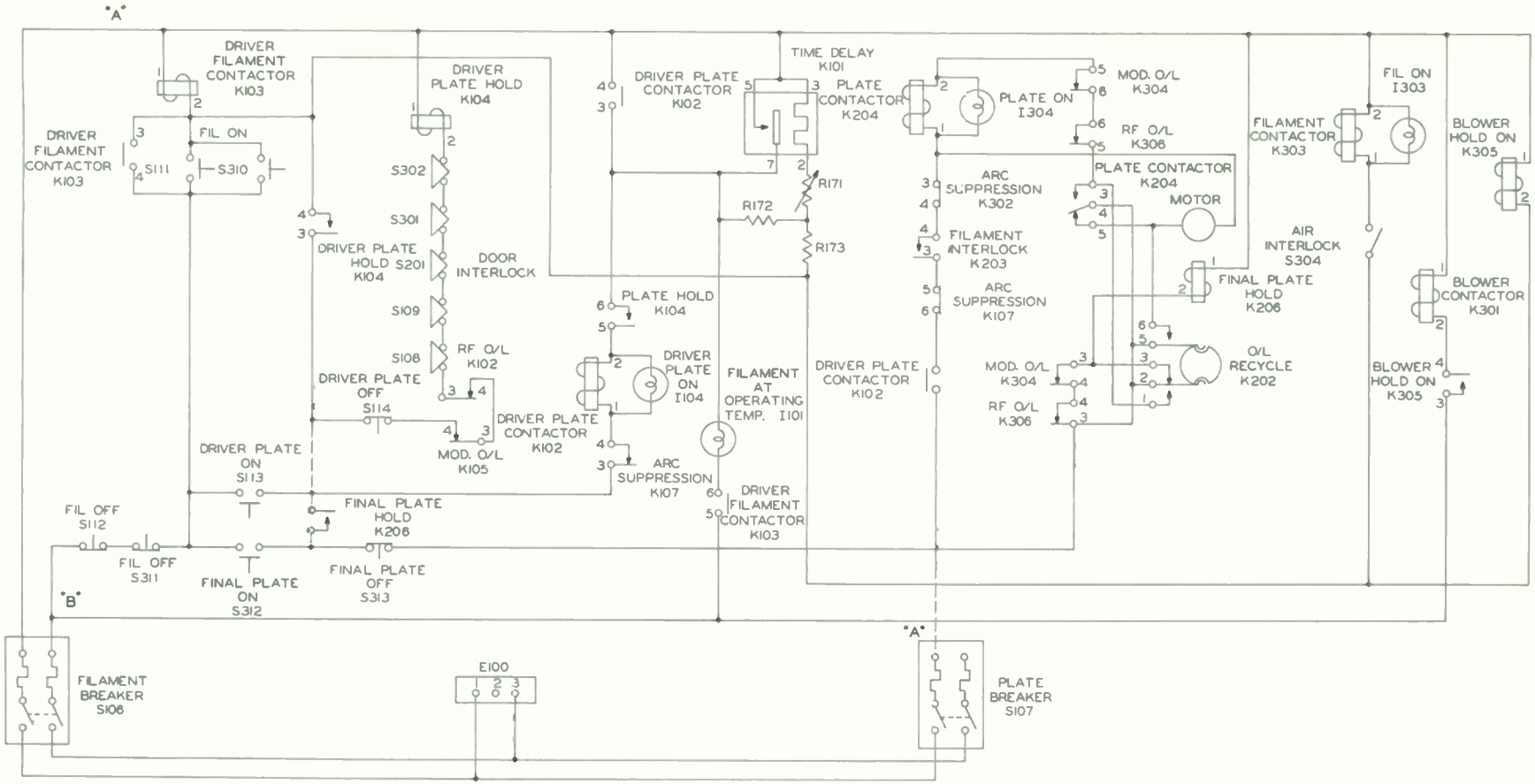


Figure 4-4. Control Circuits, Simplified

power can now be applied. R172 is connected to form a voltage divider with R173 to reduce the heat in K101 after it has operated.

4.4.3 PLATE. (See figure 4-4.)

In the manual start, the driver plate is applied first, then the PA plate is applied. Pressing DRIVER PLATE ON button S113 applies phase B to driver plate contactor K102 through arc suppressor contacts K107-3 and 4. Phase A is applied through time delay K101-5 and 7 and plate hold K104-5 and 6. (Plate hold relay K104 is operated simultaneously and hold by its own contacts K104-3 and 4.) When the DRIVER PLATE button is released, driver plate contactor is held by applying phase B through the FILAMENT OFF buttons, S112 and S311, K103-4 and 3, K104-4 and 3 and arc suppression relay K107-3 and 4. Contacts 3 and 4 of driver plate contactor K102 shunt K101-5 and 7 so that the coil of K102 does not depend upon K101-5 and 7 for phase A. Driver plate ON lamp I104 lights.

To get the final plate relay K204 operated, final plate hold relay K206 must first operate. Phase A is applied directly to the coil of K206. Phase B is applied through FILAMENT OFF buttons S112 and S311, FINAL PLATE ON button S312, FINAL PLATE OFF button S313, and overload relays K306-3 and 4, K304-3 and 4. Final hold relay K206 is then held by phase B being applied at the junctions of S312 and S313 from a source through K206-3 and 4, K104-3 and 4, K103-3 and 4, and the FILAMENT OFF buttons. The plate contactor, in all cases, is actually turned on by contacts 1 and 2 of motor-driven overload recycling relay K202. To start the motor of K202, phase A is applied through driver plate contactor interlock contacts K102-5 and 6, arc suppression relay K107-5 and 6, arc suppression relay K107-5 and 6, filament interlock relay K203-3 and 4, and arc suppression relay K302-4 and 3. Phase B is applied through FILAMENT OFF buttons S112 and S311, K103-4 and 3, K104-4 and 3, K206-4 and 3, S313, and K204-4 and 5. The motor of K202 now starts and is held by K202-5 and 6. Contacts K202-1 and 2 now close and apply phase B to plate contactor K204 through overload relays K304 and K306, contacts 5 and 6. Phase A is supplied to K204 by the same circuit that supplied phase A to the motor of K202. The motor of K202 will now rotate until a depression in the cam is found by K202-5 and 6, then it will stop. Plate relay K204 is then held by its own contacts K204-3 and 4 and by virtue of all interlocks and the final plate hold relay K206 being closed. In addition to final plate contactor being energized, PLATE ON lamp I304 is lighted. Pressing any FILAMENT OFF will destroy the plate hold circuits and turn plate and filaments off. Pressing the PA PLATE OFF button will release both PA plate contactor K204 and PA plate hold relay K206. Opening arc suppression relays K107 or K302 or driver plate relay K102 will release only plate contactor K204.

In the automatic sequence start, a complete start may be had by pressing the PA PLATE ON button. In succession, the driver filaments and blowers will come on, the PA blower will come on, the PA filaments will come on, and then the driver plate and PA plate will come on. (Refer to figure 4-4.) Pressing the PA PLATE ON button will energize PA plate hold relay K206 by the circuit at phase B of S112, S311, S312, S313, K306-3 and 4, K304-3 and 4, to the relay coil. Phase A is connected directly. This relay is held by its contacts K206-3 and 4, which are responsible for energizing of driver plate hold relay K104 through S112, S311, S312, K206-3 and 4, S114, K105-4 and 3, K106, 4 and 3, S108, S109, S201, S301, S302 to the coil of K104. Contacts 3 and 4 of driver plate hold relay K104 now energize driver filament contactor K103 to light all filaments and start the heater element of time delay relay K101. Contacts K104-3 and 4 now become K104 holding contacts. Now, because the two plate hold relays K104 and K206 are already operated and held, the driver plate will come on at the end of the K101 delay period, and contacts 5 and 6 of driver plate contactor K102 will start a PA plate turn-on cycle by energizing the motor of K202.

A partial automatic turn-on involving only the driver is accomplished by pressing the DRIVER PLATE ON button, S113. Pressing this button energizes the driver plate-hold relay K104 which then energizes filament contactor K103 and locks itself at contacts 3 and 4. Now, because hold relay K104 is already operated, the plate then comes on after the usual warmup cycle.

4.4.4 OVERLOAD CIRCUITS. (See figure 4-4.)

In paragraph 4.4.3 above, it was shown how the PA plate power was turned on by relay K202. Should an overload occur and open K304-5 and 6 or K306-5 and 6 and drop out PA plate relay K402, contacts K204-4 and 5 will close and start the motor of K202; contacts K202-6 and 5 will close to again energize PA plate relay K204. Final plate hold relay, K206 will hold through the first overload because K202-2 and 3 are in parallel with the series contacts (3 and 4) of overload relays K304 and K306. Should another overload occur while K202 is running, contacts K202-2 and 3 will now be open and when the overload relays K304 and K306 open, contacts 3 and 4 will no longer be paralleled, and K206 will have to release. K206-3 and 4 will then open and turn off the PA plate supply permanently. Should an overload occur in the driver stage, K105 or K106 will open and de-energize plate hold relay K104 which will, in turn, de-energize PA plate hold relay K206, and both plate supplies will turn off. The fastest way to return to the air would be to press the PA PLATE ON button, S312.

4.4.5 ARC SUPPRESSION SYSTEM.

Refer to the control circuit schematic, figure 4-4. Contacts 3 and 4 of K107 are connected in series with the coil of driver plate contacts K102. Contacts 5 and 6 of K107 and 3 and 4 of K302 are connected in series with the coil of plate contactor K204. Should an arc

occur in the driver plate circuit, K107 would open and momentarily turn off both high voltage supplies. Contacts 7 and 8 of K107 break cathode return from 4-125A in driver bay to prevent plate current surge due to time constant of power supply if plate tuning capacitor arcs. Should an arc occur in the power amplifier plate circuit, K302 would open and momentarily turn off only the power amplifier-modulator plate supply. See figure 2-5. The coil of K107 is connected between a voltage source and the driver output network. Anytime an arc occurs at one of the arc gaps, a ground is applied to the relay coil through the ionization stream of the arc, and the relay is pulsed to turn off momentarily the plate power supplies. The coil of K302 is connected similarly except that an arc gap can be connected at the tower network also. In event an arc is produced by either the output network or the transmission line, the relay would be energized, and the power amplifier-modulator plate supply would be turned off momentarily.

section 5

maintenance

NOTE

This transmitter has been constructed of materials considered to be the best obtainable for the purpose and has been carefully inspected and adjusted at the factory in order to reduce maintenance to a minimum. To ensure peak performance and prevent failure or impairment of operation, adhere to a definite schedule of periodic checks and maintenance procedures.

5.1 Routine Maintenance.

5.1.1 CLEANING.

5.1.1.1 GENERAL. The greatest enemies to uninterrupted service in equipment of this type are dirt and corrosion. Corrosion is accelerated by the presence of moisture and dust. In certain localities it is impossible to keep moisture out of the equipment, but dust can be removed periodically by means of a soft brush or a dry oil-free jet of air. There is always a slight accumulation of dust in the vicinity of high voltage circuits. Remove dust as often as a perceptible quantity accumulates at any point in the equipment. It is very important to keep the moving parts, such as tap switches, free of dust in order to prevent undue wear. In general, it will be found that tap switch contacts, tube prongs, and cable connectors are most affected by corrosion. When the equipment is operated near salt water or in other corrosive atmospheres, switches, cables, plugs, and other parts should be inspected and cleaned more frequently in order to keep the equipment in operating condition.

Check all connections at least each month. Tighten any nuts, bolts, or screws that may have become loose. The contacts of cable connectors should be checked to ensure clean, firm, mechanical and electrical connections. Interlock switches should be inspected and cleaned weekly. Moving parts, such as tuning controls, should be checked regularly for excessive wear.

5.1.1.2 AIR FILTERS. The transmitter is furnished with permanent type air filters which should be cleaned whenever a perceptible quantity of dust and dirt accumulates on the filter element. A single type of filter is used in all three bays. Replacement air filters may be ordered from Collins Radio Company under part number 009-1069-00.

To remove the filters from the PA modulator bay for cleaning, slip the cover directly to the rear, and lift out the filters. To remove the filter from the power supply or driver cabinet, remove the filter top retainer strip from the rear of the cabinet, slide the filter to one side, and lift it out the rear of the cabinet.

To clean the air filters, first remove the heavy dust accumulation with a vacuum cleaner. The dust should be removed from the side opposite that of air flow. After the heavy dust accumulation is removed, pass a fine stream of water through the filter opposite that of air flow. With most of the dust and dirt removed from the filter, wash the filter in a solution of hot water and detergent. After the filter is reasonably dry, lower the filter into a container of SAE number 10 oil, remove, and let the filter drain until oil ceases to drip from the filter. Replace the filters into the three bays.

5.1.1.3 PA AND MODULATOR TUBES. Once every week, remove the PA and modulator tubes, and clean the accumulated dust from the cooling fins. To do this, direct a blast of clean, dry air through the fins from the top of the tube. At this time, check to see that the filament cooling hoses are clean and clear of the sidewall.

CAUTION

When replacing the tubes, see that they seat properly to prevent air leaks. Be sure the hold-down clip is on to ensure good electrical connection. See paragraph 2.4.2.

5.1.2 LUBRICATION. The bearings and pulleys on each flexible condenser drive cable should be lubricated at two points with SAE No. 30 oil at least once each month.

The bearings of the two ventilating fans are sealed in oil and do not require lubrication.

The PA cabinet blower motor employs wool-packed bearings. Fill the oil cups with SAE No. 10 motor oil upon installing the blower; then check the bearings for heat at one-week intervals, and establish a schedule. Maintain this schedule thereafter.

5.1.3. ROUTINE TUBE MAINTENANCE. Do not abuse tubes by operating them above their ratings. Keep a record of the length of time the tubes are in use. A check on the emission of all tubes should be made at least every 1000 hours of service. Replace tubes that have been in service for a long time. Spare preaged mercury vapor rectifier tubes should be available for immediate replacement purposes. In order to have these tubes ready for emergency use, they should be placed in the equipment during off-the-air hours and run for twenty minutes with only the filaments lighted. This will remove the mercury coating from the tube elements. The tubes should then be removed carefully from the equipment and stored in an upright position in a place where there is no possibility that they will be inverted or agitated. When preaged tubes are placed in the equipment they should be handled carefully in order to avoid the additional twenty minute waiting period that will be required if mercury is allowed to come in contact with the tube elements.

5.2 Trouble Shooting.

The most frequent cause of trouble in equipment of this type is tube failure. Check the tubes by replacing them with tubes that are known to be good and noting any change of performance. Low emission tubes may be the cause of erratic or poor performance of the equipment. If there is any doubt concerning the emission of a tube, it should be checked. Tube failure may cause distortion or hum. A tube suspected of causing this difficulty may be checked by replacing it with a tube that is known to be in good condition.

If the transmitter fails to start, circuits should be checked in the order in which they are made operative. The primary control circuit diagram, figure 4-1, should be of assistance in locating trouble in the primary circuits. Table 3-1, typical meter readings, and table 5-1, typical voltages and currents, are supplied as a reference of typical voltages and currents in the average 21E/M. A list of typical readings of all panel meters of the individual transmitter should be made as an aid to rapid trouble shooting.

5-2 Refer to figures 7-1 and 7-6 for internal connecting of the r-f tank circuits and for transformer details.

5.3 Adjustments.

5.3.1 AIR INTERLOCK SWITCH S304. To adjust air pressure switch S304, remove cover of microswitch, assembly and locking wire from knurled adjustment knob. Adjust knob so that filament contactor operates slightly before blower reaches full speed.

5.3.2 BLOWER HOLD RELAY K305. The time delay action of K305 is produced by air entering a bellows through a small adjustable orifice. Excessive dust in the air may have a detrimental effect on the operation of this relay. Should the time delay period repeatedly get shorter, the relay should be removed from the transmitter and an inspection be performed to locate air leaks. The adjusting screw is on top of the relay.

5.3.3 OVERLOAD RECYCLING RELAY K202. This unit consists of a pair of snap switches operated by a motor-driven cam. See figure 3-1. The right-hand switch contains contacts 5 and 6 which must close before contacts 1 and 2 (in the left-hand switch) and must break after contacts 1 and 2. In addition, the roller arm of contacts 5 and 6 must ride up off the cam valley far enough to prevent motor momentum from reclosing the switch immediately after completion of the cycle. The holes in which the two switches are mounted are slotted at a slight angle so that, by loosening the mounting screws, the switches may be moved slightly in any direction.

5.4 Replacement of Parts.

5.4.1 METERS. To replace a meter, the entire meter panel must be removed. Access to the meter panel retainer screws may be had through the top front panel. See paragraph 2.4.2.f.

First, remove the top front panel; then reach through the opening and remove the heavy strap connections from the rear of the r-f and plate current meters. Disengage the meter panel connector, and then remove the panel mounting screws. Carefully lower and remove the meter panel.

5.4.2 CIRCUIT BREAKERS. The circuit breakers of the driver and PA cabinets are inaccessible from the rear, but they are not difficult to replace. This operation requires the services of two men. While one man is supporting the breaker by its connecting wires from the rear, the other man should remove the breaker front panel mounting screws. When the screws are removed, lower the breaker and remove the wires. Connect the new breaker, and shove it back up in place; then have the other man insert and tighten the panel screws.

5.5 Ordering Replacement Parts.

When ordering replacement parts for any Collins equipment, address the Product Support Division, Collins Radio Company, Service Division, Dallas Texas. Be sure to state the type and serial number of the equipment, the item number and part number of the part required (obtain item numbers and part numbers from the parts list), and the quantity desired. Additional information on ordering replacement parts is included inside the front cover of this book.

TABLE 5-1. TUBE VOLTAGE AND CURRENT MEASUREMENTS

SYMBOL DESIG.	TUBE TYPE	FUNCTION	NORMAL OPERATING CHARACTERISTICS
		21M	
		R-F Section	
V101	6AU6	Crystal oscillator Pierce circuit	Plate 270 volts Crystal current 1.8 ma Cathode current 4 ma
V102	6SJ7	Buffer amplifier class C	Plate voltage 280 volts Screen voltage 130 volts Grid Current 0.1 ma Cathode current 6.5 ma
V103	807	Intermediate amplifier class C	Plate voltage 530 volts Screen voltage 130 volts Grid current 1 ma Cathode current 75 ma
V104, V105	4-125A	R-f driver amplifier class C (parallel operation)	Plate voltage 2700 volts Screen voltage 220 volts Plate current 100 ma Grid current 22 ma
V302	3X2500A3	Final amplifier class C	10,600 Watts: Plate voltage 5100 v, Plate current 2.8 A, Grid current 230 ma 5500 Watts: Plate voltage 3600 v, Plate current 2.0 A, Grid current 200 ma
		Power Supply Section	
V110	5U4G	Bias rectifier, single phase, full wave, choke input	Output from Filter 100 volts 100 ma
V113, V114	866A	Low voltage rectifier single phase, full wave, choke input	Output from Filter 530 volts 250 ma
V111, V112	872A	Intermediate voltage rectifier, single phase full wave, choke input	Output from Filter 2700 volts 360 ma
V201, V202	866A	Modulator and r-f amplifier, bias voltage, single phase full wave, choke input	Output from Filter 1100 volts 200 ma
V204 thru V208	575A	High voltage rectifier, three phase, full wave, choke input	Output from Filter 5000 volts 5.5 amp

TABLE 5-1. TUBE VOLTAGE AND CURRENT MEASUREMENTS (Cont)

SYMBOL DESIG.	TUBE TYPE	FUNCTION	NORMAL OPERATING CHARACTERISTICS		
		Audio Section			
V106, V107	6SJ7	Audio amplifier, pentode connected, push-pull, class A	Plate voltage Plate current	300 volts 2 ma per tube	
V108, V109	4-125A	Audio driver amplifier push-pull, class A	Plate voltage Cathode current	2700 volts 125 ma	
			10,600 watts	5500 watts	
V303, V304	3X3000-A1	Modulator, push-pull, class AB_1	Plate voltage Cathode current, 2 tubes, 0 signal. Cathode current, 2 tubes, 100% modulation at 1000 cps	5100 v 0.4 amp 2.5 amp	3600 v 0.4 amp 1.2 amp
		21E			
		R-F Section			
V101	6AU6	Crystal oscillator Pierce circuit	Plate Crystal current Cathode current	270 volts 1.8 ma 4 ma	
V102	6SJ7	Buffer amplifier class C	Plate voltage Screen voltage Grid current Cathode current	280 volts 130 volts 0.1 ma 6.5 ma	
V103	807	Intermediate amplifier class C	Plate voltage Screen voltage Grid current Cathode current	530 volts 130 volts 1 ma 75 ma	
V104, V105	4-125A	R-f amplifier class C (parallel operation)	Plate voltage Screen voltage Plate current Grid current	2700 volts 220 volts 100 ma 22 ma	
			5500 watts	1100 watts	
V301	3X2500-A3	Final amplifier class C	Plate voltage Plate current Grid current	5100 v 1.3 A 175 ma	2300 v 0.55 A 150 ma

TABLE 5-1. TUBE VOLTAGE AND CURRENT MEASUREMENTS (Cont)

SYMBOL DESIG.	TUBE TYPE	FUNCTION	NORMAL OPERATING CHARACTERISTICS
		Power Supply Section	
			Output from Filter
V110	5U4G	Bias rectifier, single-phase, full wave, choke input	100 volts 100 ma
			Output from Filter
V113, V114	866A	Low voltage, rectifier single-phase, full wave, choke input	530 volts 250 ma
			Output from Filter
V111, V112	872A	Intermediate voltage rectifier, single-phase, full wave, choke input	2700 volts 360 ma
			Output from Filter
V201, V202	866A	Modulator and r-f amplifier, bias voltage, single phase, full wave, choke input	1100 volts 200 ma
			Output from Filter
V204 thru V208	575A	High voltage rectifier three-phase, full wave, choke input	5000 volts 3.0 amp
		Audio Section	
V106, V107	6SJ7	Audio amplifier, pentode connected, push-pull class A	Plate voltage 300 volts Plate current 2 ma per tube
V110, V111	4-125A	Audio driver amplifier, push-pull class A	Plate voltage 2700 volts cathode current 125 ma
			5500 watts / 1100 watts
V303, V304	3X3000A1	Modulator, push-pull, class AB_1	Plate voltage 5100 v / 2300 v Cathode current, 2 tubes 0 signal 0.4 amp / 0.3 amp Cathode current 2 tubes, 100% modulation at 1000 cps 1.45 amp / 0.78 amp

TABLE 5-2. 21E OUTPUT TANK COMPONENT CHART

21E OUTPUT TANK COMPONENTS CHART 350 OHM RESISTIVE LOAD														
KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C314	C315	C316	C321	C322	C323	C324	KC
540 TO 590	980 0062 00 120 UH 33 3/4 TURNS TOTAL	32	980 0053 00 26 UH 16 TURNS TOTAL	16	506 4581 002	546 7811 003 5.5 uh	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	939 1026 00 510 UUF	939 1026 00 510 UUF	939 1026 00 510 UUF	939 1026 00 510 UUF	540 TO 590
600 TO 640		29		16									939 1026 00 510 UUF	600 TO 640
650 TO 690		27.5		16									939 1018 00 240 UUF	650 TO 690
700 TO 740		26		16										700 TO 740
750 TO 790		25		16								939 1018 00 240 UUF		750 TO 790
800 TO 840		24.5		16										800 TO 840
850 TO 890		23.5		15							939 1018 00 240 UUF			850 TO 890
900 TO 940		22.5		14.5										900 TO 940
950 TO 990		21.5		14										950 TO 990
1000 TO 1040		21		13.5	506 4578 002	1120								1000 TO 1040
1050 TO 1090		20		13										1050 TO 1090
1100 TO 1140		19.5		12.5										1100 TO 1140
1150 TO 1190		19		12										1150 TO 1190
1200 TO 1240	980 0063 00 60 UH 23 3/4 TURNS TOTAL	21.5		11.8		546 7812 00 1.5 uh		OUT	OUT	939 1018 00 240 UUF				1200 TO 1240
1250 TO 1290		21		11.5										1250 TO 1290
1300 TO 1340		20.5		11.2						919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	OUT	1300 TO 1340
1350 TO 1390		20		11										1350 TO 1390
1400 TO 1440		19.5		10.7										1400 TO 1440
1450 TO 1490		19		10.5										1450 TO 1490

TABLE 5-2. 21E OUTPUT TANK COMPONENT CHART (Cont)

21E OUTPUT TANK COMPONENTS CHART 350 OHM RESISTIVE LOAD (Cont)														
KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C314	C315	C316	C321	C322	C323	C324	KC
1500 TO 1540		18.5		10.2										1500 TO 1540
1550 TO 1590		18		10								OUT		1550 TO 1590
1600 TO 1640		17.5		9.8										1600 TO 1640
21E OUTPUT TANK COMPONENTS CHART 50 OHM RESISTIVE LOAD														
540 TO 590	980 0062 00 120 UH 33 3/4 TURNS TOTAL	29	980 0053 00 26 UH 16 TURNS TOTAL	13.3	506 4581 002	546 7811 003 5.5 uh 1120	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	939 1040 00 2000 UUF	939 1040 00 2000 UUF	939 1033 00 1000 UUF	939 1026 00 510 UUF	540 TO 590
600 TO 640		27		12.5					919 0033 00 250 UUF		939 1033 00 1000 UUF	939 1033 00 1000 UUF	939 1033 00 1000 UUF	600 TO 640
650 TO 690		25		12					919 0033 00 250 UUF		939 1040 00 2000 UUF	939 1026 00 510 UUF	939 1018 00 240 UUF	650 TO 690
700 TO 740		24		11.2					OUT		939 1033 00 1000 UUF	939 1033 00 1000 UUF	939 1018 00 240 UUF	700 TO 740
750 TO 790		23		10.7						939 1033 00 1000 UUF		939 1033 00 1000 UUF	939 1033 00 1000 UUF	750 TO 790
800 TO 840		22		10.2						939 1040 00 2000 UUF		939 1026 00 510 UUF	939 1018 00 240 UUF	800 TO 840
850 TO 890		21		9.8						939 1033 00 1000 UUF		939 1033 00 1000 UUF	939 1026 00 510 UUF	850 TO 890
900 TO 940		20		9.4								939 1033 00 1000 UUF	929 1018 00 240 UUF	900 TO 940
950 TO 990		19.2		8.9							939 1033 00 1000 UUF	939 1026 00 510 UUF	939 1026 00 510 UUF	950 TO 990
1000 TO 1040		18.5		8.7						939 1033 00 1000 UUF			939 1026 00 510 UUF	1000 TO 1040
1050 TO 1090		18		8.5			919 0033 00 250 UUF					939 1026 00 510 UUF		1050 TO 1090
1100 TO 1140		17.5		8.2									939 1018 00 240 UUF	1100 TO 1140
1150 TO 1190		17		8								939 1018 00 240 UUF		1150 TO 1190
1200 TO 1240		19.5		7.8					OUT			939 1018 00 240 UUF		1200 TO 1240

TABLE 5-2. 21E OUTPUT TANK COMPONENT CHART (Cont)

21E OUTPUT TANK COMPONENTS CHART 50 OHM RESISTIVE LOAD (Cont)														
KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C314	C315	C316	C321	C322	C323	C324	KC
1250 TO 1290	980 0063 00 60 UH 23 3/4 TURNS TOTAL	19		7.6	506 4578 002	546 7812 00 1.5 uh		OUT			939 1026 00 510 UUF	939 1026 00 510 UUF		1250 TO 1290
1300 TO 1340		18.3		7.4										1300 TO 1340
1350 TO 1390		17.8		7.2						939 1026 00 510 UUF			939 1026 00 510 UUF	1350 TO 1390
1400 TO 1440		17.4		7									939 1026 00 510 UUF	1400 TO 1440
1450 TO 1490		17		6.8									929 1026 00 510 UUF	1450 TO 1490
1500 TO 1540		16.5		6.6									939 1018 00 240 UUF	1500 TO 1540
1550 TO 1590		16		6.5									939 1018 00 240 UUF	1550 TO 1590
1600 TO 1640		15.6		6.4									939 1018 00 240 UUF	1600 TO 1640
21E OUTPUT TANK COMPONENTS CHART 70 OHM RESISTIVE LOAD														
540 TO 590	980 0062 00 120 UH 33 3/4 TURNS TOTAL	29.5		16	506 4581 002	546 7811 003 5.5 uh		919 0033 00 250 UUF	919 0033 00 250 UUF	939 1040 00 2000 UUF	939 1040 00 2000 UUF	939 1026 00 510 UUF	939 1018 00 240 UUF	540 TO 590
600 TO 640		28		16					919 0033 00 250 UUF	939 1033 00 1000 UUF	939 1033 00 1000 UUF	939 1033 00 1000 UUF	939 1033 00 1000 UUF	600 TO 640
650 TO 690		26.5		15					919 0033 00 250 UUF	939 1040 00 2000 UUF		939 1026 00 510 UUF	939 1018 00 240 UUF	650 TO 690
700 TO 740		25		14.5						939 1033 00 1000 UUF		939 1033 00 1000 UUF	939 1026 00 510 UUF	700 TO 740
750 TO 790		23.5		13.5								939 1033 00 1000 UUF	939 1018 00 240 UUF	750 TO 790
800 TO 840		22.5		13								939 1026 00 510 UUF	939 1026 00 510 UUF	800 TO 840
850 TO 890		21.5		12.5						939 1033 00 1000 UUF		939 1026 00 510 UUF		850 TO 890
900 TO 940		21		12								939 1026 00 510 UUF		900 TO 940
950 TO 990		20		11.5								939 1018 00 240 UUF	939 1018 00 240 UUF	950 TO 990

TABLE 5-2. 21E OUTPUT TANK COMPONENT CHART (Cont)

21E OUTPUT TANK COMPONENTS CHART 70 OHM RESISTIVE LOAD (Cont)														
KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C314	C315	C316	C321	C322	C323	C324	KC
1000 TO 1040		19.3		11								939 1018 00 240 UUF		1000 TO 1040
1050 TO 1090		18.5	980 0053 00 26 UH 16 TURNS TOTAL	10.6										1050 TO 1090
1100 TO 1140		18		10.2		1120	919 0033 00 250 UUF						939 1026 00 510 UUF	1100 TO 1140
1150 TO 1190		17.5		10					OUT				939 1026 00 510 UUF	1150 TO 1190
1200 TO 1240		20		9.7								939 1026 00 510 UUF	939 1026 00 510 UUF	1200 TO 1240
1250 TO 1290		19.5		9.5										1250 TO 1290
1300 TO 1340		19		9.2	506 4578 002			OUT		939 1026 00 510 UUF	939 1026 00 510 UUF			1300 TO 1340
1350 TO 1390	980 0063 00 60 UH 23 3/4 TURNS TOTAL	18.5		9		546 7812 003 1.5 uh								1350 TO 1390
1400 TO 1440		18		8.7									939 1018 00 240 UUF	1400 TO 1440
1450 TO 1490		17.5		8.5										1450 TO 1490
1500 TO 1540		17		8.3								939 1018 00 240 UUF		1500 TO 1540
1550 TO 1590		16.8		8.1										1550 TO 1590
1600 TO 1640		16.3		8										1600 TO 1640
21E OUTPUT TANK COMPONENTS CHART 240 OHM RESISTIVE LOAD														
540 TO 590		30		16					919 0033 00 250 UUF	939 1033 00 1000 UUF	939 1033 00 1000 UUF	939 1026 00 510 UUF	939 1018 00 240 UUF	540 TO 590
600 TO 640		28.5		16					919 0033 00 250 UUF	939 1033 00 1000 UUF	939 1033 00 1000 UUF	939 1018 00 240 UUF	939 1018 00 240 UUF	600 TO 640
650 TO 690		27		16					919 0033 00 250 UUF	939 1033 00 1000 UUF			939 1018 00 240 UUF	650 TO 690
700 TO 740		26		16									939 1026 00 510 UUF	700 TO 740

TABLE 5-2. 21E OUTPUT TANK COMPONENT CHART (Cont)

21E OUTPUT TANK COMPONENTS CHART 240 OHM RESISTIVE LOAD (Cont)														
KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C314	C315	C316	C321	C322	C323	C324	KC
750 TO 790	980 0062 00 120 UH 33 3/4 TURNS TOTAL	24.5	980 0053 00 26 UH 16 TURNS TOTAL	15.5	506 4581 002	546 7811 003 5.5 uh	919 0033 00 250 UUF	919 0033 00 250 UUF	OUT	939 1026 00 510 UUF	939 1026 00 510 UUF	939 1026 00 510 UUF	939 1026 00 510 UUF	750 TO 790
800 TO 840		23.5		15									939 1018 00 240 UUF	800 TO 840
850 TO 890		22.5		14.2										850 TO 890
900 TO 940		21.5		13.7						939 1026 00 510 UUF		939 1018 00 240 UUF		900 TO 940
950 TO 990		20.8		13										950 TO 990
1000 TO 1040		20		12.6	506 4578 002	1120					939 1018 00 240 UUF			1000 TO 1040
1050 TO 1090		19.2		12.4		546 7812 003 1.5 uh		OUT						1050 TO 1090
1100 TO 1140		18.5		12.0										1100 TO 1140
1150 TO 1190		18		11.5						939 1018 00 240 UUF		939 1018 00 240 UUF		1150 TO 1190
1200 TO 1240	980 0063 00 60 UH 23 3/4 TURNS TOTAL	21		11.0										1200 TO 1240
1250 TO 1290		20.5		10.7										1250 TO 1290
1300 TO 1340		19.7		10.4										1300 TO 1340
1350 TO 1390		19.2		10.2										1350 TO 1390
1400 TO 1440		18.7		10.0										1400 TO 1440
1450 TO 1490		18.2		9.7						919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	OUT	1450 TO 1490
1500 TO 1540		17.7		9.5										1500 TO 1540
1550 TO 1590		17.2		9.2										1550 TO 1590
1600 TO 1640		16.8		9.0										1600 TO 1640

TABLE 5-3. 21E GRID TANK COMPONENTS CHART

KC	L301	C302	C304	C305	C305A	C305B	C305C	C305D	C305E	C372	KC
550 640	980 0076 00 60 uh	913 1427 00 200 mmf	913 1427 00 200 mmf	913 1427 00 200 mmf	913 1427 00 200 mmf	913 1427 00 200 mmf	913 1427 00 200 mmf	913 1427 00 200 mmf	913 1427 00 200 mmf	938 2104 00 6200 mmf	550 640
650 790								OUT	OUT	938 2100 00 5100 mmf	650 790
800 940						OUT	OUT			938 2094 00 3900 mmf	800 940
950 970											950 970
980 1040										938 2088 00 3000 mmf	980 1040
1050 1340				OUT							1050 1340
1350 1400		913 1420 00 150 mmf	913 1426 00 150 mmf							938 2080 00 2000 mmf	1350 1400
1410 1600		913 1422 00 100 mmf	913 1422 00 100 mmf								1410 1600

TABLE 5-4. 21M OUTPUT TANK COMPONENT CHART

21M OUTPUT TANK COMPONENTS CHART 50 OHM RESISTIVE LOAD

KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C311	C314	C315	C316	C317	C318	C321	C322	C323	KC
540 TO 590	980 0062 00 120 UH 33 3/4 TURNS TOTAL	21.8		13.3	506 4581 002	546 7811 003 5.5 uh			919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	939 2040 00 2000 UUF	939 2040 00 2000 UUF	939 2037 00 1500 UUF	540 TO 590
600 TO 640		20.5		12.5								919 0033 00 250 UUF			939 2033 00 1000 UUF	600 TO 640
650 TO 690		19.1		12.0								OUT			939 2031 00 820 UUF	650 TO 690
700 TO 740		18.3		11.2											939 2018 00 240 UUF	700 TO 740
750 TO 790		17.5		10.7						919 0033 00 250 UUF	OUT		939 2037 00 1500 UUF	939 2037 00 1500 UUF	939 2033 00 1000 UUF	750 TO 790
800 TO 840		16.8		10.2										939 2037 00 1500 UUF	939 2031 00 820 UUF	800 TO 840
850 TO 890		16		9.8									939 2037 00 1500 UUF		939 2033 00 1000 UUF	850 TO 890
900 TO 940		15.3		9.4											939 2031 00 820 UUF	900 TO 940
950 TO 990		14.7		8.9					919 0033 00 250 UUF					939 2033 00 1000 UUF	939 2033 00 1000 UUF	950 TO 990
1000 TO 1040	980 0063 00 60 UH 23 3/4 TURNS TOTAL	16.8	980 0053 00 26 UH 16 TURNS TOTAL	8.7	506 4578 002	1120	939 2044 00 3000 UUF	919 0033 00 250 UUF		OUT			939 2033 00 1000 UUF		939 2033 00 1000 UUF	1000 TO 1040
1050 TO 1090		16.2		8.5		546 7812 003 1.5 uh										1050 TO 1090
1100 TO 1140		15.7		8.2										939 2031 00 820 UUF	939 2031 00 820 UUF	1100 TO 1140
1150 TO 1190		15.1		8							OUT	OUT	939 2031 00 820 UUF			1150 TO 1190
1200 TO 1240		14.8		7.8										939 2031 00 820 UUF		1200 TO 1240
1250 TO 1290		14.2		7.6											939 2026 00 510 UUF	1250 TO 1290
1300 TO 1340		13.8		7.4						OUT						1300 TO 1340
1350 1390		13.5		7.2									939 2033 00 1000 UUF	939 2026 00 510 UUF		1350 TO 1390
1400 TO 1440		13.3		7.0									939 2033 00 1000 UUF	939 2026 00 510 UUF		1400 TO 1440
1450 TO 1490		13		6.8									939 2033 00 1000 UUF	939 2026 00 510 UUF		1450 TO 1490
1500 TO 1540		12.5		6.6					OUT				939 2031 00 820 UUF	939 2031 00 820 UUF	939 2018 00 240 UUF	1500 TO 1540
1550 TO 1590		12.2		6.5									939 2031 00 820 UUF	939 2031 00 820 UUF	939 2018 00 240 UUF	1550 TO 1590
1600 TO 1640		12		6.4									939 2031 00 820 UUF	939 2031 00 820 UUF	939 2018 00 240 UUF	1600 TO 1640

TABLE 5-4. 21M OUTPUT TANK COMPONENT CHART (Cont)

21M OUTPUT TANK COMPONENTS CHART 70 OHM RESISTIVE LOAD

KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C311	C314	C315	C316	C317	C318	C321	C322	C323	KC
540 TO 590	980 0062 00 120 UH 33 3/4 TURNS TOTAL	24.5	980 0053 00 26 UH 16 TURNS TOTAL	16	506 4581 002	546 7811 003 5.5 uh	939 2044 00 3000 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	939 2040 00 2000 UUF	939 2040 00 2000 UUF	939 2031 00 820 UUF	540 TO 590
600 TO 640		23		16								919 0033 00 250 UUF	939 2037 00 1500 UUF	939 2037 00 1500 UUF	939 2033 00 1000 UUF	600 TO 640
650 TO 690		21.8		15								OUT		939 2037 00 1500 UUF	939 2031 00 820 UUF	650 TO 690
700 TO 740		20.5		14.5										939 2033 00 1000 UUF	939 2033 00 1000 UUF	700 TO 740
750 TO 790		19.5		13.5											939 2031 00 820 UUF	750 TO 790
800 TO 840		18.7		13.0									939 2033 00 1000 UUF		939 2033 00 1000 UFF	800 TO 840
850 TO 890		18		12.5									939 2033 00 1000 UUF			850 TO 890
900 TO 940		17.5		12.0									939 2033 00 1000 UUF		939 2031 00 820 UUF	900 TO 940
950 TO 990		16.5		11.5									939 2031 00 820 UUF	939 2031 00 820 UUF		950 TO 990
1000 TO 1040	980 0063 00 60 UH 23 3/4 TURNS TOTAL	19		11.0	506 4578 002	1120				OUT			939 2031 00 820 UUF			1000 TO 1040
1050 TO 1090		18.2		10.6									939 2031 00 820 UUF		939 2026 00 510 UUF	1050 TO 1090
1100 TO 1140		17.7		10.2									939 2033 00 1000 UUF	939 2026 00 510 UUF		1100 TO 1140
1150 TO 1190		17.2		10.0		546 7812 00 1.5 uh					OUT		939 2033 00 1000 UUF	939 2026 00 510 UUF		1150 TO 1190
1200 TO 1240		16.5		9.7									939 2033 00 1000 UUF	939 2026 00 510 UUF		1200 TO 1240
1250 TO 1290		16		9.5										939 2031 00 820 UUF		1250 TO 1290
1300 TO 1340		15.5		9.2										939 2031 00 820 UUF		1300 TO 1340
1350 TO 1390		15.2		9.0												1350 TO 1390
1400 TO 1440		14.8		8.7					OUT				939 2031 00 820 UUF	939 2026 00 510 UUF	939 2018 00 240 UUF	1400 TO 1440
1450 TO 1490		14.5		8.5												1450 TO 1490
1500 TO 1540		14		8.3												1500 TO 1540
1550 TO 1590		13.7		8.1										939 2018 00 240 UUF		1550 TO 1590
1600 TO 1640		13.5		8.0										939 2018 00 240 UUF		1600 TO 1640

TABLE 5-4. 21M OUTPUT TANK COMPONENT CHART (Cont)

21M OUTPUT TANK COMPONENTS CHART 240 OHM RESISTIVE LOAD																
KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C311	C314	C315	C316	C317	C318	C321	C322	C323	KC
540 TO 590	980 0062 00 120 UH 33 3/4 TURNS TOTAL	25	980 0053 00 26 UH 16 TURNS TOTAL	16	506 4581 002	546 7811 003 5.5 uh	939 2044 00 3000 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	939 2033 00 1000 UUF	939 2033 00 1000 UUF	939 2031 00 820 UUF	540 TO 590
600 TO 640		23.8		16								919 0033 00 250 UUF	939 2031 00 820 UUF	939 2031 00 820 UUF	939 2031 00 820 UUF	600 TO 640
650 TO 690		22.5		16									939 2031 00 820 UUF	939 2031 00 820 UUF	939 2026 00 510 UUF	650 TO 690
700 TO 740		21.5		16						919 0033 00 250 UUF			939 2033 00 1000 UUF	939 2026 00 510 UUF	939 2026 00 510 UUF	700 TO 740
750 TO 790		20.5		15.5	506 4581 002						OUT		939 2031 00 820 UUF	939 2031 00 820 UUF	939 2018 00 240 UUF	750 TO 790
800 TO 840		19.5		15									939 2031 00 820 UUF	939 2031 00 820 UUF	939 2018 00 240 UUF	800 TO 840
850 TO 890		19		14.2									939 2026 00 510 UUF	939 2026 00 510 UUF	939 2026 00 510 UUF	850 TO 890
900 TO 940		18		13.7									939 2026 00 510 UUF	939 2026 00 510 UUF	939 2026 00 510 UUF	900 TO 940
950 TO 990		17.3		13					919 0033 00 250 UUF				939 2031 00 820 UUF	939 2018 00 240 UUF		950 TO 990
1000 TO 1040	980 0063 00 60 UH 23 3/4 TURNS TOTAL	20.2		12.6	506 4578 002	546 7812 002 1.5 uh		919 0033 00 250 UUF		OUT			939 2031 00 820 UUF	939 2018 00 240 UUF		1000 TO 1040
1050 TO 1090		19.2		12.4									939 2031 00 820 UUF	939 2018 00 240 UUF		1050 TO 1090
1100 TO 1140		18.8		12										939 2026 00 510 UUF		1100 TO 1140
1150 TO 1190		18		11.5								OUT				1150 TO 1190
1200 TO 1240		17.3		11							OUT					1200 TO 1240
1250 TO 1290		17		10.7									939 2026 00 510 UUF		939 2018 00 240 UUF	1250 TO 1290
1300 TO 1340		16.5		10.4						OUT						1300 TO 1340
1350 TO 1390		16		10.2										939 2018 00 240 UUF		1350 TO 1390
1400 TO 1440		15.8		10					OUT							1400 TO 1440
1450 TO 1490		15.2		9.7									939 2018 00 240 UUF			1450 TO 1490
1500 TO 1540		14.8		9.5												1500 TO 1540
1550 TO 1590		14.5		9.2												1550 TO 1590
1600 TO 1640		14.2		9												1600 TO 1640

TABLE 5-4. 21M OUTPUT TANK COMPONENT CHART (Cont)

21M OUTPUT TANK COMPONENTS CHART 350 OHM RESISTIVE LOAD																
KC	L305	L305 TURNS APPROX	L306	L306 TURNS APPROX	L302	L304	C311	C314	C315	C316	C317	C318	C321	C322	C323	KC
540 TO 590	980 0062 00 120 UH 33 3/4 TURNS TOTAL	27	980 0053 00 26 UH 16 TURNS TOTAL	16	506 4581 002	546 7811 003 5.5 uh	939 2044 00 3000 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	919 0033 00 250 UUF	939 2033 00 1000 UUF	939 2026 00 510 UUF	939 2026 00 510 UUF	540 TO 590
600 TO 640		25		16								919 0033 00 250 UUF	939 2033 00 1000 UUF			600 TO 640
650 TO 690		24.5		16									939 2031-00 920 UUF			650 TO 690
700 TO 740		22.5		16									939 2026 00 510 UUF			700 TO 740
750 TO 790		21		16									939 2026 00 510 UUF			750 TO 790
800 TO 840		20.5		16									939 2031 00 820 UF			800 TO 840
850 TO 890		19.5		15					919 0033 00 250 UUF				939 2031 00 820 UUF			850 TO 890
900 TO 940		18.7		14.5									939 2031 00 820 UUF			900 TO 940
950 TO 990		18		14									939 2026 00 510 UUF			950 TO 990
1000 TO 1040	980 0063 00 60 UH 23 3/4 TURNS TOTAL	21		13.5	506 4578 002	1120				OUT	OUT	OUT		939 2018 00 240 UUF	939 2018 00 240 UUF	1000 TO 1040
1050 TO 1090		20		13		546 7812 003 1.5 uf										1050 TO 1090
1100 TO 1140		19.5		12.5												1100 TO 1140
1150 TO 1190		19		12												1150 TO 1190
1200 TO 1240		18.3		11.8									939 2018 00 240 UUF			1200 TO 1240
1250 TO 1290		17.7		11.5												1250 TO 1290
1300 TO 1340		17.3		11.2												1300 TO 1340
1350 TO 1390		16.7		11												1350 TO 1390
1400 TO 1440		16.3		10.7												1400 TO 1440
1450 TO 1490		16		10.5												1450 TO 1490
1500 TO 1540		15.5		10.2					OUT				919 0033 00 250 UUF	919 0033 00 250 UUF	OUT	1500 TO 1540
1550 TO 1590		15.2		10									919 0033 00 250 UUF	919 0033 00 250 UUF		1550 TO 1590
1600 TO 1640		14.8		9.8									919 0033 00 250 UUF	919 0033 00 250 UUF		1600 TO 1640

TABLE 5-5. 21M GRID TANK COMPONENT CHART

21M GRID TANK COMPONENTS CHART											
KC	L301	C302	C304	C305	C305A	C305B	C305C	C305D	C305E	C372	KC
550 640	980 0076 00 60UH	913 1427 00 200UUF	913 1427 00 400UUF	913 1427 00 200UUF	913 1427 00 200UUF	913 1427 00 200UUF	913 1427 00 200UUF	913 1427 00 200UUF	913 1427 00 200UUF	938 2104 00 6200UUF	550 640
650 740										938 2100 00 5100UUF	650 740
750 790							OUT	OUT	OUT		750 790
800 840										938 2094 00 3900UUF	800 840
850 960						OUT					850 960
970 1040										938 2088 00 3000UUF	970 1040
1050 1340					OUT						1050 1340
1350 1600				OUT						938 2080 00 2000UUF	1350 1600

TABLE 5-6. 21E/M DRIVER PLATE TANK COMPONENT CHART

<table>
<tr><th colspan="10">21E/M DRIVER PLATE TANK COMPONENTS CHART (300J)</th></tr>
<tr><th>KC</th><th>L107</th><th>L108</th><th>C145</th><th>C145A</th><th>C148</th><th>C149</th><th>C150</th><th>C151</th><th>C190</th><th>KC</th></tr>
<tr><td>540
590</td><td rowspan="8">505-1460-002
4MH</td><td rowspan="8">980-0041-00
150UH</td><td rowspan="8">924-1022-00
200UUF</td><td rowspan="3">913-1441-00
200UUF</td><td rowspan="3">906-2402-00
4000UUF</td><td rowspan="3">906-2402-00
4000UUF</td><td>906-2402-00
4000UUF</td><td rowspan="5">OUT</td><td rowspan="3">936-1149-00
.022UF</td><td>540
590</td></tr>
<tr><td>600
640</td><td rowspan="3">906-2208-10
2000UUF</td><td></td></tr>
<tr><td>650
790</td><td rowspan="5">906-2208-10
200UUF</td><td>650
790</td></tr>
<tr><td>800
840</td><td rowspan="6">OUT</td><td rowspan="5">906-2208-10
2000UUF</td><td rowspan="6">OUT</td><td>800
840</td></tr>
<tr><td>850
890</td><td>850
890</td></tr>
<tr><td>900
990</td><td>938-2062-00
820UUF</td><td>938-2048-00
430UUF</td><td>900
990</td></tr>
<tr><td>1000
1090</td><td>1000
1090</td></tr>
<tr><td>1100
1140</td><td rowspan="3">571-0460-10
1.9MH</td><td rowspan="3">980-0040-00
81UH</td><td rowspan="3">OUT</td><td>938-2048-00
430UUF</td><td rowspan="3">OUT</td><td>1100
1140</td></tr>
<tr><td>1150
1290</td><td rowspan="2">938-2062-00
820UUF</td><td>938-2062-00
820UUF</td><td>1150
1290</td></tr>
<tr><td>1300
1600</td><td>938-2062-00
820UUF</td><td>938-2048-00
430UUF</td><td>1300
1600</td></tr>
</table>

section 6

parts list

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
		21 E/M Transmitter	505-9578-006
		21 E/M Driver	506-2515-005
B101	Ventilating fan motor	VENTILATING FAN: 8-inch ventilating fan and guard assembly 230 volts	230-0164-00
		FAN BLADE: one piece, aluminum	009-1226-00
C101	Crystal frequency trimmer for Y101	CAPACITOR: variable, 7.5 uuf to 102.7 uuf	922-0028-00
C102	Crystal frequency trimmer for Y102	CAPACITOR: variable, 7.5 mmf to 102.7 uuf	922-0028-00
C103	Feedback capacitor for V101	CAPACITOR: mica, 1000 uuf p/m 20%, 3500 wvdc	914-0019-00
C104	Cathode bypass capacitor for V101	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C105	Screen bypass for V101	CAPACITOR: mica, 150 uuf p/m 20%, 500 wvdc	935-0114-00
C106	Coupling capacitors V101 to V102	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C107		NOT USED	
C108		NOT USED	
C109	Multimeter bypass buffer grid, 2.5 ma position	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C110	Plate decoupling capacitor for V101	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C111	Cathode bypass capacitor for V102	CAPACITOR: Mica, 0.01 uuf p/m 5%, 500 wv	910-1103-10
C112	Screen bypass capacitor for V102	CAPACITOR: mica, 0.01 uuf p/m 5%, 500 wv	910-1103-10
*C113	Plate tank padding capacitor for V102	CAPACITOR: mica, 100 uuf p/m 10%, 500 wvdc (p/o T-102)	912-0495-00
C-114, C115	Plate tank trimmer capacitor for V102	CAPACITOR: double, variable 5-10 uuf min to 100-105 uuf max (p/o T-102)	922-4800-00
C116	Compensating capacitor grid to cathode of V103	CAPACITOR: ceramic, 20 uuf p/m 5%, 500 wv	916-4188-00
C117		NOT USED	
C118		NOT USED	
C119	Coupling capacitor V102 to V103	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C120	Plate decoupling capacitor for V102	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C121	Multimeter bypass capacitor for 807 Grid, 25-ma position	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C122	Screen bypass capacitor for V103	CAPACITOR: mica, 0.01 p/m 5%, 500 wv	910-1103-10
C123	Screen bypass capacitor for V103	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C124	Plate tank padding capacitor for V103	CAPACITOR: mica, 100 uuf p/m 10%, 500 wvdc (p/o T-103)	912-0495-00
C125, C126	Plate tank trimmer capacitor for V103	CAPACITOR: double, variable, 5-10 uuf min to 100-105 uuf max (p/o T-103)	922-4800-00
C127		NOT USED	
C128		NOT USED	
C129	Plate decoupling capacitor for V103	CAPACITOR: mica, 1000 uuf p/m 20%, 3500 wvdc	914-0019-00
C130	Decoupling capacitor for low voltage stage	CAPACITOR: mica, 10,000 20uuf p/m 20%, 1200 wv	936-1127-00
C131	Neutralizing capacitor	CAPACITOR: 7 uuf	
C132	Coupling capacitor V103 to V104 and V105	CAPACITOR: mica, 1000 uuf p/m 20%, 3500 wvdc	914-0019-00

*21M only.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C133	Meter bypass capacitor, PA grid, 25-ma position	CAPACITOR: mica, 0.01 uf p/m 5% 500 wv	910-1103-10
C134	Filament bypass capacitor for V104	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C135	Filament bypass capacitor for V105	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C136	Filament bypass capacitor for V104	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C137	Filament bypass capacitor for V105	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C138	Screen bypass capacitor for V104	CAPACITOR: ceramic, 67 uuf p/m 5%, 5000 wv	913-0090-00
C139	Screen bypass capacitor for V105	CAPACITOR: ceramic, 67 uuf p/m 5%, 5000 wv	913-0090-00
C140	Bypass capacitor for PA plate current meter M102	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C141	Plate decoupling capacitor for V104 and V105	CAPACITOR: ceramic, 500 uuf plus 50% minus 20%, 20,000 wvdc	913-1101-00
C142	R-f coupling capacitor	CAPACITOR: ceramic 200 uuf, p/m 10%, 7500 wvdc	913-1441-00
C143	Screen bypass capacitor for V104	CAPACITOR: ceramic, 67 uuf p/m 5%, 5000 wv	913-0090-00
C144	Screen bypass capacitor for V105	CAPACITOR: ceramic, 67 uuf p/m 5%, 5000 wv	913-0090-00
*C145	Padder capacitor for PA plate tank 540 kc - 1090 kc	CAPACITOR: fixed, 200 uuf 27 plates	924-1022-00
*C145A	540 kc - 790 kc	CAPACITOR: ceramic, 200 uuf, p/m 10%, 7500 wvdc	913-1441-00
C146	PA plate tuning capacitor	CAPACITOR: variable, air-dielectric; 58 uuf to 185 uuf	920-0075-00
C147	PA plate loading capacitor	CAPACITOR: variable, aid-dielectric; 840 uuf max, 65 uuf min	920-0114-00
*C148	Padder capacitor driver output network	CAPACITOR: mica, p/m 10%, 5000 wv	no part no. here
		820 uuf	938-2062-00
		2000 uff	906-2208-10
		4000 uuf	906-2402-00
*C-149	Padder capacitor driver output network	CAPACITOR: 820 uuf ± 5%, 5000 v d-c	938-2062-00
		2000 uuf	906-2208-00
		4000 uuf	906-2402-00
*C150	Padder capacitor driver output network	CAPACITOR: same as C148	no part no. here
		430 uuf	938-2048-00
		820 uuf	938-2062-00
		2000 uuf	906-2208-10
		4000 uuf	906-2402-00
*C151	Padder capacitor driver output network	CAPACITOR: mica p/m 10% 5000 wv	no part no. here
		430 uuf	906-3401-10
C152	Plate decoupling capacitor for V104 and V105	CAPACITOR: ceramic, 500 uuf plus 50% minus 20%, 20,000 wvdc	913-1101-00
C153	Bypass capacitor for multimeter M104	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C154	NOT USED	CAPACITOR: mica, 3300 uuf p/m 20%, 1300 wvdc	936-0283-00
C155	NOT USED	CAPACITOR: mica, 3300 uuf p/m 20%, 1200 wvdc	936-0283-00
C156	V106, V107 screen bypass	CAPACITOR: paper 0.1 uf p/m 10% 600 wvdc	961-5114-00
C157		NOT USED	
C158	Coupling capacitor V106 to V108	CAPACITOR: paper 0.1 uf p/m 10% 600 wvdc	961-5114-00

*Values depend upon frequency of operation.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C159	Coupling capacitor V107 to V109	CAPACITOR: paper 0.1 uf p/m 10%, 600 wvdc	961-5114-00
C160	Filament bypass capacitor for V108 and V109	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C161	Filament bypass capacitor for V108 and V109	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C162	Plate decoupling capacitor for V106 and V107	CAPACITOR: paper, 2 uf p/m 10%, 600 wvdc	930-0046-00
C163	Filter capacitor	CAPACITOR: paper, 4 uf 4000 v dc	930-0045-00
C164	Bypass capacitor PA plate voltage meter	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C165	Filament bypass capacitor for V103	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C166	Filament bypass capacitor for V103	CAPACITOR: mica, 0.01 uf p/m 5%, 500 wv	910-1103-10
C167	Filter capacitor bias supply filter	CAPACITOR: paper, 8 uf p/m 10%, 600 wvdc	930-0048-00
C168		NOT USED	
C169	Tunes L114 in HV filter to ripple	CAPACITOR: paper, 0.08 uf p/m 5% 6000 wv	930-0424-00
C170	Filter capacitor high voltage supply filter	CAPACITOR: same as C163	930-0045-00
C171	Bypass capacitor for modulator plate current meter, M105	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C172	Filter capacitor, low voltage supply	CAPACITOR: paper, 10 uf p/m 10%, 1000 wvdc	930-0038-00
C173	Filter capacitor, low voltage supply filter	CAPACITOR: paper, 10 uf p/m 10%, 1000 wvdc	930-0038-00
C174		CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C175		Same as C174	
C176		Same as C174	
C177		Same as C174	
C178		Same as C174	
C179		Same as C174	
C180		Same as C174	
C181		Same as C174	
C182	Mod grid coupling	CAPACITOR: plasticon 0.1 uf p/m 10%, 5000 wv	933-0033-00
C183	V109 grid equalizer	CAPACITOR: 0.25 uf p/m 10%, 600 wvdc	961-5132-00
C184	Filter capacitor, high voltage supply filter	CAPACITOR: same as C163	930-0045-00
C185	Coupling capacitor to frequency monitor jack, J104	CAPACITOR: mica, 0.01 uf p/m 500 wv	910-1103-10
C186		NOT USED	
C187	V108 grid equalizer	CAPACITOR: same as C183	961-5132-00
C188	ARC suppr blocking	CAPACITOR: mica, .022 uf p/m 20%, 600 wv	936-1149-00
C189	V108, V109 screen bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 1200 wv	936-1125-00
C190		CAPACITOR: Same as C188	936-1149-00
C191	Mod grid coupling	CAPACITOR: Same as C182	933-0033-00
C192	Driver output blocking	CAPACITOR: fixed, 10,000 uuf p/m 10%, 2500 wv	937-2025-00
C193	Driver output blocking	CAPACITOR: fixed, 10,000 uuf p/m 10%, 2500 wv	937-2025-00
C194	Mod-mon. blocking	CAPACITOR: fixed, 0.01 uuf p/m 5%, 500 wv	910-1103-10
C195	K105 coil bypass	CAPACITOR: dry-electrolytic, 1100 uf 25 wv	184-2000-00
C196	K106 coil bypass	CAPACITOR: dry-electrolytic, 1100 mf 25 wv	184-2000-00
C197	K107 coil bypass	CAPACITOR: 2 mfd ±10% 600 wvdc	930-0046-00
C198		CAPACITOR: mica; 1000 uuf ±5%, 500 v dc	935-4217-00
C199		CAPACITOR: same as C198	935-4217-00
E100	Primary power input terminal board	BOARD: 3 terminals	306-0069-00
E101	Terminal board connecting modulator chassis to power supplies	TERMINAL BOARD: 13 terminals	367-5130-00
E102	Terminal board connecting r-f chassis to power supplies	TERMINAL BOARD: 13	367-5130-00
E103	Audio input terminal board	TERMINAL BOARD: 5 terminals	367-4050-00
E104	Audio monitoring output terminal board	TERMINAL BOARD: 2 terminals	367-4020-00
E105	Control interconnect	TERMINAL BOARD: 16 terminals	367-5160-00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
F101	Fuse in primary of bias supply transformer T106	FUSE: cartridge, 1 amp 250 v	264-4280-00
F102	Fuse in primary of high voltage rectifier filament transformer, T107	FUSE: cartridge, 1 amp 250 v	264-4280-00
F103	Fuse in primary of filament transformer, T109	FUSE: cartridge, 3 amp 250 v	264-0009-00
F104	Fuse in primary of low voltage supply transformer	FUSE: cartridge, 1 amp 250 v	264-4280-00
I101	Filaments at operating temperature indicator	BULB: candelabra base, 230-250 10 w	262-0169-00
I102	Lumiline meter panel lamp, illuminates meter panel	BULB: Lumiline, disc base, 125 v a-c rms, 40 w	262-0170
I103	Lumiline meter panel lamp, illuminates meter panel	BULB: Lumiline, disc base, 125 v a-c rms, 40 w	262-0170-00
I104	Plate ON lamp, indicates when high and low voltage is on	BULB: candelabra base, 230-250, 10 w	262-0169-00
J100	Jack for modulation monitor	CONNECTOR: receptacle, single female contact	357-9005-00
J101	Modulator unit connector	CONNECTOR: receptacle, 4 female contacts	364-2040-00
J102	Modulator unit connector	CONNECTOR: receptacle, 8 female contacts	366-2080-00
J103	R-f chassis connector	CONNECTOR: receptacle, 8 female contacts	366-2080-00
J104	Frequency monitor jack	CONNECTOR: receptacle, single female contact	357-9005-00
K101	Thermal time delay relay provides adequate filament warm-up period	RELAY: 3 amp 150 v dc, 3 amp 250 v a-c contacts	402-0211-00
K102	Plate relay, shunts thermal element in K101 with resistor shorts K101 relay contacts, and completes circuit from S107 to T108 and T110	RELAY: 25 amp 600 v contacts 220 v coil	401-1201-00
K103	Driver filament contactor	RELAY: 15 amp 600 v contacts 220 v coil	401-1202-00
K104	Driver plate hold	RELAY: 5 amp 220 v a-c	405-0608-00
K105	Driver modulator overload	RELAY: current overload; 0.075 to 0.3A O.C.	405-0186-00
K106	Driver r-f overload	RELAY: current overload; 0.075 to 0.3A O.C.	405-0186-00
K107	Arc suppression	RELAY: 2 amp 230 v a-c	940-1727-00
L101		Not used in standard broadcast band	
L102		COIL: (p/o T102)	
L102A	Part of plate tank coil for V102	Section of L102	
L102B	Part of plate tank coil for V102	Section of L102	
L103		Not used in standard broadcast band	
L104		COIL: (p/o T103)	
L104A	Part of plate tank coil for V103	Section of L104	
L104B	Part of plate tank coil for V103	Section of L104	
L105		Not used in standard broadcast band	
L106	F-f choke in B-plus lead to V103	COIL: R-f choke, 3 section, 1 mh, 300 ma	240-5800-00
*L107	R-f choke in B-plus lead to V104 and V105	COIL: r-f choke, 200 turns #24 AWG DS wire or COIL: r-f choke, 800 turns #22 AWG wire	571-0460-10 505-1460-002
L108	PA plate tuning coil	INDUCTOR: r-f fixed tank, 150 mh	980-0041-00
L109	L-section inductance	COIL: r-f, 30 turns #10 copper wire	504-9624-003
L110	Static drain choke, feeds modulation monitor	COIL: 56 turns, #22 copper wire	506-9995-003
L111		NOT USED	
L112	Filter choke, bias voltage supply filter	REACTOR: filter, 12 h, 375 ohm d-c resistance, 2000 TV	668-0004-00
L113		NOT USED	
L114	Filter choke, high voltage supply filter	REACTOR: filter, 20 hy at 170 ma, 15 h at 360 ma, 100 ohm d-c resistance, 7500 TV	668-0072-00

*Values depend upon frequency of operation.

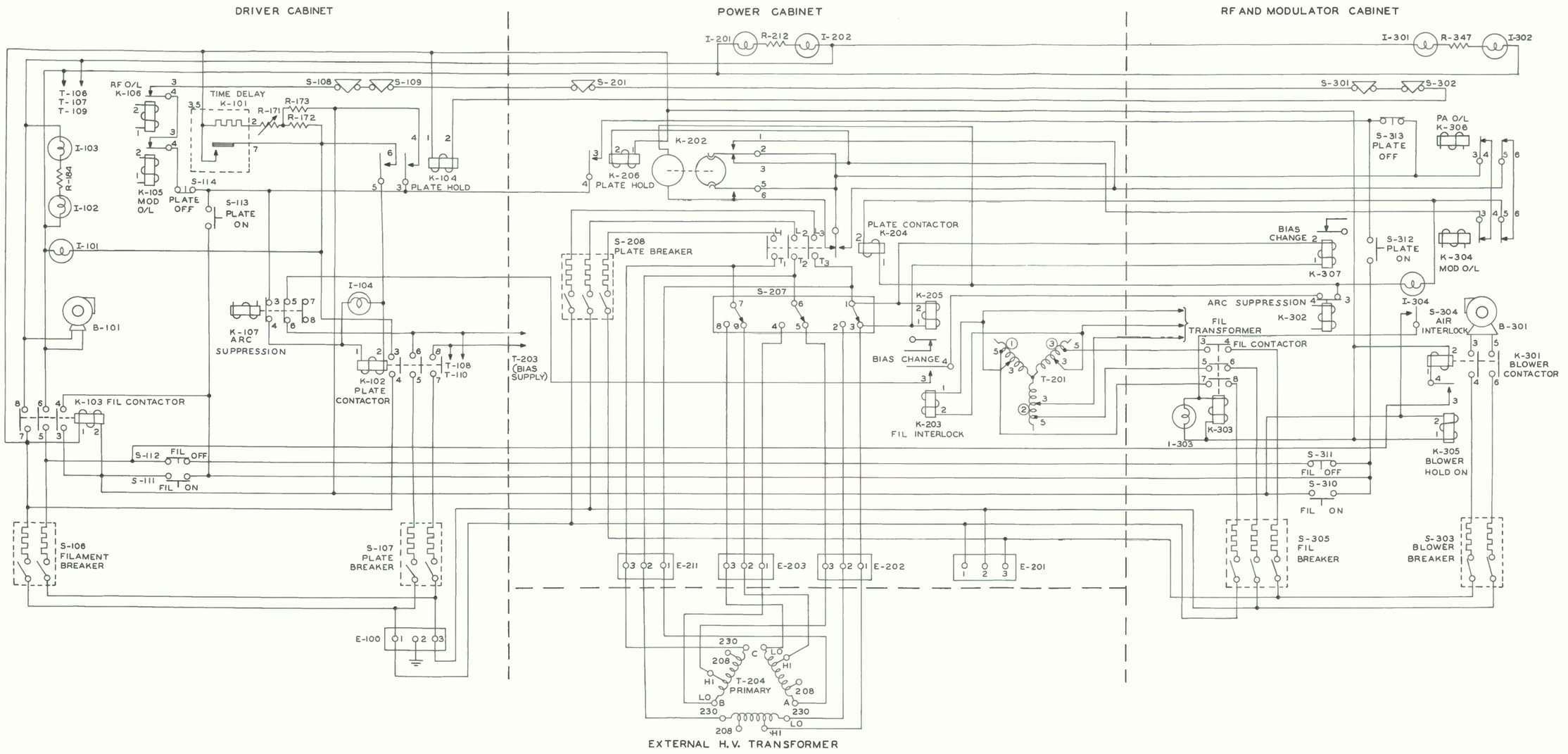


Figure 4-3. Control Circuits

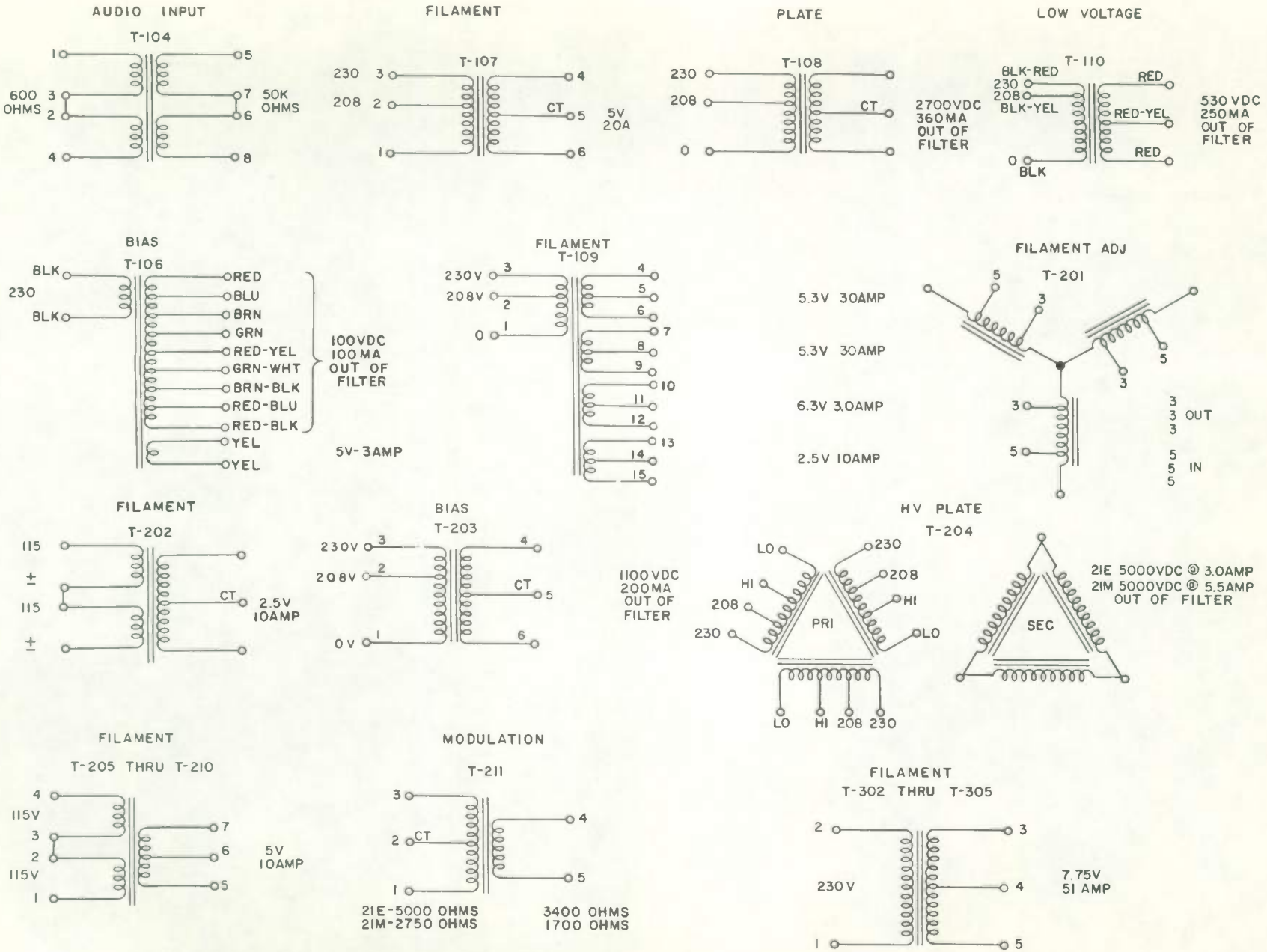


Figure 7-6. Transformer Details

ORDER FROM
SIM YOUNG

NEED: FREQ.
LINE Z
POWERS

DISSIPATION LOAD CIRCUIT

Circuit was designed so that it could be switched in and out without disturbing impedance match.

Reactance values between coil taps are based on impedance. Dissipate desired power in the dummy load, with the remainder radiated by the antenna.

Johnson contactor should be interlocked with power reduction circuit to prevent operation of the transmitter at 5,000 watts into the dissipation circuit.

Coil and capacitor comparisons versus frequency are shown below:

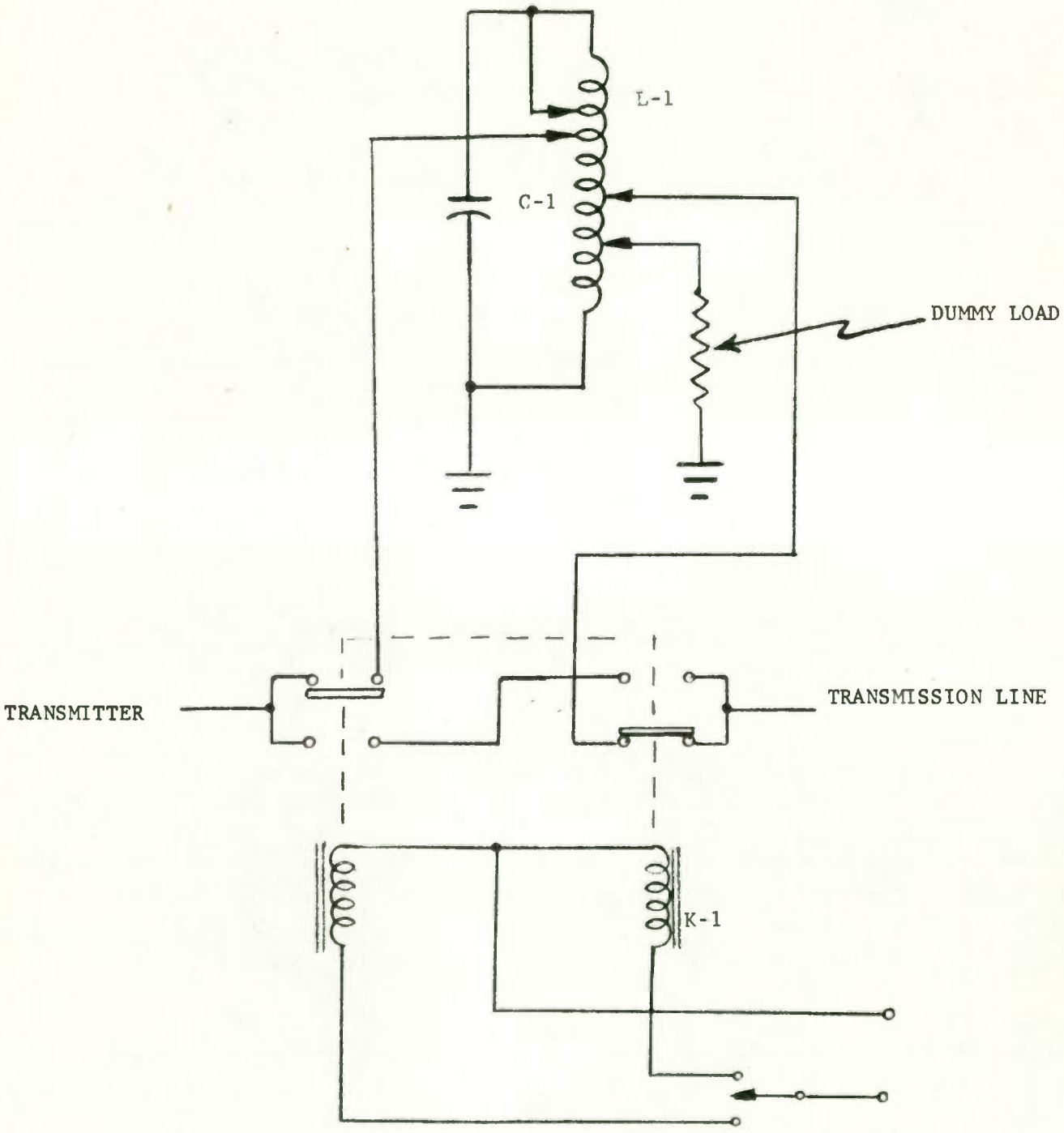
	Coil	Capacitor
540 - 680 KC	28 uh	5100 pf
680 - 1100 KC	22 uh	3000 pf
1100 - 1600 KC	15 uh	2000 pf

Parts required are as follows:

1		Capacitor
1		Coil
1	522-1410-004	172G1 52 Ohm Dummy Load (172G2 73 OHM)
1	410-0210-000	145-102-13 Johnson Switch
4	190-2530-000	Coil Mounting Insulators
4	362-2000-000	Inductor Clips
1	*980-0049-00	28 uh Coil
1	*980-0133-00	22 uh Coil
1	*980-0132-00	15 uh Coil
1	*939-1050-000	5100 pf Capacitor
1	*939-1044-00	3000 pf Capacitor
1	*939-1040-00	2000 pf Capacitor
1	**266-3078-000	Toggle Switch SPDT
1	***097-1461-000	Dual Momentary Relay
1	***097-1458-000	Rotary Actuator 108-10A

* Select proper coil and condenser combination for your frequency.
** Used with local control.
*** Used with Remote control.

PCA POWER REDUCTION FOR 21-E



SINGLE POLE DOUBLE THROW
TOGGLE SWITCH WITH SPRING
RETURN TO "OFF"

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
XV105	Socket for V105	SOCKET: tube, 5 prong	220-1016-00
XV106	Socket for V106	SOCKET: tube, octal 8 prong	220-1005-00
XV107	Socket for V107	SOCKET: tube, octal 8 prong	220-1005-00
XV108	Socket for V108	SOCKET: tube, 5 prong	220-1016-00
XV109	Socket for V109	SOCKET: tube, 5 prong	220-1016-00
XV110	Socket for V110	SOCKET: tube, octal 8 prong	220-1059-00
XV111	Socket for V111	SOCKET: tube, 4 prong	220-5420-00
XV112	Socket for V112	SOCKET: tube, 4 prong	220-5420-00
XV113	Socket for V113	SOCKET: tube, 4 prong	220-5410-00
XV114	Socket for V114	SOCKET: tube, 4 prong	220-5410-00
Y101	Quartz crystal	CRYSTAL	
Y102	Quartz crystal	CRYSTAL	
		21E/M POWER SUPPLY AND POWER AMPLIFIER BAYS	506-2508-004
B201	Ventilating Fan motor	FAN MOTOR: unit bearing with shaded pole, 230 volts	230-0164-00
		FAN BLADE: one piece, aluminum	009-1226-00
C201	HV filter	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
C202	HV filter	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
C203	HV filter	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
C204	HV filter	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
C205 thru C209		NOT USED	
C210	Bias filter	CAPACITOR: paper, 4 uf p/m 20%, 3000 wv	930-4314-00
		ALT.	930-0098-00
C211	Bias filter	CAPACITOR: paper, 4 uf p/m 20%, 3000 wv	930-4314-00
		ALT.	930-0098-00
B301	Tube Cooling	DIRECT BLOWER: direct connected blower and motor assembly, 1 hp	009-1225-00
C301	PA grid tuning	CAPACITOR: variable 37 min to 251 max uuf	920-0096-00
**C302	PA grid pad	CAPACITOR: mica, p/m 5%, 5000 wv	
		200 uuf	913-1427-00
		150 uuf	913-1426-00
		100 uuf	913-1422-00
C303		NOT USED	
**C304	PA grid pad	CAPACITOR: mica, p/m 5%, 5000 wv	
		200 uuf	913-1427-00
		150 uuf	913-1426-00
		100 uuf	913-1422-00
C305	PA grid pad	CAPACITOR: mica, p/m 5%, 5000 wv	
		200 uuf	913-1427-00
C306	Filament bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 500 wv	910-1103-10
C307	Filament bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 500 wv	910-1103-10
*C308	Filament bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 500 wv	910-1103-10
*C309	Filament bypass	CAPACITOR: same as ref C308	910-1103-10
C310	PA neutralizing	CAPACITOR: variable, 10-60 uuf 20 kv	919-0081-00
C311	PA plate blocking	CAPACITOR: mica, 1500 uuf p/m 5%, 15,000 wv	939-2037-00
*C311	PA plate blocking	CAPACITOR: mica, 3000 uuf p/m 10%, 12,000 wv	939-2044-00
C312	Plate bypass	CAPACITOR: ceramic, 500 uuf plus 50%, minus 20%, 20,000 wvdc	913-1101-00
C313	PA tuning	CAPACITOR: variable, 60 min to 300 max uuf 10,000 TV	919-0122-00
**C314	PA tuning padder	CAPACITOR: vacuum 250 uuf p/m 10%, 10 KV	919-0033-00
**C315	PA tuning padder	CAPACITOR: vacuum 250 uuf p/m 10%, 10 KV	919-0033-00
**C316	PA tuning padder	CAPACITOR: vacuum 250 uuf p/m 10%, 10 KV	919-0033-00
**C317	PA tuning padder	CAPACITOR: vacuum 250 uuf p/m 10%, 10 KV	919-0033-00
**C318	PA tuning padder	CAPACITOR: vacuum 250 uuf p/m 10%, 10 KV	919-0033-00
**C319	PA tuning padder	CAPACITOR: vacuum 250 uuf p/m 10%, 10 KV	919-0033-00
C320	PA loading	CAPACITOR: variable, 496 max to 56 min uuf	920-9600-00

**Determined by frequency.
*21M only.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
**C321	PA loading pad	CAPACITOR: mica, p/m 5%, 10,000 wv	
		510 uuf	939-1026-00
		1000 uuf	939-1033-00
		2000 uuf	939-1040-00
**C322	PA loading pad	CAPACITOR: same as C321	
**C323	PA loading pad	CAPACITOR: mica, p/m 5%, 10,000 wv	
		510 uuf	939-1026-00
		1000 uuf	939-1033-00
**C324	PA loading pad		
C325	Mod monitor adjust	CAPACITOR: variable, 320 max to 13.5 min uuf, 500 v	922-1400-00
C326		NOT USED	
C327	Meter bypass	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C328	Meter bypass	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C329	PA grid bypass	CAPACITOR: ceramic, 1000 uuf p/m 20%, 5000 wvdc	913-0101-00
C330	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C331	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C332	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C333	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C334	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C335	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C336	Feedback network	CAPACITOR: mica, 4700 uuf p/m 5%, 2500 v dc	936-1103-00
C337	Feedback network	CAPACITOR: same as C336	936-1103-00
C338	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C339	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C340	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C341	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C342	Feedback network	CAPACITOR: mica, 47 uuf p/m 20%, 2500 wvdc	936-0162-00
C343	Feedback network	CAPACITOR: mica, 27 uuf p/m 20%, 2500 wvdc	936-0162-00
C344	Mod grid bypass	CAPACITOR: ceramic, 1000 uuf p/m 20%, 5000 wvdc	913-0101-00
C345	Mod grid bypass	CAPACITOR: ceramic, 1000 uuf p/m 20%, 5000 wvdc	913-0101-00
C346	Mod fil. bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 500 wv	910-1103-10
C347	Mod fil. bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 500 wv	910-1103-10
C348	Mod fil. bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 500 wv	910-1103-10
C349	Mod fil. bypass	CAPACITOR: mica, 10,000 uuf p/m 5%, 500 wv	910-1103-10
C350	Mod coupling	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
*C351	Mod coupling	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
C352	Meter bypass	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
C353	Meter bypass	CAPACITOR: mica, 5100 uuf p/m 5%, 500 wvdc	935-2105-00
*C354	HV filter	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
*C355	HV filter	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
*C356	HV filter	CAPACITOR: paper, 2 uf p/m 10%, 6000 wv	930-0327-00
*C357	HV filter	CAPACITOR: paper, 2 uf p/m 10%	930-0327-00
C357		NOT USED	
C358		NOT USED	
C359		NOT USED	
C360		NOT USED	
C361	Audio monitor bypass	CAPACITOR: mica, 1000 uuf p/m 5%, 500 wvdc	935-4052-00
C362		NOT USED	
C363		NOT USED	

**Determined by frequency.
*21M only.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C364	Neutralizing	CAPACITOR: ceramic, 40 uuf p/m 5%, 5000 wvdc	913-0836-00
C365	Neutralizing	CAPACITOR: ceramic, 40 uuf p/m 5%, 5000 wvdc	913-0836-00
**C366	PA loading pad	CAPACITOR: mica, 1000 uuf p/m 5%, 10,000 wvdc	939-1033-00
C367	L307 isolating	CAPACITOR: fixed, 22,000 uuf p/m 20%, 600 wv	936-1149-00
**C368	L307 isolating	CAPACITOR: fixed, 22,000 uuf p/m 20%, 600 wv	936-1149-00
C369	Transmission line	CAPACITOR: fixed, .02 uuf p/m 5%, 3000 wv	939-1064-00
C370	K304 coil bypass	CAPACITOR: dry-electrolytic 1100 uf, 25 wv	184-2000-00
C371	K306 coil bypass	CAPACITOR: dry-electrolytic 1100 uf, 25 wv	184-2000-00
**C372	Grid return	CAPACITOR: mica, p/m 5%, 2000 uuf, 5000 wv	938-2080-00
		3000 uuf, 3000 wv	938-2088-00
		3900 uuf, 3000 wv	938-2094-00
		5100 uuf, 3000 wv	938-2104-00
		6200 uuf, 3000 wv	938-2104-00
C373	K302 audio bypass	CAPACITOR	930-0046-00
E201	AC input connector	TERMINAL BLOCK: 3 term	306-0068-00
E202	HV transf. pri conn	TERMINAL BLOCK: 3 term	306-0069-00
E203	HV transf. pri conn	TERMINAL BLOCK: 3 term	306-0069-00
E204	Part of S204 and S205	INSULATOR: feedthru	190-6920-00
E205	Part of S205	INSULATOR: feedthru	190-6920-00
E206	Part of S204	INSULATOR: feedthru	190-6920-00
E207	Relay panel conn	BOARD TERMINAL: 10 term	367-5100-00
E209	Relay panel conn	TERMINAL STRIP: 9 term	367-5090-00
E210	Control interconn	TERMINAL STRIP: 16 term	367-5160-00
E211	HV transf. pri conn	CONNECTOR STRIP: 3 term	306-0069-00
E301	Audio monitor conn	CONNECTOR STRIP: 2 term	367-4020-00
E302	Relay panel conn	CONNECTOR STRIP: 14 term	367-5140-00
E303	R-f output conn	INSULATOR: feedthru	190-6920-00
E304	PA r-f input conn	STANDOFF: conical	190-2510-00
E305	PA r-f input conn	STANDOFF: conical	190-2510-00
F201	Bias rect, fil. fuse	FUSE: cartridge, 1/4 amp 125 v	264-4240-00
F202	Bias rect. pl. fuse	FUSE: cartridge, 3.0 amp 250 v	264-0009-00
F203	HV rect. fil. fuse	FUSE: cartridge, 3/4 amp 125 v	264-4270-00
F204	HV rect. fil. fuse	FUSE: cartridge, 3/4 amp 125 v	264-4270-00
F205	HV rect. fil. fuse	FUSE: cartridge 3/4 amp 125 v	264-4270-00
F301	T302 pri fuse	FUSE: cartridge, 3 amp 250 v	264-0009-00
F302	T303 pri fuse	FUSE: cartridge, 3 amp 250 v	264-0009-00
F303	T304 pri fuse	FUSE: cartridge, 3 amp 250 v	264-0009-00
F304	T305 pri fuse	FUSE: cartridge, 3 amp 250 v	264-0009-00
I201	Meter panel bulb	BULB: lumiline, disc base, 125 v, 40 w	262-0170-00
I202	Meter panel bulb	BULB: lumiline, disc base, 125 v, 40	262-0170-00
I203		NOT USED	
I204		NOT USED	
I301	Meter panel light	BULB: lumiline, disc base, 125 v, 40 w	262-0170-00
I302	Meter panel light	BULB: lumiline, disc base, 125 v, 40 w	262-0170-00
I303	Blower pilot light	BULB: candelabra base, 230-250 v, 10 w	262-0169-00
I304	Filament pilot light	BULB: candelabra base, 230-250 v, 10 w	262-0169-00
J301	Meter cable connector	CONNECTOR: receptacle, 4 female contacts	364-2040-00
J302	Mod. monitor output	CONNECTOR: receptacle, 1 female contact	357-9005-00
J303		NOT USED	
K201		NOT USED	
K202	Micro switch contact	SWITCH: snap action, 10A-125 v a-c, 5A-250 v a-c	260-0561-00
	Motor	SYNCHRONOUS: 4 rpm	230-0045-00
K203	Filament interlock	RELAY: contact arrangement, 1 c left 1 c right (12 pole double throw)	405-0615-00
K204	Plate contactor	RELAY: contact arrangement, 1 ND 1 NC, 3 poles	401-1318-00
K205	Bias change relay	RELAY: contact arrangement, 1 c left 1 c right (2 poles double throw)	405-0616-00

**Determined by frequency.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
*K205	Bias change relay	RELAY: control arrangement, 2 c (double pole double throw)	405-0619-00
K206	Plate hold	RELAY: 5 amp 220 v a-c	405-0608-00
K301	Blower contactor	RELAY: contact arrangement, 3 NO-15A contact rating	401-1202-00
K302	Arc suppression	RELAY: 2 amp 230 v a-c	970-1727-00
K303	Filament contactor	RELAY: contact arrangement, 3 NO-15A contact rating	401-1202-00
K304	Modulator overload	RELAY: current overload; cont. current .225A; 2 NC contacts	405-0186-00
K305	Blower delay	RELAY: contact arrangement 1 c	402-0235-00
K306	R-f overload	RELAY: current overload; cont. current .225A; 2 NC contacts	405-0186-00
**K307	Bias change	RELAY: 5 amp 2000 v contacts 115 a-c coil	407-1045-00
L201	Bias filter choke	REACTOR: filter, 6.6 hy min at 0.20 amp d-c, 85 ohm max.	678-0384-00
L202	HV filter choke	REACTOR: filter, 1.5 hy min at 3.0 amp d-c, 6 ohm max.	668-0089-00
*L203	HV filter choke	REACTOR: filter, 1.5 hy min at 3.0 amp d-c, ohm max.	668-0089-00
L204		NOT USED	
L205		NOT USED	
L301	PA grid tuning	INDUCTOR: r-f fixed tank, 60 mh	980-0076-00
***L302	Parasitic suppressor coil	RESISTOR ASSY: OR: RESISTOR ASSY:	506-4578-002 506-4581-002
L303		NOT USED	
***L304	PA plate choke	TRANSFORMER: 1 tapped winding; 1200 turns no. 18 AWG; 550 to 1120 kc OR: TRANSFORMER: 1 tapped winding; 650 turns no. 18 AWG; 1120 to 1600 kc	546-7811-003 546-7812-003
L305	PA plate tank	INDUCTOR: r-f fixed tank, 60 mh OR: INDUCTOR: r-f fixed tank, 120 mh	980-0063-00 980-0062-00
*L305	PA plate tank	INDUCTOR: r-f fixed tank, 30 mh OR: INDUCTOR: r-f fixed tank, 60 mh	980-0064-00 980-0063-00
L306	PA output loading coil	INDUCTOR: r-f fixed tank, 26 mh	980-0053-00
L307	Modulation monitor coil	COIL ASSY: modulation, 11-1/2 turns per inch	506-0537-003
L308		NOT USED	
L309	Modulation choke	REACTOR: fixed inductance type; 26.5 h, 1.5 amp, 91 ohms	668-0910-00 or 668-0003-00
*L309	Modulation choke	REACTOR: modulation, 30 hy 50 ohm d-c resistance, 18,000 TV	668-0911-00 or 668-0018-00
L311		NOT USED	
L312		NOT USED	
L313		NOT USED	
L314	Mod monitor conn filter	COIL: r-f choke, 3 sections, #29 copper wire	240-0013-00
L315	Parasitic choke	SUPPRESSOR, PARASITIC: 50 ohm resistor, 3/16 in. dia. silver plated copper tubing	540-3955-002
M201	Filament primary meter	METER: a-c voltmeter 0-300 range, 60-scale divisions	452-0046-00
M202	Filament hours	METER: 0-9999.9 hours; 230 v 60 cps	458-0190-00
***M202	Filament hours	METER: 0-999.9 hours; 230 v 50 cps	097-6881-00
M301	R-f output meter	METER: r-f ammeter 0-15 range, 75 scale divisions	451-0178-00
*M301	R-f output meter	METER: r-f ammeter 0-20 amp 40 scale divisions	451-0179-00
M302	PA plate current	METER: d-c ammeter, 0-3 amp 60 scale divisions	450-0100-00
*M302		METER: d-c ammeter, 0-4A; 40 divisions	450-0101-00

*21M only.

**21E only.

***Determined by frequency.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
M303	HV d-c voltmeter	METER: d-c voltmeter, 0-6000 volts d-c, 75 scale divisions	458-0212-00
M304	Multimeter	METER: d-c milliammeter, 0-25 range	458-0170-00
M305	Mod plate current	METER: d-c ammeter, 0-3 range, 60 scale division	450-0100-00
*M305	Mod plate current	METER: d-c ammeter, 0-4 range, 40 scale division	450-0101-00
MP200	Power supply air filter	FILTER: air conditioning	009-1069-00
MP300	Power amplifier air filter	FILTER: air conditioning	009-1069-00
P301	Meter plug	CONNECTOR: cable	363-8042-00
P302	Modulation monitor	CONNECTOR: coax cable, right angle	357-9014-00
R201	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710-6204-10
R202	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710-6204-10
R203	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710-6204-10
R204	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710-6204-10
R205	Surge limiter	RESISTOR: 17 ohms ±20%, 6.5 amps, nichrome wire	714-0019-00
R206	Surge limiter	RESISTOR: same as R205	714-0019-00
R207	Surge limiter	RESISTOR: same as R205	714-0019-00
R208	Low power mod bias adj	RESISTOR: 250 ohm p/m 10%, 200 w	716-0005-00
R210		NOT USED	
R211		NOT USED	
R212	Meter light dropping	RESISTOR: WW, 100 ohm p/m 10%, 25 wv	710-3100-20
R301	PA tube grid	RESISTOR: 1500 ohm p/m 10%, 50 w	710-0093-00
*R301	PA tube grid	RESISTOR: 500 ohms p/m 10%, 50 w	710-2705-00
R302	M303 meter multiplier	TERMINAL BOARD: Includes six 1-megohm, 2 w resistors	506-0626-002
R303		NOT USED	
R304	M303 shunt	RESISTOR: 10,000 ohm p/m 10%, 2 w	745-5694-00
R305	Feedback network	RESISTOR: 8200 ohm p/m 5%, 2 w	745-5690-00
R306	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R307	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R308	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R309	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R310	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R311	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R312	Feedback network	RESISTOR: same as R304	745-5694-00
R313	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R314	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R315	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R316	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R317	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R318	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705-4001-00
R319	V303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745-5722-00
R320	V303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745-5722-00
R321	V303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745-5722-00
R322	V303 grid series resistor	RESISTOR: 4700 ohm p/m 10%, 2 w	745-5680-00
R323	V304 grid series resistor	RESISTOR: 4700 ohm p/m 10%, 2 w	745-5680-00
R324	V304 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745-5722-00
R325	V304 grid resistance	RESISTOR: 47,000 ohm p/m 10%, 2 w	745-5722-00
R326	V304 grid resistance	RESISTOR: 47,000 ohm p/m 10%, 2 w	745-5722-00
R327		NOT USED	
R328	M304 shunt (mod)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710-2511-00
R329	M304 shunt (mod)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710-2511-00
*R330	M304 shunt (PA)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710-2511-00

*21M only.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R331	M304 shunt (PA)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710-2511-00
R332	Audio monitor voltage generator	RESISTOR: 3 ohm p/m 5%, 100 w	710-2009-00
R333	M304 multiplier	RESISTOR: 910 ohm p/m 1%, 1/2 w	705-2130-00
R334	PA grid meter shunt	RESISTOR: 4.0 ohm p/m 1%, 1 w	722-0046-00
R335	Mod bias adj	RHEOSTAT: 10,000 ohm p/m 10%, 25 w	735-1042-00
R336	Mod bias adj	RHEOSTAT: 10,000 ohm p/m 10%, 25 w	735-1042-00
R337	Bias voltage divider	RESISTOR: 7500 ohm p/m 10%, 200 w	710-0156-00
R338	Bias voltage divider	RESISTOR: 1500 ohm p/m 10%, 200 w	710-2605-00
**R339	Bias voltage divider	RESISTOR: 15,000 ohm p/m 10%, 25 w	710-3154-20
R340	Bias voltage divider	RESISTOR: WW 15,000 ohm p/m 10%, 100 w	710-5154-20
R341	Modulator overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710-1252-00
R342	Modulator overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710-1252-00
R343	Mod overload relay shunt	RESISTOR: WW, 5 ohm p/m 10%, 25 w	710-3520-00
*R343	Mod overload relay shunt	RESISTOR: WW, 2 ohm p/m 5%, 25 w	710-3220-00
R344	R-f overload relay shunt	RESISTOR: WW, 5 ohm p/m 10%, 25 w	710-3520-00
*R344	R-f overload relay shunt	RESISTOR: WW, 2 ohm p/m 5%, 25 w	710-3220-00
R345	Arc suppression divider	RESISTOR: WW, 20,000 ohm p/m 10%, 25 w	710-3204-20
R346	Arc suppression divider	RESISTOR: WW, 20,000 ohm p/m 10%, 25 w	710-3204-20
R347	Meter light dropping	RESISTOR: WW, 100 ohm p/m 10%, 25 w	710-3100-20
R348	Parasitic resistor	RESISTOR: 1.0 megohm p/m 10%, 2 w	745-5778-00
R349	R-f overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710-1252-00
R350	R-f overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710-1252-00
R351	Parasitic resistor	RESISTOR: fixed film, 500 ohm 10%, 11.2 w	712-2201-00
S201	HV interlock	CONTACT ASSEM: female section of door interlock switch	260-4040-00 260-4050-00 (Same as S-109)
S202	Bias supply shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl, 0.218 in. diam x 0.064 in. thk	 504-9587-002 504-9553-001
S203	HV supply shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl, 0.218 in. diam x 0.064 in.	 504-9587-002 504-9553-001
S204	HV sec grounding interlock	Includes: SPRING: 10 turns right hand wound wire CONTACT: brass, cad pl, 2-3/8 in. diam x 0.064 in. thk SHAFT: 4-9/16 in. lg x 5/16 in. diam	 506-0515-002 506-0514-002 506-0513-002
S205	HV sec grounding interlock	Includes: SPRING: 10 turns right hand wound wire CONTACT: brass, cad pl, 2-3/8 in. x 0.064 in. thk SHAFT: 4-9/16 in. lg x 5/16 in. diam	 506-0515-002 506-0514-002 506-0513-002
S206		NOT USED	
S207	HV-LV selector	SWITCH: Rotary, 3 pole, 2 position	266-0044-00
S208	HV plate control and breaker	SWITCH: Magnetic, 3 pole, 3 overload coils	260-0415-00
*S208	HV plate control and breaker	SWITCH: Magnetic, 3 pole, 3 overload coils	260-0935-00
S209		NOT USED	
S210		NOT USED	
S301	HV interlock	SWITCH: 2 female contacts, momentary action	260-4040-00 260-4050-00 (Same as S-109)
S302	HV interlock	SWITCH: 2 female contacts, momentary action	260-4040-00 260-4050-00 (Same as S-109)
S303	Blower breaker and switch	SWITCH: magnetic, 2 pole, 2 overload coils	260-0220-00

**Determined by frequency.
*21M only.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
S304	Blower interlock	SWITCH: air pressure 7.5 amperes 30 v d-c	260-1261-00
S305	Filament breaker and switch	SWITCH: magnetic, 3 pole, 3 overload coils	260-0407-00
S306	Meter circuit selector	SWITCH: rotary, 2 pole, 8 position, 2 section	259-0441-00
S307	Bias shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl; 0.218 in. diam x 0.064 in. thk	 504-9587-002 504-9553-001
S308	HV shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl; 0.218 in. diam x 0.64 in. thk	 504-9587-002 504-9553-001
S309	HV shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl; 0.218 in. diam x 0.064 in. thk	 504-9587-002 504-9553-001
S310	Filament on	SWITCH: Push, 40 amp 110 v	260-0355-00
S311	Filament off	SWITCH: Push, 40 amp 110 v	260-0352-00
S312	Plate on	SWITCH: Push, 40 amp 110 v	260-0355-00
S313	Plate off	SWITCH: Push, 40 amp 110 v	260-0352-00
S314	HV shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl; 0.218 in. diam x 0.064 in. thk	 504-9587-002 504-9553-001
T201	Filament voltage	TRANSFORMER, variable autotransformer 230 v, 60 cps, 3 phase	664-0079-00
T202	Bias rect filament	TRANSFORMER: filament, pri: 230 v 2.5 v CT	662-0495-00
T203	Bias rect plate	TRANSFORMER: power, pri: 208 v tapped sec: as required for 1100 v d-c at 200 ma, CT	662-0001-00
T204	HV plate	TRANSFORMER: plate, 230/208 v rms 3 phase, 50/60 cps	662-0492-00 or 664-0003-00
*T204	HV plate	TRANSFORMER: plate, 230/208 v rms 3 phase, 50/60 cps	662-0909-00 or 664-0011-00
T205	HV rectifier filament	TRANSFORMER: filament, pri no. 1: 115 v, pri no. 2: 115 v 1000 rms TV, sec: 5 v TV, 15,000 rms TV	662-0186-00
T206	HV rectifier filament	TRANSFORMER: filament, pri no. 1: 115 v, pri no. 2: 115 v, 1000 rms TV sec: 5 v TV, 15,000 rms TV	662-0186-00
T207	HV rectifier filament	TRANSFORMER: filament, pri no. 1: 115 v, pri no. 2: 115 v, 1000 rms TV sec: 5 v TV, 15,000 rms TV	662-0186-00
T208	HV rectifier filament	TRANSFORMER: filament, pri no. 1: 115 v, pri no. 2: 115 v, 1000 rms TV sec: 5 v TV, 15,000 rms TV	662-0186-00
T209	HV rectifier filament	TRANSFORMER: filament, pri no. 1: 115 v, pri no. 2: 115 v, 1000 rms TV sec: 5 v TV, 15,000 rms TV	662-0186-00
T210	HV rectifier	TRANSFORMER: filament, pri no. 1: 115 v, pri no. 2: 115 v, 1000 rms TV sec: 5 v TV, 15,000 rms TV	662-0186-000
T211	Modulation	TRANSFORMER: modulation, pri: 5000 ohm CT, sec: 3400 ohm, 18,000 rms TV	667-0480-00 or 667-0042-00 or 667-0060-00
*T211	Modulation	TRANSFORMER: modulation, pri: 2700 ohm CT, sec: 1700 ohm, 18,000 rms TV	667-0066-00

*21M only.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
T302	V303 filament transformer	TRANSFORMER: filament, pri: 230 v, sec: 7.75 v CT	662-0085-00
T303	V304 filament transformer	TRANSFORMER: filament, pri: 230 v, sec: 7.75 v CT	662-0085-00
T304	V301 filament transformer	TRANSFORMER: filament, pri: 230 v, sec: 7.75 v CT	662-0085-00
*T305	V305 filament transformer	TRANSFORMER: filament, pri: 230 v, sec: 7.75 v CT	662-0085-00
V201	Bias rectifier	TUBE: rectifier 866A	256-0049-00
V202	Bias rectifier	TUBE: rectifier 866A	256-0049-00
V203	HV rectifier	TUBE: rectifier 575A	256-0080-00
V204	HV rectifier	TUBE: rectifier 575A	256-0080-00
V205	HV rectifier	TUBE: rectifier 575A	256-0080-00
V206	HV rectifier	TUBE: rectifier 575A	256-0080-00
V207	HV rectifier	TUBE: rectifier 575A	256-0080-00
V208	HV rectifier	TUBE: rectifier 575A	256-0080-00
V301	Power amplifier	TUBE: triode 3X2500A3	256-0108-00
*V302	Power amplifier	TUBE: triode 3X2500A3	256-0108-00
V303	Modulator	TUBE: triode 3X3000A1	256-0100-00
V304	Modulator	TUBE: triode 3X3000A1	256-0100-00
XC310	Socket for C310	SOCKET: for capacitor, brass	506-0593-002
XF201	Socket for F201	FUSE HOLDER: extractor post type for 3 AG fuses	265-1040-00
XF202	Socket for F202	FUSE HOLDER: same as XF201	
XF203	Socket for F203	FUSE HOLDER: same as XF201	
XF204	Socket for F204	FUSE HOLDER: same as XF201	
XF205	Socket for F205	FUSE HOLDER: same as XF201	
XF301	Socket for F301	FUSE HOLDER: same as XF201	265-1040-00
XF302	Socket for F302	FUSE HOLDER: same as XF201	265-1040-00
XF303	Socket for F303	FUSE HOLDER: same as XF201	265-1040-00
XF304	Socket for F304	FUSE HOLDER: same as XF201	265-1040-00
XI201A	Socket for I201	MTG: socket for lumiline lamp bulb	262-0177-00
XI201B	Socket for I201	MTG: socket for lumiline lamp bulb	262-0177-00
XI202A	Socket for I202	MTG: socket for lumiline lamp bulb	262-0177-00
XI202B	Socket for I202	MTG: socket for lumiline lamp bulb	262-0177-00
XI203		NOT USED	
XI204		NOT USED	
XI301A	Socket for I301	MTG: socket for lumiline lamp bulb	262-0177-00
XI301B	Socket for I301	MTG: socket for lumiline lamp bulb	262-0177-00
XI302A	Socket for I302	MTG: socket for lumiline lamp bulb	262-0177-00
XI302B	Socket for I302	MTG: socket for lumiline lamp bulb	262-0177-00
XI303	Socket for I303	LAMP HOLDER: for use with candelabra screw base lamp	262-0255-00
XI304	Socket for I304	LAMP HOLDER: for use with candelabra screw base lamp	262-0255-00
XV201	Socket for V201	SOCKET: 4 Pin UX	220-5410-00
XV202	Socket for V202	SOCKET: 4 Pin UX	220-5410-00
XV203	Socket for V203	SOCKET: 4 Pin Jumbo	220-5420-00
XV204	Socket for V204	SOCKET: 4 Pin Jumbo	220-5420-00
XV205	Socket for V205	SOCKET: 4 Pin Jumbo	220-5420-00
XV206	Socket for V206	SOCKET: 4 Pin Jumbo	220-5420-00
XV207	Socket for V207	SOCKET: 4 Pin Jumbo	220-5420-00
XV208	Socket for V208	SOCKET: 4 Pin Jumbo	220-5420-00
XV301	Socket for V301	PLATE: electrical shield, includes 2 capacitors	506-0621-004
*XV302	Socket for V302	PLATE: electrical shield, includes 2 capacitors	506-0621-004
XV303	Socket for V303	PLATE: electrical shield, includes 2 capacitors	506-0621-004
XV304	Socket for V304	PLATE: electrical shield, includes 2 capacitors	506-0621-004

*21M only.

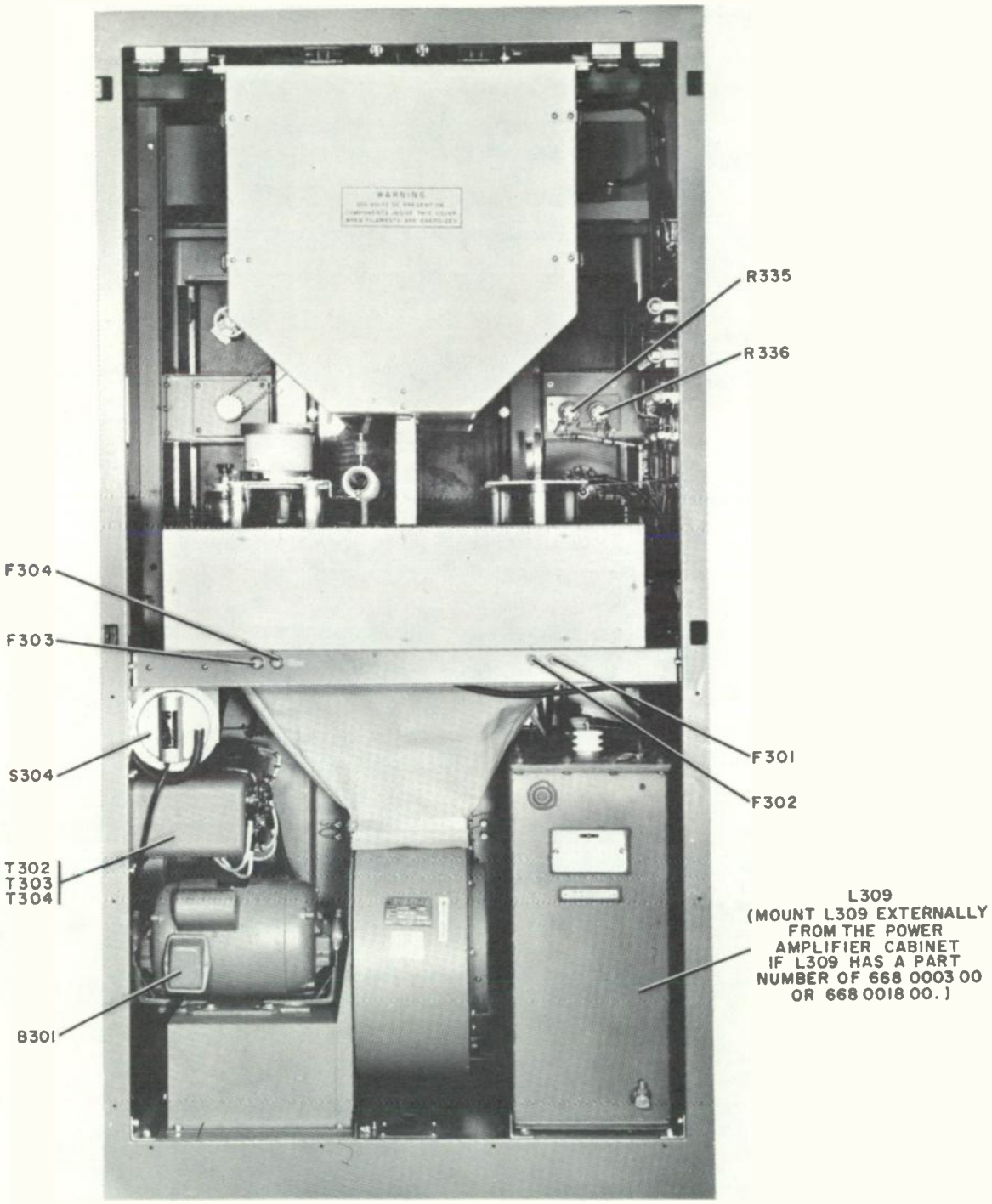


Figure 6-1. Power Amplifier Cabinet, Rear View

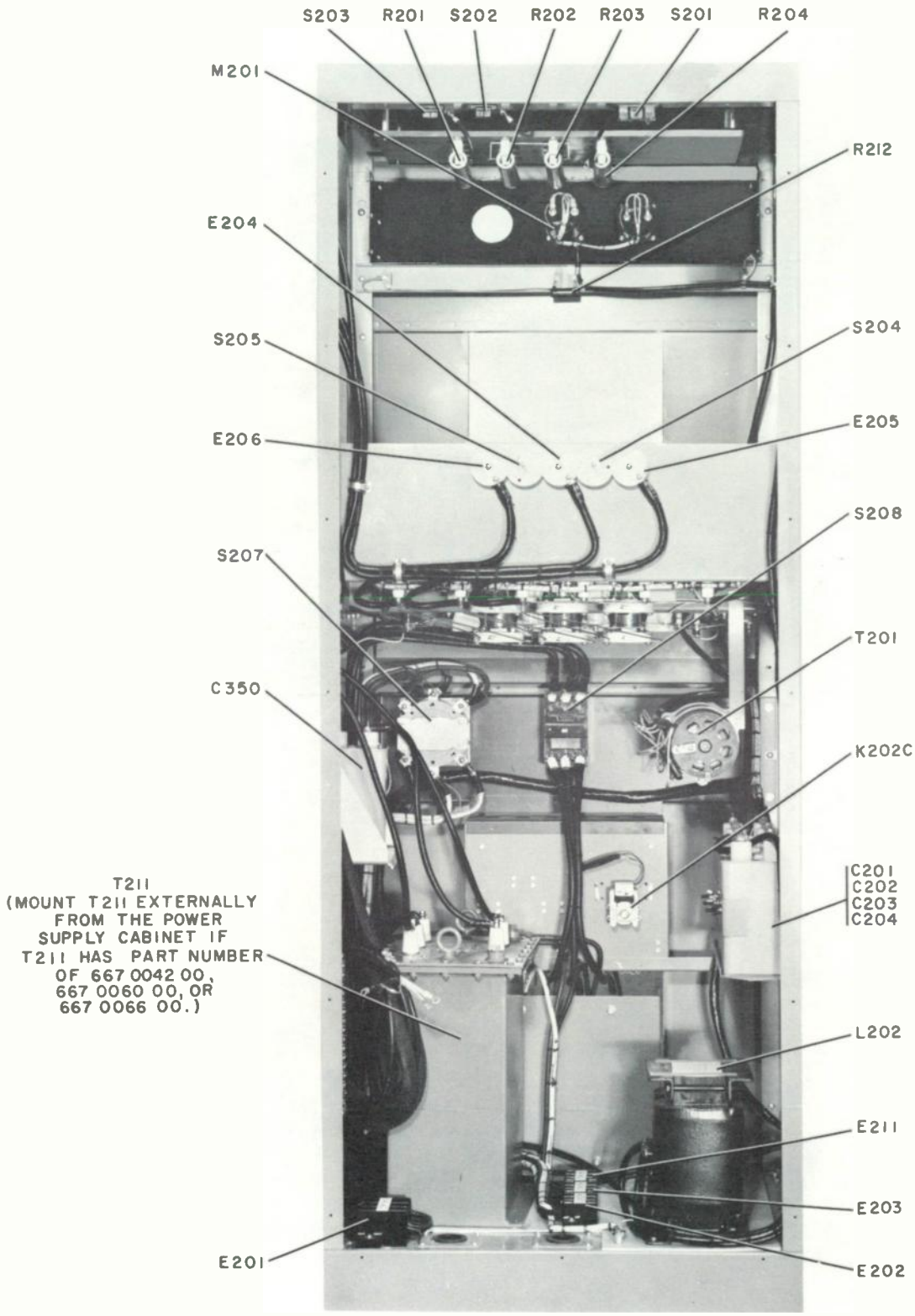


Figure 6-2. Power Supply Cabinet, Rear View

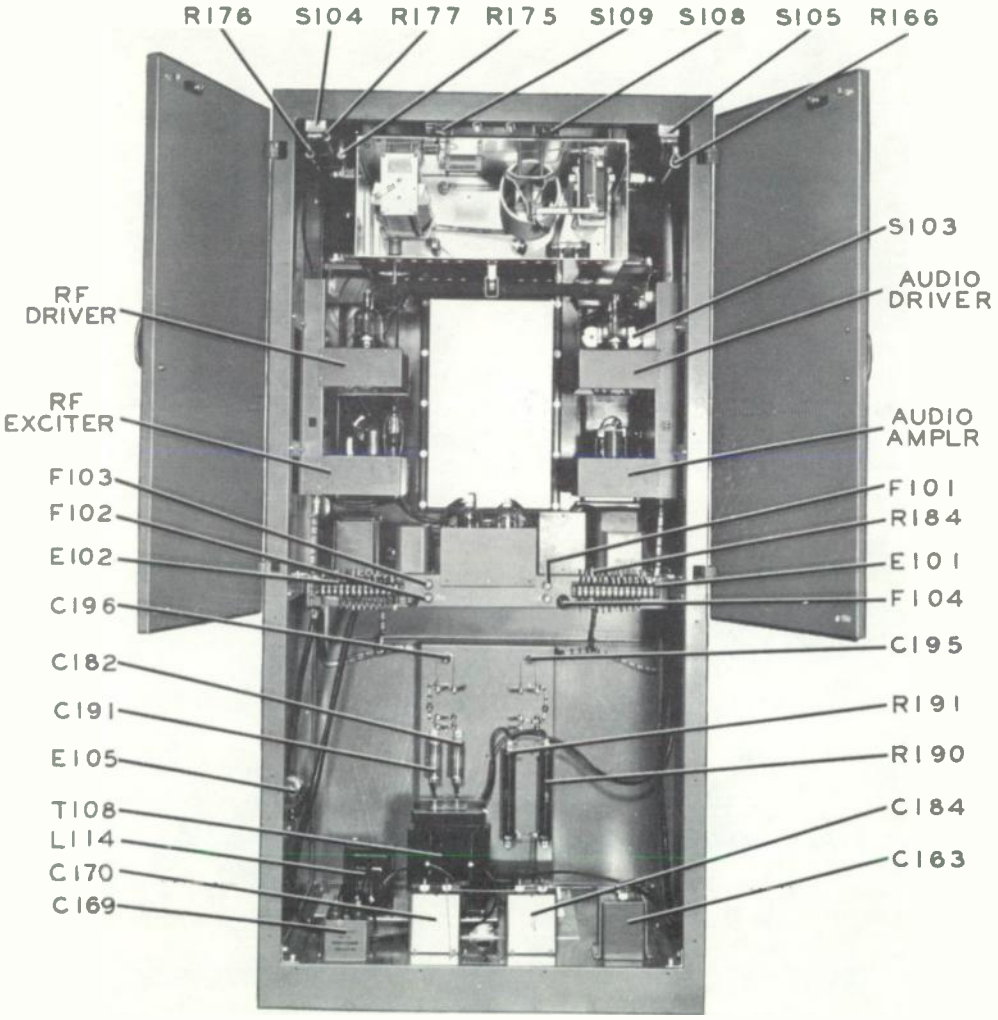
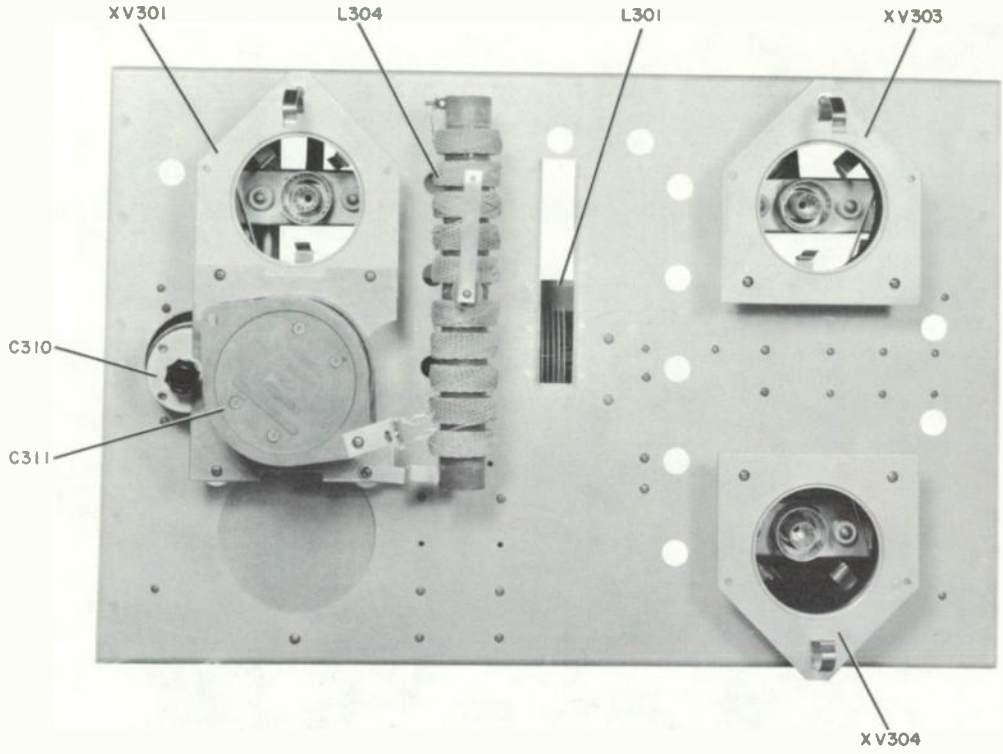


Figure 6-3. Driver Cabinet, Rear View



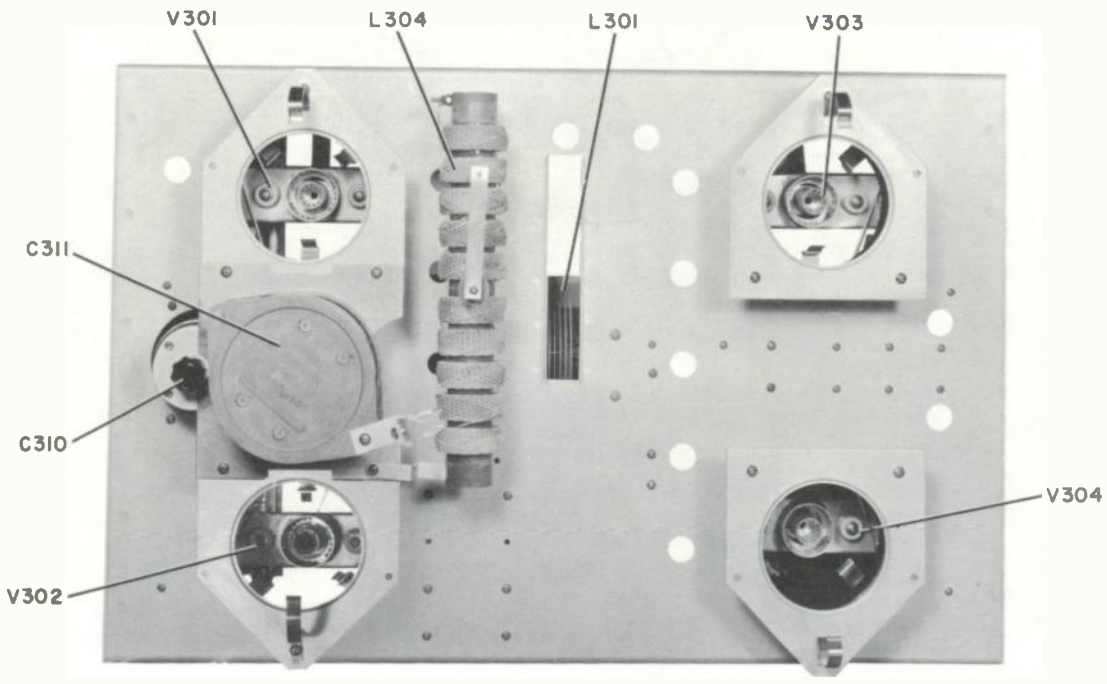
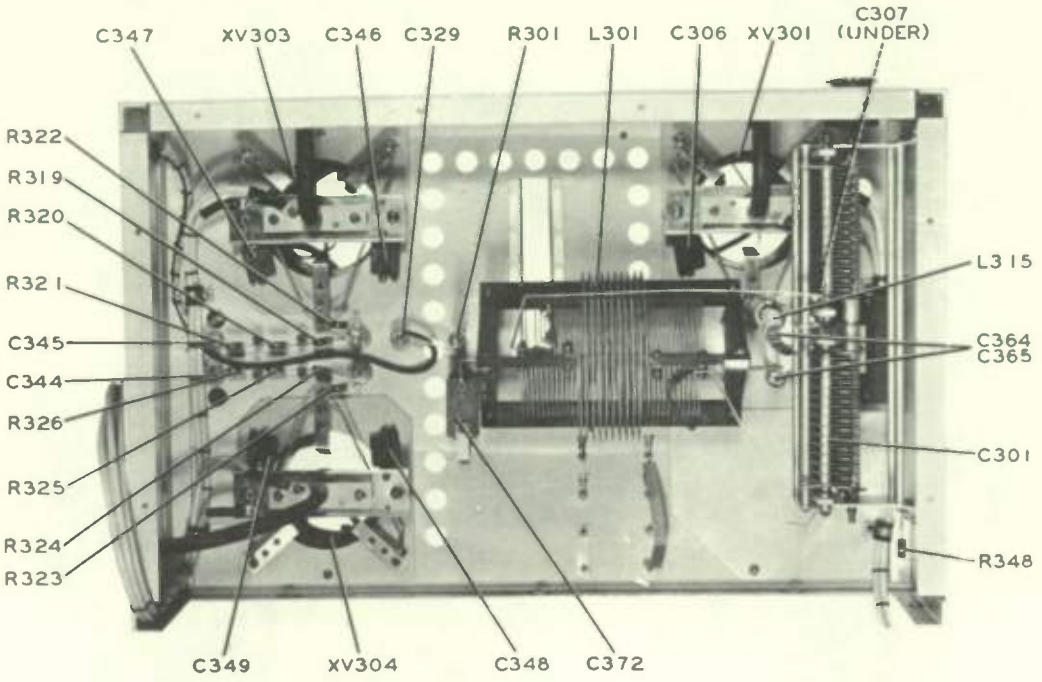
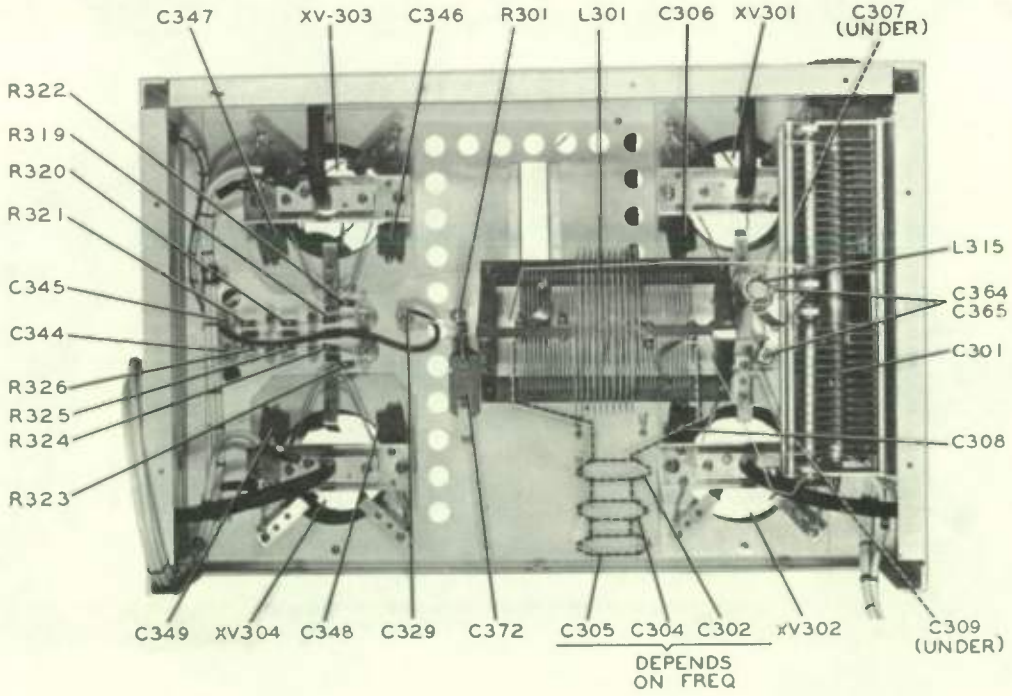


Figure 6-4. Power Amplifier R-F Chassis, Top View



21 E



21 M

Figure 6-5. Power Amplifier R-F Chassis, Bottom View, 21E and 21M

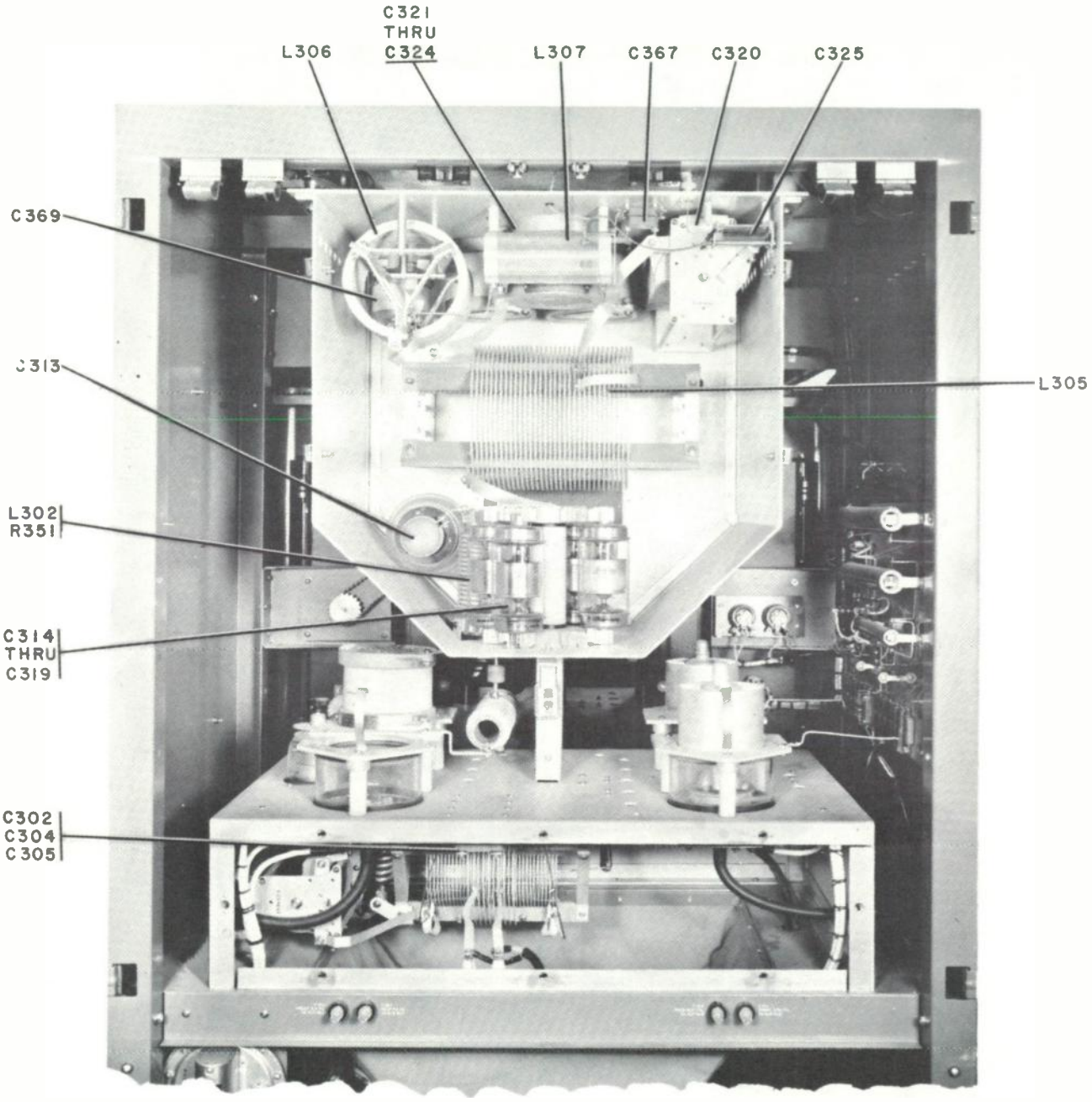


Figure 6-6. Power Amplifier Output Network, Rear View

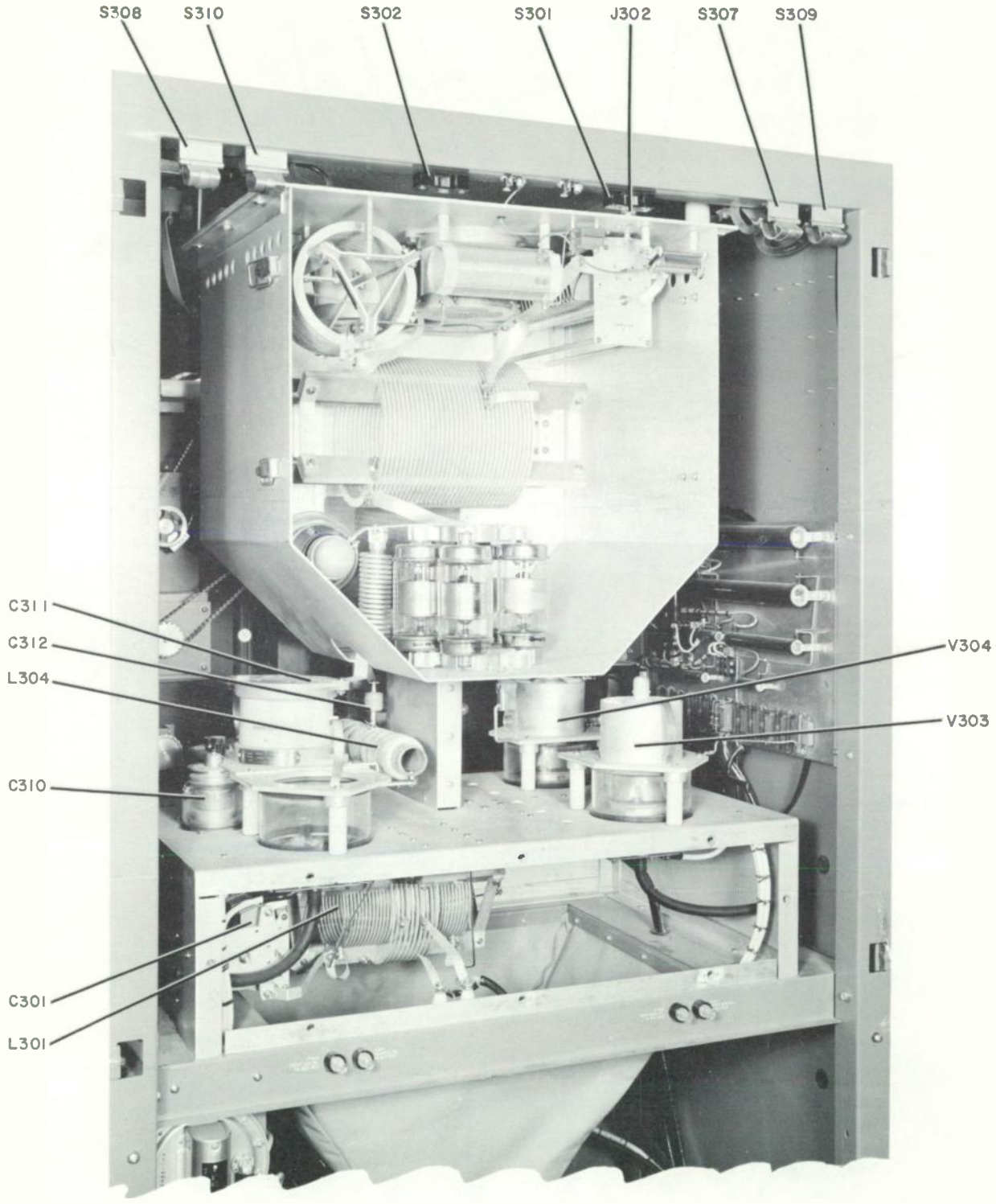


Figure 6-7. Power Amplifier Parts Arrangement, Rear Open

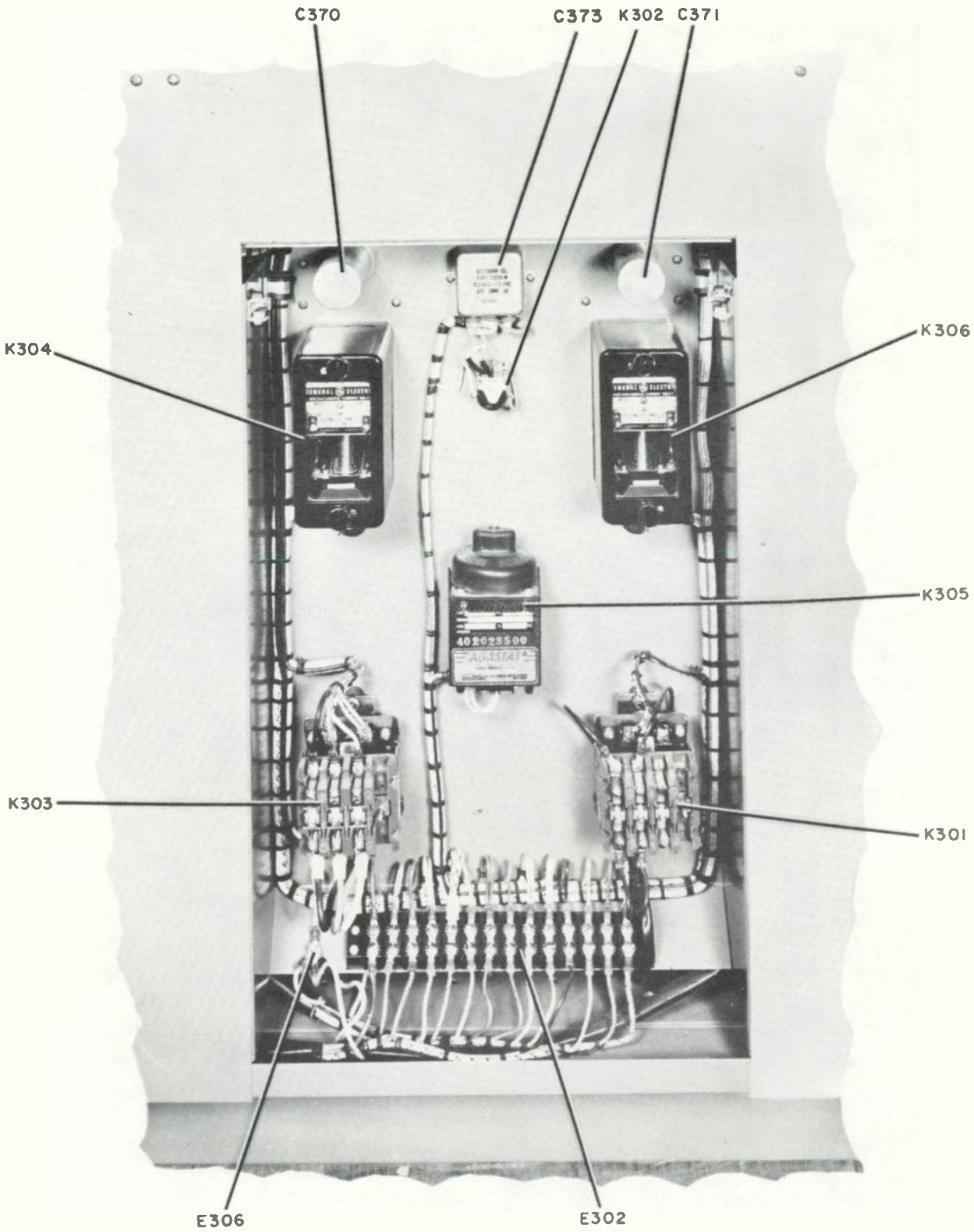


Figure 6-8. Power Amplifier Relay Enclosure

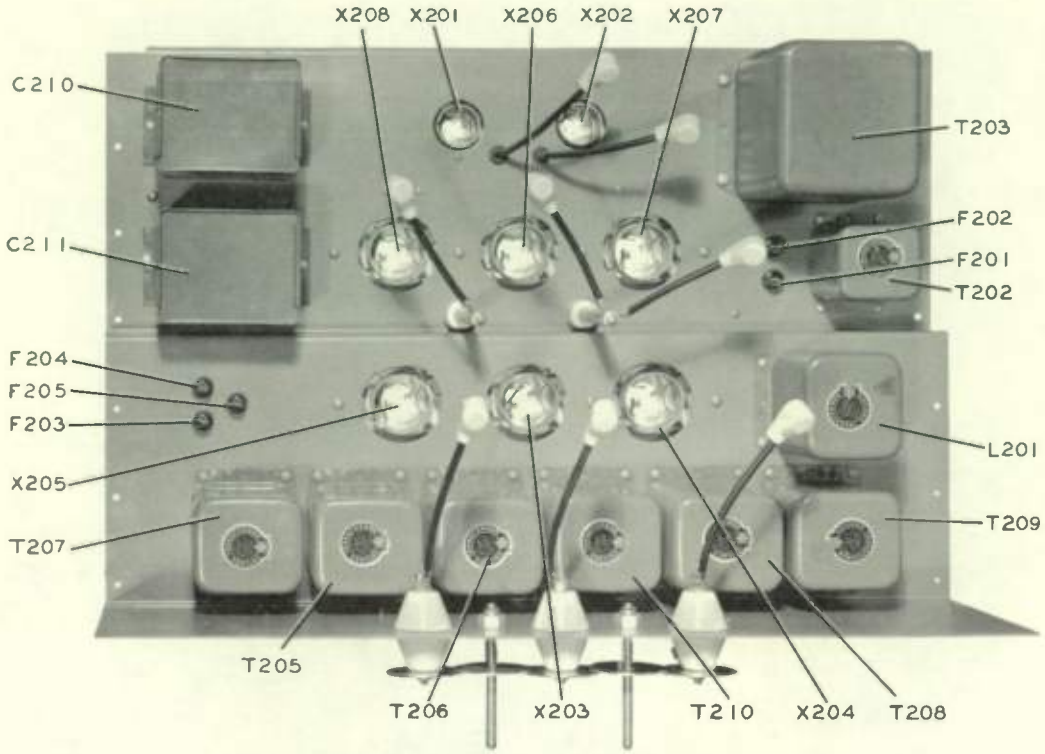


Figure 6-9. Power Supply Cabinet Rectifier Chassis, Top View

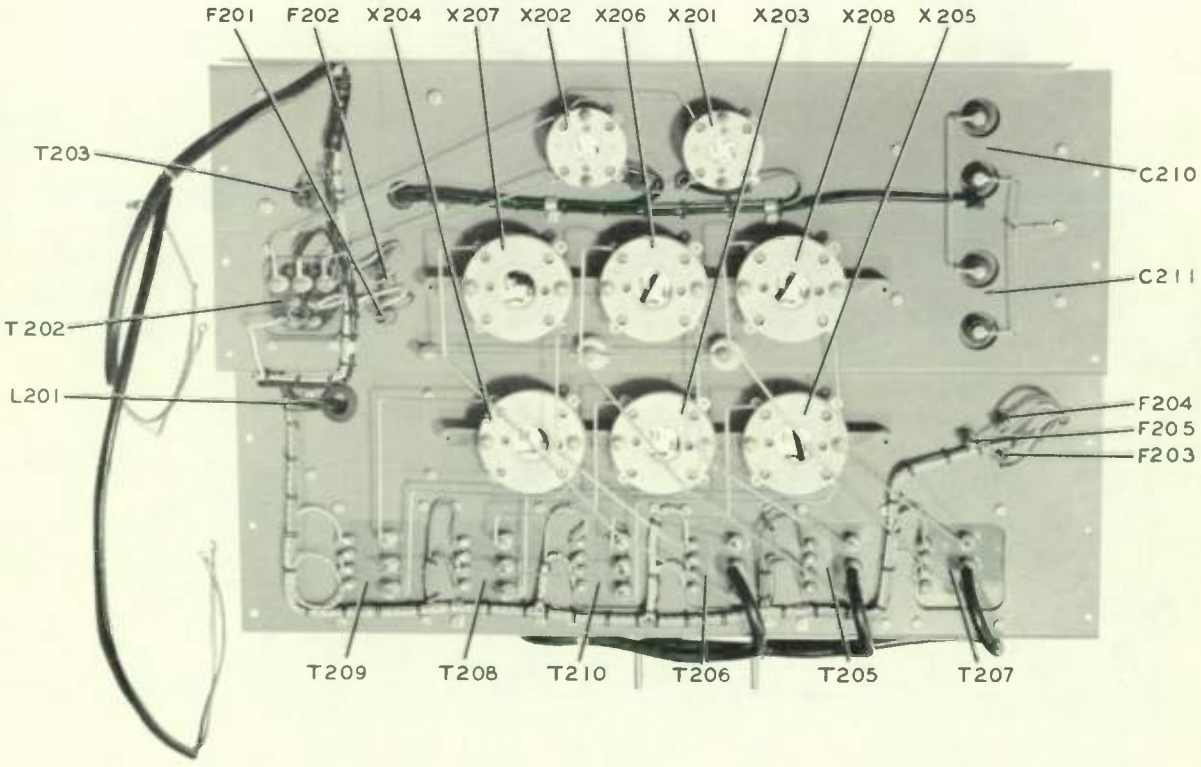


Figure 6-10. Power Supply Cabinet Rectifier Chassis, Bottom View

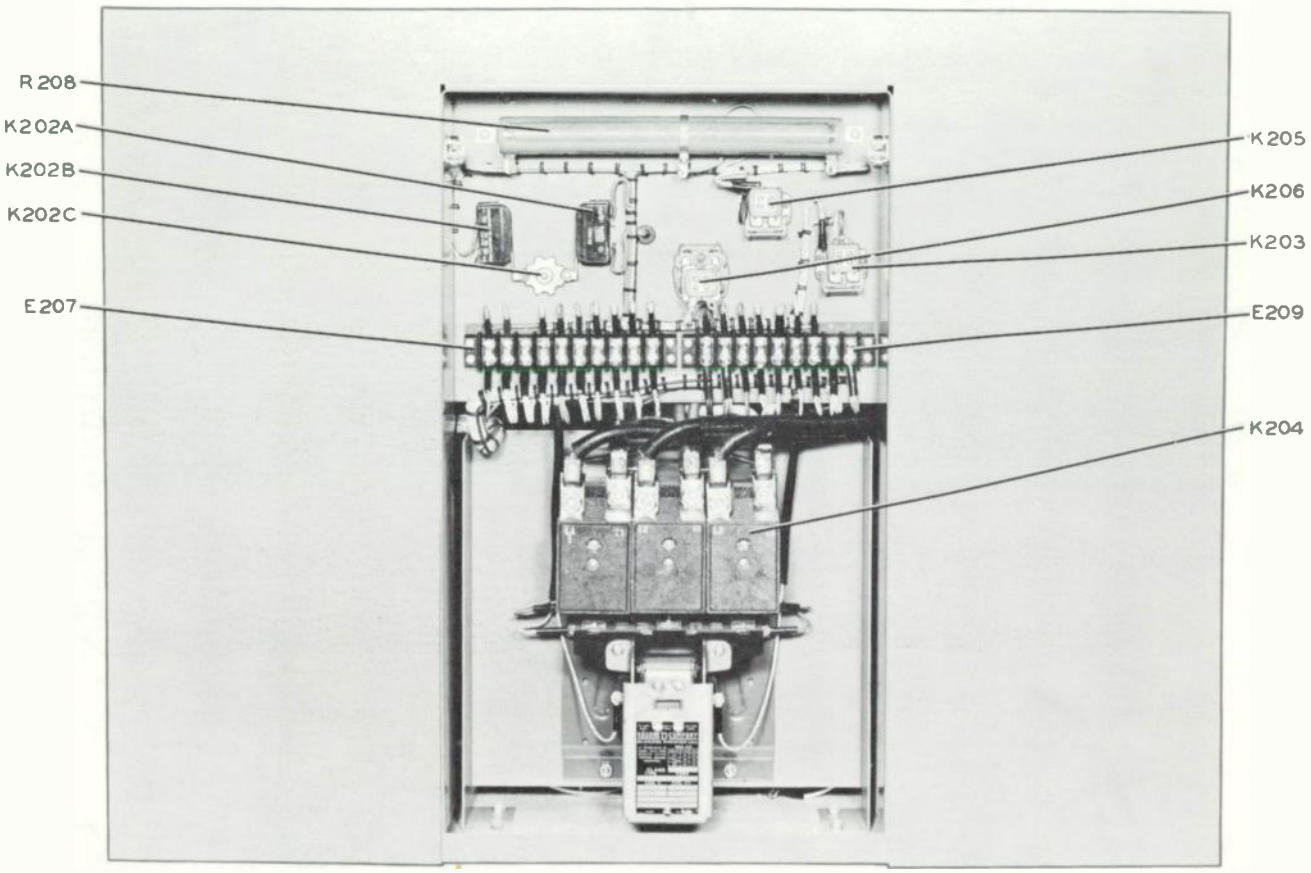


Figure 6-11. Power Supply Cabinet, Relay Enclosure

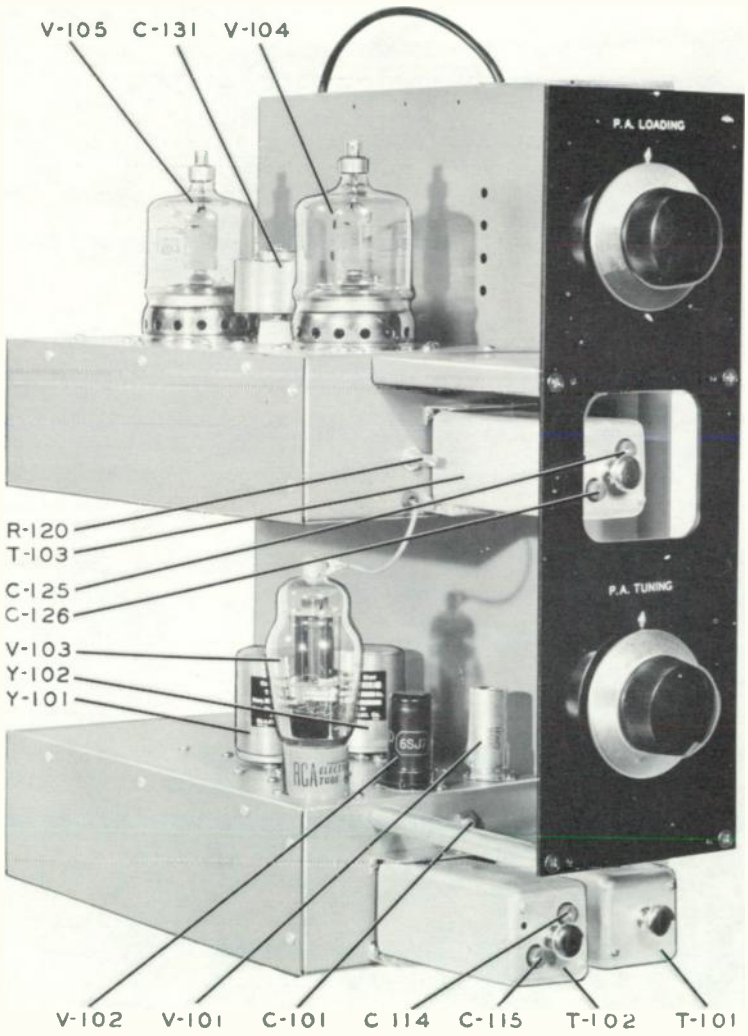


Figure 6-12. Driver Cabinet R-F Chassis, Top View

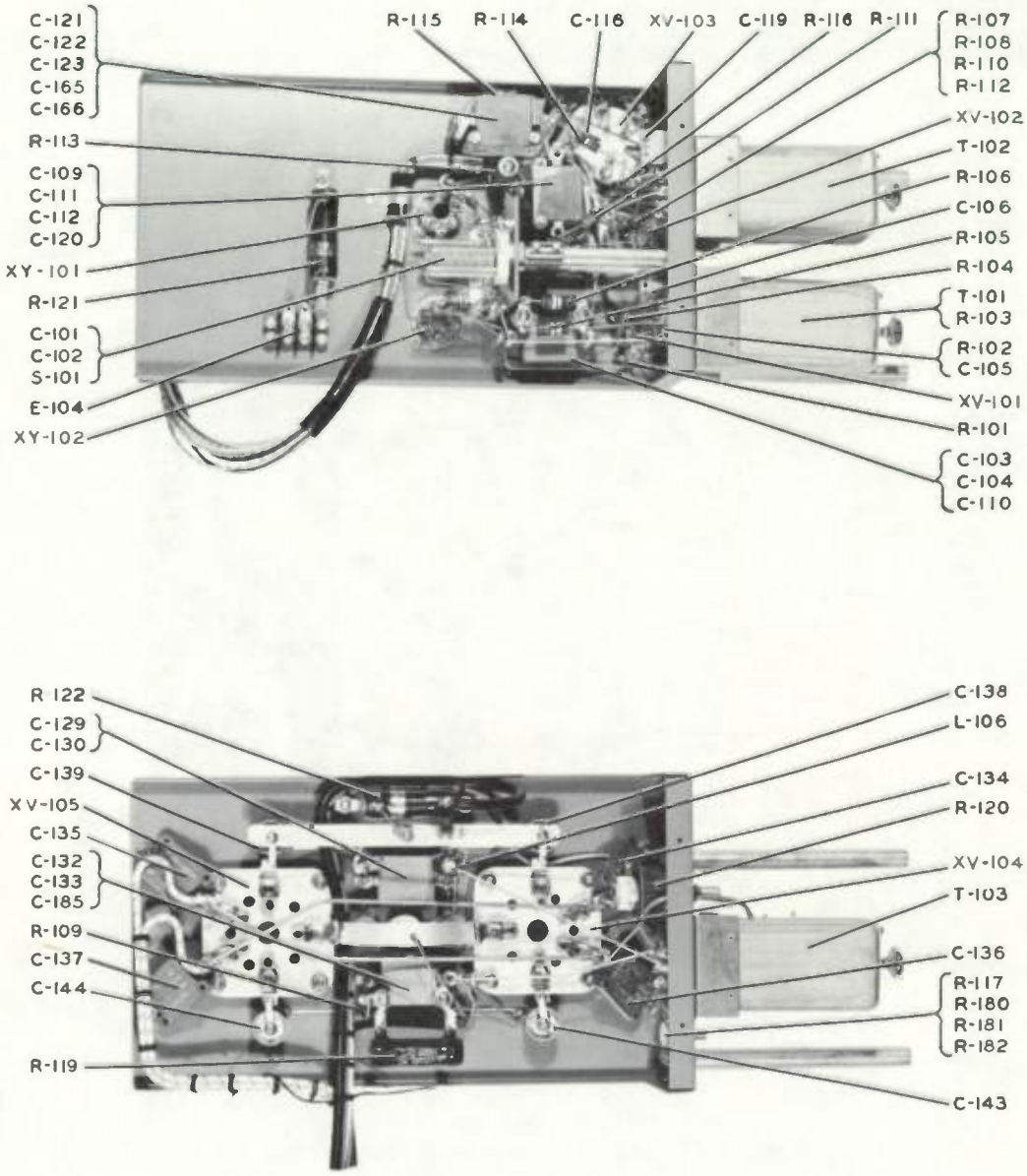


Figure 6-13. Driver Cabinet R-F Chassis, Bottom View

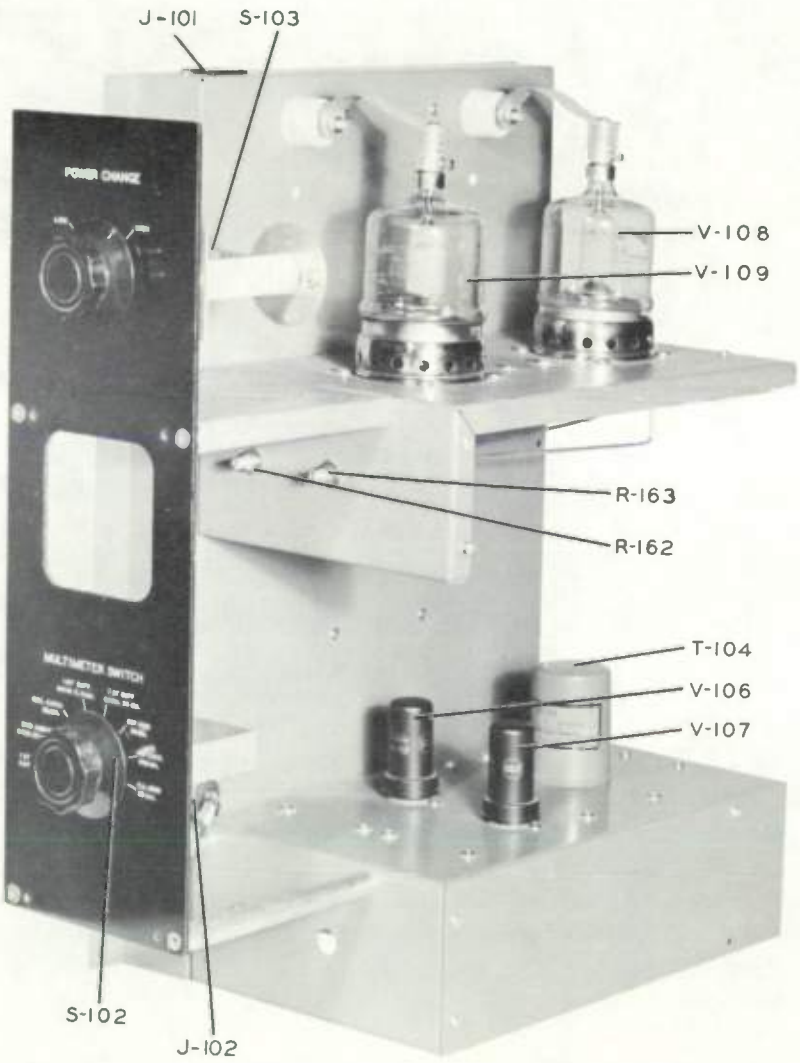


Figure 6-14. Driver Cabinet, Audio Chassis, Top View

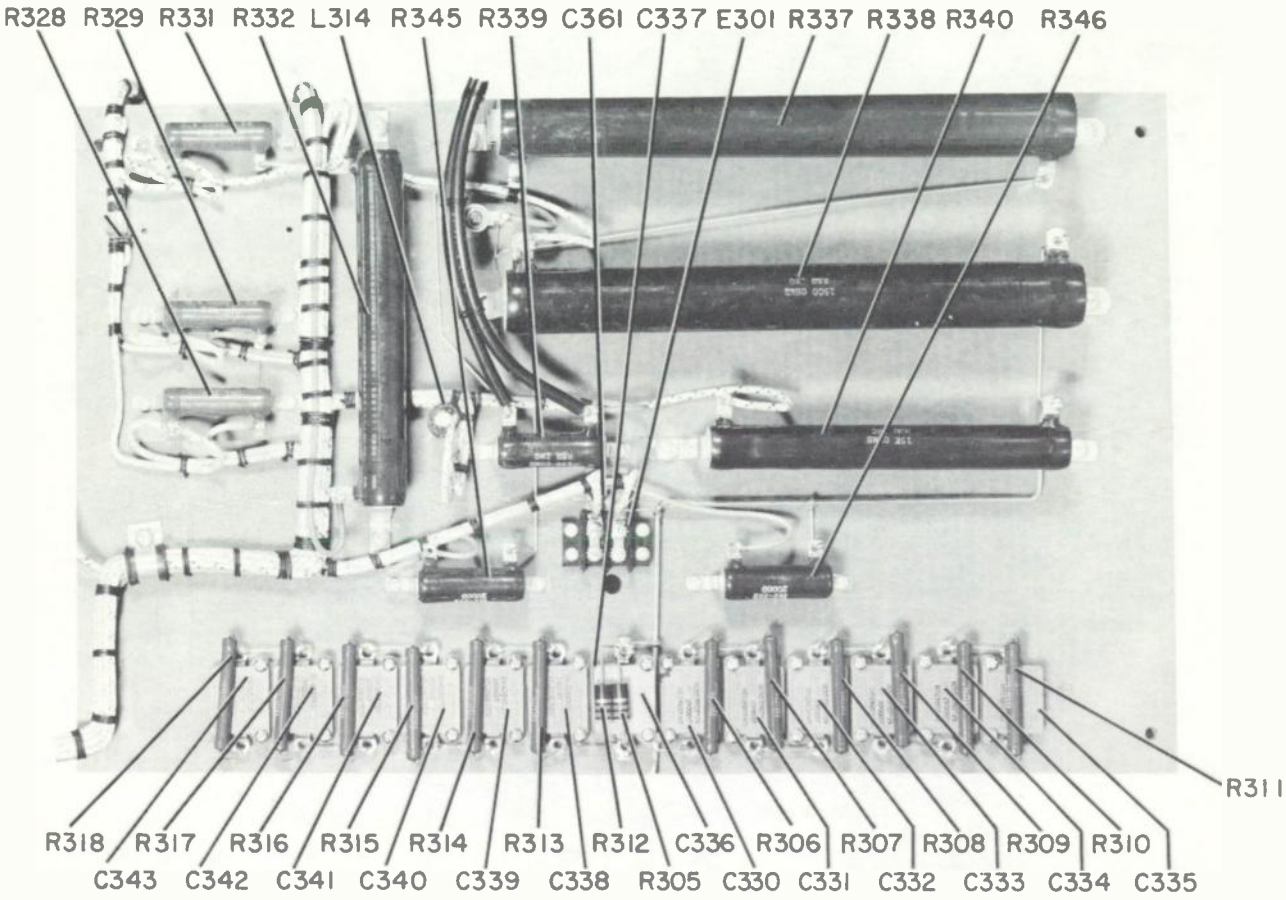
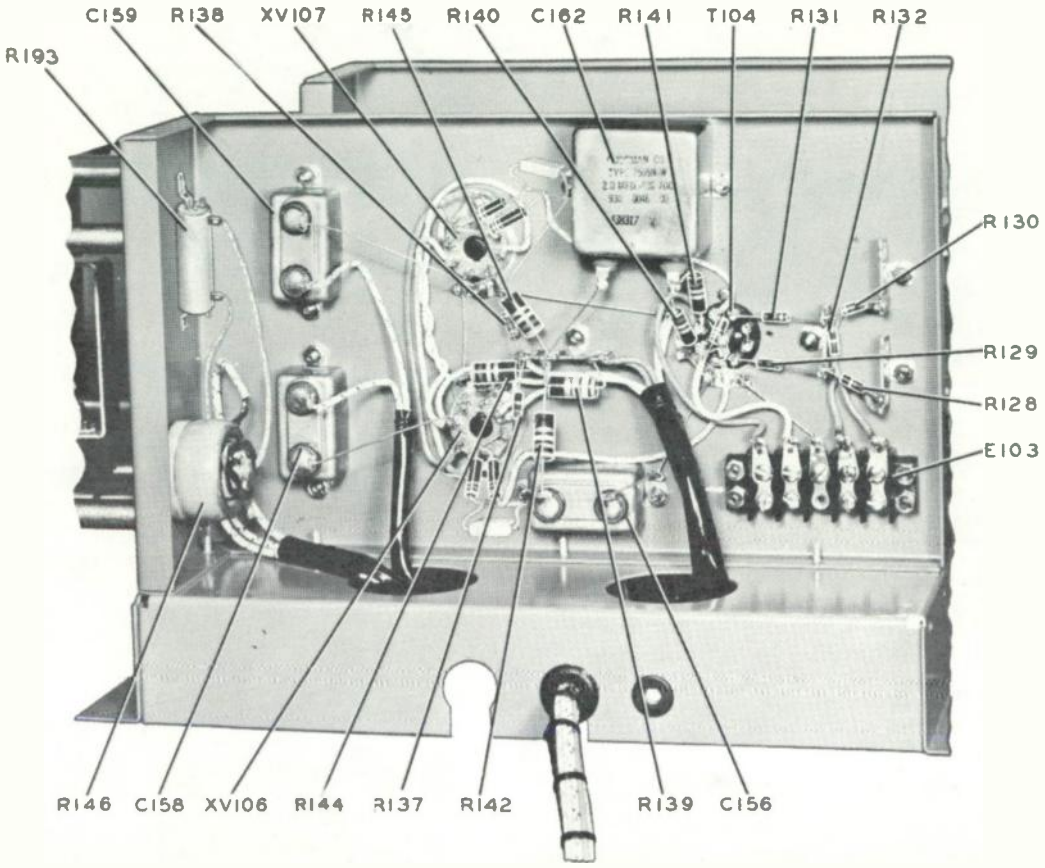


Figure 6-15. Audio Feedback Board, 21E Power Amplifier Cabinet



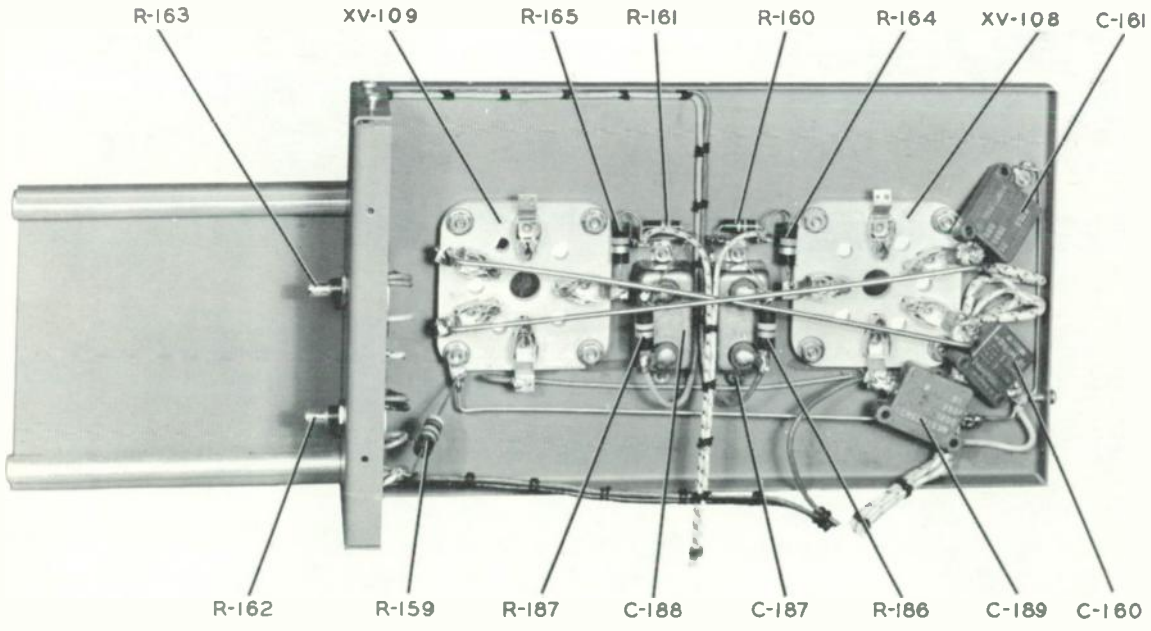


Figure 6-16. Driver Cabinet Audio Chassis, Bottom View

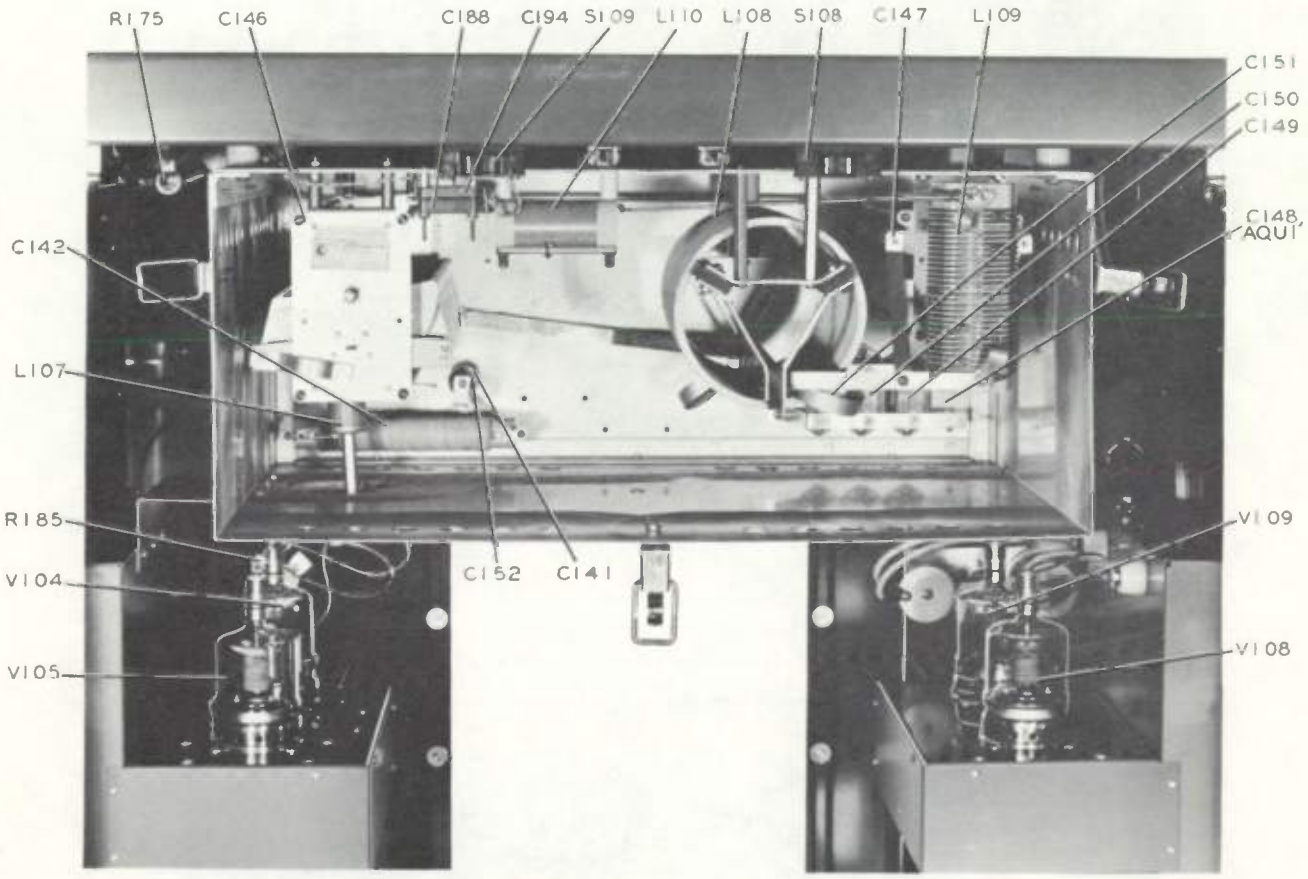
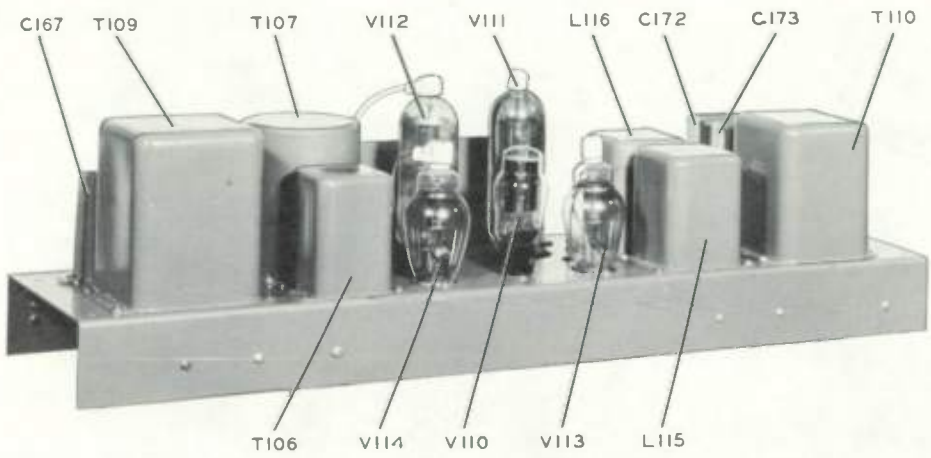
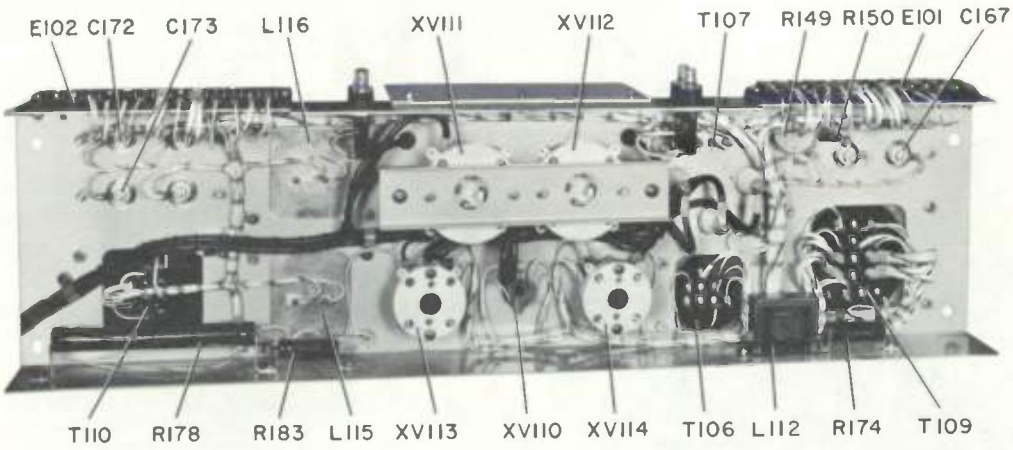


Figure 6-17. Driver Cabinet Output Network, Rear View





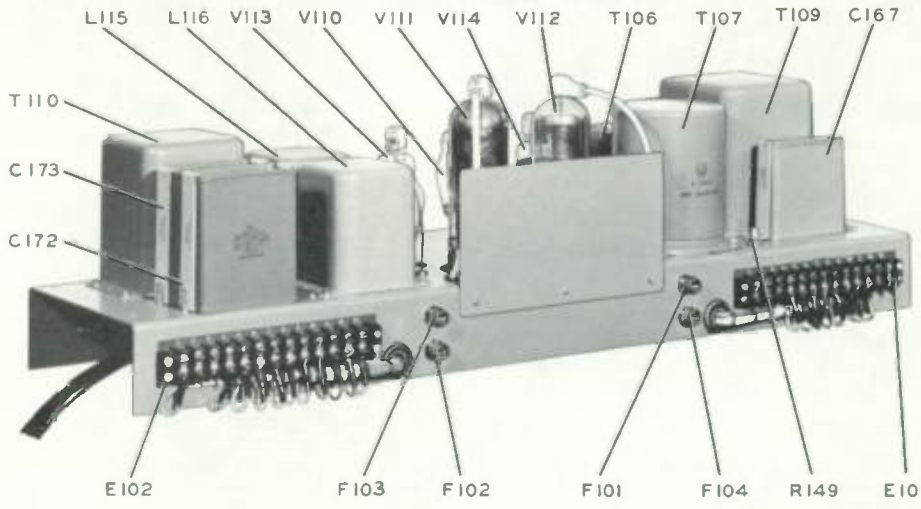


Figure 6-18. Driver Cabinet Low Voltage Power Shelf

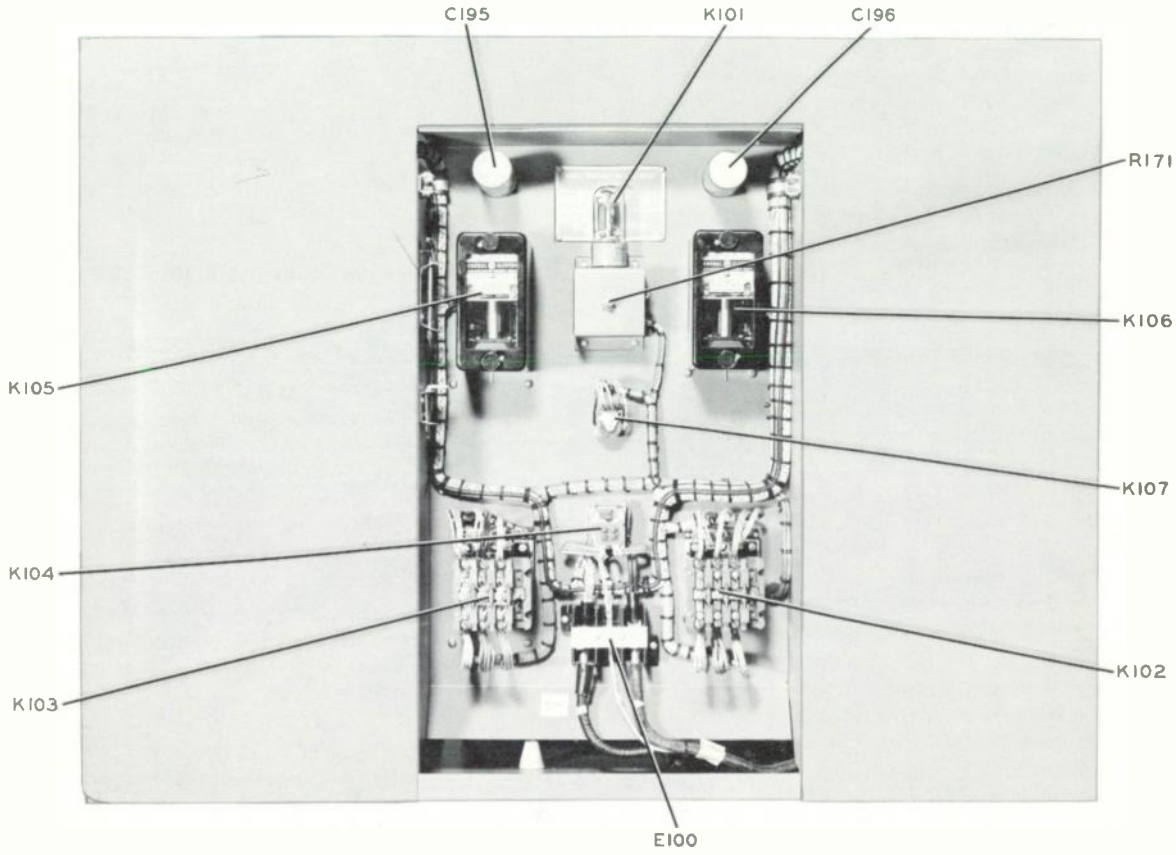
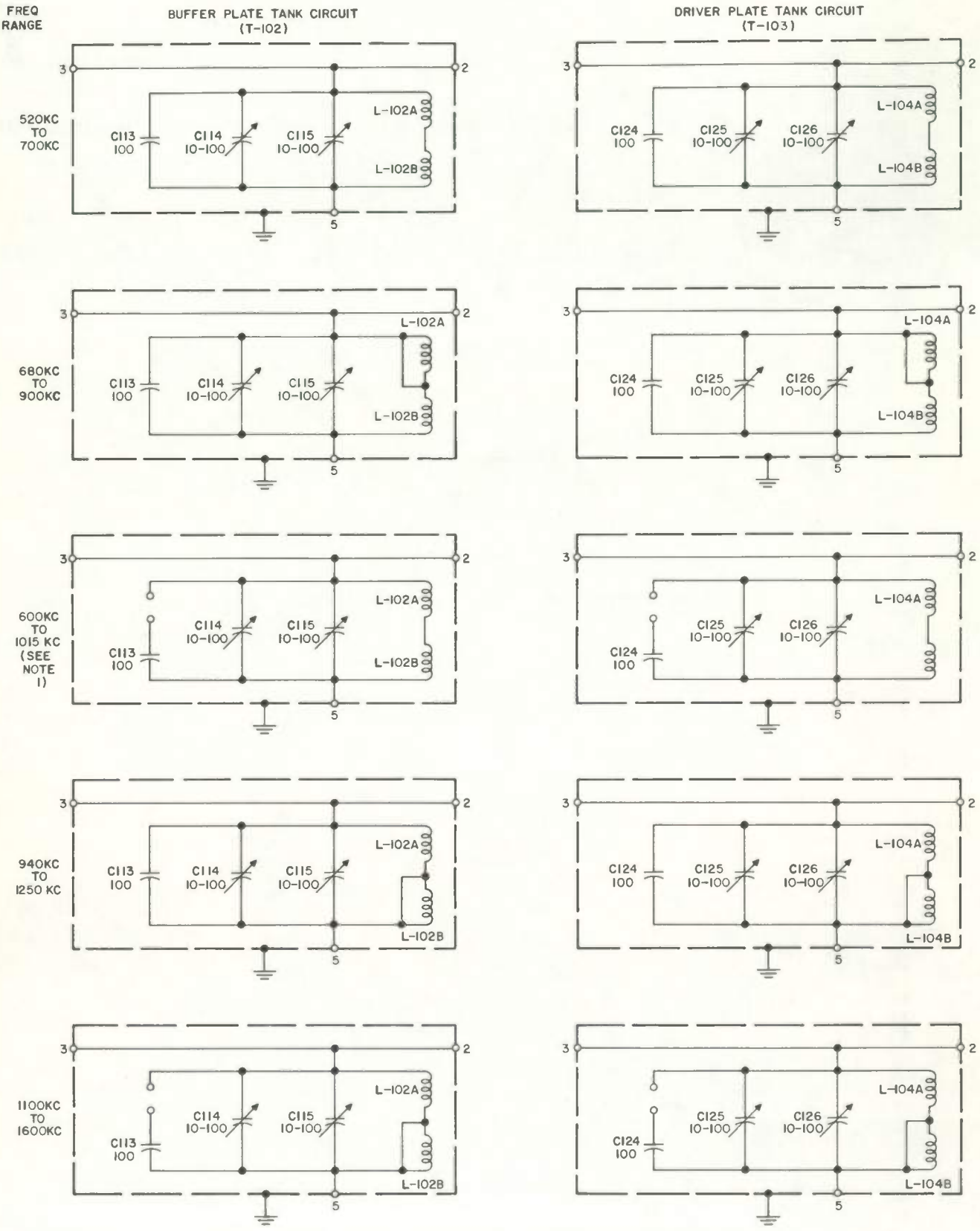


Figure 6-19. Driver Cabinet, Relay Enclosure

section 7

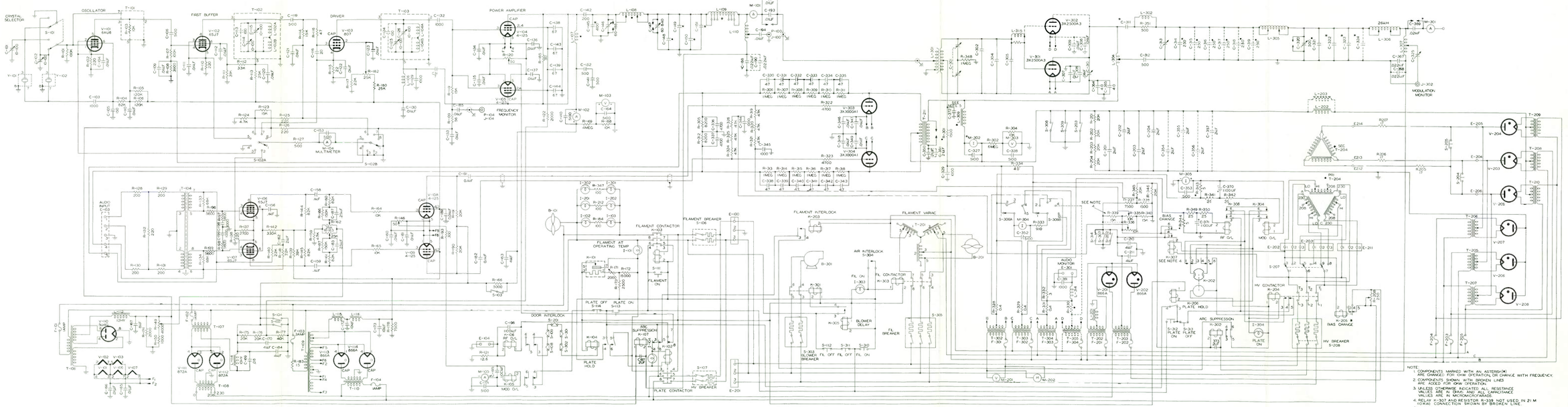
illustrations



NOTE:

1. THIS CIRCUIT INTENDED FOR USE BETWEEN 900KC AND 940KC.

Figure 7-1. T102 and T103 Internal Connections



NOTE:
1. COMPONENTS MARKED WITH AN ASTERISK(*) ARE CHANGED FOR CW OPERATION, OR CHANGE WITH FREQUENCY.
2. COMPONENTS SHOWN WITH BROKEN LINES ARE ADDED FOR CW OPERATION.
3. UNLESS OTHERWISE INDICATED ALL RESISTANCE VALUES ARE IN OHMS AND ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
4. RELAY K-307 AND RESISTOR R-339 NOT USED IN 21 M KW/KW CONNECTION SHOWN BY BROKEN LINE.
5. C-172 VALUE CHANGES WITH FREQUENCY AS FOLLOWS:
   1350-1600 KC, 2000 UUF
   1170-1340 KC, 3000 UUF
   800-960 KC, 3600 UUF
   650-790 KC, 5100 UUF
   550-640 KC, 6200 UUF

Figure 7-2. 21E/M Complete Schematic

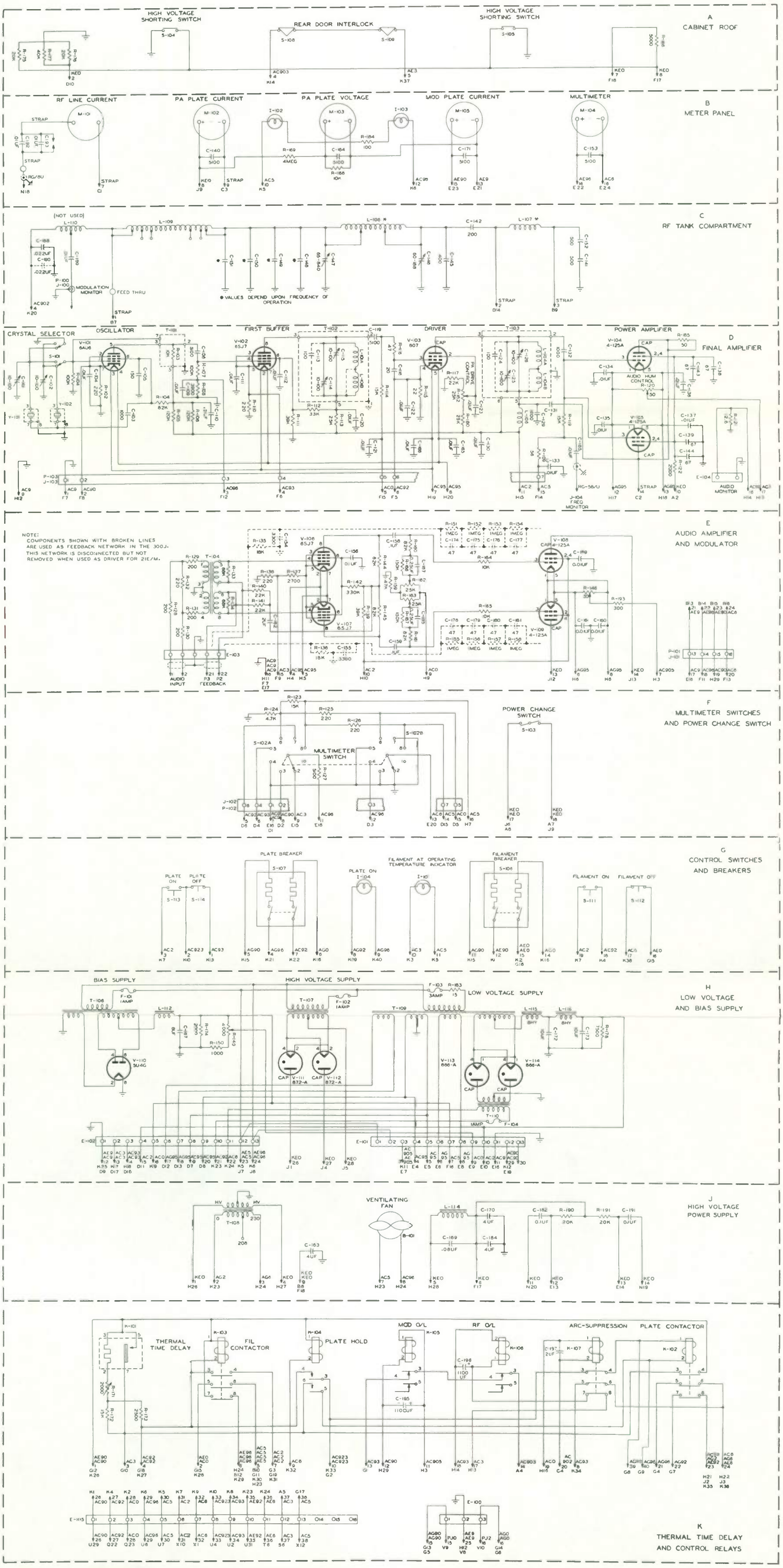
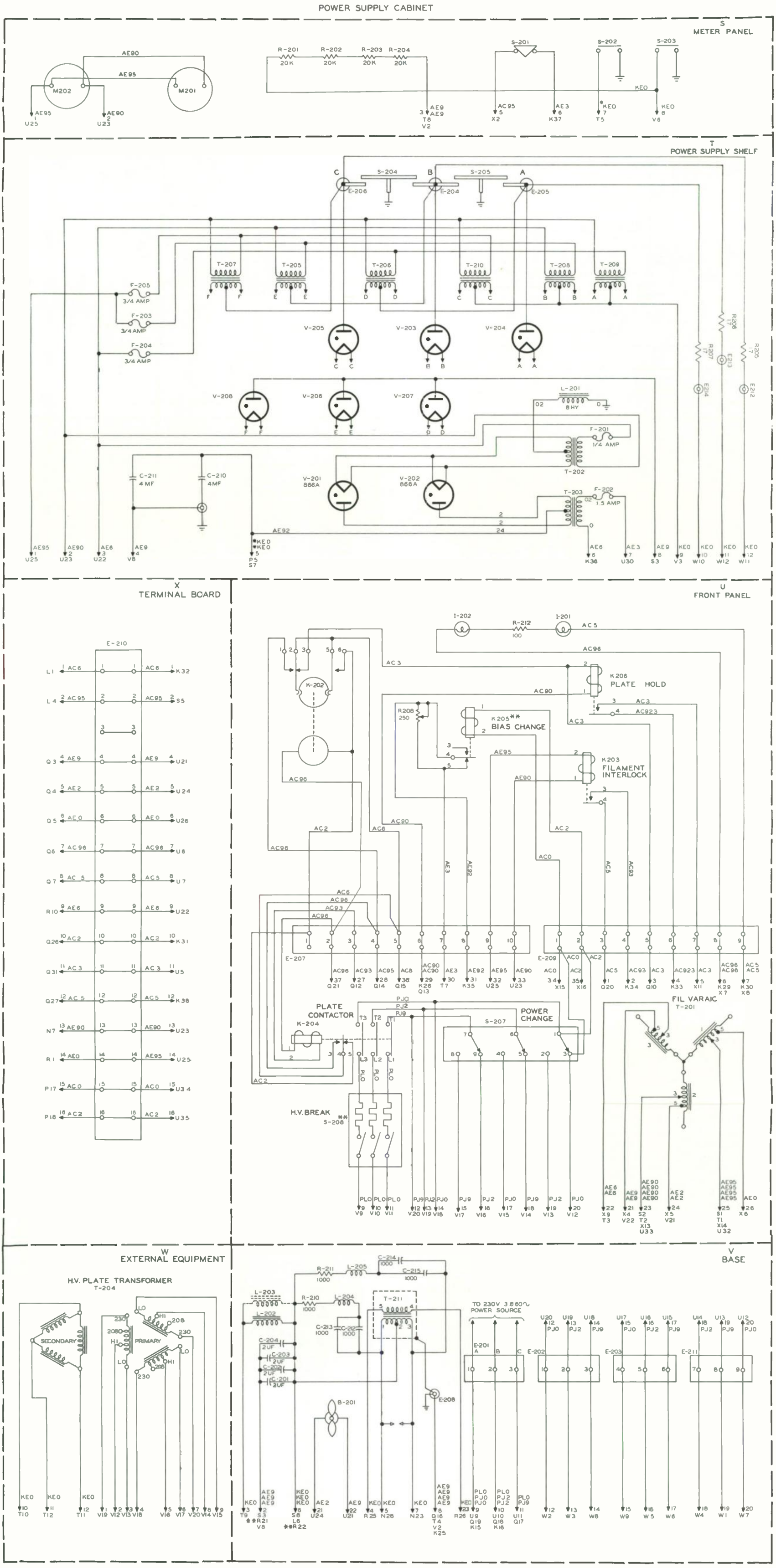


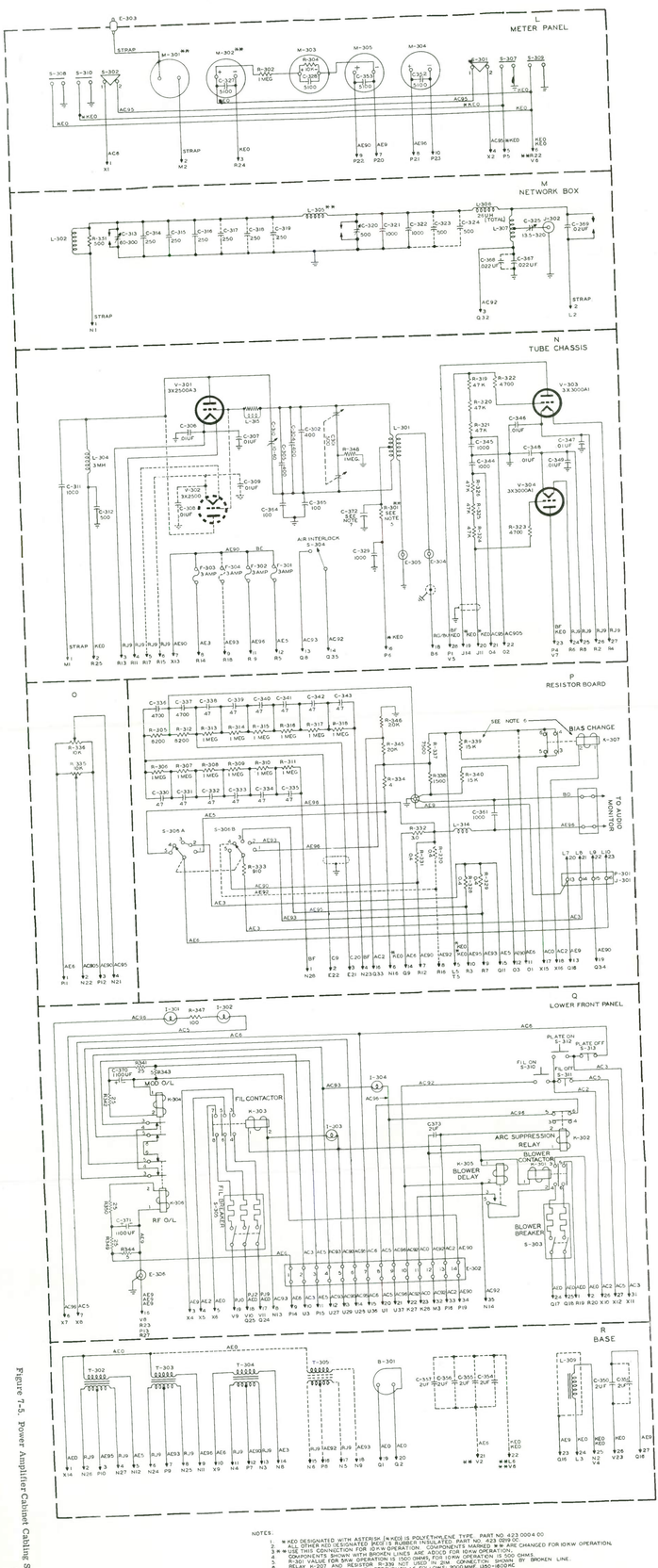
Figure 7-3. Driver Cabling Schematic



NOTES:

1. *KEO DESIGNATED WITH ASTERISK (*KEO) IS POLYETHLENE TYPE. PART NO. 423 0004 00.
2. ALL OTHER KEO DESIGNATED (KEO) IS RUBBER INSULATED. PART NO 423 0219 00.
3. **USE THIS CONNECTION FOR 10KW OPERATION. COMPONENTS MARKED * * ARE CHANGED FOR 10KW OPERATION.
4. COMPONENTS SHOWN WITH BROKEN LINES ARE ADDED FOR 10KW OPERATION.

Figure 7-4. Power Supply Cabling Schematic



NOTES:

1. ✱KEO DESIGNATED WITH ASTERISH (✱) KEO IS POLYETHYLENE TYPE, PART NO. 423 0009 00
2. ALL OTHER KEO DESIGNATED (KEO) IS RUBBER INSULATED, PART NO. 423 0010 00
3. ✱✱ USE THIS CONNECTION FOR 10 KW. ALL OTHER COMPONENTS MARKED ✱✱ ARE CHANGED FOR 10 KW OPERATION.
4. ◇ COMPONENTS SHOWN WITH DOTTED LINES ARE ADDED FOR 10 KW OPERATION.
5. ✱ RESISTOR VALUE FOR 10 KW OPERATION IS 1500 OHMS, FOR 10 KW OPERATION IS 500 OHMS.
6. R-339 AND RESISTOR R-339 NOT USED IN 2M OPERATION. ✱✱ INDICATED BY BROKEN LINE.
7. C-372 VALUE CHANGES WITH FREQUENCY AS FOLLOWS: 2000 MMF, 1250-1810MC
   1000 MMF, 970-1340MC
   500 MMF, 800-1150MC
   350 MMF, 720-1040MC
   200 MMF, 550-840MC

Figure 7-5. Power Amplifier Cabinet Cabling Schematic
7-9/7-10

COLLINS