INSTRUCTIONS

BTA-5T A-M Transmitter

(ES-34229)

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INDUSTRIAL ELECTRONIC PRODUCTS, CAMDEN, N. J.

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BTA-5T Broadcast Transmitter

Production Data Sheet

Sheet #2

Power Output 5.2 Kw. Efficiency 87.5 %

Audio Input 10 dbm

Neutralization - Feed-thru volts, Start ✓, Finish ✓

Neutralization Transformer Connections ✓

Audio Response: (50% Mod.)

Frequency	Response	Frequency	Response
30 ~	-.1 db	5,000 ~	+.4 db
50 ~	+.5 db	7,500 ~	+.1 db
400 ~	0 db	10,000 ~	+.4 db
500 ~	0 db	12,000 ~	-2.0 db
1,000 ~	0 db	15,000 ~	-5.5 db

Distortion: (95% Mod.)

Frequency	%	Frequency	%
50 ~	2 %	7,500	1.5 %
100 ~	1.5 %	10,000	1.8 %
1,000 ~	1.6 %	12,000	2 %
5,000 ~	1.1 %	15,000	2.5 %

Modulation Capabilities 105 %

PA Plate I + ____ Ma., - 100 Ma.

Hum & Noise - 62 db

Frequency Monitor Output ✓ volts

PA Output Control + 220 watts - 220 watts

H.V. Rect. Check ✓ L.V. Rect. Check ✓

Bias Rect. Check ✓

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HTA-5T Broadcast Transmitter

Production Data Sheet

Date 5/23/61 Frequency 550 KC Testman [illegible]

Serial # 1060 (Driver), 1060 P.A., 1060 Mod. Transformer
(To be stencilled after test.)

Circuit Check ✓, Ground Switches ✓, Control Circuits ✓

Motor Tuning ✓, Air Switch ✓, Thermal Switch ✓, Blower ✓

Overload Relays:

2K101 PA OL	✓	1K603 2nd AF OL	✓
2K102 Mod. OL	✓	1K605 LV OL	✓
2K103 HV OL	✓	1K606 Driver OL	✓
		1K402 Time Delay	✓

Arc Gap Settings, 2T101 ✓ (3/16"), 1L501 ✓ (3/16")

Tuning ✓, Bias Adjustment ✓, Mod. Adjustment ✓

Meter Readings

Circuit	Switch	Position	Meter	Readings	Circuit	Switch	Position	Meter	Readings
Osc. IK-1	1S201	1	1M201	80	PA Grid			2M103	.47
Osc. IK-2	"	2	"	95					
Buf. IG	"	3	"	90					
Buf. IP	"	4	"	50					
IPA IG	"	5	"	85	PA Plate E	-	-	1M501	4.95
IPA IK-4	"	6	"	55	PA Plate I	-	-	2M101	1.2
IPA IK-1	"	7	"	55					
1st AF IK-R	"	8	"	45	Mod. IK-L	2S101	1	2M102	.1
1st AF IK-L	"	9	"	47	Mod. IK(X2)	"	2	"	.2
2nd AF Mod. IK-L	"	10	"	72	Mod. IK-R	"	3	"	.1
2nd AF Mod. IK-R	"	11	"	78					
Filaments	S103	1	1M202	235					
Phase #1	"	2		240					
Phase #2	"	3		240					
Phase #3	"	4		240					

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FIRST AID

WARNING

OPERATION OF ELECTRONIC EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL MUST AT ALL TIMES OBSERVE ALL SAFETY REGULATIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE THE EQUIPMENT WITH VOLTAGE SUPPLY ON. UNDER CERTAIN CONDITIONS DANGEROUS POTENTIALS MAY EXIST IN CIRCUITS WITH POWER CONTROLS IN THE OFF POSITION DUE TO CHARGES RETAINED BY CAPACITORS, ETC. TO AVOID CASUALTIES, ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

Personnel engaged in the installation, operation and maintenance of this equipment or similar equipment are urged to become familiar with the following rules both in theory and in the practical application thereof. It is the duty of every radioman to be prepared to give adequate First Aid and thereby prevent avoidable loss of life.

ARTIFICIAL RESPIRATION

(Courtesy of the American Red Cross)

If victim is not breathing, begin some form of artificial respiration at once. Wipe out quickly any foreign matter visible in the mouth, using your fingers or a cloth wrapped around your fingers.

MOUTH-TO-MOUTH (MOUTH-TO-NOSE) METHOD


Fig. 1

Tilt victim's head back. (Fig. 1). Pull or push the jaw into a jutting-out position. (Fig. 2).


Fig. 2

If victim is a small child, place your mouth tightly over his mouth and nose and blow gently into his lungs about 20 times a minute. If victim is an adult (see Fig. 3), cover the mouth with your mouth, pinch his nostrils shut, and blow vigorously about 12 times a minute.


Fig. 3

If unable to get air into lungs of victim, and if head and jaw positions are correct, suspect foreign matter in throat, To remove it, place victim in position shown in Fig. 4, and slap sharply between shoulder blades.


Fig. 4

Rescuers who cannot, or will not, use mouth-to-mouth or mouth-to-nose technique should use a manual method.

THE BACK PRESSURE-ARM LIFT (HOLGER-NIELSEN) METHOD

Place victim face-down, bend his elbows and place his hands one upon the other, turn his head slightly to one side and extend it as far as possible, making sure that the chin is jutting out. Kneel at the head of the victim. Place your hands on the flat of the victim's back so that the palms lie just below an imaginary line running between the armpits (Fig. 5).


Fig. 5

Rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert steady, even pressure downward upon the hands (Fig. 6).


Fig. 6

Immediately draw his arms upward and toward you, applying enough lift to feel resistance and tension at his shoulders (Fig. 7). Then lower the arms to the ground. Repeat this cycle about 12 times per minute, checking the mouth frequently for obstruction.


Fig. 7

If a second rescuer is available, have him hold the victim's head so that the jaw continues to jut out (Fig. 8). The helper should be alert to detect any stomach contents in the mouth and keep the mouth as clean as possible at all times.


Fig. 8

RELATED INFORMATION FOR BOTH METHODS

If vomiting occurs, quickly turn the victim on his side, wipe out his mouth, and then reposition him.

When a victim is revived, keep him as quiet as possible until he is breathing regularly. Keep him from becoming chilled and otherwise treat him for shock. Continue artificial respiration until the victim begins to breathe for himself or a physician pronounces him dead or he appears to be dead beyond any doubt.

Because respiratory and other disturbances may develop as an aftermath, a doctor's care is necessary during the recovery period.

BURNS

FIRST DEGREE BURN

SKIN REDDENED. Temporary treatment—Apply baking soda or Unguentine.

SECOND DEGREE BURN

SKIN BLISTERED. Temporary treatment — Apply baking sode, wet compress, white petroleum jelly, foille jelly, olive oil, or tea.

THIRD DEGREE BURN

FLESH CHARRED. Temporary treatment — Apply baking soda, wet compress, white petroleum jelly, or foille spray. Treat for severe shock.

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TECHNICAL DATA

Electrical Data

AF Input Impedance	150/600 ohms
AF Input Level, 100% Modulation	+10 ±2 dbm
AF Response:	
50 to 7500 cps	±1 db
30 to 10,000 cps	±1.5 db
AF Distortion, 95% Modulation:	
50 to 10,000 cps	2.5%
Noise, Below 100% Modulation	60 db
Frequency Range	535 to 1620 kc
Frequency Stability	±5 cps
Type of Output	Single ended
Carrier Shift, 0–100% Modulation, 400 cps	3% at constant line voltage, 5% at normal line voltage regulation
Output Impedance	40 to 250 ohms
RF Voltage for Frequency Monitoring	10 volts, RMS, 75 ohms
RF Voltage for Modulation Monitoring	10 volts, 75 ohms
Power Output, Nominal	5000 watts
Power Output Capability	5500 watts
Power Supply	208 to 240 volts, ±11 volts
*Line Frequency	60 cps
Phase	3
Power Consumption:	
0% Modulation	10 kw
100% Modulation	14.5 kw
Average Program Modulation	11 kw
Power Factor	90%
Permissible Combined Line Voltage Variation and Regulation	±5%
Crystal Heater Power Supply	117 volts, 50–60 cps

Dimensions and Weight

Height	88 inches overall (84 inches less floor channels)
Width	69 inches
Depth	32 inches (less door handle)
Weight:	
Transmitter	3800 pounds approximately
Plate Transformer	420 pounds approximately
Altitude Range	0 to 7500 feet
Ambient Operating Temperature:	
BTA-5T	−20°C (−4°F) Minimum +45°C (113°F) Maximum

* 50 cps kit available.

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EQUIPMENT LIST

TYPE BTA-5T (ES-34229)

Quantity	*Description*	*RCA Reference No.*
1	Amplifier, Modulator and HV Rectifier	MI-27635-C
1	Transmitter Driver	MI-27650-A
1	Plate Transformer	MI-27636
1	Installation Material Kit	MI-34610
**1	Blower	MI-34616 or 34616-A
1	Miscellaneous Hardware Kit	MI-7474
1	Set of Frequency Determining Parts	MI-34648
1	Right Hand Cabinet Door	MI-27645
1	Left Hand Cabinet Door	MI-27645-A
1	Nameplate	MI-28180-1
1	Touch-Up Finish Kit	MI-27660-A
2	Instruction Book	IB-30279
*	Dome Type Insulator	MI-19406-A
*	Coaxial Line Output Adapter Plate	MI-34613*
1	Set of Operating Tubes	ES-34230
1	Crystal Type TMV-130B	MI-27493

* One of either supplied according to type of transmission line and installation requirements.
** Depending on altitude.

OPTIONAL AND ACCESSORY EQUIPMENT

Set of Spare Tubes	ES-34208
Crystal, Type TMV-130B (Conelrad and/or Spare)	MI-27493
Remote Antenna Current Meter	MI-27644
Remote Ammeter Pickup Unit	MI-27966
Filament Hours Elapsed Time Indicator	MI-34614
Remote Control System, Type BTR-11B	ES-27216
Remote Control System, Type BTR-20A	ES-27217
A-M Frequency Monitor, Type BW-11A	MI-30011-A
A-M Modulation Monitor, Type BW-66F	MI-30066-B
Power Cut Back Kit (1000/500W)	MI-34646
Conelrad Kit	ES-34245
Conelrad Kit Keying Unit	MI-34312-4

RECOMMENDED TEST EQUIPMENT

RCA Type WV-97A VoltOhmyst
RCA Type WM-71A Distortion and Noise Meter
RCA Type WA-28A Audio Push Button Oscillator
RCA Type WO-88A Oscilloscope
RCA Type BW-66F A-M Modulation Monitor
7.5 kw Dummy Load matched in impedance to output line (such as Ohmspun Type or equivalent).

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TUBE COMPLEMENT

Tube	*Type*	*Function*
1V101	6AK5	Oscillator
1V102	5763	Buffer-Amplifier
1V601	6146	Intermediate RF Amplifier
1V501	6155/4-125A	Driver
1V502	6155/4-125A	Driver
2V103	5762	Power Amplifier
1V603	2E26	1st Audio Amplifier
1V604	2E26	1st Audio Amplifier
1V301	6155/4-125A	2nd Audio Amplifier
1V302	6155/4-125A	2nd Audio Amplifier
2V101	3X3000 F1	Modulator
2V102	3X3000 F1	Modulator

DESCRIPTION

General

The RCA Type BTA-5T A-M Broadcast Transmitter shown in Figure 1, is designed to transmit high fidelity amplitude modulated signals within the range of the standard broadcast band, 535 kc to 1620 kc. Nominal power output is 5000 watts; however, the transmitter has a power output capability of 5500 watts to compensate for losses in the transmission line and antenna tuning equipment. Operating power requirements are a 208–240 volt, 50–60 cycle, 3 phase main power source and a separate 115 volt 50–60 cycle, single phase power input for the crystal heaters. Remote control of main, standby, and Conelrad crystals is made possible through built-in relays. A Power Cutback Kit MI-34646 for reducing the power to 1 kilowatt or 500 watts, is also available. Conelrad Kit ES-34245 permits push-button switching of RF circuits from any operating frequency to either 640 kc or 1240 kc Conelrad Frequency.

The transmitter can be tuned from the front panel with the use of only two controls. Provisions for remote control operation are incorporated in the transmitter. All doors and back panels are interlocked to open the circuits of all the d-c supplies. Grounding switches are used on doors and back panels to provide a discharge path for the high voltage filter capacitors 1C501 to 1C503. Grounding hooks are provided in the rear and front portions of each cabinet. The plate transformer is housed in a locked cabinet accessible only by key. The transmitter is air cooled by a blower located in the Amplifier-Rectifier cabinet. A time delay relay is used to maintain the blower in operation for one minute after the transmitter is shut down. This additional time hastens component cooling and lengthens the life of the tubes.

The transmitter is housed, except for the plate transformer, in two cabinets made of aluminized steel to give improved magnetic and electrostatic shielding. All operating controls and meters are on the front panels on either side of the cabinet doors.

The vertical mounting technique, such as is used in equipment racks, has been employed in mounting the component chassis in the transmitter cabinets to make maintenance and service more convenient.

Opening the front doors of the cabinets gives access to the front vertical panels on which tubes, feedback ladders, and overload relays are mounted. The remaining components are mounted on the rear of the panels, with the larger power components located on the floors of the cabinets. The left hand cabinet contains the control unit and the exciter-driver; the right hand cabinet houses the amplifier, modulator, and high voltage rectifier. Floor space occupied by the cabinets is 5′9″ by 2′8″. The height of the cabinets is 84 inches. The shield over the connector across the top of the two cabinets is 4 inches high.

Circuit

Refer to block diagram, Figure 22, and schematic diagram, Figure 25.

The RF circuit of the BTA-5T consists of five stages. In the first stage, a 6AK5 tube, 1V101, is used

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Figure 1—BTA-5T A-M Broadcast Transmitter

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as a crystal-controlled oscillator. The crystal portion of this stage has temperature-controlled crystals whose frequency is constant within plus or minus five cycles. The first and second crystals are for main and standby operation, respectively, the third is for Conelrad operation. The output of 1V101 (6AK5) drives the buffer-amplifier stage 1V102, a 5763 tube. Both of these stages are built on a single, etched panel. The output of 1V102 (5763) is coupled to the third stage, a 6146 tube, 1V601, used as an intermediate amplifier. Resistor 1R601 in the cathode circuit provides a pick-up point for a sample of r-f for the station's frequency monitor. The r-f is coupled through capacitor 1C601 to jack 1J601.

The output of 1V601 (6146) is coupled through 1C604 to the grids of two 6155/4-125 tubes 1V501–1V502, connected in parallel. The output of this stage, which is tuned by a slug-tuned tank coil, 1L301, furnishes the energy to drive the final or power amplifier stage.

The high efficiency power amplifier stage 2V103 consists of one plate-modulated 5762 tube. Neutralization of the PA stage is obtained by using a broadband transformer 2T106, and variable vacuum capacitor 2C107.

The power amplifier tank network consists of variable vacuum capacitor 2C110, plate coil 2L104, second harmonic filter trap 2L105 and 2C115, third harmonic filter trap 2C145 and 2L109 and motor driven output coil 2L106. Included in this network are frequency determining capacitors 2C111 through 2C116. The power amplifier high efficiency circuit consists of two third-harmonic resonators. One is connected in the plate circuit of tube 2V103 (5762) and consists of capacitor 2C142 and inductor 2L110. The other resonator is connected in the cathode circuit of 2V103 (5762) and consists of capacitors 2C143 and 2C144 and inductor 2L111. The inductor has an inner conductor for supplying the filament current to 2V103 (5762). The function of the circuit is to modify the class "C" wave to form a flat top wave thereby increasing the amplifier efficiency. (Refer to the Addendum in the back of the book for a detailed explanation of the new system.) The adjustment of the resonators is described in detail under the title *Preliminary PA tuning* in the section titled *TUNING.*

Power amplifier plate tuning is accomplished by adjusting capacitor 2C110. Coil 2L108 is connected across the output network to supply an r-f signal of 10 volts for modulation monitoring, at jack 2J101. Taps on the coil permit voltage adjustment, as required, to compensate for changes in operating power levels and loads. Coil 2L108 serves also as the static drain choke for the transmission line.

The audio section of the BTA-5T consists of a first and second amplifier stage and a modulation output stage. Each stage uses two tubes connected in push-pull. Audio-input is applied through the equalizer 1Z501 to the audio input transformer 1T601, and then to the first audio amplifier stage 1V603 (2E26) and 1V604 (2E26).

The output of the first audio amplifier is coupled to the grids of two 6155/4-125 tubes, 1V301 and 1V302, the second audio amplifier. The output from the second stage drives the modulators, a pair of 3X3000F1 tubes, 2V101 and 2V102. The output of the modulator is coupled to the plates of the power amplifier through modulation transformer 2T101.

Feedback voltage to the first audio amplifier is derived from resistor-capacitor networks 2Z101 and 2Z102 in the plate circuits of 2V101 (3X3000F1) and 2V102 (3X3000F1), respectively.

Three power supplies furnish the four dc operating voltages: bias voltage, low voltage, intermediate high voltage, and high voltage.

The bias voltage supply is a full wave bridge circuit comprising transformer 1T501, printed circuit silicon rectifiers 1Z502 and 1Z503, and filter 2C119, 2C120, 2R108.

The low voltage supply is a full wave rectifier consisting of transformer 1T402, printed circuit silicon rectifier 1Z601, and filter 1L602, 1C607.

The intermediate high voltage is obtained from the HV rectifier neutral or common point on the secondary of plate transformer 3T101. The intermediate high voltage is filtered through 1L502 and 1C515.

The plate supply high voltage is obtained from the three phase, full wave rectifier portion of the HV rectifier stage, 2Z103 through 2Z108. The high voltage is filtered through 1C501, 1C502, 1C503, and 1L501. Provision is made for connecting 1L501 to the half voltage for tuning purposes.

LAYOUT

The basic step in installation of the transmitter is to decide upon the equipment layout and make provisions for the necessary external connections. After the space requirements have been determined, the equipment can be unpacked, checked to ascertain that all components are available and nothing has been

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damaged in shipment, assembled, and connected as specified. Outline dimensions for the transmitter are shown in Figure 23.

Inasmuch as some of the optional and associated items include their own instruction books, the installation procedure for such units will not be repeated. Instead, reference should be made to the instruction book accompanying such equipment.

Factors to be considered in layout are incoming power lines, accessibility of a good station ground, and the route for the transmission line to the antenna. The room in which the transmitter is to be installed should be well-ventilated and have an abundant supply of clean, dry air. The maximum ambient temperature is listed under TECHNICAL DATA.

Separate disconnect switches and power leads must be supplied for the 208–240 volt and 117 volt incoming power lines. Note that the crystal ovens require a separate 117 volt line so that the ovens may be energized 24 hours a day without interruption.

Disconnect switches and wiring must be provided for such items as the transmitter room exhaust fan, if any, and any monitoring racks. The tower lighting circuit should also be planned, although no material is provided for this item.

Wiring to and from the transmitter should be carried in conduit or a trench terminating below the unit. The floor plan, Figure 24, indicates where this wiring should enter the unit. The ground connection of the PA cabinet must be connected to the station ground with copper strap two-inches wide (item 4 (F) of MI-34610).

It is not intended that these instructions shall supersede any applicable local codes. Where the instructions in this book conflict with any local electrical, construction, or building code, the provisions of the applicable local code should be followed.

Transmission Line Layout

The r-f output from the transmitter terminates at the insulated fitting, as shown in Figure 24. Beyond this point no lines or fittings are supplied with the transmitter, but must be ordered separately. Depending upon the type of installation and transmission line, a suitable adaptor plate and an insulator may be selected from Table 1.

Installation data for the 1-5/8-inch coaxial transmission line and also for such items as dehydrators or nitrogen units is given in the Transmission Line instruction book, IB-36164.

TABLE 1.

Adapter Plate Reference	*Transmission Line Type*
MI-19406-A	230-ohm, open (5 or 6 wire)
MI-34613-1	50-ohm, coaxial (7/8″ styroflex or RG-17A/U)
MI-34613-1	70-ohm, coaxial (7/8″ styroflex or RG-35A/U)
MI-34613-2	52/70-ohm, coaxial (1-5/8″ rigid)
MI-34613-3	50- or 70-ohm, coaxial (7/8″ styroflex, pressurized)

The RCA Type BPA-11A Antenna Tuning Unit is recommended for matching the antenna to the transmitter. If desired, the uit can also be furnished to supply an a-f voltage for program monitoring, and a rectified carrier current for remote antenna current indication.

An antenna tuning house is also desirable, especially when multi-element arrays are used, since it offers weather protection and facilities for test and measuring units, tower lighting equipment, and intercommunication components.

Before completing the layout from the transmitter to the transmission line and antenna, station engineering personnel should check the antenna system for protection against atmospheric static accumulations and electrical storms. If this is not done, the transmitter may be damaged. Refer to the next two headings for a discussion of the details involved.

Atmospheric Static Accumulations

In certain localities, atmospheric conditions build up high static potentials on the antenna towers, making it imperative to provide a drain path to ground for these accumulations. If no direct path is provided, the charge will build up potential until flashover occurs, either across the tower base arc-gap or across one of the capacitors in the antenna coupling system.

Where tower lighting chokes are used and one side of the ac supply line is grounded, the lighting choke will act as a satisfactory discharge path. When neither side of the ac line is grounded, or when a toroidal tower lighting transformer is utilized a drain path must be provided. Such a path, however, may already exist in the transmitter output circuit or antenna coupling unit. Existence of such a path may be checked after installation and before any circuits are energized by connecting an ohmmeter between the

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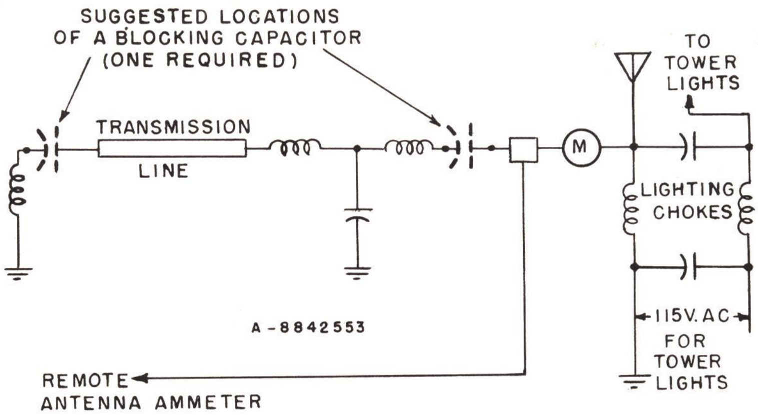

Figure 2—Tower Lighting Circuit

tower and ground. Any resistance up to approximately 250,000 ohms will provide a satisfactory return circuit. When no discharge path is indicated, one may be supplied by the installation of an r-f choke or a 100,000- to 200,000-ohm Globar resistor. Connect either the choke or the resistor from the antenna feed line to ground. The line terminating unit will generally serve to house the component used.

Electrical Storms

In areas subject to lightning storms, a direct electrical path from the tower to ground is required to avoid capacitor and antenna current meter burnout if lightning strikes the tower. This requirement can generally be met by installing arc-gaps across the base insulators. If these gaps are properly spaced, at the instant of discharge the gaps will present a low impedance path to ground and thus carry directly to ground any current caused by the lightning striking the tower. Although there is a second path to ground through the tuning equipment or transmitter output, the higher impedance of this second path usually prevents excessive discharge under normal conditions. In instances where the tuning house is located under the tower or directly adjacent to it, the ratio of these two impedances may not be sufficiently high to prevent appreciable discharge current through the tuning equipment to ground with consequent destruction of the coupling equipment. To increase this ratio, a one- or two-turn loop should be installed in the antenna lead from the tower to the tuning house. No such loop is required where the tuning house is more than several feet from the tower. In the latter instance, the longer lead provides the necessary higher impedance.

Antenna Current Readings

Under certain circumstances, when the tower lights are on, the 60-cycle tower lighting current may cause fluctuation or inaccuracies in the antenna current meter reading. This condition is created when the tower itself serves as one side of the lighting circuit and hence provides a common path for the tower lighting current and the r-f current. Where this situation exists, it is possible to have two ground return paths for the 60-cycle lighting current: one through the antenna coupling equipment and transmitter output circuit; the other in the a-c lighting circuit through the tower lighting chokes to ground where one side of the a-c is grounded. A simplified schematic diagram of a typical circuit illustrating this possibility is shown in Figure 2. To prevent the meter fluctuations, it is necessary for the 60-cycle tower lighting current to be returned via a path other than the r-f circuits feeding the tower.

If a toroidal tower lighting transformer is used, no antenna current meter fluctuations will occur. Where lighting chokes are utilized, the circuit should be checked for the existence of a second ground path as previously described.

Elimination of the 60-cycle return path through the coupling equipment or transmitter output circuit is achieved by inserting a blocking capacitor in the antenna feed line. The capacitor may be connected in either of two places, just ahead of the antenna current meter or between the transmitter output and the transmission line. The location depends upon the type of coupling circuit used in the line terminating unit. As a general rule, the reactance of the blocking capacitor, shown dotted in Figure 2 should not be

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greater than approximately one-tenth the characteristic impedance of the transmission line.

To determine whether antenna current meter variations can be caused by the condition just described, turn on the tower lights while the transmitter is OFF. The presence of any current readings on the antenna current meter at this time indicates the need for corrective measures.

Unpacking

An understanding of the overall shipping system will be of assistance in unpacking the equipment and locating items. Each RCA equipment is accompanied by a packing list which lists the complete contents of the shipment by "master item" or "MI" numbers. This shipping voucher is usually packed in one of the smaller cardboard cartons, appropriately marked.

Where more than one item is listed on an MI, a sub-division or "item" number is listed after the MI number. Thus a component might carry the designation, "MI-99999-2". This indicates that the part is "item 2" on the MI-99999 list. These MI sheets are essentially packing lists, and where there are two or more boxes to a major unit, the box containing the MI sheet is identified by stenciling. Thus it is possible to identify the contents of each box and systematically plan the overall uncrating. All items listed on the MI sheets should be located before crates or boxes are destroyed, to avoid loss of small items overlooked during unpacking.

The MI sheets, as previously noted, are of value only in locating items for assembly. The MI sheets should not be used for installation sequence nor for installation details. Refer to the appropriate drawings and the following notes for installation information.

It is possible that the configuration or mechanical design of a component or part may be different in appearance or that its location may have been changed from that shown in a photograph or drawing.

Changes such as these are the result of manufacturing considerations or design modifications that have been incorporated during production, after the photographs and drawings have been released for publication.

However, the function of any different-appearing component or part is the same as that of its illustrated counterpart, unless otherwise specified.

The equipment may now be unpacked. Tubes and crystals should not be unpacked until required. In addition, the frequency-determining parts MI-34648 should be left in their carton until installation is specified.

INSTALLATION

1. Remove the red metal straps used to support the large in-place components during shipment.

2. The various components removed from the cabinets and packed separately for shipment are individually tagged with an MI and item number. Do not remove any identification tags until these components have been installed. The hardware required for re-assembly is shipped in place or it will be specified as needed. Refer to the appropriate photographs and drawings for the location and placement of the components shipped separately.

3. Remove the covers from the transmitter wire ducts.

4. Place the cabinets in their final location.

5. Refer to Figure 23. Bolt the cabinets together using the hardware supplied as part of MI-34610, items 3 and 5. Make certain the surface on which the cabinets rest is flat and that the cabinets are in alignment.

6. Install the front doors and check their operation.

7. Place the rear cover panels on the cabinet. See that all snap fasteners function properly and that corners fit uniformly. Remove the cover panels and set them aside until the installation is completed.

8. Refer to Figure 19. Remove the front cover panel over the LINE and PLATE circuit breakers (1S501 and 1S502) in the Transmitter-Driver cabinet. Refer to Figure 16. Remove the front cover panel over the HV silicon rectifiers in the Amplifier-Rectifier cabinet.

9. Install all components that were removed for shipment, except the blower, 2B101, the modulation transformer, 2T101, the modulation reactor, 2L107, and capacitors 2C139 to 2C141.

When installing the variable vacuum capacitor 2C110, rotate the capacitor shaft until the capacitor is at the point of maximum capacity, then back the shaft off approximately a half turn from this point. Turn the tuning dial (located on the Amplifier-Rectifier panel) to zero. Mount 2C110 in the cabinet, clamp it in place by means of the screw in the mounting flange, and lock the universal joint in place with the setscrew. Make certain that the tuning dial does not shift from zero while being connected to the capacitor.

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10. To interconnect the two cabinets, refer to the interconnection diagram, Figure 26 and to Table 12 to orient the interconnecting cable (MI-34610, item 1) to the various terminal contacts. Run the cable through the wire ducts, see Figure 24, and make the cable connections according to the identification tags on the cable leads.

11. Connect the station ground to the ground stud plate in the lower left side wall of the Amplifier-Rectifier cabinet. See Figure 18.

12. Connect the two coaxial cables from the Input Transformer, 1T601, (see Figures 25 and 26) through the holes and grommets in the cabinet walls to the feedback ladders 2Z101 and 2Z102. Dress the leads so they do not touch any other components.

13. Take both the GTO-15 cables and run them through the holes in the cabinet walls. Connect one cable from 1C311 to the bottom of 2R103 and the other cable from 1C312 to the bottom of 2R104, see Figure 26. Dress the leads away from the resistors.

14. Install the connector, MI-34610, item 7, across the top of the two cabinets, refer to Figure 26, from insulator 101A to 101B. This joins the driver stage to the PA stage. Center the shield, MI-34610, item 6, over the connector and fasten it in place as shown in Figure 23.

15. Bring the station's three phase input line up through the front right side hole in the floor of the Transmitter-Driver cabinet and connect it to the Line Circuit Breaker, 1S501. See Figures 19 and 25.

16. Connect the Plate Transformer (3T101) primaries H1, H2, and H3 to the Plate Contactor, 1K407, using the wire supplied under MI-34610, item 4 (A). Route the wire up through the front left side hole in the floor of the Transmitter-Driver cabinet. Make the primary delta connections (terminals H4 through H9) according to the diagram on the transformer nameplate.

17. Connect the Plate Transformer (3T101) secondaries, R1, R2, and R3, to 229A, 228A and 227A respectively, see Figure 25, on the rectifier shelf. Cut the leads to the proper length from the wire supplied under MI-34610, item 4 (B) and route them through the front right side hole in the floor of the Amplifier-Rectifier cabinet.

18. Connect a lead from the neutral tap (N) on the secondary of the Plate Transformer to 1-104B in the Transmitter-Driver Cabinet, see Figure 17. Use a length cut from MI-34610, item 4 (B) for this purpose. Route this lead in the same wire trench with the Plate Transformer secondaries up to the cabinet wire duct. Run the wire through the cabinet wire duct that is the most convenient to the front right side hole in the floor of the Transmitter-Driver Cabinet, and up to insulator 1-104B.

19. Connect the 117 V crystal heaters supply to pins 4 and 5 of terminal board B in the Transmitter-Driver cabinet. See Figure 17.

20. Adjust the arc gap contacts on the Modulation Transformer, 2T101 (Figure 16) and the Filter Reactor, 1L501, (Figure 15) for a space of 3/16″ between contacts.

21. Place the Blower, 2B101, on the left side of the Amplifier-Rectifier cabinet. Align the shock mounts with the eight holes in the floor and bolt in place, see Figure 18. Place the boot over the blower duct. Arrange the boot to be as straight and wrinkle-free as possible. Connect the blower motor to terminal board A, terminals 34, 35, and 36. See Figure 26.

22. Place the Modulation Transformer, 2T101, in the front left side corner of the Amplifier-Rectifier cabinet with the primary terminals toward the wall, see Figure 16.

NOTE: The Modulation Transformer, and the Modulation Reactor (refer to Step 23) are to be located on the floor of the cabinet in such a manner that there is at least one inch of clearance between the winding of these components and the ground surfaces in the cabinet.

23. Install the Modulation Transformer Blocking Capacitors 2C139, 2C140, and 2C141, see Figure 16, in the front right side of the Amplifier-Rectifier cabinet. Refer to appropriate schematic diagram and (a) connect the capacitors in parallel; (b) connect the red lead from the low terminal of 2T101 to the hot side of the blocking capacitors and connect the white lead from the high terminal of 2T101 to the 3-inch cone insulator, 2-104A; (c) connect the two white leads from the primary of 2T101 directly to the modulator tube sockets 2XV101 and 2XV102.

24. Place the Modulation Reactor, 2L107, on the rear, right side of the Amplifier-Rectifier cabinet, see Figure 18. Connect the lead from the outer winding of 2L107 to the 2-inch cone insulator, 2-105A.

NOTE: If Power Cut-back and Conelrad Kits intended for use with the transmitter are on hand, they may be installed now according to the instructions supplied with each kit. However do not connect the kits in the circuit at this time. This will be done later at the end of the control circuit check.

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25. Install the nameplate, MI-28180-1, on the rear of the transmitter-driver cabinet.

26. Set aside tubes, crystals, and frequency determining parts. These components will be installed later.

27. Circuit check the connections of the components previously installed using an ohmmeter, or battery and buzzer. If the latter is used, temporarily short-circuit each meter or disconnect one side of each to prevent the meter from being damaged.

CONTROL CIRCUIT CHECK

In order to determine that the various switches, motors, and control components are functioning properly, the following control circuit check should be made before applying plate and bias voltages to the transmitter.

1. Place all switches in the OFF position.

2. Do not put any tubes in their sockets.

3. Check all grounding switches. Refer to Figures 15, 16, 17, and 18 for their location and to the schematic for their electrical connections. Make certain the grounding hooks are firmly connected to the cabinets.

4. Disconnect and tape the primary leads to the LV Transformer, 1T402, the Bias Transformer, 1T501, and Plate Transformer, 3T101.

If terminals 2-25A and 2-26A (see schematic) are not used as external interlock connections, short them together with a connecting link.

5. Replace the cover panel over the Line and Plate circuit breakers and replace the panel over the silicon rectifiers.

WARNING

DO NOT ATTEMPT TO REMOVE OR REPLACE THE PANEL OVER THE SILICON RECTIFIERS UNLESS THE LINE CIRCUIT BREAKER, 1S501, IS IN THE OFF POSITION. THIS WILL PREVENT SHOCK HAZARD TO PERSONNEL AND DAMAGE TO EQUIPMENT SHOULD THE PANEL ACCIDENTALLY COME IN CONTACT WITH THE LINE MULTI-METER SWITCH, 2S103.

6. Place the Line Circuit Breaker, 1S501 to ON.

7. Record the voltages shown on LINE VOLTMETER 1M202 for positions 1-2, 2-3, and 3-1. Place 1S501 to OFF.

8. Set the primary taps on the filament transformers, 1T301, 1T302, 1T603, 2T102, 2T103, 2T104, and 1T602 and on the control transformer, 1T401, to the tap position corresponding to the voltages indicated on the LINE VOLTMETER. (OR as close as possible if the range of the taps does not permit the exact setting.)

9. Replace all rear covers.

10. Place the Line Circuit Breaker, 1S501, and the Filament Circuit Breaker, 1S211, to ON. Place the SINGLE-MULTI Switch, 1S401, to SINGLE. Place the TRANS ON/OFF Switch, 1S203, to ON.

11. Check the operation of the blower motor, 2B101. If the rotation of the blower is incorrect, air turbulence will result causing Air Switch, 2S107, to open (see schematic). Consequently, the Filament Contactor 1K404, which is connected in series with the air switch, will open and filament voltage will be removed. Improper operation of the blower may be corrected by reversing one blower lead connected to terminals 2-35A and 2-36A.

12. Rotate the FILAMENT CONTROL knob from one extreme to the other and record the voltage indicated on the FILAMENT meter, 1M202, for each extreme position. Adjust this control to obtain a voltage corresponding to the filament transformer tap settings.

13. Check the operation of the INTERLOCK indicator 2I102, see Figure 20. This is a green jewel and it should be lit when all doors and interlock switches are closed and all panels are in place. When any door or panel is open the indicator should be OFF.

NOTE: There is a 30–45 second delay in the plate circuit after the TRANS ON/OFF switch is placed to ON. This is effected by Plate Time Delay Contactor 1K601.

14. After the elapse of the delay time, place the OL RESET—ON/OFF switch, 1S204 (Figure 20) to ON. Plate On relay, 1K602, should close and the red PLATE ON indicator, 1I201, should light. Check the operation of the lamp by opening and closing the various doors and panels individually. Both the PLATE ON and INTERLOCK indicators should go off when any door is opened or any panel removed.

15. Open the Transmitter-Driver cabinet door and temporarily fasten the interlock switch, 1S216 (Figure 15) closed so that the PLATE ON indicator is lit. Slide the covers off the Overload Relays 1K603, 1K605, and 1K606 (see Figure 19). Manually actuate the armature of each relay in turn, while observing that the PLATE ON indicator goes off and the yellow

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OVERLOAD indicator, 2I101 (Figure 20) lights. The ON-OL RESET switch must be placed in OL RESET position after each relay is actuated. Replace the relay covers and restore the interlock switch to normal operation. Repeat this procedure with the overload relays, 2K101, 2K102, 2K201 or 2K301, 2K202 and 2K203 in the Amplifier-Rectifier cabinet (see Figure 16).

16. Place the OL RESET—PLATE ON/OFF switch OFF and the TRANS ON/OFF switch OFF in this order. Check that the blower runs for approximately one minute after these switches are turned OFF.

17. Simultaneously push up both toggles on the CONELRAD CRYSTAL selector switch, 1S205, (A and B) to the CONELRAD position. This should cause the CONELRAD Indicator, 1I202, see Figure 20, to light. Subsequent individual operation of each toggle to CRYSTAL position 1 and CRYSTAL position 2 should cause the CONELRAD indicator to go OFF.

18. Remove the rear cover on the Amplifier-Rectifier cabinet. Note the position of the tuning slug in the Plate Tank Coil, 2L106, see Figure 18. Place the Filament Circuit Breaker in the ON position and hold the RAISE/LOWER switch in the RAISE position for about ten seconds. Now check the tuning slug in coil 2L106; the slug should be upward in the coil above the position initially noted. Press the RAISE/LOWER switch to LOWER and check that the slug descends in the coil. In the event the travel of the slug is opposite from that indicated by the switch position, reverse the leads on motor 2B102.

19. If Conelrad or Power Cutback Kits were installed and are intended for use at this time, connect them according to the instructions accompanying each kit. After the kits have been connected, check the operation of the control portion of each kit.

TUNING

WARNING

USE EXTREME CAUTION WHEN TUNING OR CHECKING THE TRANSMITTER. THE VOLTAGES REQUIRED TO OPERATE THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO CAUSE SERIOUS INJURY OR LOSS OF LIFE. TAKE CARE NOT TO TOUCH ANY CIRCUITS WHEN THE POWER IS ON. SWITCH THE PLATE CIRCUIT OFF AND GROUND ALL CAPACITORS AND CIRCUITS BEFORE MAKING ANY CAPACITOR OR COIL TUNING ADJUSTMENTS.

Preliminary Adjustments

1. Place all switches and circuit breakers in the OFF position.

2. Install the TMV-130B crystal (MI-27493) in crystal socket number 1Y101, see Figure 19.

3. Install all tubes in the transmitter, but before inserting the type 5762 tube 2V103, in its socket, bend the center filament strap forward so that it is clear of adjacent components. Adjust the air jets to cool the tube filaments.

4. Install the Frequency Determining Parts, MI-34648. See Figures 18 and 21 for the location of the components in the cabinets. The frequency determining parts required for a particular frequency and output line impedance are given in Table 2.

5. Tuning charts, showing the number of active turns used on the various tank coils for a given frequency, are shown in Figures 3 thru 10. The PA network coils are located in the Amplifier-Rectifier cabinet, Figure 18. The driver coil, 1L301, is located in the Transmitter-Driver cabinet, Figure 21. Connect the jumper on each coil, except coils 2L110 and 2L111, according to the appropriate frequency curve indicated on the tuning chart of each coil. Tap settings of buffer coil 1L601 are given in Table 11. All turns on coils 2L110 and 2L111 should be shorted, initially.

6. Connect the audio input line to terminals 1-28B and 1-29B. Refer to the appropriate schematic. Connect the frequency monitor to jack 1J601, see Figure 21, in the Transmitter-Driver cabinet and the modulation monitor to jack 2J101 in the Amplifier-Rectifier cabinet, see Figure 18.

7. Install the PA output insulator. Terminate the transmitter output with a dummy load whose impedance is equal to that of the antenna or with the antenna of known impedance.

8. Re-connect the primary leads of the low voltage transformer, 1T402. Turn the bias potentiometers, 2R105 and 2R106, fully clockwise, see Figure 20.

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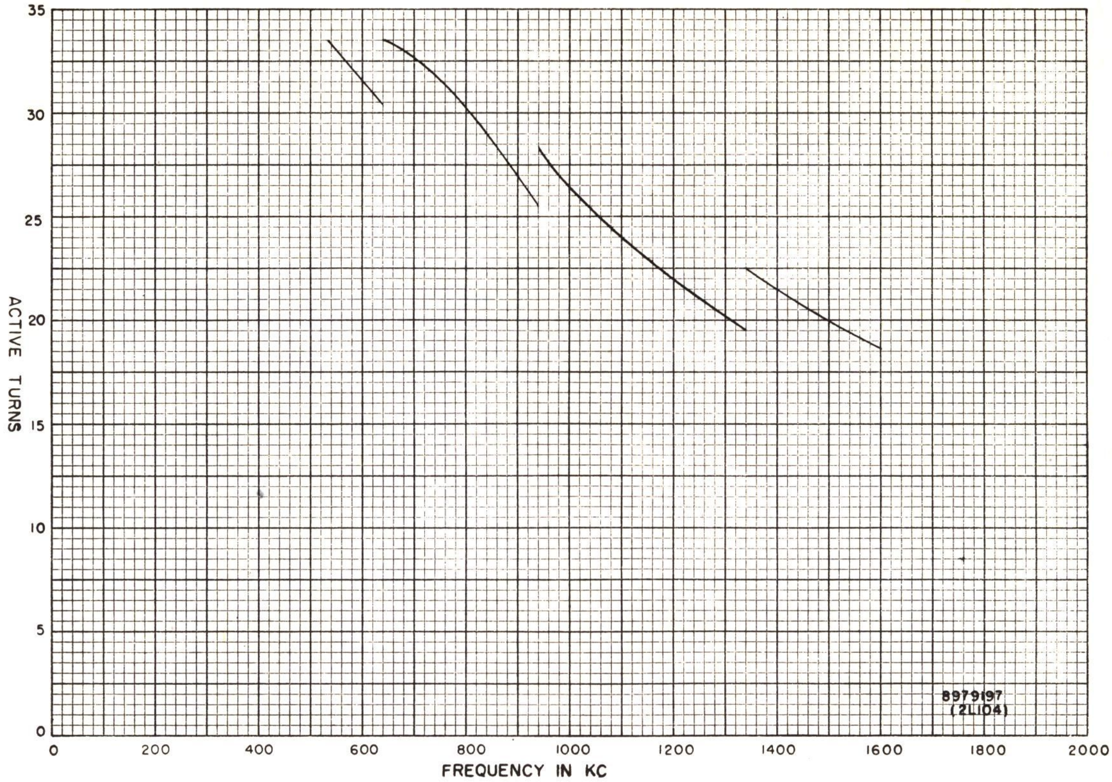

Figure 3—Tuning Chart, Coil 2L104

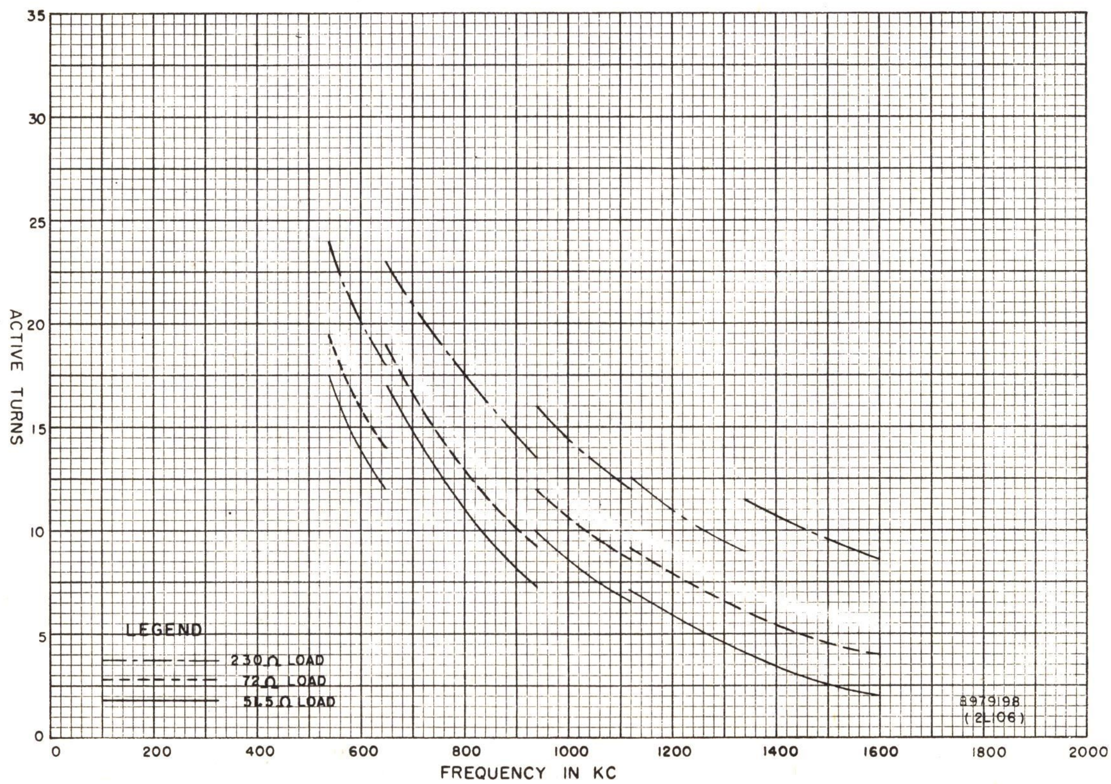

Figure 4—Tuning Chart, Coil 2L106

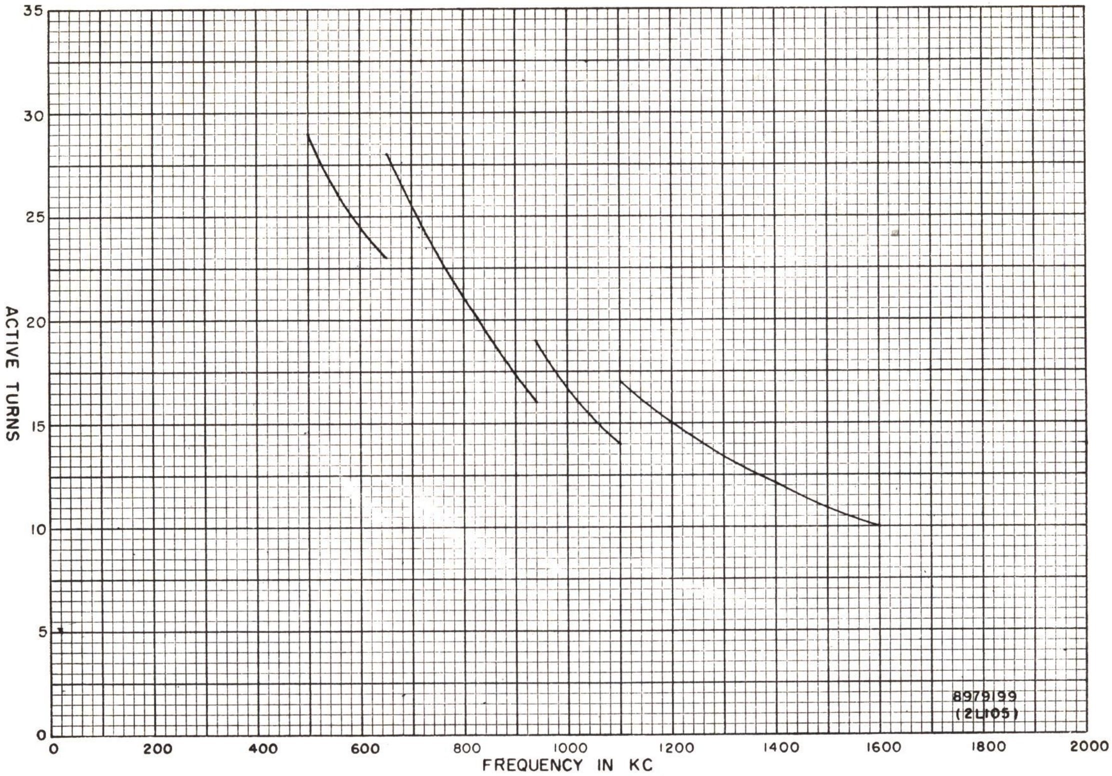

Figure 5—Tuning Chart, Coil 2L105

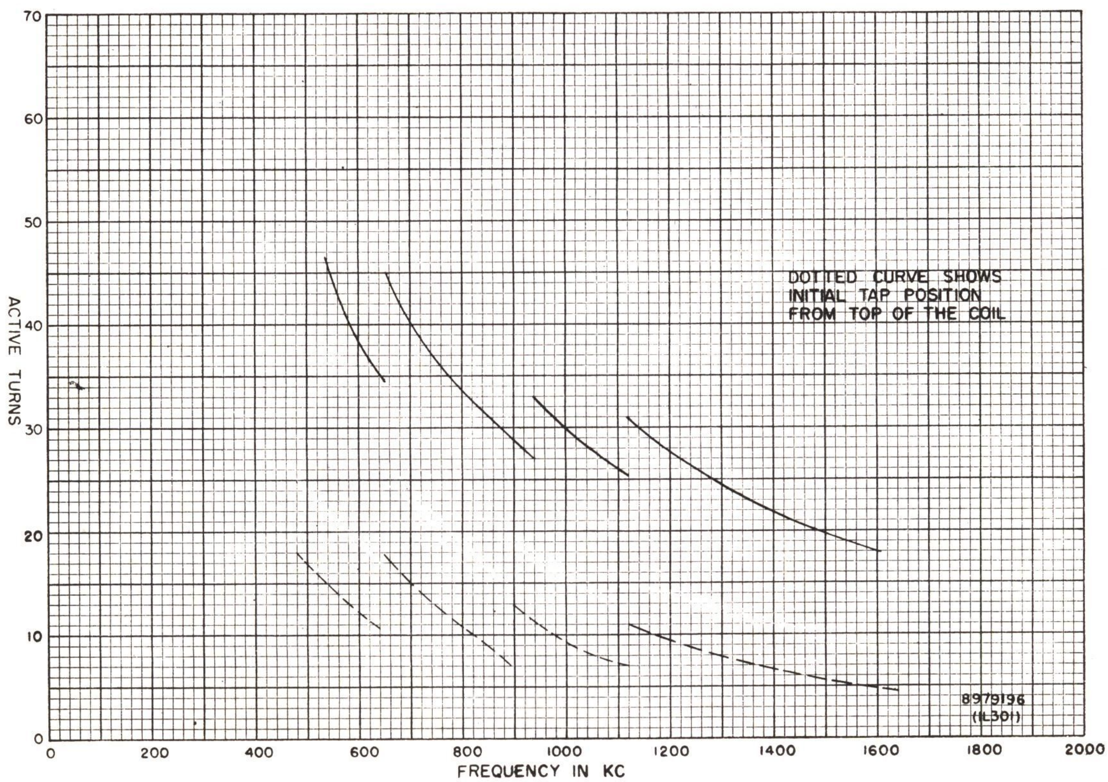

Figure 6—Tuning Chart, Coil 1L301

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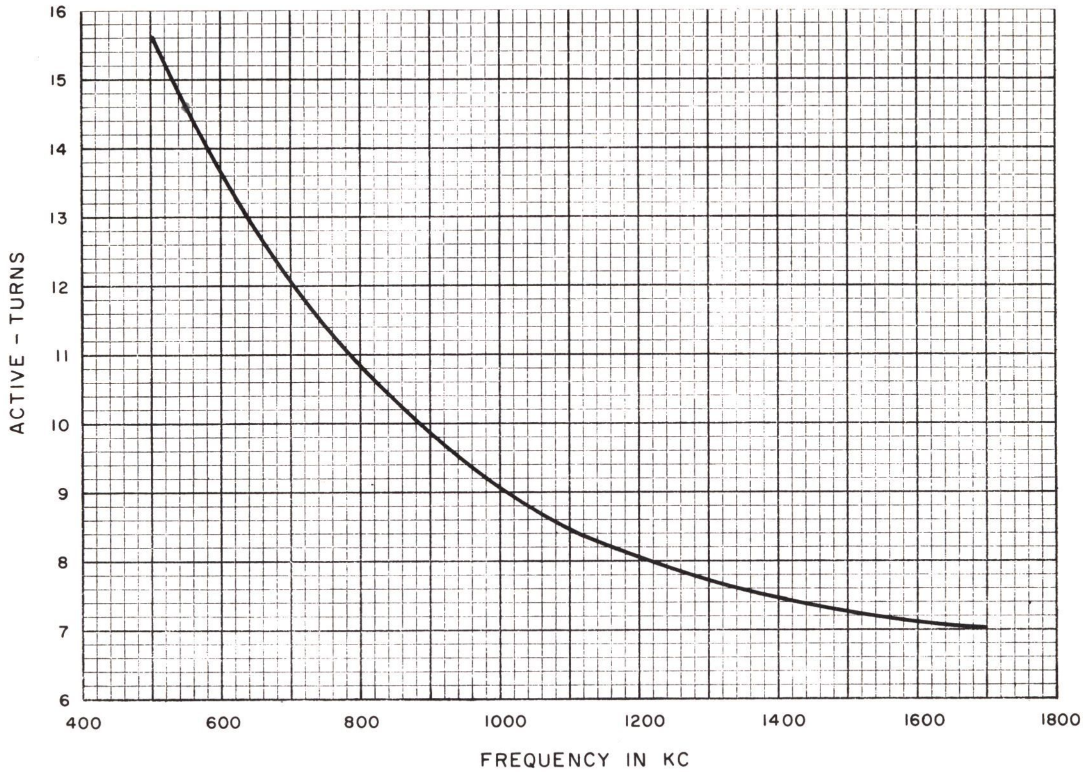

Figure 7—Tuning Chart, Coil 2L110

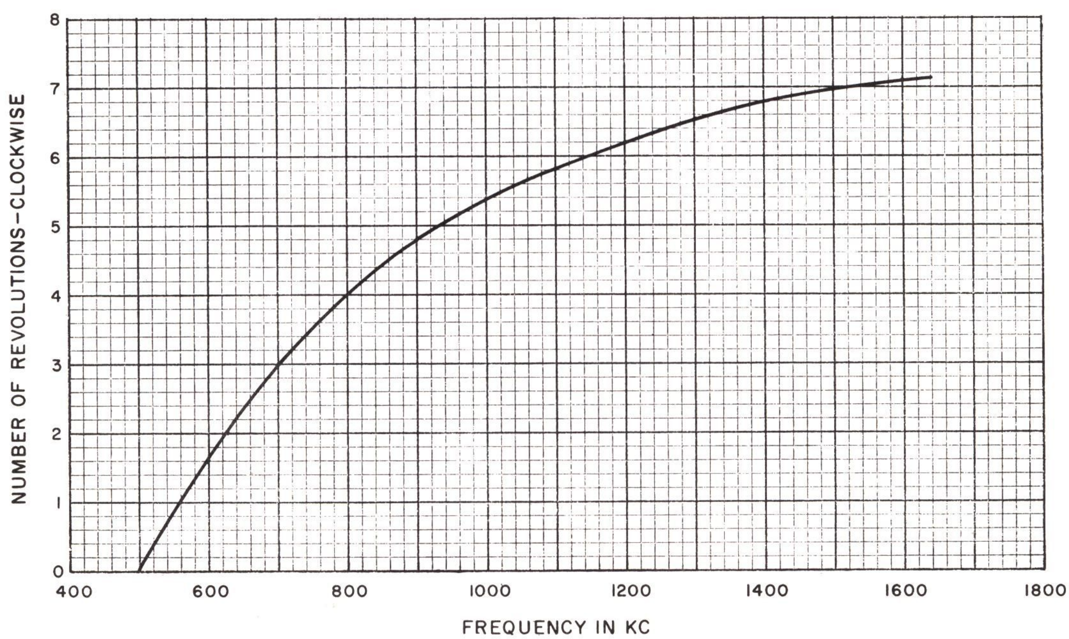

Figure 8—Tuning Chart, Capacitor 2C142

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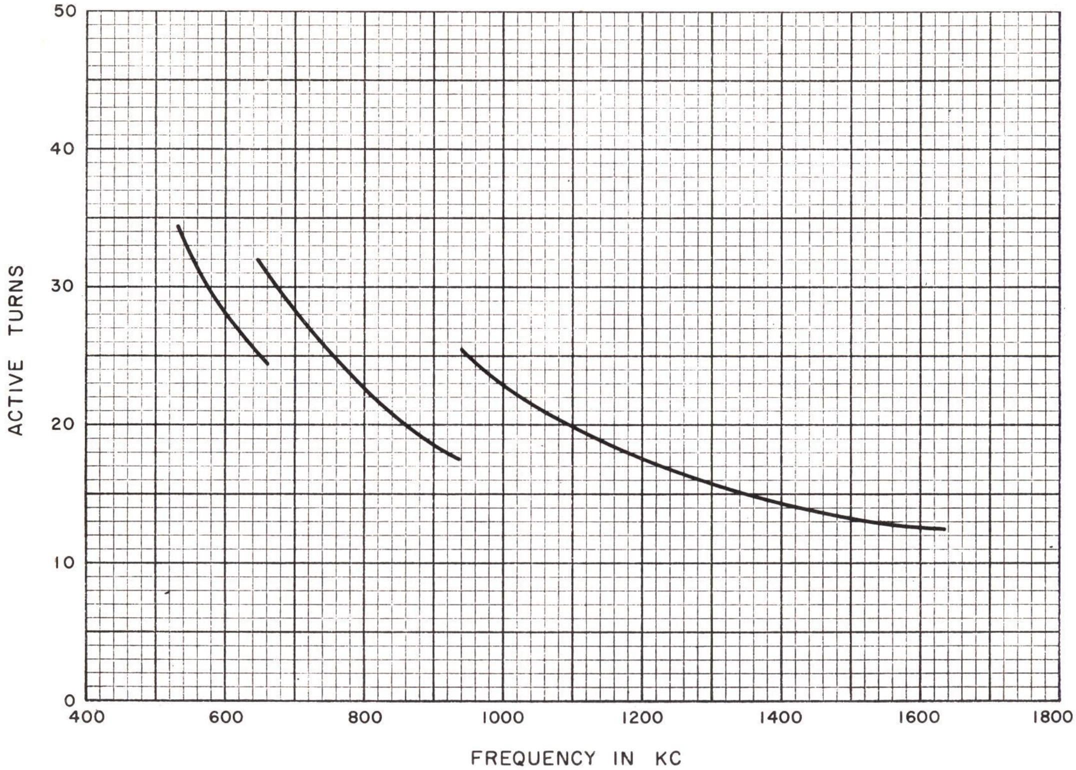

Figure 9—Tuning Chart, Coil 2L109

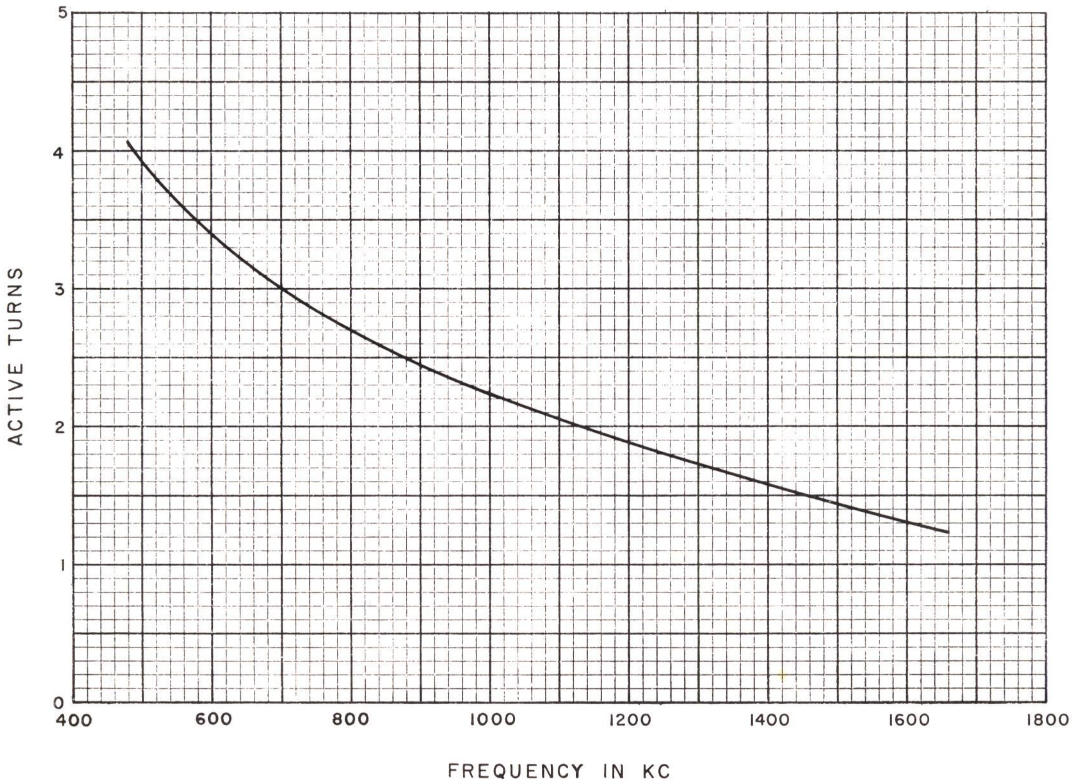

Figure 10—Tuning Chart, Coil 2L111

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TABLE 2. FREQUENCY DETERMINING PARTS (MI-34648)

Frequency in KC	*Capacitors (Values in mmf)*								
	1C305	*2C111*	*2C112*	*2C113*	*2C114*	*2C115*	*2C116*	*2C144*	*2C145*
51.5 or 72 Ohms Line									
535–650	820	500	1000	1000	1000	430	7500	2700	270
650–780	560	500	500	1000	1000	330	5100	2000	200
780–940	560	500	—	1000	1000	330	5100	2000	200
940–1120	430	—	500	1000	—	270	3900	1500	120
1120–1340	330	—	500	1000	—	200	3900	1000	120
1340–1620	330	—	—	1000	—	200	3000	1000	120
230 Ohm Line									
535–650	820	500	1000	1000	1000	430	3000	2700	270
650–780	560	500	500	1000	1000	330	2700	2000	200
780–940	560	500	—	1000	1000	330	2200	2000	200
940–1120	430	—	500	1000	—	270	2200	1500	120
1120–1340	330	—	500	1000	—	200	1500	1000	120
1340–1620	330	—	—	1000	—	200	1500	1000	120

TABLE 3. TYPICAL SOCKET VOLTAGES
(High Voltage Plate Circuit Breaker in OFF Position)

WARNING: Do not measure with high voltage on.

Tube	*Type*	*Function*	*Plate*		*Cathode*		*Grid*		*Screen*		*Fils*	
			Pin	*Volts*	*Pin*	*Volts*	*Pin*	*Volts*	*Pin*	*Volts*	*Pin*	*Volts AC*
1V101	6AK5	Oscillator	5	140	7	1.0	1	—	6	50	3–4	6.3
1V102	5763	Oscillator Buffer	1	180	7	.7	8.9	—	6	170	4–5	6.3
1V601	6146	RF Amplifier	CAP	300	1, 4, 6	16	5	−5	3	90	2–7	6.3
1V603	2E26	1st Audio Amplifier	CAP	440	1, 4, 6	24	5	—	3	140	2–7	6.3
1V604	2E26	1st Audio Amplifier	CAP	440	1, 4, 6	24	5	—	3	140	2–7	6.3
1V501	6155/4-125	2nd Audio Amplifier	CAP	—	—	9	3	—	2, 4	180	1–5	5.0
1V502	6155/4-125	2nd Audio Amplifier	CAP	—	—	9	3	—	2, 4	180	1–5	5.0
1V301	6155/4-125	Driver	CAP	—	—	20	3	−~~50~~ 0	2, 4	250	1–5	5.0
1V302	6155/4-125	Driver	CAP	—	—	20	3	−~~50~~ 0	2, 4	250	1–5	5.0
2V101	3x3000F1	Modulator	—	—	—	—	—	−1000	—	—	—	7.5
2V102	3x3000F1	Modulator	—	—	—	—	—	−1000	—	—	—	7.5
2V103	5762	Power Amplifier	—	—	—	—	—	—	—	—	—	12.6

All Voltages dc and measured to ground less otherwise indicated.
Low Voltage +490 v dc.
Bias Voltage −1100 v. dc.

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Filament Check

1. Place the following switches in the ON position. LINE, CONTROL/FILAMENTS and TRANS ON/OFF. The blower motor will start and filament voltage will be applied to all tubes.

2. Measure the filament voltage across the Modulator tubes, 2V101 (3X3000F1), 2V102 (3X3000F1), and the PA tube 2V103 (5762). Adjust the Filament Control Transformer, 1T403, to correspond to the voltage given in Table 3.

3. Measure the filament voltage across the driver tubes, 1V501 (6155/4-125A), 1V502 (6155/4-125A), and the 2nd audio amplifier tubes, 1V301 (6155/4-125A), 1V302 (6155/4-125A).

4. Measure the filament voltage across the exciter tubes 1V101 (6AK5), 1V102 (5763) (part of 1Z601), 1V601 (6146), 1V603 (2E26), and 1V604 (2E26). Adjust the primary taps on the filament transformers 1T602 and 1T603 to agree with the voltage given in Table 3.

Exciter Check

1. Place the 11 Position Meter Switch, 1S201 in AMP Ig; press the CRYSTAL, SELECTOR switch to crystal number one. Put the OL RESET-PLATE ON/OFF switch in the ON position. Note the meter reading and compare it to the reading given in *Table 4. Typical Panel Meter Readings.* If necessary, change the tap on coil 1L601, see Figure 21, to a lower position in order to obtain the maximum reading. Select crystal number two, note that the AMP Ig indication falls to zero. Select crystal number one again and, beginning with the first selection of the meter switch, take readings on each position and compare the readings to that given in Table 4.

2. Connect a frequency monitor to 1J601 and check the frequency. If necessary, adjust the crystal trimmer C101, see Figure 19.

3. Place the PLATE ON/OFF, TRANS ON/OFF switches in the OFF position. After the blower stops place the LINE switch to OFF.

4. Reconnect the primary leads to the bias transformer 1T501, and the plate transformer 3T101.

Driver Check

1. Place all switches in the OFF position. Check that the TUNE-OPERATE link is in the OFF position, i.e., insulators 102B, 103B, and 104B are not link connected. NOTE: TO PROTECT THE HIGH VOLTAGE FILTER CIRCUIT, DISCONNECT THE HIGH VOLTAGE AT THIS POINT ONLY.

TABLE 4. TYPICAL PANEL METER READINGS

Meter Symbol	*Panel Designation (or switch position)*	*Modulation Level (1000 cps)*			
		0%	*50%*	*100%*	*FSD*
		Meter Reading	*Meter Reading*	*Meter Reading*	
1M201	—	—	—	—	150%
	Osc Ik-1	80%	—	—	6.5 ma
	Osc Ik-2	80%	—	—	73 ~~83~~ ma
	Buf Ig	50%	—	—	6 ma
	Buf Ip	45%	—	—	115 ~~130~~ ma
	Amp Ig (Driver)	70%	—	—	27 ~~30~~ ma
	Amp Ik-R (Driver)	45%	—	—	350 ~~400~~ ma
	Amp Ik-L (Driver)	45%	—	—	350 ~~400~~ ma
	1st AF IK-R	45%	—	—	11 ~~7.5~~ ma
	1st AF Ik-L	45%	—	—	11 ~~7.5~~ ma
	2nd AF Ik-R	~~80%~~ 65%	75%	70%	100 ~~75~~ ma
	2nd AF Ik-L	~~80%~~ 65%	75%	70%	100 ~~75~~ ma
1M202	Fils, Line 1-2, 2-3, 3-1	240 v	—	—	300 ac
1M501	Plate E	4.75 kv	—	—	6 kv
1M502	Amp (Driver Plate)	.2 amp	—	—	1 amp
2M101	PA Plate	1.25 amp	—	—	3 amp
2M102	Mod Ik-1	.1 amp	.3 amp	.6 amp	1.5 amp
	Ik (Total)	.1 amp (×2)	.3 amp (×2)	.6 amp (×2)	1.5 amp (×2)
	Ik-R	.1 amp	.3 amp	.6 amp	1.5 amp
2M103	PA Ig	~~.5~~ .3 amp	—	—	1.5 amp
2M104	Optional Meter		—	—	—

* Meter readings shown change due to modulation. Remaining meter readings may change slightly due to voltage regulation.

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WARNING

IF, IN THE COURSE OF CHECKING OR INSPECTING THE COMPONENT CONNECTIONS, IT BECOMES NECESSARY TO MAKE ANY CONNECTION CHANGES, PLACE ALL SWITCHES IN THE OFF POSITION AND USE A GROUNDING HOOK ON THE COMPONENT OR CIRCUIT BEFORE MAKING THE REQUIRED CHANGES.

2. Check the high voltage silicon rectifiers, that they are mounted firmly and all connections are secure.

3. Place the LINE, TRANS, and PLATE switches in the ON position. The 2375-volt intermediate high voltage will be applied to the Driver and 2nd AF stages.

4. Tune the Driver for minimum plate current as indicated on the PLATE AMP meter, 1M502. Observe the PA grid current on meter 2M103. Step by step, adjust the coupling tap on coil 1L301, retuning the Driver after each adjustment to obtain maximum PA grid current (2M-103).

5. Place the TRANS ON/OFF switch to OFF.

PA Neutralization

1. Using the components supplied in MI-34610, item 9, construct a tuning probe according to the schematic diagram, Figure 11. Connect the probe between the output network capacitor 2C116 and the voltmeter as shown in this diagram.

NOTE: As an alternative to constructing this probe, an r-f probe and vacuum tube voltmeter may be used as a substitute.

2. Disconnect the primary supply to the filament transformer 2T104, see Figure 16, by removing one wire between the primaries of the transformers.

3. Disconnect the strap from the neutralizing capacitor, 2C107, see Figure 18.

4. Place the LINE, TRANS, and PLATE switches ON. Rotate the PA tuning crank to obtain a maximum indication of approximately 10 v dc on the rf probe meter reading.

5. Place the TRANS and PLATE switches in OFF. Re-connect the strap on the neutralizing capacitor, 2C107. Place the PLATE switch ON and turn the PA tuning crank for a maximum indication on the probe meter. Note the meter reading. Place the PLATE switch OFF and turn the neutralizing capacitor knob about a quarter-revolution. Place the PLATE switch ON and note the reduction in the meter reading. Repeat this procedure, alternately tuning the PA for maximum with the PLATE switch ON and, with the PLATE OFF, adjusting the neutralizing capacitor for a minimum indication. Continue tuning in this manner until no further reduction of the meter indication is observed when the neutralizing capacitor is adjusted. The probe meter reading should be approximately 1 v dc.

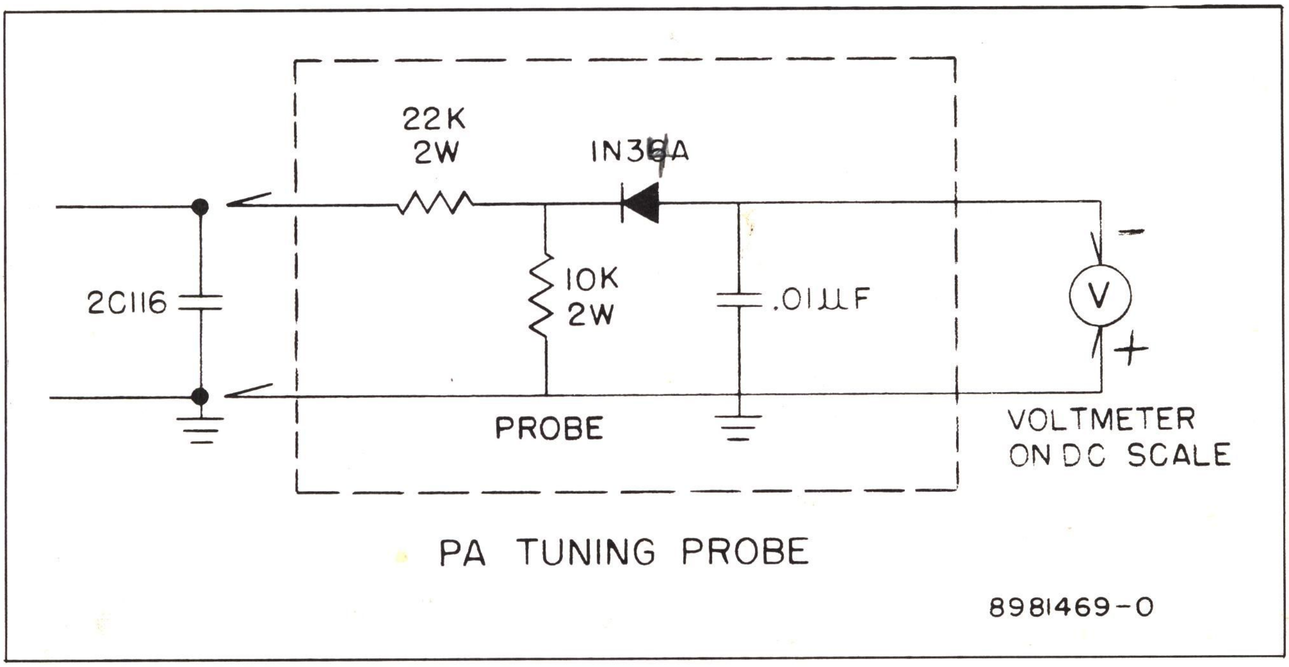

Figure 11—PA Tuning Probe

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6. Place the TRANS and PLATE switches in the OFF position. Reconnect the primary supply to transformer 2T104.

2nd Harmonic Trap Tuning

Two methods may be employed to tune the second harmonic filter trap. One method utilizes the probe constructed from MI-34610, item 9; the other requires the use of a suitable receiver tuned to the second harmonic frequency and coupled to the antenna, with the transmitter operating at its rated power output. Since a receiver may not be readily available, only the first mentioned method will be described here. However, if the second method is adopted, the final adjustment of the slug in coil 2L105 should be made with the tuning rod, MI-34610, item 9, and with the rear panel in place.

1. Retain the TUNE-OPERATE link in the OFF position. Disconnect capacitors 2C109, 2C110, and 2C111; short the active turns on coil 2L104, see Figure 18.

2. Connect the probe and meter across 2C115 so that the probe is adjacent to the capacitor and the meter is outside of the cabinet.

3. Place the TRANS and PLATE switches ON. The PA plate current and plate voltage meters should read zero; the PA grid current should be approximately 0.4 amps, while the pick-up from the probe should show several volts on the voltmeter.

4. Insert the tuning rod in the cover panel so that it engages the slug of 2L105. Observe the meter and move the slug all the way in and out of the coil. At the point where a minimum indication is obtained on the meter, stop the slug in its travel. Remove the rod from the panel.

NOTE: Typical tuning of the 2nd Harmonic Filter, 2L105, and the meter readings are illustrated in the following example.

Turns	*Meter Reading and Slug Position*	
14	3.3 v Fully in	7.0 v Fully out
13	2.3 v Partly in	4.5 v Fully out
12	2.3 v Fully in	3.0 v Fully out

This example shows typical voltages for a given number of turns on coil 2L105, relative to the position of the slug within the coil. In this example, coil 2L105 is correctly tuned at 13 turns with the slug partly in and a meter reading of 2.3 volts.

5. Place the PLATE switch OFF; remove the back cover and check that the slug is partly inside the coil. If the slug is completely inside the coil, change the position of the tap on 2L105 and repeat the procedure in Step 4.

3rd Harmonic Trap Tuning

Adjustment of the third harmonic filter trap—2C145 and 2L109—is not as critical as adjustment of the second harmonic trap, since the tank circuit provides high attenuation of the third harmonic. In most cases the tap setting for 2L109 indicated on the calibration chart, Figure 9, will provide sufficient attenuation for the third harmonic.

To make a fine adjustment of the trap proceed in the same manner as for the second harmonic trap, through Steps 1 to 3 inclusive; but in Step 2 the probe and meter should be connected across coil 2L109.

Take a meter reading at each tap position until the exact resonance point of 2L109 and 2C145 is found. Resonance will be indicated by a dip in the meter indication.

Place the TRANS switch OFF; use a grounding hook on all capacitors in the Amplifier-Rectifier cabinet. Reconnect capacitors 2C109, 2C110, and 2C111; remove the short from 2L104; remove the probe and meter. Place the TUNE-OPERATE link in the TUNE position.

Preliminary PA Tuning

1. Examine the PA and Modulator connections, noting particularly that all points of contact are solidly connected as 2375 volts will be applied to the plates in the next step.

2. Put the TRANS and PLATE switches in the ON position. Re-adjust the PA tuning to obtain a minimum plate current indication on meter 2M101.

3. Operate the POWER RAISE/LOWER switch, 1S202, to obtain 0.4 amps PA plate current. If the plate current is more than 0.4 amps, place the PLATE and TRANS switches in OFF and, after using the grounding hook on the output network, reduce the number of turns on coil 2L106. Repeat the procedure in Step 2 and this Step as required to obtain the proper current level.

NOTE: The tuning charts (shown in figures 3 through 10) give the nominal tap setting of the various tank coils for a particular frequency. However, it may be necessary to select an adjacent tap when performing the actual tuning operation with capacitor 2C110. This tuning operation assumes, of course, that 2C110 was set to maximum capacity when installed.

4. Return the PLATE and TRANS switches to the OFF position.

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Final PA Tuning

1. Place the TUNE-OPERATE link to operate, i.e., connect the link between 102B and 103B.

2. Turn the controls on the modulator bias potentiometers, 2R105 and 2R106, fully *counterclockwise.*

3. Put the TRANS and PLATE switches in the ON position. See that the plate current, indicated on meter 2M101, is 1.0 ampere or less. Adjust the tuning control and the POWER RAISE/LOWER control to obtain an indication of 1.0 ampere on meter 2M101. Note the plate voltage (1M501) plate current (2M101) and transmission line (or a remote antenna) RF current meter indications. The power output should be 3.3 KW, approximately.

4. *PLATE RESONATOR TUNING* is obtained in the following manner:

With the TRANSMITTER switch in the OFF position set tap of the plate resonator coil 2L110 in accordance with Figure 7. Obtain access to screwdriver control shaft 2C142 by removing the LH plug-button, see Figure 16.

5. Place the transmitter ON. Observing the RF current meter rotate the shaft of 2C142 half revolution in CW and half revolution in CCW direction to peak the RF current. Progressively rotate 2C142 in CW and CCW direction away from the nominal tuning point determined from the calibration curve of 2C142, Figure 8, to peak the RF current. A definite peak of this meter coincides with the resonance of 2C142 with 2L110 at the 3rd Harmonic of the carrier frequency and is the correct tuning point.

6. Refer to previously taken readings in Step 3 above. Note an increase in the power output and in the PA efficiency. Take the corresponding meter readings.

7. *CATHODE RESONATOR TUNING* is obtained in the following manner:

With the transmitter switch in OFF, set the cathode resonator coil 2L111 as per tuning chart, Figure 10. Obtain access to the righthand screw-driver control shaft 2C143 by removing the plug-button, see Figure 16. Set 2C143 to mid-capacity, i.e., half mesh.

8. Place the transmitter switch ON. While observing the RF current meter reading, rotate the 2C143 capacitor 1/4 revolution to peak the RF current.

9. If the peak does not occur within the 2C143 capacity range, place the TRANSMITTER switch to OFF. Move the tap point on 2L111 by approximately 1/4 turn away from, and on either side of, the initial tuning point determined from the calibration chart, Figure 10, each time rotating capacitor 2C143 as outlined in Step 8 above.

A definite peak of the RF meter coincides with the resonance of 2L111 with 2C143, 2C144 at the 3rd harmonic of the carrier frequency and is the correct tuning point.

10. Refer to meter readings taken in Steps 3 and 6 above. Note an increase in the power output and the efficiency increase of approximately 15 percent over and above the efficiency obtained in Step 3.

NOTE: The PA efficiency should be 90 percent approx., although the estimated efficiency may differ due to accumulation of tolerance of meter readings and the load impedance. See Addendum for detailed description of the high efficiency circuit.

11. Adjust the POWER RAISE/LOWER control to obtain the rated power which is 5-5.5 kw, depending on the transmission line losses. Verify the driver tuning, the PA tuning and tuning of both resonators at the rated power. Refer to a typical meter reading Table 4 to ascertain the proper adjustment of the transmitter. The plug button may now be replaced over the 2C142 and 2C143 control shaft.

NOTE: The efficiency of the PA stage may be improved by the usual method of slightly detuning the transmitter. If the PA tuning control is rotated CW, the power output will increase; if it is rotated CCW, the power output will decrease.

Modulator Adjustments

1. Connect the output (either 150 or 600 ohms) of the audio signal generator to the Audio Input terminals 1-28B and 1-29B (refer to the schematic, Figure 25). The Audio Input Transformer is wired for 600 ohms. For 150 ohm input, disconnect contacts 3 and 4 on 1T601; then, using a buss wire, make a jumper connection between 4 and 1 and between 3 and 6.

2. Connect the modulation monitor to the Modulation Monitoring jack, 2J101 (see Figure 18) and the distortion and noise meter to the modulation monitor.

3. Turn the test equipment ON and allow it to warm-up for approximately 10 minutes.

4. Place the TRANS and PLATE switches to ON. Adjust the transmitter for rated power output. Adjust the modulator bias potentiometers 2R105 and 2R106 so that the modulator plate currents are each 0.1 ampere. Adjust the tap on 2L108 to obtain the required sample voltage for the modulation monitor.

5. Set the audio oscillator to 1000 cycles and adjust the output for +5 dbm. Adjust the Modulation

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Monitor and the Distortion and Noise Meter. (For specific instructions on the operation of these instruments, refer to their individual instruction books.)

6. Modulate to 100 percent at 1000 cycles. This amount of modulation requires between +8 and +12 dbm input. Verify the percentage of modulation with an oscilloscope. Check that the PA plate current indicated on meter 2M101 does not change more than .05 amps. If necessary, readjust the PA stage.

7. Apply 95 percent modulation at 50 cps and check the modulator lefthand and righthand currents. The variation between the two currents should not exceed approximately 0.1 amp. If necessary, readjust the modulator bias potentiometers 2R105 and 2R106. Remove the modulation and check that the modulator static current of each tube does not exceed 0.18 amp. The current values indicate the final settings of the modulation bias potentiometers.

8. Calibrate the Distortion and Noise Meter and measure the noise level using 1000 cycles modulated at 100 percent. If the noise level is above −60 db, potentiometers 1R324 and 1R325 may require adjustment. If this is the case, place the PLATE and TRANS switches to OFF. Check the position of the wiper contacts from the rear of the cabinet. Beginning with the contacts in the center, make incremental adjustments of the contacts until the noise level measures −60 db or less.

9. Using 1000 cycles, 0 db as a reference, apply 50 percent modulation to the transmitter; then sweep through 30 to 15,000 cycles keeping the audio input constant and note the frequency response in this range. Refer to the AF Distortion under the TECHNICAL DATA and check that the frequency response is within the limits specified.

10. Perform distortion measurements from 50 to 10,000 cycles at 95 percent modulation. Distortion should be 2.5 percent or less.

11. Perform frequency response measurements at full modulation. Vary the modulation from 0 to 100 percent and note the carrier shift. This should be within 3 percent provided the power line regulation is good.

NOTE: If the power line regulation is very poor, the line reactor of the plate transformer, 3T101, may be link shorted for the purpose of making this test. However, the transmitters should not be normally operated in this manner as the plate transformer winding and the HV rectifiers are unprotected against line surges.

12. The second harmonic trap, 2L105 and 2C115 may require a slight readjustment to obtain the required attenuation. A test receiver should be used to indicate the degree of attenuation.

13. Record the tap positions of all coils, and the PA tuning capacitor, 2C110; log all meter readings. This concludes all tuning operations.

Multiple Overload Trip Operation

The sensitivity of the overload relays is set at the factory and normally no further adjustment is required. However, if the transmitter shuts down without any apparent overload, the sensitivity of the relays may be checked in the following manner. The voltage and/or current required to trip the overload relays is given in the Maintenance Section, Table 8.

1. Place the SINGLE-MULTIPLE switch, 1S401, to SINGLE position. Place the TRANS ON/OFF and the PLATE ON/OFF switches in the ON position. Do not modulate the carrier.

2. While observing meter 2M101, detune the PA by turning the tuning control of capacitor 2C110 until the meter indicates approximately 2.2 amps. At this point, the PA overload relay 2K101, Figure 18, should remove the plate voltage. If necessary, reset the sensitivity of 2K101 by making small incremental adjustments of the setscrew until the spring tension is such that it will trip the relay at the correct current.

3. The plate current should return to ON automatically and again trip 2K101 at the 2.2 amp level to remove the plate voltage.

4. If, after resetting the sensitivity of 2K101, the foregoing sequence of operation does not take place, the time delay relay, 1K402, may also require a similar adjustment. The action of 1K402 (delay time approximately 2 seconds) should be such that it permits the bias relay, 1K502, and the surge suppressor relays, 1K301 and 1K503, to open for approximately 0.5 of a second before it recloses the plate contactor, 1K602.

5. Retune the transmitter by returning the tuning control of 2C110 to its original position. Place switch 1S204 to OL RESET.

6. Detune the PA driver tank coil, 1L301, by turning the AMP TUNING control until meter 1M502 indicates 0.3 amp. This should cause the Driver overload relay, 1K606, Figure 21, to trip, thus removing the plate voltage. If necessary, reset the sensitivity of 1K606 by making the setscrew adjustment described previously.

7. Retune the transmitter by returning the AMP TUNING control to its original position.

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TABLE 5. RECOMMENDED OVERALL MAINTENANCE SCHEDULE

DAILY
Check and compare all meter readings at start-up. Adjust filament voltages if necessary.
Take steps to correct any conditions revealed by abnormal reading.
Check filament voltages every hour, for increased tube life.
Make general visual inspection after shut-down. In particular check motor and blower bearings for evidence of overheating.
If overloads have occurred, examine components concerned at shut-down, and repair or replace as necessary.
Check filament connections on the type 5762 and 3X3000 F1 tubes for evidence of overheating.
Tighten connections if required.
WEEKLY
Clean internal parts of transmitter. Use clean, soft cloth on insulators.
Use vacuum cleaner or hand blower for removing dust or dirt.
Check the blower boot for airtightness and proper connections.
Test all door interlocks and grounding switches.
Test operation of overload circuits. (Refer to "Control Circuit Check," and "Multiple Overload Trip Operation.")
Check PA and output r-f circuits for evidence of heating at connector or junction points.
Make overall check on frequency, distortion, and noise level.
Remove the cover from the high voltage rectifier compartment and visually inspect the silicon rectifiers.
MONTHLY
Check condition of relay contacts. Service if necessary. Inspect air filter. Clean if necessary, using a vacuum cleaner or brush.
Check operation of air interlock switch 2S107 by partly blocking the air intake to the blower. This will trip the filament contactor, 1K404.
Inspect the high voltage plate transformer, 3T101.
Check and record tube socket voltages. Compare with previous readings to detect irregularities.
Refer to Figure 12. Measure and record the inverse resistance of each end cell of the high voltage silicon rectifier. Unless the reading is abnormally low, the 22K resistor shunted across each rectifier need not be disconnected.
Measure the inverse resistance of each cell of the bias and the low-voltage rectifiers.
Make a detailed inspection of all transmitter components.
Inspect and service all contactors.
Clean blower impellers.
Lubricate blower motors and tuning drive mechanisms. Refer to Table 6, Lubrication Chart.
SEMI-ANNUALLY
Inspect relay contactors and replace where required.
Clean pole faces on contactors.
Test spare tubes.
Tighten all connections in transmitter.

OPERATION

In routine operation, it is necessary to operate the PLATE ON/OFF and TRANS ON/OFF switches for stopping the transmitter. All other circuit breakers and switches should be left in the ON position at the end of each shut-down.

To interrupt transmission for a short interval, operate the PLATE switch to OFF. This will maintain filament power on the tubes, and the transmitter will be returned to immediate operation when the PLATE switch is closed.

For stability, the crystal heaters are intended to be operated at all times, except when the transmitter is to be shut down for extended periods. Therefore, the external switch controlling crystal heater power should not be opened at routine shut-downs. The crystal units require a minimum of 30 minutes warm-up time before operating the transmitter.

MAINTENANCE

General

With ordinary care a minimum of service will be required to keep the BTA-5T transmitter in operation. To avoid interruptions during broadcasts, however, a regular schedule of inspection should be established. Table 5, a recommended schedule for the transmitter, should be correlated with other station equipment maintenance to insure overall peak efficiency.

Always open the LINE circuit breaker and discharge circuits with a grounding stick before touching any component.

Cleaning

Ceramic insulators and bushings should be kept clean at all times. Insulators subject to stress in high-voltage d-c fields may rupture if sufficient dust accumulates to cause a corona discharge. Clean insulators by using a soft clean cloth. Insulator specifications are covered in Table 7 and insulator details are shown in Figure 13.

Keep tube envelopes and vacuum capacitors clean to avoid possible puncture of the glass due to ion bombardment of corona. Tissue paper and alcohol are effective for this purpose.

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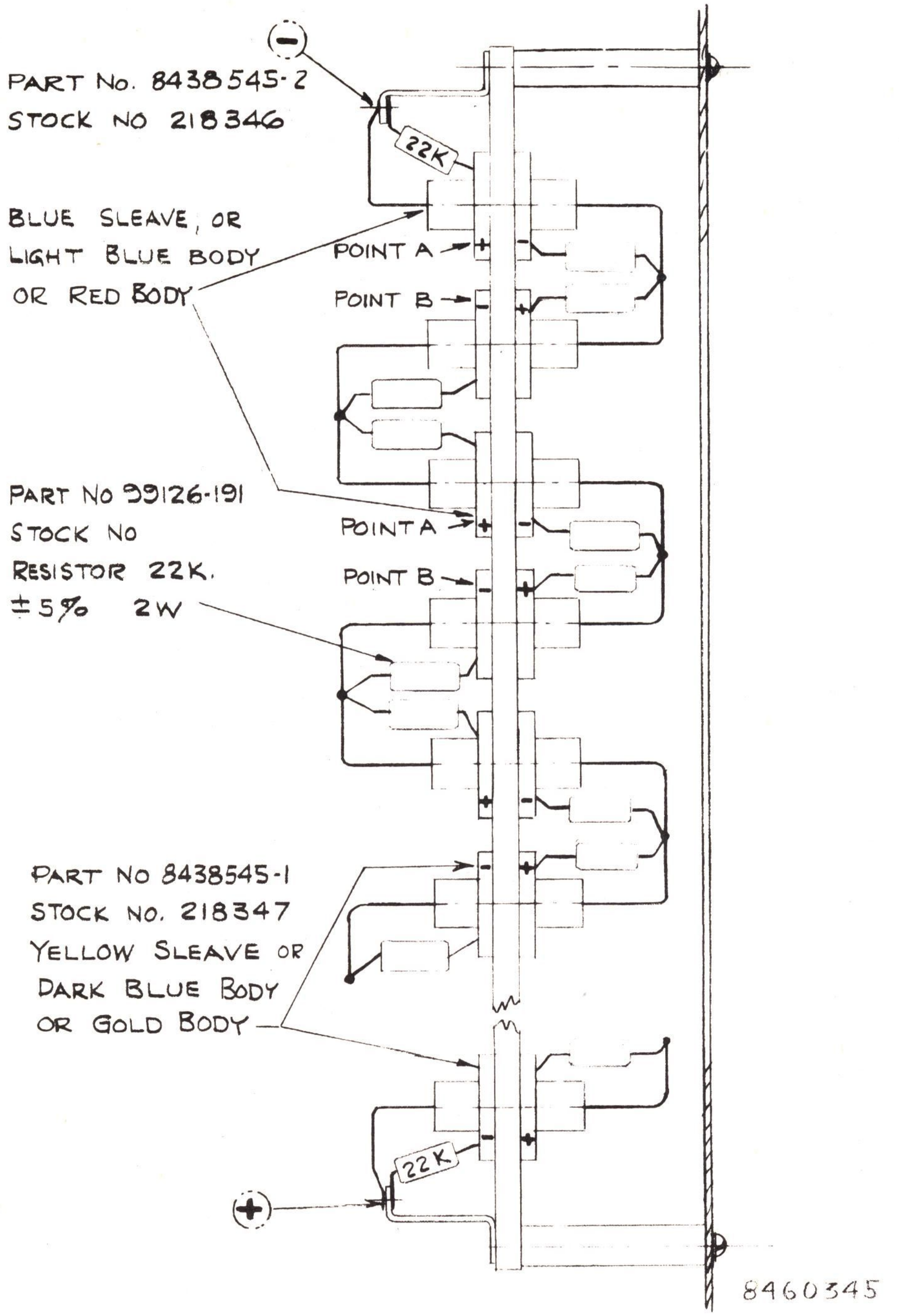

HIGH VOLTAGE SILICON RECTIFIER

NOTE: RECTIFIERS AT THE BACK OF THE ASSEMBLY BOARD CAN BE MEASURED IN PAIRS FOR THE FORWARD AND THE REVERSE RESISTIVEITY FROM THE FRONT OF THE ENCLOSURE BY CONNECTING THE METER LEADS TO POINTS "A" & "B". THE REVERSE TOTAL RESISTANCE OF TWO UNITS, BETWEEN POINT A-B IS 40 KΩ ±5 KΩ APPROX, THE FORWARD 50 Ω APPROX.

Figure 12—High Voltage Silicon Rectifier

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Clean plate tank coils with a dry cloth. NEVER USE LIQUID POLISH OR STEEL WOOL ON THESE ITEMS.

Keep safety gaps clean. If gaps are pitted, polish them with crocus cloth.

Blower blades should be cleaned regularly to preserve efficiency. Use a wire brush for removal of caked deposits of dirt, then repaint the blades with a good grade of quick-drying synthetic resin enamel.

The air filters in the transmitter may be cleaned several times with a vacuum cleaner before it becomes necessary to replace the filter element.

Vacuum Capacitors

CAUTION: When handling capacitors during maintenance or replacement, avoid undue strain or pressure on the glass-to-metal seals. Careless handling or improper installation can result in permanent damage to the capacitor.

Variable vacuum capacitor 2C110 should be examined periodically. Clean the glass envelope using the same method as for vacuum tubes. Mounting and connection fasteners should be checked and kept tight to prevent undue heating.

TABLE 6. LUBRICATION CHART

Symbol No.	*Component*	*Procedure*
1L301	Tank Coil	Oil tuning slug shaft and runners every 6 months with SAE #10 oil.
1T	Variable Filament Transformer	Oil shaft every 6 months with SAE #10 oil.
2B101	Blower Motor	Clean bearings and repack with grease every 4 years.
2B102	Plate Tank Coil (2L106) Motor	Oil motor shaft and tuning slug threaded shaft and runners every 6 months with SAE #10 oil.

TABLE 7. INSULATOR DATA

Type Designation	*Stock Number*	*Drawing Number*	*Figure*	*Dimensions in Inches*								*Tap Size*
				A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	
NS5W0104	211423	426765-3	I	3/8	1/2	.16	—	—	—	—	—	.138–32
NS5W0105	210439	426765-6	I	3/8	5/8	.19	—	—	—	—	—	.138–32
NS5W0108	208116	426765-12	I	3/8	1	.38	—	—	—	—	—	.138–32
NS5W0116	217752	426765-21	I	3/8	2	.38	—	—	—	—	—	.138–32
NS5W0208	210376	426766-9	I	1/2	1	3/8	—	—	—	—	—	8–32
NS5W0308	97457	426767-3	I	3/4	1	3/8	—	—	—	—	—	10–32
NS4W0310	97458	426767-6	I	3/4	1-1/4	3/8	—	—	—	—	—	10–32
NS5W0312	210281	426767-9	I	3/4	1-1/2	3/8	—	—	—	—	—	10–32
NS5W0321	208525	426767-21	I	3/4	4	3/8	—	—	—	—	—	10–32
NS5W0412	55800A	426768-6	I	1	1-1/2	1/2	—	—	—	—	—	.25–20
NS5W0424	211449	426768-15	I	1	3	5/8	—	—	—	—	—	.25–20
NS5W0432	209927	426768-18	I	1	4	5/8	—	—	—	—	—	.25–20
NS5W0440	209928	426768-21	I	1	5	5/8	—	—	—	—	—	.25–20
NS5W1108	218090	426772-6	II	1/2	1	3/8	—	—	—	—	—	8–32
NS5W1208	210084	426773-3	II	3/4	1	3/8	—	—	—	—	—	10–32
NS5W1210	209664	426773-6	II	3/4	1-1/4	3/8	—	—	—	—	—	10–32
NS5W1212	209711	426773-9	II	3/4	1-1/2	3/8	—	—	—	—	—	10–32
NS5W1216	209929	426773-12	II	3/4	2	3/8	—	—	—	—	—	10–32
NS5W1220	213360	426773-15	II	3/4	2-1/2	3/8	—	—	—	—	—	10–32
NS5W1224	209090	426773-18	II	3/4	3	3/8	—	—	—	—	—	10–32
NS5W2012	51781A	426762-6	III	—	1-1/2	3/8	1	1/2	—	—	—	8–32
NS5W2016	99043	426762-9	III	—	2	3/8	1-1/8	5/8	—	—	—	10–32
NS5W2024	55081	426762-12	III	—	3	3/8	1-1/2	3/4	—	—	—	10–32
NS5W4101	211247	426764-3	IV	5/8	1/4	15/16	1/2	.143	3/8	—	—	—
NS5W4201	211246	426764-53	V	3/8	1/4	1/4	1/2	.143	3/8	—	—	—
NS5W4502	51088A	426761-12	VI	1-1/8	7/16	7/8	1-3/4	1/16	1	1-1/4	17/64	—
		8987642-2	VII	3/4	1	3/4	3/8	4	—	—	—	10–32

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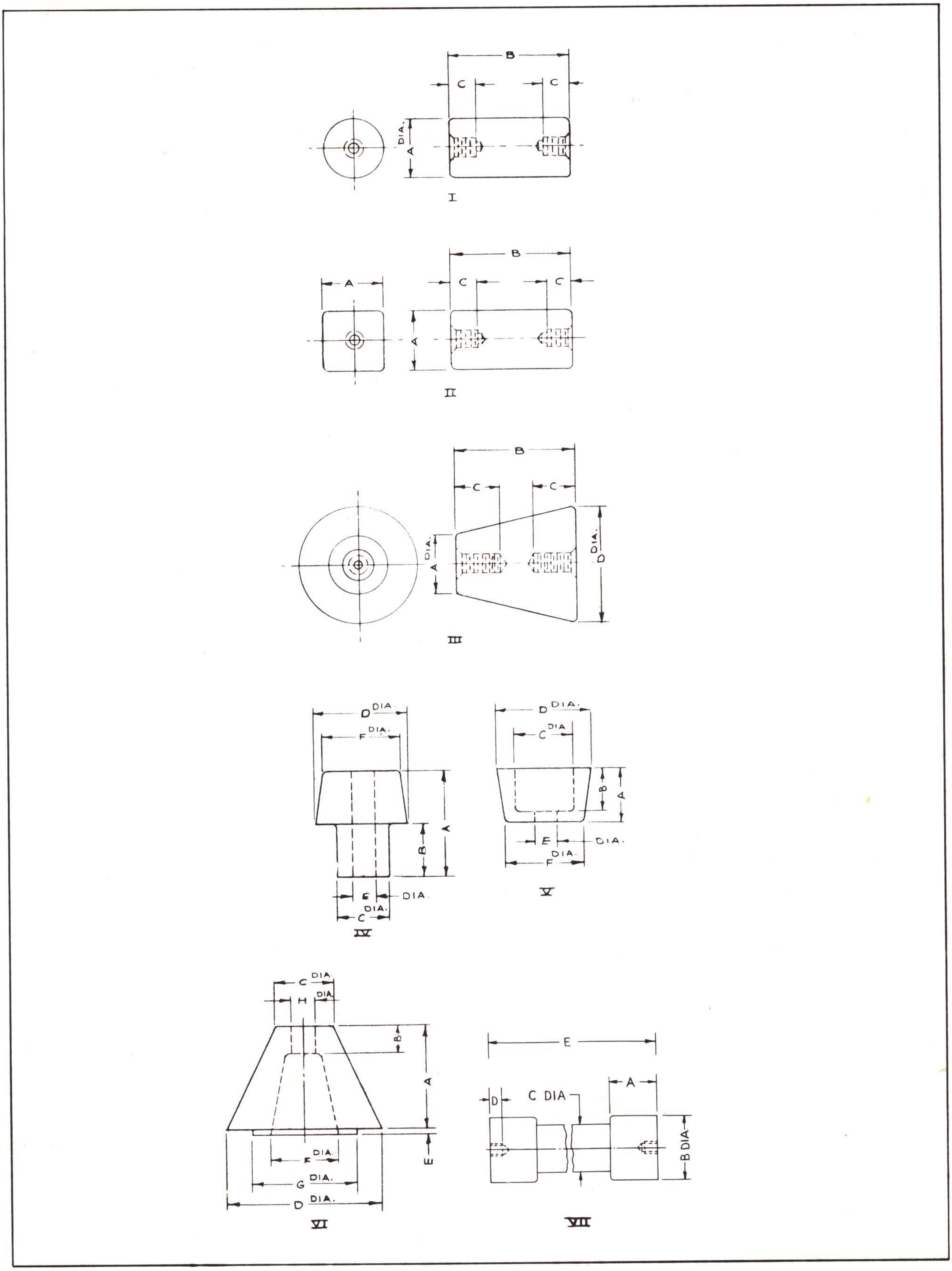

Figure 13—Insulator Details

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If it should become necessary to replace capacitor 2C110, first turn the tuning dial to zero, then disconnect the universal joint from the capacitor and remove the capacitor. Rotate the shaft of the replacement capacitor to maximum capacity, then back off the shaft a half turn from this position. Install the capacitor and lock the universal joint in place with the setscrew. The dial indication should remain at zero.

Before replacing the variable vacuum capacitor 2C142 by a new capacitor, see that the shaft of the new capacitor is set in a position to obtain the same value of capacitance provided by the removed capacitor. There may be a slight change in the previous calibration reading.

Circuit Breakers, Contactors, and Relays

Periodic inspection of circuit breakers, contactors, and relays should be made, and at such time all contacts should be cleaned and adjustments made if necessary.

Circuit Breakers and Contactors

The contactors in this transmitter have contacts made of a material which does not require dressing even though severely pitted. Contacts may be cleaned with carbon tetrachloride and a soft cloth. Keep the pole faces clean and see that they seat securely. Check the operation manually, and tighten any loose screws. Replace broken arc-chutes and defective magnetic blowouts.

Control and Overload Relays

Relay contacts should be cleaned with carbon tetrachloride applied with a soft brush, after which they should be burnished with a tool such as the RCA Stock No. 22963 Contact Cleaning Tool. Finally, contacts should be wiped with a clean piece of bond paper.

The contact fingers in control relays should be checked carefully after such cleaning operation. Make sure that good wiping occurs on contact and that stationary contacts do not follow the movable contacts too far, as the latter move to the opposite position:

Care should be taken not to disrupt the spring tension of the overload relay. If replacement of the overload relay or its spring is necessary, refer to the appropriate data in Table 8 for resetting the relay.

Time Delay Relay

The Agastat time delay relay, 1K402, is adjusted to permit proper operation of the overload reclosing circuit.

Step Notching Relays

The contacts of the d-c operated relays, 1K301 and 1K503, should be cleaned and inspected for pitting. Excessive pitting of 1K503 contacts may be due to the rapid discharge of the high voltage capacitors 1C501 to 1C503, which in turn could be caused by a faulty grounding switch, or the current limiting resistor, 1R514, becoming defective, or by flash-over.

If either of these relays are replaced, it may be necessary to readjust 1R305 to prevent the modulator overload relay, 1K603, from tripping when the PLATE is switched ON.

Overload Relays

The setting of the IPA Overload relay, 1K606, and the PA Overload relay, 2K101, may be checked by detuning the transmitter and observing the current on meter 1M501 and meter 2M101 respectively. The setting of the Modulator Overload relay, 2K102, may be checked by over-modulating the transmitter and observing the current indication on the panel meter 2M102 with switch 2S101 in the No. 1 position.

Table 8 shows the nominal energizing current or voltage required to trip each relay.

The sensitivity of the overload relays is controlled by spring tension. This is set at the factory and usually no further adjustment is required. However, if the transmitter shuts down without apparently overloading, the sensitivity of the overload relays should be checked. (Refer to Figures 16 and 19 for the location of the relays and to the appropriate schematic diagram for their electrical connections.)

To check the relays an external source of power is needed, along with a control network consisting of an ammeter, a Voltohmyst (or similar instrument) and a variable resistor. A convenient source of power is a battery cell, capable of supplying the energizing current and voltage indicated in Table 8. The variable resistor, in conjunction with the ammeter and voltmeter, is used to maintain the output of the battery at the levels shown in the Table.

Before applying power to the relays, the panel meters in the relay circuits should be shorted. This will prevent the meters from possibly being damaged should there be excessive meter deflection while the variable resistor is being adjusted.

Ground the negative side of the battery, and connect the positive side, through the variable resistor, to the appropriate tube filament or other points as indicated by the schematic diagram, Figure 25.

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The contacts on the overload relays should just close at the current or voltage values shown in Table 8, within, of course, the usual limits of meter tolerance. If a relay trips at a current or voltage other than shown, re-set the sensitivity of that relay by turning the spring tension screw (visible through the hex locking nut on the front of the relay). Turning the screw in a clockwise direction reduces the spring tension, thus increasing the sensitivity; conversely, counterclockwise rotation of the screw will reduce the sensitivity of the relay.

TABLE 8. OVERLOAD RELAY SETTING DATA

Symbol	*Function*	*Current or Voltage*
1K603	2nd AF Overload	150 MA
1K605	LV Overload	300 MA
1K606	IPA Overload	300 MA
2K101	PA Overload	2 Amps
2K102	Modulator	2 Amps
2K103	HV Rectifier Overload	1.0 V DC across relay
1S501	Line Circuit Breaker	690 Amps
1S502	Plate Circuit Breaker	460 Amps

Tubes

Check all tubes periodically. Tube failure can be anticipated by keeping a log of tube life and replacing tubes when indicated by the log or when reduced output is apparent.

The most frequent cause of failure in low-power and receiving-type tubes is a gradual loss of emission with use, or actual filament burn-out. Such a condition is easy to recognize if records have been kept on each tube. Gas type rectifier tubes fail mostly due to ion bombardment of the filament, which leads to an increase in the tube arc-drop, a tendency toward arc-back, and eventual loss of the filament. It is helpful to test the tubes from time to time and keep records which indicate tubes likely to cause trouble.

The power amplifier and modulator tubes, type 5762 and 3X3000F1, may become slightly gassy if stored for an extended length of time. To prevent this condition, it is recommended that the tubes be operated in the transmitter at intervals of three months or less. For both types of tubes start operation with the plate voltage reduced to 2400 volts, no modulation and the TUNE-OPERATE link in TUNE position. Then apply low frequency tone modulation and, while observing the tubes for gas flash-over, gradually increase the level of modulation. Next apply full plate voltage and repeat this same procedure. If no flash-over occurs, the tubes are free of gas and may be returned to storage. If gas flashes are observed, repeat the foregoing procedure but this time reduce the bias so that the transmitter can be fully modulated. An alternate method of degassing the tubes is by the gradual application of high voltage without the filament supply. The tubes should then be checked in the transmitter with the transmitter set for normal operation.

Trouble Shooting, General

The following table lists overload protective devices which require manual resetting.

Before resetting any of the overload devices, shut down the transmitter and inspect the circuit peculiar to the overload for evidence of overheating or burning. In an emergency, at least the PLATE ON/OFF switch, 1S204, should be in the OFF position.

TABLE 9. OVERLOAD DEVICES

Symbol	*Rating*	*Description of Circuit*
1F401 to 1F403	1 amp	Line voltmeter, 1M202
1F601, 1F602	1 amp	Crystal oven supply
1K501	5.0–6.5 amp	Main blower contactor
1S210	2 amp	Low voltage plate and bias
1S211	8 amp	Control circuit and filaments
*1S501	70 amp	Transmitter input line
*1S502	70 amp	High voltage plate

* See Table 8 for setting the adjustable instantaneous, magnetic overload circuit breaker.

Trouble Shooting, Instantaneous Overloads

The overload relays momentarily actuate the AGASTAT time delay relay, 1K402, the mechanical latching relay, 1K401, the auxiliary self-latching relay, 1K408 and indicator lamp 2I101. When 1S401 is in the MULTIPLE position, these relays also actuate notching relay 1K406.

Resetting the overloads consists of returning these latching relays to their normal PLATE ON position. Assuming the transmitter is functioning properly, place 1S204 in the OVERLOAD RESET position and hold it there until the plate control circuit relays (1K401, 1K408, and 1K406) are actuated and power is restored. If the plate voltage fails to return, the latching relays will recycle and settle in the OVERLOAD position and the overload indicator, 2I101, will light.

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TABLE 10. RATED POWER TYPICAL SOCKET VOLTAGES

WARNING: These voltages are given for reference only. Do not measure with high voltage on.

Tube	Type	Function	Plate		Cathode		Grid		Screen	
			Pin	Volts	Pin	Volts	Pin	Volts	Pin	Volts
1V601	6146	RF Amplifier	CAP	300	1, 4, 6	16	5	—	3	100
1V603	2E26	1st Audio Amplifier	CAP	400	1, 4, 6	42	5	18	3	140
1V604	2E26	1st Audio Amplifier	CAP	400	1, 4, 6	42	5	18	3	140
1V301	6155/4-125	2nd Audio Amplifier	CAP	850	—	25	3	—	2, 4	280
1V302	6155/4-125	2nd Audio Amplifier	CAP	—	—	25	3	—	2, 4	280
1V501	6155/4-125	Driver	CAP	—	—	—	3	−120	2, 4	280
1V502	6155/4-125	Driver	CAP	—	—	—	3	−120	2, 4	280

If the OVERLOAD indicator does not reset, open the transmitter door (or any interlock) place 1S204 to OVERLOAD RESET and then to PLATE OFF. Check circuit breakers 1S210 and 1S502 including their associated circuits.

Observe the meters and place 1S204 to the PLATE ON position. The sequence in which the relays operate after closing the PLATE switch is as follows:

Relay 1K406, contacts 7–8 close to energize the LV-PLATE relay, 1K602 and the BIAS relay 1K502. 1K502 contacts 6–4 close to energize the HV PLATE relay 1K407.

BIAS relay 1K502, contacts 3–5 close to charge 1C310 through 1R315 and after a short delay closes relays 1K301 and 1K503.

1K301 closes and shorts out 1R316 thus applying full voltage to the 2nd Audio Amplifier stage.

1K503 shorts out 1R514, the filter capacitor starting current limiting resistor.

Fault Analysis and Location

Overload relays are provided with auxiliary, normally open contacts wired to the terminal board so that a switchable, latching-indicating device can be connected as an aid in locating a faulty circuit.

Usually a faulty circuit can be found by observing the various panel meters for abnormal indications, followed by a check of the suspected circuit for evidence of malfunctioning.

The following steps, while they need not necessarily be adhered to, serve to illustrate a typical method of trouble-shooting. In addition, reference should be made to the appropriate circuit data covered in the preceding Control Circuit Check and Tuning sections.

1. At the instant of switching, note the modulator and PA meter readings. A properly operating modulator step-starting circuit will prevent the modulator overload relay from tripping. The meter indication, which will cover approximately half scale, will cover both modulator currents. Otherwise the step-starting circuit requires a check or readjustment.

2. Excessive PA or amplifier-driver plate currents could trip the relay before the meter needle is deflected to the proper level. However, the absence of any meter readings may indicate trouble in the high voltage rectifiers or elsewhere in the high voltage circuit.

3. With the high voltage plate contactor, 2S502, in OFF, check the low voltage rectifier relay, 1K605, and the exciter stage. Disable the bias before performing this check by disconnecting the leads on terminals 29D and 30D.

4. With the TUNE OPERATE link in the OFF position and 1S502 ON, check the IPA overload relay, 1K606, the overload relay, 1K603, in the 2nd AF stage, and the intermediate voltage rectifier relay, 1K605.

5. With the TUNE-OPERATE link in the TUNE position and the transmitter connected preferably to a dummy antenna, check the PA overload relay, 2K101, and the high voltage filter circuit. The PA tube may be disabled by lifting up the tube filament connections. The modulator tubes will be biased beyond cutoff; however tone modulation should bring up steady and approximately equal modulator currents.

6. Following the circuit isolation procedure outlined in the foregoing steps will make it possible in most cases to determine a faulty component causing improper transmitter operation, with the exception of a tube or component flash-over which may happen at full plate voltage. Flash-over can be located by visual observation.

7. Place the TUNE-OPERATE link in OPERATE position. Restore all connections and switches for normal transmitter operation.

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TABLE 11. BUFFER COIL 1L601 SETTINGS

Frequency in KC	*Tap*
535 to 620	Full Coil
630 to 810	1
820 to 1040	2
1050 to 1350	3
1360 to 1620	4

ADDENDUM

High Efficiency Operation

High efficiency operation of the power amplifier is obtained by using the third harmonic to produce an almost flat topped wave and thus to improve the class C operation.

With the plate and the cathode resonators shorted, the PA tube operates in the conventional class C manner at approximately 75 percent efficiency, 3.5 kw power output; the corresponding waveform is shown in Figure 14. The maximum instantaneous efficiency V_p/E_b is restricted to a short portion of the tube conduction T_1. On either side of T_1, the plate losses increase, reducing the efficiency.

When the plate resonator (2L110, 2C142) resonates at the third harmonic, the third harmonic voltage component adds twice to and subtracts once from the class C wave, producing a flat top wave, Figure 14. The maximum instantaneous efficiency extends over the T_2 portion of tube conduction, improving the average efficiency by 7–8 percent. Since the dc plate voltage remains constant, improvement in the efficiency is accompanied by the increase of the power output (i.e., increase of the RF current).

When the cathode resonator (2L111, 2C143, 2C144) resonates at the third harmonic the mechanism of operation is similar to that described above, except its primary object is to produce the flat topped grid drive. As the result of flat top and broader top grid drive, the plate waveform tends to be almost rectangular, the maximum instantaneous efficiency extends over the T_3 portion of tube conduction time, and the peak efficiency equals the average efficiency and is V_p/E_b or $\frac{(E_b - V_g)}{EB}$. Adjustment of the cathode resonator is accompanied by an increase of the efficiency, of the power output and of the power input. The average efficiency should be approximately 90 percent.

TABLE 12. EXTERNAL CONNECTIONS

Point of Connection	*External Circuit*
1S501	208/240 ±11 volts, 50/60 cycles power input
1K407	Plate Transformer 3T101 Primary
1-104B	Plate Transformer Secondary Neutral
2-229A 2-228A 2-227A	Plate Transformer Secondary
See Fig. 18	Transmitter Ground
1-4B 1-5B	115 Volts 50/60 Cycles for Crystal Heaters
1-28B 1-29B	Audio Input
1-30B	Audio Input Cable (Shield Ground)
1J601	RF to Frequency Monitor
2J101	RF to Modulation Monitor
2-25A 2-26A	External Interlocks
10B	Remote Control Plate Off
11B	Remote Control Plate On/OL Reset
1-12B	Remote Control Common
13B	Remote Control Transmitter Off
14B	Remote Control Transmitter On
1-15B	Remote Control Power Lower
1-16B	Remote Control Power Rise
31B	Remote Control Crystal No. 2
32B	Remote Control Conelrad Frequency
33B	Remote Control Main Frequency
34B	Remote Control Crystal No. 1
	NOTE: the remote control is accomplished by a momentary shorting from the common terminal 1-12B to any terminal listed above.
1-23B	Remote Plate Voltage Metering
1-27B	Remote Metering Ground
2-18A	Remote Plate Current Metering
1-1B	External Overload Indicator RF Driver
1-2B	External O/L Indicator Low Voltage
1-3B	External O/L Indicator 2nd Audio
2-21A	External O/L Indicator Plate Voltage
2-22A	External O/L Indicator Modulator
2-23A	External O/L Indicator Power Amplifier
2-24A	External O/L Indicator Common Ground

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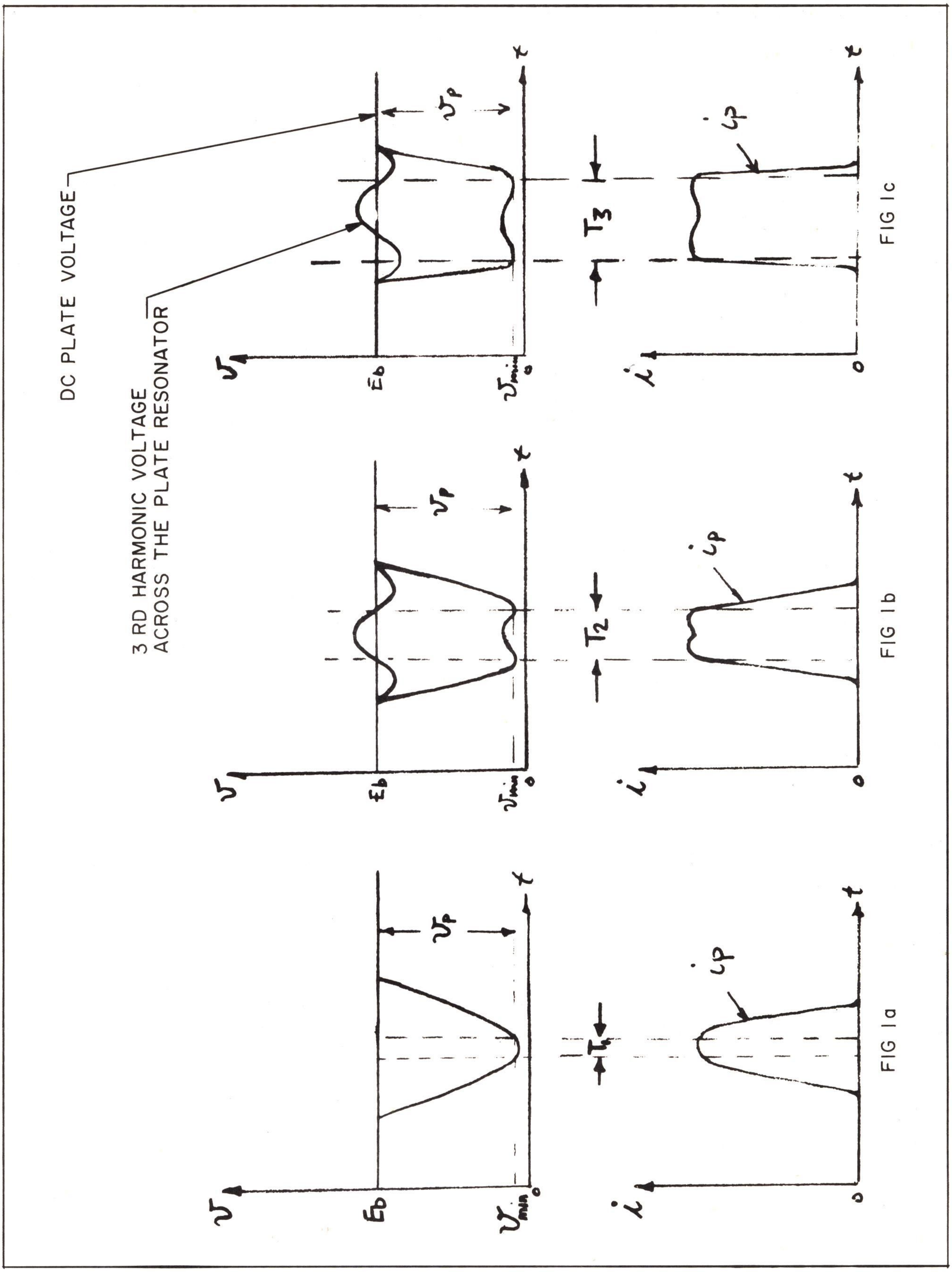

Figure 14—High Efficiency Wave Generation

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LIST OF PARTS

Symbol No.	Stock No.	Drawing No.	Description
TRANSMITTER DRIVER CABINET, MI-27650-A			
1C201, 1C202			Not Used
1C203, 1C204	610003	36655-503	Capacitor: meter by-pass, 0.01 μf, 1200 v (less term link)
1I201		459610-8	Lamp: indicator, "plate on"
	99765	459610-31	Jewel - red
	16154	459610-36	Lamp
	16155	459610-40	Resistor
	99763	459610-46	Socket:
1I202		459610-12	Lamp: indicator, "crystal on"
	99768	459610-35	Jewel - blue
	16154	459610-36	Lamp:
	16155	459610-40	Resistor
	99763	459610-46	Socket
1M201	215707	486165-2	Meter: multimeter
1M202	216023	459672-129	Meter: filament-line, 0-300 v ac
1R201, 1R202	217614	8871557-53	Resistor: fixed, wire wound, 1250 ohm, ±1%, 1 w
1S201	215704	480092-2	Switch: multimeter
1S202	211065	738998-5	Switch: power, raise-lower
1S203	211065	738998-5	Switch: trans. on-off
1S204	215702	738998-12	Switch: O.L. reset, plate on, off
1S205	216212	8430345-1	Switch: crystal
1S206 to 1S209			Not Used
1S210	220273	445084-40	Breaker: circuit, fil. and control
1S211	56371	445089-8	Breaker: circuit, L.V. plate and bias
1S212	211065	738998-5	Switch: day-night
1S213			Not Used
1S214 to 1S216	54920	8881052-1	Switch: interlock
1S217 to 1S219	216022	8954364-501	Switch: grounding
Modulator and PA Driver, MI-27646 (Part of MI-27650-A Driver Cabinet)			
1C301, 1C302	217987	990701-83	Capacitor: fixed, mica, 0.033 μf ±20%, 1200 v
1C303	216366	990704-259	Capacitor: fixed, mica, 0.0033 μf ±5%, 6000 v
1C304	208051	990703-354	Capacitor: fixed, mica, 0.002 μf ±5%, 5000 v
1C305			Capacitor: (See Freq. Det. parts - MI-34648)
1C306	217994	990700-347	Capacitor: fixed, mica, 0.001 μf ±2%, 2500 v
1C307 to 1C309			Not Used
1C310	216999	450184-1	Capacitor: fixed, paper, 4.0 μf, 400 v
1C311, 1C312	57001	990193-122	Capacitor: fixed, paper, 0.25 μf ±10%, 4000 v
1K301	94117	458722-1	Relay: modulator, step-start
1L301	217995	740486-504	Coil: tank (driver)
1L302	215593	418486-502	Choke: plate (driver)
			RESISTORS:
			Fixed, Composition - Unless otherwise specified
1R301, 1R302		99126-87	120,000 ohm, ±10%, 2 w
1R303		99126-42	22 ohm, ±10%, 2 w
1R304	218088	458574-84	wire wound, 30,000 ohm ±5%, 10 w
1R305	217992	993010-93	variable, 4000 ohm, 20 w
1R306, 1R307	98057	99033-46	wire wound, 31,500 ohm ±10%, 95 w
1R308, 1R309	215587	8871557-43	wire wound, 3.75 ohm, ±1%, 2 w
1R310, 1R311	217001	8871557-54	wire wound, 13.2 ohm, ±1%, 2 w
1R312	97132	993008-68	wire wound, 200 ohm ±5%, 10 w
1R313	217002	8871557-55	wire wound, 15.2 ohm, ±1%, 2 w
1R314	215587	8871557-43	wire wound, 3.75 ohm, ±1%, 2 w
1R315	19688	99027-39	wire wound, 6300 ohm, ±10%, 25 w
1R316	217991	99037-40	wire wound, 8000 ohm, ±10%, 200 w
1R317	19479	90027-40	wire wound, 8000 ohm, ±10%, 25 w
1R318	96214	458574-77	wire wound, 15,000 ohm, ±5%, 10 w
1R319, 1R320		99126-86	100,000 ohm, ±10%, 2 w

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Symbol No.	Stock No.	Drawing No.	Description
1R321 to 1R323		99126-50	100 ohm, ±10%, 2 w
1R324, 1R325	217993	722393-41	variable, 50 ohm, ±10%, 4 w
1T301, 1T302	217007	8430302-1	Transformer: filament
1XV301, 1XV302	207704	8900703-1	Socket: tube (4-125A)
1XV303			Not Used
Control Unit, MI-27633 (Part of MI-27650-A Driver Cabinet)			
1F401 to 1F403	22301	59075-9	Fuse: 1 amp
1K401	217988	480003-5	Relay: notching
1K402	216990	8431464-1	Relay: time delay
1K403			Not Used
1K404	216988	8412197-3	Contactor: 30 amp, 110 v, 50/60 cy
1K405	216992	8413465-1	Relay: thermal time delay
1K406	217988	480003-5	Relay: notching
1K407	216989	482711-6	Contactor: 110 v, 50/60 cy.
1K408	217990	8436572-1	Relay: auxiliary
1S401	217989	449661-108	Switch: manual, automatic
1T401	216994	8415073-7	Transformer: control
1T402	215560	486160-1	Transformer: plate
1T403	96148	457084-1	Transformer: variable
1T404	216993	8413463-1	Transformer: buck-boost
XF401	48063	893322-1	Holder: fuse
1C501 to 1C503	210631	990193-146	Capacitor: paper, 4 μf ±10%, 5000 v
1C504, 1C505	217987	990701-83	Capacitor: mica, 33,000 μμf ±20%, 1200 v
1C506, 1C507	39638	727856-233	Capacitor: mica, 270 μμf ±5%, 500 v
1C508, 1C509	56124	984678-8	Capacitor: paper, 1 μf ±10%, 600 v
1C510, 1C511			Not Used
1C512, 1C513	610003	36655-503	Capacitor: mica, 0.01 μf, 1200 v (Meter-bypass, less link)
1C514	218089	8976343-1	Capacitor: paper, 0.05 μf ±10%, 12,500 v
1C515	209037	990193-108	Capacitor: paper, 8 μf ±10%, 3000 v
1K501	217032	8707374-1	Contactor: blower
1K502	18119	440489-3	Relay: bias undervoltage
1K503	94117	458722-1	Relay: surge suppressor
1L501	95316	900431-4	Reactor: H.V. filter, 3 h, 3.5 a, ac
1L502	219106	8442910-1	Reactor: filter, 10 h, 0.40 amp, dc
1M501	216997	482744-25	Voltmeter: P.A. plate, 0-6 kv
1M502	210575	459671-53	Meter: IPA plate, 0-500 ma, DC
			RESISTORS: Fixed, Composition - Unless otherwise specified
1R501		889143-3	dummy, seamless brass tubing
1R502	19687	99031-38	wire wound, 5000 ohm, ±5%, 55 w
1R503	217143	99029-40	wire wound, 8000 ohm, ±5%, 45 w
1R504	19687	99031-38	wire wound, 5000 ohm, ±5%, 55 w
1R505		99126-42	22 ohm, ±10%, 2 w
1R506		99126-50	100 ohm, ±10%, 2 w
1R507, 1R508		99126-79	27,000 ohm, ±10%, 2 w
1R509 to 1R512			Not Used
1R513	18047	890144-41	ceramic, 5000 ohm, 36 w
1R514	45983	99037-33	wire wound, 1600 ohm, ±10%, 200 w
1R515	48821	427491-1	wire wound, 5 ohm, 50 w
1S501	217027	486189-1	Breaker: circuit, line, 70 a, 240 v
1S502	217027	486189-1	Breaker: circuit, plate, 70 a, 240 v
1T501	217018	8430341-1	Transformer: bias
1XV501, 1XV502	207704	8900703-1	Socket: (RCA 4-125A)
1Z501		755773-501	Equalizer: audio input
C1	210803	990417-124	Capacitor: paper, 0.068 μf, ±10%, 200 v
C2	99630	722031-513	Capacitor: mica, 10,000 μμf ±5%, 300 v

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Symbol No.	Stock No.	Drawing No.	Description
L1	210804	862943-12	Choke
L2	210805	8913168-1	Choke
R1, R2		722320-57	Resistor: fixed, composition, 390 ohm, ±10%, ½ w
R3 to R6		722320-63	Resistor: fixed, Composition, 1200 ohm, ±10%, ½ w
R7			Not Used
1Z502, 1Z503	220272	8722934-501	Rectifier Assembly: includes printed board and diode in place
	220274	1N2862	Rectifier: silicon diode only
		727834-94	Resistor: fixed composition, 470,000 ohms, ±10%, ½ w
Exciter, MI-27643-A (Part of MI-27650-A Driver Cabinet			
			CAPACITORS:
1C601	39670	727866-165	mica, 5600 μμf ±10%, 500 v
1C602	39652	727866-147	mica, 1000 μμf ±10%, 500 v
1C603	610003	728647-65	mica, 0.01 μf ±20%, 2500 v
1C604	601002	728647-41	mica, 1000 μμf ±20%, 2500 v
1C605, 1C606			Not Used
1C607	211133	990193-31	paper, 15 μf ±10%, 1000 v
1C608	18501	990193-8	paper, 10 μf ±10%, 600 v
1C609	56124	984678-8	paper, 1 μf ±10%, 600 v
1C610, 1C611			Not Used
1C612	39664	727866-159	mica, 3300 μμf ±10%, 500 v
1CR601, 1CR602			Not Used
1F601, 1F602	14133	990157-8	Fuse: 1 a, 250 v
1J601	51800	255223-2	Connector: coaxial
1K601	215614	8411073-5	Relay: plate time delay
1K602	216988	8412197-3	Contactor: plate on
1K603	215504	754291-3	Relay: mod. overload
1K604	216181	480070-1	Relay: transmitter on latching
1K605	215504	754291-3	Relay: L.V., overload
1K606	215504	754291-3	Relay: PA, overload
1L601	209621	429932-502	Coil: buf. plate
1L602	93658	949250-1	Reactor: L.V. filter
1P601			Not Used
1P602	216156	8415018-1	Connector: female, 18 contacts
1P603		8949731-1	Connector: phone tip
			RESISTORS:
			Fixed, Composition - Unless otherwise specified
1R601		99126-58	470 ohm, ±10%, 2 w
1R602	93644	8871557-15	wire wound, 11.5 ohm, ±1%, 1 w
1R603		99126-79	27,000 ohm, ±10%, 2 w
1R604	215507	8871557-45	wire wound, 260 ohm, ±1%, 1 w
1R605		99126-20	15,000 ohm, ±20%, 2 w
1R606	97134	458574-82	wire wound, 25,000 ohm, ±5%, 10 w
1R607	215509	8871557-47	wire wound, 51 ohm, ±1%, 1 w
1R608	219648	8986541-3	wire wound, 3.16 ohm, ±1%, 2 w
1R609, 1R610		90496-195	33,000 ohm, ±5%, 1 w
1R611, 1R612		90496-50	100 ohm, ±10%, 1 w
1R613	215511	8871557-48	wire wound, 132 ohm, ±1%, 1 w
1R614		99126-175	4700 ohm, ±5%, 2 w
1R615	215511	8871557-48	wire wound, 132 ohm, ±1%, 1 w
1R616	219511	458574-80	wire wound, 20,000 ohm, ±5%, 10 w
1R617	53702	458574-90	wire wound, 56,000 ohm, ±5%, 10 w
1R618 to 1R621			Not Used
1T601	93800	949347-1	Transformer: input
1T602, 1T603	215512	8412123-1	Transformer: filament
1XF601, 1XF602	48894	99088-2	Holder: fuse
1XV601	68590	99391-1	Socket: octal
1XV602			Not Used
1XV603, 1XV604	68590	99391-1	Socket: octal

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Symbol No.	Stock No.	Drawing No.	Description
1Z601 — Oscillator (Crystal) MI-27632 (Part of MI-27650-A Driver Cabinet)			
1Z601			OSCILLATOR: Crystal (MI-27632)
C101 to C103	215924	8946100-1	Capacitor: variable, ceramic, 5-25 μμf
C104	59906	748252-211	Capacitor: fixed, mica, 12 μμf ±5%, 500 v
C105	98385	737837-243	Capacitor: fixed, mica, 330 μμf ±10%, 500 v
C106,C107	215921	737837-245	Capacitor: fixed, mica, 390 μμf ±10%, 500 v
C108 to C110	39670	727871-165	Capacitor: fixed, mica, 5600 μμf ±10%, 500 v
C111 to C118	73960	8811182-5	Capacitor: disc, ceramic, 10,000 μμf +100 -20%, 450 v
K101,K102	215601	8410963-1	Relay: crystal switching, 110 v, 60 cycle,
L101	215920	8914343-505	Coil: plate choke, 400 UH
			RESISTOR:
			Fixed, Composition - Unless otherwise specified
R101 to R103		90496-25	Resistor: 100,000 ohm, ±20%, 1 w
R104		90496-17	4700 ohm, ±20%, 1 w
R105		99126-82	47,000 ohm, ±10%, 2 w
R106		99126-79	27,000 ohm, ±10%, 2 w
R107	69297	458574-60	wirewound, 4000 ohm, ±5%, 10 w
R108	104181	867970-304	wirewound, 0.39 ohm, ±10%, ½ w
R109		90496-117	18 ohm, ±5%, 1 w
R110		90496-144	240 ohm, ±5%, 1 w
XV101	209285	8817695-1	Socket: tube, 7 pin min
XV102	209284	8817696-1	Socket: tube, 9 pin
XY101 to XY103	207707	8817694-1	Socket: octal
1Z602		8722934-502	RECTIFIER ASSEMBLY: Includes:printed board and diodes in place
		1N2863	Rectifier: silicon diode only
		727834-94	Resistor: fixed, composition, 470,000 ohms, ±10%, ½ w
			Miscellaneous:
	52717	7862770-1	Clip: for 1″ dia. ferrule
	42736	99045-4	Clip: for 13/16″ dia. ferrule
	53325	99045-5	Clip: for 9/16″ dia. ferrule
	95590	8899056-4	Connector: tube
	217144	8898735-3	Control Box: teleflex
	55081	426762-12	Insulator: 3″ lg. x 3/4″ x 1-1/2″ steatite, conical pillar type
	210439	426765-6	Insulator: 5/8″ x 3/8″ steatite, cylindrical pillar type
	209090	426773-18	Insulator: 3″ x 3/4″ sq. steatite, square post
	210376	426766-9	Insulator: 1″ x 1/2″ steatite, cylindrical post
	51088A	426761-12	Insulator: steatite 1-1/8″ lg. x 7/8″x 1-3/4″ lead-thru type
	208116	426765-12	Insulator: steatite 1″ x 3/8″ cylindrical pillar type
	55800A	426768-6	Insulator: 1″ x 1-1/2″ steatite (cylindrical)
	51781A	426762-6	Insulator: 1″ x 1/2″ x 1-1/2″ lg. steatite (conical pillar)
	209711	426773-9	Insulator: 3/4″ x 1-1/2″ lg. steatite (square post)
	210376	426766-9	Insulator: 1/2″ x 1″ lg. steatite (cylindrical)
	211247	426764-3	Insulator: 0.62″ x 1/2″ steatite (bushing)
	211246	426764-53	Insulator: 0.38″ x 1/2″ steatite (bushing)
	210376	426766-9	Insulator: 1″ x 1/2″ steatite (cylindrical)
	211423	426765-3	Insulator: 1/2″ x 3/8″ steatite (cylindrical)
	209664	426773-6	Insulator: 1-1/4″ x 3/4″ steatite (square post)
	97745	486041-14	Insulator: 0.96″ x 0.14″ (threaded insert) double turret

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Symbol No.	Stock No.	Drawing No.	Description
	217752	426765-21	Insulator: 2″ x 3/8″ steatite (cylindrical)
	17269	737820-501	Knob: control
	215612	8928515-1	Knob: brass, 1-1/4″ lg. x 3/8″ dia.
	57692	899617-3	Mount: shock
	97745	486041-14	Terminal: threaded insert, 0.96″ high (overall), 0.59″ high (insulated portion)
			RECTIFIER AMPLIFIER, MI-27635-C
2B101	217235		Motor: blower for altitude above 2500 ft. (1730 RPM)
2B101A	222328		Motor: blower for altitude 2500 ft. and below (1140 RPM)
	217234		Mount: shock, for blower
2B102	217980	470051-2	Motor: variable inductor (2L106, output tuning)
			CAPACITORS:
2C101	217969	990703-247	mica, 1000 μμf ±5%, 5000 v
2C102	217970	990703-254	mica, 2000 μμf ±5%, 5000 v
2C103 to 2C105	217987	990701-83	mica, 33,000 μμf ±20%, 1200 v
2C107	98053	8814055-1	variable, 15-75 μμf 20 KV
2C108	99774	990706-247	mica, 1000 μμf ±5%, 20 KV
2C109	94392A	990706-254	mica, 2000 μμf ±5%, 15 KV
2C110	93923	8849438-2	variable, 25-500 μμf 15 KV
2C111 to 2C116			CAPACITOR: frequency determining part - MI-34648
2C117	610003	36655-503	0.01 μf ±20%, 1200 v (less links)
2C118	218691	990482-5	paper, 4 μf ±10%, 600 v, motor starting
2C119, 2C120	58568	990193-46	paper, 4 μf ±10%, 1500 v
2C121, 2C122	610003	36655-503	0.01 μf ±20%, 1200 v (less link)
2C123 to 2C129	215600	8843560-17	mica, 300 μμf ±2%, 5000 v (part of 2Z101)
2C130, 2C131	217983	990700-374	mica, 13,000 μμf ±2%, 1200 v (part of 2Z101)
2C132 to 2C138	215600	8843560-17	mica, 300 μμf ±2%, 5000 v (part of 2Z102)
2C139 to 2C141	93795	990193-204	paper, 1.0 μf ±10%, 10,000 v
2C142	220269	8849438-19	variable, 10-750 μμf 5 KV
2C143	220268	418329-15	variable, 37-496 μμf air-gap 0.080
2C144, 2C145			Capacitor: frequency determining part - MI-34648
2C146	39670	727866-165	mica, 5600 μμf ±10%, 500 v
2I101		459610-10	Lamp: indicator (yellow) consisting of:
	99767	459610-33	Jewel: yellow
	16154	459610-36	Lamp
	16155	459610-40	Resistor
	99763	459610-46	Socket
2I102		459610-9	Lamp: indicator (green) consisting of:
	99766	459610-32	Jewel: green
	16154	459610-36	Lamp:
	16155	459610-40	Resistor
	99763	459610-46	Socket
2J101	51800	255223-2	Connector
2K101	215504	754291-3	Relay: P.A. overload
2K102	215504	754291-3	Relay: Mod. overload
2K103	215504	754291-3	Relay: Rect. overload
2L101		8824438-502	Coil: grid suppressor
2L102			Not Used
2L103	210087	457558-502	Coil: plate choke
2L104	216706	8701498-1	Coil: plate tank
2L105	217996	740486-505	Coil: harmonic filter
2L106		648212-501	Coil: plate tank (consisting of)
	218001	8701498-5	Coil
	93888	855083-3	Bearing: ball
	206706	8879208-2	Pad
2L107	93921	949350-1	Reactor: modulation
2L108	221126	8438503-503	Coil: mod. monitor pick-up
2L109	93612	740230-1	Coil: harmonic filter
2L110	220267	8701498-10	Inductor: plate resonator

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Symbol No.	Stock No.	Drawing No.	Description
2L111	220271	8726096-1	Coil: cathode resonator
2L112	220270	461441-502	Coil: mod. filter
2M101	217982	482744-26	Meter
2M102, 2M103	217981	486165-3	Meter
2M104		8920985-1	Meter: dummy case
			RESISTORS:
			Fixed, Composition - unless otherwise specified
2R101, 2R102	19086	890145-3	50 ohms, 18 w
2R103, 2R104	95172	99033-50	wire wound, 80,000 ohms, ±5%, 95 w
2R105, 2R106	44001	144870-15	variable, 25,000 ohms, 7 w
2R107	207819	99033-47	wirewound, 40,000 ohms, ±5%, 95 w
2R108	69297	458574-60	4000 ohms, ±5%, 10 w
2R109, 2R110	217974	8973346-1	wire wound, 0.66 ohms, ±1%, 10 w
2R111	217972	8973346-2	wire wound, 0.33 ohms, ±5%, 10 w
2R112	220327	8871557-56	wire wound, 940 ohms, ±1%, 1 w
2R113	217973	8973346-3	wire wound, 0.44 ohms, ±5%, 10 w
2R114	217000	8702674-509	6.0 meg ±0.020%
2R115		99126-27	220,000 ohms, ±10%, 2 w
2R116 to 2R122	215599	8928565-1	2.2 meg ±1%, 1 w (part of 2Z101)
2R123	216743	990189-466	47,500 ohms, ±1%, 2 w (part of 2Z101)
2R124	216743	990189-466	47,5000 ohms, ±1%, 2 w (part of 2Z102)
2R125 to 2R131	215599	8928565-1	2.2 meg ±1%, 1 w
2R132		99126-7	100 ohms, ±10%, 2 w
2R133	19086	890145-3	50 ohms, 18 w
2R134			Not Used
2R135	208848	890144-33	15,000 ohms, 24 w
2R136, 2R137	45983	99037-33	wire wound, 1600 ohms, 200 w
2R138, 2R139			Not Used
2R140	217974	8973346-1	0.66 ohms, ±1%, 10 w
2R141	220327	8871557-56	940 ohms, ±1%, 1 w
2R142	217973	8973346-3	0.44 ohms, ±5%, 10 w
2R143, 2R144			Not Used
2R145	218000	8973368-1	2.5 ohms, ±10%, 110 w
2R146	206041	993007-69	250 ohms, 5 w
2S101	217975	8436571-1	Switch: mod. multimeter
2S102			Not Used
2S103	205678	473750-1	Switch: line multimeter
2S104 to 2S106	54920	8881052-1	Switch: interlock
2S107	211550	8822758-3	Switch: air interlock
2S108 to 2S110	216022	8953364-501	Switch: grounding
2T101	217775	8415099-1	Transformer: mod.
2T102, 2T103	217774	8430301-2	Transformer: filament
2T104	217776	8436568-1	Transformer: filament
2T105			Not Used
2T106	205689	738532-505	Transformer
2XV101, 2XV102			Socket: for 3X3000F1
	217979	8720714-2	Support
		8973329-1	Shield
	217977	8720715-501	Socket
		8976325-502	Shield
2XV103			Socket: for S762
	217976	8720715-502	Socket
	217978	8720714-1	Support
		8973329-2	Shield
		8976325-501	Shield
2Z101		8438501-502	Feedback ladder assembly: includes 2C123 to 2C129, 2C130, 2R116 to 2R122, 2R123
2Z102		8438501-502	Feedback ladder assembly: includes, 2C131, 2C132 to 2C138, 2R124, 2R125 to 2R131
2Z103 to 2Z108		8720774-501	Rectifier Assembly
	218347	8438545-1	Rectifier
	218346	8438545-2	Rectifier
		99126-191	Resistor

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Symbol No.	Stock No.	Drawing No.	Description
			Miscellaneous:
	221265	8907776-7	Boot
	95103	8840193-12	Cable: teleflex 25″ lg.
	96480	8833154-1	Clip: inductor (for 2L104, 2L106, 2L110)
	211323	893090-2	Clip: inductor (for 2L108, 2L109)
	221124	8849451-2	Connector
	221125	8849483-502	Connector
	95213	8898735-1	Control Box
	57339	880947-1	Coupling
	211300	477962-2	Drive: RT angle
	95160	888488-3	Fliter: air
	48697A	426768-9	Insulator: 2″ x 1″ steatite (cylindrical)
	51088A	426761-12	Insulator: 1-1/8″ lg. x 1-3/4″ x 7/8″ steatite (lead thru)
	53348	426766-12	Insulator: 1-1/4″ x 1/2″ steatite (cylindrical)
	55081	426762-12	Insulator: 3″ lg. x 1-1/2″ x 3/4″ steatite (conical pillar)
	55800A	426768-6	Insulator: 1-1/2″ x 1″ steatite (cylindrical)
	55803A	426768-3	Insulator: 1-1/4″ x 1″ steatite (cylindrical)
	97457	426767-3	Insulator: 1″ x 3/4″ steatite (cylindrical)
	99043	426762-9	Insulator: 2″ x 1-1/8″ x 5/8″ steatite (conical pillar)
	209090	426773-18	Insulator: 3″ x 3/4″ steatite (square post)
	209711	426773-9	Insulator: 1-1/2″ x 3/4″ steatite (square post)
	209927	426768-18	Insulator: 4″ x 1″ steatite (cylindrical)
	209928	426768-21	Insulator: 5″ x 1″ steatite (cylindrical)
	209929	426773-12	Insulator: 2″ x 3/4″ steatite (square post)
	210084	426773-3	Insulator: 1″ x 3/4″ steatite (square post)
	210281	426767-9	Insulator: 1-1/2″ x 3/4″ steatite (cylindrical)
	211081	426767-18	Insulator: 3″ x 3/4″ steatite (cylindrical)
	211371	426766-6	Insulator: 3/4″ x 1/2″ steatite (cylindrical)
	211449	426768-15	Insulator: 3″ x 1″ steatite (cylindrical)
	213360	426773-15	Insulator: 2-1/2″ x 3/4″ steatite (square post)
	218090	426772-6	Insulator: 1″ x 1/2″ steatite (square post)
	211297	8910643-2	Joint: universal
	17269	737820-501	Knob: control for ZS101, ZS102, 2C107
PLATE TRANSFORMER, MI-27636			
3T101	217773	840358-1	Transformer: plate

Symbol No.	RCA Reference	Drawing No.	Description
SERIES OF FREQUENCY DETERMINING PARTS, MI-34648			
NOTE: Order the parts listed in this section from B.C. TRANSMITTER SALES, RCA, CAMDEN, N.J. Be sure to give the MASTER ITEM (M.I.) NUMBER of the part, SYMBOL NUMBER and DESCRIPTION.			
535-650 KC, 51.5 or 72 Ohm Line, MI-34648-1			
1C305	MI-27699-6	990706-245	Capacitor: mica, 820 μμf ±5%, 20,000 v
2C111	MI-34600-2	8432396-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C112 to 2C114	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C115	MI-27699-4	990706-238	Capacitor: mica, 430 μμf ±5%, 20,000 v
2C116	MI-27699-13	990706-	Capacitor: mica, 7500 μμf ±5%, 10,000 v
2C144	MI-34649-5		Capacitor: mica, 2700 μμf ±5%, 3000 v
2C145	MI-27070-10	990704-233	Capacitor: mica, 270 μμf ±5%, 6000 v

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Symbol No.	RCA Reference	Drawing No.	Description
535-650 KC, 230 Ohm Line, MI-34648-2			
1C305	MI-27699-6	990706-245	Capacitor: mica, 820 μμf ±5%, 20,000 v
2C111	MI-34600-2	8432396-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C112 to 2C114	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C115	MI-27699-4	990706-238	Capacitor: mica, 430 μμf ±5%, 20,000 v
2C116	MI-27699-11	990706-264	Capacitor: mica, 5100 μμf ±5%, 20,000 v
2C144	MI-34649-5		Capacitor: mica, 2700 μμf ±5%, 3000 v
2C145	MI-27070-10	990704-233	Capacitor: mica, 270 μμf ±5%, 6000 v
650-780 KC, 51.5 or 72 Ohm Line, MI-34648-3			
1C305	MI-27699-5	990706-241	Capacitor: mica, 560 μμf ±5%, 20,000 v
2C111, 2C112	MI-34600-2	8432296-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C113, 2C114	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C115	MI-27699-3	990706-235	Capacitor: mica, 330 μμf ±5%, 20,000 v
2C116	MI-27699-11	990706-264	Capacitor: mica, 5100 μμf ±5%, 10,000 v
C144	MI-34649-4	990703-254	Capacitor: mica, 2000 μμf ±5%, 5000 v
C145	MI-27070-1	990704-230	Capacitor: mica 200 μμf ±5%, 6000 v
650-780 KC, 230 Ohm Line, MI-34648-4			
1C305	MI-27699-5	990706-241	Capacitor: mica, 560 μμf ±5%, 20,000 v
2C111, 2C112	MI-34600-2	8432396-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C113, 2C114	MI-34600-9	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C115	MI-27699-3	990706-235	Capacitor: mica, 330 μμf ±5%, 20,000 v
2C116	MI-27699-12	990706-257	Capacitor: mica, 2700 μμf ±5%, 20,000 v
2C144	MI-34649-4	990703-254	Capacitor: mica, 2000 μμf ±5%, 5000 v
2C145	MI-27070-1	990704-230	Capacitor: mica, 200 μμf ±5%, 6000 v
780-940 KC, 51.5 or 72 Ohm Line, MI-34648-5			
1C305	MI-27699-5	990706-241	Capacitor: mica, 560 μμf ±5%, 20,000 v
2C111	MI-34600-2	8432296-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C112			Not Used
2C113, 2C114	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C115	MI-27699-3	990706-235	Capacitor: mica, 330 μμf ±5%, 20,000 v
2C116	MI-27699-11	990706-264	Capacitor: mica, 5100 μμf ±5%, 12,000 v
2C144	MI-34649-4	990703-254	Capacitor: mica, 2000 μμf ±5%, 5000 v
2C145	MI-27070-1	990704-230	Capacitor: mica, 200 μμf ±5%, 6000 v
780-940 KC, 230 Ohm Line, MI-34648-6			
1C305	MI-27699-5	990706-241	Capacitor: mica, 560 μμf ±5%, 20,000 v
2C111	MI-34600-2	8432296-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C112			Not Used
2C113, 2C114	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C115	MI-27699-3	990706-235	Capacitor: mica, 330 μμf, ±5%, 20,000 v
2C116	MI-27699-8	990706-255	Capacitor: mica, 2200 μμf ±5%, 12,000 v
2C144	MI-34649-4	990703-254	Capacitor: mica, 2000 μμf ±5%, 5000 v
2C145	MI-27070-1	990704-230	Capacitor: mica, 200 μμf ±5%, 6000 v
940-1120 KC, 51.5 or 72 Ohm Line, MI-34648-7			
1C305	MI-27699-4	990706-238	Capacitor: mica, 430 μμf ±5%, 20,000 v
2C112	MI-34600-2	8432396-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C113	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C114			Not Used
2C115	MI-27699-2	990706-233	Capacitor: mica, 270 μμf ±5%, 20,000 v
2C116	MI-27699-10	990706-261	Capacitor: mica, 3900 μμf ±5%, 20,000 v
2C144	MI-34649-3	990703-251	Capacitor: mica, 1500 μμf ±5%, 5000 v
2C145	MI-27070-11	990704-225	Capacitor: mica, 120 μμf ±5%, 6000 v

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Symbol No.	RCA Reference	Drawing No.	Description
940-1120 KC, 230 Ohm Line, MI-34648-8			
1C305	MI-27699-4	990706-238	Capacitor: mica, 430 μμf ±5%, 20,000 v
2C112	MI-34600-2	8432396-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C113	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C114			Not Used
2C115	MI-27699-2	990706-233	Capacitor: mica, 270 μμf ±5%, 20,000 v
2C116	MI-27699-8	990706-255	Capacitor: mica, 2,200 μμf ±5%, 12,000 v
2C144	MI-34649-3	990703-251	Capacitor: mica, 1500 μμf ±5%, 5000 v
2C145	MI-27070-11	990704-225	Capacitor: 120 μμf ±5%, 6000 v
1120-1340 KC, 51.5 or 72 Ohm Line, MI-34648-9			
2C305	MI-27699-3	990706-235	Capacitor: mica, 330 μμf ±5%, 20,000 v
2C112	MI-34600-2	8432396-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C113	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C114			Not Used
2C115	MI-27699-1	990706-230	Capacitor: mica, 200 μμf ±5%, 20,000 v
2C116	MI-27699-10	990706-261	Capacitor: mica, 3900 μμf ±5%, 12,000 v
2C144	MI-34649-2	990703-247	Capacitor: mica, 1000 μμf ±5%, 5000 v
2C145	MI-27070-11	990704-225	Capacitor: mica, 120 μμf ±5%, 6000 v
1120-1340 KC, 230 Ohm Line, MI-34648-10			
1C305	MI-27699-3	990706-235	Capacitor: mica, 330 μμf ±5%, 20,000 v
2C112	MI-34600-2	8432396-1	Capacitor: vacuum, 500 μμf, 15,000 v
2C113	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C114			Not Used
2C115	MI-27699-1	990706-230	Capacitor: mica, 200 μμf ±5%, 20,000 v
2C116	MI-27699-7	990706-251	Capacitor: mica, 1500 μμf ±5%, 15,000 v
2C144	MI-34649-2	990703-247	Capacitor: mica, 1000 μμf ±5%, 5000 v
2C145	MI-27070-11	990704-225	Capacitor: mica, 120 μμf ±5%, 6000 v
1340-1620 KC, 51.5 or 72 Ohm Line, MI-34648-11			
1C305	MI-27699-3	990706-235	Capacitor: mica, 330 μμf ±5%, 20,000 v
2C113	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C114			Not Used
2C115	MI-27699-1	990706-230	Capacitor: mica, 200 μμf ±5%, 20,000 v
2C116	MI-27699-9	990706-258	Capacitor: mica, 3000 μμf ±5%, 12,000 v
2C144	MI-34649-2	990703-247	Capacitor: mica, 1000 μμf ±5%, 5000 v
2C145	MI-27070-11	990704-225	Capacitor: mica, 120 μμf ±5%, 6000 v
1340-1620 KC, 230 Ohm Line, MI-34648-12			
1C305	MI-27699-3	990706-235	Capacitor: mica, 330 μμf ±5%, 20,000 v
2C113	MI-34600-1	8430373-1	Capacitor: vacuum, 1000 μμf, 10,000 v
2C114			Not Used
2C115	MI-27699-1	990706-230	Capacitor: mica, 200 μμf ±5%, 20,000 v
2C116	MI-27699-7	990706-251	Capacitor: mica, 1500 μμf ±5%, 15,000 v
2C144	MI-34649-2	990703-247	Capacitor: mica, 1000 μμf ±5%, 5000 v
2C145	MI-27070-11	990704-225	Capacitor: mica, 120 μμf ±5%, 6000 v

NOTE: If there is a conflict between the value of a component shown on the schematic diagram and that given in the List of Parts, specify the value in the List Of Parts when ordering a replacement.

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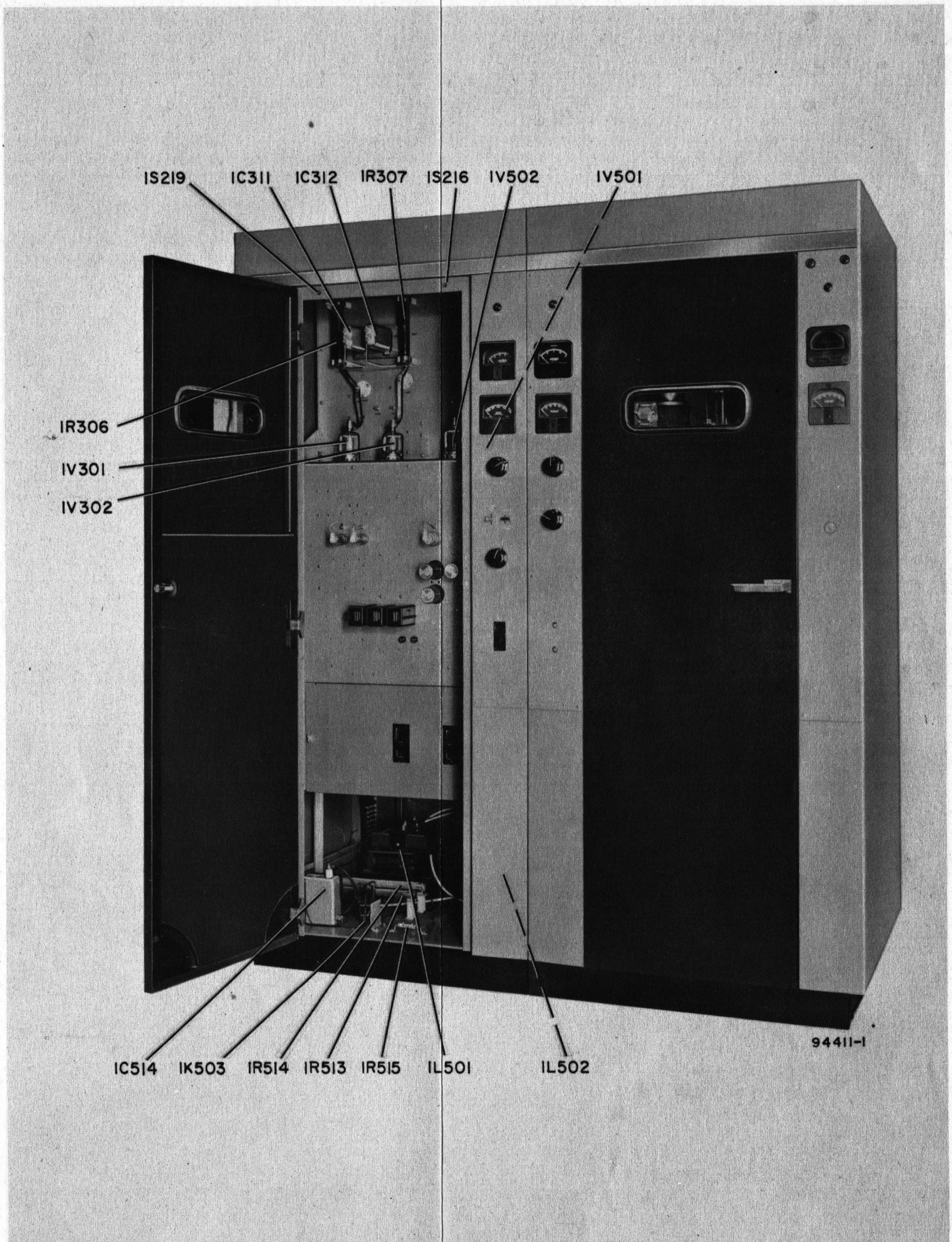

Figure 15—Front Interior View, Transmitter-Driver Cabinet

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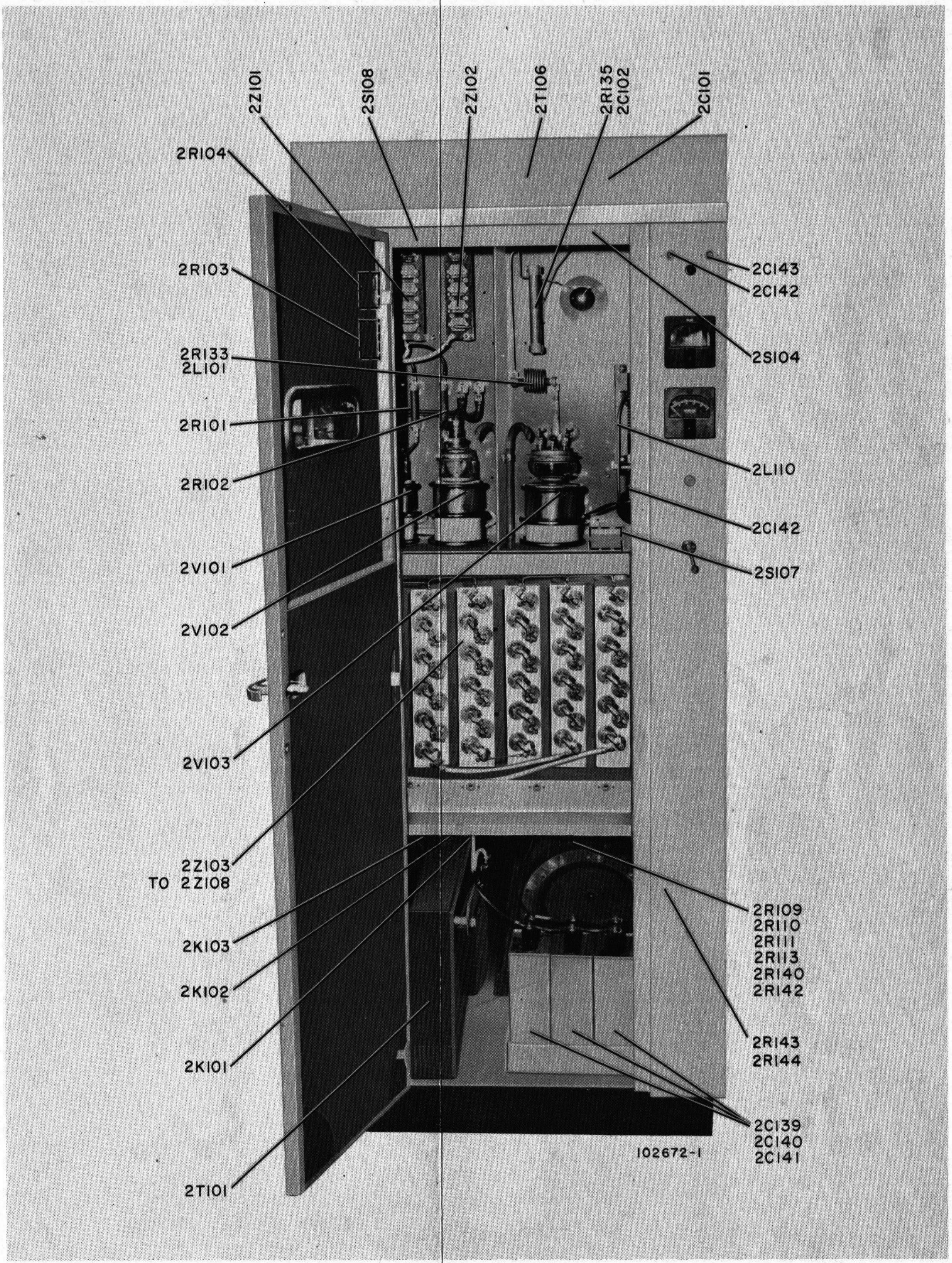

Figure 16—Front Interior View, Amplifier-Rectifier Cabinet

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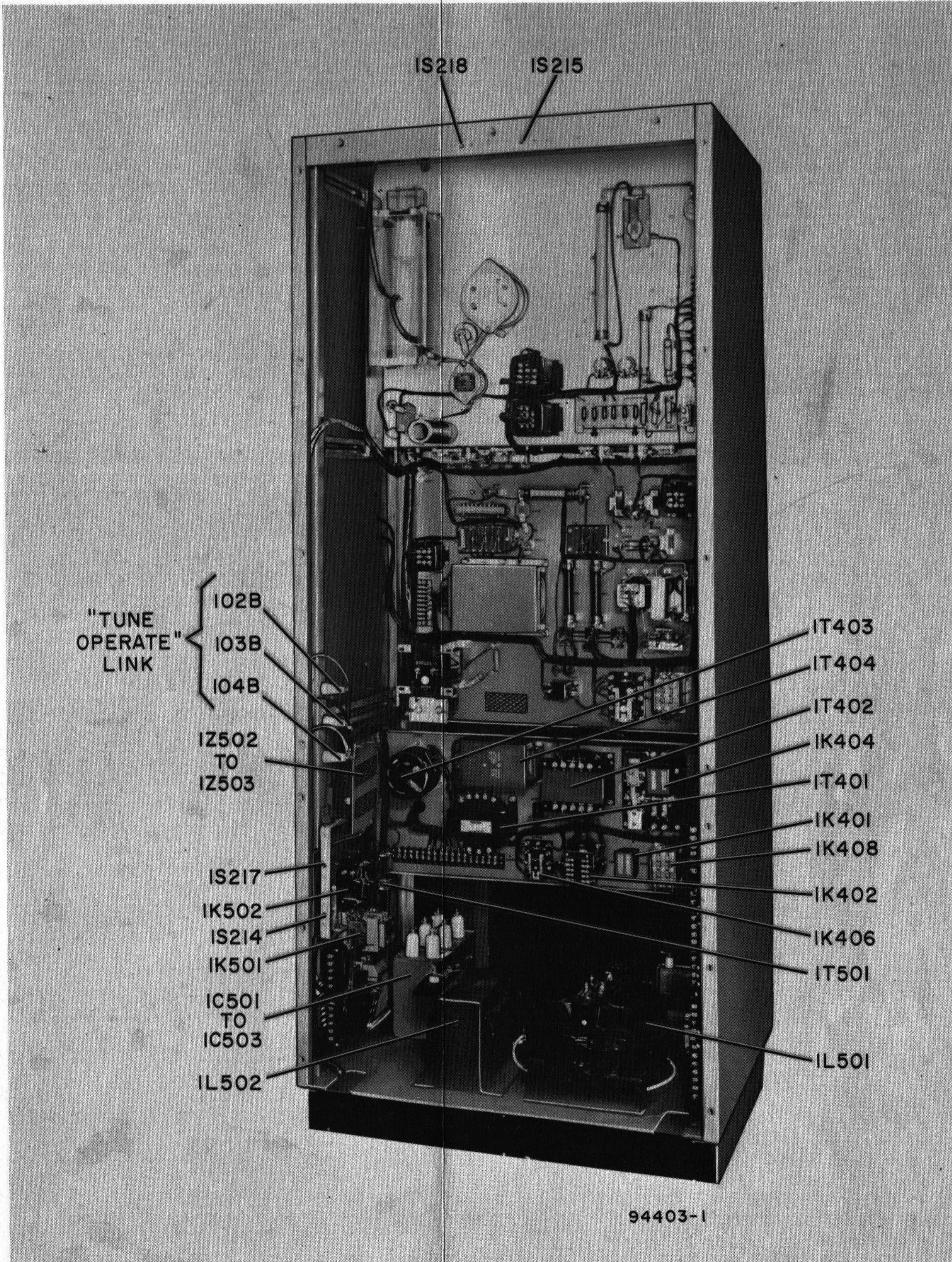

Figure 17—Rear View, Transmitter Driver Cabinet, Panels Removed

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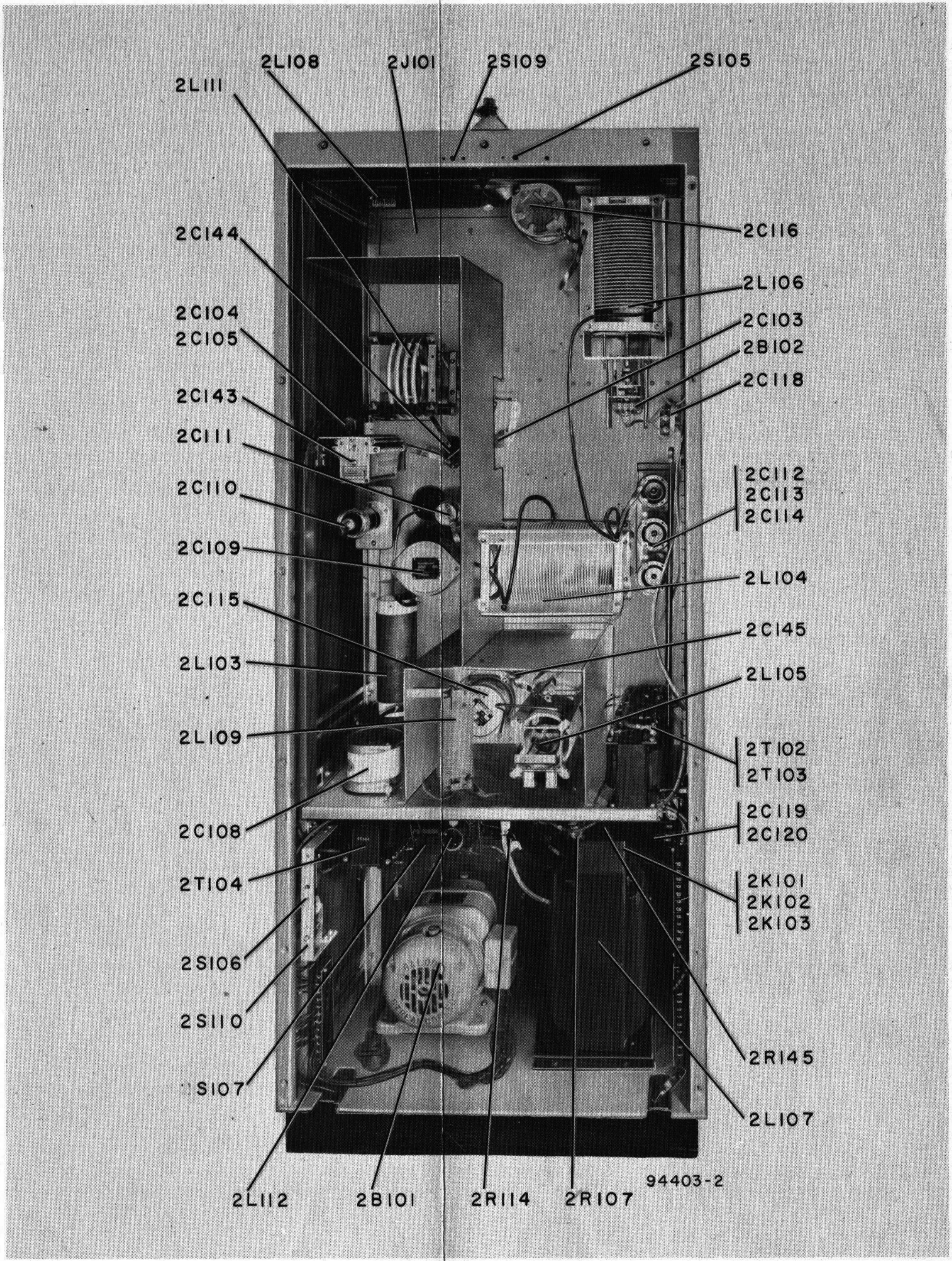

Figure 18—Rear View, Amplifier-Rectifier Cabinet, Panel Removed

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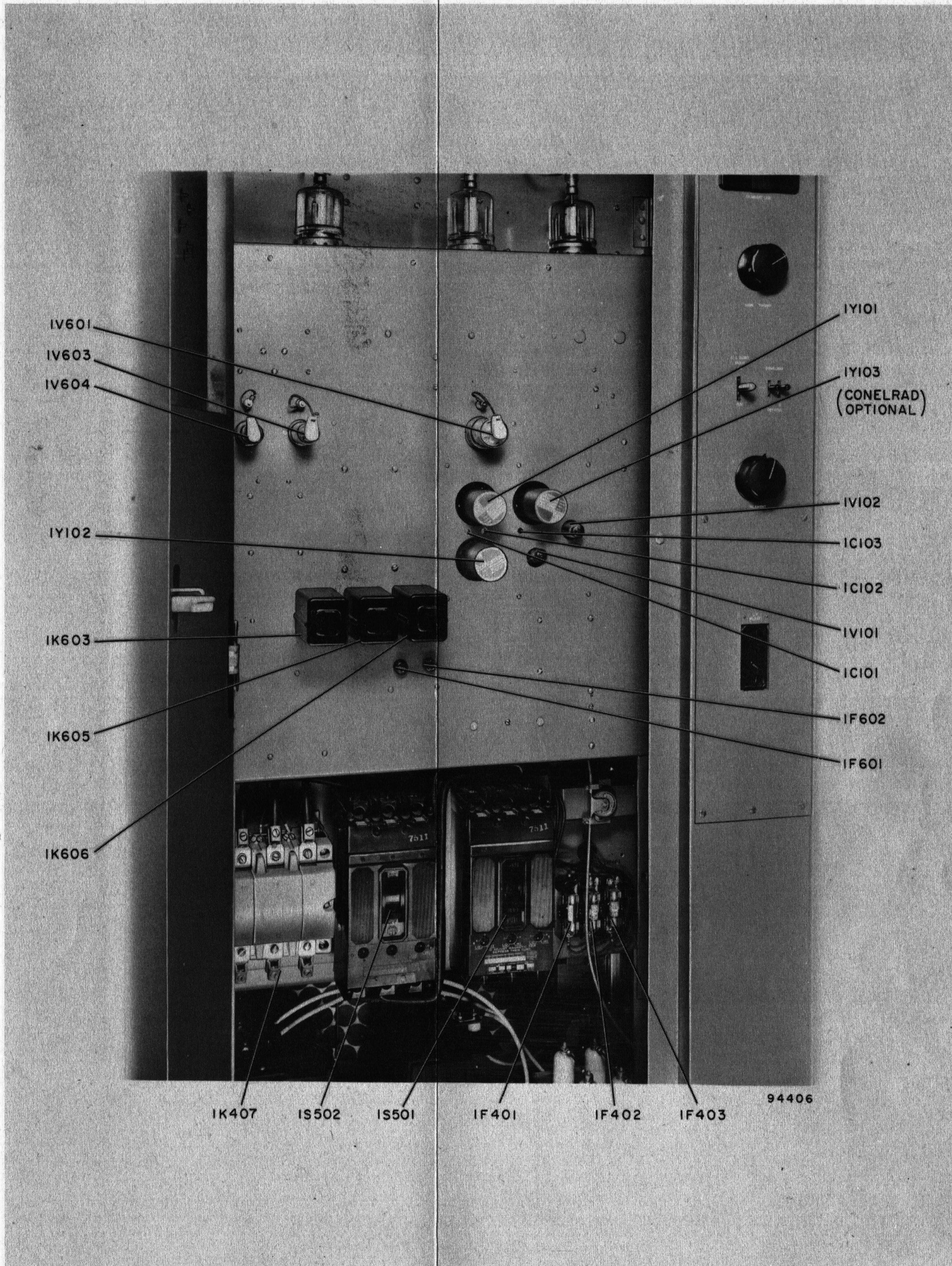

Figure 19—Front View, Exciter and First A.F. Amplifier

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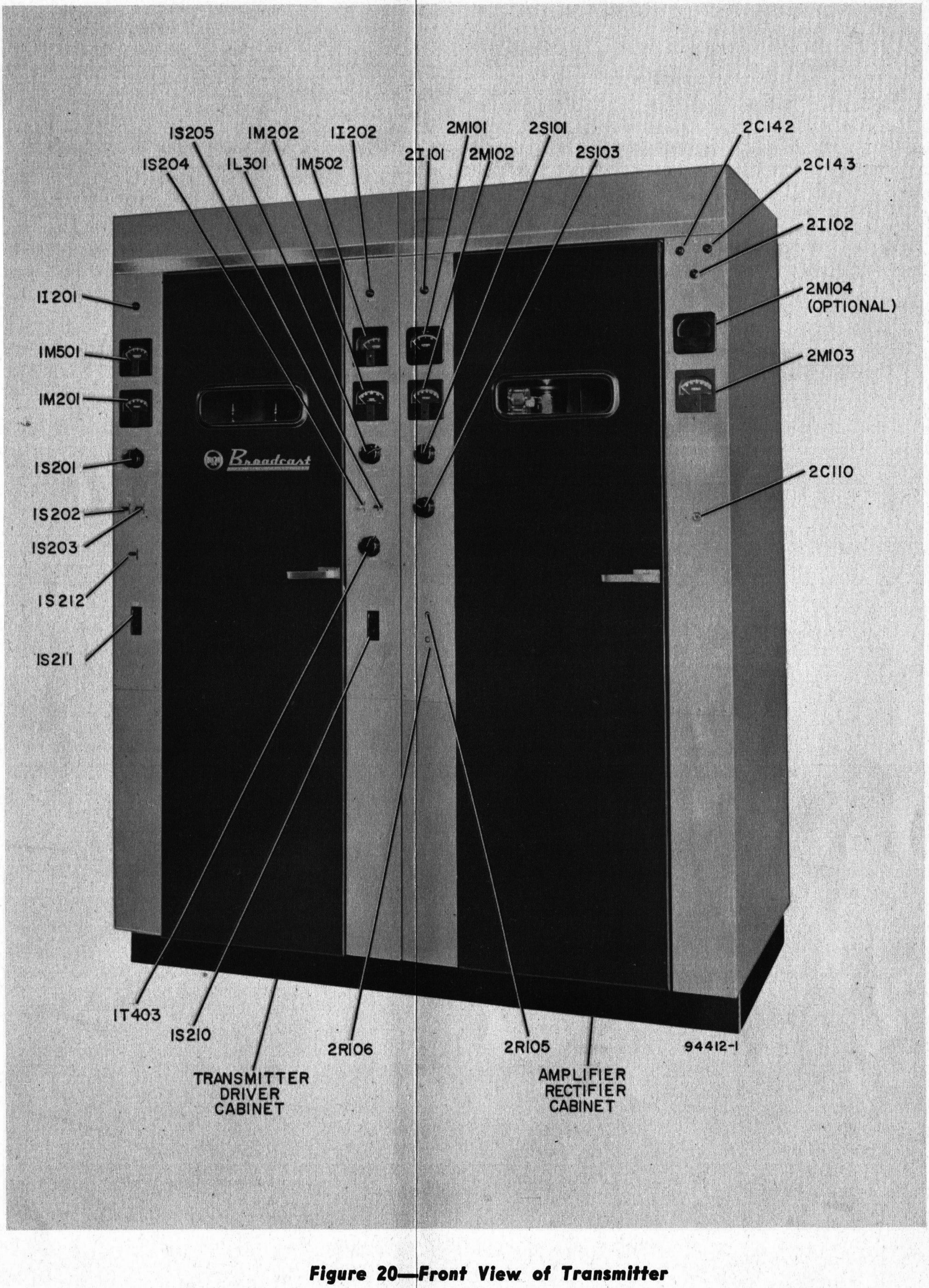

Figure 20—Front View of Transmitter

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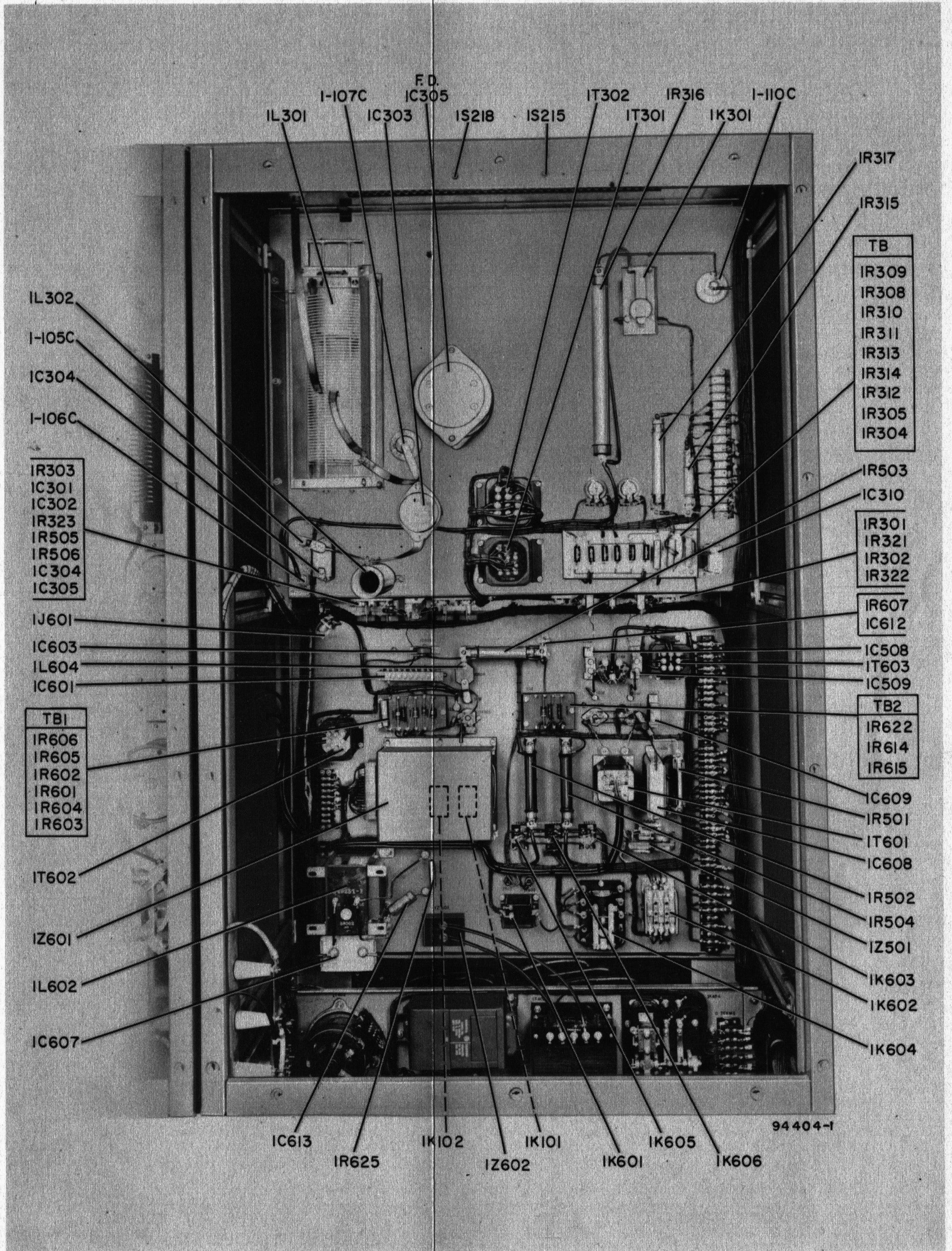

Figure 21—Modulator-PA Driver and Exciter Chassis

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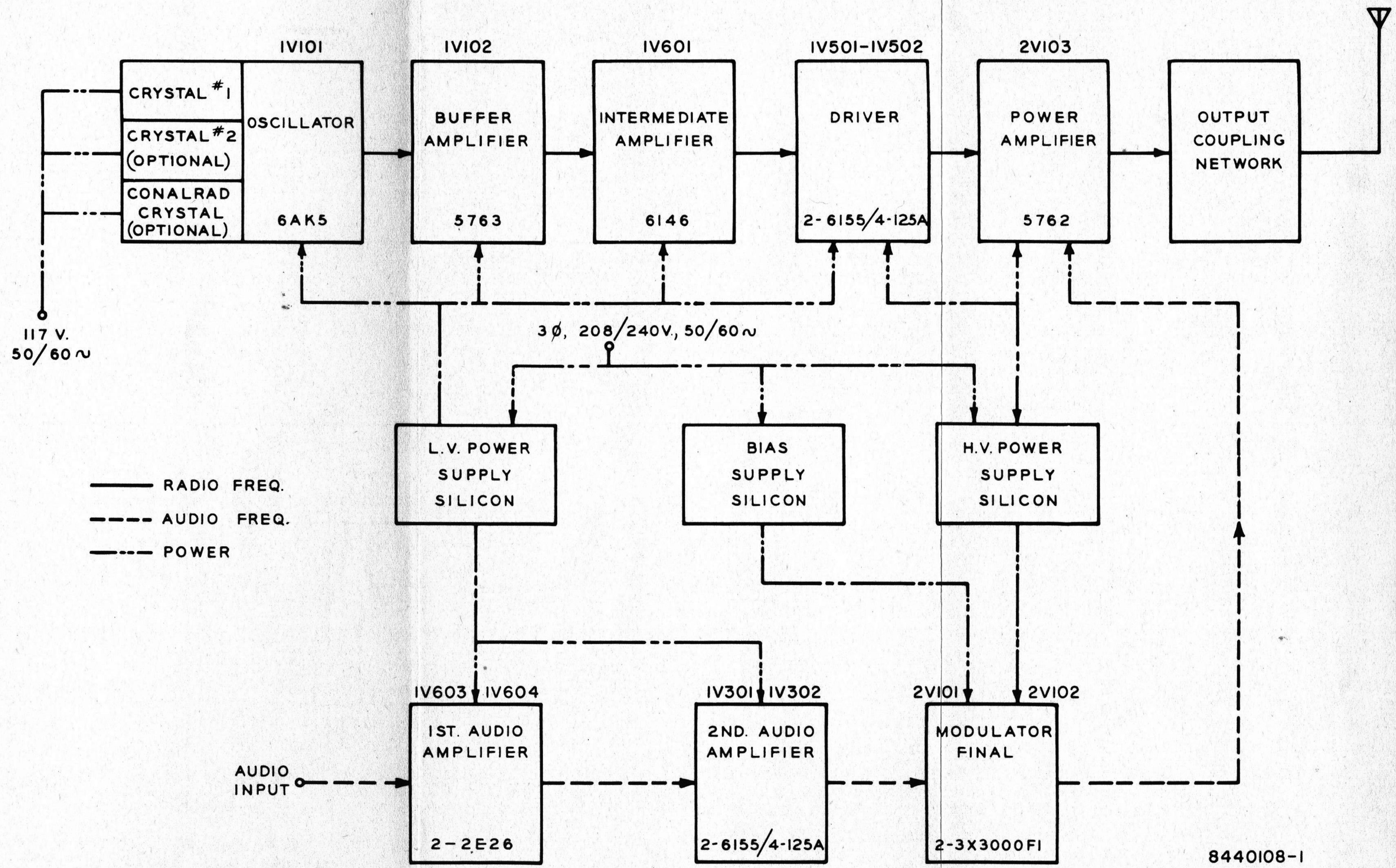

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Figure 22—Block Diagram

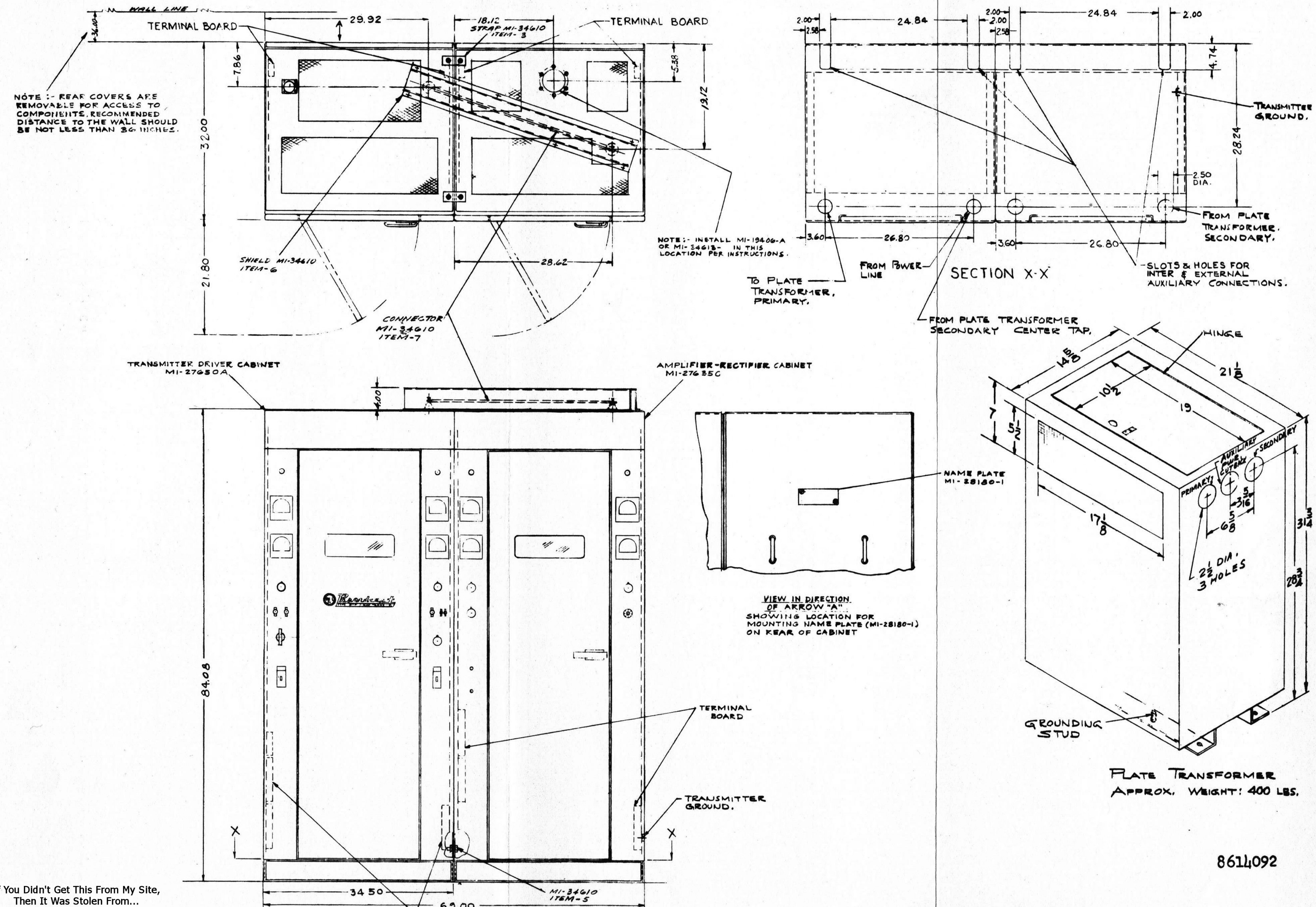

Figure 23—Outline Drawing

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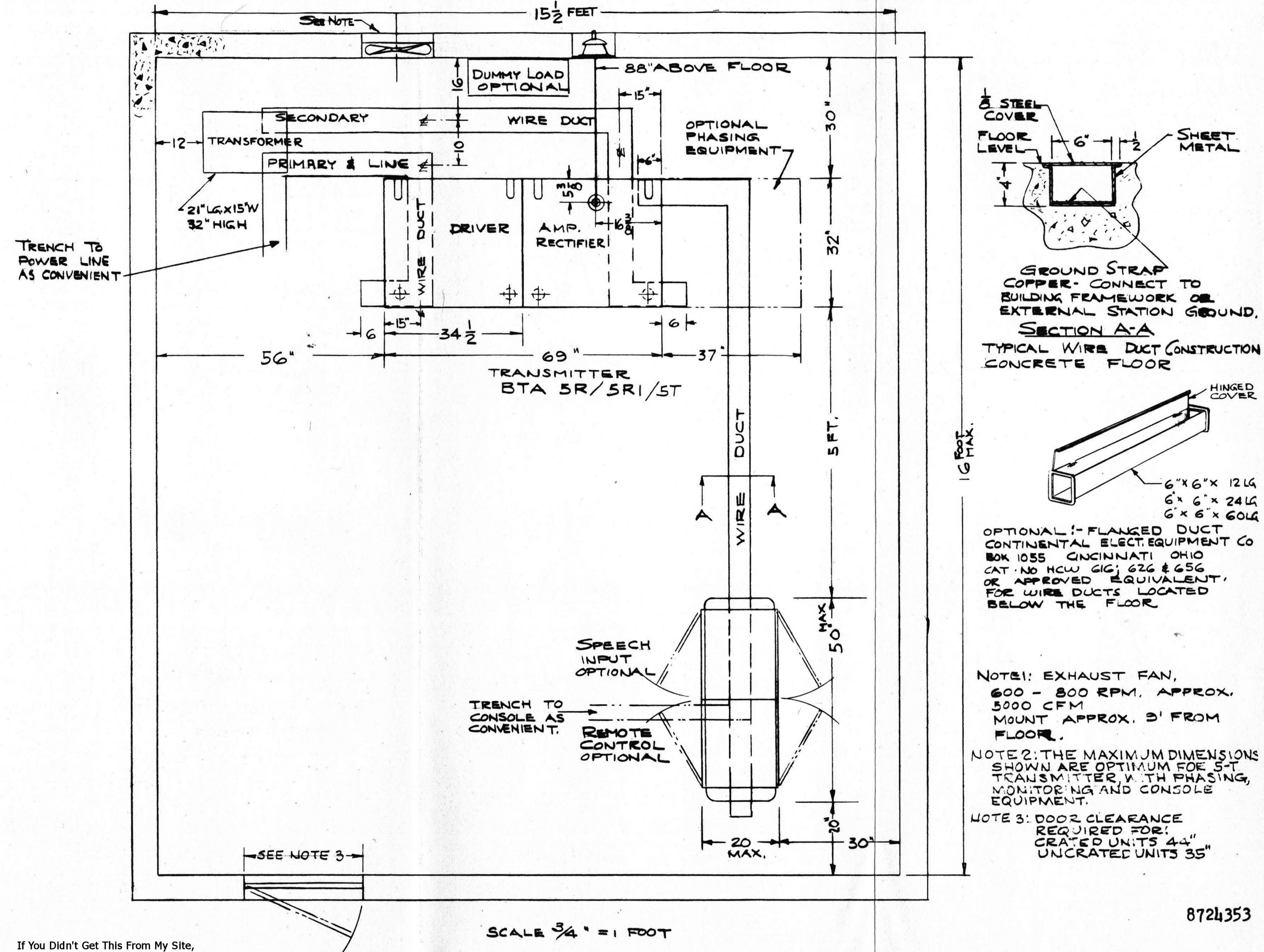

Figure 24—Typical Floor Plan

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Figure 25—Schematic Diagram

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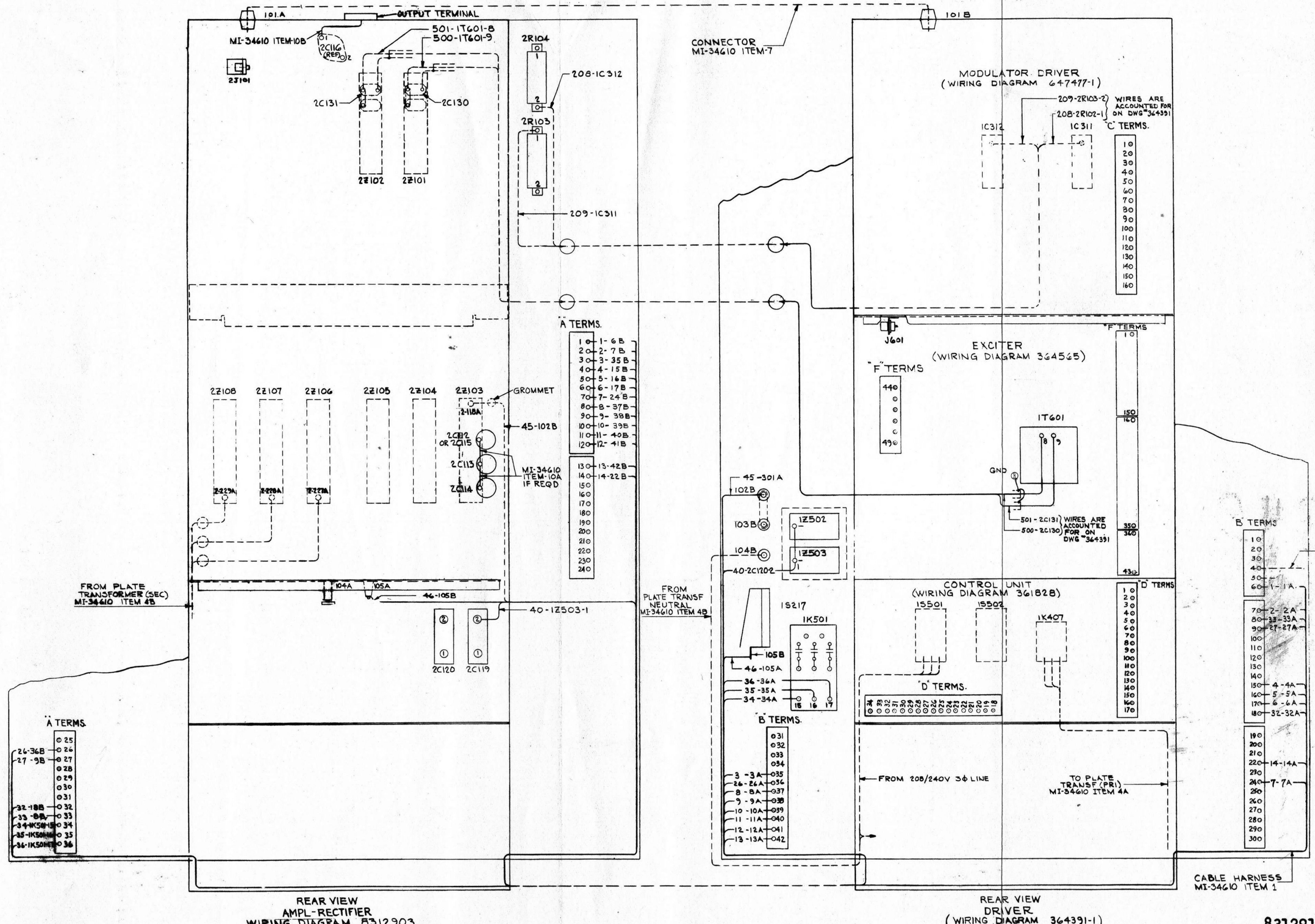

Figure 26—Interconnection Diagram

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RADIO CORPORATION OF AMERICA

INDUSTRIAL ELECTRONIC PRODUCTS

Camden 2, New Jersey

September 8, 1961

Mr. Edward R. Janney, Chief Engineer
Station KOY
840 Central Avenue, N.
Phoenix, Arizona

Dear Mr. Janney:

In your BTA-5T transmitter we use a flexible coupling unit on the drive shaft to the vacuum variable capacitor used in the "high efficiency" plate resonator. This unit sits down inside the inductance and unless it is made of a non-magnetic material, severe hearing of the unit will result with eventual failure. Please examine the flexible coupling unit for signs of heating, or better yet, check the unit with a small magnet to determine that it is made of non-magnetic material. If you should determine that your coupling unit is of magnetic material, please advise and a new coupling unit will be forwarded to avoid future difficulties.

Thank you for your cooperation in this matter.

Sincerely yours,

Geo. D. Stearns

George D. Stearns
Transmitter Merchandising

/mpl

cc: C. L. Gardner

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Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

INDUSTRIAL ELECTRONIC PRODUCTS · BROADCAST AND TELEVISION EQUIPMENT DIVISION

TB - 81-1 (BTA-5T) March 27, 1962
TB - 85-1 (BTA-5U/10U)

Issue by: N. E. Katz/L. S. Lappin

RECOMMENDED CHANGE OF POWER AMPLIFIER GRID CURRENT

The following change is to be incorporated in the PA stage of your transmitter which utilizes the type 5762 tube.

The change involves reduction of the grid current from 500 to 350 ma (380 ma maximum) per tube.

The foregoing should be accomplished in the BTA-5T by changing the resistor 2R136 from 1,600 ohms to 3,100 ohms; 2R137 remains 1,600 ohms.

A kit has been sent out to all of our BTA-5T customers. If you have not received yours, please contact us.

All BTA-5U/10U transmitters were shipped with the correct value of resistance.

The total grid resistance in the BTA-5T and BTA-5U is approximately 1,000 ohms and in BTA-10U it is approximately 500 ohms.

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November 10, 1966

RADIO KOY 55 promotion

TB-80-4 BTF-1D Transmitter

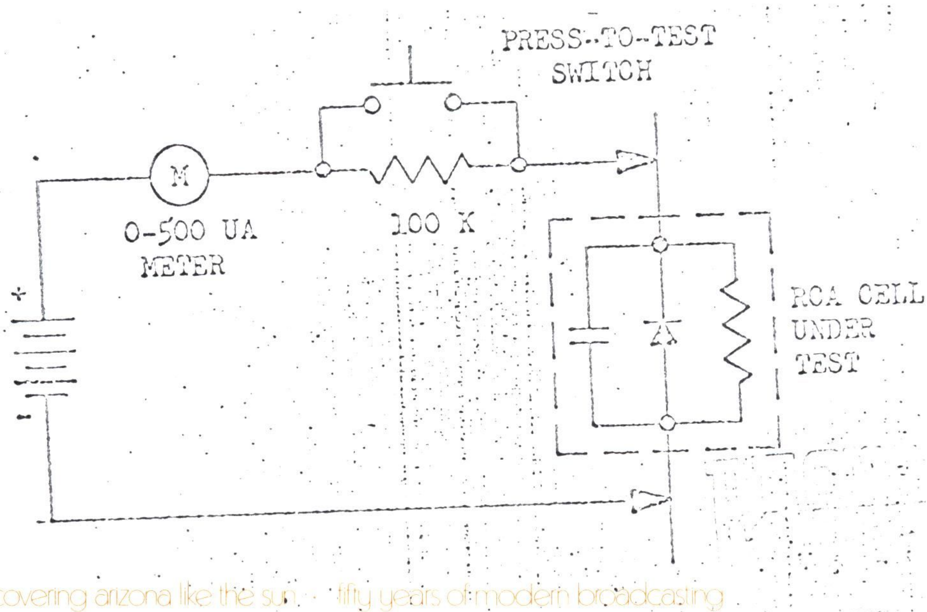
ATTACHMENT

TESTING INDIVIDUAL CELLS IN THE RCA CR300 SERIES HIGH-VOLTAGE SILICON RECTIFIER STACKS

The condition of individual cells in a RCA CR300 series stack may be checked by applying an external voltage to the individual cells and measuring the resultant current flow through the cell. A simple test circuit as shown below, can be used to perform the individual cell checks. It should be noted that some other value of voltage can be used in the test circuit; however, 50 volts was selected because it is low enough to be safe for testing, but is also sufficient to present a good indication of cell degradation. A lower voltage, such as that available in a vacuum-tube voltmeter, will not isolate defective cells unless they are almost complete shorts. Also note that the 100 kilohm resistor and the "press-to-test" switch have been included in the test circuit to protect the meter from shorted and incorrectly connected (reversed) diodes.

Connect the test circuit across the cell to be tested observing the polarity as shown in the diagram. It should be noted that an area on each of the fins of a CR300 series stack has been left unpainted to facilitate this connection. When the "press-to-test" switch is activated, a good cell will provide an indication of approximately 100 microamperes, while a cell that has degraded will indicate several hundred microamperes.

NOTE: THIS CIRCUIT IS NOT SATISFACTORY FOR CHECKING DIODES USING A VOLTAGE EQUALIZING RESISTOR BELOW 100 K. FOR TESTING DIODES IN SUCH SYSTEMS, THE EQUALIZING RESISTOR MUST BE DISCONNECTED FROM ONE END OF THE DIODE.



TEST CIRCUIT

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Memo for your maintenance file

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

BROADCAST AND COMMUNICATIONS PRODUCTS DIVISION

November 10, 1966

TB-81-2 BTA-5T

Issued by W. A. Culpepper/H. W. Wessenberg

SUGGESTIONS FOR ASSURING MAXIMUM HIGH VOLTAGE SOLID STATE RECTIFIER RELIABILITY

The attached information is sent to you in the interest of helping you to insure that conditions outside your transmitter are conducive to maximum silicon rectifier reliability.

/mc

Attachment

RECEIVED
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R. F. GOODSPEED

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SUGGESTIONS FOR THE REDUCTION OF HIGH VOLTAGE SOLID-STATE RECTIFIER FAILURES

The majority of transmitter high voltage rectifier failures can be traced to transients that occur on the input power line. Line transients are short bursts of energy, generally with steep wavefronts, that occur on the power line when heavy loads are switched on and off along the line. While transients of this nature cannot be eliminated, steps can be taken to reduce their amplitude and minimize their destructive effects. These transients are generally more severe on a long and highly reactive line. To reduce the problem, the Power Company can add power factor correcting capacitors. These capacitors not only correct power factor, but also provide snubbers to integrate the short transient pulses.

In the interest of economy, some power companies are feeding radio and television stations with an open delta circuit. The open delta circuit requires only two distribution transformers for three-phase service while other types of distribution systems require three transformers. This type of service may be fine for customers with electro-mechanical machinery; however, it leaves much to be desired for transmitter use as the phase-to-phase regulation is extremely poor and is subject to high transient voltages as the interphase reactance is not balanced. In the past, use of open delta has been restricted to emergency service; (i.e., restoration of three-phase power after failure of a transformer section), but today its use is common practice by some Power Companies.

A broadcast transmitter offers a very desirable constant power load and for this reason most Power Companies will cooperate with a broadcast station to improve their service. If a station is experiencing solid-state rectifier failures, it is suggested that their power distribution system be reviewed with the power company in an effort to minimize transient voltages and improve interphase regulation.

Another source of voltage that has been known to damage solid-state rectifiers is in the form of starting transients. These transients occur when power is applied to the plate transformer of a transmitter and the resultant inrush current is not limited by sufficient line resistance or reactance.

In most transmitter installations, the power line length is usually sufficient to provide the necessary resistance to limit this current. At times, transmitter installations are adjacent to power substations and, in such cases, it is necessary to use reactors in series with the primary of the plate transformer to provide the necessary instantaneous current limiting.

RCA transmitters of 5 kW or more have these reactors provided. It is good practice to leave these reactors in the circuit unless excessive carrier shift is experienced in an AM transmitter or poor output regulation is experienced in a TV transmitter when the video signal switches from black to white. In FM service where constant current operation is normal, the reactors should be in the circuit at all times. The new "E" line FM transmitters have sufficient leakage reactance designed in the transformer to provide this current limiting and, therefore, the use of line reactors is unnecessary.

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A routine program of tightening hardware particularly electrical connections to and from the rectifier is mandatory as heat is a major factor in the destruction of silicon properties. All rectifier cells should be periodically tested in the manner prescribed by the transmitter instruction book. A new test procedure for the black RCA CR-300 series stacks will give more consistent results than the use of a low voltage volt ohm meter as the testing device. A copy of this procedure is attached.

Lightning is another damaging hazard to solid-state rectifiers. Protection can best be made on the high side of the power distribution system at a point before entrance to the transmitter building. Again, the local Power Company can provide arresters to offer this protection, as much improvement has been made in these devices in recent years.

Emphasis cannot be placed too strongly on the use of a well-designed ground system. Heavy transients can develop in an inadequate ground system under fault or lightning conditions. To minimize the fault transients, all major equipment should be well bonded and a heavy ground buss should be returned to one common point to serve as the station ground.

The above suggestions, while intended to reduce solid-state rectifier failures, are good engineering practices to follow in order to obtain the maximum reliability and performance of any transmitting equipment regardless of the type of rectifiers employed.

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Memo for your maintenance file

RCA

TECHNICAL BULLETIN

MAINTENANCE AND MODIFICATION NOTES ON RCA BROADCAST EQUIPMENT

BROADCAST AND COMMUNICATIONS PRODUCTS DIVISION

TB-81-3
BTA-5T Transmitter

January 8, 1968

BIAS MODIFICATION

It has been determined that the modulator bias adjustment potentiometers on the BTA-5T may not have sufficient range to achieve the desired static plate current with the ceramic 3CX3000F1 and recently manufactured 3X3000F1 tubes.

In order to accommodate these new tubes, it is suggested that 2R108, a 4000 ohm 10 watt resistor, be changed to 15,000 ohms 20 watts. This resistor is a part of the bias supply filter network found between 2C119 and 2C120. After this change, the modulator bias adjustment range should be approximately -830 volts to -1090 volts which will accommodate the normal manufacturing variations in the old and new tubes. In case two tubes are used which happen to fall at opposite ends of the bias range, distortion may be reduced by adjusting the bias levels for minimum distortion. It is suggested that this adjustment be made at approximately 95% modulation with an audio frequency of 1000 Hz. Do not use a final bias setting which results in a static plate current in excess of 0.180 amperes.

A suitable replacement resistor for 2R108 is the Ohmite Brown Devil, Style 200-20, Type 1843, 15,000 ohms 20 watts. This resistor should be obtained through your regular electronic parts distributor.

If the resistor is changed, delete the stock number and drawing number presently shown in the parts list of your instruction books for 2R108 and use Stock No. 16620 RCA drawing No. 300581-22.

Issued by W. A. Culpepper & D. A. Sauer

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RCA Technical Bulletin

Maintenance and modification notes on equipment supplied
by RCA Commercial Electronic Systems Division

Audio Driver Operation and Meter Readings

Inquiries have been received recently concerning the operation of the 4-125 audio driver stage in the BTA-5T, BTA-5U and BTA-10U Transmitters (the same comments apply to the BTA-5T1, BTA-5U1/10U1, BTA-5R and BTA-5R1 Transmitters). This Technical Bulletin is being issued to provide additional information and to correct some of the Instruction Book information.

The operating parameters of the audio driver stage, 1V301 and 1V302, are affected primarily by the common cathode resistor for the stage, 1R312, and the screen voltage, which is affected by the setting of adjustable resistor 1R305.

Driver Stage Cathode Resistor

The common cathode resistor, 1R312, is identified on the older parts lists and schematics as a 200 ohm, 10 watt resistor. Newer parts lists and schematics show this resistor as a 160 ohm, 10 watt unit (it has been found that a better value for this resistor is 220 ohms, 10 watts). The drawing number in the parts list should be 993008-68, and the stook number should be 97132. If the value of 1R312 in your transmitter is other than 220 ohms, some improvement in overall distortion characteristics will be obtained by installing a 220 ohm unit.

Driver Stage Screen Voltage

The adjustment of screen divider resistor 1R305 is not specified in the Instruction Books. It has an effect on the operation of the surge suppressor relays, 1K301 and 1K503, and also on the screen voltage of the driver stage. Proper adjustment of 1R305 will be obtained when the screen voltage at pins 2 and 4 of 1XV301 and 1XV302 is 240 to 250 volts. Normally, 1R305 will be almost completely shorted out for the proper adjustment. It has been found that high frequency distortion is usually reduced when 1R305 is properly set.

1M201 Meter Readings

The "Typical Panel Meter Readings" table in the Instruction Book should be corrected. Values shown below for the 2nd AF stage reflect the proper

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cathode bias and screen voltage as described above. Corrected information on the full scale deflection (FSD) currents is also included.

Meter Symbol	Switch Position	0%	FSD
1M201			150%
	Osc. I_k-1		6.5 mA
	Osc. I_k-2		73 mA
	Buf. I_g		6 mA
	Buf. I_p		115 mA
	Amp. I_g (Driver)		27 mA
	Amp. I_k-R (Driver) (BTA-5T, BTA-5U)		350 mA
	Amp. I_k-L (Driver) (BTA-5T, BTA-5U)		350 mA
	Amp. I_k-R (Driver) (BTA-10U)		700 mA
	Amp. I_k-L (Driver) (BTA-10U)		700 mA
	1st AF I_k-R		11 mA
	1st AF I_k-L		11 mA
	2nd AF I_k-R	65%	100 mA
	2nd AF I_k-L	65%	100 mA

Typical tube socket voltages for IV301 and IV302 4-125 2nd audio amplifiers should be as follows:

Plate	Cathode	Grid	Screen
1200 Volts	20 Volts	0 Volts	250 Volts

Modulation Reactor Positioning

The modulation reactor in the BTA-5T, 2L106, and in the BTA-5U, 3L112, is physically located in close proximity to the modulation transformer. It has been found that a degree of coupling exists between these components at certain audio frequencies. Best overall operation is usually obtained when

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the modulation reactor is physically positioned so that its laminations are at right angles to the laminations of the modulation transformer. The rear view photograph of the amplifier rectifier cabinet in the BTA-5T Instruction Book shows the less desirable physical positioning of the modulation reactor, 2L107.

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RCA Technical Bulletin
Maintenance and modification notes on equipment supplied by RCA Commercial Electronic Systems Division

Improving Carrier Shift and Audio Performance

Additional Tuneup Information

It has been found that slight retuning of the plate and cathode resonators of the subject transmitter can provide a definite improvement in distortion, carrier shift and PA plate current with very little change in power amplifier efficiency.

The pertinent instruction book procedures for resonating the plate and cathode third harmonic resonators should be followed initially. It is helpful to check that each resonator is actually tuned to the third harmonic with a grid-dip meter. Some improvement in efficiency (but with poor modulation characteristics) can be obtained with plate resonators tuned to other harmonics of the carrier frequency. The resonators must both be tuned to the third harmonic to obtain optimum performance. When adjusted to the third harmonic, tuning the cathode resonator variable capacitor to the high capacity side, from the point which provides maximum output, will usually produce a sharp dip in power output and PA plate current. Tuning the cathode capacitor to the low capacity side will produce a slow drop in power output and PA plate current. This tuning reaction may be helpful in locating the proper tuning of the cathode resonator.

Once the peak in output power has been located with the cathode tuning capacitor, the tap on the cathode resonator coil should be adjusted slightly so that the peak in output occurs when the cathode tuning capacitor is near full mesh (maximum capacity).

At this point, the transmitter tuning and operation is very similar to that described in the instruction books.

To further refine the power amplifier tuning, modulate the transmitter 95% with 400 or 1,000 Hz tone. Set up a distortion meter and measure the transmitter distortion. While observing the distortion meter, tune the cathode resonator tuning capacitor toward <u>minimum</u> capacity. Continue tuning until a minimum distortion point is reached or the cathode tuning capacitor reaches minimum capacity. Leave the cathode tuning capacitor at this point.

Now, while still observing the transmitter distortion, slowly tune the

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plate harmonic resonator tuning capacitor for a sharp dip in distortion. If the distortion falls and power output falls considerably, retune the plate resonator to the starting point and continue tuning in that same direction until a sharp, definite null in distortion is found.

At this point, transmitter distortion and carrier shift will be considerably improved and the transmitter power may be slightly below what it was prior to these adjustments. Reload and retune the power amplifier using the power raise switch and the PA plate tuning capacitor (<u>not</u> the plate resonator) until rated power is again achieved. Plate resonator tuning should now be rechecked to make sure that it is properly adjusted for low distortion.

With the improved distortion characteristics, it is possible to rebalance the modulator tubes to keep them closely balanced over the low and mid-frequency audio ranges. With 95% 50 Hz modulation, adjust the modulator balance controls until the modulator cathode currents are balanced (note that a 100 ma unbalance is permissible under these conditions). Remove modulation and check that neither modulator cathode current meter shows greater than 180 ma static current. If either cathode shows greater than 180 ma, readjust it and then use the other balance control to balance the cathode currents under 50 Hz modulation. Check 50 Hz distortion.

Now modulate at 1,000 Hz. Modulator cathode currents should be within 200 ma of each other. Check distortion and carrier shift. Note that the PA plate current shift with modulation is now very small and much less than the 50 ma referenced in the instruction book.

Modulator cathode current balance at the higher audio modulating frequencies is somewhat dependent on the rf load characteristics at the higher sideband frequencies and, therefore, may be expected to vary considerably from installation to installation.

This completes the readjustment of the power amplifier stage for low distortion, low carrier shift and low PA plate current shift. Carrier shift should now be approximately the same percentage as the PA plate voltage shift with modulation.

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BTA-5T
BT-81-7

March 10, 1969

AM Transmitter Carrier Interruption Methods

We have received several inquiries concerning methods of carrier interruption on AM transmitters without operation of the normal "plate" switch and high voltage contactor. This procedure is usually desirable where short interruptions are desired for daily antenna pattern changes, antenna fault protection, or EBS operation.

Ampliphase transmitters, such as the BTA-50H1, require only interruption of the oscillator drive, by operation of relay 2K206 from an external contact. Fixed bias is used on all RF stages, and there is no excessive load change on the audio stages when the carrier is interrupted.

In high level modulated transmitters, such as the BTA-1R2, BTA-5T1, BTA-5U1/10U1, etc., several transmitter functions must be disabled, and in the proper sequence.

The sequence follows the pattern listed below:

1. Remove audio drive.
2. Provide sufficient fixed bias for all RF stages which might overload upon removal of RF drive.
3. Remove RF drive (this may be accomplished in Step 2 by properly biasing a low level rf stage).
4. To return to normal operation, return rf drive.
5. Remove fixed bias's.
6. Return audio drive to the modulator stages.

In the high level modulated transmitters referenced above, the driver stage and PA stage normally operate with self bias, and require the application of fixed bias during carrier interruption to prevent overdissipation.

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It should be noted, in Step 2, that it is desirable to maintain a small static current on the PA stage to provide a quiescent load for the modulation transformer. This may be controlled by selecting a suitable fixed bias potential for the PA during the cut-off period.

To economize on the number of relays required it is best to completely cut off the lowest power stage that is controlled. As the driver stage is commonly a tetrode, fixed grid bias is not satisfactory for complete cutoff. When the grid is cut off, the load on the preceding stage decreases, and rf drive voltage increases. Screen current drops, and screen voltage rises. The overall result is that the stage gain may increase and it becomes very difficult to completely cut off the tetrode driver stage with grid bias. (Note: If the driver screen voltage is low enough for the relay used, disconnecting the screen from any DC return will bias off the stage.)

The driver cutoff method suggested here is cathode bias. As the cathode goes positive the grid is cut off and, in addition, the screen to cathode voltage is reduced. Stage gain and cathode current are reduced. Actually, open-circuiting the cathode circuit is acceptable, as the cathode will only rise to a voltage which is about equal to the screen voltage, as long as the screen is supplied from a fixed low voltage supply. (In a triode, cathode keying results in the cathode rising to the full plate potential. The BTA-1R2 PA must be treated as a triode, as its screen voltage is derived from the PA plate voltage through a dropping resistor.) The driver filament transformer is rated for a hi-pot test of 2500 volts, so cathode keying is acceptable.

Biasing the PA stage to a low quiescent level may be done by keying in a fixed bias, sampled from the modulator bias supply. However, cathode bias may also be used, as complete cutoff is not required. In addition, cathode keying can be accomplished without disabling or affecting the normal metering circuits for the PA stage.

Removal of audio drive is most easily accomplished in the audio input circuit, as this does not introduce DC disturbances in the modulator circuits, which could cause modulator overloads. A DC relay can be shunted by a diode to increase the dropout time, thus allowing RF drive to be reestablished before audio is reapplied.

The attached circuit diagram is suggested where it is desirable to provide momentary carrier interruption on the high level modulated transmitters described above. The descriptions relate the schematic circuit points to representative RCA transmitters and outlines the wiring procedures. Specific component locations may be obtained from the pertinent instruction book. Locations for mounting the added components are not specified as there may

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be local station preferences, or modifications to the proposed circuit which cannot be anticipated. The major portion of the rewiring involves providing new meter circuit wiring so that the multimeter cannot shunt the "open" cathode contacts when the transmitter is supposedly cut off.

Additional circuitry, such as pattern changeover taking place when the transmitter disable switch is pressed, and automatic power return when the pattern has changed, but the button is still depressed, etc., may be combined with the circuitry shown.

Acknowledgment is given to stations WKBN, WFMJ, and WDBO. These stations were involved in various stages of development and test of the suggested ciecuitry, and also contributed some of the circuitry ideas. The RF cutoff circuitry was tested on a BTA-10U1 in the factory.

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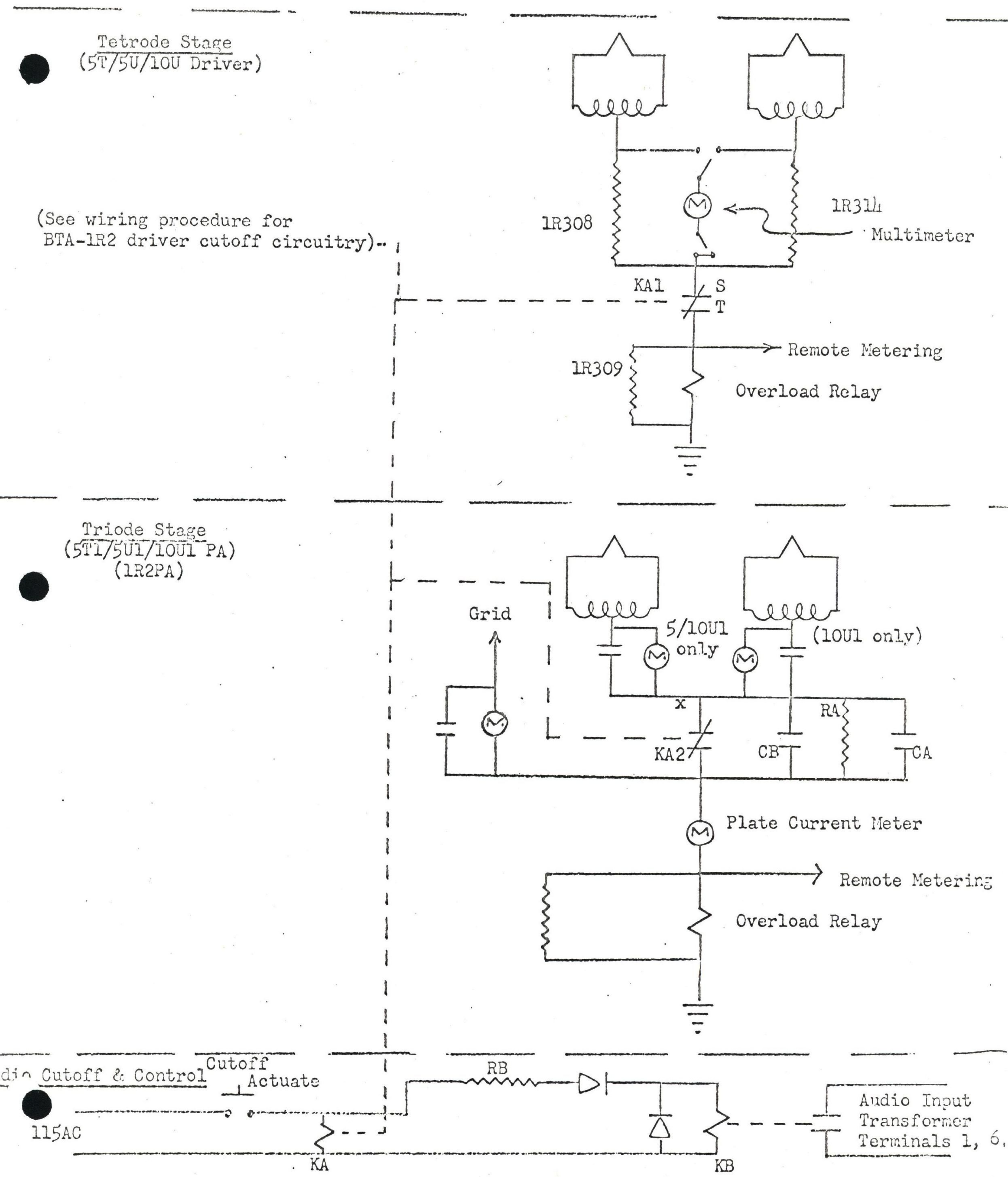
Tetrode Stage
(5T/5U/10U Driver)
(See wiring procedure for
BTA-1R2 driver cutoff circuitry)
1R308
1R314
Multimeter
KA1
S
T
Remote Metering
1R309
Overload Relay
Triode Stage
(5T1/5U1/10U1 PA)
(1R2PA)
Grid
5/10U1
only
(10U1 only)
x
RA
KA2
CB
CA
Plate Current Meter
Remote Metering
Overload Relay
dio Cutoff & Control
Cutoff
Actuate
115AC
RB
KA
KB
Audio Input
Transformer
Terminals 1, 6,

REWIRING PROCEDURES

BTA-5/10U1 PA (Wiring Diagram 8312948, and 8312958).

1) Remove the wire (#123) from 3M101-1(+) which connects to 3M103-2(-).

2) Connect the free end of this wire (#123) to 3M102-2(-). (In the BTA-5U1, install an insulator to support the free end of this wire.

3) Remove the wire between 3M101-1(+) and 3M102-2(-) (in the BTA-10U1 only).

4) Wire one side of the cut-off relay and circuitry ("Y" side of the normally closed contacts) to 3M101-1(+). Wire the other side ("X" side of the NC contacts) to 3M102-2(-). (In the BTA-5U, connect the "X" side to the insulator to which wire #123 is attached, or to 3M103-2(-)).

BTA-5T1 PA (Wiring Diagram 8312903).

1) Remove the wire (#194) from 2R140-2 (Panel end) which connects to 2T104-7.

2) Insulate and extend this wire to the "X" side of the carrier cut-off relay.

3) Connect the "Y" side of the cut-off relay circuit to 2R140-2.

BTA-1R2 PA (Wiring Diagram 8321471, 8314748).

1) Locate TB300. (Next to 1T301) Remove the wire (#9) from TB300-1 (1R316) which connects to Terminal 15C. Reconnect this wire (#9) to Terminal 3 of TB300 (1R320).

2) Remove the jumpers (#37 & #39) which connect TB300-1 to TB300-3 and TB300-3 to TB300-5. (Disconnect 1R316 & 1R317 from 1R320).

3) Install a new jumper between TB300-1 and TB300-5. (Connect 1R316 & 1R317 together).

4) Remove the wire (#13) from Terminal 17F which normally connects to 1S201B-7/8. Insulate and extend this wire (#13) to Terminal Board TB300-1/5.

5) Connect the "X" terminals of the cut-off circuitry to TB300-1/5. (1R316/1R317).

6) Connect the "Y" terminals to TB300-3. (1R320).

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REWIRING PROCEDURES (Cont'd)

BTA-5T1/5U1/10U1 Driver (Wiring Diagrams 647477, 364391, 8312913).

1) Remove the wire (#53) which connects 1R309 to 1R308.

2) Remove the wire (#15) from Terminal 17F which connects to 1S201B-7/8.

3) Insulate and extend the wire (#15) which was connected to 17F to the common terminals of resistors 1R308 and 1R314.

4) Connect the "S" terminals of the cut-off circuitry to the common terminals of 1R308 and 1R314.

5) Connect the "T" terminals of the cut-off circuitry to the "hot" end of 1R309 (end which was originally connected to 1R308), or Terminal 10C, or Terminal 17F.

BTA-1R2 Driver (Wiring Diagram 364565)

1) Remove the wire (#42) which connects 1XV601 pin 3 to 1R605/1R606. (TB1-4).

2) Connect the "S" terminals of the normally closed cut-off contact to TB1-4.

3) Connect the "T" terminals of the cut-off relay to 1XV601 pin 3.

NOTE: The voltage in this circuit is about +180 volts, which the suggested relay can switch. When the contacts are open, the screen will bias itself negative, thus cutting off the driver stage.

Suggested Components

KA Antenna changeover relay, such as Hart Advance Type AT/2c/115vA, DPDT 10A contacts. RF rating 1 kW. (Available through Newark Electronics). Contact current and voltage ratings must be suffieient to break the circuit in the power amplifier cathode.

KB DC operated dry reed relay. The Magnecraft 102MPCX8 has been used with a 24 volt dc control circuit. The 102MPCX9 (48V coil) should work in the rectified AC circuit shown without the resistor RB.

RA	BTA-10U1	400 ohm, 200 Watt Resistor.
	BTA-5T1/5U1	750 ohm, 100 Watt Resistor.
	BTA-1R2	1000 ohm, 50 Watt Resistor.

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REWIRING PROCEDURES (Cont'd)

RB Series dropping resistor, value dependent on voltage rating of relay KB.

CA 10 mfd, 600 volt paper/oil capacitor to suppress arcing when KA2 contacts open.

CB .002 mfd, 3 kv mica capacitor for RF bypassing of KA2 contacts.

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RCA Technical Bulletin
Maintenance and modification notes on equipment supplied
by RCA Commercial Electronic Systems Division

BTA-5T
BT-81-6

March 25, 1969

Splatter Filter Capacitor

The capacitor which forms part of the splatter filter (2C147 in the BTA-5T and BTA-5T1, 3C134 in the BTA-5U/10U and BTA-5U1/10U1) has been changed to a unit with higher current ratings. Please add to or change the information in your instruction book for this capacitor.

Transmitter	Capacitor	Stock No.	Drawing No.
BTA-5T BTA-5T1	2C147	93620	990703-240
BTA-5U/10U BTA-5U1/10U1	3C134	93620	990703-240

When replacing the old style capacitor with the new type, it will be necessary to fabricate new mounting straps, preferably from copper strip.

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SAN CARLOS CALIFORNIA

4-125A

(4D21)

RADIAL-BEAM POWER TETRODE

MODULATOR
OSCILLATOR
AMPLIFIER

The Eimac 4-125A is a radial-beam power tetrode intended for use as an amplifier, oscillator, or modulator. It has a maximum plate-dissipation rating of 125 watts and a maximum plate-voltage rating of 3000 volts at frequencies up to 120 Mc.

The low grid-plate capacitance of this tetrode together with its low driving-power requirement allows considerable simplification of the associated circuit and driver stage.

Cooling is by radiation from the plate and by air circulation through the base and around the envelope.

The 4-125A in class-C r-f service will deliver up to 375 watts plate power output with 2.5 watts driving power. Two 4-125A's in class-B modulator service will deliver up to 400 watts maximum-signal power output with 1.2 watts nominal driving power.

GENERAL CHARACTERISTICS

ELECTRICAL

Filament: Thoriated Tungsten	
Voltage	5.0 volts
Current	6.5 amperes
Grid-Screen Amplification Factor (Average)	5.9
Direct Interelectrode Capacitances (Average)	
Grid-Plate	0.05 $\mu\mu$fd
Input	10.8 $\mu\mu$fd
Output	3.1 $\mu\mu$fd
Transconductance (I_b=50 ma., E_b=2500V., E_{c2}=400V.)	2450 μmhos
Highest Frequency for Maximum Ratings	120 Mc

MECHANICAL

Base	5-pin metal shell
Basing	See outline drawing
Socket	E. F. Johnson Co. socket No. 122-275, National Co. No. HX-100, or equivalent
Mounting Position	Vertical, base down or up
Cooling	Radiation and forced air
Recommended Heat-Dissipating Plate Connector	Eimac HR-6
Maximum Over-all Dimensions:	
Length	5.69 inches
Diameter	2.81 inches
Net Weight	6.5 ounces
Shipping Weight	1.5 pounds

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RADIO-FREQUENCY POWER AMPLIFIER AND OSCILLATOR

Class-C Telegraphy or FM Telephony
(Key-down conditions, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	225 MAX. MA
PLATE DISSIPATION	125 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	3000	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage	—100	—150	—150	volts
D-C Plate Current	200	200	167	ma
D-C Screen Current	50	40	30	ma
D-C Grid Current	12	12	9	ma
Screen Dissipation	18	14	10.5	watts
Grid Dissipation	1.6	2	1.2	watts
Peak R-F Grid Input Voltage (approx.)	230	320	280	volts
Driving Power (approx.)[3]	2.8	3.8	2.5	watts
Plate Power Input	400	500	500	watts
Plate Dissipation	125	125	125	watts
Plate Power Output	275	375	375	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_1

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	600 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	600	600	600	volts
D-C Grid Voltage[2]	—90	—94	—96	volts
Zero-Signal D-C Plate Current	60	50	50	ma
Max-Signal D-C Plate Current	222	240	232	ma
Zero-Signal D-C Screen Current	—1.0	—0.5	—0.3	ma
Max-Signal D-C Screen Current	17	6.4	8.5	ma
Effective Load, Plate-to-Plate	10,200	13,400	20,300	ohms
Peak A-F Grid Input Voltage (per tube)	90	94	96	volts
Driving Power	0	0	0	watt
Max-Signal Plate Dissipation (per tube)	87.5	125	125	watts
Max-Signal Plate Power Output	158	230	330	watts
Total Harmonic Distortion	5	2	2.6	per ct.

HIGH-LEVEL MODULATED RADIO-FREQUENCY AMPLIFIER

Class-C Telephony
(Carrier conditions unless otherwise specified, 1 tube)

MAXIMUM RATINGS

D-C PLATE VOLTAGE[1]	2500 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
D-C GRID VOLTAGE	—500 MAX. VOLTS
D-C PLATE CURRENT	200 MAX. MA
PLATE DISSIPATION	85 MAX. WATTS
SCREEN DISSIPATION	20 MAX. WATTS
GRID DISSIPATION	5 MAX. WATTS

TYPICAL OPERATION
(Frequencies below 120 Mc.)

D-C Plate Voltage	2000	2500	volts
D-C Screen Voltage	350	350	volts
D-C Grid Voltage	—220	—210	volts
D-C Plate Current	150	152	ma
D-C Screen Current	33	30	ma
D-C Grid Current	10	9	ma
Screen Dissipation	11.5	10.5	watts
Grid Dissipation	1.6	1.4	watts
Peak A-F Screen Voltage, 100% Modulation	210	210	volts
Peak R-F Grid Input Voltage (approx.)	375	360	volts
Driving Power (approx.)[3]	3.8	3.3	watts
Plate Power Input	300	380	watts
Plate Dissipation	75	80	watts
Plate Power Output	225	300	watts

AUDIO-FREQUENCY POWER AMPLIFIER AND MODULATOR

Class-AB_2

MAXIMUM RATINGS

D-C PLATE VOLTAGE	3000 MAX. VOLTS
D-C SCREEN VOLTAGE	400 MAX. VOLTS
MAX-SIGNAL D-C PLATE CURRENT, PER TUBE	225 MAX. MA
PLATE DISSIPATION, PER TUBE	125 MAX. WATTS
SCREEN DISSIPATION, PER TUBE	20 MAX. WATTS

TYPICAL OPERATION
(Sinusoidal wave, two tubes unless otherwise specified)

D-C Plate Voltage	1500	2000	2500	volts
D-C Screen Voltage	350	350	350	volts
D-C Grid Voltage	—41	—45	—43	volts
Zero-Signal D-C Plate Current	87	72	93	ma
Max-Signal D-C Plate Current	400	300	260	ma
Zero-Signal D-C Screen Current	0	0	0	ma
Max-Signal D-C Screen Current	34	5	6	ma
Effective Load, Plate-to-Plate	7200	13,600	22,200	ohms
Peak A-F Grid Input Voltage (per tube)	141	105	89	volts
Max-Signal Avg. Driving Power (approx.)	2.5	1.4	1	watts
Max-Signal Peak Driving Power	5.2	3.1	2.4	watts
Max-Signal Plate Dissipation (per tube)	125	125	122	watts
Max-Signal Plate Power Output	350	350	400	watts
Total Harmonic Distortion	2.5	1	2.2	per ct.

[1] Above 120 Mc. the maximum plate voltage rating depends upon frequency. See page 4.

[2] The effective grid circuit resistance for each tube must not exceed 250,000 ohms.

[3] Driving power increases above 70 Mc. See page 4.

IF IT IS DESIRED TO OPERATE THIS TUBE UNDER CONDITIONS WIDELY DIFFERENT FROM THOSE GIVEN UNDER "TYPICAL OPERATION" POSSIBLY EXCEEDING THE MAXIMUM RATINGS GIVEN FOR CW SERVICE, WRITE EIMAC DIVISION OF VARIAN ASSOCIATES, FOR INFORMATION AND RECOMMENDATIONS

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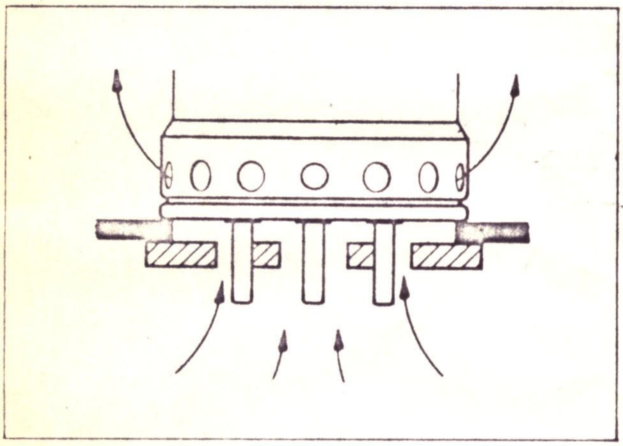
APPLICATION

MECHANICAL

Mounting—The 4-125A must be mounted vertically, base down or base up. The socket must be constructed so as to allow an unimpeded flow of air through the holes in the base of the tube and must also provide clearance for the glass tip-off which extends from the center of the base. The tube should be mounted above the chassis deck to allow free circulation of air in the manner shown in the mounting diagram below. The above requirements are met by the E. F. Johnson Co. socket No. 122-275, the National Co. socket No. HX-100, or a similar socket.

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



4-125A mounting providing base cooling, shielding and isolation of output and input compartments.

Cooling—Adequate cooling must be provided for the seals and envelope of the 4-125A. In continuous-service applications, the temperature of the plate seal, as measured on the top of the plate cap, should not exceed 170° C. A relatively slow movement of air past the tube is sufficient to prevent seal temperatures in excess of maximum at frequencies below 30 Mc. At frequencies above 30 Mc., radio frequency losses in the leads and envelope contribute to seal and envelope heating, and special attention should be given to cooling. A small fan or centrifugal blower directed toward the upper portion of the envelope will usually provide sufficient circulation for cooling at frequencies above 30 Mc., however.

In intermittent-service applications where the "on" time does not exceed a total of five minutes in any ten-minute period, plate seal temperatures as high as 220° C. are permissible. When the ambient temperature does not exceed 30° C. it will not ordinarily be necessary to provide forced cooling to hold the temperature below this maximum at frequencies below 30 Mc., provided that a heat-dissipating plate connector is used, and the tube is so located that normal circulation of air past the envelope is not impeded.

Provision must be made for circulation of air through the base of the tube. Where shielding or socket design makes it impossible to allow free circulation of air through the base, it will be necessary to apply forced-air cooling to the stem structure. An air flow of two cubic feet per minute through the base will be sufficient for stem cooling.

ELECTRICAL

Filament Voltage—For maximum tube life the filament voltage, as measured directly at the filament pins, should be the rated value of 5.0 volts. Unavoidable variations in filament voltage must be kept within the range from 4.75 to 5.25 volts.

Bias Voltage—D-c bias voltage for the 4-125A should not exceed 500 volts. If grid-leak bias is used, suitable protective means must be provided to prevent excessive plate or screen dissipation in the event of loss of excitation.

Screen Voltage—The d-c screen voltage for the 4-125A should not exceed 400 volts, except for class-AB_1 audio operation.

Plate Voltage—The plate-supply voltage for the 4-125A should not exceed 3000 volts for frequencies below 120 Mc. The maximum permissible plate voltage is less than 3000 volts above 120 Mc., as shown by the graph on page 5.

Grid Dissipation—Grid dissipation for the 4-125A should not be allowed to exceed five watts. Grid dissipation may be calculated from the following expression:

$$P_g = e_{cmp} I_c$$

where P_g = Grid dissipation,
e_{cmp} = Peak positive grid voltage, and
I_c = D-c grid current.

e_{cmp} may be measured by means of a suitable peak voltmeter connected between filament and grid.

Screen Dissipation—The power dissipated by the screen of the 4-125A must not exceed 20 watts. Screen dissipation is likely to rise to excessive values when the plate voltage, bias voltage or plate load are removed with filament and screen voltages applied. Suitable protective means must be provided to limit screen dissipation to 20 watts in the event of circuit failure.

Plate Dissipation—Under normal operating conditions, the plate dissipation of the 4-125A should not be allowed to exceed 125 watts in unmodulated applications.

In high-level-modulated amplifier applications, the maximum allowable carrier-condition plate dissipation is 85 watts. The plate dissipation will rise to 125 watts under 100% sinusoidal modulation.

Plate dissipation in excess of the maximum rating is permissible for short periods of time, such as during tuning procedures.

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OPERATION

Class-C Telegraphy or FM Telephony—The 4-125A may be operated as a class-C telegraph or FM telephone amplifier without neutralization up to about 30 Mc. if reasonable precautions are taken to prevent coupling between input and output circuits external to the tube. A grounded metallic plate on which the socket may be mounted as shown in the mounting diagram on page three provides an effective isolating shield between grid and plate circuits. In single-ended circuits, plate, grid, filament and screen by-pass capacitors should be returned through the shortest possible leads to a common chassis point. In push-pull applications the filament and screen terminals of each tube should be by-passed to a common chassis point by the shortest possible leads, and short, heavy leads should be used to interconnect the screens and filaments of the two tubes. Care should be taken to prevent leakage of radio-frequency energy to leads entering the amplifier, to prevent grid-plate coupling between these leads external to the amplifier.

Where shielding is adequate, the feed-back at frequencies above 100 Mc. is due principally to screen-lead-inductance effects, and it becomes necessary to introduce in-phase voltage from the plate circuit into the grid circuit. This can be done by adding capacitance between plate and grid external to the tube. Ordinarily, a small metal tab approximately 3/4-inch square connected to the grid terminal and located adjacent to the envelope opposite the plate will suffice for neutralization. Means should be provided for adjusting the spacing between the neutralizing capacitor plate and the envelope, but care must be taken to prevent the neutralizing plate from touching the envelope. An alternative neutralization scheme is illustrated in the diagram below. In this circuit feed-back is eliminated by series-tuning the screen to ground with a small capacitor. The socket screen terminals should be strapped together, as shown on the diagram, by the shortest posible lead, and the leads from the screen terminal to the capacitor, C, and from the capacitor to ground should be made as short as possible. All connections to the screen terminals should be made to the center of the strap between the terminals, in order to equalize the current in the two screen leads and prevent overheating one of them. The value for C given under the diagram presupposes the use of the shortest possible leads.

At frequencies below 100 Mc. ordinary neutralization systems may be used. With reasonably effective shielding, however, neutralization should not be required below about 30 Mc.

The driving power and power output under typical operating conditions, with maximum output and plate voltage, are shown on page 5. The power output shown is the actual plate power delivered by the tube; the power delivered to the load will depend upon the efficiency of the plate tank and output coupling system. The driving power is likewise the driving power required by the tube (includes bias loss). The driver output power should exceed the driving power requirement by a sufficient margin to allow for coupling-circuit losses. These losses will not ordinarily amount to more than 30 or 40 per cent of the driving power, except at frequencies above 150 Mc. The use of silver-plated linear tank-circuit elements is recommended at frequencies above 100 Mc.

Conventional capacitance-shortened quarter-wave linear grid tank circuits having a calculated Z_0 of 160 ohms or less may be used with the 4-125A up to 175 Mc. Above 175 Mc. linear grid tank circuits employing a "capacitor"-type shortening bar, as illustrated in the diagram below, may be used. The capacitor, C_1, may consist of two silver-plated brass plates one inch square with a piece of .010 inch mica or polystyrene as insulation.

Class-C AM Telephony—The r-f circuit considerations discussed above under Class-C Telegraphy or FM Telephony also apply to amplitude-modulated operation of the 4-125A. When the 4-125A is used as a class-C high-level-modulated amplifier, modulation should be applied to both plate and screen. Modulation voltage for the screen may be obtained from a separate winding on the modulation transformer, by supplying the screen voltage via a series dropping resistor from the unmodulated plate supply, or by the use of an audio-frequency reactor in the positive screen-supply lead. When screen modulation is obtained by either the series-resistor or the audio-reactor method, the audio-frequency variations in screen current which result from variations in plate voltage as the plate is modulated automatically give the required screen modulation. Where a reactor is used, it should have a rated inductance of not less than 10 henries divided by the number of tubes in the modulated amplifier and a maximum current rating of two or three times the operating d-c screen current. To prevent phase shift between the screen and plate modulation voltages at high audio frequencies, the screen by-pass capacitor should be no larger than necessary for adequate r-f by-passing. Where screen voltage is obtained from a separate winding on the modulation transformer, the screen winding should be designed to deliver the peak screen modulation voltage given in the typical operating data on page 2.

For high-level modulated service, the use of partial grid-leak bias is recommended. Any by-pass capacitors placed across the grid-leak resistance should have a reactance at the highest modulation frequency equal to at least twice the grid-leak resistance.

Class-AB₁ and Class-AB₂ Audio—Two 4-125A's may be used in a push-pull circuit to give relatively high audio output power at low distortion. Maximum ratings and typical operating conditions for class-AB_1 and class-AB_2 audio operation are given in the tabulated data.

When type 4-125A tubes are used as class-AB_1 or class-AB_2 audio amplifiers at 1500 plate volts, under the conditions given under "Typical Operation", the screen voltage must be obtained from a source having reasonably good regulation, to prevent variations in screen voltage from zero-signal to maximum-signal conditions. The use of voltage regulator tubes in a standard circuit will provide adequate regulation. The variation in screen current at plate voltages of 2000 and above is low enough so that any screen power supply having a normal order

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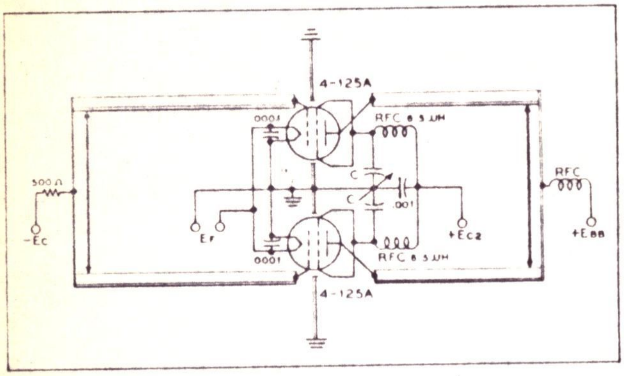
of regulation will serve. The driver plate supply makes a convenient source of screen voltage under these conditions.

Grid bias voltage for class-AB_2 service may be obtained from batteries or from a small fixed-bias supply. When a bias supply is used, the d-c resistance of the bias source should not exceed 250 ohms. Under class-AB_1 conditions the effective grid-circuit resistance for each tube should not exceed 250,000 ohms.

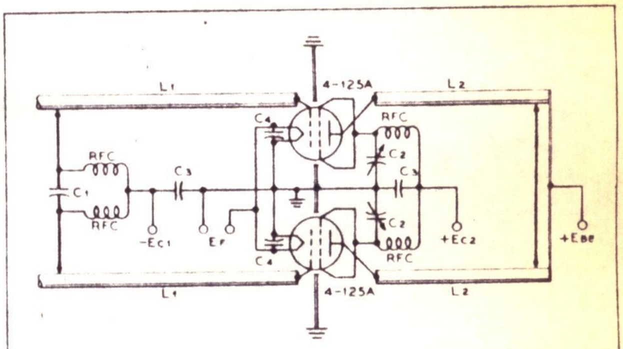
The peak driving power figures given in the class-AB_2 tabulated data are included to make possible an accurate determination of the required driver output power. The driving amplifier must be capable of supplying the peak driving power without distortion. The driver stage should, therefore, be capable of providing an undistorted average output equal to half the peak driving power requirement. A small amount of additional driver output should be provided to allow for losses in the coupling transformer.

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



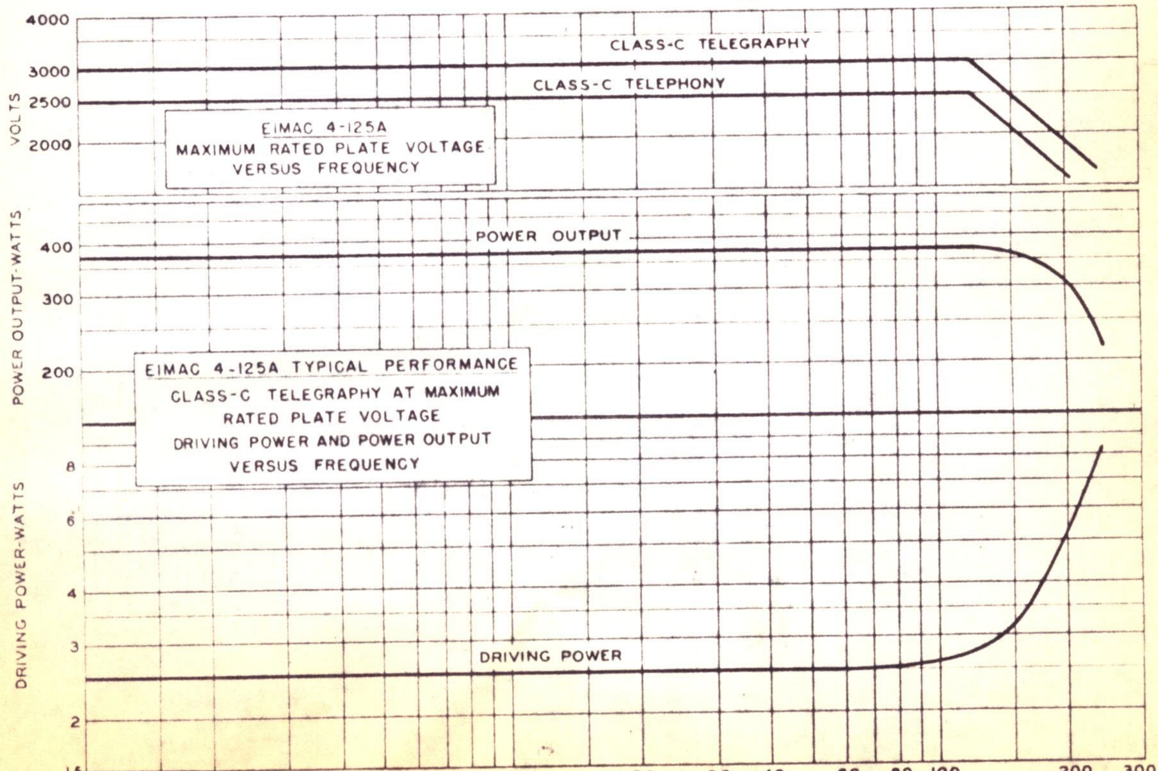
Screen-tuning neutralization circuit for use above 100 Mc.
C is a small split-stator capacitor.

$$C(\mu\mu fd) = \frac{640,000}{f^2\ (Mc.)}\text{, approx.}$$



Typical circuit arrangement useful for frequencies above 175 Mc.

C_1—See above.
C_2—Neutralizing capacitor.
C_3—.001 μfd.
C_4—100 $\mu\mu$fd.
L_1—3/8" dia. copper spaced 1" center-to-center, 6" long.
L_2—7/8" dia. brass, silver plated, spaced 1 1/2" center-to-center, 14" long.



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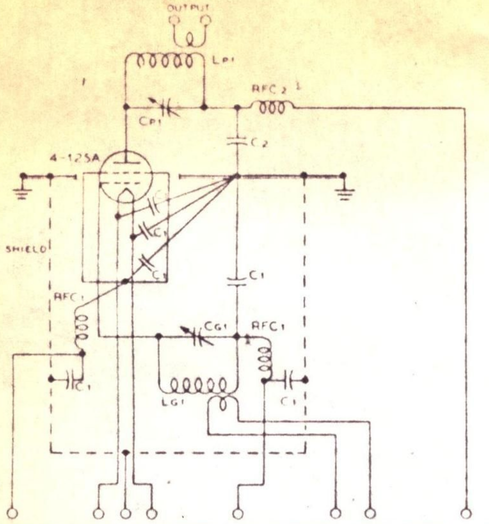
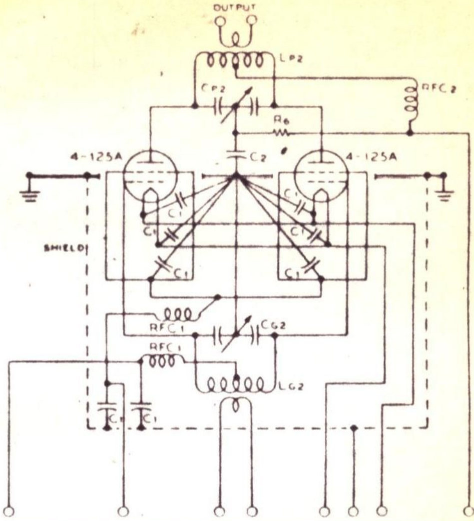


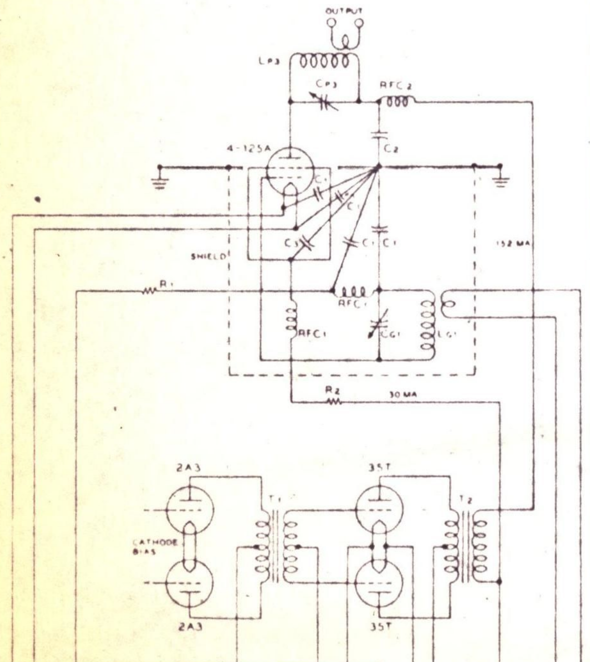
Ecc2	Ef	Ecc1	Pd	Ebb
D.C. SCREEN VOLTS	FILAMENT VOLTS	D.C. GRID VOLTS	DRIVING POWER	D.C. PLATE VOLTS
350 V, 40 MA	5.0 V	-150 V, 12 MA	3.8 WATTS	2500 V, 200 MA
350 V, 30 MA	5.0 V	-150 V, 9 MA	2.5 WATTS	3000 V, 187 MA

Typical radio-frequency power amplifier circuit, Class-C *telegraphy, 500 watts input.*

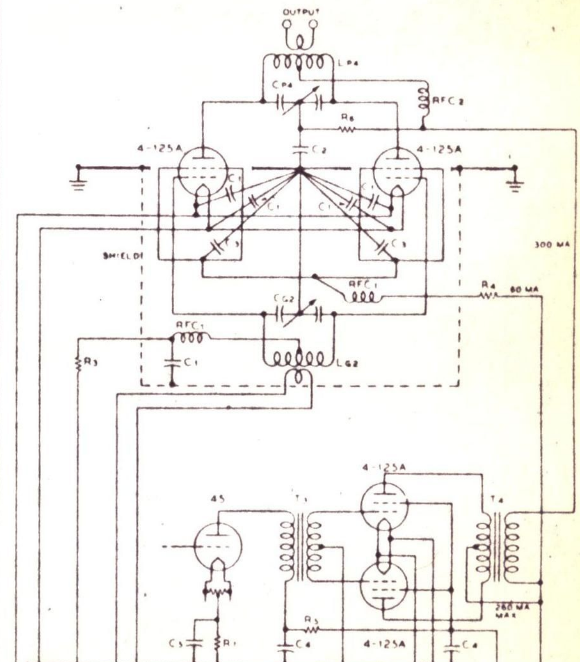


Ecc1	Ecc2	Pd	Ef	Ebb
D.C. GRID VOLTS	D.C. SCREEN VOLTS	DRIVING POWER	FILAMENT VOLTS	D.C. PLATE VOLTS
-150 V, 24 MA	350 V, 80 MA	7.6 WATTS	5.0 V	2500 V, 400 MA
-150 V, 18 MA	350 V, 60 MA	5.0 WATTS	5.0 V	3000 V, 335 MA

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



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 380 watts plate input.



Typical high-level-modulated r-f amplifier circuit, with modulator and driver stages, 750 watts plate input.

See opposite page for list of components.

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COMPONENTS FOR TYPICAL CIRCUITS

(Diagrams, Page 6)

L_{p1} - C_{p1} — Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p2} - C_{p2} — Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .200".

L_{p3} - C_{p3} — Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{p4} - C_{p4} — Tank circuit appropriate for operating frequency; Q = 12. Capacitor plate spacing = .375".

L_{g1} - C_{g1} — Tuned circuit appropriate for operating frequency.

L_{g2} - C_{g2} — Tuned circuit appropriate for operating freqency.

C_1 — .002-ufd., 500-v. mica

C_2 — .002-ufd., 5000-v. mica

C_3 — .001-ufd., 2500-v. mica

C_4 — 16-ufd., 450-v. electrolytic

C_5 — 10-ufd., 25-v. electrolytic

R_1 — 7000 ohms, 5 watts

R_2 — 70,000 ohms, 100 watts

R_3 — 3500 ohms, 5 watts

R_4 — 35,000 ohms, 200 watts

R_5 — 560 ohms, 1 watt

R_6 — 25,000 ohms, 2 watts

R_7 — 1500 ohms, 5 watts

RFC_1 — 2.5-mhy., 125-ma. r-f choke

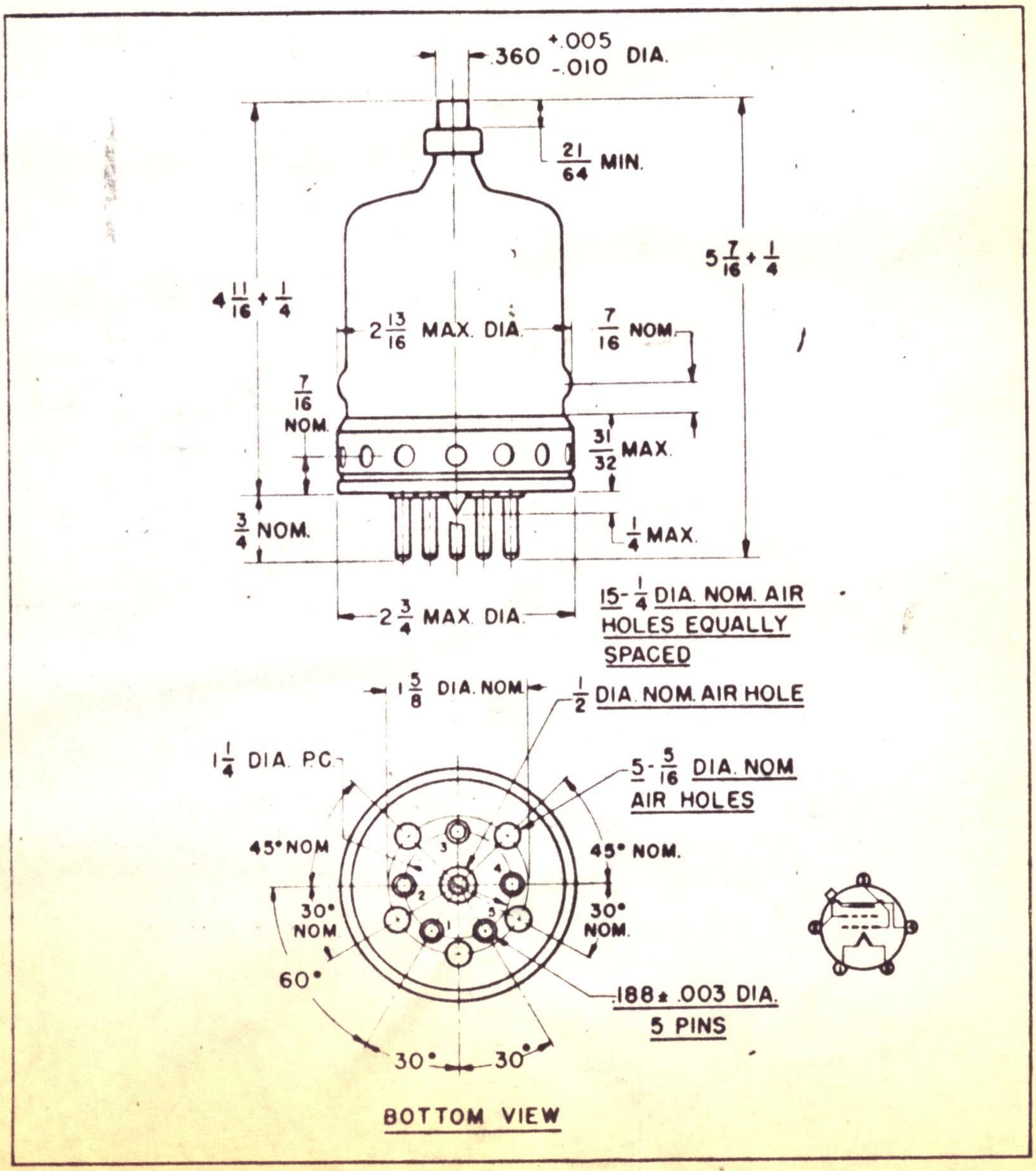
RFC_2 — 1-mhy., 500-ma. r-f choke

T_1 — 10-watt driver transformer; ratio pri. to 1/2 sec. approx. 2:1.

T_2 — 200-watt modulation transformer; ratio pri. to sec. approx. 1:1; pri. impedance = 16,200 ohms, sec. impedance = 16,500 ohms.

T_3 — 5-watt driver transformer; ratio pri. to 1/2 sec. approx. 1.1:1.

T_4 — 400-watt modulation transformer; ratio pri. to sec. approx. 2.7:1; pri. impedance = 22,200 ohms, sec. impedance = 8300 ohms.



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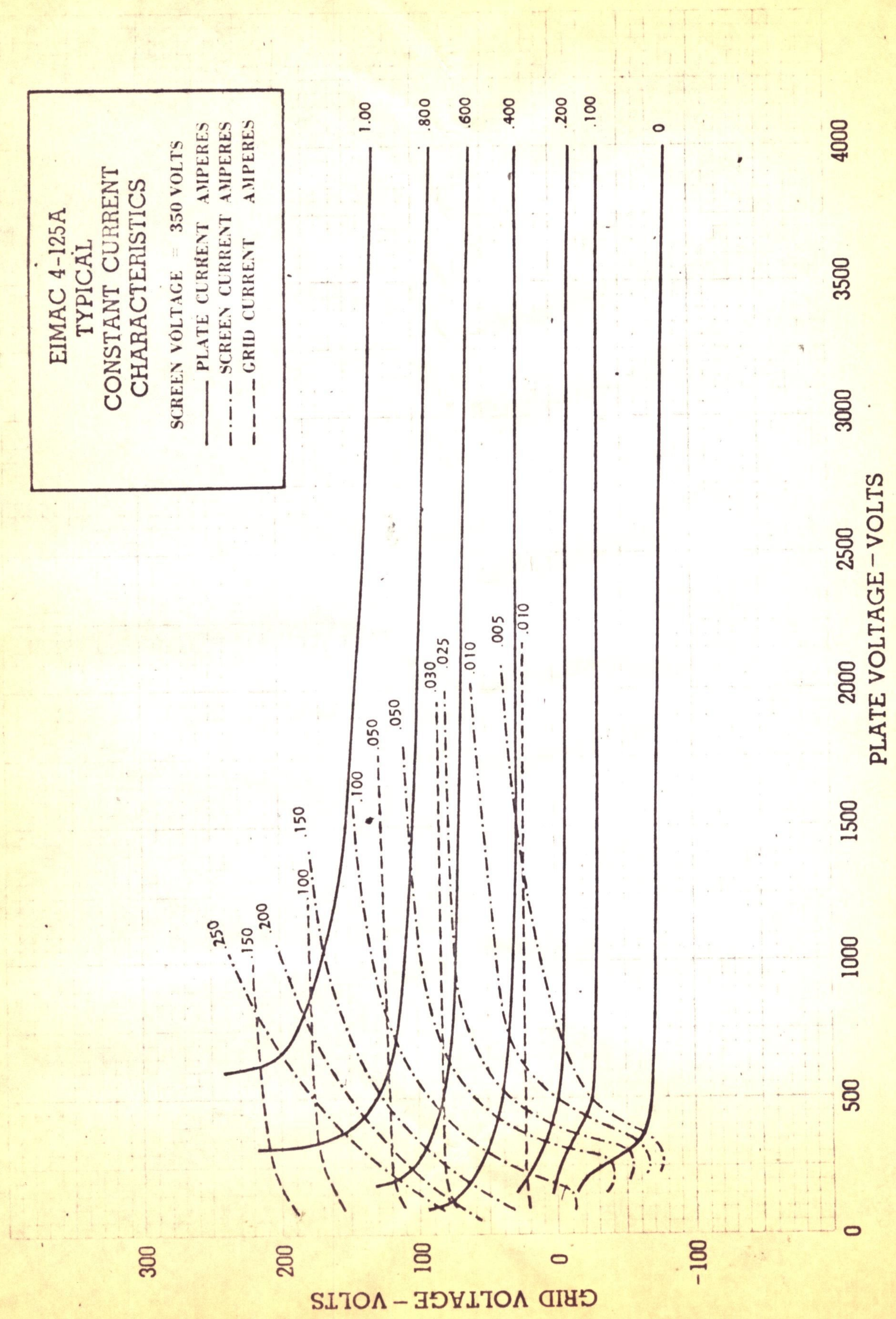

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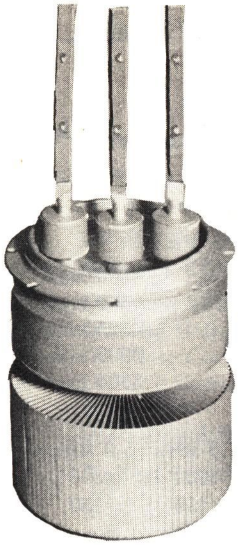

RCA-4654/5762

Power Triode

- **VHF Grid-Drive or Cathode-Drive Operation**
- **Forced-Air Cooled**
- **6350 Watts VHF TV Output at 216 MHz**
- **7000 Watts CW Output at 30 MHz**

The RCA 4654/5762 is a ceramic-metal version of the RCA-5762 to obtain higher ratings with similar cooling systems. It is designed as a forced-air-cooled power triode for VHF CW and television service in portable and stationary equipment. The tube features a long-life, thoriated tungsten filament, low-loss ceramic, insulating seals, and an efficient, integral radiator.

General Data

Electrical:

Filamentary Cathode, Thoriated-Tungsten Type:		
Voltage (ac or dc)	12.6 typical	V
	13.2 max.	V
Current:		
Typical value at 12.6 volts	29	A
Maximum value for starting, even momentarily	175	A
Cold Resistance	0.052	Ω
Minimum heating time	15	s
Amplification Factor	29	
Direct Interelectrode Capacitances:		
Grid to plate	21	pF
Grid to filament	19	pF
Plate to filament	0.5	pF

Mechanical:

Operating Position	Vertical, either end up
Overall Length	(181.1 mm) 7.13 max. in
Greatest Diameter	(119.1 mm) 4.69 max. in
Terminal Connections	See Dimensional Outline
Radiator	Integral part of tube
Weight (Approx.)	(2.8 kg) 6-1/4 lbs

Thermal:

Terminal Temperature (Plate, grid and filament)	250 max. °C
Plate-Core Temperature	250 max. °C
Envelope Temperature (at hottest point)	250 max. °C

This bulletin gives application information unique to the RCA 4654/5762. General information, covering the installation and operation of this tube type, is given in the "**Application Guide for RCA Power Tubes**" 1CE-300. Close attention to the instructions contained therein will assure longer tube life, safer operation, less equipment downtime, and fewer tube handling accidents.

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RCA Electronic Components

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AF Power Amplifier & Modulator – Class B[a]

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC Plate Voltage	6200 max.	V
Max.-Signal DC Plate Current	1.5 max.	A
Max.-Signal Plate Input	8700 max.	W
Plate Dissipation	5000 max.	W

Typical Operation:

Values are for 2 tubes

DC Plate Voltage	4700	V
DC Grid Voltage	-200	V
Peak AF Grid-to-Grid Voltage	900	V
Zero-Signal DC Plate Current	0.3	A
Max.-Signal DC Plate Current	2.8	A
Effective Load Resistance (Plate to plate)	3640	Ω
Max.-Signal Driving Power (Approx.)	195	W
Max.-Signal Power Output (Approx.)	8800	W

RF Power Amplifier – Class B Television Service[b]

Synchronizing-level conditions per tube unless otherwise specified. At frequency of 54 to 216 MHz.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC Plate Voltage	4500 max.	V
DC Plate Current	2.0 max.	A
DC Grid Current (Pedestal level)	0.325 max.	A
Plate Input	9000 max.	W
Plate Dissipation	5000 max.	W

Typical Operation in Cathode-Drive Circuit:

Bandwidth[c]	of 10 MHz	8.5 MHz	6.0 MHz	
DC Plate Voltage	3000	3200	4300	V
DC Grid Voltage	-105	-110	-150	V
Peak RF Grid Voltage:				
Synchronizing level	380	435	500	V
Pedestal level	290	310	355	V
DC Plate Current:				
Synchronizing level	1.8	1.8	2.0	A
Pedestal level	1.36	1.35	1.5	A
DC Grid Current:				
Synchronizing level	0.265	0.400	0.439	A
Pedestal level	0.115	0.130	0.118	A
Driving Power (Approx.):				
Synchronizing level	625	770	983	W
Power Output (Approx.):				
Synchronizing level	3150	4000	6350	W
Pedestal level	1800	2300	3590	W

Grid Modulated RF Power Amplifier – Class C Television Service[b]

Synchronizing-level conditions per tube unless otherwise specified. At frequency of 54 to 216 MHz.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC Plate Voltage	3700 max.	V
DC Grid Voltage (White level)	-800 max.	V
DC Plate Current	1.9 max.	A
DC Grid Current (Pedestal level)	0.225 max.	A
Plate Input	6500 max.	W
Plate Dissipation	5000 max.	W

Typical Operation in Cathode-Drive Circuit:

	Bandwidth[c] of 8.5 MHz	
DC Plate Voltage	3200	V
DC Grid Voltage:		
Synchronizing level	-110	V
Pedestal level	-220	V
White level	-520	V
Peak RF Grid Voltage	435	V
DC Plate Current:		
Synchronizing level	1.8	A
Pedestal level	1.25	A
DC Grid Current (Approx.):		
Synchronizing level	0.400	A
Pedestal level	0.130	A
Driving Power (Approx.):		
Synchronizing level	770	W
Power Output (Approx.):		
Synchronizing level	4000	W
Pedestal level	2300	W

Plate Modulated RF Power Amplifier – Class C Telephony[b]

Carrier conditions per tube for use with a maximum modulation factor of 1.0. See Ratings vs. Frequency Chart.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC Plate Voltage	5000 max.	V
DC Grid Voltage	-1000 max.	V
DC Plate Current	1.0 max.	A
DC Grid Current	0.3 max.	A
Plate Input	5000 max.	W
Plate Dissipation	3300 max.	W

Typical Operation in Grid-Drive Circuit:

	Up to 30 MHz	At 110 MHz	
DC Plate Voltage	4700	4000	V
DC Grid Voltage	-400	-350	V
From a grid resistor of	1425	1460	Ω
Peak RF Grid Voltage[d]	675	600	V
DC Plate Current	0.96	0.93	A
DC Grid Current (Approx.)	0.28	0.24	A
Driving Power (Approx.)	170	130	W
Power Output (Approx.)	3700	2800	W

Typical Operation in Cathode-Drive Circuit:

	Up to 30 MHz	At 110 MHz	
DC Plate Voltage	4700	4000	V
DC Grid Voltage	-400	-350	V
From a grid resistor of	1425	1460	Ω
Peak RF Grid Voltage	675	600	V
DC Plate Current	0.96	0.93	A
DC Grid Current (Approx.)	0.28	0.24	A
Driving Power (Approx.)[e]	720	600	W
Power Output (Approx.)	4200	3200	W

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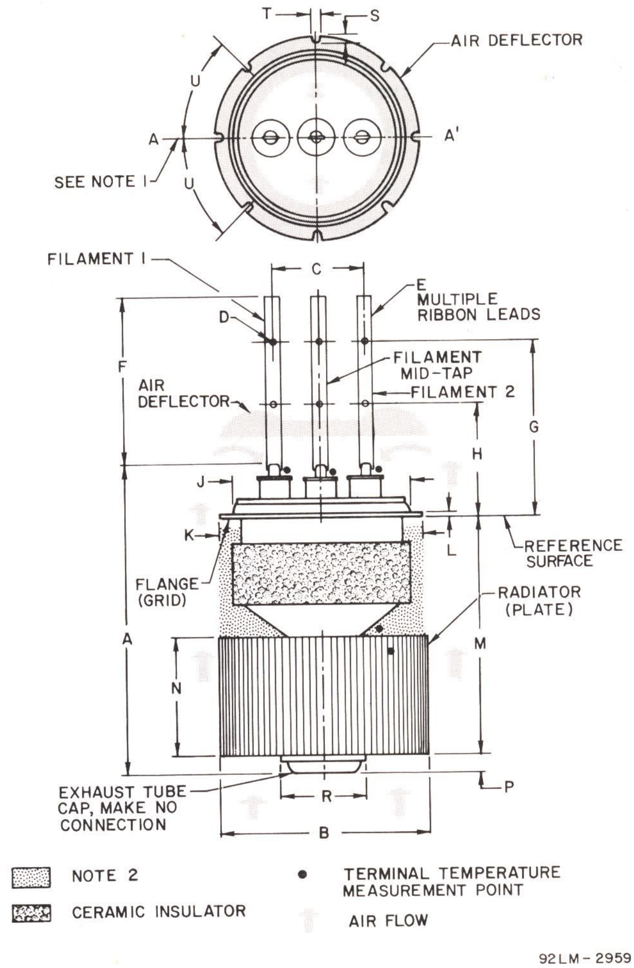
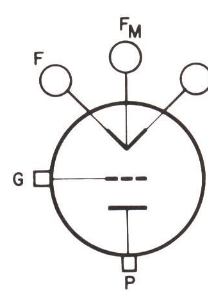
Dimensional Outline



Tabulated Dimensions*

Dimension	Value		
A	7.12	(180.85)	Max.
B	4.62 ± .06	(117.4 ± 1.5)	
C	2.5	(63.5)	Max.
D Dia.	0.144	(3.658)	
E	0.31 ± .06	(7.9 ± 1.5)	
F	3.5	(88.9)	Min.
G	3.88 ± .38	(98.5 ± 9.7)	
H	2.50 ± .38	(63.5 ± 9.7)	
J Dia.	3.94	(100.08)	Max.
K Dia.	4.56 ± .03	(115.8 ± .8)	
L	0.062 ± .015	(1.58 ± .38)	
M	5.25 ± .12	(133.4 ± 3.1)	
N	2.75	(69.85)	Max.
P	0.5	(12.7)	Max.
R	2.0	(50.8)	Max.
S	0.210	(5.334)	
T	0.182	(4.623)	
U	45°	0.785 Radians	

Terminal Diagram



F_1: filament 1
F_m: filament mid-tap
F_2: filament 2
G: grid-flange
P: plate-radiator

Notes for Dimensional Outline

1. Plane of filament leads will not deviate more than 3½° from plane passing through AA', normal to grid flange.
2. Keep all stippled regions clear. In general do not allow intrusions into these annular regions. If such intrusions are required contact RCA Power Tube Application Engineering, Lancaster, PA for instructions.

*Dimensions are in inches unless otherwise stated. Dimensions in parentheses are in millimeters and are derived from the basic inch dimension (1 inch = 25.4 mm).

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Ratings versus Frequency

Frequency has a limiting effect on certain critical parameters. These parameters include: plate voltage, plate input, grid voltage, and grid current. The permissible percentage of maximum rated value for these parameters varies with frequency and service. The service falls into two categories: 1. Television Class B or C service, and 2. all other recommended service. All other recommended service includes:

- Class C Telephony, Plate Modulated
- Class C Telegraphy and FM Telephony
- Class C Amplifier or Oscillator (self-rectifying)
- Class C Amplifier or Oscillator (with separate rectified unfiltered plate supply)

Permissible Percentage of Maximum Rated Values

Service	TV (B, C)	All Other Service			
Frequency	54 to 216	30	110	220	MHz
Plate Voltage	100	100	84	72	%
Plate Input	100	100	84	72	%
Grid Voltage	100	100	100	60	%
Grid Current	100	100	100	83	%

Typical Constant-Current Characteristics

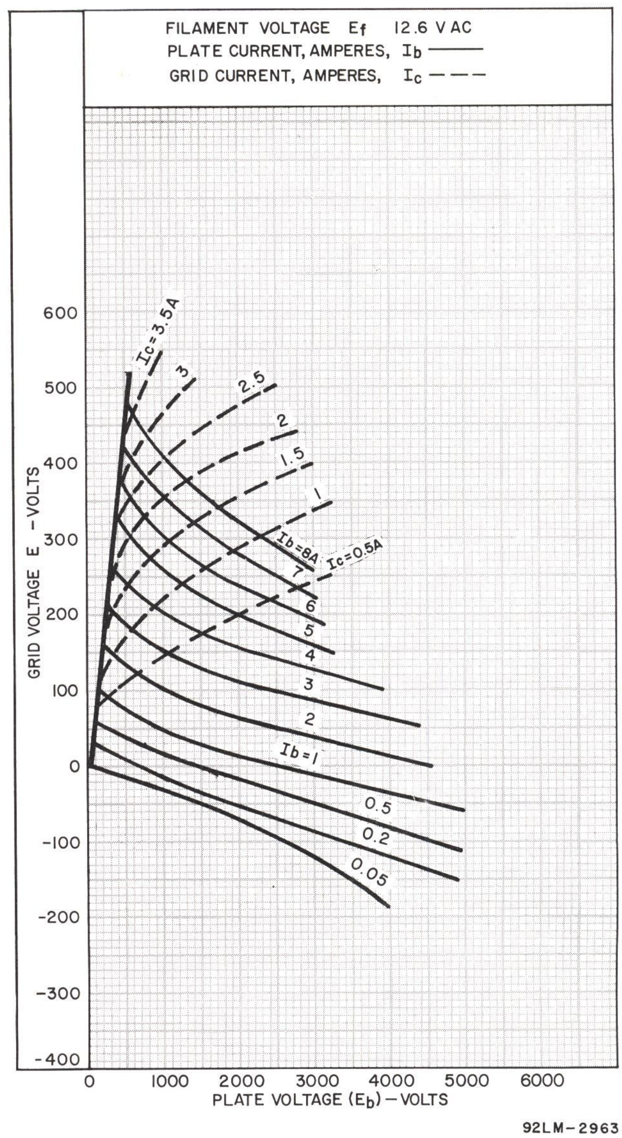

Figure 1

Mechanical

Mounting

The tube requires a clamp support for the radiator (plate connection), a flexible connector for the grid-terminal flange, and three connectors for the filament leads. The tube should be supported in a vertical position with either end up or down. If the tube is subjected in service to considerable vibration, it is advisable to support the mounting by means of a spring suspension. The installation of all wires and connections must be made so that they will not intrude upon the stippled area.

Electrical

Filament

The filament is center-tapped in order to minimize the effect of filament lead inductance, and not to permit operation of the two sections in parallel. At the higher frequencies, all three filament leads should be connected in parallel by means of rf bypass capacitors. Any one of these three leads may then be used as the rf return to the filament.

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RF Power Amplifier & Osc. – Class C Telegraphy[b] and RF Power Amplifier – Class C FM Telephony[b]

See Ratings vs. Frequency Chart

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC Plate Voltage	6200 max. V
DC Grid Voltage	-1000 max. V
DC Plate Current	1.4 max. A
DC Grid Current	0.3 max. A
Plate Input	8700 max. W
Plate Dissipation	5000 max. W

Typical Operation in Grid-Drive Circuit:

	Up to 30 MHz	
DC Plate Voltage	6000	V
DC Grid Voltage:		
From a fixed supply of	-550	V
From a grid resistor of	1900	Ω
From a cathode resistor of	360	Ω
Peak RF Grid Voltage	875	V
DC Plate Current	1.25	A
DC Grid Current (Approx.)	0.290	A
Driving Power (Approx.)	225	W
Power Output (Approx.)	6000	W

Typical Operation in Cathode-Drive Circuit:

	Up to 30 MHz	At 110 MHz	At 220 MHz	
DC Plate Voltage	6000	5000	4300	V
DC Grid Voltage:				
From a fixed supply of	-550	-340	-200	V
From a grid resistor of	1900	1225	807	Ω
From a cathode resistor of	360	208	134	Ω
Peak RF Grid Voltage	875	625	432	V
DC Plate Current	1.25	1.35	1.25	A
DC Grid Current (Approx.)	0.290	0.275	0.25	A
Driving Power (Approx.)	1225	1000	542	W
Power Output (Approx.)	7000	5500	4000	W

Self-Rectifying Oscillator or Amplifier – Class C[b]

See Ratings vs. Frequency Chart

Maximum CCS Ratings, *Absolute-Maximum Values:*

AC Plate Voltage (RMS)	7000 max. V
DC Grid Voltage	-300 max. V
DC Plate Current	0.635 max. A
DC Grid Current	0.135 max. A
Plate Input[f]	4900 max. W
Plate Dissipation	5000 max. W

Typical Operation:

AC Plate Voltage (RMS)	6600	V
DC Grid Voltage	-127	V
DC Plate Current	0.625	A
DC Grid Current (Approx.)	0.105	A
Driving Power (Approx.)[g]	60	W
Power Output (Approx.)	3350	W

Amplifier or Oscillator – Class C[b]

With separate, rectified, unfiltered, single-phase, full-wave plate supply. See Ratings vs. Frequency Chart.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC Plate Voltage	5600 max. V
DC Grid Voltage	-600 max. V
DC Plate Current	1.25 max. A
DC Grid Current	0.270 max. A
Plate Input[h]	8600 max. W
Plate Dissipation	5000 max. W

Typical Operation:

DC Plate Voltage	5000	V
DC Grid Voltage	-260	V
DC Plate Current	1.2	A
DC Grid Current (Approx.)	0.260	A
Driving Power (Approx.)[i]	150	W
Power Output (Approx.)	5650	W

Footnotes for Ratings

[a] See section V.C.1 of 1CE-300.

[b] See section V.C.2 of 1CE-300.

[c] Computed between -3 dB points in a single-tuned circuit and based on the tube output capacitance only.

[d] Driver modulated approximately 30%.

[e] Carrier power of driver modulated 100%.

[f] Plate input is 1.11 times the product of the ac voltage (rms) and the dc plate current.

[g] From a self-rectified driver.

[h] Plate input is 1.23 times the product of the dc plate voltage and the dc plate current.

[i] From a driver with a rectified, unfiltered, single-phase, full-wave plate supply.

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Forced-Air Cooling

Air Flow:

Through Radiator – Adequate air flow, to limit the plate-core temperature to 250° C, should be delivered by a blower through the radiator before and during the application of all voltages to the tube in accordance with **Figure 2.** "Typical Cooling Characteristics".

To Grid and Filament Terminals – 10 min. cfm. The specified air flow from a one-inch dia. nozzle, or as obtained by deflectors, should be directed into the filament header before and during the application of any voltages in order to limit the temperature of the filament and grid terminals to 250° C.

During Standby Operation – Cooling air is required when only filament voltage is applied to the tube.

During Shutdown Operation – Air flow should continue for a few minutes after all electrode power is removed.

Typical Air-Cooling Characteristics

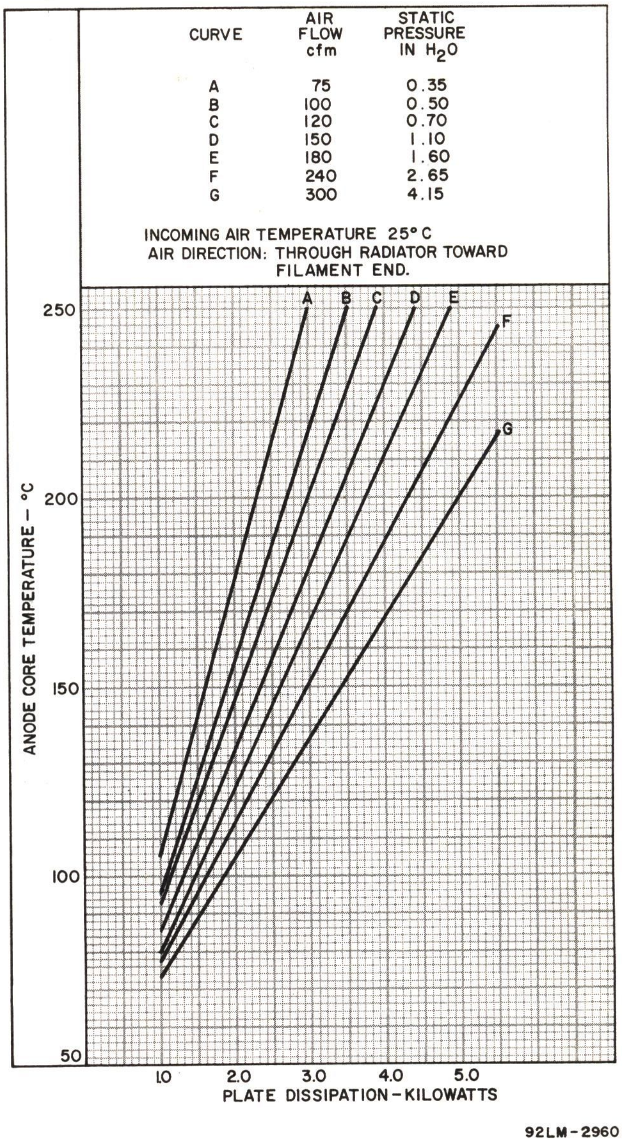

Figure 2

Characteristics Range Values

	Note	Min.	Max.	
Filament Current	k	27	31	A
Amplification Factor	k,m	25	33	
Grid-Plate Capacitance	–	18.7	22.7	pF
Grid-Filament Capacitance	–	15.5	22.5	pF
Plate-Filament Capacitance	–	0.38	0.62	pF
Grid Voltage	k,n	-125	-190	V
Plate Voltage	k,p	1350	1750	V
Plate Voltage	k,r	2600	3400	V
Useful Power Output	k,s	3	–	kW

Notes for Characteristic Range Values

k With 12.6 volts rms on filament.

m With dc grid voltage of -25 volts measured from center tap of filament supply, and dc plate voltage adjusted to give dc plate current of 0.5 ampere.

n With dc plate voltage of 4000 volts, and dc grid voltage adjusted to give dc plate current of 0.05 ampere.

p With dc grid voltage of 0 volts measured from center tap of filament supply, and dc plate voltage adjusted to give dc plate current of 0.5 ampere.

r With dc grid voltage of -50 volts measured from center tap of filament supply, and dc plate voltage adjusted to give dc plate current of 0.5 ampere.

s In a self-excited, coaxial, oscillator circuit and with dc plate voltage of 5000 volts, dc plate current of 1.1 amperes, grid resistor of 1500 ± 10% ohms, dc grid current of 0.250 to 0.300 ampere, and frequency of 110 MHz.

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VHF Grid-Drive or Cathode-Drive Operation
Thoriated-Tungsten Filament
Forced-Air Cooled
6350 Watts VHF TV Output at 216 Mc
4000 Watts CW Output at 220 Mc
7000 Watts CW Output at 30 Mc

RCA-5762/7C24
POWER TRIODE

RCA-5762/7C24 is a forced-air-cooled power triode designed for use in vhf television and cw service in stationary and portable equipment. It is rated as an af power amplifier and modulator in class B service; an rf power amplifier in class C telephony; in class B and C television service; an rf power amplifier and oscillator in class C telegraphy service; a self-rectifying oscillator or amplifier in class C service; and an amplifier or oscillator in class C service with separate, rectified, unfiltered, single-phase, full-wave plate supply.

The flanged-header grid terminal is a design feature of particular value when the 5762 is used in cathode-drive circuits. In such circuits this terminal, when used with a large circular connector, effectively isolates the cathode circuit from the plate circuit and provides a direct low-inductance path to the grid. As a result, neutralization is generally unnecessary in cathode-drive service.

Features of the 5762 also include a thoriated-tungsten filament and an integral radiator. Details of these features are described in the **Application Guide for RCA Power Tubes, 1CE-300.**●

INDEX

● This bulletin is to be used in conjunction with the publication **Application Guide for RCA Power Tubes, 1CE-300.** For a copy, write RCA, Commercial Engineering, Harrison, N.J.

GENERAL DATA

Electrical:

Filamentary Cathode, Thoriated-Tungsten Type:		
Voltage (ac or dc)	12.6 typical / 13.2 max.	volts / volts
Current:		
Typical value at 12.6 volts	29	amp
Maximum value for starting, even momentarily	175	amp
Cold Resistance	0.052	ohm
Minimum heating time	15	sec

See further information on the filament in section V.A.3 of 1CE-300.

Amplification Factor	29	
Direct Interelectrode Capacitances:		
Grid to plate	18	pf
Grid to filament	19	pf
Plate to filament	0.5	pf

Mechanical:

Operating Position	Vertical, either end up
Overall Length	7.13" max.
Greatest Diameter	4.69" max.
Terminal Connections	*See Dimensional Outline*
Radiator	Integral part of tube
Weight (Approx.)	6-1/4 lbs.

Thermal:

Terminal Temperature (Plate, grid and filament)	180 max.	°C
Plate-Core Temperature	180 max.	°C

See Dimensional Outline for temperature-measurement points

Bulb Temperature (at hottest point)	180 max.	°C

For further information, see section IV.A of 1CE-300.

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Supersedes 5762/7C24 9-56
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AF POWER AMPLIFIER & MODULATOR -- Class B[a]

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	6200 max.	volts
MAX.-SIGNAL DC PLATE CURRENT	1.5 max.	amp
MAX.-SIGNAL PLATE INPUT	8700 max.	watts
→ PLATE DISSIPATION	4000 max.	watts

Typical Operation:

Values are for 2 tubes

DC Plate Voltage	4700	volts
DC Grid Voltage	-200	volts
Peak AF Grid-to-Grid Voltage	900	volts
Zero-Signal DC Plate Current	0.3	amp
Max.-Signal DC Plate Current	2.8	amp
Effective Load Resistance (Plate to plate)	3640	ohms
Max.-Signal Driving Power (Approx.)	195	watts
Max.-Signal Power Output (Approx.)	8800	watts

→ RF POWER AMPLIFIER -- Class B Television Service[b]

Synchronizing-level conditions per tube unless otherwise specified. At Frequency of 54 to 216 Mc.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	4500 max.	volts
DC PLATE CURRENT	2.0 max.	amp
DC GRID CURRENT (Pedestal level)	0.325 max.	amp
PLATE INPUT	9000 max.	watts
PLATE DISSIPATION	4000 max.	watts

Typical Operation in Cathode-Drive Circuit:

Bandwidth of	*10 Mc*	*8.5 Mc*	*6.0 Mc*	
DC Plate Voltage	3000	3200	4300	volts
DC Grid Voltage	-105	-110	-150	volts
Peak RF Grid Voltage:				
Synchronizing level	380	435	500	volts
Pedestal level	290	310	355	volts
DC Plate Current:				
Synchronizing level	1.8	1.8	2.0	amp
Pedestal level	1.36	1.35	1.5	amp
DC Grid Current:				
Synchronizing level	0.265	0.400	0.439	amp
Pedestal level	0.115	0.130	0.118	amp
Driving Power (Approx.):				
Synchronizing level	625	770	983	watts
Power Output (Approx.):				
Synchronizing level	3150	4000	6350	watts
Pedestal level	1800	2300	3590	watts

GRID MODULATED RF POWER AMPLIFIER -- Class C Television Service[b]

Synchronizing-level conditions per tube unless otherwise specified. At Frequency of 54 to 216 Mc.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	3700 max.	volts
DC GRID VOLTAGE (White level)	-800 max.	volts
DC PLATE CURRENT	1.9 max.	amp
DC GRID CURRENT (Pedestal level)	0.225 max.	amp
PLATE INPUT	6500 max.	watts
→ PLATE DISSIPATION	4000 max.	watts

Typical Operation in Cathode-Drive Circuit:

Bandwidth of	*8.5 Mc*	
DC Plate Voltage	3200	volts
DC Grid Voltage:		
Synchronizing level	-110	volts
Pedestal level	-220	volts
White level	-520	volts
Peak RF Grid Voltage	435	volts
DC Plate Current:		
Synchronizing level	1.8	amp
Pedestal level	1.25	amp
DC Grid Current (Approx.):		
Synchronizing level	0.400	amp
Pedestal level	0.130	amp
Driving Power (Approx.):		
Synchronizing level	770	watts
Power Output (Approx.):		
Synchronizing level	4000	watts
Pedestal level	2300	watts

PLATE MODULATED RF POWER AMPLIFIER -- Class C Telephony[b]

Carrier conditions per tube for use with a maximum modulation factor of 1.0. See Ratings vs. Frequency Chart.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	5000 max.	volts
DC GRID VOLTAGE	-1000 max.	volts
DC PLATE CURRENT	1.0 max.	amp
DC GRID CURRENT	0.3 max.	amp
PLATE INPUT	5000 max.	watts
→ PLATE DISSIPATION	2700 max.	watts

Typical Operation in Grid-Drive Circuit:

	Up to 30 Mc	*At 110 Mc*	
DC Plate Voltage	4700	4000	volts
DC Grid Voltage	-400	-350	volts
From a grid resistor of	1425	1460	ohms
Peak RF Grid Voltage[c]	675	600	volts
DC Plate Current	0.96	0.93	amp
DC Grid Current (Approx.)	0.28	0.24	amp
Driving Power (Approx.)	170	130	watts
Power Output (Approx.)	3700	2800	watts

Typical Operation in Cathode-Drive Circuit:

DC Plate Voltage	4700	4000	volts
DC Grid Voltage	-400	-350	volts
From a grid resistor of	1425	1460	ohms
Peak RF Grid Voltage	675	600	volts
DC Plate Current	0.96	0.93	amp
DC Grid Current (Approx.)	0.28	0.24	amp
Driving Power (Approx.)[d]	720	600	watts
Power Output (Approx.)	4200	3200	watts

→ Indicates a change.

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RF POWER AMPLIFIER & OSC. -- Class C Telegraphy[b] and RF POWER AMPLIFIER -- Class C FM Telephony[b]

See Ratings vs. Frequency Chart

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	6200 max.	volts
DC GRID VOLTAGE	-1000 max.	volts
DC PLATE CURRENT	1.4 max.	amp
DC GRID CURRENT	0.3 max.	amp
PLATE INPUT	8700 max.	watts
→ PLATE DISSIPATION	4000 max.	watts

Typical Operation in Grid-Drive Circuit:

	Up to 30Mc	
DC Plate Voltage	6000	volts
DC Grid Voltage:		
From a fixed supply of	-550	volts
From a grid resistor of	1900	ohms
From a cathode resistor of	360	ohms
Peak RF Grid Voltage	875	volts
DC Plate Current	1.25	amp
DC Grid Current (Approx.)	0.290	amp
Driving Power (Approx.)	225	watts
Power Output (Approx.)	6000	watts

Typical Operation in Cathode-Drive Circuit:

	Up to 30 Mc	*At 110 Mc*	↓ *At 220 Mc*	
DC Plate Voltage	6000	5000	4300	volts
DC Grid Voltage:				
From a fixed supply of	-550	-1000	-200	volts
From a grid resistor of	1900	4100	807	ohms
From a cathode resistor of	360	740	134	ohms
Peak RF Grid Voltage	875	1350	432	volts
DC Plate Current	1.25	1.1	1.25	amp
DC Grid Current (Approx.)	0.290	0.245	0.25	amp
Driving Power (Approx.)	1225	1680	542	watts
Power Output (Approx.)	7000	5500	4000	watts

SELF-RECTIFYING OSCILLATOR OR AMPLIFIER -- Class C[b]

See Ratings vs. Frequency Chart

Maximum CCS Ratings, *Absolute-Maximum Values:*

AC PLATE VOLTAGE (RMS)	7000 max.	volts
DC GRID VOLTAGE	-300 max.	volts
DC PLATE CURRENT	0.635 max.	amp
DC GRID CURRENT	0.135 max.	amp
PLATE INPUT[e]	4900 max.	watts
→ PLATE DISSIPATION	4000 max.	watts

Typical Operation:

AC Plate Voltage (RMS)	6600	volts
DC Grid Voltage	-127	volts
DC Plate Current	0.625	amp
DC Grid Current (Approx.)	0.105	amp
Driving Power (Approx.)[f]	60	watts
Power Output (Approx.)	3350	watts

AMPLIFIER or OSCILLATOR -- Class C[b]

With separate, rectified, unfiltered, single-phase, full-wave plate supply. See Ratings vs. Frequency Chart.

Maximum CCS Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	5600 max.	volts
DC GRID VOLTAGE	-600 max.	volts
DC PLATE CURRENT	1.25 max.	amp
DC GRID CURRENT	0.270 max.	amp
PLATE INPUT[g]	8600 max.	watts
→ PLATE DISSIPATION	4000 max.	watts

Typical Operation:

DC Plate Voltage	5000	volts
DC Grid Voltage	-260	volts
DC Plate Current	1.2	amp
DC Grid Current (Approx.)	0.260	amp
Driving Power (Approx.)[h]	150	watts
Power Output (Approx.)	5650	watts

FOOTNOTES

[a] See section V.C.1 of 1CE-300.
[b] See section V.C.2 of 1CE-300.
[c] Driver modulated approximately 30%.
[d] Carrier power of driver modulated 100%.
[e] Plate input is 1.11 times the product of the ac voltage (rms) and the dc plate current.
[f] From a self-rectified driver.
[g] Plate input is 1.23 times the product of the dc plate voltage and the dc plate current.
[h] From a driver with a rectified, unfiltered, single-phase, full-wave plate supply.

→ Indicates a change.

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RATINGS vs. FREQUENCY

FREQUENCY	30	110	220		Mc
MAX. PERMISSIBLE PERCENTAGE OF MAX. RATED PLATE VOLTAGE AND PLATE INPUT:					
Class B Television Service	Full Ratings -- 54 to 216 Mc				
Class C Television Service	Full Ratings -- 54 to 216 Mc				
Class C Telephony, Plate-Modulated	100	84	72		per cent
Class C Telegraphy and FM Telephony	100	84	72		per cent
Class C Amplifier or Osc., Self-Rectifying	100	84	72		per cent
Class C Amplifier or Osc. with Separate, Rectified, Unfiltered Plate Supply	100	84	72		per cent
MAX. PERMISSIBLE PERCENTAGE OF MAX. RATED DC GRID VOLTAGE AND DC GRID CURRENT:					
Class B Television Service	Full Ratings -- 54 to 216 Mc				
Class C Television Service	Full Ratings -- 54 to 216 Mc				
			Volt.	*Cur.*	
Class C Telephony, Plate-Modulated	100	100	60	83	per cent
Class C Telegraphy, and FM Telephony	100	100	60	83	per cent
Class C Amplifier or Osc., Self-Rectifying	100	100	60	83	per cent
Class C Amplifier, or Osc. with Separate, Rectified, Unfiltered Plate Supply	100	100	60	83	per cent

CHARACTERISTICS RANGE VALUES

	Note	*Min.*	*Max.*	
Filament Current	1	27	31	amp
Amplification Factor	1,2	25	33	
Grid-Plate Capacitance	-	16.5	20.5	pf
Grid-Filament Capacitance	-	15.5	22.5	pf
Plate-Filament Capacitance	-	0.38	0.62	pf
Grid Voltage	1,3	-125	-190	volts
Plate Voltage	1,4	1350	1750	volts
Plate Voltage	1,5	2600	3400	volts
Useful Power Output	1,6	3	-	kw

Note 1: With 12.6 volts rms on filament.

Note 2: With dc grid voltage of -25 volts measured from center tap of filament supply, and dc plate voltage adjusted to give dc plate current of 0.5 ampere.

Note 3: With dc plate voltage of 4000 volts, and dc grid voltage adjusted to give dc plate current of 0.05 ampere.

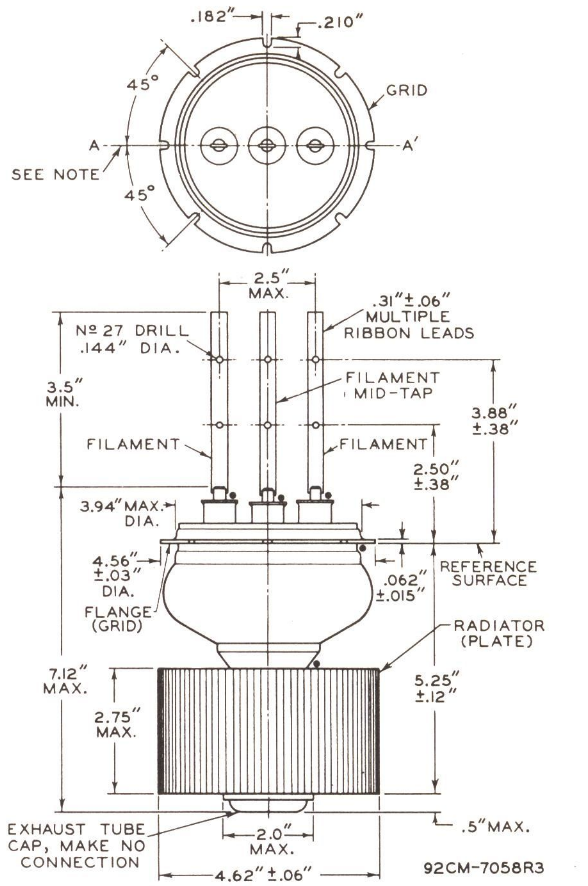
Note 4: With dc grid voltage of 0 volts measured from center tap of filament supply, and dc plate voltage adjusted to give dc plate current of 0.5 ampere.

Note 5: With dc grid voltage of -50 volts measured from center tap of filament supply, and dc plate voltage adjusted to give dc plate current of 0.5 ampere.

Note 6: In a self-excited, coaxial, oscillator circuit and with dc plate voltage of 5000 volts, dc plate current of 1.1 amperes, grid resistor of 1500 ± 10% ohms, dc grid current of 0.250 to 0.300 ampere, and frequency of 110 Mc.

→ Indicates a change.

DIMENSIONAL OUTLINE

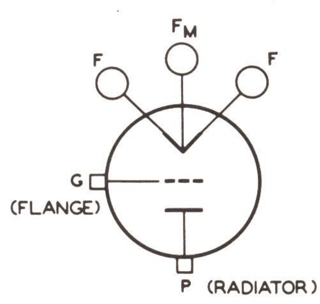


DIMENSIONS IN INCHES

● Temperature Measurement Point.

Note: Plane of filament leads will not deviate more than 3-1/2° from plane passing through AA′ normal to grid flange.

TERMINAL DIAGRAM



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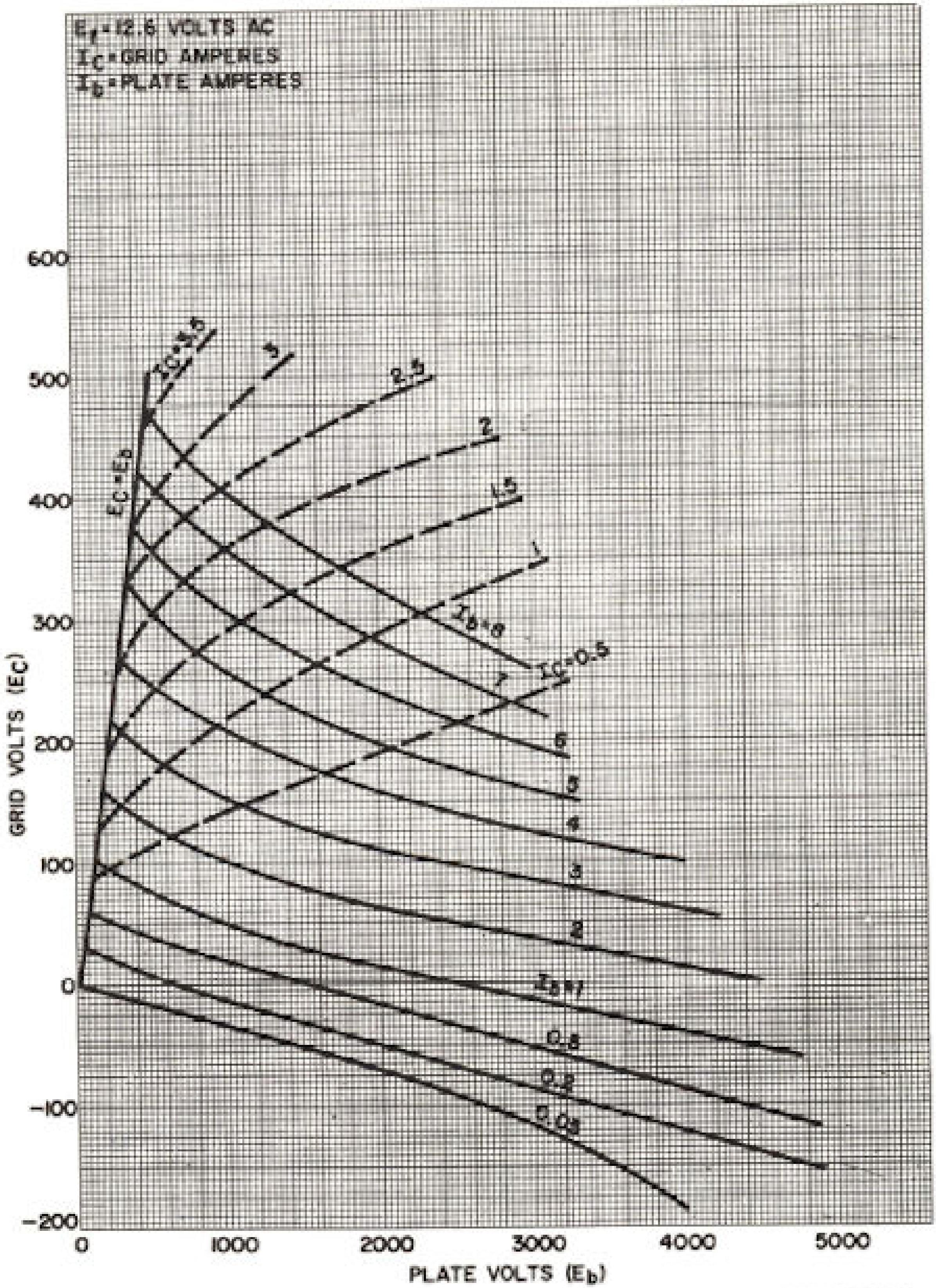
TYPICAL CONSTANT-CURRENT CHARACTERISTICS



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MECHANICAL

Mounting

The tube requires a clamp support for the radiator (plate connection), a flexible connector for the grid-terminal flange, and three connectors for the filament leads. The tube should be supported in a vertical position with either end up or down. If the tube is subjected in service to considerable vibration, it is advisable to support the mounting by means of a spring suspension. The installation of all wires and connections must be made so that they will not be close to or touch the glass parts.

For further information on mechanical considerations, see section III of 1CE-300.

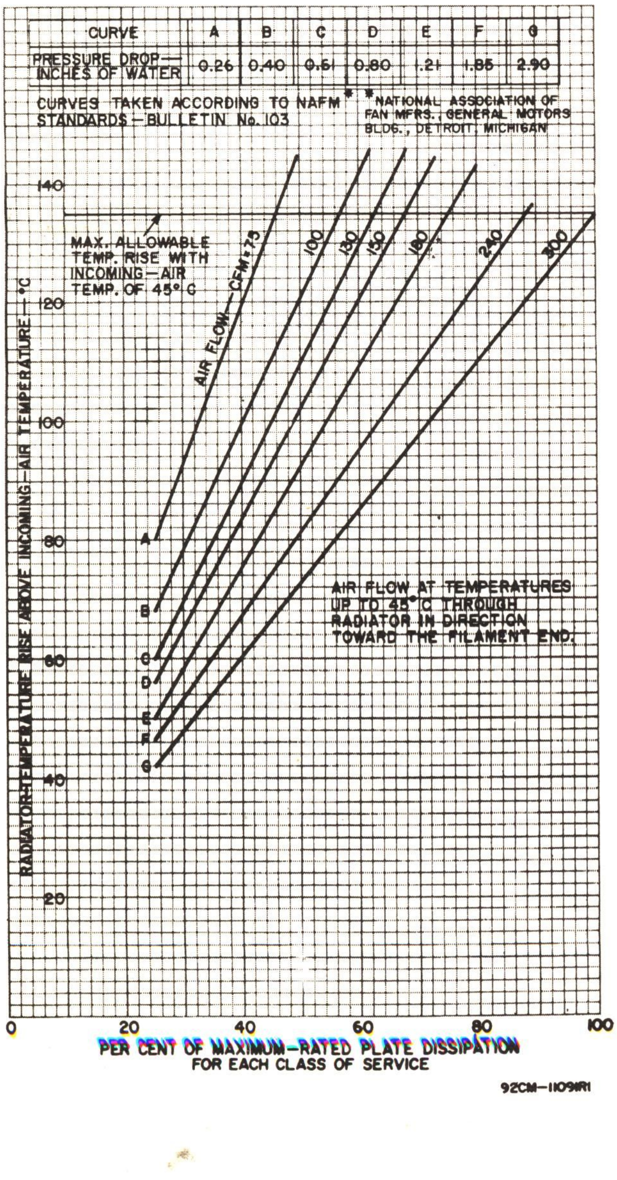
ELECTRICAL

Filament

The filament is center-tapped in order to minimize the effect of filament lead inductance, and not to permit operation of the two sections in parallel. At the higher frequencies, all three filament leads should be connected in parallel by means of rf bypass capacitors. Any one of these three leads may then be used as the rf return to the filament.

For further information on electrical considerations, see section V of 1CE-300.

TYPICAL COOLING CHARACTERISTICS



FORCED-AIR COOLING

Air Flow:

Through radiator -- Adequate air flow to limit the plate-core temperature to 180° C should be delivered by a blower through the radiator before and during the application of all voltages to the tube. Flow of incoming air at temperatures up to 45° C are given for various plate dissipations in the following tabulation:

Percentage of Max. Rated Plate Dissipation for Each Class of Service . .	100	80	60	per cent
Minimum Air Flow. . .	300	214	125	cfm
Static Pressure	2.9	1.47	0.58	in. of water

To Grid and Filament Terminals . . . 10 min. cfm

The specified air flow from a 1"-diameter nozzle should be directed into the filament header before and during the application of any voltages in order to limit the temperature of the filament and grid terminals to 180° C.

During Standby Operation -- Cooling air is required when only filament voltage is applied to the tube.

During Shutdown Operation -- Air flow should continue for a few minutes after all electrode power is removed.

For further information on forced-air cooling, see section IV.C of 1CE-300.

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"SOME THOUGHTS ON SUPERMODULATION"

M. Lieberman
March 1974

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"SOME THOUGHTS ON SUPERMODULATION"

The purpose of this paper is to acquaint you with 125% positive peak modulation of AM medium wave transmitters - also called "supermodulation". We have always said our current transmitters will make at least 130% - and they do - every one of them! They will make this extra modulation because they have been designed with reserve in the drive circuits and power supply which is just where the demand comes from. Manufacturers who have skimped in their transmitter design are "paying the penalty". Either they admit flat out their equipment won't supermodulate or they deviate slightly from the truth.

Now, some transmitters will supermodulate when new, but as they age, the ability to do so falls off. RCA Ampliphase transmitters, however, will supermodulate all the time. Tubes are run at only half their capabability, extra power is available from the power supply, and the drive regulator will provide all the drive necessary to provide at least 130% positive peak modulation.

To understand the need and derivation of this swing to supermodulation, let's spend a minute and look at the way this all came about.

For years, the broadcaster's only concern about his AM medium wave transmitter was - did it modulate and did it sound good? If the answer to both was "yes", he was satisfied. The broadcaster assumed that if the transmitter was limited to 100% negative peaks of modulation, then the positive peaks were also limited to 100%.

However, through the years the rules for new radio stations were changed which placed stations closer together, which in turn found stations wanting to sound louder to overcome adjacent stations. Additionally, with the population shift to the suburbs and increased competition from other stations (FM and TV included), the broadcaster recognized the need for higher averages and peaks of modulation. Now the broadcaster began to look at his equipment and ask, if audio peaks go beyond the "normal" excursion, will the transmitter pass it?

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To answer this question, let us look at what a transmitter is made up of. With the exception being our phase-to-amplitude (Ampliphase) and Continental's Class B linear (Dougherty), the other transmitters in use today use a high powered audio amplifier to modulate a Class C RF amplifier. The Gates PDM system also uses this approach. In these transmitters, a single high voltage power supply powers both the modulators and RF amplifiers. It is in this single high voltage supply that the problem of providing for higher peaks of modulation develop. As the modulation draws more current to follow the audio peak, the RF amplifier is also drawing more current in order to supply the demand for more RF. In the plate modulated transmitter, the instantaneous plate voltage can vary by 20 to 25% between 100% and 125% positive peak modulation. If the power supply is marginal to begin with, the positive peak excursions will round off and the transmitter will exhibit carrier shift. This is due to the drop in voltage caused by the big demand for more audio and RF power. This voltage drop reduces the RF level and the modulation B+ from the modulator itself.

Before proceeding any further, let's dwell a little on carrier shift. Earlier we spoke of a voltage drop causing carrier shift. Just what is carrier shift and how does it apply to "supermodulation"? We can define carrier shift as a change in the average value of current produced by a carrier--modulated or unmodulated. Under modulation, produced by a symmetrical wave shape, the value of carrier decreases at the trough (negative) of modulation as much as it increases at the peak (positive) of modulation. As a result, we will see no change in the average value of the carrier.

What about a transmitter not capable of symmetrical modulation below 100% or stated another way - a transmitter that doesn't have enough RF to make the crest of modulation or enough modulator power to close the carrier.

In the case of the insufficient RF, as the modulator calls for more RF needed to make peaks, the RF supply runs out and the peaks are rounded or flattened. Assuming the transmitter had enough modulator power to close the carrier, the average value of carrier will decrease because peak power was not attained and the transmitter will exhibit negative carrier shift.

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In the case of insufficient modulator power to close the carrier but enough RF power to achieve positive peaks, the transmitter will experience an increase in the average value of the carrier and a positive carrier shift.

So what! Well, the transmitter's output will increase or decrease depending upon whether the carrier shift is positive or negative. This is important when you consider the FCC regulation regarding over and under power. The FCC permits AM transmitters to operate at a maximum of 10% below or 5% above the transmitter's rated output. If a 1000 watt transmitter has a 5% carrier shift, that 1000 watts is down to 900 watts and the maximum underpower permitted by the FCC. We arrived at 900 watts by the following:

$100\% - 5\% = 95\%$

$(95)^2 = 90\%$

Since power is equal to the square of the voltage, then 95% squared is equal to 90% power. The same applies for positive carrier shift except in this case a 5% positive carrier shift would put the transmitter at 10% over power which is 5% more than permitted by law.

Up to now, our discussion has centered primarily around symmetrical sinusoidal waveforms. However, as we all know, music and speech are complex waveforms and asymmetrical by nature. Thus, the need for reserve in the power supply is even magnified when one tries to reproduce or enhance this asymmetry.

The next consideration, therefore, is the audio processing in front of the transmitter. It is not the purpose of this paper to be involved in audio processing techniques. The subject is well covered elsewhere. It is wise, however, to be aware of the need for proper processing and that RCA has the proper equipment.

We have discussed plate modulated transmitters and their ability or inability to supermodulate. What about RCA transmitters?

RCA uses plate modulation in only one transmitter - the BTA-1S 1 kw transmitter. This transmitter uses a pair of 4-400A tetrodes to modulate another pair of 4-400A tetrodes. The circuit is not new to RCA - we have used it since 1958 when we shipped the first

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BTA-1R series transmitter to Station WBMK in West Point, Georgia. Since then, we've shipped over 450 BTA-1R series and over 25 BTA-1S transmitters all over the world. Just for the record, we are in our second shop order of 25 BTA-1S Transmitters. And you know what - every single one of them will "supermodulate", not only to 125% on positive peaks, but to 130%. In fact, we are sending out a field letter to every customer advising him how - for a 25 cent resistor change - he can get 130% from his transmitter. We've made the change in the current shop order so all BTA-1S transmitters inherently "supermodulate" when they leave Meadow Lands.

In our other transmitters, we use Ampliphase which is described in detail elsewhere. However, since modulation takes place at a low level, the power supply only has to respond to the power amplifier section. The drive regulator takes care of shaping the audio to follow the pre-processed audio and the power supply will supply B+ for all the RF the transmitter wants. As a result, a BTA-5L1 has gone to 147% (125% maximum permitted in the U.S.), a BTA-10L1 regularly operates at 138% in the Dominican Republic (pretty loose rules there), and a BTA-50J and BTA-100J easily make 130% positive peaks in continuous tone modulation (probably 150% on randomly occuring peaks).

Now that we have reviewed some of the aspects in the supermodulation of AM medium wave transmitters, let us consider the mathematical justification of these statements.

First, we should address ourselves to determining just what is necessary in the way of increased audio power for 125% positive peak modulation. As we all know, the modulated power of an AM transmitter is in the side bands and it is this side band power that we are concerned with. At 100% modulation, the side band power is equal to 50% of the carrier power.

$$\text{Side band power} = \frac{M^2}{2} \times P_C$$

where $M = \dfrac{\%\text{ of modulation}}{100}$

P_C = carrier power

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Thus, for a 1000 watt transmitter at 100% modulation, we have 500 audio watts in the side bands.

$$(1)^2 \times 1000 =$$
$$0.5 \times 1000 = 500 \text{ watts}$$

Since no transmitter is 100% efficient, the power consumption by the transmitter will be greater than the power output. Let's now determine how much power it takes for 100% modulation. A typical 1000 watt transmitter will draw 3100 V DC at 400 milliamperes (0.4A) in order to produce its rated output. Thus, we can see that 1240 watts (3100 x 0.4) is needed to get 1000 watts out. Using our side band power formula from before, we learn that for 1000 watts output at 100% modulation, we need 620 audio watts.

$$\frac{M^2}{2} \times P_c = \frac{(1)^2}{2} \times 1240 = .5 \times 1240 = 620 \text{ watts}$$

Now that we know what is needed for 100% modulation, let us look at 125% positive peak modulation. Referring to our side band power formula once again, we note that for 125% positive peak modulation, the side band power for the same carrier power, is up to 781.25 watts.

$$\frac{M^2}{2} \times P_c = \left(\frac{1.25}{2}\right)^2 \times 1000 = \frac{1.5625}{2} \times 1000 = 781.25 \text{ watts}$$

However, the input power needed to generate that extra side band power also climbs as we see in the following exercise.

It can be readily determined the difference between the input power at 100% and 125% is almost 20% and this difference has to come from the power supply. Now one can understand why some transmitters will not "supermodulate". The power supply is just not large enough to deliver the extra power needed.

What has all this "supermodulation" brought us? To begin with, the supermodulation itself does nothing for the loudness of the received signal. The difference between 100% positive peak

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modulation and 125% positive peak modulation is only 1.938 dB in average side band power and it's the side band power we hear. How come only 1.938 dB, you ask?

Remembering our 1000 watt transmitter again, we determined that at 100% positive peaks we have 500 audio watts in the side bands and at 125% positive peaks, we have 781.25 audio watts in the side bands. Thus, the true average side band power difference is:

$$\frac{781.25}{500.00} - 1.5625 \times 10 \log_{10} = 1.938 \text{ dB}$$

The real reason we want the transmitter to "supermodulate" is that the process raises the "head room" of the modulation capability of the transmitter and signal processing may be used to effectively raise or increase the "average level of modulation". It is this increase in the average level of modulation that makes the transmitter sound louder -- not the 125% positive peaks. The 125% positive peaks occur randomly and usually are of short duration. But, if the transmitter is capable of passing 125% on positive peaks, then it is capable of producing a higher average level of modulation.

So, there you have it. We have tried to put this down informally so everyone will understand "the secret of supermodulation" and be able to talk effectively about our equipment as well as what the customer can expect from ours as well as the competition.

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