INSTRUCTION BOOK

VERY HIGH FREQUENCY TRANSMITTER

TYPE TV-15

SERIAL NOS. 1-771

MADE FOR

FEDERAL AVIATION AGENCY

CONTRACT CCA-34318

DATED SEPT. 22, 1958

CONTRACTOR

DAYSTROM-WESTON INDUSTRIAL DIVISION
OF DAYSTROM, INCORPORATED
POUGHKEEPSIE, NEW YORK

SAFETY NOTICE

The attention of operating and maintenance personnel is directed to Federal Airways MANOP IV-A-4 for instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating and maintenance personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside equipment with high-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. To avoid casualties always remove power and discharge and ground circuits prior to touching them by use of a grounding stick.

DON'T TAMPER WITH INTERLOCKS:

Do not depend on the door interlock switches for protection, but always shut down the equipment. Under no circumstances should the interlocks be bypassed, short-circuited, or tampered with in any way, except by authorized maintenance personnel when considered unavoidable, nor should reliance be placed upon the interlock switches for removing voltages from the equipment. The grounding stick should always be employed (after shutting off all power) to insure that circuits are electrically "dead".

RESUSCITATION:

Maintenance personnel should familiarize themselves with the technique for resuscitation found in the Manual of First Aid Instructions.

GUARANTEE

The equipment including all spare parts, except electron tubes, batteries, natural rubber and material normally consumed in operation (unless such excepted items fail as a result of improper application, in which case the gaurantee applies to these items also), is guaranteed for a period of one year from the date it is placed in operation by the Government, but not more than two years from the date of delivery of the equipment to and acceptance by the Government. Upon notice in writing of failures the contractor shall repair or replace all such items f. o. b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government.

If 20% or more of the total quantity of any part or component to which the above guarantee applies, but not less than two of any such part or component furnished under the contract, fail in normal service, that fact shall be conclusive evidence that the particular part of component or the equipment design is unsuitable for the purpose intended. The contractor upon notice of this fact shall replace or correct the part of equipment design in a manner satisfactory to the Government in all equipments and spare parts without cost to the Government, unless the use of such part, component, or design was required by the Government.

The above guarantee period shall not include any period of time the equipment fails to perform satisfactorily due to any such defect and any item repaired or replaced by the contractor pursuant to this guarantee shall be guaranteed anew under the same conditions for a further period of one year.

The contractor may elect to have any defective or damaged item returned to his plant, he to pay the return transportation charges, but he shall not delay the prompt replacement of the defective or damaged item. If, upon examination of the defective or damaged item, it can be shown to the satisfaction of the Government that the item is not defective within the meaning of this guarantee, the contractor may bill the Government for the cost of the replacement, including transportation.

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SUMMARY SHEET

Name and Type Number of Equipment	Very-High-Frequency Radio Transmitter, Type TV-15
Procurement Specification and Date	CAA-R-1063a; June 10, 1958
Frequency Range	Single channel, 118 to 152 mc
Frequency Control	Crystal
Frequency Accuracy	± 0.002%
Frequency Stability	± 0.0005%
Crystal	Type CR-32/U;29.5 to 38 mc
Power Output into 50 ohm Resistive Load	50 watts
Type of Emission	Amplitude-modulated
Modulation Capability	0-100%
Audio Frequency Response	300 to 4000 cps, within 3 db
Output (Antenna) Impedance	50 ohms
Audio Input Impedance	600 ohms
Audio Input Level	-15 to +10 dbm
Carrier Level Change	10% max, up to 90% modulation
Carrier Hum and Noise Level	Min 50 db below 90% modulation
Hum Distortion	Min 50 db below A-F level
Harmonic Output	75 db max
Spurious Frequency Output	-80 db max
Ambient Temperature	-10°C to +60°C
Ambient Relative Humidity	0 to 100%
Power Supply	105 to 130 volts, 50 to 60 cps, single phase
Power Requirements	
Normal Operation	640 watts, 696 volt-amperes, 0.92PF
Standby	170 watts, 1.56 amperes, 0.91PF
Power Available for External Accessories	25 watts at 120Vac
Duty	Continuous
Weight	
Uncrated	137 lb
Crated	220 lb
Equipment Supplied	
Very High Frequency Radio Transmitter	Type TV-15
Power Supply and Modulator Chassis	1 each
R.F. Chassis	1 each
Blank A Panel	1 each
Power Cord, W101	1 each
Power Cable, W102	1 each
Antenna Connector, P204	1 each
Electron Tube Complement	
OB2	3 each
2E26	1 each
4X150A	1 each
5R4GY	4 each
6AU6	1 each
6X4	1 each
12AT7	1 each
12AU7	2 each
5763	1 each
6146	3 each
Fuse Complement	
8/10A, 125V, 3AG, slow blow	1 each
1A, 125V, 3AG, slow blow	1 each
10A, 32V, 3AG, slow blow	1 each
5A, 125V, 3AG	1 each

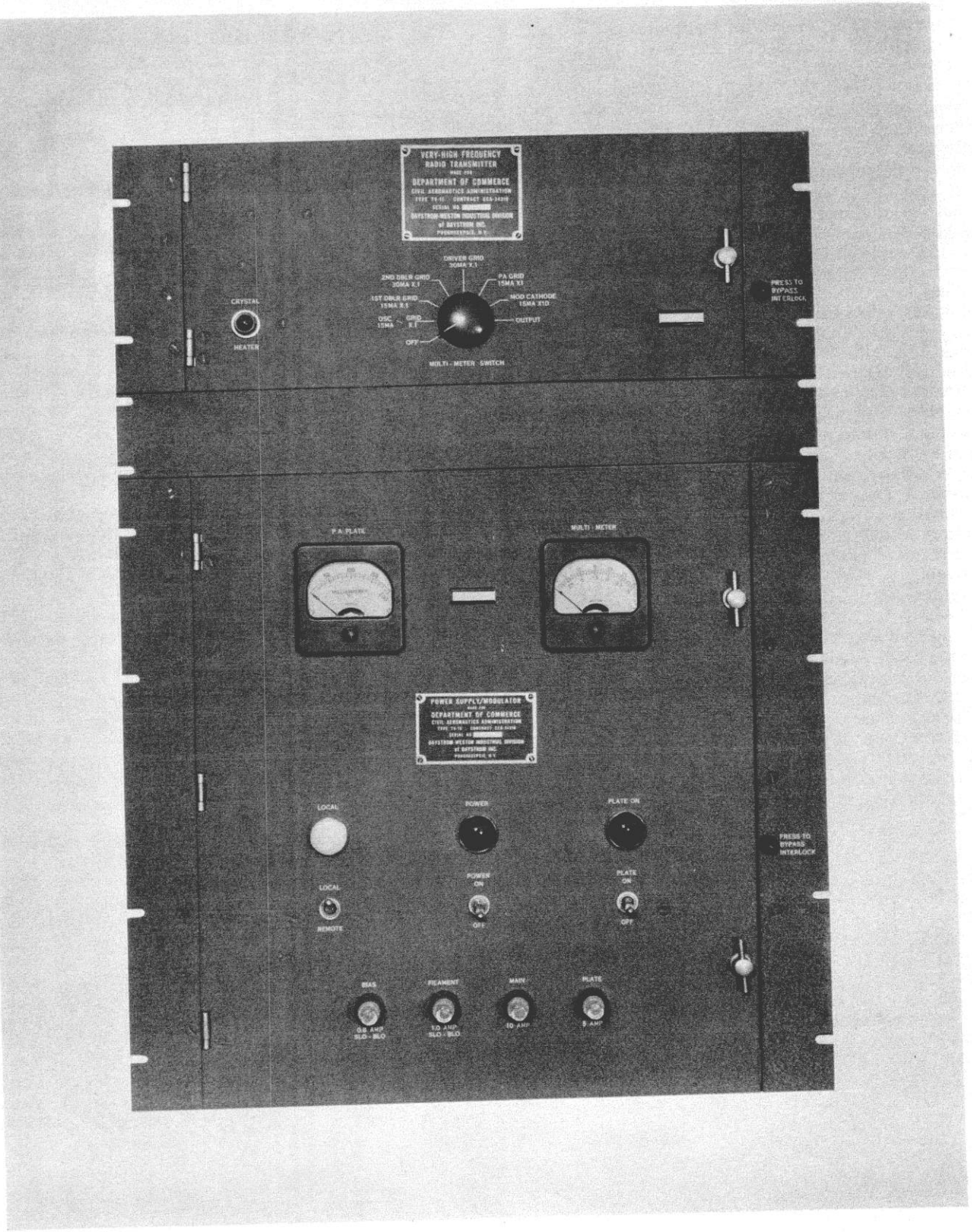

Figure 1. Very-High-Frequency Radio Transmitter, Type TV-15

SECTION I GENERAL DESCRIPTION

1. INTRODUCTION.

1.1 Scope of instruction book.- This instruction book covers the installation, operation, theory, and maintenance of Very-High-Frequency Radio Transmitter, Type TV-15.

1.2 Purpose of equipment.- The equipment covered is a 50 watt, amplitude modulated, single channel v-h-f- radiotelephone transmitter designed to operate at any frequency in the range of 118 to 152 megacycles. It is intended for ground-to-air voice communications at CAA stations, towers, and centers.

2. DESCRIPTION.

2.1 Mechanical construction.-(See figure 1.) The transmitter consists of two separate units designed to be mounted in a standard 19 inch rack or cabinet. The front panels, which are slotted for conventional rack mounting have an overall height of 26-5/32 inches including the two inch spacer between the two panels. Overall depth is approximately 13-3/4 inches.

2.1.1 All controls normally used in operation, indicator lamps, and indicating type fuse holders are mounted on the panel doors. Opening the doors which are hinged at the left, provides ready access to parts for adjustment and tuning.

2.1.2 The components of the a-f circuits are mounted on the lower of the two chassis. The r-f section components are mounted on the upper chassis spaced a few inches behind the front panel. The r-f tubes are installed in a horizontal position from the front of the transmitter. Nearly all the parts and wiring associated with these circuits is accessible from the rear when the chassis cover is removed. A shielded subassembly enclosing the power amplifier stage is mounted in the upper right hand corner inside the door. The power amplifier tube is cooled by means of a blower mounted on the rear of the r-f chassis.

2.1.3 The power supply rectifier and voltage regulator tubes are mounted with the heavier components, such as transformers and filter chokes, on the lower chassis. These components are accessible from the rear of the transmitter.

2.2 Interlocks.- The transmitter is equipped with two interlock switches which remove the plate supply voltage when the front panel doors are opened. For maintenance and adjustment, these interlocks can be held closed mechanically by means of push buttons mounted on the front panels, so that the doors can be opened without de-energizing the transmitter. The interlock switches should be by-passed only by qualified maintenance personnel; refer to the safety notice in the beginning of this instruction book.

2.3 Shielding and filtering.- In order to maintain a minimum radiation of harmonic frequencies and spurious frequencies, extensive shielding and filtering has been incorporated. All components capable of radiating such signals are enclosed between the front panel and the r-f chassis, behind the panel. When the panel door is closed, these components are completely shielded. R-f leakage through the space between the door and its frame is prevented by woven metal shielding along the door frame, which insures complete shielding when the door is closed.

2.3.1 A low pass filter at the antenna output prevents the radiation of harmonics. R-F feedback into the power or control lines is eliminated by the use of by-pass capacitors on all lines leaving the transmitter.

SECTICN 2 INTEGRATICN INTO SYSTEM

1. INTEGRATICN DATA. - No system integration data was included in this instruction book as issued by the contractor.

Paragraph

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Figure 6. Power Distribution and Control Circuits, Simplified Schematic Diagram

1. FUNCTIONAL DESCRIPTION.

1.1 General. - Very - High - Frequency Radio Transmitter, Type TV-15, produces a 50 watt, amplitude-modulated carrier at any selected frequency in the range of 118 to 152 megacycles. For purposes of discussion, the transmitter can be considered to comprise three functional sections or groups of circuits: the r-f section, the a-f section and the power supply and control circuits. A block diagram of the transmitter, illustrating the r-f and a-f sections, is shown in figure 2. (Complete schematic diagrams are shown in figures 25 and 26.)

1.2 R-f section. - The r-f section generates the 50 watt carrier, and is conventional in practically all respects. Oscillator V201, a 12AT7 twin triode, is crystal controlled. Its output is between 29.5 and 38 megacycles, depending upon the frequency of the crystal employed. (The crystal frequency is determined by dividing the desired carrier frequency by four.) The signal from the oscillator is amplified by the buffer amplifier V202, a 6AU6 pentode. This signal is then doubled in frequency by the first doubler, V203, resulting in an output from the first doubler stage between 59 and 76 megacycles. The signal is again doubled by the second doubler, V204. The first doubler stage utilizes a 5763 pentode, while the second doubler stage utilizes a 2E26 beam-power tube.

1.2.1 The output from the second doubler, at a frequency between 118 and 152 megacycles, is applied to the driver, V205. The driver, a 6146 beam-power tube, raises the signal power level sufficiently to drive the power amplifier V206, a 4X150A power tetrode. The output of the power amplifier, modulated by the audio signal from the modulator stage, passes through the low pass filter, FL201 before reaching the antenna transmission line. The low-pass filter reduces the radiation of harmonics to a negligible level.

1.3 A-f section. - The a-f section amplifies the audio input, supplied from a 600 ohm line, to a power level capable of modulating the r-f carrier output from the power amplifier. The first speech amplifier utilizes one section of V101, a 12AU7 twin triode. The second and third speech amplifiers utilize the two sections of V102, a 12AU7 twin triode. These stages provide sufficient amplification of the audio signal to drive the push-pull 6146 modulator tubes, V103 and V104. The audio power generated in the modulator stage is used to modulate the power amplifier plate and screen grids.

1.3.1 The response of the a-f section is flat within 3db between 300 and 4000 cycles, and is down at least 26db at 10,000 cycles. (See figure 3.) This response is designed to emphasize voice frequencies in the 300 to 4000 cycle range, and to attenuate those frequencies not required for intelligible voice communication.

1.4 Power supply and control circuits. - The power supply provides all voltages required for operation of the transmitter from a nominal 120 volt, 50 or 60 cycle source. It contains two power supplies, one of

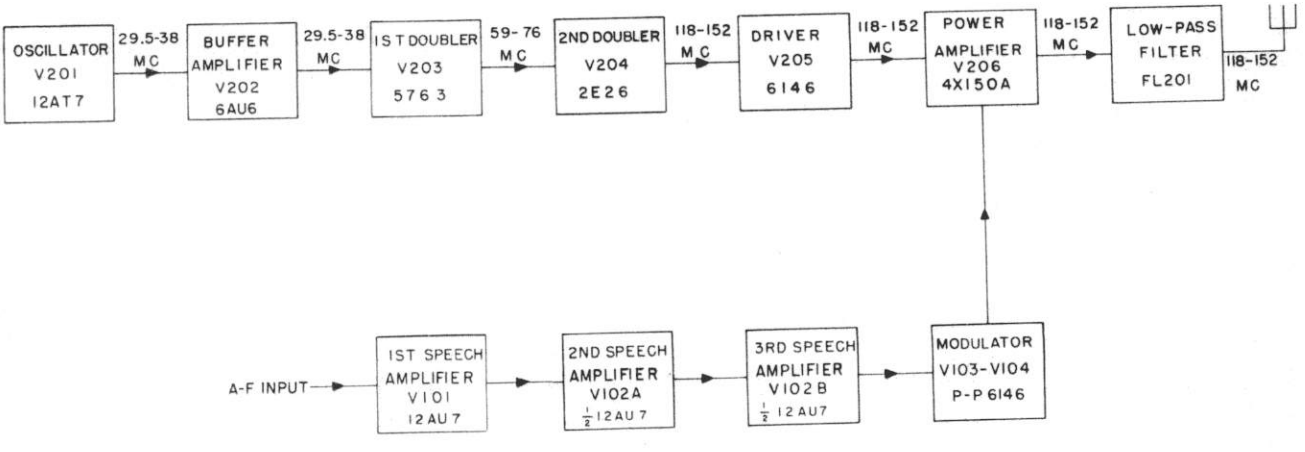


Figure 2. Transmitter Block Diagram

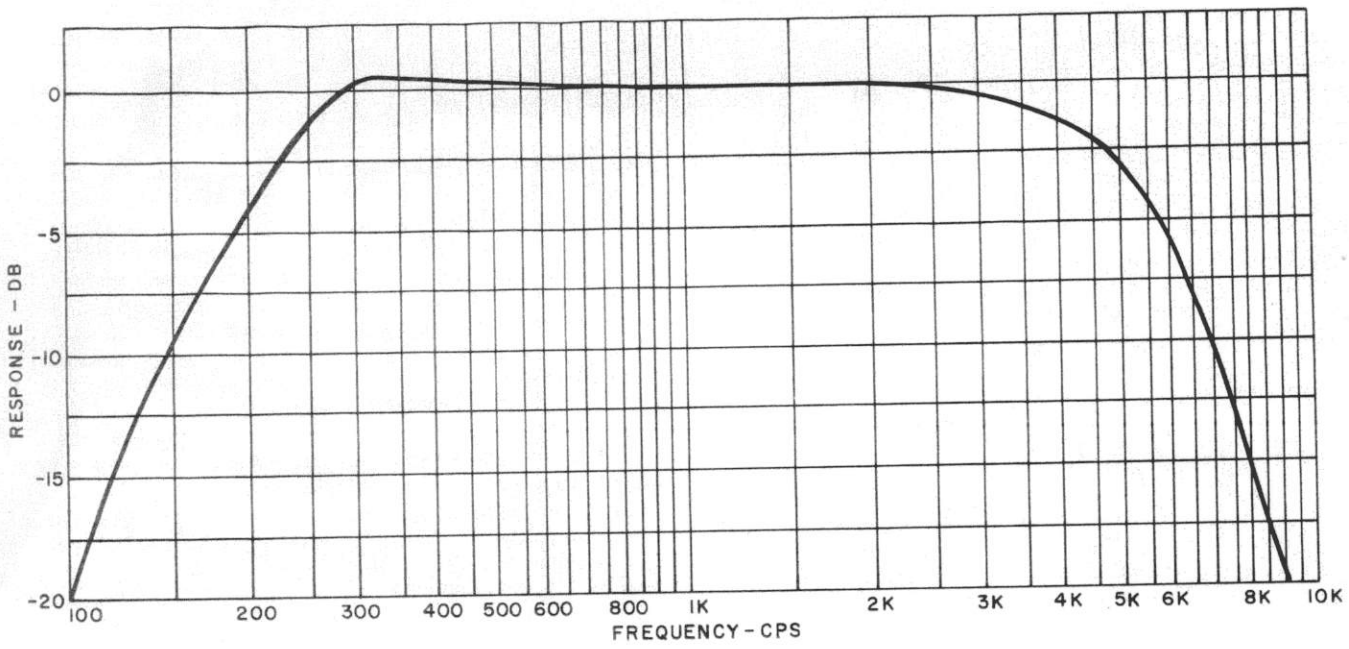


Figure 3. Typical Audio-Frequency Response

which provides voltage for plates and screens, while the second supplies bias voltage. The control circuits allow either local or remote operation of the transmitter.

2. R-F SECTION.

2.1 Oscillator.- (See figure 4.) The oscillator stage utilizes twin triode V201, a type 12AT7, in an overtone crystal circuit. Crystal Y201, a type CR-32/U unit in crystal oven HR201, functions in an overtone mode. The overtone frequency of the crystal employed must be between 29.5 and 38 megacycles:

$$\text{Crystal frequency} = \frac{\text{Output frequency}}{4}$$

2.1.1 One-half of V201 (triode A) is arranged as a cathode follower, the output being obtained across cathode resistor R202. Bypass capacitors C202 and C206 in conjunction with the impedance of resistors R206 and R207 put the plate of triode A at r-f ground potential. The second half of V201 (triode B) functions as a grounded-grid amplifier. Its plate circuit, comprising coil L203 in parallel with the shunt capacitance between the plate of V201 and ground is resonated at the crystal frequency.

2.1.2 Shock excitation, at the moment that plate voltage is applied to the stage, results in a random-noise signal generated by both triodes. Crystal Y201 presents a high impedance to all components of this noise except that which is at the series-resonant frequency of the crystal. At that frequency alone there is a low impedance path between the two cathodes. Any small signal at the crystal frequency which is generated in triode A (or in triode B and applied to the grid of triode A through capacitor C201) is fed to the cathode of triode B via the low-impedance path through the crystal. The signal is then amplified by triode B, and a portion of the output developed across the plate tank circuit is fed back to the grid of triode A, in phase with the original signal. The circuit action is regenerative, producing an output signal whose frequency is determined by the crystal oscillating in its series-resonant mode.

2.1.3 An indication of oscillation is the flow of current in the grid circuit of triode A. This current is monitored by MULTI-METER M101 when MULTI-METER SWITCH S202 is in the OSC GRID position. Resistor R203 is the meter shunt; capacitor C203 and r-f choke L202 functions as a low-pass filter to keep r-f from the meter circuit.

2.1.4 In order to maintain frequency stability over a wide range of temperature and humidity conditions, crystal Y201 is mounted in crystal oven HR201. (See figure 26.) The oven heating element is connected to the 6.3 volt secondary of transformer T201 in series with a thermostatic switch. This switch opens and closes the circuit to the heating element, maintaining the oven temperature between 71° C and 79°C. CRYSTAL HEATER lamp I201 indicates that the heating element is energized.

2.2 Buffer amplifier. - (See figure 26.) The signal from the oscillator is applied via capacitor C207 to the grid of buffer amplifier V202, a 6AU6 pentode. This

tube functions as a class A amplifier and in addition to amplifying the output of the oscillator, isolates that stage from loading effects of the succeeding stages.

2.2.1 The plate circuit of V202 is tuned to the same frequency as the oscillator. The plate tank consists of coil L204 in parallel with the shunt capacitance between the plate of V202 and ground.

2.3 First doubler. - (See figure 26.) Inductive coupling between coils L204 and L205 transfers the signal from V202 to the grid of first doubler V203, a 5763 pentode. The grid tank, compromises coil L205 in parallel with the tube input capacitance and stray capacitance of the grid circuit. It is tuned to the oscillator frequency by adjustment of L205. The grid of V203 is biased for class C operation by a combination of fixed and grid-leak bias. The fixed bias is obtained from the bias supply through resistor R212. The grid-leak bias results from grid-current flow through resistor R211 and the d-c path to ground through the bias supply. Resistors R212 and R213 act as a shunt for meter M101 when switch S202 is in the 1ST DOUB GRID position.

2.3.1 The plate circuit of V203 is tuned to the second harmonic of the input signal frequency and comprises coil L206 in parallel with the shunt capacitance between the plate of V203 and ground. Tuning over the range of 59 to 76 megacycles is accomplished by adjustment of the inductance of L206.

2.4 Second doubler. - (See figure 26.) The output from the first doubler is inductively coupled from L206 to L208 in the grid circuit of second doubler V204 a 2E26 beam-power tube. The grid circuit is similar in configuration to that used in the first doubler stage.

2.4.1 The plate circuit of V204 consists of coil L209, the shunt output capacitance of the second doubler stage and the shunt input capacitance of the driver stage. These shunt capacitances are effectively in series, their junction being ground, and are in parallel with L209 to form a parallel-resonant circuit. R-F choke L210 isolates coil L209 from r-f ground to permit this configuration. The tank circuit is tunable over the range of 118 to 152 megacycles (the second harmonic of the input signal frequency) by adjustment of the inductance of L209.

2.5 Driver. - (See figure 26.) Driver V205 is a 6146 beam-power tube functioning as a Class C r-f power

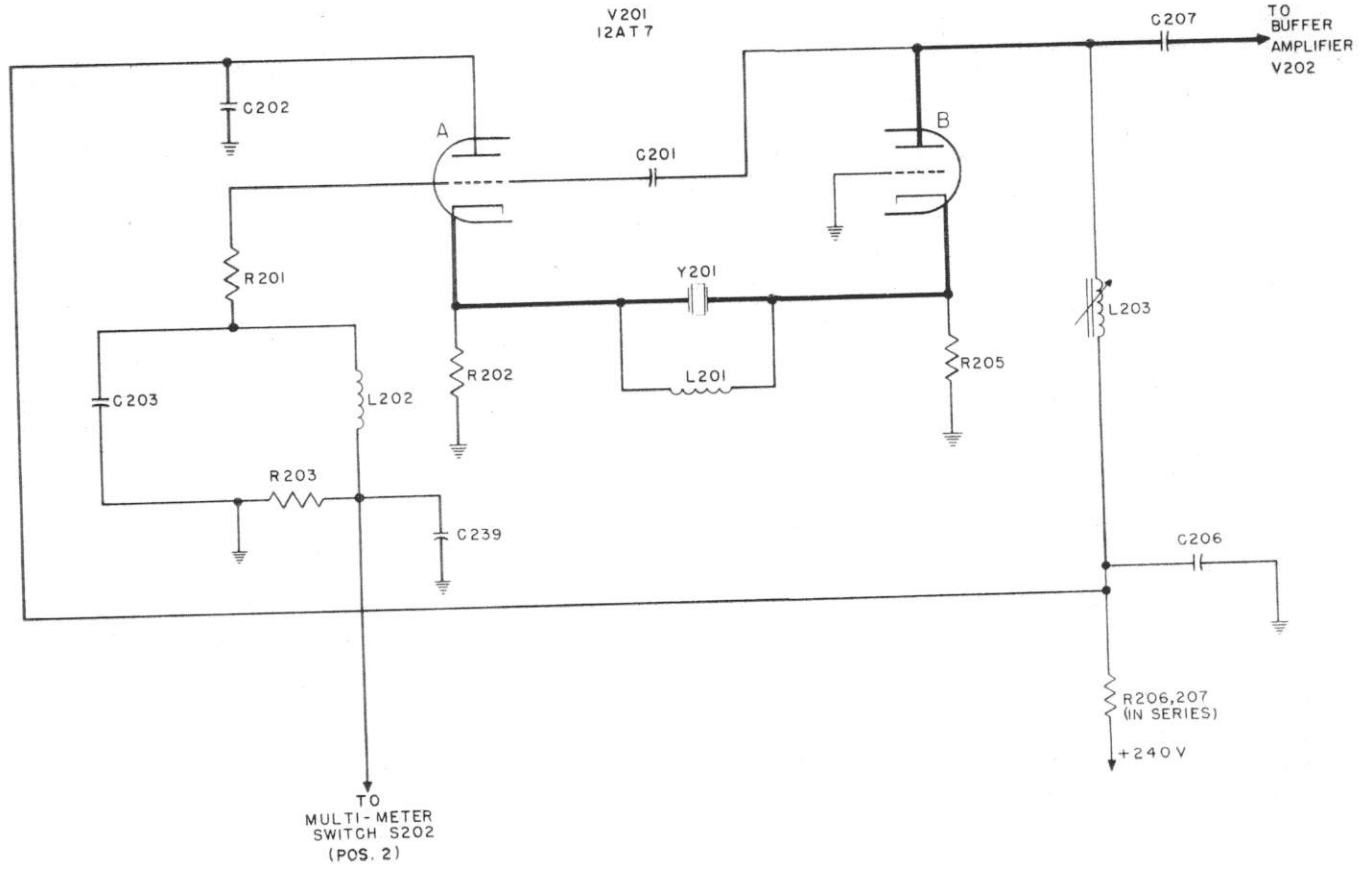


Figure 4. Oscillator, Simplified Schematic Diagram

amplifier. Bias is obtained from the junction of resistors R220 and R229, which in series with resistor R231 are connected to the -108 vdc output of the bias supply. Additional grid-leak bias results from grid-current flowing through resistors R127, R128, R223, R224, R229, R231. Resistor R224 is the shunt for meter M101 when switch S202 is in the DRIVER GRID position.

2.5.1 The plate circuit of V205 is parallel resonant; it comprises the capacitance (from the plate of V205 to ground) in parallel with coil L212 and capacitor C224 in series. Since the plate-to-ground capacitance of the circuit is fixed by the tube and stray capacitances, tuning is accomplished by adjusting variable capacitor C224. This capacitor effectively varies the capacitive reactance of the parallel-resonant tank circuit. The values of L212 and C224 are such that the series circuit they form must always be inductive. The range of C224 permits tuning from 118 to 152 megacycles. Excitation to the power amplifier is provided by link coupling between driver plate coil L212 and power-amplifier grid coil L215, via link coils L213 and L214 and an interconnecting length of coaxial cable.

2.5.2 The output of the driver stage (the amount of excitation supplied to the power amplifier) is controlled by varying the screen-grid voltage of V205. This is accomplished by adjusting PA GRID DRIVE potentiometer R227, which, in conjunction with resistors R222 and R228, forms a voltage divider between the screen bias bus and ground.

2.6 Power amplifier. - (See figure 26.) The power amplifier V206 is a 4X150A power tetrode. Bias for class C operation is obtained from the bias supply; additional bias results from grid-current flow through resistors R216 and R231 and the bias supply voltage divider network (resistors R127, R128 and the coil resistance of relay K102.) Resistor R216 shunts meter M101 when MULTI-METER SWITCH S202 is in the PA GRID position.

2.6.1 Variable capacitor C228, in series with grid coil L215, tunes the input to the signal frequency, 118 to 152 megacycles. Variable capacitor C231, in series with plate coil L218 permits tuning the output tank circuit from 118 to 152 megacycles. These capacitors vary the capacitive reactance of the parallel-resonant tank circuits. Effective r-f bypassing at the screen grid terminal of V206 is required to minimize feedback from plate to grid. This is provided by a bypass capacitor which is an integral part of tube socket V206. The socket also features special construction so that air from blower B201 is convected around the envelope and seals of V206, keeping the operating temperature of the tube within safe limits.

2.6.2 Plate current is monitored by PA PLATE meter M102, and both plate and screen are modulated by the audio output of the modulator stage. The modulated output from the plate tank circuit of V206 is inductively coupled to coil L219, then routed to low-pass filter FL201 by means of a coaxial line terminated by connector P203. Coil L219 is mounted so that its position relative to L218 can be varied. This arrangement permits adjustment of the output coupling. Variable capacitor C233 is used to tune out any reactance in the output link circuit to provide for maximum power transfer to a resistive load.

2.6.3 A small portion of the r-f signal is taken from the output circuit for metering and monitoring purposes. This voltage is coupled from coil L219 through capacitor C226 and is developed across resistor R234. The signal is rectified by CR201, a 1N69 germanium diode. The diode load consists of resistors R232 and R233 in series; r-f ripple voltage is bypassed to ground by capacitor C227. R-f choke L220 provides a return path to ground for the antenna circuit. The rectified voltage which exists across the diode load is available for two purposes. The total rectified voltage is present at test point TP201. The signal between this point and ground (test point TP202) represents the demodulated audio obtained from the modulated carrier, and may be observed on a test oscilloscope. The portion of the voltage which is developed across R233 is applied to switch S202 so that meter M101 will indicate the relative r-f output level when the switch is in the OUTPUT position.

2.7 Low-pass filter. - Low-pass filter FL201 attenuates any harmonics which may be produced in the output stage so that there is negligible radiation of such signals from the antenna. The filter has an impedance of 50 ohms, and is designed to feed an antenna system having the same impedance. The typical attenuation characteristic of low pass filter FL201, with respect to a 50 ohm resistive load, over the operating frequency range of the transmitter, is shown in figure 5.

3. A-F SECTION.

3.1 Input circuit and first speech amplifier. - (See figure 25.) The audio input signal from a 600 ohm line reaches the primary winding of the input transformer T101 via terminals 1 and 4 of terminal board TB101. The secondary winding of the input transformer is shunted by potentiometer R101. Adjustment of MOD GAIN potentiometer R101 sets the level of the input to the first speech amplifier, V101, and thereby determines the ultimate modulation level.

3.1.1 The first speech amplifier utilizes one half of V101, a 12AU7 twin triode. The amplified signal which is developed across plate load resistor R103 is coupled through capacitor C102, and a low-pass filter network consisting of resistors R104, R105, R133 and capacitors C104 and C105, to the grid of the second speech amplifier V102A. The low-pass filter is designed to sharply attenuate those frequencies above 4000 cycles.

3.2 Second speech amplifier. - (See figure 25.) The second speech amplifier, V102A, utilizes one half of a 12AU7 twin triode. The amplified signal which is developed across plate load resistor R107 is coupled through capacitor C107 to the grid of V102B, the third speech amplifier, and second half of the 12AU7 twin

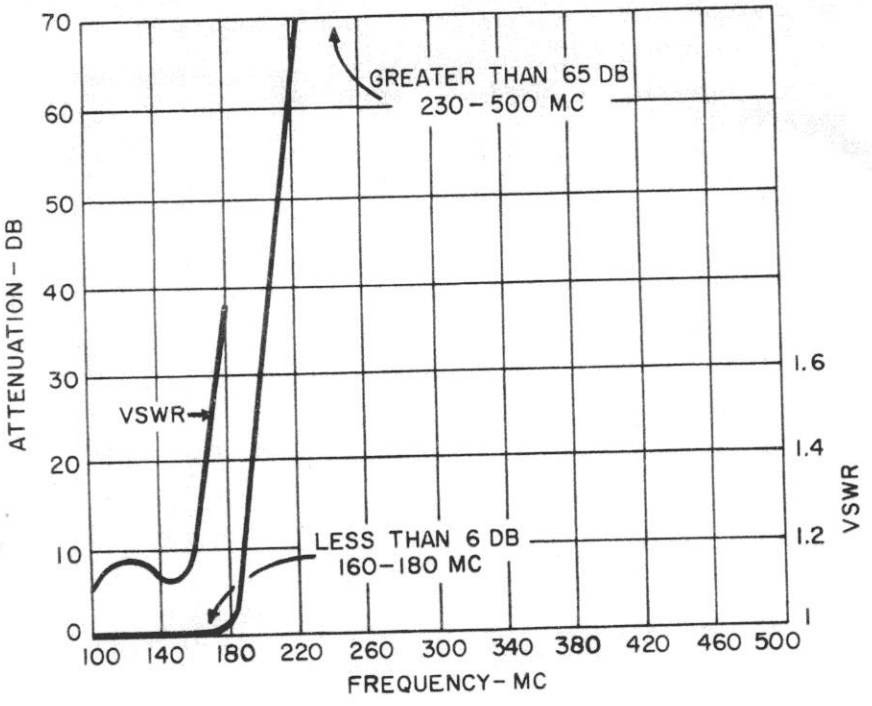


Figure 5. Typical Attenuation Characteristic of Filter FL201

triode. Resistors R109 through R111 and capacitors C108 and C109 form a high-pass filter network designed to attenuate those frequencies below 300 cycles. Out of phase feedback through resistor R112 is used to further attenuate those frequencies beyond 4000 cycles.

3.3 Third speech amplifier.- (See figure 25.) The amplified signal of V102B is developed in the primary of T102 the interstage transformer that couples the output of V102B to the grids of the two modulator tubes V103 and V104, 6146 beam power pentodes.

3.4 Modulator.- (See figure 25.) Push-pull 6146 beam-power tubes (V103 and V104), operating in class AB1, are used as modulators. The output of tube V102B is applied to the grids of V103 and V104 from interstage transformer T102. Fixed grid bias of approximately -50 volts is obtained from the junction of R127 and R128 the voltage divider across the bias supply. Feedback from the plate of modulator V104 to the cathode of speech amplifier V102B is obtained with the network of resistor R114 through R118 and capacitor C111. Audio distortion is minimized and the a-f level is stabilized by the use of this network.

3.4.1 Modulation transformer T103 matches the plate-to-plate load impedance of the modulator tubes to the plate and screen impedances of the power amplifier. Separate windings are used to modulate the plate and screen simultaneously, modulation of both tube elements being required for full output modulation. Modulator cathode (plate plus screen) current is indicated on meter M101 when switch S202 is in the MOD CATH position. Resistors R119 and R215 act as the meter shunt for this position.

4. POWER SUPPLIES.

4.1 Main plate supply.-(See figure 25.) The main plate supply utilizes four 5R4GY rectifiers, V105 through V108, in a full-wave circuit. A two-section filter is used, comprising capacitors C113 and C114 and reactors L101 and L102. The output voltages, obtained from the voltage divider (R130, 131, 135 and R132) connected across the output, supply the plates and screen grids of all tubes in the transmitter. The voltages produced by the power supply can be easily checked on pins 3, 10 and 11 of connector J102. R-f feedback through the power supply circuits is eliminated by capacitors C119 and C120.

4.1.1 Screen voltage for modulator tubes V103 and V104 is regulated by two OB2 glow-discharge regulator tubes, V109 and V110, connected in series. Voltage from the 600 volt bus is dropped to 225 volts at the plate of V109 as a result of variable drop across resistors R129 through R132.

4.2 Bias supply.- (See figure 25.) Bias rectifier V111, a 6X4 full-wave rectifier and voltage regulator V112 provide regulated bias voltages for the first and second doubler, driver, power amplifier and modulator grids. Bias voltage for the modulator grids is obtained from the voltage divider network R127 and R128 connected

across the output of the bias supply filter comprising capacitors C115 through C117 and resistors R125 and R126.

4.2.1 When relay K101 is unenergized, so that no plate or screen voltages are applied to the a-f and r-f tubes (refer to paragraph 5.3.1 below), resistor R121 is connected across the output of the bias supply through the normally closed contacts of K101. This added load across the bias supply keeps the bias voltages at safe values in the absence of plate, screen and excitation voltages.

5. POWER DISTRIBUTION AND CONTROL.

5.1 Primary power source. - The transmitter is designed for operation from a nominal 115 volt, 50 to 60 cycle, single-phase line. However, it will operate equally well at any input voltage between 105 and 130 volts.

5.2 Primary Power Distribution. - (See figure 6.) Power is applied to the primary of auto transformer T106 through main fuse F101 when power switch S101 is closed. This is indicated by power lamp I101, connected across the a-c line through dropping resistor R122. The output of auto transformer T106 is applied to blower B201 through filament fuse F104, to the primary of bias supply transformer T105 through bias fuse F103 and to the primary of filament transformer T201 through filament fuse F104 (providing blower airswitch S201 is closed.) When interlock switch S103 is closed, power is also applied to the plate supply transformer T104 as indicated by plate lamp I103 connected across the primary through dropping resistor R124.

5.2.1 Energizing blower B201 starts the flow of cooling air around the base of the power amplifier tube, closing air-flow switch S201 which completes the circuit to the primary of T201. Thus, unless the blower is operating to close switch S201, the filaments of the r-f tubes will not be energized.

5.3 Local operation. - (See figure 6.) When switch S105 is in the LOCAL position, the coil of relay K101 is connected across the a-c line in series with PLATE switch S102. LOCAL indicator lamp I102 is also connected across the line in series with dropping resistor R123; the lighted lamp indicates that the equipment is set up for local operation.

5.3.1 Closing PLATE switch S102 energizes relay K101, whose contacts connect the coil of relay K102 across the bias supply. The voltage from the bias supply energizes K102, whose contacts complete the circuit to one side of the primary of plate transformer T104 through PLATE fuse F102. The other side of the primary receives power through closed air-flow switch S201. Terminals 11 and 12 of TB101 are provided 120 volts ac for external use, (such as an antenna change-over relay) which must be energized when plate power is applied within the transmitter. PLATE-ON, lamp I103 indicates that the high-voltage power supply has been energized. Note that plate power cannot be applied if either relay K102 is deenergized or switches S201, S103 or S203 are open. Thus, if the bias supply fails, if the air flow from blower B201 is interrupted or drastically reduced, or, if either door is opened, the tubes in the transmitter are protected.

5.4 Remote operation. - (See figure 6.) When switch S105 is in the REMOTE position, the coil of relay K101 is connected to switch S104 and lamp I102 is extinguished. Remote control can than be accomplished by either of two methods.

5.4.1 When AC-DC switch S104 is in the AC position, an external switch connected to terminals 9 and 10 of TB101 will, upon closure, complete the 120 volt a-c circuit to the coil of relay K101. When switch S104 is in the DC position, the coil of K101 is connected to terminals 7 and 8 of TB101. Connecting a 48 volt d-c source to those terminals will energize the relay. Energizing relay K101 by means of either remote circuit results in the application of high voltage to the transmitter tubes, as described in paragraph 5.3.1 above.

5.4.2 AC-DC switch S104 is mounted on the rear of the lower vertical chassis (see figure 18). The switch, a three pole double throw toggle type, need only be set once at the time of installation.

5.5 External-line filtering. - Radiation of r-f energy via the power or control lines is minimized by the use of bypass capacitors C119 and C120. These are used on the PA grid and plate modulation lines leaving the power supply and modulator chassis.

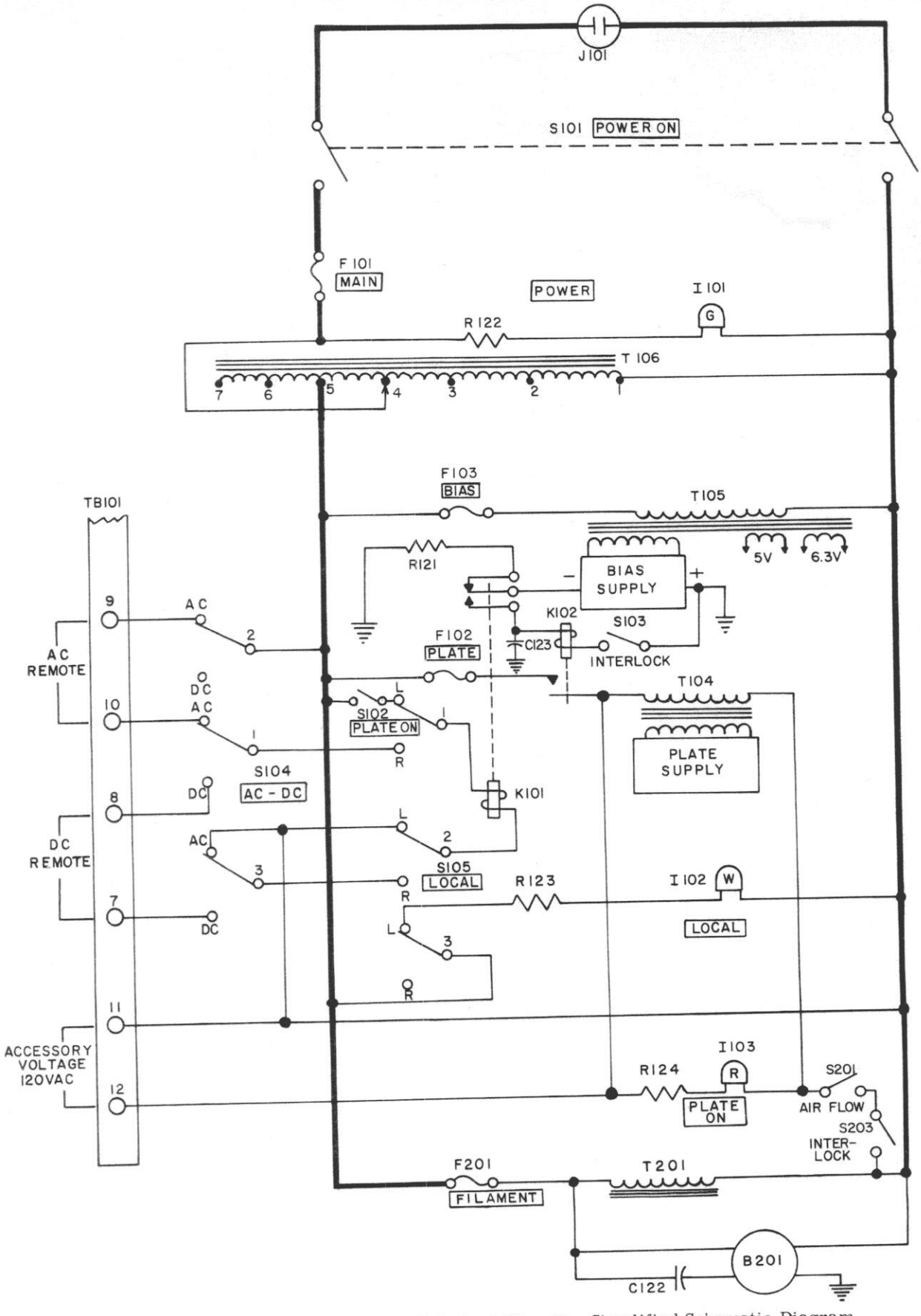


Figure 6. Power Distribution and Control Circuits, Simplified Schematic Diagram

SECTION 4 INSTALLATION

Paragraph

Initial Procedures. . . . . 1.
Location and Mounting of Transmitter . . . . 2.
External Connections. . . . . 3.
Initial Adjustment . . . . . 4.
Figure 7. Transmitter Installation Drawing.
Figure 8. Assembly of UG-21D/U Connector to Coaxial Cable.
Figure 9. Approximate Initial Settings of Coil Tuning Slugs.
Figure 10. Variation of PA Plate Current and Power Output with Changes in PA Grid Current (Antenna Load Fixed)

1. INITIAL PROCEDURES.

1.2 Inspection. - After unpacking the transmitter, inspect it carefully for evidence of damage which may have occurred during shipment. Pay particular attention to the tubes, meters, fuses, and relays, which are generally more susceptible to damage than are the other components. Inspect each tube individually, including those which have been removed from the transmitter and shipped in cartons within the packing case. Be certain that each of the tubes which has been shipped in place in the transmitter is properly seated in its socket. Check all moving parts, such as switches, relays, tuning controls, the panel doors, etc., for normal movement.

1.3 Installation of tubes. - Tubes V101, V102, V111, V201, V202 and V203 have been shipped in place in their respective sockets. Tube V204 (type 2E26), tubes V103, V104, and V205 (type 6146), tube V206 (type 4X150A), tubes V105 through V108 (type 5R4GY), and tubes V109, V110 and V112 (type 0B2) have been removed from the transmitter and shipped separately inside the packing case. Carefully install those tubes in the appropriate sockets; see figures 18, 20 and 21.

1.3.1 When seating V206 in its socket, be careful not to crack the glass seal. After the tube is seated, place air chimney E201 (also shipped in a carton within the packing case) over the tube; see figure 21. Then tighten the toggle clamp on anode connector E202 so that good contact exists between the plate of the tube and the connector.

2. LOCATION AND MOUNTING OF TRANSMITTER.

2.1 General. - The transmitter is designed for mounting in a standard 19-inch cabinet or rack. The cabinet or rack should be located to permit access to the rear of the transmitter for connections and normal maintenance. The equipment location should also be such that the ambient temperature will remain between -10°C and +60°C.

2.1.1 Under normal conditions, the transmitter should not interact with other communications equipment. However, to insure satisfactory operation, and as a safety precaution, all equipment in a specific location should be bonded to a common ground.

2.2 Location with respect to external wiring. - The transmitter must be connected to a 105 to 130 volt a-c source, the a-f input line, the antenna or antenna relay (including the power line to the relay coil), and a remote-control line if remote control is to be used. While the length of these lines is not critical, the routing of them to and from the mounting rack or cabinet must be considered. Also, it is advisable to keep the length of the antenna transmission line as short as possible, since transmission line loss is a direct function of line length.

2.3 Mounting. - Standard slots in the panel permit the transmitter to be mounted conventionally to the cabinet or rack by the use of standard hardware. A minimum of 26-5/32 inches of cabinet or rack space is required, as shown in figure 7.

3. EXTERNAL CONNECTIONS.

3.1 Antenna. - The transmitter is designed to operate into a 50 ohm resistive load. Therefore, the antenna system which is to be used should have a characteristic impedance close to this value at the frequency to be employed.

3.1.1 A type UG-21D/U coaxial connector (P204) is supplied with the transmitter. This connector is to be used to terminate the coaxial cable, at the transmitter end, which is routed directly from the antenna or from an antenna changeover relay to which the antenna is connected. After attaching P204 to the cable (see figure 8), and ascertaining that there is no short between the inner and outer conductors, connect the cable to receptacle J204; see figure 18.

3.2 Antenna relay control. - If an antenna changeover relay is employed, connect a two-wire line between its coil and terminals 11 and 12 on terminal board TB101; see figure 18. This line will be carrying line voltage, and must be insulated, and routed accordingly.

3.3 Ground. - Be certain that the transmitter is electrically grounded to the cabinet or rack in which it is mounted. The cabinet or rack must be adequately bonded to the station ground.

3.4 Audio input. - Connect a 600 ohm line to terminals 1 and 4 of terminal board TB101. If a shielded line is used, ground the shield to terminal 5 of TB101. Be certain that terminals 2 and 3 on TB101 are connected together.

NOTE

Ground only one end of the shield.

3.5 Remote control. - If the transmitter is to be operated from a remote location, connect the control circuit as specified below in either paragraph 3.5.1, for a-c control, or in paragraph 3.5.2, for d-c control.

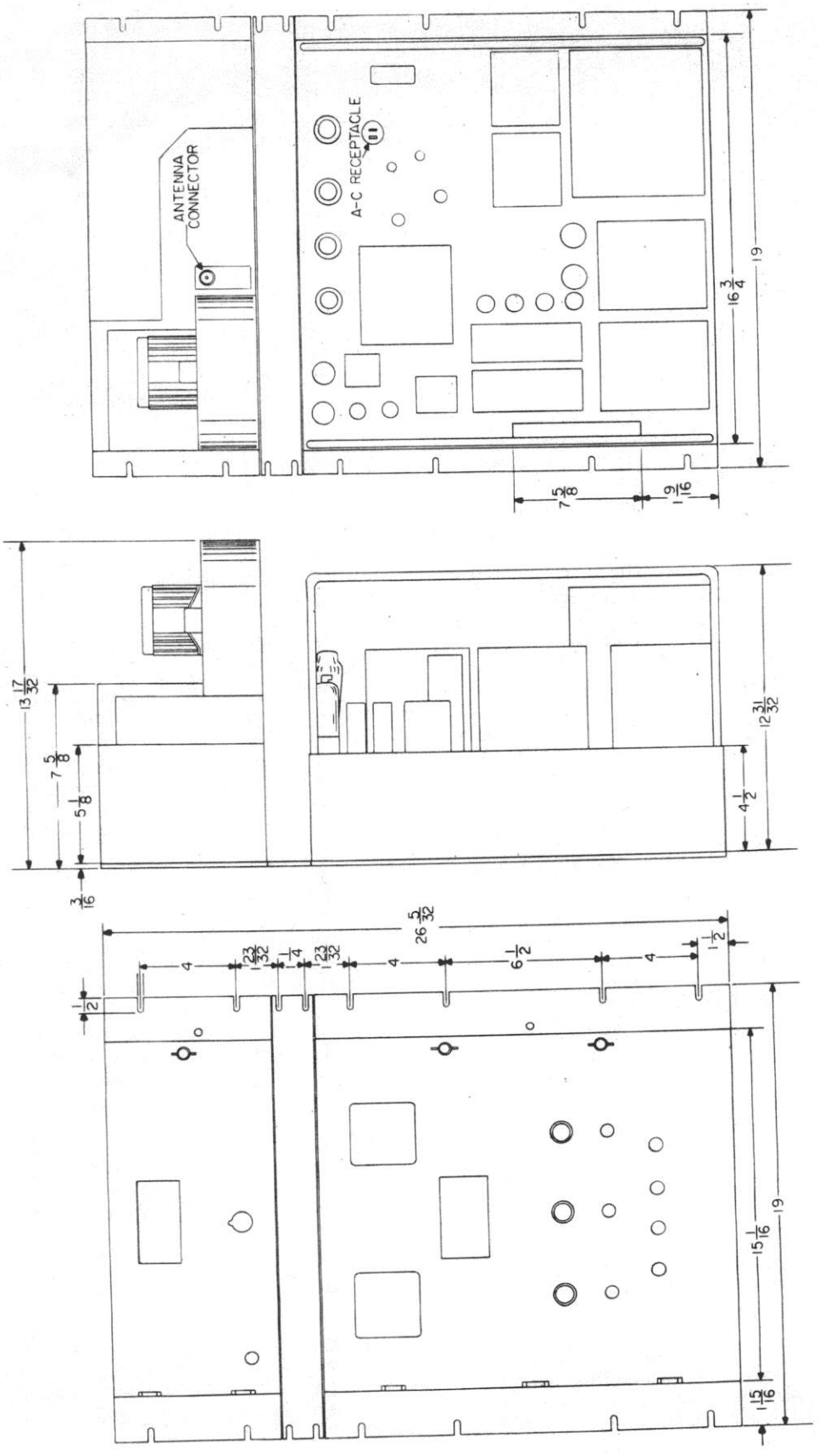
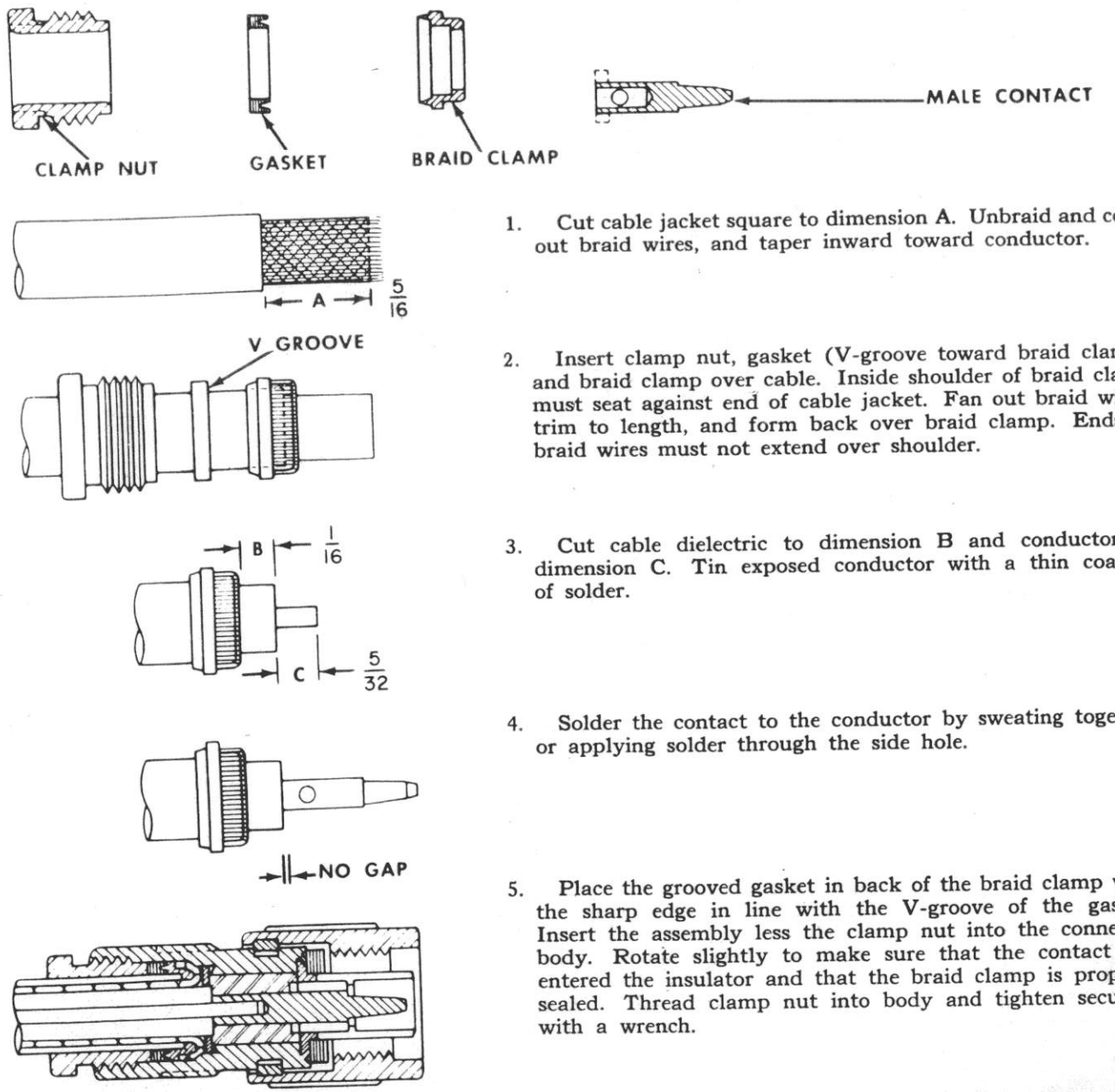


Figure 7. Transmitter Installation Drawing



1. Cut cable jacket square to dimension A. Unbraid and comb out braid wires, and taper inward toward conductor.

2. Insert clamp nut, gasket (V-groove toward braid clamp) and braid clamp over cable. Inside shoulder of braid clamp must seat against end of cable jacket. Fan out braid wires, trim to length, and form back over braid clamp. Ends of braid wires must not extend over shoulder.

3. Cut cable dielectric to dimension B and conductor to dimension C. Tin exposed conductor with a thin coating of solder.

4. Solder the contact to the conductor by sweating together or applying solder through the side hole.

5. Place the grooved gasket in back of the braid clamp with the sharp edge in line with the V-groove of the gasket. Insert the assembly less the clamp nut into the connector body. Rotate slightly to make sure that the contact has entered the insulator and that the braid clamp is properly sealed. Thread clamp nut into body and tighten securely with a wrench.

Figure 8. Assembly of UG-21D/U Connector to Coaxial Cable

3.5.1 A-c remote control requires only the installation of a two-wire line between the transmitter and a remotely located switch (single-pole single-throw.) The design of relay K101 will permit the relay to operate from the remote switch with a line resistance as high as 3000 ohms. Connections to the transmitter are made at terminals 9 and 10 of terminal board TB101. This line must be suitably insulated to accommodate line supply voltage.

3.5.2 D-c remote control requires the application of 48 volts dc to the transmitter from an external source to energize control relay K101. Application of this d-c control voltage can be controlled from any remote point, provided that the loop resistance of the control line does not exceed 3000 ohms. Connections to the transmitter are made at terminals 7 and 8 of terminal board TB101. Polarity of the connections is not important.

3.6 Power source. - A single-phase power source of 105 to 130 volts at 50 to 60 cycles is required. The maximum power which the transmitter will draw from this supply is approximately 700 watts.

3.6.1 During manufacture, the primary of transformer T106 was wired for operation from a 120 volt source. If the actual line voltage is other than 120 ± 2.5 volts, change the wiring to the transformer (see figure 19) to a tap which is suitable to the measured line voltage. The tap voltage and the transformer terminals are indicated on the schematic diagram, figure 25; actual wiring appears in figure 23.

3.6.2 If the transmitter has been used in another installation, be sure to check, and, if necessary, change the wiring to the primary of T106, before application of line supply power.

CAUTION

Do not connect the power cord to the a-c source until instructed to do so in paragraph 4.

4. INITIAL ADJUSTMENT.

4.1 Final inspection. - Recheck all external connections which were installed in the procedures of paragraph 3 of this section. Check the fuses mounted in the fuse holders on the panel door. (See figure 17.) Be certain that fuses of the correct ratings are installed. The fuse ratings are marked on the outside of the door, adjacent to each holder, and are also listed in Section 10.

4.2 Dummy load. - Connect a suitable dummy load to receptacle J204 in place of the antenna transmission line. The dummy load must have a power-handling capability of at least 75 watts at the carrier frequency, and have an impedance of 50 ohms. Use of the dummy load will eliminate unnecessary radiation during the initial adjustment procedures, and will minimize possible interference with other signals.

4.3 Installation of crystal. - Install a type CR-32/U crystal (not supplied with the transmitter) of the proper frequency in crystal oven HR201; see figure 19. The crystal frequency is determined by dividing the desired carrier frequency by four.

4.4 Initial control settings. - Set the transmitter controls as follows (see figure 17):

4.4.1 On the panel doors, place both the POWER switch and the PLATE switch in the OFF position. Set the LOCAL/REMOTE switch to LOCAL, and turn the MULTIMETER SWITCH to its OFF position.

4.4.2 Depress the pushbuttons marked PRESS TO BYPASS INTERLOCK and, keeping them depressed, open the panel doors. The pushbuttons may then be released. This procedure keeps interlock switches S103 and S203 closed while the panel doors are open, and permits the transmitter to be energized without the doors being closed. Exercise extreme caution when the transmitter is energized with the panel doors open; the high voltages present may be fatal if direct contact is made.

SAFETY FIRST

4.4.3 Turn MOD GAIN control R101 fully counterclockwise and PA GRID DRIVE control R227 to midposition; see figures 19 and 20.

4.4.4 Set the tuning slugs in coils L203, L204, L205, L206, L208, and L209 so that their 6-32 studs project from the coil by approximately the distances indicated in figure 9 for the carrier frequency desired. An alignment tool (H101), to be used for making coil adjustments, and an allen wrench are provided in mounting clips located inside the lower panel door; see figure 19.

4.4.5 Connect power cord W101 to the a-c supply.

4.5 Tuning procedures and adjustments. - Place the transmitter in operation as follows (see figure 17):

4.5.1 Place the POWER switch in its ON Position; the green POWER indicator lamp, the white LOCAL indicator lamp, and the amber CRYSTAL HEATER indicator lamp should light. Allow the transmitter to warm up for at least 30 seconds.

NOTE

The CRYSTAL HEATER indicator lamp will remain lighted until the crystal oven reaches operating temperature, at which time the lamp will extinguish. The lamp will then relight whenever the crystal-oven heater is energized.

4.5.2 Place the PLATE switch in its ON position. The red PLATE-ON indicator lamp should light.

NOTE

Except for front-panel controls, the controls and adjustments referenced in the procedures which follow are located inside the transmitter. They are accessible when the panel doors are open; see figure 19.

4.5.3 Turn the MULTI-METER SWITCH to the OSC GRID position. Adjust the tuning slug in OSC PLATE coil L203 for maximum grid current indication (approximately 75) on the MULTI-METER. Then adjust the tuning slug in BUFFER PLATE coil L204 for a dip in oscillator grid current.

SAFETY FIRST

4.5.4 Turn the MULTI-METER SWITCH to the 1ST DOUB GRID position. Adjust the tuning slugs in 1ST DOUB GRID coil-L205 and BUFFER PLATE coil L204 for maximum grid current indication (approximately 80) on the MULTI-METER. Recheck the three coil adjustments. Then adjust the tuning slug in 1ST DOUB PLATE coil L206 for a dip in grid current.

4.5.5 Turn the MULTI-METER SWITCH to the 2ND DOUB GRID position. Adjust the tuning slugs in 2ND DOUB GRID coil L208 and 1ST DOUB PLATE coil L206 for maximum grid current indication (approximately 80) on the MULTI-METER. Recheck both adjustments. Then adjust the tuning slug in 2ND DOUB PLATE coil L209 for a dip in grid current.

4.5.6 Turn PA GRID DRIVE control R227 to approximately mid-range. Turn OUTPUT TUNING capacitor C233 completely counter-clockwise (maximum capacitance) and turn OUTPUT COUPLING coil L219 completely counterclockwise (minimum coupling).

4.5.7 Turn the MULTI-METER SWITCH to the DRIVER GRID position. Adjust DRIVER PLATE tuning capacitor C224 and PA GRID tuning capacitor C228 for minimum driver grid current, and adjust PA plate tuning capacitor C232 for minimum current

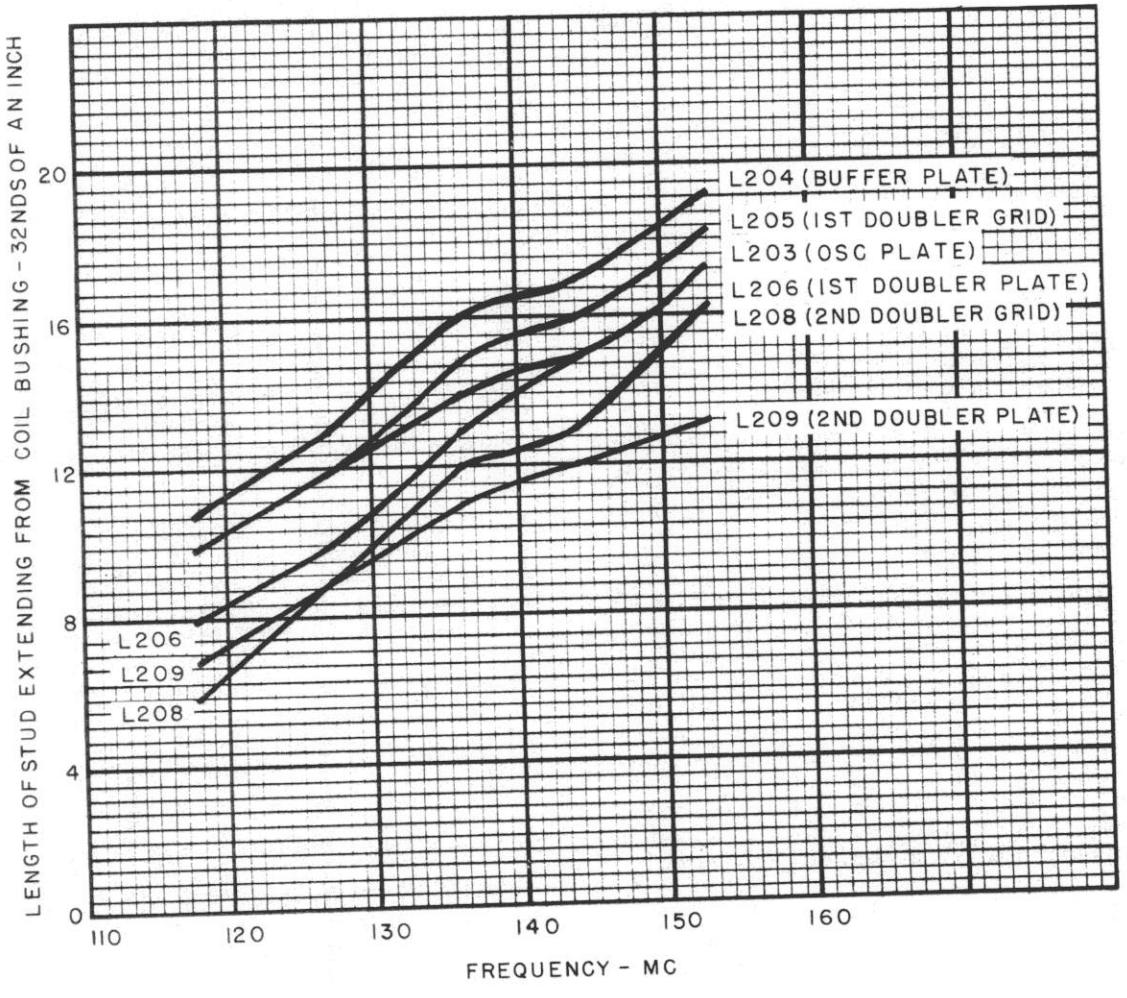


Figure 9. Approximate Initial Settings of Coil Tuning Slugs

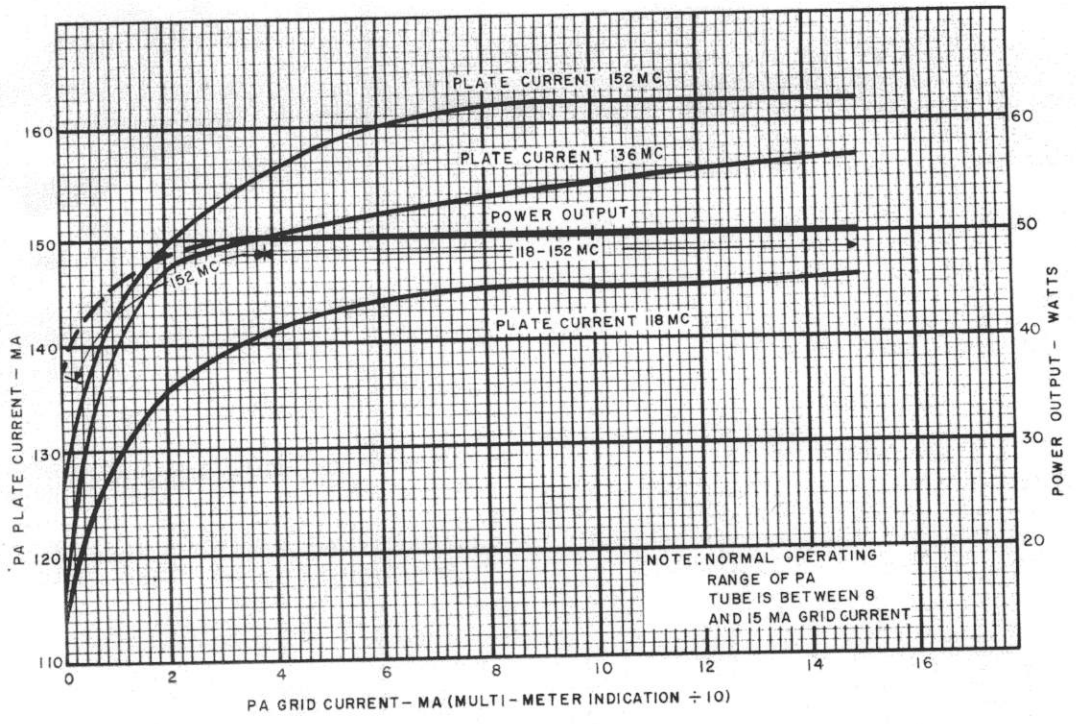


Figure 10. Variation of PA Plate Current and Power Output with Changes in PA Grid Current (Antenna Load Fixed)

indication on the PA PLATE meter. Then readjust 2ND DOUB PLATE coil L209 for maximum grid current indication on the MULTI-METER.

4.5.8 Turn the MULTI-METER SWITCH to the PA GRID position. Adjust DRIVER PLATE tuning capacitor C224 and PA GRID tuning capacitor C228 for maximum grid current indication on the MULTI-METER.

4.5.9 Readjust PA plate tuning capacitor C232 for minimum current indication on the PA PLATE meter, and lock the tuning control. Then adjust OUTPUT TUNING capacitor C233 for maximum plate current. Readjust the OUTPUT COUPLING and OUTPUT TUNING controls to obtain a value of plate current, indicated in figure 10, which corresponds to the carrier frequency being employed and the PA GRID current obtained in paragraph 4.5.8 above. For frequencies other than those shown in figure 10, an approximate interpolation between values will be satisfactory.

4.5.10 Turn the MULTI-METER SWITCH to the DRIVER GRID position. Adjust 2ND DOUB GRID coil L208 for maximum grid current indication on the MULTI-METER.

4.5.11 Turn the MULTI-METER SWITCH to the PA GRID position. Adjust DRIVER PLATE tuning capacitor C224 and PA GRID tuning capacitor C228 for maximum grid current indication on the MULTI-METER. Recheck both tuning adjustments, and then turn PA GRID DRIVE control R227 until the MULTI-METER reading is 90.

4.5.12 Turn the MULTI-METER SWITCH to the MOD CATH position; the reading on the MULTI-METER should be 25. In those cases where a meter indication as high as 25 cannot be obtained, because of modulator tubes having low cut-off bias characteristics, the maximum obtainable meter indication (not less than 15) should be used. Then, with the speech signal, which is to be used in normal operation, present on the a-f input line, turn MOD GAIN control R101 until the MULTI-METER indication on voice peaks is approximately 100.

4.5.13 Set the PLATE switch to its OFF position.

4.5.14 If remote operation is to be employed, set AC-DC switch S104 (see figure 18) to the position appropriate to the external control line, either AC or DC, as detailed in paragraph 3.5 of this section. Set the LOCAL/REMOTE switch to REMOTE; the white LOCAL indicator lamp should go out. Check the remote control of the transmitter by closing the control

switch at the remote operating position. There should be no difference in meter readings from those obtained in paragraphs 4.5.9 and 4.5.12 of this section. De-energize the remote control circuit.

4.5.15 If a dummy load was used during the preceding adjustments, disconnect it from receptacle J204 and reconnect the antenna transmission line. Return the PLATE switch to its ON position, or instead, if the transmitter has been set up for remote operation, close the remotely located control switch; repeat the procedures detailed in paragraphs 4.5.9 through 4.5.12. Then remove plate power by placing the PLATE switch in its OFF position, or opening the remote control switch, depending on whether local or remote operation is to be used.

4.5.16 Set the POWER switch to its OFF position. Fill in the installation and guarantee expiration dates on the rear of the upper panel door, and close both doors.

SECTION 5 OPERATION

1. INTRODUCTION. - Operation of the transmitter consists of energizing and deenergizing the a-c power and plate voltage circuits by means of the switches mounted on the lower door and, when remote control is employed, by means of the remotely located switch. The operating procedures outlined in this section are to be followed after the equipment has been installed and prepared for operation as specified in Section 4.

2. OPERATING PROCEDURES (See figure 17.)

2. 1 Preliminary control settings. - Prior to operation, be certain that the POWER switch and the PLATE switch are both set to their OFF positions. Turn the MULTI-METER SWITCH to the MOD CATH position. The LOCAL/REMOTE switch will have been set, during installation, to the position appropriate to the type of operation to be employed; do not change the setting of the switch.

2. 2 Applying a-c power. - To apply a-c power to the transmitter, place the POWER switch in the ON position. The green POWER indicator lamp and the amber CRYSTAL HEATER lamp should both light. If the transmitter has been set up for local operation LOCAL/REMOTE switch in the LOCAL position, the white LOCAL indicator lamp should also light. Allow the transmitter to warm up for at least 30 seconds before proceeding.

NOTE

The CRYSTAL HEATER indicator lamp will remain lighted until the crystal oven reaches operating temperature, at which time the lamp will extinguish. The lamp will then relight whenever the crystal-oven heater is energized.

2. 3 Applying and removing plate power, local operation. - To apply plate power locally, the LOCAL/REMOTE switch must be in the LOCAL position and the LOCAL indicator lamp lighted. Place the transmitter on the air by setting the PLATE switch in the ON position. The red PLATE-ON indicator lamp should light. A normal reading should be indicated on the PA PLATE meter, and the modulator cathode current indicated on the MULTI-METER should vary in accordance with the speech input. Refer to paragraph 2. 5 below for details concerning the meter readings to be expected.

2. 3. 1 At the end of the transmission, remove plate power by returning the PLATE switch to its OFF position.

2. 4 Applying and removing plate power, remote operation. - To apply plate power from a remote location, the LOCAL/REMOTE switch must be in the REMOTE position and the LOCAL indicator lamp extinguished. Place the transmitter on the air by closing the external remote-control switch. The red PLATE-ON indicator lamp should light, a normal reading should be indicated on the PA PLATE meter, and the modulator cathode current indicated on the MULTI-METER should vary in accordance with the speech input. Refer to paragraph 2. 5 below for details concerning the meter readings to be expected.

2. 4. 1 At the end of the transmission, remove plate power by opening the remote-control switch.

2. 5 Monitoring meter readings. - During transmissions, and at times specified by local operating procedures, monitor and log the reading of the PA PLATE meter. Set the MULTI-METER SWITCH to each of its positions, and log the reading of the MULTI-METER

TABLE 1. MULTI-METER CALIBRATION AND TYPICAL READINGS

MULTI-METER SWITCH Position	Full-Scale Range (ma)	Factor for Current Reading	Typical MULTI-METER Reading	Typical Current (ma)
OFF	-	-	-	-
OSC GRID	1. 5	0. 1	8	0. 8
1ST DOUB GRID	1. 5	0. 1	10	1. 0
2ND DOUB GRID	3. 0	0. 1	14	1. 4
DRIVER GRID	3. 0	0. 1	16	1. 6
PA GRID	15	1	9	9
MOD CATH	150	10	3 (No a-f input) 10 (voice peaks)	30 100
OUTPUT	*	*	13	*

* Actual current not pertinent; readings are relative.

for each switch position. Then return the MULTIMETER SWITCH to the MOD CATH position.

2. 5. 1 Compare the meter readings to those previously logged, or with the typical values shown in table 1 and figure 10. If there are marked differences in any of the readings, or if a series of logged readings show increasing differences from the normal value, the situation should be investigated by qualified maintenance personnel.

2. 6 Removing a-c power. - To deenergize the transmitter completely, place the POWER switch in the OFF position.

3. CHANGING FREQUENCY OF OPERATION. - Changing frequency is not considered a normal operating procedure. The tuning procedures involved, which must be performed by a qualified technician, are detailed in Section 4, paragraph 4.

4. REPLACING PANEL-MOUNTING FUSES. - A blown panel-mounted fuse is indicated by a lighted neon lamp in the cap of the fuse holder. Be sure to replace the blown fuse with one of the same current rating, as marked on the panel door adjacent to the fuse holder. If the replacement fuse also blows, corrective maintenance techniques must be applied to locate the fault.

SECTION 6 PREVENTIVE MAINTENANCE

1. GENERAL. - Very-High-Frequency Radio Transmitter, Type TV-15, has been designed for continuous duty, and can be expected to provide as trouble-free operation as is possible. Although a certain amount of component failure must be expected in equipment of this type, it is often possible to forestall complete equipment breakdown by performance of preventive maintenance techniques. These techniques include both physical and electrical procedures.

2. ROUTINE MAINTENANCE PROCEDURES.

2.1 Specific procedures. - The specific preventive maintenance procedures which should be performed, and the intervals recommended for these procedures, are listed in table 2. The periods specified are maximum time intervals; if operating conditions or schedules warrant it, the times between performances of the maintenance procedures should be reduced.

2.2 Physical inspection. - A physical inspection of the transmitter should be made at each routine maintenance check. Make a visual inspection of resistors, transformers, chokes, etc. for evidence of discoloration resulting from overheating. If the transmitter has been in operation, check the transformers, reactors, and blower to determine if there is any overheating. Check capacitors for leakage of oil. Any such leakage or overheating is an indication of a possible impending failure, and corrective measures should be taken immediately.

3. RELAY MAINTENANCE.

3.1 General. - Relays K101 and K102 (see figure 11) require periodic inspection and cleaning in order to rid the contacts of dust and corrosion. Transmitter operation is dependent upon satisfactory functioning of these relays.

3.2 Cleaning. - If relay contacts are dirty or corroded, clean them by moistening a clean strip of paper with a volatile cleaning solvent (Federal Specification P-S-661) and drawing the moistened paper between the contacts while holding them closed. If dirt or corrosion remains after two or three such treatments, burnish the contacts with a suitable burnishing tool.

NOTE

Do not use carbon tetrachloride to clean relay contacts.

3.3 Inspection. - Inspect the relays to be sure that the armatures are free and do not bind during movement. Springs should be straight and free from damage; contact gaps should be uniform. Be careful not to disturb the spring settings or contact adjustments and gaps.

4. LUBRICATION. - No lubrication is required. The bearings in the blower motor B201 are sealed, and have a life expectancy of at least one year of continuous operation.

TABLE 2. ROUTINE PREVENTIVE MAINTENANCE

Period	Item	Maintenance Procedure
Weekly	Meter readings	Compare readings with those previously logged or with typical values listed in table 1 and figure 10. Investigate extreme differences and correct fault.
	Blower operation	Check blower B201 to insure that tube V206 is being cooled. Be certain that air flow around tube is not obstructed.
Monthly	Control knobs and switches	Tighten loose knobs and mounting nuts.
	Relays	Clean contacts and inspect for normal operation; see Section 6, par. 3.
	Chassis, parts, etc.	Blow out accumulated dust with compressed air, or carefully brush off.
Semi-annually	Power-supply voltages	Check power-supply voltages at terminals 1, 3, 10 and 11 on J102 against values shown on schematic, figure 25. Investigate differences and correct fault.
	Blower	Clean unit and check bearings; see Section 7, par. 3.

SECTION 7 CORRECTIVE MAINTENANCE DATA

Paragraph

Troubleshooting . . . . . 1.
Adjustments . . . . . 2.
Replacement of Bearings in Blower B201 . . 3.
Summary of Type-Test Data . . . . . 4.
Table 3. Trouble Chart
Table 4. Tube-Socket Voltage and Resistance Measurements
Table 5. Typical Audio-Frequency Response Data
Table 6. Typical R-F Tube Plate and Screen Voltages with No Excitation
Table 7. Typical Rectifier Peak Inverse Voltages
Table 8. Typical Effect on Frequency of Detuning
Figure 11. Relay K101
Figure 12. Blower B201
Figure 13. Basic Test Setup
Figure 14. Basic Test Setup with Modulation and Spurious Frequencies
Figure 16. Test Setup for Measurement of Low-Pass Filter Attenuation

1. TROUBLESHOOTING.

1.1 General. - When troubleshooting the transmitter to analyze and/or isolate a fault, make use of the maintenance features which have been incorporated into the equipment. Analysis of the readings obtained on PA PLATE meter M102 and on MULTI-METER M101 for the various positions of MULTI-METER SWITCH S202 will generally provide a quick check as to whether the trouble is in the r-f section, the a-f section, or both (in which case the power supplies should be investigated). The meters will, in nearly all instances, also permit the technician to determine which stage is at fault if trouble occurs in the r-f section. The power supply voltages can be easily measured on pins 1, 3, 10 and 11 of J102. Audio quality can be checked quickly at test jacks TP201 and TP202, on the rear of the upper panel door; see figure 18.

1.1.1 Additional aids for the maintenance technician have been included in this instruction book. The transmitter schematic and wiring diagrams and the tube-socket voltage and resistance measurements will probably provide the most important data for troubleshooting. The trouble chart should also be helpful and may provide additional information or procedures which have been overlooked while attempting to isolate the fault; refer to paragraph 1.2 below.

1.2 Trouble chart. - The trouble chart, table 3, lists the symptoms of possible troubles, their probable causes, and remedies. It is assumed that, prior to troubleshooting, it has been definitely established that line voltage is present at the transmitter, and that all fuses and indicator lamps are in place and are operable.

1.2.1 The trouble chart has been arranged in a sequence which systematically eliminates possible causes after the first time that each appears in the table. Once mentioned, a possible cause is not repeated if it can be assumed that it would have been rectified by virtue of its appearance in a preceding step in the table. Proper use of the table, therefore, requires that the transmitter be energized in the sequence indicated in the table, and that each symptom as it appears in the table be checked before proceeding to the next.

1.3 Voltage and resistance measurements. Tube-socket voltage and resistance measurements appear in table 4. All d-c voltage readings should be made with a voltmeter having a sensitivity of 20,000 ohms per volt, unless otherwise specified. The sensitivity for a-c measurements is not critical; any a-c volt-meter or multimeter rated at 1000 ohms per volt or better may be used.

1.4 Bypassing interlock switchs S103 and S203. - The procedure for bypassing the interlock switchs so the panel doors can be opened without deenergizing the transmitter, appears in Section 4, paragraph 4.4.2.

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2. ADJUSTMENTS.

2.1 Non-operating controls. - Adjustment of all controls is covered in Section 4, paragraph 4.

2.2 Relay K101. - If relay K101 fails to close in normal operation, and it has been established that the control circuits are functioning properly, that proper control voltage is present at the coil, and that the coil is not open, it may be necessary to readjust the relay contacts or spring tension. This can be done by performing the procedures of paragraphs 2.2.1 through 2.2.5.

2.2.1 Remove all power from the transmitter, and open the lower panel door. Refer to figure 11 while making the following adjustments on control relay K101.

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2.2.2 Place a 0.002 inch shim between the pole piece and the relay armature. Depress the relay armature manually.

2.2.3 Loosen the lock nut and adjust the normally open contact until it just makes contact with the armature. This will provide the necessary overtravel required.

2.2.4 Remove the 0.002 inch shim from the pole piece. Place a 0.005 inch shim between the normally open contact and the armature. Loosen the lock nut and adjust the normally closed contact until the shim fits snugly.

2.2.5 Check the spring tension for 35 to 40 grams pull. Adjust the spring tension if necessary. (See figure 11.) After adjusting the spring tension (if required) tighten all locks nuts.

TABLE 3. TROUBLE CHART

Symptom	Probable Cause	Remedy
POWER AND CONTROL CIRCUITS		
Green POWER lamp I101 does not light when POWER switch S101 is set to ON.	Lamp I101 defective.	Replace I101.
	Power cord W101 defective.	Repair or replace power cord W101.
	Resistor R122 open.	Replace R122.
	Switch S101 defective.	Replace S101.
MAIN fuse F101 blows repeatedly with S102 closed.	Short in transmitter.	Remove V105, V106, V107, V108, V111; check wiring, S102 through S201, by-pass capacitors, fuse holders, etc.; replace defective part.
	Short in a-c remote control circuit (with switch S104 set to AC).	Check external remote control circuit; replace defective part or remove short.
Blower B201 does not start.	Blower motor defective.	Replace B201.
	Capacitor C122 open.	Replace C122.
Blower B201 noisy.	Mounting hardware loose.	Tighten or replace hardware.
	Blower bearings worn.	Replace bearings; see Section 7, par. 3.
FILAMENT fuse F104 blows repeatedly.	Shorted Filament circuit.	Check circuits from secondaries of T201; remove short.
	Transformer T201 shorted.	Replace T201.
	Short in blower circuit.	Check wiring and power circuit; replace defective part.
	Blower damaged or motor defective.	Repair or replace B201.
BIAS fuse F103 blows repeatedly.	Short in bias supply.	Check V111; trouble shoot power supply; replace defective part.
	Shorted filament circuit.	Check V105, V106, V107, V108; check circuits from filament windings of T105, remove short.
Amber CRYSTAL HEATER lamp I201 does not light.	Transmitter in recent use; crystal over, HR201 at operating temperature.	None required; lamp should light only when HR201 is energized.
	Lamp I201 defective.	Replace I201.
	Resistor R204 open.	Replace R204.
	Crystal oven HR201 defective.	Replace HR201.

TABLE 3. TROUBLE CHART (Cont.)

Symptom	Probable Cause	Remedy
POWER AND CONTROL CIRCUITS (Cont.)		
White LOCAL lamp I102 does not light when switch S105 is set to LOCAL.	Lamp I102 defective.	Replace I102.
	Resistor R123 open.	Replace R123.
	Switch S105 defective.	Replace S105.
Red PLATE ON lamp I103 does not light when PLATE switch S102 is set to ON and switch S105 is set on LOCAL. (Transmitter operation otherwise normal.)	Lamp I103 defective.	Replace I103.
	Resistor R124 open.	Replace R124.
PLATE fuse F102 blows	Short in plate supply.	Check V105, V106, V107, V108; trouble shoot power supply; replace defective part.
	Power amplifier stage or transformer T103 defective.	Check for and remove short.
		Trouble shoot; see procedures under portion of this chart headed "R-F Section."
	Short in external accessory voltage circuit.	Check external circuit; replace defective part or remove short.
	Short in plate power control circuit.	Check K101, K102, XF102; replace defective part or remove short.
Red PLATE-ON lamp I103 does not light when PLATE switch S102 is set to ON and switch S105 is set to LOCAL. Both PA PLATE meter M102 and MULTI-METER M101 (with switch S202 set to MOD CATH) read zero.	No output from bias supply.	Check V111, V112, K102; trouble shoot power supply; replace defective part; Check operation of blower B201 for reduced or obstructed air flow. Remove obstruction or replace B201 or C122.
	Air-flow switch S201 open.	
	Plate power control circuit defective.	Check K101, K102, S102, S105, S201; replace defective part.
Transmitter does not function when switch S105 is set to REMOTE-AC and remote control switch is closed. (Transmitter operation normal with S105 set to LOCAL.)	Remote control line open.	Check and repair remote control circuit.
	Switch S104 or S105 defective.	Replace defective switch.

TABLE 3. TROUBLE CHART (Cont.)

Symptom	Probable Cause	Remedy
	R-F SECTION	
Zero reading on MULTI-METER M101 for any or all positions of MULTI-METER SWITCH S202, except OFF. (Transmitter operation otherwise normal.)	MULTI-METER circuit defective.	Check M101, S202; trouble shoot meter circuit; replace defective part.
Zero or low reading on MULTI-METER M101; switch S202 set to OSC GRID.	Oscillator tank circuit detuned.	Adjust L203; see Section 4, par. 4.5.3.
	Oscillator defective.	Check V201; trouble shoot oscillator circuit; replace defective part.
	Crystal Y201 defective.	Replace Y201.
	Main plate supply defective.	Check V105, V106, V107, V108; trouble shoot power supply; replace defective part.
Zero or low reading on MULTI-METER M101; switch S202 set to 1ST DOUB GRID.	Tank circuits between buffer amplifier and first doubler detuned.	Adjust L204, L205; see Section 4, par. 4.5.3 and 4.5.4.
	Buffer amplifier defective.	Check V202; trouble shoot buffer amplifier circuit; replace defective part.
	First doubler defective.	Check V203; trouble shoot first doubler circuit; replace defective part.
Zero or low reading on MULTI-METER M101 switch S202 set to 2ND DOUB GRID.	Tank circuits between first and second doublers detuned.	Adjust L206, L208; see Section 4, par. 4.5.4 and 4.5.5.
	First doubler defective.	Check V203; trouble shoot first doubler circuit; replace defective part.
	Second doubler defective.	Check V204; trouble shoot second doubler circuit; replace defective part.
Zero or low reading on MULTI-METER M101; switch S202 set to DRIVER GRID.	Tank circuit of second doubler detuned.	Adjust L209; see Section 4, par. 4.5.5 through 4.5.7.
	Driver defective.	Check V205; trouble shoot driver circuit; replace defective part.
	Second doubler defective.	Check V204; trouble shoot second doubler circuit; replace defective part.

TABLE 3 TROUBLE CHART (Cont.)

Symptom	Probable Cause	Remedy
Zero or low reading on MULTI-METER M101; switch S202 set to PA GRID.	PA GRID DRIVE control R227 misadjusted.	Adjust R227; see Section 4, par. 4.5.11.
	Driver tank circuit and power amplifier grid detuned.	Adjust C224, C228, see Section 4, par. 4.5.7 through 4.5.11.
	Power amplifier defective.	Check V206; trouble shoot power amplifier circuit; replace defective part.
	Driver defective.	Check V205; trouble shoot driver circuit; replace defective part.
	Coupling circuit between driver and power amplifier misaligned or open.	Check coupling between L212 and L213; between L214 and L215; reposition link L213 or L214.
		Check coaxial cable between L213 and L214; replace if defective.
Abnormally high reading on MULTI-METER M101; switch S202 set to PA GRID.	PA GRID DRIVE control R227 misadjusted.	Adjust R227; see Section 4, par. 4.5.11.
	Meter shunt defective.	Check R216; replace if defective.
Abnormally high reading on PA PLATE meter M102.	Power amplifier plate tank or output coupling circuit detuned.	Retune; see Section 4, par. 4.5.9 through 4.5.11.
	Power amplifier defective.	Check V206; trouble shoot power amplifier circuit; replace defective part.
Zero or abnormal reading on MULTI-METER M101; switch S202 set to OUTPUT; reading other than zero on PA PLATE meter M102.	Power amplifier plate tank or output coupling circuit detuned.	Retune; see Section 4, par. 4.5.9 through 4.5.11.
	Output monitoring circuit defective.	Check CR201; trouble shoot monitoring circuit; replace defective part.
	Filter FL201 defective.	Replace FL201 if Shorted.
	Power amplifier defective.	Check B206; trouble shoot power amplifier circuit; replace defective part.
Zero or low reading on PA PLATE meter M102.	Power amplifier defective.	Check V206; trouble shoot power amplifier circuit; replace defective part.
	Meter circuit defective.	Check M102, trouble shoot meter circuit; replace defective part.
	Modulation transformer T103 defective.	Check secondaries of T103; replace transformer it open.

TABLE 3. TROUBLE CHART(Cont)

Sympton	Probable Cause	Remedy
	A-F SECTION	
Zero or low reading on MULTI-METER M101; switch S202 set to MOD CATH. (No a-f input to transmitter.)	Modulator bias incorrect.	Check V111, V112; trouble shoot power supply.
	Modulator defective.	Check V103, V104; trouble shoot modulator; replace defective part.
	Modulator plate supply defective.	Check V105, V106, V107, V108; trouble shoot power supply; replace defective part.
	Screen voltage regulator defective.	Check V109, V110; trouble shoot power supply circuit; replace defective part.
Abnormally high reading on MULTI-METER M101; switch S202 set to MOD CATH. (No a-f input to transmitter.)	Modulator bias incorrect.	Check V111, V112; trouble shoot power supply.
	Screen voltage regulator defective.	Check V109, V110; trouble shoot power supply circuit; replace defective part.
	Short in modulator grid circuit.	Trouble shoot modulator; replace defective part.
	Meter shunt R119 or R215 open.	Replace defective resistor.
Low modulation level, or low readings on MULTI-METER M101 on voice peaks; switch S202 set to MOD CATH.	MOD GAIN control R101 improperly set.	Adjust R101; see Section 4, par. 4.5.12.
	Weak tube.	Check V101 through V104; replace defective tube.
	Defective circuit between T101 and T103.	Trouble shoot a-f section: replace defective part.
	Shorted transformer winding.	Check T101, T102, T103; replace defective transformer.
Audio distortion and/or hum (monitored at test jacks TP201 and TP202).	Heater-to-cathode leakage in tube.	Check V101 through V104, also V206; replace defective tube.
	Leaky coupling capacitor. Defective transformer winding.	Check C102, C107, C108, C109; replace defective part. Check T101, T102 and T103.
	Change in resistor value or defective bypass capacitor.	Trouble shoot a-f section; replace defective part.
Audio distortion (reported from receiving site).	Overmodulation; MOD GAIN control R1 improperly set.	Adjust R101; See Section 4, par. 4.5.12.

TABLE 4. TUBE SOCKET VOLTAGE AND RESISTANCE MEASUREMENT

TUBE	Measure	Pin No. 1	2	3	4	5	6	7	8	9	Cap
MODULATOR AND POWER SUPPLY SECTION											
V101 12AU7 1st speech Amp.	V	0	0	0	0	0	77	[a]0	3.8	6.3ac	
	R	Inf	Inf	Inf	0	0	135K	35K Vol. Con. Max.	3.9K	0.1	
V102 2nd and 3rd Speech Amp.	V	180	0	8	0	0	82	0	2.9	6.3ac	
	R	27K	700K	2.7K	0	0	130K	750K	2.7K	0.1	
V103 6146 Modulator	V	1.0	0	225	1.0	-53	1.0	6.3ac	0	--	590
	R	9.1	0	7.2K	9.1	14.5K	9.1	0.1	Inf	--	4.8K
V104 6146 Modulator	V	1.0	0	225	1.0	-53	1.0	6.3ac	0	--	590
	R	9.1	0	7.2K	9.1	14.5K	9.1	0.1	Inf	--	4.8K
V105 5R4GY Rectifier	V	--	5.0ac	--	780ac	---	780ac	---	[i]5.0ac	--	
	R	--	4.8K	--	33	---	33	---	4.8K		
V106 5R4GY Rectifier	V	---	5.0ac	---	780ac	---	780ac	--	[i]5.0ac		
	R	---	4.8K	---	33	---	33	--	4.8K		
V107 5R4GY Rectifier	V	---	[i]5.0ac	---	780ac	---	780ac	--	[i]5.0ac		
	R	---	4.8K	---	30	---	30	--	4.8K		
V108 5R4GY Rectifier	V	---	[i]5.0ac	---	780ac	---	780ac	--	[i]5.0ac		
	R	---	4.8K	---	30	---	30	--	4.8K		
V109 OB2 Voltage Regulator	V	210	---	---	---	---	---	105	---		
	R	7.2K	Inf	---	Inf	7.2K	---	Inf	---		
V110 OB2 Voltage Regulator	V	105	---	---	---	---	---	0	---		
	R	Inf	0	---	0	Inf	---	0	---		
V111 6 x 4 Rectifier	V	-255	---	6.3ac	0	---	-255	0	---		
	R	8K	---	0.1	0	---	8K	0	---		
V112 OB2 Voltage Regulator	V	0	---	---	---	---	---	108	---		
	R	0	---	---	---	0	---	4.6K	---		

Table 4. TUBE SOCKET VOLTAGE AND RESISTANCE MEASUREMENT (Cont.)

TUBE	Measure	Pin No. 1	2	3	4	5	6	7	8	9	Cap
R-F SECTION											
V201 12AT7 Oscillator	V	[a]130	-7	1.2	6.3ac	6.3ac	130	0	1.2	0	
	R	15K	12.5K	110	.2	.3	15K	0	110	0	
V202 6AU6 Buffer Amp.	V	0	0	0	6.3ac	[c]240	120	1.4			
	R	6800	0	0	.3	3.3K	26K	220			
V203 5763 1st Doub	V	[c]240	---	0	6.0ac	0	155	0	[c]-30	[c]-30	
	R	4K	---	0	.2	0	8.3K	0	28K	28K	
V204 2E26 2nd Doub	V	0	6.3ac	138	0	[c]-90	0	0	0		[k]160
	R	0	.2	18K	0	48K	0	0	0		5.5K
V205 6146 Driver	V	0	6.3ac	[d]-80	0	[c]-46	0	0	0		[k]300
	R	0	.2	8K	0	14K	0	0	0		3.8K
V206 4X150A P A	V	218	0	0	0	---	0	6.0ac	0	[f]-100	[k]600
	R	3K	0	0	0	---	0	.2	0	[g]3.8K	5K

NOTES:
1. All voltage measurements dc unless otherwise noted.
2. D-c measurements made with 20,000 ohm/volt meter unless otherwise noted; ac measurements made with 1000 ohm/volt meter.
3. All resistance measurements in ohms, measured to ground, K=1000.

[a] Measure with vtvm.

[b] Measure with vtvm with 21 uh r-f choke (Ohmite Z-28 or equal) in series with probe.

[c] Measure with vtvm at cold (r-f ground) side of tank coil.

[d] Varies with setting of PA GRID DRIVE control R227.

[e] Measure with vtvm with 1.8 uh r-f choke (Ohmite Z-144 or equal) in series with probe.

[f] Measure at high side of R216.

[g] Measure at center pin of XV206.

[h] Varies with setting of MOD GAIN control R101.

[i] Measure between pins 2 and 8.

[j] Measure with vtvm.

[k] Measure at power-supply side of plate r-f choke.

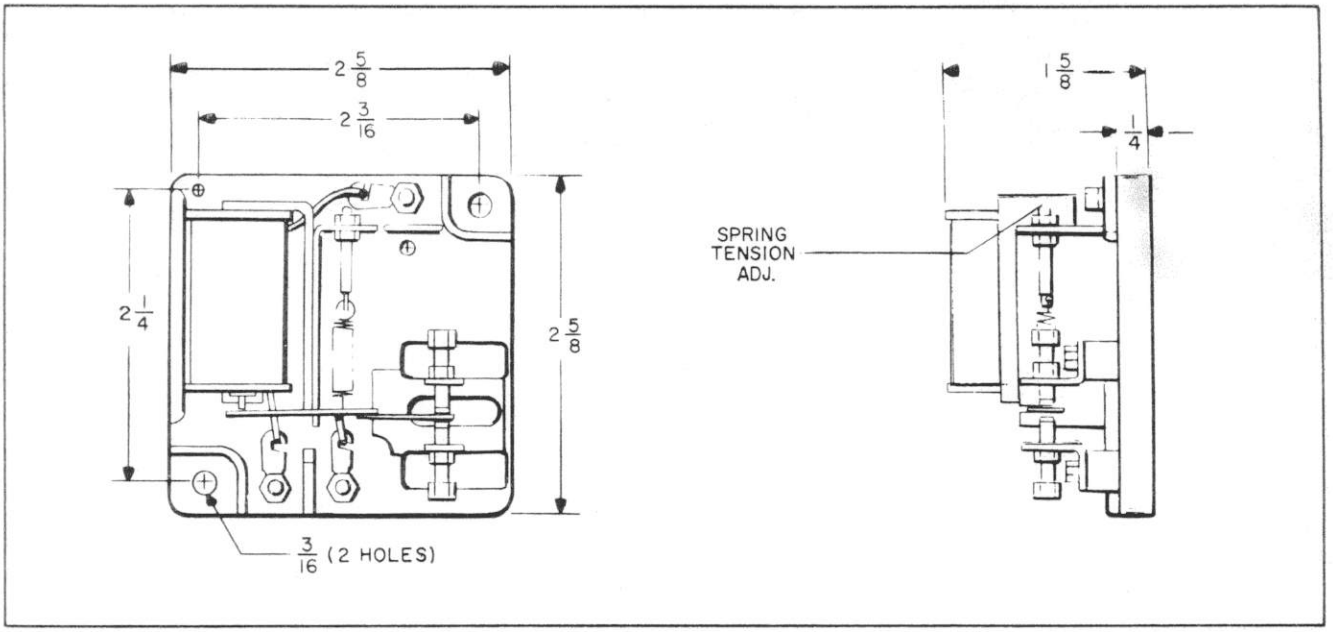
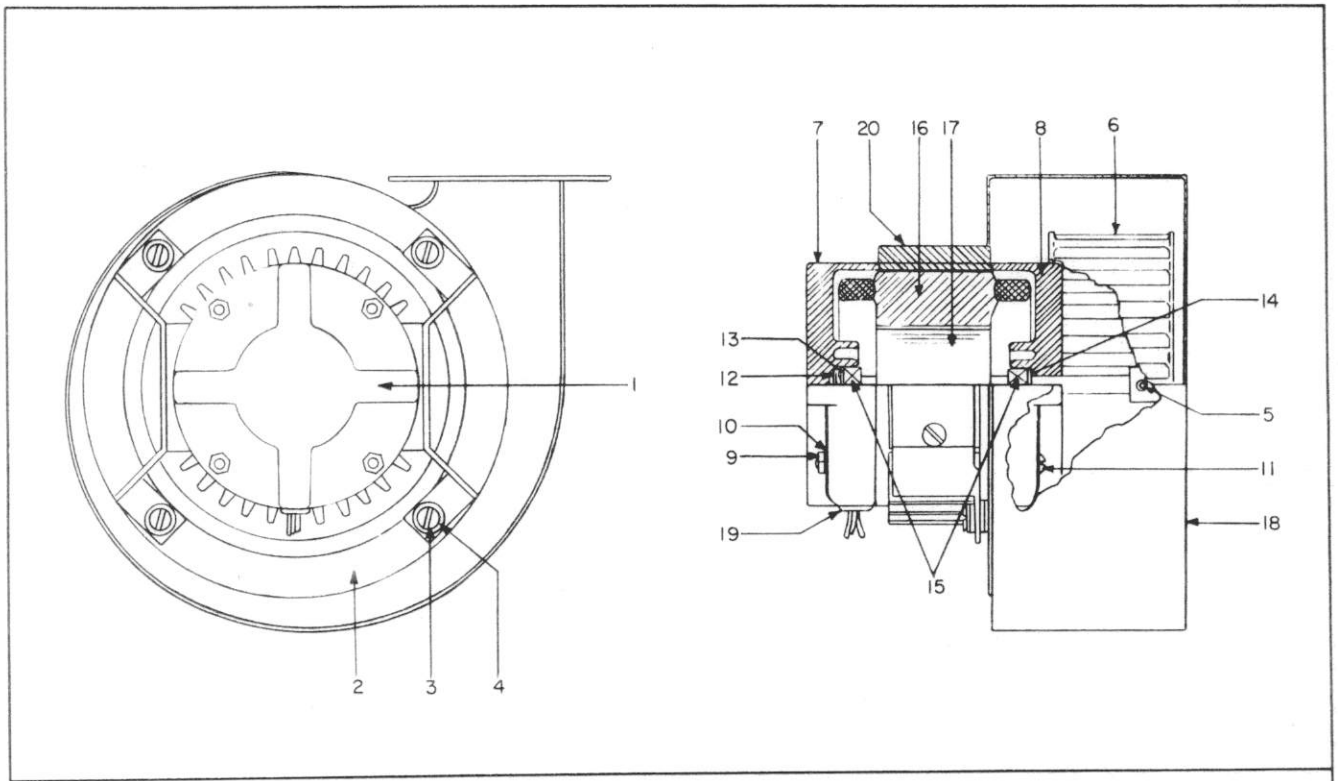


Figure 11. Relay K101



1 Motor assembly	6 Blower wheel	11 Through bolt	16 Stator assembly
2 Inlet ring	7 End Cap	12 Shim	17 Rotor assembly
3 Screw	8 End Cap	13 Load spring	18 Housing
4 Washer	9 Nut	14 Shim	19 Grommet
5 Set screw	10 Washer	15 Bearing	20 Motor frame

Figure 12. Blower B201

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2.2.6 Set the LOCAL/REMOTE switch to REMOTE and the AC-DC switch to DC. Connect a 48 volt battery to terminals 7 and 8 of TB101, placing a 2700 ohm resistor in series with one of the leads. Check that the relay pulls in. Set the AC-DC switch to AC and connect a single pole single throw switch between terminals 9 and 10 on TB101. Set the POWER switch to ON, close the remote switch, again checking that the relay pulls in. Set the LOCAL/REMOTE switch to LOCAL and the relay should again pull in.

2.2.7 Replace any connections previously removed and restore all switches to their original positions.

3. REPLACEMENT OF BEARINGS IN BLOWER B201.

3.1 Removal of blower. - After removing all power from the transmitter, unplug P202 from J202; see figure 18. Since it is not necessary to remove the entire blower assembly from the transmitter for replacement of bearings, part of the procedure outlined below is for removal of the motor from the blower housing.

3.2 Disassembly. - (See figure 12.) Disassemble the blower as follows:

3.2.1 Remove the motor assembly (1) and the inlet ring (2) by removing four screws (3) and washers (4) which secure it to the housing (18). Be careful not to lose the four spaces used to mount the motor assembly.

3.2.2 Loosen the set screw (5) and remove blower wheel (6) and inlet ring (2).

3.2.3 Remove end cap (7) by removing four through-bolts (11), four nuts (9), and four lock washers (10). It may be necessary to gently tap the ribs of the end cap with a mallet to loosen it. If it does not come free readily carefully pry it off with a screwdriver.

CAUTION

Apply the mallet only to the ribs on the end cap. Do not force the end cap off.

3.2.4 Remove rotor assembly (17) with the bearings assembled to it. Remove shims (12) and (14) and load spring (13).

3.2.5 Remove bearings (15) with a suitable bearing puller. Be sure that the puller applies pressure only to the inner race of the bearing (and the shaft); avoid excessive pressure, which may bend the shaft.

3.3 Reassembly. After cleaning all parts of the blower which are to be reassembled, proceed as follows:

3.3.1 Press a new bearing (O201) on the journal at each end of the shaft, using an arbor press and a suitable bearing installer. The latter can be a short length of pipe or tubing whose inner diameter clears the shaft and which will press against the inner race of the bearing, but not the outer race. Be certain that the bearing is carefully aligned with the journal before applying pressure, and that the bearing outer race is free to rotate during the press-on operation.

3.3.2 Replace the shims and load spring. Be sure that the load spring is placed between the shims and the bearing face, and that all of the shims are replaced.

3.3.3 Reassemble the remainder of the blower, using the reverse procedure of disassembly. Be certain that all hardware is replaced in the same location as prior to disassembly.

3.3.4 After reassembly, check the operation of the blower wheel by manually rotating it a few times before plugging P202 to J202. The wheel should rotate freely.

3.3.5 Plug P202 to J202 and operate the POWER switch to ON. The blower should operate smoothly and quietly.

4. SUMMARY OF TYPE-TEST DATA.

4.1 Use of type-test data. - The type tests included in this instruction book are those tests which are performed on the transmitter by the manufacturer, prior to shipment. The accompanying type-test data represent results of such tests, as obtained from a typical equipment, along with minimum acceptable data. By performing the tests outlined, it is possible for maintenance personnel to determine whether or not a particular transmitter meets minimum performance standards based on the requirements of the specification applicable to the design, manufacture, and performance of the transmitter.

4.2 Test conditions. - The conditions under which type tests should be performed, unless otherwise specified, are as follows:

4.2.1 Line voltage: 120 volts ac, 60 cps.

4.2.2 Transmitter output: 50 watts into 50 ohm resistive-load wattmeter.

4.2.3 Modulation: Zero.

4.2.4 Ambient temperature: $30^{\circ}C \pm 10^{\circ}C$, at any relative humidity.

4.2.5 Circuit Alignment: All stages tuned to resonance.

4.3 Frequency range. - Tune the transmitter to frequencies of 117 and 153 megacycles to insure that all stages will cover the required frequency range of 118 to 152 megacycles. Adjust the OUTPUT/COUPLING and OUTPUT TUNING controls to record maximum power output.

4.3.1 Typical results are 68 watts maximum power output at 117 megacycles, and 72 watts maximum power output at 153 megacycles.

4.4 Stability power output with variations in line volt-

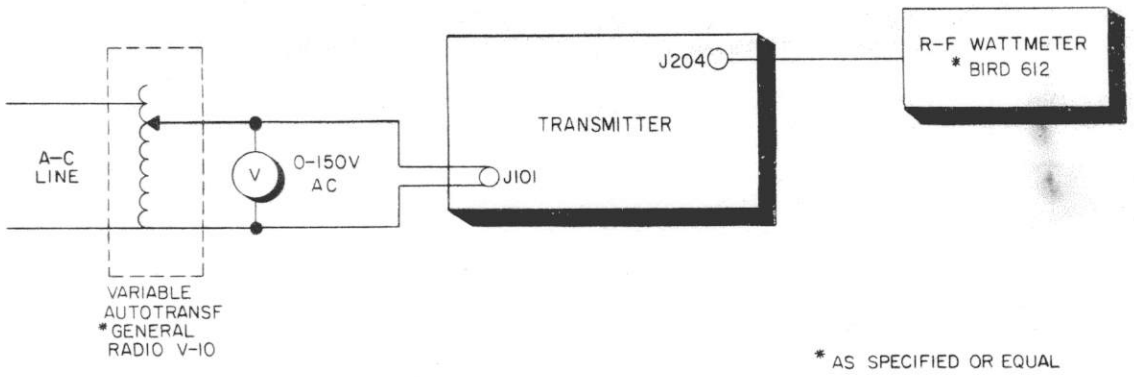


Figure 13. Basic Test Setup

age. - Using the test setup shown in figure 13, adjust the transmitter for an output of 50 watts at 152megacycles, with the input voltage set at 120 volts. When the input voltage is lowered to 105 volts or raised to 130 volts, the output power should not fall below 32.5 watts nor rise above 67.5 watts (50 watts ± 35percent.)

4.4.1 Typical results are 37.5 watts output for an input of 105 volts, and 61 watts output for an input of 130 volts.

4.5 Input power. - See figure 14 for the test setup to be used. Adjust the a-f oscillator for an input of 0 dbm at 1000 cycles. Adjust the transmitter for an output of 50 watts, and set the MOD GAIN control for 90 percent modulation. The input power should not exceed 700 watts, as measured by the a-c watt meter, and the power factor should be at least 0.92.

NOTE

$$\text{Power factor} = \frac{\text{Watts}}{\text{Voltage x current}}$$

4.5.1 Typical results are 580 watts input power at a power factor of 0.93.

4.6 Carrier level shift. - Adjust the transmitter for a power output of exactly 50 watts with zero modulation; use the test setup shown in figure 14, except that the a-c ammeter and wattmeter are not required. Then adjust the a-f oscillator for an input of 0 dbm at 1000 cycles, and set the MOD GAIN control for 90 percent modulation. Note the power output from the trans-

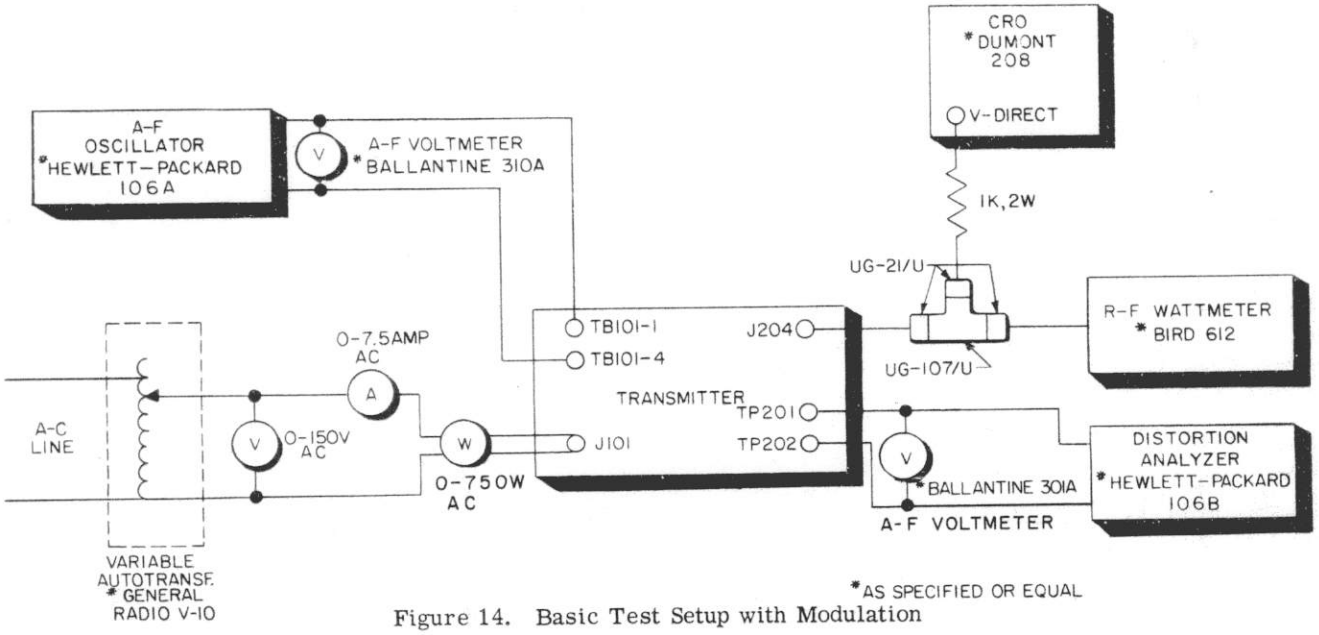


Figure 14. Basic Test Setup with Modulation

mitter. It should not differ by more than 2.5 watts from the 50 watts established with zero modulation.

4.6.1 Typical carrier shift is 1.5 watts.

4.7 Hum distortion. - To measure hum distortion, use the test setup shown in figure 13, except that the a-c ammeter and wattmeter are not required. In addition, connect a harmonic wave analyzer (Hewlett-Packard 300A or equal) to test jacks TP201 and TP202. Adjust the transmitter for a power output of 50 watts with zero modulation. Then adjust the a-f oscillator for an input of 0 dbm at 1000 cycles, and set the MOD GAIN control for 70 percent modulation. The root-sum-square value of all hum distortion frequencies should not be greater than 50 db below the amplitude of the 1000 cycle modulation frequency.

4.7.1 Typical hum distortion is -54 db.

4.8 Audio-frequency response. - Use the test setup described in paragraph 4.7 above, but set the MOD GAIN for 90 percent modulation. After establishing a reference level of 0 dbm on the output meter of the harmonic wave analyzer for the 1000 cycle modulation frequency, measure the relative outputs at the frequencies indicated in table 5. Be sure to keep the audio input constant at 0 dbm as the a-f oscillator frequency is changed.

4.8.1 Typical audio-frequency response data appear in table 5. A curve of typical response data is shown in figure 3. The response should not vary by more than 3 db between 300 and 4000 cycles, and should be at least 26 db below the 1000 cycle reference at 10,000 cycles.

4.9 Audio-frequency distortion. - To measure audio-frequency distortion, use the test setup shown in figure 14, except that the a-c ammeter and wattmeter are not required. In addition, connect a distortion and noise meter (Hewlett-Packard 106B or equal) to test jacks TP201 and TP202. Adjust the transmitter for a power output of 50 watts with zero modulation. Then adjust the a-f oscillator for an input of -15 dbm (0.137 volt) at 1000 cycles, and set the MOD GAIN control for 90 percent modulation. The distortion measured should not exceed 10 percent.

4.9.1 Typical audio-frequency distortion is 3.3 percent.

4.10 Carrier noise. - Under the same test setup and conditions as specified in paragraph 4.9 above, the hum and noise level on the carrier should be at least 50 db below the 1000 cycle modulation. Noise-level measurements must be made in accordance with the instructions for the distortion and noise meter employed.

4.10.1 Typical carrier noise is -61 db.

4.11 Crystal-oven operating temperature. - Attach an iron-constantan wire thermocouple to the crystal clamp in crystal oven HR201. Bring the thermocouple leads out between the base and cover of the oven, being certain that the cover is installed in its proper positions. Connect the thermocouple leads to a suitable thermocouple bridge (Leeds and Northrup 8667 or equal).

TABLE 5. TYPICAL AUDIO-FREQUENCY RESPONSE DATA.

FREQUENCY (cps)	RELATIVE OUTPUT (db)
100	-20
200	- 5
300	+ 0.2
400	+ 0.1
500	0
1000	0
1500	0
2000	0
3000	- 0.8
4000	- 1.5
5000	- 2.5
7500	-11.5
10000	-26.5

4.11.1 Using the test setup shown in figure 13, adjust the transmitter for an output of 50 watts and allow enough time for the crystal oven to reach a stable operating temperature. The temperature, as measured by the thermocouple bridge, should be 75°C ± 5°C.

4.11.2 Typical crystal oven operating temperature is 75.4°C.

4.12 Crystal-oven heater power. - Connect a 0 to 10 volt a-c voltmeter between pins 3 and 7 of crystal-oven socket XHR201. Disconnect the lead to pin 3 of the socket and insert a 0 to 1.5 ampere a-c ammeter between pin 3 and the disconnected lead. Remove CRYSTAL HEATER lamp I201.

4.12.1 With the transmitter operating normally at 50 watts output, the crystal-oven heater voltage should be 6.3 volts, and the current should be less than 1.0 ampere.

4.12.2 Typical crystal-oven heater power is 6.3 volts and 0.75 amperes.

4.13 Crystal activity. - With the transmitter operating normally at 50 watts output (see figure 13), note the OSC GRID current reading on the MULTI-METER. Determine the equivalent resistance of the crystal by substituting non-inductive resistors (approximately 15 to 22 ohms, 1/2 watt, composition) for the crystal at pins 4 and 6 of crystal-oven socket XHR201 until a like value of OSC GRID current is obtained when OSC PLATE coil L203 is retuned to result in the same frequency as was obtained under crystal control. When a resistor which yields the desired results is selected, measure its resistance (R) and place it in the crystal

socket within crystal oven HR201. Retune OSC PLATE coil L203 to the same frequency as that of the crystal.

4.13.1 Measure the r-f voltages to ground from pins 4 and 6 of crystal-oven socket XHR201, using an r-f vacuum-tube voltmeter (Hewlett-Packard 410B or equal). Knowing the resistance (R) of the crystal-substitute resistor, calculate the equivalent of the power dissipated in the crystal as follows:

$$P = \frac{E_{pin\ 4} - E_{pin\ 6}{}^{2}}{R}$$

4.13.2 Power dissipated in the crystal should not exceed 1.0 milliwatt. Typical power dissipation is 0.27 milliwatt.

4.14 Bias of r-f tubes. - Remove crystal oven HR201 and energize the transmitter using the test setup shown in figure 13. Measure the plate and screen voltages of V202 through V206. Table 6 will provide an indication of typical voltages on the r-f tubes with no excitation. Both maximum and typical voltages appear in the table.

4.15 Power-amplifier efficiency.-With the transmitter operating normally at a frequency of 136 megacycles and with an output of 50 watts (see figure 13), measure the d-c plate input to power amplifier V206. Repeat the measurement with the transmitter operating at 152 megacycles. The plate efficiency (ratio of power output to plate power input) should be at least 50 percent at 136 megacycles and at least 45 percent at 152 megacycles.

4.15.1 Typical plate efficiencies are 55 percent at 136 megacycles and 49.5 percent at 152 megacycles.

4.16 Peak inverse voltages of rectifiers. - With the transmitter operating normally at 50 watts output (see figure 13), measure the d-c voltages at the input filter capacitors indicated in table 7 and the a-c (rms) voltage to ground from the plates of each of the rectifier tubes. Calculate the peak inverse voltage as follows:

$$E_{pk} = E_{dc} + 1.4E_{ac}$$

where E_{pk} is the peak inverse voltage, E_{dc} is the d-c voltage at the input filter capacitor, and E_{ac} is the rms voltage from the rectifier plate to ground.

TABLE 6. TYPICAL R-F TUBE PLATE AND SCREEN VOLTAGES WITH NO EXCITATION

Tube	Plate voltage		Screen voltage	
	Max	Typical	Max	Typical
V202(6AU6)	275	270	150	140
V203(5763)	275	270	185	180
V204(2E26)	190	185	175	165
V205(6146)	330	320	140	100
V206(4X150A)	625	620	330	320

* Screen current must be zero.

SAFETY FIRST

4.16.1 The peak inverse voltage at V111 should not exceed 1250 volts; the peak inverse voltages at V105, V106, V107, and V108 should not exceed 2100 volts. Typical measurements appear in table 7.

4.17 Blower operation. - Use the test setup shown in figure 13, with the a-c input voltage to the transmitter reduced to 105 volts. Turn the transmitter on and off several times to insure that the air flow is sufficient to operate air-flow switch S201.

4.18 Frequency, accuracy and stability. - Frequency, accuracy and stability measurements are made with the transmitter set up as shown in figure 13, except that the a-c ammeter, and wattmeter are not required. Modulation should be zero, unless otherwise specified. In addition connect a receiver to the vertical input of an oscilloscope and a Hewlett Packard 106A audio oscillator to the horizontal input of the oscilloscope. Have a Gersch frequency meter on hand near the transmitter.

SAFETY FIRST

4.18.1 Frequency accuracy. - With the transmitter

TABLE 7. TYPICAL RECTIFIER PEAK INVERSE VOLTAGES

Filter Input Volts		Rectifier Plate Voltage		Peak
Component	VDC	Tube	VAC	Inverse Voltage
C115	255	V111	225	570
L101	640	V105	780	1730
C113	630	V106	780	1730
L102	630	V107	780	1730
C114	620	V108	780	1730

line voltage at 120 volts and the transmitter power output at 50 watts, tune receiver to oscillator frequency (29.5 mcs for 118 mcs) and zero beat the Gersch frequency meter to oscillator frequency. Record the oscillator frequency to establish a reference for the following tests and set the Hewlett Packard 106A audio oscillator to obtain a lissajou figure on the oscilloscope. The measured frequency must be within ± 0.002 percent of the crystal frequency.

4.18.1.1 Typical frequency measurements established a deviation of 210 cycles from a crystal frequency of 29.500000 megacycles. (Allowable limit: ± 590 cycles.

NOTE

After establishing the reference frequency, do not make any adjustments to the transmitter except as specified in the following tests.

4.18.2 Effect of line-voltage variation. - Reduce the line voltage to 105 volts and measure the frequency deviation from the reference frequency established in paragraph 4.18.1 above by adjusting the audio oscillator to obtain a new lissajou figure on the oscilloscope and reading the frequency difference on the audio oscillator. Raise the line voltage to 130 volts and again measure the frequency deviation from the reference frequency. Reset the line voltage to 120 volts.

4.18.2.1 The frequency deviation from the reference frequency should be less than ± 0.0005 percent of the oscillator frequency. Typical deviations are -49 cycles and + 11 cycles for line voltages of 105 and 130 volts, respectively. (Allowable limit: ± 148 cycles for crystal frequency of 29.50000 megacycles.)

4.18.3 Effect of changing oscillator tube. - Reestablish a reference frequency, as outlined in paragraph 4.18.1 above. Replace oscillator tube V201 with 6 12AT7 tubes selected at random, and measure the deviation from the reference frequency for each tube.

4.18.3.1 The frequency deviation from the reference frequency should be less than ± 0.0005 percent of the oscillator frequency. Typical deviation for three tubes selected at random are -32, -15, and -60 cycles. (Allowable limit: ± 148 cycles for crystal frequency of 29.50000 megacycles.)

4.18.4 Effect of detuning. - Reestablish a reference frequency, as outlined in paragraph 4, 18.1 above. Detune the tuning elements specified in table 8, one at a time, to effect a 20 percent change in the grid current of the following stage (as indicated by MULTI-METER M101 with MULTI-METER SWITCH S202 in the position specified in the table.) After each tuning element is detuned, measure the deviation from the reference frequency. Be certain to retune for maximum grid current before detuning the next circuit.

4.18.4.1 The frequency deviation from the reference frequency should be less than ± 0.0005 percent of the oscillator frequency. Typical deviations are shown in table 8. (Allowable limit: ± 148 cycles for crystal frequency of 29.50000 megacycles.)

4.18.5 Effect of power-output variation. - Reestablish a reference frequency, as outlined in paragraph 4.18.1 above. Reduce the antenna coupling to lower the power output of the transmitter to 25 watts, and measure the deviation from the reference frequency.

4.18.5.1 The frequency deviation from the reference frequency should be less than ± 0.0005 percent of the oscillator frequency. Typical deviation is 5 cycles. (Allowable limit: ± 148 cycles for crystal frequency of 29.50000 megacycles.)

4.18.6 Effect of modulation. - Reestablish a reference frequency, as outlined in paragraph 4.18.1 above. Adjust the MOD GAIN control for 50 percent modulation, and measure the deviation from the reference frequency. Repeat the measurement with 90 percent modulation.

4.18.6.1 The frequency deviation from the oscillator frequency should be less than ± 0.0005 percent. Typical deviation is 10 cycles for both 50 and 90 percent modulation. (Allowable limit: ± 148 cycles for crystal frequency of 29.50000 megacycles.)

TABLE 8. TYPICAL EFFECT ON FREQUENCY OF DETUNING.

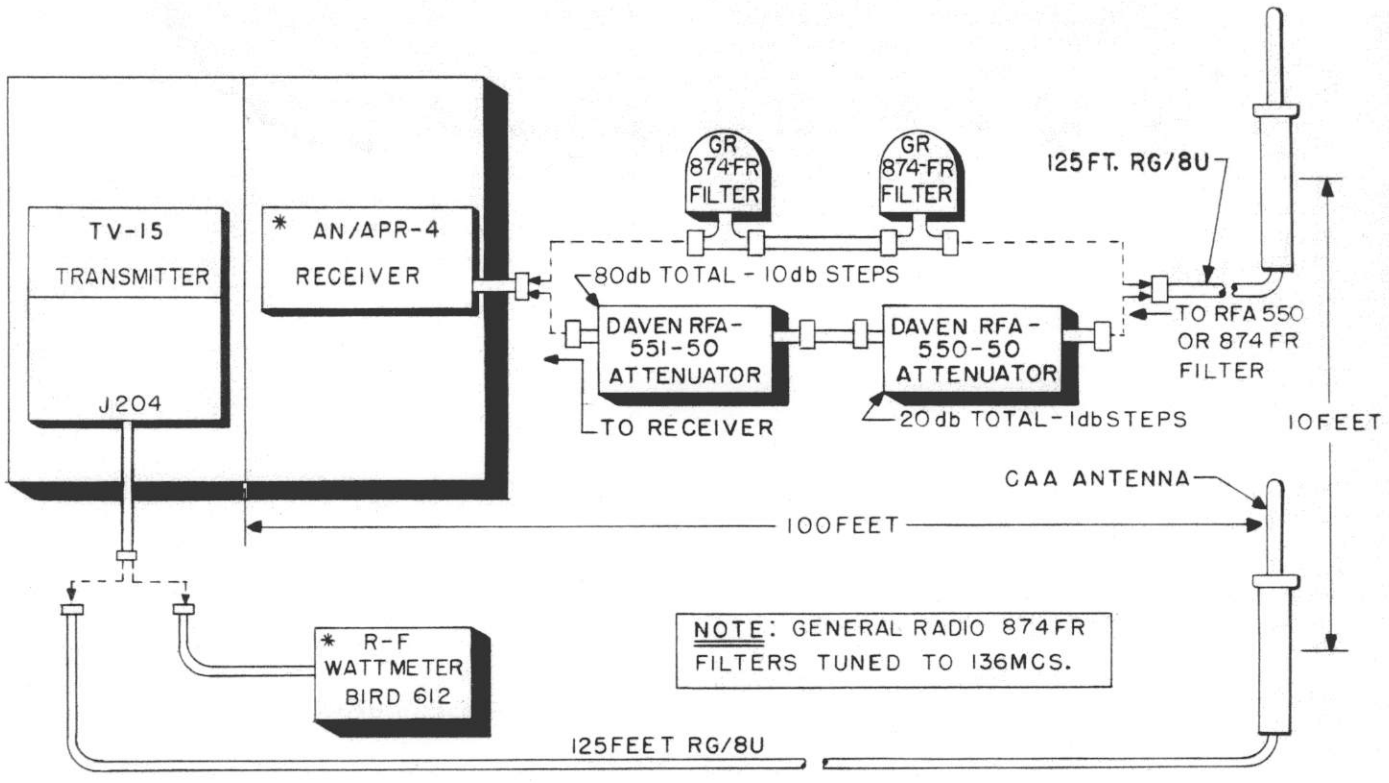
Tuning Element	MULTI-METER SWITCH position	Frequency Deviation (cps)
L204	1ST DOUB GRID	-120 to +130
L205	1ST DOUB GRID	less than 20
L206	2ND DOUB GRID	less than 20
L208	2ND DOUB GRID	less than 20
L209	DRIVER GRID	less than 20
C223	PA GRID	less than 20
C228	PA GRID	less than 20

4.19 Harmonic and Spurious frequencies. - Using the test setup shown in figure 15, tune the transmitter to 136 mcs with 50 watts output to CAA antenna. Connect the two Daven attenuators RFA550 and 551 in receiving antenna line and measure the reference voltage to be used later for 0 db reference level. The total loss for the two Daven attenuators equals 100 decibels.

4.19.1 Read "S" meter level when receiver is tuned to 136 mcs. Record this reading. Remove the two Daven attenuators and substitute two General Radio 874-FR rejection filters.

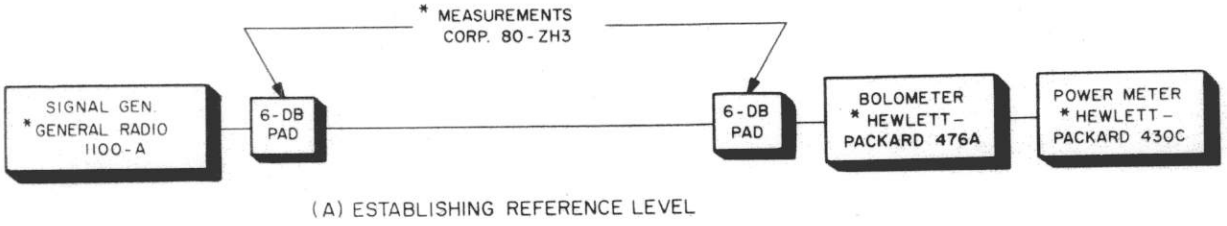
NOTE

These filters are designed for similar measurements on television transmitters and are required by FCC regulations for making this type test. (See General Radio booklet 888-C.)

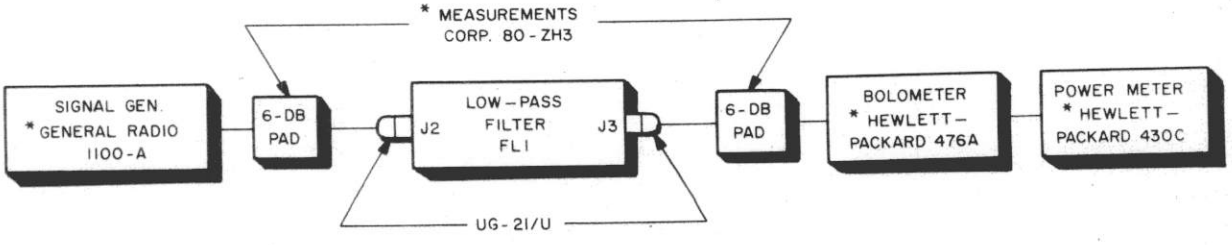


* AS SPECIFIED OR EQUAL

Figure 15. Test Setup for Measurement of Harmonic and Spurious Frequencies



(A) ESTABLISHING REFERENCE LEVEL



(B) MEASURING FILTER ATTENUATION

* AS SPECIFIED OR EQUAL

Figure 16. Test Setup for Measurement of Low-Pass Filter Attenuation

4.19.2 Tune both filters for minimum carrier indication at receiver "S" meter. Then search and record meter readings for all signals received from 25 to 1000 mcs. For each frequency record also the equivalent signal strength required by substitution of a calibrated signal source such as a Measurements model 80 and model 84 signal generator. The reference reading in microvolts divided by each signal reading in microvolts equals a ratio which is convertible to decibels as follows:

$$DB = 20 \text{ LOG}_{10} \frac{V1}{V2} .$$

These readings constitute radiated noise level.

4.19.3 Substitute a Bird model 612 wattmeter for the transmitting antenna and make a new search. Record each signal level as detailed above. These readings in decibel constitute conducted noise level.

4.20 Low-pass filter attenuation. - Using the test setup shown in figure 16 (A), tune the signal generator to 118 megacycles and adjust its output for a convenient reference level on the bolometer power meter. Then insert low-pass filter FL201, as shown in figure 16 (B), and note the indication on the power meter. It should be within 0.5 db of the reference power level.

4.20.1 Repeat the preceding measurements every 10 megacycles between 118 and 160 megacycles. In each case, the difference between power outputs from the bolometer with and without the filter inserted should be 0.5 db or less.

4.20.2 Substitute a suitable receiver (AN/APR-4 or equal) for the bolometer and associated power meter. Tune the signal generator to any frequency between 118 and 152 megacycles; and adjust its output to provide a reference level on the receiver S-meter. Note the generator output.

4.20.3 Tune both the signal generator and receiver from 160 to 230 megacycles, and adjust the generator output to maintain the signal level constant at the reference established in paragraph 4.20.2 above. The generator output should require gradual increases throughout the frequency range, and there should be no peaks or discontinuities evident on the receiver S-meter.

4.20.4 Repeat the procedures of paragraph 4.20.3 above between 230 and 400 megacycles. The output from the signal generator should be at least 65 db below the reference output established in paragraph 4.20.2.

4.20.5 Attenuation characteristics of a typical filter appear in figure 5.

SECTION 8 OVERHAUL PROCEDURE

1. OVERHAUL. - No overhaul data was included in this instruction book as issued by the contractor.

SECTION 9 MODIFICATIONS

1. No factory modifications were made to the equipment as issued by the contractor.

2. FIELD MODIFICATIONS. - The field modifications which have been made on the equipment after shipment from the factory are described in table 9. All information in this instruction book, including the diagrams in Section 12, is correct and includes the field modifications.

TABLE 9. FIELD MODIFICATIONS

Modification No.	Equipment Serial Nos.	Modification
2	1 to 300	C123 incorporated

NOTE: Modification kits start with No. 2.

Ref Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
B201	FAN, CENTRIFUGAL: 105-130vac, 50-60cps, 3 wires, one phase, 3300 rpm at 60cps, 0.6A, 0.85 PF, 1/20 HP, cont. duty 12.5CFM at 1.40 in. water static pressure (at 60 cps) 1.62 in. dia. rotor	17	CBC-L15B-1		B201	24-0965.00
C101	CAPACITOR, FIXED, PAPER DIELECTRIC: 1.0mf ±20%; 100WVDC	1		CP10A3EB105M	C101	12-8255.00
C102	CAPACITOR, FIXED, PAPER DIELECTRIC: .05mf 600WVDC	1		CP20A1EF503M	C102, C107	12-8256.00
C103	CAPACITOR, FIXED, PAPER DIELECTRIC: 2.0mf 600WVDC	1		CP53B1EF205M	C103	18-8257.00
C104	CAPACITOR, FIXED, MICA DIELECTRIC: 500 mmf ±20%, 500 WVDC	2		CM20B501M	C104	12-8258.00
C105	CAPACITOR, FIXED, MICA DIELECTRIC: 200 mmf ±10%, 500WVDC	2		CM20B201K	C105, C108, C109, C110	12-8259.00
C106	Not Used					
C107	Same as C102					
C108	Same as C105					
C109	Same as C105					
C110	Same as C105					
C111	CAPACITOR, FIXED, PAPER DIELECTRIC: 1.0mf 100WVDC	1		CP10A1EB105M	C111	12-8260.00
C112	CAPACITOR, FIXED, PAPER DIELECTRIC: 0.5mf 400WVDC	1		CP53B1EE504M	C112 C123	12-8261.00
C113	CAPACITOR, FIXED, PAPER DIELECTRIC: 10mf 1000WVDC	1		CP70E1FG106V	C113, C114	12-8262.00
C114	Same as C113					
C115	CAPACITOR, FIXED, PAPER DIELECTRIC: 4mf 600WVDC	1		CP41B1EF405V	C115, C116, C117	12-3991.00
C116	Same as C115					
C117	Same as C115					
C118	CAPACITOR, FIXED, MICA, DIELECTRIC: .001mf 600WVDC	2		CM45B102K	C118, C121	12-2008.00
C119	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .01mf 600WVDC	3		CK63Y103Z	C119, C204, C205	12-0847.00

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN. NME, or Mil Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
C120	CAPACITOR, FIXED, CERAMIC DIELECTRIC: .001mf 600WVDC	3		CK61Y102Z	C120 C219 C221 C223 C225	12-8263.00
C121	Same as C118					
C122	CAPACITOR, FIXED, PAPER DIELECTRIC; 4mf 330WVDC	2	8033-4A		C122	12-8348.00
C123	Same as C112					
C201	CAPACITOR, FIXED, MICA DIELECTRIC: 47 mmf 300WVDC	2		CM15E4705	C201	12-8264.00
C202	CAPACITOR, FIXED, MICA DIELECTRIC: 510 mmf 300WVDC	2		CM15E4705	C202	12-8265.00
C203	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 470 mmf 600WVDC	3	319-471		C203 C210 C211 C216 C218 C229 C238 C239	12-8347.00
C204	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 10, 000 mmf, 600WVDC	3		CK63Y103Z	C204 C205	12-0847.00
C205	Same as C204					
C206	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 470 mmf 600WVDC	3		CK60Y471Z	C206 C209 C212	12-8266.00
C207	CAPACITOR, FIXED, MICA DIELECTRIC: 10 mmf 300WVDC	2		CM150010	C207	12-8267.00
C208	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 47 mmf 600WVDC	3		CK60Y4702	C208	12-8268.00
C209	Same as C206					
C210	Same as C203					
C211	Same as C203					
C212	Same as C206					
C213	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 270 mmf 600WVDC	3		CK60Y271Z	C213 C214 C215	12-8269.00
C214	Same as C213					
C215	Same as C213					
C216	Same as C203					

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or Mil Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
C217	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 100 mmf 600WVDC	3		CK60Y101Z	C217 C227 C234 C235 C236 C237	12-8270.00
C218	Same as C203					
C219	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 mmf 620WVDC	3	327-102		C219 C223 C225	12-8346.00
C220	CAPACITOR, FIXED, MICA DIELECTRIC: 100 mmf ±5%, 500 WVDC	2		CM20C101K	C220	12-1607.00
C221	CAPACITOR, FIXED, MICA DIELECTRIC: 500 mmf 500WVDC	3	370FA-501K		C221	12-8344.00
C222	Same as C207					
C223	Same as C219					
C224	CAPACITOR, VARIABLE, AIR DIELECTRIC: 2.7- 19.6 mmf 1100VAC Breakdown	5	160-110-27		C224	12-8350.00
C225	Same as C219					
C226	CAPACITOR, FIXED, MICA DIELECTRIC: 1 mmf 300WVDC	2		CM15C010	C226	12-8271.00
C227	Same as C217					
C228	CAPACITOR, VARIABLE, AIR DIELECTRIC: 1.8-8.7 mmf 1100VAC Breakdown	5	160-104		C228	12-8349.00
C229	Same as C203					
C230	Not Used				C230	Not Furnished Separately
C231	CAPACITOR, VARIABLE, AIR DIELECTRIC: 5.4- 51 mmf 1750VAC	11	11622-1		C231	12-8171.00
C232	CAPACITOR, FIXED, CERAMIC DIELECTRIC: 1000 mmf 2000WVDC	6	3992		C232	12-8345.00
C233	CAPACITOR, VARIABLE, AIR DIELETRIC: 2.6- 25 mmf 850VAC Breakdown	5	148-2		C233	12-8351.00
C234	Same as C217					
C235	Same as C217					
C236	Same as C217					
C237	Same as C217					

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Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
J203	CONNECTOR, RECEPTACLE, ELECTRICAL: coaxial connector, (part of FL201)	7				Not Supplied Separately
J204	CONNECTOR, RECEPTACLE, ELECTRICAL: coaxial connector, (part of FL201)	7				Not Supplied Separately
K101	RELAY, ARMATURE: Sensitive, S.P.D.T.	16	321DC91		K101	14-3235.00
K102	RELAY, ARMATURE: Plate, S.P.S.T.	16	26109-110		K102	14-3236.00
L101	REACTOR: Choke, 50 HY, 0.6 A dc, 100 V, 60 cps, dc resistance -30 ohms, WKGV - 1100			TFIRX04MB	L101, L102	13-6016.00
L102	Same as L101					
L201	COIL, RADIO FREQUENCY: 2.54 mh	6	4175		L201	13-6072.00
L202	COIL, RADIO FREQUENCY: 21 mh	6	4174		L202	13-6073.00
L203	COIL, RADIO FREQUENCY: adjustable	6	4176		L203	13-6065.00
L204	COIL, RADIO FREQUENCY: adjustable	6	4179		L204	13-6066.00
L205	COIL, RADIO FREQUENCY: adjustable	6	4177		L205	13-6067.00
L206	COIL, RADIO FREQUENCY: adjustable	6	4180		L206	13-6068.00
L207	COIL, RADIO FREQUENCY: 7 mh	6	4173		L207	13-6069.00
L208	COIL, RADIO FREQUENCY: adjustable	6	4178		L208	13-6070.00
L209	COIL, RADIO FREQUENCY: adjustable	6	4181		L209	13-6064.00
L210	COIL, RADIO FREQUENCY: 84 mh	6	4171		L210, L216	13-6063.00
L211	COIL, RADIO FREQUENCY: 1.8 mh	6	4172		L211, L217, L220	13-6062.00
L212, L213	TRANSFORMER, RADIO FREQUENCY: adjustable	6	4182		L212, L213	13-6058.00
L214, L215	TRANSFORMER, RADIO FREQUENCY: adjustable	6	4183		L214, L215	13-6059.00
L216	Same as L210					
L217	Same as L211					

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
C238	Same as C203					
C239	Same as C203					
CR201	SEMICONDUCTOR DEVICE, DIODE: Germanium, 75 v peak inverse voltage, 40 ma average, 125 ma peak current.	4	IN69		CR201	09-9707.80
E201	CHIMNEY, AIR: Ceramic	5	124-111-1		E201	07-1206.00
E202	CONNECTOR, ELECTRON TUBE: Toggle clamp type, PA anode	6	3819		E202	19-1314.00
F101	FUSE, CARTRIDGE: 10 A, 125 V, 1/4 by 1 1/4 in. long, 3 AG Type	8	GLH-10		F101	10-1547.00
F102	FUSE, CARTRIDGE: 5 A, 125 V, 1/4 by 1 1/4 in. long, 3 AG Type	8	MTH-5		F102	10-0632.00
F103	FUSE, CARTRIDGE: 8/10 A, 125 V, 1/4 by 1 1/4 in. long, 3 AG SLO BLO Type	8	BDL-8/10		F103	10-0117.00
F104	FUSE, CARTRIDGE: 1A, 125 V, 1/4 by 1 1/4 in. long, 3 AG SLO BLO Type		MDL-1		F104	10-0118.00
FL201	FILTER, LOW PASS: 50 ohm impedance, 75 watts power capacity, -6db 160 - 180 mc, -65 db 230 - 500 mc	7	8314A		FL201	13-6071.00
HR201	OVEN, CRYSTAL:	9	TC-68		HR201	59-0099.00
H101	ALIGNMENT TOOL, ELECTRONIC EQUIPMENT:	10	GC8609		H101	37-4005.00
I101	LAMP, INCANDESCENT: 120 V, CW, S6 bulb, candelabra screwbase	12	S6		I101 I102 I103	27-0276.00
I102	Same as I101					
I103	Same as I101					
I201	LAMP, INCANDESCENT: 6 - 8 V, 0.15 A, NO.	13	NO. 47		I201	27.0075.00
J101	CONNECTOR, RECEPTACLE ELECTRICAL: Two contacts, 125 V. 15 A. AC line, male	13	4343-5		J201	07-3074.00
J102	CONNECTOR, RECEPTACLE ELECTRICAL: 16 contacts, female	14	26-4401-16S		J102	07-3322.50
J201	CONNECTOR, RECEPTACLE ELECTRICAL: 16 contacts, male	14	26-4401-16P		J201	07-3323.00
J202	CONNECTOR, RECEPTACLE ELECTRICAL: 4 contacts, male	15	P-304-AB		J202	07-3105.00

Ref Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
R109	RESISTOR, FIXED, COMPOSITION: 100K, 1/2 watt, ±5%	19		RC20GF104J	R109, R111	11-0712.00
R110	RESISTOR, FIXED, COMPOSITION: 15K, 1/2 watt, ±10%	19		RC20GF153K	R110	11-0550.00
R111	Same as R109					
R112	Same as R105					
R113	Same as R106					
R114	RESISTOR, FIXED, COMPOSITION: 390, 1 watt, ±10%	19		RC32GF391K	R114	11-1044.00
R115	RESISTOR, FIXED, COMPOSITION: 39K, 2 watt, ±10%	19		RC42GF393K	R115, R116, R117, R118	11-1016.00
R116	Same as R115					
R117	Same as R115					
R118	Same as R115					
R119	RESISTOR, FIXED, WIRE WOUND: 9.1, 1/2 watt, ±5%	19		RU3B9R1J	R119, R216	11-3095.00
R120	RESISTOR, FIXED, COMPOSITION: 22K, 2 watt, ±10%	19		RC42GF223K	R120	11-0588.00
R121	RESISTOR, FIXED, COMPOSITION: 12K, 2 watt, ±10%	19		RC42GF123K	R121	11-0541.00
R122	RESISTOR, FIXED, WIRE WOUND: 400, 5 watt, ±5%			RW55G401	R122, R123, R124	11-2313.95
R123	Same as R122					
R124	Same as R122					
R125	RESISTOR, FIXED, WIRE WOUND: 2.5K, 10 watt	21		RW29G252	R125	11-3097.00
R126	RESISTOR, FIXED, WIRE WOUND: 1.0K, 10 watt	21		RW29G102	R126	11-2433.00
R127	RESISTOR, FIXED, COMPOSITION: 27K, 1/2 watt, ±10%	19		RC20GF273K	R127, R128	11-0600.00
R128	Same as R127					
R129	RESISTOR, FIXED, WIRE WOUND: 4K, 5 watt	6	3931		R129	11-3190.00
R130	RESISTOR, FIXED, WIRE WOUND: 1.25K, 50 watt	6	3929		R130	11-3189.00

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
L218	COIL, RADIO FREQUENCY: pick-up	6	3856		L218	13-6060.00
L219	COIL, RADIO FREQUENCY: pick-up	6	3842		L219	13-6061.00
L220	Same as L211					
M101	AMMETER: 0-200 madc full scale deflection Type 301	6	3908		M101	30-4826.00
M102	AMMETER: 0 - 200 uadc full scale deflection Type 301, dual scale 0-15 and 0-30	6	3909		M102	30-4827.00
O-201	BEARING, BALL, ANNULAR: double seal, (part of motor B201), 0.33 i d, 0.86 o d	20	38PP-C1		O-201	17-1600.00
P101	CONNECTOR, PLUG, ELECTRICAL: Two contacts, male, (part of W101)	13	2716		P101	07-2061.00
P102	CONNECTOR, PLUG, ELECTRICAL: 16 contacts, male, (part of W102)	14	26-4501-16P		P102	07-2319.50
P103	CONNECTOR, PLUG, ELECTRICAL: Two contacts, female, (part of W101)	13	3092		P103	07-2320.50
P201	CONNECTOR, PLUG, ELECTRICAL: 16 contacts, female, (part of W102)	14	26-4501-16S		P201	07-2319.00
P202	CONNECTOR, PLUG, ELECTRICAL: 4 contacts, female	15	S-304-FHT		P202	07-2320.00
P203	CONNECTOR, PLUG, ELECTRICAL: coaxial	15		UG-88/U	P203	07-2047.00
P204	CONNECTOR, PLUG, ELECTRICAL: coaxial	15		UG-21D/U	P204	07-2035.00
R101	RESISTOR, VARIABLE: composition, 50K, 2 watt, DB-Log Taper, Type J	19	84355		R101	11-4445.00
R102	RESISTOR, FIXED, COMPOSITION: 3.9K, 1/2 watt, ±10%	19		RC20GF392K	R102	11-0445.20
R103	RESISTOR, FIXED, COMPOSITION: 100K, 1/2 watt, ±10%	19		RC20GF104K	R103, R104, R107	11-0714.00
R104	Same as R103					
R105	RESISTOR, FIXED, COMPOSITION: 470K, 1/2 watt, ±10%	19		RC20GF474K	R105, R112	11-0817.00
R106	RESISTOR, FIXED, COMPOSITION: 2.7K, 1/2 watt, ±10%	19		RC20GF272K	R106, R113	11-0415.00
R107	Same as R103					
R108	RESISTOR, FIXED, COMPOSITION: 1M, 1/2 watt, ±10%	19		RC20GF105K	R108	11-0862.00

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
R218	RESISTOR, FIXED, COMPOSITION: 47K, 1/2 watt, ±10%	19		RC20GF473K	R218	11-0647.00
R219	RESISTOR, FIXED, COMPOSITION: 47, 1/2 watt, ±5%	19		RC20GF470J	R219, R224	11-0143.00
R220	Same as R213					
R221	Same as R201					
R222	RESISTOR, FIXED, WIRE WOUND: 1.75K, 10 watt	21			R222	11-2983.00
R223	RESISTOR, FIXED, COMPOSITION: 125K, 2 watt, ±10%	19		RC42GF123K	R223	11-0541.00
R224	Same as R219					
R225	RESISTOR, FIXED, COMPOSITION: 560, 2 watt, ±10%	19		RC42GF561K	R225	11-1045.00
R226	RESISTOR, FIXED, COMPOSITION: 1.0K, 1 watt, ±10%	19		RC32GF102K	R226	11-0346.50
R227	RESISTOR, VARIABLE: COMPOSITION, 10K, 2 watt, ±10%	19	JLU-1031		R227	11-4072.75
R228	RESISTOR, FIXED, WIRE WOUND: 670, 10 watt	21		RW29G671	R228	11-3098.00
R229	RESISTOR, FIXED, COMPOSITION: 6.8K, 2 watt, ±10%	19		RC42GF682K	R229	11-0499.00
R230	RESISTOR, FIXED, COMPOSITION: 8.2K, 2 watt, ±10%	19		RC42GF822K	R230	11-0513.00
R231	RESISTOR, FIXED, COMPOSITION: 820, 2 watt, ±10%	19		RC42GF821K	R231	11-1047.00
R232	RESISTOR, FIXED, COMPOSITION: 10K, 1/2 watt, ±10%	19		RC20GF103K	R232	11-0521.00
R233	RESISTOR, FIXED, COMPOSITION: 390, 1/2 watt, ±10%	19		RC20GF391K	R233	11-0280.00
R234	RESISTOR, FIXED, COMPOSITION: 100, 2 watt, ±10%	19		RC42GF101K	R234	11-1043.00
S101	SWITCH, TOGGLE: DPST, 6 A, 125 V	23		ST-28K Bright Nickel	S101	08-7264.00
S102	SWITCH, TOGGLE: SPST, 6 A, 125 V	23		ST-12A Bright Nickel	S102	08-7006.00
S103	SWITCH, INTERLOCK: SPST, Normally open	24	CAE241195-8909K128		S103	08-7501.00
S104	SWITCH, TOGGLE: 3PDT, 15 A, 125 V	23	82617		S104, S105	08-7268.00

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
R131	RESISTOR, FIXED, WIRE WOUND: 1. 0K, 50 watt	21		RW35G102	R131	11-3099.00
R132	RESISTOR, FIXED, WIRE WOUND: 600, 50 watt	21		RW35G601	R132	11-3101.00
R133	RESISTOR, FIXED, COMPOSITION: 1M, 1/2 watt, ±10%	19		RC20GF105K	R133	11-0862.00
R134	RESISTOR, FIXED, WIRE WOUND: 2.0K, 10 watt	21		RW29G202	R134	11-3096.00
R135	RESISTOR, FIXED, WIRE WOUND: 5.0K, 50 watt	21		RW35G502	R135	11-3100.00
R201	RESISTOR, FIXED, COMPOSITION: 12K, 1/2 watt, ±10%	19		RC20GF123K	R201 R221	11-0943.00
R202	RESISTOR, FIXED, COMPOSITION: 220, 1/2 watt, ±10%	19		RC20GF221K	R202 R205 R209	11-0238.00
R203	RESISTOR, FIXED, COMPOSITION: 100, 1/2 watt, ±10%	19		RC20GF101J	R203 R212	11-0178.15
R204	RESISTOR, FIXED, WIRE WOUND: 8, 5 watt	21		RW55G8RO	R204	11-3102.00
R205	Same as R202					
R206	RESISTOR, FIXED, COMPOSITION: 5.6K, 2 watt, ±10%	19		RC42GF562K	R206 R207	11-1037.00
R207	Same as R206					
R208	RESISTOR, FIXED, COMPOSITION: 6.8K, 1/2 watt, ±10%	19		RC20GF682K	R208	11-0493.00
R209	Same as R202					
R210	RESISTOR, FIXED, COMPOSITION: 22K, 1/2 watt, ±10%	19		RC20GF223K	R210	11-0581.00
R211	RESISTOR, FIXED, COMPOSITION: 27K, 1/2 watt, ±10%	19		RC20GF272K	R211	11-0415.00
R212	Same as R203					
R213	RESISTOR, FIXED, COMPOSITION: 470, 1 watt, ±10%	19		RC32GF471K	R213 R220	11-0298.00
R214	RESISTOR, FIXED, COMPOSITION: 820, 1 watt, ±10%	19		RC32GF821K	R214	11-1046.00
R215	RESISTOR, FIXED, COMPOSITION: 6.8K, 1/2 watt, ±5%	19		RC20GF862J	R215	11-0491.50
R216	Same as R119					
R217	RESISTOR, FIXED, COMPOSITION: 3.3K, 1 watt, ±10%	19		RC32GF332K	R217	11-0433.00

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
V101	ELECTRON TUBE: dual triode	22		12AU7	V101, V102	09-3095.00
V102	Same as V101					
V103	ELECTRON TUBE: pentode	22		6146	V103, V104, V205	09-6900.00
V104	Same as V103					
V105	ELECTRON TUBE: Rectifier	22		5R4GY	V105, V106, V107, V108	09-1150.00
V106	Same as V105					
V107	Same as V105					
V108	Same as V105					
V109	ELECTRON TUBE: Voltage re-ulating	22		0B2	V109, V110, V112	09-0425.00
V110	Same as V109					
V111	ELECTRON TUBE: Rectifier	22		6X4	V111	09-1895.00
V112	Same as V109					
V201	ELECTRON TUBE: Dual triode	22		12AT7	V201	09-3085.00
V202	ELECTRON TUBE: Pentode	22		6AU6	V202	09-1405.00
V203	ELECTRON TUBE: Pentode	22		5763	V203	09-6530.00
V204	ELECTRON TUBE: Pentode	22		2E26	V204	09-0540.00
V205	Same as V103					
V206	ELECTRON TUBE: Power tetrode	27		4X150A	V206	09-1040.00
W101	CABLE ASSEMBLY, POWER, ELECTRICAL: ac line cord, two conductors, male connector on one end, female connector on other end	6	4169		W101	21-2547.00
W102	CABLE ASSEMBLY, POWER, ELECTRICAL: 16 conductors, P102 on one end, P201 on other end	6			W102	21-2548.00
XDS101	LAMPHOLDER: Candelabra screw socket, green jewel	29	31901-112		XDS101	27-3035.00
XDS102	LAMPHOLDER: Candelabra screw socket, white jewel	29	31901-115		XDS102	27-3045.00

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
S105	Same as S104					
S201	SWITCH, AIRFLOW: SPST, Normally open	25	V4-12		S201	08-5519.00
S202	SWITCH, ROTARY: 2 pole 8 position	26	97344-H2C		S202	08-5324.00
S203	Same as S103	24				
T101	TRANSFORMER, AUDIO FREQUENCY: Voice input, input; (1-2) (3-4) 600 ohms, output; (5-6) 40K ohms, 300 - 4000 cps 1db, +15 10dbm primary dc 80ma bal., WKG. V. 175	18		TF1RX11AJ	T101	13-6011.00
T102	TRANSFORMER, AUDIO FREQUENCY: Driver, input; (1-2) 10K ohms, output; (3-4-5) 75K ohms C. T., 300 - 4000cps 3db, primary cd 20ma, WKG. V. 175, 200MW	18		TF1RX15AJ	T102	13-6017.00
T103	TRANSFORMER, AUDIO FREQUENCY: Modulation, input; (1-2-3) 8.5K ohms, output; plate (4-5) 3.5K ohms, grid (6-7) Tertiary winding, WKG. V. 1140	18		TF1RX12KA	T103	13-6010.00
T104	TRANSFORMER, POWER, STEP-UP: Primary 120 V 50/60 cps, Secondary 1580 VCT 600 ma dc. WKG. V. 1100	18		TF1RX02YY	T104	13-6015.00
T105	TRANSFORMER, POWER, STEP-DOWN AND STEP - UP: Primary 120 V 50/60 cps, Secondaries (3-4-5) 450 VCT 70madc WKG. V. 535 (6-7) 5 V. 8 A., WKG. V. 1100 (8-9) 6.3 V, 3.7 A, WKG. V. 535	18		TF1RX03YY	T105	13-6013.00
T106	TRANSFORMER, POWER, VARIABLE: Auto (1-2) 105 V (1-3) 110 v (1-4) 115 v (1-5) 120 v, 5.9 A, 50/60 cps, WKG. V. 535 (1-6) 125V (1-7) 130 V	18		TF1RK01YY	T106	13-6012.00
T201	TRANSFORMER, POWER, STEP-DOWN: Input; (1-2) 120 V, 50/60 cps, Output; (3-4) 6.0 V, 3.35 A, WKG. V. 360, (5-6) 6.3 V, 3.3 A	18		TF1RX01HA	T201	13-6014.00
TB101	TERMINAL BOARD: 12 terminals	15	12-242-Y		TB101	19-1050.05
TB102	TERMINAL BOARD: 6 terminals	15	6-141-3/4W		TB102	19-1021.85
TP201	JACK, TIP: Insulated, black, single female contact	5	105-203-200		TP201	07-4501.20
TP202	JACK, TIP: Insulated, red, single female contact	5	105-202-200		TP202	07-4501.10

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
XDS103	LAMPHOLDER: Candelabra screw socket, red jewel	29	31901-111		XDS103	27-3037.00
XDS201	LAMPHOLDER: Miniature bayonet socket, amber jewel	29	87401-113		XDS201	27-3064.00
XF101	FUSEHOLDER: Indicating type, 250 V, 20 A, with neon lamp and 220K resistor	8	HKL		XF101, XF102, XF103, XF104	10-3013.25
XF102	Same as XF101					
XF103	Same as XF101					
XF104	Same as XF101					
XV101	SOCKET, ELECTRON TUBE: 9 pin miniature, mica filled, shield base	28		TS103P01	XV101, XV102	07-6090.00
XV102	Same as XV101					
XV103	SOCKET, ELECTRON TUBE: octal, mica filled	28		TS101P01	XV103, XV104, XV105, XV106, XV107, XV108	07-6079.00
XV104	Same as XV103					
XV105	Same as XV103					
XV106	Same as XV103					
XV107	Same as XV103					
XV108	Same as XV103					
XV109	SOCKET, ELECTRON TUBE: 7 pin miniature, mica filled, shield base	28		TS102P01	XV109, XV110, XV111, XV112	07-6044.00
XV110	Same as XV109					
XV111	Same as XV109					
XV112	Same as XV109					
XV201	SOCKET, ELECTRON TUBE: 9 pin miniature, ceramic, shield base	28		TS103C01	XV201, XV203	07-6089.00
XV202	SOCKET, ELECTRON TUBE: 7 pin miniature, ceramic, shield base	28		TS102C01	XV202	07-6056.00
XV203	Same as XV201					
XV204	SOCKET, ELECTRON TUBE: octal, ceramic, ring mount	14	49-SS8		XV204	07-6071.60

Ref. Desig.	Name of Component and Description	Mfr's Code	Mfr's Part No.	JAN, NME, or MIL Type Desig.	All Ref. Desig. Involved	CAA Catalog Numbers
XV205	Same as XV201					
XV206	SOCKET, ELECTRON TUBE: Holds V206, a 4X150A; includes C230, a 2700mmf capacitor	5	124-100-1		XV206	07-6080.00
XY201	SOCKET, ELECTRON TUBE: octal, ceramic, for crystal holder	28		TS101C01	XY201	07-6072.50
Y201	CRYSTAL UNIT, QUARTZ: 29.5 - 38.0 mc, (not supplied with transmitter)			CR-32/U	Y201	

MANUFACTURER'S NAMES AND ADDRESSES

1. Pyramid Electric Company
Orange Street
Darlington, South Carolina

2. Sangamo Electric Company
1201 N. 11th Street
Springfield, Ill.

3. Erie Resistor Corp.
Erie, Pa.

4. CBS-Hytron
100 Endicott Street
Danvers, Mass.

5. E. F. Johnson Company
Waseca, Minnesota

6. Daystrom-Weston Industrial
Division of Daystrom Inc.
229 Manchester Road
Poughkeepsie, New York

7. Karr Engineering Corp.
Palo Alto, California

8. Bussmann Manufacturing Co.
University at Jefferson
St. Louis 7, Mo.

9. Sherold Crystal Co.
Cedar Rapids, Iowa

10. General Cement Mfg. Co.
400 S. Wyman St.
Rockford, Ill.

11. Hammarlund Mfg. Co., Inc.
460 W. 34th St.
New York, N. Y.

12. Sylvania Electric Products, Inc.
1740 Broadway
New York 19, N. Y.

13. General Electric Co.
1 River Road
Schenectady 5, New York

14. Amphenol Electronics Corp.
1858 S. 50th Avenue
Chicago, Ill.

15. Cinch-Jones Mfg. Co.
1026 S. Homan Avenue
Chicago 24, Ill.

16. Kurman Electric Co.
191 Newell Street
Brooklyn, New York

17. Rotating Components, Inc.
269 Green Street
Brooklyn 22, N. Y.

18. Berkshire Transformer Corp.
Kent, Conn.

19. Allen-Bradley Co.
136 W. Greefield Ave.
Milwaukee 4, Wis.

20. Fafnir Bearing Co.
New Britain, Conn.

21. Tech-Ohm Co.
36-11 33RD Street
Long Island City, New York

22. Radio Corporation of America
415 S. Fifth Street
Harrison, N. J.

MANUFACTURER'S NAMES AND ADDRESSES (Cont.)

23. Arrow, Hart and Hageman
103 Hawthorn Street
Hartford 6, Conn.

24. Cutler-Hammer, Inc.
411 N. 12th St.
Milwaukee 1, Wis.

25. Micro Switch Division
Minneapolis-Honeywell Regular Co.
Chicago and Spring Streets
Freeport, Ill.

26. Oak Manufacturing Co.
1260 N. Clybourn, Chicago 10, Ill.

27. Eitel-McCullough, Inc.
798 San Mateo Ave.
San Bruno, Calif.

28. EBY Sales
130 Lafayette Street
New York, N. Y.

29. Dialight Corporation of America
60 Steward Avenue
Brooklyn 37, N. Y.

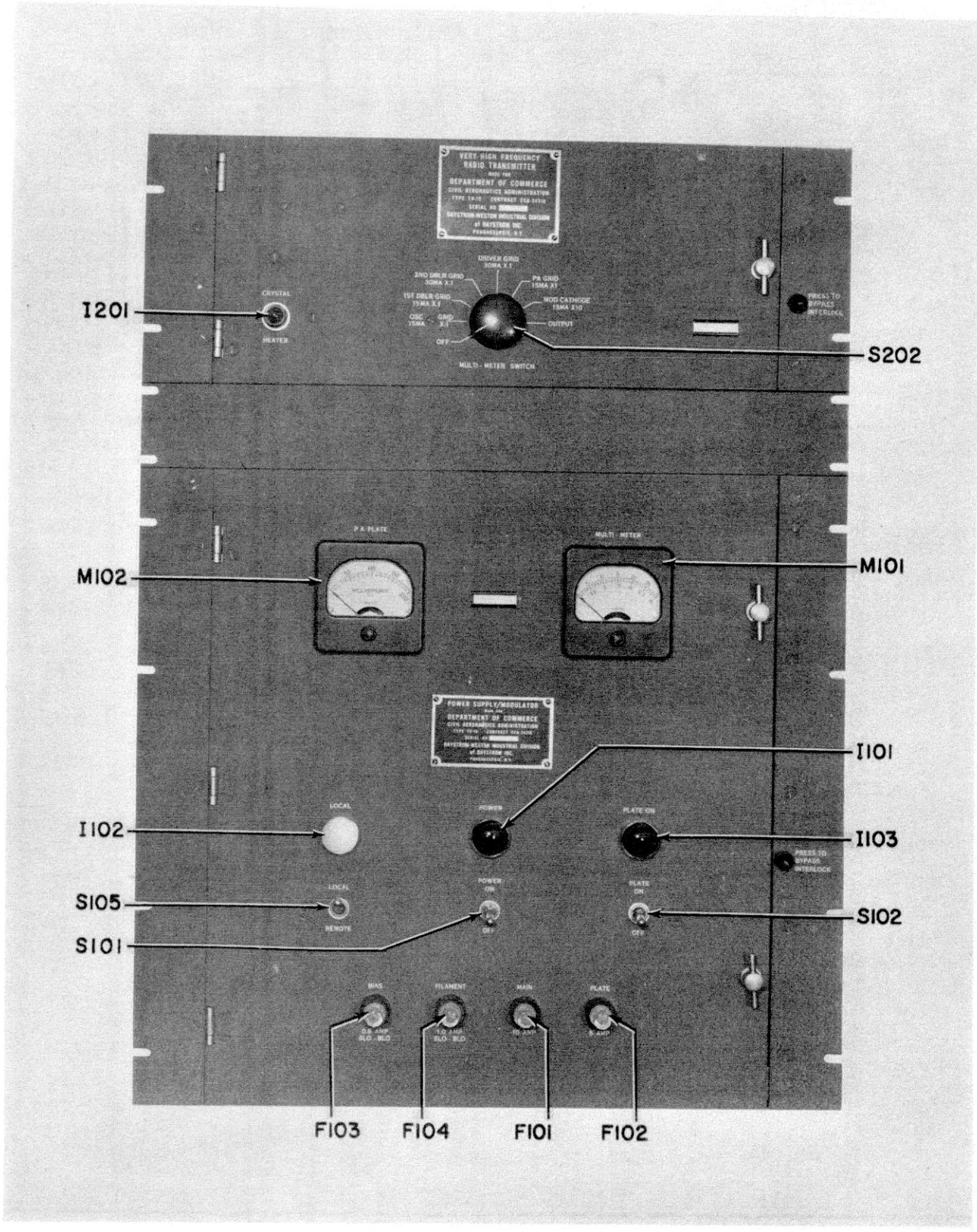


Figure 17. Transmitter, Front View

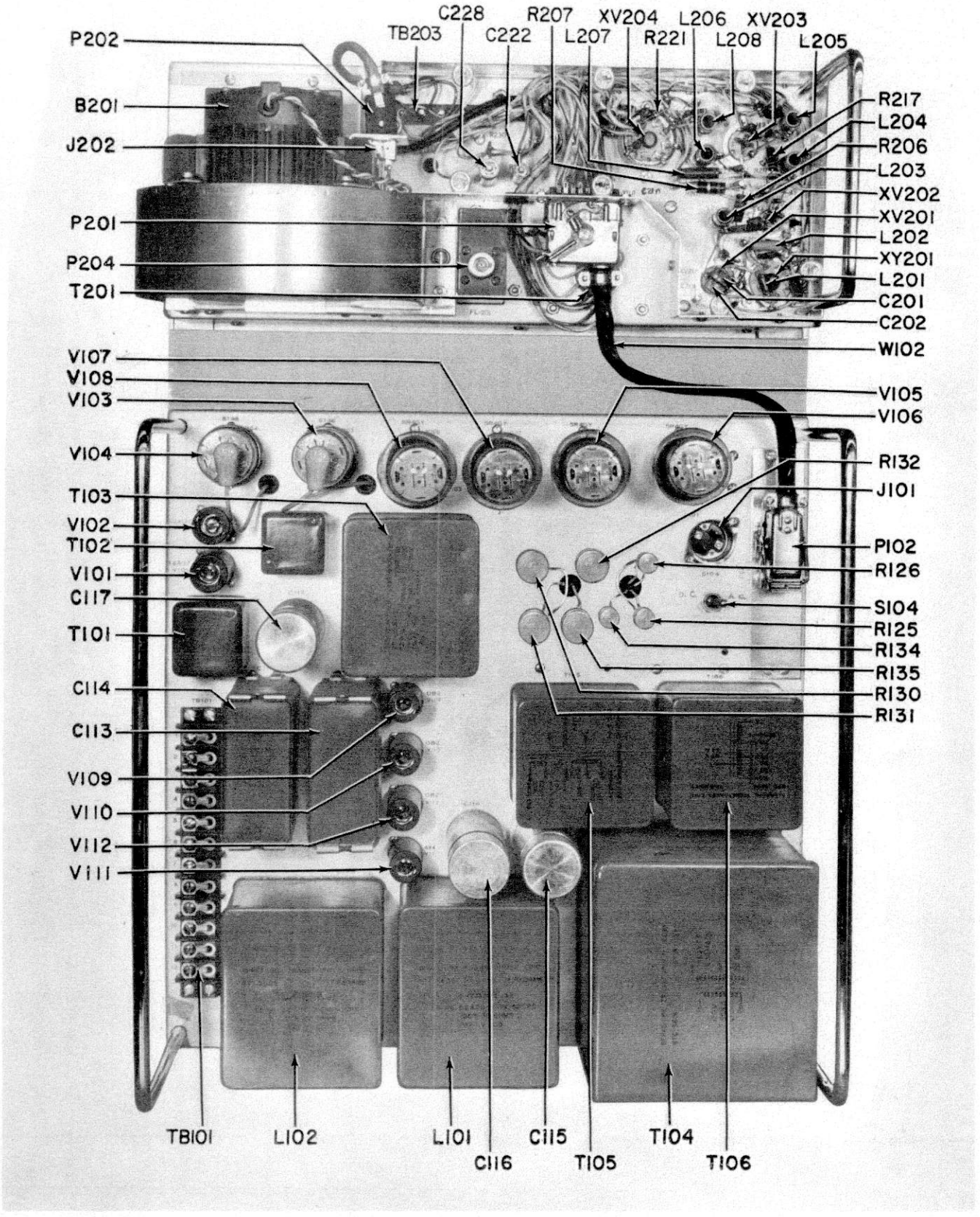


Figure 18. Transmitter, Rear View, Covers Removed

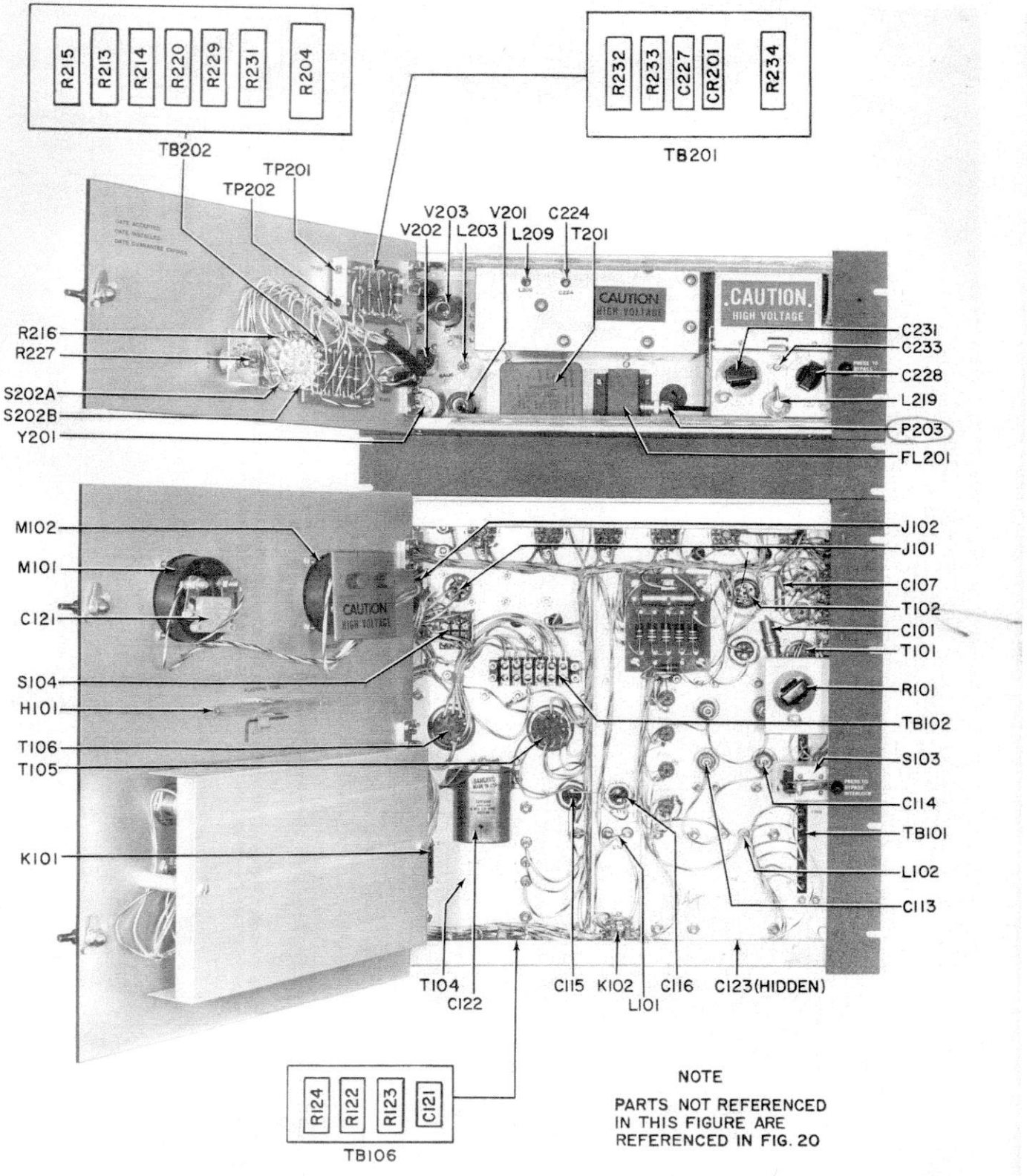


Figure 19. Transmitter, Panel Doors Open

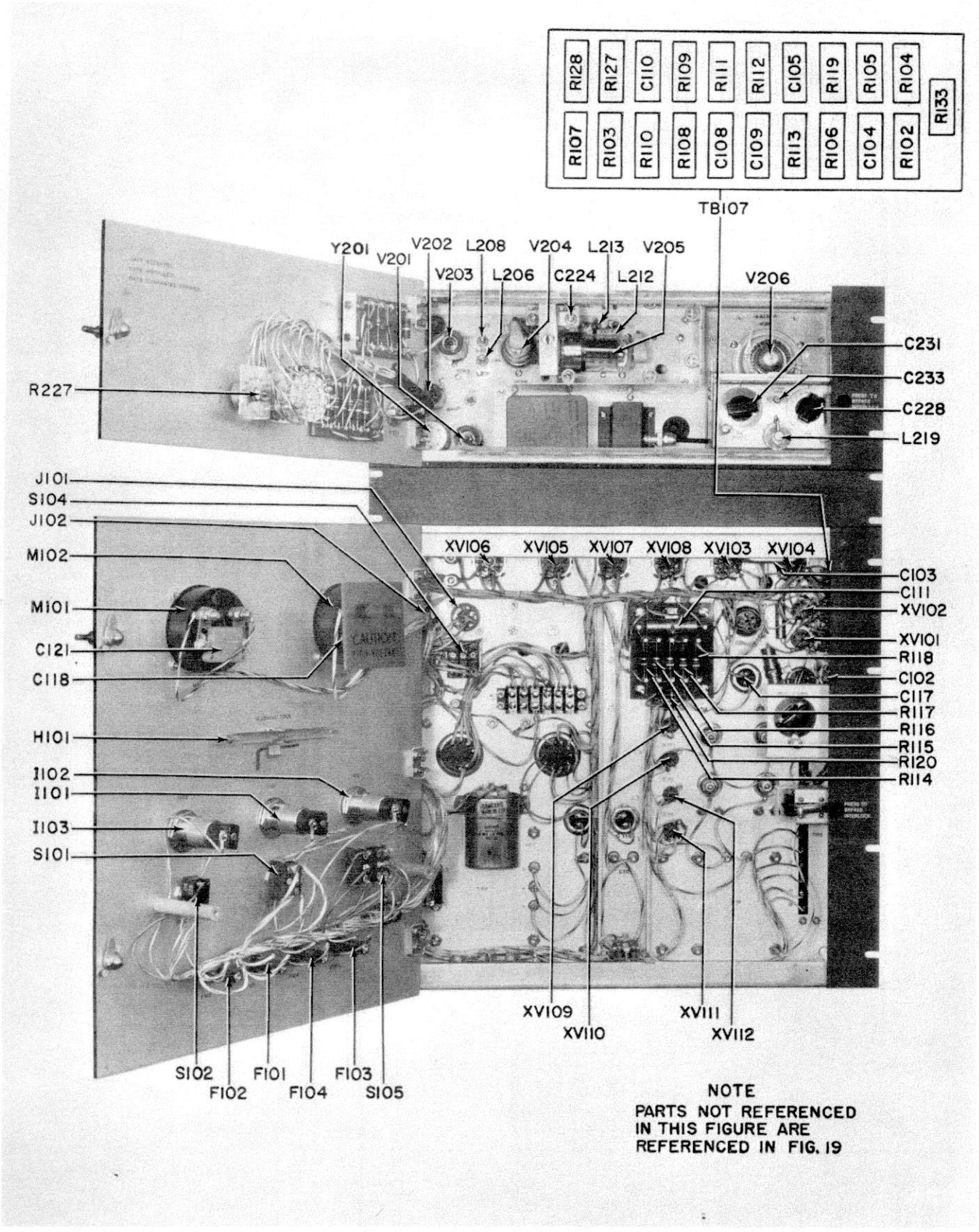


Figure 20. Transmitter, Panel Doors Open and Covers Removed

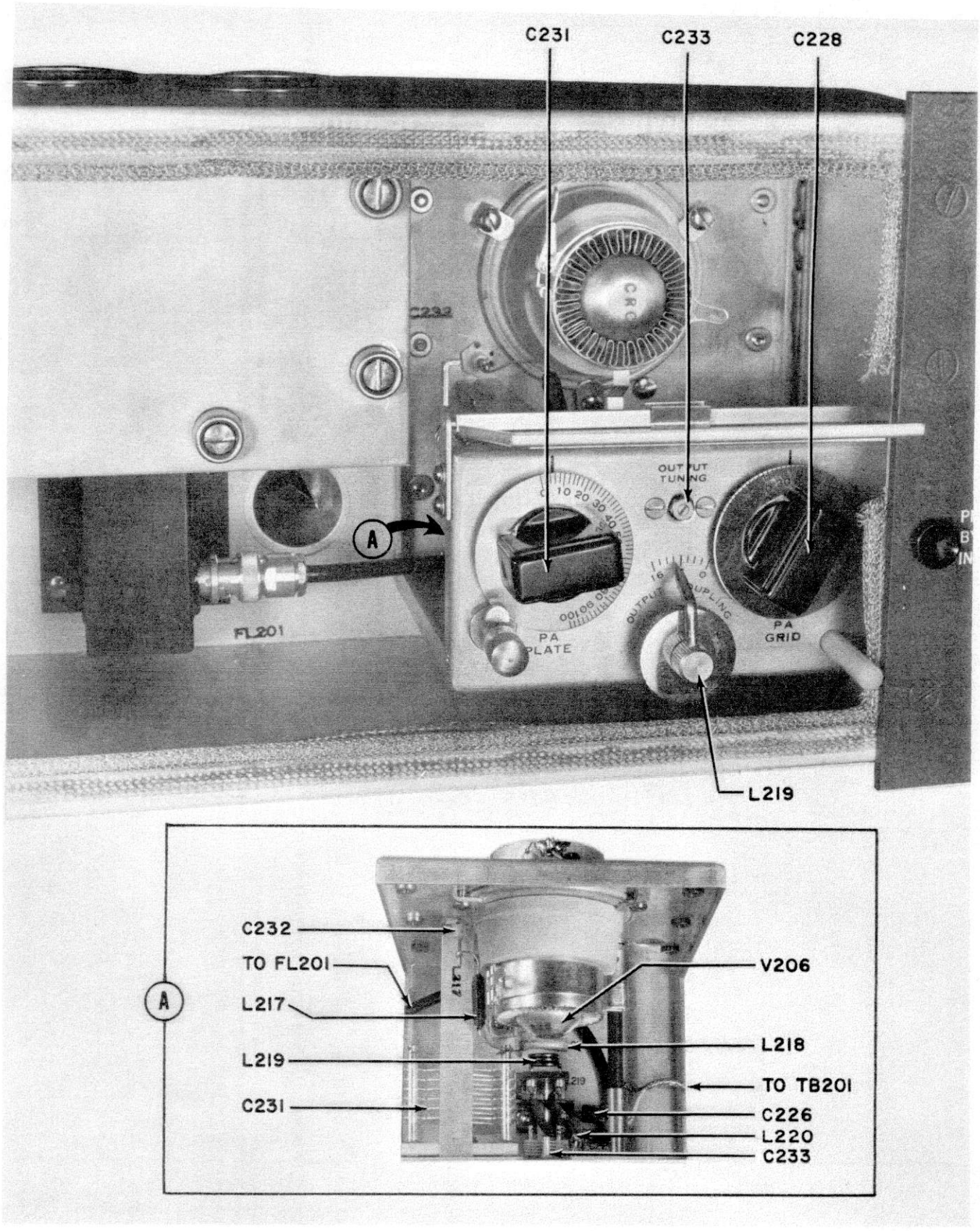


Figure 21. Transmitter, PA Assembly, Front

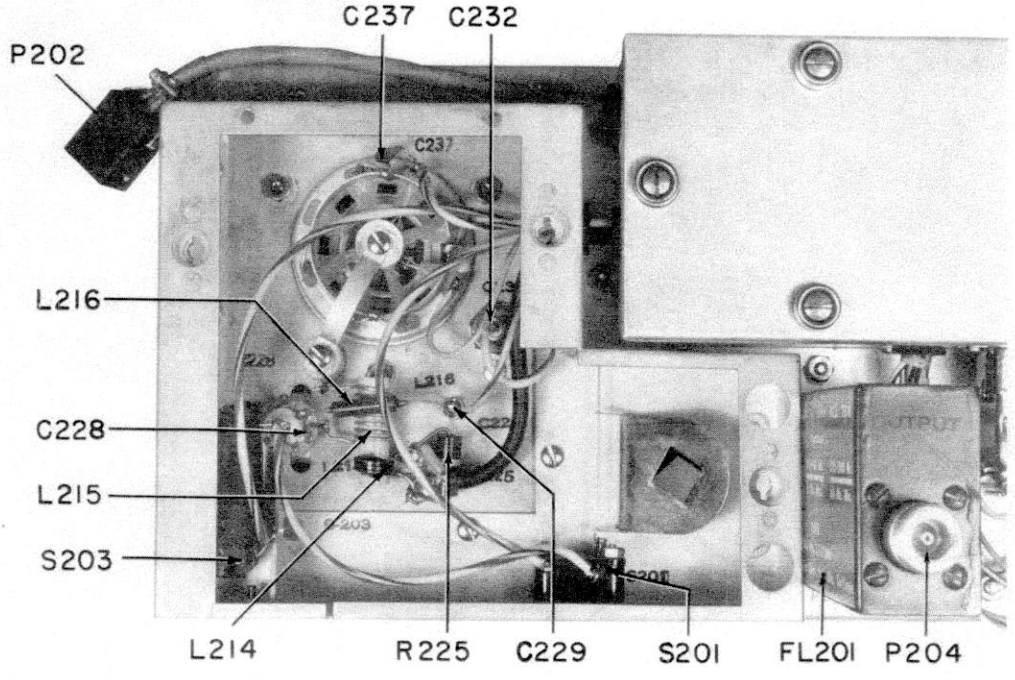
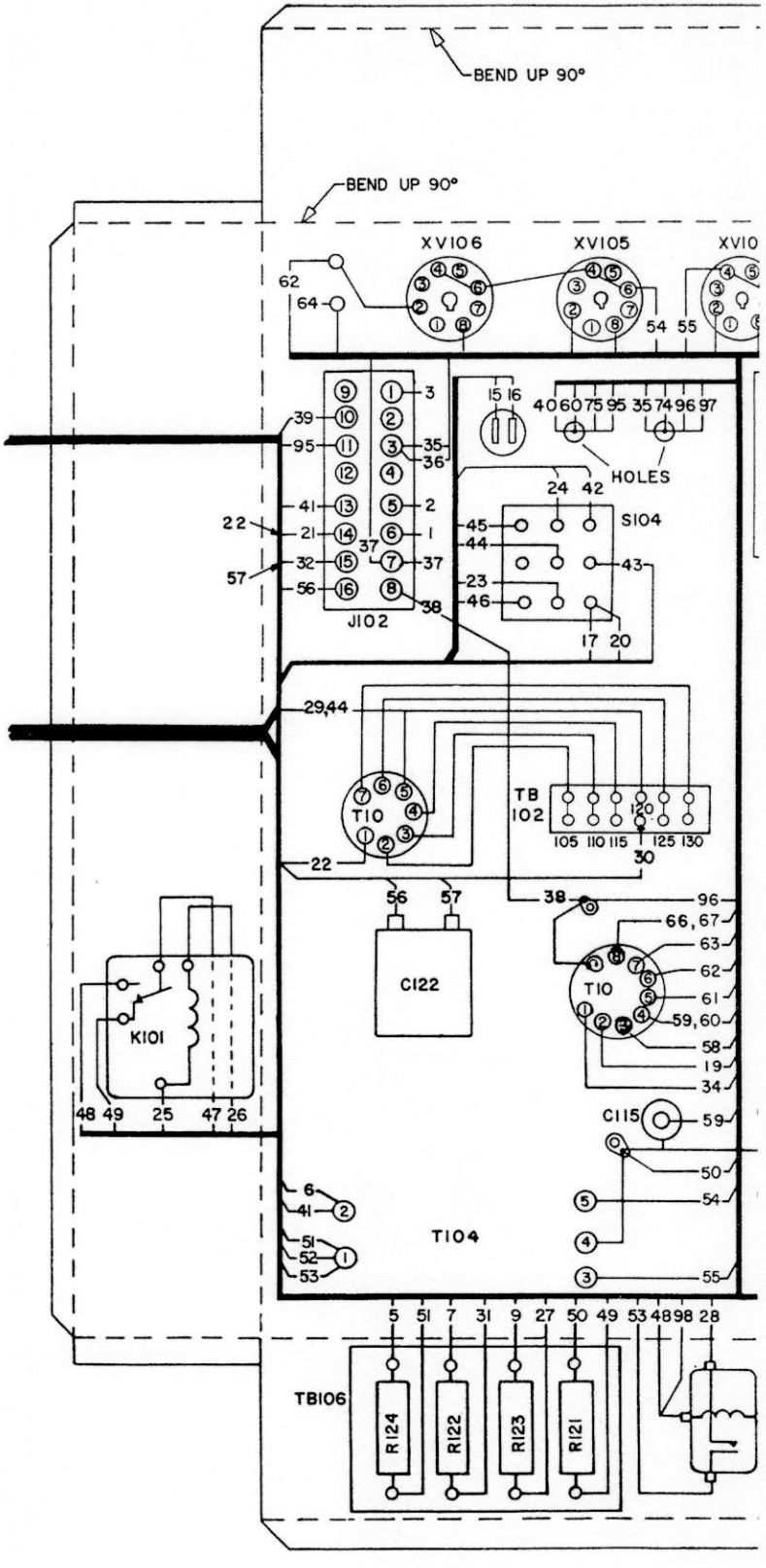


Figure 22. Transmitter, PA Assembly, Rear

NOTE:
FOR WIRE COLOR CODE SEE SHEET 3



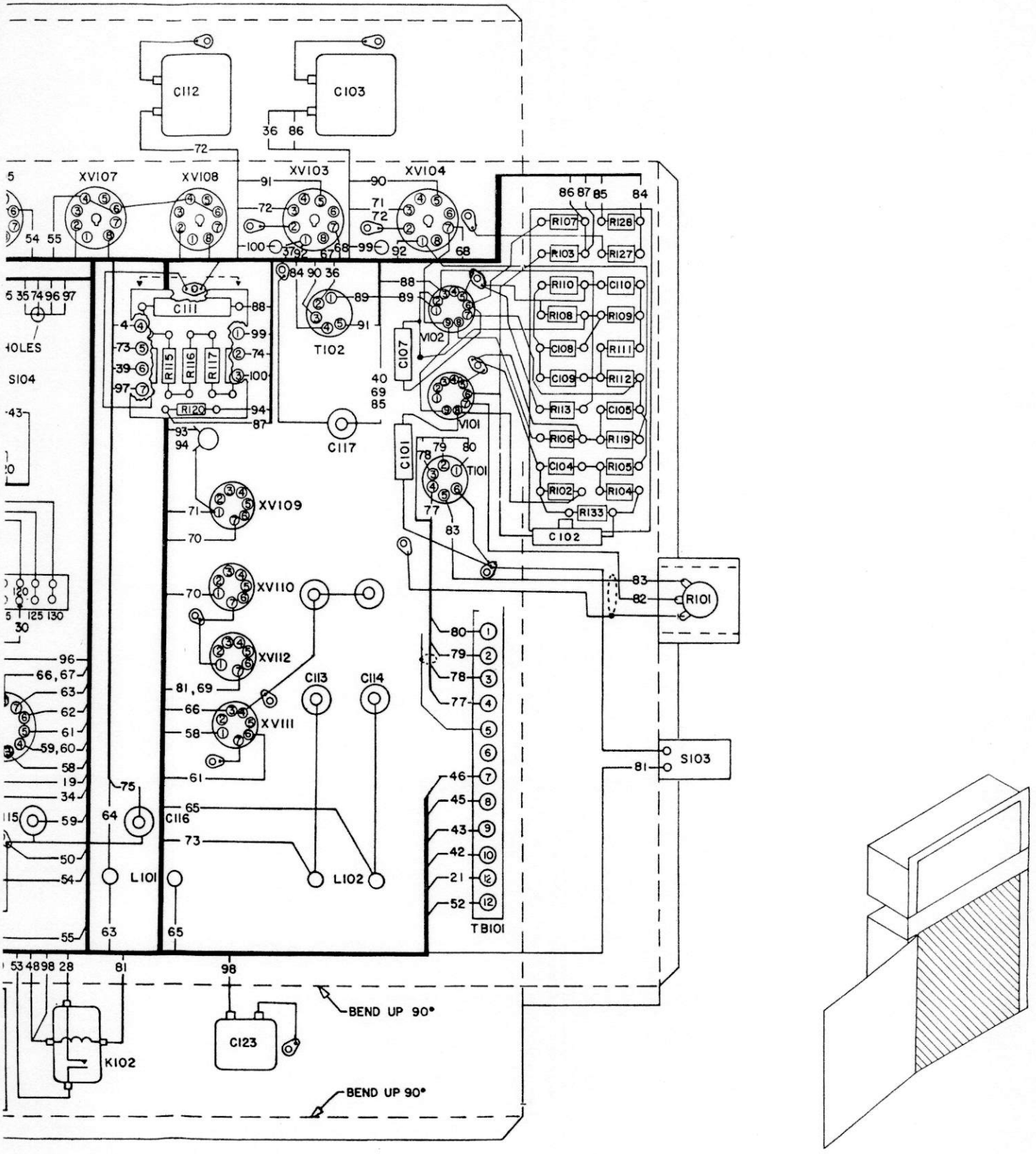


Figure 23. Transmitter Practical Wiring Diagram, Modulator and Power Supply (Sheet 2 of 3)

LEAD	COLOR	LEAD	COLOR
1	WH-BLK-BLK	51	WH-GY-YW
2	WH-BLK-RD	52	WH-GY-YW
3	WH-RD	53	WH-GY-YW
4	WH-RD	54	WH-RD
5	WH-GY-ORN	55	WH-RD
6	WH-GY-GRN	56	WH-GY-RD
7	WH-GY-PUR	57	GY-BLK
8	WH-GY-BLU	58	WH-RD
9	WH-GY-BRN	59	WH-BLK-RD
10	GY-RD	60	WH-PUR
11	WH-GY-RD	61	WH-RD
12	WH-GY-RD	62	WH-RD
13	WH-GY-RD	63	WH-RD
14	WH-GY	64	WH-RD
15	WH-GY	65	WH-RD
16	WH-GY-BLK	66	WH-BRN
17	WH-GY-BLU	67	WH-BRN
18	WH-GY-BLU	68	WH-BRN
19	WH-GY-BLU	69	WH-PUR
20	WH-GY-BLU	70	WH-OR
21	WH-GY-BLU	71	WH-OR
22	WH-GY-BLU	72	WH-OR
23	GY-YW	73	WH-RD
24	GY-OR	74	WH-RD
25	GY-GRN	75	NO WIRE
26	GY-BLU	76	SHIELD
27	GY-PUR	77	WH-BLK
28	WH-GY-ORN	78	WH-BLU
29	WH-GY-RD	79	WH-GY-GRN
30	WH-GY-BRN	80	WH-GRN
31	WH-GR-BRN	81	WH-PUR
32	GY-BLK	82	WH-GRN
33	WH-GY-RD	83	WH-BLU
34	GY-BRN	84	WH-BLK-RD
35	WH-RD-RD	85	WH-PUR
36	WH-RD-RD	86	WH-RD-RD
37	WH-YW	87	WH-RD-RD
38	WH-BLK	88	WH-YW
39	WH-ORN	89	WH-BLU
40	WH-PUR	90	WH-GRN
41	WH-GY-GRN	91	WH-GRN
42	WH-BLK-GY	92	WH-YW
43	GY-RD	93	WH-RD-RD
44	WH-GY-GRN	94	WH-RD-RD
45	WH-RD-BLK	95	WH-PUR
46	WH-BLK-BLK	96	WH-BLK
47	WH-PUR	97	WH-RD
48	WH-PUR	98	WH-PUR
49	WH-RD-BLK	99	WH-RD
50	WH-BLK	100	WH-RD

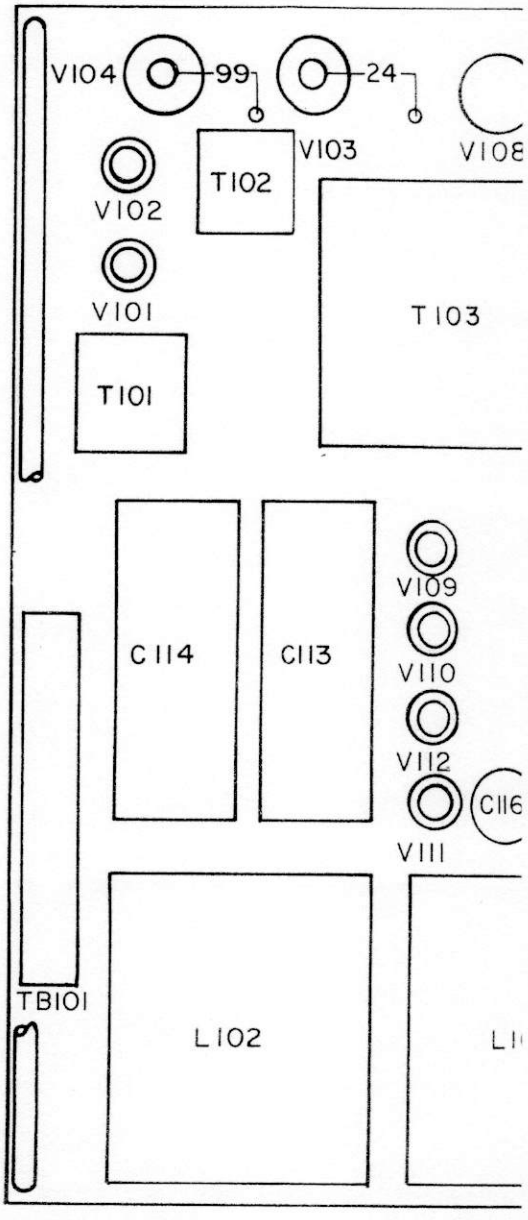


Figure 23.

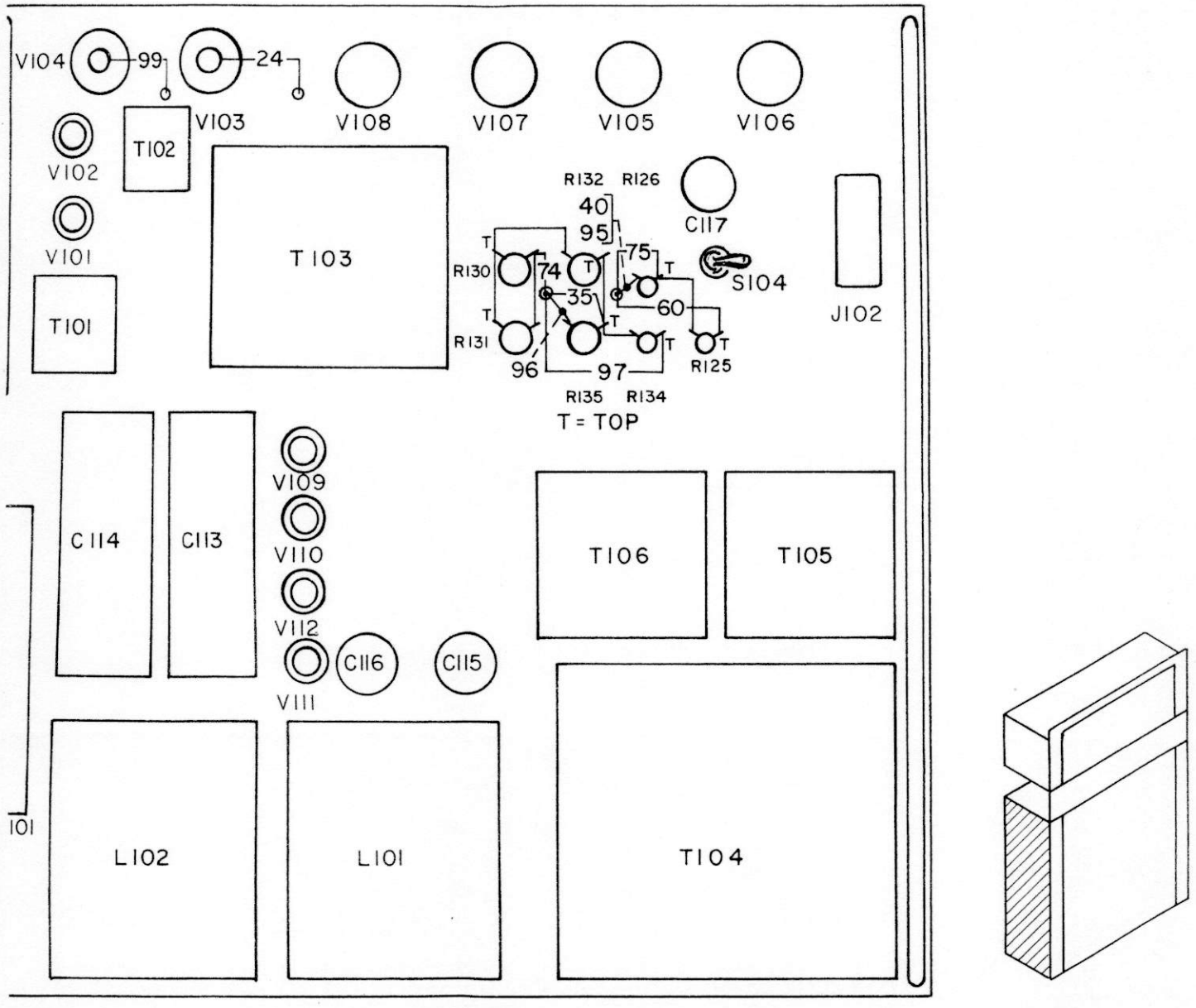
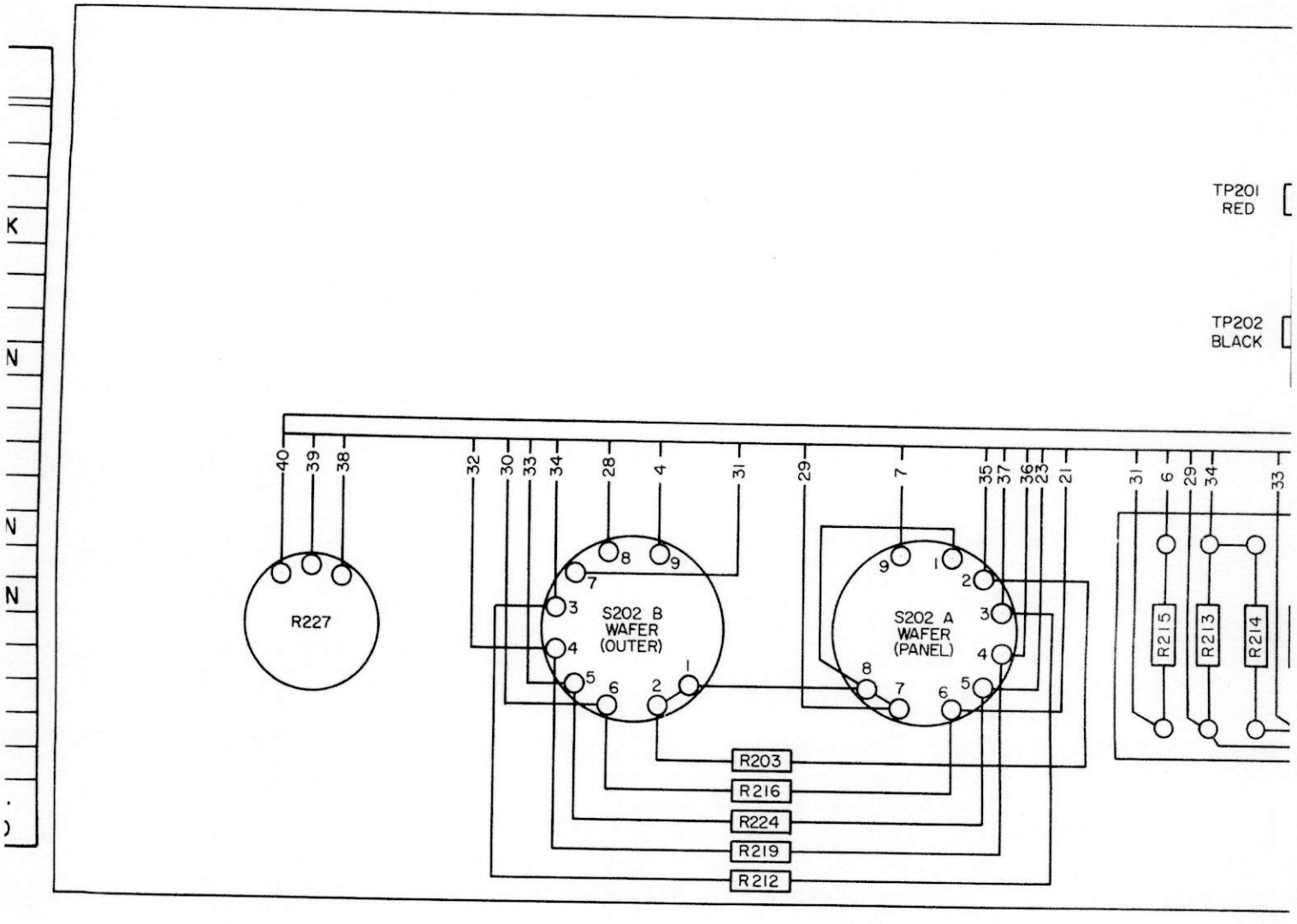


Figure 23. Transmitter Practical Wiring Diagram, Modulator and Power Supply (Sheet 3 of 3)

LEAD	COLOR	LEAD	COLO
1	WH-RD	23	WH-GR
2	WH-RD-RD	24	WH-GY
3	WH-OR	25	WH-BR
4	WH-BLK-RD	26	WH-BR
5	WH-PUR	27	WH-BL
6	WH-YW	28	WH-BL
7	WH-BLK-BLK	29	WH-BL
8	WH-GY-GRN	30	WH-PU
9	WH-GY-BLU	31	WH-YW
10	GY-BLK	32	WH-PU
11	WH-GY-RD	33	WH-PU
12	WH-BLK	34	WH-PU
13	WH-BRN-BRN	35	WH-PU
14	WH-BRN-BRN	36	WH-GR
15	WH-BRN	37	WH-GR
16	WH-GY-GRN	38	WH-OR
17	GY-BLK	39	WH-RD
18	WH-RD-OR	40	WH-OR
19	WH-OR-BLK	41	WH-BR
20	WH-RD	42	RG58C
21	WH-GRN-YW	43	SINGLE
22	WH-BRN		WH, SHI


TP201
RED
TP202
BLACK
40
39
38
32
30
33
34
28
4
31
29
7
35
37
36
23
21
31
6
29
34
33
R227
S202 B
WAFER
(OUTER)
S202 A
WAFER
(PANEL)
R215
R213
R214
R203
R216
R224
R219
R212

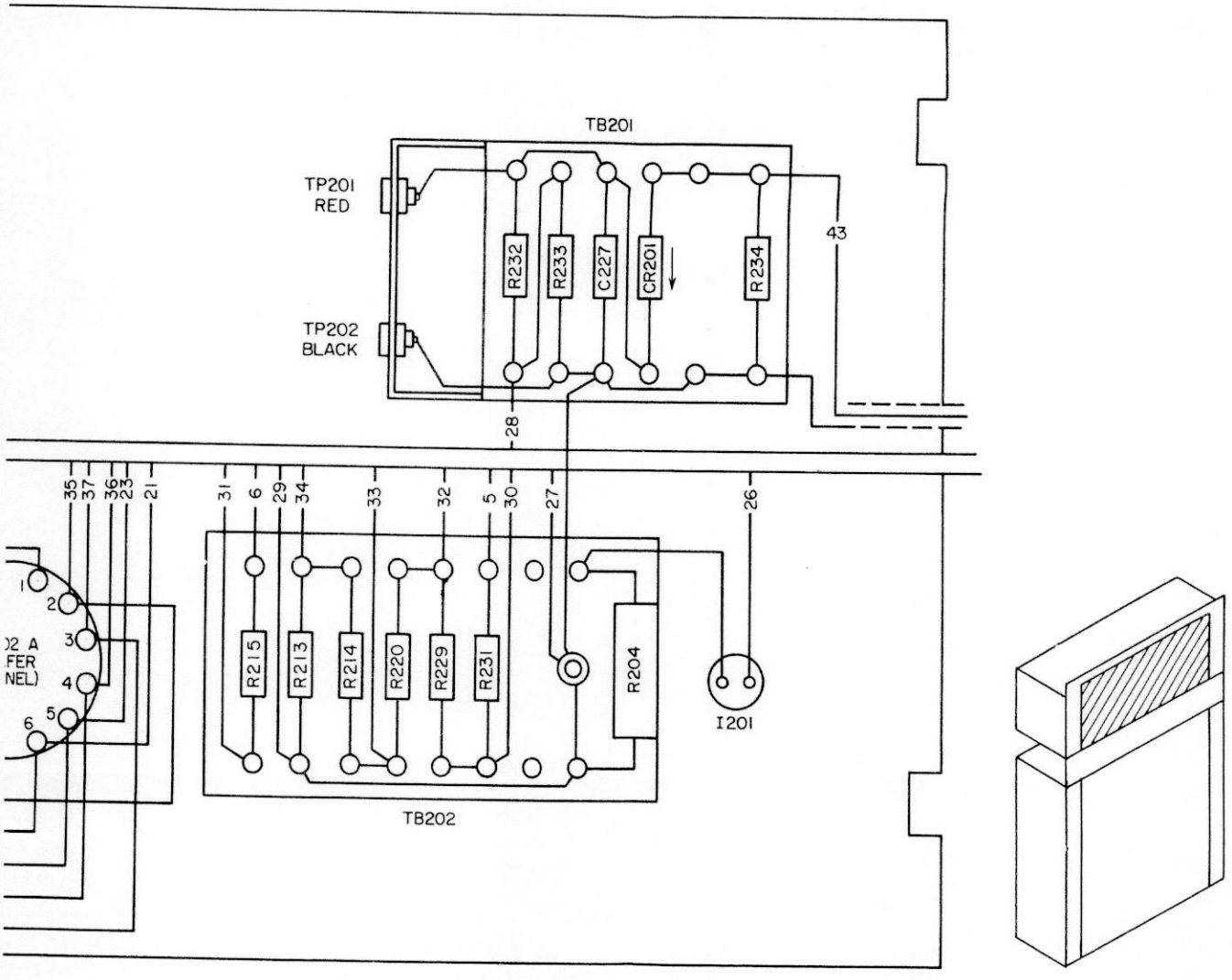
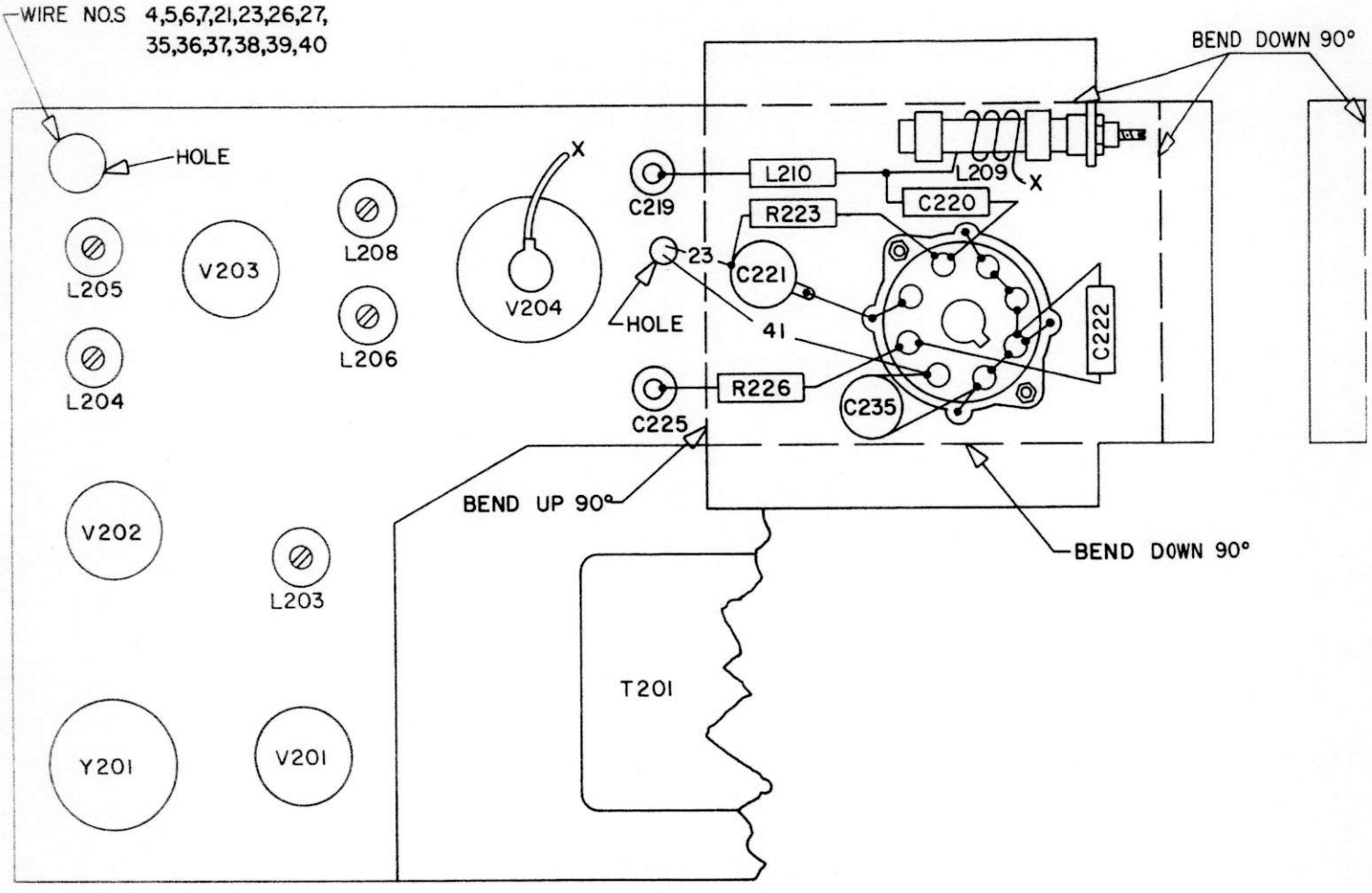
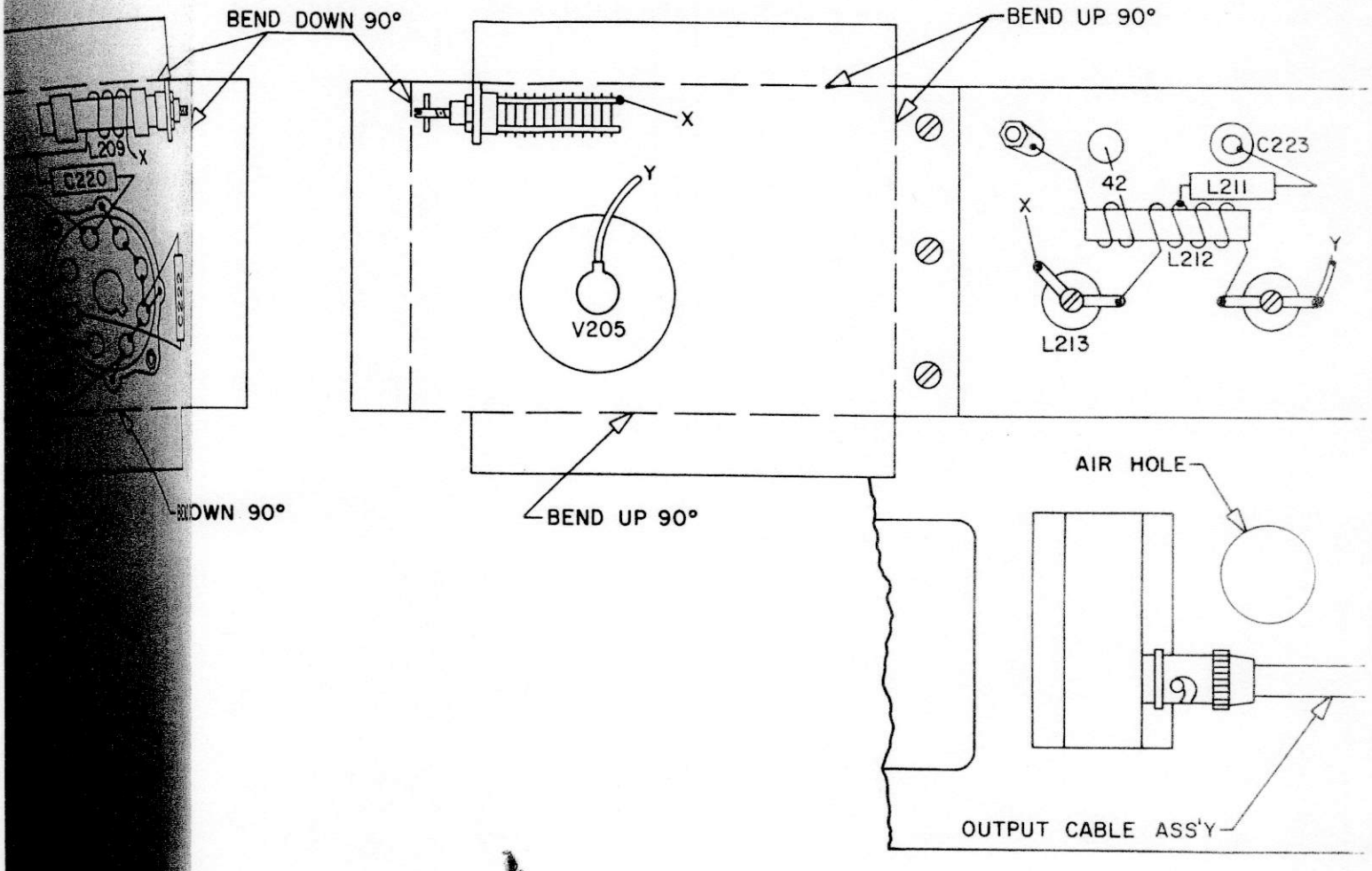


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 1 of 3)



NOTE:
FOR WIRE COLOR CODE
SEE SHEET 1


BEND DOWN 90°
BEND UP 90°
L209
X
C220
C222
X
Y
V205
42
C223
L211
X
L212
Y
L213
DOWN 90°
BEND UP 90°
AIR HOLE
OUTPUT CABLE ASS'Y

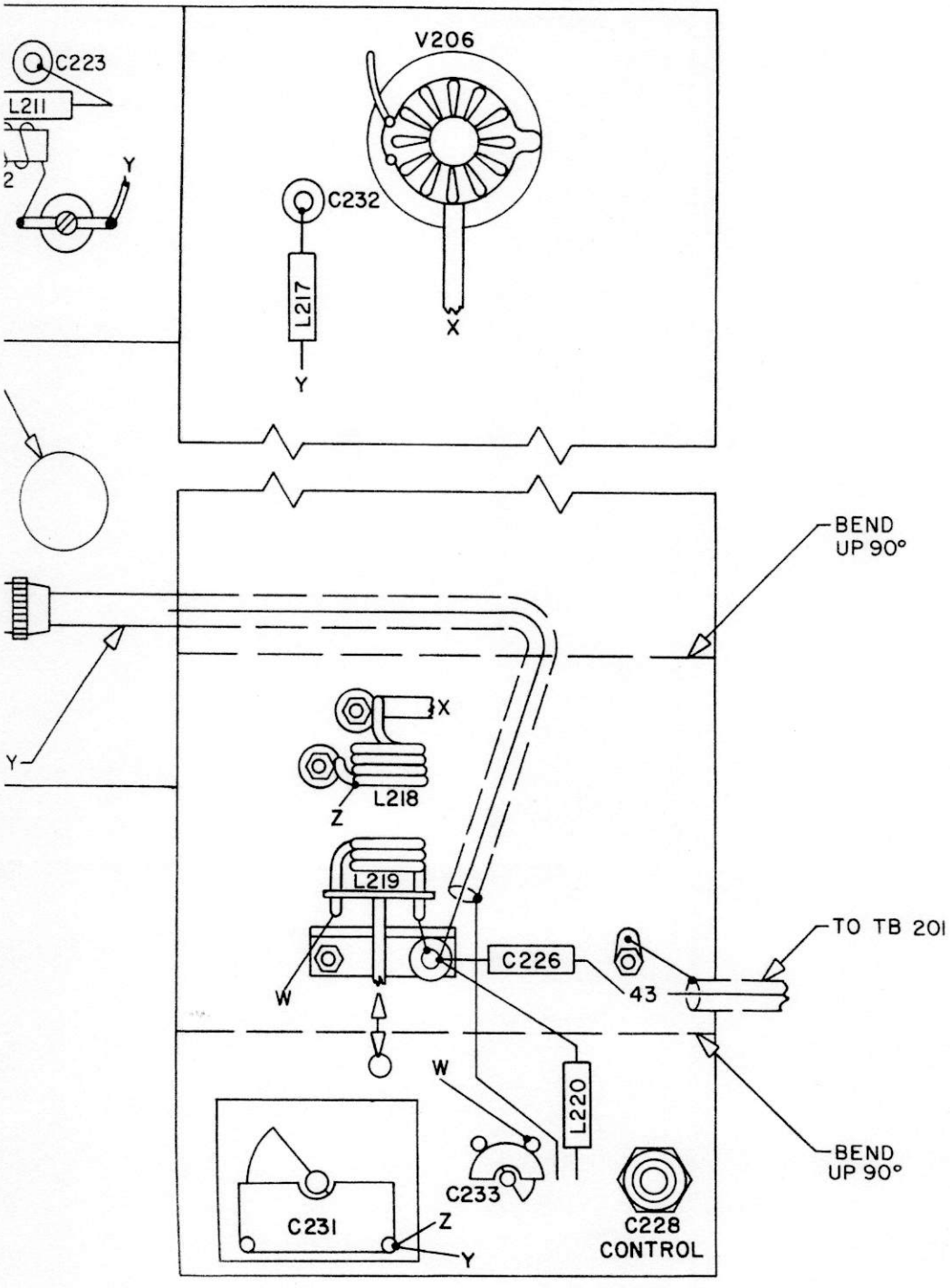
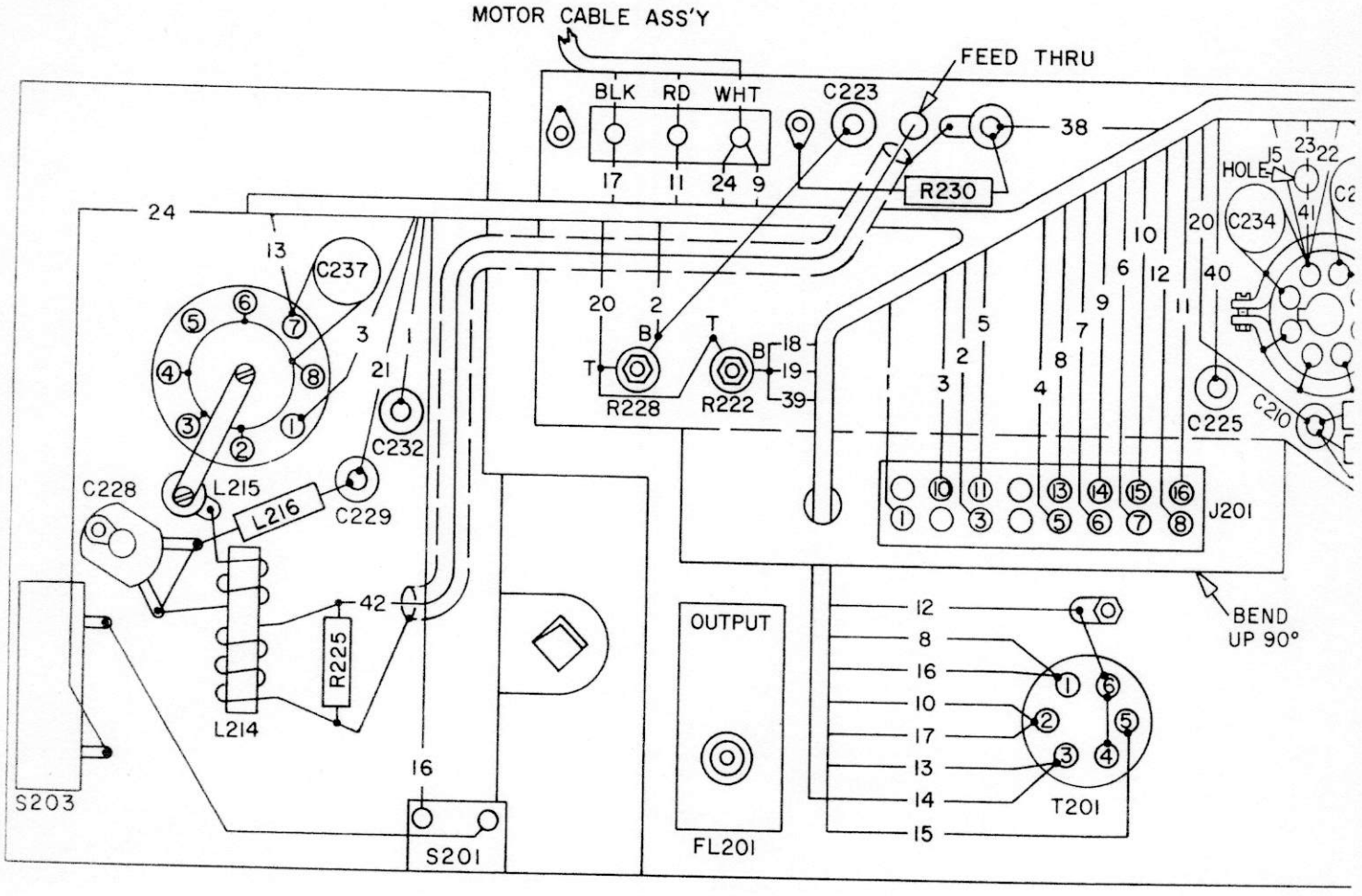
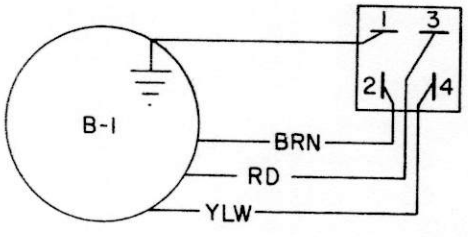
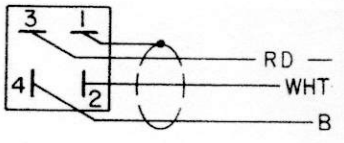


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 2 of 3)







MOTOR CABLE AS

Figu

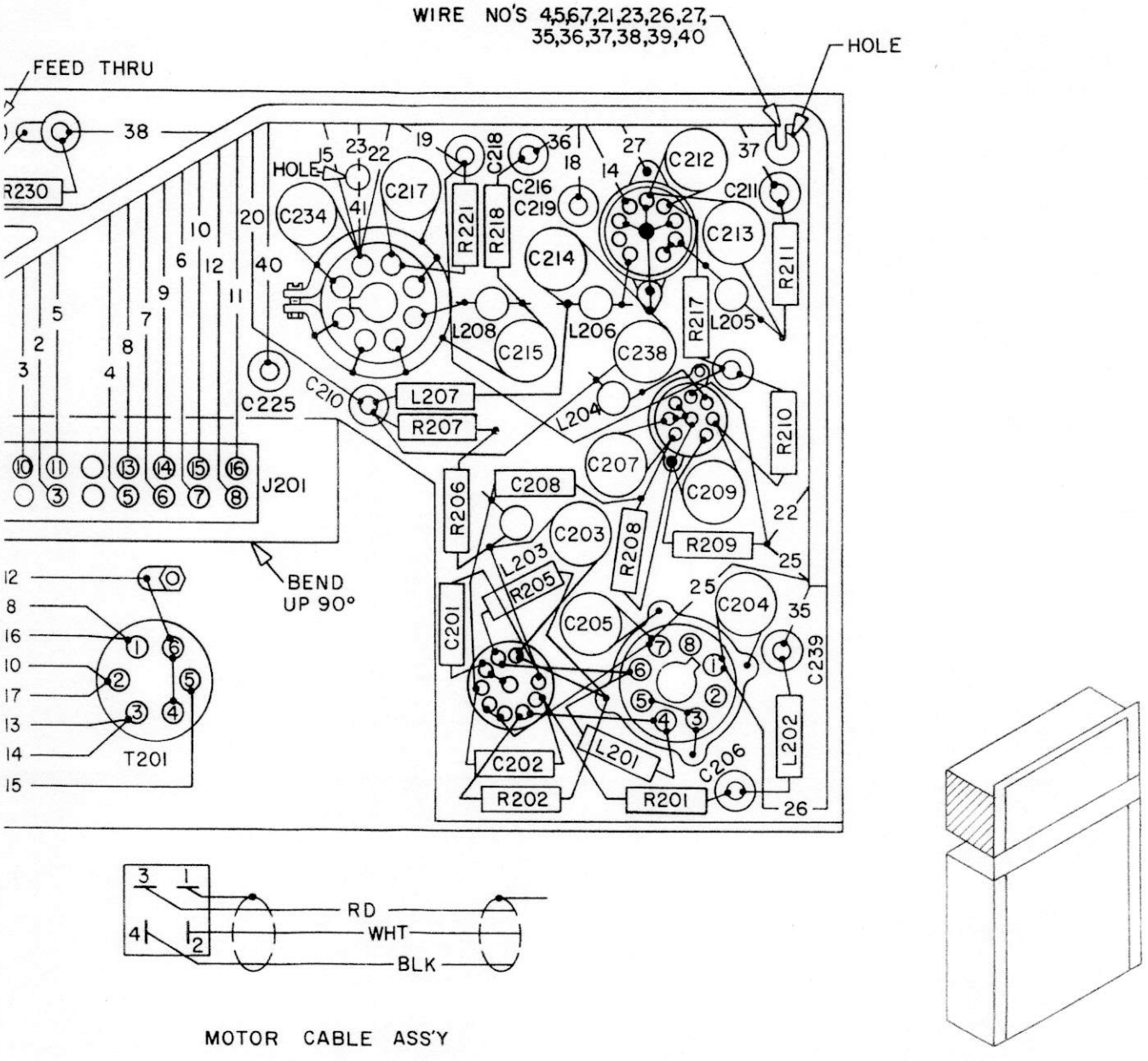
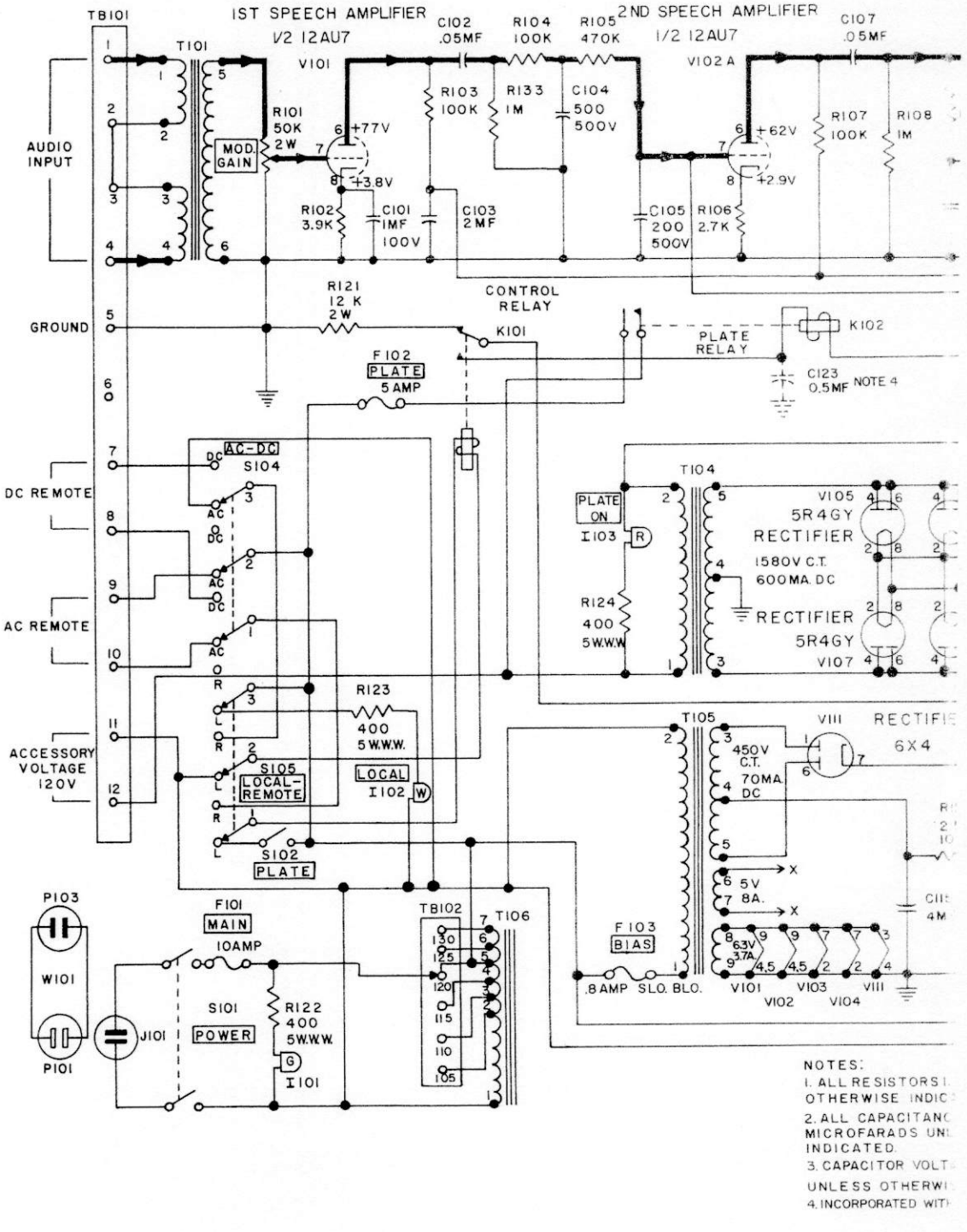


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 3 of 3)



NOTES:
1. ALL RESISTORS I
OTHERWISE INDIC
2. ALL CAPACITANC
MICROFARADS UN
INDICATED.
3. CAPACITOR VOLT
UNLESS OTHERWI
4. INCORPORATED WIT

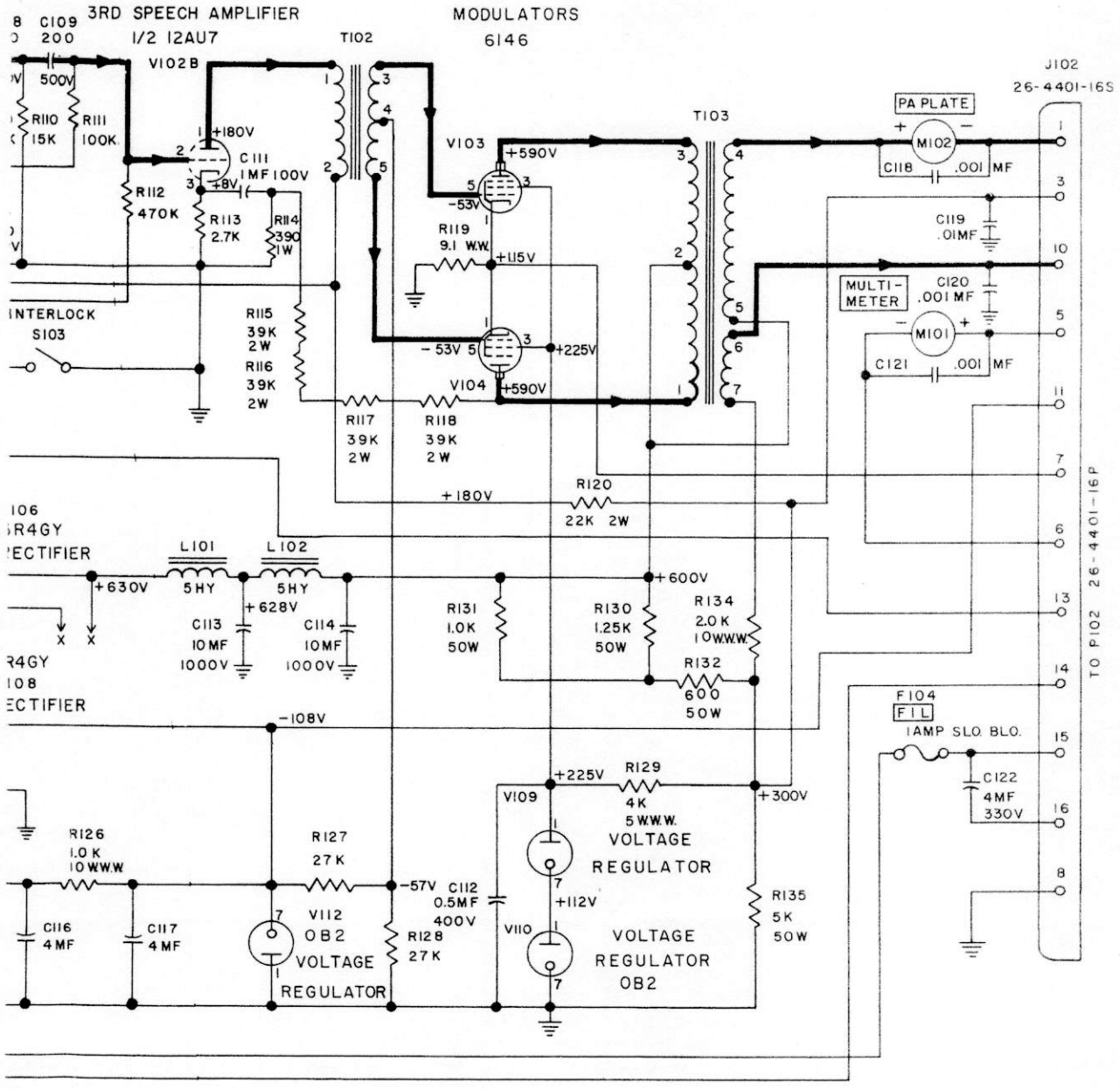
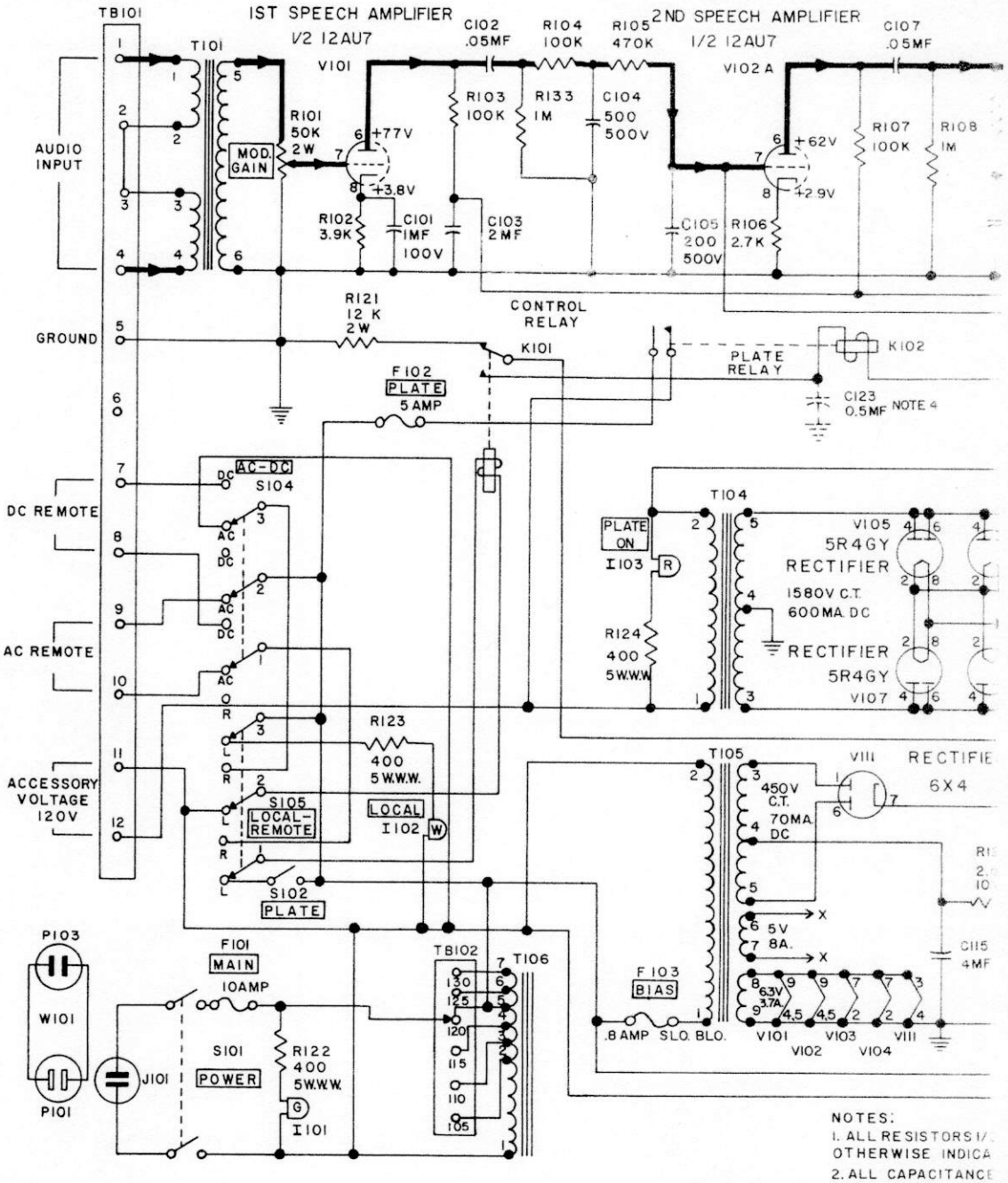
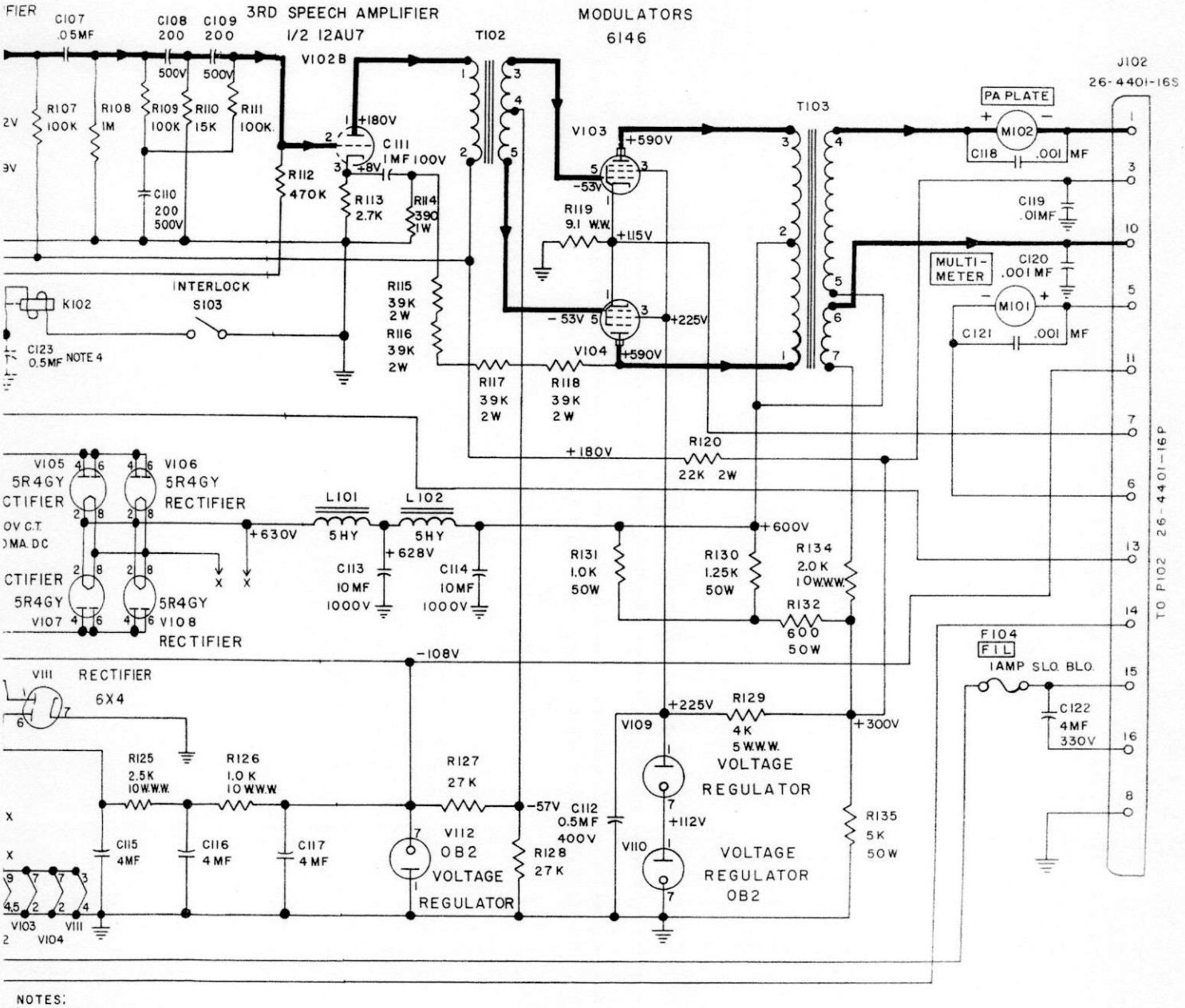


Figure 25. Transmitter Schematic Diagram, Modulator and Power Supply

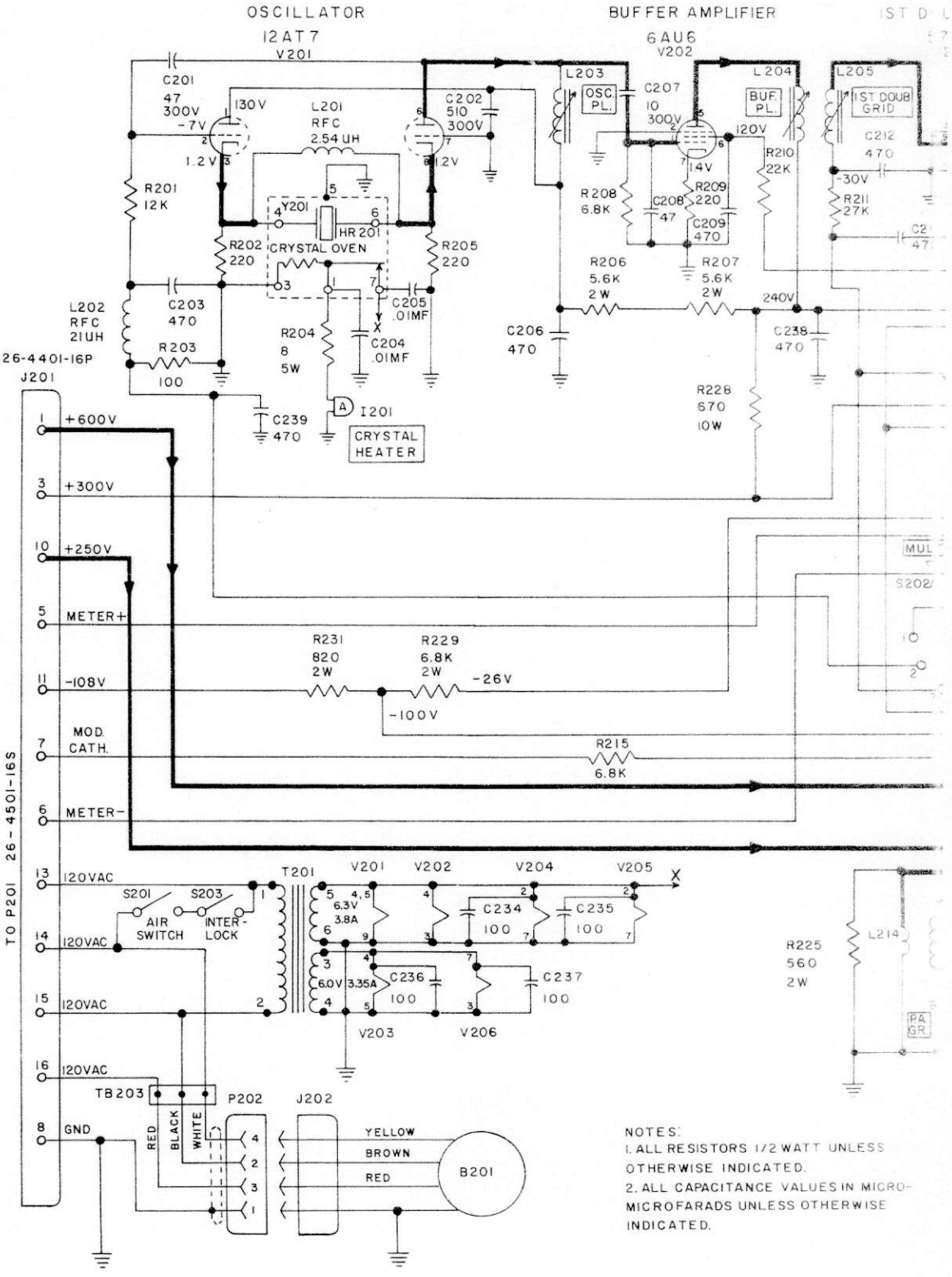


NOTES:
1. ALL RESISTORS 1/
OTHERWISE INDICA
2. ALL CAPACITANCE
MICROFARADS UNL
INDICATED.
3. CAPACITOR VOLTA
UNLESS OTHERWIS
4. INCORPORATED WITH

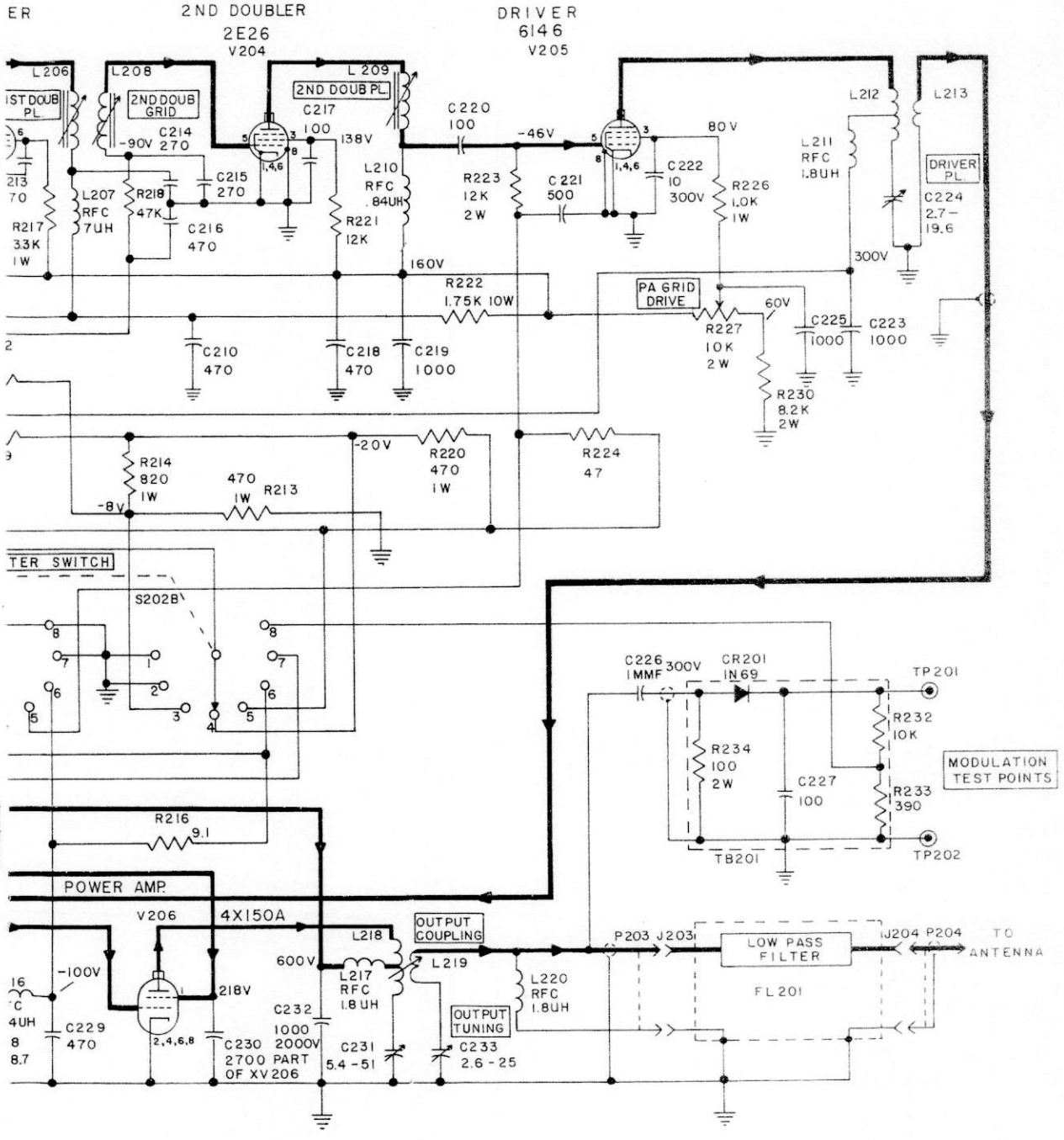


NOTES:
1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS OTHERWISE INDICATED.
3. CAPACITOR VOLTAGE RATING: 600 VDCW UNLESS OTHERWISE INDICATED.
4. INCORPORATED WITH MODIFICATION KIT NO. 2.

Figure 25. Transmitter Schematic Diagram, Modulator and Power Supply

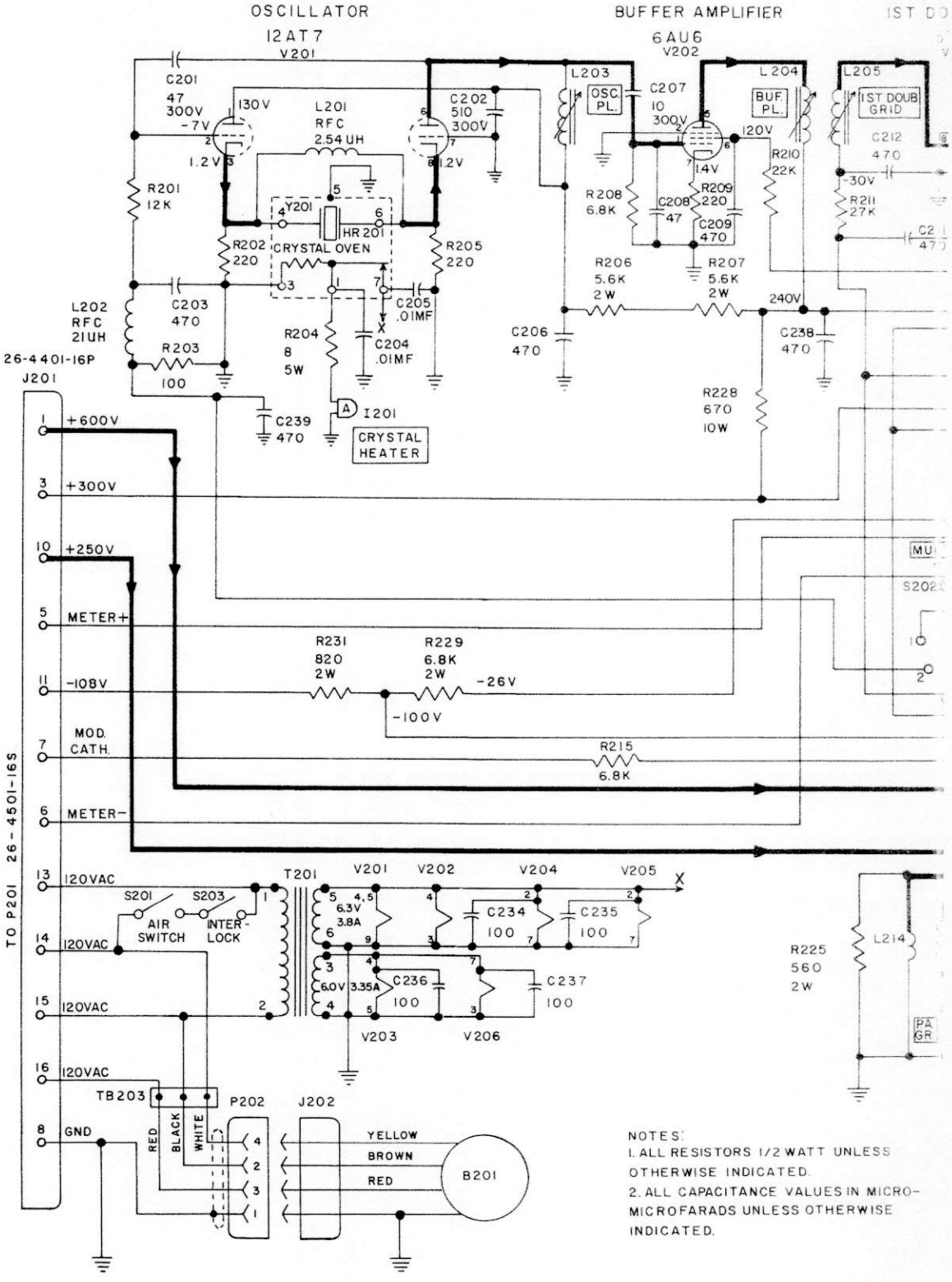


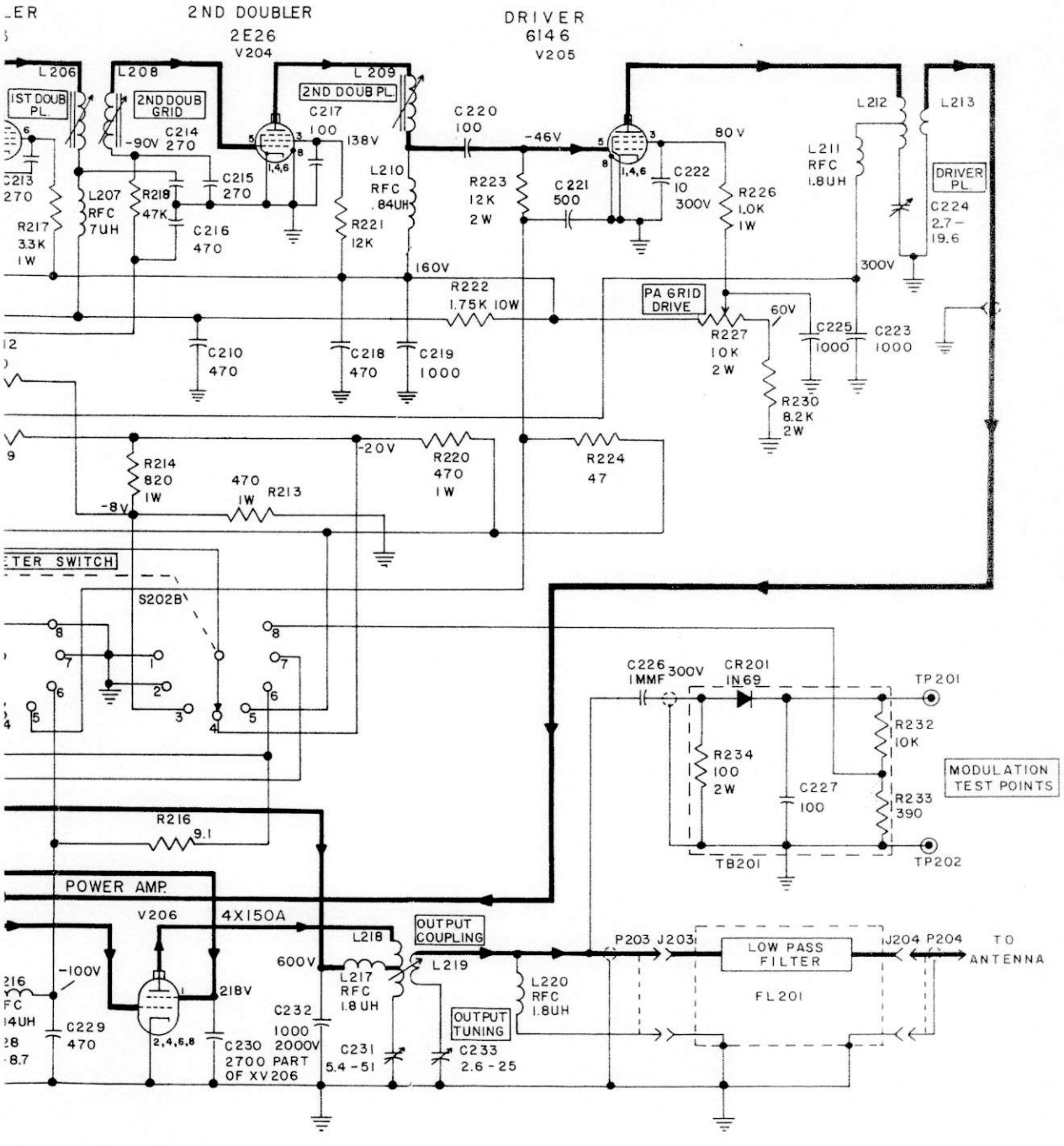
NOTES:
1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS OTHERWISE INDICATED.



CAPACITOR VOLTAGE RATING: 600 VDCW
LESS OTHERWISE INDICATED.
MULTI-METER SWITCH, S202, POSITIONS:
1. OFF
2. OSC GRID _____ 15MA
3. IST DOUB GRID _____ 15MA
4. 2ND DOUB GRID _____ 30MA
5. DRIVER GRID _____ 3MA
6. PA GRID _____ 15MA
7. MOD CATHODE _____ 150 MA
8. OUTPUT _____ REL

Figure 26. Transmitter Schematic Diagram, R-F Section and PA


OSCILLATOR
12AT7
V201
BUFFER AMPLIFIER
6AU6
V202
C201
47
300V
-7V
130V
L201
RFC
2.54 UH
C202
510
300V
1.2V
1.2V
R201
12K
Y201
HR 201
CRYSTAL OVEN
R202
220
R205
220
L202
RFC
21UH
C203
470
R203
100
C205
.01MF
R204
8
5W
C204
.01MF
I201
CRYSTAL
HEATER
C239
470
26-4401-16P
J201
+600V
+300V
+250V
METER+
-108V
MOD.
CATH.
METER-
TO P201 26-4501-16S
120VAC
120VAC
120VAC
120VAC
GND
S201
AIR
SWITCH
S203
INTER-
LOCK
T201
6.3V
3.8A
6.0V
3.35A
V201
V202
V204
V205
V203
V206
C234
100
C235
100
C236
100
C237
100
TB203
P202
J202
RED
BLACK
WHITE
YELLOW
BROWN
RED
B201
L203
OSC.
PL.
C207
10
300V
L204
BUF.
PL.
120V
1.4V
R208
6.8K
C208
47
R209
220
C209
470
R210
22K
R206
5.6K
2W
R207
5.6K
2W
240V
C206
470
C238
470
R228
670
10W
L205
1ST DOUB
GRID
C212
470
-30V
R211
27K
R231
820
2W
R229
6.8K
2W
-26V
-100V
R215
6.8K
R225
560
2W
L214
PA
GR
MU
S202
NOTES:
1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS OTHERWISE INDICATED.



CAPACITOR VOLTAGE RATING: 600VDCW
ILESS OTHERWISE INDICATED.
MULTI-METER SWITCH, S202, POSITIONS:
1. OFF
2. OSC GRID _____ 15MA
3. IST DOUB GRID _____ L5MA
4. 2ND DOUB GRID _____ 30MA
5. DRIVER GRID _____ 3MA
6. PA GRID _____ 15MA
7. MOD CATHODE _____ 150 MA
8. OUTPUT _____ REL

Figure 26. Transmitter Schematic Diagram, R-F Section and PA

LEAD	COLOR	LEAD	COLO
1	WH-RD	23	WH-GRN
2	WH-RD-RD	24	WH-GY-
3	WH-OR	25	WH-BRN
4	WH-BLK-RD	26	WH-BRN
5	WH-PUR	27	WH-BLK
6	WH-YW	28	WH-BLU
7	WH-BLK-BLK	29	WH-BLK
8	WH-GY-GRN	30	WH-PUR
9	WH-GY-BLU	31	WH-YW
10	GY-BLK	32	WH-PUR
11	WH-GY-RD	33	WH-PUR
12	WH-BLK	34	WH-PUR
13	WH-BRN-BRN	35	WH-PUR
14	WH-BRN-BRN	36	WH-GRN
15	WH-BRN	37	WH-GRN
16	WH-GY-GRN	38	WH-OR-
17	GY-BLK	39	WH-RD-
18	WH-RD-OR	40	WH-OR
19	WH-OR-BLK	41	WH-BRN
20	WH-RD	42	RG58C/
21	WH-GRN-YW	43	SINGLE (
22	WH-BRN		WH, SHIE

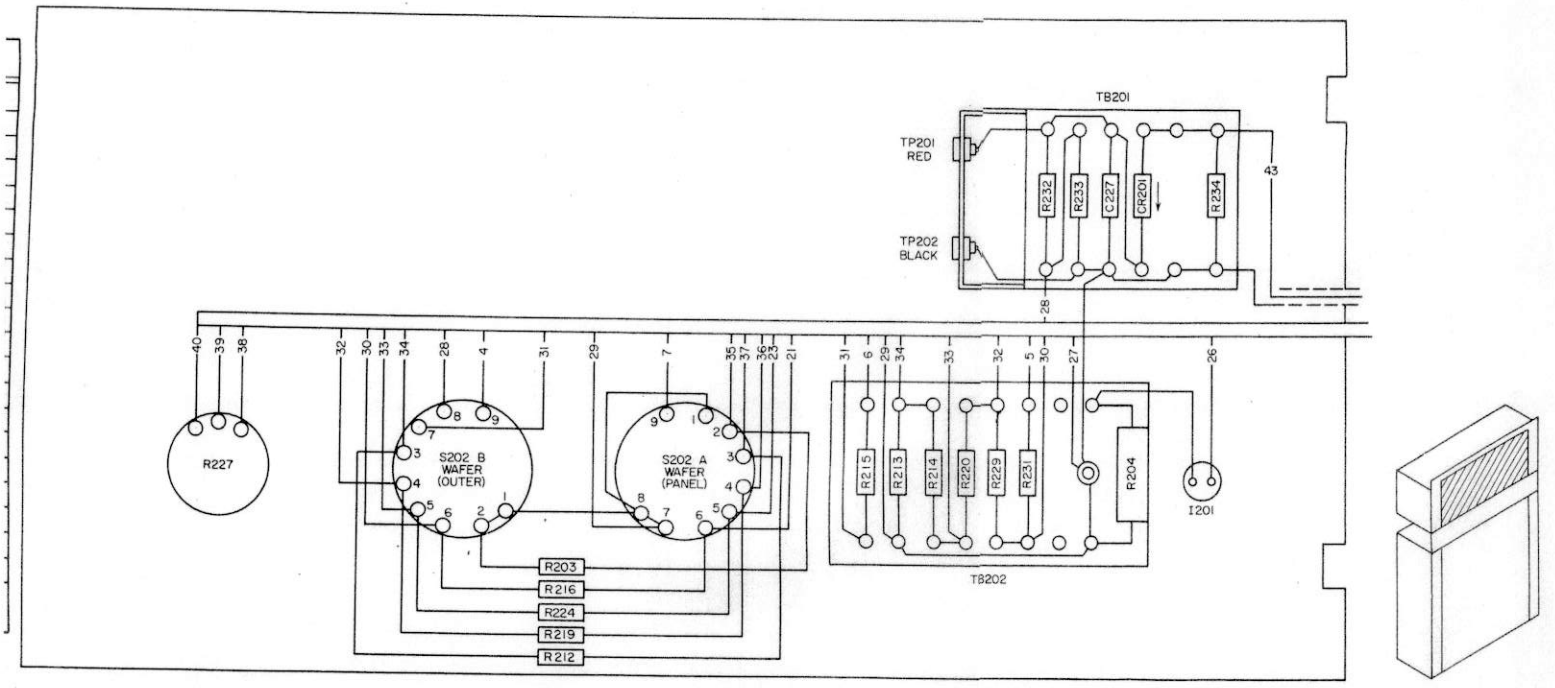
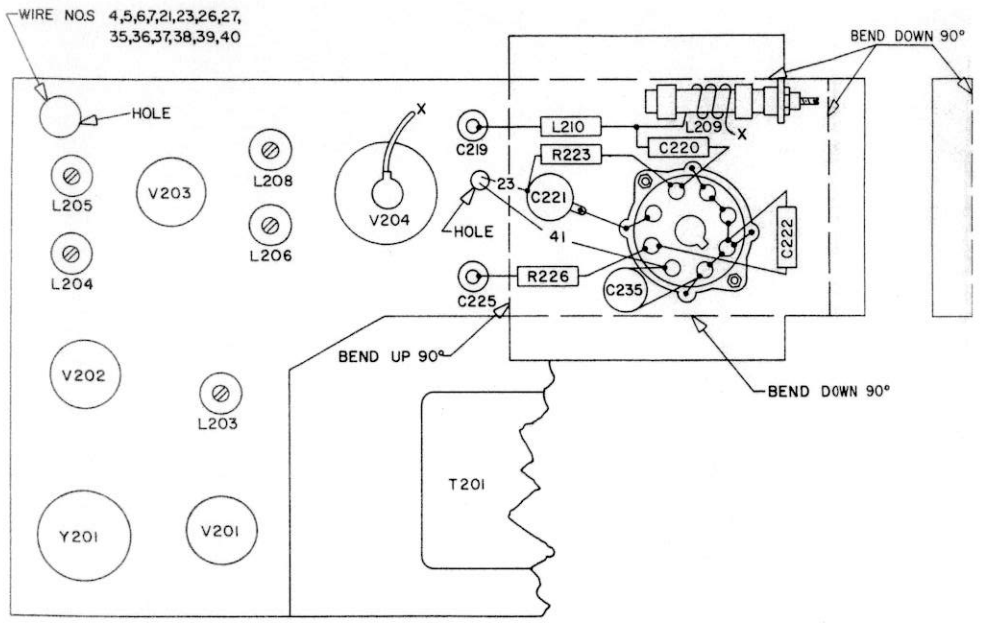


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 1 of 3)



NOTE:
FOR WIRE COLOR CODE
SEE SHEET 1

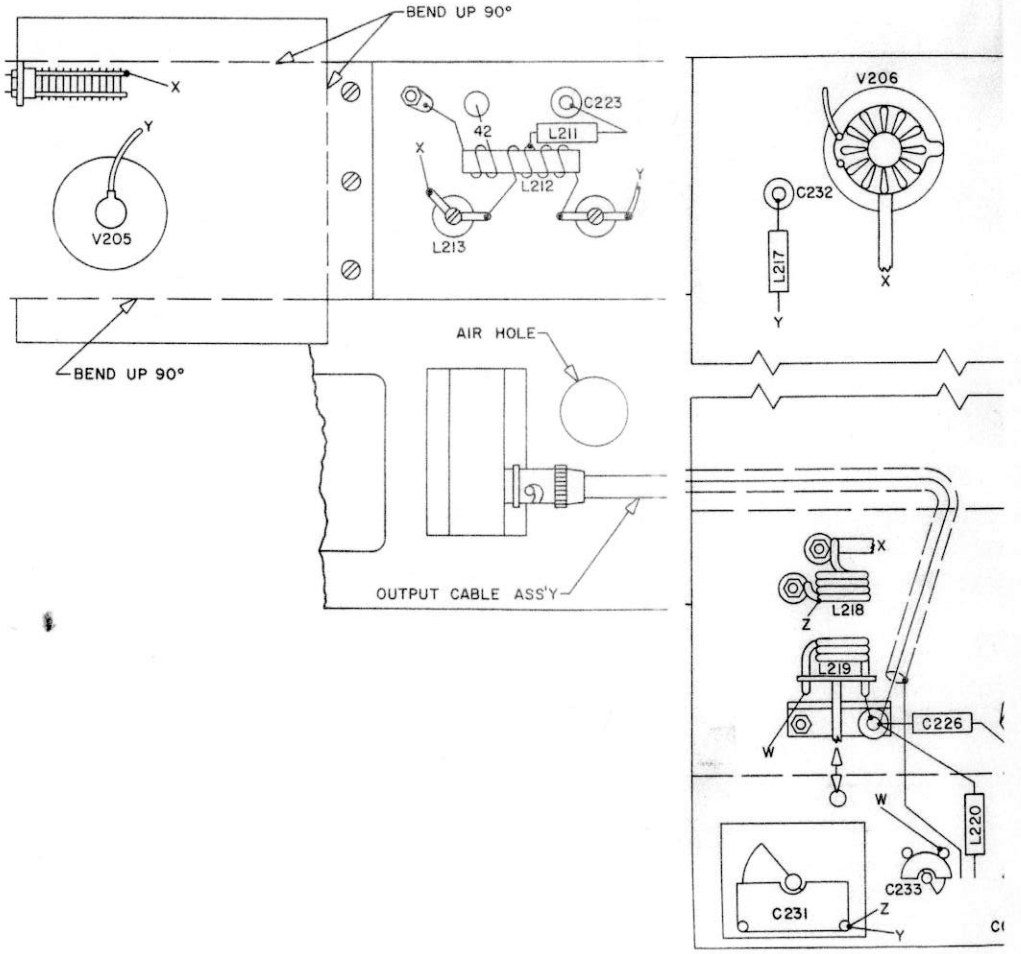


Figure 24. Transmi

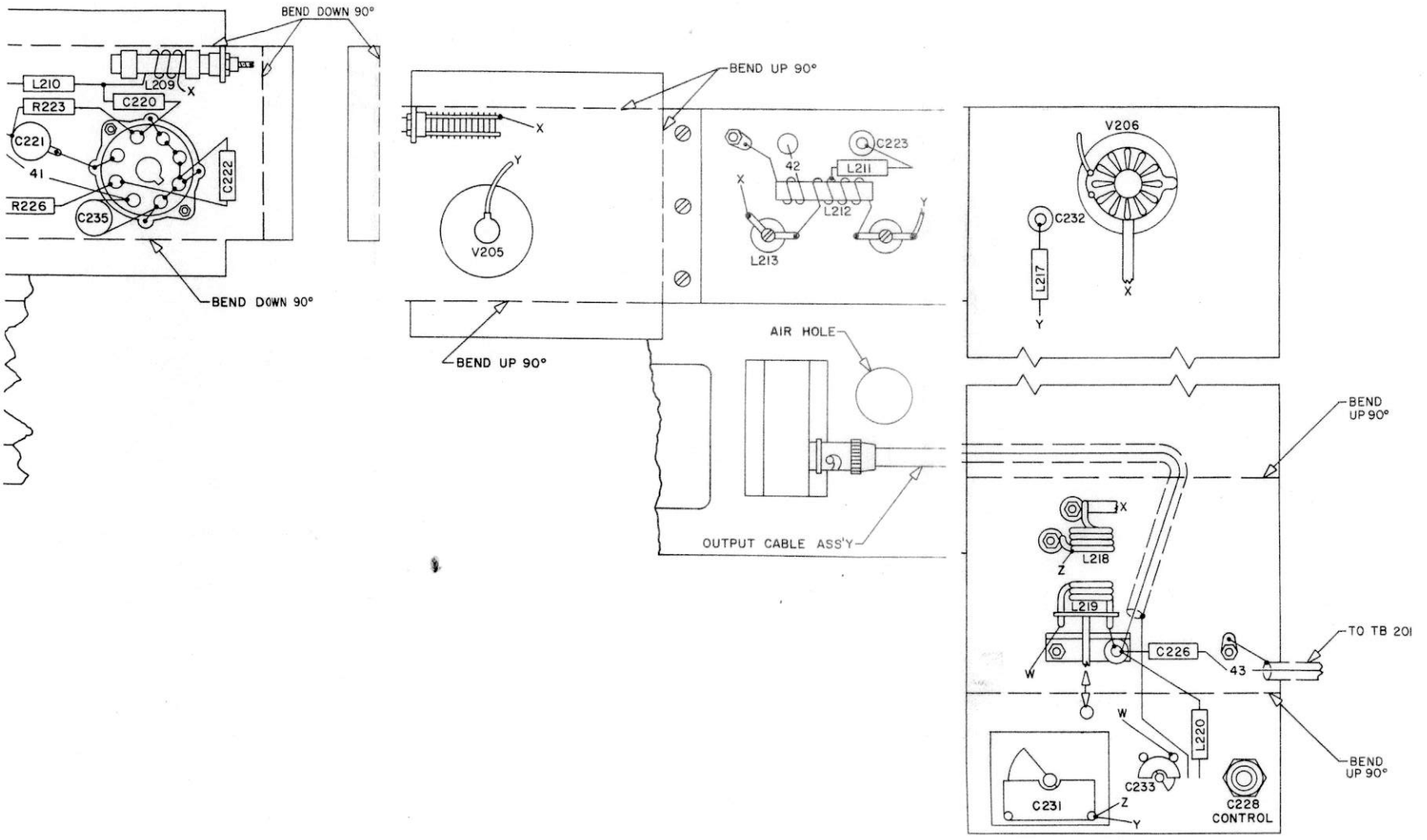


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 2 of 3)

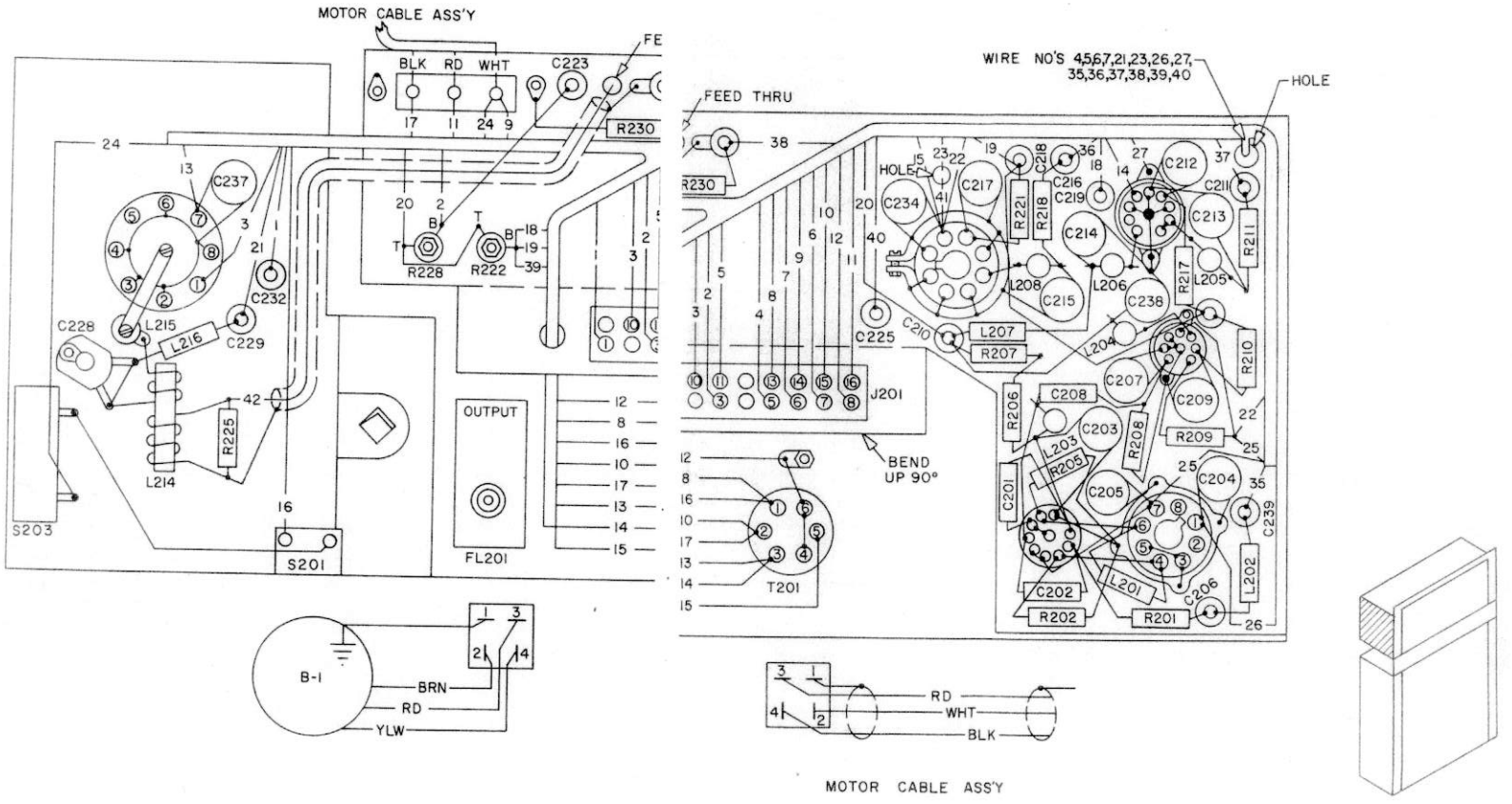


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 3 of 3)

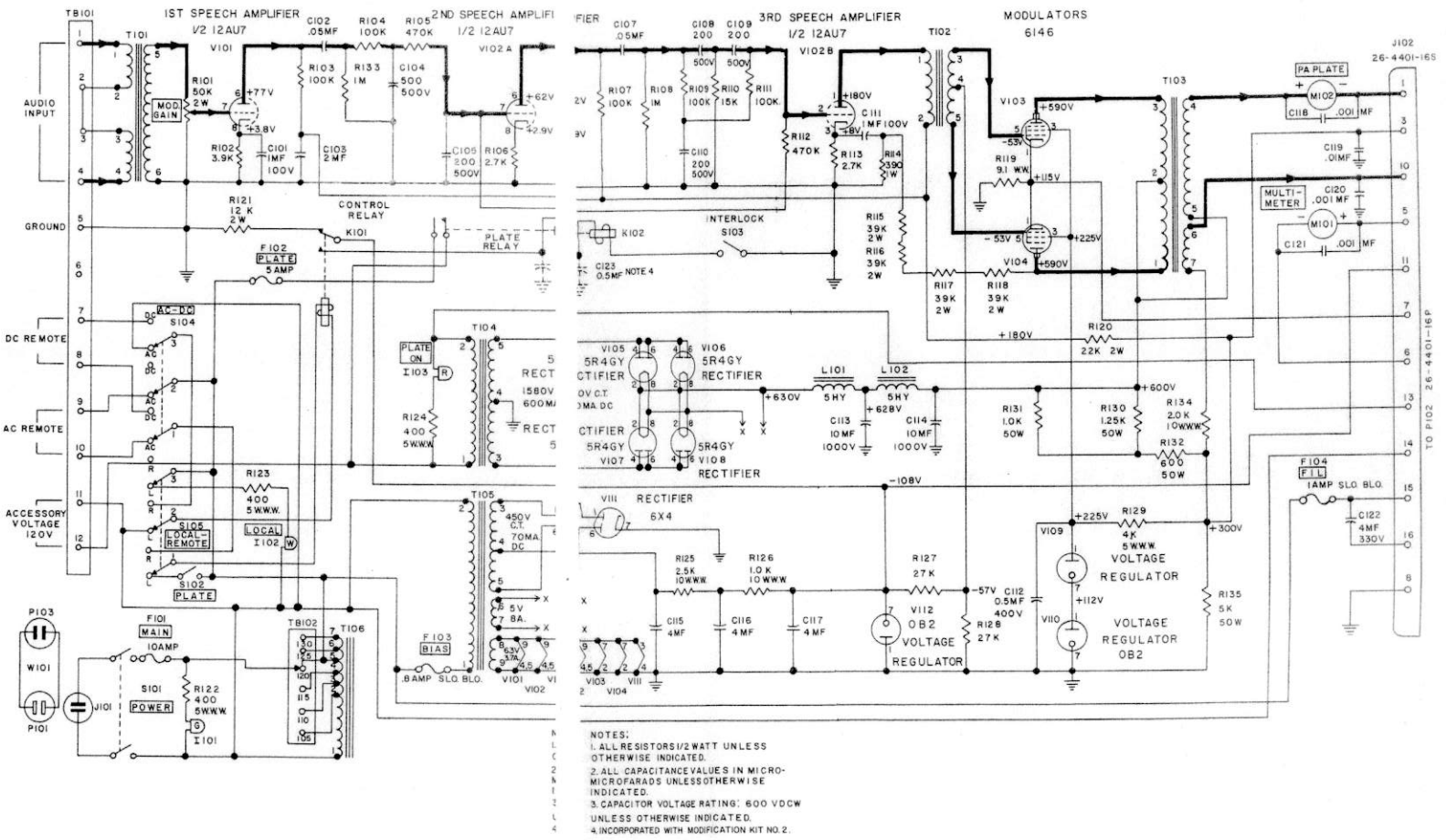
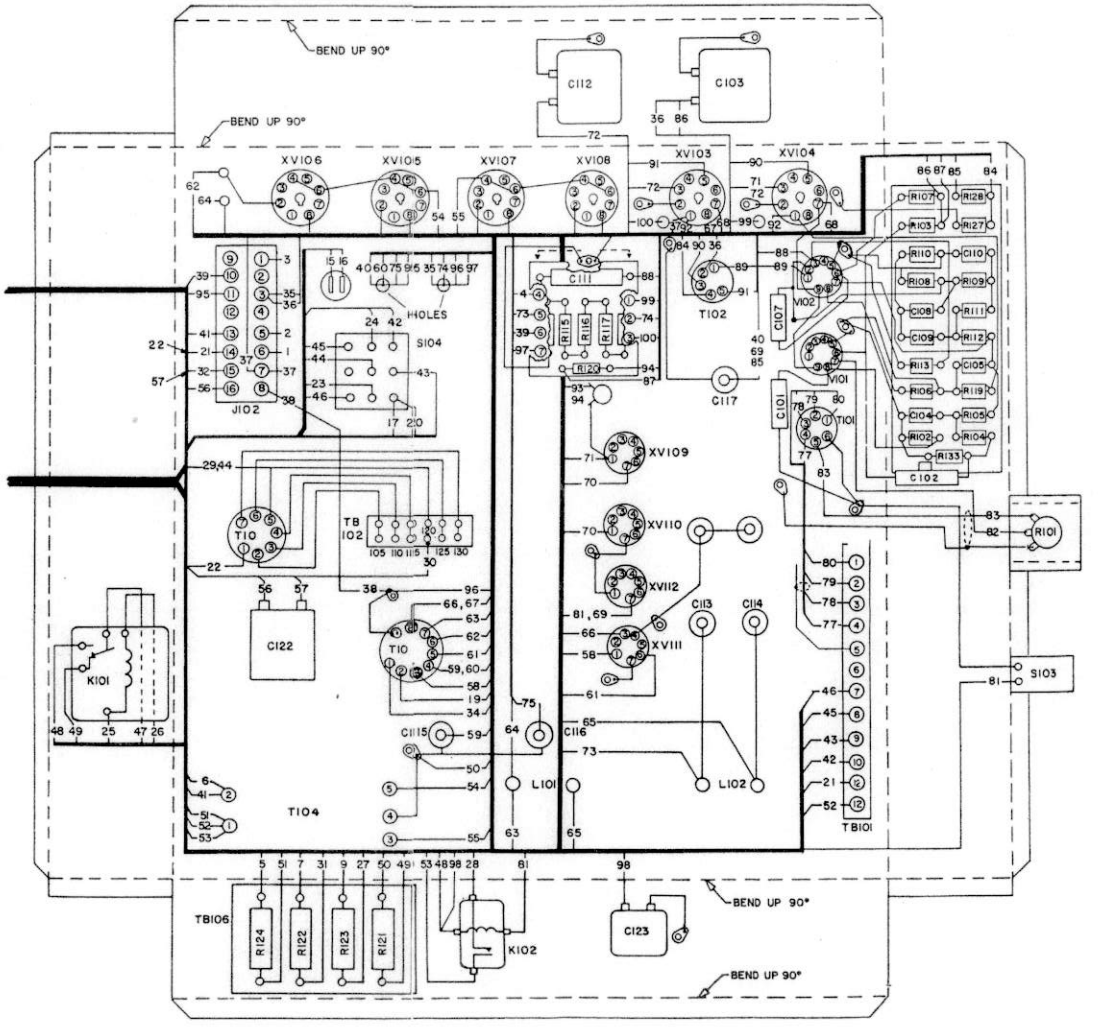


Figure 25. Transmitter Schematic Diagram, Modulator and Power Supply

NOTE:
FOR WIRE COLOR CODE SEE SHEET 3



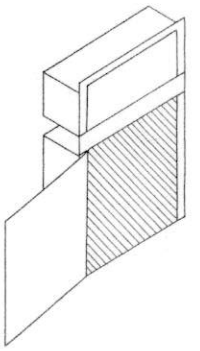


Figure 23. Transmitter Practical Wiring Diagram, Modulator and Power Supply (Sheet 2 of 3)

LEAD	COLOR	LEAD	COLOR
1	WH-BLK-BLK	51	WH-GY-YW
2	WH-BLK-RD	52	WH-GY-YW
3	WH-RD	53	WH-GY-YW
4	WH-RD	54	WH-RD
5	WH-GY-ORN	55	WH-RD
6	WH-GY-GRN	56	WH-GY-RD
7	WH-GY-PUR	57	GY-BLK
8	WH-GY-BLU	58	WH-RD
9	WH-GY-BRN	59	WH-BLK-RD
10	GY-RD	60	WH-PUR
11	WH-GY-RD	61	WH-RD
12	WH-GY-RD	62	WH-RD
13	WH-GY-RD	63	WH-RD
14	WH-GY	64	WH-RD
15	WH-GY	65	WH-RD
16	WH-GY-BLK	66	WH-BRN
17	WH-GY-BLU	67	WH-BRN
18	WH-GY-BLU	68	WH-BRN
19	WH-GY-BLU	69	WH-PUR
20	WH-GY-BLU	70	WH-OR
21	WH-GY-BLU	71	WH-OR
22	WH-GY-BLU	72	WH-OR
23	GY-YW	73	WH-RD
24	GY-OR	74	WH-RD
25	GY-GRN	75	NO WIRE
26	GY-BLU	76	SHIELD
27	GY-PUR	77	WH-BLK
28	WH-GY-ORN	78	WH-BLU
29	WH-GY-RD	79	WH-GY-GRN
30	WH-GY-BRN	80	WH-GRN
31	WH-GR-BRN	81	WH-PUR
32	GY-BLK	82	WH-GRN
33	WH-GY-RD	83	WH-BLU
34	GY-BRN	84	WH-BLK-RD
35	WH-RD-RD	85	WH-PUR
36	WH-RD-RD	86	WH-RD-RD
37	WH-YW	87	WH-RD-RD
38	WH-BLK	88	WH-YW
39	WH-ORN	89	WH-BLU
40	WH-PUR	90	WH-GRN
41	WH-GY-GRN	91	WH-GRN
42	WH-BLK-GY	92	WH-YW
43	GY-RD	93	WH-RD-RD
44	WH-GY-GRN	94	WH-RD-RD
45	WH-RD-BLK	95	WH-PUR
46	WH-BLK-BLK	96	WH-BLK
47	WH-PUR	97	WH-RD
48	WH-PUR	98	WH-PUR
49	WH-RD-BLK	99	WH-RD
50	WH-BLK	100	WH-RD

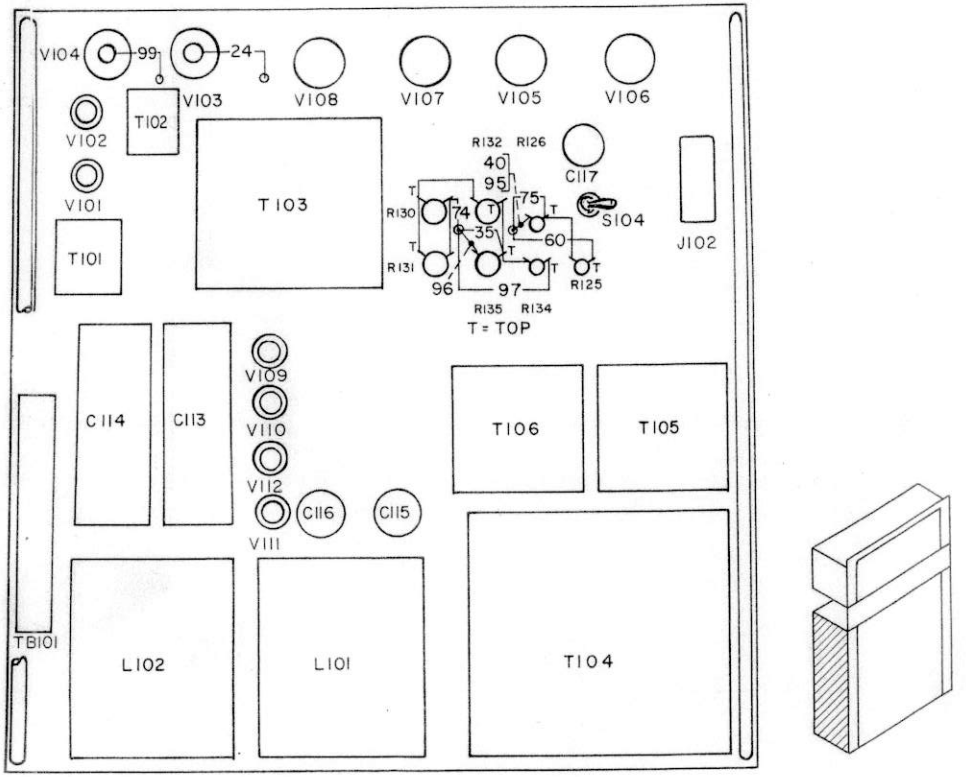
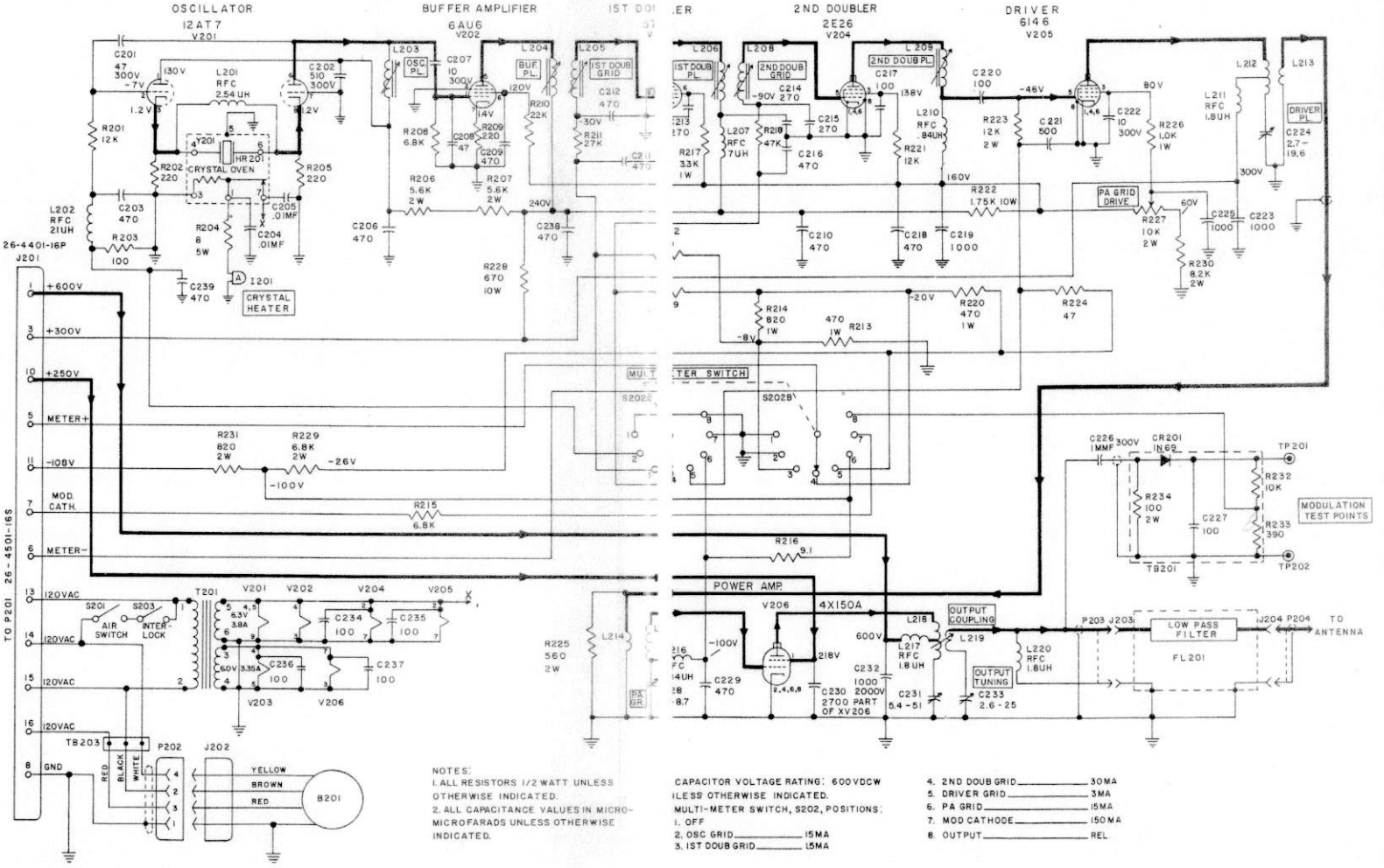


Figure 23. Transmitter Practical Wiring Diagram, Modulator and Power Supply (Sheet 3 of 3)



NOTES:
1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS OTHERWISE INDICATED.

CAPACITOR VOLTAGE RATING: 600VDCW UNLESS OTHERWISE INDICATED.

MULTI-METER SWITCH, S202, POSITIONS:
1. OFF
2. OSC GRID 15MA
3. 1ST DOUB GRID 15MA
4. 2ND DOUB GRID 30MA
5. DRIVER GRID 3MA
6. PA GRID 15MA
7. MOD CATHODE ..... 150 MA
8. OUTPUT ..... REL

Figure 26. Transmitter Schematic Diagram, R-F Section and PA

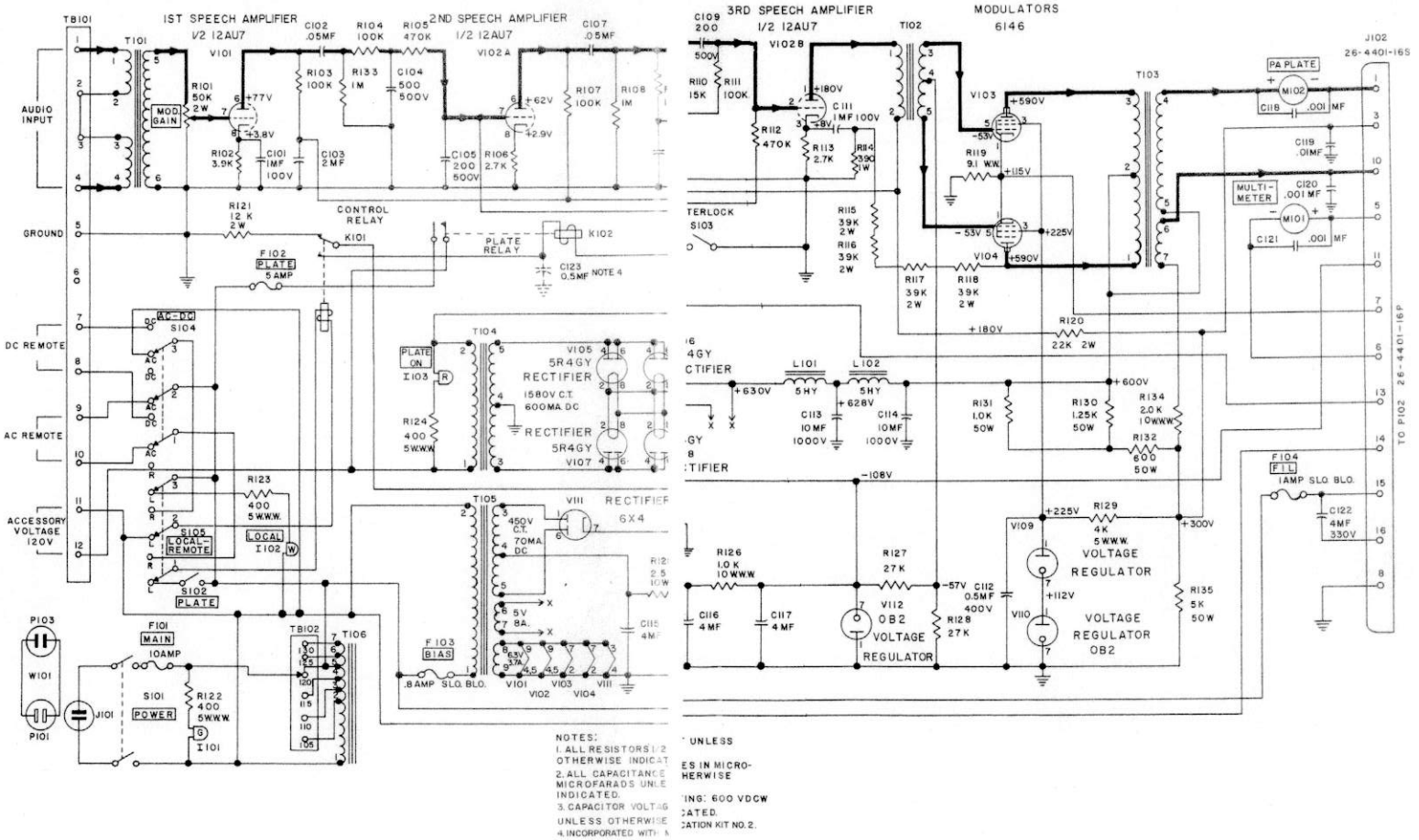
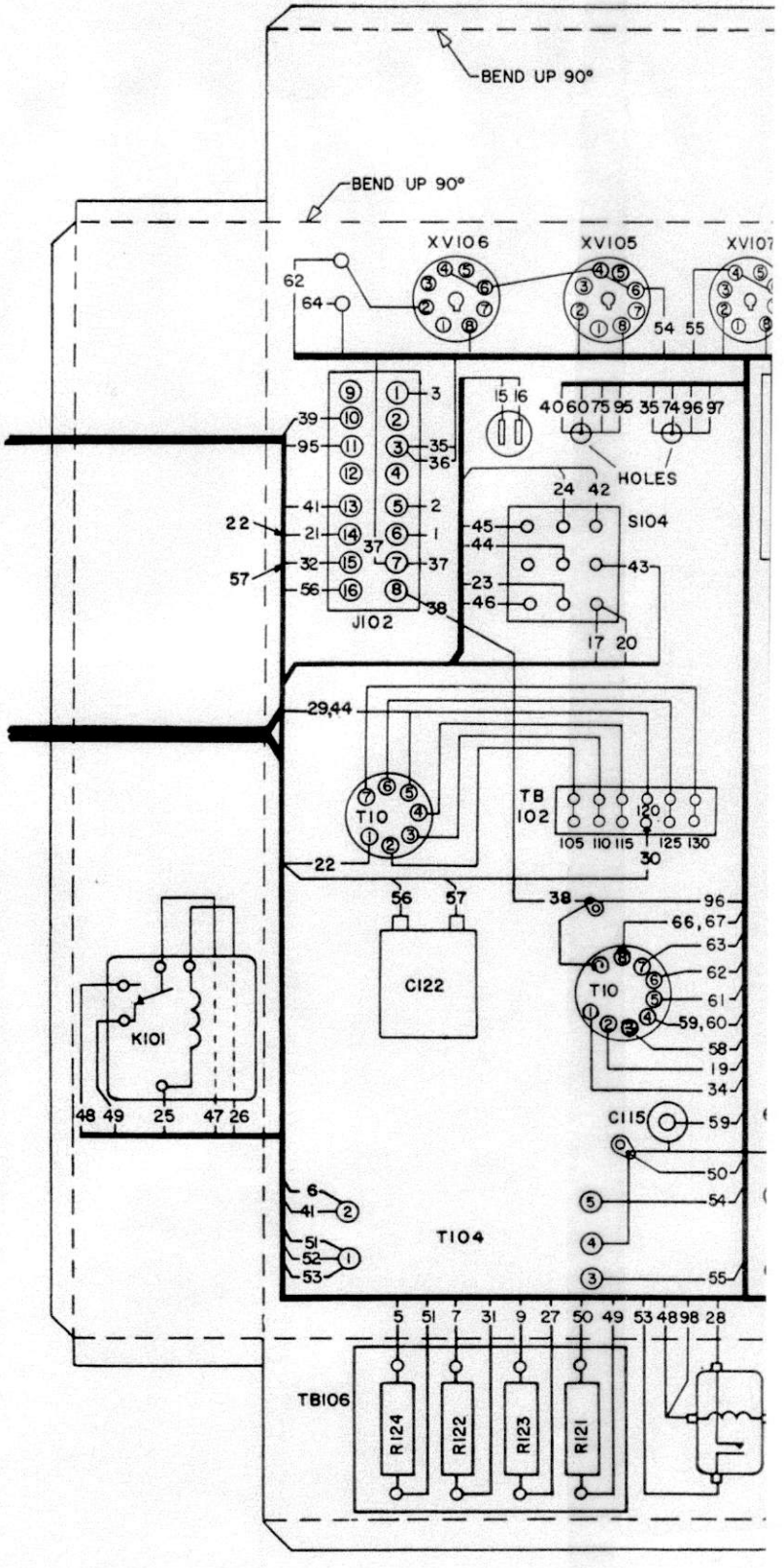


Figure 25. Transmitter Schematic Diagram, Modulator and Power Supply

NOTE:
FOR WIRE COLOR CODE SEE SHEET 3



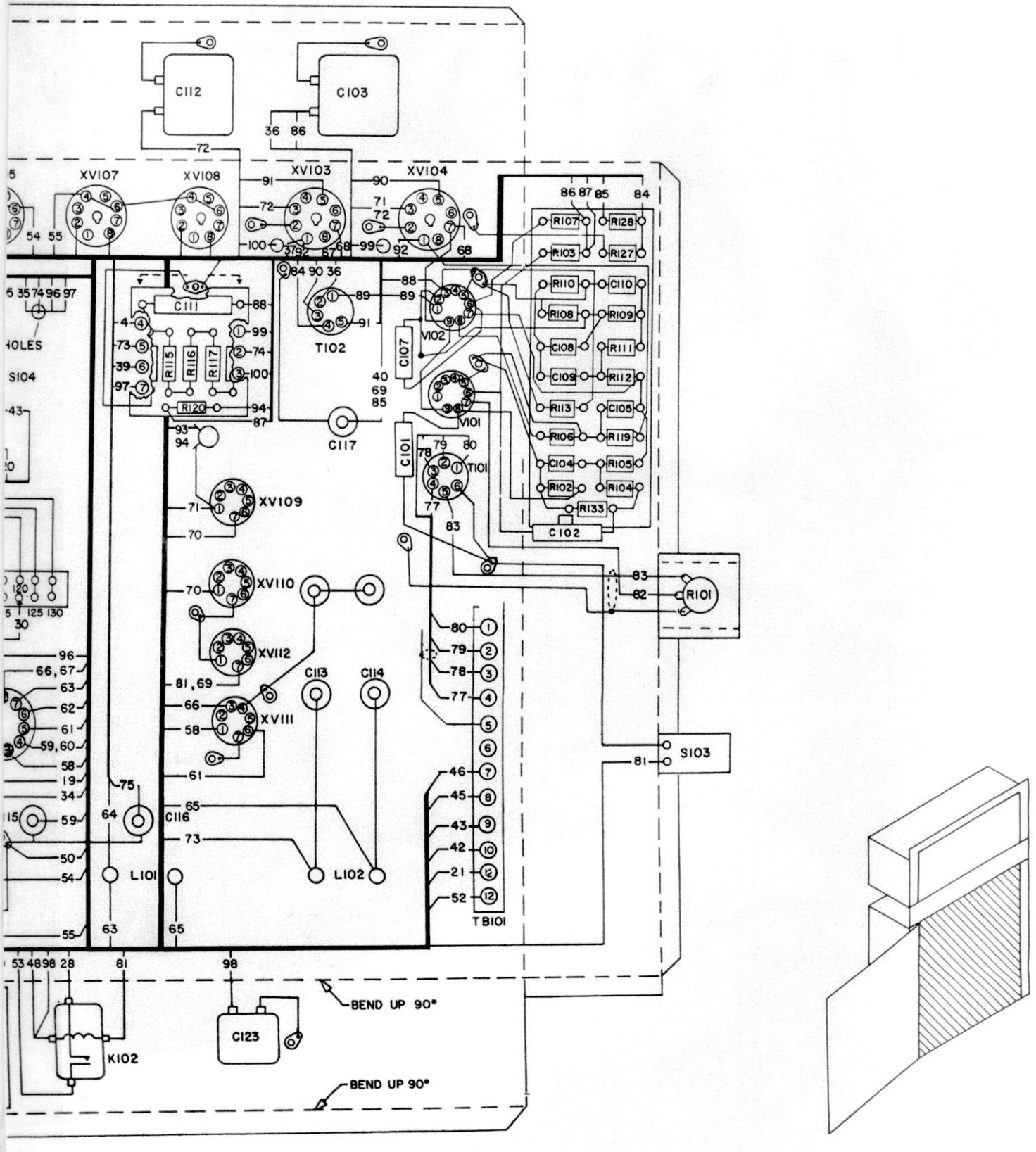


Figure 23. Transmitter Practical Wiring Diagram, Modulator and Power Supply (Sheet 2 of 3)

LEAD	COLOR	LEAD	COLOR
1	WH-BLK-BLK	51	WH-GY-YW
2	WH-BLK-RD	52	WH-GY-YW
3	WH-RD	53	WH-GY-YW
4	WH-RD	54	WH-RD
5	WH-GY-ORN	55	WH-RD
6	WH-GY-GRN	56	WH-GY-RD
7	WH-GY-PUR	57	GY-BLK
8	WH-GY-BLU	58	WH-RD
9	WH-GY-BRN	59	WH-BLK-RD
10	GY-RD	60	WH-PUR
11	WH-GY-RD	61	WH-RD
12	WH-GY-RD	62	WH-RD
13	WH-GY-RD	63	WH-RD
14	WH-GY	64	WH-RD
15	WH-GY	65	WH-RD
16	WH-GY-BLK	66	WH-BRN
17	WH-GY-BLU	67	WH-BRN
18	WH-GY-BLU	68	WH-BRN
19	WH-GY-BLU	69	WH-PUR
20	WH-GY-BLU	70	WH-OR
21	WH-GY-BLU	71	WH-OR
22	WH-GY-BLU	72	WH-OR
23	GY-YW	73	WH-RD
24	GY-OR	74	WH-RD
25	GY-GRN	75	NO WIRE
26	GY-BLU	76	SHIELD
27	GY-PUR	77	WH-BLK
28	WH-GY-ORN	78	WH-BLU
29	WH-GY-RD	79	WH-GY-GRN
30	WH-GY-BRN	80	WH-GRN
31	WH-GR-BRN	81	WH-PUR
32	GY-BLK	82	WH-GRN
33	WH-GY-RD	83	WH-BLU
34	GY-BRN	84	WH-BLK-RD
35	WH-RD-RD	85	WH-PUR
36	WH-RD-RD	86	WH-RD-RD
37	WH-YW	87	WH-RD-RD
38	WH-BLK	88	WH-YW
39	WH-ORN	89	WH-BLU
40	WH-PUR	90	WH-GRN
41	WH-GY-GRN	91	WH-GRN
42	WH-BLK-GY	92	WH-YW
43	GY-RD	93	WH-RD-RD
44	WH-GY-GRN	94	WH-RD-RD
45	WH-RD-BLK	95	WH-PUR
46	WH-BLK-BLK	96	WH-BLK
47	WH-PUR	97	WH-RD
48	WH-PUR	98	WH-PUR
49	WH-RD-BLK	99	WH-RD
50	WH-BLK	100	WH-RD

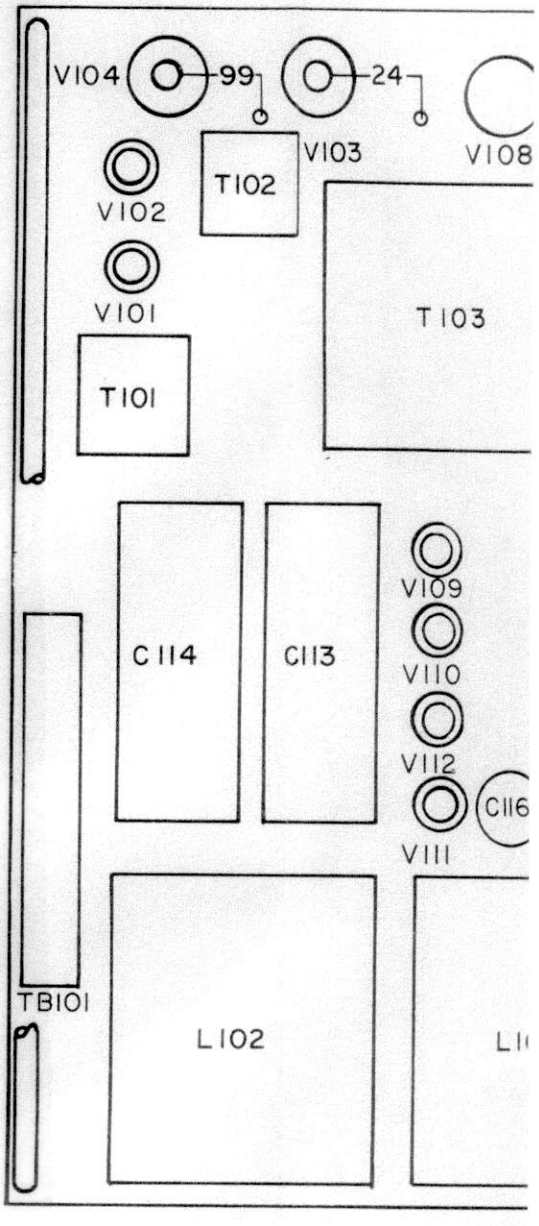


Figure 23.

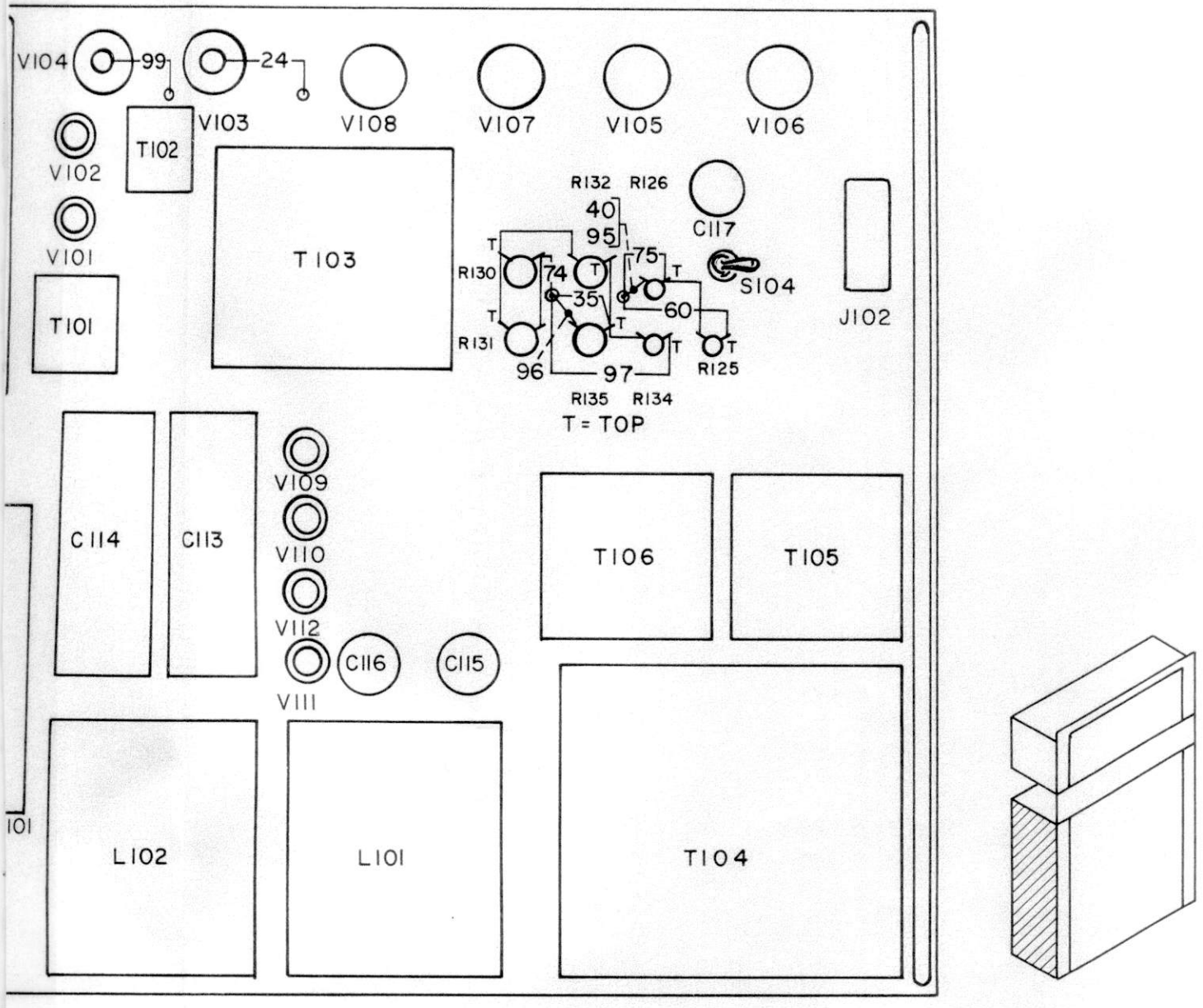
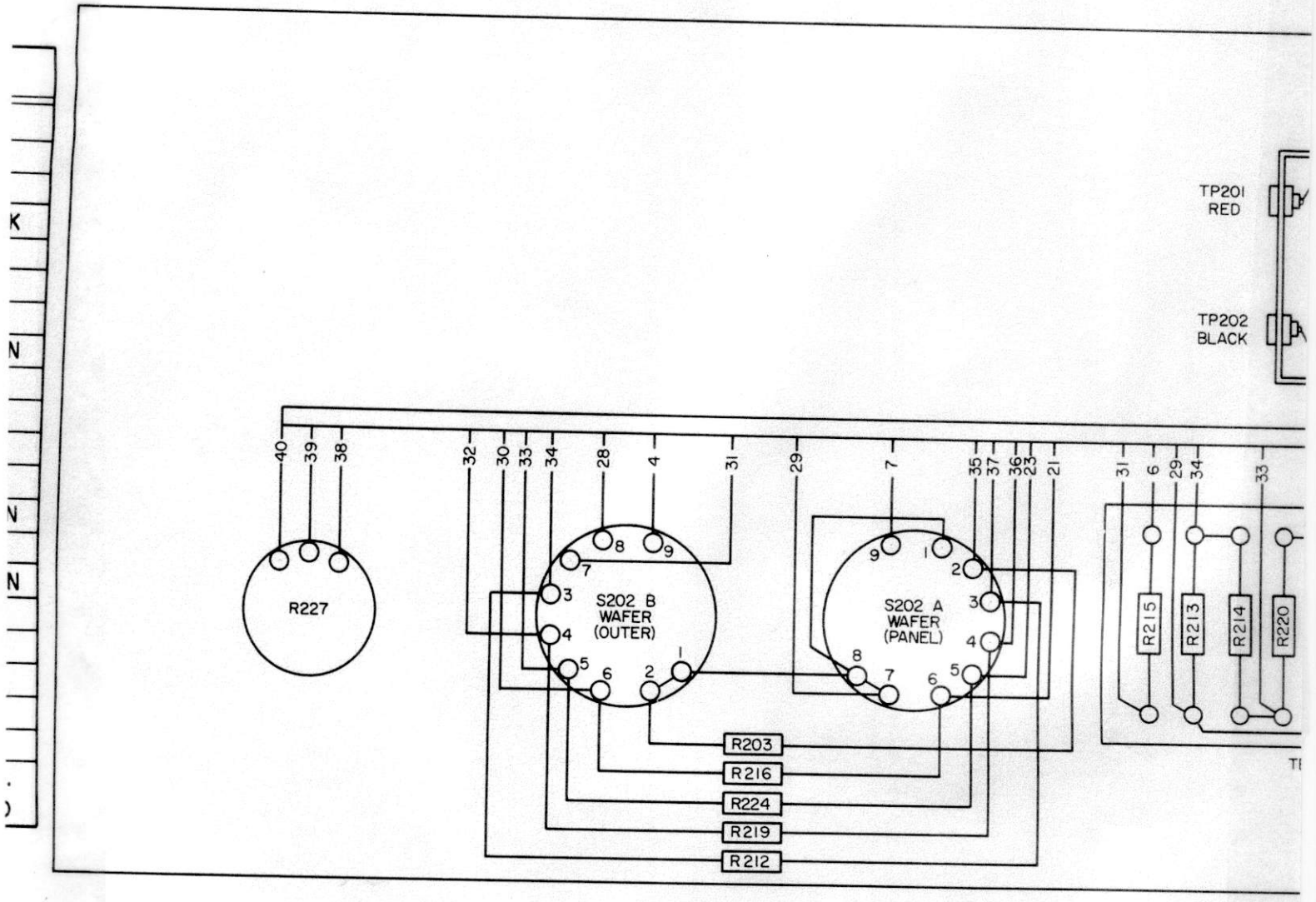


Figure 23. Transmitter Practical Wiring Diagram, Modulator and Power Supply (Sheet 3 of 3)

LEAD	COLOR	LEAD	COLO
1	WH-RD	23	WH-GRN
2	WH-RD-RD	24	WH-GY-
3	WH-OR	25	WH-BRN
4	WH-BLK-RD	26	WH-BRN
5	WH-PUR	27	WH-BLK
6	WH-YW	28	WH-BLU
7	WH-BLK-BLK	29	WH-BLK
8	WH-GY-GRN	30	WH-PUR
9	WH-GY-BLU	31	WH-YW
10	GY-BLK	32	WH-PUR
11	WH-GY-RD	33	WH-PUR
12	WH-BLK	34	WH-PUR
13	WH-BRN-BRN	35	WH-PUR
14	WH-BRN-BRN	36	WH-GRN
15	WH-BRN	37	WH-GRN
16	WH-GY-GRN	38	WH-OR-
17	GY-BLK	39	WH-RD-
18	WH-RD-OR	40	WH-OR
19	WH-OR-BLK	41	WH-BRN
20	WH-RD	42	RG58C/
21	WH-GRN-YW	43	SINGLE (
22	WH-BRN		WH, SHIE


TP201
RED
TP202
BLACK
40
39
38
32
30
33
34
28
4
31
29
7
35
37
36
23
21
31
6
29
34
33
R227
S202 B
WAFER
(OUTER)
S202 A
WAFER
(PANEL)
R215
R213
R214
R220
R203
R216
R224
R219
R212

Fig

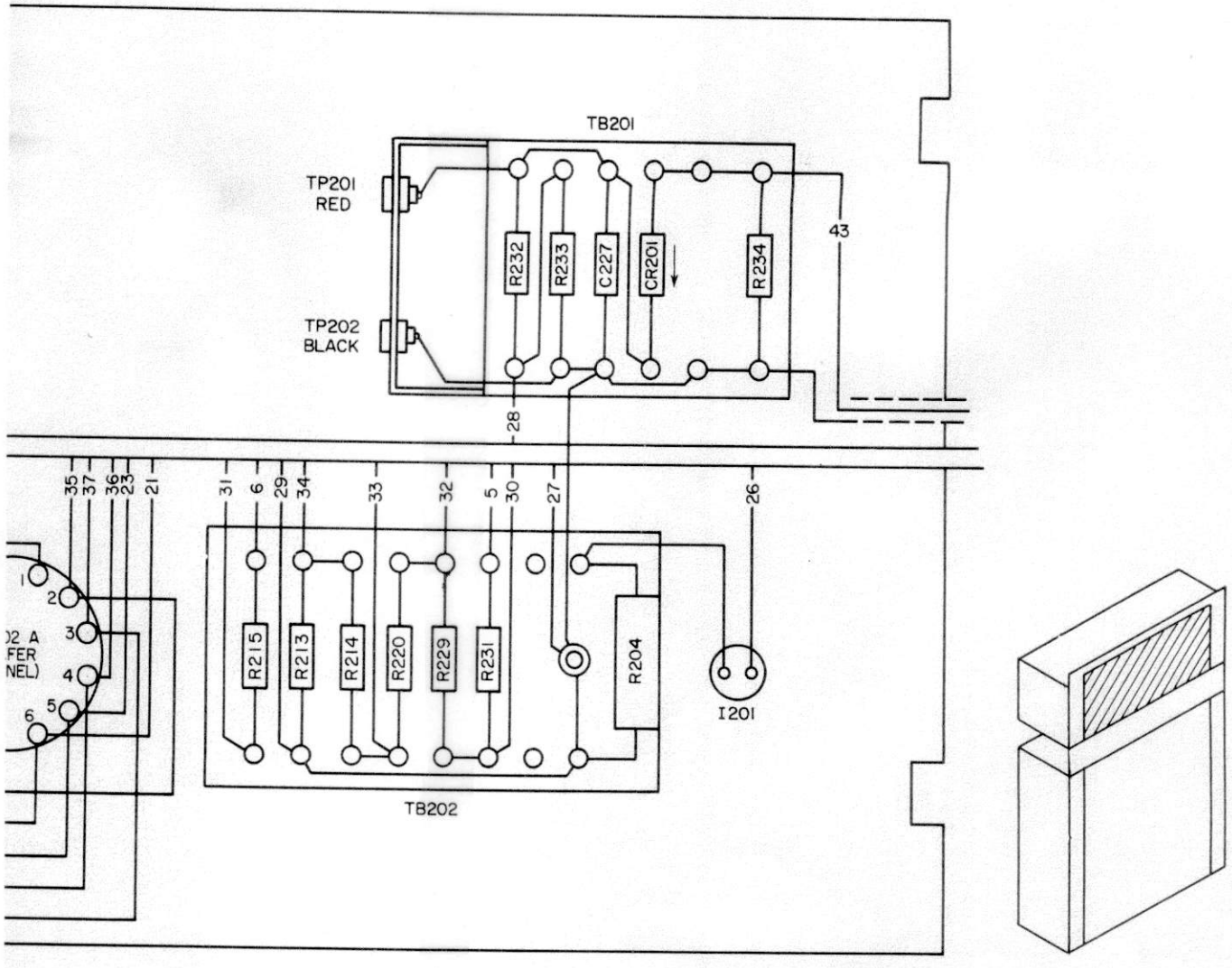
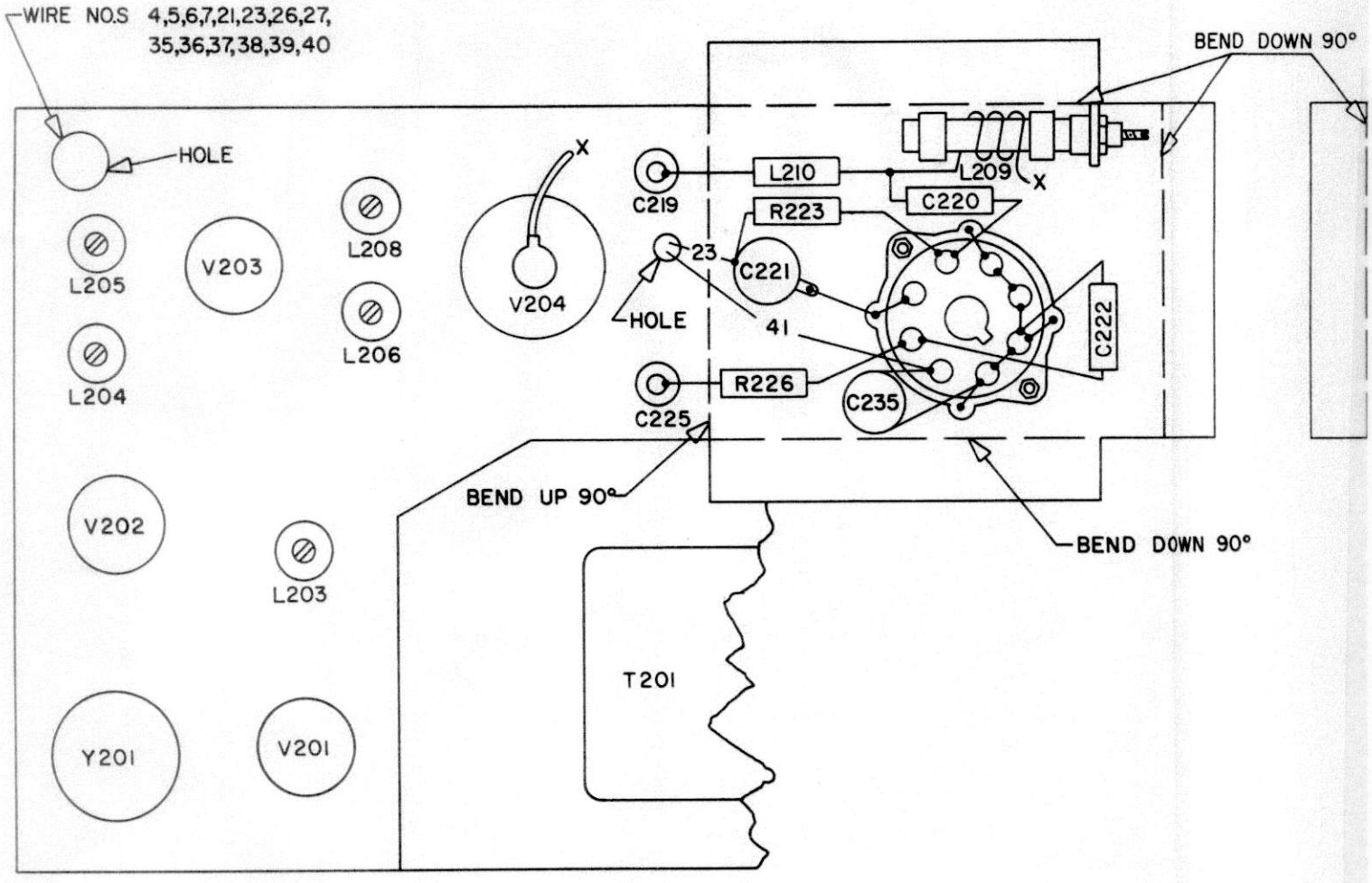
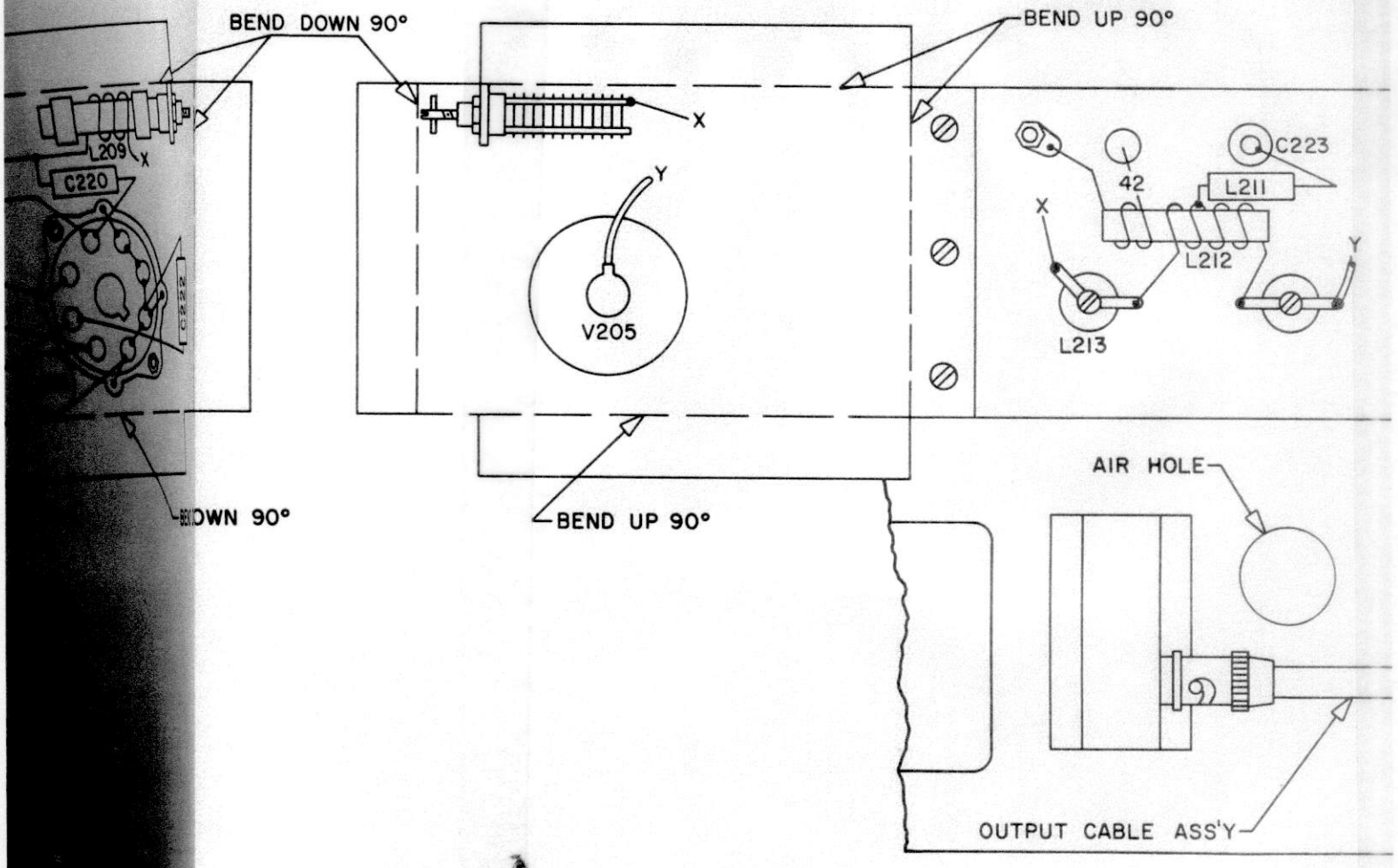


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 1 of 3)



NOTE:
FOR WIRE COLOR CODE
SEE SHEET 1


BEND DOWN 90°
BEND UP 90°
L209
X
C220
C222
X
Y
V205
42
C223
L211
X
L212
Y
L213
BEND DOWN 90°
BEND UP 90°
AIR HOLE
OUTPUT CABLE ASS'Y

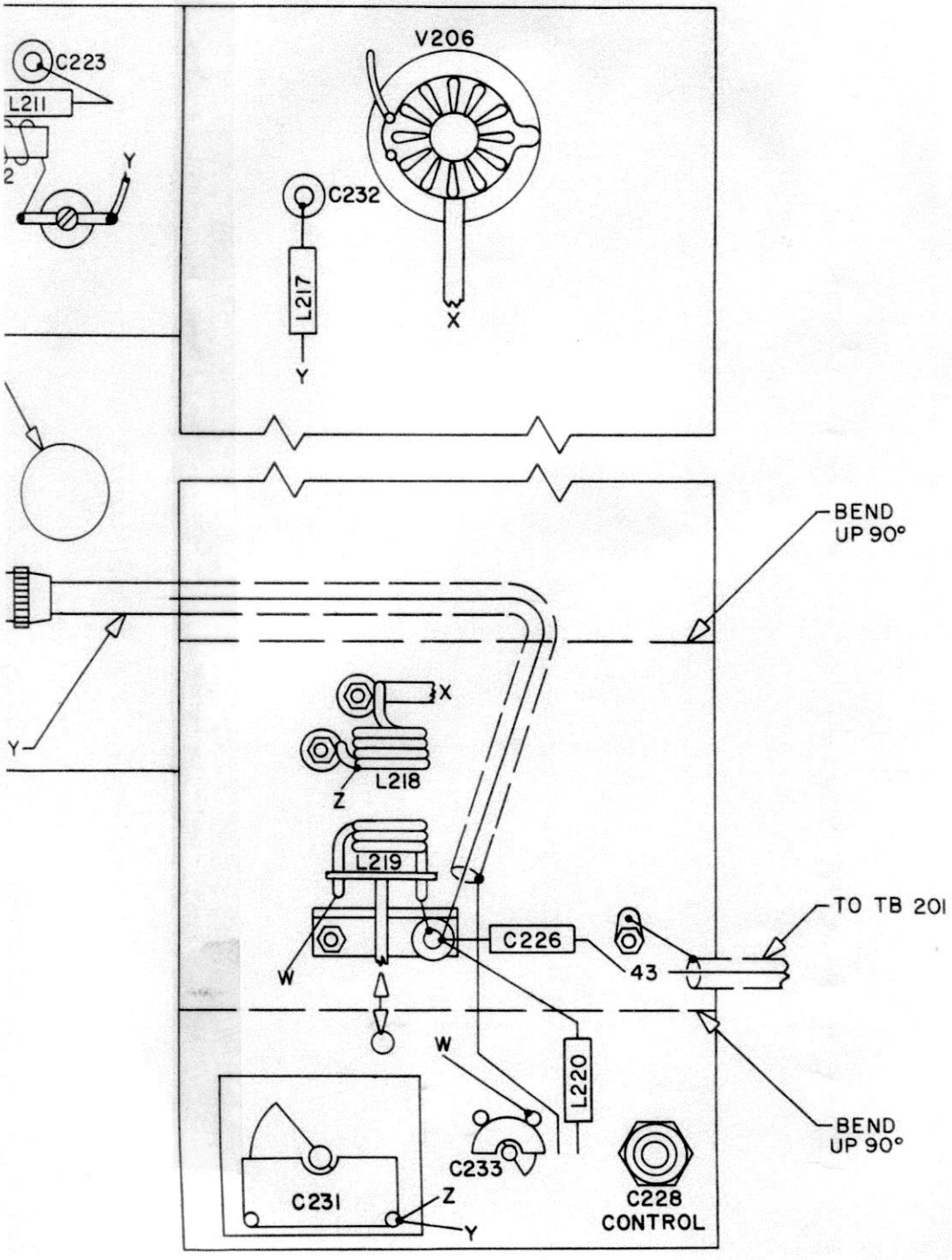
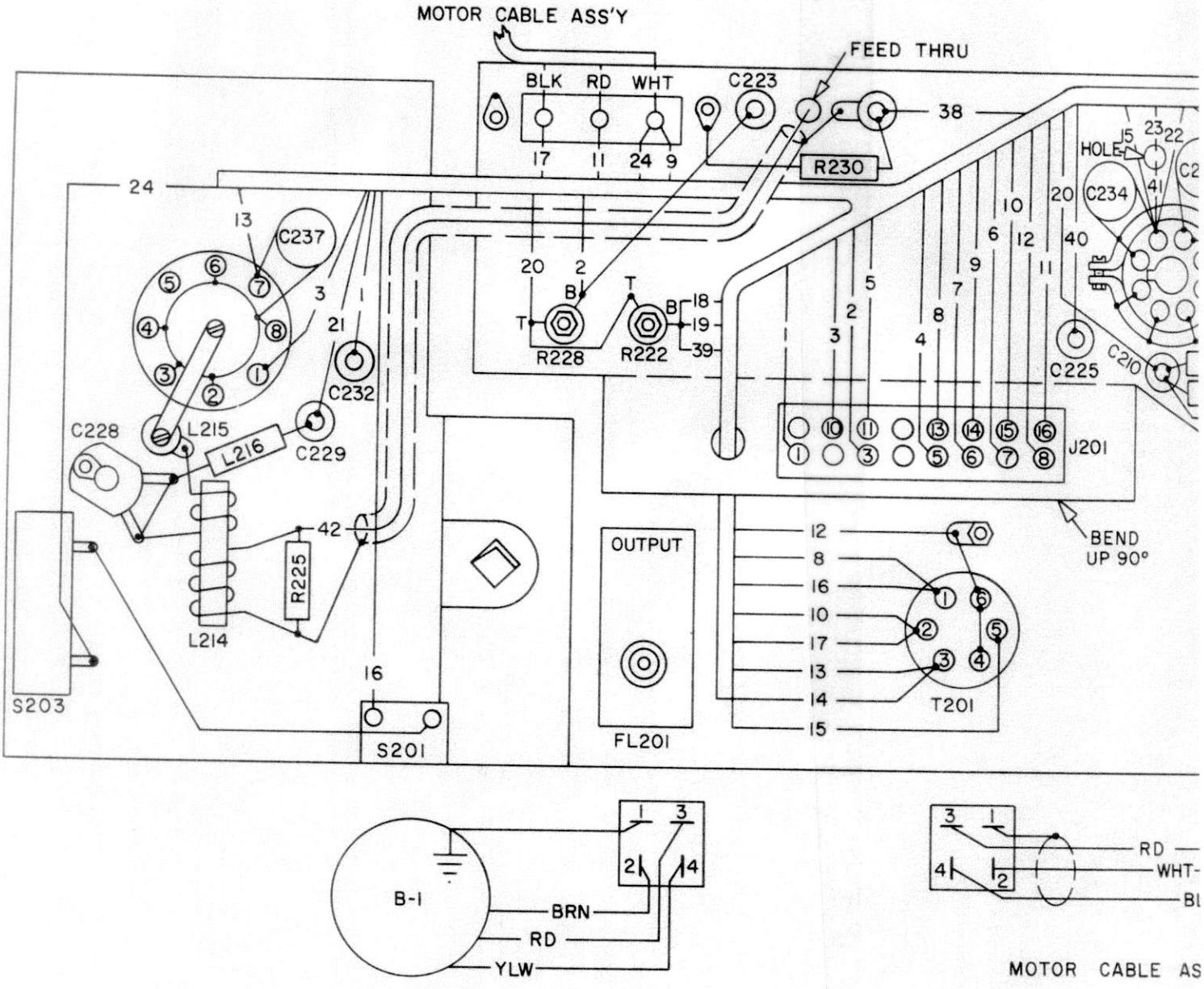


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 2 of 3)


MOTOR CABLE ASS'Y
FEED THRU
BLK
RD
WHT
C223
38
17
11
24
9
R230
24
13
C237
20
2
B
T
T
B
18
19
39
R228
R222
3
21
1
C232
C228
L215
L216
C229
42
R225
L214
S203
16
S201
OUTPUT
FL201
12
8
16
10
17
13
14
15
T201
J201
C225
C210
C234
HOLE
BEND
UP 90°
B-1
BRN
RD
YLW
RD
WHT-
MOTOR CABLE AS

Figur

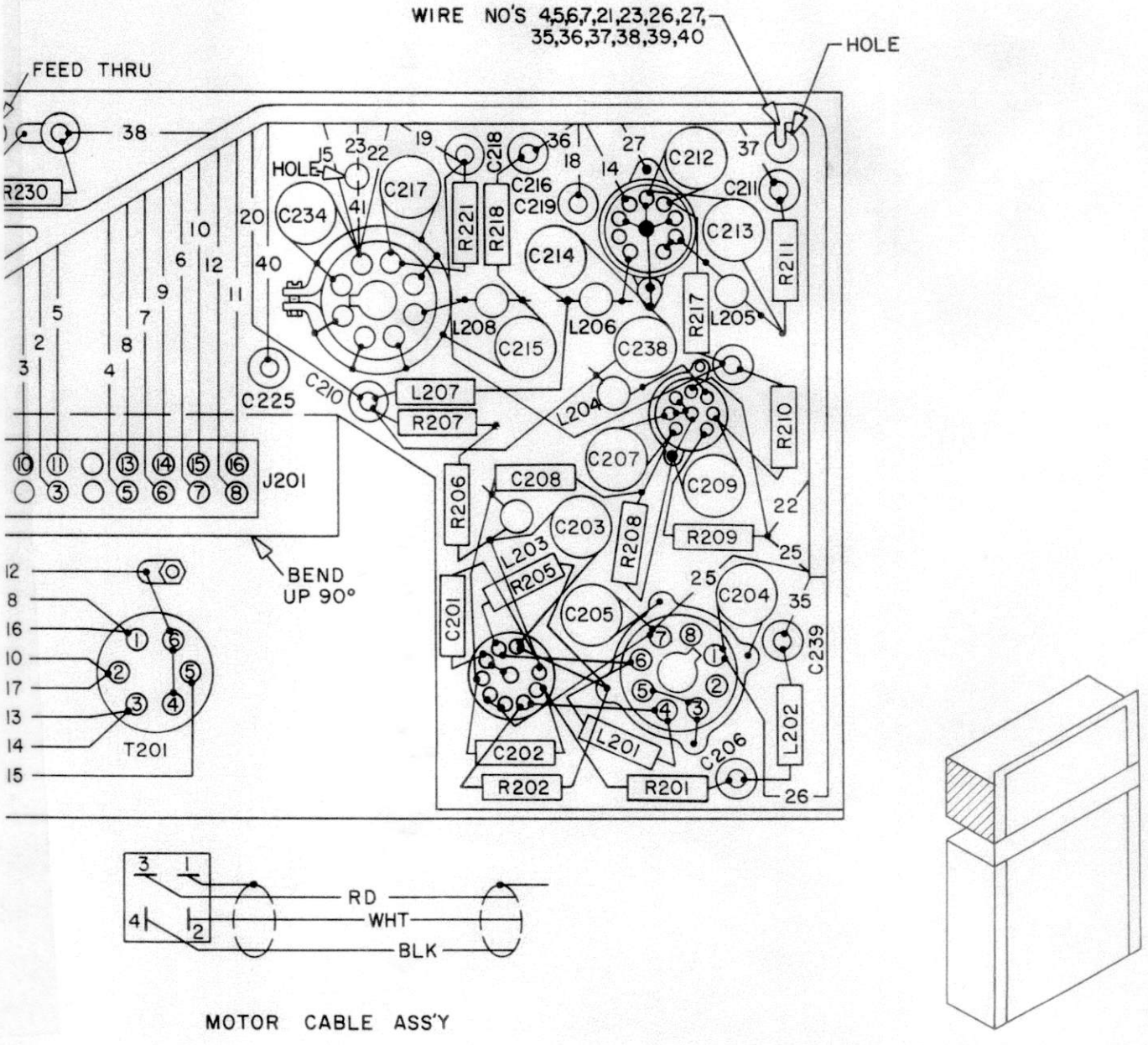
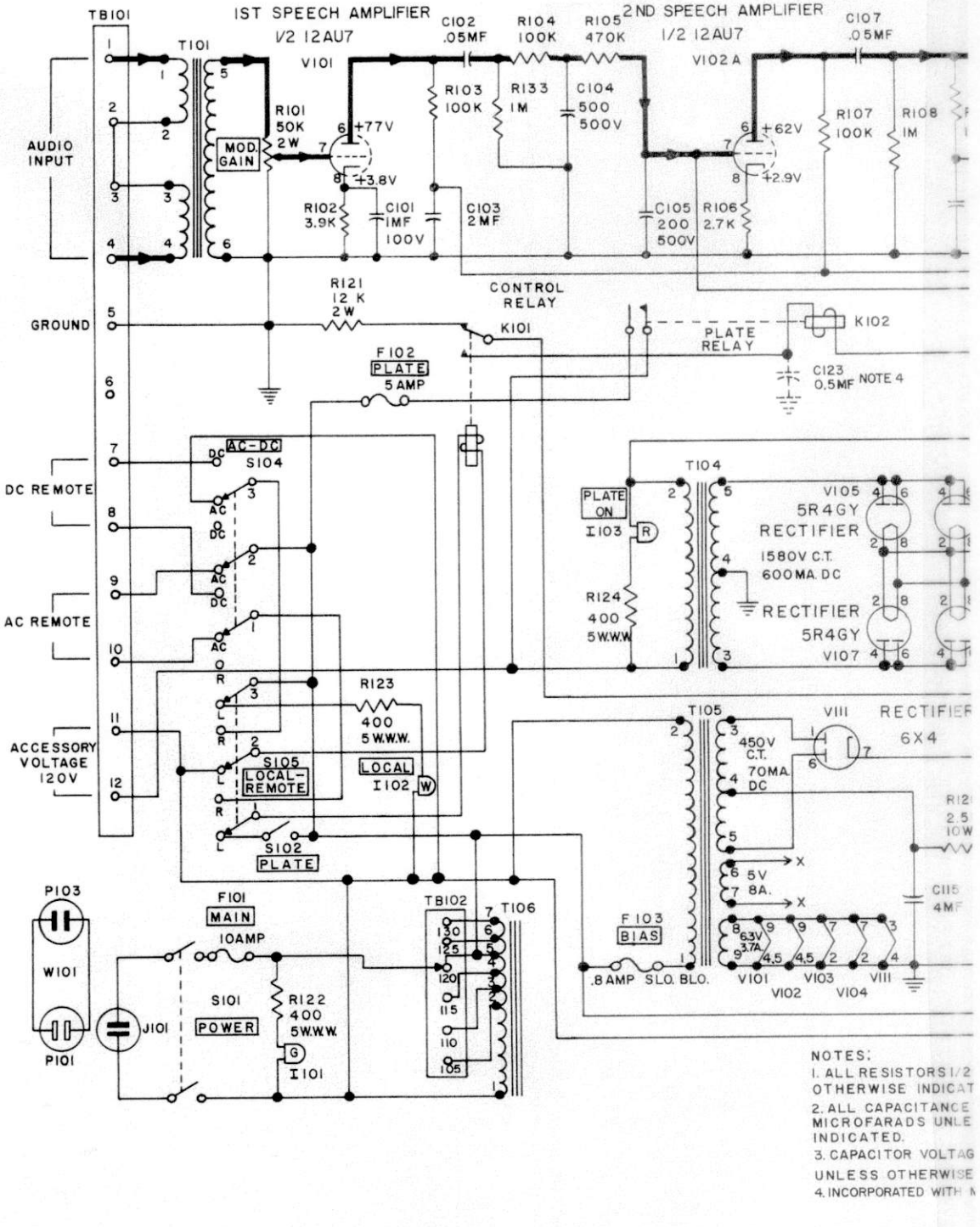


Figure 24. Transmitter Practical Wiring Diagram, R-F Section (Sheet 3 of 3)



NOTES:
1. ALL RESISTORS 1/2
OTHERWISE INDICAT
2. ALL CAPACITANCE
MICROFARADS UNLE
INDICATED.
3. CAPACITOR VOLTAG
UNLESS OTHERWISE
4. INCORPORATED WITH

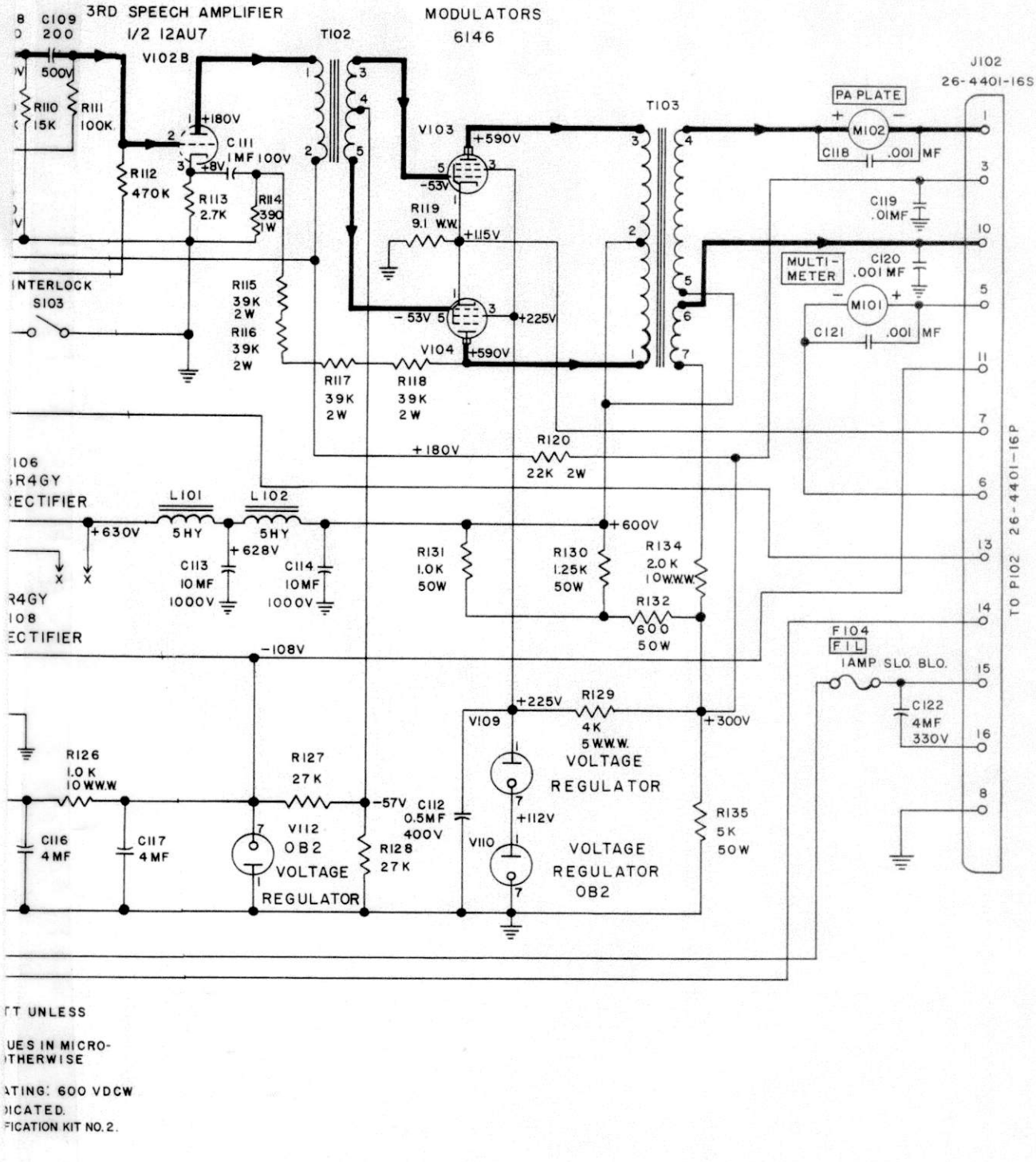
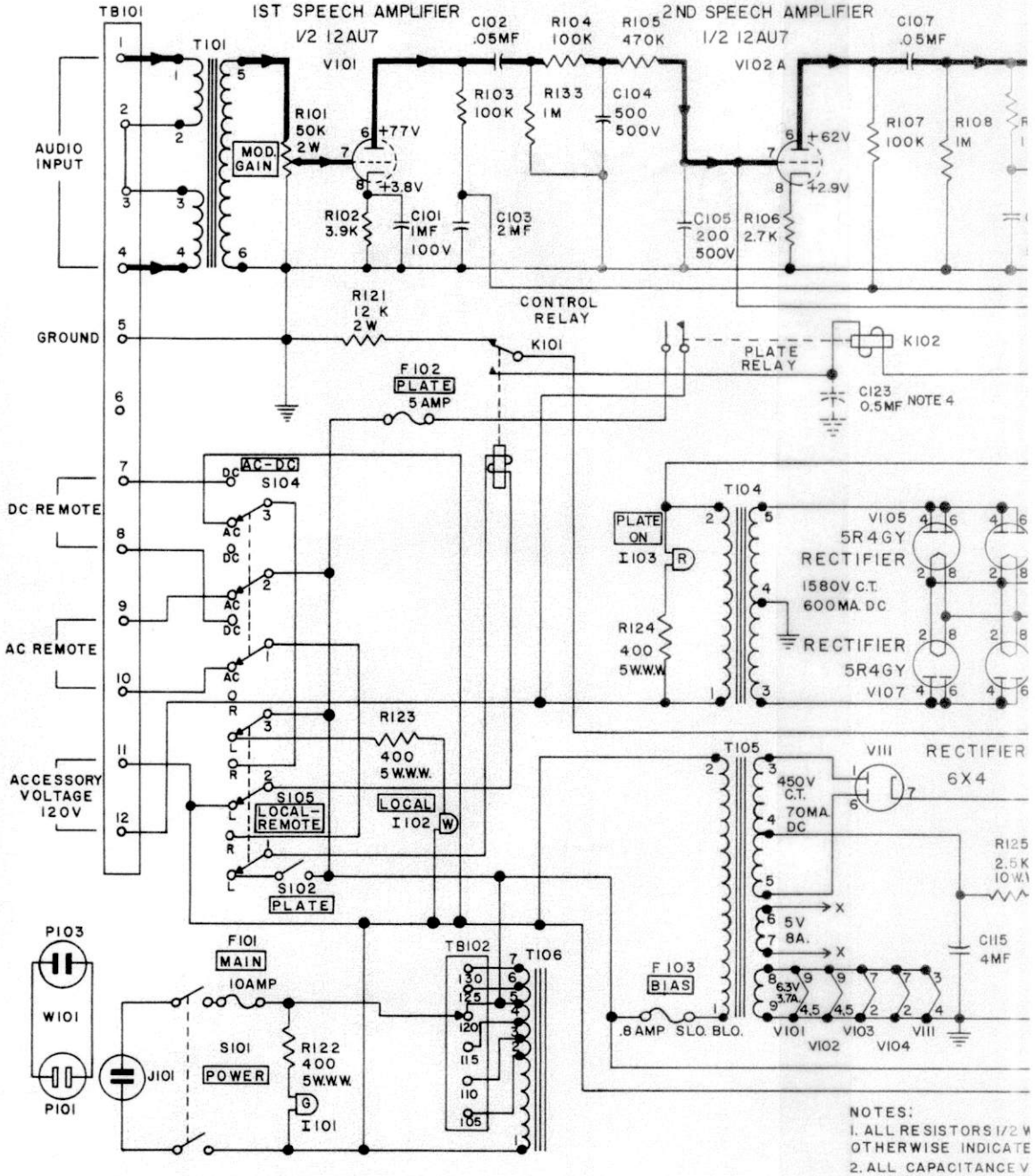
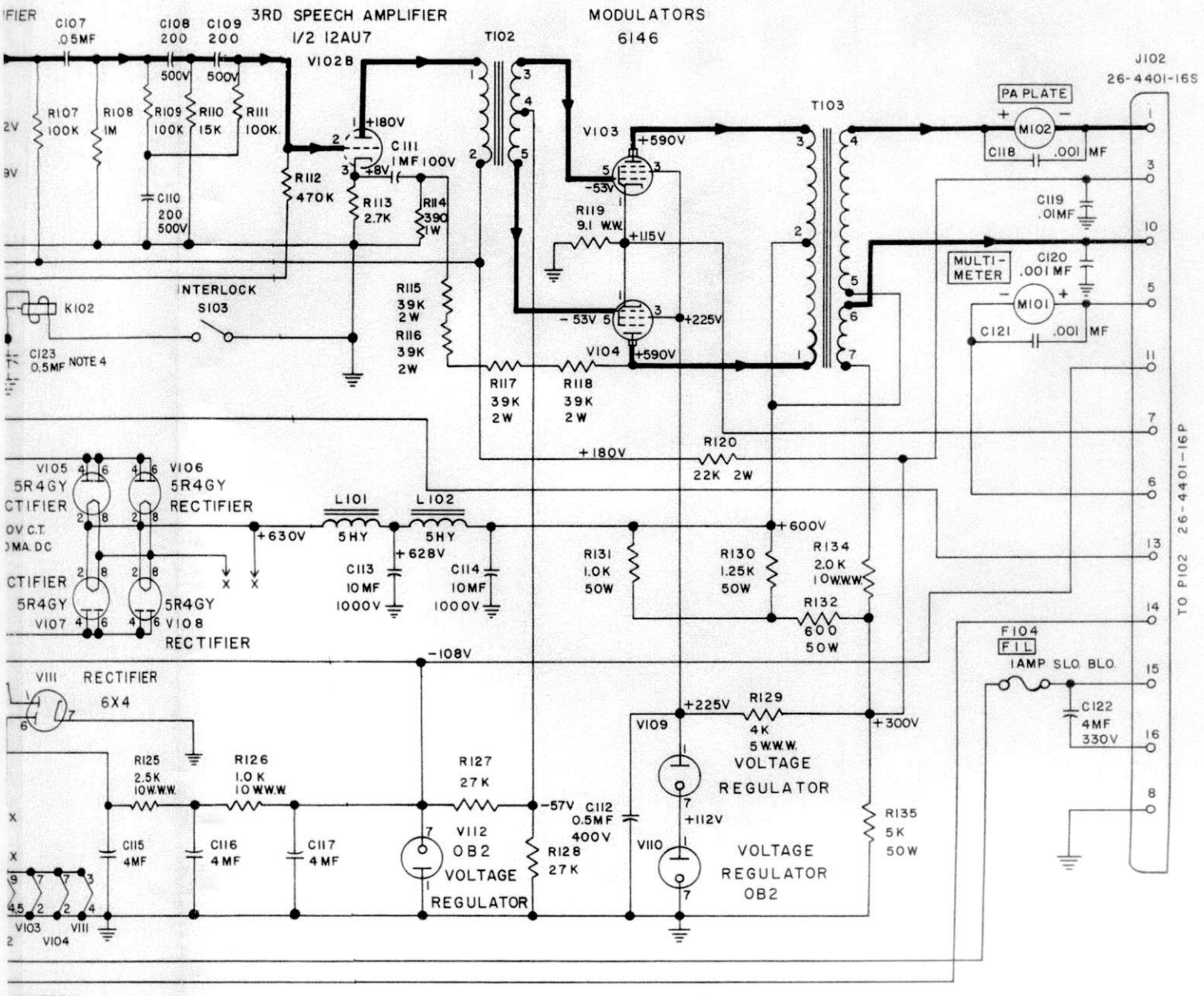


Figure 25. Transmitter Schematic Diagram, Modulator and Power Supply

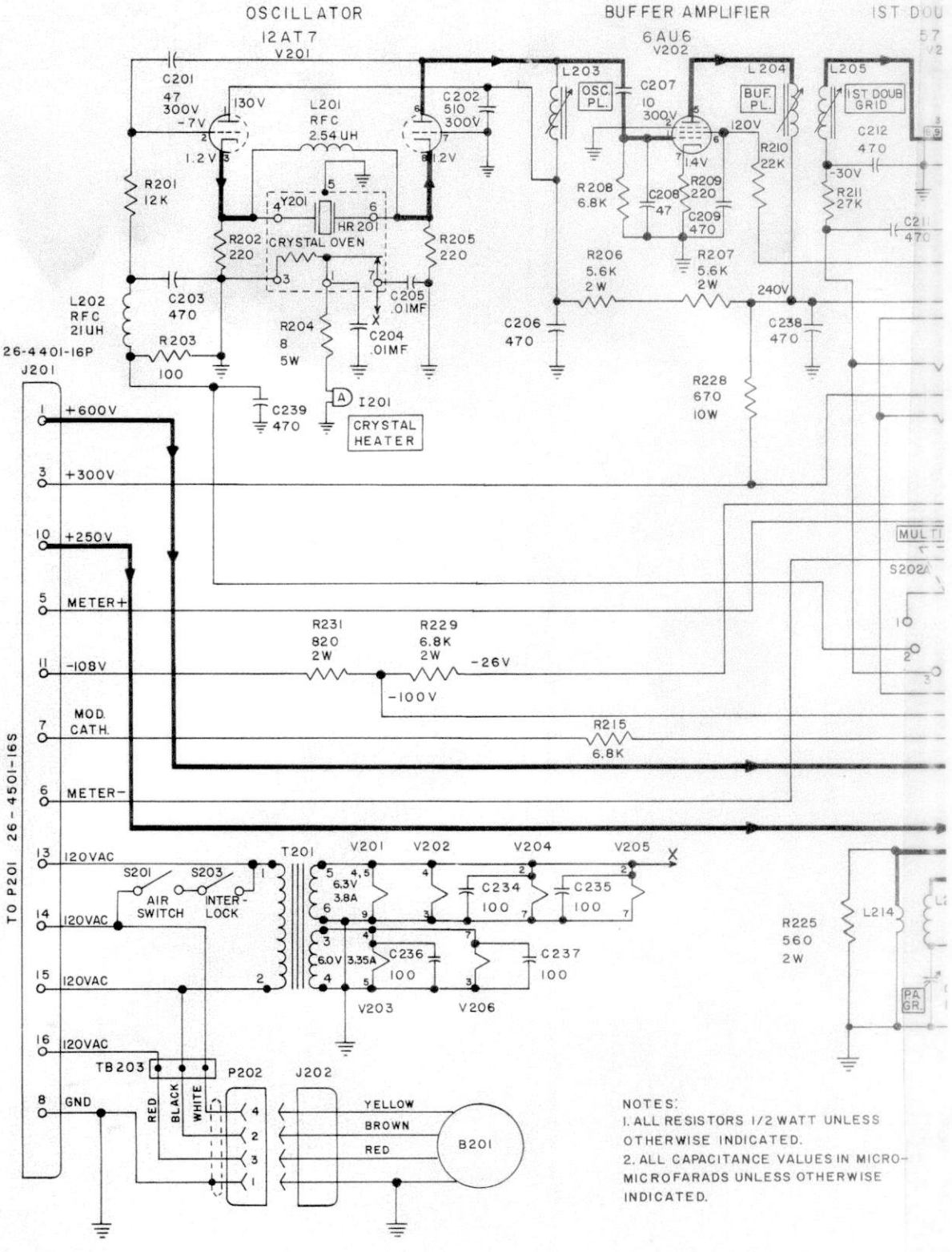


NOTES:
1. ALL RESISTORS 1/2 W
OTHERWISE INDICATE
2. ALL CAPACITANCE V
MICROFARADS UNLES
INDICATED.
3. CAPACITOR VOLTAGE
UNLESS OTHERWISE
4. INCORPORATED WITH MC

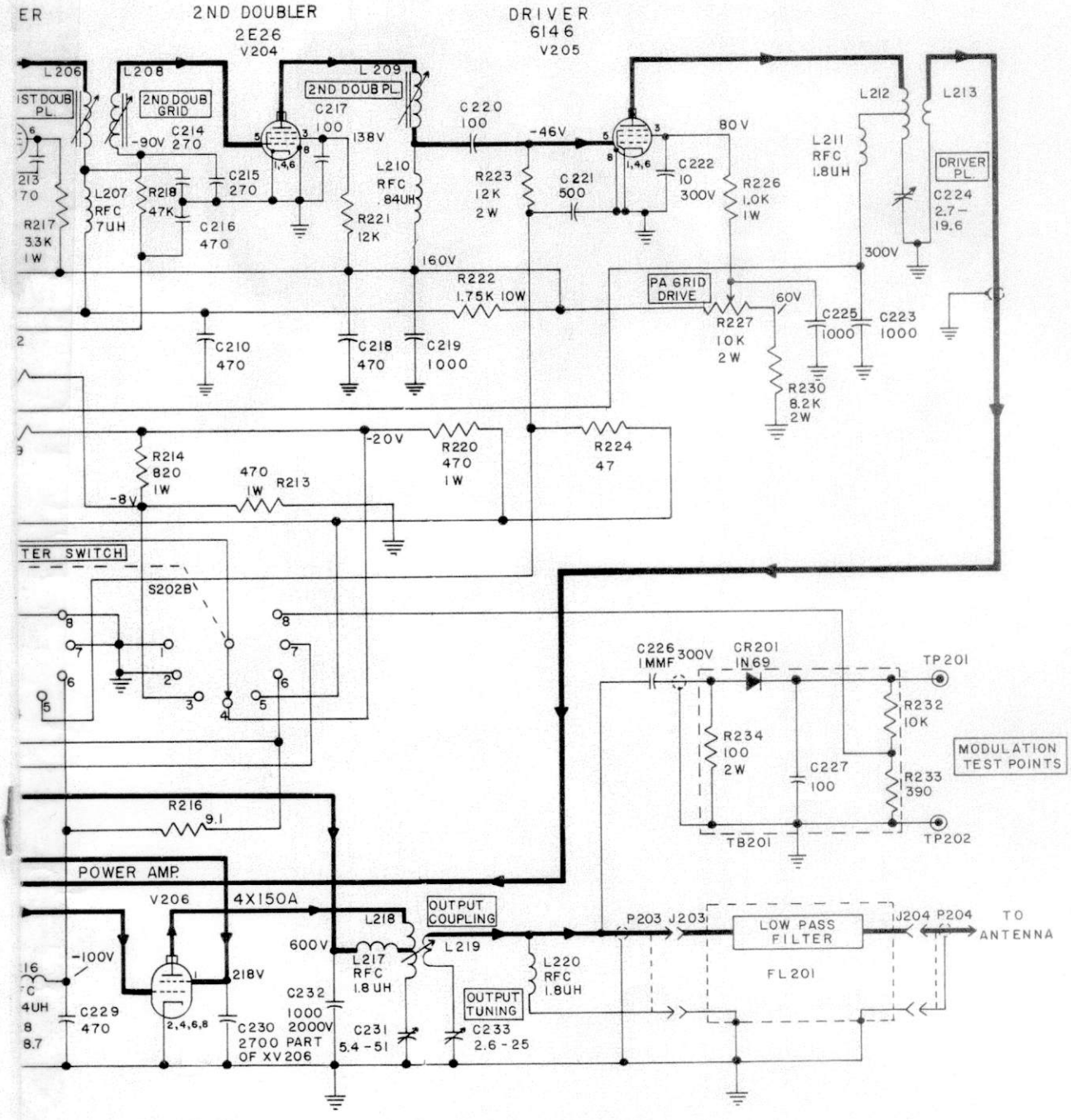


NOTES:
1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS OTHERWISE INDICATED.
3. CAPACITOR VOLTAGE RATING: 600 VDCW UNLESS OTHERWISE INDICATED.
4. INCORPORATED WITH MODIFICATION KIT NO. 2.

Figure 25. Transmitter Schematic Diagram, Modulator and Power Supply



NOTES:
1. ALL RESISTORS 1/2 WATT UNLESS OTHERWISE INDICATED.
2. ALL CAPACITANCE VALUES IN MICRO-MICROFARADS UNLESS OTHERWISE INDICATED.

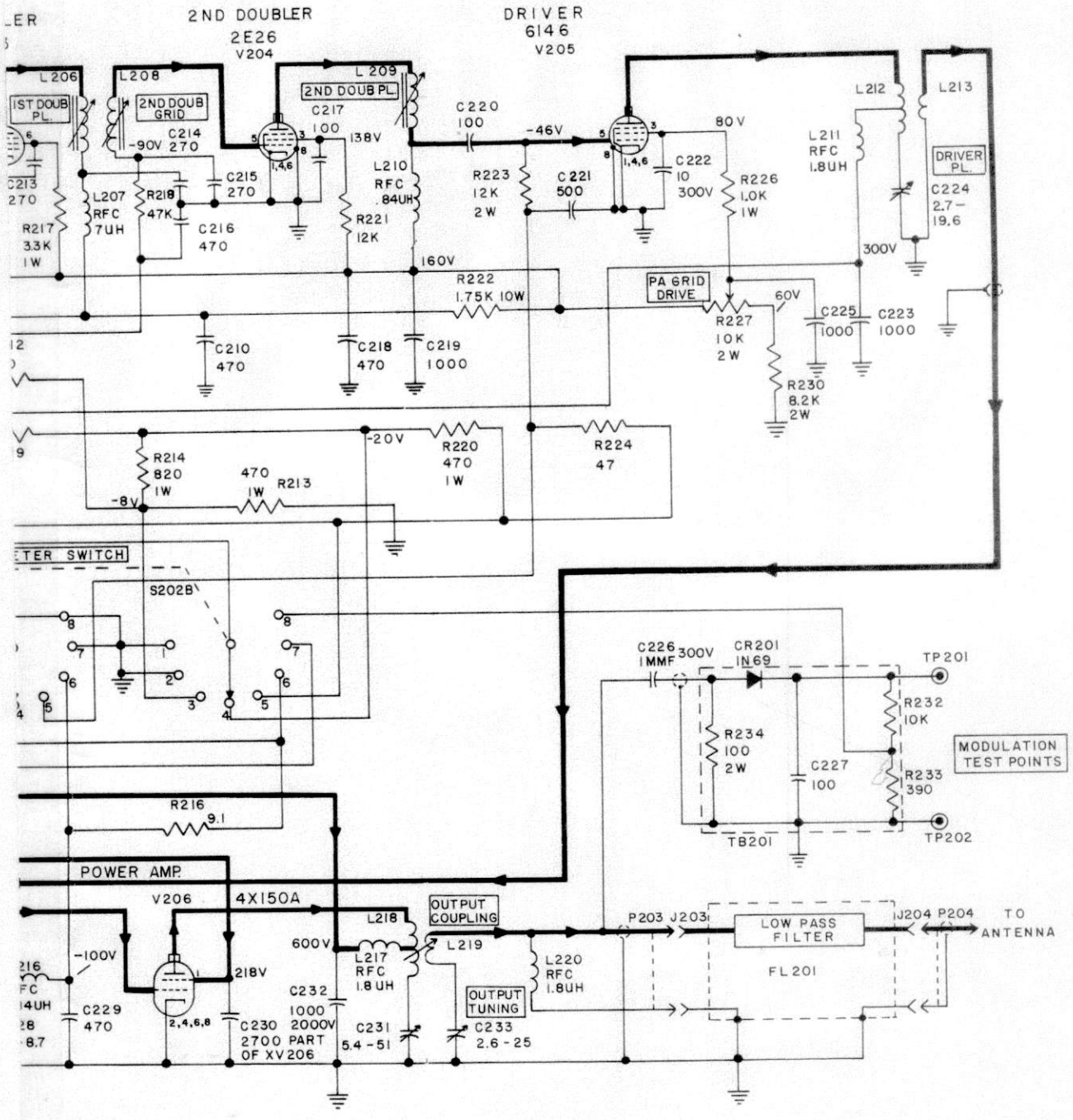


CAPACITOR VOLTAGE RATING: 600VDCW LESS OTHERWISE INDICATED.

MULTI-METER SWITCH, S202, POSITIONS:

1. OFF
2. OSC GRID _____ 15MA
3. 1ST DOUB GRID _____ 1.5MA
4. 2ND DOUB GRID _____ 30MA
5. DRIVER GRID _____ 3MA
6. PA GRID _____ 15MA
7. MOD CATHODE _____ 150MA
8. OUTPUT _____ REL.

Figure 26. Transmitter Schematic Diagram, R-F Section and PA



CAPACITOR VOLTAGE RATING: 600VDCW
ILESS OTHERWISE INDICATED.
MULTI-METER SWITCH, S202, POSITIONS:
1. OFF
2. OSC GRID _____ 15MA
3. IST DOUB GRID _____ 15MA
4. 2ND DOUB GRID _____ 30MA
5. DRIVER GRID _____ 3MA
6. PA GRID _____ 15MA
7. MOD CATHODE _____ 150MA
8. OUTPUT _____ REL.

Figure 26. Transmitter Schematic Diagram, R-F Section and PA