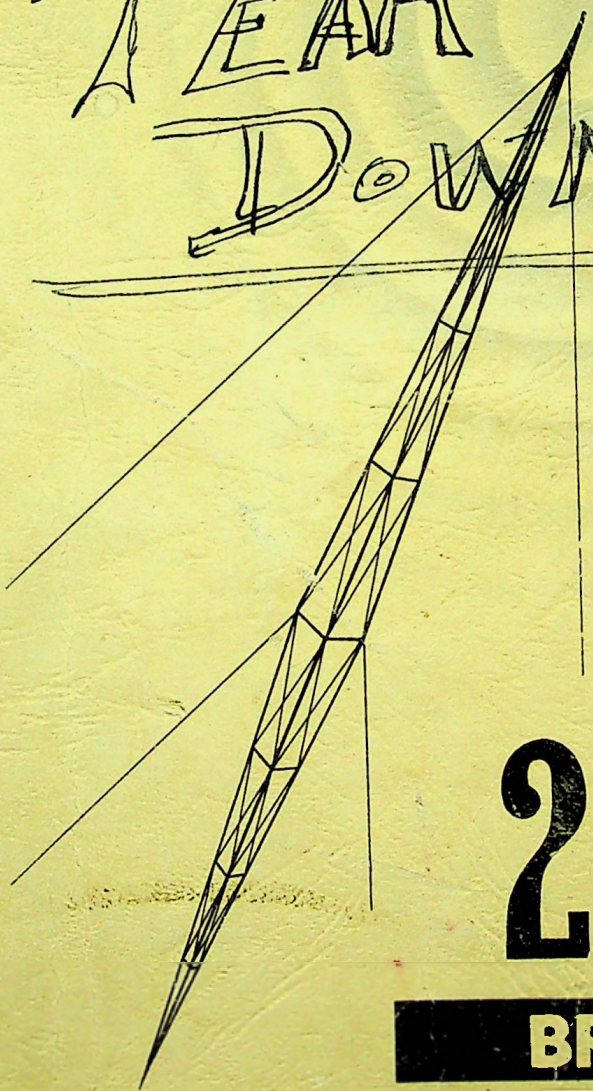
INSTRUCTION BOOK

TEAR DOWN DEPT.



21E/M

BROADCAST TRANSMITTER

COLLINS®

Instruction Book

MODELS 21E AND 21M
BROADCAST TRANSMITTERS

Cedar Rapids, Iowa, U.S.A.

520 9756 00
2nd Edition, 1 June 1958
Printed in the United States of America

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Sales Service Department
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(B) Date of delivery of equipment
(C) Date placed in service
(D) Number of hours of service
(E) Nature of trouble
(F) Cause of trouble if known
(G) Part number (9 or 10 digit number) and name of part thought to be causing trouble
(H) Item or symbol number of same obtained from parts list or schematic
(I) Collins' number (and name) of unit sub-assemblies involved in trouble
(J) Remarks

HOW TO ORDER REPLACEMENT PARTS. When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable. To enable us to give you better replacement service, please be sure to give us complete information.

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INFORMATION NEEDED:

(A) Quantity required
(B) Collins' part number (9 or 10 digit number) and description
(C) Item or symbol number obtained from parts list or schematic
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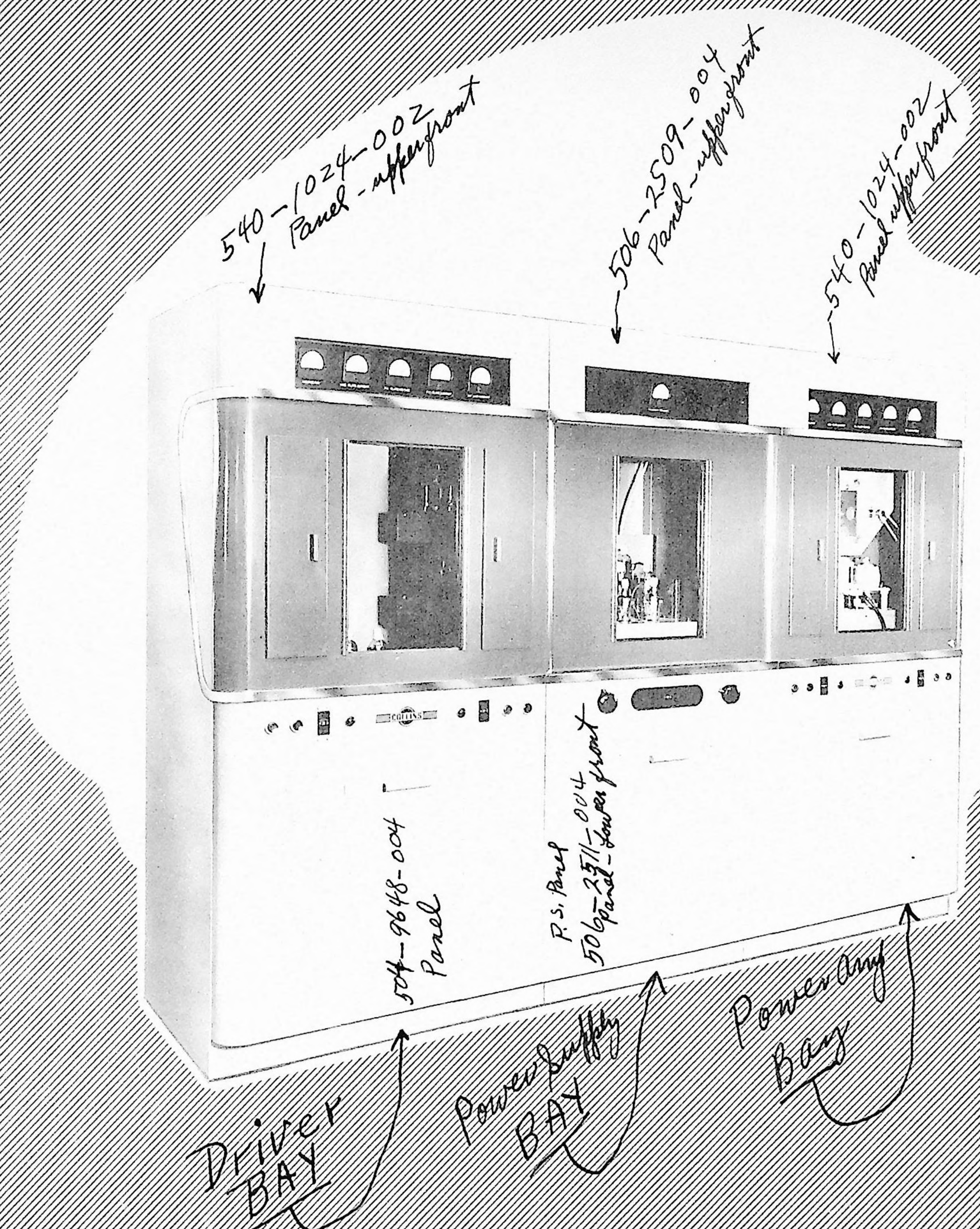
540-1024-002 Panel-upperfront
506-2509-004 Panel-upperfront
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COLLINS
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Power Supply BAY
Power Amp Bay

SECTION I

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, 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 inclosures 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 grey enamel. Streamlined polished chrome styling strips separate the two color areas.

a. MECHANICAL FEATURES.

1. TUBES. All tubes are visible through the front windows.

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

3. RELAYS. 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 line-up 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:	540-1600 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% +20°C to +45°C
Audio Frequency Response:	Within ±2 db from 50 to 10,000 cps measured at 75% modulation
Residual Noise Level:	55 db below 100% modulation from 0 to 30 kc
	60 db below 100% modulation from 150 cycles to 7500 cps
Carrier Shift:	Less than 3%
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% modulation. 150 ohm connection of input transformer is possible when desired.
Distortion:	Less than 3% over the range 50 to 7500 cps, measured at 95% modulation.

Temperature Range:	+15° to +45°C ambient
Altitude Range:	Sea Level to 6000 feet
Power Source:	208/230 V three phase 60 cps 50 cps on special order
Weight:	Approximately 2700 lbs. for 21E Approximately 3000 lbs. for 21M
Dimensions:	105-1/4" wide, 76" high, 28" deep (Plate transformer extra)

Power Demand:

	Power (KW)	Power Factor (%)
*5000 Watts 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 Watts 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

Tube Complement.

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

* 21E Capable of 5,500 Watts Output, 21M Capable of 10,600 Watts Output.

SECTION II

INSTALLATION

2.1. GENERAL.

2.1.1. Inspect the shipping crates for evidence of possible damage to the equipment within. If, upon removal of the equipment, 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.

2.2.1. 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 being lost, however, search all the 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 & antenna ground system. Attach adequate length (for instance, 5 feet) of number 6 copper wire to the ground strap at points underneath each cabinet and neatly coil preparatory to setting the cabinets on the frame. Run a number 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 (35kw for 21M) for the transmitter alone, all other sources of load extra. Install a three-phase, metal, cutout box, independent of other loads, with 100 ampere fuses for the 21E and 125 ampere for the 21M and connect it to the transmitter/plate transformer duct with a metal conduit of 2" minimum diameter. Observe standard electrical conduit grounding practices but be sure that the conduit is grounded with number 4 wire to the transmitter ground strap, too. See figure 2-1 for primary wire sizes.

2.3.6. DUCT WIRING. The following wires 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).

Wires	From	To
Main power feed (3 wires plus copper ground)	Line cutout box mounted on transmitter room wall	Power cabinet E-201
Plate Transformer Primary (9 wires plus transformer frame ground)	Power cabinet E-202, E-203 and E-211	Plate transformer primary terminals
Plate Transformer Secondary (3 wires, with 5 to 6 ft. extra at cabinet end)	Plate transformer secondary terminals	Power Cabinet E-212, E-213, E-214
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)	E-103 of driver cabinet 6SJ7 tube chassis. (See paragraph 2.9.)
Frequency Monitor Connections	Frequency Monitor (not furnished)	J-104 on the bottom of the driver cabinet R-F chassis. (See paragraph 2.11.)

Wires	From	To
Modulation Monitor	Modulation Monitor (not furnished)	J-302 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)	E-301 on the right hand sidewall (viewed from rear) of the PA cabinet. Watch voltage clearance.

2.3.7. OUTPUT CONNECTION. Normally the transmitter output connection is to a feed-thru on the roof of the power amplifier cabinet. See figure 2-1. If it is desired to route the transmitter output out 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 feedthru in the roof of the power amplifier cabinet to ground the outer conductor of the rigid transmission line. Use a 7/8" or 1-5/8" line for the 21E and a 1-5/8" line for the 21M of the impedance value established in the sales contract. (Either 50 or 72 ohms.)

2.4. REASSEMBLY.

2.4.1. GENERAL. All parts that have been removed are keyed to their mounting positions by sticker tags. Match the tag number or letter on the part with the tag number or letter on the chassis or cabinet. The parts should be replaced after the cabinets are set up on the mounting frame but leave the large transformers and reactors and the PA blower until the interconnecting cables have been pulled through the side walls. 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 cutout box switch is open and fuses removed.

a. Place the power cabinet frame in the center position on the mounting frame; shove the associated 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 and 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 and at the same time feed 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 sidewalls 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 counterclockwise a portion of a turn. Support the panels from the front to prevent them from falling.

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

h. Mount the vacuum variable capacitor C-313 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 7-3 and paragraph 2.4.5.

m. Install the heavy components into the base of the power cabinet and make connections. See figure 7-2 and paragraph 2.4.3.

n. Install the heavy components (except blower) into the base of the amplifier cabinet and make connections. See figure 7-1 and paragraph 2.4.4.

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

p. Attach the r-f output line.

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

r. Install the tubes.

CAUTION

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

s. Install the crystals; see figure 7-12 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 7-2.

c. Set the filter choke (or chokes) in place as shown in figure 7-2. The 21E takes one choke and the 21M two chokes (L-202 and L-203).

d. Install and connect the audio compensating board as shown in figures 2-2 and 7-2.

e. Connect all the base components and side mounted filter capacitors. (See figure 8-4.)

f. Install surge resistors R-205, R-206, and R-207. (See figure 2-2.)

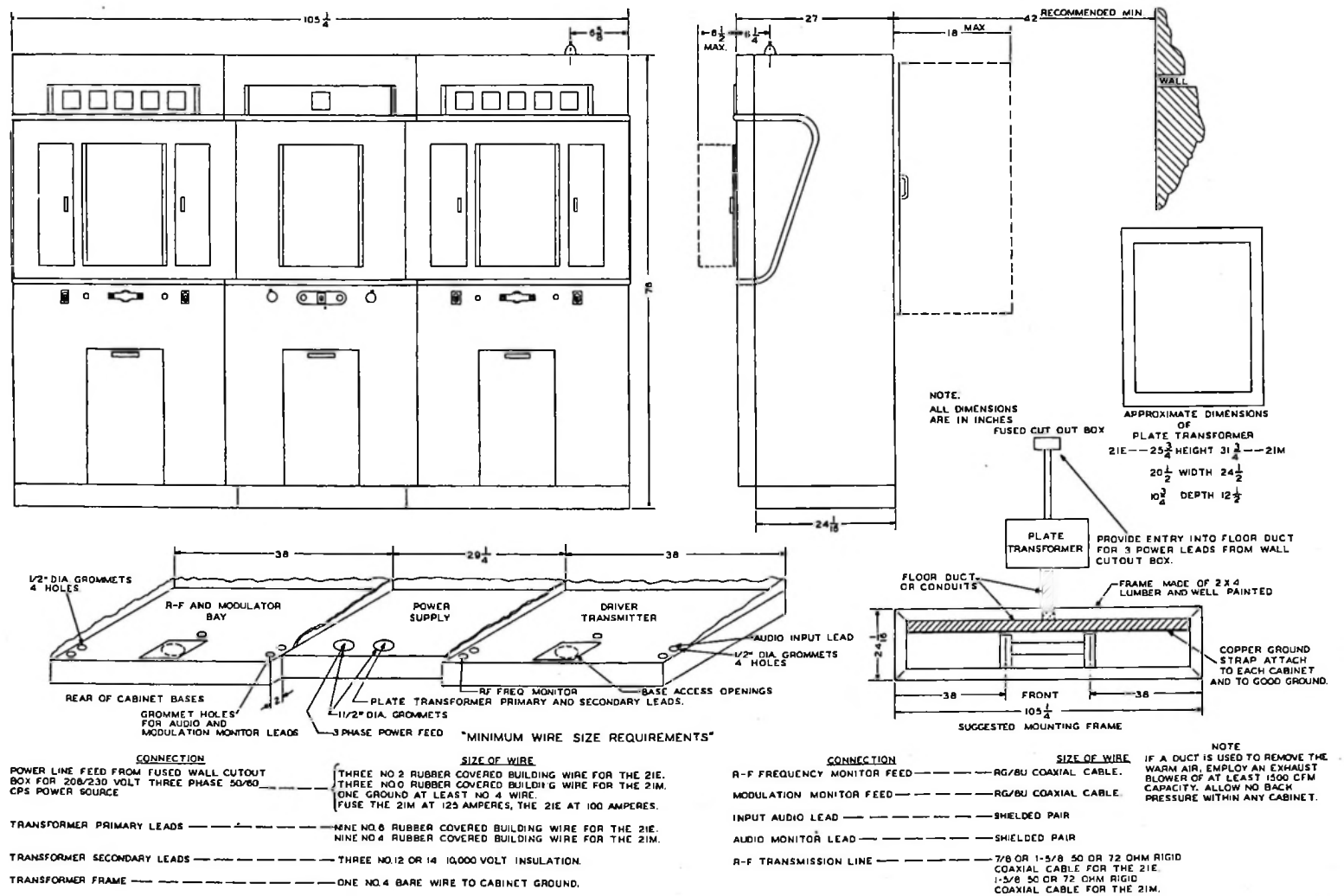
g. After all other cabinets have been assembled and interconnecting wires installed, connect the rear fan to the powerstat, T-201. One lead goes to powerstat terminal that has a white wire and the other to the powerstat terminal that has a red wire.

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 7-1) was removed for shipment. This box is suspended from the roof of the cabinet by two metal standoffs and three ceramic standoffs. Carefully hold the box in position and replace the mounting screws. Use caution in tightening up 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 7-1.



"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

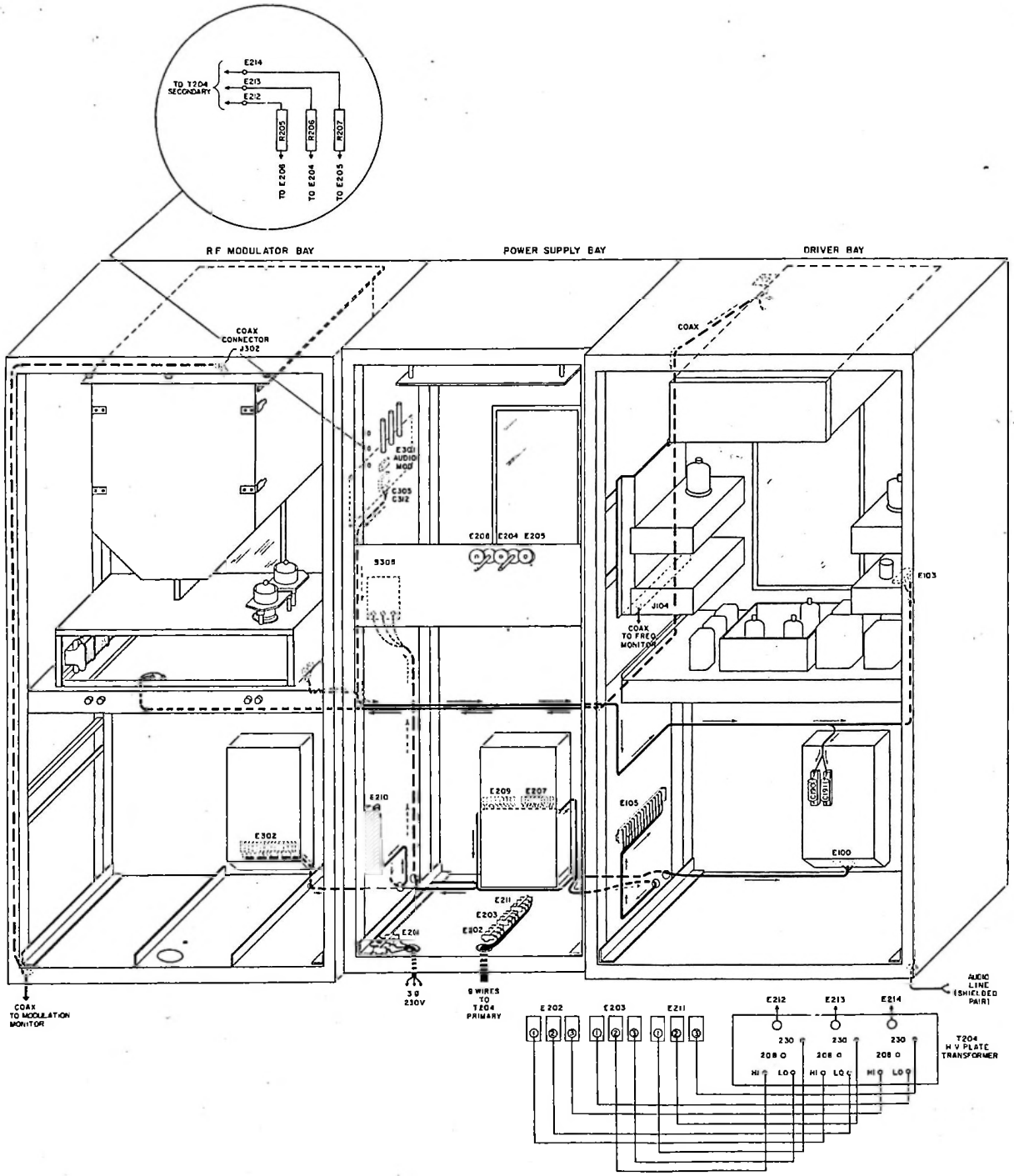


Figure 2-2. Cabling Details

d. "Turn the vacuum variable capacitor shaft C-313 towards the high capacity direction (counter-clockwise) until the "protective disengagement" starts to take place. Then rotate shaft of C-313 clockwise just until threads have engaged and front end of capacitor is held firmly against the brushing cap. Leave the capacitor at this setting.

Rotate the dial independently counter-clockwise 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.

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 counter-clockwise rotation to assure that the counter-clockwise stop of the dial engages before the capacitor shaft begins to loosen up."

e. Set C-320, the power amplifier variable loading capacitor, to minimum capacity. Turn the PA LOADING control to 0. Slide the flexible coupler head on 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 M-301.

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 2-4 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 feed thru 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 7-5

h. Connect the input wires to filament breaker S-305. To do this, remove the breakers 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 T-304 next to the front panel followed by T-303, then T-302. Notice the arrangement of the lugs and the form of the connecting wires and mount the transformers to match.

j. The 21M transmitter requires an additional transformer T-301 which should be installed in the front-center position of the cabinet base.

k. Install L-309 in the front right-hand corner of the base.

m. For the 21E, install C-350 in the rear right-hand corner of the base. For the 21M, install L-301 in this position.

n. For the 21M put C350, C351, C354, C355, and C356 in the shelf over L-309 and L-310.

o. Make all other base connections at this time. See figures 2-2 and 8-5.

p. 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. 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.

q. 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, also, the HV strap to M-102.

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 set-screws. 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 7-3.

e. Refer to figures 7-3 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 7-3 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 L-108 and loading coil L-109 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 circuts. 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 E-101 and E-102 on the rear of the low voltage power shelf. Refer to the Installation Connections Diagram, figure 2-2, to the Interunit Cable Diagram, figure 8-3, and to tags on the wires for assistance in making the proper connections.

j. In order to further 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 E-102. 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 whenever the filament circuits are energized.

2.5. POWER CONNECTIONS.

2.5.1. PRIMARY. The 230V 3-phase power connections connect to terminal block E-201 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 E-201 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 E-100. Observe polarity. Terminal 2 of E-100 is at ground potential.

Nine wires connect the high voltage power transformer T-204 to connector blocks E-202, E-203, and E-211. See figure 2-2. These wires enter the power cabinet through the right-hand 1 1/2" 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 8-4, and pictorial diagram figure 2-2 for proper transformer connections. Incorrect phasing will result in shortened rectifier tube life.

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 E-212, E-213, and E-214. Connect these wires with soldering lugs.

CAUTION

Phasing of primary and secondary leads of high voltage transformer T-204 is very important. Connect as shown by tags and schematic.

2.6. GROUND CONNECTION.

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 E-100.

In the power cabinet, the ground wire connects to E-208, 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 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 E-304 and E-305 at the rear of the PA grid coil. The cable must be grounded at the tank box and at the ground clamp 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 E-103 (the shield to terminal number 3). (See figure 7-16.) 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 C-190 and the other to C-191 located on the rear of the front panel (orange colored tubular condensers). Observe polarity. Connect the shield of this pair to the ground stud on the side stiffener on the right-hand side (viewed from rear).

2.8. INTER-UNIT CABLING DIAGRAM.

The Inter-Unit Cabling Diagrams, figures 8-3, 8-4, and 8-5, 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 2-3. 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 on that board to pass through the area on the diagram where the board is drawn.

A small portion of unit F from the Inter-Unit Cabling Diagram, figure 8-3, is shown in figure 2-3. The two KEO designations indicate that two type KEO wires leave this point. The K in KEO indicates the type of wire (high voltage insulated cable). E indicates size of wire (#14). O 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 KEO2. If a shield were used, the

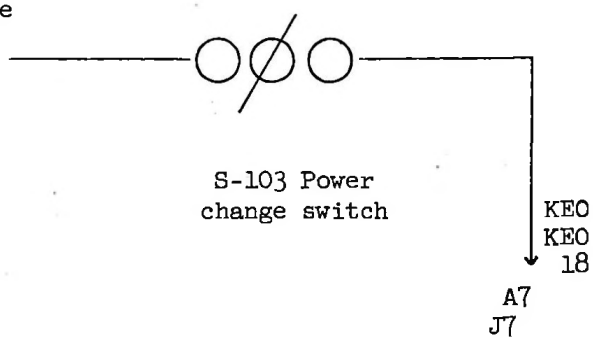


Figure 2-3. Inter-Unit Cabling Example.

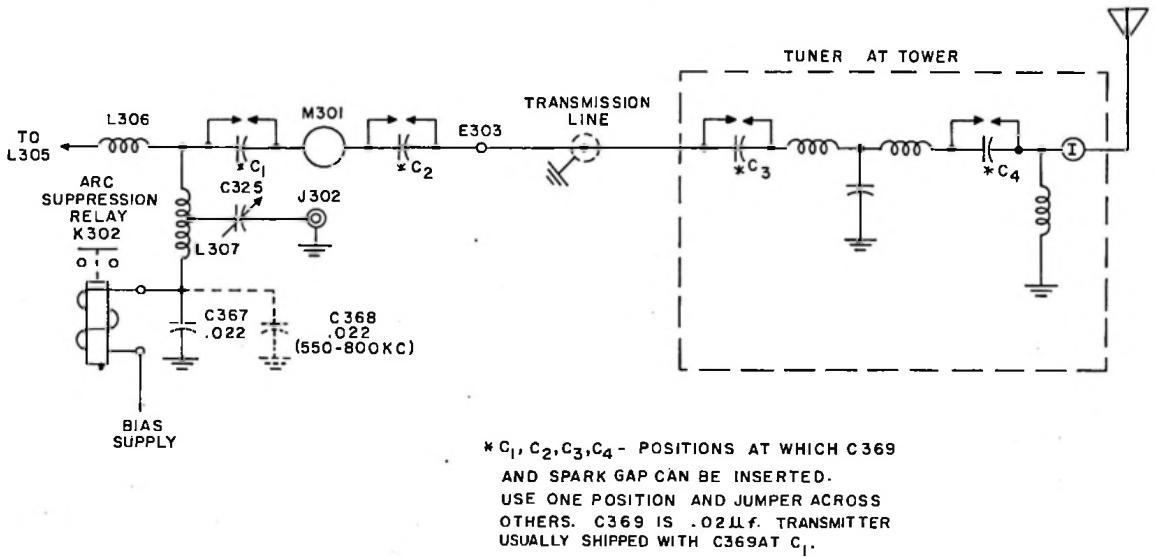


Figure 2-4. Arc Suppression Circuit

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.

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 Inter-Unit Cabling Diagram, figure 8-3.

TABLE 2-1. 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)

TABLE 2-2. LIST OF WIRE SIZES AND COLOR CODES

Letter	Size of Wire (AWG)	Number	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		

Cable Identification Example:

A JAN Type WL, #22AWG, Shielded, White wire with Red Tracer would be labeled CAS92. A black #14AWG neon sign cable would be labeled KEO. A breakdown of these two descriptions is shown below.

C	A	S	9	2
Type of Wire Jan Type WL	Size of Wire #22AWG	Shielded	Color of Body White	Color of Tracer Red

K	E	O
Type of Wire Neon Sign Cable	Size of Wire #14AWG	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 E-103 located inside the lower shelf of the driver cabinet audio chassis. The location of this terminal board can be seen in figure 7-16. Connect the two leads of the twisted pair to terminals 1 and 2 of E-103. Connect the shield to terminal 3 of E-103.

2.10. R-F OUTPUT CONNECTIONS.

See paragraph 2.3.6.

2.11. FREQUENCY MONITOR CONNECTIONS.

Coaxial frequency monitor connector J-104 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 J-104. 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 J-104.

2.12. MODULATION MONITOR CONNECTIONS.

Coaxial modulation monitor connector J-302 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 J-302.

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, E-301 is located on the right-hand (viewed from rear) sidewall of the amplifier cabinet about half way up from the base. Connect one wire of the shielded twisted pair to the high terminal on E-301. 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.

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 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 any are found, remove them with crocus cloth. Set gaps as follows:

Driver Bay

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

P.A. Bay

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

2.15. INITIAL ADJUSTMENT.

2.15.1. PREADJUSTMENT INSPECTION. (Read 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 extreme counterclockwise position.

b. Remove the plate caps from the two 866A and two 872A mercury-vapor rectifier tubes, V-113 through V-116 in the driver cabinet and from the two 866As and the six 872As (or 575As) in the power cabinet. Make sure that the plate caps hang free and are not near any metal parts.

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. Close 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. Blower B-301 should start up. As the blower comes up to speed the filament contactor K-303 should close, applying voltage to the filament transformer primary and illuminating the green panel light located next to the FILAMENT breaker in the power amplifier bay. Assuming that the filaments are all lit, the next step is to set the primary voltage as read on M-201 in the center bay to 230 volts. This is accomplished by adjusting the three-phase variac, T-201, located in the rectifier bay. This is the left-hand knob on the front panel. Clockwise rotation of the knob increases the voltage. In the event some are not lit, check the fuses first in looking for the trouble. Closing of the filament contactor should also start up circulating fans B-101 and B-201.

c. Having adjusted the filament primary voltage to 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, the blower hold relay K-305 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 the air interlock switch S-304. 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 again be closed 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, K-101, should be adjusted to give a delay of approximately 30 seconds. The delay time is controlled by potentiometer R-171 located just below K-101. 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 K-104 and K-102 and light I-104 providing time delay relay K-101 has operated and I-101 is lighted. Pressing plate ON

button on final bay should then energize the plate hold relay K-206 and plate contactor K-204 in middle bay. Red indicator light I-304 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 driver plate contactors drop out. A similar check should be made on the filament interlock relay K-203 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 also be made on the overload circuit, by operating the d-c overload relays K-105, K-106, K-304 and K-306 manually. Overload relays K-304, K-306 should drop out only plate contactor K-204. K-105 and K-106 should drop out both contactors (K-102 and K-204). Refer to paragraph 4.4.4. for details of overload circuit operation. Operation of arc-suppression circuits may be checked by manually operating K-107 and K-302. K-302 should momentarily interrupt K-204 (plate contactor) K-107 should momentarily interrupt both K-102 and K-204.

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 x.

j. Replace the plate caps on the 866A voltage rectifier tubes V-113 and V114 (driver cabinet).

NOTE

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE PROPER SAFETY PRECAUTIONS. DO NOT MAKE ADJUSTMENTS INSIDE OF THE EQUIPMENT WITH THE HIGH VOLTAGE APPLIED. DO NOT DEPEND UPON THE DOOR INTERLOCKS FOR PROTECTION. ALWAYS SHUT DOWN THE EQUIPMENT WHEN MAKING ADJUSTMENTS.

k. Rotate the crystal selector switch, S-101 to the desired position. The location of this switch is shown in figure 3-1.

m. 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 properly age the mercury vapor rectifier tubes. Aging is required for all new mercury vapor tubes and for old tubes that have been agitated or inverted.

n. Press the driver cabinet PLATE switch.

o. 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.

p. Rotate the multimeter switch to the position designated 807 grid, 25 ma. It may be necessary to adjust C-114 and C-115, 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 in parallel as shown in figure 8-2 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.

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

r. Rotate the multimeter switch to the PA grid position to check the adjustment of the 807 r-f driver plate trimmer capacitors, C-125 and C-126. 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 8-2 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.

s. Turn off the plate and filament power and replace the plate caps on the 872A high voltage rectifier tubes, V-111 and V-112 in the driver cabinet and on the 866A and 872A (or 575A) tubes in the power cabinet.

t. Turn the two driver cabinet bias adjustment controls, R-162 and R-163, to the maximum clockwise position. This adjustment results in maximum bias and minimum audio driver tube plate current.

u. Turn the driver cabinet power change switch, S-103, to the low position.

v. Set the driver amplifier loading to minimum by turning the driver cabinet PA loading control, C-147, to 100 on the dial.

w. Close the transmitter rear doors.

x. 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 push buttons to turn the blower and filaments on and off. This is necessary to get proper time delay and blower hold-on.

y. Press a FILAMENT push-button. After the warmup cycle (control circuit lamp lights) press the driver PLATE ON button.

z. Adjust the driver amplifier tuning control, C-146, for minimum driver amplifier plate current. Observe r-f ammeter on driver cabinet. If it is reading off scale, check resonance of the PA grid tuned circuit and observe clip settings in the primary and secondary of L-301. The r-f meter is shunted by a piece of buss wire for further protection.

aa. Tune the PA grid circuit to resonance as indicated by a rise in PA GRID CURRENT. Adjust the clips of L-301 if necessary. With the driver LOADING control at 100, final amplifier grid current should read between 50 and 150 ma. providing the link circuit between the driver and PA grid circuit is properly terminated.

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.

ab. Turn the driver cabinet power change switch, S-102, to the high position.

ac. Increase the LOADING of the driver cabinet until the PA grid current reads approximately 175 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.

ad. Adjust the audio driver bias controls, R-162 and R-163 until 100 ma of audio driver plate current is drawn and the plates of the two 4-125A audio driver tubes, V-110 and V-111, appear to be dissipating equal amounts of power.

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

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

ag. Turn the PA LOADING dial to full capacity (100 on the dial). Set taps on L-305 and L-306 to position indicated on test data sheet.

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

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

CAUTION

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

aj. Press the driver PLATE ON push button.

ak. Tune the PA PLATE tuning condenser until an r-f pattern appears on the scope. Adjust until the pattern indicates resonance of the PA tank.

am. By small steps return the neutralizing capacitor towards the position from which it was turned in step ai. Watch the height of the pattern in the scope 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.

an. Turn the driver off and remove the oscilloscope connection from the transmitter. This is important!

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

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

aq. Check the resonance of the grid circuit and make a quick reading of all meters and 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 L-306 set as indicated in the test data sheet. Changes in these two components will usually necessitate a readjustment of the PA TUNING control.

ar. 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.

as. 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.

at. Adjust the two MODULATOR BIAS ADJUSTMENT controls R-335 and R-336 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.

au. Connect an oscilloscope to the modulation monitoring jack J-302 and obtain a workable pattern by adjusting the taps and condenser associated with L-307, starting in a minimum position.

av. Gradually introduce (see warning below) a 1000 cps audio signal to the transmitter audio input terminals and watch the modulator plate current indication. 100% modulation should occur at about 1.5 amp plate current per tube for the 21E and 2.6 amp for the 21M.

WARNING

When modulating the transmitter with test tones do not run modulation levels over 50% 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.

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

ax. Adjust R-208 until 200 ma average static cathode current per tube is obtained on the modulator tubes.

ay. To change the setting of the RF circuits overload relays, (see figures 7-8 & 7-19) 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 K-106 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 K-306 in a similar manner but watch PA plate current.

az. 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 1000 cps into the audio input and run the gain up until proper overload drop out is established.

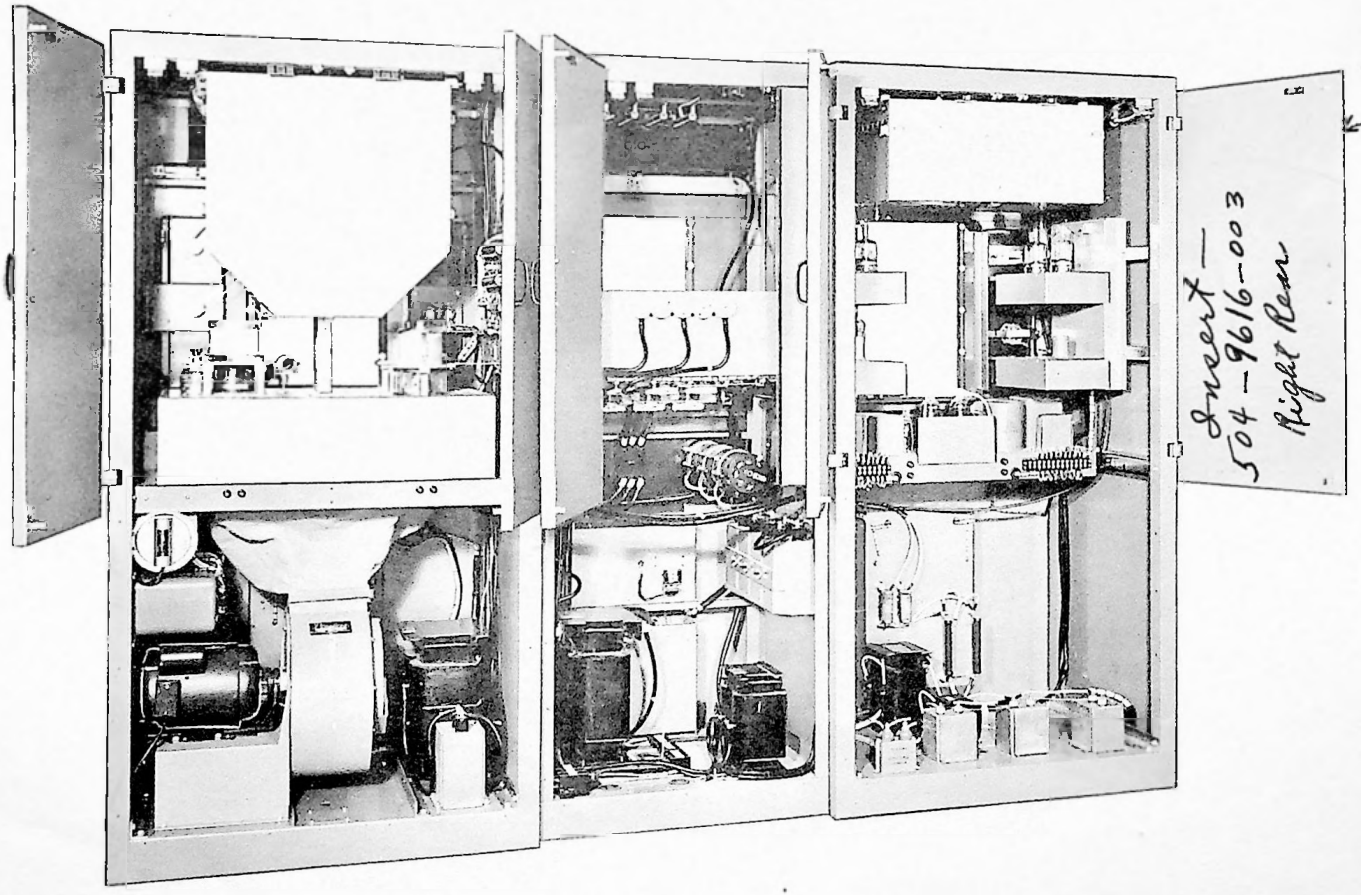


Figure 2-5. 21E Rear View, Open

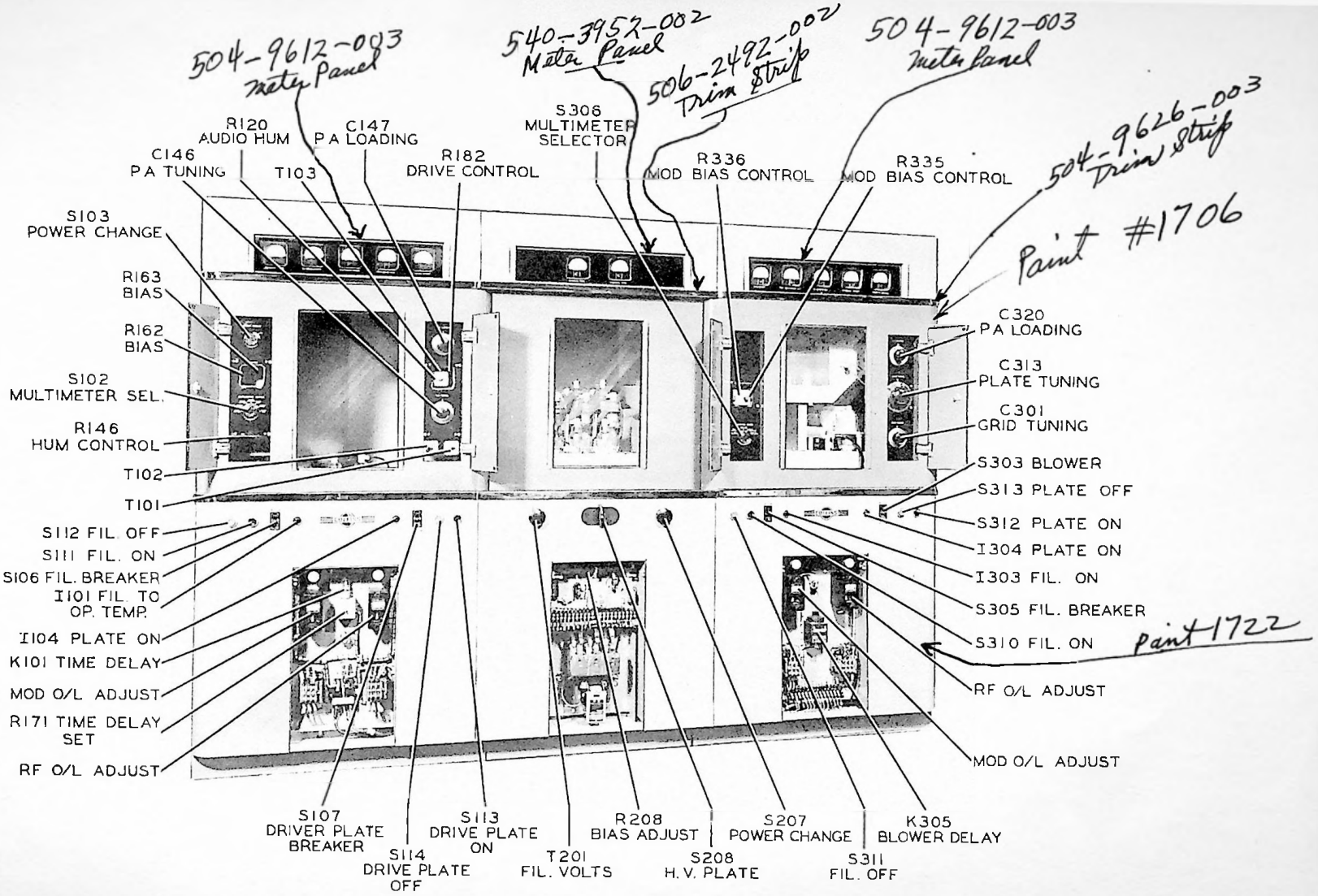


Figure 3-1. Operating Controls and Parts Arrangement, Front View

SECTION III

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 insures full warm up cycle and cooling cycle. Use a FILAMENT push button to turn the blower and filaments off.

d. Press a FILAMENT ON push button.

e. Adjust FILAMENT PRIMARY for 230V.

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 push button. Observe meter readings.

i. Press the power amplifier PLATE ON push button.

j. Check all meter readings including all of the circuits that are read on the multimeter switches. Typical meter readings are listed in table.

k. Make all possible monitoring operations.

m. 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 push button, 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.)

Table 3-1. Typical Meter Readings, Broadcast Band

21E and 21M (Driver)

Switch	Switch Position	Meter	Meter Reading
Multimeter Switch	1st Audio Cath. 25 ma.	Multimeter	4 ma.
Multimeter Switch	Osc. Cath. 25 ma.	Multimeter	4 ma.
Multimeter Switch	1st Buff. Grid. 2.5 ma.	Multimeter	1.0 ma.
Multimeter Switch	1st Buff. Cath. 25 ma.	Multimeter	6.5 ma.
Multimeter Switch	807 Grid 25 ma.	Multimeter	1 ma.
Multimeter Switch	807 Cath. 250 ma.	Multimeter	75 ma.
Multimeter Switch	P.A. Grid 25 ma.	Multimeter	22 ma.
Driver Power Change	High	Mod. Plate Current (Driver)	125 ma.
Driver Power Change	High	P.A. Plate Voltage	2700 volts
Driver Power Change	High	P.A. Plate Current (Driver)	100 ma.
Multimeter Switch	P.A. Grid Current 250 ma.	Multimeter	
	(Low Power)		150 ma.
	(High Power)		175 ma.
Multimeter Switch	Rear Modulator Cathode 2.5 amp.	Multimeter	
	(Low Power, no signal)		0.15 amp.
	(Low Power, 100% Mod. at 1000 cps)		0.390 amp.
	(High Power, no signal)		0.200 amp.
	(High Power, 100% Mod. at 1000 cps)		0.725 amp.
Multimeter Switch	Front Modulator Cathode 2.5 amp. (All values identical to the Rear Mod. Cathode Values)	Multimeter	

Table 3-1. (Cont.)

21E

Switch	Switch Position	Meter	Meter Reading
Multimeter switch	Front P.A. Cathode 2.5 amp.	Multimeter	
	(Low Power)		0.55 amp.
	(High Power)		1.3 amp.
Power Change	Low (no signal)	Mod. Plate current	0.3 amp.
	High (no signal)		0.4 amp.
	Low (100% Mod. 1000 cps)		0.78 amp.
	High (100% Mod. 1000 cps)		1.45 amp.
Power Change	Low	P.A. Plate Voltage	2300 V
	High		5100 V
Power Change	Low	P.A. Plate current	0.55 amp.
	High		1.3 amp.

21M

Multimeter Switch	P.A. Grid Current, 250 ma.	Multimeter	
	(Low Power)		200 ma.
	(High Power)		230 ma.
Multimeter Switch	Rear Mod. Cathode, 2.5 amp.	Multimeter	
	(Low Power, no signal)		0.2 amp.
	(Low Power, 100% Mod. 1000 cps)		0.6 amp.
	(High Power, no mod.)		0.2 amp.
	(High Power, 100% Mod. 1000 cps)		1.25 amp.
Multimeter Switch	Front Mod. Cathode 2.5 amp. (All values identical to the Rear Mod. Cathode values)	Multimeter	
Multimeter Switch	Front P.A. Cathode 2.5 amp.	Multimeter	
	(Low Power)		1.0 amp.
	(High Power)		1.3 amp.
Multimeter Switch	Rear P.A. Cathode 2.5 amp. (Same as Front P.A. Cathode)		

Table 3-1. (Cont.)

21M

Switch	Switch Position	Meter	Meter Reading
Power Change	Low (no signal)	Mod Plate current	0.4 amp.
	High (no signal)		0.4 amp.
	Low (100% Mod. 1000 cps)		1.2 amp.
	High (100% Mod. 1000 cps)		2.5 amp.
Power Change	Low	P.A. Plate Voltage	3600 Volts
	High		5100 Volts
Power Change	Low	P.A. Plate current	2.0 amp.
	High		2.6 amp.

3.3. DESCRIPTION OF OPERATING CONTROLS. (See figure 3-1.)

3.3.1. BLOWER BREAKER, S-303 (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, S-106 (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, S-305 (PA CABINET LEFT).

This breaker protects the filament circuits of the transmitter. When the blower is up to speed, air interlock switch S-304 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 insure proper warm up.

3.3.4. FILAMENT ON PUSH BUTTONS.

The FILAMENT ON push buttons are normally open, spring return switches. As shown in the Control Circuit diagram, figure 4-2, operation of a FILAMENT ON push button 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 push button will also energize all filaments, low voltage bias, fans, blower, and start the plate delay cycle.

3.3.5. FILAMENT PILOT LIGHT, I-304. (ADJACENT TO PA FILAMENT BREAKER)

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

3.3.6. FILAMENT VOLTAGE CONTROL, T-201. (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, R-171. (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 K-104, 5, and 6 and the coil of plate relay K-102. 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 automatically select 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. The thermal time delay relay provides the quickest possible return to the air after a power interruption. When the plate contactor contacts close, they place resistor R-172 in shunt with the relay heater element and relay adjustment R-171 to reduce the current through the heater while the transmitter is on the air.

3.3.8. FILAMENT CIRCUIT PILOT LIGHT, I-101. (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, S-107. (DRIVER CABINET RIGHT)

The driver plate breaker S-107 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 PUSH BUTTON, S-114.

Pressing this normally open switch will energize the driver plate contactor K-102, providing the filament circuit has been energized long enough to actuate the time delay relay K-101. When plate contactor K-102 operates, the driver plate and PA bias supplies are turned on and plate pilot lamp I-104 is illuminated.

3.3.11. DRIVER PLATE PILOT LIGHT, I-104. (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 K-204.

3.3.12. PA PLATE PUSH BUTTON, S-312.

This push button 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 push buttons). Second, it can be used to originate a sequence start, in which case the driver FILAMENT and PLATE push button need not be pressed but the entire transmitter will automatically turn on with the proper circuits being energized at the proper intervals. Third, this push button is also used as an overload reset button in case an overload in the PA or Modulator plate circuits turns the transmitter off.

3.3.13. MULTIMETER SWITCH, S-102. (DRIVER)

Multimeter switch S-102 is a two-pole seven-position switch located behind the left door on the front of the driver cabinet as shown in figure 3-1. This switch inserts multimeter M-104 into any one of seven 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, S-306.

This switch is located inside the left-hand enclosure of the power amplifier front panel. It selects the circuit to be metered by the MULTIMETER M-304. Circuits metered are 1. PA GRID CURRENT, 2. REAR MODULATOR CATHODE, 3. FRONT MODULATOR CATHODE, 4. FRONT PA CATHODE, and 5. REAR PA CATHODE (position 5 is used in the 21M only).

3.3.15. HIGH POWER-LOW POWER, S-207. (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, S-208. (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, I-304. (PA CABINET, RIGHT SIDE)

This pilot light lights when primary voltage is being applied to the plate contactor K-204.

3.3.18. MODULATOR BIAS ADJUST, R-335 and R-336.

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 the MULTIMETER M-304. 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, R-208.

This resistor, a wire-wound semi-adjustable resistor, is located at the top of the power cabinet relay enclosure. R-208 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, S-103.

Power change switch S-103 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. The power change switch, S-103, 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, C-114, C-115.

The first buffer tank circuit trimmers, C-114 and C-115, 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 8-2. One of the trimmers should be adjusted to give a good tuning range with the second trimmer.

3.3.22. 807 TANK TRIMMERS, C-125, C-126.

C-125 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 8-2. 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, R-182.

R-F drive control, R-182, 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 R-182 should be adjusted to hold the 4-125A grid current to below 20 ma.

3.3.24. DRIVER CABINET POWER AMPLIFIER TUNING AND LOADING, C-146 and C-147.

The driver amplifier plate circuit tuning and loading controls C-146 and C-147 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 the PA LOADING capacitor, C-147, 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, C-301.

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 in the PA GRID CURRENT position. PA grid current should be approximately 155 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, C-313 and C-320.

The power amplifier plate circuit tuning and loading controls, C-313 and C-320, 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, C-320, 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 whenever 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 yelding 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, C-310, located between the two power amplifier tubes, does not require readjustment.

3.3.27. CRYSTAL SELECTOR SWITCH, S-101.

Crystal selector switch S-101 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 7-12) is selected.

3.3.28. CRYSTAL FREQUENCY TRIMMER CONTROLS, C-101, C-102.

Crystal frequency trimmer controls C-101 and C-102 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. C-101, the upper control, adjusts the frequency of Y-101, the left-hand crystal as seen from the front of the transmitter.

3.3.29. AUDIO DRIVER BIAS ADJUSTMENTS, R-162 AND R-163.

Audio driver bias adjustments R-162 and R-163 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

the driver plate supply on 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. R-149 may be adjusted to give good range with R-162 and R-163.

3.3.30. AUDIO HUM CONTROLS, R-120 AND R-189.

Audio hum controls R-120 and R-189 are screwdriver adjustments. R-120 is located behind the upper right inspection plate of the driver cabinet as shown in figure 3-1. R-189 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 R-120 and R-189, inject a 1000 cycle audio signal of sufficient amplitude to modulate the carrier 100 per cent. Calibrate a noise meter, remove the modulation, and read the noise level. Adjust audio hum control R-189 first then R-120 to reduce the noise level.

3.3.31. OVERLOAD ADJUST, K-105-K-106. (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, K-304-K306. (PA CABINET RELAY ENCLOSURE)

These relays are adjusted similarly to K-105 and K-106, see paragraph 3.3.31, above.

SECTION IV

THEORY OF OPERATION

4.1. R-F SECTION.

As a result of major advances in crystal stability and oscillator design, the 21E/M transmitter has eliminated the use of a crystal oven and its associated thermostats, relays and other controls. 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 transmitter are extremely straightforward and trouble free. A 6AU6 oscillator and 6SJ7 buffer are followed by an 807 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 transmitter 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 L-307 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 to grids of the first audio stage.

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.

* Other impedances are available on special order.

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 automatically select 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 whenever 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, T-202, which is excited simultaneously with application of transmitter filament power, a full-wave plate transformer, T-203, which is excited upon application of plate power to the driver cabinet, a pair of 866A rectifiers and a suitable choke input filter. A variable resistor, R-208, in the primary lead of T-203 is shorted out by contacts of bias change relay K-205, when the transmitter is operating high power. K-307 inserts additional bleeder resistor R-339 to reduce modulator bias on low power. R-335 and R-336 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 divider R-338 and R-339. The maximum output voltage of this supply is minus 1200 volts.

The high voltage supply employs a three 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 S-207. Six 872A (21E) or six 575A (21M) mercury vapor rectifier tubes are used in the bridge circuit. A choke input filter consisting of L-202, C-201, C-202, C-203, and C-204 is used in the 21E. In the 21M, a choke, L-203, is paralleled with L-202 and capacitors C-354, C355, and C356 are added.

Whenever the rear doors of the power cabinet are opened, the high voltage and the bias supplies are disabled by interlock switch S-201 and the high voltage leads from plate transformer T-204 are shorted to ground by S-204 and S-205, also the filter capacitors are shorted by S-203 and the bias supply filter is shorted by S-202. Whenever the PA cabinet rear doors are opened, the high voltage supply is disabled by S-301 and S-302, the high voltage filter capacitors

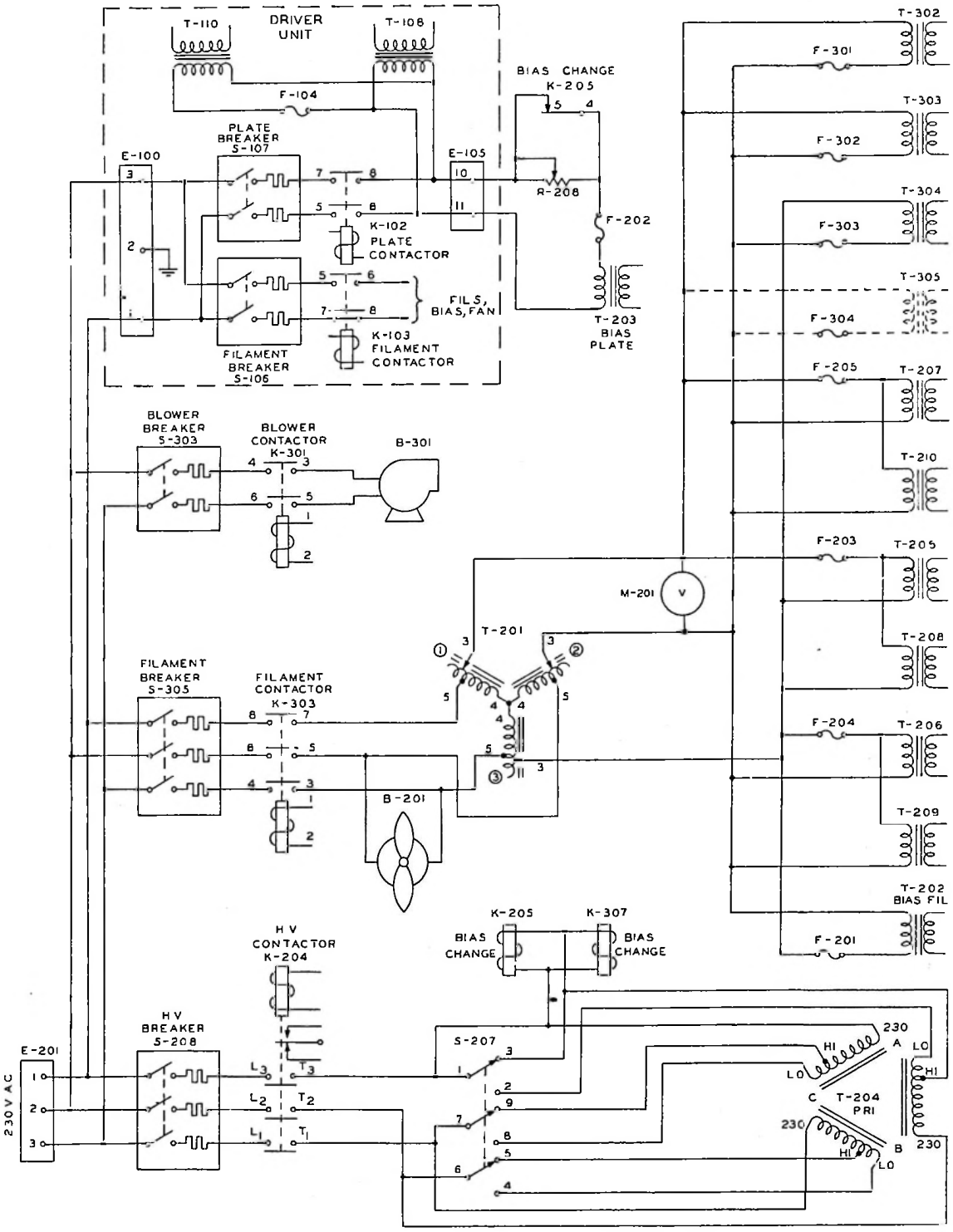


Figure 4-1. Primary Power Circuits

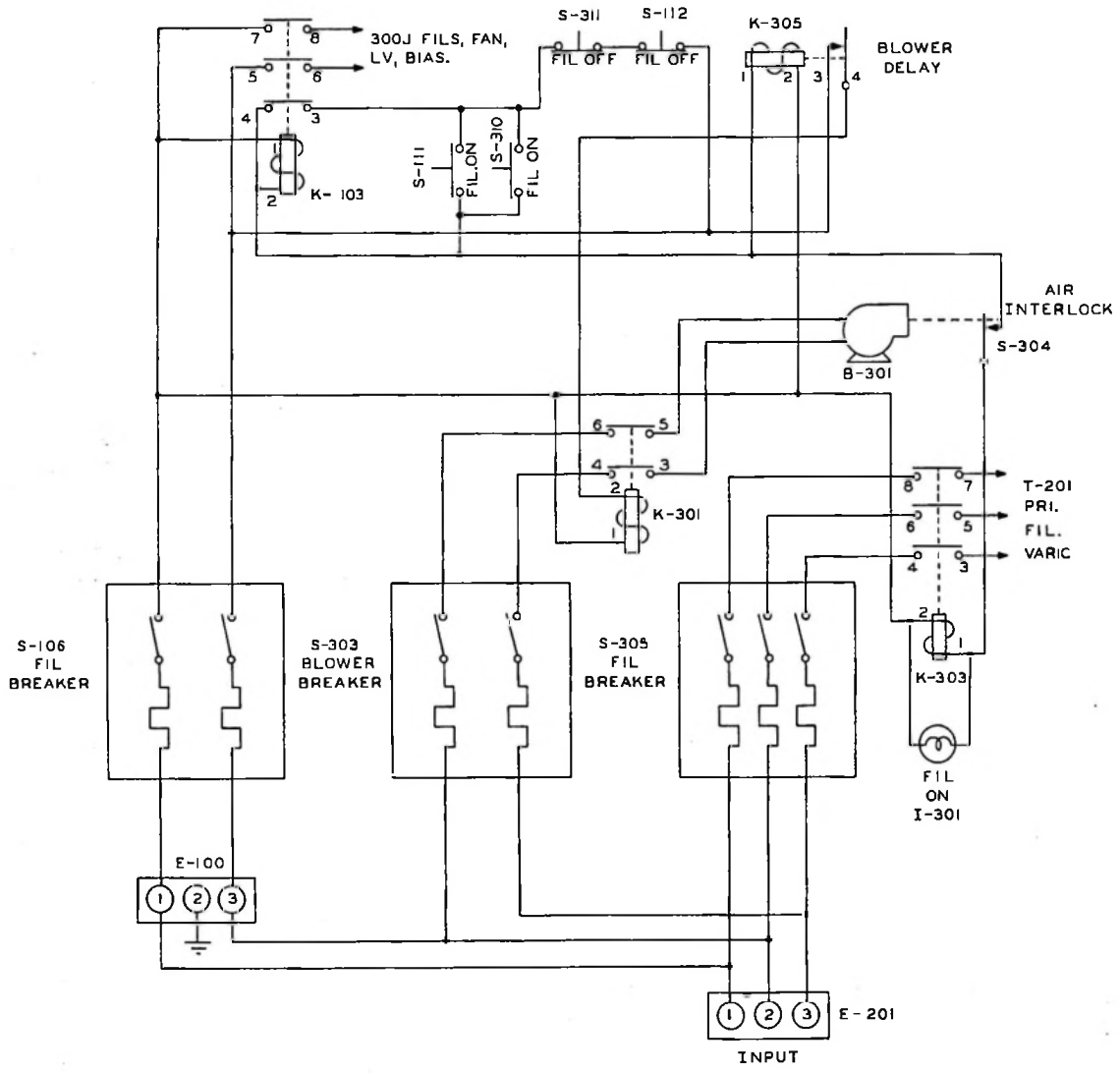


Figure 4-2. Filament Control Circuits

are shorted by S-308 and S-309, and the bias supply filter is shorted by S-307 and S-310. 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.

a. FILAMENT. (See figure 4-1.) T-201, FILAMENT ADJUST is a 3-phase, 230 V, 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 T-201, the load being equally divided between each phase as nearly as possible. The secondary of T-201 connects to the primaries of the filament transformers through suitable protective fuses. The primary of T-201 connects to the 230-volt phase input line through filament relay K-303 and FILAMENT breaker switch S-305. Filament relay K-303 closes after FILAMENT breaker S-106 of the driver cabinet and BLOWER switch S-303 have been thrown ON and a FILAMENT ON push-button has been pressed to start the tube cooling blower B-301. Blower B-301 actuates air interlock switch S-304 which closes the relay coil circuit to energize filament relay K-303. (See figure 4-2.) The contacts of K-305 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 insures that the tubes will not be damaged because of a delayed rise in temperature when the transmitter is shut down.

b. PLATE. (See figure 4-1.) The 3-phase 230-volt current to excite plate transformer T-204 flows first through HV BREAKER switch S-208 then through high voltage contactor K-204 and through HV-LV switch S-207. S-207 is connected to select primary taps for power-change. Paragraph 4.4.3. explains the circuit to get high voltage contactor K-204 energized.

Plate transformers T-108 and T-110 of the driver cabinet are excited by 230 v single phase current from the power source (terminals 1 and 2 of E-201) through PLATE breaker switch S-107 (driver cabinet) and plate relay K-102. Paragraph 4.4.3. explains how K-102 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 S-106 will do likewise.

b. Pressing DRIVER PLATE OFF button or 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 S-313 opens final plate relay only.

d. Arc suppression relay K-107 in driver r-f circuit opens driver plate relay K-102 and final plate relay K-204. The driver relay resets immediately, the PA relay after a very short interval because a turn on cycle is initiated at relay K-202.

e. Arc suppression relay K-302 in the final r-f circuit opens only the final plate relay K-204. This relay resets after a very short interval because a turn-on cycle is initiated at relay K-202.

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.

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 and 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 K-103 directly. Phase B is applied to the coil through FILAMENT OFF buttons S-112 and S-113 when either FILAMENT ON button S-111 or S-310 is pressed. When filament relay K-103 closes, contacts K-103.3 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 K-305 is energized to apply power to blower contactor K-301. When the air stream is at nearly full pressure, air interlock switch S-304 closes to energize PA filament contactor K-303. Blower hold relay K-305 is a bellows type in which air entering a bellows thru 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 insure complete cooling of the tubes. Simultaneously with the application of driver filament power, time delay relay K-101 begins to heat by virtue of phase A being directly applied to pin 3 of K-101 and phase B being applied to pin 2 from K-103.3 thru R-173 and R-171. When K-101.5 and 7 close, filament-at-operating-temperature lamp I-101 lights and plate power can now be applied. R-172 is connected to form a voltage divider with R-173 to reduce the heat in K-101 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 S-113 applies phase B to driver plate contactor K-102 thru arc suppressor contacts K-107.3 and 4. Phase A is applied thru time delay K-101.5 and 7, and plate hold K-104.5 and 6. (Plate hold relay K-104 is operated simultaneously and held by its own contacts K-104.3 and 4.) When the DRIVER PLATE button is released, driver plate contactor is held by applying phase B thru the FILAMENT OFF buttons, S-112 and S-311, K-103.4 and 3, K-104.4 and 3 and arc suppression relay K-107.3 and 4. Contacts 3 and 4 of driver plate contactor K-102 shunt K-101.5 and 7 so that the coil of K-102 does not depend upon K-101.5 and 7 for phase A. Driver plate ON lamp I-104 lights.

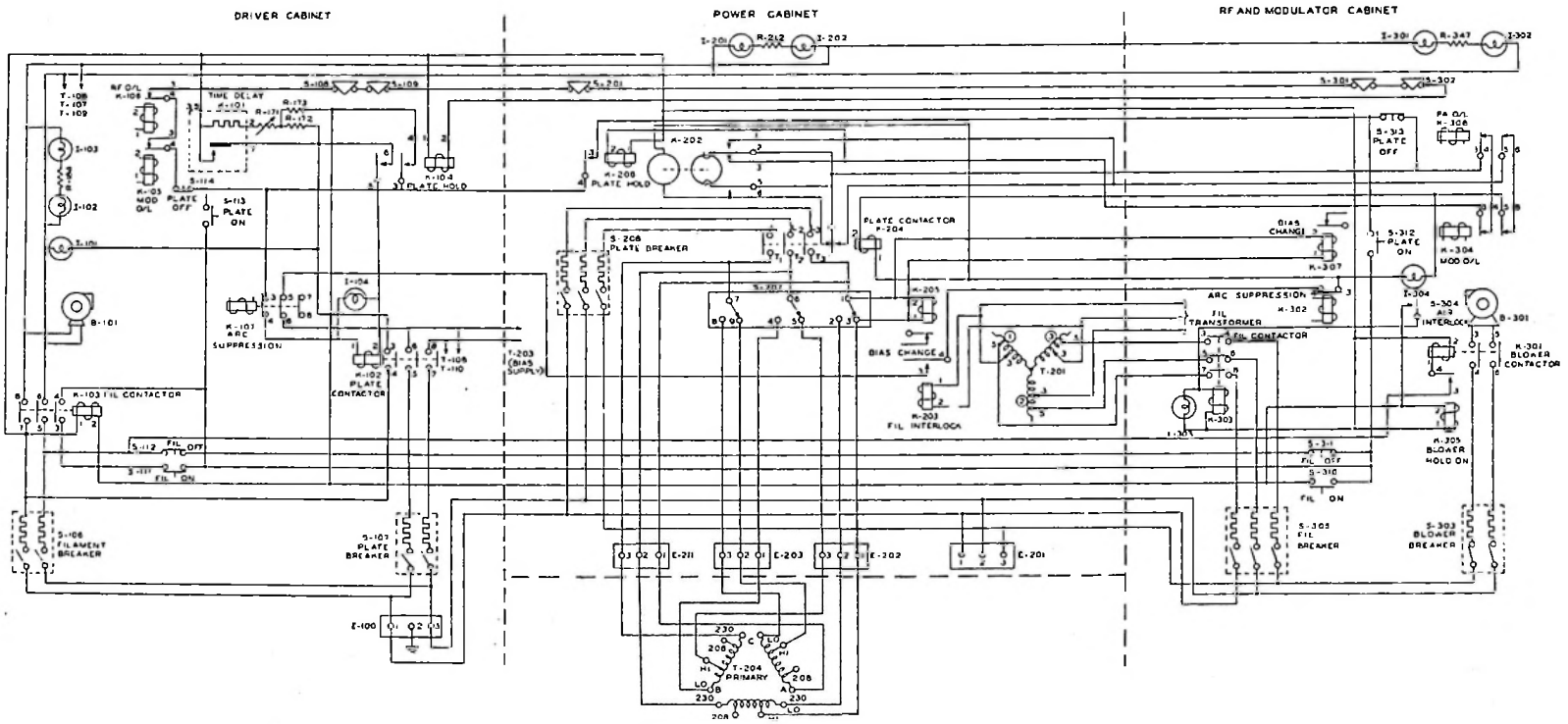


Figure 4-3. Control Circuits

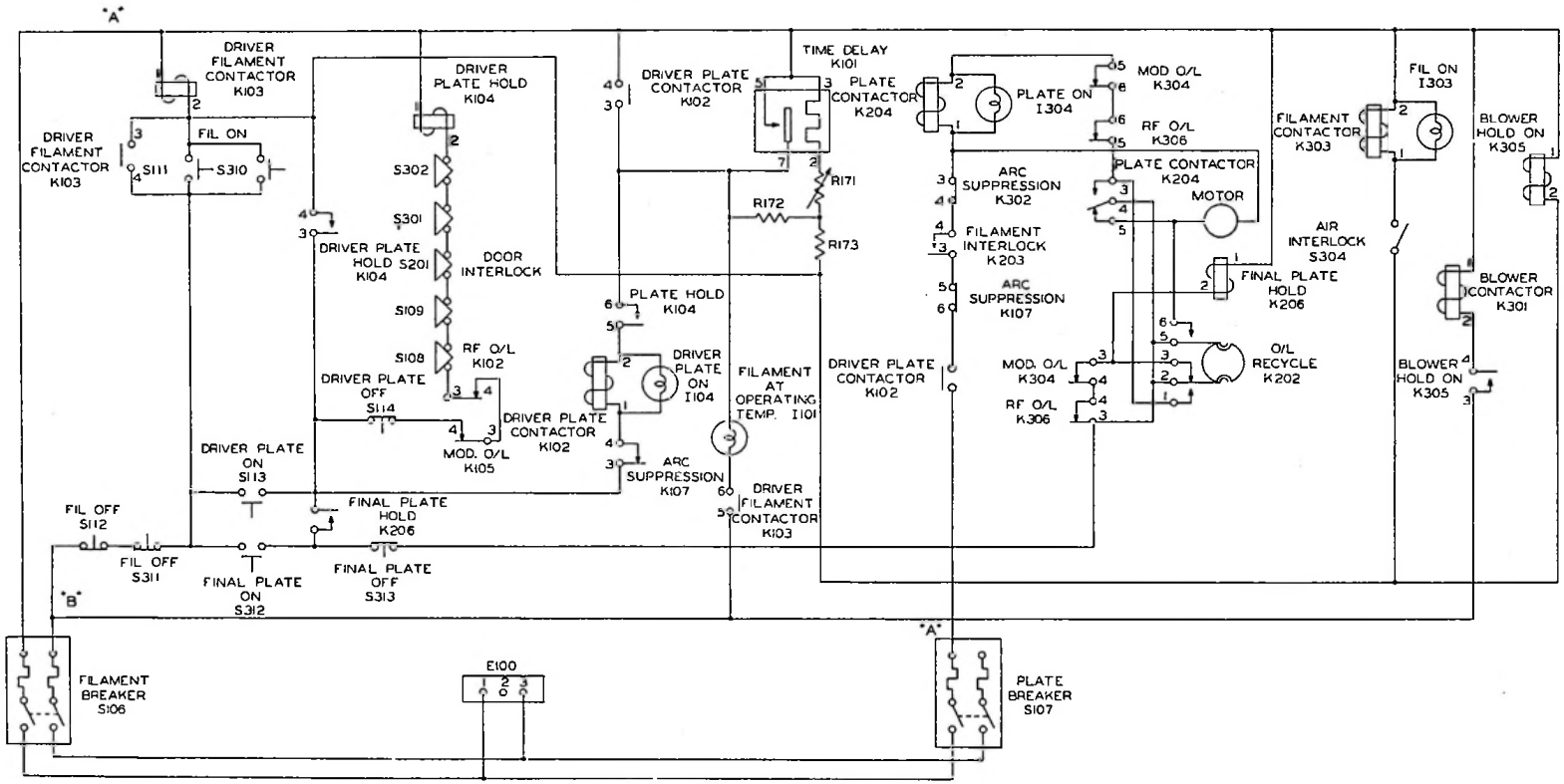


Figure 4-4. Control Circuits, Simplified

To get the final plate relay K-204 operated, final plate hold relay K-206 must first operate. Phase A is applied directly to the coil of K-206. Phase B is applied thru FILAMENT OFF buttons S-112 and S-311, FINAL PLATE ON button S-312, FINAL PLATE OFF button S-313, and overload relays K-306.3 and 4, K-304.3 and 4. Final hold relay K-206 is then held by phase B being applied at the junctions of S-312 and S-313 from a source thru K-206.3 and 4, K-104.3 and 4, K-103.3 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 K-202. To start the motor of K-202, phase A is applied thru driver plate contactor interlock contacts K-102.5 and 6, arc suppression relay K-107.5 and 6, arc suppression relay K-107.5 and 6, filament interlock relay K-203.3 and 4 and arc suppression relay K-302.4 and 3. Phase B is applied thru FILAMENT OFF buttons S-112 and S-311, K-103.4 and 3, K-104.4 and 3, K-206.4 and 3, S-313 and K-204.4 and 5. The motor of K-202 now starts and is held by K-202.5 and 6. Contacts K-202.1 and 2 now close and apply phase B to plate contactor K-204 thru overload relays K-304 and K-306, contacts 5 and 6. Phase A is supplied to K-204 by the same circuit that supplied phase A to the motor of K-202. The motor of K-202 will now rotate until a depression in the cam if found by K-202.5 and 6, then it will stop. Plate relay K-204 is then held by its own contacts K-204.3 and 4 and by virtue of all interlocks and the final plate hold relay K-206 being closed. In addition to final plate contactor being energized, PLATE ON lamp I-304 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 the PA plate contactor K-204 and the PA plate hold relay K-206. Opening the arc suppression relays K-107 or K-302 or driver plate relay K-102 will release only plate contactor K-204.

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 K-206 by the circuit at phase B of S-112, S-311, S-312, S-313, K-306.3 and 4, K-304.3 and 4, to the relay coil. Phase A is connected directly. This relay is held by its contacts K-206.3 and 4, which are responsible for energizing of driver plate hold relay K-104 thru S-112, S-311, S-312, K-206.3 and 4, S-114, K-105.4 and 3, K-106, 4 and 3, S-108, S-109, S-201, S-301, S-302 to the coil of K-104. Contacts 3 and 4 of driver plate hold relay K-104 now energize driver filament contactor K-103 to light all filaments and start the heater element of time delay relay K-101. Contacts K-104.3 and 4 now become K-104 holding contacts. Now, because the two plate hold relays (K-104 and K-206) are already operated and held, the driver plate will come on at the end of the K-101 delay period and, contacts 5 and 6 of driver plate contactor K-102 will start a PA plate turn on cycle by energizing the motor of K-202.

A partial automatic turn on involving only the driver is accomplished by pressing the DRIVER PLATE ON button S-113. Pressing this button energizes the driver plate-hold relay K-104 which then energizes filament contactor K-103 and locks itself at contacts 3 and 4. Now, because hold relay K-104 is already operated, the plate then comes on after the usual warm up 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 K-202. Should an overload occur and open K-304.5 and 6 or K-306.5 and 6 and drop out PA plate relay K-402, contacts K-204.4 and 5 will close and start the motor of K-202, contacts K-202.6 and 5 will close to again energize PA

plate relay K-204. The final plate hold relay K-206 will hold thru the first overload because K-202.2 and 3 are in parallel with the series contacts (3 and 4) of overload relays K-304 and K-306. Should another overload occur while K-202 is running, contacts K-202.2 and 3 will now be open and when the overload relays K-304 and K-306 open, contacts 3 and 4 will no longer be paralleled and K-206 will have to release. K-206.3 and 4 will then open and turn off the PA plate supply permanently. Should an overload occur in the driver stage, K-105 or K-106 will open and de-energize plate hold relay K-104 which will in turn de-energize PA plate hold relay K-206 and both plate supplies will turn off. The fastest way to return to the air would be to press the PA PLATE ON button, S-312.

4.4.5. ARC SUPPRESSION SYSTEM.

Refer to the control circuit schematic figure 4-4. Contacts 3 and 4 of K-107 are connected in series with the coil of driver plate contacts K-102. Contacts 5 and 6 of K-107 and 3 and 4 of K-302 are connected in series with the coil of plate contactor K-204. Should an arc occur in the driver plate circuit, K-107 would open and momentarily turn off both high voltage supplies. Contacts 7 and 8 of K-107 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, K-302 would open and momentarily turn off only the power amplifier-modulator plate supply. See figure 2-4. The coil of K-107 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 momentarily turn off the plate power supplies. The coil of K-302 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 momentarily turned off.

SECTION V

MAINTENANCE

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 insure 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.

a. 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 periodically removed by means of a soft brush or a dry oilfree 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 insure 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.

b. AIR FILTERS. The transmitter is ordinarily furnished with fiberglass air filters, part no. 009 1296 00, for the PA-modulator bay, (although cleanable type filters, part no. 009 1129 00, may be obtained on special order), and with a cleanable filter, part no. 009 1096 00, on the power supply and driver bays.

To remove the filters from the PA-modulator bay, slip the cover directly to the rear and lift out the filters. Surface dirt may be removed from the fiberglass filters with a vacuum cleaner; however, fiberglass filters should be replaced as soon as appreciable dirt loading occurs.

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 filter with the steel or the bronze filler, remove the heavy dust deposit with a vacuum cleaner then swish the filter around in a container of carbon tetrachloride. After the filter is reasonably dry, lower it into a container of #10 motor oil, remove it and let it drain. This completes the cleaning and recharging.

WARNING

The fumes from carbon tetrachloride are very dangerous when breathed. If possible, do the above cleaning out-of-doors and avoid breathing the fumes.

c. 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 insure good electrical connection. See paragraph 2.4.2.r.

5.1.2. LUBRICATION. The bearings and pulleys on each flexible condenser drive cable should be lubricated at two points with SAE 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 #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 carefully removed from the equipment and stored in an upright position in a place where there is no possiblility 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 listortion 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 transmitter. A list of typical readings of all panel meters of the individual transmitter should be made as an aid to rapid trouble shooting.

5.3. ADJUSTMENTS.

5.3.1. AIR INTERLOCK SWITCH, S-304. To adjust air pressure switch, S-304, 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, K-305. The time delay action of K-305 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, K-202. 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 of 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. step 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 Sales Service Department, Collins Radio Company, Cedar Rapids, Iowa. 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 in the guarantee inside the front cover of this book.

TABLE 5-1. TUBE VOLTAGE AND CURRENT MEASUREMENTS

21M

Symbol Designation	Tube Type	Function	Normal Operating Characteristics
		R-F Section	
V-101	6AU6	Crystal Oscillator Pierce Circuit	Plate 270 volts Crystal Current 1.8 ma Cathode Current 4 ma
V-102	6SJ7	Buffer Amplifier Class C.	Plate Voltage 280 volts Screen Voltage 130 volts Grid Current 0.1 ma Cathode Current 6.5 ma
V-103	807	Intermediate Amplifier Class C	Plate Voltage 530 volts Screen Voltage 130 volts Grid Current 1 ma Cathode Current 75 ma
V-104, V-105	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 10,600 watts 5500 watts
V-302	3X2500-A3	Final Amplifier Class C	Plate Voltage 5100 V 3600 V Plate Current 2.8 A 2.0 A Grid Current 230 ma 200 ma
		Power Supply Section	
V-110	5U4G	Bias Rectifier, single phase, full wave, choke input	Output from Filter 100 volts 100 ma
V-113, V-114	866A	Low Voltage Rectifier, single phase, full wave choke input	Output from Filter 530 volts 250 ma
V-111, V-112	872A	Intermediate Voltage Rectifier, single phase,	Output from Filter 2700 volts 360 ma
V-201, V-202	866A	Modulator & R-F Amplifier, bias voltage, single phase full wave, choke input	Output from Filter 1100 volts 200 ma

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

21M

Symbol Designation	Tube Type	Function	Normal Operating Characteristics	
V-204 thru V-208	575A	High Voltage Rectifier, three phase, full wave, choke input	Output from Filter	5000 volts 5.5. amps
		Audio Section		
V-106, V-107	6SJ7	Audio Amplifier, pentode connected, push-pull, Class A	Plate Voltage Plate Current	300 volts 2 ma per tube
V-108, V-109	4-125A	Audio Driver Amplifier push-pull, Class A	Plate Voltage Cathode Current	2700 volts 125 ma
V-303, V-304	3X3000-A1	Modulator, Push-Pull, Class AB1	10,600 watts Plate Voltage Cathode Current, 2 tubes, 0 signal. Cathode Current, 2 tubes, 100% modulation at 1000 cps.	5500 watts 5100 V / 3600 V 0.4 Amp / 0.4 Amp 2.5 Amp / 1.2 Amp

21E

		R-F Section		
V-101	6AU6	Crystal Oscillator Pierce Circuit	Plate Crystal Current Cathode Current	270 volts 1.8 ma 4 ma
V-102	6SJ7	Buffer Amplifier Class C	Plate Voltage Screen Voltage Grid Current Cathode Current	280 volts 130 volts 0.1 ma 6.5 ma
V-103	807	Intermediate Amplifier Class C	Plate Voltage Screen Voltage Grid Current Cathode Current	530 volts 130 volts 1 ma 75 ma
V-104, V-105	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

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

21E

Symbol Designation	Tube Type	Function	Normal Operating Characteristics	
			5500 watts	1100 watts
V-301	3X2500-A3	Final Amplifier Class C	Plate Voltage 5100 A Plate Current 1.3 A Grid Current 175 ma	2300 V 0.55 A 150 ma
		Power Supply Section		
			Output from Filter	
V-110	5U4G	Bias Rectifier, single phase, full wave, choke input	100 volts 100 ma	
			Output from Filter	
V-113, V-114	866A	Low Voltage, Rectifier single phase, full wave choke input	530 volts 250 ma	
			Output from Filter	
V-111, V-112	872A	Intermediate Voltage Rectifier, single phase, full wave, choke input	2700 volts 360 ma	
			Output from Filter	
V-201, V-202	866A	Modulator and R-F Amplifier, bias voltage, single phase full wave, choke input	1100 volts 200 ma	
			Output from Filter	
V-204 thru V-208	872A	High Voltage Rectifier three phase, full wave, choke input	5000 volts 3.0 amps	
		Audio Section		
V-106, V-107	6SJ7	Audio Amplifier, Pentode connected, push-pull, Class A	Plate Voltage Plate Current	300 volts 2 ma per tube

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

21E

Symbol Designation	Tube Type	Function	Normal Operating Characteristics		
V-110, V-111	4-125A	Audio Driver Amplifier, push-pull, Class A	Plate Voltage Cathode Current	2700 volts 125 ma	
				5500 watts	1100 watts
V-303, V-304	3X3000A1	Modulator, push-pull, Class AB1	Plate Voltage Cathode Current, 2 tubes 0 signal Cathode Current, 2 tubes, 100% modulation at 1000 cps	5100 V 0.4 Amp 1.45 Amp	2300 V 0.3 Amp 0.78 Amp

TABLE 5-2. 21E OUTPUT TANK COMPONENTS CHART

50-70 Ω RESISTIVE LOAD

KC	L305	L306	L302	C314	C315	C316	C321	C322	C323	C324	C368	KC
540 590	980 0062 00 120 uh	980 0053 00 26 uh	506 4581 002	919 0033 00 250 mmf.	919 0033 00 250 mmf	919 0033 00 250 mmf	939 1040 00 2000 mmf	939 1040-00 2000 mmf	939 1033 00 1000 mmf	939 1026 00 510 mmf	939 1149 00 .022 mf	540 590
600 640												600 640
650 790												650 790
800 890	980 0063 00 60 uh										OUT	800 890
900 990							939 1033 00 1000 mmf	939 1033 00 1000 mmf				900 990
1000 1090			506-4578-002		OUT	OUT						1000 1090
1100 1600												1100 1600

NOTE: C323 and C324 in or out as required to obtain desired loading.

TABLE 5-3. 21E GRID TANK COMPONENTS CHART

KC	L301	C302	C304	C305	C372	KC
550 640	980 0076 00 60 uh	906 3401 10 400 mmf	906 3801 10 800 mmf	906 3401 10 400 mmf	938 2104 00 6200 mmf	550 640
650 790				OUT	938 2100 00 5100 mmf	650 790
800 940					938 2094 00 3900 mmf	800 940
950 970			938 2032 00 200 mmf			950 970
980 1040					938 2088 00 3000 mmf	980 1040
1050 1340			OUT			1050 1340
1350 1400					938 2080 00 2000 mmf	1350 1400
1410 1600		938 2032 00 200 mmf				1410 1600

TABLE 5-4. 21M OUTPUT TANK COMPONENTS CHART

<table>
<tr><th colspan="16">50-70 Ω RESISTIVE LOAD</th></tr>
<tr><th>KC</th><th>L305</th><th>L306</th><th>L302</th><th>C311</th><th>C316</th><th>C317</th><th>C318</th><th>C319</th><th>C321</th><th>C322</th><th>C323</th><th>C324</th><th>C366</th><th>C368</th><th>KC</th></tr>
<tr><td>540
590</td><td rowspan="7">980 0063 00
60 uh</td><td rowspan="12">980 0053 00
26 uh</td><td rowspan="6">506 4581 002</td><td rowspan="4">939 2037 00
1500 mmf</td><td rowspan="9">919 0033 00
250 mmf</td><td rowspan="6">919 0033 00
250 mmf</td><td rowspan="4">919 0033 00
250 mmf</td><td>919 0033 00
250 mmf</td><td rowspan="4">939 1040 00
2000 mmf</td><td rowspan="4">939 1040 00
2000 mmf</td><td rowspan="3">939 1033 00
1000 mmf</td><td rowspan="4">939 1026 00
510 mmf</td><td rowspan="2">939 1033 00
1000 mmf</td><td rowspan="5">936 1149 00
.022 mfd</td><td>540
590</td></tr>
<tr><td>600
620</td><td rowspan="11">OUT</td><td>600
620</td></tr>
<tr><td>630
640</td><td rowspan="10">OUT</td><td>630
640</td></tr>
<tr><td>650
690</td><td>OUT</td><td>650
690</td></tr>
<tr><td>700
890</td><td rowspan="8">939 2033 00
1000 mmf</td><td rowspan="8">OUT</td><td rowspan="7">939 1033 00
1000 mmf</td><td rowspan="7">939 1033 00
1000 mmf</td><td rowspan="4">939 1033 00
1000 mmf</td><td>939 1033-00
1000 mmf</td><td>700
890</td></tr>
<tr><td>900
990</td><td>939 1026-00
510 mmf</td><td rowspan="7">OUT</td><td>900
990</td></tr>
<tr><td>1000
1040</td><td rowspan="6">506 4578 002</td><td rowspan="6">OUT</td><td rowspan="2">OUT</td><td>1000
1040</td></tr>
<tr><td>1050
1090</td><td rowspan="5">980 0064 00
30 uh</td><td>1050
1090</td></tr>
<tr><td>1100
1140</td><td rowspan="4">939 1026 00
510 mmf</td><td rowspan="4">939 1026 00
510 mmf</td><td>1100
1140</td></tr>
<tr><td>1150
1290</td><td rowspan="3">OUT</td><td>1150
1290</td></tr>
<tr><td>1300
1390</td><td>1300
1390</td></tr>
<tr><td>1400
1600</td><td>939 1026 00
510 mmf</td><td>939 1026
00
510 mmf</td><td>1400
1600</td></tr>
</table>

TABLE 5-5. 21M GRID TANK COMPONENTS CHART

KC	L301	C302	C304	C305	C372	KC
550 640	980 0076 00 60 uh	906 3401 10 400 mmf	906 3401 10 400 mmf	906 3801 10 800 mmf	938 2104 00 6200 mmf	550 640
650 740				906 3401 10 400 mmf	938 2100 00 5100 mmf	650 740
750 790				938 2032 00 200 mmf		750 790
800 840					938 2094 00 3900 mmf	800 840
850 960				OUT		850 960
970 1040					938 2088 00 3000 mmf	970 1040
1050 1340			938 2032 00 200 mmf			1050 1340
1350 1600			OUT		938 2080 00 2000 mmf	1350 1600

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

<table>
<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="7">505 1460 002
4 mh</td><td rowspan="10">980 0041 00
150 uh</td><td rowspan="7">924 1022 00
200 mmf</td><td rowspan="3">913 1441 00
200 mmf</td><td rowspan="3">906 2402 00
4000 mmf</td><td rowspan="2">906 2402 00
4000 mmf</td><td>906 2402 00
4000 mmf</td><td rowspan="5">OUT</td><td rowspan="3">936 1149 00
.022 mf</td><td>540
590</td></tr>
<tr><td>600
640</td><td rowspan="4">906 2208 10
2000 mmf</td><td>600
640</td></tr>
<tr><td>650
790</td><td rowspan="6">906 2208 10
2000 mmf</td><td>650
790</td></tr>
<tr><td>800
840</td><td rowspan="7">OUT</td><td rowspan="6">906 2208 10
2000 mmf</td><td rowspan="7">OUT</td><td>800
840</td></tr>
<tr><td>850
890</td><td>850
890</td></tr>
<tr><td>900
990</td><td rowspan="2">906 3801 10
800 mmf</td><td rowspan="2">906 3401 10
400 mmf</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
1.9 mh</td><td rowspan="3">OUT</td><td>906 3401 10
400 mmf</td><td rowspan="3">OUT</td><td>1100
1140</td></tr>
<tr><td>1150
1290</td><td rowspan="2">906 3801 10
800 mmf</td><td>906 3801 10
800 mmf</td><td>1150
1290</td></tr>
<tr><td>1300
1600</td><td>906 3801 10
800 mmf</td><td>906 3401 10
400 mmf</td><td>1300
1600</td></tr>
</table>

SECTION VI

TABLE 6-1

PARTS LIST

MAJOR ASSEMBLY: 21E/M DRIVER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
B-101	Ventilating Fan Motor	VENTILATING FAN: 8 inch ventilating fan and guard assembly 230 V	230 1064 00
		FAN BLADE: one piece; aluminum	009 1226 00
C-101	Crystal frequency trimmer for Y-101	CAPACITOR: variable, 7.5 mmf to 102.7 mmf	922 0028 00
C-102	Crystal frequency trimmer for Y-102	CAPACITOR: variable, 7.5 mmf to 102.7 mmf	922 0028 00
C-103	Feedback capacitor for V-101	CAPACITOR: Mica, 1000 mmf p/m 20%, 3500 WVDC	914 0019 00
C-104	Cathode bypass capacitor for V-101	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-105	Screen bypass for V-101	CAPACITOR: Mica, 150 mmf p/m 20%, 500 WVDC	935 0114 00
C-106	Coupling capacitor V-101 to V-102	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-107		Not Used	
C-108		Not Used	
C-109	Multimeter bypass buffer grid, 2.5 ma position	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-110	Plate decoupling capacitor for V-101	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-111	Cathode bypass capacitor for V-102	CAPACITOR: Mica, .01 mmf p/m 5%, 500 WV	910 1103 10
C-112	Screen bypass capacitor for V-102	CAPACITOR: Mica, .01 mmf p/m 5%, 500 WV	910 1103 10

MAJOR ASSEMBLY: 21E/M DRIVER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-113	Plate tank padding capacitor for V-102	CAPACITOR: Mica, 100 mmf p/m 10%, 500 WVDC (p/o T-102)	912 0495 00
C-114 and C-115	Plate tank trimmer capacitor for V-102	CAPACITOR: Double, Variable 5-10 mmf min to 100-105 mmf max (p/o T-102)	922 4800 00
C-116	Compensating capacitor grid to cathode of V-103	CAPACITOR: Ceramic, 20 mmf p/m 5%, 500 WV	916 4188 00
C-117		Not Used	
C-118		Not Used	
C-119	Coupling capacitor V-102 to V-103	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-120	Plate decoupling capacitor for V-102	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-121	Multimeter bypass capacitor for 807 Grid, 25 ma position	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-122	Screen bypass capacitor for V-103	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-123	Screen bypass capacitor for V-103	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-124	Plate tank padding capacitor for V-103	CAPACITOR: Mica, 100 mmf p/m 10%, 500 WVDC (p/o T-103)	912 0495 00
C-125 and C-126	Plate tank trimmer capacitor for V-103	CAPACITOR: Double, Variable, 5-10 mmf min to 100-105 mmf max (p/o T-103)	922 4800 00
C-127		Not Used	
C-128		Not Used	
C-129	Plate decoupling capacitor for V-103	CAPACITOR: Mica, 1000 mmf p/m 20%, 3500 WVDC	914 0019 00
C-130	Decoupling capacitor for low voltage stage	CAPACITOR: Mica, 10,000 mmf p/m 20%, 1200 WV	936 1127 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-131	Neutralizing condenser	CAPACITOR: 7 mmf	
C-132	Coupling capacitor V-103 to V-104 and V-105	CAPACITOR: Mica, 1000 mmf p/m 20%, 3500 WVDC	914 0019 00
C-133	Meter bypass capacitor, PA Grid, 25 ma position	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-134	Filament bypass capacitor for V-104	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-135	Filament bypass capacitor for V-105	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-136	Filament bypass capacitor for V-104	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-137	Filament bypass capacitor for V-105	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-138	Screen bypass capacitor for V-104	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
C-139	Screen bypass capacitor for V-105	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
C-140	Bypass capacitor for PA plate current meter M-102	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-141	Plate decoupling capacitor for V-104 and V-105	CAPACITOR: Ceramic, 500 mmf plus 50% minus 20%, 20,000 WVDC	913 1101 00
C-142	R-F Coupling capacitor	CAPACITOR: Ceramic 200 mmf, p/m 10%, 7500 WVDC	913 1441 00
C-143	Screen bypass capacitor for V-104	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
C-144	Screen bypass capacitor for V-105	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
*C-145	Padder capacitor for PA plate tank 540 kc - 1090 kc	CAPACITOR: Fixed, 200 mmf, 27 plates	924 1022 00

*Values depend upon frequency of operation

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
*C-145A	540 kc - 790 kc	CAPACITOR: Ceramic, 200 mmf, p/m 10%, 7500 WVDC	913 1441 00
C-146	PA plate tuning capacitor	CAPACITOR: Variable, air-dielectric; 58 mmf to 185 mmf	920 0075 00
C-147	PA plate loading capacitor	CAPACITOR: Variable, air-dielectric; 840 mmf max, 65 mmf min	920 0114 00
*C-148	Padder Capacitor Driver Output Network	CAPACITOR: Mica, p/m 10%, 5000 WV	
		800 mmf	906 3801 10
		2000 mmf	906 2208 10
		4000 mmf	906 2402 00
*C-149	Padder Capacitor Driver Output Network	Same as C-148	
*C-150	Padder Capacitor Driver Output Network	CAPACITOR: Mica, p/m 10%,	
		400 mmf	906 3401 10
		800 mmf	906 3801 10
		2000 mmf	906 2208 10
		4000 mmf	
*C-151	Padder Capacitor Driver Output Network	CAPACITOR: Mica p/m 10%, 5000 WV	
		400 mmf	906 3401 10
C-152	Plate decoupling capacitor for V-104 and V-105	CAPACITOR: Ceramic, 500 mmf plus 50% minus 20%, 20,000 WVDC	913 1101 00
C-153	Bypass capacitorfor multimeter M-104	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-154	Not Used	CAPACITOR: Mica, 3300 mmf p/m 20%, 1300 WVDC	936 0283 00
C-155	Not Used	CAPACITOR: Mica, 3300 mmf p/m 20%, 1200 WVDC	936 0283 00

*Values depend upon frequency of operation

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-156	V-106, V-107 screen bypass	CAPACITOR: Paper .1 mf p/m 10%, 600 WVDC	961 5114 00
C-157		Not Used	
C-158	Coupling capacitor V-106 to V-108	CAPACITOR: Paper .1 mf p/m 10%, 600 WVDC	961 5114 00
C-159	Coupling capacitor V-107 to V-109	CAPACITOR: Paper .1 mf p/m 10%, 600 WVDC	961 5114 00
C-160	Filament bypass capacitor for V-108 and V-109	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-161	Filament bypass capacitor for V-108 and V-109	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-162	Plate decoupling capacitor for V-106 and V-107	CAPACITOR: Paper, 2 mf p/m 10%, 600 WVDC	930 0046 00
C-163	Filter capacitor	CAPACITOR: Paper, 4 mf p/m 20%, 3000 WVDC	930 4314 00
C-164	Bypass capacitor PA plate voltage meter	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-165	Filament bypass capacitor for V-103	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-166	Filament bypass capacitor for V-103	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-167	Filter capacitor bias supply filter	CAPACITOR: Paper, 8 mf p/m 10%, 600 WVDC	930 0048 00
C-168		Not Used	
C-169	Tunes L-114 in H.V. filter to ripple	CAPACITOR: Paper, 0.08 mf p/m 5%, 6000 WV	930 0424 00
C-170	Filter capacitor high voltage supply filter	CAPACITOR: Paper, 4 mf p/m 10%, 3000 WVDC	930 4314 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-171	Bypass capacitor for modulator plate current meter, M-105	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-172	Filter capacitor, low voltage supply	CAPACITOR: Paper, 10 mf p/m 10%, 1000 WVDC	930 0038 00
C-173	Filter capacitor, low voltage supply filter	CAPACITOR: Paper, 10 mf p/m 10%, 1000 WVDC	930 0038 00
C-174	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-175	Not Used	Same as C-174	
C-176	Not Used	Same as C-174	
C-177	Not Used	Same as C-174	
C-178	Not Used	Same as C-174	
C-179	Not Used	Same as C-174	
C-180	Not Used	Same as C-174	
C-181	Not Used	Same as C-174	
C-182	Mod. Grid Coupling	CAPACITOR: Plasticon .1 mf p/m 10%, 5000 WV	933 0033 00
C-183	V-109 grid equalizer	PAPER, .25 mf p/m 10%, 600 WVDC	961 5132 00
C-184	Filter capacitor, high voltage supply filter	CAPACITOR: Paper, 4 mf p/m 10%, 3000 WV	930 4314 00
C-185	Coupling capacitor to frequency monitor jack, J-104	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-186		Not Used	
C-187	V-108 grid equalizer	CAPACITOR: Paper, .25 mf p/m 10%, 600 WV	961 5132 00
C-188	ARC-Suppr. Blocking	CAPACITOR: Mica, .022 mf p/m 20%, 600 WV	936 1149 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-189	V-108, V-109 screen bypass	CAPACITOR: Mica, 10,000 mmf p/m 20%, 1200 WV	936 1127 00
C-190		CAPACITOR: Same as C-188	936 1149 00
C-191	Mod. grid coupling	CAPACITOR: Plasticon, .1 mf p/m 10%, 5000 WV	933 0033 00
C-192	Driver output blocking	CAPACITOR: Fixed, 10,000 mmf p/m 10%, 2500 WV	937 2025 00
C-193	Driver output blocking	CAPACITOR: Fixed, 10,000 mmf p/m 10%, 2500 WV	937 2025 00
C-194	Mod-Mon. blocking	CAPACITOR: Fixed, 0.01 mmf p/m 5%, 500 WV	910 1103 10
C-195	K-105 Coil Bypass	CAPACITOR: Dry-electrolytic, 1100 mf 25 WV	184 2000 00
C-196	K-106 Coil Bypass	CAPACITOR: Dry-electrolytic, 1100 mf 25 WV	184 2000 00
C-197	K-107 Coil Bypass	CAPACITOR: 2 mfd. ±10% 600 WVdc	930 0046 00
E-100	Primary power input terminal board	BOARD: 3 terminals	306 0069 00
E-101	Terminal board connecting modulator chassis to power supplies	BOARD: 13 terminals	367 5130 00
E-102	Terminal board connecting r-f chassis to power supplies	BOARD: 13 terminals	367 5130 00
E-103	Audio input terminal board		
E-104	Audio monitoring output terminal board	BOARD: 2 terminals	367 4020 00
E-105	Control Interconnect	BOARD: 16 terminals	367 5160 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
F-101	Fuse in primary of bias supply transformer T-106	FUSE: Cartridge, 1 amp 250 V	264 4280 00
F-102	Fuse in primary of high voltage rectifier filament transformer, T-107	FUSE: Cartridge, 1 amp 250 V	264 4280 00
F-103	Fuse in primary of filament transformer, T-109	FUSE: Cartridge, 3 amp 250 V	264 0009 00
F-104	Fuse in primary of low voltage supply transformer	FUSE: Cartridge, 1 amp 250 V	264 4280 00
I-101	Filaments at operating temperature indicator	BULB: Candelabra base, 230-250 10 w	262 0169 00
I-102	Lumiline meter panel lamp, illuminates meter panel	BULB: Lumiline, disc base, 125 VAC RMS, 40 w	262 0170
I-103	Lumiline meter panel lamp, illuminates meter panel	BULB: Lumiline, disc base, 125 VAC RMS, 40 w	262 0170 00
I-104	Plate ON lamp, indicates when high and low voltage is on	BULB: Candelabra base, 230-250 , 10 w	262 0169 00
J-100	Jack for modulation monitor	CONNECTOR: Receptacle, single female contact	357 9005 00
J-101	Modulator unit connector	CONNECTOR: Receptacle, 4 female contacts	364 2040 00
J-102	Modulator unit connector	CONNECTOR: Receptacle, 8 female contacts	366 2080 00
J-103	R-f chassis connector	CONNECTOR: Receptacle, 8 female contacts	366 2080 00
J-104	Frequency monitor jack	CONNECTOR: Receptacle, single female contact	357 9005 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
J-105	Socket for F-101	HOLDER: Fuse, extractor post for 3AG cartridge fuse	265 1075 00
J-106	Socket for F-102	HOLDER: Fuse, extractor post for 3AG cartridge fuse	265 1048 00
J-107	Socket for F-103	HOLDER: Fuse, extractor post for 3AG cartridge fuse	265 1040 00
J-108	Socket for F-104	HOLDER: Fuse, extractor post for 3 AG cartridge fuse	265 1040 00
K-101	Thermal time delay relay provides adequate filament warm-up period	RELAY: 3 amp 150 VDC, 3 amp 250 V AC contacts	402 0211 00
K-102	Plate relay, shunts thermal element in K-101 with resistor shorts K-101 relay contacts, and completes circuit from S-107 to T-108 and T-110	RELAY: 25 amp 600 V contacts 220 V coil	401 1201 00
K-103	Driver filament contactor	RELAY: 15 amp 600 V contacts 220 V coil	401 1202 00
K-104	Driver plate hold	RELAY: 5 amp 220 VAC	405 0608 00
K-105	Driver modulator overload	RELAY: Current overload; 0.075 to 0.3A O.C.	405 0186 00
K-106	Driver r-f overload	RELAY: Current overload; 0.075 to 0.3A O.C.	405 0186 00
K-107	Arc suppression	RELAY: 2 amp 230 VAC	970 1727 00
L-101		Not used in Standard Broadcast Band	
L-102		COIL: (p/o T-102)	
L-102A	Part of plate tank coil for V-102	Section of L-102	
L-102B	Part of plate tank coil for V-102	Section of L-102	

L108 {980-0040-00 (42 Turns) 980-0041-00 (56 Turns)

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
L-103		Not used in Standard Broadcast Band	
L-104		COIL: (p/o T-103)	
L-104A	Part of plate tank coil for V-103	Section of L-104	
L-104B	Part of plate tank coil for V-103	Section of L-104	
L-105		Not used in Standard Broadcast Band	
L-106	R-F choke in B plus lead to V-103	COIL: R-f choke, 3 section, 1 mh, 300 ma	240 5800 00
*L-107	R-F choke in B plus lead to V-104 and V-105	COIL: R-f choke, 200 turns #24 AWG DS wire	571 0460 10
		or COIL: R-f choke, 800 turns #22 AWG wire	505 1460 002
L-108	PA plate tuning coil	INDUCTOR: R-f fixed tank, 150 mh 56 Turns	980 0041 00
L-109	L section inductance	COIL: R-f, 30 turns #10 copper wire	504 9624 003
L-110	Static drain choke, feeds modulation monitor	COIL: 56 turns, #22 copper wire	506 9995 003
L-111		Not Used	
L-112	Filter choke, bias voltage supply filter	REACTOR: Filter, 12 hy, 375 ohm dc resistance, 2000 TV	668 0004 00
L-113		Not Used	
L-114	Filter choke, high voltage supply filter	REACTOR: Filter, 20 hy at 170 ma, 15 hy at 360 ma, 100 ohm dc resistance, 7500 TV	668 0072 00

*Values depend on frequency of operation

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
L-115	Filter choke, low voltage supply filter	REACTOR: Filter, 8.0 hy, 85 ohm dc resistance, 2500 VRMS	678 0384 00
L-116	Filter choke, low voltage supply filter	REACTOR: Filter, 8.0 hy, 85 ohm dc resistance, 2500 VRMS	678 0384 00
M-101	Meters r-f line current	METER: R-f ammeter, 0-3 amp	451 0080 00
M-102	Meters PA plate current	METER: 0-300 ma	450 0090 00
M-103	Meters PA plate voltage	METER: 0-1 ma, 0-4000 VDC	458 0196 00
M-104	Multimeter	METER: 0-1 ma dc 250 division scale	458 0170 00
M-105	Meters modulator plate current	METER: 0-300 ma dc	450 0090 00
P-100	Plug for modulation monitor	CONNECTOR: R-f concentric cable	357 9014 00
P-101	Connects from J-102 to M-104, M-105	CONNECTOR: Cable	363 8042 00
P-102	Connects from J-103 to J-104	CONNECTOR: Cable	365 8080 00
P-103	Connects from J-104 to J-103	CONNECTOR: Cable	365 8080 00
P-104	Plug for frequency monitor	CONNECTOR: R-f concentric cable	357 9014 00
R-101	Grid resistor for V-101	RESISTOR: .1 megohm p/m 10%, 1/2 w	745 1436 00
R-102	Cathode resistor for V-101	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 ~~1324~~ 1058 00
R-103	Plate load, resistor for V-101	RESISTOR: 10,000 ohm p/m 10%, 1 w (p/o T-101)	745 3394 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-104	Screen voltage dropping resistor for V-101	RESISTOR: 82,000 ohm p/m 10%, 1/2 w	745 1433 00
R-105	Voltage dropping resistor, V-101	RESISTOR: .12 megohm p/m 10%, 2 w	745 5740 00
R-106	Voltage dropping resistor, V-101	RESISTOR: .12 megohm p/m 10%, 2 w	745 5740 00
R-107	Grid resistor, V-102	RESISTOR: .1 megohm p/m 10%, 1/2 w	745 1436 00
R-108	Multimeter shunt resistor 1st Buffer Grid, 2.4 ma position	RESISTOR: 3900 ohm p/m 10%, 1/2 w	745 1377 00
R-109	Voltage Divider feeds frequency monitor	RESISTOR: 56 ohm p/m 10%, 2 w	745 5600 00
R-110	Cathode resistor for V-102	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 1324 00
R-111	Voltage dividing resistor for V-102	RESISTOR: 39,000 ohm p/m 10%, 1 w	745 3419 00
R-112	Screen voltage dropping resistor, V-102	RESISTOR: 33,000 ohm p/m 10%. 1 w	745 3415 00
R-113	Voltage dropping resistor, V-102	RESISTOR: 25,000 ohm p/m 10%, 10 w	710 1254 20
R-114	Grid resistor, V-103	RESISTOR: 15,000 ohm p/m 10%, 1 w	745 3401 00
R-115	Cathode resistor, V-103	RESISTOR: 22 ohm p/m 10%, 2 w	745 5582 00
R-116	Stabilizing resistor V-103	RESISTOR: 47 ohm p/m 10%, 1/2 w	745 1296 00
R-117	Screen voltage dividing resistor, V-103	RESISTOR: 22,000 ohm p/m 10%, 2 w	745 5708 00
R-118		Not Used	

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-119	Grid resistor, V-104 and V-105	RESISTOR: 15,000 ohm p/m 20%, 25 w	710 3154 20
R-120	Audio hum control B	RESISTOR: 50 ohm p/m 10%, 25 w	735 0201 00
R-121	Audio voltage source for audio monitor	RESISTOR: 12.6 ohm p/m 20%, 20 w	710 0044 00
R-122	Screen dropping resistor, V-104 and V-105	RESISTOR: 2000 ohm p/m 5%, 25 w	710 3241 00
R-123	Voltage dividing resistor for bias supply	RESISTOR: 15,000 ohm p/m 10%, 1 w	745 3401 00
R-124	Part of 807 Grid resistance	RESISTOR: 4700 ohm p/m 10%, 1 w	745 3380 00
R-125	Shunt resistor for multimeter, 807 Grid, 25 ma position	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 1324 00
R-126	Shunt resistor for multimeter, PA Grid, 25 ma position	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 1324 00
R-127	Multimeter series resistor	RESISTOR: 5100 ohm p/m 5%, 1/2 w	745 1382 00
R-128	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1322 00
R-129	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1322 00
R-130	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1322 00
R-131	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1323 00
R-132	Audio input pad	RESISTOR: 220 ohm p/m 5%, 1/2 w	745 1323 00
R-133	T-104 sec. load	RESISTOR: 68,000 ohm p/m 10%, 1/2 w	745 1429 00
R-134	T-104 sec. load	RESISTOR: 68,000 ohm p/m 10%, 1/2 w	745 1429 00
R-135		Not Used	

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-136		Not Used	
R-137	V-106, V-107 Cathode	RESISTOR: 2700 ohm p/m 10%, 1/2 w	745 1370 00
R-138	Shunt V-106, V-107 meter	RESISTOR: 220 ohm p/m 5%, 1/2 w	745 1323 00
R-139	V-106, V-107 screen decoupling	RESISTOR: 39,000 ohm p/m 10%, 2 w	745 5719 00
R-140	V-106 grid return	RESISTOR: 22,000 ohm p/m 10%, 1 w	745 3408 00
R-141	V-107 grid return	RESISTOR: 22,000 ohm p/m 10%, 1 w	745 3408 00
R-142	Screen resistor, V-106, V-107	RESISTOR: 0.33 megohm p/m 10%, 2 w	745 5757 00
R-143		Not Used	
R-144	Plate Load, V-106	82,000 ohm p/m 10%, 1 w	745 3433 00
R-145	Plate Load, V-107	82,000 ohm p/m 10%, 1 w	745 3433 00
R-146	Hum adjust	RESISTOR: 50 ohm, p/m 10%, 25 w	735 0201 00
R-149	Bias adjust	RESISTOR: 4000 ohm p/m 10%, 4 w	377 0040 00
R-150	Bias voltage divider for V-108, V-109	RESISTOR: 1000 ohm p/m 10%, 2 V	745 5652 00
R-151	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00
R-152	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00
R-153	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-154	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00
R-155	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00
R-156	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00
R-157	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00
R-158	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 5778 00
R-159	V-108, V109 frid return	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 5722 00
R-160	Part of grid resistance of V-108 and V-109	RESISTOR: 82,000 ohm p/m 10%, 1 w	745 3433 00
R-161	Part of grid resistance of V-108 and V-109	RESISTOR: 82,000 ohm p/m 10%, 1 w	745 3433 00
R-162	Modulator bias adjustment	RESISTOR: Variable, 25,000 ohm p/m 10%, 4 w	377 0011 00
R-163	Modulator bias adjustment	RESISTOR: Variable, 25,000 ohm p/m 10%, 4 w	377 0011 00
R-164	Stabilizing resistor V-108	RESISTOR: 10,000 ohm p/m 10%, 1/2 w	745 1394 00
R-165	Stabilizing resistor V-109	RESISTOR: 10,000 ohm p/m 10%, 1/2 w	745 1394 00
R-166	Voltage dropping resistor for Power Change Switch	RESISTOR: 5000 ohm p/m 10%, 160 w	710 6542 00
R-167		Not Used	
R-168	DC Plate Voltmeter M-103, shunt resistor	RESISTOR: 10,000 ohm p/m 10%, 2 w	745 5694 00
R-169	Series resistor for DC Plate Voltmeter	RESISTOR: 4 megohm (Special)	505 5098 002
R-170		Not Used	

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-171	Varies length of filament time delay	RESISTOR: Variable, 2000 ohm p/m 10%, 4 w	377 0008 00
R-172	Shunt resistor for K-101	RESISTOR: 15,000 ohm p/m 10%, 10 w	710 1154 20
R-173	Voltage dropping resistor for K-101	RESISTOR: 2500 ohm p/m 10%, 10 w	710 0030 00
R-174	Bleeder resistor for bias supply	RESISTOR: 2000 ohm p/m 10%, 25 w	710 3242 00
R-175	Part of bleeder resistance for high voltage supply	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00
R-176	Part of bleeder resistance for high voltage supply	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00
R-177	Part of bleeder resistance for high voltage supply	RESISTOR: 40,000 ohm p/m 10%, 100 w	710 5404 20
R-178	Bleeder resistor for low voltage supply	RESISTOR: 7500 ohm p/m 10%, 100 w	710 0132 00
R-179		Not Used	
R-180	Screen voltage dropping resistor V-103	RESISTOR: 25,000 ohm p/m 10%, 10 w	710 1254 20
R-182	Audio hum control A	RESISTOR: Variable, 25,000 ohm p/m 10%, 4 w	377 0011 00
R-183	Primary voltage dropping resistor	RESISTOR: WW, 15 ohm p/m 10%, 25 w	710 3152 00
R-184	Series dropping for I-102 and I-103	RESISTOR: Fixed; WW 100 ohm p/m 10%, 25 w	710 3100 20
R-185	Parasitic Suppressor	RESISTOR: Fixed globar; 50 ohm, carborundum bar	712 1400 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-186	V-108 grid equalizer	RESISTOR: .15 megohm p/m 10%, 2 w	745 5743 00
R-187	V-109 grid equalizer	RESISTOR: .15 megohm p/m 10%, 2 w	745 5743 00
R-188		Not Used	
R-189		Not Used	
R-190	V-109 plate	RESISTOR: 20,000 ohm p/m 5%, 160 w	710 6204 10
R-191	V-108 plate	RESISTOR: 20,000 ohm p/m 5%, 160 w	710 6204 10
R-193	V-108, V-109 cathode bias	RESISTOR: WW 300 ohm p/m 10%, 25 w	710 3300 20
S-101	Selects desired crystal, crystal selector switch	SWITCH: Rotary, 2 pole, 2 position	259 0362 00
S-102	Multimeter switch selects circuit to to be metered	SWITCH: Rotary, 2 pole, 8 position	259 0441 00
S-103	Power change switch shorts out dropping resistor R-166 and R-167	SWITCH: High voltage rotary, SPST, special	504 9633 003
S-104	Mechanical door interlock, discharges high voltage filter capacitors	SHORTING BAR: Gravity operated	
S-105	Mechanical door interlock, discharges high voltage filter capacitors	SHORTING BAR: Gravity operated	
S-106	Filament ON-OFF switch and breaker, applies voltage to filaments, blower and bias supply	CIRCUIT BREAKER: Magnetic	260 0238 00

MAJOR ASSEMBLY: 21E/M DRIVER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
S-107	Plate ON-OFF switch and breaker, applies voltage T-108 and T-110	CIRCUIT BREAKER: Magnetic 10 Amp. curve 1	260 0222 00
S-108	Electrical door interlock, removes the high and low voltage	CONTACT ASSEM: Male section of door interlock switch CONTACT ASSEM: Female section of door interlock switch	260 4040 00 260 4050 00
S-109	Electrical door interlock, removes the high and low voltage	CONTACT ASSEM: Male section of door interlock switch CONTACT ASSEM: Female section of door interlock switch	260 4040 00 260 4050 00
S-111	Driver filament ON	SWITCH: Push, 40 amp 110 V	260 0355 00
S-112	Driver filament OFF	SWITCH: Push, 40 amp 110 V	260 0352 00
S-113	Driver plate ON	SWITCH: Push, 40 amp 110 V	260 0355 00
S-114	Driver plate OFF	SWITCH: Push, 40 amp 110 V	260 0352 00
T 101	Plate tank r-f can, V-101	OSCILLATOR PLATE TUNING ASSEM: (incl R-103)	504 9594 002
T-102	Plate tank r-f can, V-102	INTERMEDIATE PLATE TUNING ASSEM: C-113, C-114, C-115, L-102A, L-102B	504 9632 003
T-103	Plate tank r-f can, V-103	INTERMEDIATE PLATE TUNING ASSEM: (incl C-124, C-125, C-126, L-104A, L-104B)	504 9632 003
T-104	Audio input transformer, feeds V-106 and V-107	TRANSFORMER: HF input audio pri: 600 ohm CT, Sec: 50,000 ohm CT	677 0114 00
T-105		Not Used	
T-106	Bias Supply transformer	TRANSFORMER: Power, Pri: 230 V Sec #1: 360, 320, 250, V CT Sec #2: 5 V	672 0392 00
T-107	Filament transformer for high voltage rectifier tubes	TRANSFORMER: Filament, Pri: 230/208, Sec: 5 V CT 20 amp, 10,000 TV rms	662 0209 00

MAJOR ASSEMBLY: 21E/M DRIVER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
T-108	High voltage transformer	TRANSFORMER: Plate 208/230 V nom, 50/60 cps single phase, sec 2700 VDC	662 0070 00
T-109	Filament transformer 866A rectifier tubes and all R-f and audio tubes	TRANSFORMER: Filament, Pri: 230, 208 V Sec #1: 5.3 V CT, Sec #2: 5.3 V CT, Sec #3: 6.3 V CT, Sec #4: 2.5 V CT	672 0381 00
T-110	Low voltage supply transformer	TRANSFORMER: Plate, Pri: 230, 208 V Sec: 550 VDC	672 0383 00
V-101	Oscillator	TUBE: Pentode 6AU6	255 0202 00
V-102	Buffer amplifier	TUBE: Pentode 6SJ7	255 0030 00
V-103	R-f driver	TUBE: Beam 807	256 0033 00
V-104	Power amplifier	TUBE: Tetrode 4-125A	256 0068 00
V-105	Power amplifier	TUBE: Tetrode 4-125A	256 0068 00
V-106	1st Audio amplifier	TUBE: Pentode 6SJ7	255 0030 00
V-107	1st Audio amplifier	TUBE: Pentode 6SJ7	255 0030 00
V-108	Modulator	TUBE: Tetrode 4-125A	256 0068 00
V-109	Modulator	TUBE: Tetrode 4-125A	256 0068 00
V-110	Bias supply rectifier	TUBE: Rectifier 5U4G	255 0032 00
V-111	High voltage supply rectifier	TUBE: Rectifier 872A	256 0037 00
V-112	High voltage supply rectifier	TUBE: Rectifier 872A	256 0037 00
V-113	Low voltage supply rectifier	TUBE: Rectifier 866A	256 0049 00
V-114	Low voltage supply rectifier	TUBE: Rectifier 866A	256 0049 00
X-100	Socket for I-101	MTG: Pilot light, for candelabra base bulbs DISC: Green	262 0255 00 262 0255 00

MAJOR ASSEMBLY: 21E/M DRIVER

ITEM	CIRCUIT FUNCTION	DESCTIPTION	PART NUMBER
X-101	Socket for I-104	MTG: Pilot light, for candelabra bulbs	262 0255 00
		DISC: Red	262 0259 00
X-102	Socket for I-102	MTG: Socket for lumiline lamp bulb	262 0177 00
X-103	Socket for I-102	MTG: Socket for lumiline lamp bulb	262 0177 00
X-104	Socket for I-103	MTG: Socket for lumiline lamp bulb	262 0177 00
X-105	Socket for I-103	MTG: Socket for lumiline lamp bulb	262 0177 00
X-106	Adapter	ADAPTER: for lumiline bulb	262 0175 00
X-107	Adapter	ADAPTER: for lumiline bulb	262 0175 00
X-108	Adapter	ADAPTER: for lumiline bulb	262 0175 00
X-109	Adapter	ADAPTER: for lumiline bulb	262 0175 00
X-112	Socket for T-101	SOCKET: Tube, chassis mtg 7 prong	220 1790 00
X-114	Socket for T-102	SOCKET: Tube, chassis mtg 7 prong	220 1790 00
X-116	Socket for T-103	SOCKET: Tube, chassis mtg, 7 prong	220 1790 00
X-118	Socket for Y-101	SOCKET: Tube, octal, 8 prong	220 1005 00
X-119	Socket for Y-102	SOCKET: Tube, octal, 8 prong	220 1005 00
X-124		Not Used	
X-125		Not Used	
X-126	Socket for K-101	SOCKET: Tube, octal, 8 prong	220 1005 00
XV-101	Socket for V-101	SOCKET: Tube, miniature, 7 pin	220 1034 00
XV-102	Socket for V-102	SOCKET: Tube, octal, 8 prong	220 1005 00

MAJOR ASSEMBLY: 21E/M DRIVER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
XV-103	Socket for V-103	SOCKET: Tube, 5 contacts	220 5520 00
XV-104	Socket for V-104	SOCKET: Tube, 5 prong	220 1016 00
XV-105	Socket for V-105	SOCKET: Tube, 5 prong	220 1016 00
XV-106	Socket for V-106	SOCKET: Tube, octal 8 prong	220 1005 00
XV-107	Socket for V-107	SOCKET: Tube, octal 8 prong	220 1005 00
XV-108	Socket for V-108	SOCKET: Tube, 5 prong	220 1016 00
XV-109	Socket for V-109	SOCKET: Tube, 5 prong	220 1016 00
XV-110	Socket for V-110	SOCKET: Tube, octal 8 prong	220 1005 00
XV-111	Socket for V-111	SOCKET: Tube, 4 prong	220 5420 00
XV-112	Socket for V-112	SOCKET: Tube, 4 prong	220 5420 00
XV-113	Socket for V-113	SOCKET: Tube, 4 prong	220 5410 00
XV-114	Socket for V-114	SOCKET: Tube, 4 prong	220 5410 00
Y-101	Quartz crystal	CRYSTAL	
Y-102	Quartz crystal	CRYSTAL	
B-201	Ventilating Fan motor	FAN MOTOR: Unit bearing with shaded pole, 230 volt	230 0164 00
		FAN BLADE: one piece, aluminum	009 1226 00
B-301	Tube cooling	DIRECT BLOWER: Direct connected blower and motor assembly, 1 hp	009 1225 00
C-201	HV filter	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
C-202	HV filter	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
C-203	HV filter	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
C-204	HV filter	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
C-205		Not Used	

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-206		Not Used	
C-207		Not Used	
C-208		Not Used	
C-209		Not Used	
C-210	Bias filter	CAPACITOR: Paper, 4 mf p/m 20%, 3000 WV	930 4314 00
		ALT.	930 0098 00
C-211	Bias filter	CAPACITOR: Paper, 4 mf p/m 20%, 3000 WV	930 4314 00
		ALT.	930 0098 00
C-212	Audio Compensating	CAPACITOR: Ceramic, 1000 mmf p/m 20%, 5000 WV	913 0101 00
C-213	Audio Compensating	CAPACITOR: Ceramic, 1000 mmf p/m 20%, 5000 WV	913 0101 00
C-214	Audio Compensating	CAPACITOR: Ceramic, 1000 mmf p/m 20%, 5000 WV	913 0101 00
C-215	Audio Compensating	CAPACITOR: Ceramic, 1000 mmf p/m 20%, 5000 WV	913 0101 00
C-301	PA grid tuning	CAPACITOR: Variable 37 min to 251 max mmf	920 0096 00
C-302	PA grid pad	CAPACITOR: Mica, p/m 5%, 5000 WV 200 mmf 400 mmf	 938 2032 00 906 3401 10
C-303		Not Used	
C-304	PA grid pad	CAPACITOR: Mica, p/m 5%, 5000 WV 200 mmf 400 mmf 800 mmf	 938 2032 00 906 3401 10 906 3801 10
C-305	PA grid pad	CAPACITOR: Mica, p/m 5%, 5000 WV 200 mmf 400 mmf 800 mmf	 938 2032 00 906 3401 10 906 3801 10

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-306	Filament bypass	CAPACITOR: Mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-307	Filament bypass	CAPACITOR: Mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
*C-308	Filament bypass	CAPACITOR: Mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
*C-309	Filament bypass	CAPACITOR: Same as ref. C-308	
C-310	PA neutralizing	CAPACITOR: Variable, 10-60 mmf 20 KV	919 0081 00
C-311	PA plate blocking	CAPACITOR: Mica, 500 mmf p/m 10%, 20,000 TV OR	901 3502 00
		CAPACITOR: Mica, 1500 mmf p/m 5%, 15,000 WV OR	939 2037 00
		CAPACITOR: Mica, 1000 mmf p/m 5%, 20,000 WV	939 2033 00
C-312	Plate bypass	CAPACITOR: Ceramic, 500 mmf plus 50%, minus 20%, 20,000 WVDC	913 1101 00
C-313	PA tuning	CAPACITOR: Variable, 60 min to 300 max mmf 10,000 TV	919 0122 00
**C-314	PA tuning padder	CAPACITOR: Vacuum 250 mmf p/m 10%, 10 KV	919 0033 00
**C-315	PA tuning padder	CAPACITOR: Vacuum 250 mmf p/m 10%, 10 KV	919 0033 00
**C-316	PA tuning padder	CAPACITOR: Vacuum 250 mmf p/m 10%, 10 KV	919 0033 00
**C-317	PA tuning padder	CAPACITOR: Vacuum 250 mmf p/m 10%, 10 KV	919 0033 00
**C-318	PA tuning padder	CAPACITOR: Vacuum 250 mmf p/m 10%, 10 KV	919 0033 00
**C-319	PA tuning padder	CAPACITOR: Vacuum 250 mmf p/m 10%, 10 KV	919 0033 00
C-320	PA loading	CAPACITOR: Variable, 496 max to 56 min mmf	920 9600 00

*21M only
**Determined by frequency

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
**C-321	PA loading pad	CAPACITOR: Mica, p/m 5%, 10,000 WV	
		510 mmf	939 1026 00
		1000 mmf	939 1033 00
		2000 mmf	939 1040 00
**C-322	PA loading pad	Same as C-321	
**C-323	PA loading pad	CAPACITOR: Mica, p/m 5%, 10,000 WV	
		510 mmf	939 1026 00
		1000 mmf	939 1033 00
**C-324	PA loading pad	Same as C-323	
C-325	Mod. monitor adjust	CAPACITOR: Variable, 320 max to 13.5 min mmf, 500 V	922 1400 00
C-326		Not Used	
C-327	Meter bypass	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-328	Meter bypass	CAPACITOR: Mica 5100 mmf p/m 5%, 500 WVDC	925 2105 00
C-329	PA grid bypass	CAPACITOR: Ceramic, 1000 mmf p/m 20%, 5000 WVDC	913 0101 00
C-330	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-331	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-332	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-333	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-334	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-335	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-336	Feedback network	CAPACITOR: Mica, 3900 mmf p/m 20%, 2500 WVDC	936 1099 00

**Determined by frequency

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-337	Feedback network	CAPACITOR: Mica, 3900 mmf p/m 20%, 2500 WVDC	936 1099 00
C-338	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-339	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-340	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-341	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-342	Feedback network	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-343	Feedback network	CAPACITOR: Mica, 27 mmf p/m 20%, 2500 WVDC	936 0162 00
C-344	Mod. grid bypass	CAPACITOR: Ceramic, 1000 mmf p/m 20%, 5000 WVDC	913 0101 00
C-345	Mod. grid bypass	CAPACITOR: Ceramic, 1000 mmf p/m 20%, 5000 WVDC	913 0101 00
C-346	Mod. fil. bypass	CAPACITOR: Mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-347	Mod. fil. bypass	CAPACITOR: Mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-348	Mod. fil. bypass	CAPACITOR: Mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-349	Mod. fil. bypass	CAPACITOR: Mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-350	Mod. Coupling	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
*C-351	Mod. Coupling	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
C-352	Meter bypass	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00

*21M only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-353	Meter bypass	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
*C-354	HV filter	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
*C-355	HV filter	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
*C-356	HV filter	CAPACITOR: Paper, 2 mf p/m 10%, 6000 WV	930 0327 00
C-357		Not Used	
C-358		Not Used	
C-359		Not Used	
C-360		Not Used	
C-361	Audio monitor by-pass	CAPACITOR: Mica, 1000 mmf p/m 10%, 500 WVDC	935 4053 00
C-362		Not Used	
C-363		Not Used	
C-364	Neutralizing	CAPACITOR: Ceramic, 40 mmf p/m 5%, 5000 WVDC	913 0836 00
C-365	Neutralizing	CAPACITOR: Ceramic, 40 mmf p/m 5%, 5000 WVDC	913 0836 00
**C-366	PA loading pad	CAPACITOR: Mica, 1000 mmf p/m 5%, 10,000 WVDC	939 1033 00
C-367	L-307 isolating	CAPACITOR: Fixed, 22,000 mmf p/m 20%, 600 WV	936 1149 00
**C-368	L-307 isolating	CAPACITOR: Fixed, 22,000 mmf p/m 20%, 600 WV	936 1149 00
C-369	Transmission line	CAPACITOR: Fixed, .02 mmf p/m 5%, 3000 WV	939 1064 00
C-370	K-304 coil bypass	CAPACITOR: Dry-Electrolytic 1100 mf, 25 WV	184 2000 00

*21M only
**Determined by frequency

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-371	K-306 coil bypass	CAPACITOR: Dry-Electrolytic 1100 mf, 25 WV	184 2000 00
**C-372	Grid return	CAPACITOR: Mica, p/m 5%,	
		2000 mmf, 5000 WV	938 2080 00
		3000 mmf, 3000 WV	938 2088 00
		3900 mmf, 3000 WV	938 2094 00
		5100 mmf, 3000 WV	938 2104 00
		6200 mmf, 3000 WV	938 2104 00
C-373	K-302 audio bypass	Capacitor	930 0046 00
E-201	AC input connector	TERMINAL BLOCK: 3 term	306 0068 00
E-202	HV tranf, pri conn	TERMINAL BLOCK: 3 term	306 0069 00
E-203	HV tranf. pri conn	TERMINAL BLOCK: 3 term	306 0069 00
E-204	Part of S-204 and S-205	INSULATOR: Feedthru	190 6920 00
E-205	Part of S-205	INSULATOR: Feedthru	190 6920 00
E-206	Part of S-204	INSULATOR: Feedthru	190 6920 00
E-207	Relay panel conn	BOARD TERMINAL: 10 term	367 5100 00
E-209	Relay panel conn	TERMINAL STRIP: 9 term	367 5090 00
E-210	Control interconn	TERMINAL STRIP: 16 term	367 5160 00
E-211	HV transf. pri conn	CONNECTOR STRIP: 3 term	306 0069 00
E-301	Audio monitor conn	CONNECTOR STRIP: 2 term	367 4020 00
E-302	Relay panel conn	CONNECTOR STRIP: 14 term	367 5140 00
E-303	R-f output conn	INSULATOR: Feedthru	190 6920 00
E-304	PA r-f input conn	STANDOFF: Conical	190 2510 00
E-305	PA r-f input conn	STANDOFF: Conical	190 2510 00
F-201	Bias rect. fil fuse	FUSE: Cartridge, 1/4 amp 125 V	264 4240 00
F-202	Bias rect. pl. fuse	FUSE: Cartridge, 3.0 amp 250 V	264 0009 00
F-203	HV rect. fil fuse	FUSE: Cartridge, 3/4 amp 125 V	264 4270 00
F-204	HV rect. fil fuse	FUSE: Cartridge, 3/4 amp 125 V	264 4270 00

*21M only
**Determined by frequency

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
F-205	HV rect fil fuse	FUSE: Cartridge 3/4 amp 125 V	264 4270 00
F-301	T-302 pri fuse	FUSE: Cartridge, 3 amp 250 V	264 0009 00
F-302	T-303 pri fuse	FUSE: Cartridge, 3 amp 250 V	264 0009 00
F-303	T-304 pri fuse	FUSE: Cartridge, 3 amp 250 V	264 0009 00
F-304	T-305 pri fuse	FUSE: Cartridge, 3 amp 250 V	264 0009 00
I-201	Meter panel bulb	BULB: Lumiline, disc base, 125 V, 40 w	262 0170 00
I-202	Meter panel bulb	BULB: Lumiline, disc base, 125 V, 40	262 0170 00
I-203		Not Used	
I-204		Not Used	
I-301	Meter panel light	BULB: Lumiline, disc base, 125 V, 40 w	262 0170 00
I-302	Meter panel light	BULB: Lumiline, disc base, 125 V, 40 w	262 0170 00
I-303	Blower pilot light	BULB: Candelabra base, 230-250 V, 10 w	262 0169 00
I-304	Filament pilot light	BULB: Candelabra base, 230-250 V, 10 w	262 0169 00
J-301	Meter cable conn	CONNECTOR: Receptacle, 4 female contacts	364 2040 00
J 302	Mod. monitor output	CONNECTOR: Receptacle, 1 female contact	357 9005 00
J-303		Not Used	
K-201		Not Used	
K-202	Micro switch contact	SWITCH: Snap action, 10A-125 VAC, 5A-250 VAC	260 0561 00
	Motor	SYNCHRONOUS: 4 rpm	230 0045 00
K-203	Filament interlock	RELAY: Contact arrangement, 1 c left 1 c right (12 pole double throw)	405 0615 00

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
K-204	Plate contactor	RELAY: Contact arrangement, 1 ND 1 NC, 3 poles	401 1318 00
K-205	Bias change relay	RELAY: Contact arrangement, 1 c left 1 c right (2 poles double throw)	405 0616 00
*K-205	Bias change relay	RELAY: Control arrangement, 2 c (double pole double throw)	405 0619 00
K-206	Plate hold	RELAY: 5 amp 220 VAC	405 0608 00
K-301	Blower contactor	RELAY: Contact arrangement, 3 NO-15A contact rating	401 1202 00
K-302	Arc suppression	RELAY: 2 amp 230 VAC	970 1727 00
K-303	Filament contactor	RELAY: Contact arrangement, 3 NO-15A contact rating	401 1202 00
K-304	Modulator overload	RELAY: Current overload; cont. current .225A; 2 NC contacts	405 C186 00
K-305	Blower delay	RELAY: Contact arrangement 1 c	402 0235 00
K-306	R-F overload	RELAY: Current overload; cont current .225A; 2 NC contacts	405 0186 00
**K-307	Bias change	RELAY: 5 amp 2000 V contacts 115 AC coil	407 1045 00
L-201	Bias filter choke	REACTOR: Filter, 6.6 hy min at 0.20 amp DC, 85 ohm max.	678 0384 00
L-202	HV filter choke	REACTOR: Filter, 1.5 hy min at 3.0 amp DC, 6 ohm max	668 0089 00
*L-203	HV filter choke	REACTOR: Filter, 1.5 hy min at 3.0 amp DC, ohm max	668 0089 00
L-204	Audio compensating inductor	COIL: Audio filter, 350 turns No. 22 wire	506 3597 002
L-205	Audio compensating inductor	COIL: Audio filter, 350 turns No. 22 wire	506 3597 002
L-301	PA grid tuning	INDUCTOR: R-f fixed tank, 60 mh	980 0076 00

*21M only
**21E only

Low Frequency – Large Coils
L304 – 546-7811-003

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
***L-302	Parasitic suppressor coil	RESISTOR ASSY: – 1/4" Spacing OR: RESISTOR ASSY: – Coils Nearly Touching	506 4578 002 506 4581 002
L-303		Not Used	
L-304	PA plate choke	High Freq. Small Coils INDUCTOR: R-f choke, 1.1 mh	546-7812-003 ~~506-0617-003~~
L-305	PA plate tank	INDUCTOR: R-f fixed tank, 60 mh OR: INDUCTOR: R-f fixed tank, 120 mh	980 0063 00 980 0062 00
*L-305	PA plate tank	INDUCTOR: R-f fixed tank, 30 mh OR; INDUCTOR: R-f fixed tank, 60 mh	980 0064 00 980 0063 00
L-306	PA output loading coil	INDUCTOR: R-f fixed tank, 26 mh	980 0053 00
L-307	Modulation monitor coil	COIL ASSY: Modulation, 11 1/2 turns per inch	506 0537 003
L-308		Not Used	
L-309	Modulation choke	REACTOR: Modulation, 30 hy 50 ohm dc resistance, 18,000 TV	~~668 0078 00~~ 668-0910-00
*L-310	Modulation choke	REACTOR: Modulation, 30 hy 50 ohm dc resistance, 18,000 TV	668 0078 00
L-311		Not Used	
L-312		Not Used	
L-313		Not Used	
L-314	Mod. monitor conn filter	COIL: R-f choke, 3 sections, #29 copper wire	240 0013 00
M-201	Filament primary meter	METER: Ac voltmeter 0-300 range, 60 scale divisions	452 0046 00
M-202	Filament hours	METER: 0-9999.9 hours; 230 V 60 cps	458 0190 00
M-202	Filament hours	METER: 0-999.9 hours; 230 V 50 cps	097-6881-00 ~~458 0923 00~~
M-301	R-f output meter	METER: R-f ammeter 0-15 range, 75 scale divisions	451 0085 00
*M-301	R-f output meter	METER: R-f ammeter 0-20 amp 40 scale divisions	451 0086 00
M-302	PA plate current	METER: Dc ammeter, 0-3 amp 60 scale divisions	450 0100 00

*21M only
***Determined by frequency

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
*M-302		METER: Dc ammeter, 0-4A; 40 divisions	450 0101 00
M-303	HV dc voltmeter	METER: Dc voltmeter, ~~0-750~~ 0-6 KV. volts dc, 75 scale divisions	458 0212 00
M-304	Multimeter	METER: Dc milliammeter, 0-25 range	458 0170 00
M-305	Mod. plate current	METER: Dc ammeter, 0-3 range, 60 scale division	450 0100 00
*M-305	Mod. plate current	METER: Dc ammeter, 0-4 range, 40 scale division	450 0101 00
P-301	Meter plug	CONNECTOR: Cable	363 8042 00
P-302	Modulation monitor	CONNECTOR: Coax cable, right angle	357 9014 00
R-201	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710 6204 10
R-202	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710 6204 10
R-203	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710 6204 10
R-204	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 160 w	710 6204 10
R-205	Surge Limiter	RESISTOR: 17 ohms ±20%, 6.5 amps, nichrome wire	714 0019 00
R-206	Surge Limiter	RESISTOR: Same as R-205	714 0019 00
R-207	Surge Limiter	RESISTOR: Same as R-205	714 0019 00
R-208	Low power mod. bias adj	RESISTOR: 250 ohm p/m 10%, 200 w	716 0005 00
R-210	Audio compensating network	RESISTOR: 1000 ohm p/m 10%, 160 w	710 2730 00
R-211	Audio compensating network	RESISTOR: 1000 ohm p/m 10%, 160 w	710 2730 00
R-212	Meter light dropping	RESISTOR: WW, 100 ohm p/m 10%, 25 WV	710 3100 20
R-301	PA tube grid	RESISTOR: 1500 ohm p/m 10%, 50 w	710 0093 00
*R-301	PA tube grid	RESISTOR: 500 ohm p/m 10%, 50 w	710 2705 00

*21M only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-302	M-303 meter multiplier	TERMINAL BOARD: Includes six 1 megohm, 2 w resistors	506 0626 002
R-303		Not Used	
R-304	M-303 shunt	RESISTOR: 10,000 ohm p/m 10%, 2 w	745 5694 00
R-305	Feedback network	RESISTOR: 8200 ohm p/m 5%, 2 w	745 5690 00
R-306	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-307	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-308	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-309	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-310	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-311	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-312	Feedback network	RESISTOR: 8200 ohms p/m 5%, 2 w	745 5690 00
R-313	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-314	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-315	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-316	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-317	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-318	Feedback network	RESISTOR: 1 meg p/m 1%, 2 w	705 4001 00
R-319	V-303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 5722 00
R-320	V-303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 5722 00
R-321	V-303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 5722 00
R-322	V-303 grid series resistor	RESISTOR: 4700 ohm p/m 10%, 2 w	745 5680 00

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-323	V-304 grid series resistor	RESISTOR: 4700 ohm p/m 10%, 2 w	745 5680 00
R-324	V-304 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 5722 00
R-325	V-304 grid resistance	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 5722 00
R-326	V-304 grid resistance	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 5722 00
R-327		Not Used	
R-328	M-304 shunt (mod)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710 2511 00
R-329	M-304 shunt (mod)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710 2511 00
*R-330	M-304 shunt (PA)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710 2511 00
R-331	M-304 shunt (PA)	RESISTOR: 0.4 ohm p/m 2%, 20 w	710 2511 00
R-332	Audio monitor voltage generator	RESISTOR: 3 ohm p/m 5%, 100 w	710 2009 00
R-333	M-304 multiplier	RESISTOR: 910 ohm p/m 1%, 1/2 w	705 2130 00
R-334	PA grid meter shunt	RESISTOR: 4.0 ohm p/m 1%, 1 w	722 0046 00
R-335	Mod bias adj	RHEOSTAT: 10,000 ohm p/m 10%, 25 w	735 1042 00
R-336	Mod bias adj	RHEOSTAT: 10,000 ohm p/m 10%, 25 w	735 1042 00
R-337	Bias voltage divider	RESISTOR: 7500 ohm p/m 10%, 200 w	710 0156 00
R-338	Bias voltage divider	RESISTOR: 1500 ohm p/m 10%, 200 w	710 2605 00
**R-339	Bias voltage divider	RESISTOR: 15,000 ohm p/m 10%, 25 w	710 3154 20
R-340	Bias voltage divider	RESISTOR: WW 15,000 ohm p/m 10%, 100 w	710 5154 20
R-341	Modulator overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710 1252 00
R-342	Modulator overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710 1252 00
R-343	Mod overload relay shunt	RESISTOR: WW, 5 ohm p/m 10%, 25 w	710 3520 00

*21M only
**21E only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
*R-343	Mod overload relay shunt	RESISTOR: WW 2 ohm p/m 5%, 25 w	710 3220 00
R-344	R-f overload relay shunt	RESISTOR: WW 5 ohm p/m 10%, 25 w	710 3520 00
*R-344	R-f overload relay shunt	RESISTOR: WW 2 ohm p/m 5%, 25 w	710 3220 00
R-345	Arc suppression divider	RESISTOR: WW, 20,000 ohm p/m 10%, 25 w	710 3204 20
R-346	Arc suppression divider	RESISTOR: WW, 20,000 ohm p/m 10%, 25 w	710 3204 20
R-347	Meter light dropping	RESISTOR: WW, 100 ohm p/m 10%, 25 w	710 3100 20
R-348	Parasitic Resistor	GLOBAR: 500 ohm p/m 10%	712 2201 00
R-349	R-f overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710 1252 00
R-350	R-f overload surge dampener	RESISTOR: 25 ohm p/m 10%, 10 w	710 1252 00
S-201	HV interlock	CONTACT ASSEM: Female section of door interlock switch	260 4040 00 260 4050 00 (Same as S-109)
S-202	Bias supply shorting interlock	Includes: HINGE: Safety device CONTACT: Brass, cad pl, 0.218" diam x 0.064" thk	 504 9587 002 504 9553 001
S-203	HV supply shorting interlock	Includes: HINGE: Safety device CONTACT: Brass, cad pl, 0.218" diam x 0.064"	 504 9587 002 504 9553 001
S-204	HV sec. grounding interlock	Includes: SPRING: 10 turns right hand wound wire CONTACT: Brass, cad pl, 2-3/8" diam x 0.064" thk SHAFT: 4-9/16" lg x 5/16" diam	 506 0515 002 506 0514 002 506 0513 002
S-205	HV sec. grounding interlock	Includes: SPRING: 10 turns right hand wound wire CONTACT: Brass, cad pl, 2-3/8" x 0.064" thk SHAFT: 4-9/16" lg x 5/16" diam	 506 0515 002 506 0514 002 506 0513 002

*21M only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
S-206		Not Used	
S-207	HV-LV selector	SWITCH: Rotary, 3 pole, 2 position	266 0044 00
S-208	HV plate control and breaker	SWITCH: Magnetic, 3 pole, 3 overload coils	260 0415 00
*S-208	HV plate control and breaker	SWITCH: Magnetic, 3 pole, 3 overload coils	260 0935 00
S-209		Not Used	
S-210		Not Used	
S-301	HV interlock	SWITCH: 2 female contacts, momentary action	260 4040 00 260 4050 00 (Same as S-109)
S-302	HV interlock	SWITCH: 2 female contacts, momentary action	260 4040 00 260 4050 00 (Same as S-109)
S-303	Blower breaker and switch	SWITCH: Magnetic, 2 pole, 2 overload coils	260 0220 00
S-304	Blower interlock	SWITCH: Air pressure 7.5 amperes 30 VDC	260 1261 00
S-305	Filament breaker and switch	SWITCH: Magnetic, 3 pole, 3 overload coils 10AMP	260 0407 00
S-306	Meter circuit selector	SWITCH: Rotary, 2 pole, 8 position, 2 section	259 0441 00
S-307	Bias shorting interlock	Includes: HINGE: Safety device CONTACT: Brass, cad pl; 0.218" diam x 0.064" thk	 504 9587 002 504 9533 001
S-308	HV shorting interlock	Includes: HINGE: Safety device CONTACT: Brass, cad pl; 0.218" diam x 0.64" thk	 504 9587 002 504 9553 001

*21M only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
S-309	HV shorting interlock	Includes: HINGE: Safety device CONTACT: Brass, cad pl; 0.218" diam x 0.064" thk	504 9587 002 504 9553 001
S-310	Filament on	SWITCH: Push, 40 amp 110 V	260 0355 00
S-311	Filament off	SWITCH: Push, 40 amp 110 V	260 0352 00
S-312	Plate on	SWITCH: Push, 40 amp 110 V	260 0355 00
S-313	Plate off	SWITCH: Push, 40 amp 110 V	260 0352 00
S-314	HV shorting interlock	Includes: HINGE: Safety device CONTACT: Brass, cad pl; 0.218" diam x 0.064" thk	504 9587 002 504 9553 001
T-201	Filament voltage	TRANSFORMER, variable autotransformer 230 V, 60 cps, 3 phase	664 0079 00
T-202	Bias rect. filament	TRANSFORMER: Filament, pri: 230 V 2.5 V CT	672 0399 00
T-203	Bias rect. plate	TRANSFORMER: Power, pri: 208 V tapped Sec: as required for 1100 VDC at 200 ma, CT	662 0087 00
T-204	HV plate	TRANSFORMER: Plate, 230/208 VRMS 3 phase, 50/60 cps	662-049-00 ~~662 0090 00~~
*T-204	HV plate	TRANSFORMER: Plate, 230/208 VRMS 3 phase, 50/60 cps	662 0091 00
T-205	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
T-206	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
T-207	HV rectifier filament	TRANSFORMER: Filament, pri No. 1: 115 V, pri N . 2: 115 V, 1000 RMS TV Sec: 5 V TV, 15,000 RMS TV	662 0186 00

*21M only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
T-208	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
T-209	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
T-210	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 00
T-211	Modulation	TRANSFORMER: Modulation, pri: 5000 ohm CT, Sec: 3400 ohm, 18,000 RMS TV	667 0080 00
*T-211	Modulation	TRANSFORMER: Modulation, pri: 5000 ohm CT, Sec: 3400 ohm, 18,000 RMS TV	667 0081 00
T-302	V-303 filament transformer	TRANSFORMER: Filament, pri: 230 V, Sec: 7.75 V CT	662 0085 00
T-303	V-304 filament transformer	TRANSFORMER: Filament, pri: 230 V, Sec: 7.75 V CT	662 0085 00
T-304	V-301 filament transformer	TRANSFORMER: Filament, pri: 230 V, Sec: 7.75 V CT	662 0085 00
*T-305	V-305 filament transformer	TRANSFORMER: Filament, pri: 230 V, Sec: 7.75 V CT	662 0085 00
V-201	Bias rectifier	TUBE: Rectifier 866A	256 0049 00
V-202	Bias rectifier	TUBE: Rectifier 866A	256 0049 00
V-203	HV rectifier	TUBE: Rectifier 872A	256 0037 00
*V-203	HV rectifier	TUBE: Rectifier 575A	256 0080 00
V-204	HV rectifier	TUBE: Rectifier 872A	256 0037 00
*V-204	HV rectifier	TUBE: Rectifier 575A	256 0080 00
V-205	HV rectifier	TUBE: Rectifier 872A	256 0037 00

*21M only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
*V-205	HV rectifier	TUBE: Rectifier 575A	256 0080 00
V-206	HV rectifier	TUBE: Rectifier 872A	256 0037 00
*V-206	HV rectifier	TUBE: Rectifier 575A	256 0080 00
V-207	HV rectifier	TUBE: Rectifier 872A	256 0037 00
*V-207	HV rectifier	TUBE: Rectifier 575A	256 0080 00
V-208	HV rectifier	TUBE: Rectifier 872A	256 0037 00
*V-208	HV rectifier	TUBE: Rectifier 575A	256 0080 00
V-301	Power Amplifier	TUBE: Triode 3X2500A3	256 0108 00
*V-302	Power Amplifier	TUBE: Triode 3X2500A3	256 0108 00
V-303	Modulator	TUBE: Triode 3X3000A1	256 0100 00
V-304	Modulator	TUBE: Triode 3X3000A1	256 0100 00
XC-310	Socket for C-310	SOCKET: For capacitor, brass bright alloy plate	506 0593 002
XF-201	Socket for F-201	FUSE HOLDER: Extractor post type for 3AG fuses	265 1046 00
XF-202	Socket for F-202	Same as XF-201	
XF-203	Socket for F-203	Same as XF-201	
XF-204	Socket for F-204	Same as XF-201	
XF-205	Socket for F-205	Same as XF-201	
XF-301	Socket for F-301	FUSE HOLDER: Extractor post type for 3AG fuses	265 1046 00
XF-302	Socket for F-302	FUSE HOLDER: Extractor post type for 3AG fuses	265 1040 00
XF-303	Socket for F-303	FUSE HOLDER: Extractor post type for 3AG fuses	265 1040 00
*XF-304	Socket for F-304	FUSE HOLDER: Extractor post type for 3AG fuses	265 1040 00

*21M only

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
XI-201A	Socket for I-201	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-201B	Socket for I-201	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-202A	Socket for I-202	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-202B	Socket for I-202	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-203		Not Used	
XI-204		Not Used	
XI-301A	Socket for I-301	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-301B	Socket for I-301	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-302A	Socket for I-302	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-302B	Socket for I-302	MTG: Socket for lumiline lamp bulb	262 0177 00
XI-303	Socket for I-303	LAMP HOLDER: For use with candelabra screw base lamp	262 0255 00
XI-304	Socket for I-304	LAMP HOLDER: For use with candelabra screw base lamp	262 0255 00
XV-201	Socket for V-201	SOCKET: 4 Pin UX	220 5410 00
XV-202	Socket for V-202	SOCKET: 4 Pin UX	220 5410 00
XV-203	Socket for V-203	SOCKET: 4 Pin Jumbo	220 5420 00
XV-204	Socket for V-204	SOCKET: 4 Pin Jumbo	220 5420 00
XV-205	Socket for V-205	SOCKET: 4 Pin Jumbo	220 5420 00
XV-206	Socket for V-206	SOCKET: 4 Pin Jumbo	220 5420 00
XV-207	Socket for V-207	SOCKET: 4 Pin Jumbo	220 5420 00
XV-208	Socket for V-208	SOCKET: 4 Pin Jumbo	
XV-301	Socket for V-301	PLATE: Electrical shield, includes 2 capacitors	506 0621 004

MAJOR ASSEMBLY: 21E/M TRANSMITTER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
*XV-302	Socket for V-302	PLATE: Electrical shield, includes 2 capacitors	506 0621 004
XV-303	Socket for V-303	PLATE: Electrical shield, includes 2 capacitors	506 0621 004
XV-304	Socket for V-304	PLATE: Electrical shield, includes 2 capacitors	506 0621 004
	21M		
	T204 H.V. Plate Transf. use 664-0011-00 Transf. Return 662-0492-00 or 664-0003-00		
	T211 Modulation Transf. use 667-0066-00 Transf.		
	L309 Modulation Reactor use 668-0018-00 Reactor		

*21M only

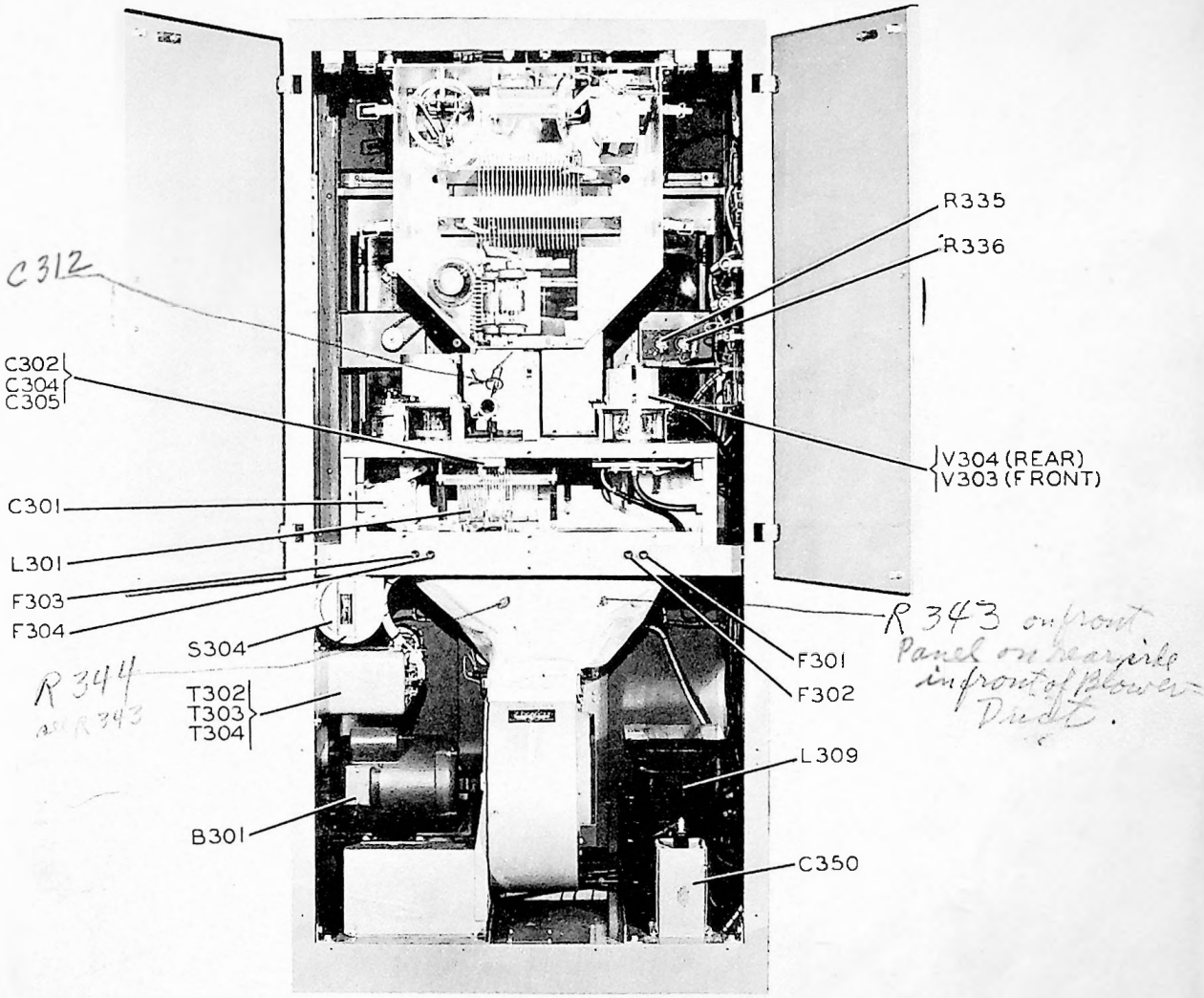


Figure 7-1A. Power Amplifier Cabinet, Rear View

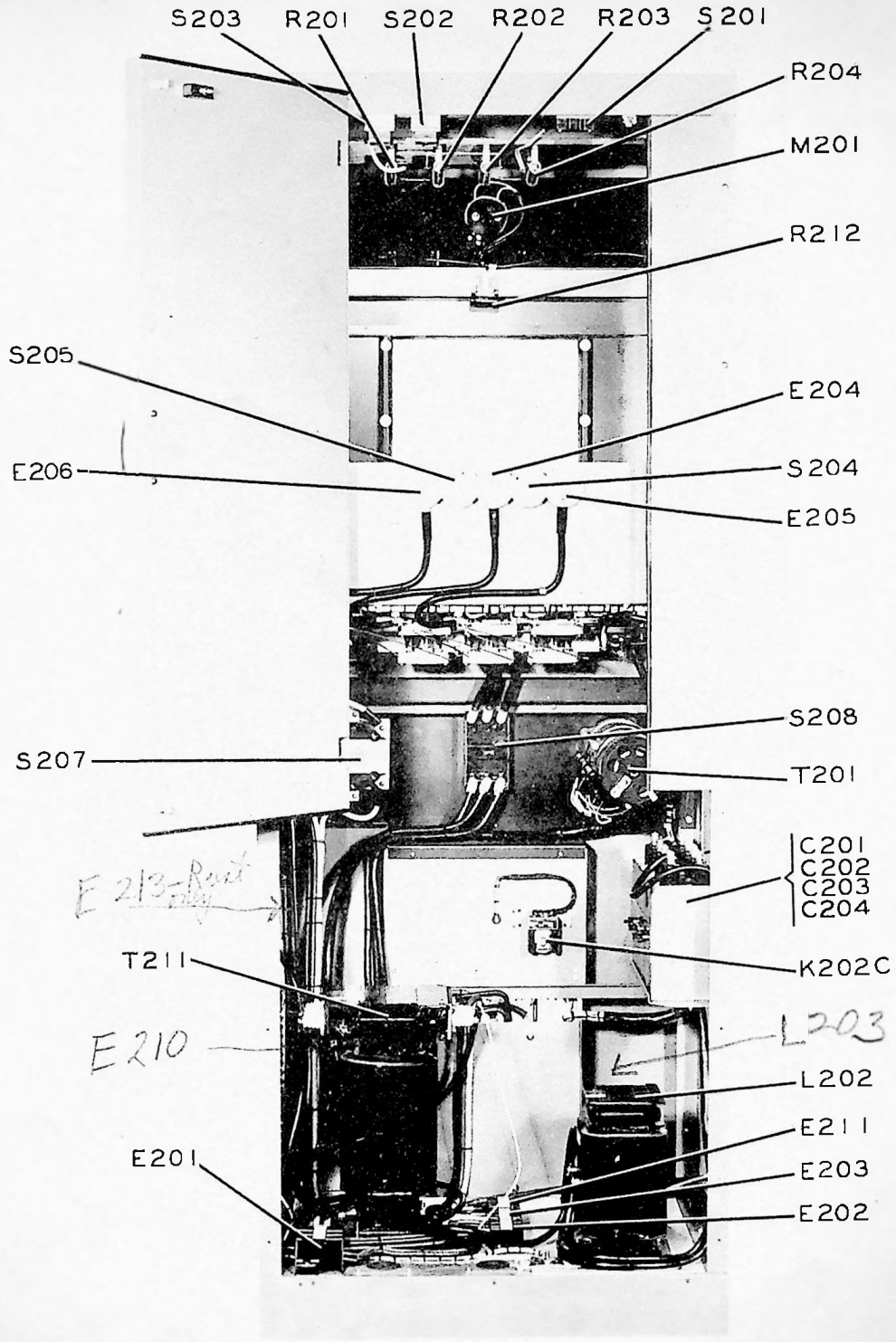


Figure 7-2A. Power Supply Cabinet, Rear View

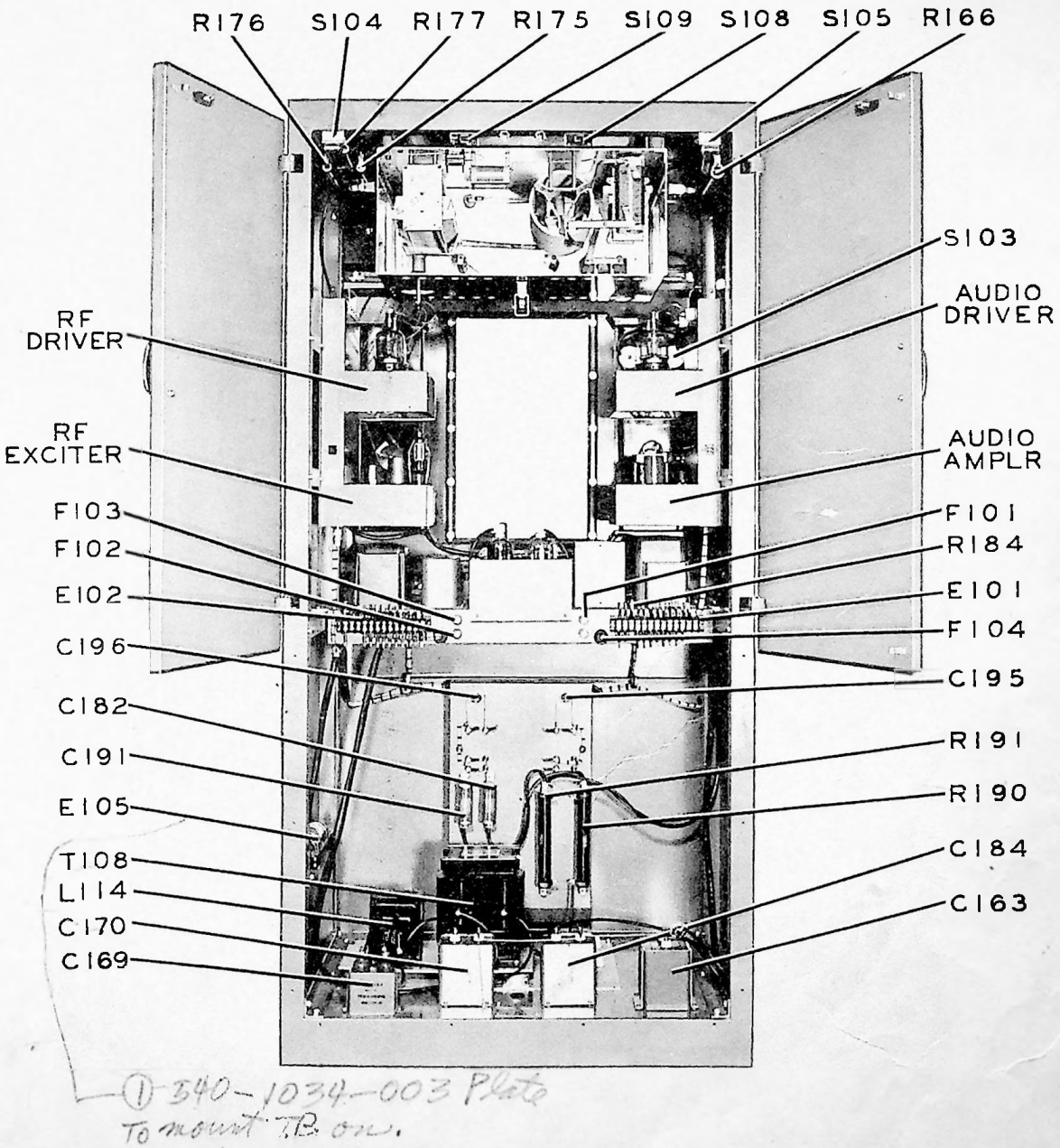
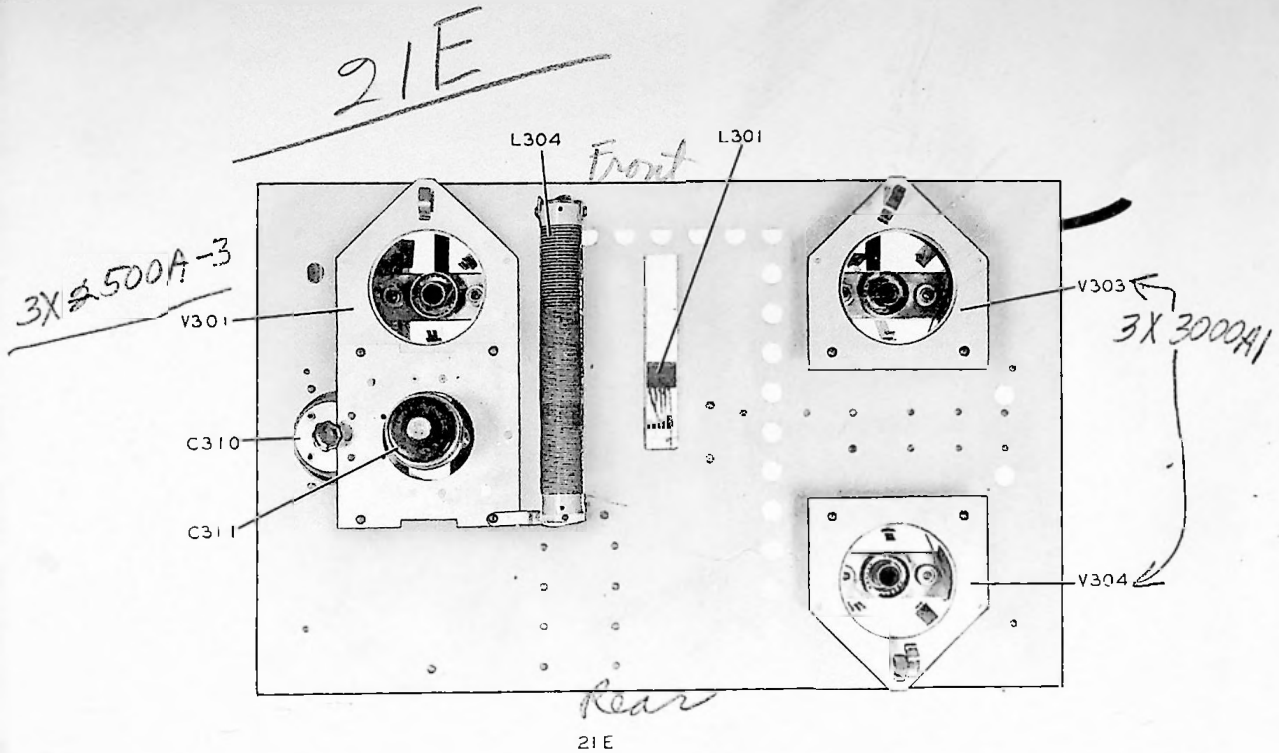


Figure 7-3. Driver Cabinet, Rear View



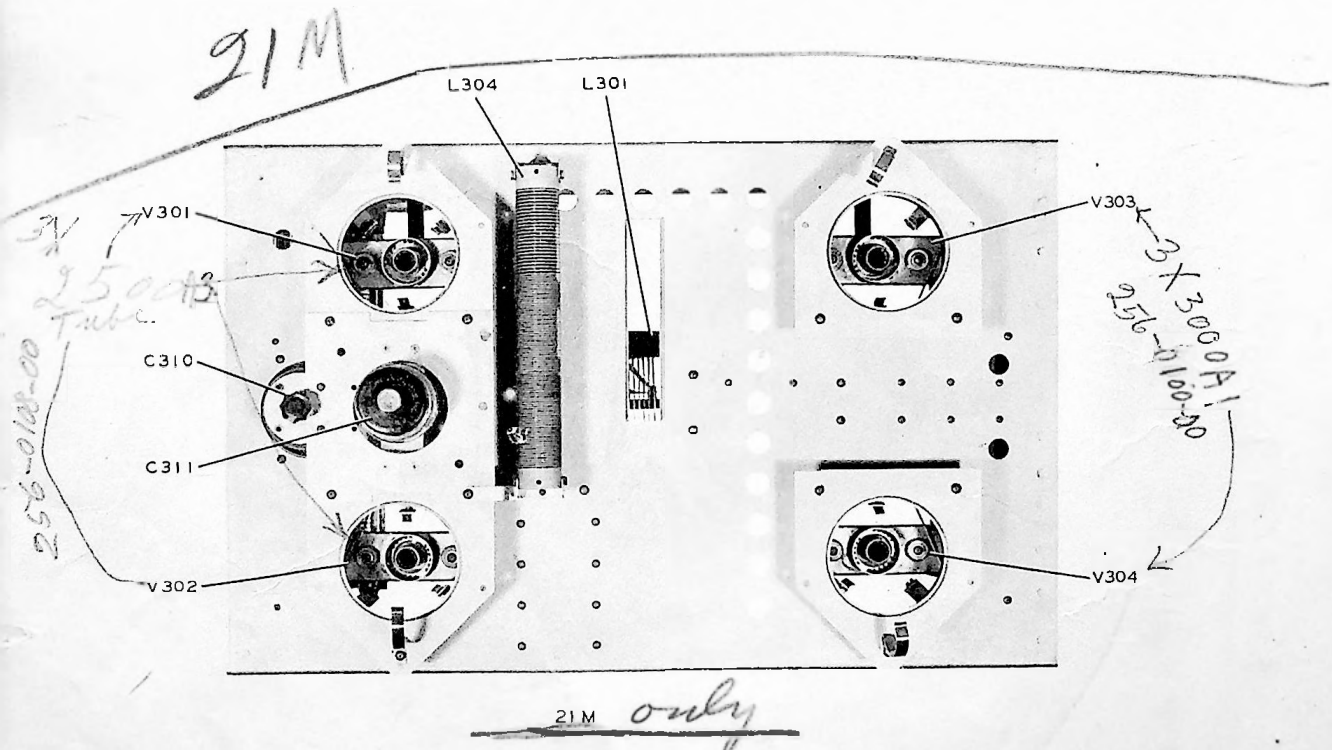
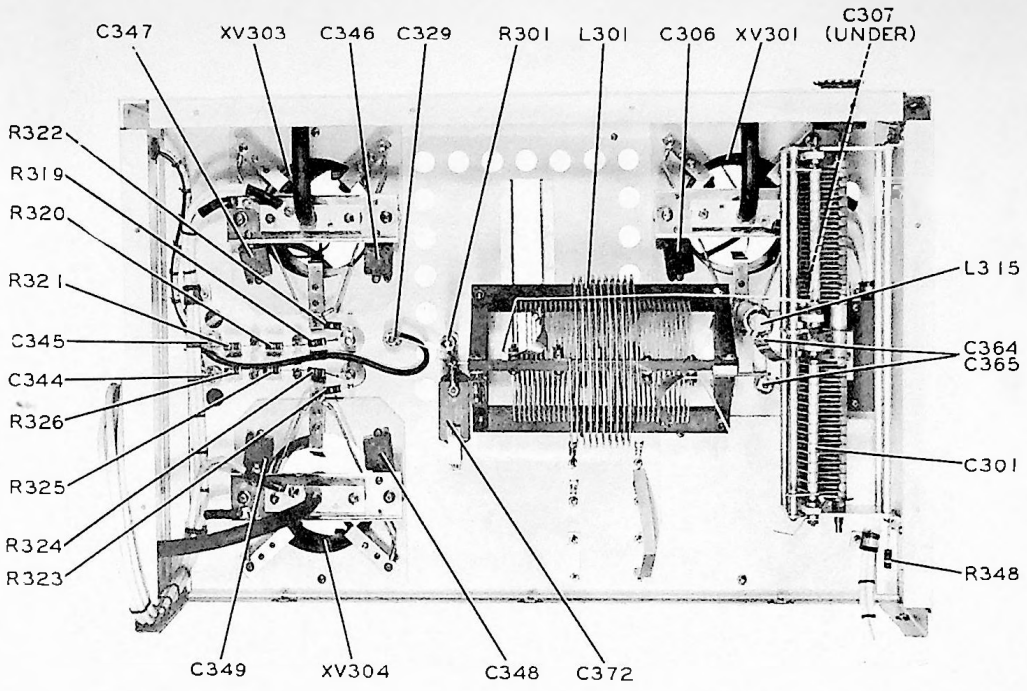
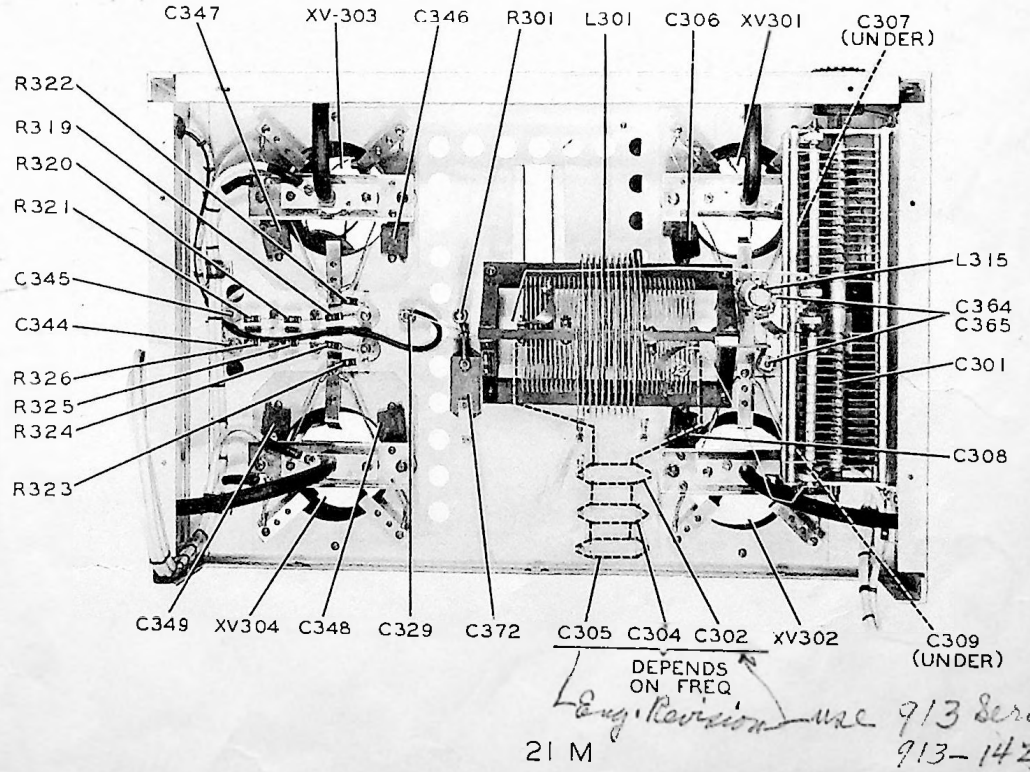


Figure 7-4. Power Amplifier RF Chassis, Top View



21 E



21 M

Eng. Revision MC 913 Series Cap.
913-1427-00
200 MMF
913-1422-00
100 MMF

Figure 7-5. Power Amplifier R-F Chassis, Bottom View

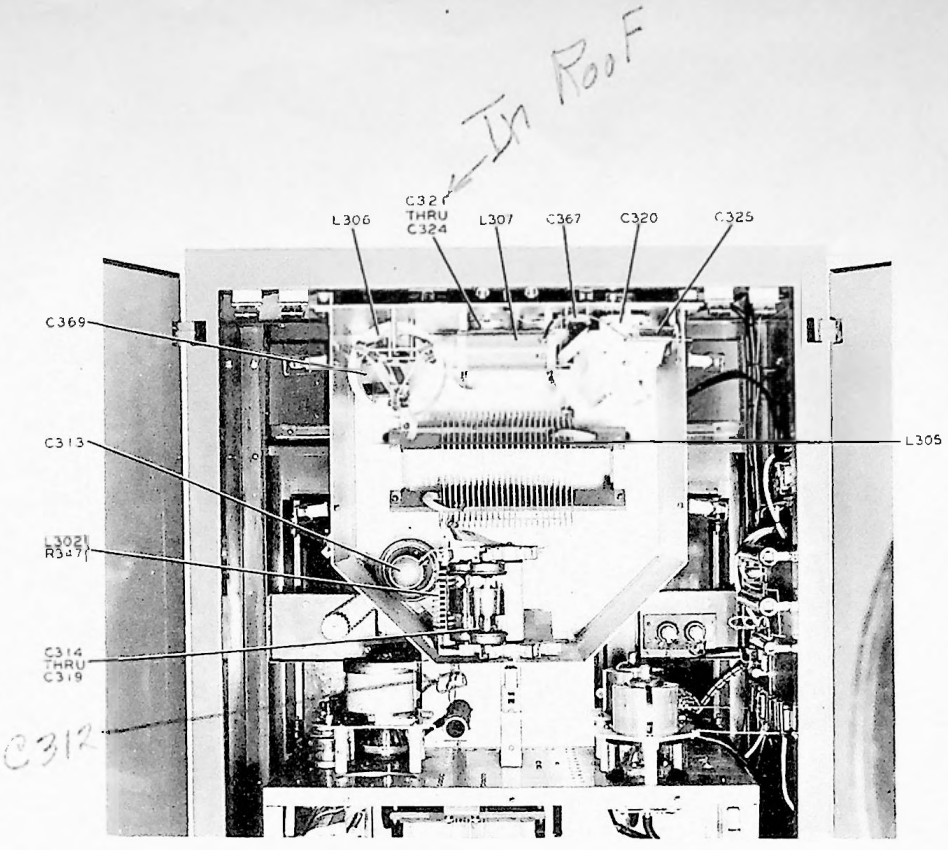


Figure 7-6. Power Amplifier Output Network, Rear View

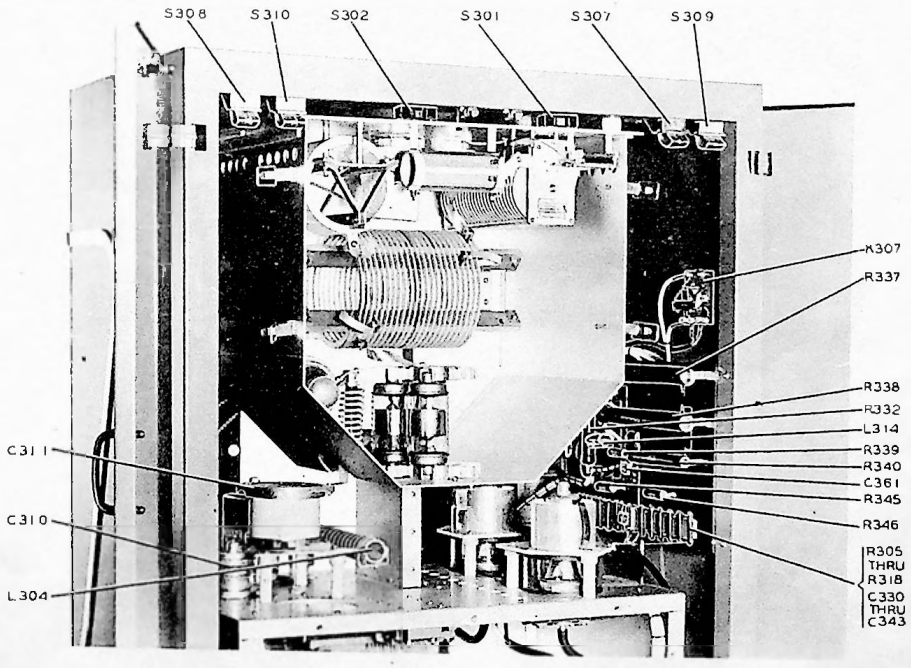


Figure 7-7. Power Amplifier Parts Arrangement, Rear Open

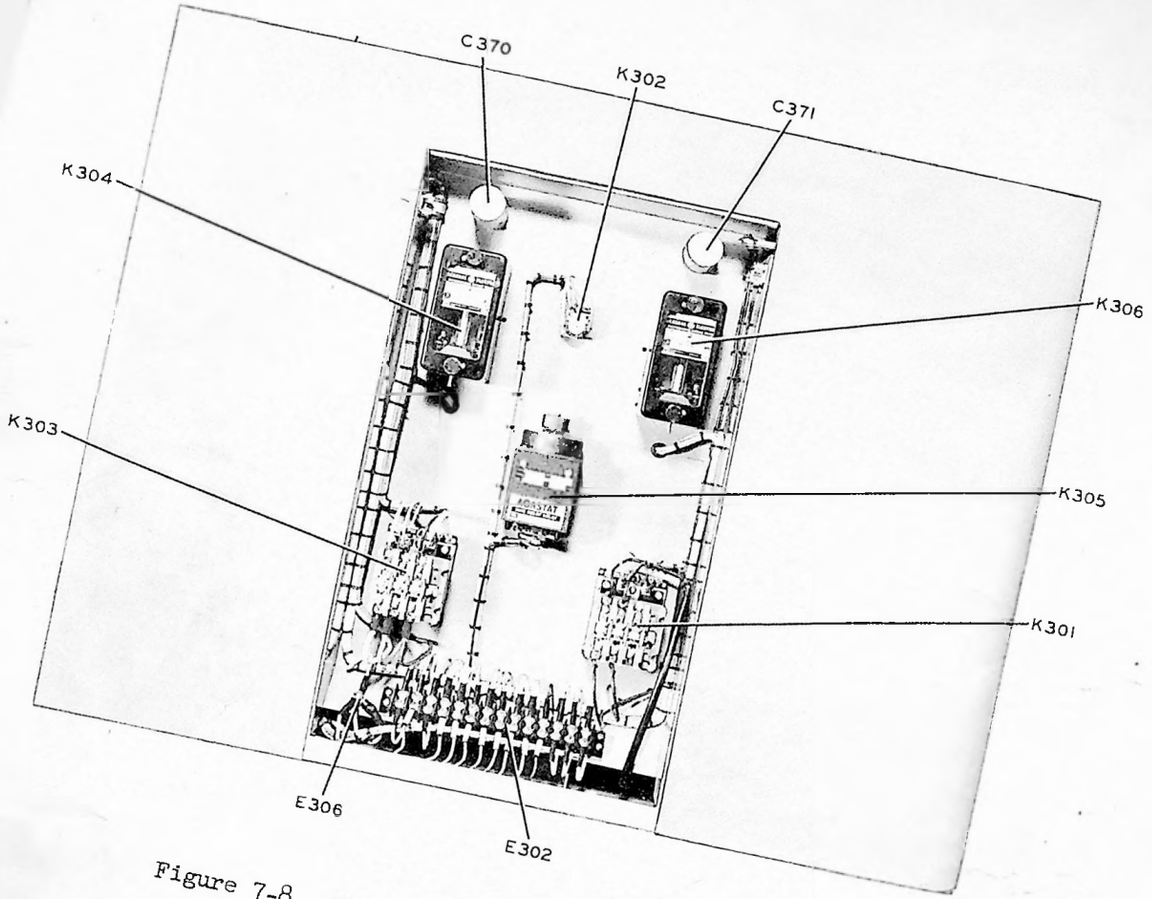


Figure 7-8. Power Amplifier Relay Enclosure

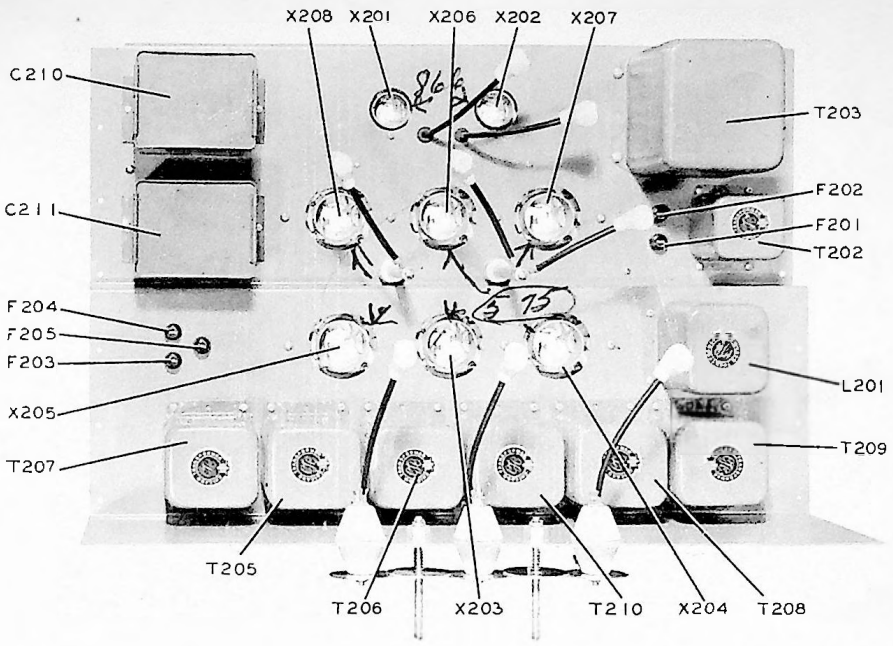


Figure 7-9. Power Supply Cabinet Rectifier Chassis, Top View

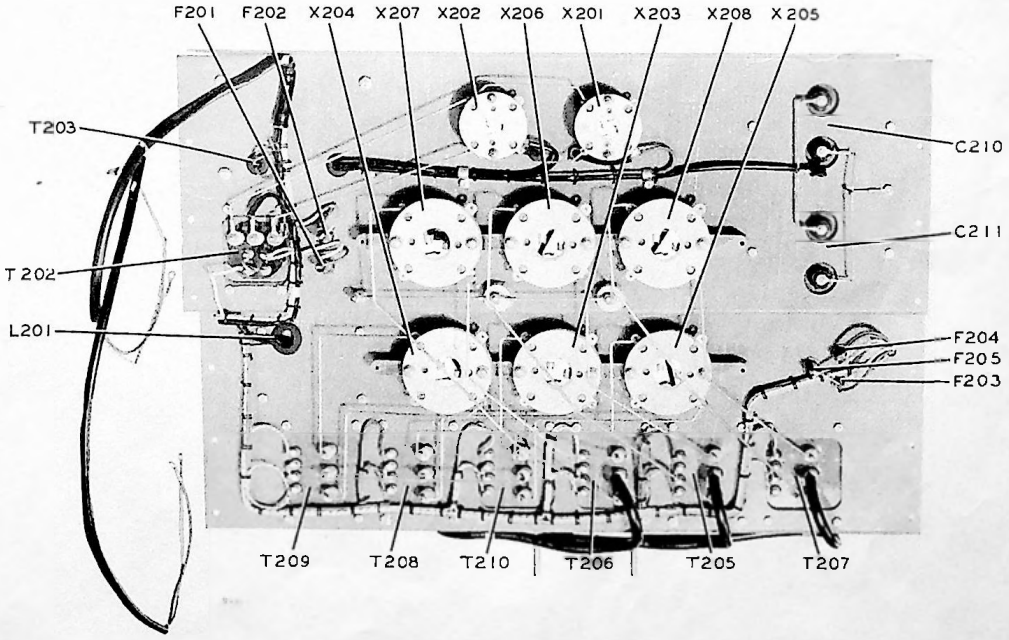


Figure 7-10. Power Supply Cabinet Rectifier Chassis, Bottom View

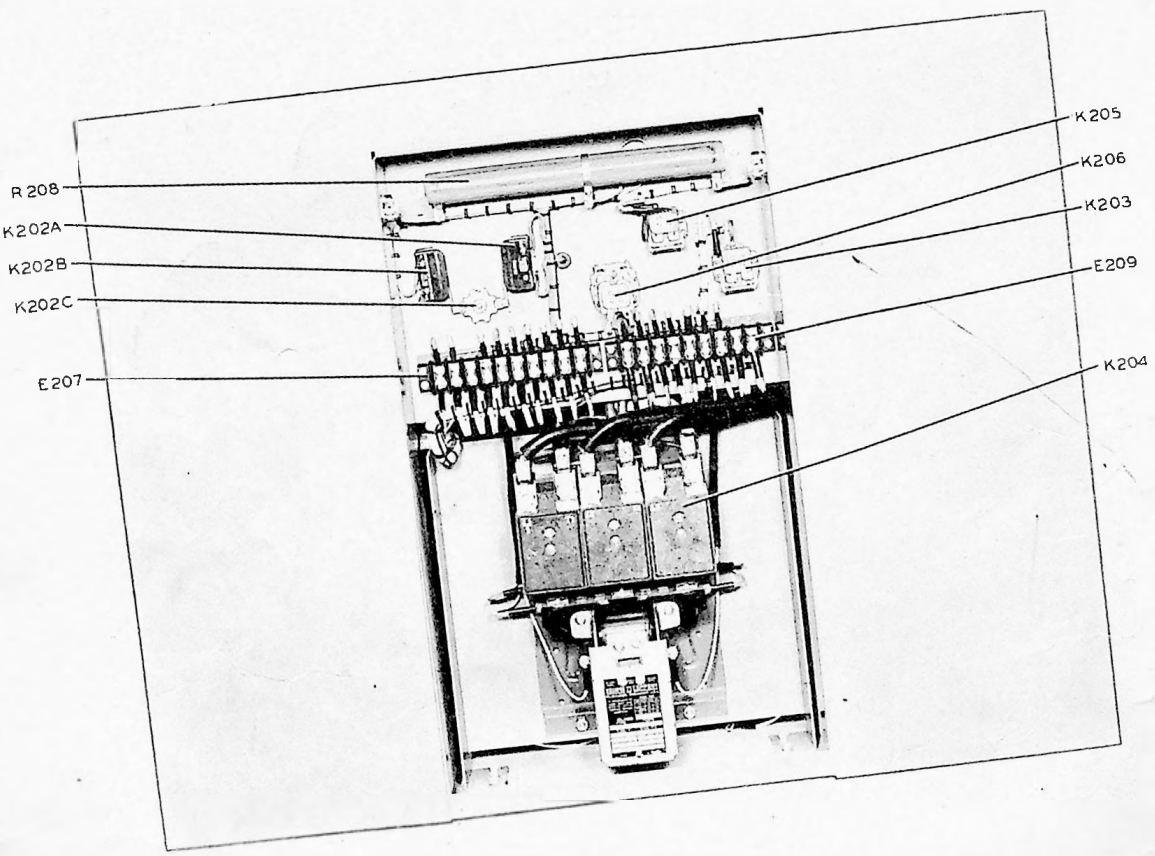


Figure 7-11. Power Supply Cabinet, Relay Enclosure

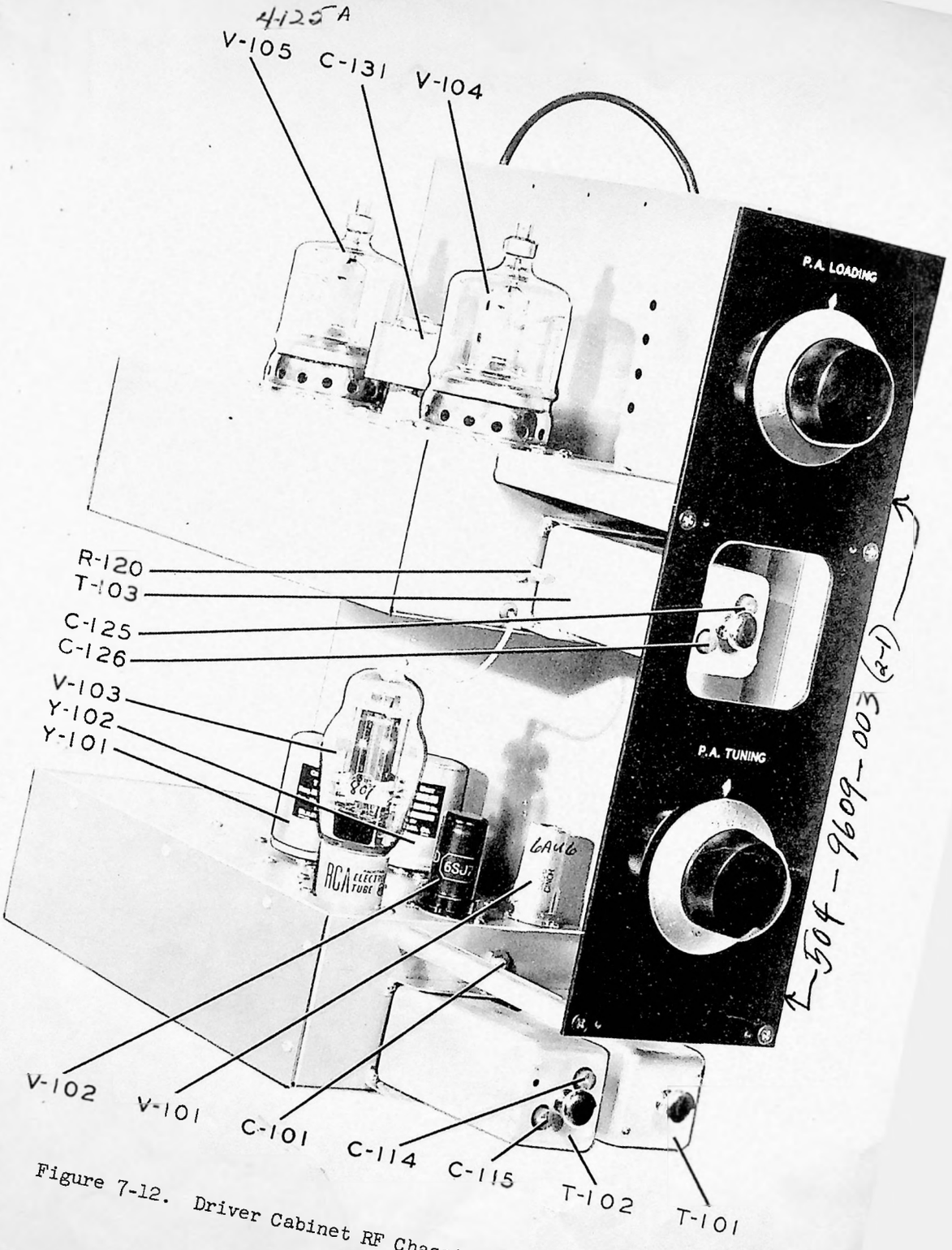


Figure 7-12. Driver Cabinet RF Chassis, Top View

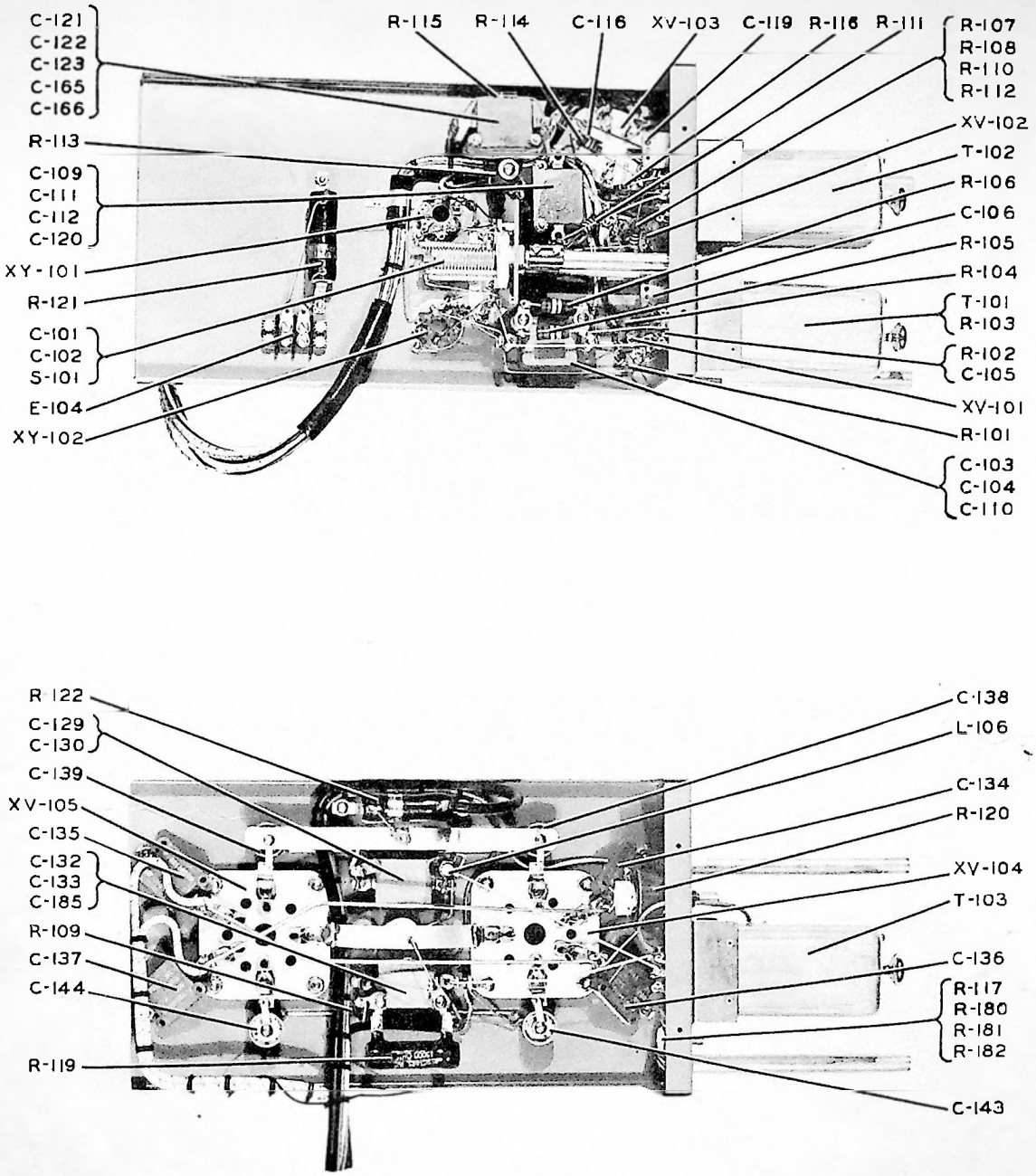


Figure 7-13. Driver Cabinet R-F Chassis, Bottom View

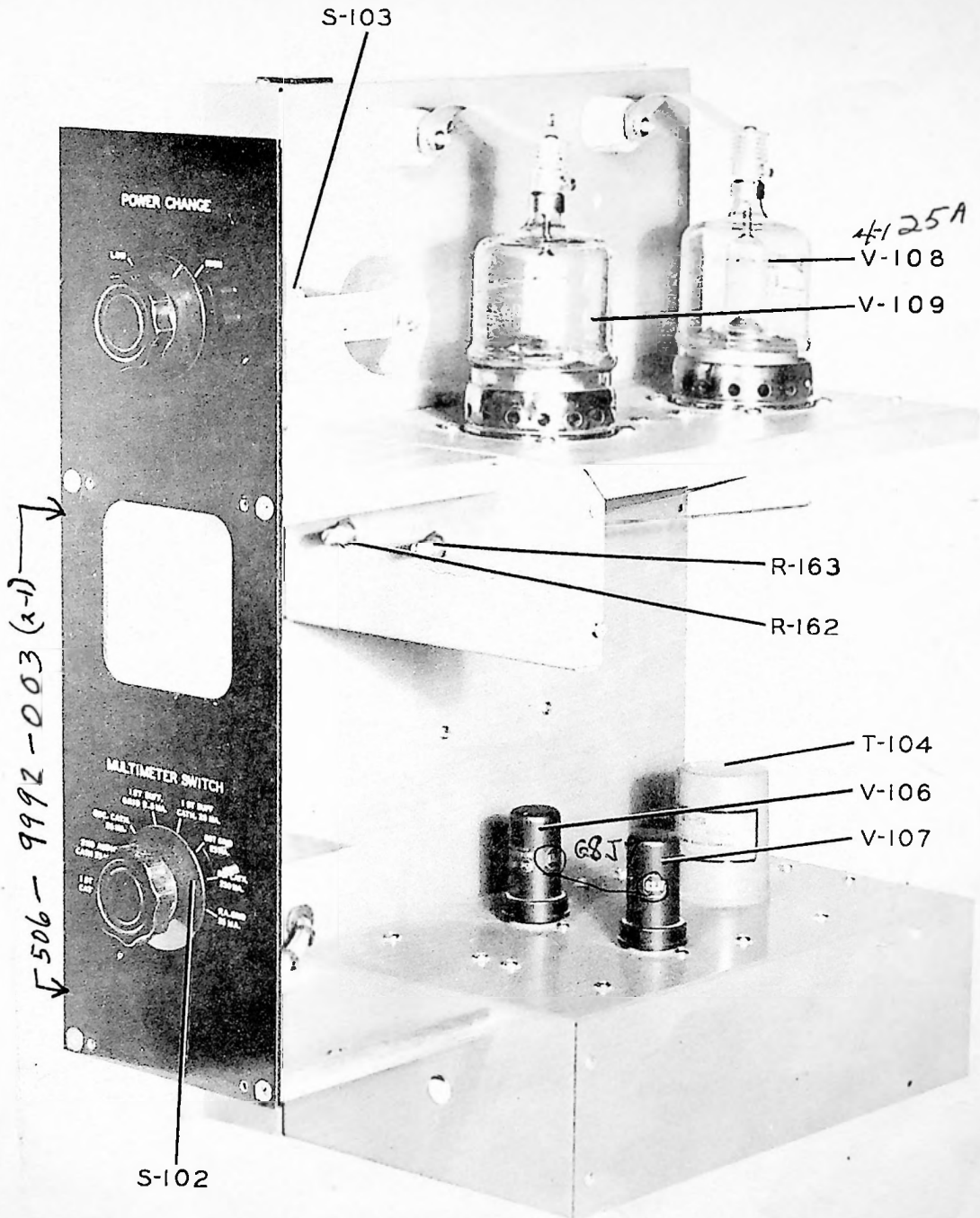


Figure 7-14. Driver Cabinet Audio Chassis, Top View

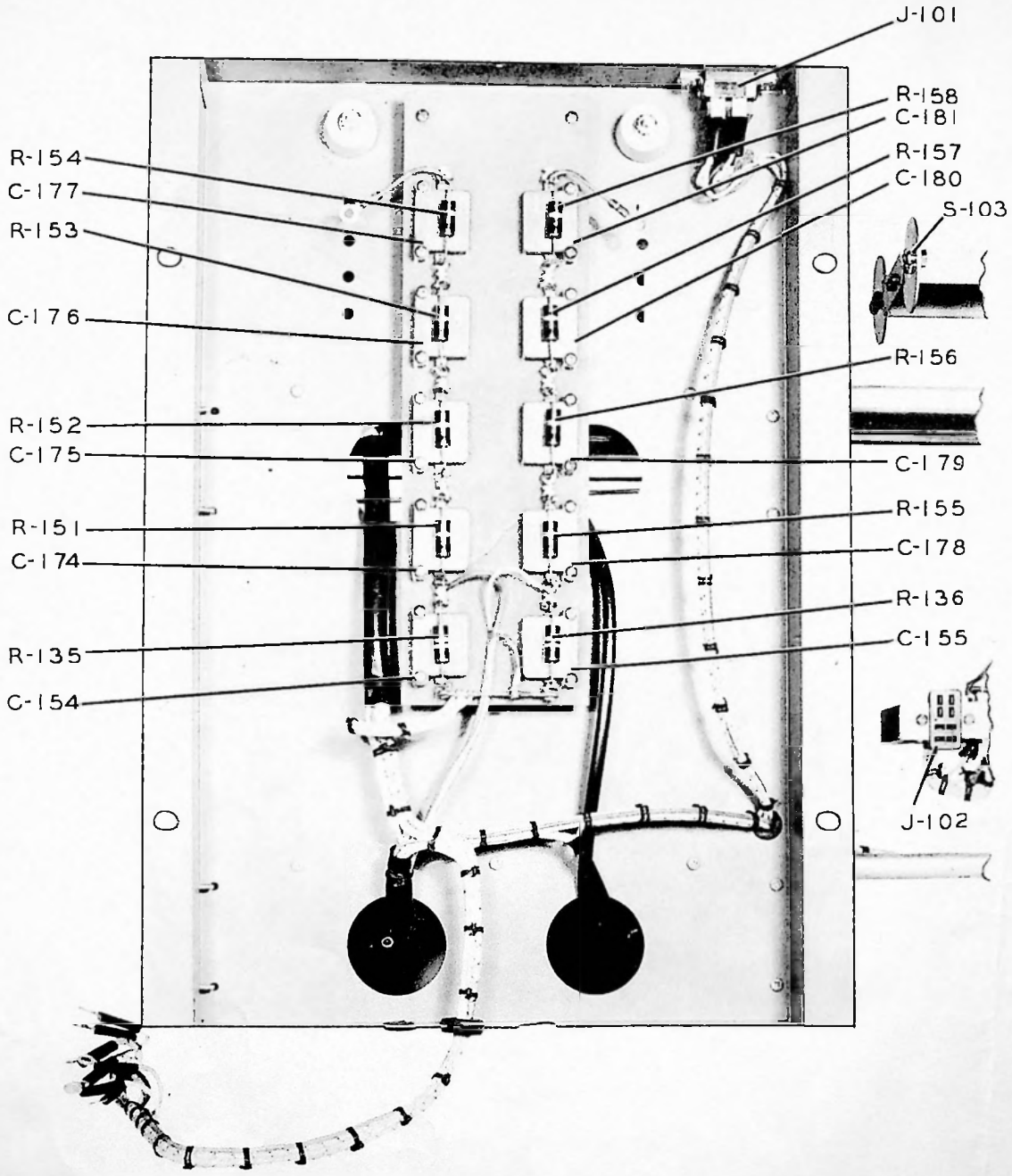


Figure 7-15. Driver Cabinet Audio Chassis, Side View

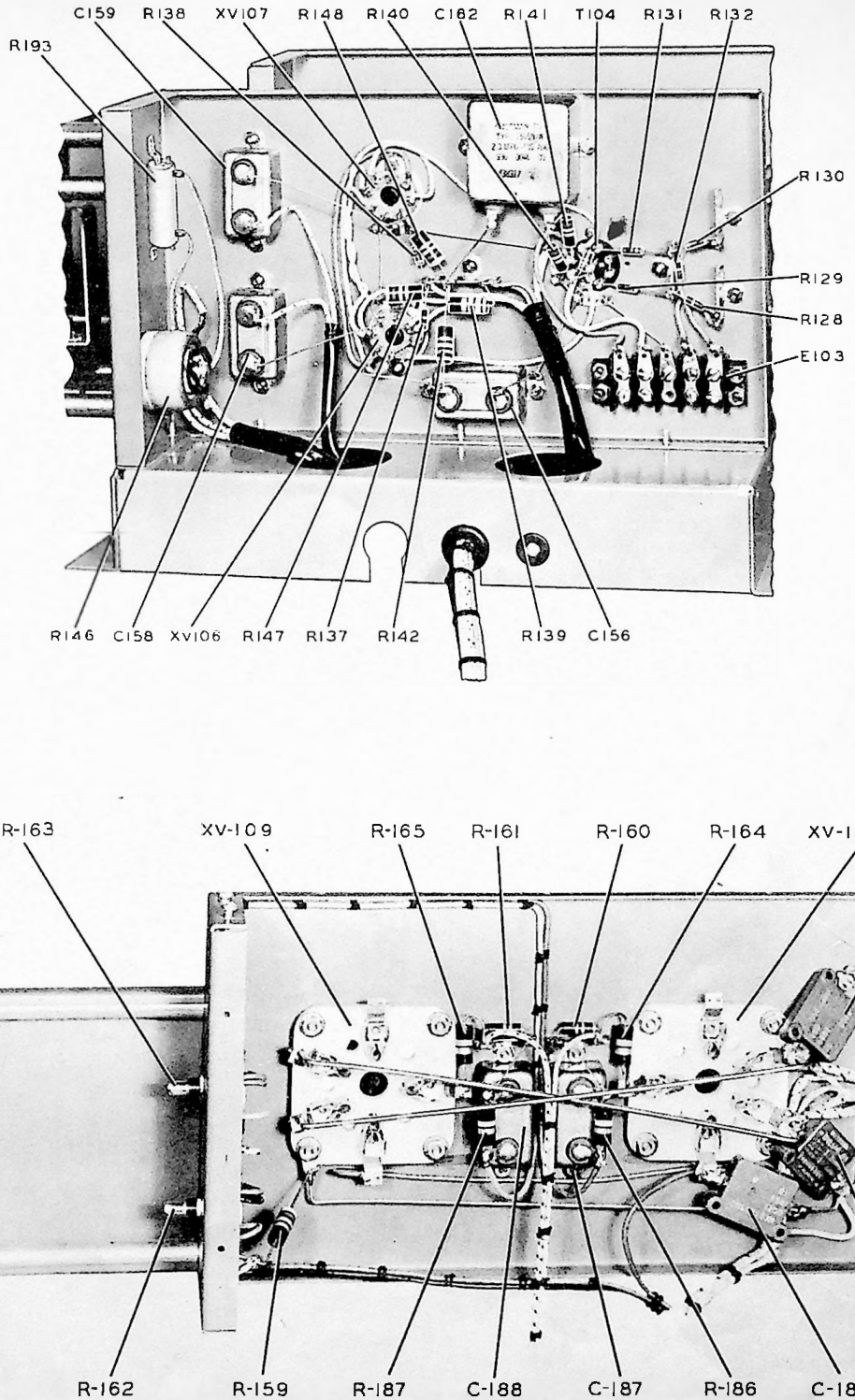


Figure 7-16. Driver Cabinet Audio Chassis, Bottom View

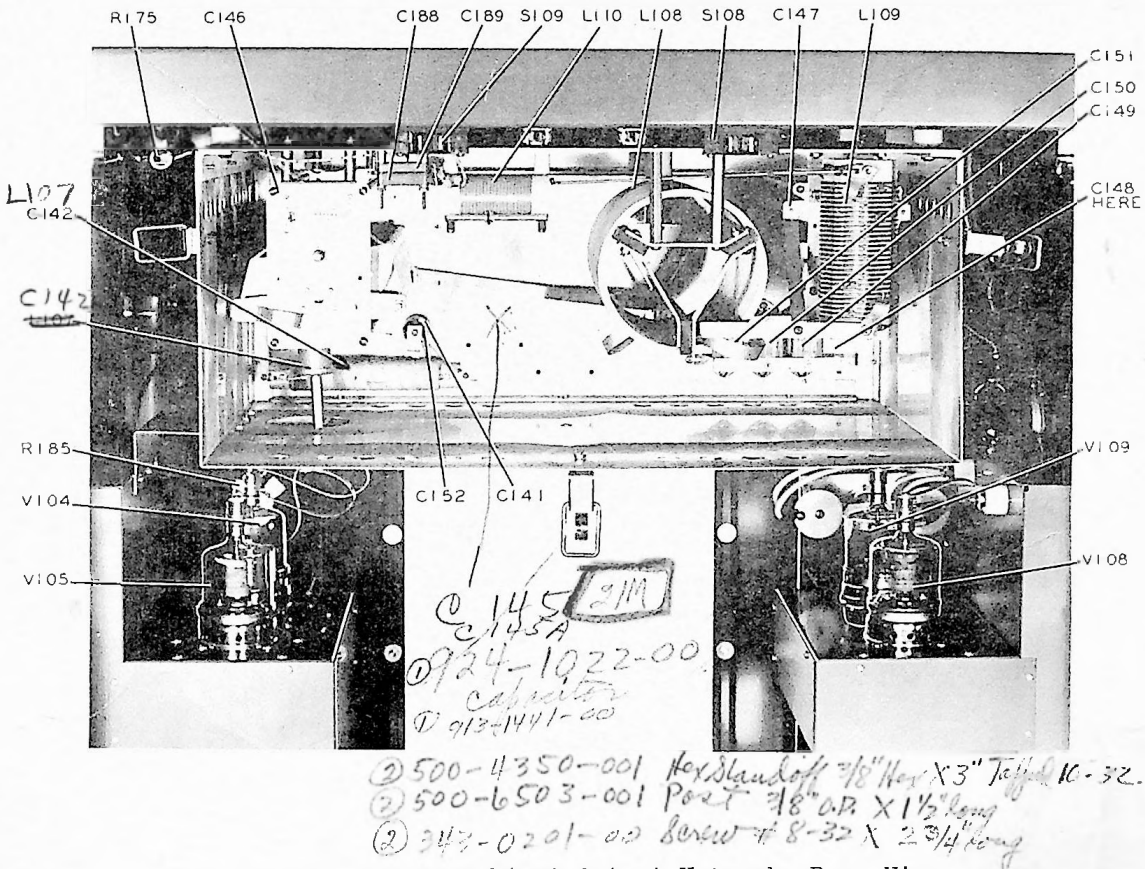
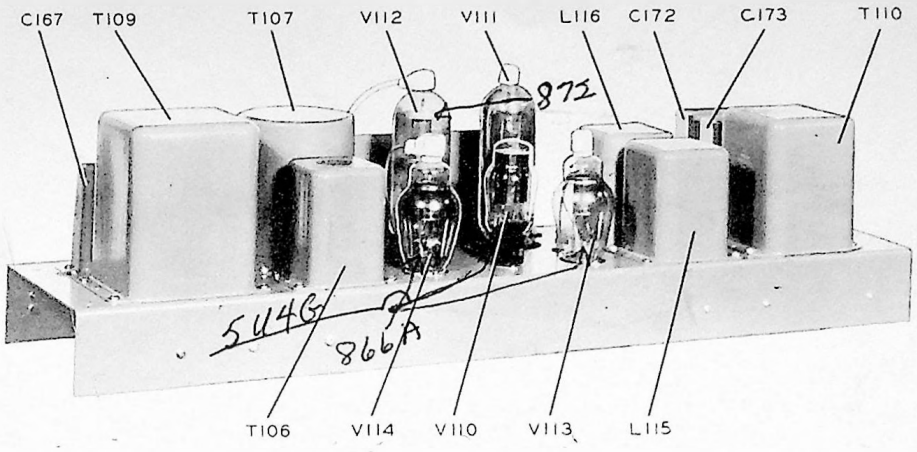
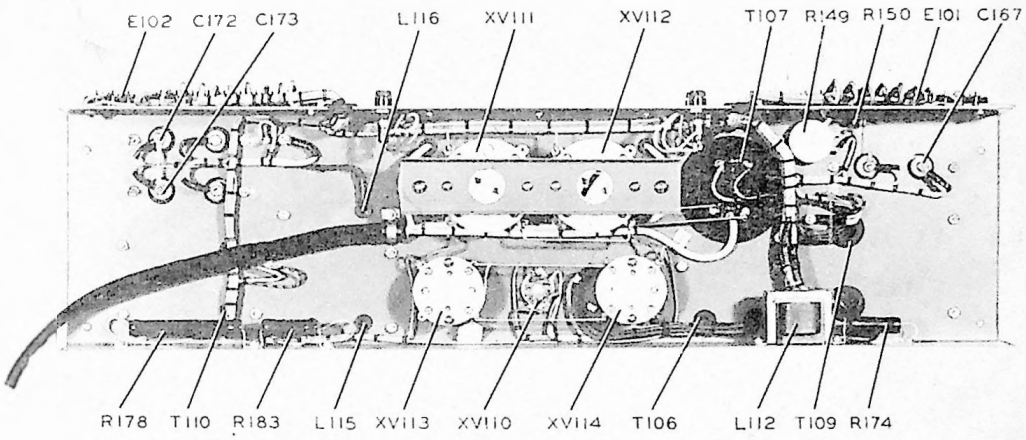


Figure 7-17. Driver Cabinet Output Network, Rear View





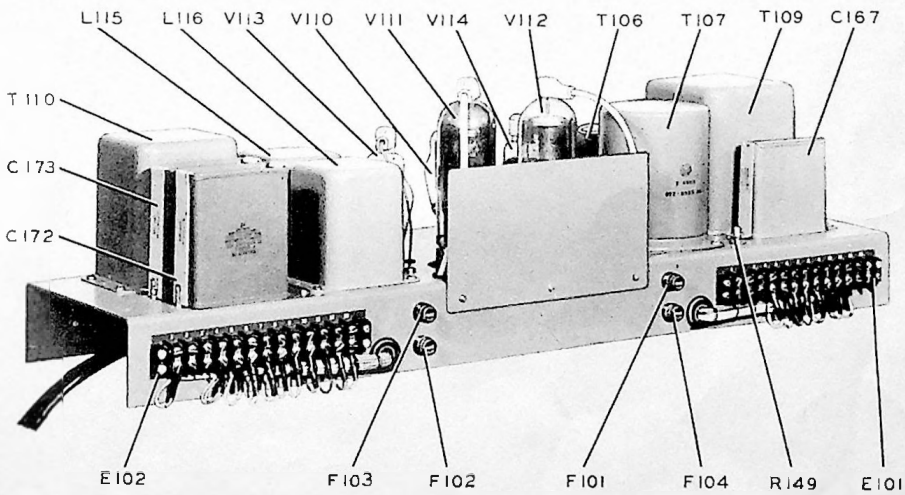


Figure 7-18. Driver Cabinet, Low Voltage Power Shelf

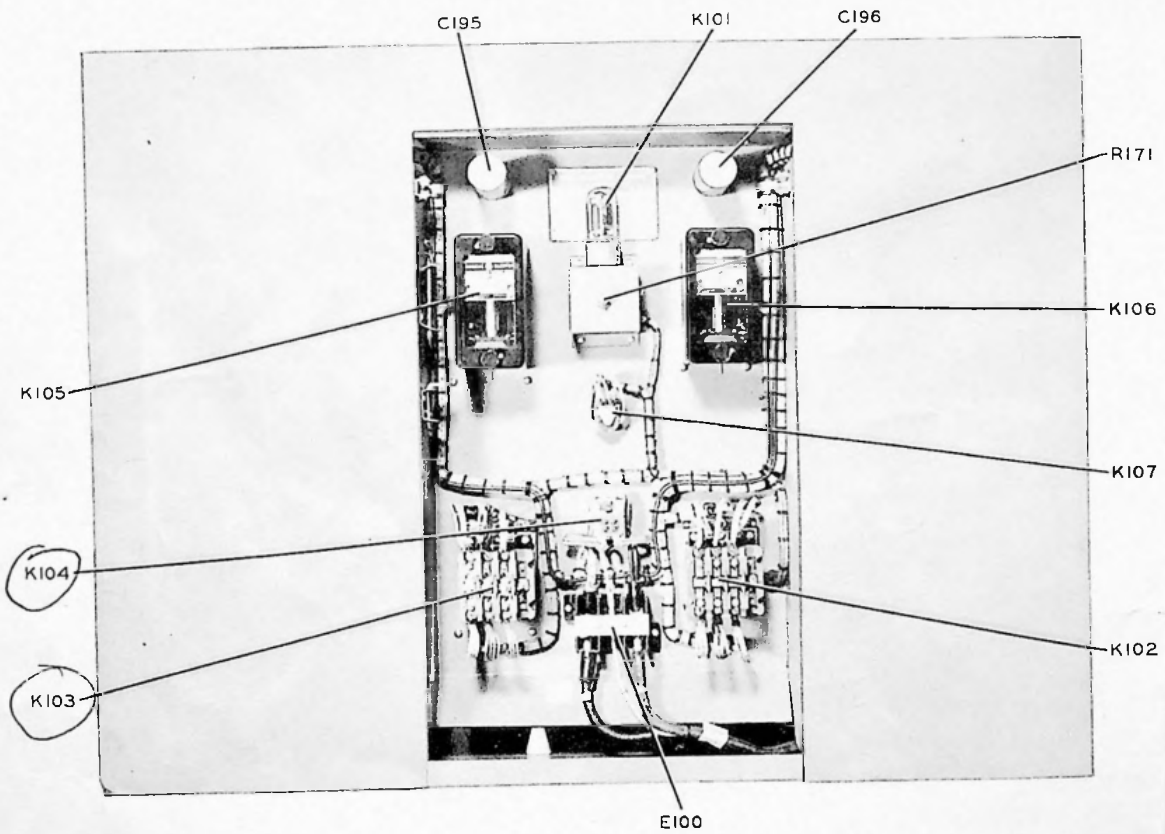


Figure 7-19. Driver Cabinet, Relay Enclosure

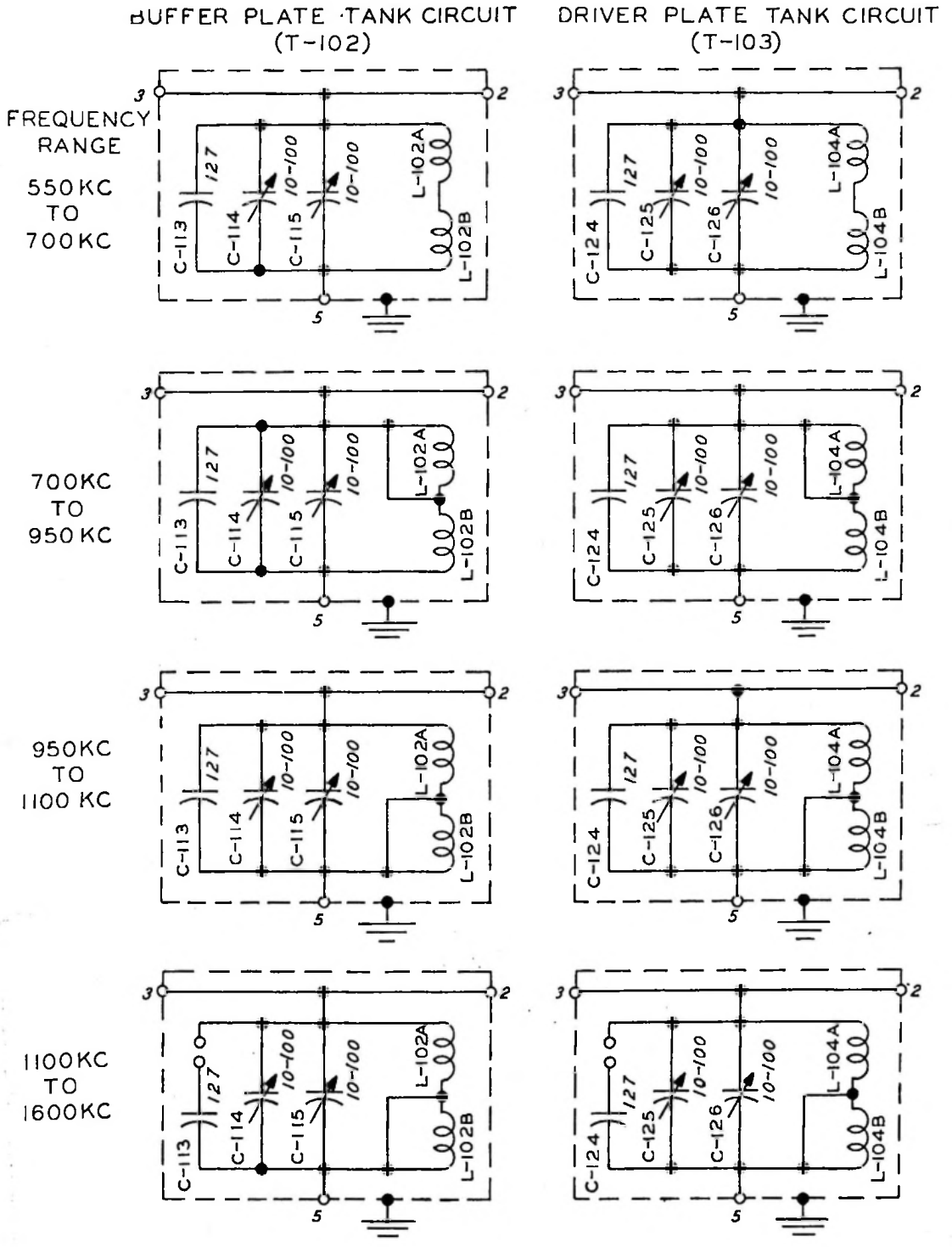


Figure 8-1. T-102 and T-103 Internal Connections

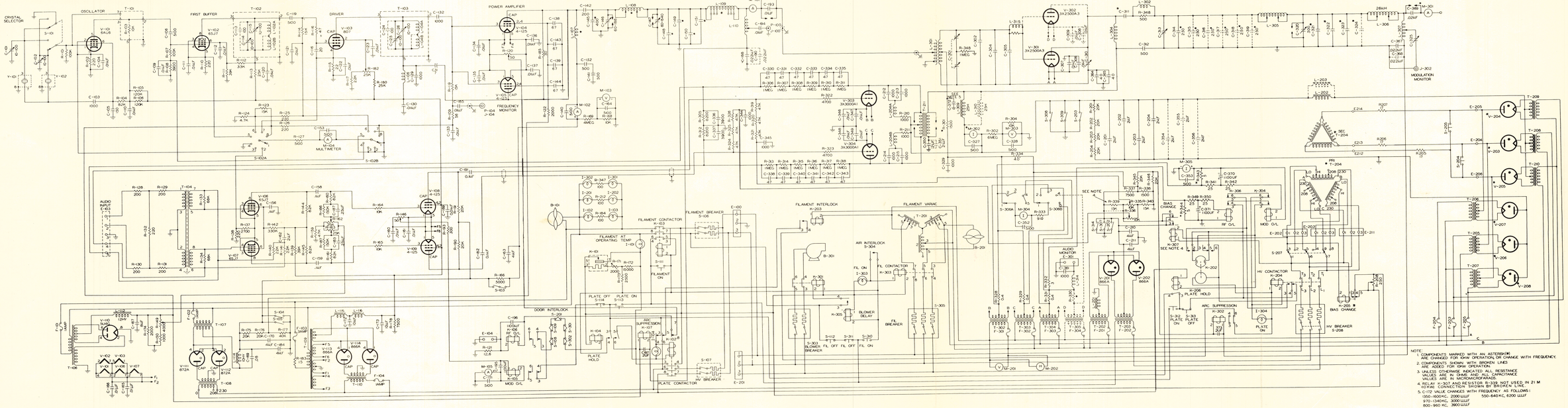


Figure 8-2. 21E/M Complete Schematic

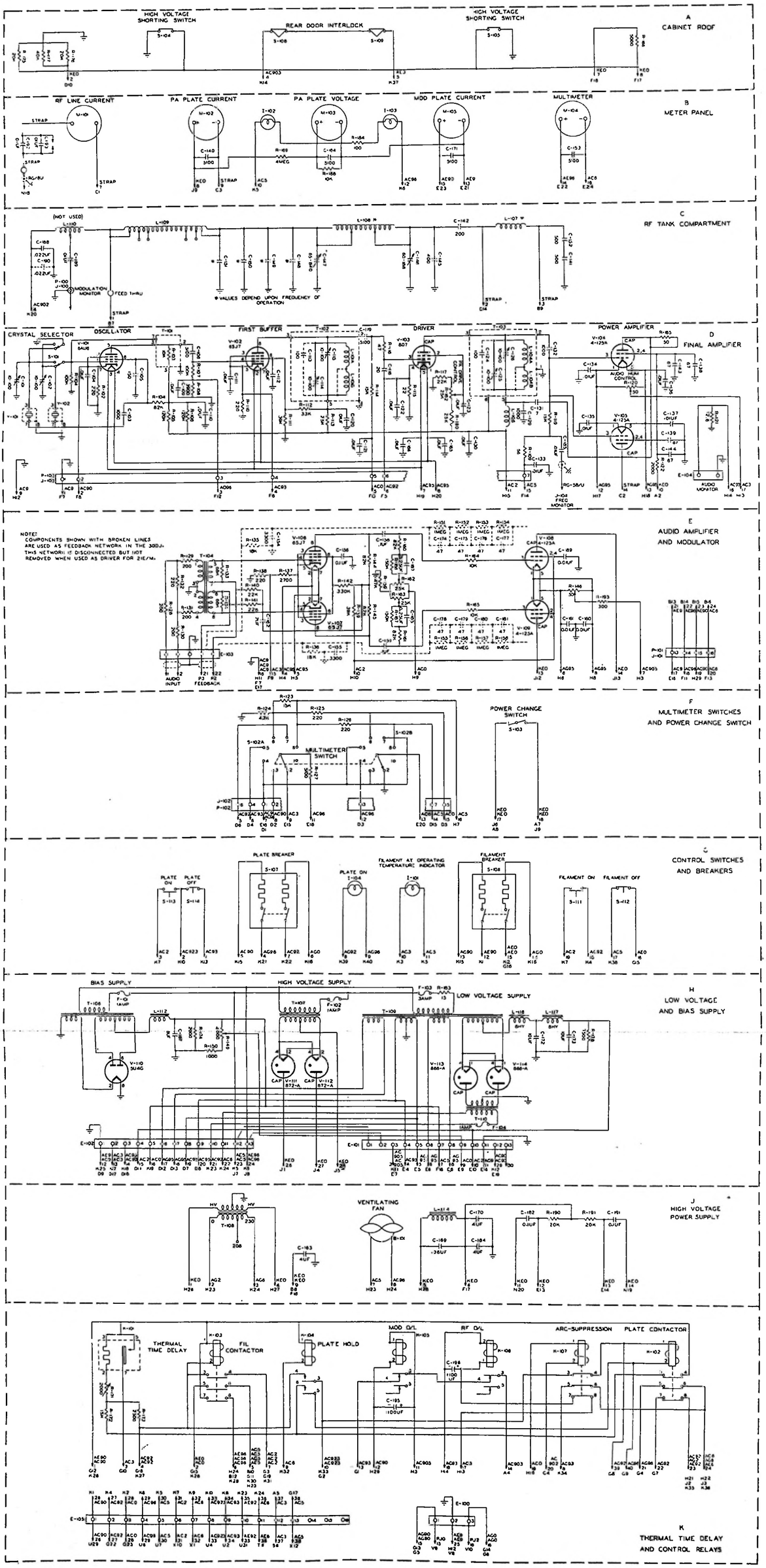


Figure 8-3. Driver Cabling Schematic

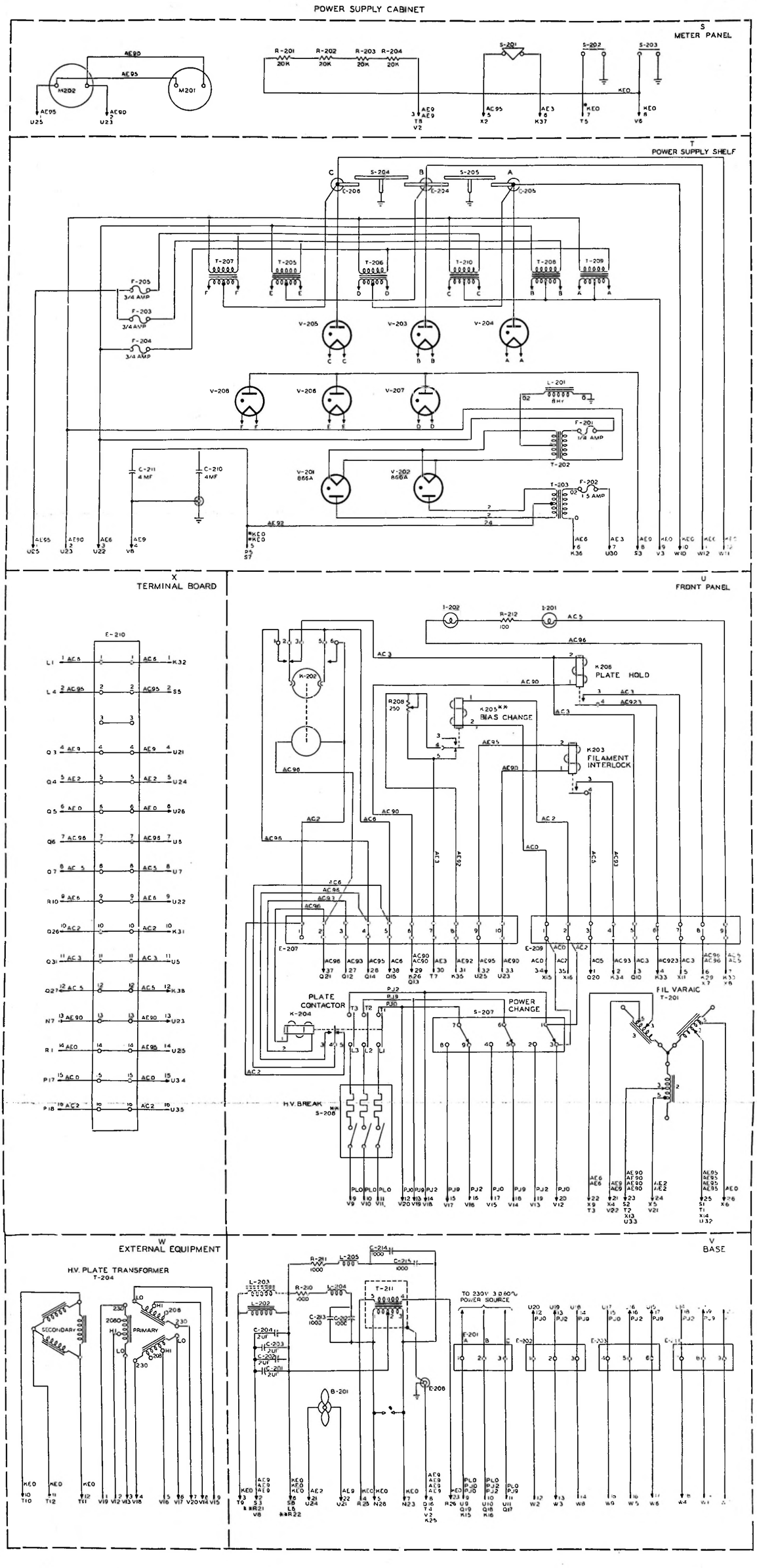


Figure 8-4. Power Supply Cabinet Cabling Schematic

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 021900.
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.

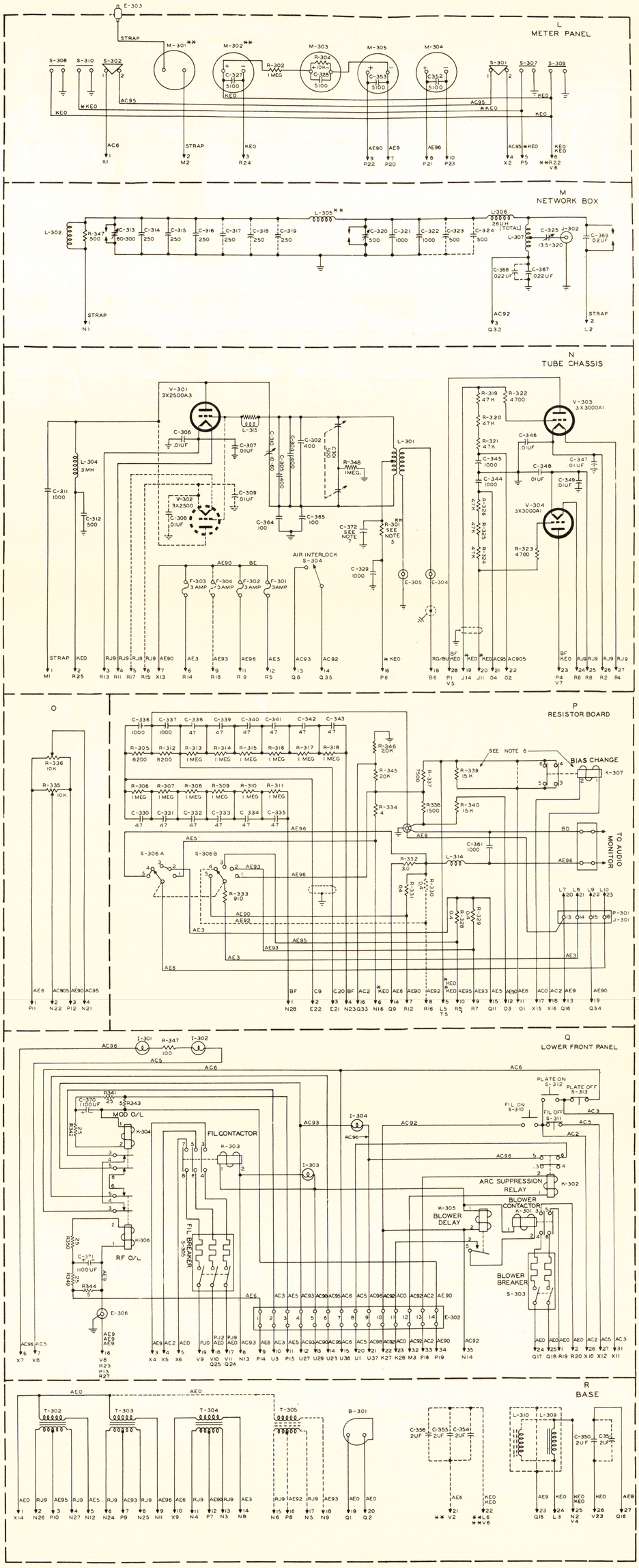


Figure 8-5. Power Amplifier Cabinet Cabling Schematic

NOTES.

1. * KEO DESIGNATED WITH ASTERISK (* KEO) IS POLYETHYLENE 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 10 KW OPERATION. COMPONENTS MARKED ** ARE CHANGED FOR 10 KW OPERATION.
4. COMPONENTS SHOWN WITH BROKEN LINES ARE ADDED FOR 10 KW OPERATION.
5. R-301 VALUE FOR 5KW OPERATION IS 1500 OHMS, FOR 10 KW OPERATION IS 500 OHMS.
6. RELAY K-207 AND RESISTOR R-339 NOT USED IN 21M. CONNECTION SHOWN BY BROKEN LINE.
7. C-372 VALUE CHANGES WITH FREQUENCY AS FOLLOWS: 2000 MMF, 1350 - 1800 KC
   3000 MMF, 970 - 1340 KC
   4000 MMF, 800 - 950 KC
   5100 MMF, 650 - 790 KC
   6200 MMF, 560 - 640 KC

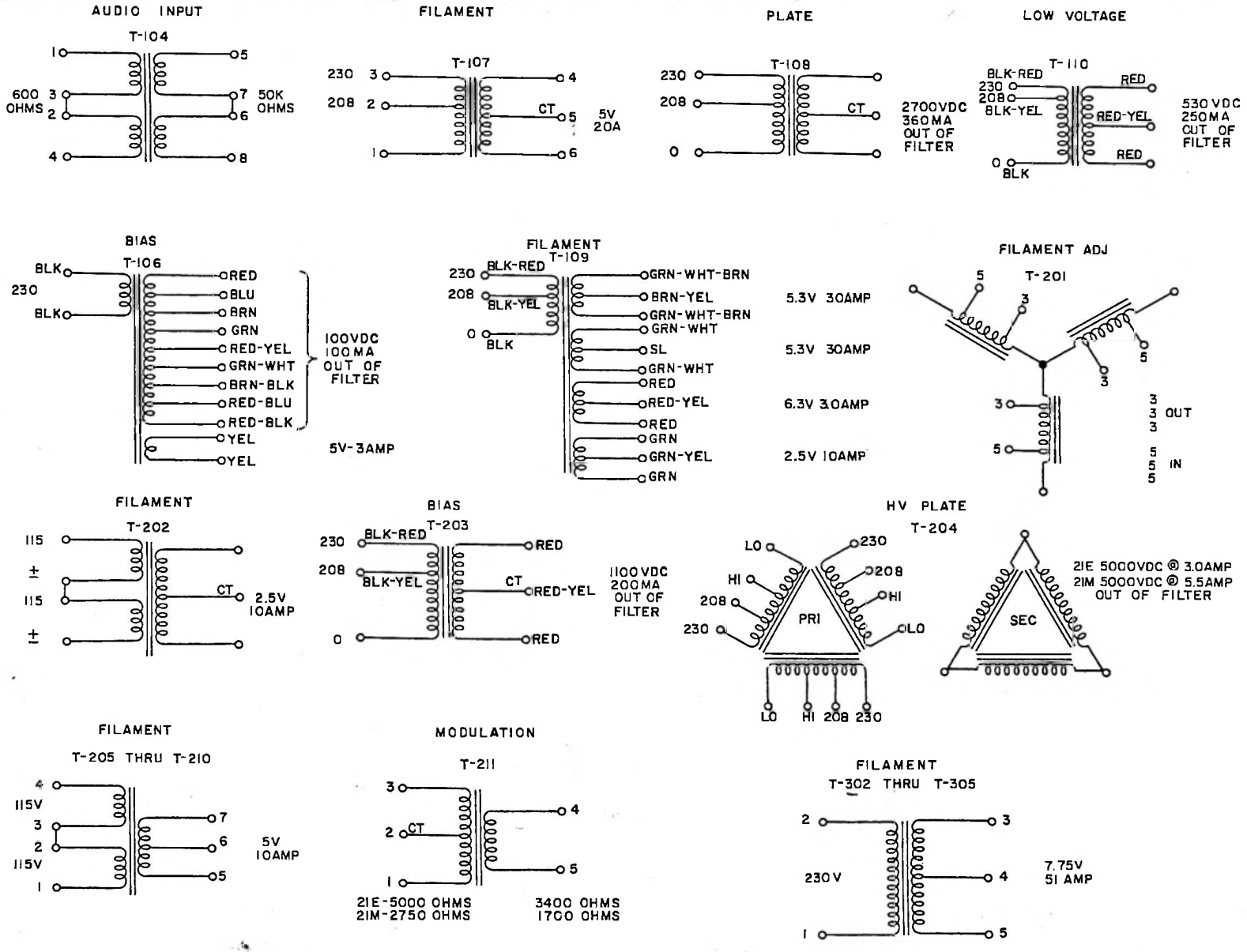


Figure 8-6. Transformer Details

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