COLLINS

MODELS 21E AND 21M

BROADCAST TRANSMITTERS

INSTRUCTION BOOK

GUARANTEE

The equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts, or accessories which are defective as to design, workmanship or material, and which are returned to Collins at its factory, transportation prepaid, provided

(a) Notice of the claimed defect is given Collins within one (1) year from date of delivery and goods are returned in accordance with Collins' instructions.

(b) Equipment, accessories, tubes, and batteries not manufactured by Collins or from Collins' designs are subject to only such adjustments as Collins may obtain from the supplier thereof.

(c) No equipment or accessory shall be deemed to be defective if, due to exposure or excessive moisture in the atmosphere or otherwise after delivery, it shall fail to operate in a normal or proper manner.

Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

The guarantee of these paragraphs is void if equipment is altered or repaired by others than Collins or its authorized service center.

No other warranties, expressed or implied, shall be applicable to any equipment sold hereunder, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in this paragraph contained. In no event shall Collins have any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials, or from any other cause.

HOW TO RETURN MATERIAL OR EQUIPMENT. If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. If the item is thought to be defective, such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. (With respect to tubes we suggest that your adjustments can be speeded up if you give notice of defect directly to the tube manufacturer.) Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in handling of your returned merchandise.

ADDRESS:

Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

INFORMATION NEEDED:

(A) Type number, name, and serial number of equipment
(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.

ADDRESS:

Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

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
(D) Collins' type number, name, and serial number of principal equipment
(E) Unit sub-assembly number (where applicable)

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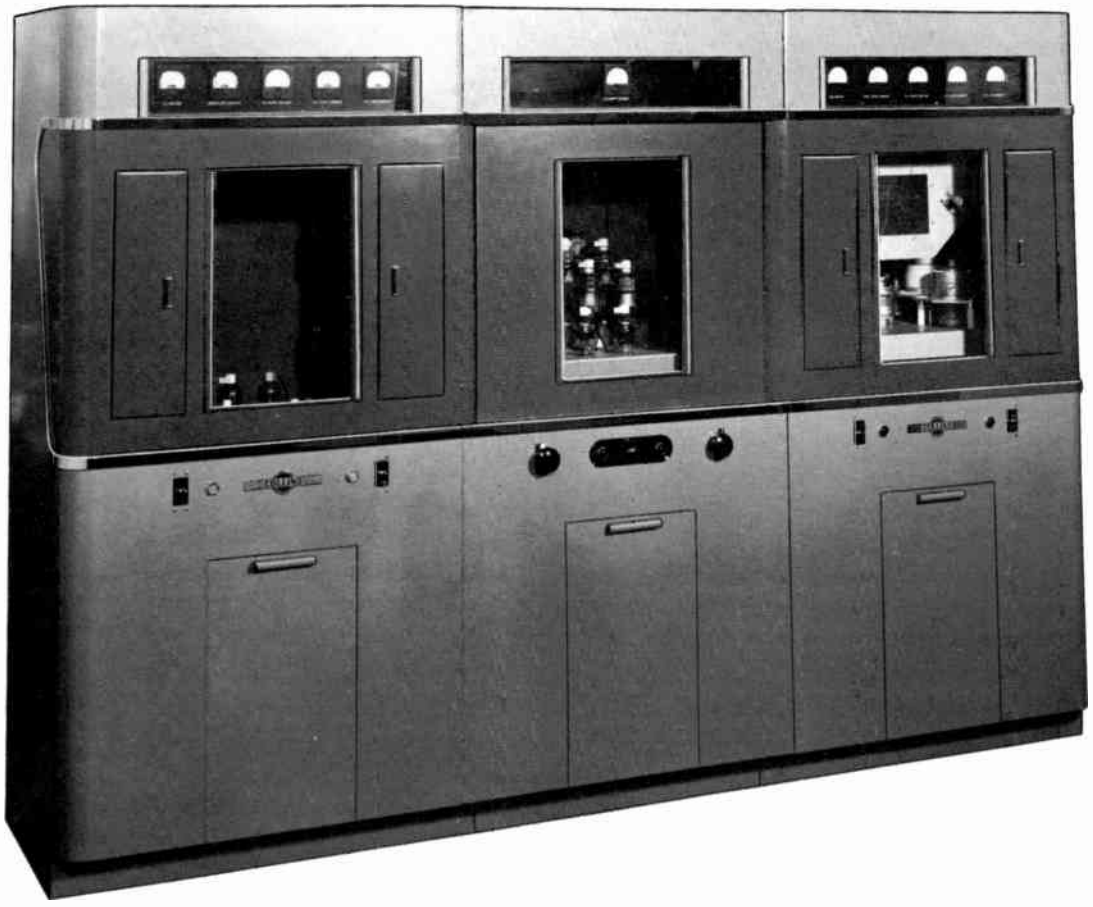


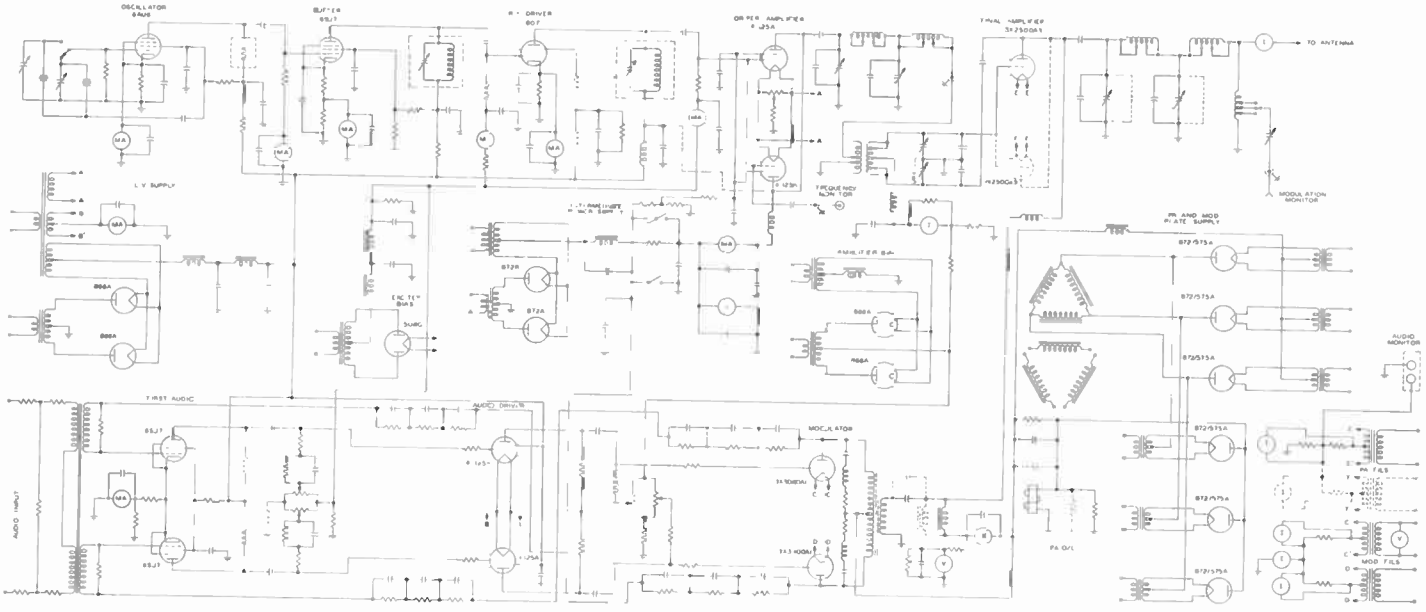


Figure 1-1. Front View and Simplified Schematic.

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 1600K but can be extended to 18 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 equipments 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 switches 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 a 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 a 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 manual automatic re-setting overload relay in the power amplifier-modulator plate circuit.

1.2. SPECIFICATIONS.

Frequency Range:	540-1600 kc standard. Frequencies to 18 mc available
Power Output:	21E - 5,500 Watts 21M - 10,600 Watts
Frequency Stability:	±10 cps
Audio Frequency Distortion	Less than 3% from 50-7500 cps for 95% modulation, including all harmonics up to 16 kc
Residual Noise Level:	58 db below 100% modulation from 0 to 30 kc 65 db below 100% modulation from 150 cycles to 15 kc
Carrier Shift:	Less than 3%
RF Output Impedance:	75/50 ohms standard. Other impedances available
Audio Input Impedance:	600/150 ohms
Peak Limiting:	Audio peaks clipped at approximately 1 db above 100% mod.

Audio Input Level:	+10 dbm ±2 db., Pad input
Temperature Range:	+15° to +45° C Ambient
Altitude Range:	Sea Level to 6000 feet
Power Source:	208/230 V three phase 50/60 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	2.64	75.7
5000 Watts 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 Blower Only	3.28	76.5
10,000 Watts Output - No Modulation	21.2	90.5
- 30% Modulation	23.6	91.0
- 100% Modulation	32.8	91.5

* 21E Capable of 5500 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, 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 sides 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 case 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 no parts are discarded with the packing material.

2.3. PRE-INSTALLATION.

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

Increased overall 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 exhausting fan.

2.3.2. MOUNTING FRAME. A mounting frame under the transmitter will greatly facilitate the installation of power leads.

The mounting frame shown in figure 2-1 is adequate and recommended.

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

2.3.4. GROUND STRAP. See figure 2-1. Install a heavy copper strap along the front edge of the duct that is under the transmitter. Attach this ground strap to the building and antenna ground system. Attach adequate length (for instance, 5 feet) of 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 (35 KW for 21M) for the transmitter alone, all other sources of load extra. Install a three-phase, metal, cut-out 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 cut-out box mounted on transmitter room wall	Power cabinet E-201
Plate Transformer Primary (6 wires plus transformer frame ground)	Power cabinet E-202 and E-203	Plate transformer primary terminals
Plate Transformer Secondary (3 wires, cut 5 to 6 ft. long at cabinet end)	Plate transformer secondary terminals	Power cabinet E-204, E-205, E-206 (standoffs of spring operated safety switches)
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 4-125A tube chassis (See paragraph 2.9)

Wires	From	To
Frequency Monitor Connections	Frequency Monitor (not furnished)	J-104 on the bottom of the driver cabinet RF chassis. (See paragraph 2.11.)
Modulation Monitor	Modulation Monitor (not furnished)	J-302 at the top, rear of the PA RF 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 feed-thru 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 RE-ASSEMBLY.

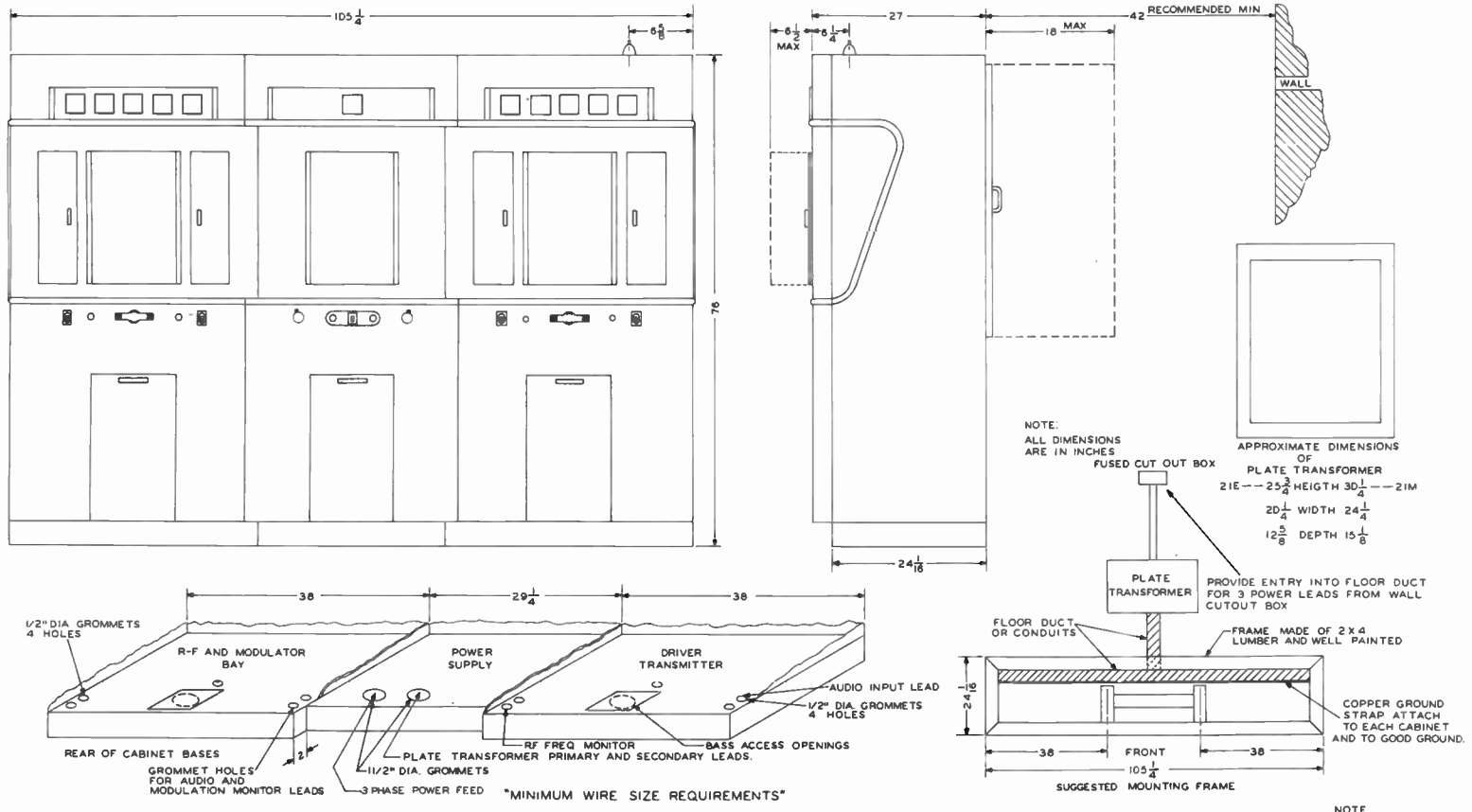
2.4.1. GENERAL. All parts that have been removed are keyed to their mounting positions by sticker tags. Match the tag number or letter on the part with the tag number or letter on the chassis or cabinet. The parts should be replaced after the cabinets are set up on the mounting frame but leave the large transformers and reactors and the PA blower until after 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 pre-installation procedures have been completed, re-assemble the transmitter in the following order:

WARNING

Be sure cut-out 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 2-1.



"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	SIX NO 6 RUBBER COVERED BUILDING WIRE FOR THE 21E. SIX 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 Drawing.

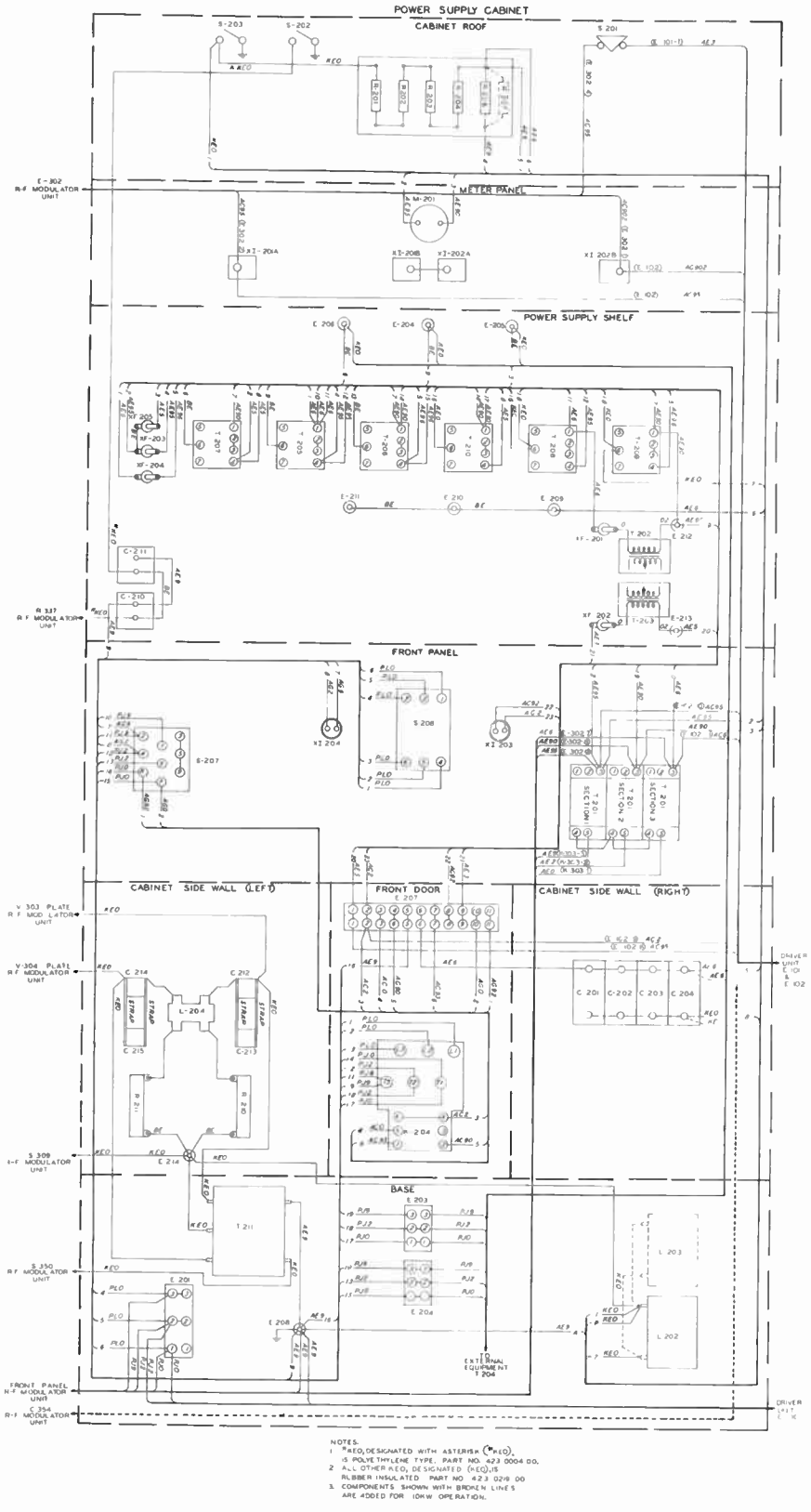


Figure 2-2. Power Supply Cabinet Installation Connections.

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 RF 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 two main interconnecting cables from the power cabinet through the sidewalls of the amplifier and driver cabinets.

f. Remove all the window retainer screws, except two on each side. This is to facilitate servicing and cleaning procedures.

g. Mount and connect the RF 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.

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 RF 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 up against the panel or disconnected.

s. Install the crystals; see figure 7-8 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 figure 2-2.

e. Connect all the base components and side mounted filter capacitors.

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

2.4.4. REASSEMBLY DETAILS OF POWER AMPLIFIER CABINET.

a. Perform step b. of paragraph 2.4.2.

b. The RF Tank box (see figure 7-1) was removed for shipment. This box is suspended from the roof of the cabinet by two metal stand-offs and three ceramic stand-offs. Carefully hold the box in position and replace the mounting screws. Use caution in tightening up the screws in the ceramic stand-offs to prevent breakage.

c. Assemble the air duct (two L shaped pieces of aluminum) between the PA chassis and the RF tank box with the self tapping screws provided (14 screws) see figure 7-1.

d. Turn the vacuum variable capacitor shaft C-313 toward the high capacity direction until the capacitor bottoms (plates stop moving). Turn the PA PLATE TUNING dial toward increasing numbers until a stop is reached. Set the dial at 500. Loosen the dial sprocket set screws and remove the sprocket. Hang the drive chain on the capacitor sprocket, then hang the dial sprocket in the loop of the chain and slip the sprocket back on the dial shaft. Tighten the sprocket set screws.

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 set screw.

f. Reach around the tank box (left front corner) and attach the output strap to RF line meter M-301.

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 figure 2-3.

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. RE-ASSEMBLY 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 step b. of paragraph 2.4.

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.

d. Mount the heavy components in the base of the cabinet as shown in figure 7-3.

e. Refer to figures 7-3, and 2-4 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 rf 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 rf tank cans are associated with the oscillator, buffer, and rf driver plate circuits. Refer to figure 3-1 and install the cans in their proper sockets.

i. Complete all internal connections including inter-chassis 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 2-4, to the Inter-Unit Cabling Diagram, figure 8-4, 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 10 and 11 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 control switch is turned on.

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

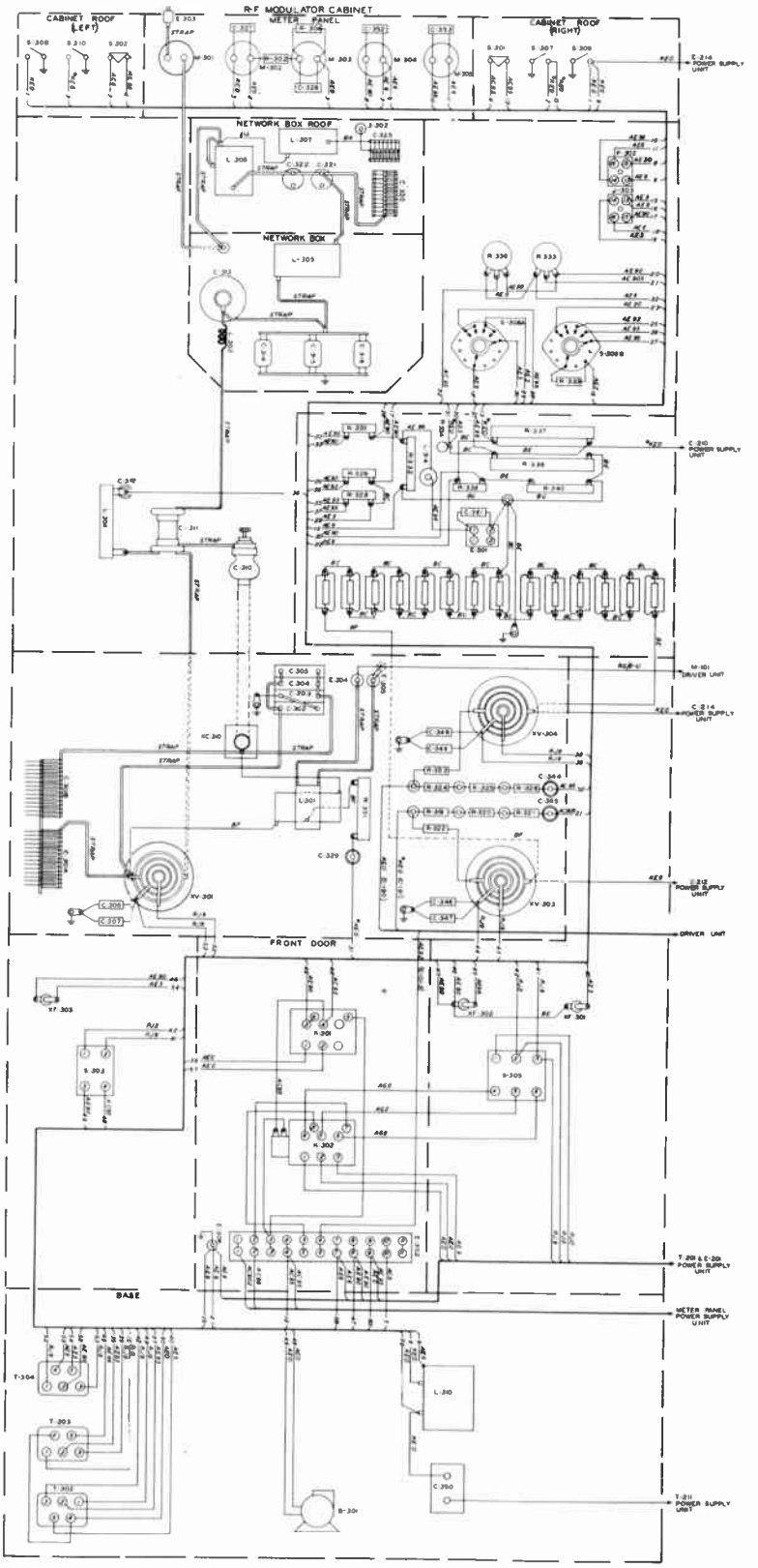


Figure 2-3A. 21E Power Amplifier Cabinet Installation Connections.

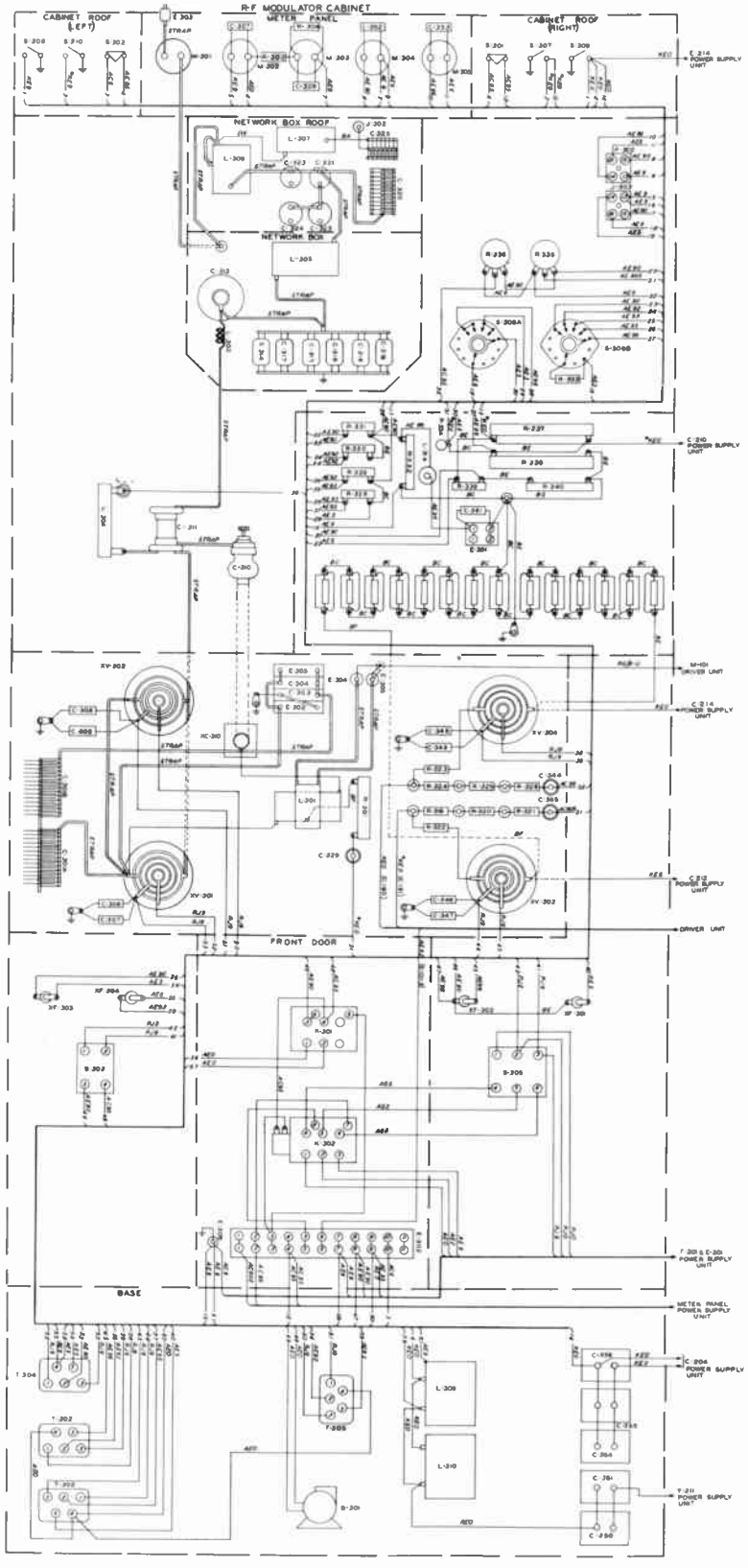


Figure 2-3B. 21M Power Amplifier Cabinet Installation Connections.

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.

Six wires connect the high voltage power transformer T-204 to connector blocks E-202 and E-203. See figure 2-1. 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 8-5. 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-204, E-205 and E-206, the stationary contacts of the high voltage door shorting switches, S-204 and S-205. 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 schematics.

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 RF 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 FEED-BACK. 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 7-12). 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 tublar 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).

2.7.3. MISCELLANEOUS. The control cable that enters the driver cabinet near the left hand edge of the low-voltage power shelf contains two wires which do not terminate at any terminal. These two wires are to be individually spliced to the two wires in the cable that comes from the front panel that also do not tie to terminals. These wires may be bolted together with small bolts. Splice the AC95 wire from the power cabinet to the AC95 wire from the front panel cable and the AC6 wire from the power cabinet to the AC90 wire. Tape these splices thoroughly to prevent them from touching each other or any other conductor.

2.8. INTER-UNIT CABLING DIAGRAM

The Inter-Unit Cabling Diagrams, figures 8-4, 8-5, and 8-6, 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 2-5. The numbers to the right of the lines above the arrow heads represent the types 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.

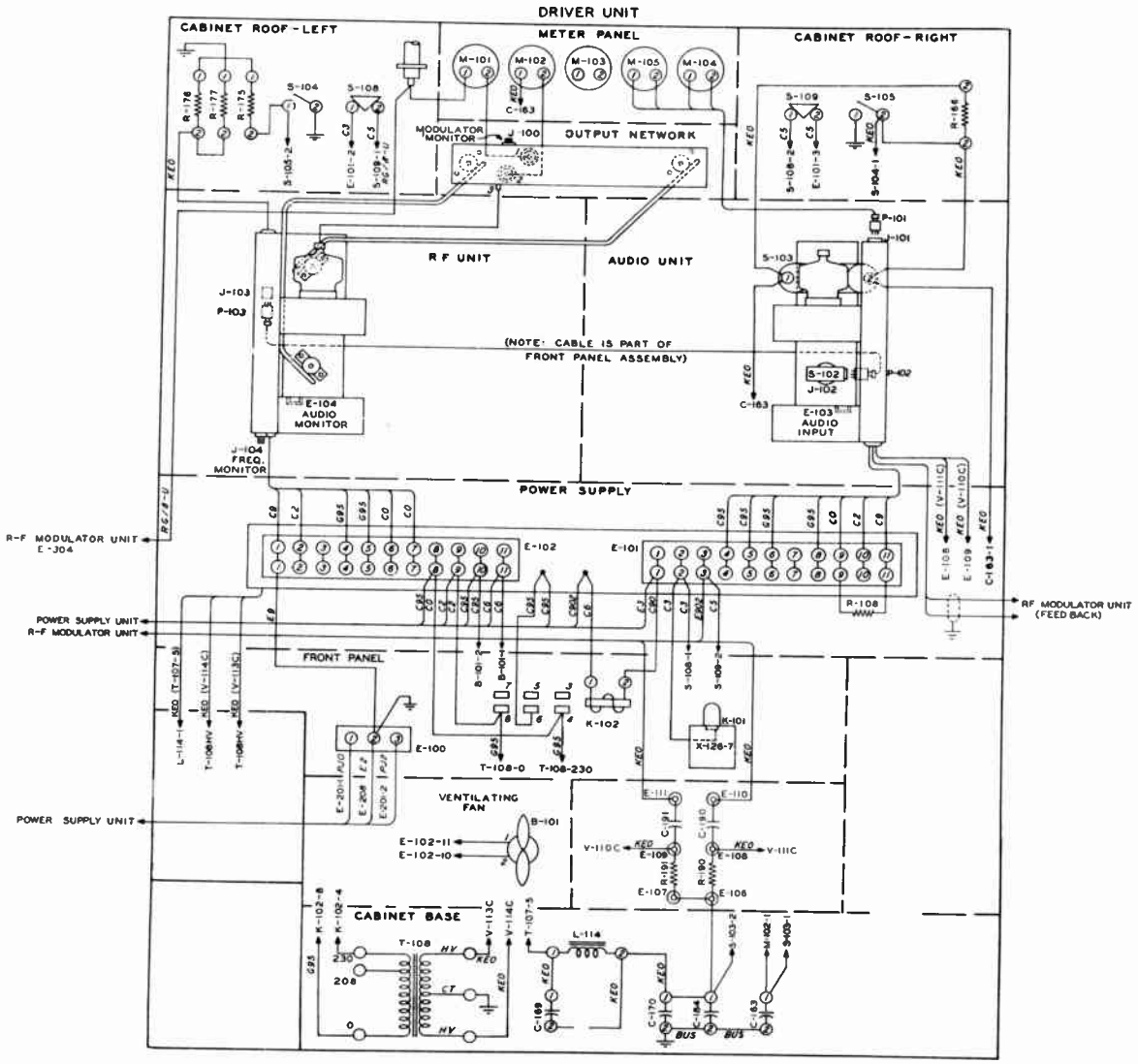


Figure 2-4. Driver Cabinet Installation Connections.

A small portion of unit F from the Inter-Unit Cabling Diagram figure 8-4, is shown in figure 2-5. The two KE0 designations indicate that two type KE0 wires leave this point. The K in KE0 indicates the type of wire (high voltage insulated cable). E indicates size of wire (#14). 0 indicates color of wire (black). If a tracer were used on this wire an additional number would be added to indicate the color of the tracer. For example, if this wire was black with a red tracer, the designation would have been KE02. If a shield were used, the wire would be called KES02, the S indicating a shield. The color code used for wires and tracers is the same as that used for resistors and condensers.

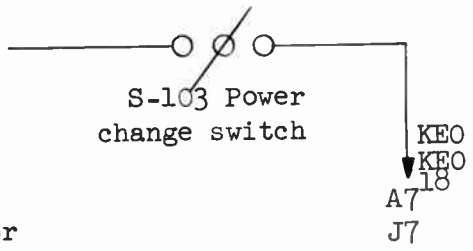


Figure 2-5. Inter-Unit Cabling Example

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 quarter inch copper tubing shown at point 1, unit C, of the Inter-Unit Cabling Diagram, figure 8-4.

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	44	9	White
L	2		
M	11		
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 KE0. 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	0
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 7-12. 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 RF 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 rf chassis as shown in figure 2-4. 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-302.

2.12. MODULATION MONITOR CONNECTIONS.

Coaxial modulation monitor connector J-302 is supplied with the proper mating plug. Figure 2-4 shows this connector located on the top of the rf 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 7-5. 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) side wall 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 feed-back divider.

2.14. OVERALL 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 respected. Check fans and blowers to see that they rotate freely. Remove and inspect all fuses.

2.15. INITIAL ADJUSTMENT.

2.15.1. PRE-ADJUSTMENT 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 switches 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 P.A. bay. No power should be applied as yet to the blower or the filaments. Now, closing the control circuit breaker should immediately turn on the meter panel lights. Blower B-301 should start up and the red indicator light next to the blower breaker should light 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 blower switch. Check to see if the filaments of all the tubes are lit. 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. 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. 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 percent 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 control circuit breaker 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 to the right of filament relay K-303 in 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 the 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 action of the switch. The switch mounting is slotted to provide adjustment, and may require adjustment. In operation, as the air pressure builds up, the canvas duct should expand, coming into contact with the actuating arm of the air interlock switch and closing the micro switch, thus closing the circuit to the filament contactor coil. With a removal of air pressure, the canvas duct will collapse, allowing the micro switch to return to its normally open position.

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, driver plate contactor K-102 should close when the time delay operates, and time delay light I-101 should light. Now, closing the driver breaker switch S-107 should result in closing of the high voltage plate contactor K-204.

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 the high voltage final and driver plate contactors drop out. A similar check should be made on the filament interlock relay K-304 by operating this relay manually.

h. At this stage, a check can also be made on the overload circuit, by operating the d.c. overload relay K-201 manually. (Refer to paragraph 4.5 for a description of the overload circuit.)

i. This completes the check of the power circuit. Throw the control and plate switches to the off positions.

NOTE

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

j. Replace the plate caps on the 866A voltage rectifier tubes V-115 and V-116 (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. Throw the control switch to the on position (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. Throw the driver cabinet plate switch (only) to the on position.

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 will be necessary to adjust C-114 and C-115, the first buffer tank circuit trimmers. The location of screwdriver adjustments, 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. The first trimmer adjustment opening should then be sealed with scotch tape 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 rf 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. The first trimmer opening should then be sealed with scotch tape and all adjustments made with the second trimmer.

s. Turn off the plate and filament switches and replace the plate caps on the 872A high voltage rectifier tubes, V-113 and V-114 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 control breaker to turn the blower and filaments on and off. This is necessary to get proper time delay and blower hold-on.

y. Turn on the Control breaker (left end of transmitter). After warm-up cycle (control circuit lamp lights) turn the driver plate breaker on.

z. Adjust the driver amplifier tuning control, C-146, for minimum driver amplifier plate current. Observe RF 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 seconday of L-301. The RF 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 the 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 200 ma for the 21E or 230 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 date 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 the driver plate switch to OFF.

af. Turn the MODULATOR BIAS ADJUSTMENT controls to full clockwise position (Highest bias).

ag. Turn the PA LOADING dial to full capacity (100 on the dial).

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 rf feedthru. Remember in which direction the capacitor was turned.

CAUTION

Be sure the PA plate breaker is OFF.

aj. Turn the driver plate switch to ON.

ak. Tune the PA PLATE tuning condenser and adjust taps on the power amplifier tank coil until a rf 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.

an. 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 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.

aw. 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.

ay. 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 periods of over one minute at a time or serious damage to the modulator tubes will result. This is particularly true when modulating with tones of 5000 cps and higher or with tones of 100 cps or lower. Damage to the modulator tubes will be first noted by solder depositing in the cavity between the anode radiator and the anode seal.

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.

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 the PA BLOWER and FILAMENT 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 the CONTROL breaker to turn the blower and filaments off.

d. Throw the CONTROL breaker to ON. This will be used as the transmitter start switch.

e. Adjust FULAMENT 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. Move the driver PLATE breaker to ON. Observe meter readings.

i. Move the power amplifier PLATE breaker to ON.

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 (and off) by first following paragraph 3.1.1. to get the equipment operating then by merely turning the driver cabinet CONTROL switch ON and OFF, 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. Throw the driver cabinet CONTROL switch to OFF.

b. Throw the PLATE circuit breakers to OFF.

c. Let the PA cabinet blower run for 2 to 5 minutes as controlled by the delay relay, except in most serious emergencies.

d. Open the power feed cut-out, external to the transmitter, before entering to repair the circuit.

3.2.2 ROUTINE:

a. Throw the CONTROL breaker to OFF. (The blower will continue to run from 2 to 5 minutes).

Table 3-1. Typical Meter Readings, Broadcast Band

21E and 21M

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.

21E

Switch	Switch Position	Meter	Meter Reading
Multimeter Switch	P.A. Grid Current 250 ma.	Multimeter	
	(Low Power)		200 ma.
	(High Power)		220 ma.
Multimeter Switch	Rear Modulator Cathode 2.5 amp.	Multimeter	
	(Low Power, no signal)		0.15 amp.
	(Low Power, 100% Mod. at 1000 cps)		0.325 amp.
	(High Power, no signal)		0.2 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	
Multimeter Switch	Front P.A. Cathode 2.5 amp.	Multimeter	
	(Low Power)		0.48 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)		0.65 amp.
	High (100% Mod. 1000 cps)		1.45 amp.
Power Change	Low	P.A. Plate Voltage	2900 V
	High		5100 V
Power Change	Low	P.A. Plate Current	0.48 amp.
	High		1.3 amp.

21M

Switch	Switch Position	Meter	Meter Reading
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)		0.75 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	

21M

Switch	Switch Position	Meter	Meter Reading
Multimeter Switch	Front P.A. Cathode 2.5 amp. (Low Power)	Multimeter	0.8 amp.
	(High Power)		1.3 amp.
Multimeter Switch	Rear P.A. Cathode 2.5 amp. (Same as Front P.A. Cathode)		
Power Change	Low (no signal)	Mod. Plate Current	0.4 amp.
	High (no signal)		0.4 amp.
	Low (100% Mod. 1000 cps)		1.5 amp.
	High (100% Mod. 1000 cps)		2.5 amp.
Power Change	Low	P.A. Plate Voltage	2900 Volts
	High		5100 Volts
Power Change	Low	P.A. Plate Current	1.6 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 turns on the tube cooling blower and lights the blower pilot lamp. 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-305 (PA CABINET LEFT)

This breaker protects the filament circuits of the transmitter plus the low voltage bias supply. 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.

3.3.3. CONTROL CIRCUIT BREAKER. (FAR LEFT)

The CONTROL circuit breaker, S-106, is a toggle-type magnetically operated circuit breaker. As shown in the Control Circuit diagram, figure 4-3, operation of the CONTROL circuit breaker energizes the meter lights and control

circuit for the transmitter. When the BLOWER and FILAMENT circuit breakers are ON, the CONTROL circuit breaker will also energize all filaments, low voltage bias, fans, blower, and start the filament delay cycle.

3.3.4. BLOWER PILOT LIGHT, I-303 (ADJACENT TO BLOWER BREAKER)

This lamp indicates when power is being applied to the blower motor.

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

This lamp indicates when power is being applied to the primaries of the filament transformers.

3.3.6. FILAMENT VOLTAGE CONTROL, T-201. (POWER CABINET LEFT)

Controls the pirmary voltage of all filament transformers. This primary voltage, indicated on FILAMENT PRIMARY METER should be 230 volts.

3.3.7. THERMAL TIME DELAY RELAY ADJUSTMENT, R-171. (DRIVER RELAY ACCESS)

The thermal time delay relay contains a heating element, a bi-metallic strip, and a set of contacts. As shown in figure 4-3, the time delay relay contacts are in series with the door interlocks. The temperature within the relay affects the bi-metallic element and causes the contacts to open or close. Thermal inertia of the heating element and bi-metallic 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 bi-metallic 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 relay 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. CONTROL CIRCUIT PILOT LIGHT, I-101. (DRIVER CABINET LEFT.)

This 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.)

One set of contacts on the plate relay are hold-in contacts which short the thermal time delay relay contacts as shown in figure 4-3. The

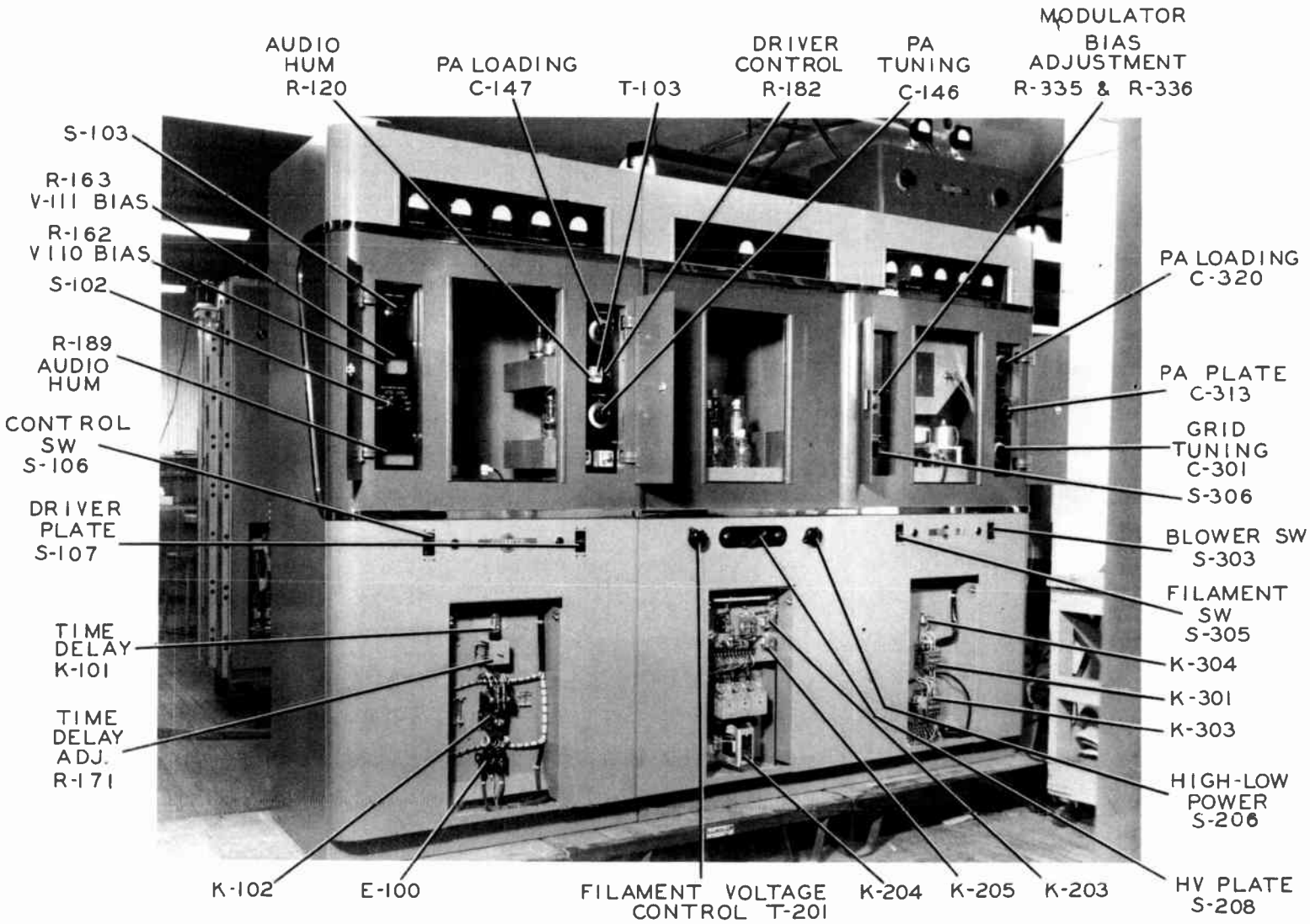


Figure 3-1. 21E/M Operating Controls and Parts Arrangement, Front View.

remaining two sets of contacts on the plate relay are in series with the DRIVER plate switch. These contacts cause the DRIVER plate switch to be inoperative when the plate relay is open. Closure of the plate relay and DRIVER plate switch energizes the driver low voltage and high voltage power supplies and the driver plate pilot light. Energized also are the PA and Modulator bias supply and the PA plate contactor K-204.

3.3.10. DRIVER PLATE PILOT LIGHT, I-104. (DRIVER CABINET RIGHT)

The driver plate pilot light is energized upon application of primary voltage to the driver plate transformer, HV bias transformer and PA plate contactor K-204.

3.3.11. 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.

3.3.12. 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).

3.3.13. HIGH POWER-LOW POWER, S-207. (POWER CABINET, RIGHT)

This switch selects high power or low power operation by connecting the plate transformer in either a "Y" or a "delta" configuration. High power is selected when the knob points straight up or down, low power is selected when the knob points to either side.

3.3.14. HIGH VOLTAGE BREAKER, S-208. (POWER CABINET CENTER)

When manually operated this breaker applies primary voltage to the HV plate transformer (providing the blower, filaments, and driver plate supply are on the the door interlocks are closed.) 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.

3.3.15. HIGH VOLTAGE BREAKER PILOT LIGHT, I-204. (POWER CABINET)

This pilot light lights when primary voltage is being applied to the plate transformer.

3.3.16. 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 5kw should be 200 ma (adjust for high power operation) and for 10kw should be 200 ma (adjust for high power operation).

3.3.17. BIAS ADJUST, R-208.

This resistor, a wire-wound semi-adjustible resistor is located at the top of the power cabinet relay enclosure. R-208 is in the primary 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.

3.3.18. 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.

3.3.19. FIRST RF 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 rf 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.

3.3.20. 807 TANK TRIMMERS, C-125, C-126.

C-125 and C-126, 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. The first trimmer adjustment opening should then be sealed with scotch tape and all adjustments made with the second trimmer.

3.3.21. RF DRIVE CONTROL, R-182.

RF 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 RF driver amplifier. Drive control R-182 should be adjusted to hold the 4-125A grid current to below 20 ma.

3.3.22. 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.

3.3.23. 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 at least 175 ma and not over 200 ma. for 21E and 225 to 240 ma for the 21M in the broadcast band. See test data sheets for short wave band.

3.3.24. 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 is 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-330, 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 rf 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 rf line current. The power amplifier plate current will also increase; however, the increase in power to the rf line constitutes a large proportion of the increase in power to the power amplifier circuit, thus yielding a higher plate efficiency. Adjust the PA tuning and PA loading controls to the point where the desired amount of rf 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.

3.3.25. 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 7-8) is selected.

3.3.26. 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.

3.3.27. 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.

3.3.28. 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 driven amplifier filament circuit and the audio driver filament circuit to points which will minimize the hum caused by the ac 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 percent. 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.

3.3.29 OVERLOAD ADJUST, R-205.

This control is a shaft projecting from the panel of the power cabinet relay enclosure below the large wire-wound resistor R-208. Turning this shaft clockwise increases the plate current value at which the plate current overload system will work.

3.3.30. OVERLOAD SELECTOR, S-209.

The overload selector switch, S-209, is a small toggle switch located along the left side of the power cabinet relay enclosure. It selects "two cycle" overload protection in the up position and recycling protection in the down position. In the two cycle system, the transmitter power amplifier plate supply will turn off and immediately try to turn on again. If the overload persists, the plate supply will again turn off and lock off.

In the recycling system, the power amplifier plate supply will turn off with the first overload and attempt to turn on at regular short intervals until either the overload is cleared or the power amplifier plate supply is turned off.

3.3.31. OVERLOAD RESET, S-210.

This control is a momentary push-button which is pushed to reset the "two cycle" overload system after the second overload has occured and the transmitter is locked off. Turning the transmitter filaments off will also reset the system but is slower. This push button is located adjacent to the overload pilot lamp.

3.3.32. OVERLOAD INDICATOR PILOT LIGHT, I-203 (POWER CABINET)

This pilot light lights after permanent overload turns plate supply off.

SECTION IV

THEORY OF OPERATION

4.1. RF 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 rf chassis, with one of the two always available in a stand-by condition. Crystals are easily selected by means of the crystal selector switch located behind the right-hand control panel.

All rf 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 rf 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 rf 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. This coil is connected from the output end of the L section to ground.

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.

*Other impedances are available on special order.

4.3. POWER SUPPLIES

The modified 300J 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 dc voltage for the plates of the audio drivers and the plates and screens of the rf driver tubes. The low voltage supply uses two type 866A half-wave mercury vapor rectifiers in a single-phase full-wave circuit to provide dc 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 rf driver amplifier tubes.

Overload protection is provided by magnetically operated circuit breakers associated with the filament and plate switches, 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 RF 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. R-335 and R-336 select the bias needs for the modulators in high-power operation and R-208 in low-power operation. (See figure 4-1). The value of bias for the RF power amplifier tubes is pre-determined 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 secondary of the high voltage transformer connected in a delta configuration and the primary connected in a delta connection for high power and a Y connection for low power. The change being accomplished by 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, C-355 and C-356 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 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. These breakers also function as switches. 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 a plate current overload relay which is equipped with manual or automatic reset. See paragraph 4.5.

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 21E/M transmitter.

The filament transformers of the driver cabinet are excited from phase 1 and 2 of T-201. The filament transformers of the remainder of the 21E/M are excited from all 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 3 phase input line through filament relay K-303 and FILAMENT breaker switch S-305. Filament relay K-303 closes after CONTROL switch S-106 of the driver cabinet and BLOWER switch S-303 have been thrown ON 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 connects the primary of plate transformer T-204 in a delta configuration for high power and in a "y" configuration for low power. Paragraph 4.4.1. 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 ON-OFF switch S-107 (driver cabinet) and plate relay K-102. Paragraph 4.4.1. explains how K-102 is energized.

4.4. CONTROL CIRCUITS.

4.4.1. PLATE POWER CONTROL. (See figure 4-3) The plate power supplies are interlocked with the filament supplies so that it is impossible to turn any plate supply on unless the filaments have been first turned on. The PA plate supply is interlocked with the driver plate supply so that the driver plate supply must be turned on before the PA plate can be turned on. Other interlocks include: door interlocks, overload interlock and cooling blower interlock.

Assume that all the filament, plate and blower switches are turned ON, the door interlocks are all closed and power is applied to E-201.

The current path from terminal 3 of Blower switch S-303 through the coil of K-301, the air interlock S-304 to terminal 4 of S-106 turns on the blower Contactor K-301 which starts the tube blower motor B-301. The air stream from B-301 causes the foreward contacts of S-304 to close and energize filament contactor K-303 to light up all tube filaments and energize filament interlock relay K-304. Simultaneously with the above action, the heater of time delay relay K-101 is energized by the current from terminal 3 of filament switch S-106 through the heater of K-101, relay time adjust R-171, and R-173 to terminal 4 of S-106. After a pre-determined period, contacts 5 and 7 of K-101 close, and by means of the circuit from terminal 7 of K-101 through door interlocks S-108, S-109, S-201, S-301, S-302, and filament interlock relay K-304 to the coil of plate relay K-102, energizes plate contactor K-102. Contacts 5 and 6 of K-102 are in parallel with contacts 5 and 7 of time delay relay K-101 to insure a positive contact through K-101. The power to excite plate transformers T-108 and T-110 in the driver cabinet is drawn from contacts 8 and 4 of plate contactor K-102 after this relay is closed by the above described circuit. These same contacts now furnish power to set the PA and modulator plate supply relay system in motion. Plate contactor K-204 is operated through closing of contacts 1 and 2 of the motor driven overload recycling relay K-202. The current path for starting the motor of K-202 is from terminal 4 of K-102 to terminal 3 of K-202 and from terminal 8 of K-102 through contacts 4 and 5 of plate contactor K-204 to terminal 4 of K-202. Contacts 5 and 6 of K-202 are hold contacts to keep K-202 running after K-204 has operated. Once the motor of K-202 is started, contacts 1 and 2 close and energize plate contactor K-204. The circuit from terminal 1 of plate contactor K-204 goes through contacts 7 and 6 of lockout relay K-203, contacts 3 and 4 of plate overload relay K-201 to terminal 4 of plate contactor K-102. The circuit from terminal 2 of K-204 goes through contacts 1 and 2 of overload recycling relay K-202 to contact 8 of K-102. Contacts 3 and 4 of plate contactor K-204 are in parallel

with contacts 1 and 2 of K-202 and hold K-204 operated after K-202 has cycled and turned off when contacts 5 and 6 of K-202 have opened. Opening any door or turning off any filament, blower or plate switch (except S-208) will de-energize plate contactor K-204.

4.5. OVERLOAD CIRCUIT

4.5.1. LOCK OUT CYCLE. Assume that the transmitter is turned on and operating normally. Set OVERLOAD SELECTOR switch S-209 to the position shown in figure 4-4 for LOCK OUT operation. An overload in the HV plate circuit sufficient to operate plate overload relay K-201 will open the plate contactor K-204 coil circuit at contacts 3 and 4 of K-201. The plate contactor K-204 will turn off the HV plate supply but contacts 4 and 5 of K-204 will close and start the motor of overload recycling relay K-202. (See figure 4-5) K-202 will repeat the turning on cycle described above in paragraph 4.4.1. to again close plate power contactor K-204. If the overload still persists, plate overload relay K-201 will again pulse and open the coil circuit of K-204 at contacts 3 and 4 of K-201. Also, contacts 5 and 6 of K-201 energize lock out relay K-203 through contacts 1 and 2 of K-202 which then breaks the coil circuit of plate contactor K-204 at contacts 6 and 7 of K-203. K-203 locks by virtue of contacts 3 and 4 of K-203 which connect the coil of K-203 through S-210, S-209 and contacts 4 and 5 of K-204 to terminal 8 of plate contactor K-102. The overload system can be reset by pressing S-210 which releases the lock-out relay K-203.

4.5.2. RECYCLING. Assume that the transmitter is turned on and operating normally and overload selector switch S-209 is in the position opposite to that shown in figure 4-4. An overload in the PA plate circuit sufficient to operate plate overload relay K-201 will open the coil circuit of plate contactor K-204 at contacts 3 and 4 of K-201 turning the plate supply to the PA and modulator off. The turn-on cycle will attempt to turn the plate supply on again but if the overload persists, K-201 will again open the coil of K-204 and contacts 4 and 5 of plate contactor K-204 will complete the motor circuit of K-202 which will lock in and run to close contacts 1 and 2 of K-202. Lock out relay K-203 will be energized by the circuit from K-203 terminal 2 through 5 and 6 of K-201, 1 and 2 of K-202 to terminal 8 of K-102. Lock out relay K-203 will then lock because of the circuit from terminal 2 of K-203 through K-203 contacts 3 and 4, S-210, S-209, contacts 1 and 2 of K-202 to terminal 8 of K-102. The lock out relay will prevent operation of plate contactor K-204 until the overload cycling relay K-202 makes a complete cycle and opens the lock out relay coil at contacts 1 and 2 of K-202. The motor of K-202 continues to turn because of contacts 4 and 5 of K-204 and the turn-on cycle (paragraph 4.4.1.) tries to turn the PA plate voltage on again. If the overload persists the above cycle will repeat and keep repeating until the overload is cleared or the transmitter is manually turned off.

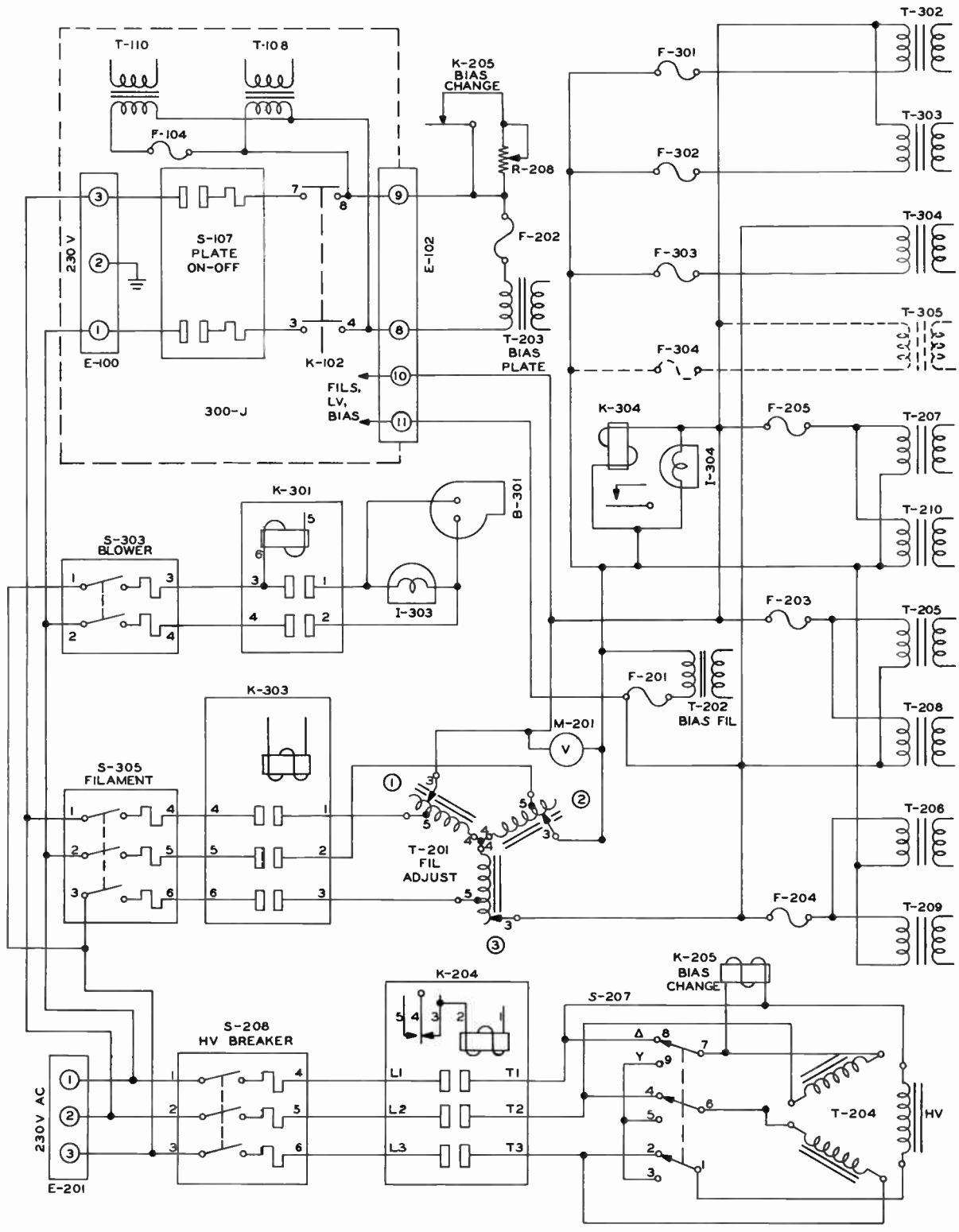


Figure 4-1. Primary Power Circuits.

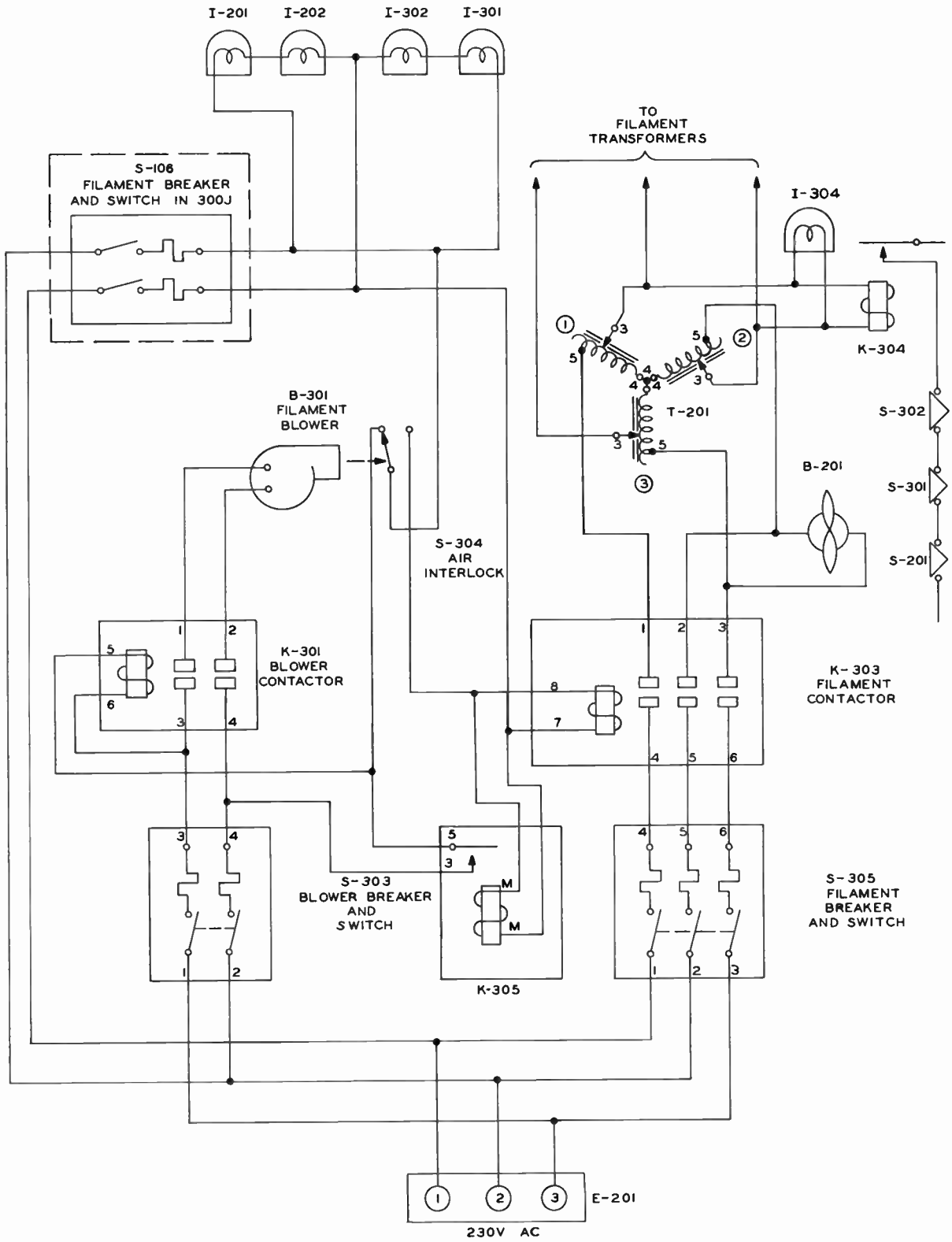


Figure 4-2. Filament Control Circuits.

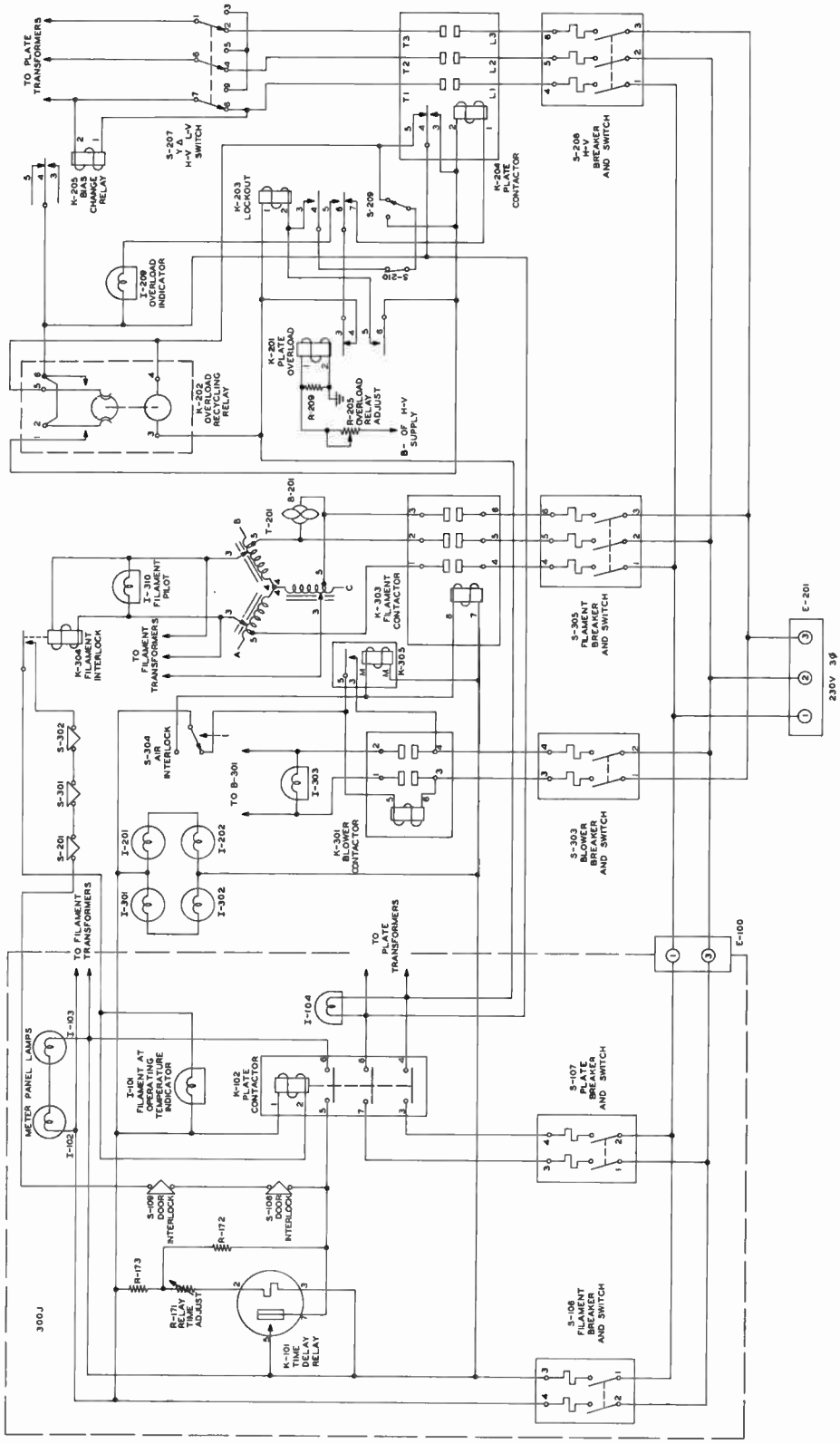


Figure 4-3. Complete Control Circuits.

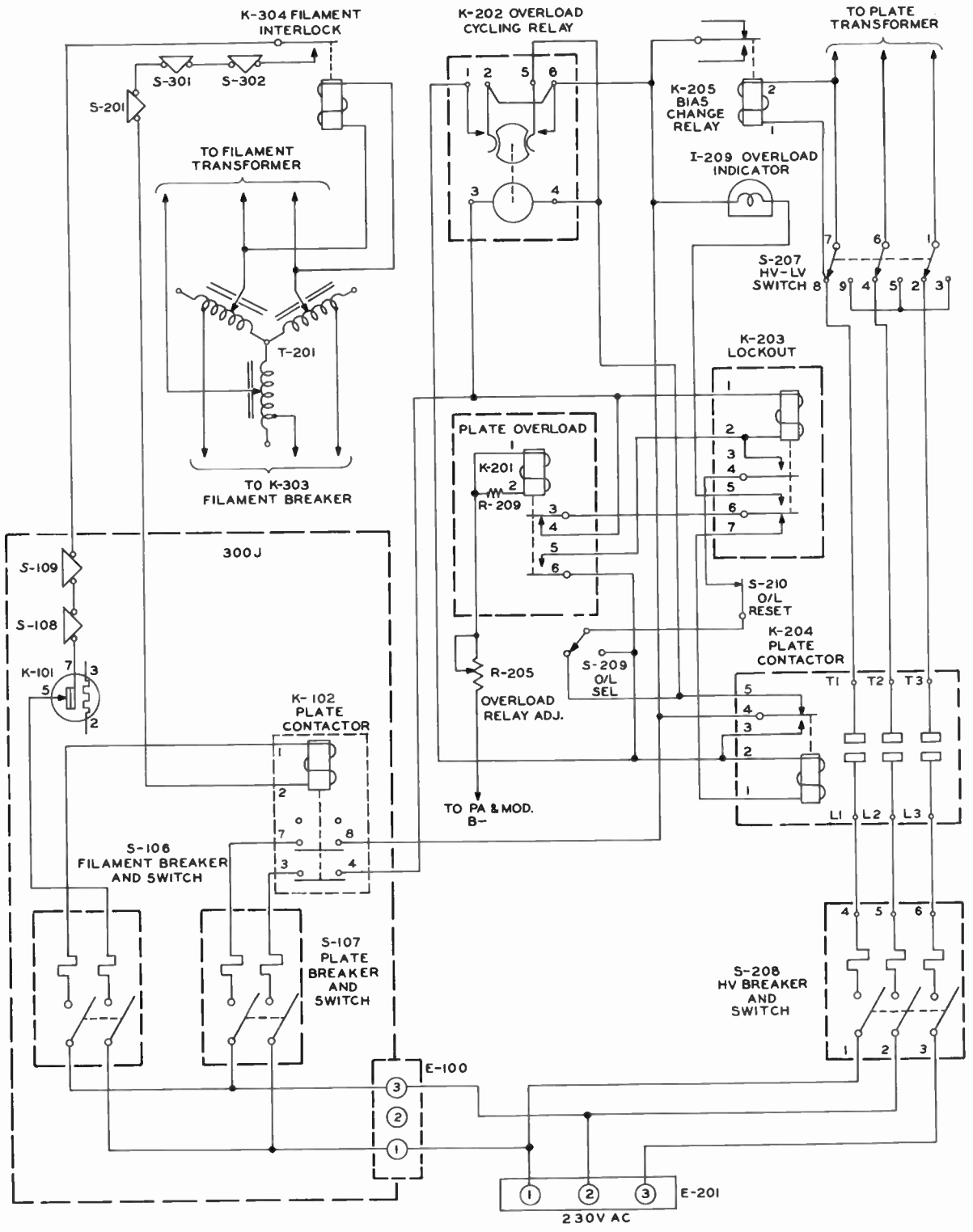


Figure 4-4. PA Plate Control Circuits -Normal.

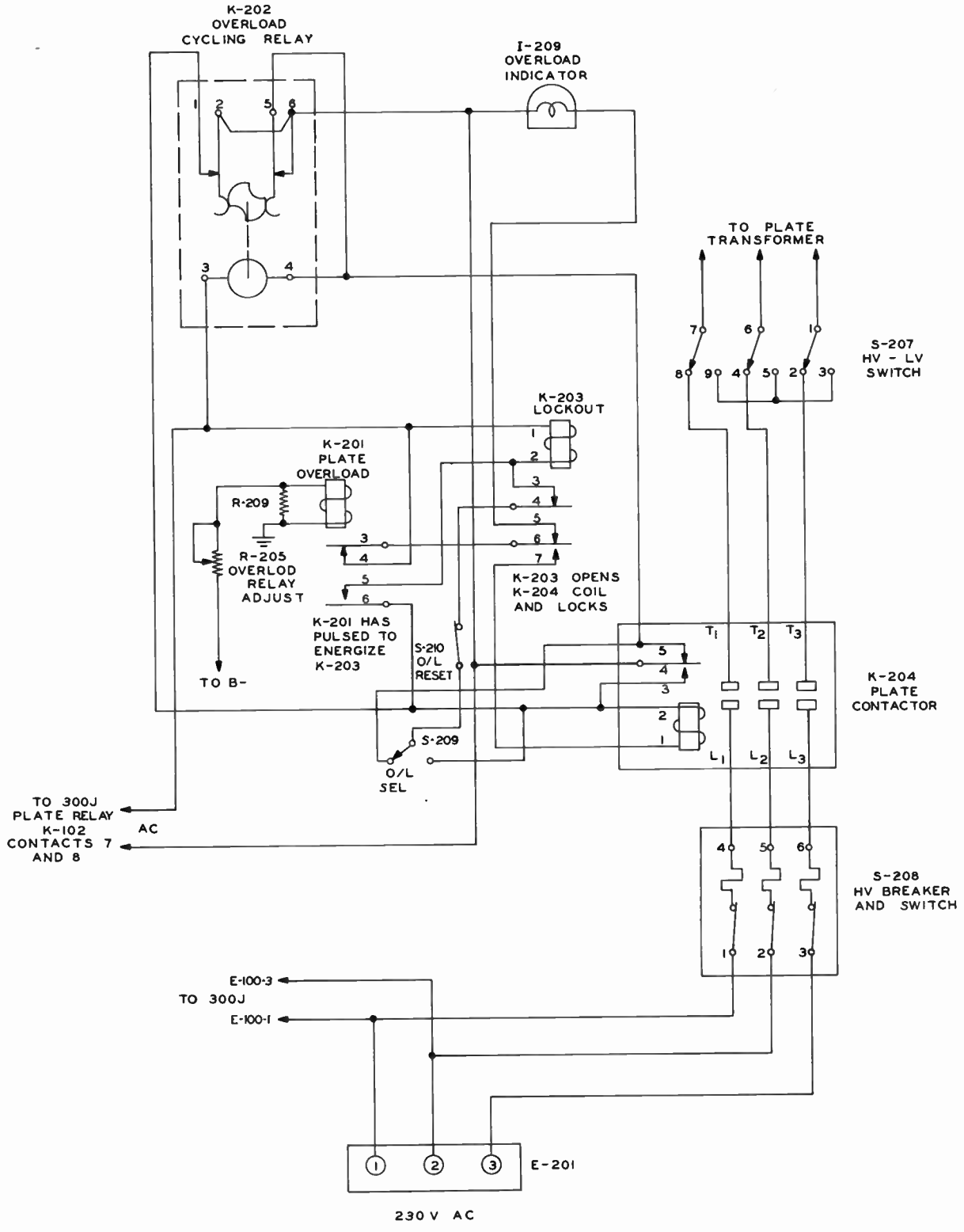


Figure 4-5. PA Plate Control Circuit, Relay Positions Shortly after Overload.

SECTION 5

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 once 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. PA CABINET AIR FILTER. Two types of filters are available for use with the transmitter. Both may be cleaned and re-used.

To remove the filter, 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 aluminum filler (009 1227 00) use a vacuum cleaner to remove the larger quantity of dust or tap the filter gently on the floor to dislodge the dust. Then run tap water from the dirty side through the filter under slight pressure or swish the filter in a container of mildly soapy water. After the filter is completely dried, recharge it by spraying the filler with R-P Hand Koter fluid from the hand spray container obtained from the manufacturer of the filter.

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.

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, pre-aged, 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 possibility that they will be inverted or agitated. When pre-aged tubes are placed in the equipment they should be handled carefully in order to avoid the additional twenty minute waiting period that will be required if mercury is allowed to come in contact with the tube elements.

5.2. TROUBLE SHOOTING.

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

cause distortion or hum. A tube suspected of causing this difficulty may be checked by replacing it with a tube that is known to be in good condition.

If the transmitter fails to start, circuits should be checked in the order in which they are made operative. The Primary Control Circuit Diagram, figure 4-1, should be of assistance in locating trouble in the primary circuits. Table 3-1, Typical Meter Readings, and Table 5-1, Typical Voltages and Currents, are supplied as a reference of typical voltages and currents in an 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. This switch is located in the PA cabinet below and to the rear of the grid tuning box. Remove the lower rear panel from the PA cabinet. Loosen the two bolts that mount the switch to the mounting bracket. Turn the blower breaker only on and adjust the switch forward or backward in the mounting slots until the air pressure in the canvas duct will throw the switch. Operation of the switch can be checked by manipulating the switch arm with the fingers. Tighten the mounting bolts and turn the blower breaker off. Check to see that S-304 snapped back.

CAUTION

Do not turn the filament breaker or any other breaker on during the adjustment procedure.

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.

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 for 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 four meter panel retainer screws may be had through the front tube viewing windows.

First, remove the window glass then reach through the window opening and remove the heavy strap connections from the rear of the RF and plate current meters. Disengage the meter panel connector and then remove the four 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 & CURRENT MEASUREMENTS

21M

Symbol Designation	Tube Type	Function	Normal Operating Characteristics		
		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. Driver Amplifier Class C (Parallel Operation)	Plate Voltage Screen Voltage Plate Current Grid Current	2700 volts 220 volts 100 ma 22 ma	
				11000 watts	5500 watts
V-301 V-302	3X2500A3	Final Amplifier Class C	Plate Voltage Plate Current Grid Current	5100 V 2.6 A 230 ma	2900 V 1.6 A 200 ma

21M

Symbol Designation	Tube Type	Function	Normal Operating Characteristics
		Power Supply Section	
V-112	5U4G	Bias Rectifier, single phase, full wave, choke input	Output from Filter 100 volts 100 ma
V-115, V-116	866A	Low voltage, rectifier, single phase, full wave, choke input	Output from Filter 530 volts 250 ma
V-113, V-114	872A	Intermediate voltage rectifier, single phase, full wave, choke input	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
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 300 volts Plate Current 2 ma per tube
V-110, V-111	4-125A	Audio driver amplifier Push-pull, Class A	Plate Voltage 2700 volts Cathode Current 125 ma
V-303, V-304	3X3000A1	Modulator, Push-pull, Class AB1	11000 watts / 5500 watts Plate Voltage 5100 V / 2900 V Cathode current, 0.4 Amp / 0.4 Amp 2 tubes, 0 signal. Cathode current, 2.5 Amp / 1.5 Amp 2 tubes, 100% modulation at 1000 cps.

21E

Symbol Designation	Tube Type	Function	Normal Operating Characteristics		
		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.Driver Amplifier Class C (Parallel Operation)	Plate Voltage Screen Voltage Plate Current Grid Current	2700 volts 220 volts 100 ma 22 ma	
				5500 watts	1100 watts
V-301	3X2500A3	Final Amplifier Class C	Plate Voltage Plate Current Grid Current	5100 V 1.3 A 220 ma	2900 V 0.48 A 200 ma
		Power Supply Section			
				Output from Filter	
V-112	5U4G	Bias Rectifier, single phase, full wave, choke input		100 volts 100 ma	
				Output from Filter	
V-115,V-116	866A	Low voltage, rectifier, single phase, full wave, choke input		530 volts 250 ma	
				Output from Filter	
V-113,V-114	872A	Intermediate voltage rectifier, single phase, full wave, choke input		2700 volts 360 ma	

21E

Symbol Designation	Tube Type	Function	Normal Operating Characteristics	
				Output from Filter
V-201,V-202	866A	Modulator & R.F. Amplifier, bias voltage, single phase, full wave, choke input		1100 volts 220 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
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 2900 V 0.4 Amp 0.3 Amp 1.45 Amp 0.65 Amp

TABLE 5-2

21-E OUTPUT TANK COMPONENTS CHART

50-70 Ω RESISTIVE LOAD

KC	L305	L306	C314	C315	C316	C321	C322	C323
550-600	980-0062-00 120 uh	980-0053-00 26 uh	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
600-650	980-0062-00 120 uh	980-0053-00 26 uh	919-0033-00 250 mmf	919-0033-00 250 mmf	Out	939-1040-00 2000 mmf	939-1040-00 2000 mmf	939-1033-00 1000 mmf
650-800-	980-0062-00 120 uh	980-0053-00 26 uh	919-0033-00 250 mmf	919-0033-00 250 mmf	Out	939-1040-00 2000 mmf	939-1033-00 1000 mmf	939-1033-00 1000 mmf
800-900-	980-0063-00 60 uh	980-0053-00 26 uh	919-0033-00 250 mmf	919-0033-00 250 mmf	Out	939-1040-00 2000 mmf	939-1033-00 1000 mmf	939-1033-00 1000 mmf
900-1100-	980-0063-00 60 uh	980-0053-00 26 uh	919-0033-00 250 mmf	919-0033-00 250 mmf	Out	939-1033-00 1000 mmf	939-1033-00 1000 mmf	939-1033-00 1000 mmf
1100-1600-	980-0063-00 60 uh	980-0053-00 26 uh	919-0033-00 250 mmf	Out	Out	939-1033-00 1000 mmf	939-1033-00 1000 mmf	939-1033-00 1000 mmf

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

TABLE 5-3

21-E GRID TANK COMPONENTS CHART

KC	L301	C302, C303	C304	C305
550-640	980-0076-00 60 uh	906-3801-10 800 mmf	906-3401-10 400 mmf	906-3401-10 400 mmf
640-840	980-0076-00 60 uh	906-3801-10 800 mmf	906-3401-10 400 mmf	Out
840-970	980-0076-00 60 uh	906-3801-10 800 mmf	Out	Out
970-1320	980-0076-00 60 uh	906-3401-10 400 mmf	Out	Out
1320 - 1600	980-0076-00 60 uh	Out	Out	Out

TABLE 5-4

21-M OUTPUT TANK COMPONENTS CHART

50-70 Ω RESISTIVE LOAD

	550	600	625	650	700	900	1000	1050	1100	1150	1300	1400	1600
C311			939 - 2037 - 00 1500 uuf					939 - 2033 - 00 1000 uuf					
C316				919 - 0033 - 00 250 uuf								Out	
C317			919 - 0033 - 00 250 uuf							Out			
C318			919 - 0033 - 00 250 uuf						Out				
C319	919-0033-00 250 uuf						Out						
C321			939-1040-00 2000 uuf					939 - 1033 - 00 1000 uuf					939 - 1026 - 00 510 uuf
C322			939-1040-00 2000 uuf				939-1033-00 1000 uuf					939-1026-00 510 uuf	
C323		939-1033-00 1000 uuf		Out		939-1033-00 1000 uuf					939-1026-00 510 uuf		
C324		939-1026-00 510 uuf			939-1033-00 1000 uuf	939-1026-00 510 uuf		Out			939-1026-00 510 uuf		
C366		939-1033-00 1000 uuf					Out						
L305				980-0063-00 60 uh						980-0064-00 30 uh			
L306						980-0053-00 26 uh							

TABLE 5-5

21-M GRID TANK COMPONENTS CHART

Frequency KC	L301	C302, C303	C304	C305
550-650	980-0076-00 60 uuh	906-3801-10 800 uuf	906-3401-10 400 uuf	906-3401-10 400 uuf
650-850	980-0076-00 60 uuh	906-3801-10 800 uuf	906-3401-10 400 uuf	Out
850-950	980-0076-00 60 uuh	906-3801-10 800 uuf	Out	Out
950-1350	980-0076-00 60 uuh	906-3401-10 400 uuf	Out	Out
1350-1600	980-0076-00 60 uuh	Out	Out	Out

SECTION VI

TABLE 6-1

PARTS LIST

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
B-101	Ventilating Fan	VENTILATING FAN: 8 inch ventilating fan and guard assembly 230 v	230 0164 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 by-pass capacitor for V-101	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-105	Screen by-pass 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 by-pass 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 by-pass capacitor for V-102	CAPACITOR: Mica, .01 mmf p/m 5%, 500 WV	910 1103 10
C-112	Screen by-pass capacitor for V-102	CAPACITOR: Mica, .01 mmf p/m 5%, 500 WV	910 1103 10
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

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-116	Compensating capacitor grid to cathode of V-103	CAPACITOR: Ceramic, 20 mmf p/m 5%, 500 WV	916 4420 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 by-pass capacitor for 807 Grid, 25 ma position	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-122	Screen by-pass capacitor for V-103	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-123	Screen by-pass 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, .01 mf p/m 5%, 500 WV	910 1103 10
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 by-pass capacitor, PA Grid, 25 ma position	CAPACITOR: Mica, .01 mf p/m 500 WV	910 1103 10

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-134	Filament by-pass capacitor for V-104	CAPACITOR: Mica, .01 mf p/m, 5%, 500 WV	910 1103 10
C-135	Filament by-pass capacitor for V-105	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-136	Filament by-pass capacitor for V-104	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-137	Filament by-pass capacitor for V-105	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-138	Screen by-pass capacitor for V-104	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
C-139	Screen by-pass capacitor for V-105	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
C-140	By-pass 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		Not Used	
C-143	Screen by-pass capacitor for V-104	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
C-144	Screen by-pass capacitor for V-105	CAPACITOR: Ceramic, 67 mmf p/m 5%, 5000 WV	913 0090 00
C-145	Padder capacitor for PA plate tank Not used above 590 kc	CAPACITOR: fixed, 400 mmf, 37 plates	924 1021 00
C-146	PA plate tuning capacitor	CAPACITOR: Variable, air-dielectric; 63 mmf to 337 mmf	920 0074 00
C-147	PA plate loading capacitor	CAPACITOR: Variable, air-dielectric; 840 mmf max, 65 mmf min	920 0114 00
*C-148	Padder capacitor PA output network	CAPACITOR: Mica, 800 mmf 5000 WV OR CAPACITOR: Mica, 400 mmf 5000 WV	906 3801 10 906 3401 10

* Values depend upon frequency of operation.

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
*C-149	Padder capacitor PA output network	CAPACITOR: Mica, 2000 mmf p/m 5%, 6000 WV	906 2208 10
		OR	
		CAPACITOR: Mica, 800 mmf p/m 5%, 5000 WV	906 3801 10
*C-150	Padder capacitor, PA output network	CAPACITOR: Mica, 2000 mmf p/m 5%, 6000 WV	906 2208 10
		OR	
		CAPACITOR: Mica, 800 mmf p/m 5%, 5000 WV	906 3801 10
		OR	
		CAPACITOR: Mica, 400 mmf p/m 5%, 5000 WV	906 3401 10
*C-151	Padder capacitor, PA output network	CAPACITOR: Mica, 800 mmf p/m 5%, 5000 WV	906 3801 10
		OR	
		CAPACITOR: Mica, 400 mmf p/m 5%, 5000 WV	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	By-pass capacitor for 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%, 1200 WVDC	936 0283 00
C-155	Not Used	CAPACITOR: Mica, 3300 mmf p/m 20%, 1200 WVDC	936 0283 00
C-156	V-106, V-107 screen by-pass	CAPACITOR: Paper .1 mf p/m 10%, 600 WVDC	961 5114 00
C-157		Not Used	
C-158	Coupling capacitor V-108 to V-110	CAPACITOR: Paper .1 mf p/m 10%, 600 WVDC	961 5114 00
C-159	Coupling capacitor V-109 to V-111	CAPACITOR: Paper .1 mf p/m 10%, 600 WVDC	961 5114 00

* Values depend upon frequency of operation.

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-160	Filament by-pass capacitor for V-110 and V-111	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-161	Filament by-pass capacitor for V-110 and V-111	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	D-C blocking capacitor for T-105	CAPACITOR: Paper, 4 mf p/m	930 4314 00
C-164	By-pass capacitor PA plate voltage meter	CAPACITOR: Mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-165	Filament by-pass capacitor for V-103	CAPACITOR: Mica, .01 mf p/m 5%, 500 WV	910 1103 10
C-166	Filament by-pass 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 20%, 600 WVDC	956 2014 00
C-168	Filter capacitor bias supply filter	CAPACITOR: Paper, 8 mf p/m 20%, 600 WVDC	956 2014 00
C-169	Tunes L-114 in H.V. filter to ripple frequency	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
C-171	By-pass 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 filter	CAPACITOR: Paper, 8 mf p/m 20%, 600 WVDC	956 2014 00
C-173	Filter capacitor, low voltage supply filter	CAPACITOR: Paper, 8 mf p/m 20%, 600 WVDC	956 2014 00

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-174	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-175	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-176	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-177	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-178	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-179	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-180	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-181	Not Used	CAPACITOR: Mica, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-182		Not Used	
C-183		Not Used	
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-110 grid equalizer	CAPACITOR: Paper, .25 mf p/m 10%, 600 WV	961 5132 00
C-188	V-111 grid equalizer	CAPACITOR: Paper, .25 mf p/m 10%, 600 WV	961 5132 00
C-189	V-110, V-111 screen by-pass	CAPACITOR: Mica, 10,000 mmf p/m 20%, 1200 WV	936 1127 00
C-190	Mod. grid coupling	CAPACITOR: Plasticon, .1 mf p/m 10%, 5000 WV	933 0033 00

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-191	Mod. grid coupling	CAPACITOR: Plasticon, .1 mf p/m 10%, 5000 WV	933 0033 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: 11 terminals	367 5110 00
E-102	Terminal board connecting r-f chassis to power supplies	BOARD: 11 terminals	367 5110 00
E-103	Audio input terminal board	BOARD: 3 terminals	367 4030 00
E-104	Audio monitoring output terminal board	BOARD: 2 terminals	367 4020 00
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 v 10w	262 0169 00
I-102	Lumiline meter panel lamp, illuminates meter panel	BULB: Lumiline, disc base, 125 VAC RMS, 40 w	262 0170 00
I-103	Lumiline meter panel lamp, illuminates meter panel	BULB: Lumiline, disc base, 125 VAC RMS, 40 w	262 0170 00

MAJOR ASSEMBLY: 300/J

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
I-104	Plate ON lamp, indicates when high and low voltage is on	BULB: Candelabra base, 230-250 v, 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	RF Chassis connector	CONNECTOR: Receptacle, 8 female contacts	366 2080 00
J-104	Frequency monitor jack	CONNECTOR: Receptacle, single female contact	357 9005 00
J-105	Socket for F-101	HOLDER: Fuse, extractor post for 3AG cartridge fuse	265 1002 00
J-106	Socket for F-102	HOLDER: Fuse, extractor post for 3AG cartridge fuse	265 1002 00
J-107	Socket for F-103	HOLDER: Fuse, extractor post for 3AG cartridge fuse	265 1002 00
J-108	Socket for F-104	HOLDER: Fuse, extractor post for 3AG cartridge fuse	265 1002 00
K-101	Thermal time delay relay provides adequate filament warm-up period	RELAY: 3 amp 150 v DC, 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
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	

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
L-102B	Part of plate tank coil for V-102	Section of L-102	
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	RF choke in B plus lead to V-103	COIL: RF Choke, 3 section, 1 mh, 300 ma	240 5800 00
*L-107	RF choke in B plus lead to V-104 and V-105	COIL: RF Choke, 200 turns #24 AWG DS wire OR COIL: RF choke, 800 turns #22 AWG wire	571 0460 10 505 1460 002
*L-108	PA plate tuning coil	INDUCTOR: RF fixed tank, 150 mh	980 0041 00
L-109	L Section inductance	COIL: RF, 30 turns #10 copper wire	504 9624 003
L-110	Static drain choke, feeds modulation monitor	COIL: 56 turns, #22 copper wire	572 0700 30
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	Filter choke, bias voltage supply filter	REACTOR: Filter, 12 hy, 375 ohm DC resistance, 2000 TV	668 0004 00
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
L-115		Not Used	
L-116	Filter choke, low voltage supply filter	REACTOR: Filter, 8.0 hy, 85 ohm DC resistance, 2500 VRMS	678 0384 00
L-117	Filter choke, low voltage supply filter	REACTOR: Filter, 8.0 hy, 85 ohm DC resistance, 2500 VRMS	678 0384 00
* Values	Depend on Frequency of Operation.		

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
M-101	Meters r-f line current	METER: RF ammeter, 0-3 amp	451 0080 00
M-102	Meters PA plate current	METER: 0-300 ma	450 0094 00
M-103	Meters PA plate voltage	METER: 0-1 ma, 0-4000 V DC (includes R-169)	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 0094 00
P-100	Plug for modulation monitor	CONNECTOR: RF concentric cable	357 9014 00
P-101	Connects from J-102 to M-104 and 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: RF concentric cable	357 9014 00
R-101	Grid resistor for V-101	RESISTOR: .1 megohm p/m 10%, 1/2 w	745 1170 00
R-102	Cathode resistor for V-101	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 1058 00
R-103	Plate load, resistor for V-101	RESISTOR: 10,000 ohm p/m 10%, 1 w (p/o T-101)	745 3128 00
R-104	Screen voltage dropping resistor for V-101	RESISTOR: 82,000 ohm p/m 10%, 1/2 w	745 1167 00
R-105	Voltage dropping resistor, V-101	RESISTOR: .12 megohm p/m 10%, 2 w	745 5174 00
R-106	Voltage dropping resistor, V-101	RESISTOR: .12 megohm p/m 10%, 2 w	745 5174 00
R-107	Grid resistor, V-102	RESISTOR: .1 megohm p/m 10%, 1/2 w	745 1170 00
R-108	Multimeter shunt resistor, 1st Buffer Grid, 2.5 ma position	RESISTOR: 3900 ohm p/m 10%, 1/2 w	745 1111 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-109	Voltage divided feeds frequency monitor	RESISTOR: 56,000 ohm p/m 10%, 2 w	745 5034 00
R-110	Cathode resistor for V-102	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 1058 00
R-111	Voltage dividing resistor for V-102	RESISTOR: 39,000 ohm p/m 10%, 1 w	745 3153 00
R-112	Screen voltage dropping resistor, V-102	RESISTOR: 33,000 ohm p/m 10%, 1 w	745 3149 00
R-113	Voltage dropping resistor, V-102	RESISTOR: 25 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 3135 00
R-115	Cathode resistor, V-103	RESISTOR: 22 ohm p/m 10%, 2 w	745 5016 00
R-116	Stabilizing resistor, V-103	RESISTOR: 47 ohm p/m 10%, 1/2 w	745 1030 00
R-117	Screen voltage dividing resistor, V-103	RESISTOR: 22,000 ohm p/m 10%, 2 w	745 5142 00
R-118		Not Used	
R-119	Grid resistor, V-104 and V-105	RESISTOR: 15 ohm p/m 20%, 25 w	710 3154 20
R-120	Audio hum control B	RESISTOR: 50 ohm p/m 10%, 25 w	735 5020 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 3135 00
R-124	Part of 807 Grid resistance	RESISTOR: 4700 ohm p/m 10%, 1 w	745 3114 00
R-125	Shunt resistor for multimeter, 807 Grid, 25 ma position	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 1058 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-126	Shunt resistor for multimeter, PA Grid, 25 ma position	RESISTOR: 220 ohm p/m 10%, 1/2 w	745 1058 00
R-127	Multimeter series resistor	RESISTOR: 5100 ohm p/m 5%, 1/2 w	745 1116 00
R-128	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1056 00
R-129	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1056 00
R-130	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1056 00
R-331	Audio input pad	RESISTOR: 200 ohm p/m 5%, 1/2 w	745 1056 00
R-132	Audio input pad	RESISTOR: 220 ohm p/m 5%, 1/2 w	745 1057 00
R-133	T-104 sec. load	RESISTOR: 68,000 ohm, p/m 10%, 1/2 w	745 1163 00
R-134	T-104 sec. load	RESISTOR: 68,000 ohm, p/m 10%, 1/2 w	745 1163 00
R-135	Not Used	RESISTOR: 10,000 ohm p/m 10%, 2 w	745 9139 00
R-136	Not Used	RESISTOR: 10,000 ohm p/m 10%, 2 w	745 9139 00
R-137	V-106, V-107 Cathode	RESISTOR: 2,700 ohm p/m 10%, 1/2 w	745 1104 00
R-138	V-106, V-107 meter shunt	RESISTOR: 220 ohm p/m 5%, 1/2 w	745 1057 00
R-139	V-106, V-107 screen	RESISTOR: .47 megohm p/m 10%, 2 w	745 9209 00
R-140	V-106 grid return	RESISTOR: 22,000 ohm p/m 10%, 2 w	745 9153 00
R-141	V-107 grid return	RESISTOR: 22,000 ohm p/m 10%, 2 w	745 9153 00
R-142		Not Used	
R-143		Not Used	
R-144		Not Used	
R-145		Not Used	
R-146		Not Used	
R-147		Not Used	
R-148	V-106, V-107 plate decoupling	RESISTOR: 39,000 ohm p/m 10%, 2 w	745 9164 00
R-149	V-106 plate	RESISTOR: 82,000 ohm p/m 10%, 2 w	745 9178 00
R-150	V-107 plate	RESISTOR: 82,000 ohm p/m 10%, 2 w	745 9178 00
R-151	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00
R-152	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00
R-153	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00
R-154	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00

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ITEM	CIRCUIT FUNCTION	DISCRIPTION	PART NUMBER
R-155	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00
R-156	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00
R-157	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00
R-158	Not Used	RESISTOR: 1 megohm p/m 10%, 2 w	745 9223 00
R-159	V-110, V-111 grid return	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 9167 00
R-160	Part of grid resistance of V-110 and V-111	RESISTOR: 82,000 ohm p/m 10%, 1 w	745 3167 00
R-161	Part of grid resistance of V-110 and V-111	RESISTOR: 82,000 ohm p/m 10%, 1 w	745 3167 00
R-162	Modulator bias adjutment	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-110	RESISTOR: 10,000 ohm p/m 10%, 1/2 w	745 1128 00
R-165	Stabilizing resistor V-111	RESISTOR: 10,000 ohm p/m 10%, 1/2 w	745 1128 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 5128 00
R-169	Series resistor for DC Plate Voltmeter	RESISTOR: 4 megohm (p/o M-103)	
R-170		Not Used	
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: 5000 ohm p/m 10%, 10 w	710 1542 00

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ITEM	CIRCUIT FUNCTION	DISCRIPTION	PART NUMBER
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%, 50 w	710 0099 00
R-179		Not Used	
R-180	Screen voltage dropping resistor, V-103	RESISTOR: 56,000 ohm p/m 10%, 2 w	745 5160 00
R-181	Screen voltage dropping resistor, V-103	RESISTOR: 56,000 ohm p/m 10%, 2 w	745 5160 00
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		Not Used	
R-185	Parasitic Suppressor	RESISTOR: fixed globar; 50 ohm, carborundum bar	712 1400 00
R-186	V-110 grid equalizer	RESISTOR: .15 megohm p/m 10%, 2 w	745 9188 00
R-187	V-111 grid equalizer	RESISTOR: .15 megohm p/m 10%, 2 w	745 9188 00
R-188		Not Used	
R-189	Hum Adjust	RESISTOR: 50 ohm p/m 10%, 25 w	735 0201 00
R-190	V-111 plate	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-191	V-110 plate	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00
S-101	Selects desired crystal, crystal selector switch	SWITCH: Rotary, 2 pole, 2 position	259 0362 00
S-102	Multimeter switch selects circuit 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 operaced	
S-106	Filament ON-OFF switch and breaker applies voltage to filaments, blower and bias supply	CIRCUIT BREAKER: Magnetic	260 0238 00
S-107	Plate ON-OFF switch and breaker, applies voltage T-108 and T-110	CIRCUIT BREAKER: Magnetic	260 0221 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 door interlock switch CONTACT ASSEM: Female section of door interlock switch	260 4040 00 260 4050 00
T-101	Plate tank rf can, V-101	OSCILLATOR PLATE TUNING ASSEM: (incl R-103)	504 9594 002
T-102	Plate tank rf can, V-102	INTERMEDIATE PLATE TUNING ASSEM: (incl C-113, C-114, C-115, L-102A, L-102B)	504 9632 003

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
T-103	Plate tank rf 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 7500 RMS TV	
T-106	Bias Supply transformer	TRANSFORMER: Power, Pri: 230 v Sec #1: 360, 320, 280, 240, v CT Sec #2: 5 v	672 0392 00
T-107	Filament transformer for high voltage rectifier tubes	TRANSFORMER: Filament, Pri: 203 v, Sec: 5 v CT	672 0382 00
T-108	High voltage transformer	TRANSFORMER: Plate 208/230 v nom, 50/60 cps single phase, sec 2700v DC	662 0070 00
T-109	Filament transformer 866A rectifier tubes and all RF and audio tubes	TRANSFORMER: Filament, Pri: 230,208v, Sec #1: 5.3 v CT, Sec #2: 5.3 v CT, Sec #3: 6.3 v CT, Sec #4: 2.5 CT	672 0381 00
T-110	Low voltage supply transformer	TRANSFORMER: Plate, Pri: 230, 208 v, Sec: 550 v DC	672 0383 00
V-101	Oscillator	TUBE: Pentode 6AU6	255 0202 00
V-102	Buffer Amplifier	TUBE: Pentode 6SJ7	255 0030 00
V-103	RF 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		Not Used	
V-109		Not Used	
V-110	Modulator	TUBE: Tetrode 4-125A	256 0068 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
V-111	Modulator	TUBE: Tetrode 4-125A	256 0068 00
V-112	Bias supply rectifier	TUBE: Rectifier 504G	255 0032 00
V-113	High voltage supply rectifier	TUBE: Rectifier 872A	256 0037 00
V-114	High voltage supply rectifier	TUBE: Rectifier 872A	256 0037 00
V-115	Low voltage supply rectifier	TUBE: Rectifier 866A	256 0049 00
V-116	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 0258 00
X-101	Socket for I-104	MTG: Pilot light, for candelabra bulbs DISC: Red	262 0255 00 262 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-110	Socket for V-104	SOCKET: Tube, 5 prong	220 1016 00
X-111	Socket for V-105	SOCKET: Tube, 5 prong	220 1016 00
X-112	Socket for T-101	SOCKET: Tube, chassis mtg 7 prong	220 1790 00
X-113	Socket for V-103	SOCKET: Tube, 5 contacts	220 5520 00
X-114	Socket for T-102	SOCKET: Tube, chassis mtg, 7 prong	220 1790 00
X-115	Socket for V-102	SOCKET: Tube, octal, 8 prong	220 1005 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
X-116	Socket for T-103	SOCKET: Tube, chassis mtg, 7 prong	220 1790 00
X-117	Socket for V-101	SOCKET: Tube, miniature, 7 pins	220 1034 00
X-118	Socket for Y-101	SOCKET: Tube, octal, 8 prong	220 1005 500
X-119	Socket for Y-102	SOCKET: Tube, octal, 8 prong	220 1005 500
X-120	Socket for V-110	SOCKET: Tube, 5 prong	220 1016 00
X-121	Socket for V-111	SOCKET: Tube, 5 prong	220 1016 00
X-122	Socket for V-106	SOCKET: Tube, octal, 8 prong	220 1005 00
X-123	Socket for V-107	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
X-127	Socket for V-112	SOCKET: Tube, octal, 8 prong	220 1005 00
X-128	Socket for V-115	SOCKET: Tube, 4 prong	220 5410 00
X-129	Socket for V-116	SOCKET: Tube, 4 prong	220 5410 00
X-130	Socket for V-113	SOCKET: Tube, 4 prong	220 5420 00
X-131	Socket for V-114	SOCKET: Tube, 4 prong	220 5420 00
Y-101	Quartz crystal	CRYSTAL	
Y-102	Quartz crystal	CRYSTAL	

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
B-201	Ventilating fan	FAN MOTOR: unit bearing with shaded pole, 230 volt	230 0164 00
B-301	Tube cooling blower	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, 2mf p/m 10%, 6000 WV	930 0327 00
C-205		Not Used	
C-206		Not Used	
C-207		Not Used	
C-208		Not Used	
C-209		Not Used	
C-210	Bias filter	CAPACITOR: paper, 4mf 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: paper, 1000 mmf p/m 20%, 600 WV	931 0101 00
C-213	Audio Compensating	CAPACITOR: paper, 1000 mmf p/m 20%, 600 WV	931 0101 00
C-214	Audio Compensating	CAPACITOR: paper, 1000 mmf p/m 20%, 600 WV	931 0101 00
C-215	Audio Compensating	CAPACITOR: paper, 1000 mmf p/m 20%, 600 WV	931 0101 00
C-301	PA grid tuning	CAPACITOR: variable, 38 min to 496 max mmf (wiring diagram reads 500 mmf)	920 0095 00
C-302	PA grid pad	CAPACITOR: mica, 400 mmf p/m 5%, 5000 WV OR CAPACITOR: mica, 800 mmf p/m 5%, 5000 WV	906 3401 10 906 3801 10

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-303	PA grid pad	CAPACITOR: mica, 400 mmf p/m 5%, 5000 WV	906 3401 10
		OR	
		CAPACITOR: mica, 800 mmf p/m 5%, 5000 WV	906 3801 10
C-304	PA grid pad	CAPACITOR: mica, 400 mmf p/m 5%, 5000 WV	906 3401 10
C-305	PA grid pad	CAPACITOR: mica, 400 mmf p/m 5%, 5000 WV	906 3401 10
C-306	Filament by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-307	Filament by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-308	Filament by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
C-309	Filament by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 10
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	901 3502 00
		OR	
		CAPACITOR: mica, 1500 mmf p/m 5%, 15,000 WV	939 2037 00
		OR	
		CAPACITOR: mica, 1000 mmf p/m 5%, 20,000 WV	939 2033 00
C-312	Plate by-pass	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 pad	CAPACITOR: fixed, 250 mmf p/m 10%, 10,000 WV	919 0033 00
C-315	PA tuning pad	CAPACITOR: fixed, 250 mmf p/m 10%, 10,000 WV	919 0033 00
#C-316	PA tuning pad	CAPACITOR: fixed, 250 mmf p/m 10%, 10,000 WV	919 0033 00
C-317	PA tuning pad	CAPACITOR: fixed, 250 mmf p/m 10%, 10,000 WV	919 0033 00
C-318	PA tuning pad	CAPACITOR: fixed, 250 mmf p/m 10%, 10,000 WV	919 0033 00

- For 21/M use only.

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	PARTS NUMBER
C-319	PA tuning pad	CAPACITOR: fixed, 250 mmf p/m 10%, 10,000 WV	919 0033 00
C-320	PA loading	CAPACITOR: variable, 496 max to 56 min mmf	920 9600 00
C-321	PA loading pad	CAPACITOR: mica, 1,000 mmf p/m 10%, 10,000 TV OR CAPACITOR: mica, 2000 mmf p/m 5%, 10,000 WV	900 2102 00 alt. 900 2104 00 alt. 939 1033 00 939 1040 00
C-322	PA loading pad	CAPACITOR: mica, 1000 mmf p/m 10%, 10,000 TV OR CAPACITOR: mica, 2000 mmf p/m 5%, 10,000 WV	900 2102 00 alt. 900 2104 00 alt. 939 1033 00 939 1040 00
C-323	PA loading pad	CAPACITOR: mica, 1000 mmf p/m 10%, 10,000 TV OR CAPACITOR: mica, 510 mmf p/m 5% 10,000 WV	900 2102 00 alt. 900 2104 00 alt. 939 1033 00 939 1026 00
C-324	PA loading pad	CAPACITOR: mica, 510 mmf p/m 5%, 10,000 WV OR CAPACITOR: mica, 1000 mmf p/m 10%, 10,000 WV	939 1026 00 939 1033 00
C-325	Mod. Monitor adjust	CAPACITOR: variable, 320 max to 13.5 min mmf, 500 volts	922 1400 00
C-326		Not used	
C-327	Meter by-pass	CAPACITOR: mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-328	Meter by-pass	CAPACITOR: mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-329	PA grid by-pass	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

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
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, 1000 mmf p/m 20%, 2500 WVDC	936 0250 00
C-337	Feedback network	CAPACITOR: mica, 1000 mmf p/m 20%, 2500 WVDC	936 0250 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, 47 mmf p/m 20%, 2500 WVDC	936 0162 00
C-344	Mod. grid by-pass	CAPACITOR: ceramic, 1000 mmf p/m 20%, 5000 WVDC	913 0101 00
C-345	Mod. grid by-pass	CAPACITOR: ceramic, 1000 mmf p/m 20%, 5000 WVDC	913 0101 00
C-346	Mod. fil. by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 00
C-347	Mod. fil. by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 00
C-348	Mod. fil. by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 00

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-349	Mod. fil. by-pass	CAPACITOR: mica, 10,000 mmf p/m 5%, 500 WV	910 1103 00
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-351	Mod. Coupling	CAPACITOR: paper, 1 mf p/m 10%, 10,000 WV	930 0328 00
C-352	Meter by-pass	CAPACITOR: mica, 5100 mmf p/m 5%, 500 WVDC	935 2105 00
C-353	Meter by-pass	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	C-301 isolating	CAPACITOR: mica, 4700 mmf p/m 20%, 2500 WVDC	936 1105 00
C-363	C-301 isolating	CAPACITOR: mica, 4700 mmf p/m 20%, 2500 WVDC	936 1105 00
C-364	Grid circuit balancing	CAPACITOR: ceramic, 40 mmf p/m 10%, 5000 WVDC	913 0089 00
C-365	Grid circuit balancing	CAPACITOR: ceramic, 40 mmf p/m 10%, 5000 WVDC	913 0089 00

#-For 21/M use only.

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
C-366	PA loading pad.	CAPACITOR: mica, 1000 mmf p/m 5%, 10,000 WVDC	939 1033 00
E-201	AC input connector	TERMINAL BLOCK: 3 terminals	306 0068 00
E-202	HV transf pri conn.	TERMINAL BLOCK: 3 terminals	306 0069 00
E-203	HV transf pri conn.	TERMINAL BLOCK: 3 terminals	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 Connector	CONNECTOR STRIP: 11 terminals	367 5110 00
E-301	Audio monitor connector	CONNECTOR STRIP: 2 terminals	367 4020 00
E-302	Relay panel connector	CONNECTOR STRIP: 11 terminals	367 5110 00
E-303	RF output connector	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. Plate fuse	FUSE: cartridge, 1.5 amp 250 v	264 0007 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
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 w	262 0170 00

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
I-203	Overload Indicator	BULB: candelabra base, 230-250 v 10 w	262 0169 00
I-204	HV PLATE pilot light	BULB: candelabra base, 230-250 v 10 w	262 0169 00
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-302	Mod. monitor output conn.	CONNECTOR: receptacle single female contact	357 9005 00
J-303	Meter cable conn.	CONNECTOR: receptacle, 4 female contacts	364 2040 00
K-201	Plate Overload relay	RELAY: 115 v, 60 cps, AC	410 0048 00
K-202A	Micro Switch contact	SWITCH: snap action, 10A-125 vac, 5A-250 vac	260 0561 00
K-202B	Micro Switch contact	SWITCH: snap action, 10A-125 vac, 5A-250 vac	260 0561 00
K-202C	Switch actuator	MOTOR: 230 v 60 cps, 5 w	230 0045 00
K-203	Lockout relay	RELAY: contact arrangement, 1 c left, 1 c right(12 pole double throw)	405 0615 00
K-204	Plate contactor	RELAY: contact arrangement, 1 NO 1 NC, 3 poles	401 1318 00 alt. 405 0211 00
K-205	Bias change relay	RELAY: contact arrangement, 1 c left, 1 c right (2 pole double throw)	405 0615 00
K-301	Blower contactor	RELAY: contact arrangement, 3 NO-10A contact rating	401 1202 00
K-302		Not Used	
K-303	Filament contactor	RELAY: power contactor, 3 NO-10A contact rating includes switch	506 0581 003
K-304		Not Used	
K-305	Blower Hold.	RELAY: contact arrangement 1 c, double break	402 0235 00

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
L-201	Bias filter choke	REACTOR: filter, 6.6 hy min at 0.20 amp DC, 85 ohm max	278 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, 6 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: RF fixed tank, 60 mh	980 0076 00
L-302	Parasitic suppressor coil	Not Used	
L-303		Not Used	
L-304	PA plate choke	INDUCTOR: RF choke, 1.1 mh	506 0617 003
#L-305	PA plate tank	INDUCTOR: RF fixed tank, 30 mh OR INDUCTOR: RF fixed tank, 60 mh	980 0064 00 alt. 980 0070 00 980 0063 00
L-305	PA plate tank	INDUCTOR: RF fixed tank, 60 mh OR INDUCTOR: RF fixed tank, 120 mh	980 0063 00 980 0062 00
L-306	PA output loading coil	INDUCTOR: RF 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
#L-310	Modulation choke	REACTOR: modulation, 30 hy, 50 ohm DC resistance, 18,000 TV	668 0078 00
L-311		Not Used	

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MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
L-312		Not Used	
L-313		Not Used	
L-314	Mod. Monitor conn. filter	COIL: RF 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-301	RF output meter	METER: RF ammeter 0-15 range, 75 scale divisions	451 0085 00
M-302	PA plate current	METER: DC ammeter, 0-3 range, 60 scale divisions	450 0100 00
M-303	HV DC voltmeter	METER: DC voltmeter, 0-750 volts DC, 75 scale divisions	458 0312 00
M-304	Multimeter	METER: DC milliameter, 0-25 range	458 0170 00
M-305	Mod Plate current	METER: DC ammeter, 0-3 range, 60 scale divisions	450 0100 00
P-301		CONNECTOR: Cable	363 8042 00
P-302	Meter plug	CONNECTOR: Cable	363 8042 00
R-201	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00
R-202	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00
R-203	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00
R-204	HV bleeder	RESISTOR: 20,000 ohm p/m 5%, 100 w	710 2134 00
R-205	Overload relay adjust	RESISTOR: Variable wire wound, 25 ohm	377 0003 00
R-206	Meter shunt	RESISTOR: 3 ohm p/m 5%, 100 w	710 2009 00
#R-207	Meter shunt	RESISTOR: 3 ohm p/m 5%, 100 w	710 2009 00
R-208	Low Power Mod. bias adj.	RESISTOR: 250 ohm p/m 10%, 200 w	716 0005 00
R-209	K-201 Coil shunt	RESISTOR: 27 ohm p/m 10%, 2 w	745 9031 00
R-210	Audio Compensating network	RESISTOR: 1000 ohm p/m 10%, 160 w	710 2730 00

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PARTS LIST

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-211	Audio compensating network	RESISTOR: 1000 ohm p/m 10%, 160 w	710 2730 00
R-301	PA tube grid	RESISTOR: 1500 ohm p/m 10%, 50 w	710 0093 00
#R-301	PA tubes grid	RESISTOR: 500 ohm p/m 10%, 50 w	710 2705 00
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 9139 00
R-305	Feedback network	RESISTOR: 10,000 ohm p/m 10%, 2 w	745 9139 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: 1 meg p/m 1%, 2 w	705 4001 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 9167 00
R-320	V-303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 9167 00
R-321	V-303 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 9167 00

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MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
R-322	V-303 grid series resistor	RESISTOR: 4,700 ohm p/m 10%, 2 w	745 9125 00
R-323	V-304 grid series resistor	RESISTOR: 4,700 ohm p/m 10%, 2 w	745 9125 00
R-324	V-304 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 9167 00
R-325	V-304 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 9167 00
R-326	V-304 grid resistor	RESISTOR: 47,000 ohm p/m 10%, 2 w	745 9167 00
R-327		Not Used	
R-328	M-304 shunt (mod)	RESISTOR: .4 ohm p/m 2%, 20 w	710 2511 00
R-329	M-304 shunt (mod)	RESISTOR: .4 ohm p/m 2%, 20 w	710 2511 00
#R-330	M-304 shunt (PA)	RESISTOR: 1000 ohm p/m 10%, 1 w	745 3086 00
R-331	M-304 shunt (PA)	RESISTOR: .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: 1000 ohm p/m 10%, 1 w	745 3086 00
R-334	PA grid meter shunt	RESISTOR: 4 ohm p/m 1%, 1 w	722 0046 00
R-335	Mod Bias Adj	RESISTOR: variable, 25,000 ohm	377 0011 00
R-336	Mod Bias Adj	RESISTOR: variable, 25,000 ohm	377 0011 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: 3 ohm	710 3542 00
R-340	Bias voltage divider	RESISTOR: 12,000 ohm p/m 10%, 100 w	710 2129 00
S-201	HV Interlock	CONTACT ASSEM: Female section of door interlock switch	260 4050 00
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

#-For 21/M use only.

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
S-203	HV 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-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" diam x 0.064" thk SHAFT: 4-9/16" lg x 5/16" diam	 506 0515 002 506 0514 002 506 0513 002
S-206	HV Sec.grounding interlock	Not Used	
S-207	"Y" "Delta" HV-LV switch	SWITCH: Rotary, 3 pole, 2 position	266 0044 00
S-208	HV Plate control and breaker	SWITCH: magnetic, 3 pole, 3 overload coils	260 0935 00
#S-208	HV Plate control and breaker	SWITCH: magnetic, 3 pole, 3 overload coils	260 0415 00
S-209	Overload Selector	SWITCH: Toggle, 30 amp	266 3060 00
S-210	Overload Reset	SWITCH: push, momentary action, four mtg holes	260 2020 00
S-301	HV interlock	SWITCH: 2 female contacts, momentary action	260 4050 00 alt. 260 4040 00
S-302	HV interlock	SWITCH: 2 female contacts, momentary action	260 4050 00 alt. 260 4040 00
S-303	Blower Breaker and switch	SWITCH: magnetic, 2 pole, 2 overload coils	260 0220 00
S-304	Blower interlock	SWITCH: snap action, 10A-125 v AC, 5A-250 v AC	260 0561 00

#-For 21/M use only.

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
S-305	Filament breaker and switch	SWITCH: Magnetic, 3 pole, 3 overload coils	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 9553 001
S-308	HV shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl; 0.218" diam x 0.064" thk	 504 9587 002 504 9533 001
S-309	HV shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl; 0.218" diam x 0.064" thk	 504 9587 002 504 9533 001
S-310	Bias shorting interlock	Includes: HINGE: safety device CONTACT: brass, cad pl; 0.218" diam x 0.064" thk	 504 9587 002 504 9533 001
T-201	Filament voltage control	TRANSFORMER: variable autotransformer, 230 v, 60 cps 3 phase	664 0079 00
T-202	Bias Rect. filament	TRANSFORMER: Filament, Pri: 203 v Sec: 115 v CT	672 0399 00
T-203	Bias Rect. plate	TRANSFORMER: Power, Pri: 208v tapped Sec: as required for 1100 v DC at 200 ma, CT	667 0087 00
T-204	HV plate	TRANSFORMER: Plate, 230/208 VRMS 3 phase, 50/60 cps	662 0096 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, 2500 RMS TV, Sec: 5 v TV, 10,000 RMS TV	672 0456 00
T-206	HV rectifier filament	TRANSFORMER: Filament, Pri No 1: 115 v, Pri No 2: 115 v, 2500 RMS TV, Sec: 5 v TV, 10,000 RMS TV	672 0456 00

#-For 21/M use only

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
T-207	HV rectifier filament	TRANSFORMER: Filament, Pri No 1: 115 v, Pri No 2: 115 v, 2500 RMS TV, Sec: 5 v TV, 10,000 RMS TV	672 0456 00
T-208	HV rectifier filament	TRANSFORMER: Filament, Pri No 1: 115 v, Pri No 2: 115 v, 2500 RMS TV, Sec: 5 v TV, 10,000 RMS TV	672 0456 00
T-209	HV rectifier filament	TRANSFORMER: Filament, Pri No 1: 115 v, Pri No 2: 115 v, 2500 RMS TV, Sec: 5 v TV, 10,000 RMS TV	672 0456 00
T-210	HV rectifier filament	TRANSFORMER: Filament, Pri No 1: 115 v, Pri No 2: 115 v, 2500 RMS TV, Sec: 5 v TV, 10,000 RMS TV	672 0456 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: 2750 ohm CT, Sec: 1700 ohm, 18,000 Pri, 14,000 Sec RMS TV	667 0081 00
T-302	V-303 filament transf.	TRANSFORMER: Filament, Pri: 230 v, Sec: 7.75 v CT	662 0085 00
T-303	V-304 filament transf.	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

#-For 21/M use only.

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
V-205	HV rectifier	TUBE: Rectifier 872A	256 0037 00
#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 3X3000A-1	256 0100 00
#V-302	Power Amplifier	TUBE: Triode 3X2500-A	256 0087 00
V-303	Modulator	TUBE: Triode 3X3000A-1	256 0100 00
V-304	Modulator	TUBE: Triode 3X2500-A	256 0087 00
W-301	PA grid feed	CABLE: Coaxial, nom impedance 52 ohm	425 0006 00
XC-310	Socket for C-310	SOCKET: for capacitor, brass bright alloy plate	506 0593 002
XF-301	Socket for F-301	FUSE HOLDER: extractor post type for 3AG fuses	265 1002 00
XF-302	Socket for F-302	FUSE HOLDER: extractor post type for 3AG fuses	265 1002 00
XF-303	Socket for F-303	FUSE HOLDER: extractor post type for 3AG fuses	265 1002 00
#XF-304	Socket for F-304	MTG: Socket for lumiline lamp bulb	265 1002 00
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	Mounting for I-203	MTG: Pilot light, for candelabra bulbs	262 0255 00

#-For 21/M use only.

MAJOR ASSEMBLY: 21E/M

ITEM	CIRCUIT FUNCTION	DESCRIPTION	PART NUMBER
XI-204	Mounting for I-204	MTG: Pilot light, for candelabra bulbs	262 0255 00
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	MTG: Pilot light, for candelabra bulbs	262 0033 00
XI-304	Socket for I-304	MTG: Pilot light, for candelabra bulbs	262 0033 00
XV-301	Socket for V-301	PLATE: electrical shield, includes 2 capacitors	506 0521 004
XV-302	Socket for V-302	Not Used	
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

Figure 7-1A. PA Cabinet, Rear View.

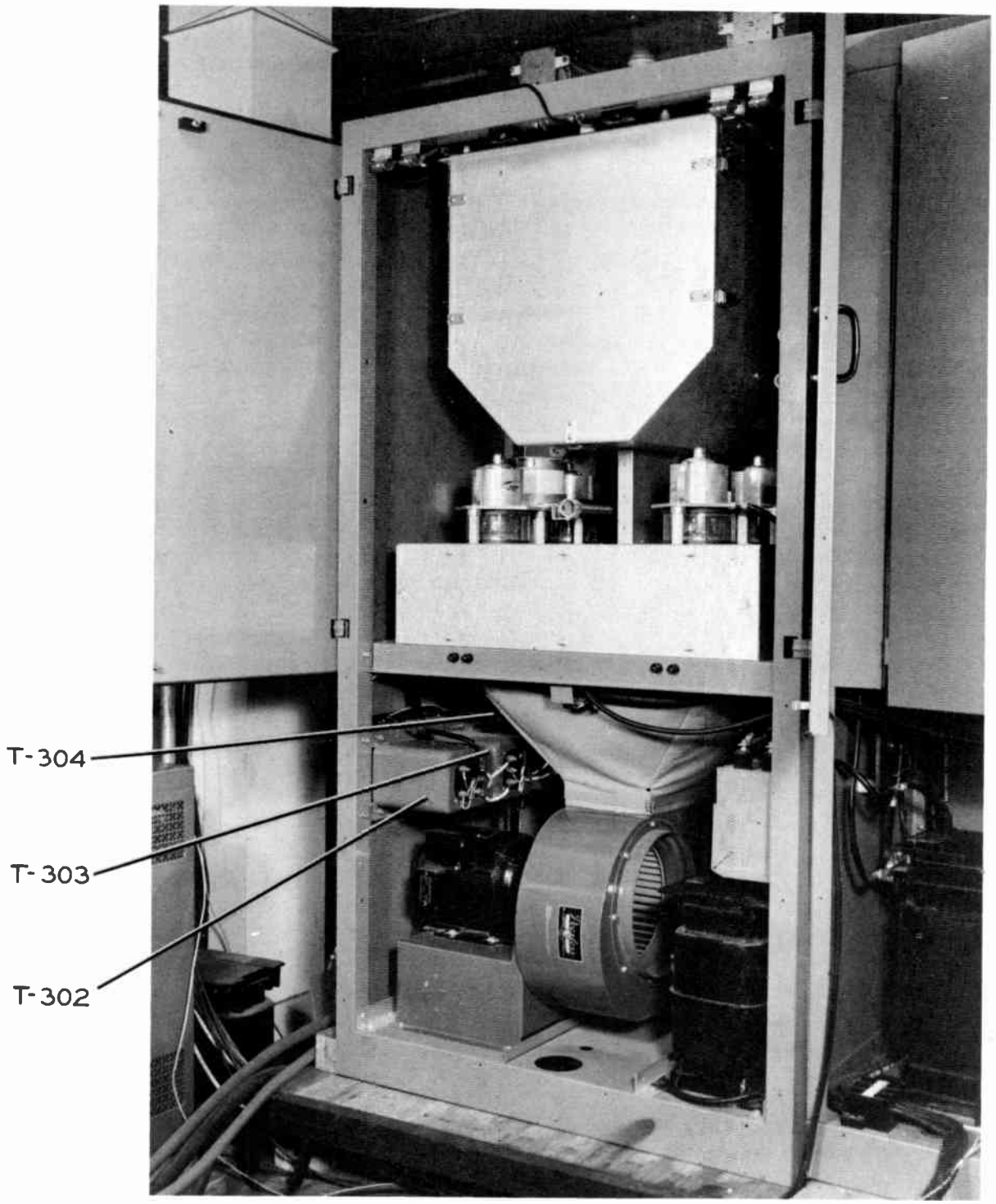


Figure 7-1B. PA Cabinet, Rear View.

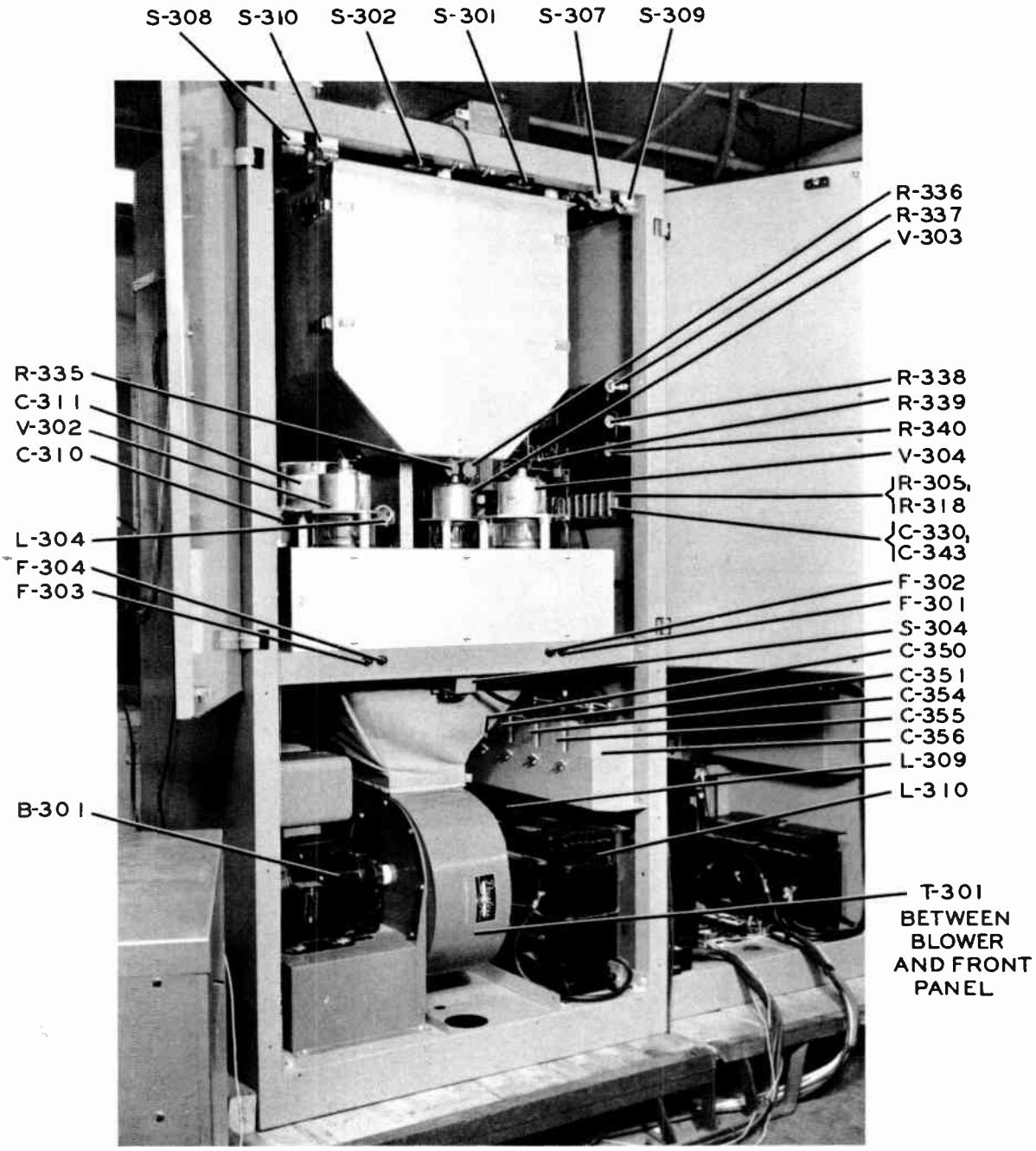


Figure 7-1C. PA Cabinet, Rear View.

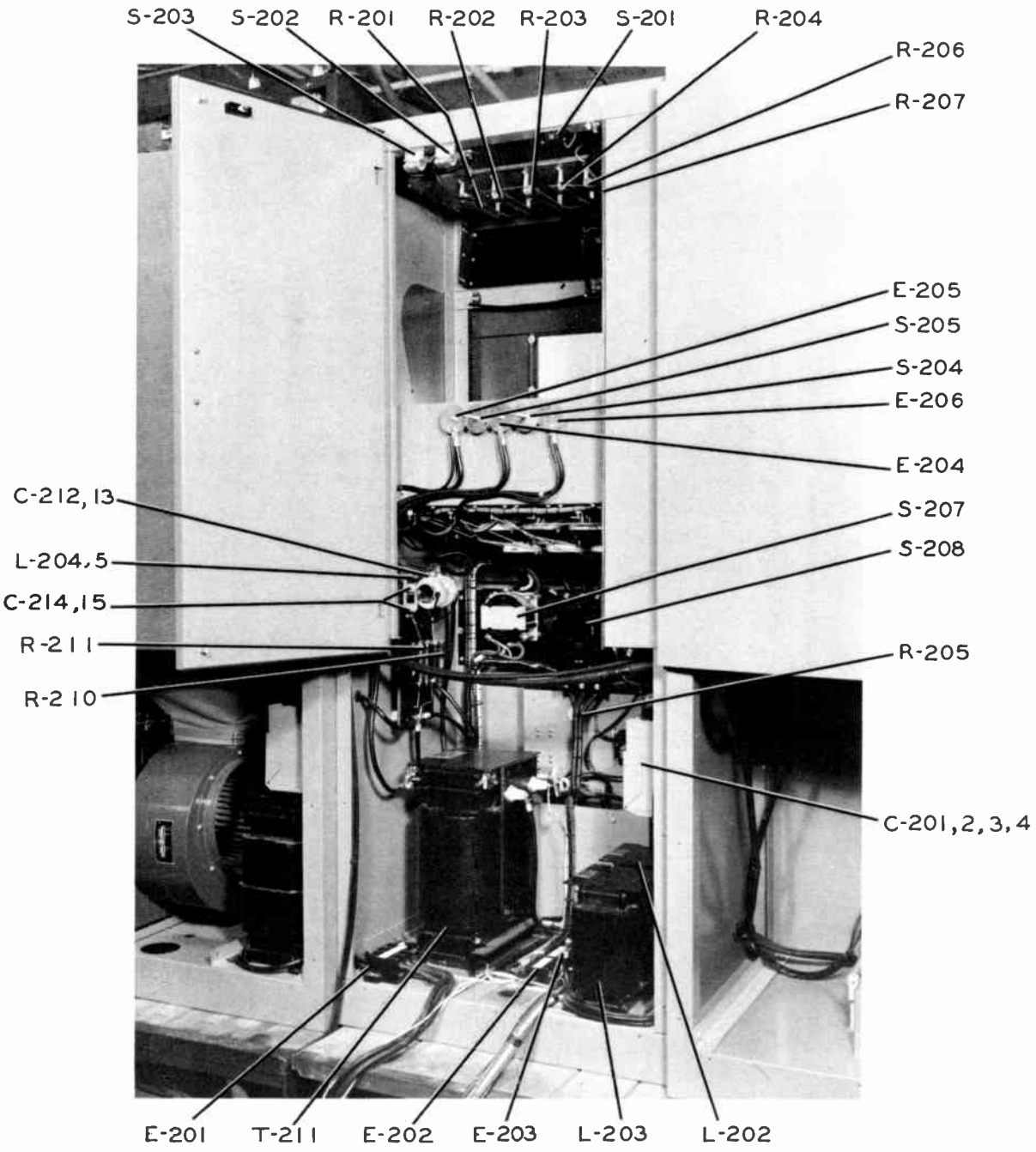


Figure 7-2A. Power Supply Cabinet, Rear View.

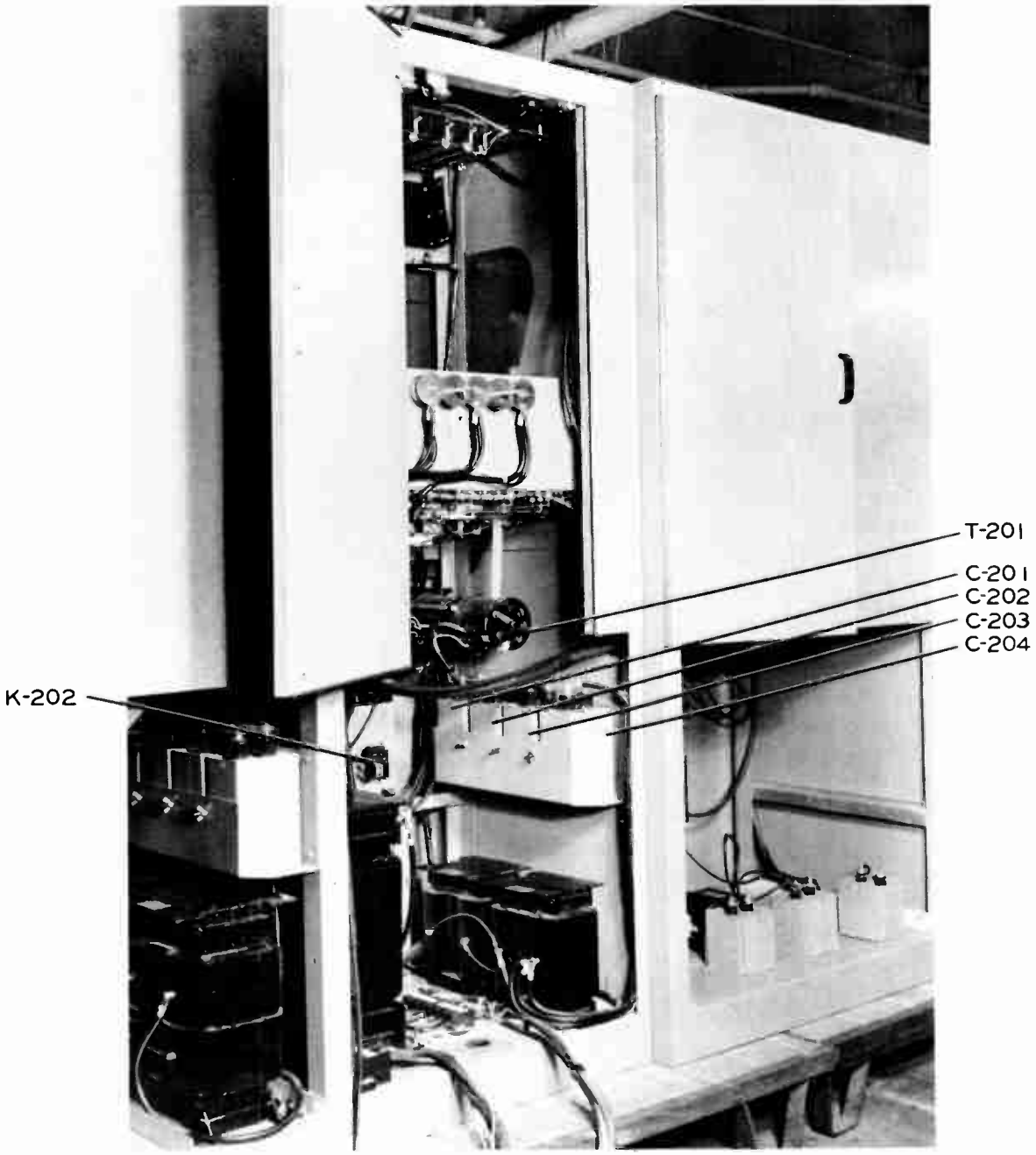


Figure 7-2B. Power Supply Cabinet, Rear View.

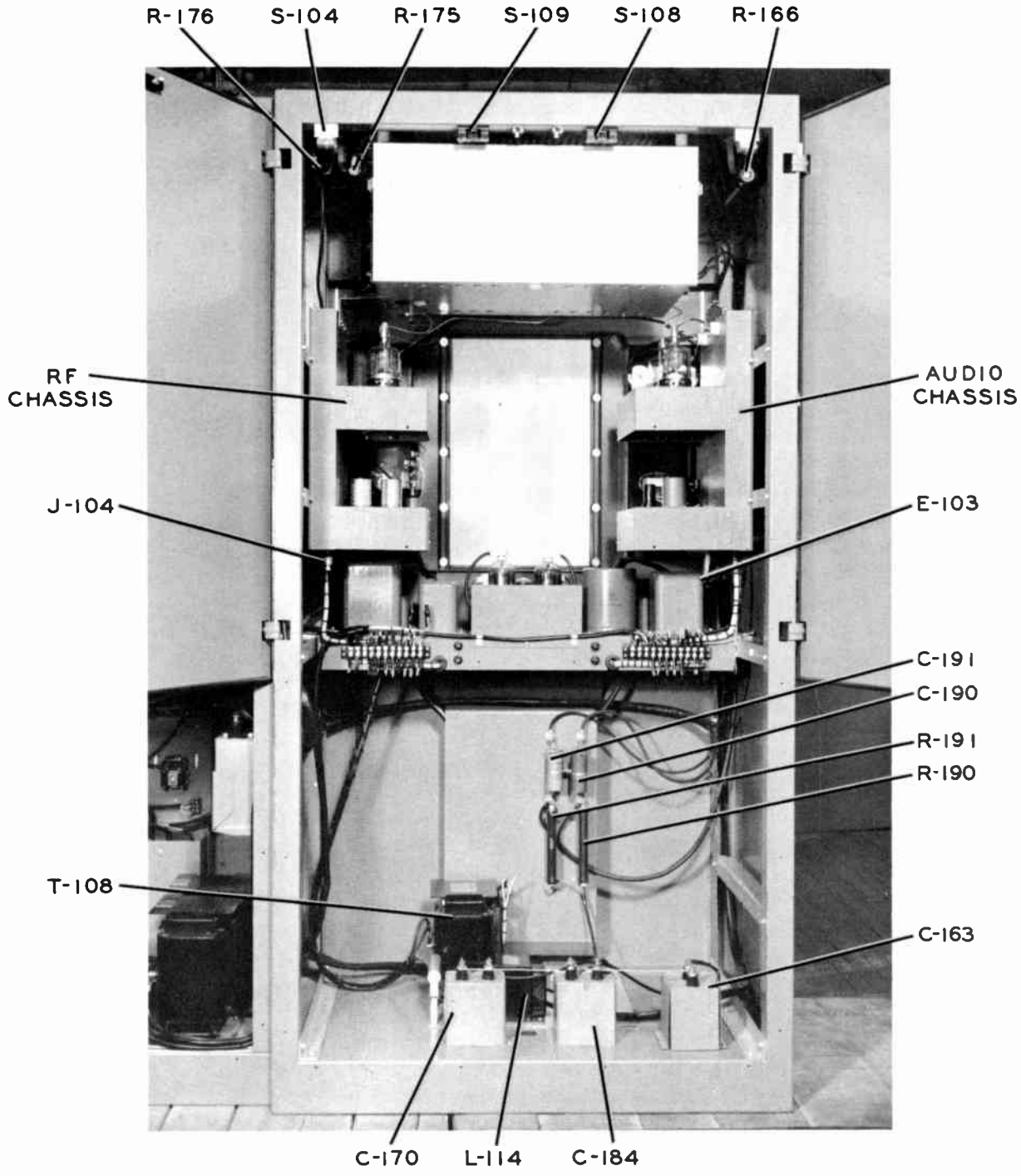
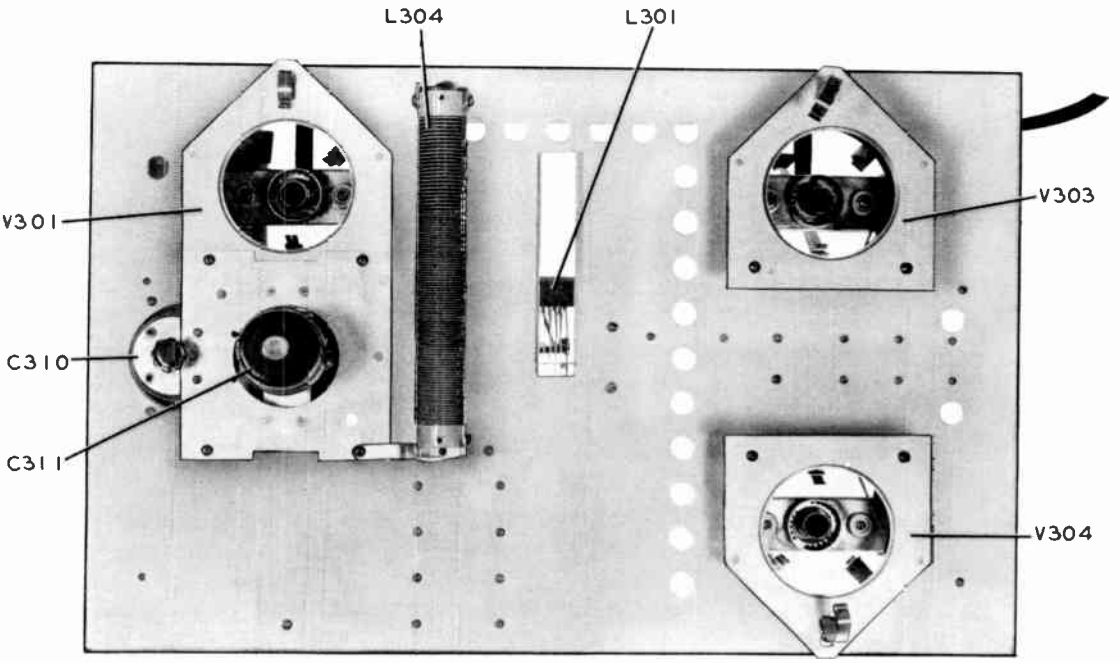


Figure 7-3. Driver Cabinet, Rear View.



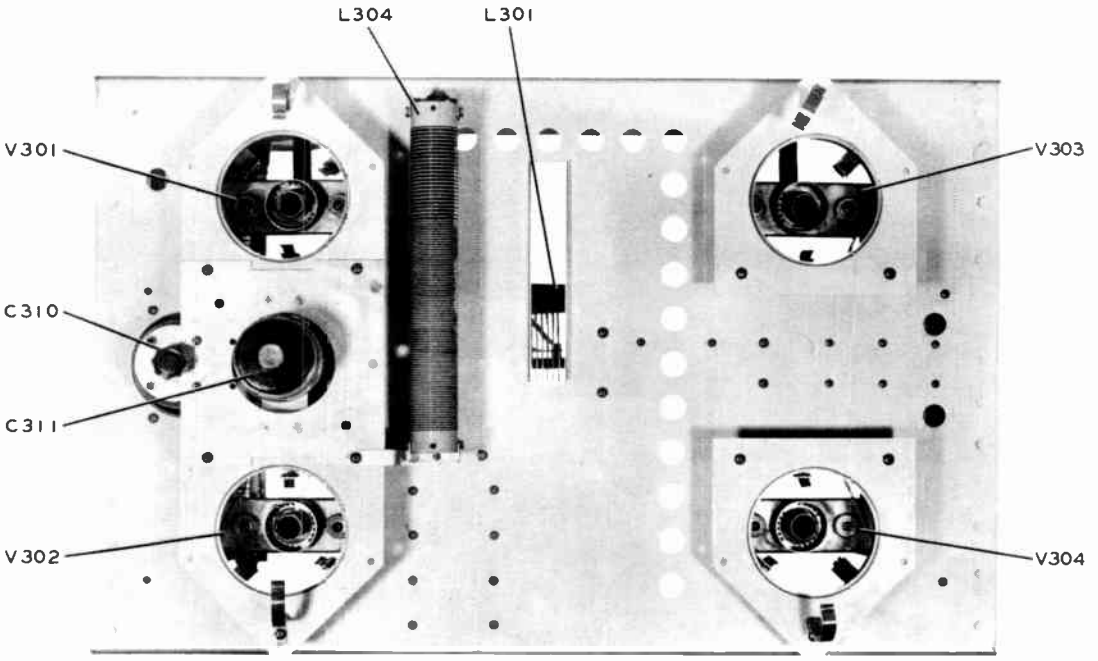
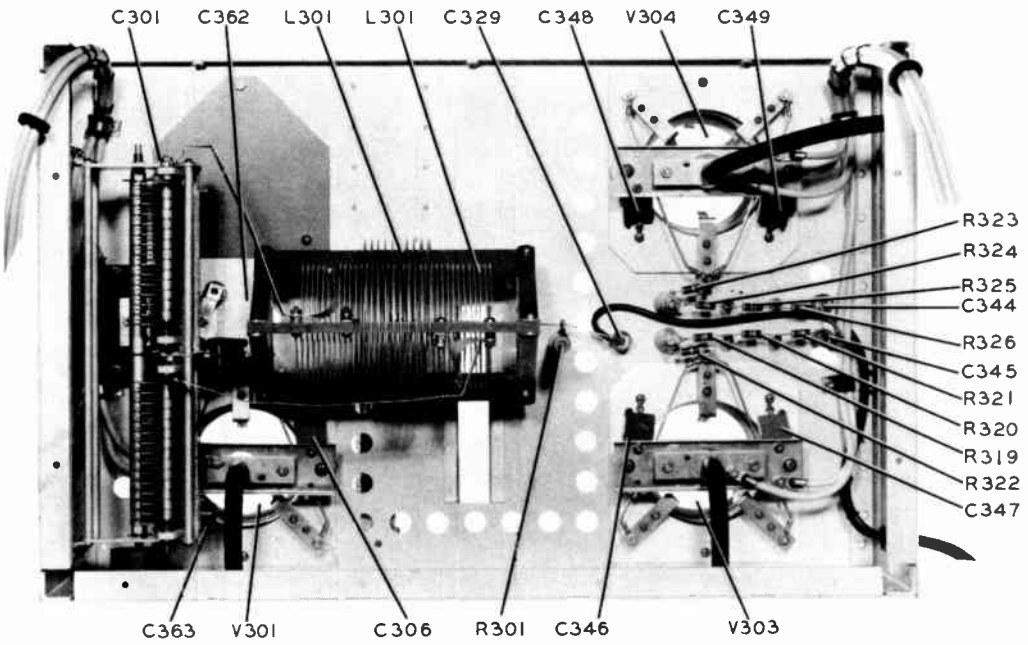
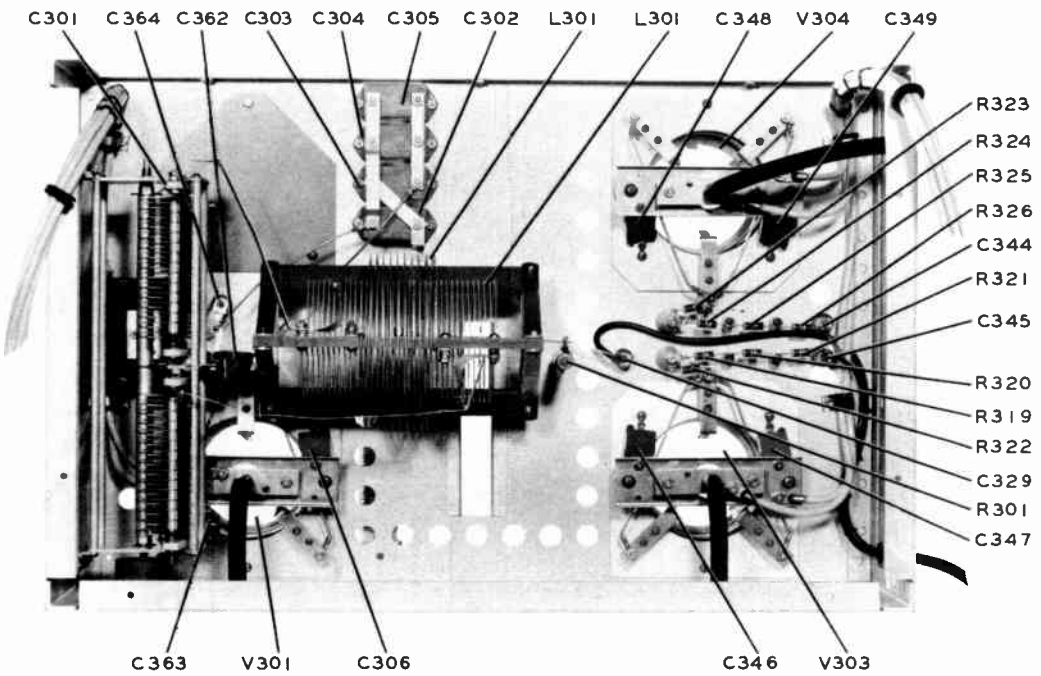


Figure 7-4. Power Amplifier RF chassis, Top View.

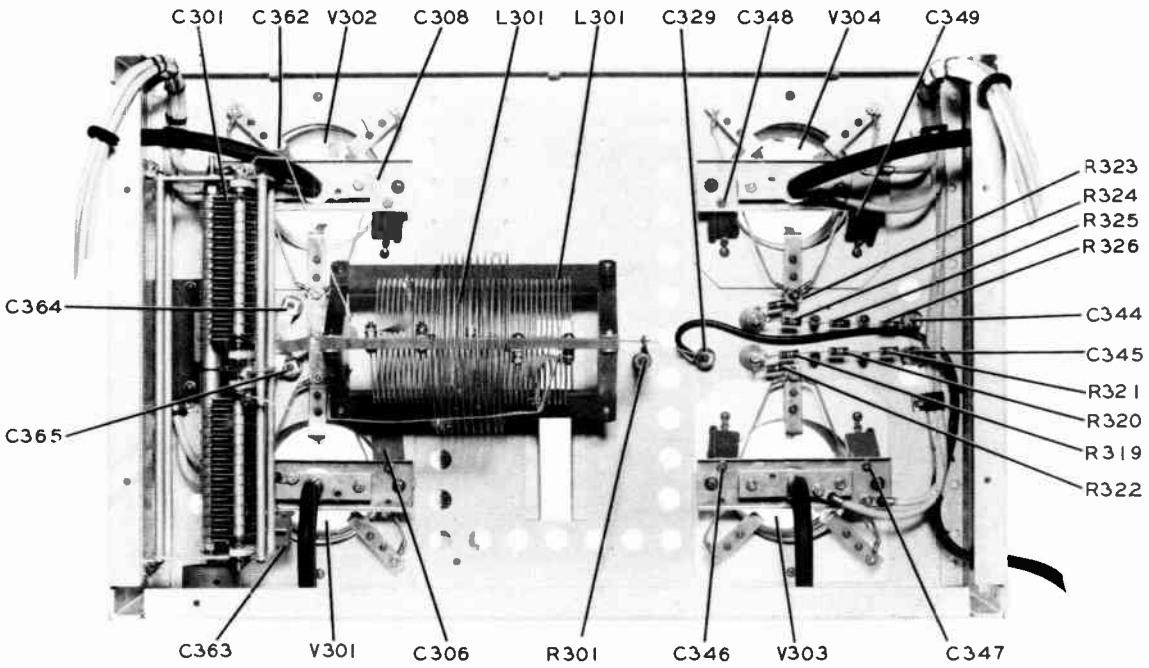


21E HIGH FREQUENCY

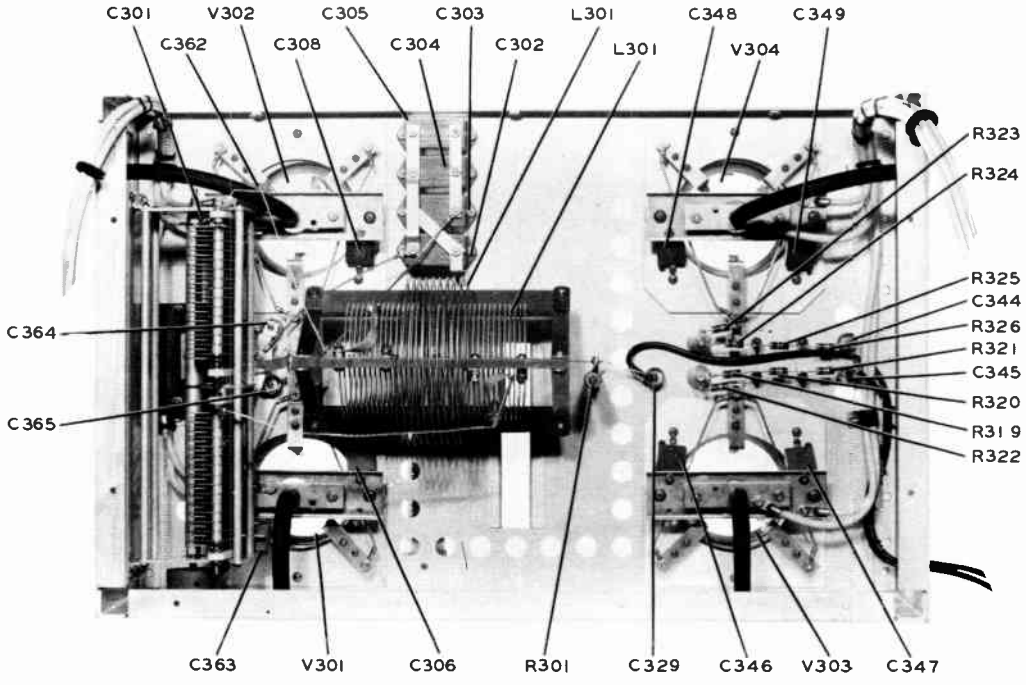


21E LOW FREQUENCY

Figure 7-5A. Power Amplifier RF Chassis, Bottom View.



21M HIGH FREQUENCY



21M LOW FREQUENCY

Figure 7-5B. Power Amplifier RF Chassis, Bottom View

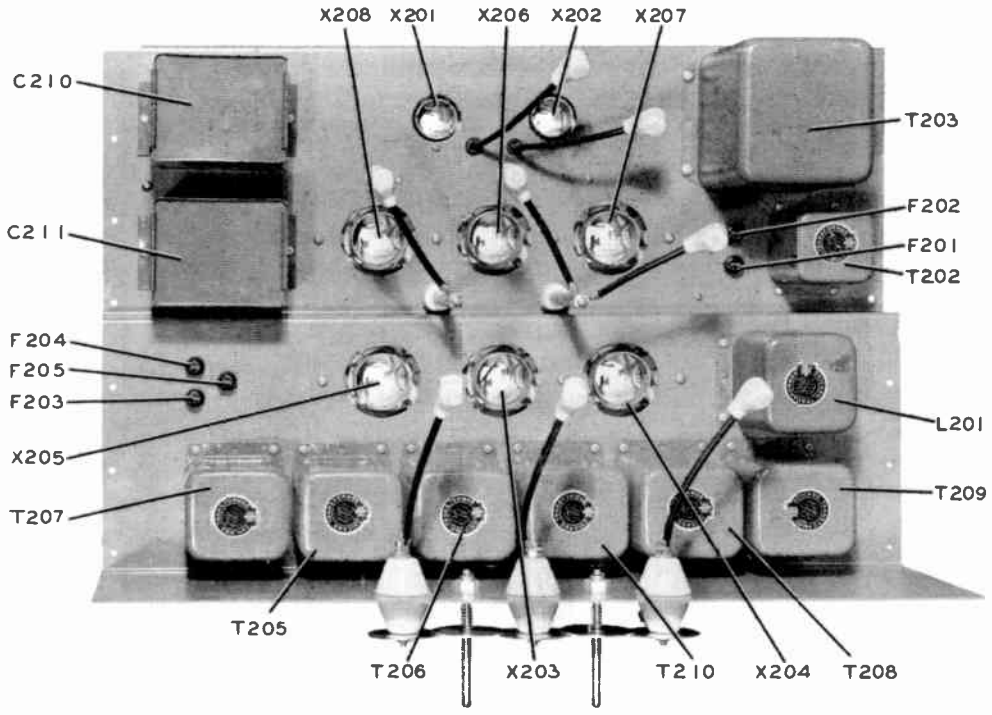


Figure 7-6. Power Supply Cabinet Rectifier Chassis, Top View.

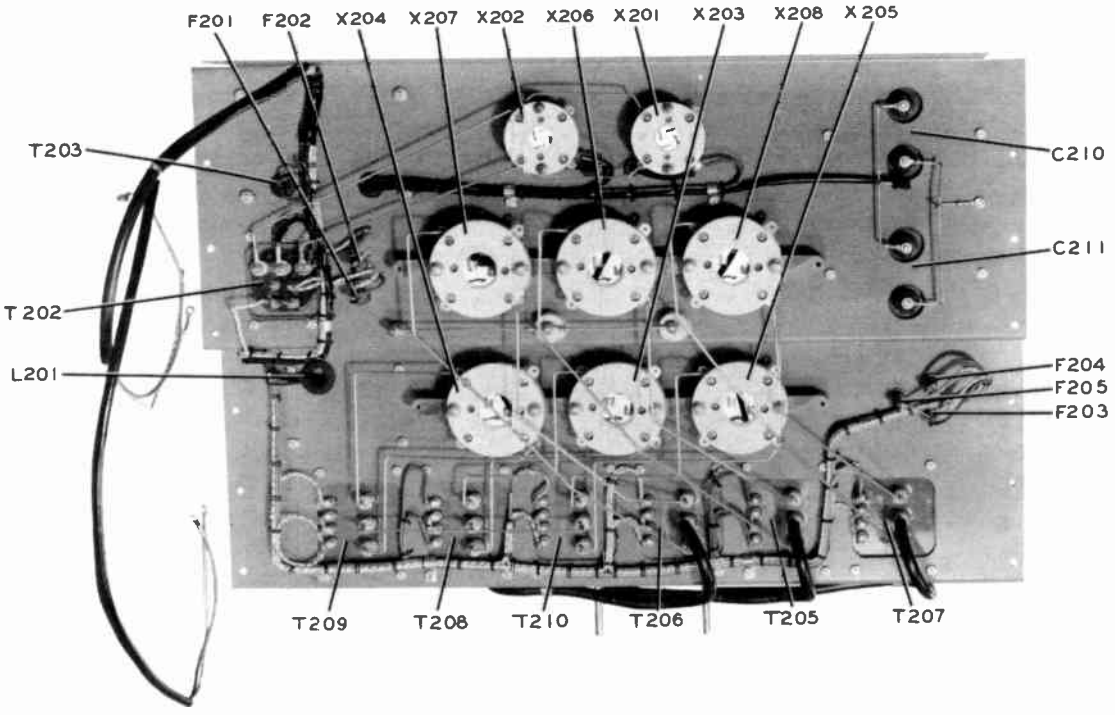


Figure 7-7. Power Supply Cabinet Rectifier Chassis, Bottom View.

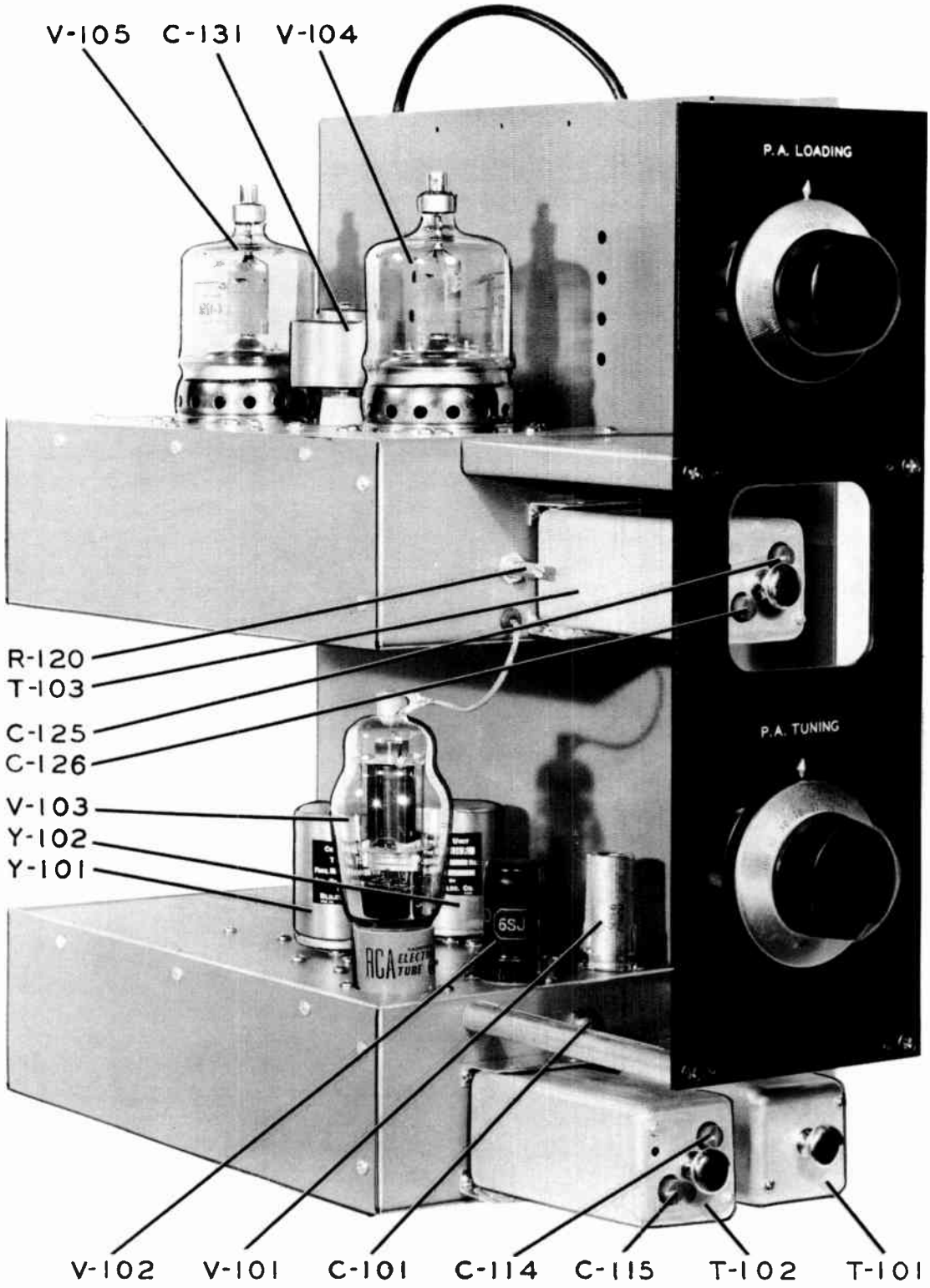


Figure 7-8. Driver Cabinet RF Chassis, Top View.

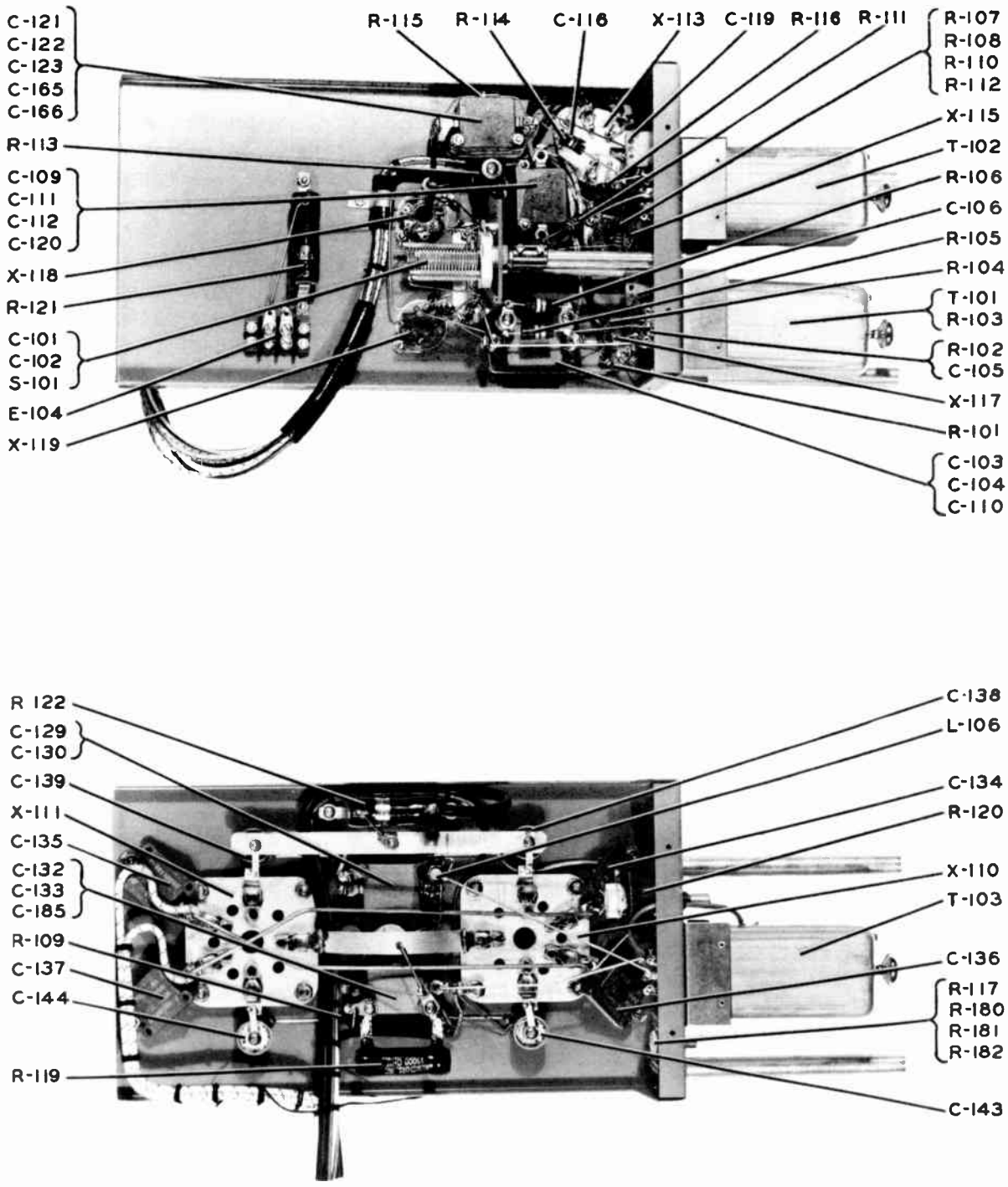


Figure 7-9. Driver Cabinet RF Chassis, Bottom View.

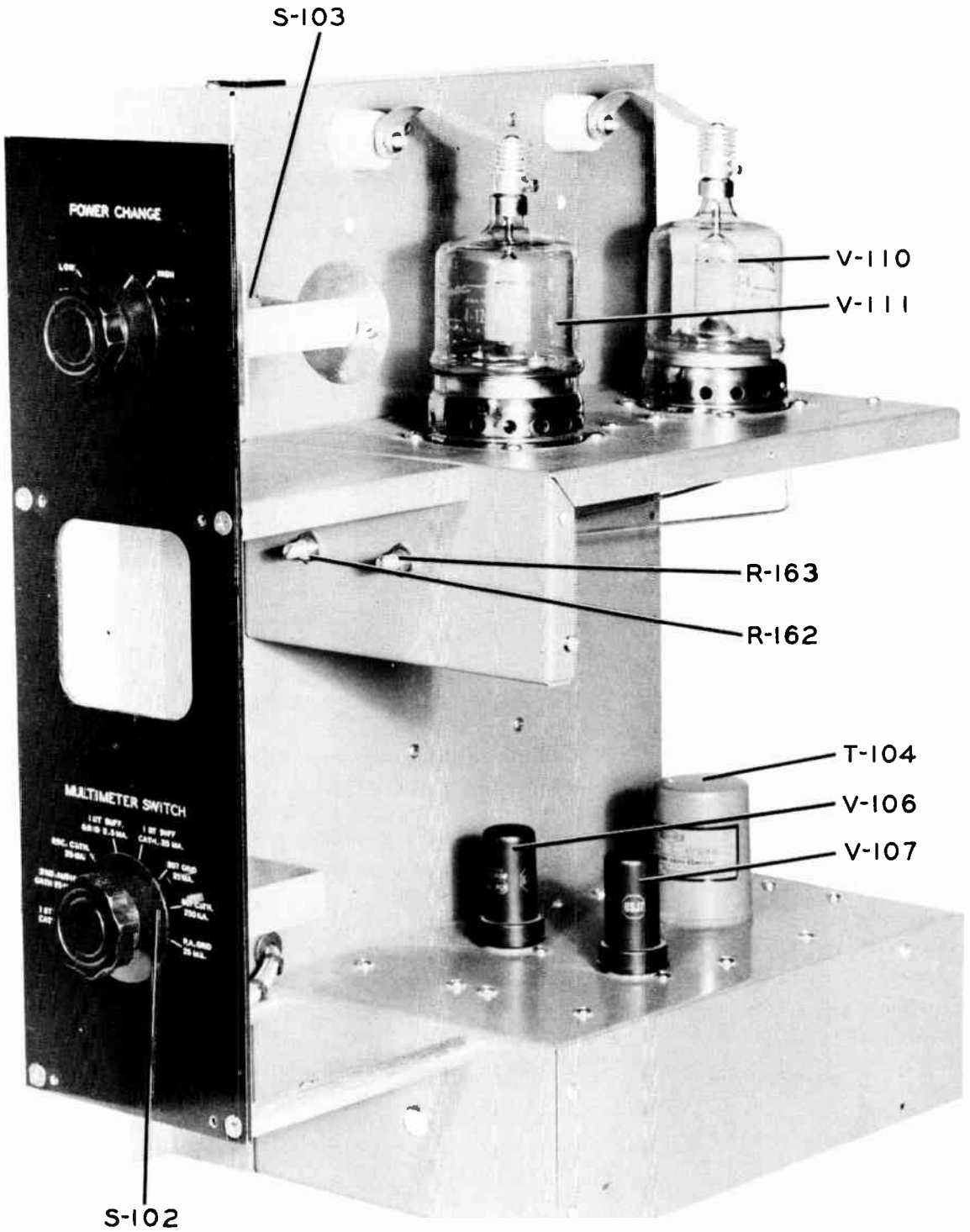


Figure 7-10. Driver Cabinet Audio Chassis, Top View.

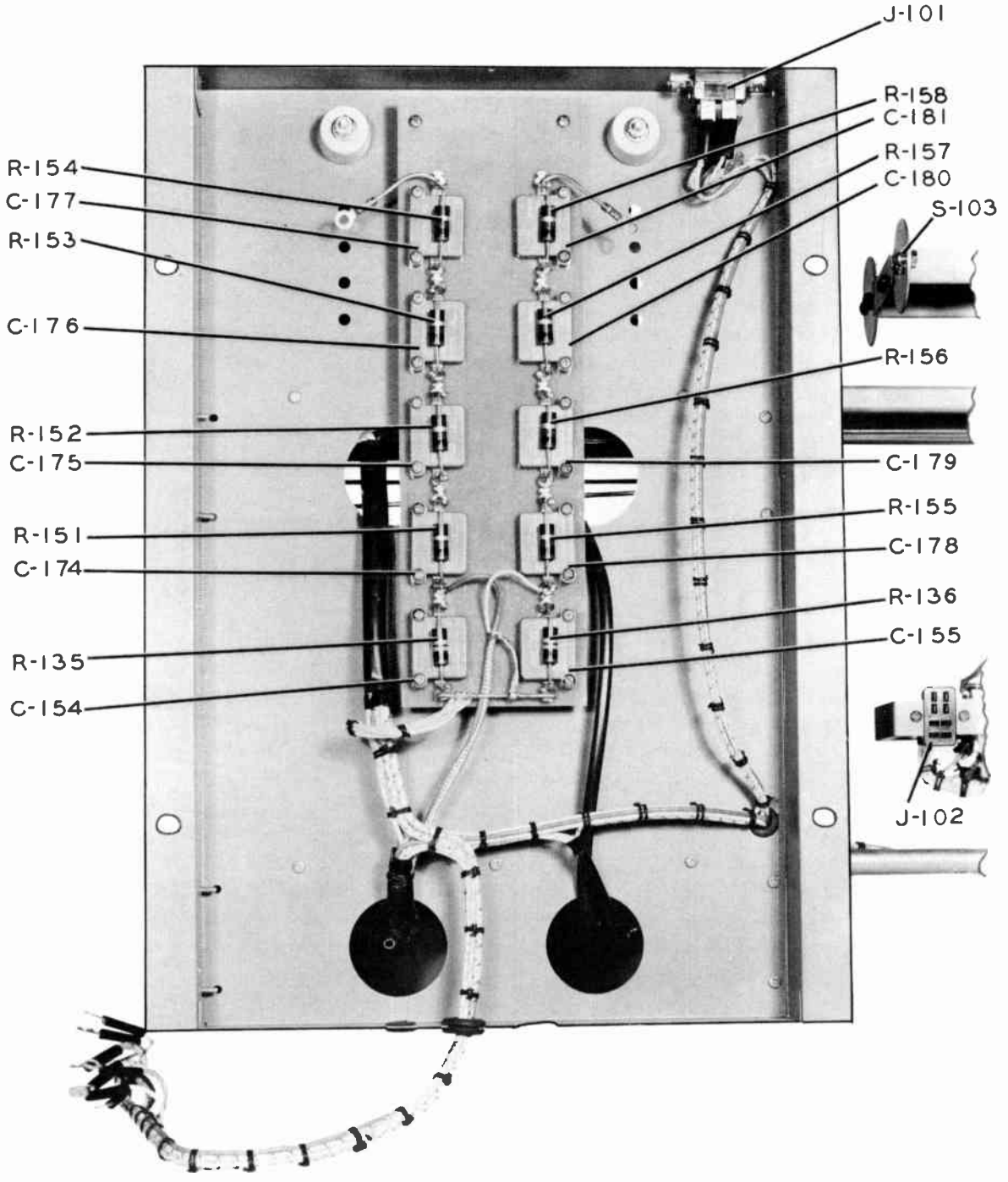
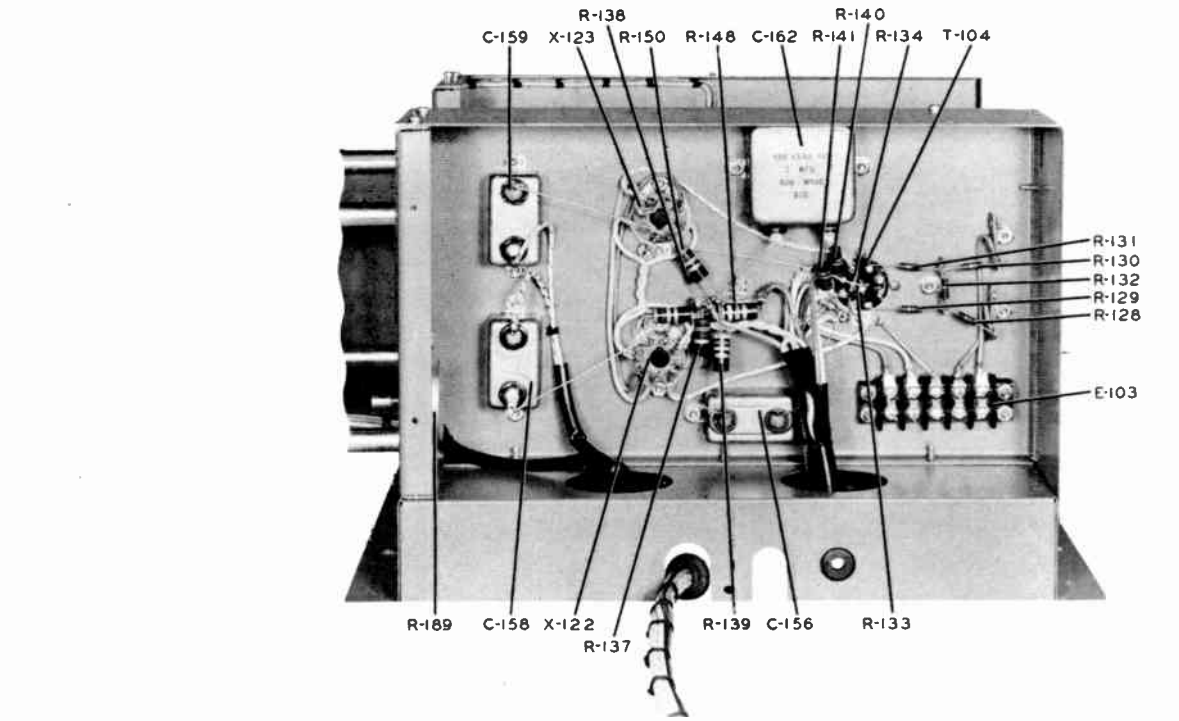


Figure 7-11. Driver Cabinet Audio Chassis, Side View.



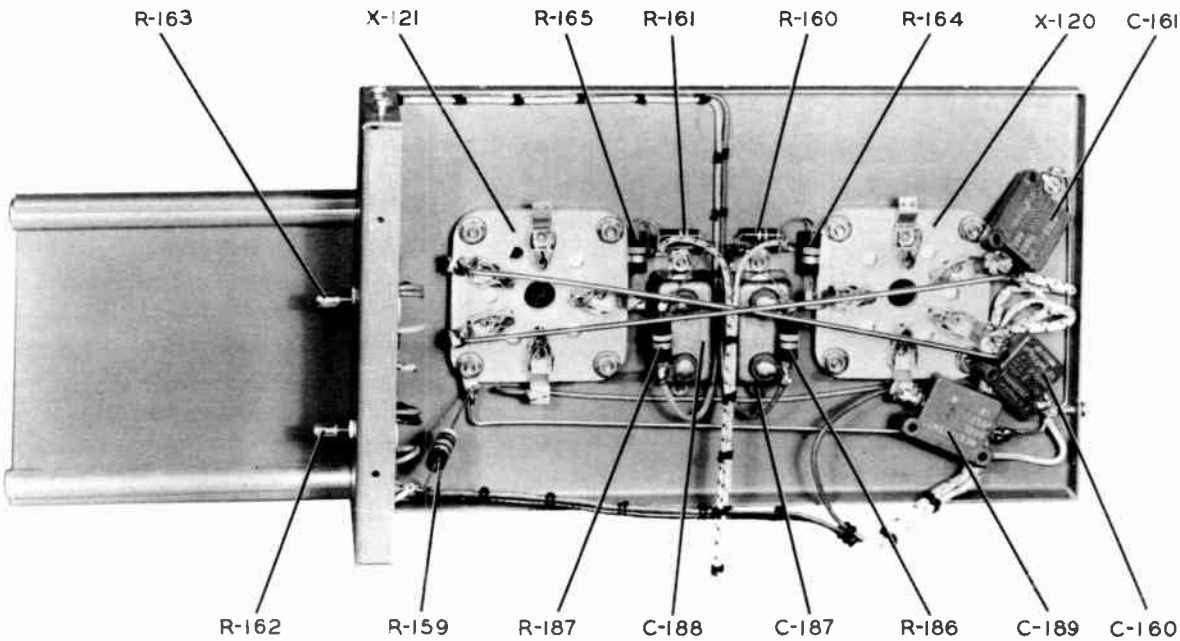


Figure 7-12. Driver Cabinet Audio Chassis, Bottom View.

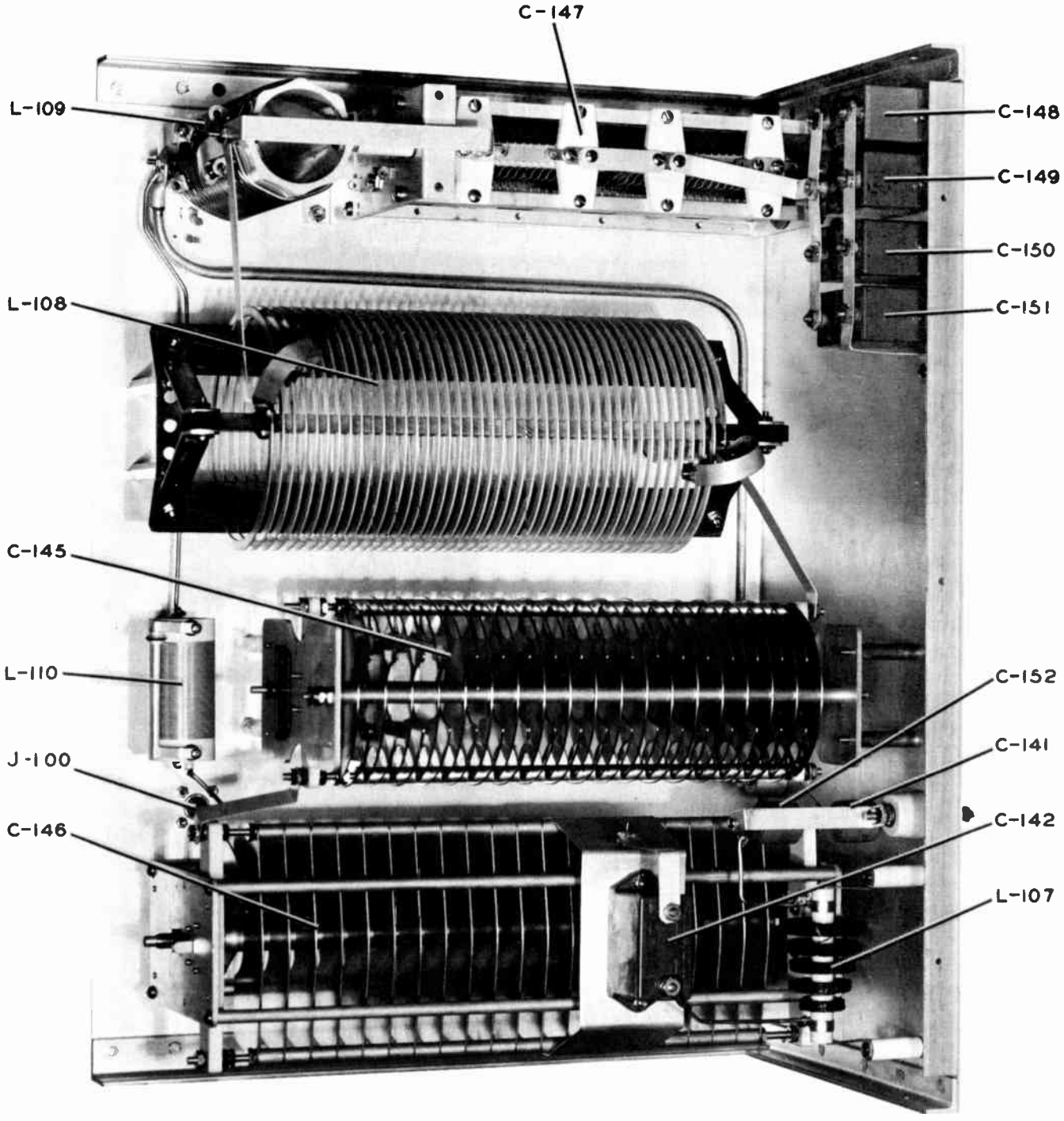


Figure 7-13. Driver Cabinet Output Network, Bottom View.

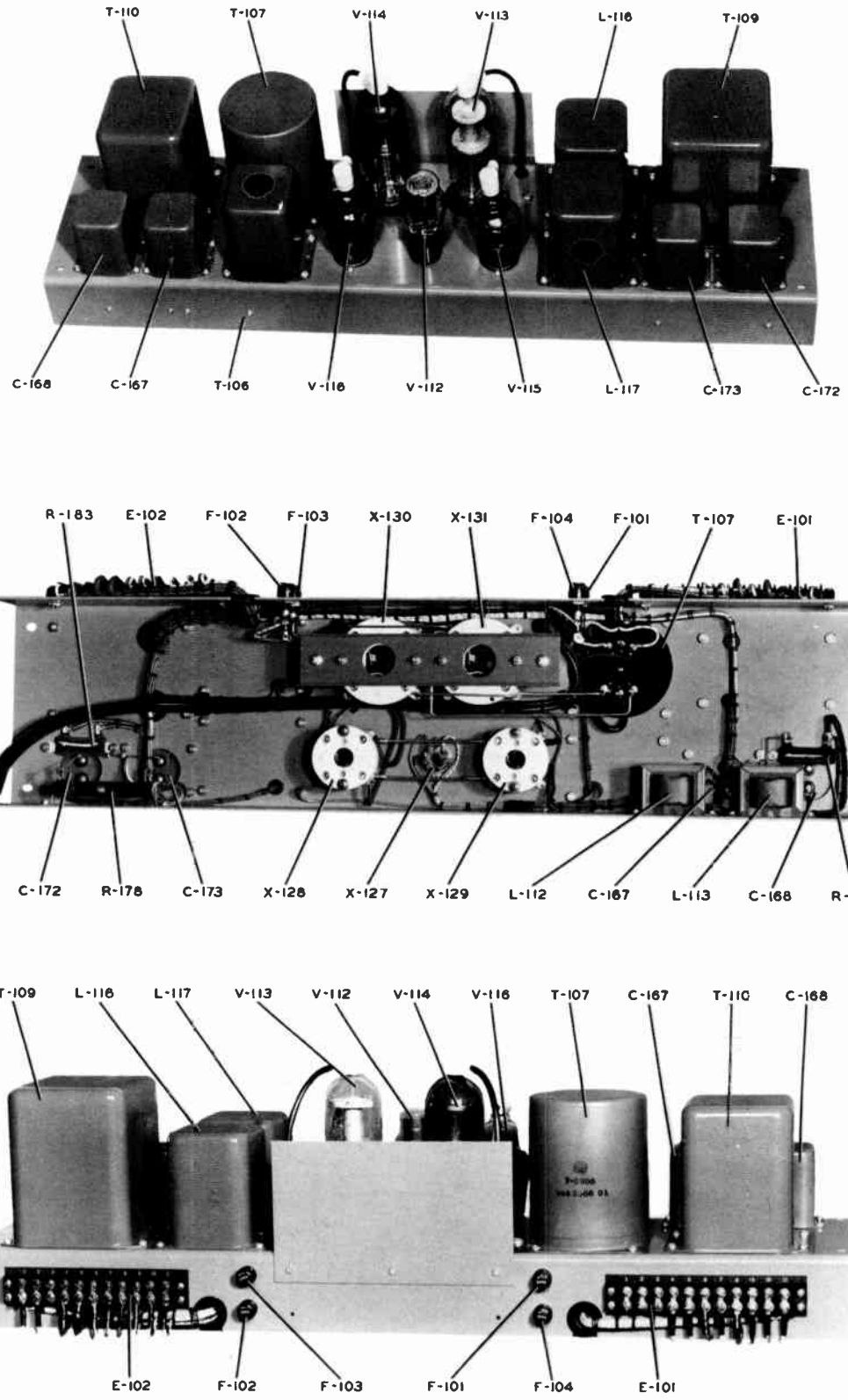


Figure 7-14. Driver Cabinet, Low Voltage Power Shelf.

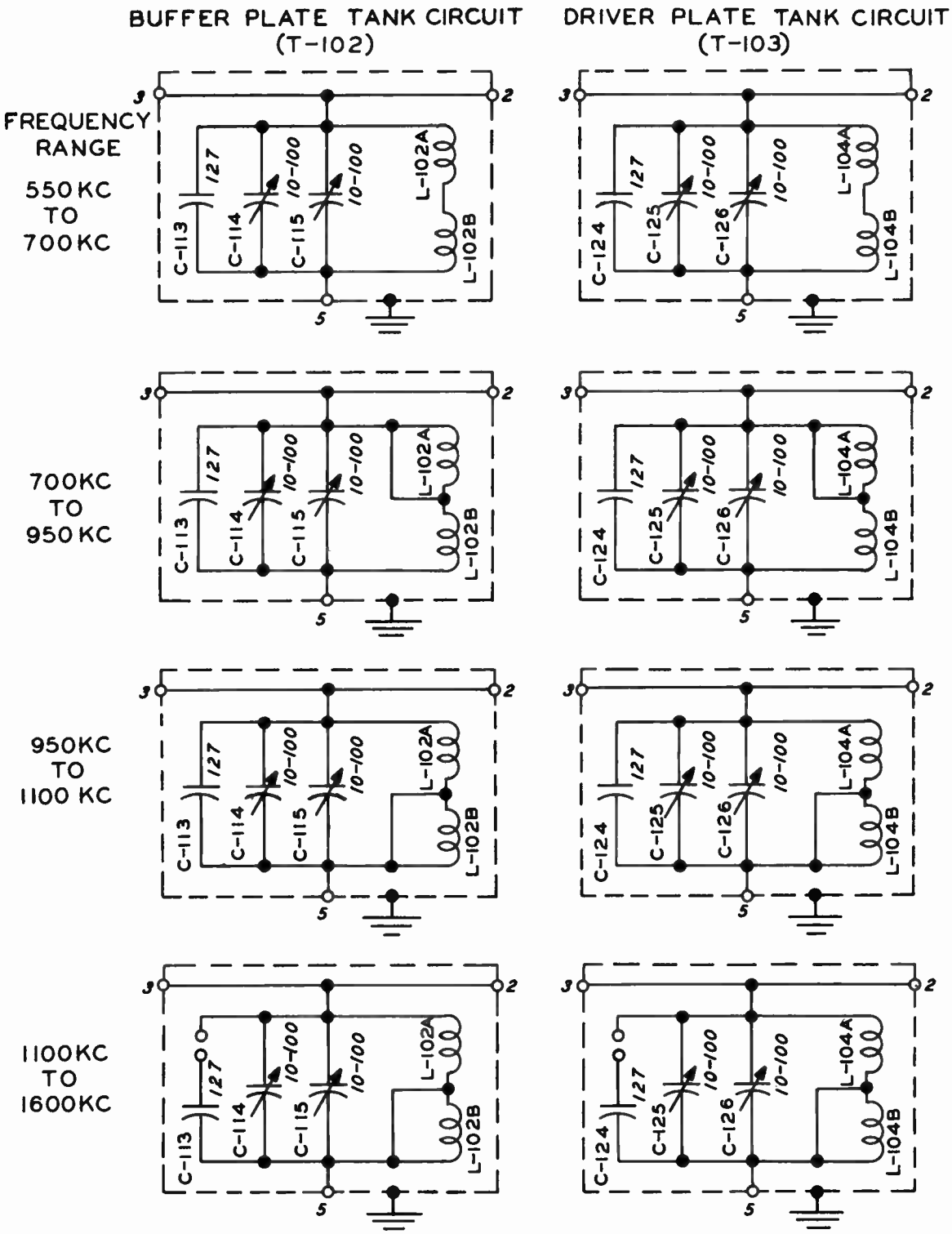


Figure 8-1. T-102 and T-103 Internal Connections.

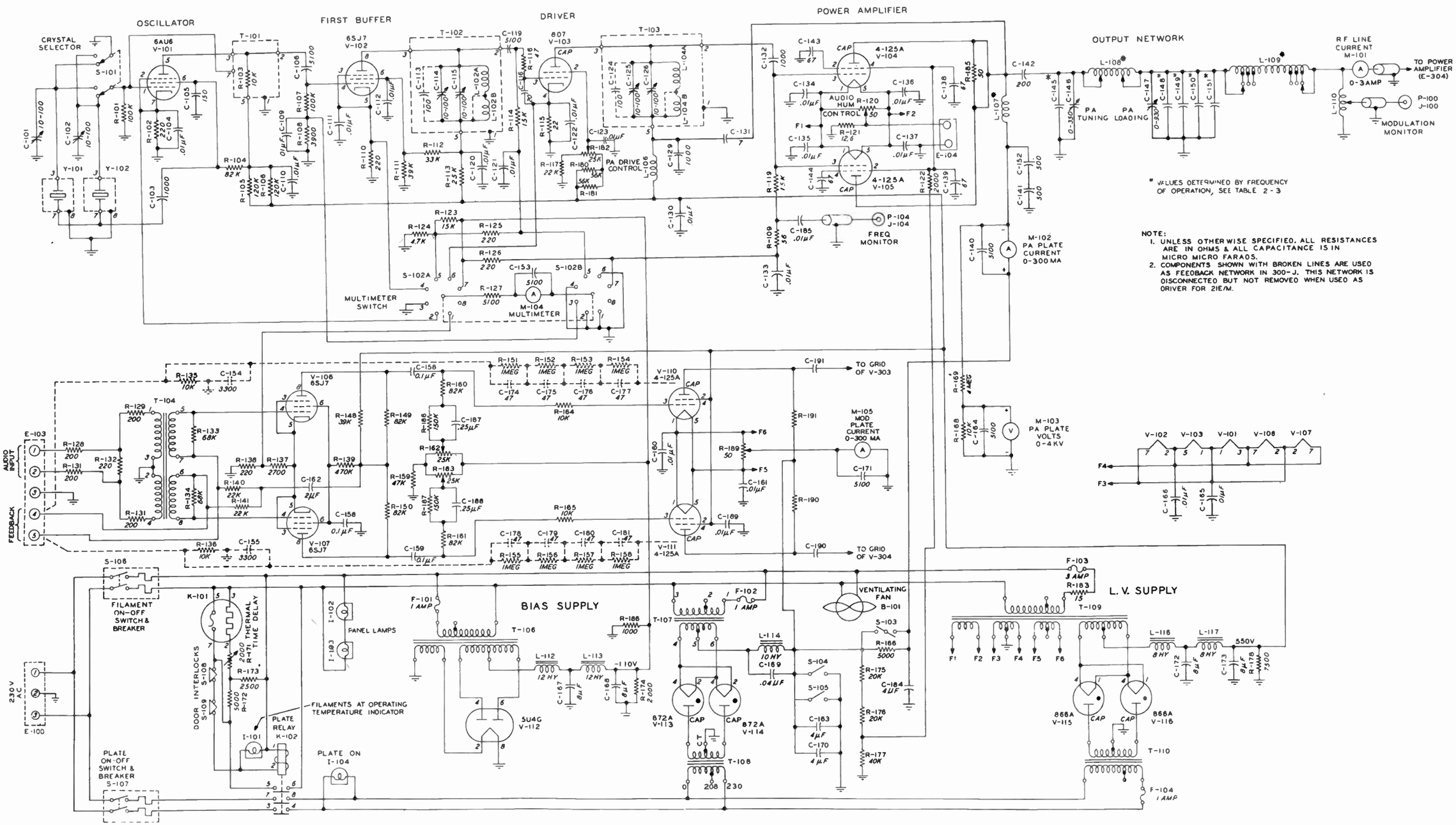


Figure 8-2. Driver Cabinet Complete Schematic.

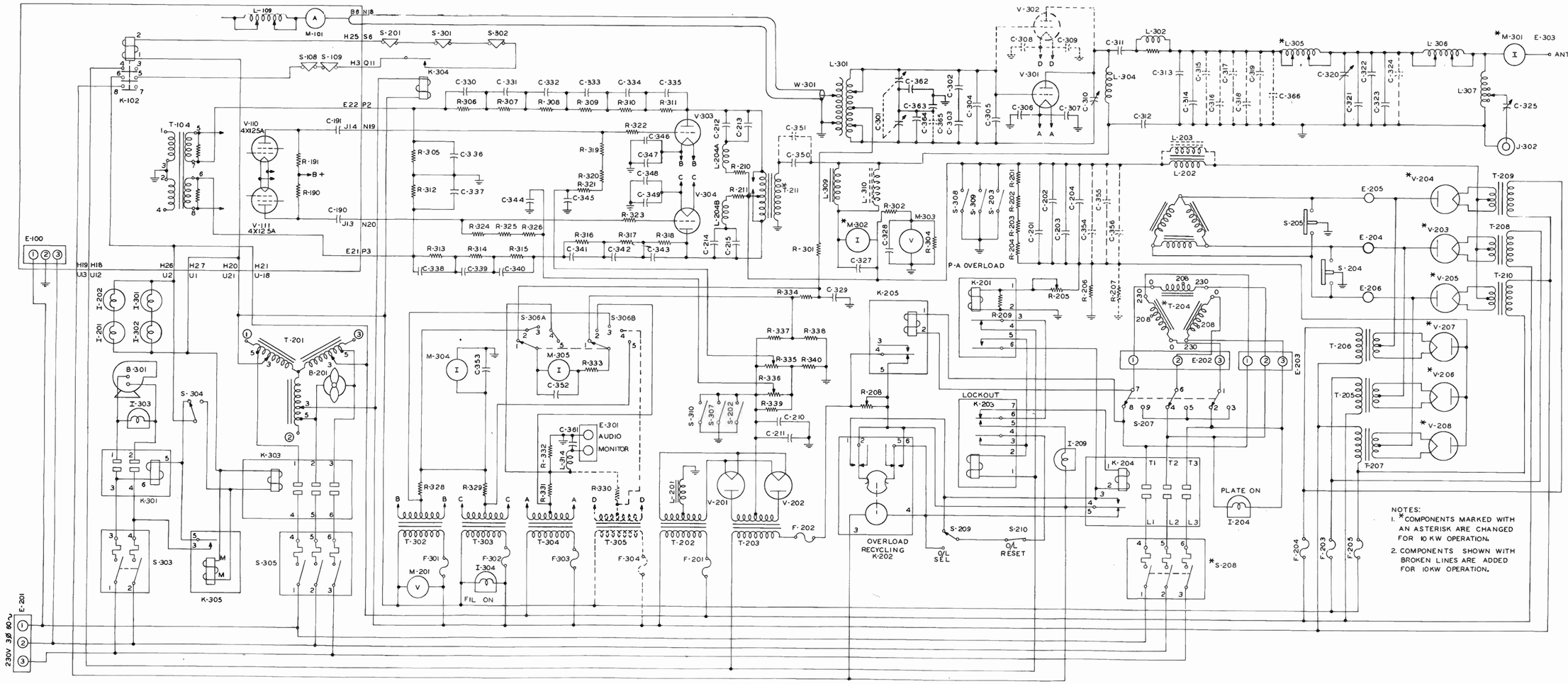


Figure 8-3. PA and Power Cabinets Complete Schematic.

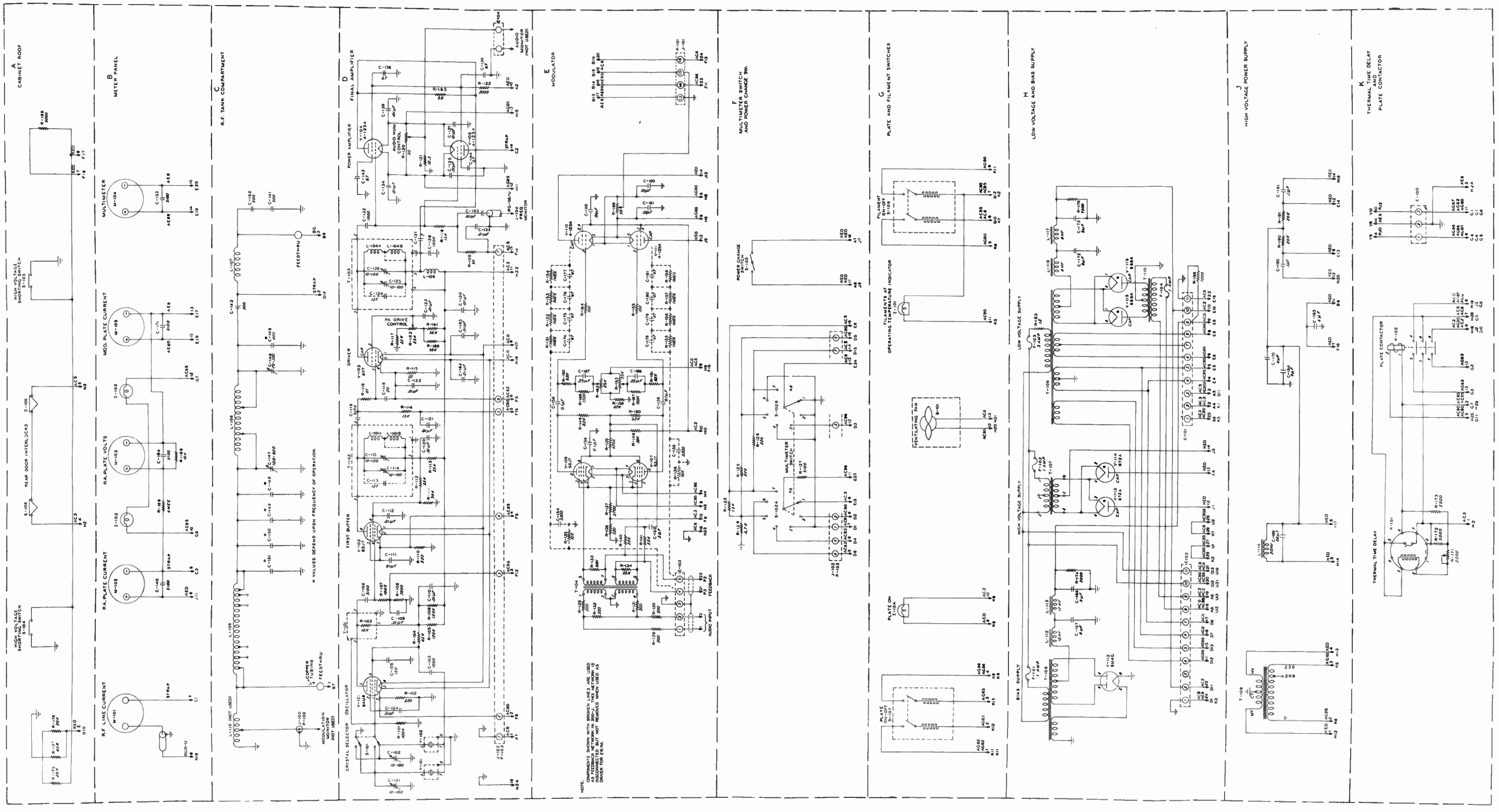


Figure 8-4. Driver Cabinet Inter-Unit Cabling Diagram.

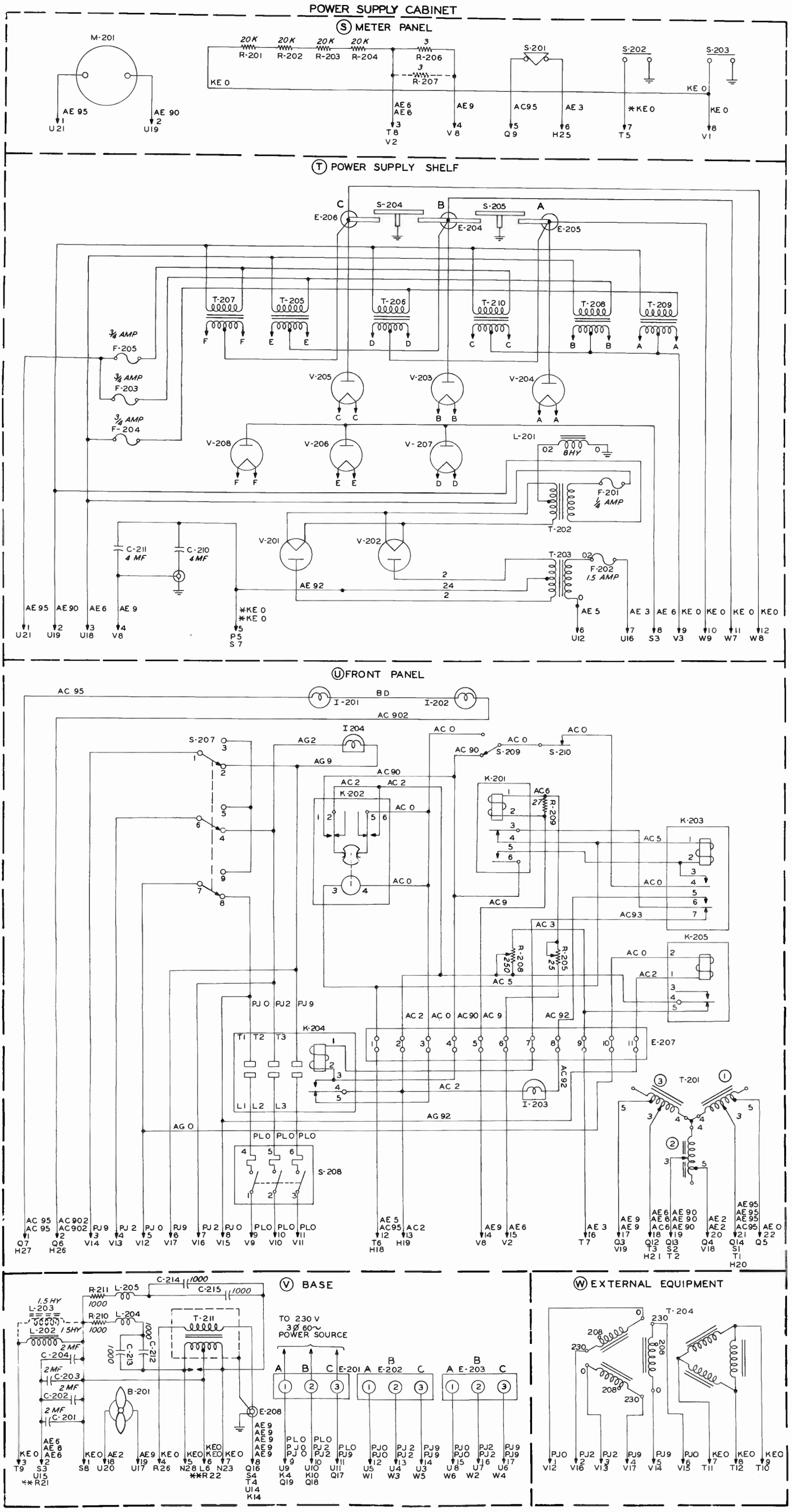
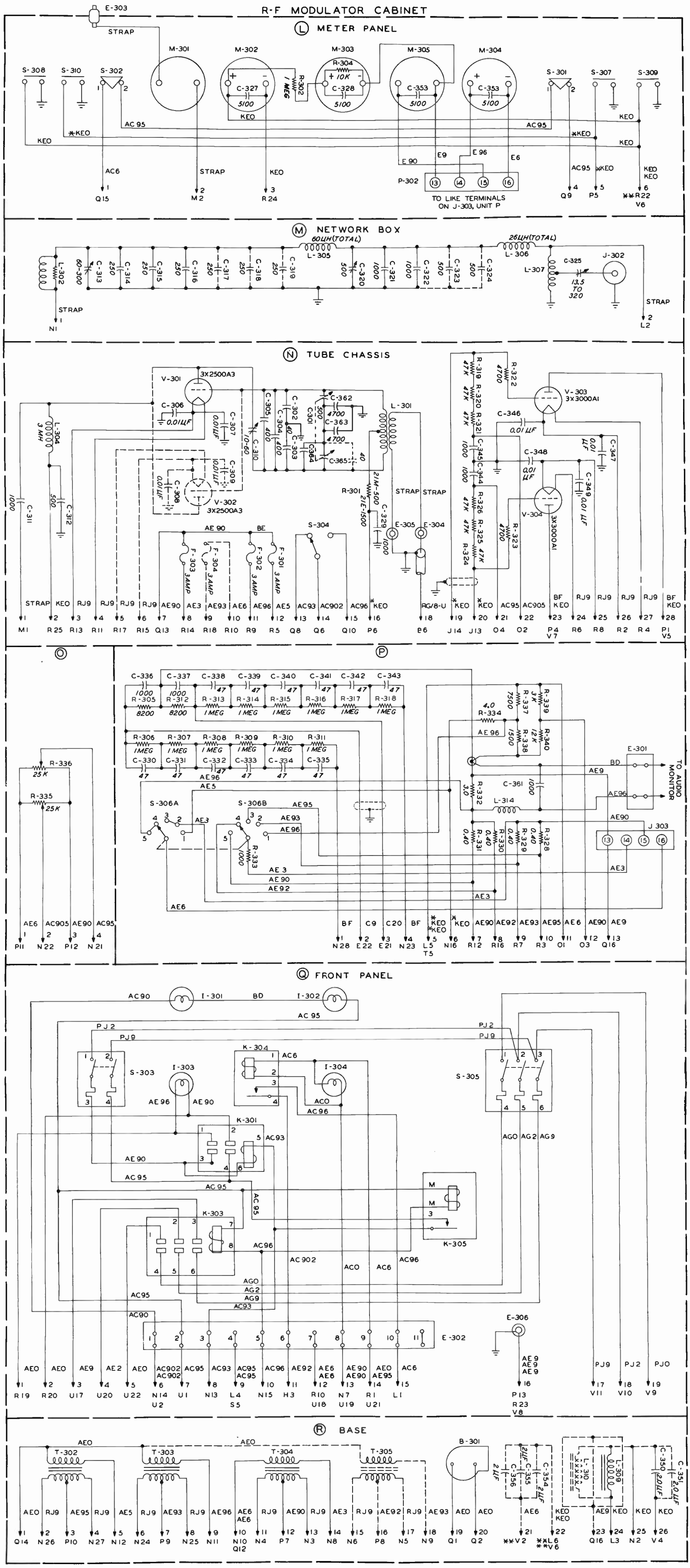


Figure 8-5. Power Supply Cabinet Inter-Unit Cabling Diagram.

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.
4. COMPONENTS SHOWN WITH BROKEN LINES ARE ADDED FOR 10KW OPERATION.



NOTES

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

Figure 8-6. Power Amplifier Cabinet Inter-Unit Cabling Diagram.