

# TM 11-5820-590-35

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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DS, GS, AND DEPOT MAINTENANCE  
MANUAL

RADIO SET AN/PRC-74

This copy is a reprint which includes current  
pages from Changes 1 and 2.

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HEADQUARTERS, DEPARTMENT OF THE ARMY

JULY 1966

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CHANGE }  
NO. 2 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC 22 August 1975

**Direct Support, General Support, and Depot Maintenance Manual  
RADIO SETS AN/PRC-74 AND AN/PRC-74A AND  
POWER SUPPLY PP-4514/PRC-74**

TM 11-5820-590-35, 21 July 1966, is changed as follows:

1. New or changed material is indicated by a vertical bar in the margin.
2. Remove and insert pages as indicated in the page list below:

*Remove pages*

1-1 and 1-2  
1-9 and 1-10  
5-1 through 5-4.1 and 5-5  
None

*Insert pages*

1-1 and 1-2  
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5-1 through 5-6  
5.1-1 through 5.1-9

3. File this change sheet in the front of the manual for reference purposes.

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DEPARTMENT OF THE ARMY  
WASHINGTON, D. C., 21 July 1966

**DS, GS, and Depot Maintenance Manual**

**RADIO SET AN/PRC-74**

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# CHAPTER 1

## FUNCTION OF RADIO SET

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### Section I. SYSTEM FUNCTION

#### 1-1. Scope

*a.* This manual contains instructions for direct support, general support, and depot maintenance of Radio Set AN/PRC-74 and AN/PRC-74A. With the aid of this manual, direct support, general support, and depot maintenance personnel can troubleshoot, test, align, and repair the AN/PRC-74. A list of tools, materials, and test equipment for direct support, general support, and depot maintenance is included.

*b.* Reporting of errors, omissions, and recommendations for improving this manual by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to **Commander, US Army Electronics Command, ATTN: AMSEL-MA-Q, Fort Monmouth, N.J., 07703.**

*Note.* For other applicable forms and records, see paragraph 2, TM 11-5820-590-12.

#### 1-2. System Operation

*a.* Radio Set AN/PRC-74 or the AN/PRC-74A (referred to as the radio set) is a lightweight, two-way communications set that is capable of receiving and transmitting voice and telegraph signals. Single-sideband (ssb) modulation is used for voice transmission, and continuous wave (cw) modulation is used for telegraph transmissions. The voice and telegraph receptions are demodulated and applied

to a headset. The frequency range of the radio set for both receive and transmit modes of operation is between 2.000 megacycles (mc) and 11.999 mc.

*b.* The radio set may be portably operated or operated at a fixed station. When portably operated, the radio set is powered by either a rechargeable nickel cadmium storage battery pack, or a dry cell battery pack. An external battery charger and power supply assemblies are provided with the radio set when used at a fixed station. The power supply assembly allows the radio set to be powered by either the alternating current (ac) or direct current (dc) voltages available at the operating site. The external battery charger assembly is used to recharge the radio set batteries prior to using the radio set portably.

*c.* Three types of antennas are supplied with the radio set. Operating in the low end of the high frequency spectrum, the range of the radio set may be extended to hundreds of miles with the proper selection of frequency and antenna type.

*d.* The operational features of the AN/PRC-74 and AN/PRC-74A are identical except that the A model has been modified by MWO 11-5820-590-35/1 to permit operation with the AN/GRA-71 coder burst equipment. Refer to TM 11-5820-590-12 for operational procedures for coder burst operation. Refer to paragraph 1-59 for circuit differences between the two models.

### Section II. GENERAL FUNCTION

#### 1-3. Introduction

*a.* This section contains the general functional operation for the radio set. It is divided into block diagram descriptions of the transmit and receive modes of operation.

*b.* An interconnection diagram of Radio Sets AN/PRC-74 and AN/PRC-74A is shown in

figure 7-1. The modules and chassis-mounted circuits of the radio set serve dual purposes operating in both the receive and transmit operational modes. Mode selection within the radio set is accomplished by transmit-receive control relays mounted in each module. Normally, these relays connect the radio set modules

and circuits to a receive configuration, with signal flowing left-to-right from the antenna to the headset (A, fig. 7-2). When a transmit mode is selected, the transmit-receive control relays interconnect the transmit portions of the modules and circuits. During this time, signal flow is left-to-right from either the telegraph key or microphone input to the antenna (B, fig. 7-2).

#### 1-4. Receive Mode of Operation

*a. General.* The function of the radio set when connected to the receive mode of operation, as shown in A, figure 7-2, is to receive a radiofrequency (RF) signal in the high frequency range from 2 mc to 11.999 mc; heretodyne the RF signal with a locally generated synthesizer signal that is 1.75 mc above the input frequency; convert the RF into a 1.75-mc intermediate frequency (IF); remove the voice or telegraph intelligence from the IF, and apply the intelligence to a headset. Two secondary modes may be utilized when the radio set is in the receive mode. The secondary modes are operate and calibrate. The operate secondary mode is used for normal communication operations. The calibrate secondary mode provides a means of periodically calibrating the tuning circuits for optimum performance.

*b. Receive-Operate.* When the receive mode has been selected and the radio set is in the operate condition, the RF input from the antenna is connected to the RF module through the power amplifier module. The power amplifier module provides the proper load for the RF input and is tuned for maximum RF signal reception. The RF module, which operates in conjunction with the synthesizer module for the heterodyning process, consists of RF tuning, synthesizer tuning, RF amplification, and mixing circuits. The synthesizer module consists of four step oscillators that are selected by front panel controls. The oscillator output frequencies are selected to produce local oscillations 1.75 mc higher than the RF input. The synthesizer output is applied to the RF module and is heterodyned with the tuned RF input. The resultant 1.75-mc difference output of the RF module is the intermediate frequency. The RF gain of the radio set is controlled by a gain control circuit that applies an output to the RF

module. The MC step frequency selector switch of the synthesizer is geared to band switches within the RF module so that the proper RF bands of operation are selected when the synthesizer frequency is changed. The 1,750-kilocycle (kc) lower sideband (lsb) IF output of the RF module is supplied to the IF audio module. Also, the IF audio module receives a 1,750-kc signal from the frequency generator module. The 1,750-kc signal in the frequency generator is produced by a highly stable, free running crystal oscillator. The two 1,750-kc signals are applied to a demodulator circuit that removes the audio intelligence in the IF audio module. The audio signal output is then amplified and supplied to the headset. The IF gain of the IF audio module is controlled by an IF gain input from the gain control circuits.

*c. Receive-Calibrate.* The calibrate secondary receive mode of operation is initiated by pressing the PUSH TO CALIBRATE switch on the radio set front panel. When the switch is pressed, a +12-volt calibrate input is applied to the power amplifier, synthesizer, frequency generator, and IF audio modules. The +12-volt calibrate signal energizes circuits in these modules which allow the operator to calibrate the radio set tuning circuits. In the synthesizer module, the 1-kc step selection circuits are effectively disabled so that the synthesizer output will be incremented in 10-kc steps. In the power amplifier module, the +12-volt calibrate signal disables the RF output to the RF module. To replace the RF output of the power amplifier module, a 10-kc calibration signal is applied to the RF module by the frequency generator module. The 10-kc calibration signal and the synthesizer module output are then heterodyned by the RF module to obtain a difference frequency, which is the 1,750-kc IF. The front panel CLARIFY tuning control, which is initiated by the PUSH TO CALIBRATE switch, is adjusted so that the 1,750-kc output of the RF module and the 1,750-kc frequency generator module output are such that a zero beat is monitored in the headset. The IF audio module which compares the two intermediate frequencies is switched to the calibrate mode to eliminate an audio crystal filtering network that is used in normal operation.

After the zero beat has been obtained, the PUSH TO CALIBRATE switch is released to remove the calibration circuits and to return the radio set to a receive-operate condition.

*d. Receive Mode Power Source.* During the receive mode, the power supply module of the radio set supplies three dc operating voltages to the system. The power supply module accepts 12 volts dc from an external power supply (para 1-9b) and produces +9 volt enable, +12 volt receive, and +12 volt for the PUSH TO CALIBRATE switch.

### 1-5. Transmit Mode of Operation

*a. General.* The function of the radio set when connected in the transmit mode of operation as shown in B, figure 7-2, is to receive audio signals from a microphone or interrupted audio tones enabled from a telegraph key, modulate the 1,750-kc IF with the audio intelligence, and multiply the IF up to a high frequency RF signal between 2 mc and 11.999 mc. The multiplied signal is then amplified and coupled to the antenna for transmission. The +12-volt calibrate circuits cannot be activated when the radio set is in a transmit configuration.

*b. Transmit Operation.* When the transmit mode of operation is selected, the receive-transmit control relays in the radio set are energized, causing the transmit circuits to be active and the receive circuits to be inactive. The signal flow to the modules begins at the telegraph key or microphone. When the telegraph key is used, a 1,600-cps audio tone<sup>a</sup> is connected to the audio circuits in the IF audio module each time the key is pressed. The audio signals are supplied back to the headset so that the operator may monitor the voice or telegraph intelligence. The audio signal is also applied to a balanced mixer circuit in the IF audio module and is modulated with the 1,750-kc output of the frequency generator module. Both sidebands of the 1,750-kc are signal amplified, and then the upper sideband is sup-

pressed while the lower sideband is supplied to the RF module. Gain of the IF amplifier within the IF audio module is controlled by the chassis-mounted gain control circuits. A cw hold control output, for holding the radio set control relays in a transmit condition during the time between the characters of a message, is routed to the power supply module by the IF audio module. The RF module also receives a signal from the synthesizer module. The synthesizer module frequency range is from 3.75 mc to 13.749 mc. A mixer in the RF module mixes the 1,750-kc lsb and synthesizer frequency producing a sum and difference frequency. The difference frequency is between 2 mc and 11.999 mc and is the upper sideband of the selected channel. The difference frequency is selected by a tuned radiofrequency amplifier and is applied to the power amplifier module. The MC step frequency selector gearing of the synthesizer module is connected to the band selection circuits in the RF module so that when the synthesizer frequency is changed, the resonant frequency of the RF module will be changed accordingly. The chassis-mounted gain control circuits and the front panel mounted R. F. GAIN control govern the level of the 2-mc to 11.999-mc RF module output. The power amplifier module is used to increase the gain of the RF signal and to couple the signal to the antenna. In addition, the power amplifier module provides a transmit level control to the gain control circuit so that RF gain in the RF module is maintained at a constant level.

*c. Transmit Mode Power Source.* During the transmit mode, the power supply module of the radio set supplies three dc operating voltages to the system. The power supply module accepts 12 volts dc from an external power supply (para 1-9b) and produces the +12-volt transmit (to energize the radio set relays), +9 volt enable, and the +40 volt for the power amplifier module.

## Section III. FUNCTIONAL ANALYSIS

### 1-6. General

This section contains a functional analysis of each of the radio set major functions. These

major functions are the receive, transmit, and power functions. Diagrams of each major function are shown in figures 7-3 through 7-5.

<sup>a</sup>Radio sets bearing serial numbers 371 and up generate a 2,000 cps audio tone.

These diagrams show the major circuits contained within each module, and also illustrate the mode selection circuits which switch the radio set from a receive to a transmit function.

### 1-7. Receive Function (fig. 7-3)

*a. General.* The receive function receives RF signals from 2 mc to 11.999 mc, converts the RF signal to a 1,750-kc IF, and then demodulates the intelligence so that it will produce audible signals in a headset. The following paragraphs describe the functional operation of the circuits within each dual purpose module that are operational during a receive mode.

*b. Power Amplifier Module.* The power amplifier module in the receive mode of operation connects the 2-mc to 11.999-mc RF input from the antenna to the input of the RF module. A receive-transmit relay, which is deenergized in the receive mode, disconnects all power amplifier circuits except for the antenna loading and tuning network. This network contains selection circuits, which are adjusted to load the antenna for optimum RF reception.

*c. Synthesizer Module.* The synthesizer module generates the 3.75-mc to 13.749-mc signal which is heterodyned with the received RF to obtain a 1,750-kc mc IF. The synthesizer signal is selected 1.75 mc above the IF and is applied to the RF module in 1-kc increments during normal operation. The synthesizer module may also be operated in the calibrate mode. During this time, the synthesizer signal output is in 10-kc increments. The basic synthesizer circuits which form the synthesizer signal consist of the push-to-calibrate and clarify tuning circuit, calibrate frequency standard, calibrate-operate control relay K2, receive-transmit control relay K1, 1-kc and 10-kc step oscillators and mixer, 100-kc step oscillator and mixer, and the mc step oscillator and mixer. The CLARIFY control and 1 KC, 10 KC, 100 KC, and MC step frequency selector switches, mounted on the radio set front panel are also part of the synthesizer module. Since the step oscillators are free running, the synthesizer module requires only dc voltages from the power supply module to operate. The 1-kc

step oscillator produces 10 different frequencies as selected by the 1 KC step frequency selector switch. The range of frequencies covered is from 6,525 kc to 6,534 kc. The 10-step frequency oscillator produces a frequency between 9,025 kc and 9,115 kc as selected by the 10 KC step frequency selector switch. These two selected step frequencies are then added together and connected to the input of the 100-kc step oscillator and mixer. The 100-kc oscillator is controlled by the 100-KC step frequency selector and has 10 different frequency outputs between 26,730 kc and 27,630 kc, in 100-kc steps. The 100-kc step oscillator output is added to the mixed 1-kc and 10-kc step oscillator outputs. The total signal is applied to the mc-step oscillator and mixer. The frequency range of the total signal is between 42,280 kc and 43,279 kc in 1-kc steps, depending upon the settings of the three front panel mounted kilocycle step frequency selectors. The mc step frequency oscillator and mixer is used to convert the synthesizer module output into its final form. The mc step oscillator frequency output is 38,530 kc to 29,530 kc in 1,000-kc steps. The final mixer takes the difference between the mc and mixed 100-kc step oscillator outputs. Therefore, the output of the final mixer is between 3.75 mc and 13.749 mc in 1-kc steps, depending upon the position of the MC step frequency selector switch. The combination of step frequency selections is normally 1.75 mc above the incoming RF. The synthesizer output is altered during calibration of the radio set. To calibrate the radio set during the receive mode, the operator presses the CLARIFY PUSH TO CALIBRATE control on the front panel. With the control in, +12 volts is provided to operate-calibrate control relay K2 in the synthesizer module. This voltage energizes K2, causing its contacts to replace the multiple 1-kc crystal frequencies with a fixed calibrate frequency standard. This process removes the 1-kc steps in the synthesizer output. The CLARIFY tuning control is then used to properly calibrate the receiver tuning circuits. The MC step frequency selector, in addition to providing the correct mc step frequency, is mechanically connected to the RF module to control frequency selections.



*d. RF Module.* During the receive function, the RF module tunes the power amplifier module and synthesizer module input frequencies, controls the RF gain, and heterodynes the RF signal with the selected synthesizer frequency to obtain the 1,750-kc IF. If the receiver is being calibrated, the RF module receives a 10-kc calibrate signal from the frequency generator module. The 10-kc calibrate signal is heterodyned with an altered synthesizer signal input. This way, the tuning circuits can be calibrated so that the synthesizer and frequency generator are in phase with one another and the RF module can be tuned properly prior to RF reception. To assure that the frequency bandpass range of the RF module circuits will be approximately the same as the RF and synthesizer input ranges, the RF module is mechanically connected to the MC step frequency selector switch on the front panel. The basic operation of the RF module is the same during both the calibrate and operate conditions except for minor differences; therefore, only the operate condition will be described. During the operate condition, the RF input from the power amplifier module is applied through the normally closed contacts of receive-transmit control relay K1 to the RF tuning circuits. The RF input is in the high-frequency range between 2 mc and 11.999 mc. The RF tuning circuits form a tuned radiofrequency (TRF) amplifier. The bandpass of the tuned circuit is controlled by bandswitching devices mechanically connected to the front panel MC step frequency selector. The RF tuning circuits also receive an RF gain control input from the chassis-mounted RF gain control circuits. The front panel R. F. GAIN control is adjusted for a desired audio level in the headset. The tuned and gain-controlled RF signal is supplied to a balanced mixer in the RF module for heterodyning. The synthesizer module tuning circuits are used to supply a 1.75-mc frequency above the input radiofrequency to the balanced mixer. The synthesizer tuning circuits in the RF module receive the 3.75-mc to 13,749-mc output of the synthesizer module. Its tuned circuits are also frequency band controlled by the MC step frequency selection. The tuned synthesizer and RF signals are heterodyned by the balanced mixer to obtain the 1,750-kc IF.

The IF output of the RF module containing the voice or telegraph audio intelligence is then applied to the IF audio module.

*e. Frequency Generator Module.* During the receive mode, the frequency generator module provides two outputs. These outputs are a highly stable 1,750-kc signal and a 10-kc calibrate signal. The frequency generator module consists of a frequency standard and a frequency divider. The frequency standard is a free running frequency generating circuit requiring only +9 volts enable from the power supply to operate. The 1,750-kc output is connected to the demodulator circuit of the IF audio module and to the frequency divider in the frequency generator module. The frequency divider divides the 1,750 kc down to 10 kc when the front panel PUSH TO CALIBRATE switch (not shown on fig. 7-3) is pressed. Therefore, a 10-kc output is provided to the RF module only when the receive function is being calibrated.

*f. IF Audio Module.* The primary function of the IF audio module is to accept the 1,750-kc IF containing the audio intelligence from the RF module and the 1,750-kc reference signal from the frequency generator module, amplify the IF, detect the audio intelligence, amplify the audio, and apply it to a headset. The 1,750-kc IF is received from the RF module and connected to the IF preamplifier through the normally closed contacts of receive-transmit control relay K1. The preamplified IF is then filtered by a crystal filter network when operate-calibrate control relay K2 is in the operate condition. The resultant output is supplied through receive-transmit control relay K3 contacts to the IF amplifier stage. The +9 volt enable line is routed through another set of K3 contacts to the IF amplifier and demodulator stage during the receive mode of operation only. The IF amplifier, which receives IF gain control from the chassis-mounted gain control circuits, further amplifies the 1,750-kc modulated IF before it is sent to the demodulator. A second input to the demodulator is the 1,750 kc reference signal. The difference in the modulated 1,750-kc and 1,750-kc reference signal is the output from the demodulator. The difference is the audio intelligence created by

voice or telegraph modulation. The audio signal is applied to an audio amplifier stage, which amplifies the signal before it is applied to the headset.

### 1-8. Transmit Function

(fig. 7-4)

a. *General.* The purpose of the transmit function is to accept either voice or telegraph key audio intelligence, modulate a 1,750-kc IF signal with the audio, multiply and amplify the IF up to a signal between 2 mc and 11.999 mc, and then couple the RF to an antenna for transmission. The following paragraphs describe the functional operation of the circuits within the dual purpose radio set modules that are operational during the transmit mode of operation.

b. *Frequency Generator Module.* The function of the frequency generator module during the transmit mode of operation is to provide a highly stable 1,750-kc IF reference signal to the IF audio module. The frequency divider circuit will not operate in the transmit mode since the PUSH TO CALIBRATE switch line does not receive power.

c. *IF Audio Module.* The IF audio module is capable of modulating a 1,750-kc IF with either voice or telegraph audio intelligence. After modulation, the modulated IF is amplified and filtered by the IF audio module before being applied to the RF module. The IF audio module consists of two receive-transmit control relays, audio tone oscillator, continuous-wave hold circuit, audio amplifier, microphone amplifier, balanced mixer, IF preamplifier, and crystal filter. Voice (audio) inputs are applied to the microphone amplifier from the microphone. When the operator closes the telegraph key, the audio tone oscillator is activated, causing a 1,600-cycle-per-second (cps) tone to be connected to the microphone amplifier. The microphone amplifier amplifies either the voice or telegraph audio intelligence and supplies it to the input of the balanced mixer. A second output of the microphone amplifier connects the audio to the audio amplifier and headset for sidetone monitoring. The other input to the balanced mixer is the 1,750-kc IF reference signal. Within the balanced mixer circuit the audio intelligence modulates the

1,750-kc IF reference signal. The modulated IF is taken from the arm of the balance control at the output of the balanced mixer and passed through the contacts of relay K1 (energized) to the IF preamplifier stage. After amplification, the IF is filtered by the crystal filter to pass only the lower sideband of the IF. The lsb IF is then connected through the transmit contacts of K3 (energized) to the input of the RF module.

d. *Synthesizer Module.* The operation of the synthesizer module during a transmit mode of operation is the same as during the receive mode of operation, except that the calibration circuits are disabled. Therefore, the synthesizer output is always a high frequency signal between 3.75 mc and 13.749 mc in 1-kc steps. The frequency output selected by the four front panel step frequency selector switches will determine the frequency of the transmitted RF.

e. *RF Module.* The operation of the RF module of the radio set during the transmit mode of operation is also the same as in the receive mode of operation except that signal flow is reversed through the module and the calibration circuits are disabled. Since signal flow is reversed, the 1,750-kc IF is now the input to the balanced mixer. The balanced mixer also receives the synthesizer module output and mixes both signals. The output of the balanced mixer is applied through the contacts of relay K1 (energized) to the RF tuning circuits. The RF tuning circuits select the difference between the two signals, which is the synthesizer frequency input minus the lower sideband of 1,750 kc. This difference frequency, which is the upper sideband of the selected channel (2 mc to 11.999 mc), is amplified and connected to the power amplifier module through the contacts of relay K2 (energized).

f. *Power Amplifier Module.* The power amplifier module in the transmit mode of operation amplifies the RF output of the RF module, controls the transmit level automatically, filters the RF, and provides a means of tuning and loading the antenna properly for optimum RF transmission. The +9-volt enable output of the power module is connected through the

<sup>a</sup>Radio Sets bearing serial numbers 371 and up generate a 2,000-cps audio tone.

contacts of relay K2 to the RF preamplifier and RF power amplifier circuits during a transmit mode only. These circuits increase the gain of the RF sufficiently to drive the antenna tuning and loading circuits. A transmit level control, which is produced by the transmit level control circuit, is applied to the input of the RF power amplifier to maintain the gain of the stage at a constant level. The transmit level control circuit establishes the control level by sampling the RF just before it is transmitted. The transmit level control output is also routed to the RF gain control circuit to maintain the RF gain control at a constant level. After preamplification and power amplification, the RF is applied to a tuning indicator circuit. This circuit provides an input to ANT. IND meter M201, which is used to monitor antenna tuning. The amplified RF is then filter by an RF filter before being supplied to the antenna tuning and loading network. The antenna tuning and loading network contains the adjustments and switches necessary to tune the antenna for optimum RF transmission.

### 1-9. Power Source (fig. 7-5)

*a. General.* The purpose of the power circuits is to receive either ac or dc source power and convert it into the dc operating voltages required by the radio set during both receive and transmit modes of operation. The following paragraphs describe the functional operation of the circuits within the radio set power supply module, the external power supply, and the external battery charger. Optional power input connections may be utilized as an input to the power circuits. When the radio set is used as a portable man-carried unit, the power input to the power supply module is +12 volts from a wet or dry cell battery. During that time, the external power supply and battery charger are not required. However, if the radio set is to be used at a field site or fixed station, the external power supply and battery charger are normally used. During that time, either +21 volts to +31 volts from a vehicular battery, or dc power source, 160 to 255 volts ac, or 80 to 130 volts ac can be the power source. The external power supply then con-

verts either the dc or ac voltage into the required +12-volt input for the radio set power supply module. The external battery charger operating from the converted voltages of the power supply is used to charge the rechargeable batteries of the radio set so that they can be used again for future portable operation.

*b. External Power Supply.* The external power supply is capable of converting either ac or dc voltages into +12 volts for the power supply module of the radio set. The ac or dc input source voltage is coupled through the input filter capacitors to the POWER ON switch. If the dc power input option has been chosen for use, the dc voltage is passed through 15-ampere fuse F1 and a blocking diode to the input of the +12-volt regulator circuit. A dc indicator is connected to the dc input line so that the operator will know that dc voltage is being applied to the external power supply. When an ac power source has been selected as the input to the external power supply, the POWER ON switch passes either 160 to 255 volts ac through 2-ampere fuse F2 or 80 to 130 volts ac through 4-ampere fuse F3 to a dc rectifier. The dc rectifier converts the ac voltage to a dc voltage (between +20 and +40 volts) that is sufficient to drive the +12-volt regulator circuit. The +12-volt regulator, which is a series-regulated circuit, accepts either the direct or converted dc voltage input and provides a +12-volt output across its load. This +12 volts is supplied to the power supply module. In addition, a +12-volt output of the +12-volt regulator is applied to the monitoring METER on the front panel of the supply.

*c. Battery Charger Assembly.* The external battery charger receives either the direct or converted dc voltage from the external power supply and provides a means of charging the +12-volt rechargeable battery used to power the radio set when it is man-carried. CHARGER switch S1A connects ground to the battery charger when placed in the ON position. A charger power on indicator monitors the application of battery charger power. To protect the battery charger from overloads, 6-ampere fuse F1 is connected in series with the CHARGER switch.

*d. Power Supply Module.* The power supply module is in the radio set. The power supply module may receive power input from either a +12-volt battery or the external power supply. In either case, the operation of the power supply module is the same. The selected optional power is connected through 2-ampere fuse F2 to the contacts of transmit-receive control relay K1 and OFF-ON-TUNE function switch S201A. The transmit-receive control relay is normally in the receive position, disconnecting the +12 volts from the dc-to-dc converter and +12-volt transmit line. When the transmit mode of operation has been selected the cw hold signal from the IF audio module energizes K1, causing the +12-volt transmit line to be energized and the dc-to-dc converter to operate. The +12-volt input to the dc-to-dc converter is converted to approximately +50 volts.

The +50-volt potential is then regulated at +40 volts by the +40-volt regulator. The +40-volt output of the power supply module is applied to the power amplifier module of the radio set. The OFF-ON-TUNE switch supplies +12 volts to the +9-volt regulator and transmit-receive control relay K1 contacts if it is positioned to ON or TUNE. The +9-volt regulator is a series-regulated circuit, which supplies +9 volts enable to the radio set modules during both the receive and transmit modes. The contacts of K1 receiving +12 volts from the function switch is connected to front panel PUSH TO CALIBRATE switch S202 only during the receive mode of operation. The PUSH TO CALIBRATE switch distributes the +12-volt calibrate control voltage to the radio set modules when it is desired to calibrate the radio set tuning circuits.

## Section IV. FREQUENCY SYNTHESIZER MODULE ANALYSIS

### 1-10. General (fig. 7-6)

The synthesizer module generates a signal used for heterodyning purposes. The synthesizer module contains a series of crystal-controlled oscillators, mixers, bandpass filters, and amplifiers that generate a selectable output signal from 3.75 mc to 13.749 mc. The selectable output signal frequency is always 1,750 kc above the RF selected by the radio set for operation. A simplified block diagram of the synthesizer module is illustrated in figure 7-6. The 1 KC step frequency selector switch S1, 10 KC step frequency selector switch S2, 100 KC step frequency selector switch S3, and MC step frequency selector switch S4 select a crystal for each of their respective oscillator circuit. All selector switches and controls necessary for synthesizer module operation are located on the front panel.

*a. 1-Kc and 10-Kc Oscillators and Mixer.* The 1-kc oscillator Q1, 10-kc oscillator Q2, and mixer Q3 are contained in assembly A5 of the synthesizer module. Crystals Y1 through Y10 and 1 KC step frequency selector switch S1 provide 1-kc oscillator Q1 a frequency range between 6,525 kc and 6,534 kc in 1-kc steps. The 1-kc oscillator crystals and switch S1 are

part of assembly A1 of the synthesizer module. Calibrate frequency standard crystal Y41 is connected to the 1-kc oscillator circuit through the contacts of relay K2 when the radio set is in the calibrate mode of operation. Calibrate frequency crystal Y41 produces 6,525 kc for calibration purposes. In calibration operation, the receiver is calibrated against a 10-kc signal generated in the frequency generator module. Calibrate frequency crystal Y41 inserts a signal (identical to position 0 of 1 KC step frequency selector switch S2) into the 1-kc oscillator, eliminating the 1-kc step action for calibration purposes. CLARIFY control C601 in the receive mode of operation, is connected through the contacts of K1 to the crystal selected by switch S1. Slight adjustments to the receive frequency can be made to receive a station more clearly by manually varying the CLARIFY control. The output of the 1-kc oscillator is applied to the input of first mixer Q3 where it is mixed with the output of 10-kc oscillator Q2. The 10 KC step frequency switch and crystals Y11 through Y20 are part of 10-kc crystal select A2 of the synthesizer module. The 10-kc oscillator generates a frequency from 9,025 kc to 9,115 kc in 10-kc steps. (During calibration, the output of the 10-kc oscillator is

adjusted by means of the PUSH TO CALIBRATE control (not shown on figure 7-6). This is accomplished by depressing the PUSH TO CALIBRATE knob and tuning it for a zero beat tone at the headset. The first mixer output is the sum of the 1-kc and 10-kc oscillators. The output of the mixer is applied to 10-kc bandpass amplifier Q4. The 10-kc bandpass amplifier has tuned circuits that reject undesired frequencies and harmonics of the first mixer output while passing signals in the frequency range of 15,550 kc to 15,649 kc. Output signals of the 10-kc bandpass amplifier are applied as one of the inputs to second mixer T5, T6.

*b. 100-Kc Oscillator.* One-hundred kc oscillator Q7 and 100-kc crystal selects Y21 through Y30 and S3 are part of 100-kc step oscillator A3. The 100-kc oscillator can produce a frequency between 26,730kc and 27,630 kc, in steps of 100 kc. The frequency is selected by 100 KC step frequency selector switch S3 and the resulting signal, generated by Q7, is supplied as an input to second mixer T5, T6 where it is combined with the output of 100-kc bandpass amplifier Q4.

*c. Second Mixer and 100-Kc Bandpass Amplifier Q5, Q6.* The 15,550 kc to 15,649-kc output of the 10-kc bandpass filter and the 26,730-kc to 27,630-kc output of 100-kc oscillator Q7 are added together by second mixer T5, T6. The second mixer output is applied to 100-kc bandpass amplifier Q5, Q6. The resulting combined and filtered output signal of the 100-kc bandpass amplifier is supplied as an output to a third mixer stage where it is combined with the output of 1 megacycle oscillator Q9. The second mixer and 100-kc bandpass amplifiers are in 100-kc mixer and bandpass amplifier A7 of the synthesizer module.

*d. Mc Oscillator.* Megacycle oscillator Q9 and crystals Y31 through Y40 are in assembly A4 of the synthesizer module. The 1-mc oscillator generates signals of 38,530 kc to 29,530 kc, selectable in 1-mc steps. Oscillator crystals are selected by means of 1 MC step frequency selector switch S4 which is also geared mechanically to the RF module.

*e. Third Mixer.* The output of the 1-mc oscillator and the output of the 100-kc bandpass

amplifiers are mixed in third mixer T12, T13, CR4. The difference frequency of the two input signals is taken from the output of the third mixer and applied to output amplifier and low-pass filter Q8, FL1. The third mixer and output amplifiers are part of mc mixer and final amplifier A8.

*f. Output Amplifier and Low-Pass Filter.* The output of the third mixer is applied to output amplifier and low-pass filter Q8, FL1. The undesirable harmonics are filtered out by FL1. The output of the synthesizer module is the difference frequency produced at the output of the low-pass filter circuit. This signal is supplied to the RF module for use in the heterodyne process. The output signal of the synthesizer module ranges from 3.75 mc to 13.749 mc.

- (1) The signal derived for each of the synthesizer module is given in the following chart:

Switch position (digit)	Oscillator			
	1 kc	10 kc	100 kc	mc
0	6,525	9,025	26,730	-----
1	6,526	9,035	26,830	-----
2	6,527	9,045	26,930	38,530 KC
3	6,528	9,055	27,030	37,530KC
4	6,529	9,065	27,130	36,530 KC
5	6,530	9,075	27,230	35,530 KC
6	6,531	9,085	27,330	34,530 KC
7	6,532	9,095	27,430	33,530 KC
8	6,533	9,105	27,530	32,530 KC
9	6,534	9,115	27,630	31,530 KC
10	----	----	----	30,530 KC
11	----	----	----	29,530 KC

- (2) A composition of the synthesizer signal is shown by the following example:

- (a) Assume the radio set frequency setting is 3,167 kc.
- (b) With 1,750 kc intermediate frequency, the synthesizer module signal required is  $1,750 + 3,167 = 4,917$  kc.
- (c) Add 1 kc oscillator (position 7) to 10 kc oscillator (position 6):  $6,532 + 9,085 = 15,617$  kc.

- (d) Add 100 kc oscillator (position 1):  
 $15,617 + 26,830 = 42,447$  kc.
- (e) Subtract 1 mc oscillator (position 3):  
 $42,447 - 37,530 = 4,917$  kc.

### 1-11. 1-Kc Oscillator (fig. 7-7)

The schematic diagram of the 1-kc oscillator circuit in the synthesizer module is shown in figure 7-7. The 1-kc oscillator Q1 and the selected crystal (Y1 through Y10) form a tuned Pierce oscillator with a frequency range from 6,525 kc to 6,534 kc. Starting at position 0 of the 1 KC step frequency selector, each crystal selected advances the signal output of Q1 by 1 kc. A trimmer capacitor associated with each crystal, C602 through C611, is part of the tuned circuit and is adjusted to the exact frequency of each position as shown in the chart for 1 KC step frequency selector switch S1. In the receive mode of operation, relay K1 is de-energized, connecting C601 to the crystal selected. CLARIFY control C601 is adjusted to receive stations more clearly. In the transmit mode of operation, relay K1 is energized, disconnecting C601, and connecting C612 and C92 to the tuned circuit of the 1-kc oscillator. Capacitor C612 is adjusted for overall frequency ranges of the oscillator. During the calibration mode, relay K2 is energized, disconnecting the crystal selected by switch S1 and connecting crystal Y41 to the 1-kc oscillator. Crystal Y41 produces 6,525 kc, which is identical to position 0 of the 1 KC step frequency oscillator selector S1. Frequency trimming of Y41 is accomplished by means of capacitor C617. Feedback for the 1-kc oscillator is from the emitter of Q1 to the junction of capacitors C14 and C15. Resistors R1 and R2 is a voltage divider network providing bias for the base of Q1. RF decoupling is provided by RF choke L1 and capacitor C18. This circuit is typical for IF decoupling circuits used throughout the synthesizer module. The 1-kc step frequency signal output is taken from capacitive divider network C15 and C16 that provides a low impedance output drive to the emitter of first mixer Q3.

### 1-12. Ten-Kc Oscillator

The 10-kc oscillator circuit is a tuned Pierce oscillator similar to the 1-kc oscillator. One of

10 crystals (Y11 through Y20) is selected by 10 KC step frequency selector S2 for 10-kc oscillator Q2. During the calibration mode, capacitor C628 is mechanically connected to the PUSH TO CALIBRATE knob. The frequency of the synthesizer output is adjusted for a zero beat with a 10-kc signal from the frequency generator module. The output of Q2 is applied to the base of first mixer Q3. Capacitive divider C21 and C22 provides a low impedance output to drive the first mixer stage.

### 1-13. First Mixer

First mixer Q3 receives the 1-kc oscillator output signal at the emitter and the 10-kc oscillator output at the base and heterodynes both signals. Base bias is developed by resistors R7 and R8 and emitter bias is developed by R9. The sum of the signals (15,550 kc to 15,649 kc) is tuned by two tuned circuits. The first tuned circuit is comprised of autotransformer T601 and capacitors C26 and C27, and is located on assembly A5. The capacitors also serve as a voltage divider network. The second tuned circuit, located on assembly A6, is made up of T602, C30, and C31. The output of the second tuned circuit is taken from the center tap of T602 and applied to 10-kc bandpass amplifier Q4.

### 1-14. 10-Kc Bandpass Amplifier

The output of the first mixer is connected to the 10-kc bandpass amplifier through T602 and coupling capacitor C32, to the base of transistor Q4. Base bias for Q4 is developed by voltage divider R11 and R12. Rf decoupling networks L10, C33, L5, and C34 block the RF signals from going to the +9-volt power source. Transistor Q4 amplifies the signal and applies the output to a tuned circuit that is tuned to 15 561 kc and has a bandwidth of 10 kc. The tuned circuit is comprised of autotransformers T603, T604 and capacitors C36, C37, and C38. The output signal of the 10-kc bandpass amplifier is taken from the center tap of T604 and applied to the primary winding of second mixer input transformer T5.



### 1-15. 100-Kc Oscillator

The 100-kc crystal oscillator generates selectable output frequencies from 26,730 kc to 27,630 kc in 100-kc steps. The 100-kc oscillator circuit consists of transistor Q7, tapped transformer T611, and 10 crystals (Y21 through Y30), which are selectable one at a time by means of 100 KC step frequency selector S3. An RF filter network, consisting of C88, L11, C85, L12, C52, R21, C53, L8, and C54, prevents 100-kc RF interference signals from entering the +9-volt power source. Bias for the base circuit of transistor Q3 is provided by voltage divider R22 and R23. The primary of T611 and C55 forms a collector tank circuit for Q3. Regenerative feedback for the 100-kc oscillator circuit is provided from the center tapped primary of T611 through C56 to the emitter of Q7. Emitter bias for Q3 is provided by R24. The 100-kc output signal is connected to the second mixer from the secondary winding of T611.

### 1-16. Second Mixer

The second mixer accepts the frequency outputs of the 10-kc bandpass amplifier and 100-kc oscillator, then heterodynes both signals, producing an upper and lower sideband. The second mixer consists of transformers T5 and T6 and single-balanced diode circuit CR3. Transformer T5 couples both input signals to single-balanced diode circuit CR3. Single-balanced diode circuit CR3 suppresses the 100-kc oscillator signal and connects the upper and lower sideband of the mixed signal to T6. The secondary of T6 is connected directly to the base of first 100-kc bandpass amplifier Q5.

### 1-17. 100-Kc Bandpass Amplifier

The 100-kc bandpass amplifier contains first 100-kc bandpass amplifier Q5 and second 100-kc bandpass amplifier Q6. First 100-kc bandpass amplifier Q5 receives the upper and lower sideband output of the second mixer and amplifies the signal, then selects the upper sideband for further amplification. Base bias for transistor Q5 is developed by voltage divider network R15 and R16. Emitter bias for Q5 is developed across resistor R17. Emitter biasing resistor R17 is bypassed by capacitor C40

to prevent degeneration. Resistor R38 and capacitor C41 form a decoupling network, keeping RF out of the +9-volt enable. Transformer T607 and capacitor C42 form a tank circuit and is coupled through C43 to a second tank circuit, T608 and C44. Both tank circuits are tuned to the upper sideband and have a bandwidth of 100 kc. The output of T608 is coupled through C45 to the base of second 100-kc bandpass amplifier Q6. The function of second 100-kc bandpass amplifier Q6 is similar to the first 100-kc bandpass amplifier. Decoupling for transistor Q6 collector circuit is accomplished by L7 and C48. Capacitor C46 provides decoupling for the base circuit. The output of the second 100-kc amplifier is taken from the center tap secondary of T610 and is applied to the third mixer where the signal is mixed with the 1-mc oscillator signal.

### 1-18. Mc Oscillator

The mc oscillator is similar to the 100-kc oscillator circuit and consists of mc oscillator transistor Q9, tuned transformer T614, MC step frequency selector switch S4, and oscillator crystals Y31 through Y40. Since the frequency range covered is greater than that of 100-kc oscillator Q7, it is necessary to add trimmer capacitors to the oscillator circuit for frequency adjustments of each selected crystal. This action is accomplished by MC step frequency selector switch S4B which selects a capacitor, C667 through C676, in conjunction with C77 through C82. Each position of S4 selects a crystal for the oscillator and a capacitor in series with the mc oscillator output tank circuit T614 and C65. The mc oscillator output is 38,530 kc to 29,530 kc in 1-mc steps. Each trimmer capacitor selected adjusts the output frequency to the exact frequency desired for each position of the MC step frequency selector switch. The MC step frequency selector switch S4 is linked mechanically to the RF module to keep the synthesizer module output signal exactly 1,750 kc above the tuned radiofrequency (TRF) amplifier stages of the RF module.

### 1-19. Third Mixer

The third mixer is a balanced bridge circuit that is designed to mix the output signal of the second 100-kc bandpass amplifier with the

output of the 1-mc oscillator. The third mixer consists of mixer transformer T12, rectifier diode network CR4, and output transformer T13. The output of the 100-kc bandpass amplifier is applied to the balanced input and the output of the mc oscillator is applied to the unbalanced input of the balanced bridge circuit. The output of the second 100-kc bandpass amplifier is suppressed and the upper and lower sidebands are coupled across transformer T13 to the base of transistor Q8.

### 1-20. Output Amplifier

Output amplifier Q8 amplifies the double sideband output from the third mixer and

couples the signal to low-pass filter FL1. Base bias for transistor Q8 is developed by voltage divider network R27 and R28. Resistors R31 and R32 provide emitter bias. Capacitors C57 and C59 are provided to prevent degeneration. Resistor R29 and capacitors C58 and C61 form a decoupling network for the output amplifier. The double sideband signal is coupled through capacitor C60 to low-pass filter FL1. Low-pass filter FL1 allows only the lower sideband signal (difference between the second 100-kc bandpass amplifier output and mc oscillator output) to pass the RF module. The frequency range of this signal is 3.75 mc to 13.749 mc and is 1,750 kc above the radio set operating frequency.

## Section V. RF MODULE ANALYSIS

### 1-21. General

(fig. 1-1)

The RF module performs two functions: in the receive mode of operation, it converts the incoming RF from the power amplifier module to a 1,750-kc intermediate frequency; in the transmit mode of operation, it converts the 1,750-kc intermediate frequency to the transmit frequency. Figure 1-1 shows how the signals are routed during the two modes of operation.

*a. Receive Mode.* During the receive mode of operation, the RF input from the power amplifier module is coupled through the contacts of relay K1 (deenergized) to the TRF amplifier. The TRF amplifier consists of three RF tuned circuits and an RF amplifier. The RF tuned circuits are tuned to the operating frequency and are connected in series to increase the selectivity of the TRF amplifier. Output from the third RF tuned circuits is coupled through the contacts of relay K2 (deenergized) to balanced mixer Z1. In the balanced mixer, the output from the third RF tuned circuits is heterodyned with a signal from the synthesizer module. The synthesizer module output signal is 1,750 kc above the operating frequency of the radio set. The resultant output from the balanced mixer is a 1,750-kc intermediate frequency applied to the IF audio module. The input from the synthesizer module is amplified by the synthesizer

amplifier stage. The synthesizer tuned circuits that follow the synthesizer amplifier stage are tuned with a section of the same ganged capacitor used by the tuned circuits of the TRF amplifier. The resonant frequency of the synthesizer tuned circuit is always 1,750 kc above that of the TRF tuned circuits. The resonant frequency of all the RF tuned circuits in the RF module is varied simultaneously by the control panel PEAK NOISE control

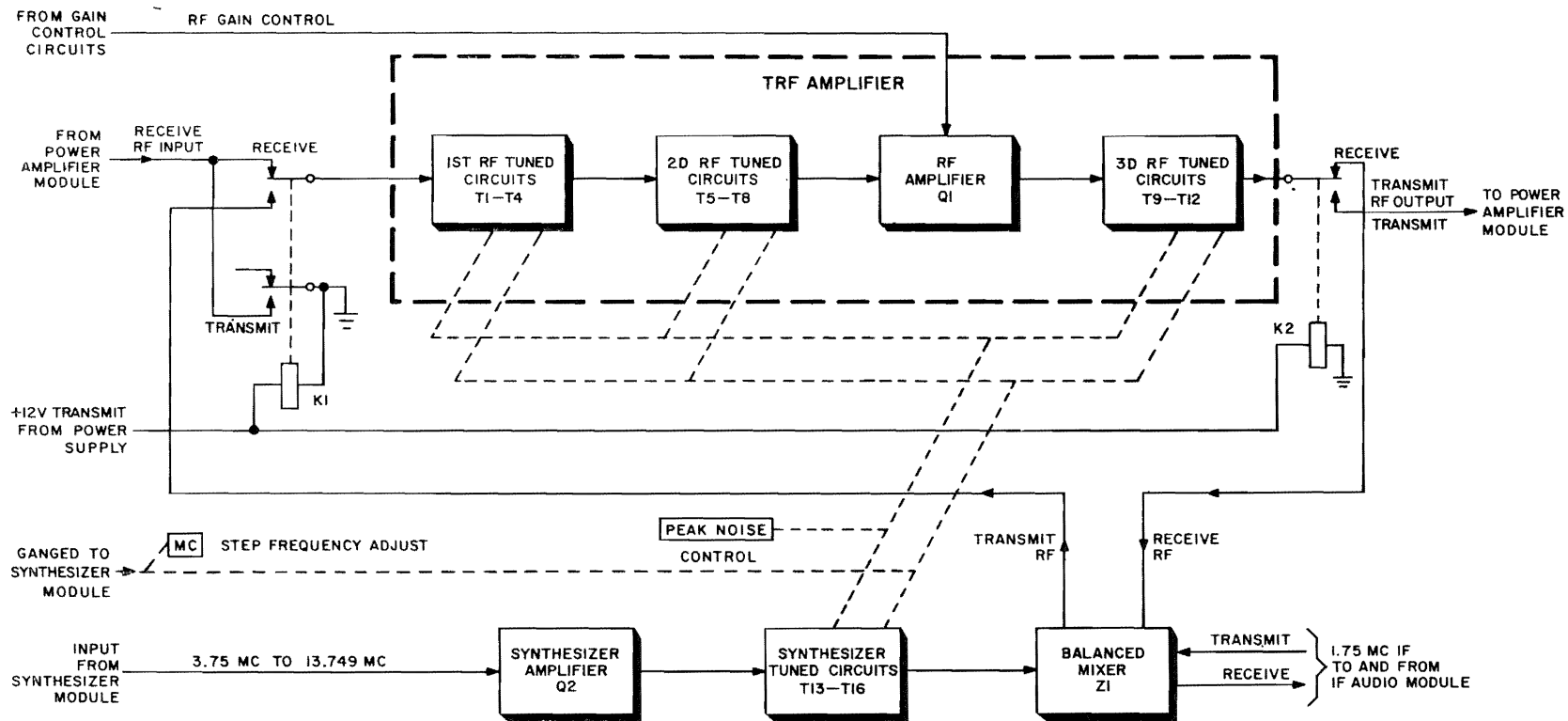
*b. Transmit Mode.* During the transmit mode of operation, the RF module receives a 1,750-kc lower sideband signal from the IF audio module. The signal is coupled to the balanced mixer and heterodyned with the amplified 3.75-mc to 13.749-mc RF input from the synthesizer module. The difference frequency output of the balanced mixer is the upper sideband of the selected channel and is coupled through the contacts of relay K1 (energized) to the TRF amplifier, and from there (through the contacts of energized relay K2) to the power amplifier module.

### 1-22. First RF Tuned Circuits

(fig. 7-8)

Input signals from the power amplifier module to the first RF tuned circuits are received at connector J702 and coupled through the contacts of relay K1 (deenergized) to switch S1A.





NOTE:  
 [ ] INDICATES EQUIPMENT MARKING.

TM5820-590-35-55

Figure 1-1. RF module, block diagram.

Switch S1A is one section of a six-wafer, four-position, gear-driven rotary switch that selects the tuned circuits of the RF module and is gear driven from the MC selector switch of the synthesizer module. The input signal is switched by S1A to one of four tank circuits in the first RF tuned circuits. The tank circuit used is determined by the band setting of switch S1A. In band 1, the input is applied to the primary of transformer T701; in band 2, the input is applied to the primary of T702; etc.

a. The radio set frequency range and synthesizer range for each of the four bands are shown in the following chart:

Band number	Rf range (mc)	Synthesizer (mc)
1	2 to 2.999	3.75 to 4.749
2	3. to 4.999	4.75 to 6.749
3	5 to 7.999	6.75 to 9.749
4	8 to 11.999	9.75 to 13.749

b. For all operating bands, tuning capacitor C701A is placed in parallel with the capacitor of the selected tank circuit. Capacitor C701 consists of four gang-tuned capacitors (C701A through C701D) which are adjusted simultaneously with the PEAK NOISE control located on the control panel of the radio set. The output signal of the first RF tuned circuits is supplied by one of the secondary windings of tuned transformers T701 through T704. The tank circuits that are not used are loaded by resistor R3 to prevent interaction with the selected tank circuit. The output from the selected transformer is connected through S1A and coupled through capacitor C8 to the second RF tuned circuits.

c. In the calibration mode, a 10-kc calibration signal from the frequency generator module is supplied to the RF module. The 10-kc signal is fed to the first RF tuned circuits through jack J701, then filtered by a resistance-inductance (RL) network composed of resistors R1, R2, and R15, and inductors L4 and L5.

### 1-23. Second RF Tuned Circuits

The second RF tuned circuits consist of switch S1B, tuned transformers T705 through T708, and capacitors C710 through C713. The

input signal is routed through S1B to the selected tank circuit. Each tank circuit has a tapped transformer to match the impedance of transistor Q1. Resistor R4 is connected to the three tank circuits that are not used. The purpose of R4 is the same as R3. Variable gang-tuned PEAK NOISE capacitor C701B, in parallel with C9, tunes the selected tank circuit for maximum output at the desired frequency in the band. The output from the selected second rf tuned circuits is coupled through switch S1B and capacitor C15 to the base of transistor Q1.

### 1-24. RF Amplifier

The signal from the second RF tuned circuits is coupled through C15 to the base of RF amplifier Q1. The gain of the RF amplifier is controlled by a positive voltage from the gain control circuit (para 1-55). The gain control voltage is connected to the base of Q1 through inductor L1. Resistor R6, diode CR1, and bypass capacitor C14 form part of a voltage divider network for the gain control circuit. Diode CR1 also provides temperature compensation for the base-to-emitter junction of Q1. Inductor L1 keeps RF out of the gain control circuits. Emitter bias is developed by R7. Inductor L2 is the load for transistor Q1. Decoupling is accomplished by capacitor C16. The output signal is coupled through C18 and S1C to one of four tank circuits in the third RF tuned circuits.

### 1-25. Third RF Tuned Circuits

The four tank circuits in the third RF tuned circuits are formed by the primary windings of transformers T709 through T712 and capacitors C720 through C723. Resistor R8 loads the three unused tank circuits. The secondary windings of transformers T709 through T712 provide low impedance outputs to balanced mixer Z1. Output from the selected tank circuit is connected to the balanced mixer through switch S1D and contacts of relay K2 (deenergized).

### 1-26. Balanced Mixer

Balanced mixer Z1 operates in both the receive and transmit modes of operation. In the receive mode of operation, the balanced mixer

receives an input from the third RF tuned circuits and from the synthesizer tuned circuits. The output of the balanced mixer is coupled through transformer T717 and jack J705 to the IF audio module. The resonant frequency for T707 and C38 is 1,750 kc. In the transmit mode of operation, the balanced mixer receives an input from the IF audio module and from the synthesizer tuned circuits. The upper and lower sideband outputs from the balanced mixer are connected through the contacts of relay K1 (energized) to the first RF tuned circuits.

### 1-27. Synthesizer Amplifier

The synthesizer amplifier receives input signals from the frequency synthesizer module. Input signals are coupled through capacitor C25 to the base of transistor amplifier Q2. Resistor R9 provides the proper impedance matching with the frequency synthesizer module. Base bias for Q2 is developed across voltage divider network R10 and R11. The load for

the collector circuit of Q2 is provided by inductor L3. Capacitor C26 and resistor R12 form a decoupling network. Emitter bias is developed across resistor R13. Capacitor C27 is an emitter bypass capacitor. Capacitor C28 couples the output of Q2 to MC step frequency selector S1F. The synthesizer amplifier output is switched by S1F and routed to the selected synthesizer tuned circuit.

### 1-28. Synthesizer Tuned Circuit

Four tank circuits in the synthesizer tuned circuits stage are formed by the primary winding of transformers T713 through R716 in parallel with capacitors C30, C731, C32, C733, C35, C734, C37, and C736. Capacitor C701D (PEAK NOISE control) is placed in parallel (through switch S1F) with the tuned circuit selected. Tuned circuits not used are loaded by resistor R14. The output from the selected synthesizer tuned circuit is coupled through switch section S1E to the balanced mixer.

## Section VI. IF AUDIO MODULE ANALYSIS

### 1-29. General (fig. 7-9)

The IF audio module is used in both the transmit and receive operation of the radio set. In receive mode of operation, the IF audio module filters and amplifies the IF signal input of 1,750 kc and demodulates it to an audio output. In transmit mode of operation, the IF audio amplifier converts the audio input signals or keyed input signals to a single-sideband 1,750-kc intermediate frequency output which is supplied to the RF module. Figure 7-9 is a block diagram of the IF audio module.

*a. Receive Mode.* In receive mode of operation, the 1,750-kc single-sideband input is from the RF module through the contacts of deenergized relay K1 and supplied to IF preamplifier Q1. The output of the IF preamplifier is applied through coupling circuit resistor R4 and capacitor C12 to crystal filter FL1. Filter FL1 increases the selectivity of the receiver by rejecting a portion of the carrier signal, thus limiting the bandwidth of the signal. In calibration mode, relay K2 is energized

and bypasses the crystal filter to prevent the calibration signal from being rejected. The output of the crystal filter is applied to IF amplifier transistors Q2 and Q3. The gain control is applied to Q2 of the IF amplifier and controls the forward gain of both IF amplifiers. Output of the IF amplifier is fed to the demodulator, Q4. In the demodulator, the received ssb IF signal from the RF module is mixed with an unmodulated 1,750-kc signal from the frequency generator module to produce an audio difference signal which is applied to the audio amplifier circuits to drive the headset or a small speaker. In receive mode of operation only, the circuits contained on circuit board assembly A1 (not shown) of the audio module are used.

*b. Transmit Mode.* When the radio set is in the transmit mode of operation, IF audio module audio inputs are from a microphone, or enabling ground from a telegraph key. Audio from the microphone is amplified by microphone amplifiers Q8, Q9, and Q10, then applied to balanced mixer Z1 where it is mixed

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with the 1,750-kc signal from the frequency generator module to produce a double-sideband suppressed-carrier signal. Resistor R432 adjusts the audio level input to the balanced mixer. The output of the balanced mixer is then routed through the contacts of relay K1 (energized) to IF preamplifier Q1. The amplified double-sideband signal is fed to crystal filter FL1 which rejects the lower sideband. This action produces a single-sideband (ssb) signal which is then routed through the contacts of relay K3 (energized) to the RF module. A portion of the audio from the microphone amplifiers is supplied to receive audio amplifiers Q5, Q6, and Q7 for monitoring purposes at the operator's headset. During cw operation, the telegraph key is pressed to cause the 1,600-cps output tone<sup>a</sup> of tone oscillator Q11 to be activated. The cw hold circuit, consisting of Q12 and Q13, will hold the radio set in a transmit mode for 2 seconds after the telegraph key is pressed. Therefore, during the time between characters the radio set will not change to a receive mode. The cw hold circuit operates only in the cw transmission mode. During the transmit mode of operation, +9-volt enable to IF amplifier Q2 and Q3 and demodulator Q4 of the receive IF circuits is removed when K3 energizes, effectively removing these circuits from operation.

### 1-30. IF Preamplifier (fig. 7-10)

During the receive mode of operation, the unfiltered 1,750-kc intermediate frequency signal output of the RF module is routed through connector J401 and the contacts of relay K1 (deenergized) to the primary of tuned circuit transformer T401 of the IF preamplifier. In the transmit mode of operation, the input to the IF preamplifier tuned circuit is from the arm of resistor R434. In either mode of operation, T401 couples the input signal to the base of IF preamplifier Q1. Transistor Q1 is an emitter-follower amplifier which drives crystal filter FL1.

### 1-31. Crystal Filter FL1

The bandpass characteristics of crystal filter FL1 limit the bandwidth of the 1,750-kc

<sup>a</sup>Radio Sets bearing serial numbers 371 and up generate a 2,000-cps audio tone.

signal supplied to it in the receive mode, and pass only the lower sideband of the double-sideband signal supplied to it during transmit mode. This limiting action during the receive mode increases the selectivity of the receiver. Crystal filter FL1 has considerable rejection at the carrier frequency. In order to pass the calibrate signal (which is at the carrier frequency when the set is properly calibrated), K2 is energized by the +12-volt calibrate and FL1 is bypassed. The output of crystal filter FL1 is routed to IF amplifier Q2, Q3 in the receive mode. In the transmit mode, the output of FL1 is connected through the contacts of K3 (energized) to connector J401. Connector J401 is connected to the RF module.

### 1-32. IF Amplifier

In the receive mode of operation, IF amplifier Q2 and Q3 receives the output of crystal filter FL1 through the deenergized contacts of relay K3. This signal is the lower sideband of the 1,750-kc IF. The signal is applied to the primary of transformer T402 from voltage divider network R6 and R7. Transformer T402 and capacitor C13 form a tank circuit. The signal is coupled to the base of Q2 through coupling capacitor C14. Transistors Q2 and Q3 are series connected, allowing the IF gain control voltage to control the gain of both transistors simultaneously. The gain control voltage is connected from the gain control circuit (para 1-55) to pin 7 of terminal board TB202; through the contacts of relay K1 (deenergized); through inductor L1 to the base of transistor Q2. Inductor L2 and capacitor C15 decouple the RF signal from the gain control circuits. Resistor R8, diode CR3, and bypass capacitor C15 form a part of a voltage divider network for the gain control circuit. Diode CR3 also provides temperature compensation for the base-to-emitter junction of Q2. The amplified output of Q2 is applied to the base of Q3 through transformer T403 and capacitor C19. Base bias for Q3 is developed across voltage divider network R10 and R11. Capacitors C18 and C20 and inductor L3 filter the IF between Q2 and Q3 to prevent feedback. The IF output is coupled through transformer T404 and capacitor C23 to the base

of demodulator Q4. Inductor L4 and capacitor C22 provide decoupling for the +9-volt enable.

### 1-33. Demodulator

In demodulator Q4, the lsb IF input signal from the IF amplifier is mixed with the unmodulated 1,750-kc signal from the frequency generator module to produce an audio difference signal. The demodulator audio gain output level is adjusted by R15 for the proper audio level. The IF input signal is coupled through C23 to the base of Q4. Base bias for Q4 is determined by the values of voltage divider R12, R13, and R14. The 1,750-kc input from the frequency generator module is connected through J402 and coupled through R17 and C25 to the emitter of Q4. The Q4 emitter bias is developed across R16 and L5. The output from the collector of Q4 is coupled across C27 to the base of audio amplifier Q5. The demodulator is enabled by +9 volt supplied through the contacts of K3 (deenergized) during the receive mode of operation. In transmit mode of operation, the +9 volts is removed from the demodulator.

### 1-34. Audio Amplifier

When the radio set is in the receive mode of operation, audio amplifier Q5 amplifies the audio output from demodulator Q4. In transmit mode of operation, microphone amplifier Q10 provides an audio signal to audio amplifier Q5. The audio amplifier then supplies the amplified audio to the operator's headset. The output signal of transistor Q5 is transformer-coupled by T5 to push-pull class B amplifiers Q6 and Q7. The signal from the microphone amplifier is coupled across R18 to the base of Q5. Base bias for Q5 is developed across voltage divider network R19 and R20. The input from the demodulator is coupled through C27 to the base of Q5. Push-pull amplifiers Q6 and Q7 are matched transistors. Transistors Q6 and Q7 are biased by R23, CR4, R24, and CR5. Diode CR5, in addition to providing base bias, is a protective device to limit current flow in the secondary winding of T405. Feedback stabilization between push-pull amplifiers Q6 and Q7 and audio ampli-

fier Q5 is provided by C29 and R22. Push-pull amplifiers Q6 and Q7 output is coupled through capacitor C30 to TB202 and to headset jacks J201 and J202 (not shown in figure 7-10). Normal audio output is 1 milliwatt (mw) into a 500-ohm headset or speaker.

### 1-35. Microphone Amplifier

The microphone amplifier is enabled by +9 volts from pin 2 of TB202 through the contacts of K3 (energized) when the radio set is in the transmit mode of operation. The microphone amplifier consists of transistors Q8, Q9, and Q10.<sup>a</sup> When the microphone is used, the microphone amplifier amplifies the audio signal; in cw transmit mode, it amplifies the 1,600-cps tone oscillator signal.<sup>a</sup> The input to the base of Q8 is routed through a low-pass filter and impedance-matching network composed of L6, L31, R25, and C32. Emitter bias for transistor Q8 is developed across R28, R3, and audio level control R432. Base bias of Q8 is developed across R27 from the emitter circuit of Q9. The three-stage amplifier is a compound connected-type amplifier with the collector of Q8 connected to the base of Q9 and the collector of Q9 connected to the base of Q10. Collector voltages for each transistor are developed across load resistors R26, R29, and R31 for Q8, Q9, and Q10, respectively. Resistor R33 and capacitor C34 make up a decoupling network. The microphone amplifier output (the emitter of Q10) supplies a side-tone signal to the audio amplifier and a signal to the balanced mixer for modulation purposes.

### 1-36. Balanced Mixer Z1

Balanced mixer Z1 mixes the audio signal with a 1,750-kc unmodulated signal from the frequency generator module. The output of Z1 is a double-sideband suppressed carrier of 1,750 kc. The microphone amplifier audio or tone signal output is taken from the arm of audio level control R432, coupled through C36 to pin 3 of Z1. The 1,750-kc input is coupled to pin 4 of Z1. The output of Z1 is taken from the arm of balance control R434 and routed through energized contacts of relay K1 and up generate a 2,000-cps audio tone.

<sup>a</sup>Radio Sets bearing serial numbers 371

to the RF module. Balance control R434 adjusts the carrier balance for a symmetrical (undistorted) double sideband signal.

### 1-37. Tone Oscillator (fig. 7-10)

The tone oscillator in the AN/PRC-74 generates a 1,600-cps tone for cw mode of operation. In the A model (serial numbers 371 and up), the tone oscillator generates a 2,000-cps audio tone. When the telegraph key line (pin 6, TB202) is grounded, the tone oscillator circuit is enabled and Q11 generates an audio tone. In the unlettered model, the 1,600-cps tank circuit for the tone oscillator is composed of L8, and capacitors C37, C38, and C39. In the A model (serial numbers 371 and up), the values of C29, C37, C38, C39, R37, and R47 are different in order to produce the 2,000-cps audio tone. Refer to figure 7-10 for the values of these components. Base bias for Q11 is developed across voltage divider R38 and R39. Emitter bias is

developed across R40 and R47. The emitter bypass capacitor is C40. The audio tone generated by the tone oscillator is taken from the junction of C38 and C39 and is applied through R36 to the microphone amplifier. A portion of the audio tone is applied to the audio amplifier and to the headset, permitting the cw operator to monitor his transmission.

### 1-38. Cw Hold Circuit (fig. 7-10)

The cw hold circuit is energized when the telegraph key is closed. When the key is released, capacitor C41 holds cw hold transistor Q12 on for approximately 1 or 2 seconds. Transistor Q13 of the cw hold circuit is controlled by Q12 and activates the receive-transmit relay in the power supply, which puts the radio set into transmit mode of operation. The action of Q12 and Q13 is break-in operation. The timing is such that the set returns to the receive mode between words but not between letters.

## Section VII. POWER AMPLIFIER MODULE ANALYSIS (HAC PART NO. 1541057-100)

### 1-39. General

The antenna tuned circuits and the antenna relay of the power amplifier module route the received ssb RF signal from the distant transmitter to the RF module when the radio set is in the receive mode of operation. During the transmit mode of operation, the power amplifier receives the RF output signal from the RF module, amplifies it, and routes it to the antenna. The power amplifier stages are untuned except for the antenna tuning and loading adjustments that match the antenna impedance to the final amplifier. A schematic diagram of the power amplifier is shown in figure 7-11. The power amplifier contains a preamplifier circuit, a power amplifier circuit, antenna coupler, tuning indicator circuit, power amplifier limiter, transmit level control circuit, and overload limiter.

### 1-40. Preamplifier

The preamplifier circuit, Q1 through Q4, is a broadband amplifier compensated to provide

constant gain in the frequency range from 2 mc to 11.999 mc. The input signal at P801 is the RF module output single-sideband RF signal and is coupled by capacitor C1 to the base of Q1. Resistor R1 is for impedance matching of the input to preamplifier transistor Q1. First preamplifier stage Q1 is an impedance-matching stage and buffer amplifier. Bias for the base of Q1 is from the +40-volt transmit voltage developed across voltage divider R5 and R4. Overload limiter Zener diodes VR1 and VR2 and resistor R18 develop a steady voltage of +40 volts which tends to vary over a wide range (+38 volts to +48 volts). The output of preamplifier Q1 is applied to the base of preamplifier Q2 through coupling capacitor C2. Preamplifier Q2 is similar to Q1 except that high frequency compensation inductor L3 in parallel with collector load resistor R9 is used to increase the overall frequency bandpass of the circuit. Inductors L4 and L7 and capacitors C7 and C9 decouple RF from the +9-volt power source for preamplifiers Q1 and Q2. The amplified output of preamplifier Q2 is supplied to the

base of preamplifier Q3 through coupling capacitor C3. Transistor Q3 is an emitter follower circuit; emitter biasing of Q3 is developed across R12. Inductor L6 prevents RF signals on the emitter of Q3 being shorted to ground

due to the low value of resistance of R12 and is part of the frequency compensation network. Inductor L5 and capacitor C27 form an RF decoupling circuit to the +9-volt power source for Q3. The output from the emitter of Q3 is





coupled through C10 to preamplifier Q4. Transistor Q4 is an emitter follower circuit, the output of which drives the primary winding of transformer T1. Transformer T1 provides phase inversion to Q5 and Q6 for push-pull operation. Base bias for Q4 is obtained from voltage divider R14 and R13. Inductor L8 is the compensation inductance for power amplifier limiter Q7. Base bias for Q4 is regulated by the power amplifier limiter circuit. Power amplifier limiter diodes FR11 and CR14 rectify a portion of power amplifier transistors Q5 and Q6 output. When the rectified dc rises above the zener limit of Zener diode VR12, the base bias of power amplifier Q7 is raised. This action causes Q7 to conduct more and lower the base bias of Q4. When the bias of Q4 is lowered, Q4 conducts less and reduces the drive to the power amplifier push-pull circuit (power amplifier transistors Q5, Q6 and transformer T2).

#### 1-41. Power Amplifier

The power amplifier is a push-pull amplifier which amplifies the output of preamplifier and couples it to the secondary of transformer T2. The +40-volt power source for the collector of Q5 and Q6 is supplied through the center tap of T2. Base bias for Q5 and Q6 is supplied through the center tap of the secondary winding of T1 by voltage divider network R16 and R17.

#### 1-42. Antenna Coupler

*a. General.* The antenna coupler provides for tuning and loading of the mc RF antenna. The antenna coupler consists of ANT connector J203, ANT LOAD switch S1, tapped coil L815, ANT TUNE control C820, and filter FL1.

*b. Receive Mode Operation.* During the receive mode of operation, RF signals intercepted by the antenna are coupled through ANT connector J203 to tapped coil L815. ANT LOAD switch S1 is a six-position front panel selector switch which selects one of the six tap points on L815 and connects it to variable ANT TUNE capacitor C820. The ANT LOAD switch is set and ANT TUNE control is adjusted to provide the proper match between

the antenna and the RF module. The 2-mc to 11.999-mc RF output of L815 and C820 is filtered by RF filter FL1 before being applied through the contacts of antenna relay K1 (de-energized) and RF connector P802 to the RF module.

*c. Transmit Mode Operation.* During the transmit mode of operation, an amplified 2-mc to 11.999-mc RF signal from the tuning indicator circuit is applied to the antenna coupler. This signal is first filtered by FL1 before being coupled by L805 and C820 to the antenna. The ANT LOAD switch and ANT TUNE control are set for a maximum RF output level as indicated on the front panel ANT IND meter.

#### 1-43. Tuning Indicator

The tuning indicator circuit is operative only during the transmit mode of operation. A signal in the frequency range of 2 mc to 11.999 mc is coupled to the input of the tuning indicator circuit by transformer T2 of the power amplifier. A voltage standing wave ratio (vswr) circuit comprised of capacitors C40, C41, and C35, resistors R22 and R34, and diodes CR4 and CR15 rectifies the RF voltage and causes ANT IND meter M201 to draw current proportional to the RF voltage. The parallel resonant circuit of capacitor C25 and variable capacitor C826, and inductor L12 provide the tune load for the power amplifiers in the secondary of T2. Resistors R19, R20, and R21 prevent parasitic oscillations in the tuned circuit. The RF output of the tuning indicator is applied through the energized contacts of antenna relay K1 to the antenna coupling circuit.

#### 1-44. Transmit Level Control

Transmit level control Q808 samples the output of the power amplifier circuit and provides a reference signal to the gain control circuits mounted on the chassis of the radio set. This transmit level control output stabilizes the gain of the RF stages in the radio set. The output of the power amplifier is sampled at power amplifier output transformer T2 and connected to the input of Q808 through variable

resistor R835. Variable resistor R835 is adjusted to maintain the transmit level control output across collector load resistor R37 at approximately 15 volts. Increases and decreases in the conduction of Q808 are maintained at a nearly constant level by Zener diode CR816, which provides the transmit level control signal to the gain control circuits.

#### 1-45. Overload Limiter

The overload limiter keeps the base bias of transistor Q1 constant regardless of the load

conditions on the +40-volt transmit. Zener diodes VR1 and VR2 in conjunction with resistors R4, R5, and R18, comprise the overload limiter circuit. If power amplifier circuit Q5 and Q6 is tuned improperly and draws excessive current, the +40-volt transmit will decrease. Zener diodes VR1 and VR2 will keep Q1 biased at the proper level, maintaining a drive on the power amplifier circuit. This action prevents Q5 and Q6 current *runaway* and damage to the power amplifier.

### Section VII.1 POWER AMPLIFIER MODULE ANALYSIS (HAC PART NO. 1541057-101)

*Note.* Power amplifier module (HAC Part No. 1541057-101) is directly interchangeable with the earlier model (HAC Part No. 1541057-100). The newer version provides greater protection for pa output transistors Q5 and Q6 during tuning procedures. The circuit differences between the two power amplifier modules may be noted by comparing figure 7-11 with figure 7-11.1. Detailed circuit analysis for the later model (HAC Part No. 1541057-101) is provided in paragraphs 1-45.1 through 1-45.7. Circuit analysis of the earlier model is covered in paragraph 1-39 through 1-45.

#### 1-45.1 General

(fig. 7-11.1)

The power amplifier module performs two functions: during transmit mode of operation, it provides final amplification for signals being transmitted and, during receive mode of operation, it provides a path for incoming signals to the RF module through the antenna coupler circuit. The only circuit in the power amplifier module which is used in both transmit and receive modes of operation is the antenna coupler circuit. The remaining circuits are operational during transmit mode only. During the receive mode, the antenna coupler circuit and the antenna relay route the received RF signal to the RF module. During the transmit mode, the power amplifier module amplifies the output of the RF module, and couples the output through the antenna coupler to the antenna. The power amplifier stages are untuned except for the antenna tuning and loading controls (ANT TUNE and ANT LOAD), which are adjusted to match the final amplifier impedance with that of the antenna. A schematic diagram of the power amplifier module is shown in figure 7-11.1. The power amplifier module consists of the preamplifier, power amplifier, tuning indicator, transmit level control, overload limiter,

and antenna coupler. These stages are covered in paragraphs 1-45.2 through 1-45.7.

#### 1-45.2 Preamplifier Circuit

(fig. 7-11.1)

The preamplifier circuit, Q1 through Q4, is a broadband amplifier that provides a constant gain in the frequency range from 2 mc through 11.999 mc. The RF input signal at P801 is applied to preamplifier stage Q1. This stage functions as an impedance-matching, buffer amplifier. The input signal is coupled through frequency compensating capacitor C42 and coupling capacitor C1 to the base of Q1. Resistor R1 matches the impedance of the input source. Biasing for Q1 is provided by overload limiter circuit (para 1-45.7) and a voltage divider circuit consisting of resistors R4 and R5. The overload limiter circuit provides a constant +9-volt level unless the +40-volt line drops to +30 volts or less. When such an excessive drop occurs, the forward bias of Q1 decreases, and the gain of the stage is reduced. The output of Q1 is routed through coupling capacitor C2 to second preamplifier stage Q2. The only difference between the first and second stages is that in the latter, high frequency compensation inductor L3 is parallel-connected with the load resistor. Inductors L4 and L7 and

capacitors C7 and C9 decouple RF signals from the +9-volt power source. The output of Q2 is routed through coupling capacitor C3 to third preamplifier stage Q3. Biasing of Q3 is provided by voltage divider resistors R10 and R11. The output signal of Q3 is developed across the emitter load consisting of resistor R12 and inductor L6. Inductor L5 and capacitor C27 decouple RF signals from the +9-volt power source. The output of Q3 is coupled through capacitor C10 to fourth preamplifier stage Q4. Forward bias for Q4 is provided by voltage divider resistors R13 and R14. Inductor L8 isolates RF signals from the relatively low-valued voltage divider resistors, R13 and R14. The output of Q4 drives the primary winding of transformer T1, which provides phase inversion for push-pull operation in the power amplifier circuit (para 1-45.3).

### 1-45.3 Power Amplifier Circuit

(fig. 7-11.1)

The power amplifier circuit is connected in a push-pull configuration. Signals from the secondary winding of transformer T1 are applied to output transistors Q5 and Q6, amplified and applied to the primary winding of transformer T2. Biasing of Q5 and Q6 is provided by voltage divider resistors R16 and R17, through the secondary winding of T1. Inductor L10 decouples RF signals from the +9-volt source. Resistors R48 and R49 insure thermal stability (increasing bias if emitter current increases) of Q5 and Q6. Capacitors C43 and C44 bypass RF signals to ground. The +40-volt source voltage is routed through T2 primary winding center tap to the collectors of Q5 and Q6. Capacitor C16 decouples RF signals from the +40-volt line. The output signal of the power amplifier circuit is routed through T2 and the tuning indicator circuit (para 1-45.5), to the antenna coupler circuit (para 1-45.4).

### 1-45.4 Antenna Coupler Circuit

(fig. 7-11.1)

*a. General.* The antenna coupler circuit is capable of matching a wide range of antenna impedances to either the power amplifier or the RF module. When the radio set is used in the transmit mode, the antenna is matched to the

final amplifying stage of the power amplifier module. When the radio set is in the receive mode, the antenna is matched to the input stage of the RF module. The antenna coupler circuit consists of ANT connector J203, ANT LOAD switch S801, tapped coil L815, ANT TUNE control C820, filter FL1, and antenna relay K1.

*b. Receive Mode Operation.* During the receive mode of operation, RF signals intercepted by the antenna are coupled through ANT connector J203 to tapped coil L815. ANT LOAD switch S801 is a six-position, front panel selector switch which selects one of the taps on L815. ANT LOAD switch and ANT TUNE capacitor C820 are adjusted to provide optimum matching between the antenna and the RF module. Low-pass filter FL1 attenuates signals above 12 mc. The received signal, after passing through FL1, is routed through deenergized antenna relay K1 to RF connector P802.

*c. Transmit Mode Operation.* During the transmit mode of operation, an amplified RF signal from the power amplifier circuit (para 1-45.3) is routed through the tuning indicator circuit (para 1-45.5), through energized relay K1, and low-pass filter FL1, to L815 and C820. The ANT LOAD switch and ANT TUNE control are adjusted for a maximum RF output as indicated on the front panel ANT IND meter.

### 1-45.5 Tuning Indicator Circuit

(fig. 7-11.1)

*a.* The tuning indicator circuit supplies current to the ANT IND meter, which indicates the degree of impedance match existing between the antenna and the final amplifying stage of the power amplifier. A maximum deflection of the ANT IND meter needle indicates optimum impedance match. A minimum deflection indicates an impedance mismatch and, as a result, a low transmitter output signal. Therefore, in addition to functioning as an impedance matching indicator, the meter reading is also a rough indication of the transmitter power output.

*b.* The tuning indicator circuit may be considered as two dc power supplies. One dc supply produces a constant, positive 1-ma current. The other dc supply produces a negative current, the magnitude of which is dependent upon the imbalance of the impedance bridge. When the

impedance bridge is balanced, the negative source supplies no current, and the positive 1-ma current causes a maximum deflection on the ANT IND meter. When the impedance bridge is not balanced, the negative current source cancels the output of the positive current source, resulting in a low reading on the ANT IND meter.

c. The positive dc supply consists of capacitors C40 and C35, diode CR15, and resistor R34. RF signals, developed across the secondary of T2, are coupled through C40 and rectified by CR15. Filtering is provided by C35 and current-limiting resistor R34. The dc circuit for this positive dc source is completed through the ANT IND meter circuit.

d. The impedance bridge may be considered as the source of the negative dc current. This bridge consists of parallel-connected L12 and C25, and C26 on one leg. Resistors R19, R20, and R21, and the antenna coupler complete the other leg. Diode CR4 and capacitor C41 are connected between the two legs of the bridge. When the voltage across the antenna coupler and C26 is unequal (due to a difference in impedance, or mismatch between the antenna and the power amplifier output), a voltage difference is developed across the two legs of the bridge. This voltage is rectified by CR4, causing a negative current to flow through R22, the ANT IND meter circuit, back to L12 to complete the dc path. The effect of the negative dc voltage offsets the positive dc voltage described in c above, and the ANT IND meter indicates a reduced reading. When the antenna coupler is tuned correctly, the bridge is balanced and no voltage is applied across CR4. This effectively eliminates the negative dc source while the positive dc source developed by the rectifying action of CR15 causes a maximum deflection on the ANT IND meter.

### 1-45.6 Transmit Level Control Circuit

The transmit level control circuit monitors the current being drawn by the final power amplifying stage Q5 and Q6 (para 1-45.3). The transmit level control output is routed to the gain control circuit (paras. 1-54 and 1-55), which controls

the gain of the RF module (paras. 1-21 through 1-28). The RF module gain-controlled output signal is then applied to the input of the power amplifier module. The gain of the transmit RF stages is thus stabilized by the transmit level control circuit and gain control circuit. The transmit level control circuit consists of resistors R31, R835, R36, and R37, inductor L16, capacitors C36 and C23, transistor Q8, and Zener diode CR16. Current drawn by Q5 and Q6 is routed through R36. The resulting voltage across R36 is monitored by Q8. Changes in the voltage across R36 are amplified by Q8, applied to CR16, and routed to the gain control circuit. When the power amplifier output is high, the RF module gain is reduced, resulting in a reduced signal at the input of the power amplifier. Conversely, a low power amplifier output results in a higher RF gain in the RF module and an increased input signal to the power amplifier. Inductor L16 and capacitor C36 prevent ac signals from affecting Q8. Resistor R835 is initially adjusted so that the collector voltage of Q8 is +21.5 volts. Zener diode CR16 limits the collector voltage to 18 volts before applying it to the gain control circuit. Zener diode CR16 also provides thermal compensation, offsetting the reaction of Q8 to thermal changes. Capacitor C23 bypasses ac signals to ground.

### 1-45.7 Overload Limiter Circuit

The overload limiter circuit consists of Zener diodes CR1 and CR2, resistor R18, and capacitor C6. The +40-volt supply output is applied to Zener diode CR1, which drops the voltage to +13 volts. Resistor R18 and Zener diode CR2 drop the voltage to +9 volts. Capacitor C6 bypasses ac signals to ground. If the +40-volt supply fluctuations are small, the overload limiter circuit will provide first preamplifier stage Q1 (para 1-45.2) with a constant +9-volt bias supply. When final power amplifying stage Q5 and Q6 (para 1-45.3) is improperly loaded, excessive current is drawn from the +40-volt supply. The current limiter circuit in the plus 40-volt regulator (para 1-53) then decreases the output of the +40-volt supply to about +30 volts. This reduction in voltage decreases the forward bias of Q1 (CR2 is no longer effective),

resulting in a smaller drive signal to Q5 and Q6. Consequently, the current requirement of Q5 and Q6 is reduced to a lower level. For ef-

ficient operation of the radio set, the antenna coupler circuit (para 1-45.4) must be tuned so that Q5 and Q6 are properly loaded.

## Section VIII. FREQUENCY GENERATOR MODULE ANALYSIS

### 1-46. General

(fig. 7-12)

The frequency generator module generates a 1,750-kc signal for the modulation and demodulation circuits in the IF audio module, and a 10-kc calibration signal for the RF module when the radio set is being calibrated. To perform these functions, the frequency generator module contains a 1,750-kc frequency standard and a frequency divider chain. The frequency standard consists of a crystal oscillator and buffer stage to produce the 1,750-kc IF signal. The frequency divider is energized only in the receive calibrate mode; a 250-kc signal is generated and then divided down to produce a 10-kc fundamental calibration signal. Figure 7-12 is a schematic diagram of the frequency generator.

### 1-47. Frequency Standard

a. The 1,750-kc oscillator is a Pierce oscillator that has frequency stability over a wide temperature range. Crystal Y1 has a temperature characteristic that is compatible with temperature-compensating capacitor C1. The frequency of the Pierce oscillator may be adjusted slightly by means of variable capacitor C603. Base bias for Q1 is developed across voltage divider network R1 and R2. The +9-volt power supplied to the collector of Q1 is coupled through inductance-capacitance (lc) filter network inductor L1 and capacitors C7 and C8. The lc filter decouples the +9-volt power source

from the output of 1,750-kc oscillator Q1. Emitter bias for Q1 is developed across resistor R4. Capacitor C5 is the emitter bypass capacitor for Q1 preventing degeneration. The emitter output of Q1 is coupled through capacitor C9 to the base of buffer amplifier Q2.

b. Buffer amplifier Q2 is tuned to 1,750 kc by transformer T1 and capacitor C6. Base bias for transistor Q2 is developed across resistors R4 and R5. Emitter bias for Q2 is developed across resistor R6. Resistor R3 is part of the low-impedance output circuit for the frequency standard.

### 1-48. Frequency Divider

The frequency divider consists of amplifier Q11, 250-kc frequency divider Q12, 50-kc frequency divider Q13, and 10-kc frequency divider Q14. The 1,750-kc output signal of the frequency standard is amplified by amplifier Q11 to drive 250-kc frequency divider (blocking oscillator) Q12, which divides the 1,750-kc signal by 7. The 250-kc frequency divider output is then applied to another blocking oscillator, 50-kc frequency divider Q13, which divides the 250-kc signal by a factor of 5. The 50-kc frequency divider output is then applied to 10-kc frequency divider Q14, where it is again divided by 5 to produce the 10-kc calibration signal which is supplied to the RF module.

a. *Amplifier Q11.* Amplifier Q11 is an emitter follower driver circuit used to drive 250-kc frequency divider blocking oscillator.



Q12 and is also an isolation stage (impedance matching) between the frequency standard and the frequency divider. When the PUSH TO CALIBRATE switch is depressed during the calibrate mode of operation, the +12-volt calibrate input is applied to the frequency divider, enabling the frequency divider circuits. The 1,750-kc signal from the frequency standard is supplied to the base of amplifier Q11. Base bias for Q11 is developed by voltage dividing network R12, R13, R11, and R3. Emitter bias is provided by resistor R14. Diode CR11 limits the negative portion of the 1,750-kc signal output of Q11 so that only the positive-going pulses are applied to the 250-kc frequency divider.

*b. 250-Kc Frequency Divider Q12.* The 250-kc frequency divider is adjusted so that every seventh pulse of the 1,750-kc input signal from amplifier Q11 causes the blocking oscillator circuit of Q12 to trigger. The frequency at which the 250-kc frequency divider will operate is controlled by the resistance-capacitance (rc) time constant of 250-kc adjust potentiometer R515, resistor R16, capacitor C11, and resistor R14, and 250-kc frequency divider Q12 tank circuits. The rc time constant is varied by means of 250-kc adjust R515 which changes the rate at which C11 will charge. Inductor L11 and capacitor C12 form a tank circuit tuned to 625 kc, which oscillates each time Q12 is pulsed. As a result of the rc time constant of C11, R515 and L11, C12, the emitter voltage of Q12 rises rapidly every seventh cycle (pulse) of the 1,750-kc input. A 250-kc signal is developed as a result of Q12 collector-to-base circuit interaction and the regener-

ative feedback across blocking oscillator transformer T11. Diode CR12 reduces secondary oscillations in the tertiary winding by providing a direct short for self-induced voltages in the secondary of transformer T11. The output from the secondary winding of T11 is applied to the primary of the 50-kc frequency divider blocking oscillator transformer T12.

*c. 50-Kc Frequency Divider Q13.* The 50-kc frequency divider is a blocking oscillator which divides the 250-kc frequency divider output by 5 to produce a 50-kc output. The 50-kc frequency divider is similar to the 250-kc frequency divider. The principle difference is that the 50-kc frequency divider base circuit of Q13 does not have a tank circuit like the 250-kc frequency divider. The 50-kc signal output of the divider is adjusted by 50-kc adjust potentiometer R520.

*d. 10-Kc Frequency Divider Q14.* The 10-kc frequency divider divides the 50-kc frequency divider output by a factor of 5. The 10-kc adjust potentiometer R525 adjusts the 10-kc signal output taken from the secondary of 10-kc frequency divider transformer T13. The output signal is the 10-kc calibration signal supplied through P502 to the RF module input jack J701.

*e. +12-Volt Voltage Regulator.* The +12-volt calibrate voltage input from the power supply is available when the PUSH TO CALIBRATE switch is depressed on the radio set control panel. The +12-volt input is decoupled from the divider circuits by rc network R30, R31 and C15, C16. Zener diode VR15 regulates the +12-volt input.

## Section IX. POWER SUPPLY MODULE ANALYSIS

### 1-49. General (fig. 7-13)

The power supply module furnishes regulated dc power to the modules of the radio set. The outputs from the power supply module are different for the receive and transmit modes of operation. During the receive mode of operation, the power supply module provides +12 volts and +9 volts to the radio set. During the transmit mode of operation, the power supply module provides +12-volt transmit, +40

volts, and +9 volts to the radio set. The power input to the power supply module is controlled by a front panel OFF-ON-TUNE function switch. Power is applied to the power supply circuits only when this switch is in either ON or TUNE position.

### 1-50. Plus 9-Volt Regulator

The +9-volt regulator receives +12 volts power from the front panel OFF-ON-TUNE function switch. The base of transistor Q5 is

held at +9 volts due to the zener action of Zener diode CR8. This causes the emitter voltage to remain at +9 volts regardless of load or source fluctuation. Diode CR7 is a temperature compensation diode for Q5. During the transmit mode of operation, the load is heavy and the battery voltage may decrease. This condition may cause the base voltage of Q5 to decrease beyond the capabilities of CR8. To offset this condition, the +40-volt transmit is connected through R7 to CR8, keeping the base of Q5 at +9 volts. As a result of this action, the +9-volt enable will remain constant. Varistor R6 also decreases in resistance as the battery voltage decreases, which helps in maintaining a constant current through CR8.

### 1-51. Receive-Transmit Relay

Receive-transmit relay K1 is energized when a ground appears on pin 1 of TB201 (fig. 7-1). During the transmit mode of operation, relay K1 is energized and couples +12 volts power from the function switch to the +40-volt regulator and dc-to-dc converter in addition to delivering the +12-volt transmit voltage to other relays and circuits in the radio set. The +12-volt voltage is supplied to PUSH TO CALIBRATE switch S202 only during the receive mode of operation by K1. As a result, it is impossible for the radio set to be calibrated while transmitting. Diode CR6 removes the transient surge caused by the collapsing field when K1 is deenergized.

### 1-52. Dc-to-Dc Converter

The dc-to-dc converter changes the +12 volts dc supplied by the external power source to a high voltage required by the power amplifier module during the transmit mode of operation.

## Section X. GAIN CONTROL CIRCUITS ANALYSIS

### 1-54. General (fig. 7-14)

The components of the gain control circuits are mounted on chassis-mounted parts board TB203. Figure 7-14 is a schematic diagram of the gain control circuit.

*a. Oscillator.* Transistors Q1 and Q2 are arranged as a saturable-core square wave oscillator. The +12-volt input is applied through fuse F1, low-pass filter L1 and C1, energized contacts of relay K1, to the emitters of Q1 and Q2. Base bias is provided by resistors R1 and R2 with bypass capacitor C6. Collector-to-base regenerative feedback is accomplished by the induced voltage in the secondary of transformer T1 (connected to the base). The oscillator output is coupled to a rectifier through the secondary of T1.

*b. Rectifier.* The input from T1 secondary is applied to diodes CR1 through CR4. The diodes are connected as a full-wave bridge rectifier. The +46 volts output from the rectifier is filtered by capacitors C1 through C3 and then is applied to the +40-volt regulator.

### 1-53. Plus 40-Volt Regulator

Transistor Q3 is part of a series regulator circuit controlled by transistor Q4. The base of Q4 is regulated by Zener diode CR5. Base bias for Q6 is developed across resistor R4. Capacitor C4 acts as a filter and varistor R3 minimizes voltage variations resulting from temperature changes. Transistor Q6 is a current limiter and functions as follows:

*a.* When the voltage drop across resistor R5 becomes great enough to cause Q6 to conduct, the change in current drawn by the collector of Q6 causes the voltage at the emitter of Q4 to decrease.

*b.* As the voltage at the emitter of Q4 is lowered, the output voltage decreases.

*c.* As the output voltage decreases, the load current decreases.

### 1-55. Circuit Analysis

*a.* The voltage divider circuit formed by potentiometer R206 and resistors R7 and R8 provides gain control bias voltages for the RF module. The voltage divider circuit formed by potentiometer R210 and resistors R9 and R11



provides gain control bias for the IF audio module. Potentiometer R201 (R. F. GAIN control, fig. 7-1) provides a means of adjusting the receiver gain adjust voltage applied to the base of transistor Q4.

b. The bias voltage developed across the RF and IF gain control circuits may be adjusted by either the receiver gain adjust input or the transmit level control input. Transistors Q1 and Q2 are in the transmit level control circuit and transistors Q3 and Q4 are in the receiver gain adjust circuit. Gain is reduced when the R.F. GAIN control is adjusted to increase the forward bias of Q4. When Q4 conducts, the emitter voltage is raised. Diode CR1 or CR2 conducts if the emitter voltage of Q4 becomes higher than the output voltage of either the RF maximum gain adjustment circuit, or the IF maximum gain adjustment circuit. The RF and IF gain control voltages supplied to the IF audio and RF modules are positive (forward biasing) voltages.

c. During the calibrate mode of operation, maximum forward bias is supplied to the base of transistor Q3 through resistor R3. With maximum conduction through Q3, the base of Q4 is brought to near ground potential. This action insures that gain is at maximum during the calibrate mode regardless of the receive gain adjust input.

d. During the transmit mode of operation, maximum forward bias is supplied to the base of transistor Q3 via resistor R2. With maximum conduction through transistor Q3, the base of Q4 is brought to nearly ground potential. The +12-volt potential applied to the base of Q3 is also supplied through resistor R15 to the collectors of transistors Q1 and Q2 and activates the transmit level control circuit during transmit mode of operation. When the output of the power amplifier module reaches the proper amplitude, a positive voltage appears at the transmit level control (TLC) input. This positive input voltage is applied through voltage divider network R12 and R13 to the base of Q1. Capacitor C10 is an RF ground. When Q1 is biased for conduction, Q2 also conducts. When Q2 conducts, its emitter voltage is raised. Diode CR1 or CR2 conducts if the emitter voltage of Q2 becomes higher than the output voltage of either the RF maximum gain adjustment circuits, or the IF maximum gain adjustment circuit. Either one, or both, of the diodes may conduct.

e. Potentiometer R35 (power amplifier module, fig. 7-11) is adjusted so that the gain control circuits stabilize when the transmitter output power is approximately 15 watts. Transistor Q1 (fig. 7-14) provides a charge source for capacitor C9. As the TLC voltage drops, C9 discharges slowly through resistor R14 and transistor Q2.

## Section XI. EXTERNAL POWER SUPPLY AND BATTERY CHARGER ANALYSIS

### 1-56. General (fig. 7-15)

The external power supply and battery charger provide converted ac or dc voltage to the radio set power supply module when the radio set is connected to commercial or battery power at a fixed station. In addition, the external power supply and battery charger are capable of recharging the batteries used to power the radio set when it is man-carried.

### 1-57. External Power Supply Circuit Analysis

a. *General.* The external power supply assembly of the radio set is capable of convert-

ing +21 volts through +31 volts dc, 80 volts to 130 volts ac, and 160 volts to 255 volts ac external power inputs into a dc voltage suitable to power the radio set. Only one of the three inputs is provided at a time to the external power supply by connecting one of three appropriate accessory cable to J1. Dc power inputs from a remote source are applied directly to the power supply regulator circuits. Ac power inputs are rectified to dc prior to being regulated. The external power supply in conjunction with circuits on the assembly case provides for conversion of the dc or ac voltages into a dc power input for the radio set.

*b. Power Turn-On and Protection Circuits.*

The power turn-on and protection circuits of the external power supply consist of POWER ON switch S1 and fuses F1 through F3. POWER ON switch S1 is a three-pole, single-throw toggle switch. The ac or dc power inputs to the switch are connected to S1 through filter capacitors C1 through C5 mounted on the module case assembly. The switch section of S1 connected to the dc power input of +21 volts to +31 volts dc routes the voltage through 15-ampere fuse F1 to the +12-volt regulator circuit external battery charger, when S1 is ON. Diode CR1 protects the regulator if the dc power source is connected with incorrect polarity. The sections of S1 that receive 80 volts to 130 volts ac and 160 volts to 255 volts ac inputs from the filter capacitors supply line voltage through 2-ampere protection fuse F2 and 4-ampere protection fuse F3, respectively, to a bridge rectifier circuit consisting of power transformer T1 and diodes CR1 through CR4 on the module case assembly. The rectifier converts the ac voltage input to +20 volts through +40 volts. The output of the rectifier is routed to the inputs of the +12-volt regulator circuit and the external battery charger. The dc return lines of the dc input and the rectifier circuit are connected to the switching regulator stages of the +12-volt regulator and external battery charger.

*c. +12-Volt Regulator Circuit.* The +12-volt regulator circuit of the external power supply consists of switching regulator Q5 and Q1, regulator control transistors Q2 and Q4, fuse F4, short protection switch Q3, overload protector Z1, and voltage reference diode VR5. A power indicator, DS1, indicates the presence of a dc power input to the external power supply. The +12-volt regulator circuit is series regulated. Increases or decreases in output load cause current to increase or decrease across output load resistors R6 and R9 of the power supply which are connected to the base of Q4. The emitter of Q4 is connected to voltage reference diode VR5, which is a 6.2-volt break-

down device. Having its emitter connected to a fixed reference, any increase or decrease in the voltage at the base of Q4 will cause its conduction to change. With an increase in output load, current increases through the power supply load, causing a higher negative voltage to be developed at the base of Q4. With a high negative potential at its base, conduction through Q4 increases, causing the base of Q2 to become more positive. With its base voltage increased, Q2 conducts, shorting the emitter of Q5 to the base of Q1 through Q2, causing Q1 and Q5 to turn off. With Q5 and Q1 off, the supply voltage drops sharply toward 0 volt causing Q4 to be biased off. Since short protection switch S3 conducts at all times (except during a shorted condition at the supply output), the switching regulator is biased on again and the same switching action occurs. The switching action depends on the input dc level and output load conditions. Short protection switch Q3 protects the regulator circuit from damage by removing positive voltage from the base of switching regulator Q1. A short at the supply places the emitter bias at a higher level than the base, causing Q3 to turn off. Overload protector Z1 protects the supply from high overload conditions.

*d. Meter Monitoring Circuit.* A front panel METER switch and meter provide a means for monitoring battery voltage (BATTERY VOLTS), radio voltage (RADIO VOLTS), and charging current (CHARGE AMPS). Meter M1 is a 0.1V dc meter with inputs selected by METER switch S2.

## 1-58. Battery Charger (fig. 7-15)

Operation of the battery charger is similar to that of the external power supply except for circuit differences. The battery charger utilizes CHARGING CURRENT potentiometer R11 as a bias control for the base of transistor Q4. The CHARGING CURRENT potentiometer provides MIN to MAX adjustment of battery charging current from 1 to 5 amperes.

## Section XII. DIFFERENCES IN MODELS

**1-59. General**

Although the operational features of the AN/PRC-74 and AN/PRC-74A are similar, except that the A model may be operated with the

AN/GRA-71, equipments with serial number 371 and higher contain components that are different from those in the first 370 radio sets. These differences are listed in paragraph 1-60.

**1-60. Differences in Modules**

Item	Radio set AN/PRC-74 serial numbers 1 through 370	Radio set AN/PRC-74A serial numbers 371 and up
Power amplifier module A5.	HAC part No. 1541057-100.	HAC part No. 1541057-101 <sup>a</sup> .
Power Supply PP-4514/PRC-74. (Case-mounted component.)	Capacitor C8 included.	Capacitor C8 not included.
IF/audio module A9.....	C437 0.022 $\mu$ f..... C438 0.1 $\mu$ f..... C439 0.1 $\mu$ f..... R437 820 ohms..... R447 3.0 kilohms..... C429 2.700 pf.....	C437 0.012 $\mu$ f. C438 0.082 $\mu$ f. C439 0.082 $\mu$ f. R437 510 ohms. R447 1.3 kilohms. C429 1,000 pf.
Battery Charger B1A-1 (HAC No. 1541125-100).	Q5 2N2015.....	Q5 723060-33 (Hughes).
Power Supply B2A-2 (HAC part No. 1541128-100).	Q5 2N2015.....	Q5 723060-33 (Hughes).

<sup>a</sup>The improved version of power amplifier module A5 may be substituted directly with the original version.



## CHAPTER 2

### DIRECT SUPPORT MAINTENANCE

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#### Section I. TROUBLESHOOTING

##### 2-1. General Instructions (figs. 4-4 and 7-16)

The direct and general support maintenance procedures in this manual supplement the procedures described in the operator's and organizational maintenance manual (TM 11-5820-590-12). The systematic troubleshooting procedure, which begins with the operational and sectionalization checks that can be performed at the operator's and organizational maintenance level, is carried to a higher level in this manual. Sectionalizing, localizing, and isolating techniques used in the troubleshooting procedures are more advanced. Section I provides functional troubleshooting procedures and section II repair instructions to be performed by direct support maintenance personnel.

##### 2-2. Organization of Troubleshooting Procedures

*a. General.* The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to a major component. The second step is to localize the fault. Localization means tracing the fault to a defective stage or part responsible for the abnormal condition. Some faults, such as burned-out resistors, arcing, and shorted transformers, can often be located by sight, smell, and hearing. The majority of faults, however, must be isolated by voltage measurements or signal substitution.

*b. Sectionalization.* The following is a group of tests arranged to reduce unnecessary work and to aid in tracing trouble in a defective radio set. The first step is to locate the

unit or units at fault by the following methods:

- (1) *Visual inspection.* Visual inspection is used to locate obvious defects without testing or measuring circuits.
- (2) *Operational tests.* Operational tests frequently indicate the general location of trouble. In many instances, the tests will help in determining the exact nature of the fault. The quarterly preventive maintenance checks and services chart (para 5-7, TM 11-5820-590-12) provides a good operational test. Additional operational tests are given in paragraph 2-4.

*c. Localization.* After the trouble has been sectionalized (*b* above), the methods in (1) and (2) below will aid in localizing the trouble to a stage or module in the suspected unit.

- (1) *Module troubleshooting procedures.* Test equipment indications, or lack of indications, and operational checks (paras 2-4 through 2-10) provide a systematic method of localizing trouble to a stage or module. The trouble symptoms listed in the module troubleshooting procedures provide additional information for localizing troubles.
- (2) *Signal substitution.* Signal substitution procedures enable the repairman to localize a trouble quickly to a stage or module. A signal generator, audio oscillator, and oscilloscope are units of test equipment that may be used in signal substitution procedures.

Observe the caution notice in paragraph 2-3 and follow the signal substitution procedures closely so that damage to transistors may be avoided.

d. *Isolation.* After the trouble has been localized (c above), the methods in (1) and (2) below will aid in isolating the trouble to a defective circuit element.

- (1) *Voltage measurements.* This equipment is transistorized. When measuring voltages, use tape or sleeving (spaghetti) to insulate the entire test prod, except for the extreme tip. A momentary short circuit can ruin the transistor. Use the same or equivalent multimeter specified.
- (2) *Intermittent troubles.* In all of the tests, the possibility of intermittent troubles should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the equipment. Make a visual inspection of the wiring and connections to the units of the set. Minute cracks in printed circuit boards can cause intermittent operation. A magnifying glass

is often helpful in locating defects in printed boards.

### 2-3. Test Equipment Required

**Caution:** This equipment contains transistor circuits. If any equipment item does not have an isolation transformer in its power supply circuit, connect one in the power output circuit. A suitable transformer is identified by FSN 5950-356-1779. Observe the following:

1. Never test equipment (other than multi-meter outputs) direct to a transistor circuit; use a coupling capacitor.
2. Make test equipment connections with care so that shorts will not be caused by exposed test equipment connectors. Tape or sleeve (spaghetti) test prods or clips as necessary to leave as little exposed as needed to make contact to the circuit under test.
3. Make sure that a normal load (such as a headset) is connected to the radio set before applying power.

The following chart lists test equipment authorized to direct support personnel for troubleshooting the radio set.

Test equipment	Technical manual	Common name
R.F. Signal Generator AN/URM-25A.	TM 11-5551A .....	Signal generator
Frequency Meter AN/USM-26 .....	TM 11-5057 .....	Frequency meter
Multimeter ME-26B/U .....	TM 11-6625-200-12 .....	Multimeter
Multimeter TS-352A/U .....	TM 11-5527 .....	Multimeter
Wattmeter AN/URM-120 .....	TM 11-6625-446-15 .....	Wattmeter
Electronic Voltmeter ME-30B/U .....	TM 11-6625-320-15 .....	Ac voltmeter
Power Supply PP-4838/U (or equivalent).	.....	0-40V power supply
Radio and Radar Repairman Tool Kit TK-101/U.	.....	Toolkit
Electronic Equipment Tool Kit TK-105/G.	.....	Toolkit
Audio dummy load (½ watt, 500 ohms).	.....	Audio dummy load
Dummy load, 50 ohms, 20 watts .....	.....	Dummy load
Probe T-connector HP-11042A (MX-3341).	(FSN 6625-798-0659)	Probe T-connector

a. *Power Source.* Use Power Supply PP-4838/U (or equivalent) as the power source during troubleshooting procedures. (Any dc power supply that is capable of supplying 0-40 dc with a minimum current of 7.5 amperes may be substituted.) Connect the power supply to

J301 on the radio set as shown in figure 2-2.

b. *Frequency Synthesizer Signal.* When an extra aligned synthesizer module is available, it is preferable to use the extra synthesizer module in place of a signal generator to supply the necessary signals.

## 2-4. Radio Set Receive Mode Test

(fig. 2-1)

The following troubleshooting test will aid the repairman in determining that the radio set is functioning properly in the receive mode. The radio set case must be removed in order to gain access to adjustments. Troubleshoot the radio set in the receive mode as follows:

- a. Remove the radio set case (para 2-12).
- b. Connect R. F. Signal Generator AN/URM-25A (or equivalent) to the ANT and GND terminals of the radio set (fig. 2-2).
- c. Set the signal generator to 2.001 mc at an output level of 0.7 microvolt.
- d. Connect audio dummy load to pins A and B of J201.
- e. Connect the ME-30B/U (or equivalent) across the load.
- f. Connect Frequency Meter AN/USM-26 (or equivalent) across the dummy load. Set controls for a 1,000-cps reading.
- g. Connect Power Supply PP-4838/U (or equivalent) to pins 2, 3 and 5, 6 of J301 and adjust for an output of 12 volts.
- h. Set the radio set frequency selector controls to 2.000 mc.
- i. Turn R. F. GAIN control fully clockwise and adjust the PEAK NOISE control for maximum audio output. If necessary, tune the signal generator so an output of 1 kc is shown on the frequency meter.
- j. Adjust ANT TUNE and ANT LOAD controls for maximum audio output.
- k. Adjust R206 and R210 (fig. 2-1) for maximum output. Check for an ME-30B/U meter reading of not less than 0.707 volt root mean square (rms).
- l. Repeat the procedures in *h* through *j* above with the radio set set to frequencies of 3.000, 5.000, and 8.000 mc, and the signal generator set to 3.001, 5.001, and 8.001 for each frequency.
- m. Check for a meter reading of not less than 0.707 volt rms at each frequency setting. If the reading is less than 0.707 volt rms for any of the frequency settings, the radio set is not working in the receive mode and further testing is required to isolate the defective module (para 2-6).

## 2-5. Radio Set Transmit Mode Test

Many circuits in the radio set are common to both transmit and receive modes. Therefore, when the transmitter is not working properly, the radio set should first be checked as described in paragraph 2-4 before performing the following transmitter test. Check the radio set transmit circuits as follows:

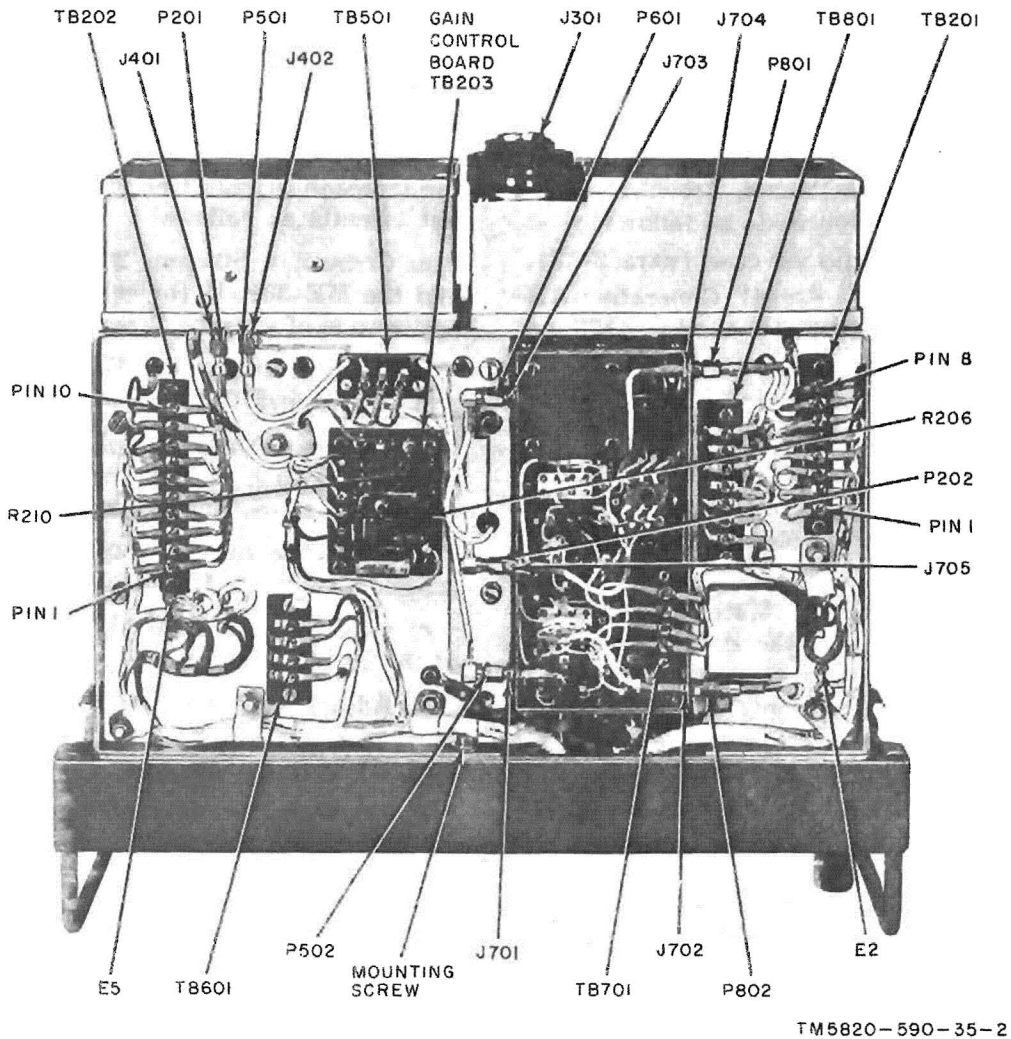
- a. Connect a 50-ohm, 20-watt dummy load and the ME-30B/U (or equivalent) to the opposite ends of a probe T-connector (para 2-3).
- b. Connect the probe T-connector as illustrated in figure 2-2.
- c. Connect Power Supply PP-4838/U (or equivalent) to pins 2, 3 and 5, 6 of J301 and adjust for an output of 12 volts.
- d. Tune the radio set to 11.555 mc as described in TM 11-5820-590-12.
- e. Hold the OFF-ON-TUNE selector switch at the TUNE position.
- f. Adjust R835 (fig. 2-3) until the unmodulated output power (as indicated on the ME-30B/U) is 25.5 volts rms.
- g. Connect the microphone to one of the AUDIO connections.
- h. Speak or whistle into microphone and check for power output peaks of 26-37 volts on the ME-30B/U.
- i. Repeat *e* through *h* above with the radio set set to frequencies of 2.000, 3.000, 5.000, and 8.000 mc. Check for a continuous wave output power of not less than 24.5 volts rms at all test frequencies (*f* above) and modulated power output peaks of 26-37 volts (*h* above). If the meter indications are not within the range specified, the radio set is not functioning properly in the transmit mode and further testing is required to isolate the defective module (para 2-7).

## 2-6. Receiver Troubleshooting

(fig. 2-1)

With test equipment connected as shown in figure 2-2 (receive), turn the radio set on and perform the following checks:

*Note.* Unless otherwise stated, restore all connections at the conclusion of each test.



TM5820-590-35-2

Figure 2-1. Radio set bottom view, carrier case removed.

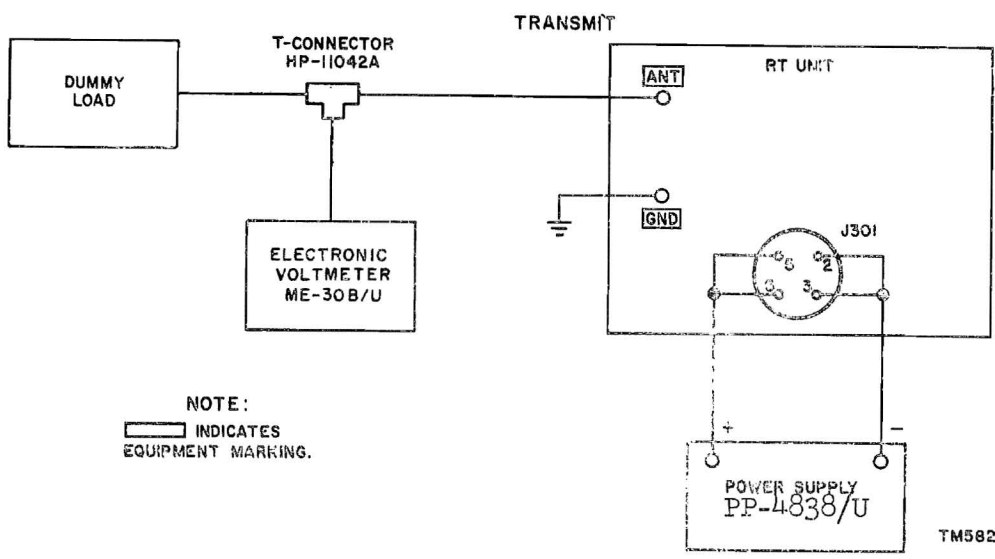
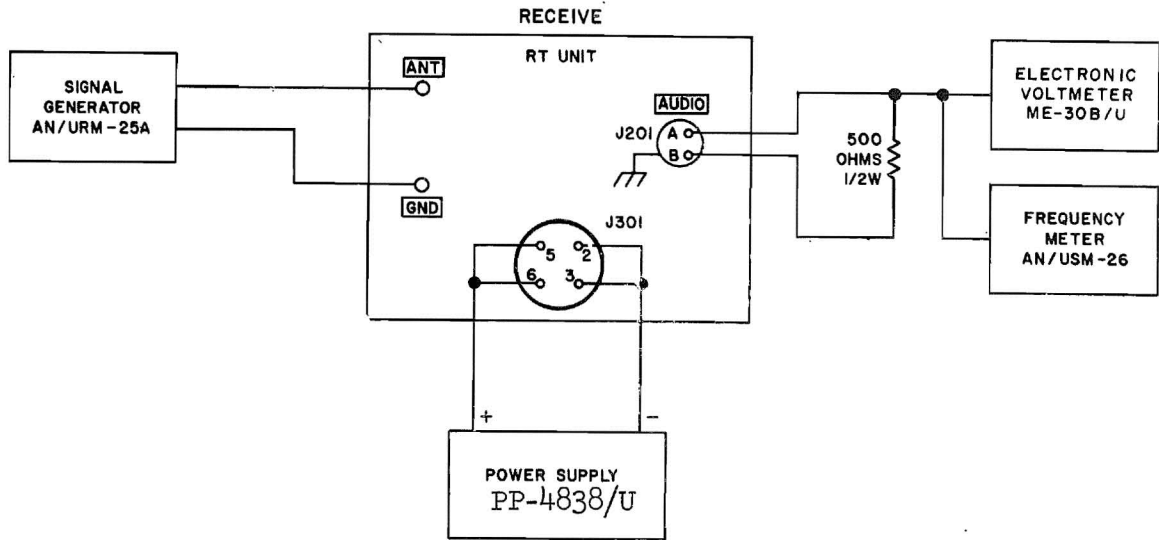
*a. Power Supply.* Use Multimeter TS-352 A/U (or equivalent) and check the radio set power supply as follows:


- (1) Connect the multimeter between pins 7 and 8 of TB 201.
- (2) Check to see that the multimeter indicates between 8.8 and 9.3 volts.
- (3) If this indication is not obtained, the power supply module is defective. Replace the power supply module (para 2-12).

*b. Frequency Synthesizer.* Check receiver sensitivity; use R.F. Signal Generator AN/URM-25A (or equivalent) in place of the synthesizer.

- (1) Disconnect P601 from J703 of the RF module.
- (2) Connect the signal generator to J703.
- (3) Set the signal generator frequency to 1.750 mc above radio set frequency setting as indicated on the front panel).
- (4) Set the signal generator output level to 250 microvolts.





NOTE:  
 INDICATES  
 EQUIPMENT MARKING.

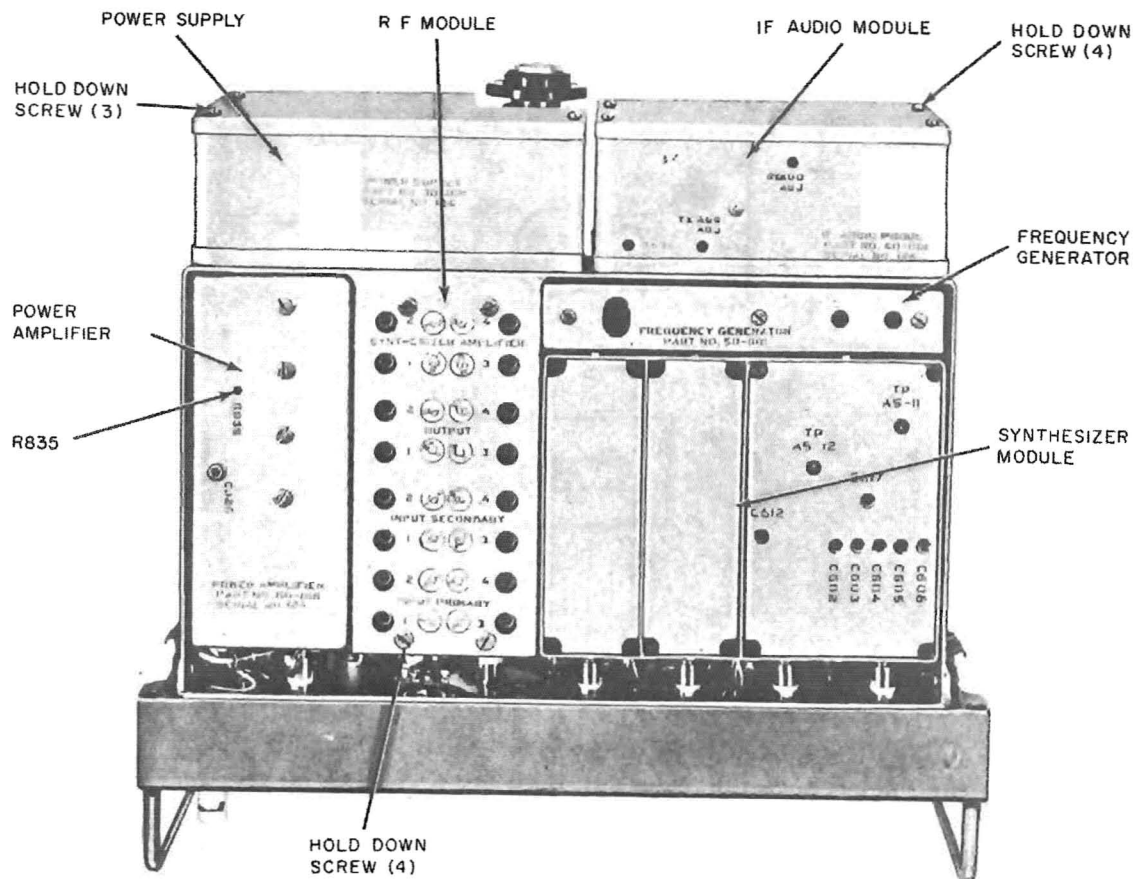
TM5820-590-35-C1-1

Figure 2-2. Radio set, receiver and transmit mode test setup.

(5) If the audio voltage (as measured on the ME-30B/U, figure 2.2) is 0.707 volt rms or greater with this arrangement, the synthesizer is defective. Replace the synthesizer (para 2-12). If no voltage is measured, proceed to c below.

c. RF Module. Check the RF module as follows:

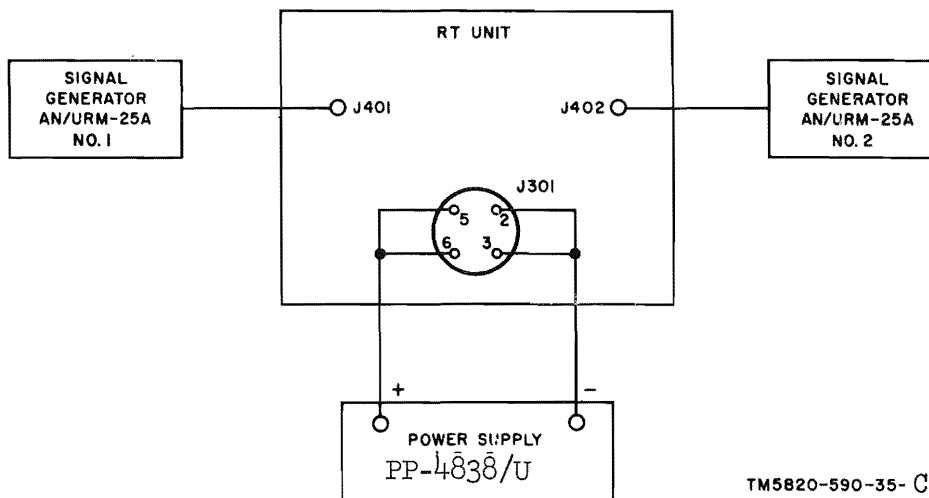
- (1) Disconnect P201 from J401 of the IF module.
- (2) Connect R.F. Signal Generator AN/URM-25A (or equivalent) to J401.
- (3) Set the signal generator frequency to 1.749 mc.



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Figure 2-3. Radio set, top view.

- (4) Set the signal generator output level to 30 microvolts.
  - (5) If the audio voltage (as measured on the ME-30B/U) is greater than 0.707 volt rms, the RF module is defective. Replace the RF module (para 2-12). If no voltage is measured, proceed to *d* below.
- d. IF Audio and Frequency Generator.* Check the IF audio and frequency generator; use two RF Signal Generators AN/URM-25A (or equivalent).
- (1) Disconnect P201 from J401 of the IF module.
  - (2) Connect signal generator No. 1 (fig. 2-4) to J401.
  - (3) Set frequency of signal generator No. 1 to 1.749 mc.
  - (4) Set the output level of signal generator No. 1 to 30 microvolts.
  - (5) Disconnect P501 from J402 of the IF module.
  - (6) Connect signal generator No. 2 to J402.
  - (7) Set frequency of signal generator No. 2 to 1.750 mc.
  - (8) Set the output level of signal generator No. 2 to 1 volt rms.
  - (9) If audio voltage is restored, the frequency generator module is defective. Replace the frequency generator module (para 2-12).
  - (10) If audio output is not restored, the IF audio module is defective. Replace the IF audio module (para 2-12).



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Figure 2-4. IF and frequency generator fault isolation test setup.

### 2-7. Transmitter Troubleshooting (fig. 2-1)

Connect the radio set to the power supply as shown in figure 2-2 (transmit). Check the radio set in the transmit mode as follows:

a. *Power Supply.* Use Multimeter TS-352 A/U (or equivalent) and check the power supply as follows:

- (1) Connect a 50-ohm, 20-watt dummy load between the ANT and GND terminals of the radio set.
- (2) Check the power supply module as follows:

Check point	Measurement	Limits (volts)
TB201-7-----	+9 v	+8.8 to 9.3
TB201-5-----	+12 v transmit	+10.5 to 17
TB201-3-----	+40 v transmit	+38.0 to 42

- (3) If any of the preceding voltage measurements are not as indicated, the power supply module is defective. Replace the power supply module (para 2-12).

b. *Power Amplifier Module* (HAC Part No. 1541057-100).

- (1) Connect Wattmeter AN/URM-126 (or equivalent) to the ANT and GND antenna terminals (fig. 2-5).

- (2) Disconnect P801 of the power amplifier module from J704 of the RF module.
- (3) Connect R. F. Signal Generator AN/URM-25A No. 1 (or equivalent) to P801.
- (4) Set the signal generator frequency to 2 mc.
- (5) Set the signal generator output level to 30 microvolts.
- (6) Hold the OFF-ON-TUNE selector switch at the TUNE position.
- (7) Adjust ANT TUNE and ANT LOAD controls for maximum indication on the ANT IND meter. Note wattmeter reading.
- (8) Set the signal generator (No. 1) frequency of 12 mc.
- (9) Set the signal generator (No. 1) output level to 100 microvolts.
- (10) Repeat (6) and (7) above.
- (11) Check for a wattmeter reading of not less than 10 watts at both frequencies.
- (12) If the power output is less than 10 watts, the power amplifier module is defective. Replace the power amplifier module (para 2-12).
- (13) Leave wattmeter connected for the synthesizer test (c below).
- (14) Connect P801 to J704.

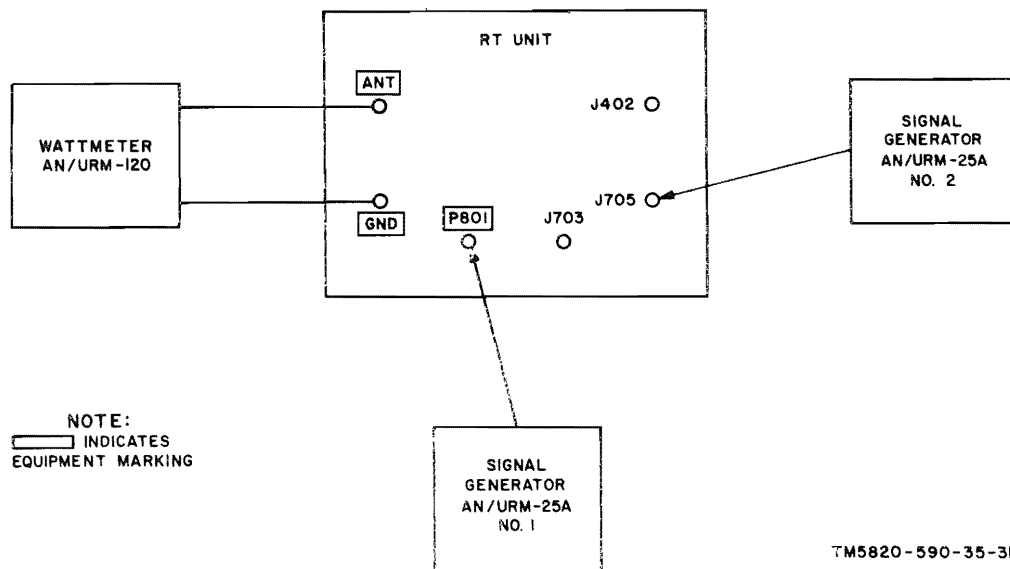


Figure 2-5. Transmit mode fault isolation test setup for unlettered model (serial numbers 1 through 370).

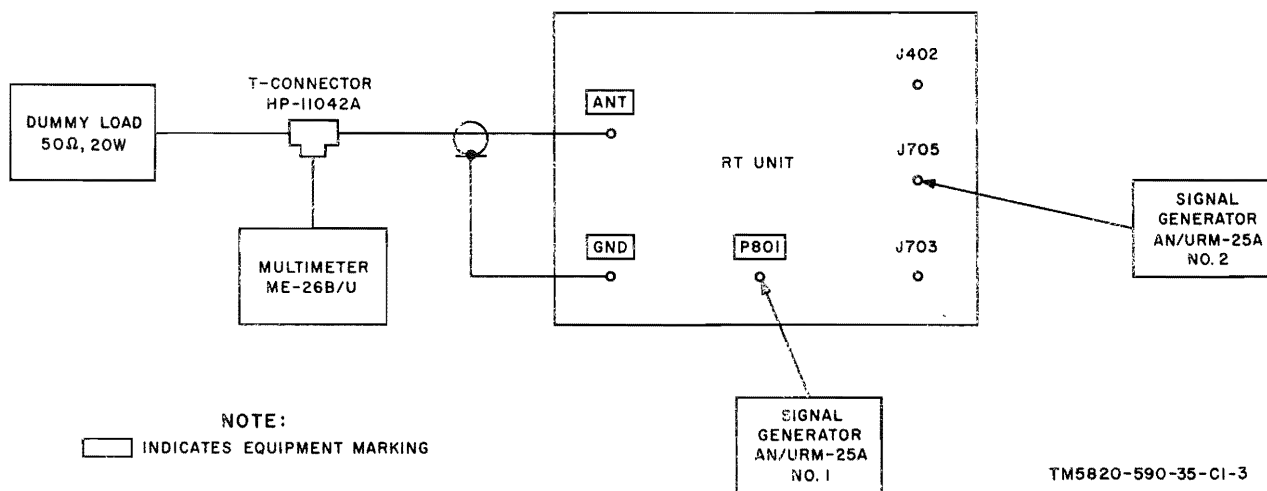


Figure 2-5.1 Transmit fault isolation test setup for AN/PRC-74A (serial numbers 371 and up).

*b.1 Power Amplifier Module (HAC Part No. 1541057-101).*

- (1) Connect Multimeter ME-26B/U and 50-ohm, 20-watt dummy load across ANT and GND antenna terminals (fig. 2-5.1).
- (2) Disconnect P801 of the power amplifier module from J704 of the RF module.
- (3) Connect RF Signal Generator AN/URM-25A (signal generator No. 1), or equivalent, to P801.
- (4) Set the RF signal generator to 2 mc at 60 mv.
- (5) Hold the OFF-ON-TUNE selector switch at TUNE.
- (6) Adjust ANT TUNE and ANT LOAD controls for a maximum indication on the ANT IND meter.
- (7) Adjust the RF signal generator level for a reading of 24.5 volts rms at the power amplifier output (on Multimeter ME-26B/U).
- (8) The RF signal generator output level must be less than 100 mv.
- (9) Repeat (5) through (8) above with the RF signal generator set at 12 mc.
- (10) If the output is less than 24.5 volts rms at either 2 mc or 12 mc, the power amplifier module is defective. Replace the power amplifier module (para 2-12).
- (11) If the power amplifier module output is 24.5 volts rms or greater, connect P801 to J704 and proceed with the next test.

*c. Frequency Synthesizer Module.*

- (1) Disconnect P601 from J703 of the RF module.
- (2) Connect R.F. Signal Generator AN/URM-25A (or equivalent) No. 1 to J703 on the RF module.
- (3) Set the signal generator frequency to 3.750 mc.
- (4) Set the signal generator output level to 100 microvolts.
- (5) Tune the radio set to 2.000 mc.

- (6) If the power output is normal (10 watts or greater), the frequency synthesizer module is defective. Replace the frequency synthesizer module (para 2-12).
- (7) If there is low output or no output, leave test equipment connected for the following test.

*d. RF Module.*

- (1) Disconnect P202 from J705 of the RF module.
- (2) Connect a second R.F. Signal Generator AN/URM-25 (or equivalent) to J705 on the RF module (fig. 2-5).
- (3) Set signal generator No. 2 frequency to 1.750 mc.
- (4) Set signal generator No. 2 output level to 30 microvolts.
- (5) Tune the radio set to 2.000 mc.
- (6) If the normal power output (10 watts or greater) is not obtained, the RF module is defective. Replace the RF module (para 2-12).
- (7) If a 10-watt output is obtained, leave the wattmeter and signal generator No. 1 connected for the following test.

*e. IF Audio and Frequency Generator Modules.*

- (1) Disconnect P501 from J402 of the IF audio module.
- (2) Connect signal generator No. 2 to J402 of the IF audio module (fig. 2-5).
- (3) Connect P202 of the IF audio module to J705 of the RF module.
- (4) Set signal generator No. 2 frequency to 1.750 mc.
- (5) Set the signal generator output level to 1 volt rms.
- (6) Tune the radio set to 2.000 mc.
- (7) If a wattmeter reading of less than 10 watts is obtained, the IF module is defective. Replace the IF audio module (para 2-12).
- (8) If a wattmeter reading of 10 watts or greater is obtained, the frequency



- generator module is defective. Replace the frequency generator (para 2-12).
- (9) Restore all connections.

### 2-8. ANT. IND Meter (M201)

To check ANT. IND meter M201, proceed as follows:

- a. Connect Power Supply HP6439/U (or equivalent) in series with a 10K-ohm resistor to terminal 1 of TB801 (fig. 2-1) and ground.
- b. Set the power supply to +10 volts  $\pm$ 5 percent, 0.001 ampere.
- c. Check to see that the ANT. IND meter (M201) is deflected approximately full scale.
- d. Disconnect the power supply and see that the ANT. IND meter (M201) needle moves smoothly to the zero position without sticking.
- e. If meter (M201) does not indicate full scale when power is applied, or the meter needle is sticking when power is removed, the ANT. IND meter is defective. Replace ANT. IND meter M201 (para 2-14).

### 2-9. Gain Control Circuit Test (figs. 2-1 and 2-6)

Use Multimeter ME-26B/U (or equivalent) and test the radio set gain control circuit as follows:

#### a. Receive Mode

- (1) Connect the multimeter to terminal 8 of gain control circuit board TB203.
- (2) Set OFF-ON-TUNE selector switch to ON.
- (3) Adjust R206 for a maximum dc voltage indication on the multimeter.
- (4) See that the multimeter indicates a voltage of not less than 1.5 volt.
- (5) Adjust R206 for a minimum voltage indication on the multimeter.
- (6) See that the multimeter indicates a voltage of not more than +1 volt.
- (7) Connect the multimeter to terminal 2 of gain control circuit board TB203.
- (8) Set R.F. GAIN control to maximum.
- (9) Repeat (3) through (6) above adjusting R210.
- (10) Using a clip lead, connect terminal 3 of gain control circuit board TB203 to terminal 4.

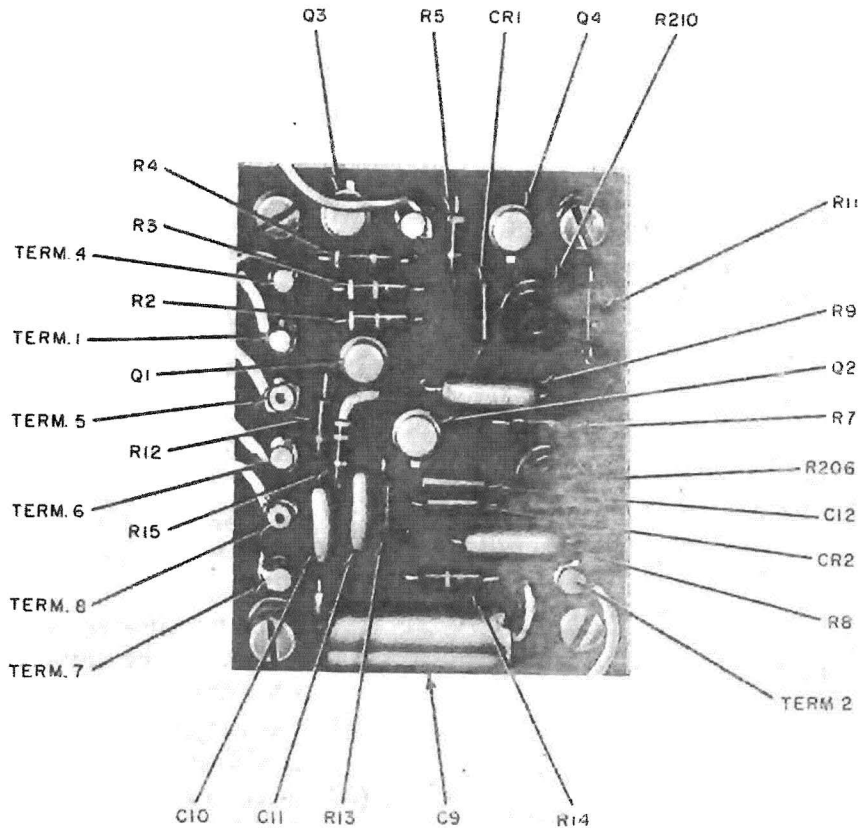
- (11) Check for a multimeter indication at terminals 2 and 8 of gain control circuit board TB203 of not more than +2.5 volts.
- (12) If the multimeter indication is not within the limits specified, the gain control circuit is not working in the receive mode.
- (13) Replace the gain control circuit board TB203 as required (para 2-12).
- (14) Leave test equipment as connected for the following test.

#### b. Calibrate Mode.

- (1) Push in the CLARIFY PUSH TO CALIBRATE control.
- (2) Check for multimeter indication of not more than +1.5 volt at terminals 2 and 8 of gain control circuit board TB203.
- (3) If the multimeter indication is above +1.5 volt, the gain control circuit is not working in the calibrate mode.
- (4) Replace gain control circuit board TB203 as required (para 2-12).
- (5) Leave test equipment as connected for the following test.

#### c. Transmit Mode.

- (1) Connect a 50-ohm 20-watt dummy load to the ANT and GND terminals of the radio set.
- (2) Hold the OFF-ON-TUNE selector switch in the TUNE position.
- (3) Disconnect clip lead at terminal 4 and connect to terminal 6.
- (4) Check for a multimeter indication at terminals 2 and 8 of not less than +2 volts.
- (5) If the multimeter indications are not within the limits specified, the gain control circuit is not working in the transmit mode.
- (6) Replace gain control circuit board TB203 as required (para 2-12).
- (7) Connect the headset to one of the AUDIO connections and adjust R206 and R210 for maximum noise in the headset.



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Figure 2-6. Gain control circuit board TB203.

**2-10. External Power Supply and Battery Charger Troubleshooting**

(fig. 2-7)

With the power supply and battery charger subassemblies installed in the case, check the external power supply and battery charger as follows:

*Note.* Refer to figure 1-3 in TM 11-5820-590-12 for cables used with the external power supply and battery charger.

*a. Power Supply.*

- (1) Connect accessory power cable Q1 to J1 on the case (fig. 2-10) and to a +28-volt power source.
- (2) Place the POWER ON switch in the ON position.
- (3) Place the METER switch to RADIO VOLTS.

- (4) Check power supply panel meter for a reading of +14 volts  $\pm$ 3 volts.
- (5) If 0 volt is indicated, check the power supply module as follows:
  - (a) 15A fuse (F1) (fig. 2-7). If this fuse is open, check capacitor C1 and diode CR1 (fig. 2-8). Replace if defective.
  - (b) 8A fuse (F4) (fig. 2-7). If 8A fuse (F4) is open, check transistor Q5 and associated components (fig. 2-8). Replace if defective. Also check for shorted condition at output connector J4 pins 2 and 6. Refer to schematic diagram (fig. 7-15).
  - (c) Q1 through Q4. Replace if defective.



- (6) If panel meter indicated a voltage level above 18 volts, check overvoltage load protector Z1 and associated components. The normal resistance of Z1 is 33 ohms when the ohmmeter positive lead is connected to + terminal and is 140 ohms when the ohmmeter leads are reversed. Replace if defective.
- (7) If panel meter indicates normal voltage output, momentarily short circuit pins 2 and 6 of J4 of the module case.
- (8) See that the panel meter drops to 0 volt.
- (9) If the panel meter does not drop to 0 volt, check transistor Q3 and resistors R7 and R8. Replace if defective. Use figure 2-8 for parts location and figure 7-15 for troubleshooting.

b. Battery Charger (fig. 2-9).

- (1) Connect accessory power cable Q1 to J1, located on the case (fig. 2-10), and to a +28-volt power source.
- (2) Place the CHARGER-ON switch to ON.

- (3) Place the METER switch located on the front panel of the external power supply to BATTERY VOLTS.

- (4) Check the panel meter located on the power supply for an indication of approximately +20 volts.

- (5) If 0 volt is indicated, check the battery charger subassembly as follows:

(a) 6A fuse (F1) (fig. 2-7). If 6A fuse (F1) is open, check capacitor C2, diode CR2, and associated components (fig. 2-9). Replace defective components.

(b) 6A fuse (F2) (fig. 2-7). If 6A fuse (F2) is open, check transistor Q5 and associated components (fig. 2-9). Replace defective components.

- (6) To check battery charger operation from an ac source, connect accessory power cable W2 to J5 (fig. 2-10), and to a 110-volt, 50- to 400-cps power source.

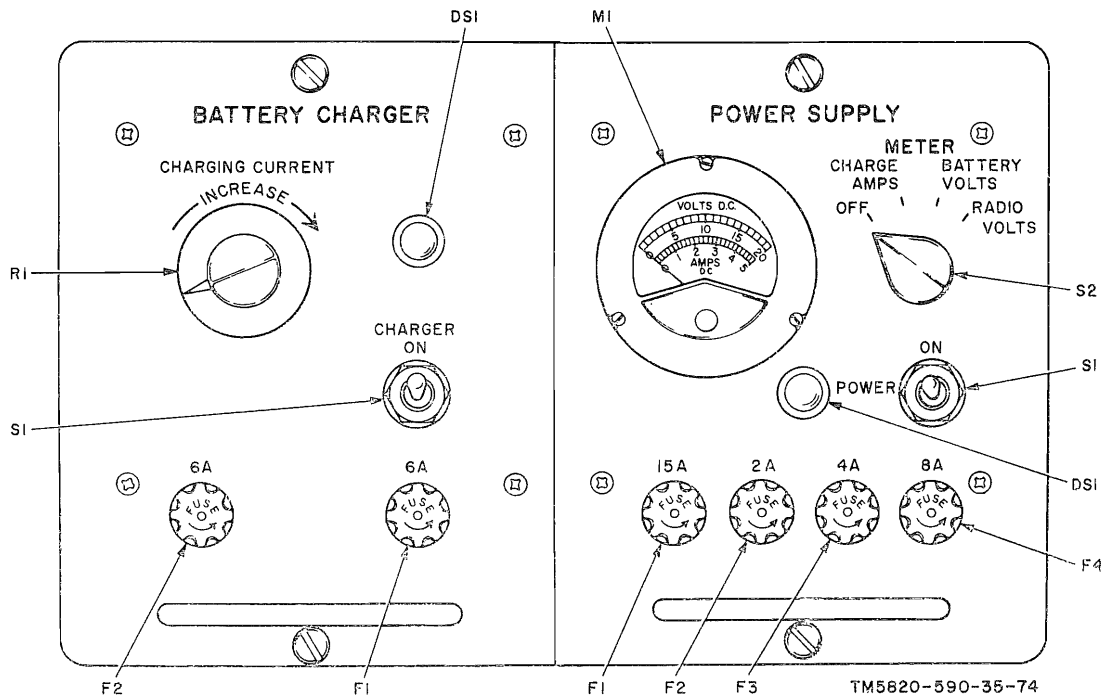


Figure 2-7. External power supply and battery charger front panel.

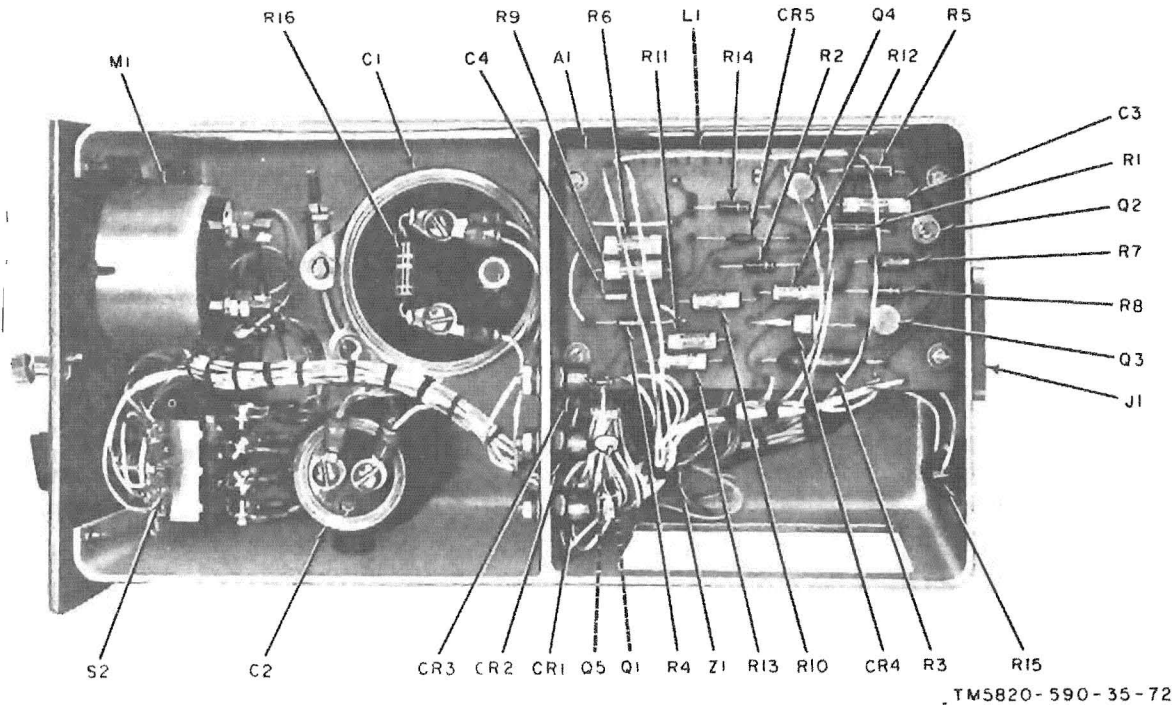


Figure 2-8. Power supply module.

- (7) With METER switch in BATTERY VOLTS position, observe that the normal voltage level of approximately +20 volts is indicated on the panel meter. *Momentarily* short the battery clips of the cable together and check to see that the panel meter drops to a 0 volt indication. (This step checks the operation of short protection switch Q3.)
- (8) If 0 volt is not indicated when the battery clips are momentarily shorted, check short protection transistor Q3 (fig. 2-9). Note that if short protection switch Q3 is faulty and battery clips are shorted too long, 6A fuse F2 (fig. 2-7) may open. Replace defective Q3 or 6A fuse F2 as required.

c. *External Power Supply and Battery Charger Case* (fig. 2-10). Using Multimeter TS-352A/U (or equivalent), troubleshoot the case as follows:

- (1) Remove the battery charger subassembly from the case (para 5-13, TM 11-5820-590-12).
- (2) Connect accessory power cable W1 to J1 and to a +28-volt power source.
- (3) Set POWER ON switch to ON.
- (4) Connect multimeter negative lead to pin 1 of J3 and positive lead to pin 2 to J3.
- (5) Check for a normal voltage indication of +21 volts to +31 volts.
- (6) If 0 volt is indicated, check power supply POWER ON switch and diodes CR1 through CR4. Replace defective part or parts.
- (7) Connect accessory power cable W2 to J1 and to a 110-volt, 50- to 400-cps power source.
- (8) Check for a normal voltage indication of +20 volts to +40 volts on the multimeter.

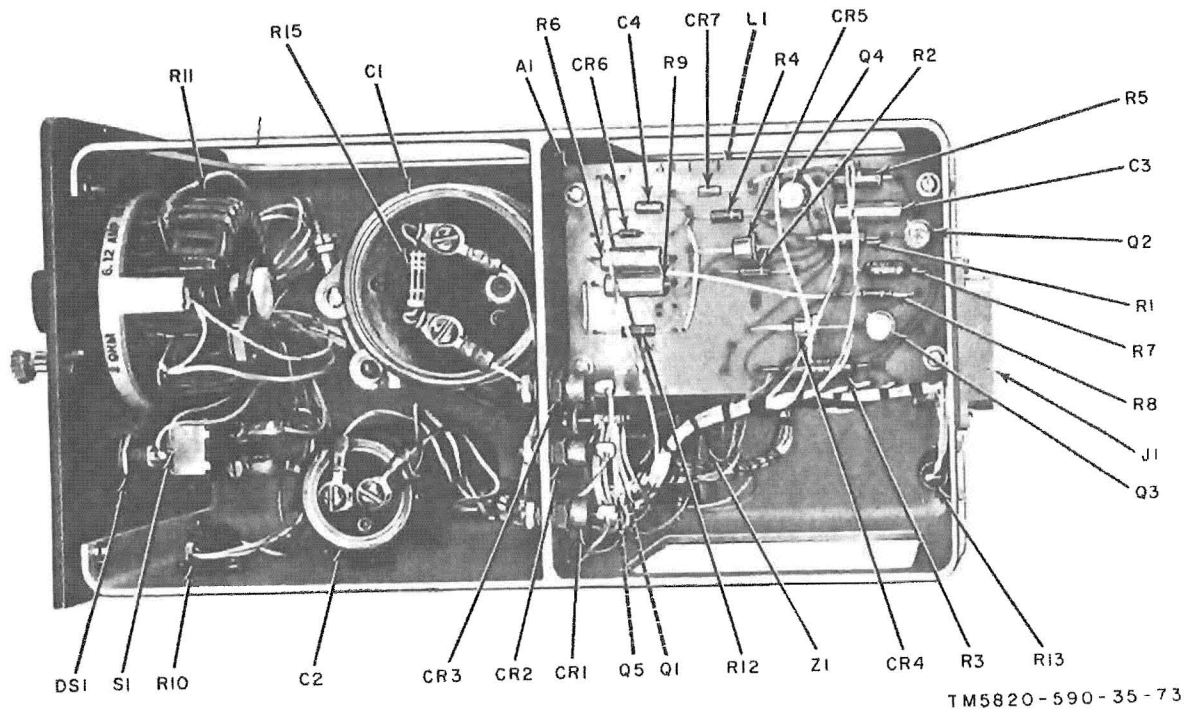


Figure 2-9. Battery charger module.

(9) If 0 volt is indicated on the multi-meter, check for the following defective components. Replace as required.  
 (a) Connecting cable W2.

(b) POWER ON switch (S1).  
 (c) 6A fuse (F2) and 4A fuse (F3).  
 (d) Transformer T1.  
 (e) Diodes CR1 through CR4.

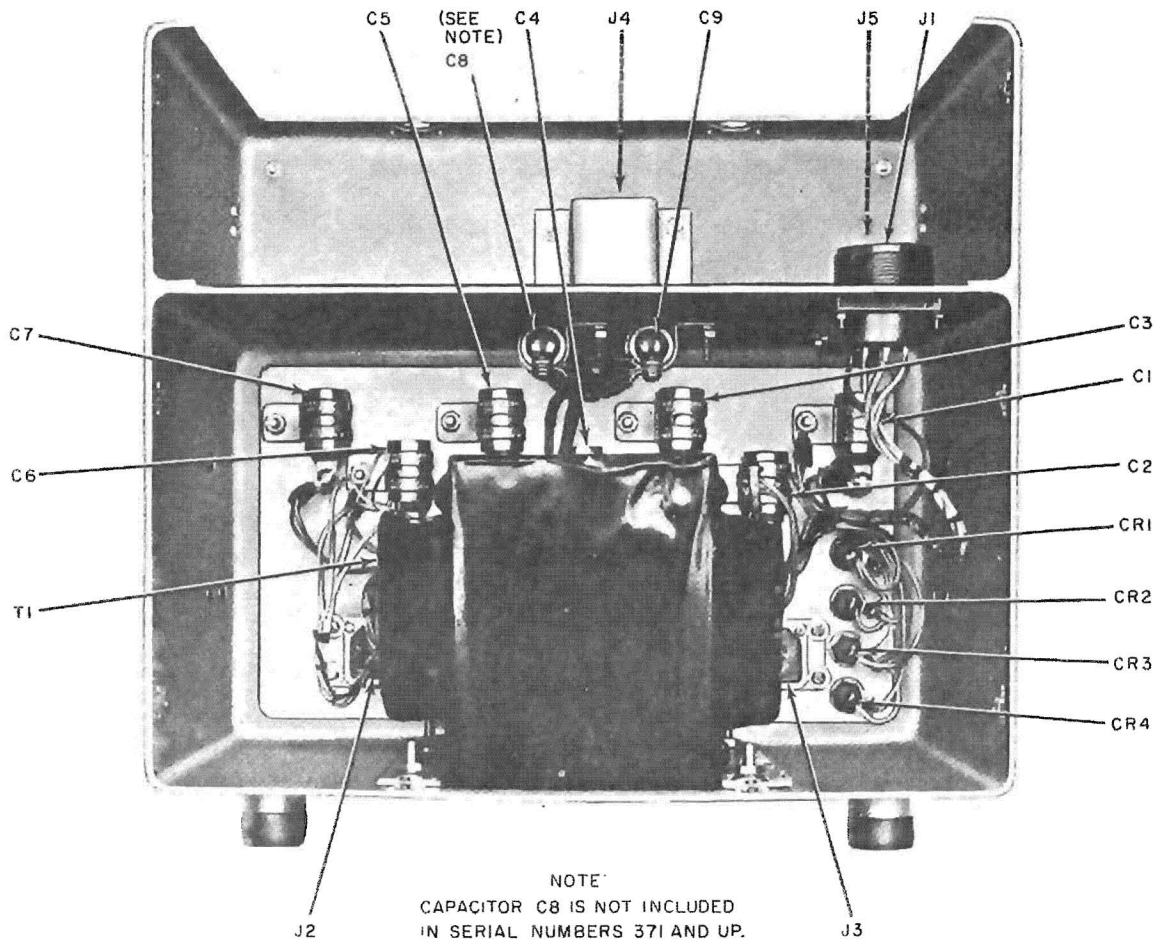


Figure 2-10. External power supply and battery charger case mounted components.

## Section II. REPAIRS

### 2-11. General Parts Replacement Techniques

The repair function at the direct support maintenance category consists of removal and replacement of modules and components of the radio set and external power supply, and adjustment of the radio set band switch gear. Follow the procedures in paragraphs 2-12 and 2-13 to remove and replace modules and component parts of the radio set and external power supply and battery charger. Observe the following precautions:

a. Before a module is removed, note the positions of the leads. Tag each lead before removing.

b. Be careful not to damage other leads or parts by pushing or pulling them out of the way.

c. Do not disturb front panel control settings unless specified.

### 2-12. Removal

Note. Refer to figure 2-3 for location of modules.

a. *Radio Set Case.* Remove the radio set case as follows:

- (1) Release the two latches that secure the radio set case to the radio set.
- (2) Lift the radio set from the case.

*b. Frequency Synthesizer Module.*

- (1) Disconnect the harness wires from TB601 (fig. 2-1).
- (2) Disconnect connector P601 (fig. 3-3) from J703 (fig. 2-1).
- (3) Rotate all synthesizer control shafts so that the rear drive portion of the white shaft coupler blocks is straight up and down (as shown in fig. 2-11).
- (4) Remove the two screws to the left of terminal 9 of TB202 (fig. 2-1).
- (5) Remove the two screws below connectors P601 and P202.
- (6) Position P601 to pass through chassis clearance hole and carefully lift synthesizer module from chassis.

*c. RF Module.* Use the following procedure for removal of the RF module:

- (1) Set MC selector control to 2.
- (2) Disconnect harness wires from TB701.
- (3) Disconnect coaxial connectors P202, P502, P801, and P802.
- (4) Disconnect P601 from J703 if it was not removed in *b* above.
- (5) Remove the two screws attaching the two front corner ground straps to the radio set.
- (6) Turn the radio set over (fig. 2-3) and remove the four screws attaching the RF module to the chassis.
- (7) Lift the RF module straight up from the radio set chassis.

*d. IF Audio Module.* Use the following procedure for removal of the IF audio module:

- (1) Disconnect harness wires from TB202.
- (2) Disconnect coaxial connectors P201 and P501.
- (3) Loosen the four captive hold-down screws on top of the intermediate frequency module and remove the module.

*e. Frequency Generator Module.* For removal of the frequency generator module, proceed as follows:

- (1) Disconnect the harness wires at TB501.

- (2) Disconnect coaxial connectors P501 and P502.
- (3) Loosen the screw below P501 and the screw above P601.
- (4) Turn the radio set over and lift the frequency generator module from the radio set chassis.

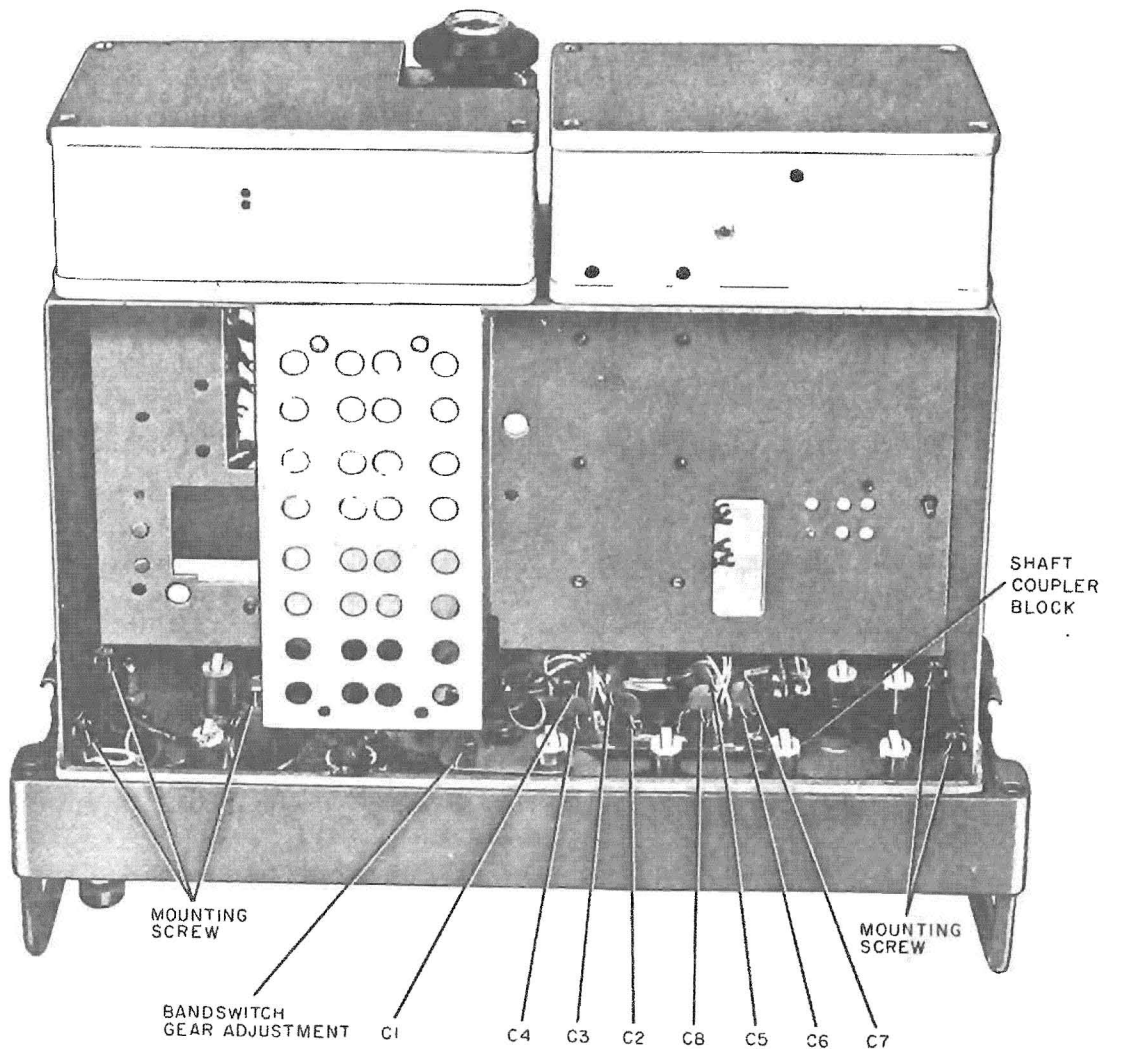
*f. Power Amplifier Module (HAC Part No. 1541057-100).*

- (1) Disconnect the harness wire at TB801.
- (2) Disconnect coaxial connectors P801 and P802.
- (3) Rotate the ANT LOAD and ANT TUNE control shafts so that the rear drive portion of the white shaft coupler blocks is straight up and down (fig. 2-11).
- (4) Loosen the screws on the right-hand side of terminals 1, 4, and 7 of TB801.
- (5) Unsolder antenna wires attached to the antenna terminal and remove ground lug attached to the chassis.
- (6) Position P801 and P802 to pass through the chassis holes and lift the power amplifier from the radio set chassis.

*f.1 Power Amplifier (HAC Part No. 1541057-101).*

- (1) Disconnect harness wires from TB801.
- (2) Disconnect coaxial connectors P801 and P802 from J702 and J704 of the RF module (fig. 2-1).
- (3) Rotate the ANT LOAD and ANT TUNE control shafts so that the white shaft coupler blocks (behind the panel) face the direction in which the power amplifier is to be removed (fig. 2-11).
- (4) Remove the three screws on the right side of TB801.
- (5) Disconnect antenna wires from TB802.
- (6) Position P801 and P802 so they can pass through the chassis holes, and lift the power amplifier module from the radio set chassis.

*g. Power Supply.* Remove the power supply as follows:



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Figure 2-11. Radio set, modules removed.

- (1) Loosen the three screws (fig. 2-3) in the corners of the power supply cover.
- (2) Disconnect the power supply cable at TB201.
- (3) Lift the power supply module from the radio set chassis.

*h. Front Panel.* Remove the radio set front panel as follows:

- (1) Disconnect and unsolder wire connections attached to the radio set chassis.

Tag all wires before unsoldering.

- (2) Remove harness wire clamps.
- (3) Remove the six mounting screws (figs. 2-1 and 2-11).
- (4) Slowly lift the radio set from the front panel until access to the front panel wiring is possible.
- (5) Unsolder and tag wires connected to the front panel.

i. *Gain Control Circuit Board TB203* (fig. 2-1). Remove gain control circuit board TB203 as follows:

- (1) Remove the screw and washer located in each corner of the circuit board.
- (2) Lift circuit board and insulators from the radio set chassis.
- (3) Disconnect and tag wires from circuit board.

j. *Terminal Boards TB 201 and TB202*. To remove terminal boards TB201 and B202, proceed as follows:

- (1) Disconnect harness wires attached to the terminal board.
- (2) Remove the screw located at each end of the terminal board and remove the board.

**2-13. Replacement**

(fig. 2-1)

*Note.* Refer to figure 2-3 for module location.

a. *Frequency Synthesizer Module.*

- (1) Rotate the synthesizer control shafts so that they will mate with the shaft coupler blocks on front panel (fig. 2-11).
- (2) Insert P601 through clearance hole in chassis.
- (3) Insert module in chassis and attach screws adjacent to E5, terminal 9 of TB202, and below connectors P601 and P202.
- (4) Connect P601 to J703 of the RF module.
- (5) Connect wiring harness to TB601.

b. *RF Module.*

- (1) Set the MC selector control to position 2.
- (2) Insert the RF module into the radio set chassis and secure it with the four holddown screws.
- (3) Connect coaxial connectors as shown in the following chart:

Connector	To jack -
P202.....	J705
P502.....	J701
P801.....	J704
P802.....	J702

- (4) Connect P601 to J703 if it was not connected in a above.
- (5) Connect harness wires to TB701.
- (6) Attach ground straps to radio set with the screws removed in paragraph 2-12c(5).

c. *IF Audio Module.*

- (1) Place the IF audio module on radio set chassis.
- (2) Tighten the four captive holddown screws on the top of the module.
- (3) Connect coaxial connectors P201 and P501 to J401 and J402 of the IF audio module.
- (4) Connect harness wires to TB202.

d. *Frequency Generator Module.*

- (1) Insert module into radio set chassis and secure with screws below P501 and above P601.
- (2) Connect coaxial connectors P501 and P502 to J402 of the IF module and J701 of the RF module.
- (3) Connect harness wires to TB501.

e. *Power Amplifier Module (HAC Part No. 1541057-100).*

- (1) Insert connectors P801 and P802 through clearance holes in radio chassis.
- (2) Rotate the ANT LOAD and ANT TUNE control shafts to mate with the shaft coupler blocks on the front panel (fig. 2-11).
- (3) Position the module in the radio set chassis and secure with screws adjacent to terminals 1, 4, and 7 of TB 801.
- (4) Solder the antenna wires to the AND and GND terminals on the front panel.
- (5) Connect coaxial connectors P801 and P802 to J702 and J704 of the RF module (fig. 2-1).
- (6) Connect harness wires to TB801.

e.1 *Power Amplifier Module (HAC Part No. 1541057-101).*

- (1) Insert coaxial connectors P801 and P802 through chassis holes in radio set chassis.
- (2) Rotate the ANT LOAD and ANT TUNE control shafts so that they can



mate with the white shaft coupler blocks on the front panel (fig. 2-11).

- (3) Position the module in the radio set chassis and secure with screws positioned adjacent to terminals 1, 4, and 7 of TB801.
- (4) Connect antenna wires to TB802.
- (5) Connect P801 and P802 to J702 and J704 of the RF module (fig. 2-1).
- (6) Connect harness wires to TB801.

*f. Power Supply Module.*

- (1) Place the power supply on the radio set chassis and secure with the three screws in the corners of the module cover (fig. 2-11).
- (2) Connect the power supply cable to TB201.

*g. Front Panel.* Replace the radio set front panel as follows:

- (1) Note the tags on the wires and solder wire connections to the front panel.
- (2) Position the radio set on the front panel and secure with the six mounting screws (figs. 2-1 and 2-11).
- (3) Secure harness wires to chassis with the harness wire clamps.
- (4) Connect and solder the tagged wires.

*h. Gain Control Circuit Board TB203* (fig. 2-1).

- (1) Connect wires to circuit board.
- (2) Position insulators and gain control circuit board TB203 over mounting holes of chassis.
- (3) Secure circuit board TB203 to chassis with the four washers and screws.

*i. Terminal Boards TB201 and TB202.*

- (1) Position the terminal board over mounting holes on chassis and attach screws.
- (2) Connect harness wires to terminal board.

*j. Radio Set Case.* Replace the radio set inside the radio set case and secure the two latches on the sides of the case.

**2-14. Front Panel Disassembly**  
(fig. 2-12)

For disassembly of the radio set front panel, remove the front panel from the radio set (para 2-12*b*) and proceed as follows:

*a.* Remove screw (1), lockwasher (2), and knob (3).

*b.* Remove nut (4), lockwasher (5), and switch S201 (6).

*c.* Remove screw (7), lockwasher (8), and knob (9).

*d.* Remove retaining ring (10), washer (11), and thrust bearing (12).

*e.* Remove two nuts (13), spacers (14) and screws (15).

*f.* Remove switch S202 (16) and plate (17).

*g.* Remove CLARIFY control shaft assembly (18) and thrust bearing (19) from front panel (101).

*h.* Disconnect wire connections to connectors J201 (48) and J202 (50).

*i.* Remove three screws (20) and switch mounting bracket (21).

*j.* Remove pin (22) and coupled block (23).

*k.* Remove screw (24), calibrate gear-driven assembly (25), washer (26), and thrust bearing (27).

*l.* Turn knob (35) to set the MC shaft assembly (39) to position 2.

*m.* Remove screw (28), lockwasher (29), and washer (30).

*n.* Remove cam mounting plate assembly (31) and thrust bearing (32). Remove alignment shims as required.

*o.* Refer to break-out of item 31 in figure 2-12. See that cam mounting plate gear turns freely. If gear does not turn freely—

- (1) Remove retaining ring and two thrust bearings.
- (2) Lift cam mounting plate and one thrust bearing from cam assembly.
- (3) Lubricate disassembled parts using lubricant per MIL-I-8660.
- (4) Place one thrust bearing and cam mounting plate on cam assembly.
- (5) Place two thrust bearings on cam assembly and attach retaining ring.

*p.* Remove the screw (33), lockwasher (34), and knob (35).

*q.* Remove retaining ring (36), washer (37), and thrust bearing (38).

*r.* Remove MC shaft assembly (39) from panel (101).

*s.* Remove three screws (40), lockwashers (41), and knobs (42).



- t.* Remove three retaining rings (43), washers (44), thrust bearings (45).
- u.* Remove three frequency controls (46) from front panel (101).
- v.* Remove nut (47) and pull connector J201 (48) from front panel (101).
- w.* Remove nut (49) and pull connector J202 (50) from front panel (101).
- x.* Remove screw (51) and knob (52).
- y.* Remove two shaft clamps (53) and remove RF GAIN control R201 (54) from front panel (101).
- z.* Remove pin (55) and coupler block (56).
- aa.* Remove screw (57), bandswitch gear-driven assembly (58), and thrust bearing (59).
- ab.* Remove pin (60) and coupler block (61).
- ac.* Remove screw (62), disk-drive assembly (63), and thrust bearing (64).
- ad.* Remove screw (65), lockwasher (66), and knob (67).
- ae.* Remove retaining ring (68), washer

(69), thrust bearing (70).

- af.* Remove PEAK NOISE control (71) and thrust bearing (72) from front panel (101).
- ag.* Remove nut (73) and pull meter M201 (74) from front panel (101).
- ah.* Remove screw (75), lockwasher (76), and knob (77).
- ai.* Remove retaining ring (78), washer (79), and thrust bearing (80).
- aj.* Remove ANT LOAD control (81) from front panel (101).
- ak.* Remove screw (82), lockwasher (86), and knob (84).
- al.* Remove retaining ring (85), washer (86), and thrust bearing (87).
- am.* Remove ANT TUNE control (88) from front panel (101).
- an.* Remove nut (89), lockwasher (90), washer (91), and thrust bearing (92).
- ao.* Remove GND binding post (93) and thrust bearing (94).



ap. Remove nut (95), lockwasher (96), washer (97), and thrust bearing (98).

aq. Remove ANT binding post (99) and thrust bearing (100) from front panel (101).

## 2-15. Front Panel Assembly (fig. 2-12)

For reassembly of the radio set front panel, proceed as follows:

a. Install thrust bearing (100) and ANT binding post (99) in front panel (101).

b. Secure ANT binding post (99) with thrust bearing (98), washer (97), lockwasher (96), and nut (95).

c. Install thrust bearing (94) and GND binding post (93) in front panel (101).

d. Secure GND binding post (93) with thrust bearing (92), washer (91), lockwasher (90), and nut (89).

e. Install ANT TUNE control (88) and secure with the thrust bearing (87), washer (86), and retaining ring (85).

f. Install knob (84) and secure with lockwasher (83) and screw (82).

g. Install ANT LOAD control (81) and secure with thrust bearing (80), washer (70), and retaining ring (78).

h. Install knob (77) and secure with lockwasher (76) and screw (75).

i. Install meter M201 (74) and secure with nut (73).

j. Install thrust bearing (72) and PEAK NOISE control (71) in front panel (101).

k. Secure PEAK NOISE control (71) with thrust bearing (70), washer (69), and retaining ring (68).

l. Install knob (67) and secure with lockwasher (66) and screw (65).

*Note.* Apply lubricant (per MIL-I-8660) to shoulder and head of screw (62). Do not allow lubricant on screw threads.

m. Insert screw (62) to disk-drive assembly (63) and place thrust bearing (64) over protruding portion of screw shoulder. Mount assembly on front panel (101) and tighten screw (62).

n. Install coupler block (61) and secure with pin (60).

*Note.* Apply lubricant (per MIL-I-8660) to shoulder and head of screw (57). Do not allow lubricant on screw threads.

o. Insert screw (57) into bandswitch gear-driven assembly (58) and place thrust bearing (59) over protruding portion of screw shoulder.

p. Mount bandswitch gear-driven assembly (58) on front panel (101) and tighten screw (57).

q. Install coupler block (56) and secure with pin (55).

r. Install RF GAIN control R201 (54) in front panel (101).

s. Place two shaft clamps (53) on RF GAIN control (54) shaft.

t. Place knob (52) over shaft clamps (53) and secure with screw (51).

u. Install connector J202 (50) in front panel (101) and secure with nut (49).

v. Install connector J201 (48) in front panel (101) and secure with nut (47).

w. Install three frequency controls (46) and secure with thrust bearing (45), washers (44), and retaining rings (43).

x. Install three knobs (42) and secure with lockwashers (41) and screws (40).

y. Install MC shaft assembly (39) in panel (101) and secure with thrust bearings (38), washer (37), and retaining ring (36).

z. Install knob (35) and secure with lockwasher (34) and screw (33).

aa. Turn MC shaft assembly (39) to position 2.

*Note.* Use thick or thin flat washer (as required) on bottom of cam mounting plate assembly (31) to align mounting plate with disk-drive assembly (63).

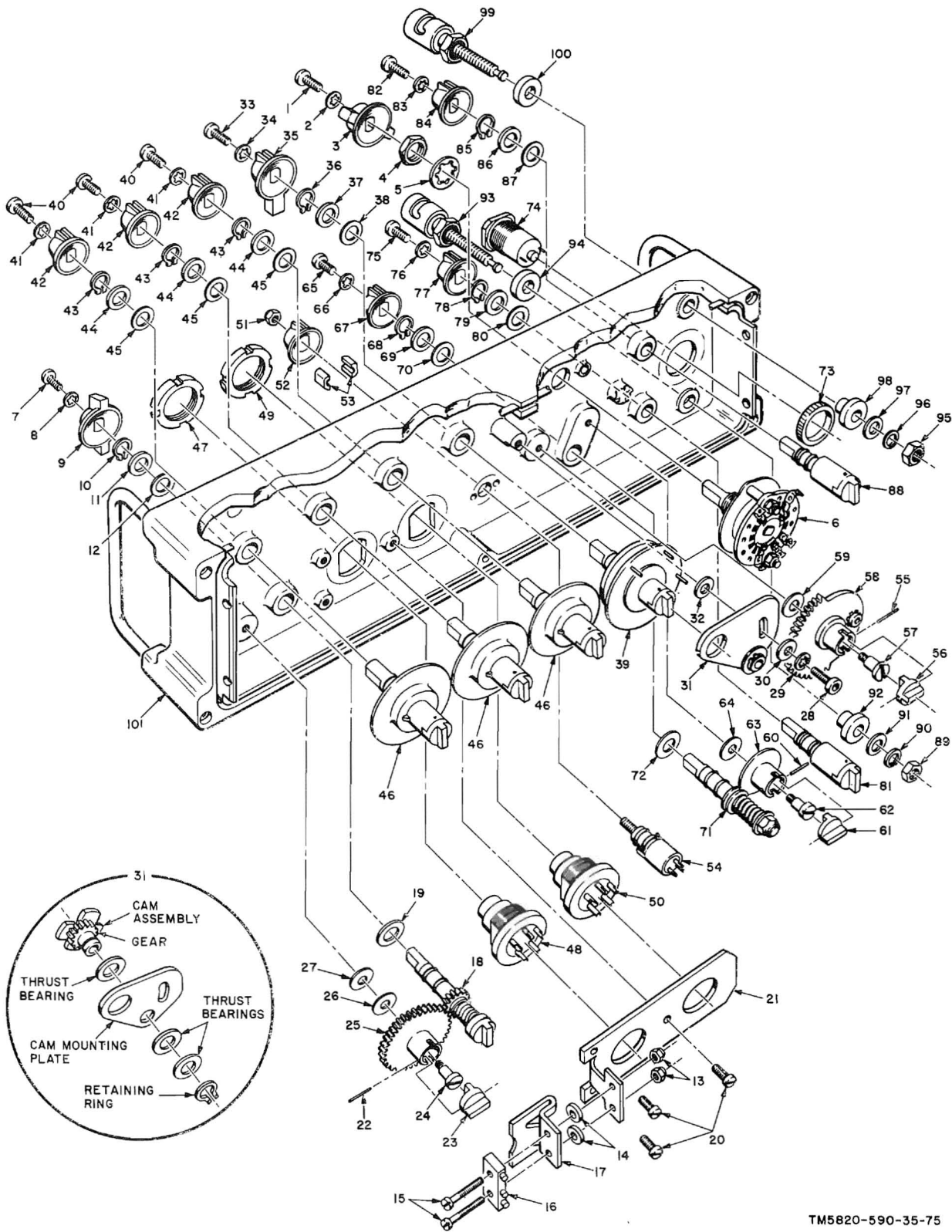
ab. Place thrust bearing (32) between cam mounting plate assembly (31) and front panel (101).

ac. Install cam mounting plate assembly (31) on rear of MC shaft assembly (39), and secure loosely with washer (30), lockwasher (29), and screw (28).

ad. Adjust screw (28) until MC shaft assembly (39) turns freely between position 2 and 11.

*Note.* Apply lubricant (per MIL-I-8660) to shoulder and head of screw (24). Do not allow lubricant to fall on screw threads.

ae. Insert screw (24) to calibrate gear-driven assembly (25) and place washer (26) and thrust bearing (27) over protruding portion of screw shoulder.



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Figure 2-12. Radio set front panel, exploded view.

1	Screw	33	Screw	67	Knob
2	Lockwasher	34	Lockwasher	68	Retaining ring
3	Knob	35	Knob	69	Washer
4	Nut	36	Retaining ring	70	Thrust bearing
5	Lockwasher	37	Washer	71	PEAK NOISE control
6	Switch (S201)	38	Thrust bearing	72	Thrust bearing
7	Screw	39	MC shaft assembly	73	Nut
8	Lockwasher	40	Screw	74	Meter M201
9	Knob	41	Lockwasher	75	Screw
10	Retaining ring	42	Knob	76	Lockwasher
11	Washer	43	Retaining ring	77	Knob
12	Thrust bearing	44	Washer	78	Retaining ring
13	Nut	45	Thrust bearing	79	Washer
14	Spacer	46	Frequency control	80	Thrust bearing
15	Screw	47	Nut	81	ANT LOAD control
16	Switch (S202)	48	Connector (J201)	82	Screw
17	Plate	49	Nut	83	Lockwasher
18	CLARIFY control shaft assembly	50	Connector (J202)	84	Knob
19	Thrust bearing	51	Screw	85	Retaining ring
20	Screw	52	Knob	86	Washer
21	Switch mounting bracket	53	Shaft clamp	87	Thrust bearing
22	Pin	54	RF GAIN control (R201)	88	ANT TUNE control
23	Coupler block	55	Pin	89	Nut
24	Screw	56	Coupler block	90	Lockwasher
25	Calibrate gear-driven assembly	57	Screw	91	Washer
26	Washer	58	Bandswitch gear-driven assembly	92	Thrust bearing
27	Thrust bearing	59	Thrust bearing	93	GND binding post
28	Screw	60	Pin	94	Thrust bearing
29	Lockwasher	61	Coupler block	95	Nut
30	Washer	62	Screw	96	Lockwasher
31	Cam mounting plate assembly	63	Disk-drive assembly	97	Washer
32	Thrust bearing	64	Thrust bearing	98	Thrust bearing
		65	Screw	99	ANT binding post
		66	Lockwasher	100	Thrust bearing
				101	Front panel

Figure 2-12—Continued.

af. Mount calibrate gear-driven assembly (25) on front panel (101) and tighten screw (24).

ag. Install coupler block (23) and secure with pin (22).

ah. Install switch mounting bracket (21) and secure with three screws (20).

ai. Install thrust bearing (19) on CLARIFY control shaft assembly (18).

aj. Insert CLARIFY control shaft assembly (18) half-way into panel (101).

ak. Install plate (17) and switch S202 (16) with NC terminal on switch toward bottom of front panel (101).

al. Secure plate (17) and switch S202 (16) with two screws (15), spacers (14), and nuts (13).

am. Secure CLARIFY control shaft assembly (18) on front side of panel (101) with thrust bearing (12), washer (11), and retaining ring (10).

an. Install knob (9) and secure with lockwasher (8) and screw (7).

ao. Adjust screw S202 (16) so that it actuates when CLARIFY control shaft assembly (18) gear engages and disengages.

ap. Install switch S201 (6) in front panel (101) and secure with lockwasher (5) and nut (4).

aq. Install knob (3) and secure with lockwasher (2) and screw (1).

## 2-16. Bandswitch Gear Adjustment (fig. 2-11)

The bandswitch mechanism is properly set if the bandswitch changes from band 1 to band 2 when the MC selector knob is moved from the 2 to the 3 position. To assure the proper operation of the RF module bandswitch by the MC selector knob, proceed as follows:

*Note.* The bandswitch gear adjustment may be made with the radio set turned on, if care is taken not to short the terminals of the OFF-ON-TUNE selector switch.

a. Use an Allen wrench and loosen the adjustment screw located on bandswitch gear.

b. Rotate the bandswitch gear in the direction required while holding the adjusting screw in place.

c. Tighten the adjusting screw when the bandswitch gear is in the proper position.

**2-17. Gain Control Adjustment**  
(fig. 2-6)

a. Connect RF Signal Generator AN/URM-25A (or equivalent) to the ANT and GND connections of the radio set.

b. Set the signal generator for an output of 2.001 mc at 1 microvolt level.

c. Set the radio set frequency controls to 2.000 mc.

d. Set the OFF-ON-TUNE selector switch to ON.

e. Adjust R206 and R210 for maximum audio output.

CHAPTER 3

GENERAL SUPPORT MAINTENANCE

Section I. TROUBLESHOOTING

**3-1. Test Equipment and Special Items  
Required for Module Troubleshooting**

The test equipment required for troubleshooting the radio set at the general support maintenance level together with the associated technical manuals are listed in *d* below. Additional items, such as test loads, must be fabricated. Fabrication details are covered in *a*, *b*, and *c* below and in figure 3-1.

*a. 20-Db Match Pad.*

- (1) Obtain a 56-ohm, ½-watt resistor (R1) a 500-ohm, ½-watt resistor (R2), and a 120-ohm, ½-watt resistor (R3).
- (2) Assemble resistors R1, R2, and R3 and connectors (Automatic Metals GG4602-900 and GG4609-000-801) as shown in figure 3-1.

*b. Shunt Loading Resistor.*

- (1) Obtain a 1K-ohm, ½-watt ±5-percent resistor (R1) and a 680 picofared (pf) capacitor (C1).
- (2) Connect to short clip leads as shown in figure 3-1.

*c. Test Loads.* Amphenel connector IPC 4700-51 contains a 51-ohm, ½-watt resistor installed in the connector. When a load resistance of another value is required, fabricate the load resistance as follows:

- (1) Obtain connector IPC 4700-51.
- (2) Disassemble the connector and remove the 51-ohm, ½-watt resistor.
- (3) Insert and solder the resistor required.
- (4) Assemble the connector.
- (5) Obtain and use miniature coaxial adapters (Amphenel 27-28 and 27-40) to connect test equipment to subminiature coaxial connectors.

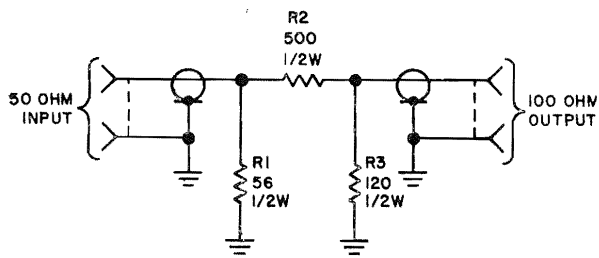
*d. Test Equipment.*

Equipment	Qty.	Technical manual
Signal Generator AN/GRM-50 .....	1	TM 11-6625-573-15
R.F. Signal Generator Set AN/URM-25A ..	1	TM 11-5551A
Frequency Meter AN/USM-26 .....	1	TM 11-5057
Audio Oscillator TS-382/U .....	1	TM 11-6625-261-12
Oscilloscope .....		
AN/USM-164 .....	1	Commercial Instructions for Tektronix Type 541.
Electronic Voltmeter AN/URM-145 .....	1	TM 11-6625-524-14
Multimeter ME-26B/U .....	1	TM 11-6625-200-12
Multimeter TS-352A/U .....	3	TM 11-5527
Power Supply PP-4838/U .....	1	
Dummy load, 50-ohm, 20-watt .....	1	
Clip-on DC milliammeter HP 428A .....	1	Commercial (Hewlett-Packard).
T-Connector HP 11042A (MX-3341) .....	1	Commercial (Hewlett-Packard).
Dummy load, 100-ohm, 20-watt .....	1	

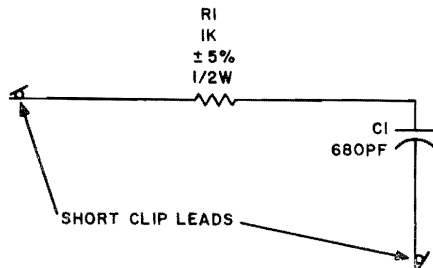
*e. Additional Equipment.*

- (1) Fabricated 20-db match pad.
- (2) Resistor, 20-ohm ± 5 percent, 10-watt.
- (3) Resistor, 40-ohm ±5 percent, 50-watt.
- (4) Resistor, 60-ohm ±5 percent, 2-watt.
- (5) Resistor, 80-ohm ±5 percent, 25-watt.
- (6) Resistor, 100-ohm ±5 percent, ½-watt.
- (7) Resistor, 500-ohm ±5 percent, ½-watt.

C1



A. MATCH PAD, 20 DB



B. SHUNT LOAD RESISTOR

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Figure 3-1. Test adapters, fabrication.

- (8) Resistor, 800-ohm  $\pm 5$  percent, 4-watt.
- (9) Resistor, 900-ohm  $\pm 5$  percent, 1/2-watt.
- (10) Resistor, 1.5K-ohm  $\pm 5$  percent, 1-watt.
- (11) Resistor, 3.3K-ohm  $\pm 5$  percent, 1-watt.
- (12) Power supply, +9V  $\pm 5$  percent, 400-milliampere.
- (13) Power supply +38V  $\pm 5$  percent, 1-ampere, fully limited at 1.3 amperes.
- (14) Resistor, 20K-ohm,  $\pm 5$  percent, 1/2-watt.
- (15) Capacitor, 220-pf,  $\pm 5$  percent.

f. *Frequency Synthesizer Signal.* Whenever an aligned synthesizer module is available, the synthesizer module may be used in place of a signal generator supplying the synthesizer signal.

### 3-2. Frequency Synthesizer Module

Troubleshoot the frequency synthesizer module as follows:

a. Connect a 100-ohm, 1/2-watt load between ground and P601 (figs. 3-2 and 3-3).

b. Connect Electronic Voltmeter AN/URM-145 (or equivalent) and Oscilloscope AN/USM-164 to a T-connector as illustrated in figure 3-2.

c. Connect the remaining connector of the T-connector to P601.

d. Connect oscilloscope vertical output signal to Frequency Meter AN/USM-26 (or equivalent).

e. Connect the (+) terminal of Power Supply PP-4838/U No. 1 (or equivalent) to pin 3 of TB601 and the (-) terminal to ground.

f. Set power supply No. 1 for an output of +9 volts  $\pm 5$  percent, 50 milliamperes (ma.).

g. Connect the (+) terminal of Power Supply PP-4838/U No. 2 (or equivalent) to pin 1 of TB601 and the (-) terminal to ground.

h. Add a jumper wire between pins 1 and 2 of TB601.

i. Set power supply No. 2 to +12 volts  $\pm 10$  percent, 225 ma to energize transmit relay K1 and calibrate relay K2.

j. Turn all frequency control knobs fully clockwise (11.999 mc).

k. Adjust calibrate capacitor C628 (fig. 3-4) for a frequency reading of 13,740 kc on the frequency meter. The output level reading on the voltmeter should be between 50 and 300 millivolts root mean square (rms). The output waveform as viewed on the oscilloscope should have no amplitude modulation or mixed frequencies. Harmonic (wave form) distortion may occur. These output level and waveform conditions should hold for all test frequencies.

l. Remove the jumper wire between terminals 1 and 2 of TB601.

m. See that the output frequency is 13,749 kc  $\pm 20$  cps.

n. Rotate each frequency control one position counterclockwise.

o. Repeat the procedure given in k, l, and m above for all frequency control positions as shown in the following chart. Note that the *calibrate frequency* setting should be obtained when terminals 1 and 2 of TB601 are connected as in h above.

p. See that the output frequency is as shown in the following chart.



Oscillator switch digit settings	Calibrate frequency (10 cps)	Output frequency, kc (+20 cps)
11999 -----	13,750 -----	13,749
10888 -----	12,630 -----	12,638
9777 -----	11,520 -----	11,527
8666 -----	10,410 -----	10,416
7555 -----	9,300 -----	9,305
6444 -----	8,190 -----	8,194
5333 -----	7,080 -----	7,083
4222 -----	5,970 -----	5,972
3111 -----	4,860 -----	4,861
2000 -----	3,750 -----	3,750

q. If any of the output frequencies are not as indicated, perform the alignment instructions (para 3-22).

r. If a synthesizer stage cannot be aligned (fig. 3-31) or the RF voltage measured is not as indicated, check the stage being aligned for defective circuit components. Replace defective components as required (para 3-9).

### 3-3. RF Module

#### a. Receive Test.

- (1) Connect Signal Generator AN/GRM-50 (or equivalent) (signal generator No. 1) through a 20-decibel (db) match pad (fig. 3-1) to J702 (figs. 3-8 and 3-9).
- (2) Set signal generator No. 1 to 2,001 kc  $\pm 1$  percent at 100 millivolts.

- (3) Connect RF Signal Generator Set AN/URM-25A (or equivalent) (signal generator No. 2) to J703.
- (4) Set signal generator No. 2 to 3,750 kc  $\pm 0.005$  percent at 100 millivolts rms.
- (5) Connect a 100-ohm, 1/2-watt resistor to J705.
- (6) Connect Electronic Voltmeter AN/URM-145 (or equivalent) across the load.
- (7) Connect the positive output terminal of Power Supply PP-4838/U (or equivalent) to terminal 3 of TB701 and connect the negative terminal to terminal 4 of TB701.
- (8) Connect a voltage divider consisting of a 1K-ohm resistor and a 5K-ohm potentiometer across the output of the power supply.
- (9) Connect the arm of the 5K-ohm potentiometer to terminal 2 of TB701.
- (10) Set bandswitch S1 (fig. 3-9) to band 1 (fully counterclockwise).
- (11) Set the power supply for an output of +9 volts  $\pm 5$  percent, 100 ma.
- (12) Adjust the 5K ohm potentiometer for a maximum output as indicated on the voltmeter.

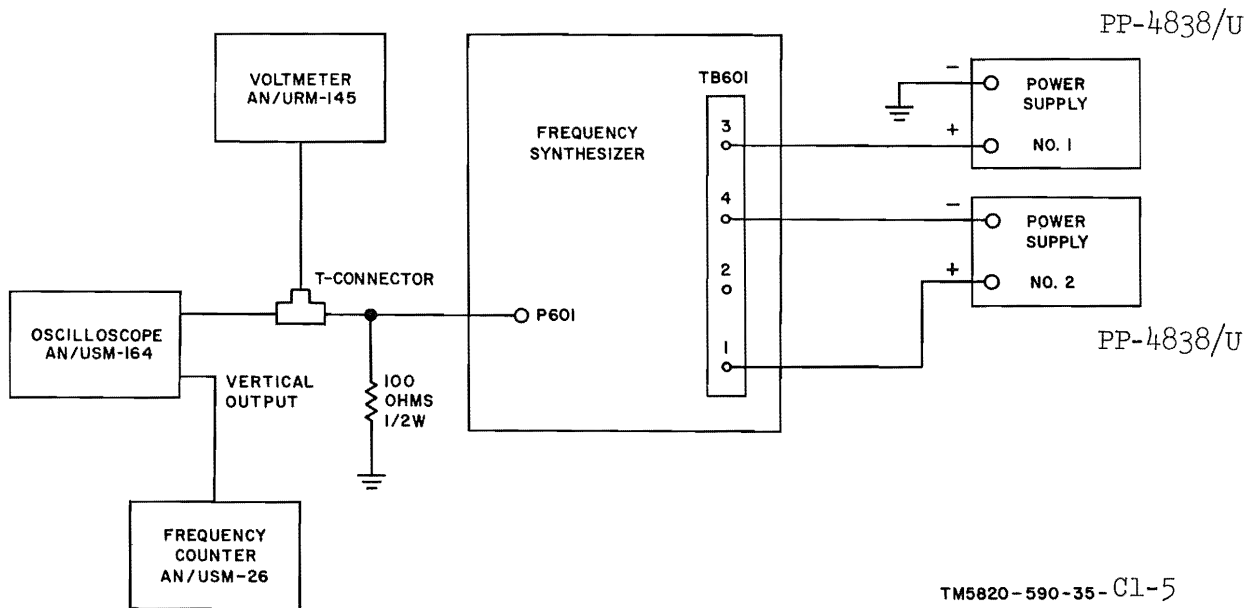
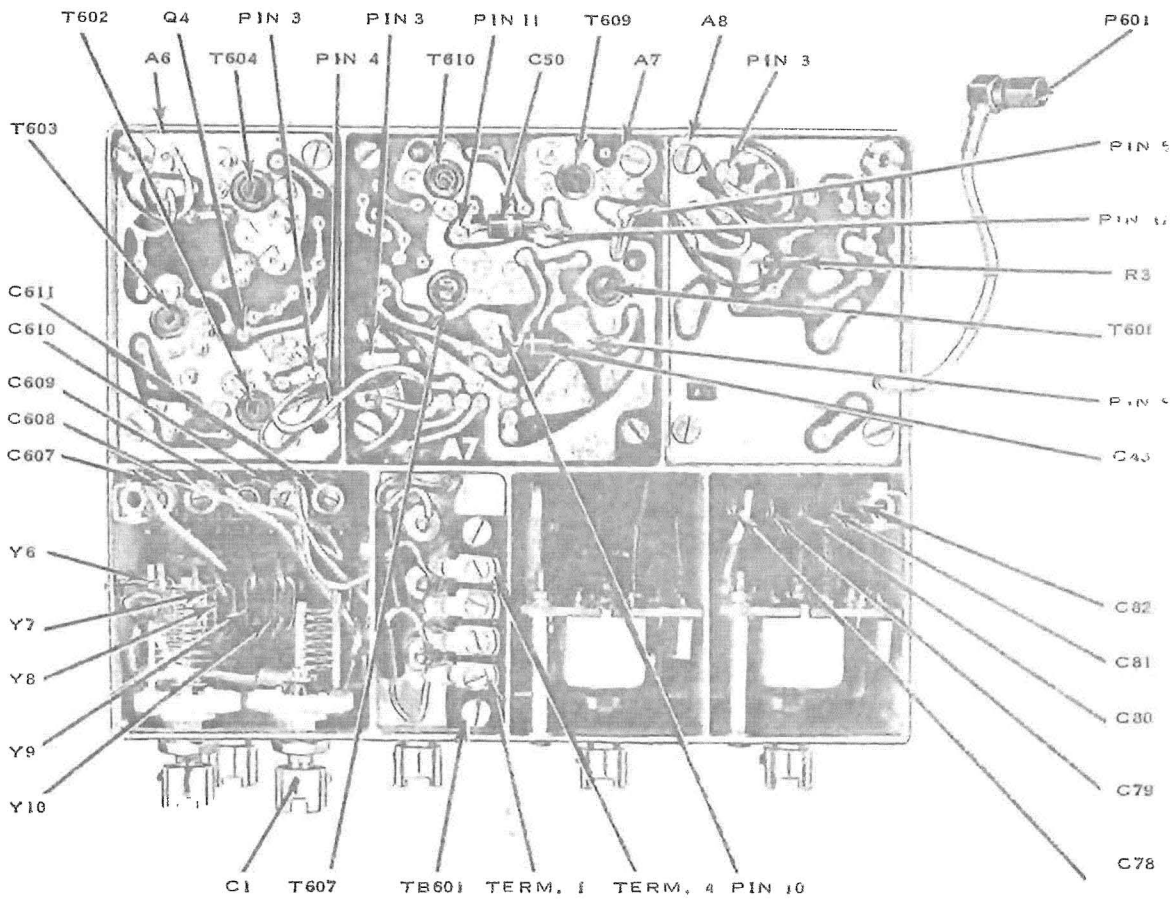


Figure 3-2. Frequency synthesizer, troubleshooting test setup.



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Figure 3-3. Frequency synthesizer module, bottom view.

- (13) Adjust C701 (fig. 3-9) for a maximum indication on the voltmeter.
- (14) See that the output across the load is 30 millivolts rms or greater.
- (15) Repeat the test for other frequency bands, as shown in the following chart.

Signal generator No. 2 frequency, kc	Band	Signal generator No. 1 frequency, kc
3,750 .....	1	2,001
4,750 .....	2	3,001
6,750 .....	3	5,001
9,750 .....	4	8,001

- (16) If an output of less than 30 millivolts is indicated for any of the preceding

frequencies, leave the test equipment as connected and perform alignment instructions for the RF module (para 3-23).

- (17) If the RF module cannot be aligned as described in paragraph 3-23, connect the test equipment as shown in figure 3-8 (receive mode), and perform the procedure given in (a) through (j) below.

*Note.* If voltage measurements for all frequency bands were below 30 millivolts, check transistors Q1 and Q2 and associated circuits as described in (j) below.

- (a) Connect Oscilloscope AN/USM-164 to pin 2 of balanced mixer Z1 (fig. 3-9).

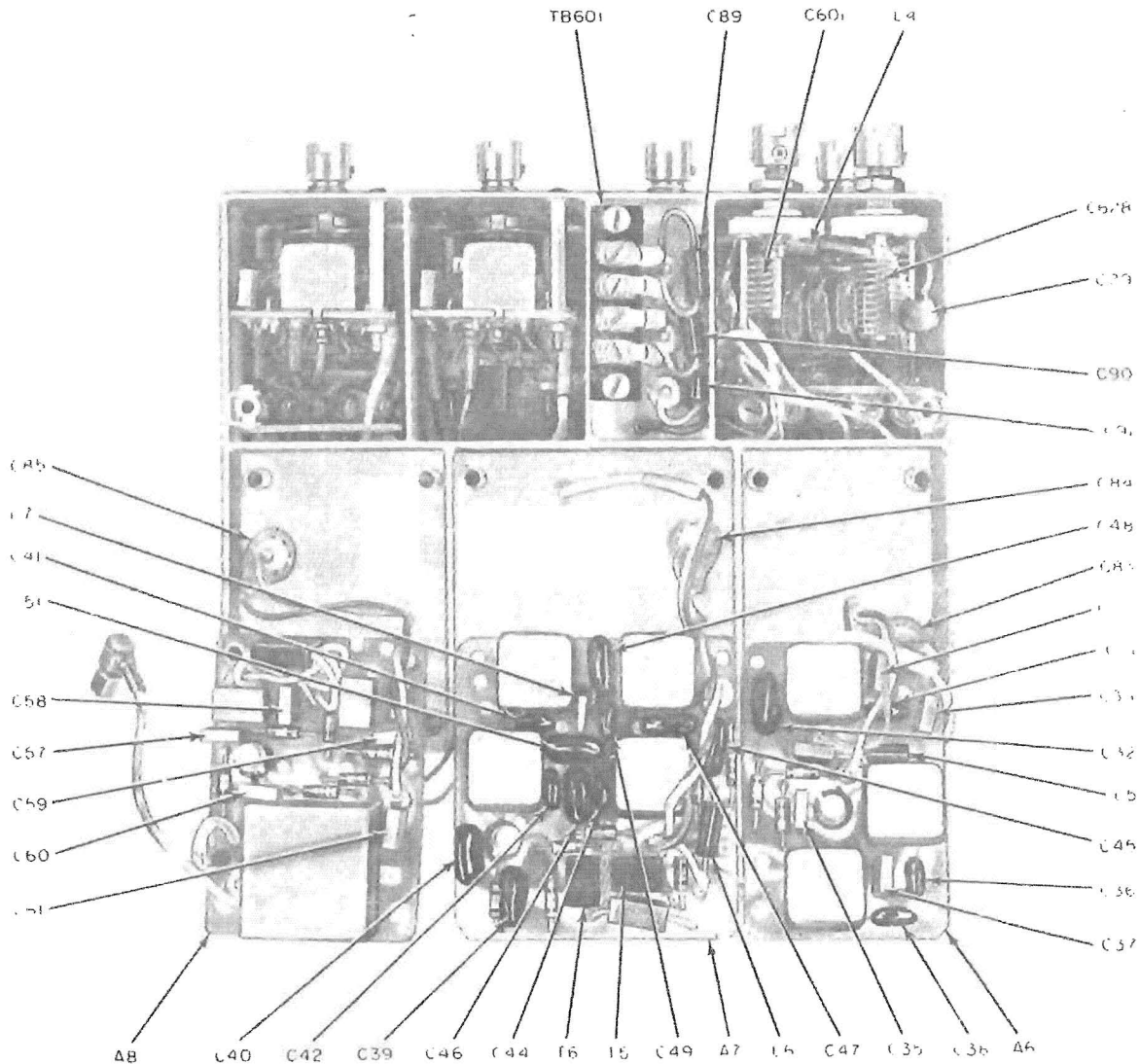
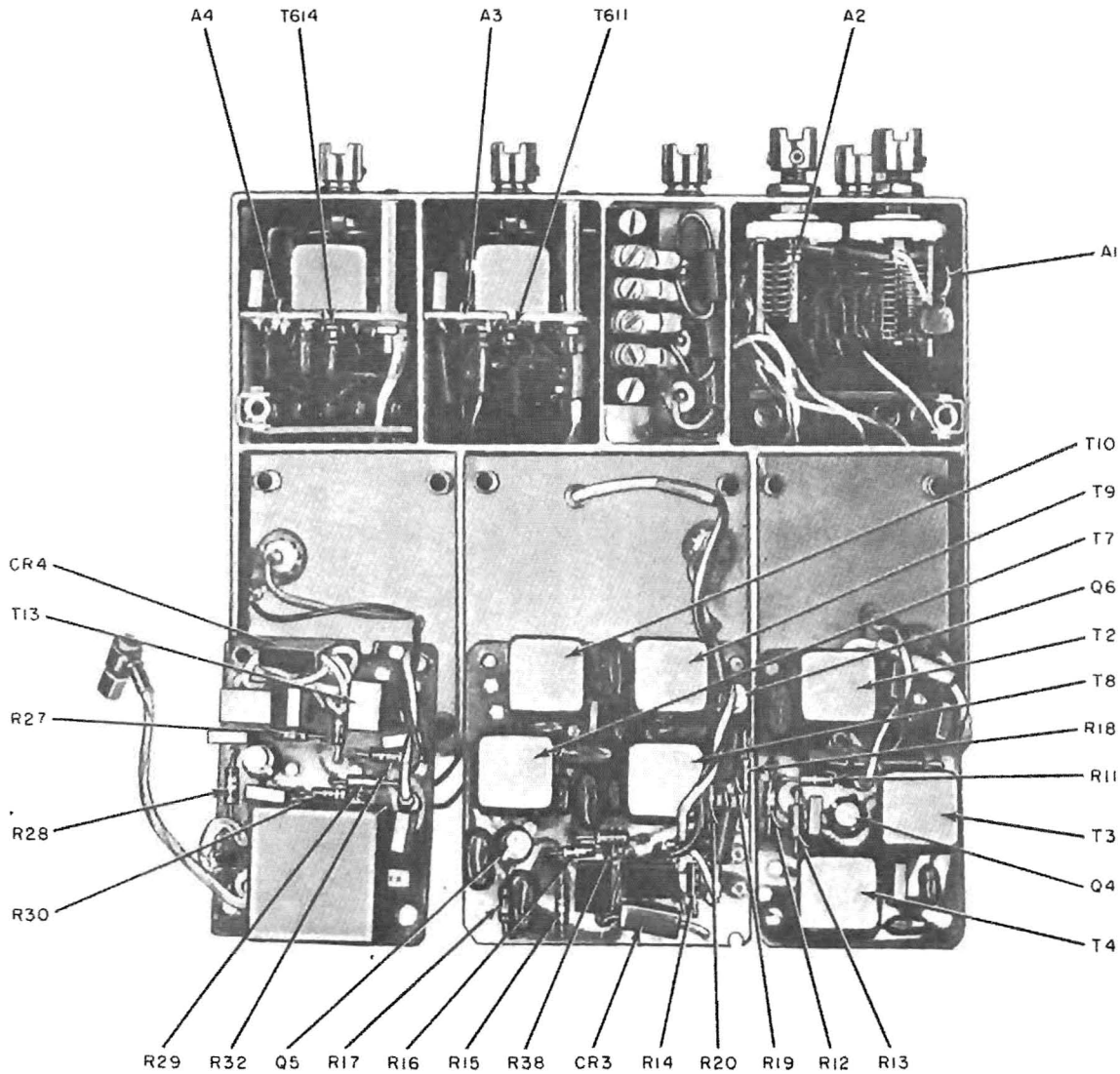


Figure 3-4. Frequency synthesizer module, bottom view, circuit boards removed.

- (b) Connect Frequency Meter AN/USM-26 to the vertical output of the oscilloscope.
- (c) Check for an RF tuned circuit output frequency of 2 mc on the frequency meter.
- (d) If an output frequency of 2001 kc is not indicated on the frequency meter, the RF tuned circuit is defective. Check the RF tuned circuit for defective components. Replace as required (para 3-11).
- (e) Connect the oscilloscope to pin 3 of Z1.
- (f) Keep the frequency meter at the vertical output of the oscilloscope.
- (g) Check for a synthesizer tuned frequency of 3,750 kc.
- (h) If a frequency of 3,750 kc is not indicated on the frequency meter,



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Figure 3-4—Continued.

the synthesizer tuned circuit is defective. Check the synthesizer tuned circuit for defective components. Replace as required (para 3-11).

- (i) If frequency measurements at pins 2 and 3 of Z1 are as indicated, check for defective balance mixer Z1, transformer T717, or capacitor C38. Replace as required (para 3-11).

- (j) Using Multimeter ME-26B/U (or equivalent), check RF amplifier Q1 and synthesizer amplifier Q2 as shown in the following chart.

Transistor	Approx voltage		
	E	B	C
Q1 -----	+0.3 volt	+0.16 volt	+8 volts
Q2 -----	+0.85 volt	+1.4 volts	+5.7 volts

Note. Figures 3-10 and 3-11 show the physical location of the components in the RF module.

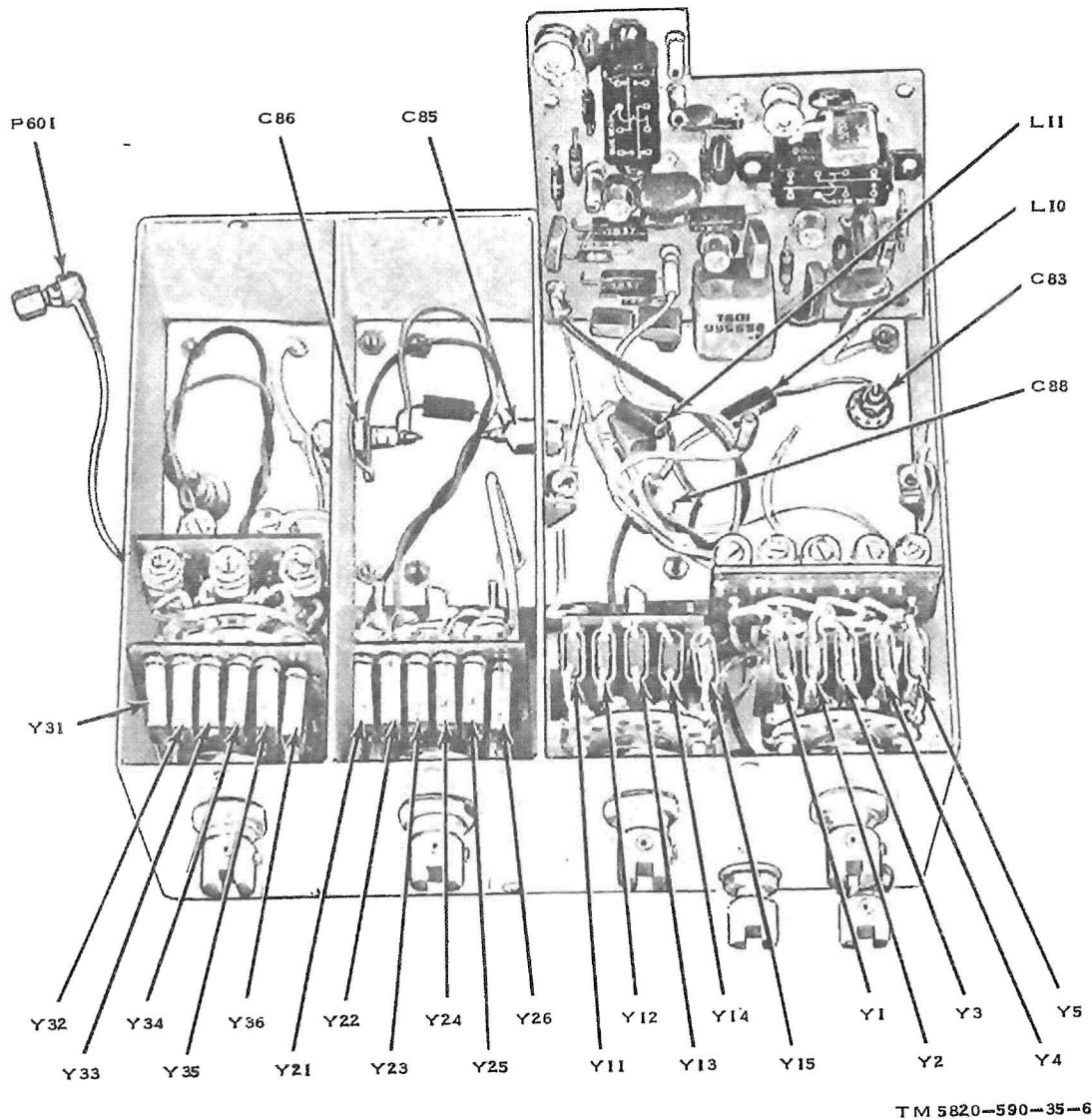
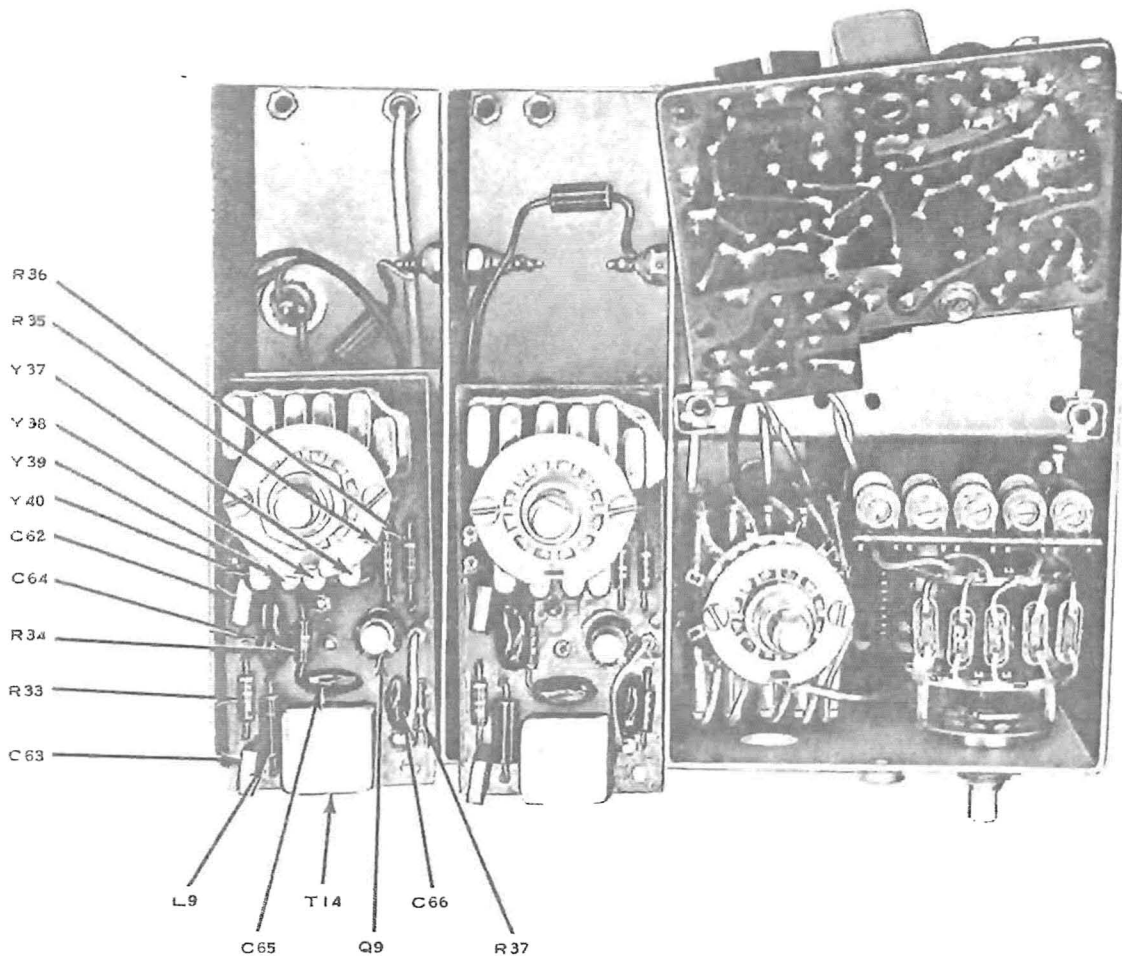


Figure 3-5. Frequency synthesizer module, top view, circuit board A5 removed.

*b. Transmit Mode.*

- (1) Connect a 100-ohm,  $\frac{1}{2}$ -watt resistor and a 220-pf capacitor to J704 (fig. 3-8).
- (2) Connect Electronic Voltmeter AN/URM-145 (or equivalent) across the load resistor.
- (3) Connect Power Supply PP-4838/U (No. 1) positive lead to pin 3 of TB701 and the negative lead to pin 4 of TB701 (fig. 3-9).
- (4) Connect Power Supply PP-4838/U (No. 2) positive lead to pin 1 of TB701 and the negative lead to pin 4 of TB701.
- (5) Set power supply No. 2 to +12 volts  $\pm 10$  percent, 500 ma.
- (6) Set power supply No. 1 to +9 volts  $\pm 5$  percent, 100 ma.
- (7) Connect signal generator No. 1 (or equivalent) through 20-db match pad (fig. 3-1) to J705.



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Figure 3-6. Frequency synthesizer module, top view, circuit boards removed.

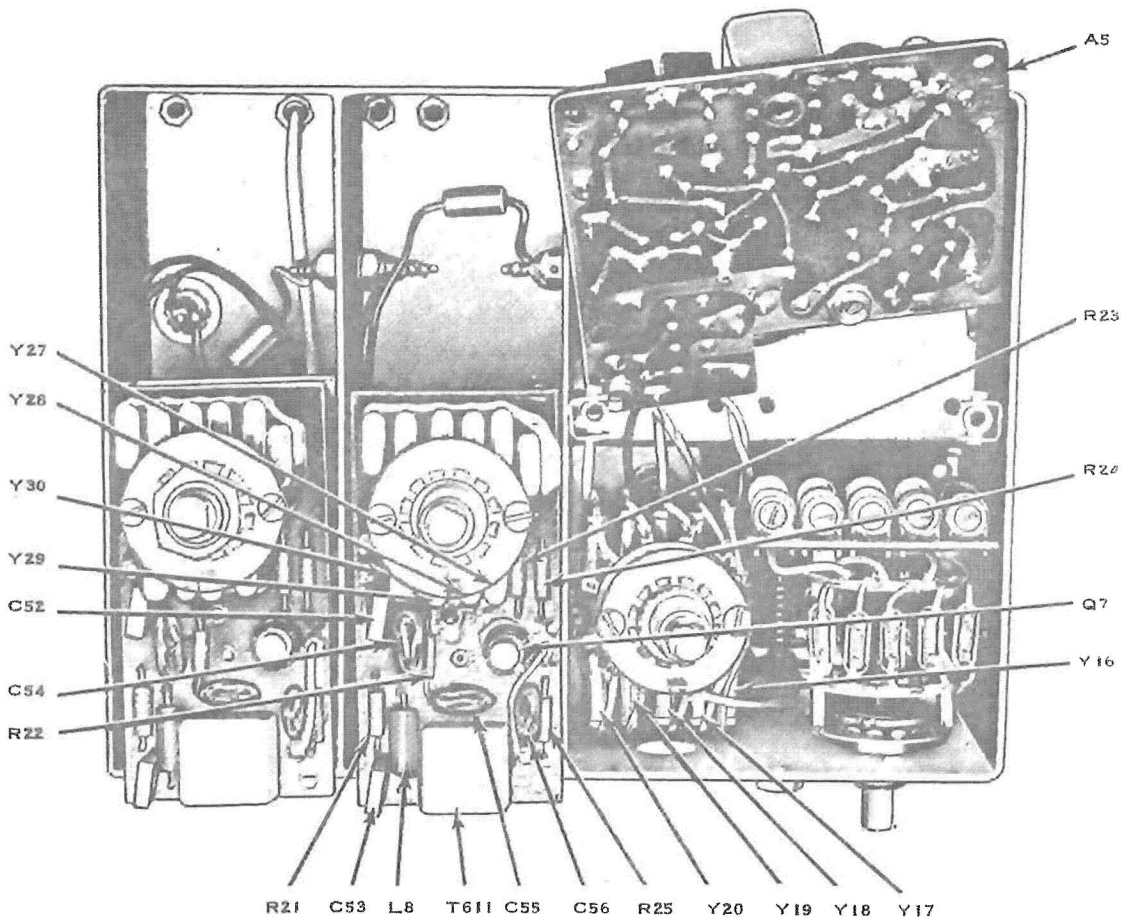
- (8) Set signal generator No. 1 for an output frequency of 1,750 kc at 260 millivolts.
- (9) Connect signal generator No. 2 (or equivalent) to J703 (fig. 3-8).
- (10) Set signal generator No. 2 for an output frequency of 3,750 kc at 100 millivolts.
- (11) Set bandswitch S1 (fig. 3-9) to band 1 (fully counterclockwise).
- (12) Adjust C701 for maximum output as indicated on the voltmeter (fig. 3-9).
- (13) See that the output at J704 is 100 millivolts minimum.
- (14) Repeat the test for frequencies in other bands as shown in the chart

below and adjust C701 for maximum output for each setting.

Signal generator No. 2 frequency, kc	Band
3,750 .....	1
4,750 .....	2
6,750 .....	3
9,750 .....	4

- (15) If an output of less than 100 millivolts rms is indicated for any of the frequencies as shown in the chart, leave the test equipment as connected and perform alignment instructions for the RF module (para 3-23).





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Figure 3-6 — Continued.

(16) If the RF module cannot be aligned as indicated in paragraph 3-23, check the RF module as described in *a* (17) (*a*) through (*j*) above; also check for defective relays K1 and K2. Replace the defective components as required (para 3-11).

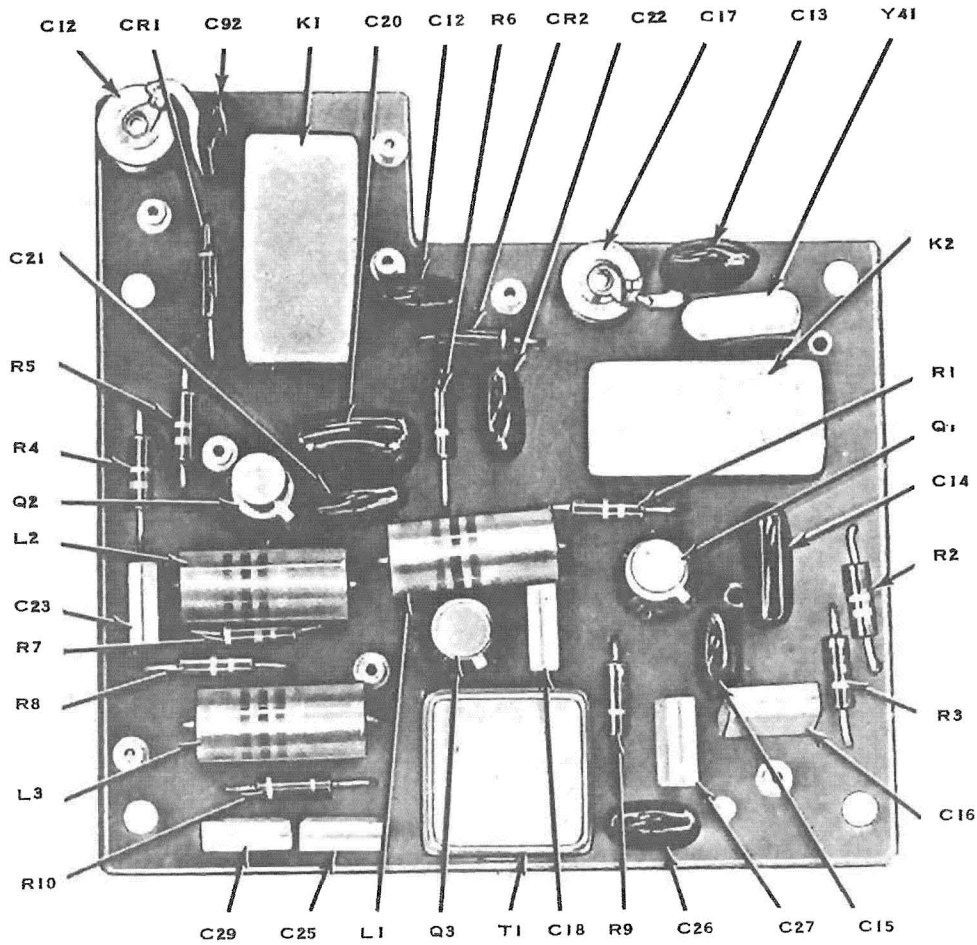
### 3-4. IF Audio Module

#### *a. Receive Test.*

- (1) Connect a 500-ohm,  $\frac{1}{2}$ -watt resistor between terminal 1 lead of TB202 (figs. 3-12 and 3-13) and ground.
- (2) Connect Multimeter ME-26B/U (or

equivalent) across the 500-ohm load resistor.

- (3) Connect signal generator No. 1 (or equivalent) through a 20-db match pad (fig. 3-1) to J401 and set it to 1.749 mc at 30 microvolts.
- (4) Connect signal generator No. 2 (or equivalent) to J402 and set to 1.750 mc at 1-volt rms output.
- (5) Connect a voltage divider, consisting of a 1K-ohm resistor and 2K-ohm potentiometer (fig. 3-12), across the output of Power Supply PP-4838/U No. 1 (or equivalent).

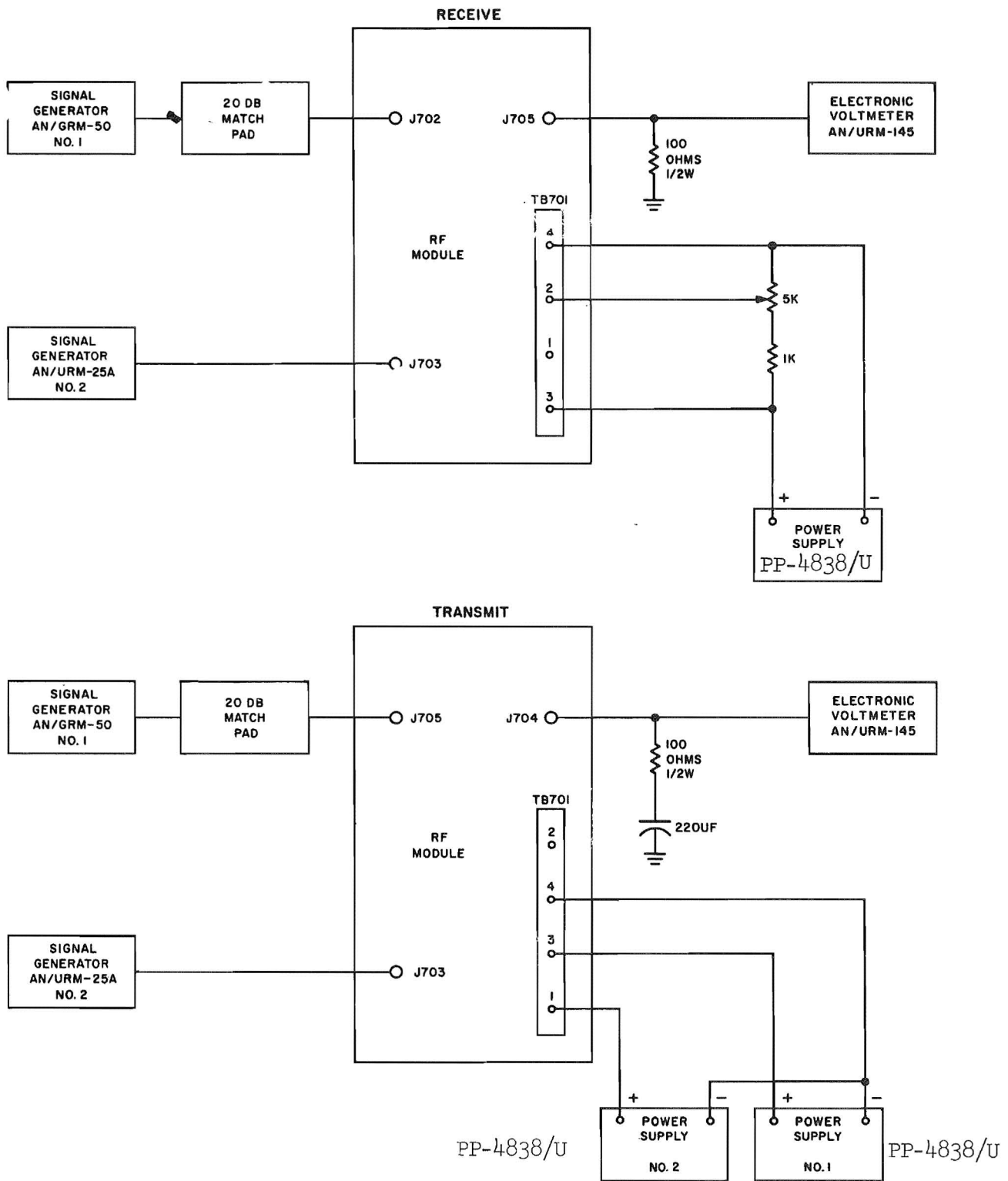


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Figure 3-7. Circuit board A5, location of components.

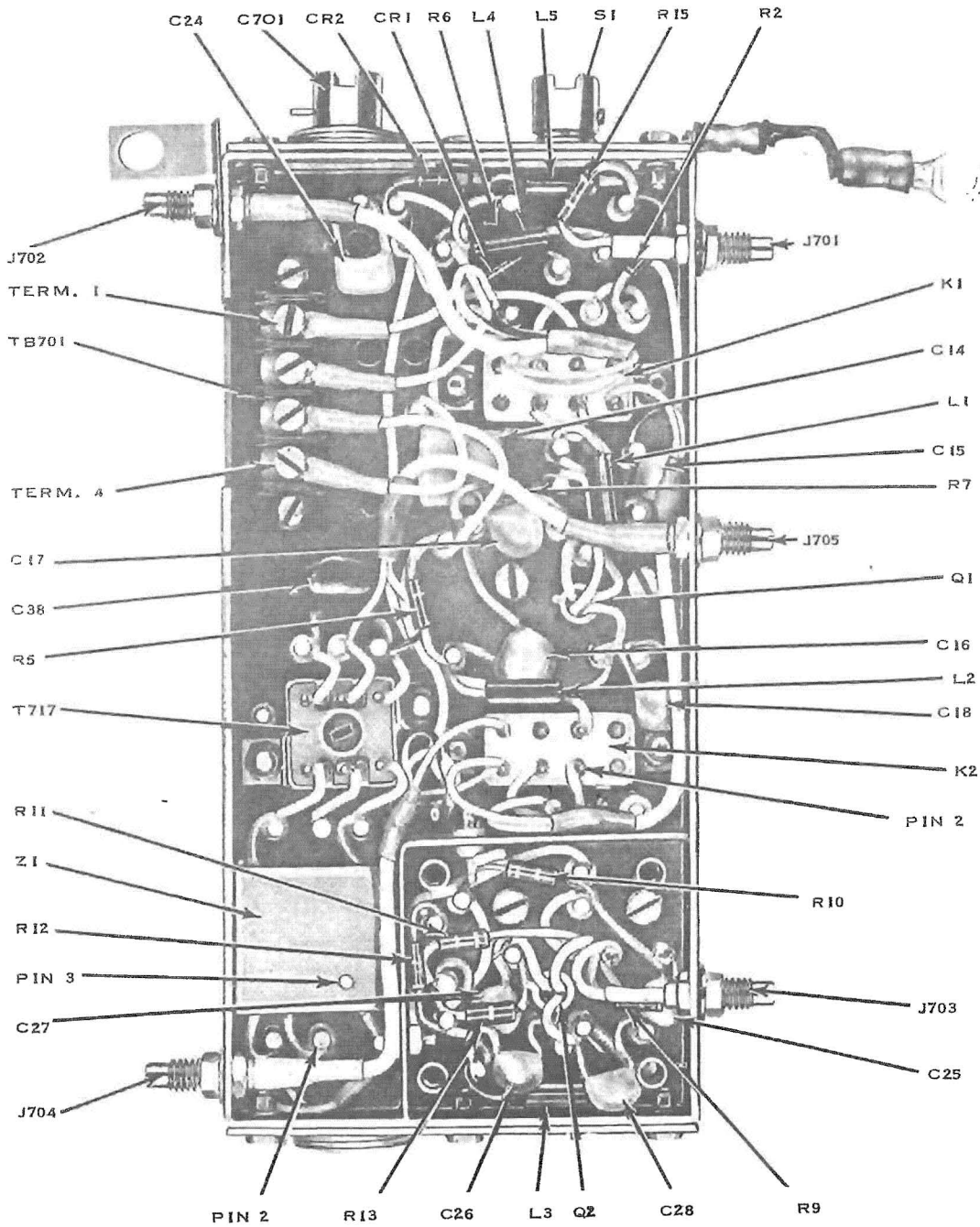
- (6) Connect the arm of the 2K-ohm potentiometer to terminal 7 lead of TB202.
- (7) Connect the positive terminal of power supply No. 1 to terminal 2 of TB202.
- (8) Set power supply No. 1 for an output of +9 volts  $\pm 5$  percent, 50 ma.
- (9) Adjust the 2K-ohm potentiometer for maximum audio output.
- (10) Check to see that audio output, as indicated on the voltmeter, is 1 volt or greater.
- (11) Connect Power Supply PP-4838/U No. 2 (or equivalent) between terminal 3 lead of TB202 and ground (fig. 3-12).
- (12) Set power supply No. 2 for an output of 12 volts  $\pm 10$  percent, 500 ma.
- (13) Check to see that audio output, as indicated on the voltmeter, is 1 volt rms or greater.
- (14) If the audio output is not as indicated, perform alignment instructions for the IF audio module (para 3-24).





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Figure 3-8. RF module troubleshooting test setup.

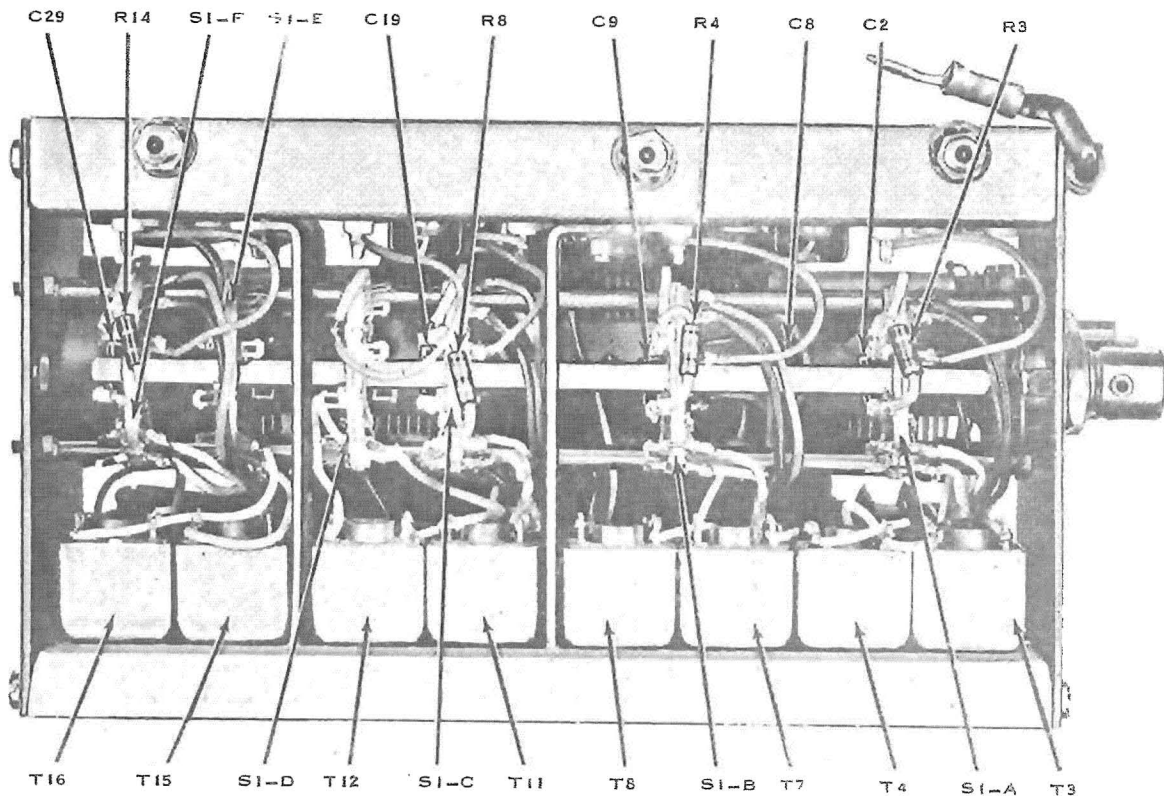


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Figure 3-9. RF module, top view.

(15) If the IF audio module cannot be aligned as indicated, check it as follows:

(a) If an output of 1 volt or greater was not obtained during the receive troubleshooting test of the IF audio



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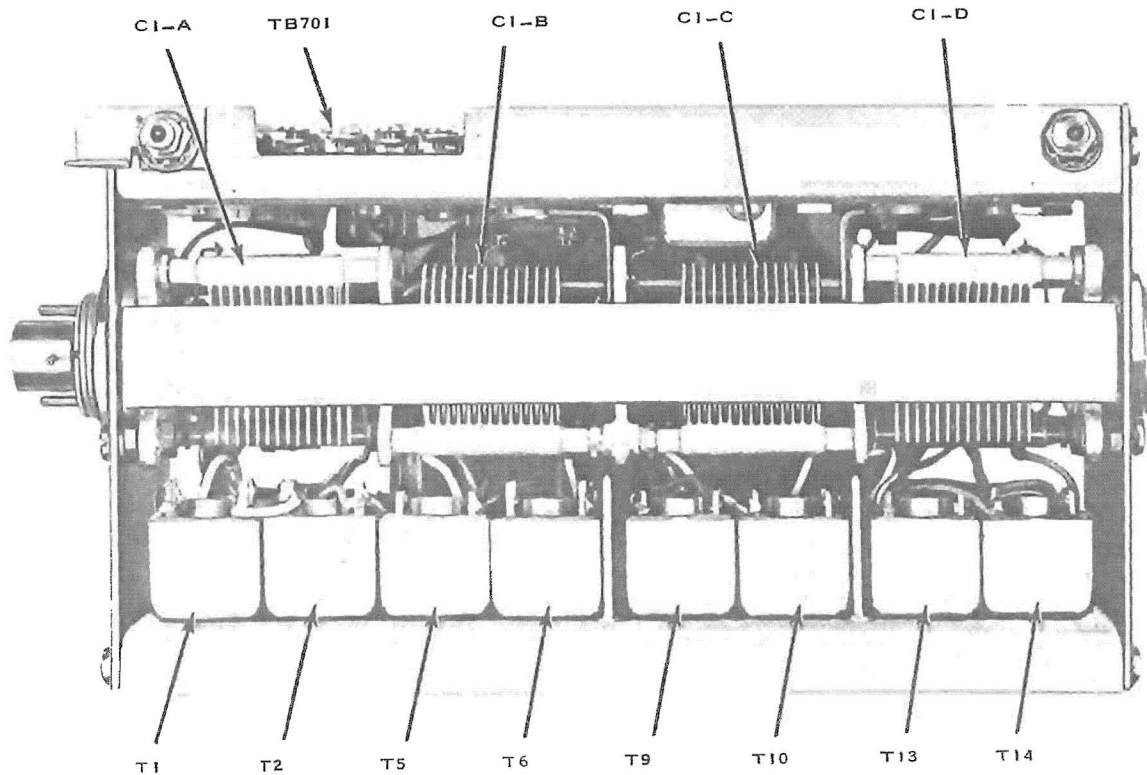
Figure 3-10. RF module, left-hand view.

module, IF audio amplifier circuit A1 is defective.

- (b) Check IF audio amplifier circuit A1 for defective components. Replace defective components as required (para 3-13).

b. *Transmit Test.*

- (1) Connect a 100-ohm, 1/2-watt resistor to J401 (figs. 3-12 and 3-13).
- (2) Connect Electronic Voltmeter AN/URM-145 (or equivalent) across the load.
- (3) Connect Signal Generator AN/URM-25A (or equivalent) to J402 and set to 1.750 mc at 1 volt rms.
- (4) Connect a 500-ohm load resistor between terminal 1 lead of TB 202 and ground.
- (5) Connect Multimeter ME-26B/U (or equivalent) across the load resistor.
- (6) Connect a voltage divider consisting of a 1K-ohm resistor and a 2K-ohm potentiometer (fig. 3-12) across the output of Power Supply PP-4838/U No. 1 (or equivalent).
- (7) Connect the arm of the 2K-ohm potentiometer to terminal 7 lead of TB202.
- (8) Connect the positive terminal of power supply No. 1 to terminal 2 of TB202.
- (9) Connect Power Supply PP-4838/U (No. 2) between terminal 4 lead of TB202 and ground.



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Figure 3-11. RF module, right-hand view.

- (10) Adjust power supply No. 1 for +9 volts and power supply No. 2 for +12 volts.
- (11) See that the IF output across the 100-ohm load resistor is 26 millivolts minimum.
- (12) See that the audio output across the 500-ohm load resistor is 300 to 600 millivolts.
- (13) Connect Audio Oscillator TS-382/U (or equivalent) between terminal 9 (audio) lead and terminal 10 (ground) lead of TB202.
- (14) Set audio oscillator to 1 kc at 1.2 millivolts.
- (15) Connect terminal 6 lead of TB202 to ground.
- (16) See that the IF output across the 100-ohm load is 26 millivolts  $\pm$  10 percent.
- (17) If any of the above output indications are not as specified, leave test equipment as connected and perform alignment instructions for the IF module (para 3-24).
- (18) If the IF audio module cannot be aligned as indicated, check it as follows:
  - (a) If an IF output of 26 millivolts minimum was not obtained at J401 or an output of 300 to 600 millivolts was not obtained at terminal 1 of TB202, microphone amplifier mixer circuit A2 is defective.

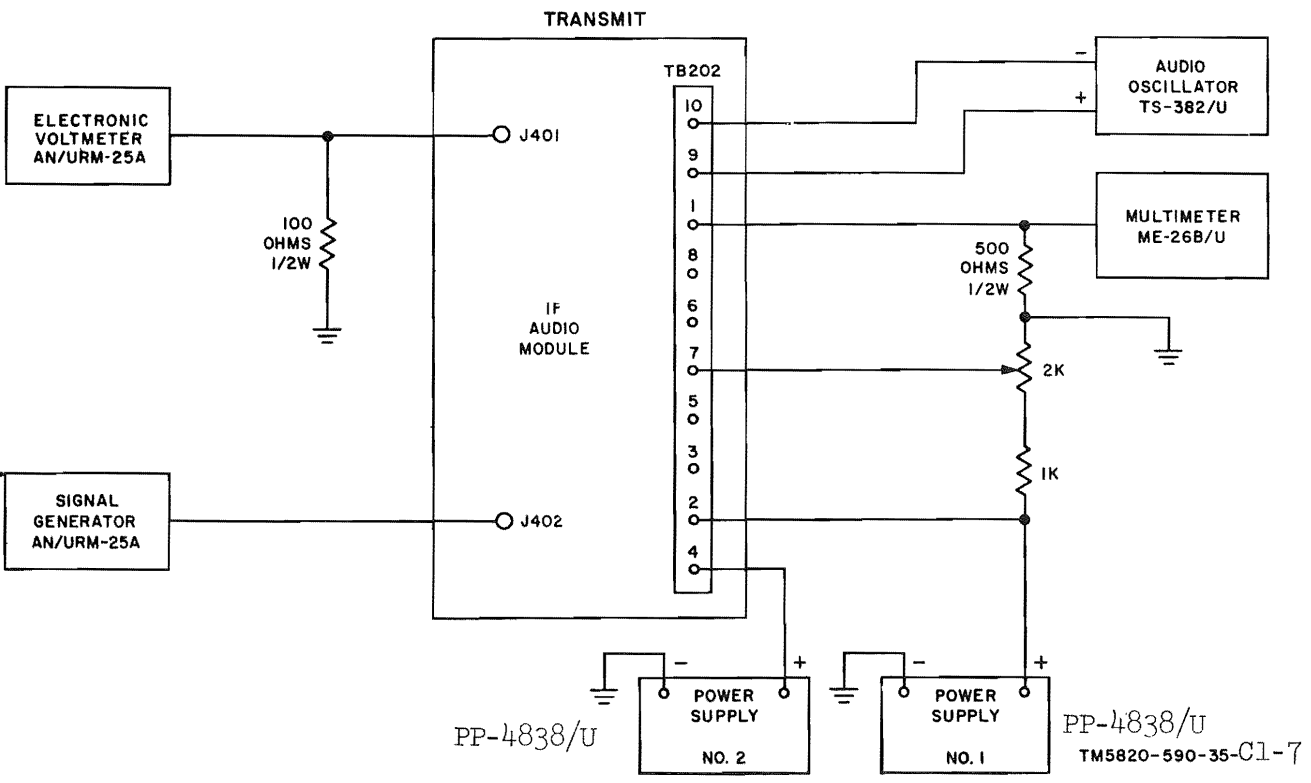
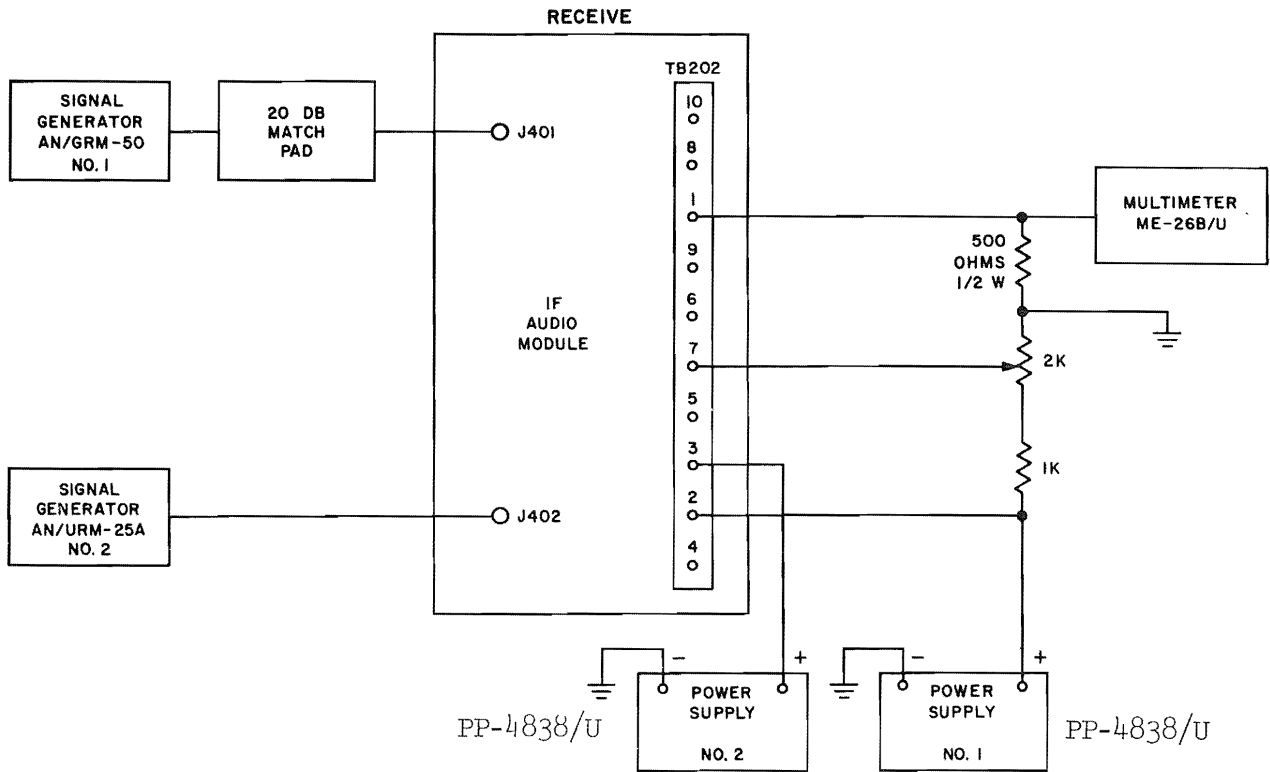
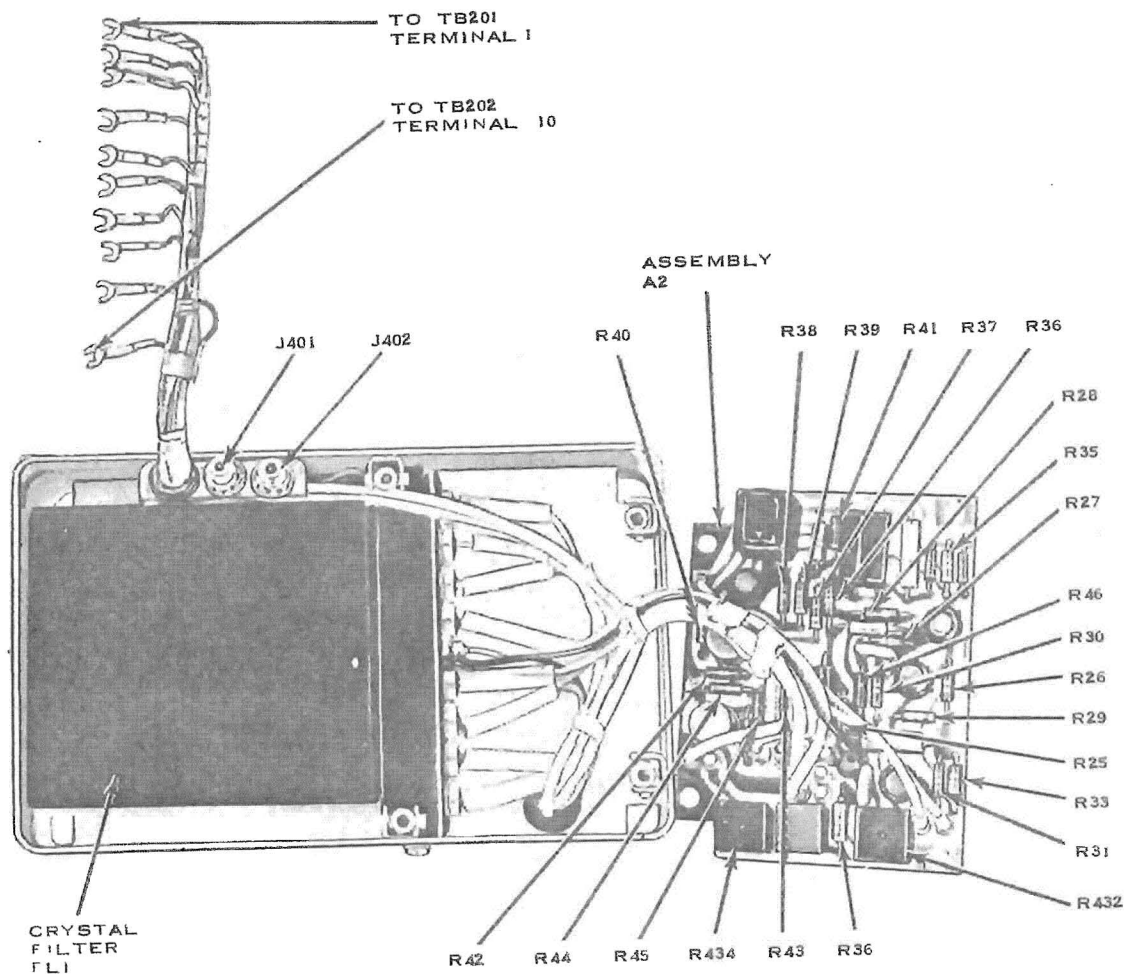


Figure 3-12. IF audio module test setup.



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Figure 3-13. IF audio module, front view component boards removed.

- (b) Check microphone amplifier mixer circuit A2 for defective components. Check for defective relays K1, K2, and K3 (fig. 3-34). Replace defective components as required (para 3-13).

### 3-5. Frequency Generator Module

a. Connect a 100-ohm, 1/2-watt resistor between P501 and ground and another 100-ohm resistor between P502 and ground (figs. 3-14 and 3-15).

b. Connect Oscilloscope AN/USM-164 (or equivalent) across the load resistor at P501.

c. Connect Frequency Meter AN/USM-26 (or equivalent) to the vertical output of the oscilloscope.

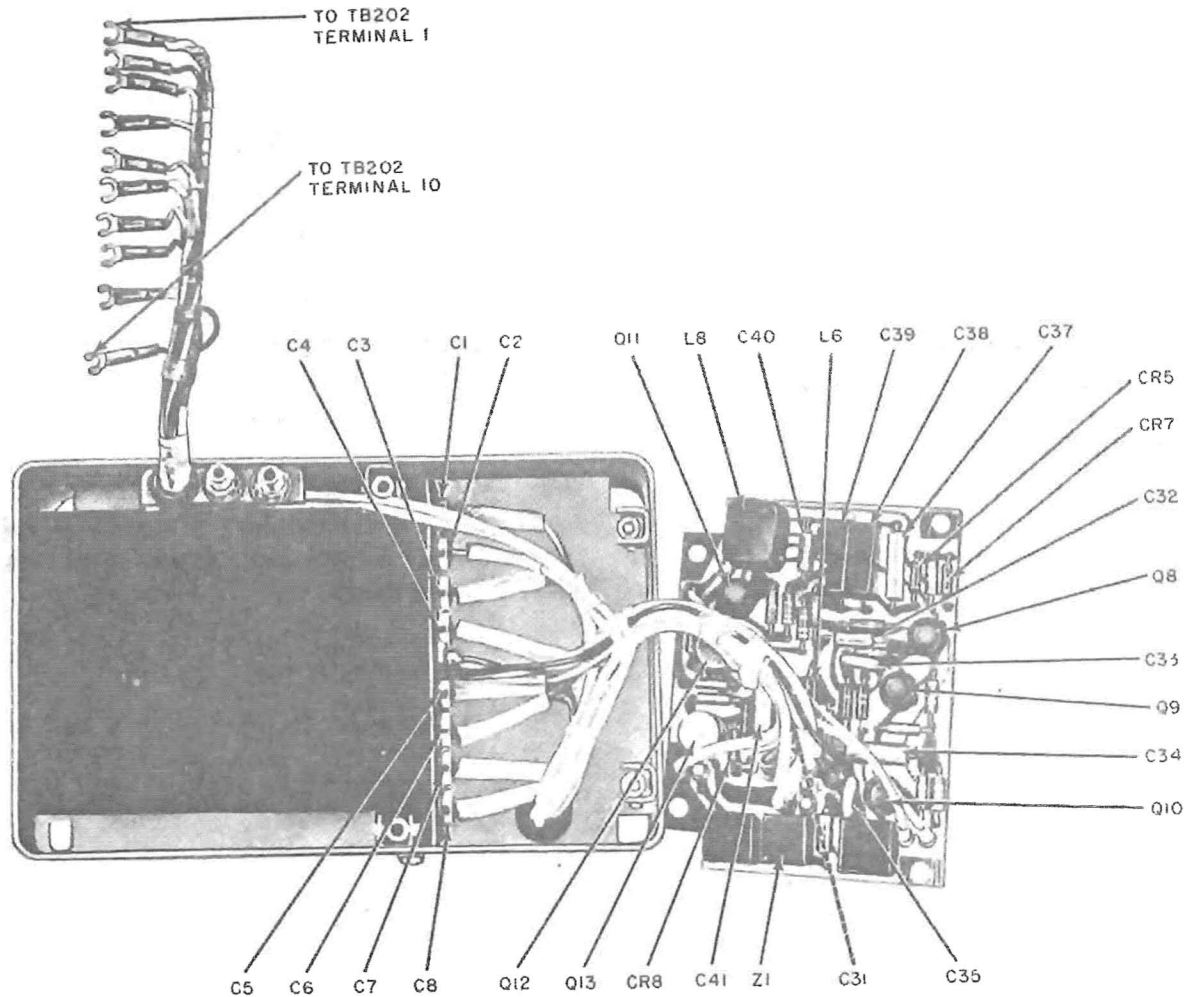
d. Connect Electronic Voltmeter AN/URM-145 across the load resistor connected to P501.

e. Connect Power Supply PP-4838/U No. 1 (or equivalent) across terminal 3(-) and terminal 1(+) of TB501.

f. Set power supply No. 1 for an output of +12 volts  $\pm$ 10 percent.

g. Connect Power Supply PP-4838/U No. 2 (or equivalent) across terminal 3(-) and terminal 2(+) of TB501.

h. Set power supply No. 2 for an output of +9 volts  $\pm$ 5 percent.



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Figure 3-13 — Continued.

*i.* Check for an output frequency of 1,750 kc  $\pm$ 10 cps at a level of 1.0 volt rms  $\pm$ 10 percent on the frequency meter. If the indication is not correct, proceed to *l* below.

*j.* Except for the load resistor, disconnect the test equipment from P501 and connect it in the same manner as P501 to P502.

*k.* Check for an output pulse with a duration of 1.25 microseconds  $\pm$ 0.25 and repetition rate of 10 kc  $\pm$ 1.0 cps as measured on the frequency meter. Pulse amplitude should be 0.7 volt peak to peak  $\pm$ 10 percent.

*l.* If the frequency generator output is not as indicated in *i* or *k* above, leave test equipment

as connected and perform alignment instructions (para 3-25).

*m.* If the frequency generator can not be aligned as indicated, check the frequency generator module as follows:

- (1) If an output as indicated in *i* above was not obtained at P501, the frequency standard is defective.
- (2) Check the frequency standard for defective circuit components. Replace defective components as required (para 3-15).

- (3) If an output as indicated in *k* above is not obtained at P502, the frequency divider is defective.
- (4) Replace the frequency divider (para 3-16) and return to depot maintenance.

**3-6. Power Amplifier Module** (HAC Part No. 1541057-100)

- a. Connect Signal Generator AN/GRM-50 (or equivalent) to P801 (figs. 3-16-3-20).
- b. Set the signal generator for an output frequency of 2 mc at 60 millivolts.
- c. Connect a 50-ohm, 20-watt dummy load and Multimeter ME-26B/U (or equivalent) to the opposite ends of a T-connector and connect the leg of the T-connector to E50 of the power amplifier module.
- d. Connect the positive lead of Multimeter TS-352A/U (or equivalent) (set up as an am-

meter) to terminal 1 of TB801 and the negative lead to ground.

e. Connect PP-4838/U No. 1 (or equivalent) to terminals 3(+) and 6(-) of TB801 and set to +12 volts  $\pm$ 5 percent, 200 ma.

f. Apply +9 volts  $\pm$ 5 percent, 40 ma power supply No. 2 output to terminals 4(+) and 6(-) of TB801.

g. Apply +40 volts  $\pm$ 5 percent, 1 ampere power supply No. 3 output to terminals 5(+) and 6(-) of TB801.

h. Adjust S1 (attached to L815) and C820 for maximum output on the ME-26B/U.

i. See that the TS-352A/U indicates an output of 0.5 to 1.0 milliamperes, and that the ME-26B/U indicates at least 24.5 volts rms.

j. Repeat the procedure given in *h* and *i* above for signal generator inputs as shown in the following chart.

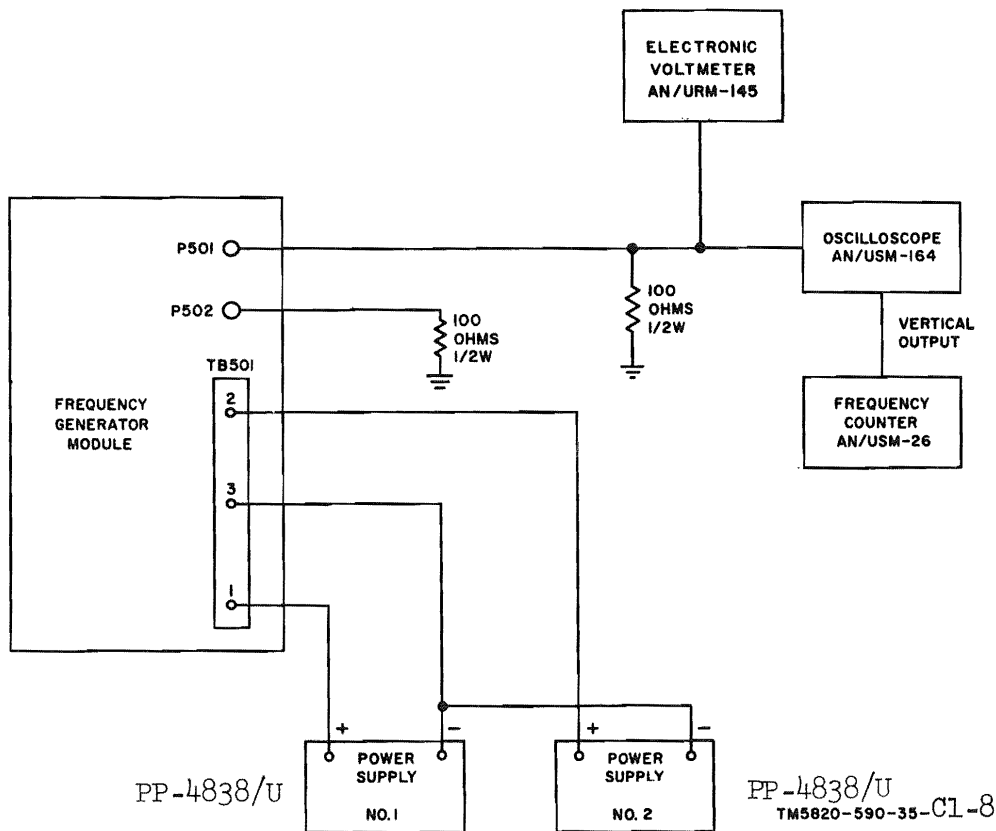
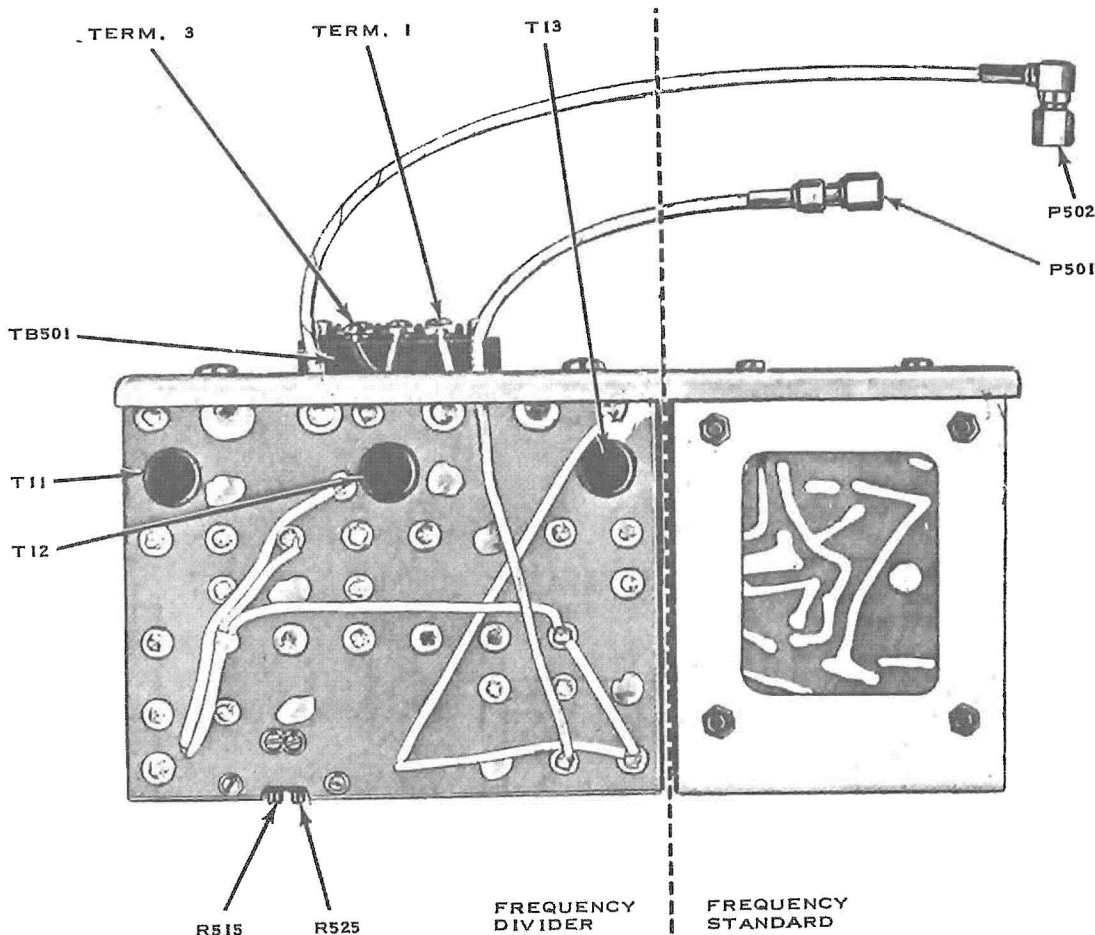


Figure 3-14. Frequency generator test setup.





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Figure 3-15. Frequency generator module, rear view.

Signal generator input	Multimeter indications
2 mc at 60 millivolts .....	0.5-1.0 ma, and 24.5
4 mc at 60 millivolts .....	volts rms for all fre-
8 mc at 60 millivolts .....	quencies.
12 mc at 60 millivolts .....	

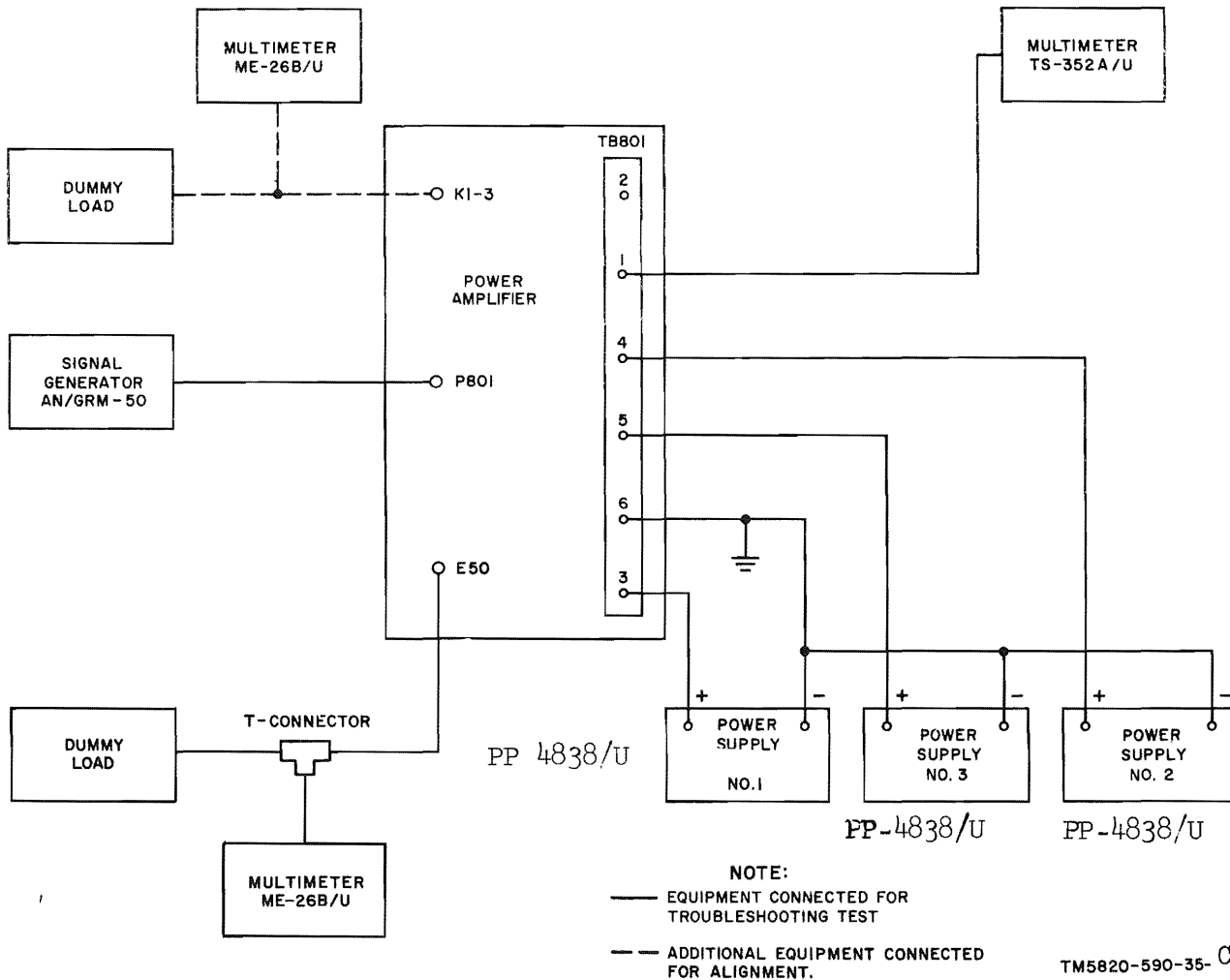
k. If the multimeter readings are not as indicated, perform alignment instructions for the power amplifier module (para 3-26).

l. If the power amplifier cannot be aligned as indicated, check the power amplifier module as follows:

- (1) Connect a 100-ohm, 20-watt load to pin 3 of K1 (fig. 3-20).

- (2) Insert a teflon strip between pins 2 and 3 of K1 so that pins will not make contact when K1 is energized.
- (3) Set the signal generator for an output of 6 mc at 20 to 40 millivolts.
- (4) Connect Voltmeter AN/URM-145 (or equivalent) between the yellow primary wire of T1 and ground.
- (5) Check for an indication of 2.1 volts on AN/URM-145.
- (6) If the gain is low, check for defective components in the preamplifier. Approximate emitter voltage of Q1, Q2, Q3, and Q4 (fig. 3-18) should be 1 volt dc, 2.5 volts dc, 2.25 volts dc, and 1.35 volt dc. Replace defective transistors.

- (7) Disconnect the AN/URM-145.
- (8) Disconnect the 100-ohm load and teflon strip from pin 3 of K1.
- (9) Connect the TS-352A/U in series with the positive lead of the power supply and terminal 5 of TB801.
- (10) Disconnect the signal generator from P801.
- (11) See that the TS-352A/U does not indicate a current reading of more than 100 ma.
- (12) If the current measurement is above 100 ma, check for defective transistor Q5 or Q6 or bias network R16 and R17 (fig. 3-20).
- (13) If no current measurement is obtained, check for defective circuit components.
- (14) Connect the signal generator to P801 and set for an output of 6 mc at 30 millivolts.
- (15) Check for current reading of 650 ma. to 1 ampere on the TS-352A/U.
- (16) If the current measurement is above or below the current range, check for defective transistor Q5 or Q6.



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Figure 3-16. Power amplifier module, test setup  
(HAC Part No. 1541057-100).

### 3-6.1 Power Amplifier Module

(1541057-101)

(figs. 3-20.1 through 3-20.5)

a. Connect test equipment to the power amplifier module as shown in figure 3-20.1.

b. Set Power Supply PP-4838/U No. 1 to  $\pm 12.0$  volts  $\pm 0.6$ , 200 ma.

c. Set power supply No. 2 to  $+9.0$  volts  $\pm 0.45$ , 400 ma.

d. Set power supply No. 3 to  $+40$  volts  $\pm 2$ , 1 ampere.

e. Set Signal Generator AN/GRM-50 to 2 mc at 10 mv.

f. Set Multimeter TS-352A/U No. 1 to the 1-MA scale, Multimeter TS-352A/U No. 2 to the 10-VDC scale, and Multimeter TS-352A/U No. 3 to the 1,000-MA scale.

g. Adjust the signal generator output level control for a reading of 850 ma on multimeter No. 3.

h. Adjust S801 (fig. 3-20.2) and C820 (fig. 3-20.2) for a maximum reading on multimeter No. 1.

i. Adjust the signal generator output level control for a reading of 24.5 volts ac on Multimeter ME-26B/U.

j. The input level from the signal generator must be equal to or less than 100 mv.

k. Multimeter No. 1 must indicate 0.5 to 1.0 ma.

l. Multimeter No. 3 must indicate 850 (+0, -150) ma.

m. Repeat *g* through *l* above for each of the following frequencies: 3 mc, 5 mc, 8 mc, and 12 mc.

n. Reduce the output of power supply No. 3 to  $+30$  volts. Multimeter ME-26B/U must indicate less than 5 volts ac.

o. If the multimeter readings are not within tolerance, perform the alignment procedure for the power amplifier module (para 3-27).

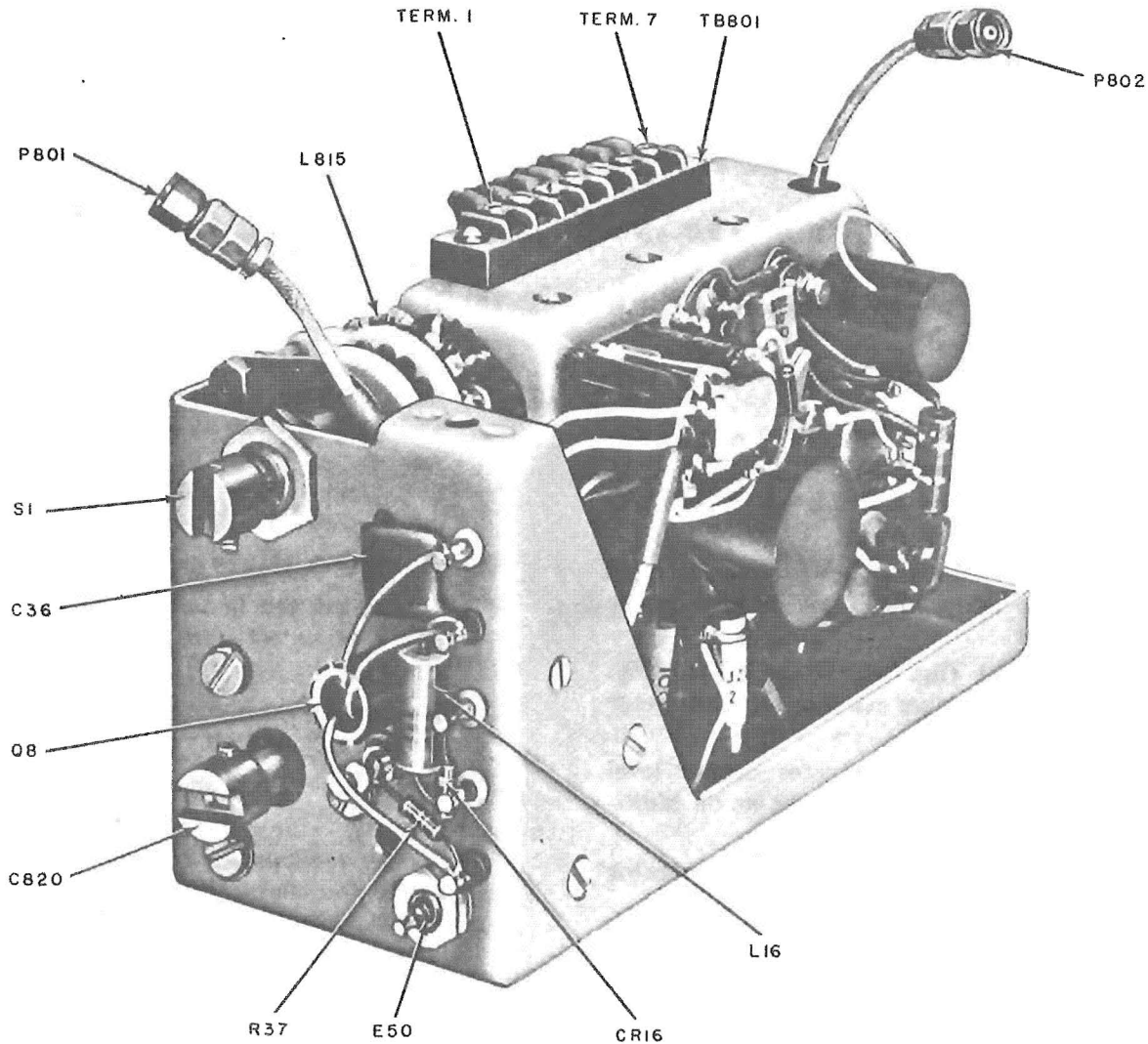
p. If the power amplifier cannot be aligned, check the power amplifier module as follows:

- (1) Unsolder wire from pin A2 of relay K1 (fig. 3-20.5), and connect a 100-ohm, 20-watt load between pin A2 and ground.

- (2) Turn on all power supplies.
- (3) Set the signal generator for an output of 6 mc at 20 to 40 mv.
- (4) Connect Multimeter ME-26B/U (or equivalent) between the yellow primary winding of transformer T1 (fig. 3-20.5) and ground. The multimeter indication must be approximately 2.1 volts ac.
- (5) If the multimeter indication in (4) above is low, check for defective components in the preamplifier. Approximate emitter voltages of Q1, Q2, Q3, and Q4 (fig. 3-20.3) must be  $+1$  volt,  $+2.5$  volts, and  $+2.25$  volts, and  $+1.35$  volt, respectively. Replace defective transistors.
- (6) Disconnect Multimeter ME-26B/U.
- (7) Disconnect the 100-ohm load and solder wire to K1, pin A2 (from FL1, pin 1).
- (8) Disconnect the signal generator from P801 (fig. 3-20.4).
- (9) Multimeter No. 3 must read less than 100 ma.
- (10) If the multimeter indication in (9) above is greater than 100 ma, check for defective transistor Q5 or Q6, or bias network R16 and R17 (fig. 3-20.5).
- (11) If no current flow is indicated in (9) above, check for defective circuit components (R16, R17).
- (12) Connect the signal generator to P801 (fig. 3-20.4) and set the output for 6 mc at 30 mv.
- (13) Multimeter No. 3 should read between 650 and 1,000 ma.
- (14) If the measurement in (13) above is not within tolerance, check for defective transistor Q5 or Q6 (fig. 3-20.5).

### 3-7. Power Supply Module

**Caution:** Do not turn off the power supply at J301 when the multimeter is connected.



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Figure 3-17. Power amplifier module (HAC Part No. 1541057-100).

a. Connect an 800-ohm, 4-watt resistor between the terminal 3 lead of TB201 of the power supply module (figs. 3-21, 3-22, and 3-23) and ground.

b. Connect an 900-ohm, 1/2-watt resistor between the terminal 7 lead of TB201 of the power supply and ground.

c. Connect Power Supply PP-4838/U (or equivalent) to pins 2 and 3(-) and 5 and 6(+) of J301, and set for an output of +10.5 volts.

d. Using a clip lead, connect the TB201 terminal 2 lead to the terminal 6 lead.

e. Measure the +9-volt output at terminal 7 lead, using Multimeter TS-352A/U (or equivalent).

f. Repeat the procedure given in a through e above, using the voltages, connections, and load resistances shown in the following chart. Voltage measured in e of the following chart should be +8.8 to +9.3 volts; other voltages should be within +0.5, to -0.25 volt of voltage measured in e of the chart.

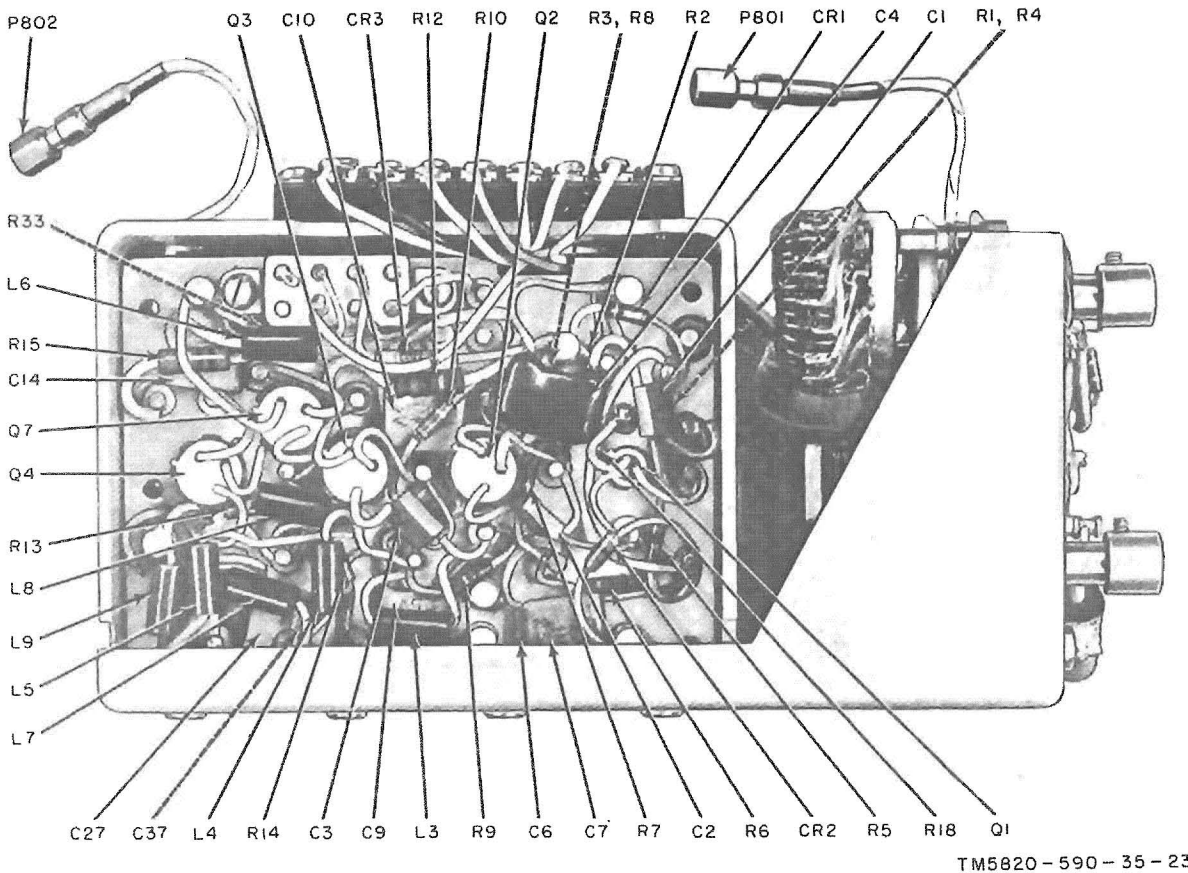


Figure 3-18. Power amplifier module, right-hand side (HAC Part No. 1541057-100).

Power supply (vdc)	Jumper between TB201-1 and TB201-8 (GND)	Load connected to TB201-7
10.5	a. Disconnected ..	a. 900 ohms, $\pm 5$ percent, $\frac{1}{2}$ watt
	b. Disconnected ..	b. 60 ohms, $\pm 5$ percent, 2 watts
	c. Connected .....	c. 20 ohms, $\pm 5$ percent, 10 watts
12.0	d. Disconnected ..	d. 900 ohms, $\pm 5$ percent, $\frac{1}{2}$ watt
	e. Disconnected ..	e. 60 ohms, $\pm 5$ percent, 2 watts (nominal)
	f. Connected .....	f. 20 ohms, $\pm 5$ percent, 10 watts
17.0	g. Disconnected ..	g. 900 ohms, $\pm 5$ percent, $\frac{1}{2}$ watt
	h. Disconnected ..	h. 60 ohms, $\pm 5$ percent, 2 watts
	i. Connected .....	i. 20 ohms, $\pm 5$ percent, 10 watts

g. If the voltage measured is not within the specified range, check for defective Q5 and associated components. Base voltage at transistor Q5 should be approximately +9.7 volts, emitter voltage should be approximately 9.2 volts.

h. Turn the power supply off.

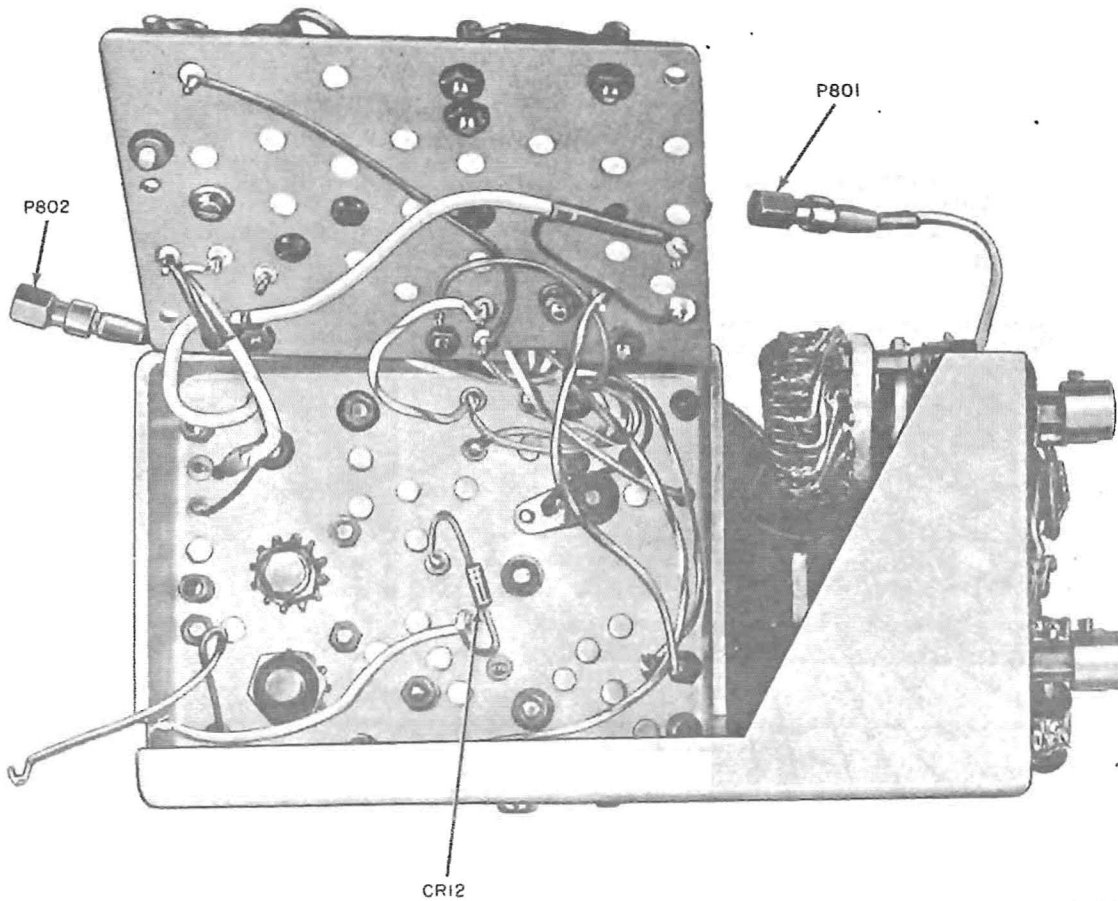
i. Connect a 900-ohm, 1/2-watt resistor between the terminal 7 lead of TB201 and ground.

j. Connect a jumper between pins 1 and 8 of TB201.

k. Turn the power supply on and set to +10.5 volts.

l. Measure the 40-volt output at the terminal 3 lead with the multimeter.

m. Repeat the procedure given in h through l above, using the voltages, connections, and



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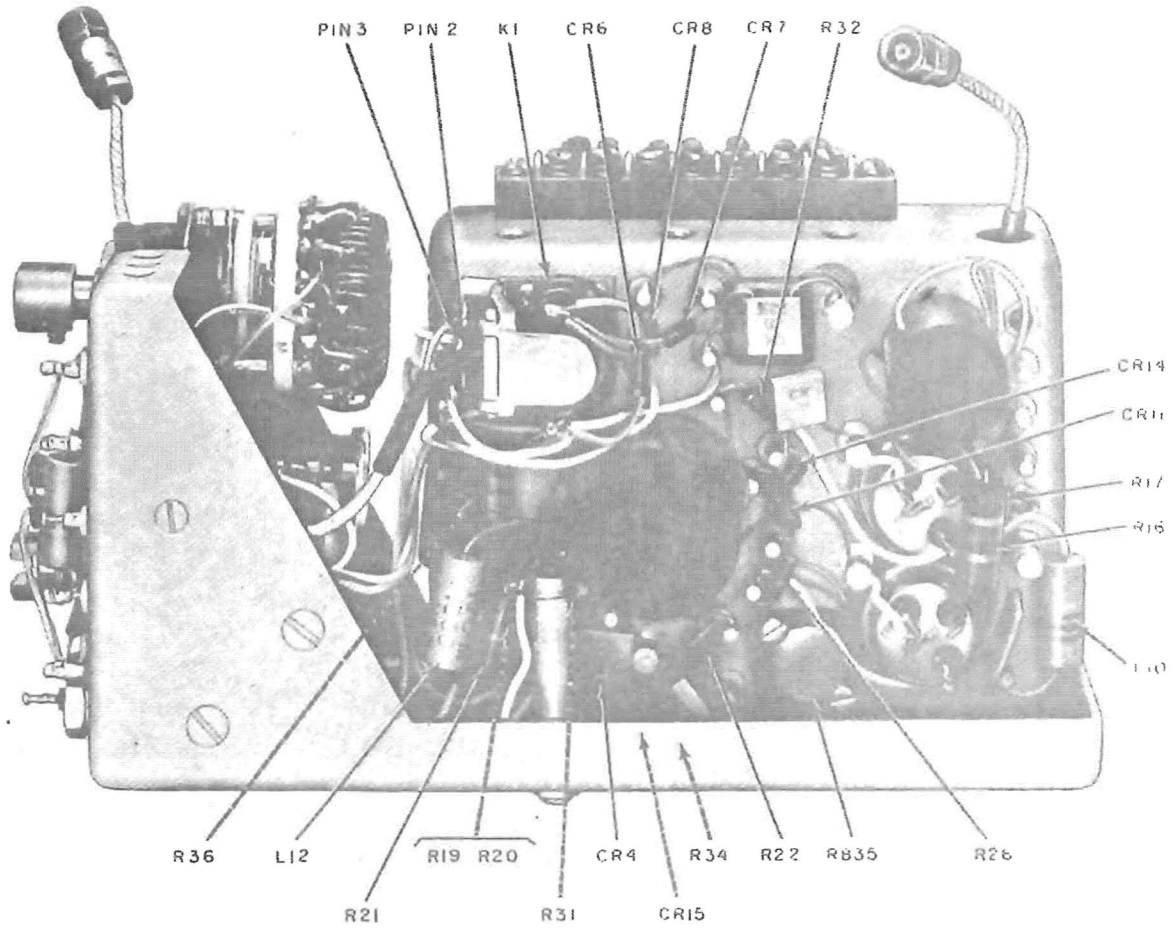
Figure 3-19. Power amplifier module, right side, component board removed  
(HAC Part No. 1541057-100)

load resistances as shown in the following chart. Voltage measured in e of the following chart should be +38 to +42 volts; other voltages should be within  $\pm 2$  volts of the voltage measured in e of the chart.

Power supply voltage (vdc)	Load connected to TB201-3
10.5	a. 800 ohms, $\pm 5$ percent, 4 watts b. 80 ohms, $\pm 5$ percent, 25 watts
12.0	c. 40 ohms, $\pm 5$ percent, 50 watts d. 800 ohms, $\pm 5$ percent, 4 watts

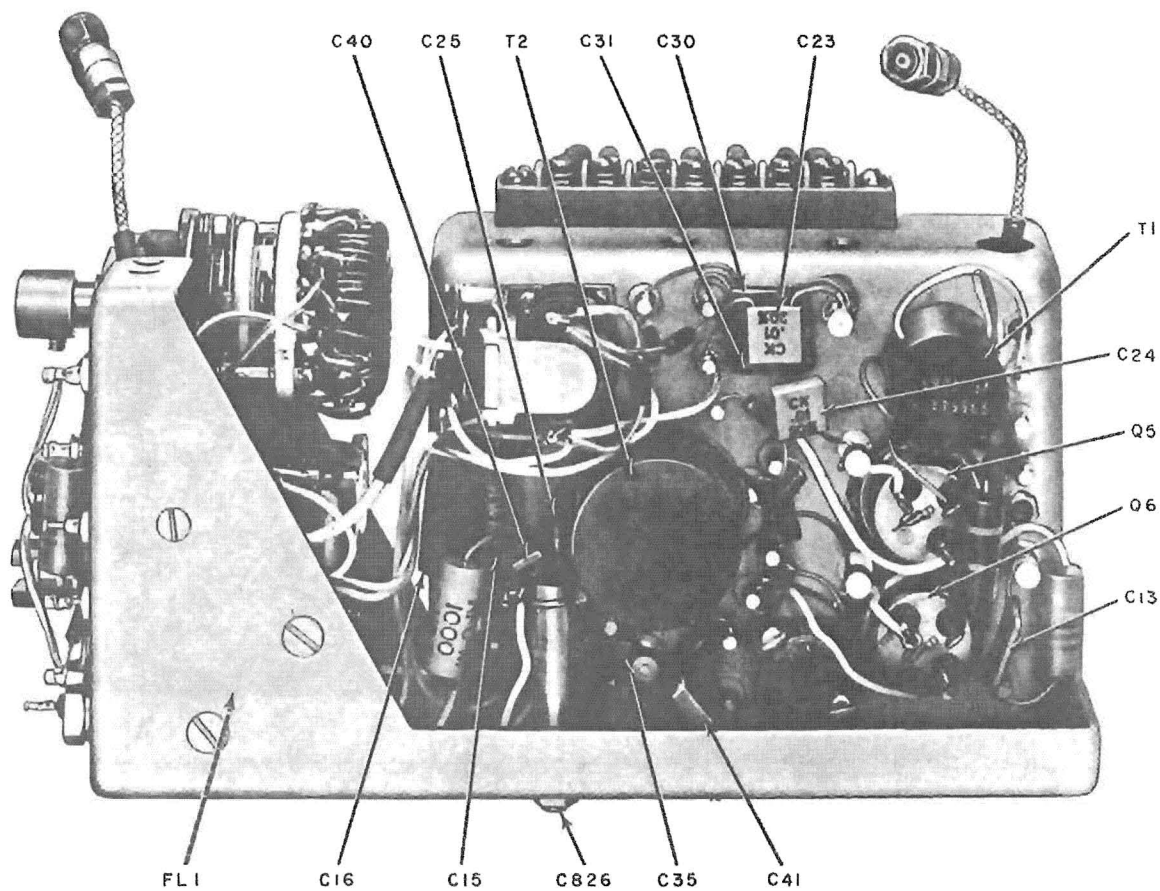
Power supply voltage (vdc)	Load connected to TB201-3
17.0	e. 80 ohms, $\pm 5$ percent, 25 watts f. 40 ohms, $\pm 5$ percent, 50 watts g. 800 ohms, $\pm 5$ percent, 4 watts h. 80 ohms, $\pm 5$ percent, 25 watts i. 40 ohms, $\pm 5$ percent, 50 watts

n. If the voltage measured is not within the range specified, check for defective transistor Q3, Q4, or Q6. Also check for defective R3 and/or defective CR5.



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Figure 3-20. Power amplifier module, left-hand side  
(HAC Part No. 1541057-100).



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Figure 3-20 — Continued.



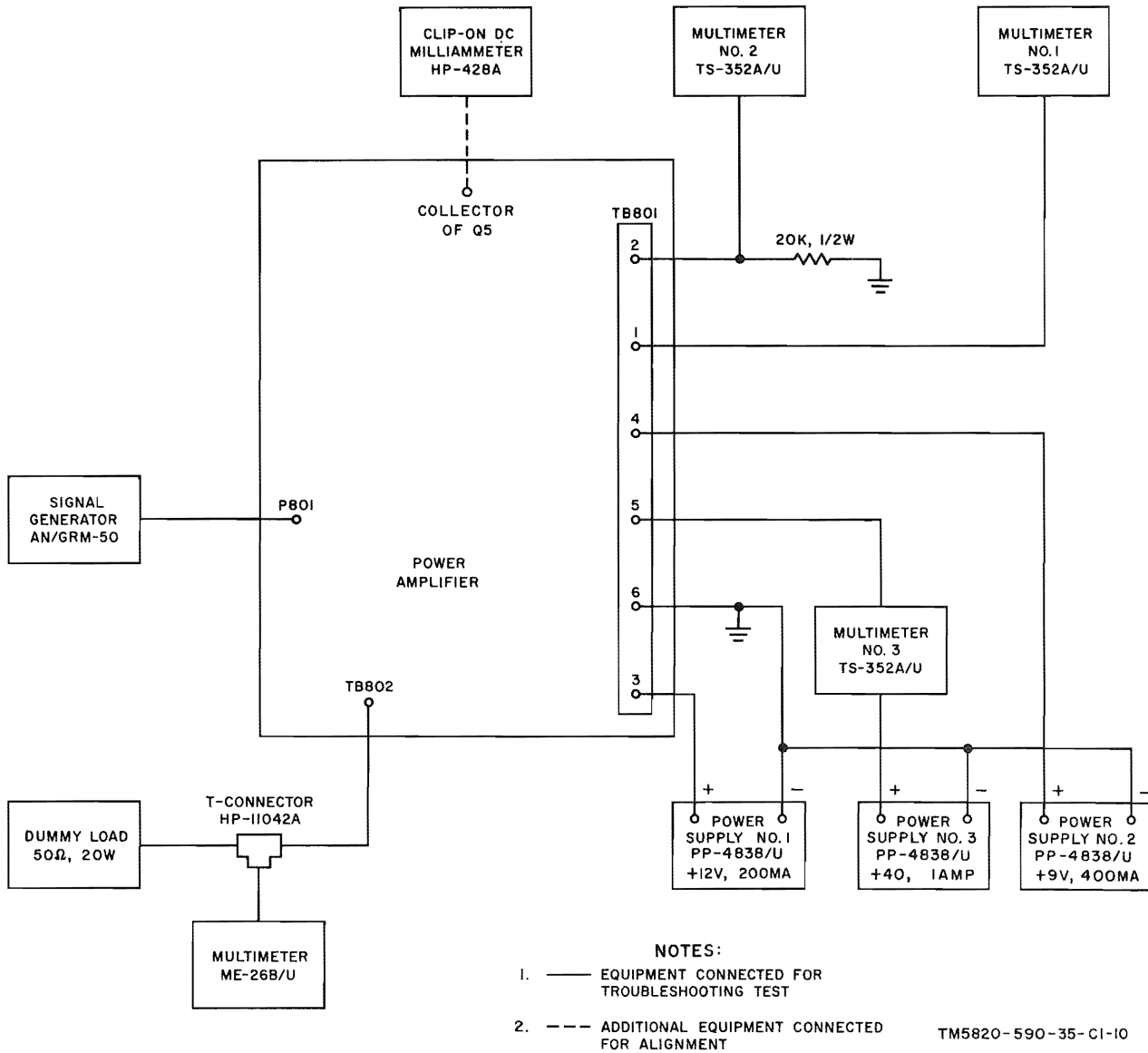
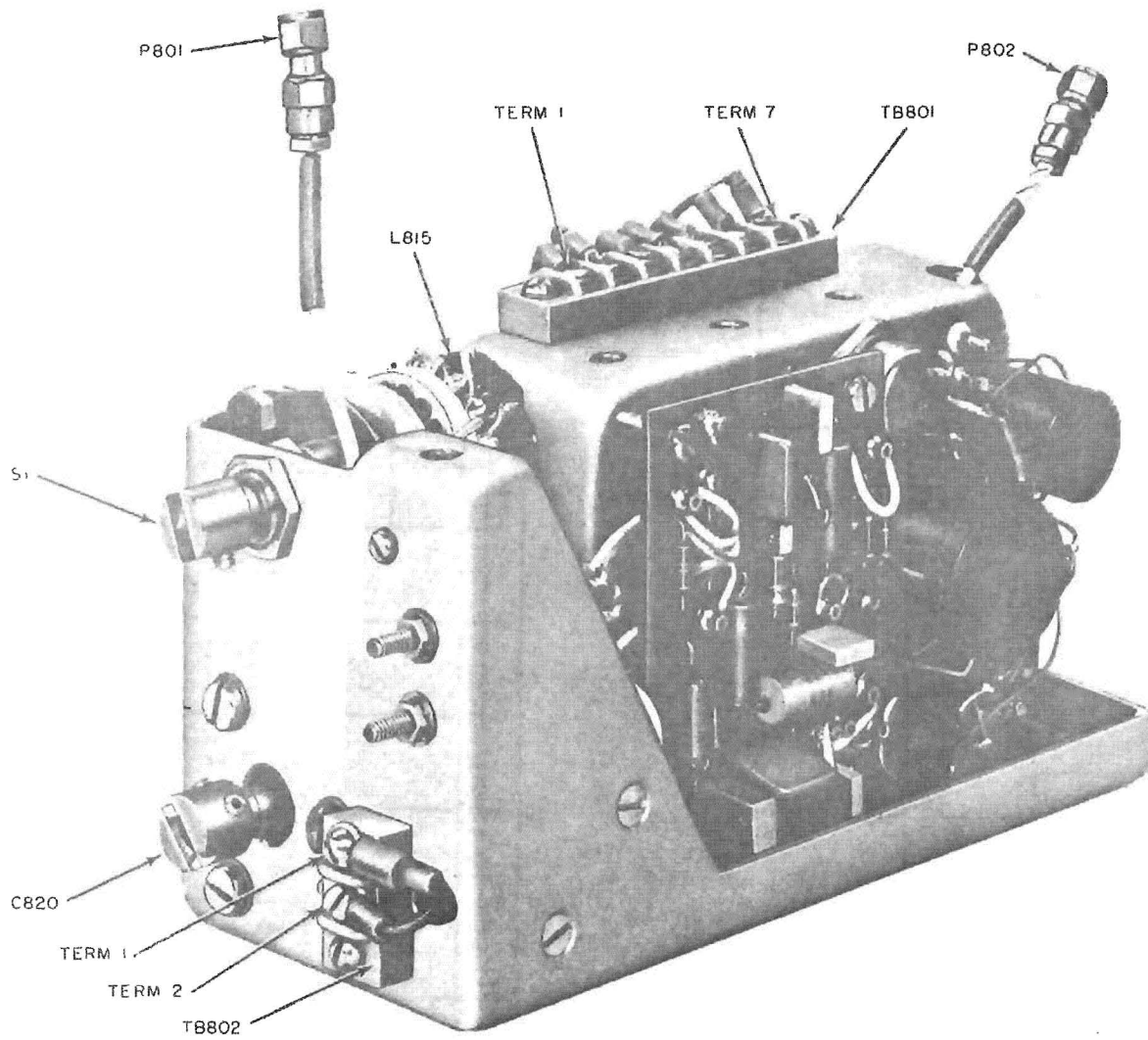
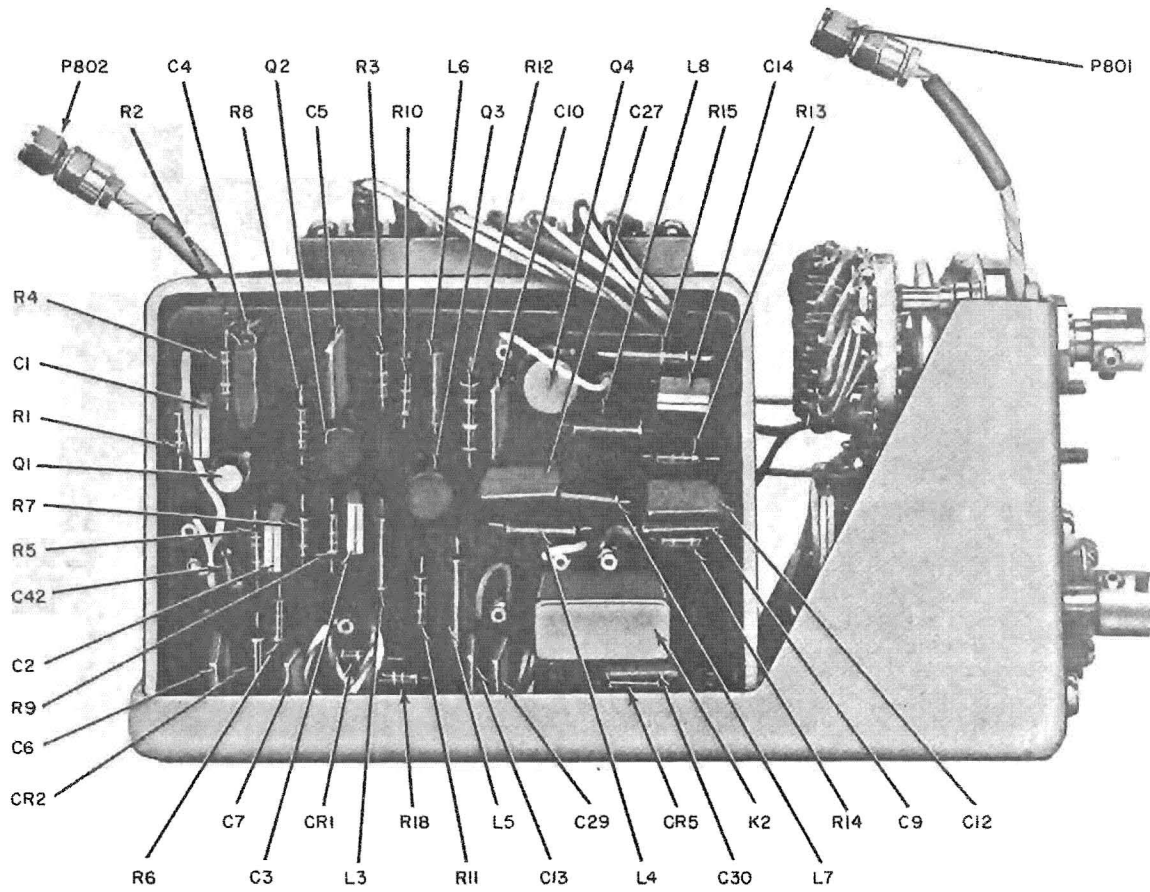


Figure 3-20.1 Power amplifier module test setup  
(HAC Part No. 1541057-101)



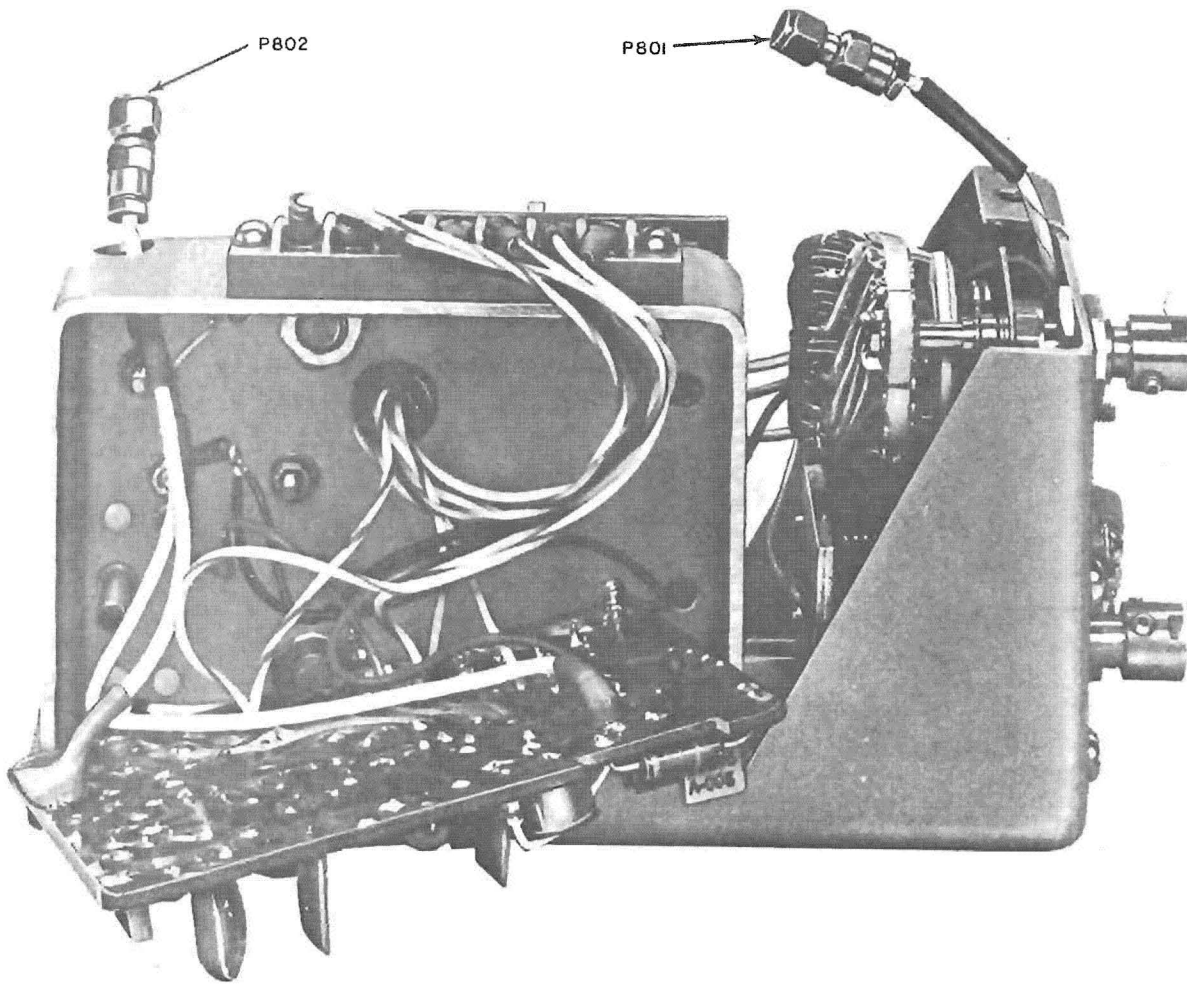
TM5820-590-35-C1-11

*Figure 3-20.2 Power amplifier module  
(HAC Part No. 1541057-101)*



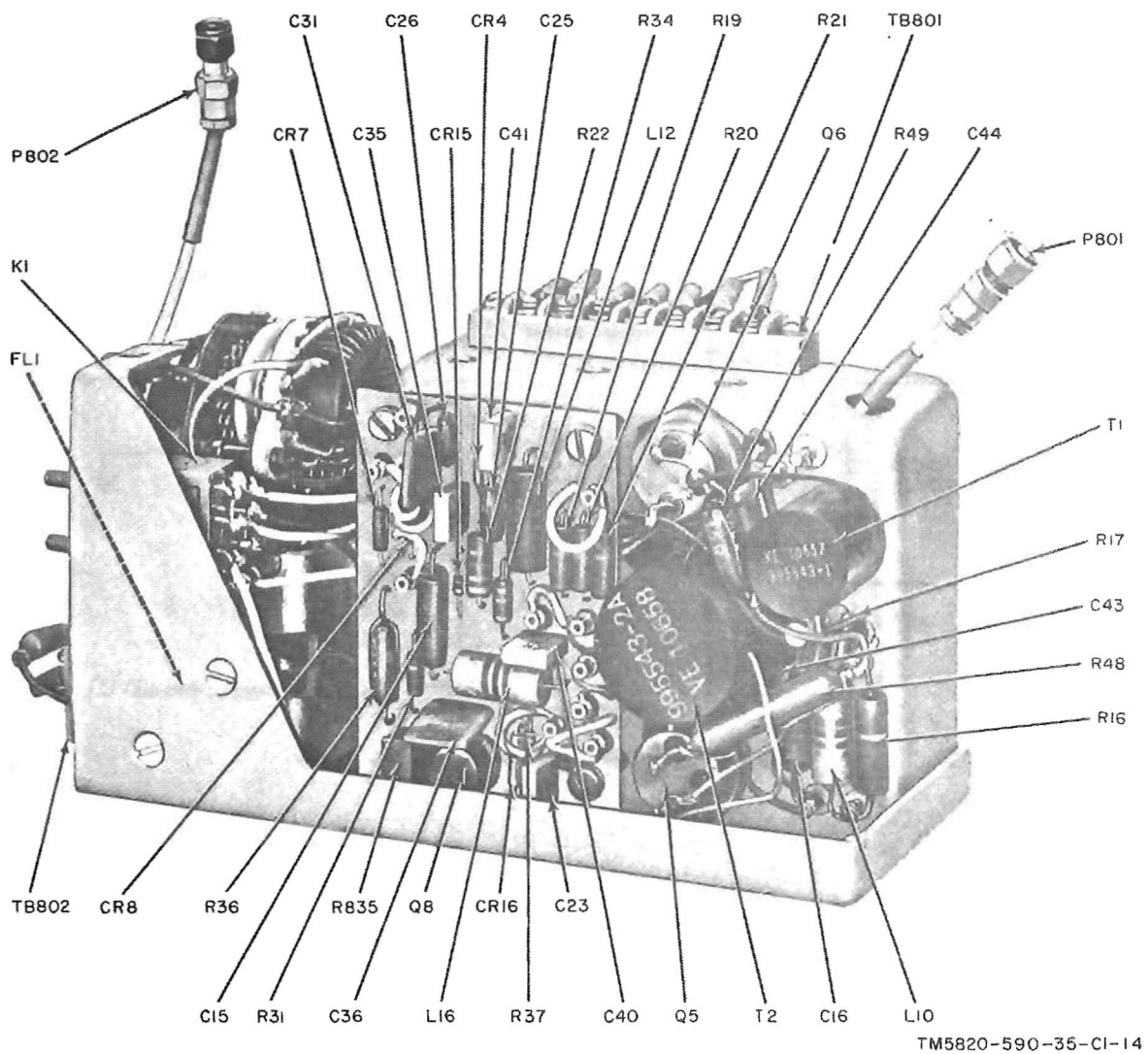
TM5820-590-35-C1-12

Figure 3-20.3 Power amplifier module, right side  
(HAC Part No. 1541057-101)



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*Figure 3-20.4 Power amplifier module, right side, component board removed  
(HAC Part No. 1541057-101)*



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Figure 3-20.5 Power amplifier module, left side  
(HAC Part No. 1541057-101)

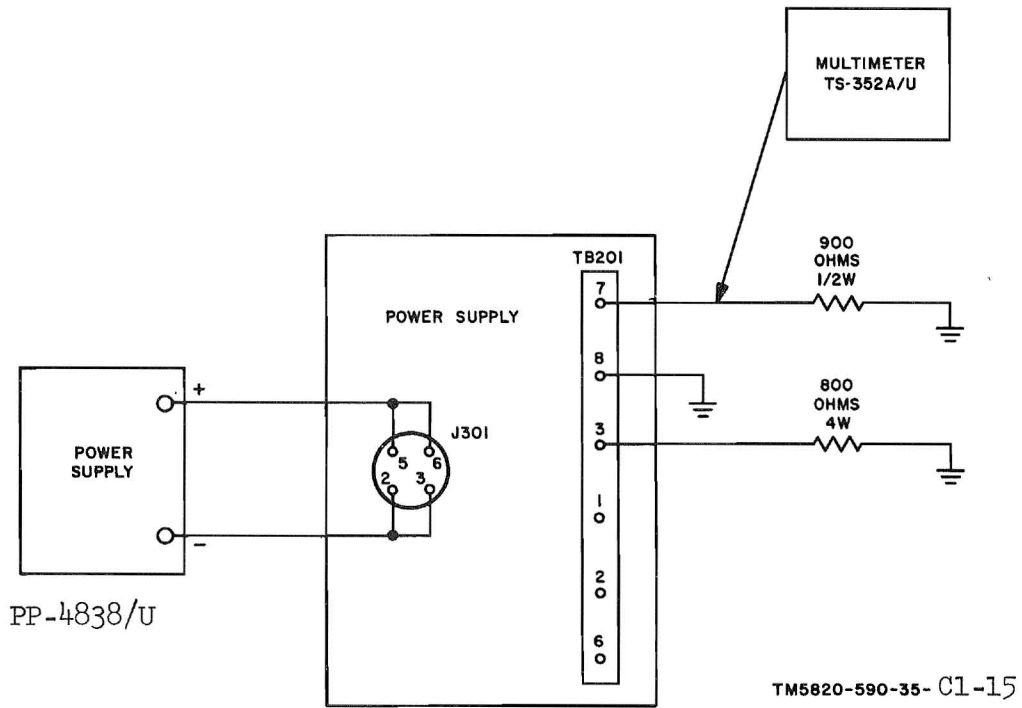
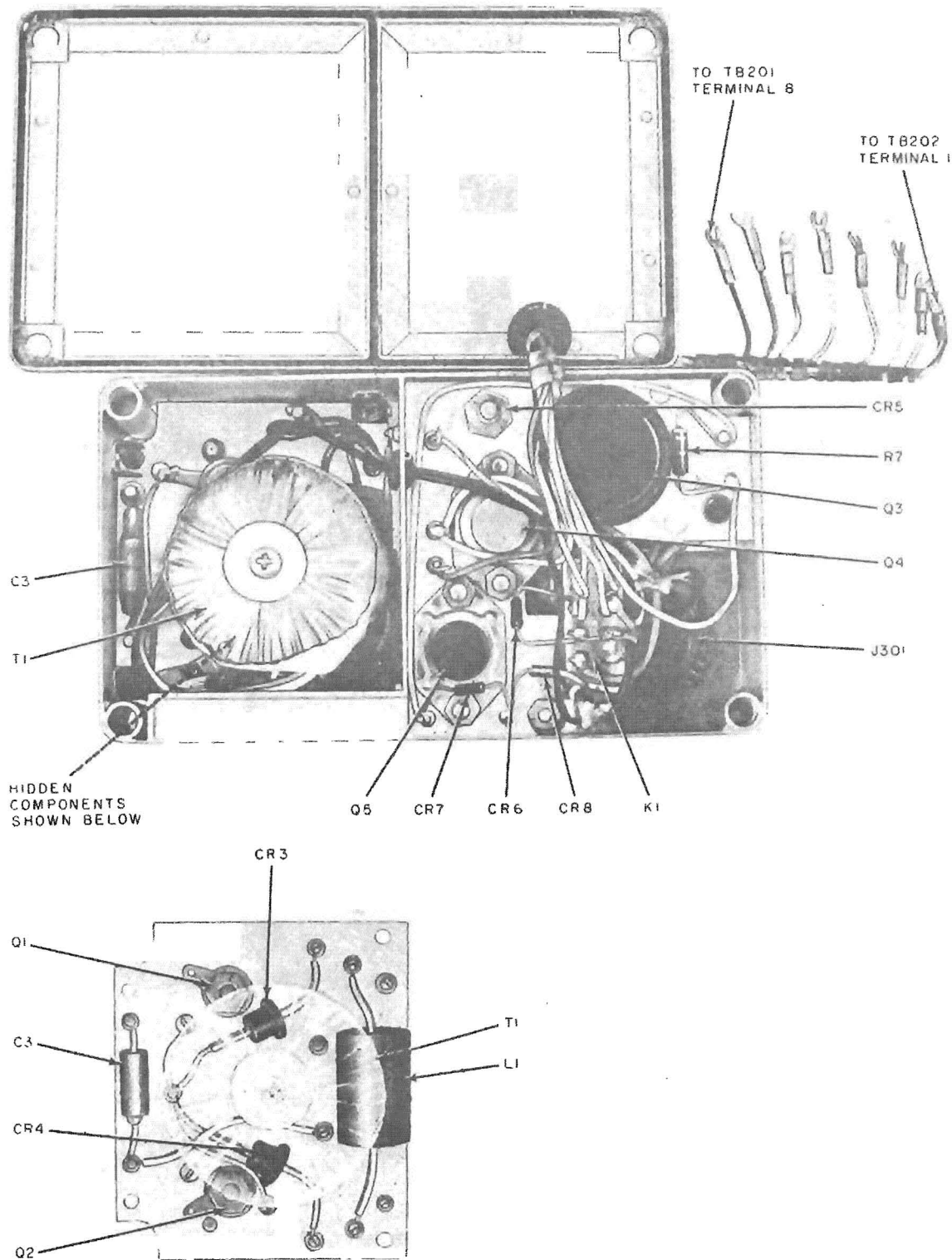
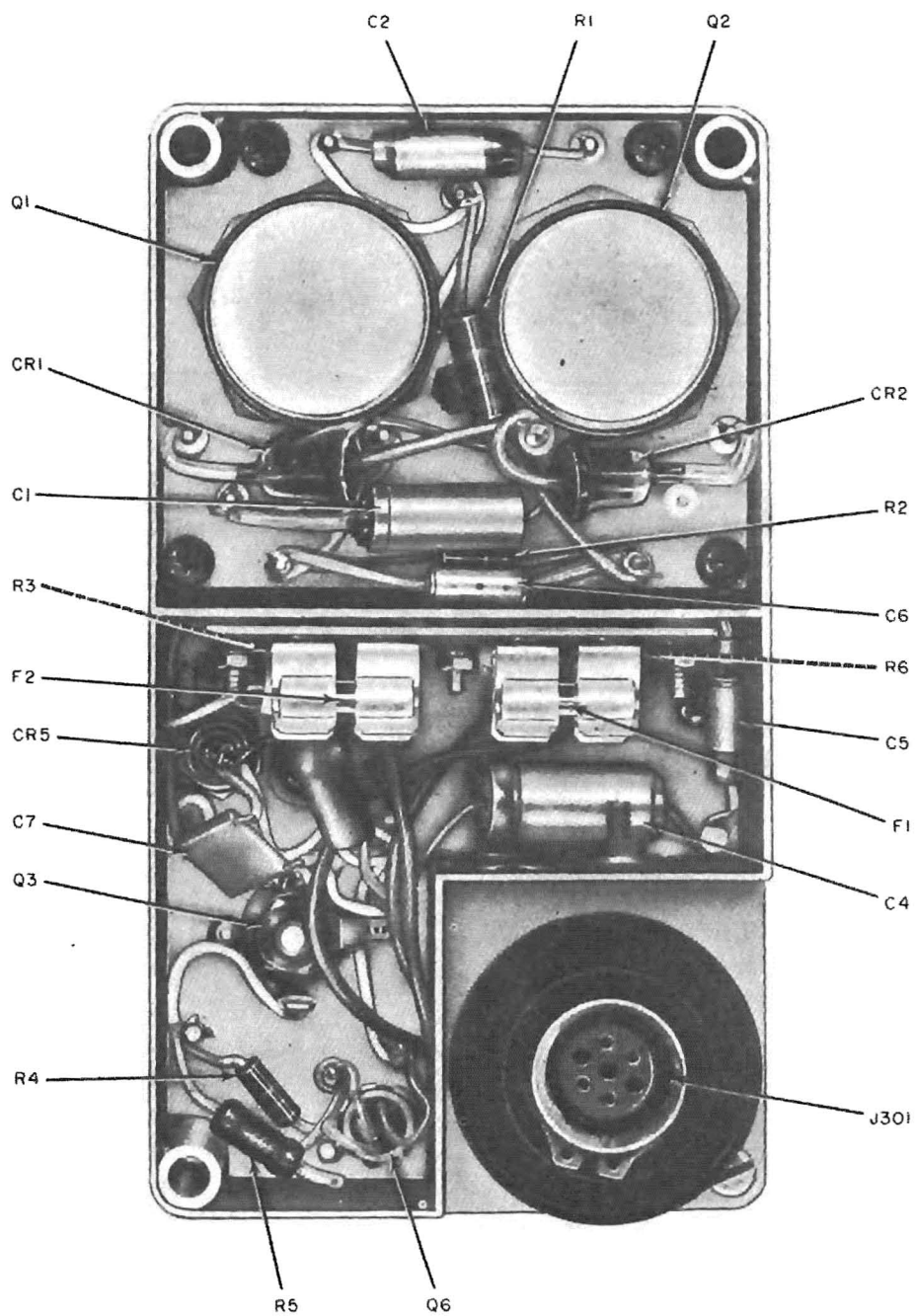


Figure 3-21. Power supply module, test setup.



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Figure 3-22. Power supply module, front view.



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Figure 3-23. Power supply module, rear view.



## Section II. REPAIRS

**3-8. General Parts Replacement Techniques**

Most parts of the radio set can be reached and replaced easily without special procedures. The following precautions apply:

*a.* Careless replacement of parts often makes new faults inevitable. Note the following points:

- (1) Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has numerous leads, tag each lead before removing.
- (2) Be careful not to damage other leads or parts by pushing or pulling them out of the way.
- (3) Do not allow drops of solder to fall into the unit.
- (4) A carelessly soldered connection may create a new fault. It is important to make well-soldered joints, because a poorly soldered joint is one of the most difficult faults to find.

*b.* Do not disturb the settings of variable coils, potentiometers, or capacitors unless specified.

*c.* Use a pencil-type soldering iron with a 25-watt maximum capacity. This unit is transistorized. If only ac-operated irons are available, use an isolation transformer. Do not use a soldering gun; damaging voltages can be induced in components. Check soldering irons for shorts to the tip before using.

*d.* When soldering transistor leads, solder quickly; where wiring permits, use a heat sink (such as long-nose pliers) between the soldered joint and the transistor. Use approximately the same length and dress of transistor leads as used originally.

**3-9. Synthesizer Module, Disassembly (fig. 3-24)**

The following paragraphs will aid general support maintenance personnel in replacing individual components, or in complete disassembly of the synthesizer module. For replacement of individual components, perform the instructions given in the applicable paragraph. For complete disassembly of the synthesizer

module, perform the instructions given in *a* through *i* below.

*a. Module Covers.* To remove the module covers, remove six screws (1) and lift module covers (56 and 57) from chassis (55).

*b. Component Boards (A5, A6, A7, and A8).* Remove component boards ((6), (7), (8), or (9)) from the synthesizer module as follows:

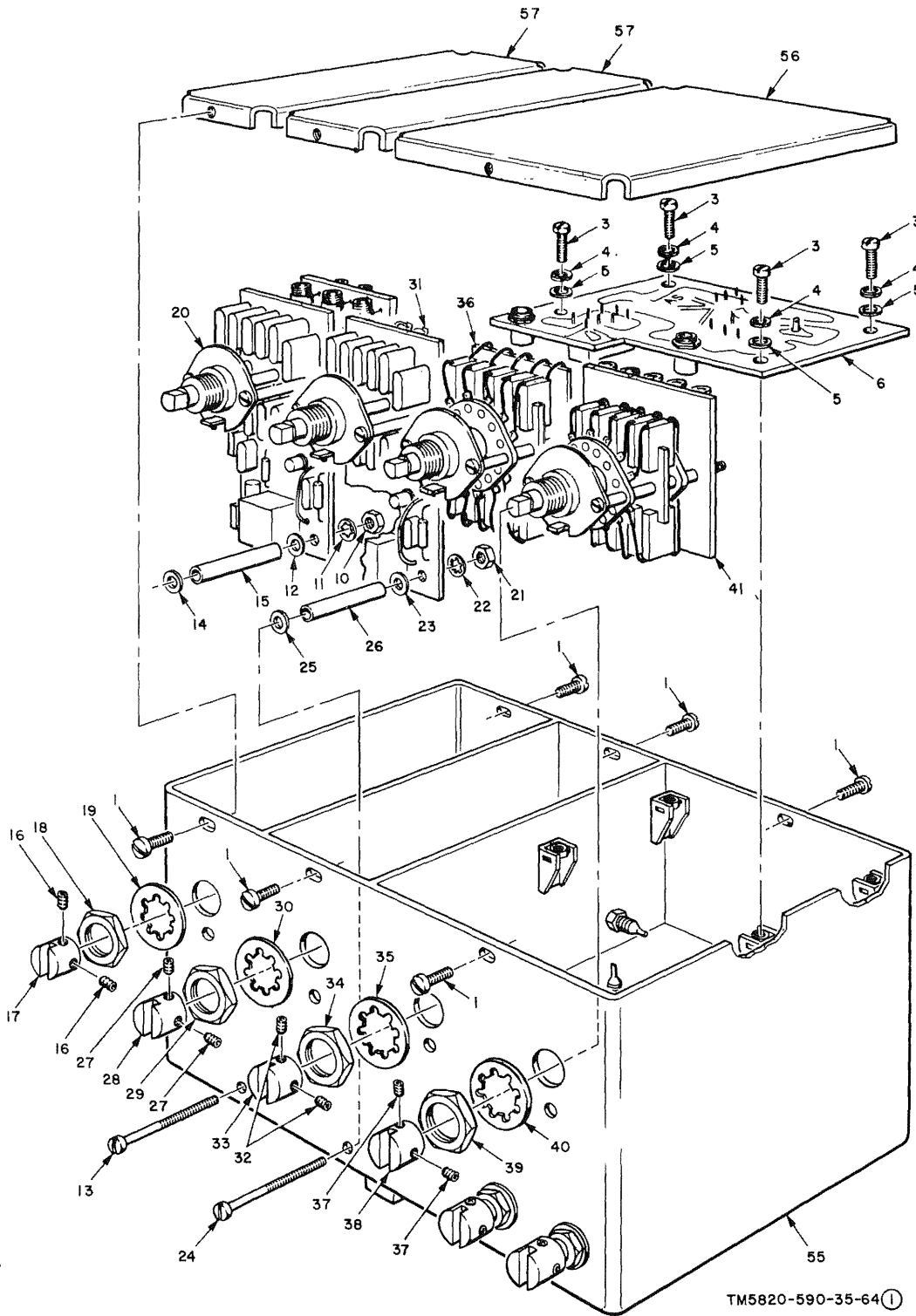
- (1) Remove screws (3 and 4), lockwashers (4), and washers (5).
- (2) Unsolder wire connections and lift component board from the chassis.

*c. 1-Mc Switch Assembly A4 Removal.* Remove 1-mc switch assembly A4 (20) as follows:

- (1) Remove nut (10) and washers (11 and 12).
- (2) Remove screw (13), glass washer (14), and spacer (15).
- (3) Remove two setscrews (16) and coupler (17).
- (4) Remove nut (18) and lockwasher (19).
- (5) Lift 1-mc switch assembly A4 (20) and unsolder the wire connections.
- (6) Disassemble 1-mc switch assembly A4 (20) (fig. 3-25) as follows:
  - (a) Remove the two nuts and washers attaching the components to the switch.
  - (b) Slide components and attaching parts from the switch.
  - (c) Remove the two screws.

*d. 100-Kc Switch Assembly A3 Removal (fig. 3-24).* Remove 100-kc switch assembly A3 (31) as follows:

- (1) Remove nut (21) and washers (22 and 23).
- (2) Remove screw (24), glass washer (25), and spacer (26).
- (3) Remove two setscrews (27) and coupler (28).
- (4) Remove nut (29) and lockwasher (30).
- (5) Lift 100-kc switch assembly A3 (31) and unsolder the wire connections.



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Figure 3-24. Frequency synthesizer module, exploded view.

1	Screw	28	Coupler
2	Stud	29	Nut
3	Screw	30	Lockwasher
4	Lockwasher	31	100-kc switch assembly A3
5	Washer	32	Setscrew
6	1-kc - 10-kc oscillator mixer amplifier component board A5	33	Coupler
7	10-kc mixer amplifier component board A6	34	Nut
8	100-kc mixer amplifier component board A7	35	Lockwasher
9	1-mc mixer amplifier component board A8	36	10-kc switch assembly A2
10	Nut	37	Setscrew
11	Lockwasher	38	Coupler
12	Washer	39	Nut
13	Screw	40	Lockwasher
14	Glass washer	41	1-kc switch assembly A1
15	Spacer	42	Setscrew
16	Setscrew	43	Coupler
17	Coupler	44	Nut
18	Nut	45	Lockwasher
19	Lockwasher	46	Capacitor C628
20	1-mc switch assembly A4	47	Setscrew
21	Nut	48	Coupler
22	Lockwasher	49	Nut
23	Washer	50	Lockwasher
24	Screw	51	Capacitor C601
25	Glass washer	52	Screw
26	Spacer	53	Washer
27	Setscrew	54	Terminal board TB601
		55	Chassis
		56	Module cover, large
		57	Module cover, small

Figure 3-24—Continued.

(6) Disassemble 100-kc switch assembly A3 (31) (fig. 3-25) as follows:

- (a) Remove the two nuts and washers attaching the components to the switch.
- (b) Slide components and attaching parts from the switch.
- (c) Remove the two mounting screws.

*e. 10-Kc Switch Assembly A2 Removal* (fig. 3-24). Remove 10-kc switch assembly A2 (36) as follows:

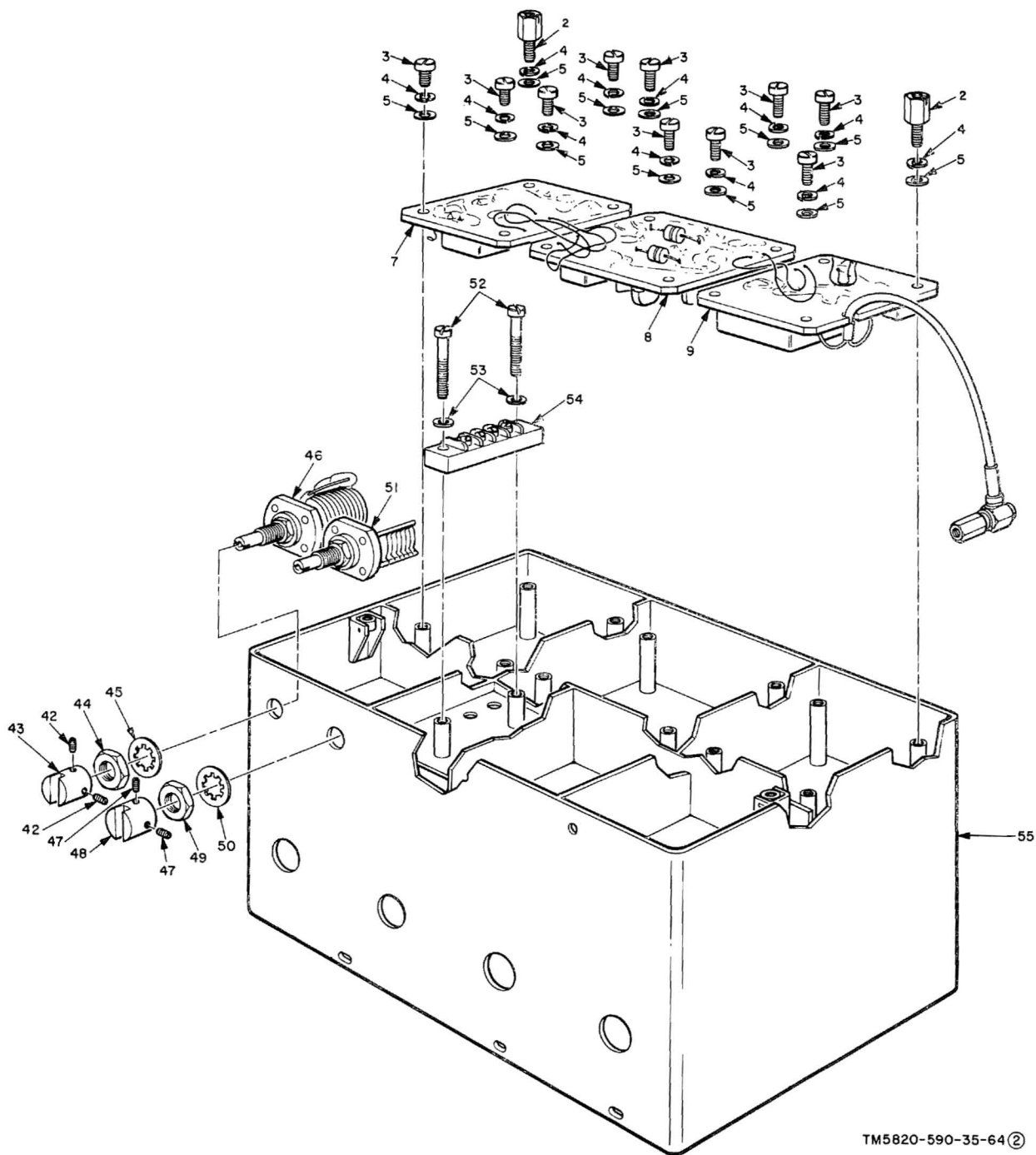
- (1) Remove two setscrews (32) and coupler (33).
- (2) Remove nut (34) and lockwasher (35).
- (3) Lift 10-kc switch assembly A2 (36) and unsolder the wire connections.
- (4) Disassemble 10-kc switch assembly A2 (36) (fig. 3-25) as follows:
  - (a) Remove the two nuts and washers attaching the components to the switch.
  - (b) Slide components and attaching parts from the switch.
  - (c) Remove the two mounting screws.

*f. 1-Kc Switch Assembly Removal A1.* Remove 1-kc switch assembly A1 (41) as follows:

- (1) Remove two setscrews (37) and coupler (38).
- (2) Remove nut (39) and lockwasher (40).
- (3) Lift 1-kc switch assembly A1 (41) and unsolder the wire connections.
- (4) Disassemble the 1-kc switch as follows:
  - (a) Remove the two nuts and washers attaching the components to the 1-kc switch (fig. 3-25).
  - (b) Slide components and attaching parts from the switch shaft.
  - (c) Remove the two mounting screws.

*g. Capacitor C628* (fig. 3-24). Remove capacitor C628 (46) as follows:

- (1) Remove two setscrews (42) and coupler (43).
- (2) Remove nut (44) and lockwasher (45).
- (3) Lift capacitor (46) from chassis (55) and unsolder the wire connections.



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Figure 3-24—Continued.

*h. Capacitor C601.* Remove capacitor C601 (51) as follows:

(1) Remove two setscrews (47) and coupler (48).

(2) Remove nut (49) and lockwasher (50).

(3) Lift capacitor C601 (51) from the chassis (55) and unsolder the wire connections.

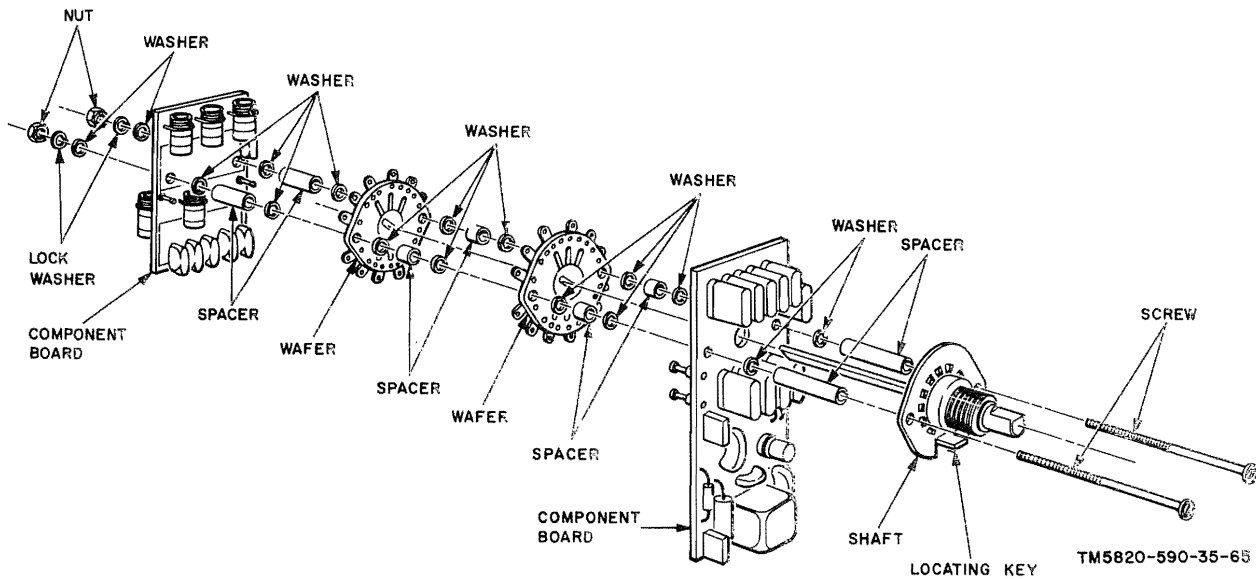


Figure 3-25. Frequency synthesizer switch disassembly.

i. Terminal Board TB601. Remove terminal board TB601 (54) as follows:

- (1) Disconnect harness wire from terminal board (54).
- (2) Remove the two screws (52) and washers (53) and lift terminal board (54) from the chassis (55).

### 3-10. Frequency Synthesizer Module Assembly (fig. 3-24)

For reassembly of individual parts or components of the frequency synthesizer, refer to the applicable paragraph. For complete reassembly of the frequency synthesizer module, refer to a through i below.

a. Terminal Board TB601. Replace terminal board (TB601) (54) as follows:

- (1) Position terminal board TB601 (54) on chassis (55) and attach washers (53) and screws (52).
- (2) Connect harness wires to terminal board.

b. Capacitor C601. Replace capacitor C601 (51) as follows:

- (1) Solder wires to capacitor (51) and position in chassis (55).

- (2) Attach lockwasher (50) and nut (49).

- (3) Place coupler (48) on capacitor shaft and attach setscrews (47).

c. Capacitor C628. Replace capacitor C628 (46) as follows:

- (1) Solder wires to capacitor (46) and position in chassis (55).
- (2) Attach lockwasher (45) and nut (44).
- (3) Place coupler (43) on capacitor shaft and attach setscrews (42).

d. 1-Kc Switch Assembly A1. Assemble and install 1-kc switch assembly (41) as follows:

- (1) Assemble 1-kc switch assembly A1 (41) as follows:
  - (a) Insert screws through mounting holes of switch (fig. 3-25).
  - (b) Install the spacers, washers, component boards, and wafers as shown in figure 3-25.
  - (c) Attach washers and nuts.
- (2) Position 1-kc switch assembly A1 (41) and solder the wire connections.
- (3) Install 1-kc switch assembly A1 (41) in chassis (55); place switch assembly locating key in mounting hole of chassis (55).

- (4) Attach lockwasher (40) and nut (39) to switch assembly shaft.
- (5) Place coupler (38) on switch assembly shaft and attach setscrews (37).

*e. 10-Kc Switch Assembly A2.* Assemble and install 10-kc switch assembly A2 (36) as follows:

- (1) Assemble 10-kc switch assembly A2 (36) as follows:
  - (a) Insert screws through mounting hole of switch (fig. 3-25).
  - (b) Install the spacers, washers, component boards, and wafers as shown in figure 3-25.
  - (c) Attach washers and nuts.
- (2) Position 10-kc switch assembly A2 (36) and solder the wire connections.
- (3) Install 10-kc switch assembly A2 (36) in chassis (55); place switch assembly locating key in mounting hole of chassis (55).
- (4) Attach lockwasher (35) and nut (34) to switch assembly shaft.
- (5) Place coupler (33) on switch assembly shaft and attach setscrews (32).

*f. 100-Kc Switch Assembly A3.* Assemble and install 100-kc switch assembly A3 (31) as follows:

- (1) Assemble 100-kc switch assembly A3 (31) as follows:
  - (a) Insert the two screws through mounting holes of the switch (fig. 3-25).
  - (b) Install the spacers, washers, component boards, and wafers as shown in figure 3-25.
  - (c) Attach washers and nuts.
- (2) Position 100-kc switch assembly A3 (31) and solder the wire connections.
- (3) Insert screw (24) through mounting holes of chassis (55).
- (4) Install glass washer (25), spacer (26), and washer (23).
- (5) Install 100-kc switch assembly A3 (31) on screw (24) and attach lockwasher (22).
- (6) Secure 100-kc switch assembly A3 (31), using the nut (21).
- (7) Attach lockwasher (30) and nut (29) to switch assembly shaft.

- (8) Place coupler (28) on switch assembly shaft and secure, using setscrews (27).

*g. 1-Mc Switch Assembly A4.* Assemble and install 1-mc switch assembly A4 (20) as follows:

- (1) Assemble 1-mc switch assembly A4 (20) as follows:
  - (a) Insert screws through mounting holes of switch (fig. 3-25).
  - (b) Install the spacers, washers, component boards, and wafers as shown in figure 3-25.
  - (c) Attach washers and nuts.
- (2) Install screw (13) through mounting hole in chassis (55).
- (3) Attach glass washer (14), spacer (15), and washer (12).
- (4) Install 1-mc switch assembly A4 (20) on screw (13) and attach the lockwasher (11) and nut (10).
- (5) Attach lockwasher (19) and nut (18) to switch assembly shaft.
- (6) Place coupler (17) on switch assembly shaft and attach setscrews (16).

*h. Component Boards A5, A6, A7, and A8.* Install component boards (6), (7), (8), and (9) as follows:

- (1) Position the component board and solder wire connections.
- (2) Attach component board to chassis (55), using washers (5), lockwashers (4), and screws (2 and 3).

*i. Module Covers.* To install the synthesizer covers, position the covers (56 and 57) on the module chassis (55) and attach the screws (1).

### 3-11. RF Module Disassembly (fig. 3-26)

Disassemble the RF module as follows:

- a.* Remove four screws (1) and cover (2).
- b.* Remove nuts (3 and 4) and lockwashers (5).
- c.* Remove six screws (6) and rear chassis plate (7).
- d.* Remove three screws (8) and ground strap (9).

*e.* Remove four screws (10) and lift lower tray assembly (11) from the module. Unsolder wire connections.

*f.* Remove two setscrews (12) and coupler (13).

*g.* Remove nut (16), lockwasher (17), and screw (18).

*h.* Remove nut (14) and lift capacitor C701 from the module. Unsolder wire connections.

*i.* Unsolder wires connected from bandswitch S1 (25) to upper tray assembly (20).

*j.* Remove three screws (19) and lift bandswitch S1 (25) and front chassis plate (26) from upper tray assembly (20).

*k.* Remove two setscrews (21) and coupler (22).

*l.* Remove nut (23) and lockwasher (24)

*m.* Remove bandswitch S1 (25) from front chassis plate (26).

### 3-12. RF Module Assembly

(fig. 3-26)

Reassemble the RF module as follows:

*a.* Install bandswitch S1 (25) in front chassis plate (26) and attach lockwasher (24) and nut (23).

*b.* Install coupler (22) on bandswitch S1 shaft and attach the two setscrews (21).

*c.* Position bandswitch S1 (25) and front chassis plate (26) on upper tray assembly (20).

*d.* Attach the three screws (19).

*e.* Attach screw (18), lockwasher (17), and nut (16).

*f.* Install capacitor C701 (15) on nut assembly (*e* above) and secure to front chassis plate (26), using the nut (14).

*g.* Install coupler (13) on capacitor shaft and attach the two setscrews (12).

*h.* Solder wire connections to lower tray assembly (11).

*i.* Attach lower tray assembly to module, using the four screws (10).

*j.* Attach ground strap (9) and secure front chassis plate (26), using three screws (8).

*k.* Attach rear chassis plate (7), using the six screws (6).

*l.* Secure bandswitch S1 (25), using the two lockwashers (5) and nuts (4).

*m.* Secure capacitor C701 (15), using nut (3).

*n.* Attach cover (2), using the four screws (1).

### 3-13. IF Audio Module Disassembly

(fig. 3-27)

Disassemble the IF audio module as follows:

*a.* Lift lower module cover (1) from module chassis (12).

*b.* Remove four screws (2) and lift IF audio amplifier component board A1 (3) from module chassis (12). Unsolder wire connections.

*c.* Lift upper module cover (4) from module chassis (12).

*d.* Remove four screws (5) and lift mike amplifier-mixer component board A2 (6) from module chassis (12). Unsolder wire connections.

*e.* Unsolder wires connected to the IN and OUT terminals of crystal filter FL1 (9).

*f.* Remove four screws (7) and lockwashers (8).

*g.* Remove wire connections and lift crystal filter FL1 (9) from module chassis (12).

*h.* Unsolder wire connections to filter bracket assembly (11).

*i.* Remove two screws (10) and lift filter bracket assembly (11) from module chassis (12).

### 3-14. IF Audio Module Assembly

(fig. 3-27)

Reassemble the IF audio module as follows:

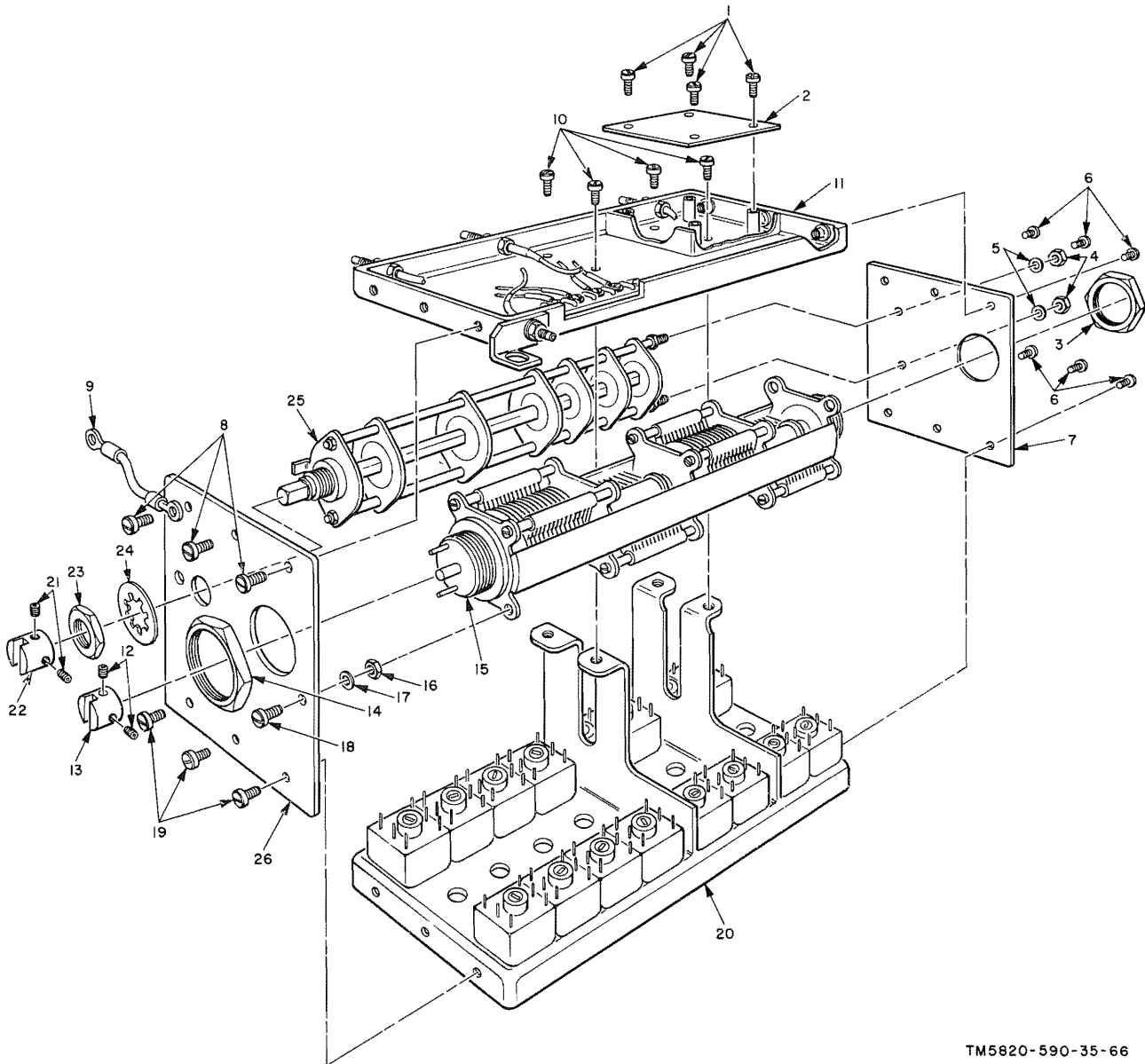
*a.* Attach filter bracket assembly A3 (11) to module chassis (12), using two screws (10). Solder wire connections.

*b.* Position crystal filter FL1 (9) in module chassis (12) and attach wire connections.

*c.* Attach crystal filter FL1 (9) to chassis (12), using four lockwashers (8) and screws (7).

*d.* Solder wire connections to mike amplifier-mixer component board A2 (6).

*e.* Attach mike amplifier-mixer component board A2 (6) to module chassis (12), using four screws (5).



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- |                      |                        |                        |
|----------------------|------------------------|------------------------|
| 1 Screw              | 10 Screw               | 19 Screw               |
| 2 Cover              | 11 Lower tray assembly | 20 Upper tray assembly |
| 3 Nut                | 12 Setscrew            | 21 Setscrew            |
| 4 Nut                | 13 Coupler             | 22 Coupler             |
| 5 Lockwasher         | 14 Nut                 | 23 Nut                 |
| 6 Screw              | 15 Capacitor C701      | 24 Lockwasher          |
| 7 Rear chassis plate | 16 Nut                 | 25 Bandswitch S1       |
| 8 Screw              | 17 Lockwasher          | 26 Front chassis plate |
| 9 Ground strap       | 18 Screw               |                        |

Figure 3-26. RF module, exploded view.

f. Place upper module cover (4) on module chassis (12).

g. Solder wire connections to IF audio amplifier component board (A1) (3).

h. Attach IF audio amplifier component board A1 (3) to module chassis (12), using four screws (2).

i. Place lower module cover (1) on module chassis (12).



### 3-15. Frequency Generator Module Disassembly

(fig. 3-28)

Disassemble the frequency generator module as follows:

- a. Remove three screws (1) and remove the cover (2).
- b. Unsolder wire connections to frequency standard component board (4).
- c. Remove two screws (3) and remove frequency standard component board (4).
- d. Unsolder wire connections to frequency generator component board (6).
- e. Remove four screws (5), frequency generator component (6), and bushings (7).
- f. Remove screws (8) and remove bracket (9).
- g. Unsolder wire connections to terminal board TB501 (13).
- h. Remove screws (10), lockwashers (11), and washers (12), and remove terminal board TB501 (13) from the base (14).

### 3-16. Frequency Generator Module Assembly

(fig. 3-28)

Reassemble the frequency generator module as follows:

- a. Attach terminal board TB501 (13) to base (14), using two washers (12), lockwashers (11), and screws (10). Solder wire connections.
- b. Attach bracket (9) to base (14), using two screws (8).
- c. Place four bushings (7) on bracket (9) and attach frequency generator component board (6), using four screws (5). Solder wire connections.
- d. Attach frequency standard component board assembly (4) to base (14), using two screws (3). Solder wire connections.
- e. Attach cover (2) to frequency generator, using three screws (1).

### 3-17. Power Amplifier Module, Disassembly

(fig. 3-29) (HAC Part No. 1541057-100)

Disassemble the power amplifier module as follows:

- a. Unsolder wires from preamplifier driver board (2).

- b. Remove four screws (1) and remove preamplifier driver board (2). Unsolder remaining wire connections.

- c. Disconnect wires from terminal board TB801 (6).

- d. Remove two screws (3), lockwashers (4), and washers (5), and lift terminal board TB801 (6) from preamplifier chassis (8).

- e. Unsolder wires from preamplifier chassis (8).

- f. Remove four screws (7) and lift preamplifier chassis (8) from power amplifier chassis (24).

- g. Unsolder wire connections to capacitor C826 (11).

- h. Remove nut (9) and lockwasher (10), and lift capacitor C826 (11) from power amplifier chassis (24).

- i. Unsolder wire connections to filter FL1 (13).

- j. Remove two screws (12) and remove filter FL1 (13).

- k. Remove four setscrews (14) and couplers (15).

- l. Unsolder wire connections from capacitor C820 (21).

- m. Remove three screws (16), solder lug (17), lockwasher (18), washers (19), and spacers (20), and lift capacitor C820 (21) from the power amplifier chassis (24).

- n. Unsolder wire connections from inductor L815 (23).

- o. Remove nut (22) and lift inductor L815 (23) from the power amplifier chassis (24).

### 3-18. Power Amplifier Module, Assembly

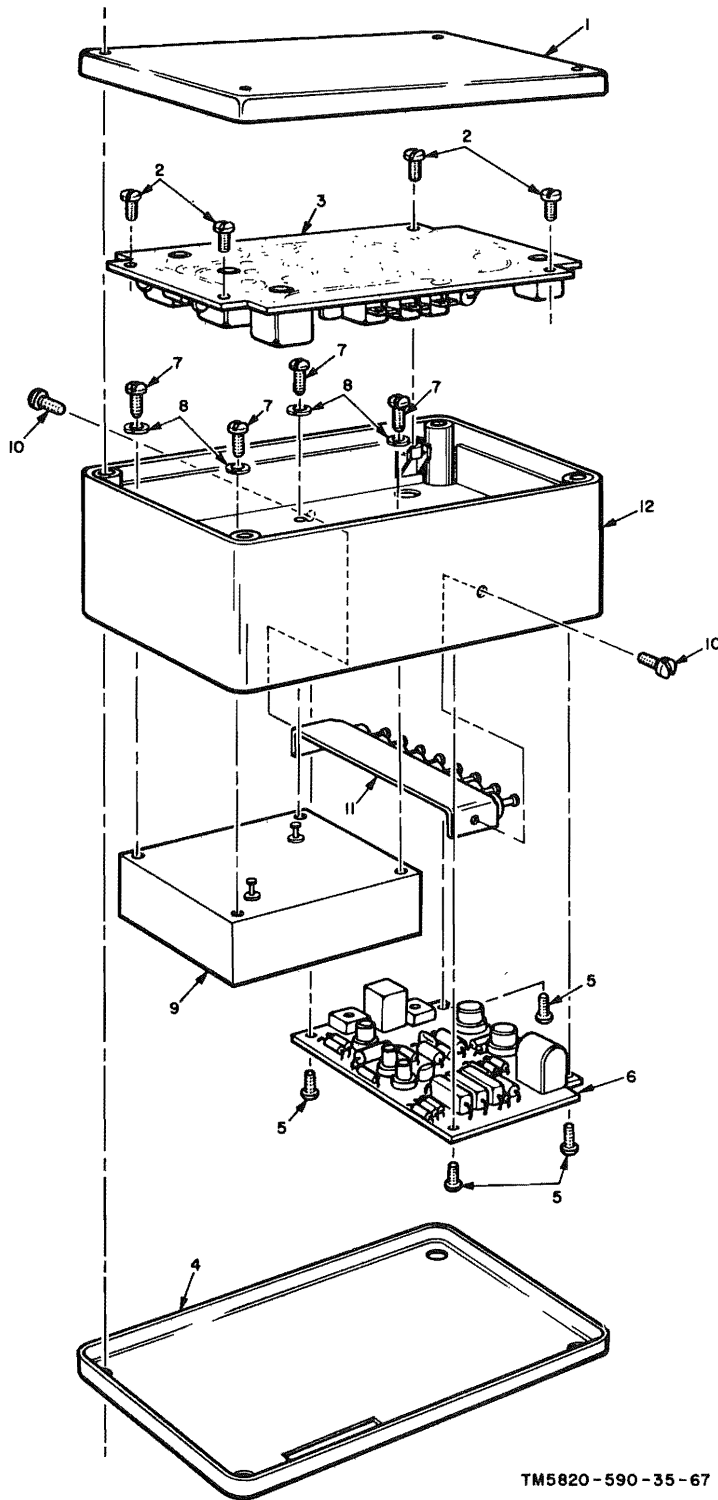
(fig. 3-29) (HAC Part No. 1541057-100)

Reassemble the power amplifier module as follows:

- a. Install inductor L815 (23) in power amplifier chassis (24) and secure, using nut (22). Apply sealing compound (per MIL-S-22473) to nut and solder the wire connections.

- b. Install capacitor C820 (21) in power amplifier chassis (24) and secure, using three spacers (20), two washers (19), lockwasher (18), solder lug (17), and three screws (16). Solder wire connections.

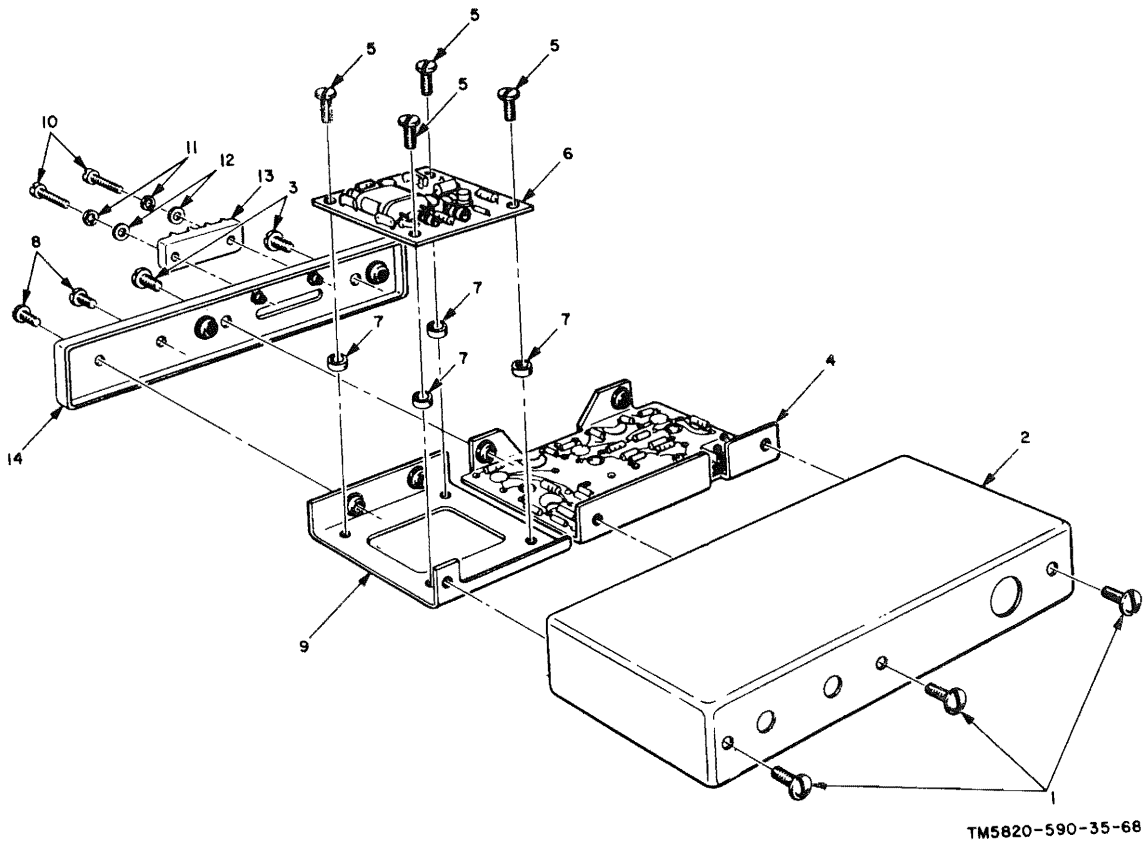
- c. Install two couplers (15) on control shafts and secure, using four setscrews (14).



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- |   |   |                               |
|---|---|-------------------------------|
| 1 Lower module cover                    | 5 Screw                                   | 9 Crystal filter FL1          |
| 2 Screw                                 | 6 Mike amplifier-mixer component board A2 | 10 Screw                      |
| 3 IF audio amplifier component board A1 | 7 Screw                                   | 11 Filter bracket assembly A3 |
| 4 Upper module cover                    | 8 Lockwasher                              | 12 Module chassis             |

Figure 3-27. IF audio module, exploded view.



1 Screw	5 Screw	9 Bracket
2 Cover	6 Frequency generator component board	10 Screw
3 Screw	7 Bushing	11 Lockwasher
4 Frequency standard component board	8 Screw	12 Washer
		13 Terminal board TB501
		14 Base

Figure 3-28. Frequency generator exploded view.

d. Install filter FL1 (13) and secure, using two screws (12).

e. Install capacitor C826 (11) on power amplifier chassis (24) and secure, using lockwasher (10) and nut (9). Apply sealing compound (per MIL-S-22473) to nut (9).

f. Position the preamplifier chassis (8) on power amplifier chassis (24) and secure, using four screws (7). Solder the wire connections.

g. Position terminal board TB801 (6) on preamplifier chassis (8) and secure, using two washers (5), lockwashers (4), and screws (3).

h. Solder wire connections to preamplifier driver board (2).

i. Position preamplifier driver board (2) on

preamplifier chassis (8) and secure, using four screws (1); solder the remaining wire connections.

### 3-18.1 Power Amplifier Module; Disassembly (HAC Part No. 1541057-101) (fig. 3-29.1)

Disassemble the power amplifier module as follows:

a. Remove four screws (1) and remove driver shield (2).

b. Unsolder wires from driver board (3) and remove driver board from preamplifier chassis (11).

c. Disconnect wires from terminal board TB801 (6).

*d.* Remove two screws (4) and washers (5), and lift terminal board TB801 (6) from preamplifier chassis (11).

*e.* Unsolder wires from preamplifier board (9).

*f.* Remove four screws (7) and washers (8) and lift preamplifier board (9) from preamplifier chassis (11).

*g.* Unsolder wires from preamplifier chassis (11).

*h.* Remove four screws (10) and lift preamplifier chassis (11) from power amplifier chassis (25).

*i.* Unsolder wires from relay K1 (14).

*j.* Remove two nuts (12) and washers (13) and lift relay K1 (14) from power amplifier chassis (25).

*k.* Unsolder wires from filter FL1 (16).

*l.* Remove two screws (15) and lift filter FL1 (16) from power amplifier chassis (25).

*m.* Remove four setscrews (17) and two shaft couplers (18).

*n.* Unsolder wires from capacitor C820 (22).

*o.* Remove three screws (19), washers (20), and spacers (21), and lift capacitor C820 (22) from power amplifier chassis (25).

*p.* Unsolder wires from inductor L815 (24).

*q.* Remove nut (23) and lift inductor L815 (24) from power amplifier chassis (25).

### **3-18.2 Power Amplifier Module, Assembly (HAC Part No. 1541057-101)**

(fig. 3-29.1)

Reassemble the power amplifier module as follows:

*a.* Install inductor L815 (24) in power amplifier chassis (25) and secure, using nut (23). Apply sealing compound (per MIL-S-22473) to nut. Solder wire connections.

*b.* Install capacitor C820 (22) in power am-

plifier chassis (25) and secure, using three spacers (21), washers (20), and screws (19). Solder wire connections.

*c.* Install two shaft couplers (18) in power amplifier chassis (25) and secure, using four setscrews (17).

*d.* Install filter FL1 (16) and secure, using two screws (15). Solder wire connections.

*e.* Install relay K1 (14) in power amplifier chassis (25) and secure, using two washers (13) and nuts (12). Solder wire connections.

*f.* Position preamplifier chassis (11) on power amplifier chassis (25) and secure, using four screws (10). Solder wire connections.

*g.* Position preamplifier board (9) on preamplifier chassis (11) and secure, using four washers (8) and screws (7). Solder wire connections.

*h.* Position terminal board TB801 (6) on preamplifier chassis (11) and secure, using two washers (5) and screws (4). Connect wires to terminal board TB801 (6).

*i.* Solder wire connections on driver board (3).

*j.* Position driver board (3) and driver shield (2) on preamplifier chassis (11) and secure, using four screws (1).

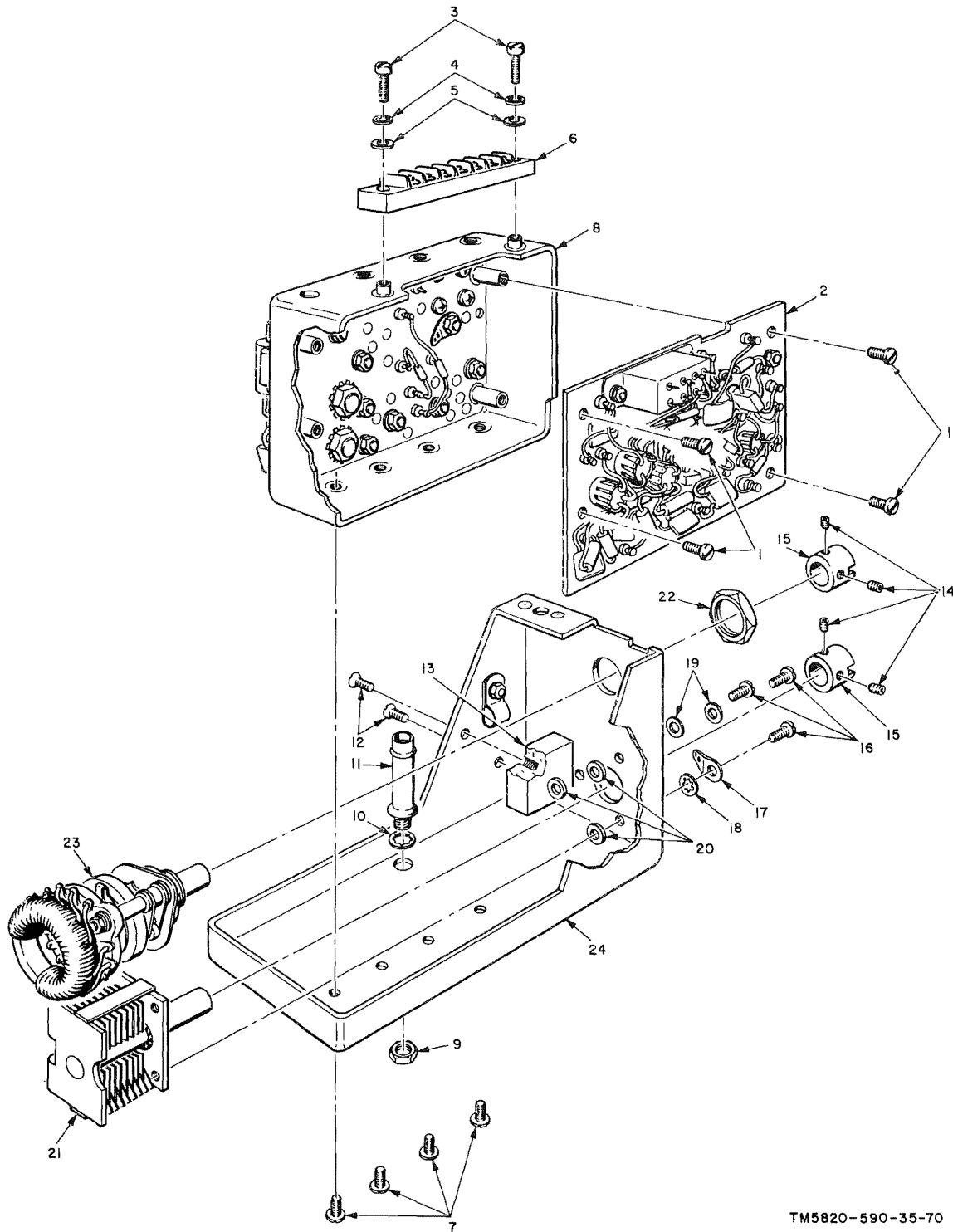
### **3-19. Power Supply Module, Disassembly (fig. 3-30)**

Disassemble the power supply module as follows:

*a.* Remove upper cover (1) and lower cover (2).

*b.* Remove four screws (3) and washers (4) and lift power transformer rectifier board (5) from chassis (25). Unsolder the wire connections.

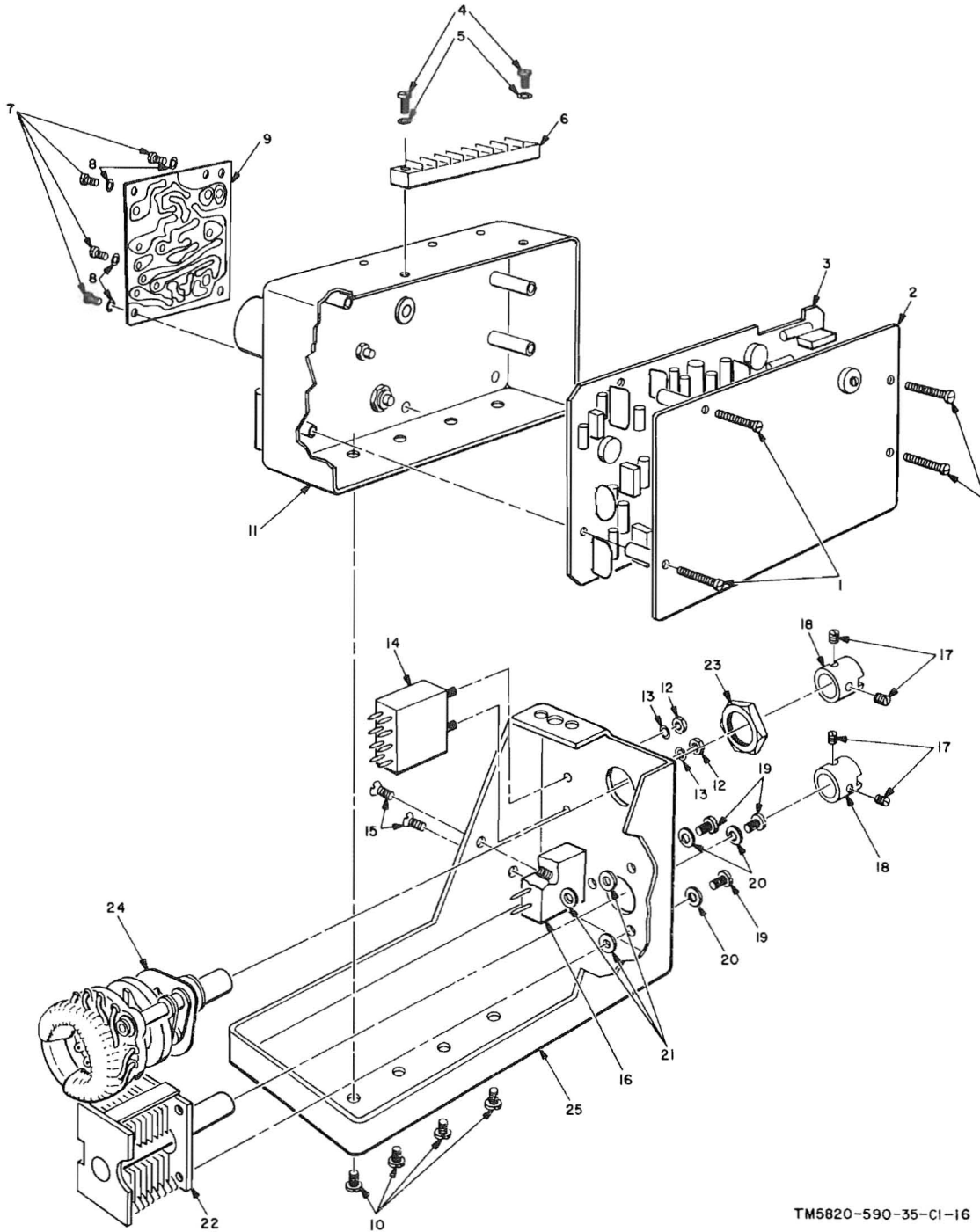
*c.* Remove three nuts (6), lockwashers (7), washers (8 and 9), screws (10), and shoulder washers (11).



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- |                             |                        |                        |
|-----------------------------|------------------------|------------------------|
| 1 Screw                     | 4 Lockwasher           | 7 Screw                |
| 2 Preamplifier driver board | 5 Washer               | 8 Preamplifier chassis |
| 3 Screw                     | 6 Terminal board TB801 | 9 Nut                  |

Figure 3-29. Power amplifier module, exploded view  
(HAC Part No. 1541057-100).



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- |                        |                         |                            |
|------------------------|-------------------------|----------------------------|
| 1 Screw                | 9 Preamplifier board    | 17 Setscrew                |
| 2 Driver shield        | 10 Screw                | 18 Shaft coupler           |
| 3 Driver board         | 11 Preamplifier chassis | 19 Screw                   |
| 4 Screw                | 12 Nut                  | 20 Washer                  |
| 5 Washer               | 13 Washer               | 21 Spacer                  |
| 6 Terminal board TB801 | 14 Relay K1             | 22 Capacitor C820          |
| 7 Screw                | 15 Screw                | 23 Nut                     |
| 8 Washer               | 16 Filter FL1           | 24 Inductor L815           |
|                        |                         | 25 Power amplifier chassis |

Figure 3-29.1 Power amplifier module, exploded view  
(HAC Part No. 1541057-101).

10 Lockwasher	15 Coupler	20 Spacer
11 Capacitor C826	16 Screw	21 Capacitor C820
12 Screws	17 Solder lug	22 Nut
13 Filter FL1	18 Lockwasher	23 Inductor L815
14 Setscrew	19 Washer	24 Power amplifier chassis

Figure 3-29—Continued.

*d.* Lift fuse block (12) from chassis (25) and unsolder wire connections.

*e.* Remove the retaining ring (13).

*f.* Lift connector J301 (19) from the chassis (25) and remove washer (14).

*g.* Unsolder wire connection to connector J301 (19).

*h.* Remove retaining ring (15), adapter seal (16), spring (17), and retaining ring (18) from connector J301 (19).

*i.* Remove the two nuts (20), lockwashers (21), and washers (22) and (23); lift relay K1 (24) from the chassis (25).

### 3-20. Power Supply Module, Assembly (fig. 3-30)

Reassemble the power supply module as follows:

*a.* Install relay K1 (24) in chassis (25) and secure, using two washers (23 and 22), lockwashers (21), and nuts (20).

*b.* Install retaining ring (18), spring (17), adapter seal (16), and retaining ring (15) on connector J301 (19).

*c.* Solder wire connections to connector J301 (19).

*d.* Install washer (14) on connector J301 (19) and assemble to chassis (25), using retaining ring (13).

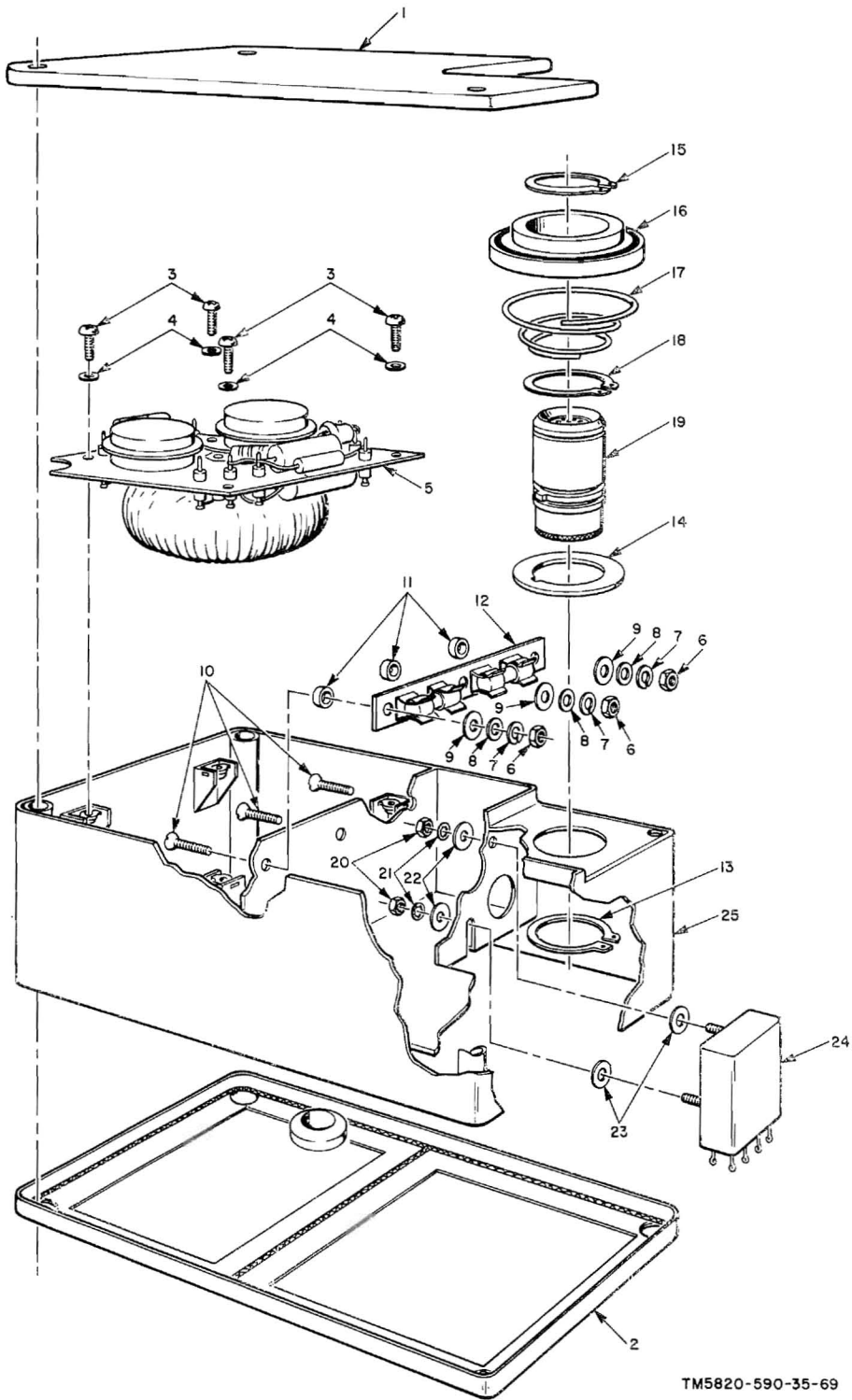
*e.* Attach wire connections to fuse block (12).

*f.* Attach fuse block (12) to chassis (25), using two shoulder washers (11), screws (10), washers (9, and 8), lockwashers (7), and nuts (6).

*g.* Attach power transformer and rectifier board (5) to chassis (25), using four washers (4) and screws (3).

*h.* Attach wire connections to power transformer and rectifier board (5).

*i.* Position lower cover (2) and upper cover (1) on the chassis (25).



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- 1 Upper cover
- 2 Lower cover
- 3 Screw

- 4 Washer
- 5 Power transformer and rectifier board

- 6 Nut
- 7 Lockwasher
- 8 Washer

Figure 3-30. Power supply, exploded view.



- |                    |                   |               |
|--------------------|-------------------|---------------|
| 9 Washer           | 15 Retaining ring | 21 Lockwasher |
| 10 Screw           | 16 Adapter seal   | 22 Washer     |
| 11 Shoulder washer | 17 Spring         | 23 Washer     |
| 12 Fuse block      | 18 Retaining ring | 24 Relay K1   |
| 13 Retaining ring  | 19 Connector J301 | 25 Chassis    |
| 14 Washer          | 20 Nut            |               |

Figure 3-30—Continued.

### Section III. ALIGNMENT

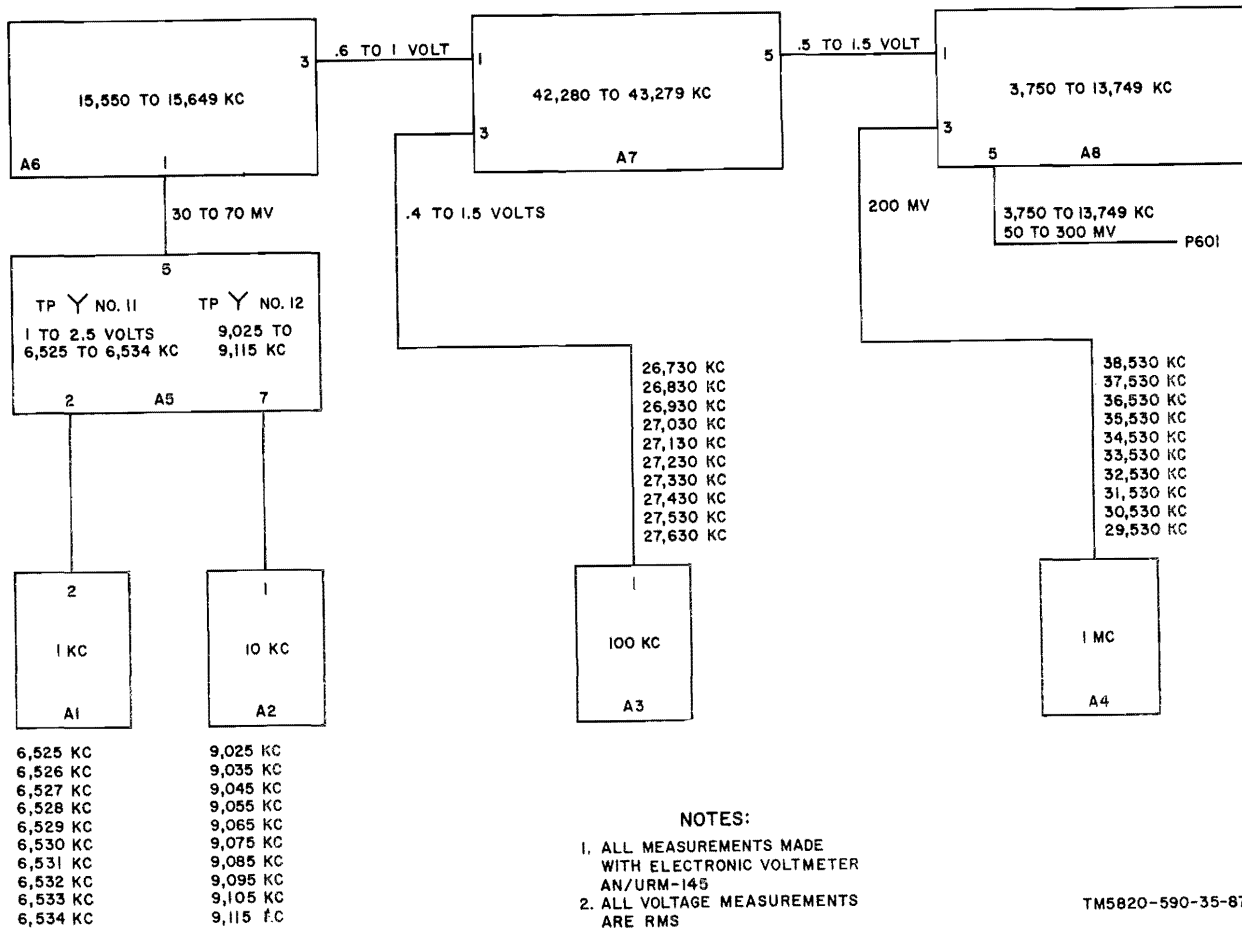
#### 3-21. Test Equipment and Special Items Required for Alignment

a. The test equipment required for aligning the radio set, together with the associated technical manuals, are listed in paragraph 3-1.

b. For the fabrication of miscellaneous items needed for the alignment of the radio set, refer to paragraph 3-1.

#### 3-22. Frequency Synthesizer Module Alignment Instructions

Failures in the frequency synthesizer module can usually be isolated to a particular circuit area by comparing test point measurements to those given in figure 3-31. The following paragraphs outline alignment procedures for the individual circuits of the frequency synthesizer.



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Figure 3-31. RF voltage levels in frequency synthesizer module.

a. 1-Kc Oscillator Alignment.

- (1) Connect Oscilloscope AN/USM-164 (or equivalent) in series with a 10K-ohm resistor to component board A5-TP11 of the frequency synthesizer (figs. 3-32 and 3-33).
- (2) Connect Frequency Meter AN/USM-26 (or equivalent) to the oscilloscope vertical signal output jack.
- (3) Connect the power supply No. 1 positive lead to terminal 3 of TB601 (fig. 3-3), and the negative lead to terminal 4 of TB601.
- (4) Connect the power supply No. 2 positive lead to terminal 2 of TB601, and the negative lead to terminal 4 of TB601.
- (5) Connect a 100-ohm resistor between P601 and ground.
- (6) Adjust power supply No. 1 to +9 volts, and power supply No. 2 to +12 volts.
- (7) Adjust capacitor C617 (fig. 3-32) to obtain a frequency output of 6525.000 kc as measured on the frequency meter.
- (8) Deenergize K2 by disconnecting the power supply No. 2 lead from terminal 2 of TB601, and place 1-kc oscillator switch S1 to the zero position (fully counterclockwise).
- (9) Rotate clarify capacitor C601 (fig. 3-4) to minimum capacity (out of mesh). Note the frequency.
- (10) Rotate C601 to maximum capacity (in mesh). Note the frequency.
- (11) Adjust trimmer capacitor C602 (fig. 3-32) as necessary until the deviations measured in (9) and (10) above are approximately equal to the amounts above and below 6525.000 kc.
- (12) Connect power supply No. 2 to terminal 1 of TB601 (fig. 3-3) and adjust it to +12 volts. Adjust capacitor C612 (fig. 3-32) to obtain a frequency output of 6525.000 kc as measured on the frequency meter.
- (13) Leave the frequency synthesizer module in the transmit function, and place 1-kc oscillator switch S1 to position

1 (one position clockwise). Adjust trimmer capacitor C603 to obtain a frequency output of 6526.000 kc as measured on the frequency meter.

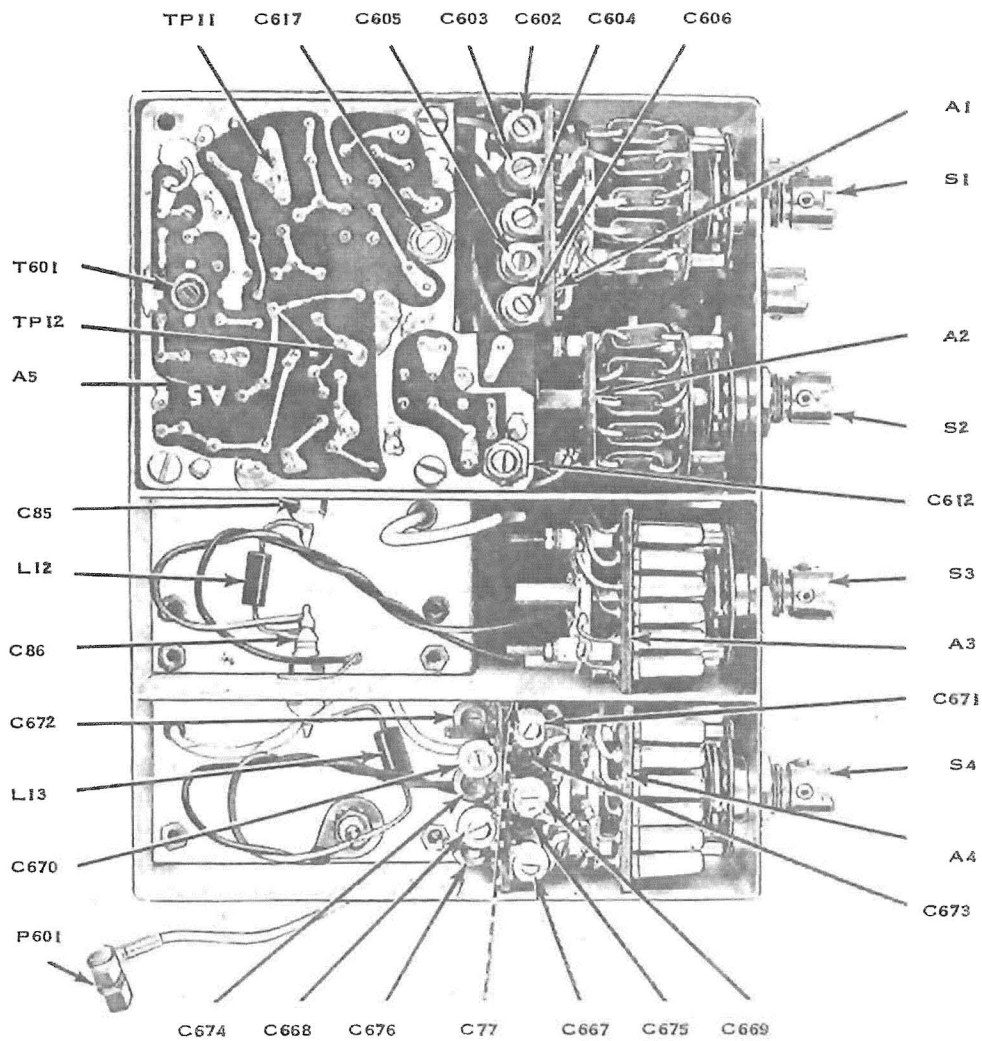
- (14) Repeat (13) above for the remaining 1-kc switch positions and frequencies shown in the following chart.

1-kc switch (S1) position	Adjust capacitor	Nominal frequency (kc)
0	C602	6,525.000
1	C603	6,526.000
2	C604	6,527.000
3	C605	6,528.000
4	C606	6,529.000
5	C607	6,530.000
6	C608	6,531.000
7	C609	6,532.000
8	C610	6,533.000
9	C611	6,534.000

- (15) Disconnect power supply No. 2 from terminal 1 of TB601 and set clarify C601 to minimum capacity (out of mesh).
- (16) Rotate 1-kc oscillator switch S1 through all 10 positions, noting the frequency at each position. The frequency at each position should deviate not less than 200 cps from the nominal frequency at that position.
- (17) Rotate C601 to maximum capacity and repeat (16) above.
- (18) Using Electronic Voltmeter AN/URM-145 (or equivalent), see that voltage at A5-TP11 is between 1.0 to 2.5 volts rms after alignment of the 1-kc oscillator.

b. 10-Kc Oscillator Alignment Check.

- (1) Except for the oscilloscope and frequency meter, connect the test equipment as shown for the 1-kc oscillator alignment (para 3-22a).
- (2) Connect Oscilloscope AN/USM-164 (or equivalent) through a 10K-ohm resistor to component board A5-TP12 (fig. 3-32).
- (3) Connect Frequency Meter AN/USM-26 (or equivalent) to the vertical output jack of the oscilloscope.
- (4) Rotate calibrate control C628 (fig. 3-4) to minimum capacity (out of mesh).



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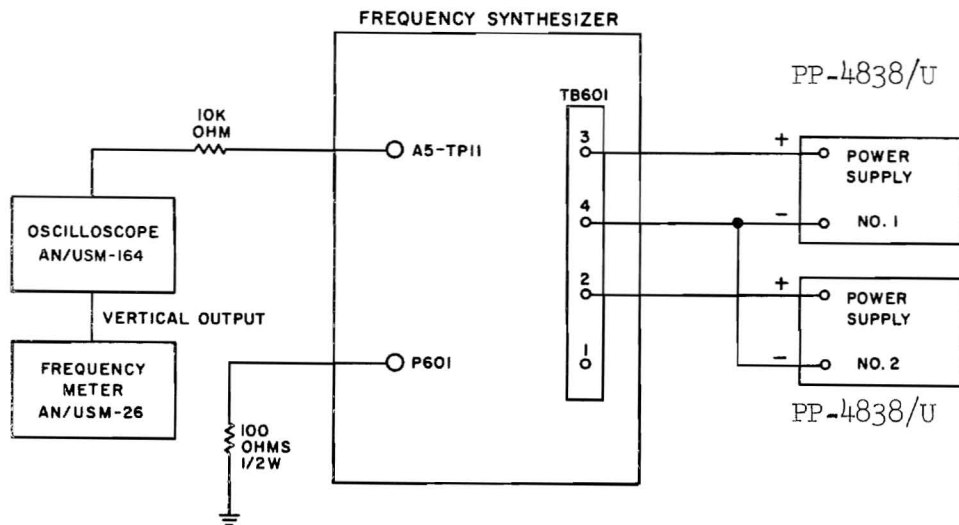
Figure 3-32. Frequency synthesizer module, top view.

(5) Rotate 10-kc oscillator switch S2 (fig. 3-32) through all 10 positions. The frequency at each position should deviate not less than 1.25 kc from the nominal frequency as shown in the following chart.

10-kc switch (S1) position	Nominal frequency (kc)
0	9025.000
1	9035.000
2	9045.000
3	9055.000

10-kc switch (S1) position	Nominal frequency (kc)
4	9065.000
5	9075.000
6	9085.000
7	9095.000
8	9105.000
9	9115.000

(6) Rotate C628 (fig. 3-4) to maximum capacity (in mesh) and repeat (5) above.



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Figure 3-33. Frequency synthesizer module, test setup.

c. 10-Kc Bandpass Alignment Check.

- (1) Connect Electronic Voltmeter AN/URM-145 (or equivalent) to pin 3 of component board A6 (fig. 3-3).
- (2) Disconnect power supply No. 2.
- (3) Set 1- and 10-kc switches S1 and S2 (fig. 3-32) to position 1 (6,526 kc and 9,035 kc, respectively).
- (4) Adjust transformers T603 and T604 (fig. 3-3) for a maximum indication on the voltmeter.
- (5) Disconnect voltmeter from pin 3 of component board A6 and connect to the base of amplifier Q4.
- (6) Adjust transformers T601, on component board A5 (fig. 3-32), and T602, on component board A6 (fig. 3-3), for maximum indication on the voltmeter.
- (4) Adjust transformer T611 (fig. 3-4), for a maximum indication on the voltmeter. The output frequency should be 27,130 kc  $\pm 1$ , and the oscilloscope should display a clean sine wave without modulation, as T611 is tuned to the maximum voltage position.
- (5) Observing the oscilloscope, rotate 100-kc switch S3 (fig. 3-32) through all 10 positions as shown in the following chart. The output should not show modulation at any of the 10 positions.
- (6) See that the frequency output is within  $\pm 1$ kc of the nominal value for each of the 10 positions. Adjust T611 as required.
- (7) Using Electronic Voltmeter AN/URM-145, see that the output voltage is 0.4 to 1.5 volt rms.

d. 100-Kc Oscillator Alignment.

- (1) Connect Oscilloscope AN/USM-164 (or equivalent) through a 100-ohm, 1/2-watt resistor to pin 3 of component board A7.
- (2) Connect Frequency Meter AN/USM-26 to the vertical output jack of the oscilloscope.
- (3) Rotate 100-kc oscillator switch S3 (fig. 3-32) to position 4.

100-kc switch (S1) positions	Nominal frequency (kc)
0	26730
1	26830
2	26930
3	27030
4	27130
5	27230
6	27330
7	27430
8	27530
9	27630

e. 1-Mc Oscillator Alignment.

- (1) Connect Frequency Meter AN/USM-26 (or equivalent) through a 510-ohm resistor to pin 3 of component board A8 (fig. 3-3).
- (2) Monitor output at A8 pin 3, using Electronic Voltmeter AN/URM-145 (or equivalent).
- (3) Rotate MC switch S4 (fig. 3-32) fully counterclockwise to position 2.
- (4) Adjust trimmer capacitor C667 counterclockwise to minimum capacity (screw flush with top of capacitor), and then rotate clockwise for 3 turns.
- (5) Observing the frequency meter, adjust T614 (fig. 3-4) until the output frequency is within  $\pm 50$  cps of the nominal frequency (38,530 kc) as listed in the following chart.

MC switch (S4) position	Adjust capacitor	Nominal frequency (kc)
2	C667	38530
3	C668	37530
4	C669	36530
5	C670	35530
6	C671	34530
7	C672	33530
8	C673	32530
9	C674	31530
10	C675	30530
11	C676	29530

- (6) Rotate MC switch S4 (fig. 3-32) clockwise to position 3.
- (7) Adjust trimmer capacitor C668 until the output frequency is within  $\pm 50$  cps of the nominal frequency (37,530 kc) as listed in the chart ((5) above).
- (8) Repeat (7) above for all the remaining positions and capacitors as shown in the chart.

*Note.* If there is not adequate trimmer capacitor range on any one of the 10 positions, readjust collector transformer T614 while at that position. Readjusting T614 requires readjusting trimmer capacitors C667 through C676.

- (9) Rotate MC switch S4 through all 10 positions. The output voltage at all points should be 200 millivolts  $\pm 2$

db. The frequency at each position should be within  $\pm 50$  cps of the nominal value at that position.

f. 100-Kc Bandpass Alignment.

- (1) Connect Frequency Meter AN/USM-26 (or equivalent) through a 510-ohm resistor to pin 5 of component board A7 (fig. 3-3).
- (2) Monitor output at A7 pin 5, using Electronic Voltmeter AN/URM-145 (or equivalent).
- (3) Set clarify capacitor C601 (fig. 3-4) and calibrate capacitor C628 to approximately midposition (half-open).
- (4) Set all frequency controls to the fourth position from full counterclockwise.
- (5) Connect shunt loading resistor (fig. 3-1) from pin 9 of A7 (fig. 3-3) to ground.
- (6) Adjust T608 (fig. 3-3) for a maximum deflection on the voltmeter.
- (7) Disconnect shunt loading resistor.
- (8) Repeat the procedure given in (4), (5), and (6) above for the remaining transformers as shown in the following chart.

Transformer being loaded	Shunt loading resistor connection	Adjust transformer
T607	A7 pin 9	T608
T608	A7 pin 10	T607
T609	A7 pin 11	T610
T610	A7 pin 12	T609

- (9) Disconnect shunt loading resistor from A7 pin 12.
- (10) Check the voltmeter for an output of 0.5 to 1.5 volts rms.
- (11) Check the frequency meter for an output of 42,725 kc  $\pm 1$ . Repeat the procedure given in (5) through (10) above if the desired output frequency is not obtained.
- (12) Rotate 100-kc oscillator switch S3 (fig. 3-32) through all 10 positions and verify that the voltmeter reading does not vary more than 2.5 db at any position. If this limit is exceeded, repeat the alignment procedure.

C1

Note. Output circuit A8 has no adjustments. The two frequencies are received in the mixer and mixed down to the desired output frequency. Fixed filter FL1 has a bandpass response flat within 3 db from 3,750 to 13,749 kc.

**3-23. RF Module Alignment**

Align the radiofrequency module as follows:

*a. RF Module Amplifier.*

- (1) Connect Signal Generator AN/GRM-50 to J702 through 20-db match pad (figs. 3-1 and 3-34).
- (2) Connect a 5K-ohm potentiometer and 1K-ohm resistor across the output of Power Supply PP-4838/U.
- (3) Connect the positive lead of the PP-4838/U to pin 3 of TB701, and the negative lead to pin 4 of TB701.
- (4) Connect the arm of the potentiometer to pin 2 of TB701.
- (5) Adjust the output of the power supply to +9 volts.
- (6) Connect AN/URM-145 to pin 2 of K2 (fig. 3-9).
- (7) Set C701 to the clockwise stop, maximum capacity (plates meshed).
- (8) Set switch S1 (fig. 3-9) to band 1 (completely counterclockwise).
- (9) Set the signal generator for an output of 2.001 mc  $\pm$ 1 percent.
- (10) Adjust the signal generator until an output is observed at pin 2 of relay K2.
- (11) Adjust the 5K potentiometer for maximum output as indicated on the AN/URM-145, reducing the signal generator to keep the output level below 100 millivolts rms.
- (12) Tune transformers T701, T705, and T709 (fig. 3-35) for maximum indication on the AN/URM-145. As peaking proceeds, reduce the signal generator level as necessary to keep the output level below 100 mv.
- (13) Rotate capacitor C701 counterclockwise to minimum capacity (plates out of mesh).
- (14) Set the signal generator to 3.001 mc  $\pm$ 1 percent.
- (15) Tune capacitors C703, C710, and C720 for a maximum indication on the

AN/URM-145. Adjust the signal generator as required to keep output below 100 mv.

- (16) Repeat (7) through (15) above until the last adjustment gives less than 1db change per trimmer capacitor adjustment.
- (17) Repeat (7) through (16) above to align the remaining bands of the radiofrequency circuit as shown in the following chart.

Band	RF (sig gen No. 1) mc	C701 setting	Tune
1	2.001	MAX (3 turns cw)	T701, T705, T709
1	3.001	MIN (3 turns ccw)	C703, C710, C720
2	3.001	MAX (3 turns cw)	T702, T706, T710
2	5.001	MIN (3 turns ccw)	C704, C711, C721
3	5.001	MAX (3 turns cw)	T703, T707, T711
3	8.001	MIN (3 turns ccw)	C705, C712, C722
4	8.001	MAX (3 turns cw)	T704, T708, T712
4	12.001	MIN (3 turns ccw)	C706, C713, C723

*b. Synthesizer Amplifier.*

- (1) Connect the Power Supply PP-4838/U positive lead to pin 3 of TB701, and the negative lead to pin 4 of TB701.
- (2) Connect Signal Generator AN/URM-25A to J703.
- (3) Connect Electronic Voltmeter AN/URM-145 to pin 3 of Z1 (fig. 3-9).
- (4) Connect a 100-ohm 1/2-watt resistor to J705.
- (5) Adjust the PP-4838/U output to +9 volts.
- (6) Set C701 to maximum capacity (plates meshed), and S1 fully counterclockwise (band 1) (fig. 3-9).
- (7) Set the signal generator for an output of 3175 mc  $\pm$ 1 percent, and adjust the level until an output is observed at pin 3 of Z1.

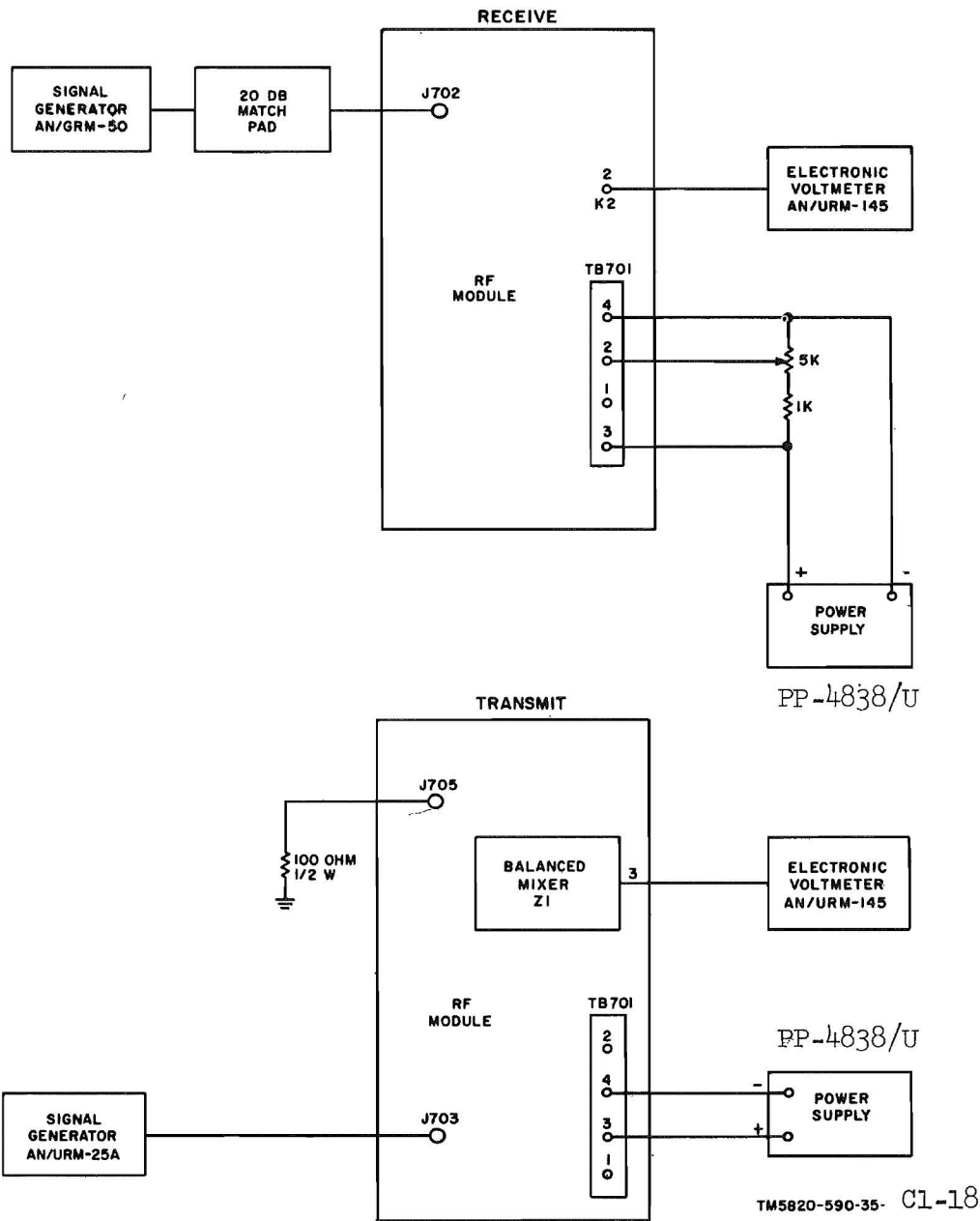
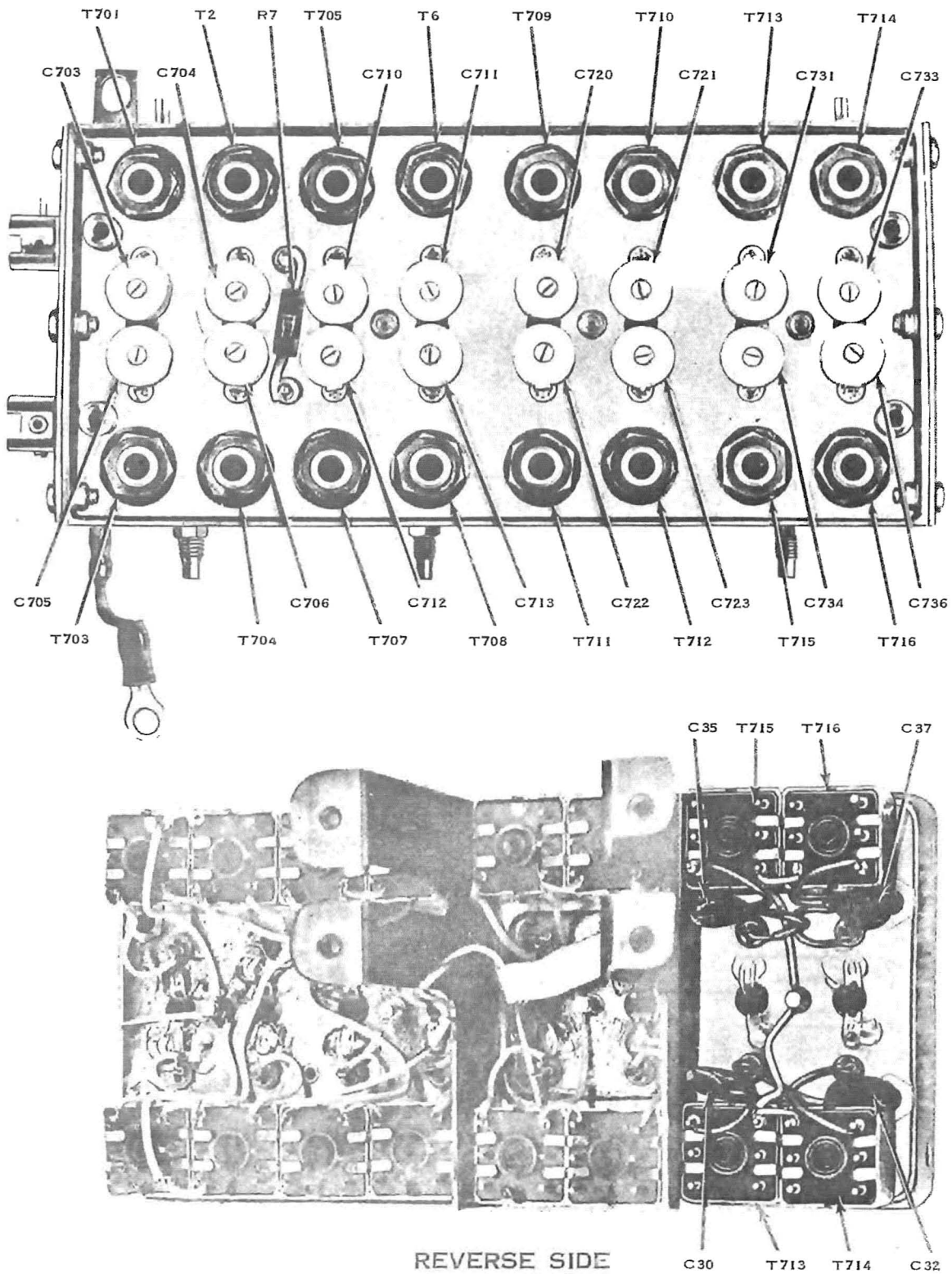


Figure 3-34. RF module, alignment test setup.

- (8) Adjust transformer T713 (fig. 3-33) for a maximum output as indicated on the AN/URM-145, reducing the signal generator level as necessary to keep the output below 100 millivolts.
- (9) Set C701 to minimum capacity (plates out of mesh).
- (10) Set the signal generator to 4.75 mc  $\pm 1$  percent.
- (11) Adjust C731 for a maximum output as indicated on the AN/URM-145; adjust the signal generator to keep the output level below 100 millivolts as required.



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Figure 3-35. RF module, bottom view.



- (12) Repeat (8) through (11) above until the last adjustment gives less than 1 db change per trimmer capacitor adjustment.
- (13) Repeat (6) through (12) above to align the remaining bands in the synthesizer circuit as shown in the following chart.

Sl setting band	Synth (sig gen.) No. 2 mc	PEAK NOISE control (C701) setting	Tune
1	3.75	MAX (3 turns cw)	T713
1	4.75	MIN (3 turns ccw)	C731
2	4.75	MAX (3 turns cw)	T714
2	6.75	MIN (3 turns ccw)	C733
3	6.75	MAX (3 turns cw)	T715
3	9.75	MIN (3 turns ccw)	C734
4	9.75	MAX (3 turns cw)	T716
4	13.75	MIN (3 turns ccw)	C736

- (14) Connect the AN/URM-145 across the 100-ohm resistor at J705.
- (15) Connect the signal generator to pin 5 of Z1.
- (16) Set the signal generator to 1.75 mc and adjust the signal generator level until an output is observed on the AN/URM-145.
- (17) Adjust T717 for maximum output as indicated on the AN/URM-145.

### 3-24. IF Audio Module Alignment

*a. Receive Mode Alignment.* With test equipment connected and adjusted as described in paragraph 3-4a, perform the following alignment instructions for the IF audio module.

- (1) Turn potentiometer R415 (fig. 3-36) approximately 10 turns clockwise.
- (2) Adjust signal generator No. 1 frequency level to obtain 1.0 volt rms as indicated on the multimeter.
- (3) Adjust the 2K-ohm potentiometer for maximum output.
- (4) Peak transformers T401, T402, T403, and T404 for a maximum audio output.

*Note.* Adjust signal generator No. 1 during peaking of transformers to keep output below 1.4 volts rms.

- (5) Repeat (4) above until no further increase is noted.

- (6) Adjust resistor R415 for 1.0-volt rms output with signal generator No. 1 output level at 30 microvolts.

*b. Transmit Mode Alignment.* With test equipment connected and adjusted as described in paragraph 3-4b, perform alignment instructions for the IF audio module as follows:

- (1) Perform the procedures given in paragraph 3-4b(1) through (10).
- (2) Adjust resistor R434 (fig. 3-13) for minimum output as indicated on the voltmeter.
- (3) Perform the procedure given in paragraph 3-4b(13), (14), and (15).
- (4) Adjust resistor R432 until the output at J401 is 26 millivolts as indicated on the voltmeter.

### 3-25. Frequency Generator Module Alignment

To align the 10-kc calibrate pulse output, connect the test equipment as shown in figure 3-14 and make the following connections:

*a.* Connect the oscilloscope to the emitter of transistor Q12 (fig. 3-35).

*b.* Connect the frequency meter to the vertical output of the oscilloscope.

*c.* Adjust R515 until an output of 245 kc  $\pm$ 100 cps is observed on the frequency meter.

*d.* Using a clip lead, short the base of Q12 to ground.

*e.* Connect the oscilloscope probe to the emitter of Q13 and adjust R520 until an output of 46 kc  $\pm$ 100 cps is observed on the frequency meter.

*f.* Remove the clip lead from Q12 and short the base of Q13 to ground.

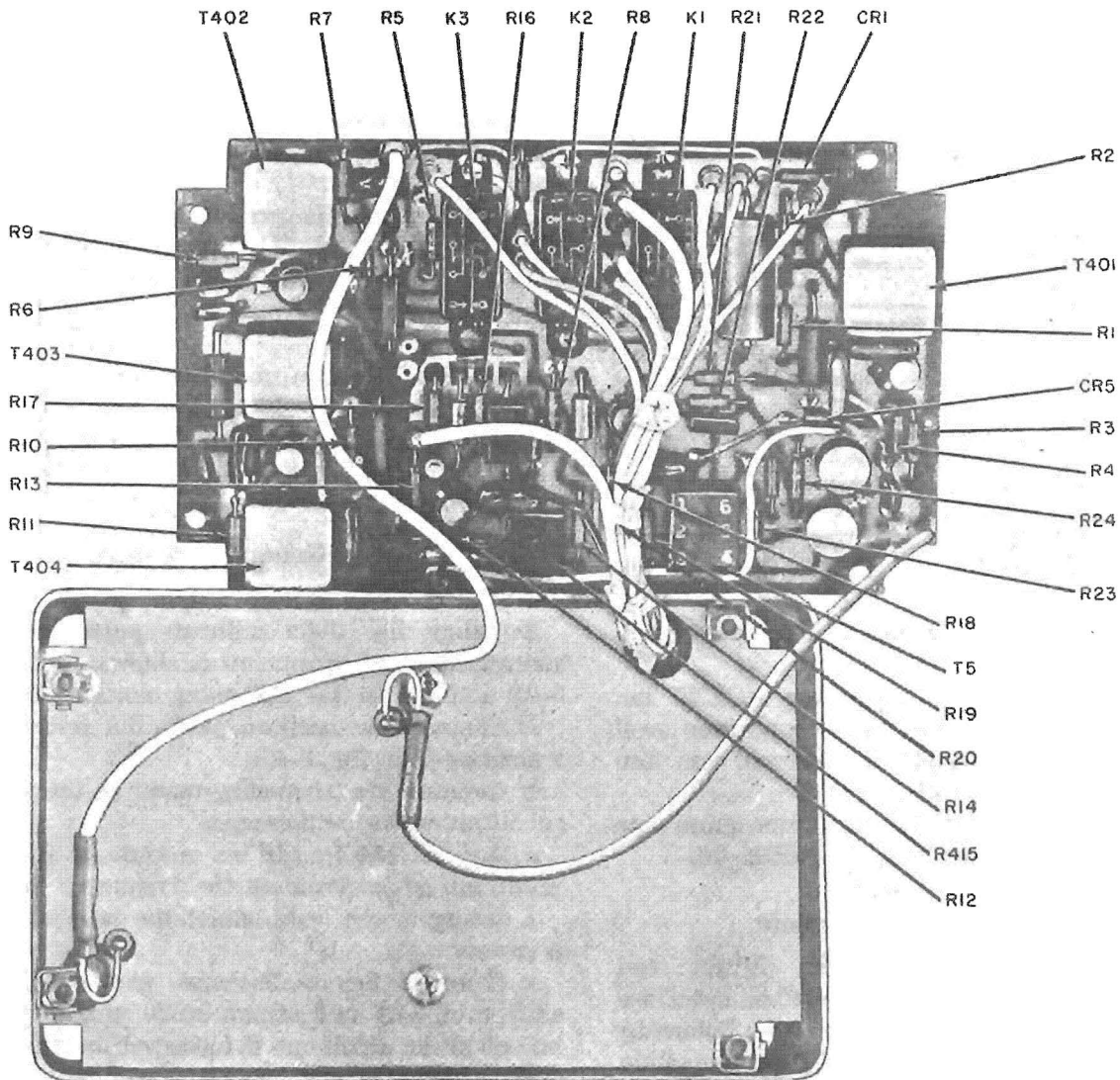
*g.* Connect the oscilloscope probe to the emitter of Q14 and adjust R525 until an output of 9.6 kc  $\pm$ 100 cps is observed on the frequency meter.

*h.* Disconnect the clip lead from Q13.

### 3-26. Power Amplifier Module Alignment (HAC Part No. 1541057-100)

With the test equipment connected as shown in figure 3-16, make the following connections:

- a.* Connect a 100-ohm, 20-watt dummy load to pin 3 of relay K1 (fig. 3-20).



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Figure 3-36. IF Audio module, rear view, components boards removed.

b. Monitor the output at pin 3 of relay K1, using Multimeter ME-26B/U (or equivalent) (fig. 3-16).

c. Set the signal generator to 5 mc at 10 millivolts.

d. Set the TS-352A/U to R X10K scale.

e. Insert a teflon strip into K1, so that pin 2 of K1 does not make contact with pin 3 when K1 closes.

f. Turn power supplies on.

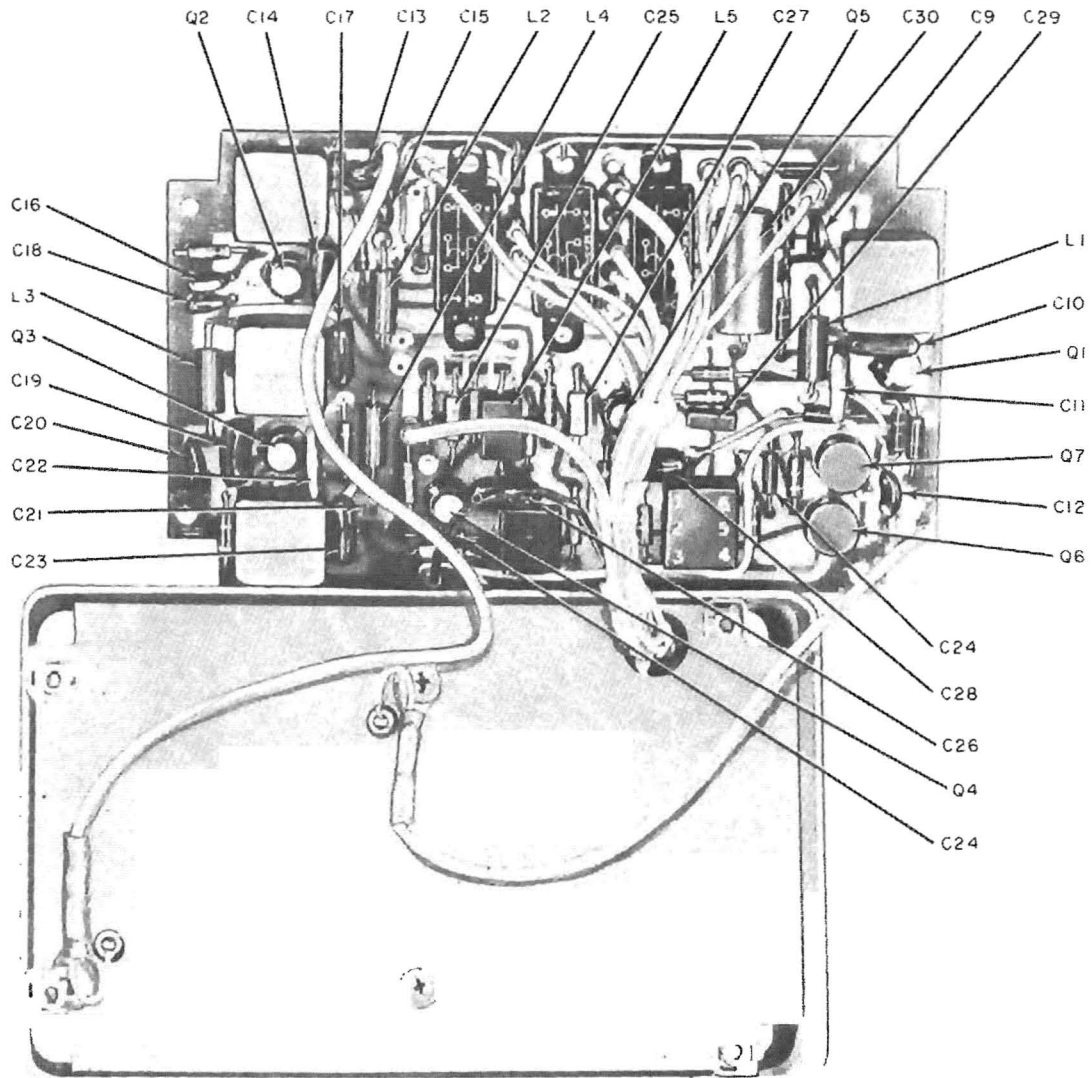
g. Adjust signal generator output until the ME-26B/U indicates an output of 28 volts rms  $\pm 2$ .

h. Adjust capacitor C826 (fig. 3-20) for a minimum deflection on TS-352A/U (C826 tunes broadly).

i. Remove the teflon strip from K1.

j. Remove the dummy load from pin 3 of K1.

k. Adjust S1 (L815) and C820 (fig. 3-17) for a maximum indication on the TS-352A/U.



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Figure 3-36—Continued.

l. Adjust the signal generator level until the power output is 24.5 volts.  
 m. Reduce power supply No. 3 to +30 volts.

n. Note that the power output is less than 5 volts.

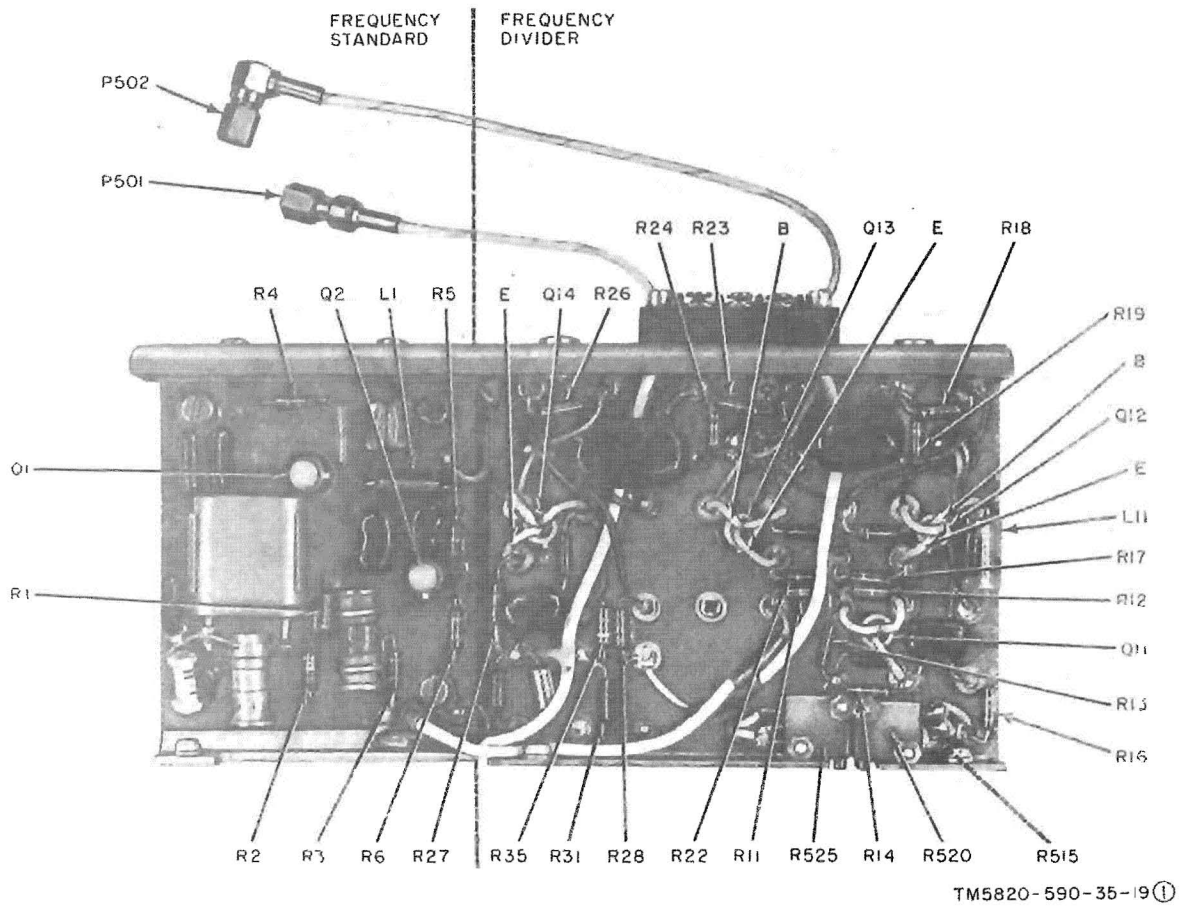
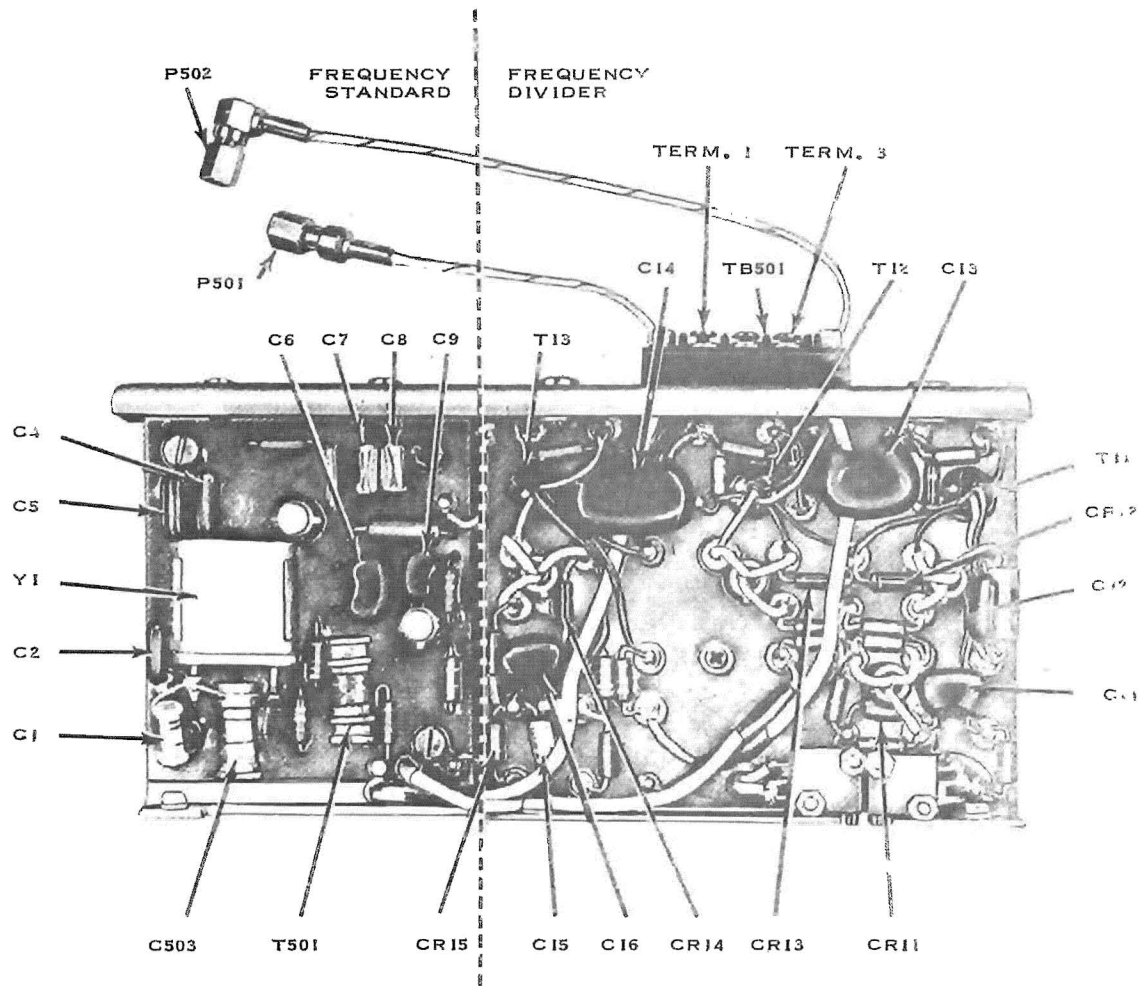


Figure 3-37. Frequency generator module, front view.



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Figure 3-37 — Continued.

### 3-27. Power Amplifier Module Alignment (HAC Part No. 1541057-101)

a. Connect the test equipment to the power amplifier module as shown in figure 3-20.1.

b. Set Power Supply PP-4838/U No. 1 to +12.0 volts  $\pm 0.6$ , 200 ma.

c. Set power supply No. 2 to +9.0 volts  $\pm 0.45$ , 400 ma.

d. Set power supply No. 3 to +40.0 volts  $\pm 2$ , 1 ampere.

e. Set Signal Generator AN/GRM-50 to 2 mc at 10 mv.

f. Set Multimeter TS-352A/U No. 1 to 1-MA scale, Multimeter TS-352A/U No. 2 to 10-VDC

scale, and Multimeter TS-352A/U No. 3 to 1,000-MA scale.

g. Adjust signal generator output level control until multimeter No. 3 indicates 850 ma.

h. Adjust L815 and C820 (fig. 3-20.2) for maximum indication on multimeter No. 1.

i. Adjust signal generator output level control until Multimeter ME-26B/U indicates 24.5 volts ac.

j. With Clip-On Dc Milliammeter HP-428A, measure the collector currents of Q5 and Q6. The difference between the two currents must not exceed 80 ma.

k. Adjust R835 (fig. 2-3) until multimeter No. 2 indicates +3.5 volts.

## CHAPTER 4

### GENERAL SUPPORT TESTING PROCEDURES

#### 4-1. General

a. Testing procedures are prepared for use by Signal Field Maintenance Shops and Signal Service Organizations responsible for general support maintenance of electronic equipment to determine the acceptability of repaired electronic equipment. These procedures set forth specific requirements that repaired electronic equipment *must* meet before it is returned to the using organization. The testing procedures may also be used as a guide for the testing of equipment that has been repaired at direct support level if the proper tools and test equipment are available. A summary of the performance standards is given in paragraph 4-7.

b. Comply with the instructions preceding the body of each chart before proceeding to the chart. Perform each test in sequence. *Do not vary the sequence.* For each step, perform all the actions required in the *control settings* columns; then perform each specific test procedure and verify it against its performance standard.

#### 4-2. Test Equipment

All test equipment required to perform the testing procedures given in this chapter are listed in the following chart and are authorized under TA-11-17, Signal Field Maintenance Shops, and TA-11-100 (11-17), Allowances of Signal Corps Expendable Supplies for Signal Field Maintenance Shop. Continental United States.

##### a. Test Equipment.

Nomenclature	Federal stock No.	Technical Manual
Signal Generator AN/GRM-50	6625-868-8353	TM 11-6625-573-15
Electronic Voltmeter AN/URM-145.	6625-973-3986	TM 11-6625-524-14
Multimeter ME-26B/U	6625-646-9409	TM 11-6625-200-12

##### b. Other Equipment.

Nomenclature	Federal stock No.	Technical Manual
Power Supply PP-4838/U (or equivalent).		
Dummy load, 50-ohm, 20-watt	None	None.
Probe T-Connector HP11042A	None	Commercial.

c. *Fabricated Equipment.* A 20-db match pad (fig. 4-1) is required for final testing of the radio set. Fabricate the 20-db match pad as follows:

- (1) Obtain a 56-ohm, 1/2-watt resistor (R1), a 500-ohm, 1/2-watt resistor

(R2), and 120-ohm, 1/2-watt resistor (R3).

- (2) Assemble resistors R1, R2, and R3, and connectors Automatic Metals GG4602-900-819 and GG4609-000-801 as shown in figure 4-1.

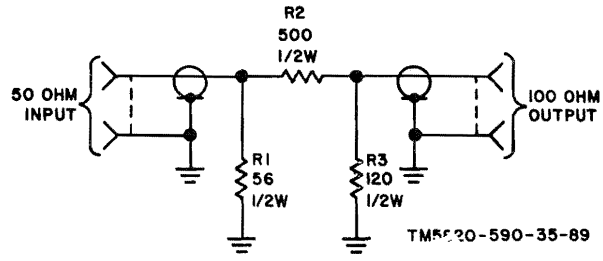


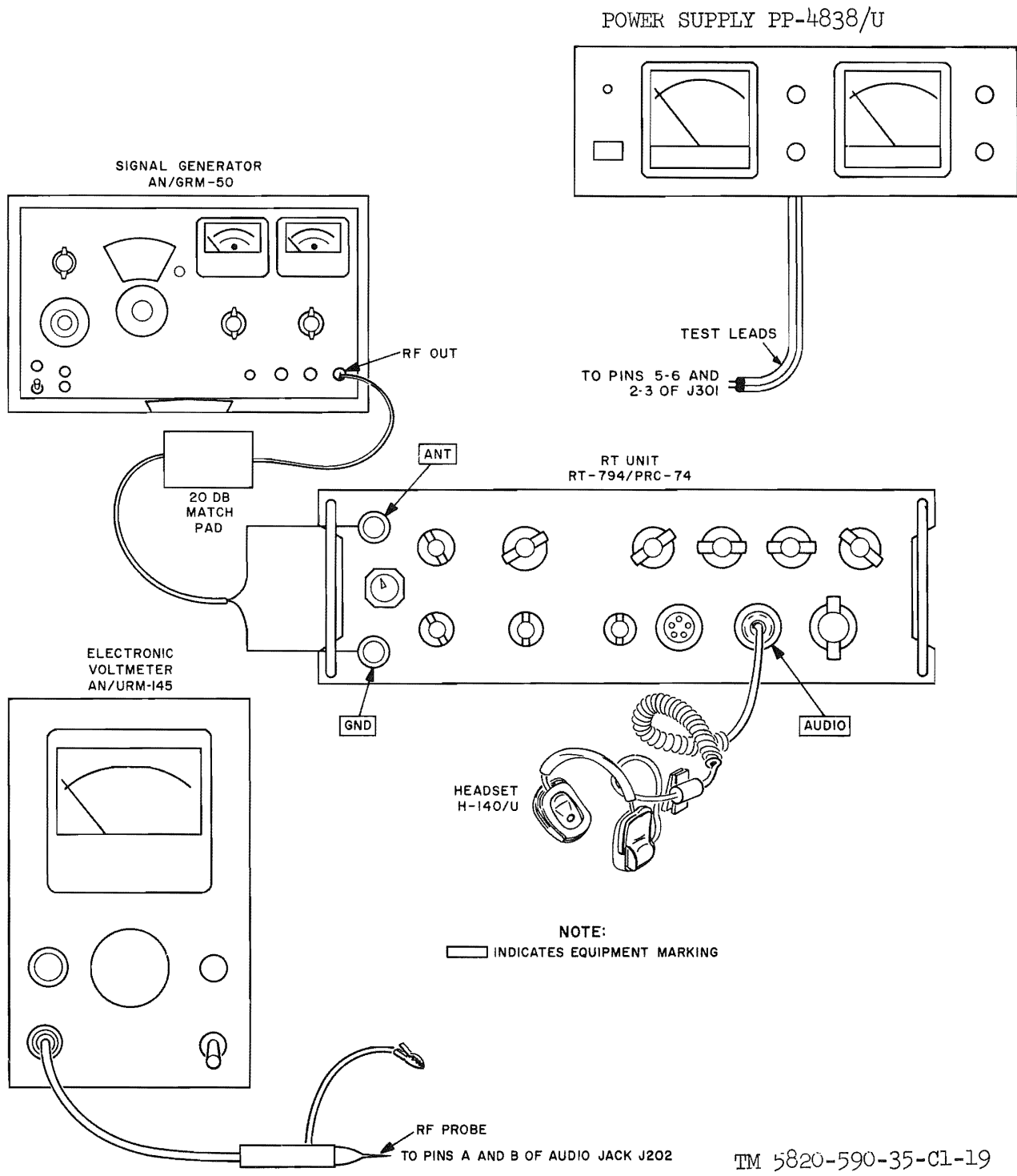
Figure 4-1. 20-dB match pad.



### 4-3. Physical Tests and Inspection

- a. *Test Equipment and Materials.* None.
- b. *Test Connections and Conditions.* None.
- c. *Procedure.*

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	None .....	<i>Radio Set AN/PRC-74</i> Controls may be in any position ....	<ul style="list-style-type: none"> <li>a. Inspect all controls and mechanical parts for loose or missing screws or nuts.</li> <li>b. Inspect connectors for looseness and damage.</li> </ul>	<ul style="list-style-type: none"> <li>a. Screw and nuts will be tight; none missing.</li> <li>b. No looseness or damage evident.</li> </ul>
2	None .....	Controls may be in any position ....	<ul style="list-style-type: none"> <li>a. Turn OFF-ON-TUNE switch to ON and then to TUNE.</li> <li>b. Turn CLARIFY-PUSH TO CALIBRATE switch throughout switch range. Push in and turn switch throughout switch range.</li> <li>c. Turn ANT TUNE, ANT LOAD, and PEAK NOISE controls 360°.</li> <li>d. Turn R.F. GAIN, MC, 100KC, 10KC, and 1KC throughout control limits.</li> <li>e. Turn the power supply METER switch to CHARGE AMPS, to BATTERY VOLTS, and then to RADIO VOLTS.</li> <li>f. Turn CHARGING CURRENT control throughout control limits.</li> <li>g. Operate POWER ON and CHARGE ON switches.</li> </ul>	<ul style="list-style-type: none"> <li>a. Operates freely to ON: spring-return from TUNE.</li> <li>b. Operates freely throughout switch ranges: spring-return from PUSH TO CALIBRATE.</li> <li>c. Controls will turn freely without binding or excessive looseness.</li> <li>d. Control will turn freely without binding or excessive looseness.</li> <li>e. Switch operates freely to each position without binding or excessive looseness.</li> <li>f. Control will turn without binding or excessive looseness.</li> <li>g. Switches will operate freely without binding or excessive looseness.</li> </ul>
3	N/A .....	N/A .....	<p>Inspect equipment case for damage, missing parts and condition of finish and panel lettering.</p> <p><i>Note.</i> Touchup painting is recommended in lieu of refinishing whenever practicable. Screwheads and receptacles will not be painted or polished with abrasives.</p>	No damage or missing parts evident. External surfaces intended to be painted will not show bare metal. Panel lettering will be legible.



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Figure 4-2. Radio set receive test.

#### 4-4. Radio Set, Receive Test

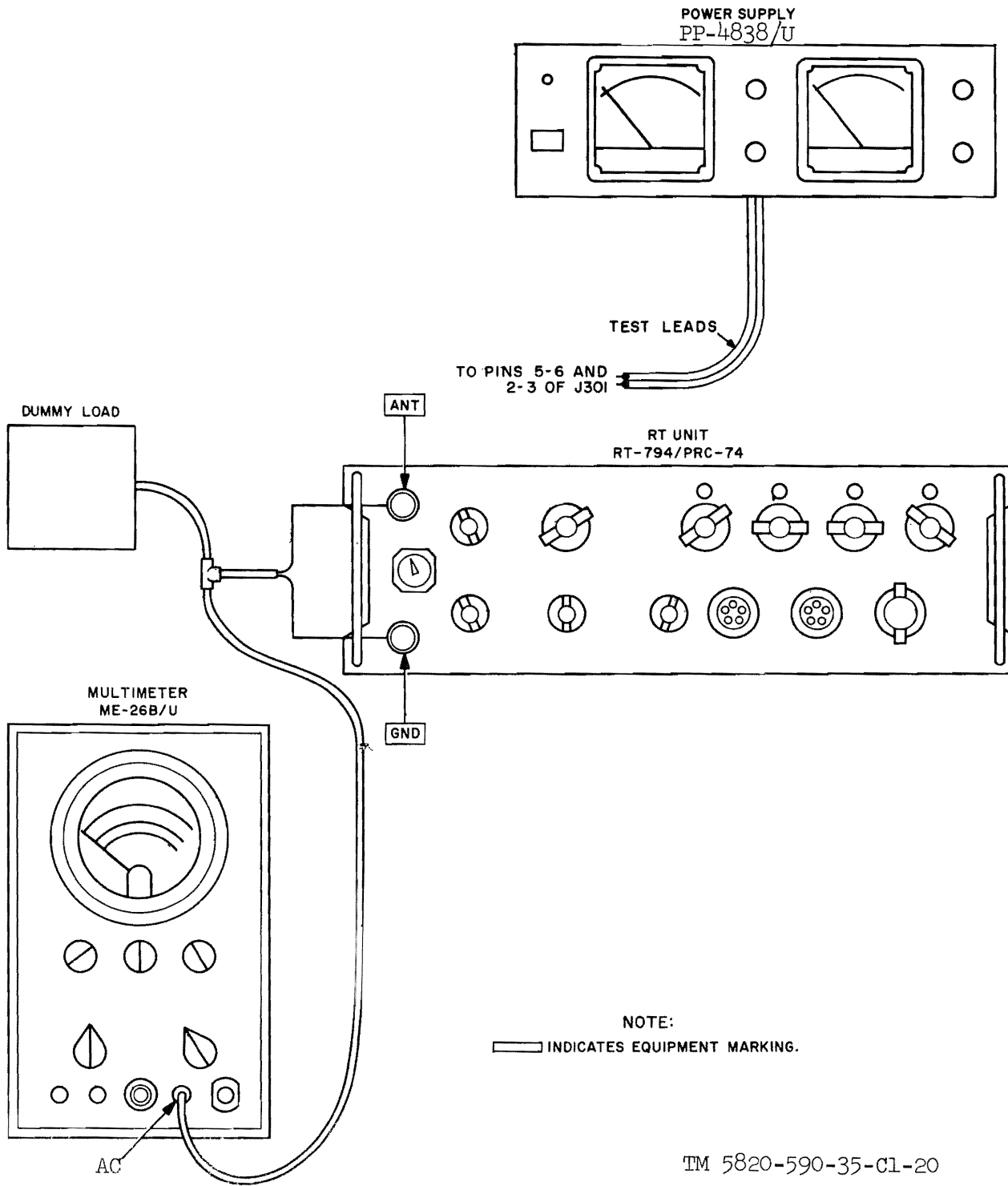
##### a. Test Equipment and Materials.

- (1) Signal Generator AN/GRM-50.
- (2) Electronic Voltmeter AN/URM-145.
- (3) Power Supply PP-4838/U (or equivalent).
- (4) 20-db match pad.

b. *Test Connections and Conditions.* Connect the equipment as shown in figure 4-2. Turn on the equipment and allow 5 minutes to warm up before proceeding.

##### c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	<b>AN/GRM-50</b> POWER: ON VERNIER ATTENUATOR: 7 microvolts. RANGE: 2.001 mc PP-4838/U VOLTAGE ADJUST: 12V.	<b>RT-794/PRC-74</b> MC: 2 100 KC: 0 10 KC: 0 1 KC: 0 OFF-ON-TUNE: ON	a. Adjust signal generator for frequency beat note of approximately 1 kc in audio output. b. Turn R. F. GAIN fully clockwise. c. Adjust PEAK NOISE, ANT LOAD, and ANT TUNE for maximum audio output. d. Adjust R206 and R210 on TB203 (fig. 2-1) for maximum audio output.	a. None. b. None. c. None. d. None.
2	<b>AN/URM-145</b> RANGE: .01 VOLTS	-----	a. Disconnect headset ----- b. Connect AN/URM-145 to pins A and B of J202 (AUDIO connector). c. Repeat the test with rt unit frequency controls set to 3.000, 5.000, and 8.000 mc, and AN/GRM-50 set to frequencies of 3001, 5001, and 8001 mc.	a. None. b. AN/URM-145 indication should be not less than 0.707V rms. c. AN/URM-145 indications should not be less than 0.707 volt rms at all frequency settings.



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Figure 4-3. Radio set transmit test.

#### 4-5. Radio Set, Transmit Test

##### a. Test Equipment and Materials.

- (1) Multimeter ME-26B/U.
- (2) Power Supply PP-4838/U (or equivalent).
- (3) Probe T-connector HP11042A.
- (4) Dummy load, 50-ohm, 20-watt.

b. *Test Connections and Conditions.* Connect equipment as shown in figure 4-3. Turn on equipment and allow 5 minutes to warm up before proceeding.

##### c. Procedure.

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	PP-4838/U VOLTAGE ADJUST: 12V.  ME-26B/U FUNCTION: + RANGE: 100V	RT-794/PRC-74 MC: 11 100 KC: 5 10 KC: 5 1 KC: 5 OFF-ON-TUNE: ON  -----	a. Turn R. F. GAIN fully clockwise. b. Adjust PEAK NOISE, ANT LOAD, and ANT TUNE for maximum output. c. Adjust R206 and R210 on TB203 (fig. 2-1) for maximum output. d. Turn OFF-ON-TUNE switch to TUNE. e. Adjust R835 (fig. 2-3) on power amplifier module until continuous-wave output as indicated on ME-26B/U is 25.5 volts rms. f. Connect microphone to either AUDIO jack. g. Speak or whistle into microphone. h. Repeat d through g above, with radio set frequency controls set to 2,000, 3,000, 5,000, and 8,000 mc.	a. None. b. None. c. None. d. None. e. ME-26B/U indication: 25.5 volts rms. f. None. g. ME-26B/U should indicate peaks of not less than 26 volts or more than 37 volts. h. ME-26B/U indication should not be less than 24.5 volts rms at all frequency settings.



#### 4-6. External Power Supply and Battery Charger

a. *Test Equipment and Materials.*

Multimeter ME-26B/U.

b. *Test Connections and Conditions.* Remove battery charger module. Connect negative lead of Multimeter ME-26B/U to pin 1 of J3 (fig. 2-10) and positive lead to pin 2. Turn on test equipment and allow 1 minute to warm up.

c. *Procedure.*

Step No.	Control settings		Test procedure	Performance standard
	Test equipment	Equipment under test		
1	ME-26B/U FUNCTION: + RANGE: 100V	PP-4514/PRC-74 POWER: ON	a. Connect P1A of cable W1 to J1 and to a +28-volt power source. b. Disconnect cable W1 and connect P1B of cable W2 to J1 and to a 110-volt, 50- to 400-cps power source.	a. ME-26B/U indication: 28 volts. b. ME-26B/U indication: 20-40 volts.
2	ME-26B/U Disconnected	-----	a. Replace battery charger module. b. Connect P1A of cable W1 to J1 and to a +28V power source. c. Turn METER switch to RADIO VOLTS. d. Momentarily short circuit pins 2 and 6 of J4.	a. None. b. None. c. Power supply meter should indicate 14 ±3 volts. d. Power supply meter should indicate 0 volt.
3	-----	PP-4514/PRC-74 CHARGER: ON	a. Turn METER switch to BATTERY VOLTS. b. Connect cable W5 to J5. c. Turn CHARGING CURRENT control fully clockwise. d. Momentarily short battery clips of cable.	a. Power supply panel meter should indicate 20 volts. b. None. c. None. d. Power supply meter should indicate 0 volt.

**4-7. Summary of Test Data**

Personnel may find it convenient to arrange a checklist in a manner similar to that shown below:

RT UNIT RT-794/PRC-74 (Radio Set,

	Actual Test Data	Performance Standard	
<b>1. RECEIVE MODE</b>			
a. 2.000	_____	0.707V rms min	
b. 3.000	_____	0.707V rms min	
c. 5.000	_____	0.707V rms min	
d. 8.000	_____	0.707V rms min	
<b>2. TRANSMIT MODE</b>			
		Continuous Wave Output	Power Output Peaks
a. 2.000	_____	2.5V rms min	26-37V
b. 3.000	_____	2.5V rms min	26-37V
c. 5.000	_____	2.5V rms min	26-37V
d. 8.000	_____	2.5V rms min	26-37V

PP-4514/PRC-74

	Actual Test Data	Performance Standard	
<b>OUTPUT VOLTAGE REGULATION</b>			
a. Module Case	_____	28V	20-40V
b. Power Supply Module	_____	14 ±3V	0V
c. Battery Charger	_____	20V	0V



## CHAPTER 5

### DEPOT TESTING

#### 5-1. Purpose of Depot Testing

The tests outlined on this chapter are designed to measure the performance capability of repaired radio set modules. Modules that meet the minimum standards stated in the tests will furnish satisfactory operation equivalent to that of new equipment. The module must be installed in the radio set in order to per-

form these tests. If the complete radio set is not available, repeat module troubleshooting tests (para 3-1).

#### 5-2. Test Equipment Required

The following test equipment is required for depot testing the radio set modules.

##### a. Test Equipment.

Equipment	Federal stock no.	Qty	Technical manual
Signal Generator AN/GRM-50 -----	6625-868-8353	1	TM 11-6625-573-15
R. F. Signal Generator Set AN/URM-25A -----	-----	1	TM 11-5551A
Frequency Meter AN/USM-26 -----	6625-543-1356	1	TM 11-5057
Audio Oscillator TS-382/U -----	6625-091-9486	1	TM 11-6625-261-12
Oscilloscope AN/USM-164 -----	-----	1	Tektronix Type 541
Electronic Voltmeter AN/URM-145 -----	6625-973-3986	1	TM 11-6625-524-14
Multimeter ME-26B/U -----	6625-646-9409	1	TM 11-6625-200-12
Multimeter TS-352A/U -----	6625-242-5023	2	TM 11-5527
Power Supply PP-4838/U (or equivalent) ...	-----	1	
Dummy load, 50-ohm, 20-watt -----	None -----	1	None.

##### b. Additional Equipment.

- (1) Fabricated 20-db match pad.
- (2) Resistor, 20 ohm  $\pm 5$  percent, 10 watts.
- (3) Resistor, 40 ohm  $\pm 5$  percent, 50 watts.
- (4) Resistor, 60 ohm  $\pm 5$  percent, 2 watts.
- (5) Resistor, 80 ohm  $\pm 5$  percent, 25 watts.
- (6) Resistor, 100 ohm  $\pm 5$  percent, 1/2 watt.
- (7) Resistor, 500 ohm,  $\pm 5$  percent, 1/2 watt.
- (8) Resistor, 800 ohm  $\pm 5$  percent, 4 watts.
- (9) Resistor, 900 ohm,  $\pm 5$  percent, 1/2 watt.

*c. Test Equipment Connections.* Test setups required for depot testing will be the same as those used for troubleshooting, except that Power Supply PP-4838/U (or equivalent) will be connected to pins 2, 3, (-) and 5, 6 (+) of J301 for all tests. Set the power supply to +12 volts. Use adapters Amphenol 27-28 and 27-40 to connect test equipment to subminiature coaxial connectors. Fabricate test loads as described in paragraph 3-1.

#### 5-3. Frequency Synthesizer Module

With the test equipment connected as shown in figure 3-2 and described in paragraph 5-2c, perform the following:

- a. Set the OFF-ON-TUNE selector switch to ON.

b. Set the frequency control knobs to read 11,999 mc.

c. Push and adjust the PUSH TO CALIBRATE knob for a frequency reading of 13,740-kc on the frequency meter. The output level reading on the voltmeter should be between 50 and 300 millivolts. The output waveform as viewed on the oscilloscope should have no amplitude modulation or mixed frequencies. Harmonic (waveform) distortion may occur. These output level and waveform conditions should hold for all following test frequencies.

d. Place the radio set in the transmit mode of operation by holding the OFF-ON-TUNE selector switch at TUNE. Check for an output frequency of 13,749 kc  $\pm$  20 cps.

e. Repeat b, c, and d above, using the test frequencies shown in the following chart.

Oscillator switch digit settings	Calibrate frequency ( $\pm$ 10 cps)	Output frequency, kc $\pm$ 50 cps
11999	13,740	13,749
10888	12,630	12,638
9777	11,520	11,527
8666	10,410	10,416
7555	9,300	9,305
6444	8,190	8,194
5333	7,080	7,083
4222	5,970	5,972
3111	4,860	4,861
2000	3,750	3,750

**5-4. RF Module**

a. *Receive Test.* With the exception of signal generator No. 2, connect the test equipment as shown in figure 3-8 and described in paragraph 5-2c and perform the following:

- (1) Turn the MC frequency control to position 2 (this switches the bandswitch to band 1).
- (2) Set signal generator No. 1 to 2,001 kc  $\pm$  1 percent at 100 millivolts.
- (3) Turn the ON-OFF-TUNE switch to ON.
- (4) Turn the R.F. GAIN control maximum clockwise.
- (5) Adjust the PEAK NOISE control for a maximum indication on the voltmeter.
- (6) Adjust R206 (fig. 2-1) for a maximum indication on the voltmeter.

- (7) See that the output across the load is 30 millivolts or greater.
- (8) Repeat the test for other frequency bands, as shown in the following chart.

MC control	Band	Signal generator No. 1 frequency, mc
2	1	2,001
3	2	3,001
5	3	5,001
8	4	8,001

b. *Transmit Test.* With the test equipment connected as shown in figure 3-8 and described in paragraph 5-2c, perform the following:

- (1) Set the MC selector to 2 (this places the bandswitch to band 1).
- (2) Connect a jumper wire from terminal 1 of TB701 to terminal 2 of TB201. This places the RF module in transmit mode.
- (3) Set signal generator No. 1 to 1,750 kc  $\pm$  1 percent.
- (4) Set signal generator No. 2 to 3,750 kc.
- (5) Turn the OFF-ON-TUNE selector switch to ON.
- (6) Turn the R.F. GAIN control maximum clockwise.
- (7) Adjust the PEAK NOISE control for a maximum indication on the voltmeter.

*Note.* The procedure in (6) above need not be repeated if already performed during receive mode test.

- (8) Adjust R206 for a maximum indication on the voltmeter.
- (9) See that the output across the load is 100 millivolts minimum.
- (10) Repeat the test for frequencies in the other bands as shown in the following chart.
- (11) Connect lead to terminal 1 of TB701 at the conclusion of this test.

MC control	Band	Signal generator No. 2 kc
2	1	3,750
3	2	4,750
5	3	6,750
8	4	9,750

### 5-5. IF Audio Module

*a. Receive Test.* With the test equipment connected as shown in figure 3-12 and described in paragraph 5-2c, perform the following:

- (1) Set signal generator No. 1 (or equivalent) to 1.749 mc at 30 microvolts.
- (2) Set signal generator No. 2 (or equivalent) to 1.750 mc at 1-volt rms output.
- (3) Turn the ON-OFF-TUNE selector switch to ON.
- (4) Set the R. F. GAIN control to maximum. The audio output should be 1-volt rms or greater.
- (5) Push in the CLARIFY-PUSH TO CALIBRATE control. The audio output should be 1-volt rms or greater.

*b. Transmit Test.* With the test equipment connected as shown in figure 3-12, perform the following:

- (1) Disconnect the +12-volt transmit lead from terminal 4 of TB202 (fig. 2-1).
- (2) Using a clip lead, connect the +12-volt lead to terminal 2 of TB201.
- (3) Remove the receive-transmit lead from terminal 1 of TB201. Position the disconnected lead to prevent accidental contact.
- (4) Turn the OFF-ON-TUNE switch to ON.
- (5) Connect terminal 6 of TB202 to ground. The if. output across the 100-ohm load at J401 should be 26 millivolts minimum. Audio output across the 500-ohm load at terminal 1 of TB202 should be 300 to 600 millivolts.
- (6) Disconnect terminal 6 of TB202 from ground.
- (7) Turn on Audio Oscillator TS-382/U (or equivalent).
- (8) Set the audio oscillator to 1 kc at 1.2 millivolts.
- (9) See that the *if* output across the 100-ohm load at J401 is 26 millivolts  $\pm 10$  percent.

### 5-6. Frequency Generator Module

With the test equipment connected as shown in figure 3-14 and described in paragraph 5-2c, perform the following:

- a.* Check for an output frequency of 1,750 kc  $\pm 10$  cps at a level of .1 volt rms  $\pm 10$  percent on the frequency meter.
- b.* Connect the test equipment to P502.
- c.* Check for an output pulse with a duration rate of 1.25 microseconds  $\pm 0.25$  and a repetition rate of 10 kc  $\pm 1$  cps. The pulse amplitude should be 0.7 volt peak to peak  $\pm 10$  percent.

### 5-7. Power Amplified Module

#### (HAC Part No. 1541057-100)

With the test equipment connected as shown in figure 3-16, and described in paragraph 5-2c perform the following:

- a.* Connect a 50-ohm, 20-watt dummy load and Multimeter ME-26B/U (or equivalent) to the opposite ends of a T-connector and connect the leg of the T-connector to the ANT and GND terminals of the radio set.
- b.* Adjust the ANT TUNE and ANT LOAD for maximum output.
- c.* See that TS-352A/U indicates an output of 0.5-1.0-milliampere, and that the ME-26B/U indicates an output of 24.5 volts rms.
- d.* Repeat the test for the signal generator inputs as shown in the following chart.

Signal generator input	Voltage indication
2 mc at 60 millivolts ....	} 0.5-1.0 ma, 24.5 volts rms for all frequencies.
4 mc at 60 millivolts ....	
8 mc at 60 millivolts ....	
12 mc at 60 millivolts ....	

- e.* Set the radio set frequency controls to 11.555.
- f.* Adjust R835 (fig. 3-20) until the ME-26B/U indicates 25.5 volts.

#### 5-7.1 Power Amplifier Module

##### (HAC Part No. 1541057-101)

- a.* Using a T-connector, connect Multimeter ME-26B/U and 50-ohm, 20-watt dummy load across ANT and GND antenna terminals (fig. 2-5.1).

b. Disconnect P801 (fig. 2-1) of the power amplifier module from J704 of the RF module.

c. Connect R. F. Signal Generator AN/URM-25A, or equivalent, to P801.

d. Hold the OFF-ON-TUNE selector switch at TUNE.

e. Adjust ANT TUNE and ANT LOAD controls for a maximum indication on the ANT IND meter.

f. Adjust the RF signal generator level for a reading of 24.5 volts rms at the output (ANT and GND antenna terminals).

g. The RF signal generator level must be less than 100 mv. The ANT IND meter must indicate between midscale and full scale.

h. Repeat d through g above with the RF signal generator set at each of the following frequencies: 4 mc, 8 mc, and 12 mc.

### 5-8. Gain Control Circuit

(fig. 2-6)

Using Multimeter ME-26B/U (or equivalent), test radio set gain control circuit TB203 as follows:

#### a. Receiver Test.

- (1) Connect the multimeter to terminal 8 of gain control circuit board TB203.
- (2) Set the OFF-ON-TUNE selector switch to ON. **Rotate the RF Gain Control fully CW.**
- (3) Adjust R206 for a maximum voltage indication on the multimeter.
- (4) See that the multimeter indicates a voltage of not less than +1.5 volts.
- (5) Adjust R206 for a minimum voltage indication on the multimeter.
- (6) See that the multimeter indicates a voltage of not more than +1 volt.
- (7) Connect the multimeter to terminal 2 of gain control circuit board TB203.
- (8) Set the R. F. GAIN control to maximum.
- (9) Repeat (3) through (6) above, adjusting R210.
- (10) Using a clip lead, connect terminal 3

of gain control circuit board TB203 to terminal 4.

- (11) Check for a multimeter indication, at terminals 2 and 8 of gain control circuit board TB203, of not more than +2.6 volts.
- (12) If the multimeter indication is not within the limits specified, the gain control circuit is not working in the receive mode.
- (13) Leave the test equipment as connected for the test in b below.

#### b. Calibrate Test.

- (1) Push the CLARIFY-PUSH TO CALIBRATE control.
- (2) Check for a multimeter indication of not more than +1.5 volts at terminals 2 and 8 of gain control circuit board TB203.
- (3) If the multimeter indication is above +1.5 volts, the gain control is not working in the calibrate mode.
- (4) Leave test equipment as connected for the test in c below.

#### c. Transmit Test.

- (1) Connect a 50-ohm load to the ANT and GND terminals of the radio set.
- (2) Place the OFF-ON-TUNE selector switch at TUNE.
- (3) Disconnect clip lead at terminal 4 and connect to terminal 6.
- (4) Check for a multimeter indication at terminals 2 and 8 of not less than +2 volts.
- (5) If the multimeter indications are not within the limits specified, the gain control circuit is not working in the transmit mode.
- (6) Replace gain control circuit board TB23 as required (para 2-12).
- (7) Connect the headset to one of the AUDIO connections and adjust R206 and R210 for maximum noise in the headset.

**5-9. Power Supply Module**

With the test equipment connected as shown in figure 3-21, perform the following :

**Caution:** Do not turn off the power supply at J301 when the multimeter is connected.

a. Using a clip lead, connect terminal 2 to terminal 6 of TB201.

b. Turn on the power supply to +12 volts.

c. Measure the 9-volt dc output at terminal 7 of TB201, using Multimeter TS-352A/U (or equivalent).

d. Repeat a and c above, using the voltages, connections, and load resistances shown in the following chart. Voltage measured in e of the chart should be +8.8 to +9.3 volts; other voltages should be within +0.5 to -0.25 volt of the voltage measured in e of the chart.

Source voltage	TB201-1 to TR201-8 (GND)	Loads connected to TR201-7
10.5	a. Disconnected ....	a. 900 ohms ±5 percent, ½ watt
	b. Disconnected ....	b. 60 ohms ±5 percent, 2 watts
	c. Connected .....	c. 20 ohms ±5 percent, 10 watts
12.0	d. Disconnected ....	d. 900 ohms ±5 percent, ½ watt
	e. Disconnected ....	e. 60 ohms ±5 percent, 2 watts (nominal)
	f. Connected .....	f. 20 ohms ±5 percent, 10 watts
17.0	g. Disconnected ....	g. 900 ohms ±5 percent, ½ watt
	h. Disconnected ....	h. 60 ohms ±5 percent, 2 watts
	i. Connected .....	i. 20 ohms ±5 percent, 10 watts

e. Set the power supply to +10.5 volts at 10 amperes.

f. Connect a 800-ohm  $\pm 5$  percent, 1/2-watt load to terminal 7 of TB201.

g. Measure the 40-volt output at terminal 3 of TB201, using the multimeter.

h. Repeat e, f, and g above, using the voltages, connections, and load resistances shown in the following chart. Voltage measured in e of the chart should be +38 to +42 volts for RT-794/PRC-74, and +39.5 to 43.5 volts for RT-794A/PRC-74A; other voltages should be within  $\pm 2$  volts of voltage measured in e of the chart.

Source voltage (vdc)	Loads connected to TB201-3
10.5	a. 800 ohms $\pm 5$ percent, 4 watts b. 80 ohms $\pm 5$ percent, 25 watts c. 40 ohms $\pm 5$ percent, 50 watts
12.0	d. 800 ohms $\pm 5$ percent, 4 watts e. 80 ohms $\pm 5$ percent, 25 watts f. 40 ohms $\pm 5$ percent, 50 watts
17.0	g. 800 ohms $\pm 5$ percent, 4 watts h. 80 ohms $\pm 5$ percent, 25 watts i. 40 ohms $\pm 5$ percent, 50 watts

**5-10. External Power Supply and Battery Charger**

*a. Power Supply.*

- (1) Connect accessory power cable W1 between J1 of the module case (fig. 2-10) and to a +28-volt power source.
- (2) Set the POWER ON switch to ON.
- (3) Set the METER switch to RADIO VOLTS.

- (4) Check the power supply panel meter for a meter reading of +14.3 volts.

*b. Battery Charger.*

- (1) Connect accessory power cable W1 between J1 of the module case and to a +28-volt power source.
- (2) Set the METER switch to BATTERY VOLTS.
- (3) See that the panel meter on the power supply front panel indicates approximately +20 volts.

*c. Module Case.* Using Multimeter AN/URM-105 (or equivalent), test the external power supply and battery charger module as follows:

- (1) Remove the battery charger module from the module case.
- (2) Connect accessory power cable W1 to J1 of the module case and to a +28-volt power source.
- (3) Connect the multimeter negative lead to pin 1 of J3 and the positive lead to pin 2.
- (4) Set the POWER ON switch to ON.
- (5) Check for a voltage indication of +21 to +31 volts on the multimeter.
- (6) Disconnect accessory power cable W1 from J1 and connect accessory power W2 between J1 and to a 110-volt, 50- to 400-cps power source.
- (7) Check for a voltage indication of +20 to +40 volts on the multimeter.

## CHAPTER 5.1 DEPOT OVERHAUL STANDARDS

### 5.1-1. Purpose

The tests presented in this chapter measure the performance capability of a repaired Radio Set AN/PRC-74A. A radio set that meets the minimum standards stated in these tests will operate in a manner equivalent to new equip-

#### *a. Test Equipment.*

<i>Nomenclature</i>	<i>Qty</i>	<i>National stock No.</i>	<i>Technical Manual</i>
Signal Generator (RF) AN/GRM-50	1	6625-00-819-0472	TM 11-6625-573-14
Signal Generator (AF) AN/URM-127	2	6625-00-783-5965	TM 11-6625-683-15
Frequency Meter AN/USM-207	1	6625-00-911-6368	TM 11-6625-700-10
Multimeter ME-26B/U	1	6625-00-542-6407	TM 11-6625-200-15
Voltmeter ME-30B/U	1	6625-00-669-0742	TM 11-6625-320-12
Spectrum Analyzer TS-723A/U	1	6625-00-668-9718	TM 11-5097
Test Set, Radio AN/GRM-33A	1	5820-00-893-4913	TM 11-5820-523-12
Multimeter AN/PSM-6B	1	6625-00-957-4374	TM 11-6625-475-10
Voltmeter, Electronic ME-202/U	1	6625-00-709-0288	TM 11-6625-537-15
Power Supply PP-4838	2		
Attenuator, Variable CN-796/U	1	5985-00-831-5991	
Multimeter ME-87A/U	1	6625-00-223-5248	
Probe-T-Connector, HP 11042	1	6625-00-713-4356	
Dummy Load DA-75/U	1	5985-00-280-3480	
Connector U-182/U	1		
Headset H-140/U	1	5965-00-892-1010	
Plug Hughes Part No. 996952-1	1		
BNC T-Connector UG-274A/U	2		

#### *b. Additional Fabricated Equipment (fig. 5.1-1).*

(1) Adder network (transformer type preferred).

(2) Power cable.

(3) Test cable.

(4) Resistor, Variable 0 to 7.5 ohms, 1000 watts, NSN 5905-00-195-4496.

(5) Resistor, 20 ohms  $\pm 5$  percent, 10 watts.

(6) Resistor, 40 ohms  $\pm 5$  percent, 10 watts.

(7) Resistor, 60 ohms  $\pm 5$  percent, 2 watts.

(8) Resistor, 80 ohms  $\pm 5$  percent, 25 watts.

(9) Resistor, 100 ohms  $\pm 5$  percent, 1/2 watt.

(10) Resistor, 500 ohms,  $\pm 5$  percent, 1/2 watt.

(11) Resistor, 800 ohms  $\pm 5$  percent, 4 watts.

(12) Resistor, 900 ohms  $\pm 5$  percent, 1/2 watt.

### 5.1-3. Receive Mode Tests

These tests will determine that the radv set

ment.

### 5.1-2. Test Equipment Required

The following chart lists the equipment required for testing. All test equipment must have been previously certified or calibrated.

operates properly in the receive mode. Prior to performing the tests, remove the case from the radio set.

#### *a. Receiver Sensitivity and Audio Output.*

(1) Connect the test equipment and power supply as shown in figure 5.1-2.

(2) Set the power supply to +12 volts.

(3) Set the signal generator for an output of 7.0 microvolts at 2.001 mc and set the attenuator to 20 db.

(4) Set the radio set to 2.000 mc and with RF GAIN fully clockwise adjust PEAK NOISE, ANT LOAD, and ANT TUNE for a maximum noise in the headset.

(5) Adjust the signal generator for a 1-kc beat frequency as displayed on the frequency meter.

(6) The level, as indicated on the voltmeter, should be greater than 0.707 volt.

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(7) Repeat procedures given in (2) through (6) above for the remaining frequencies noted in the chart below:

Radio set frequency in megacycles	Signal generator frequency in megacycles	Minimum audio output level in volts
2.000	2.001	0.707
4.000	4.001	0.707
7.000	7.001	0.707
11.000	11.001	0.707

**b. Signal-To-Noise Ratio.**

(1) Maintaining the radio set frequency at 11.000 mc and the signal generator at 11.001 mc, record the indicated audio output level on the voltmeter.

(2) Disconnect the signal generator from the radio set and again record the audio level.

(3) Divide the signal indication (step 1) by the noise voltage reading (step 2). The resultant signal-to-noise ratio shall not be less than 3.16 (10 db).

*For example:* If the first reading is 1.2 microvolts and the second reading is 0.2 microvolts, the signal-to-noise ratio is 6 (15.6 db).

**c. Audio Distortion Test.**

(1) Connect the test equipment and power supply as shown in figure 5.1-3.

(2) Set the power supply to 12 volts, and the attenuator to 20 db.

(3) Set the signal generator to 2.001 mc at 500-uv level output.

(4) Tune the radio set to 2.000 mc; then fine tune the signal generator for an audio beat frequency of 1 kc as indicated on the frequency meter.

(5) Set the RF GAIN control on the radio set for an output level of 1.414 volts as indicated on the voltmeter.

(6) Using the spectrum analyzer as a distortion analyzer, measure the total harmonic distortion. It shall not exceed ten percent.

**d. Frequency Clarifier Test.**

(1) Set the CLARIFY PUSH TO CALIBRATE control to midposition and adjust the frequency of the radio set to 2.000 mc.

(2) Adjust PEAK NOISE, ANT LOAD, and ANT TUNE for maximum noise in the headset.

(3) With the attenuator set at 20 db, set the signal generator to 2.001 mc at 7-microvolt output. Then, fine tune the generator to produce a 700-cps beat frequency as indicated on the frequency meter.

(4) Without pushing the knob in, rotate the CLARIFY/PUSH TO CALIBRATE control to the 9 O'clock position. The frequency indication on the frequency meter must be above 900 cps.

(5) Rotate the CLARIFY/PUSH TO CALIBRATE control to 3 O'clock position. The frequency indication must be below 500 cps.

**e. RF GAIN Control Test.**

(1) Tune the radio set to 2.000 mc and peak for maximum noise.

(2) With the attenuator set at 20 db, set the signal generator to 2.001 mc at 5-microvolt output. Then, fine tune the generator to produce a 1-kc beat frequency as indicated on the frequency meter. Set the RF GAIN control fully clockwise and note the audio level.

(3) Increase the signal input 100 db by setting the signal generator attenuator to 0.5 volt.

(4) Reduce the RF GAIN control setting until the audio output level is the same as in step (2) above.

(5) Set the signal generator level to 1.0 volt. Set the attenuator to 0 db by placing all the switches in the out position.

(6) Turn the RF GAIN control to maximum clockwise position.

(7) The audio output level shall not be less than 0.707 volt.

**f. Bandpass Test.**

(1) Tune the radio set to 2.000 mc.

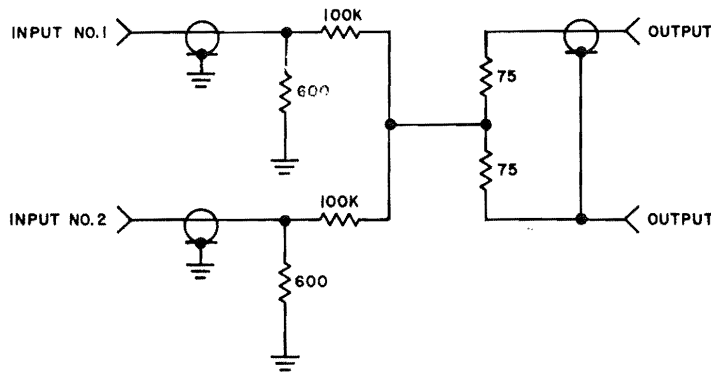
(2) With the attenuator set at 51 db, set the signal generator to 2.001 at 20 millivolts to produce a 1-kc display on the frequency meter. Maintain the radio set output level, as indicated on the voltmeter, at 1.0 volt by adjusting the RF GAIN control on the radio set.

(3) Slowly tune the signal generator and find the point of maximum output as indicated on the voltmeter. Note the frequency meter indication. Adjust the RF GAIN control for an output level of 1.414 volts at this frequency setting.

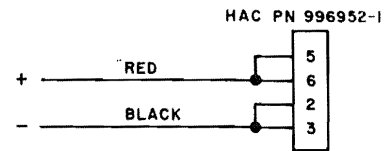
(4) From this maximum output setting, decrease the signal generator frequency until the audio output voltage drops to 1.0 volt (3-db point). Use the frequency meter to verify that this setting is 300 cps, or less.

(5) From the maximum output setting, increase the signal generator frequency until the audio output voltage drops to 1.0 volt. This indication should be 2700 cps, or more.

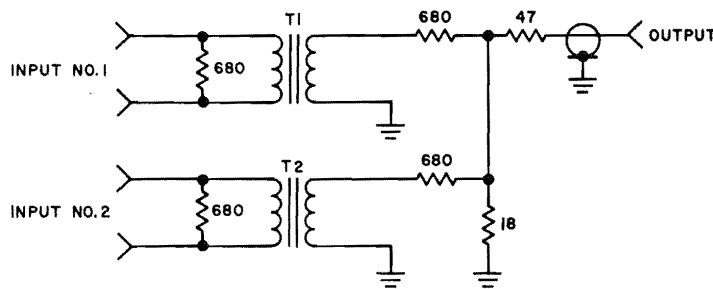




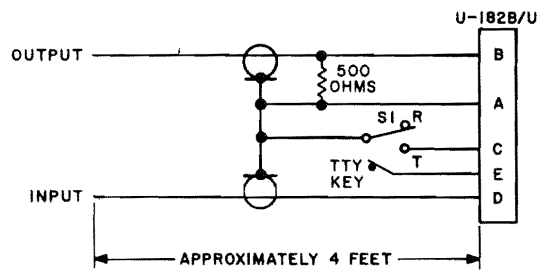
A. ADDER



D. POWER CABLE



B. ADDER



C. TEST CABLE

NOTES:

1. ALL RESISTANCES IN OHMS  $\pm 5\%$ , 1/4 WATT.
2. T1, T2, 30:1 TURNS RATIO.
3. OUTPUT LEADS OF ADDER (B) ARE ISOLATED FROM GROUND. SHIELD ENCLOSURE IS ISOLATED FROM RADIO SET CHASSIS GROUND.

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Figure 5.1-1. Fabricated cables and parts.

*g. Adjacent Channel Rejection.*

- (1) Set the switch attenuator pad for 6 db.
- (2) Tune the radio set to 2,000 mc.
- (3) Observe the frequency meter and tune the signal generator to 6500 cps above the radio set frequency.
- (4) The indication on the voltmeter should not exceed 1.414 volts.
- (5) Tune the signal generator lower in

frequency; pass through zero beat, and observe a beat note of 350 cps below the carrier frequency. The audio output level shall not exceed 1.414 volts.

**5.1-4. Transmitter Tests**

These tests will verify that the transmitter portion of the radio set meets the minimum requirements of a new radio set.

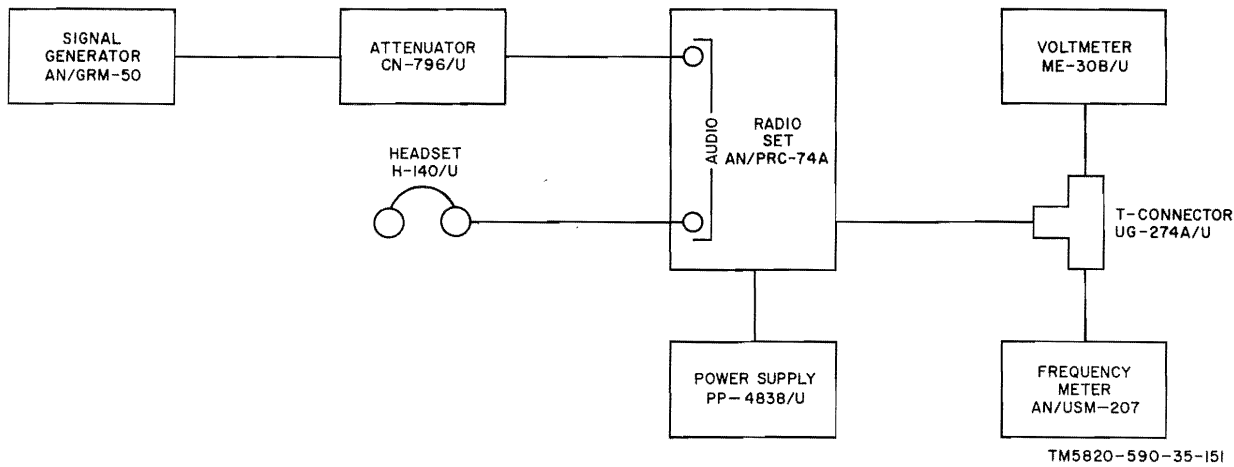


Figure 5.1-2. Receiver sensitivity and audio output.

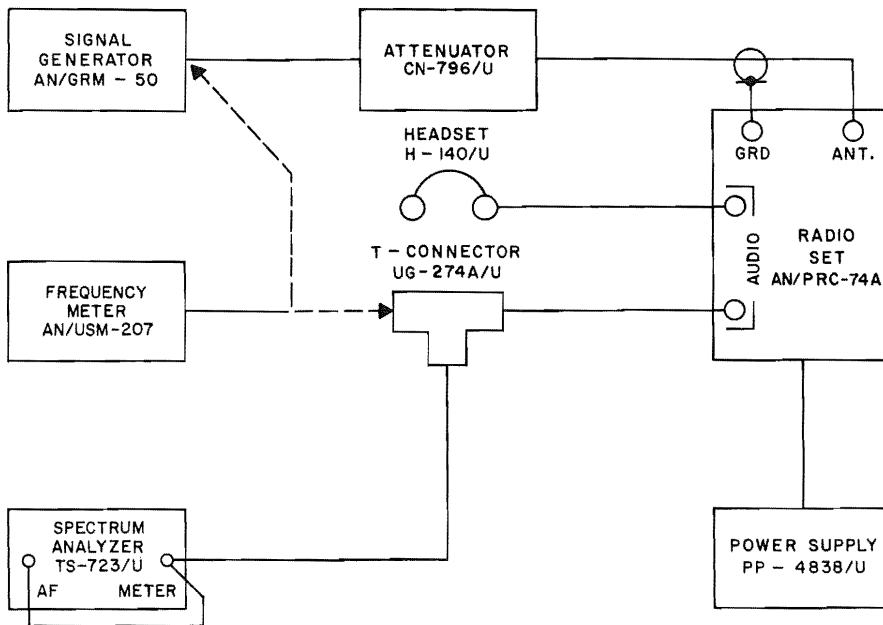


Figure 5.1-3. Audio distortion test.

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**NOTE**

Throughout these tests, whenever the radio set is retuned, it is essential that the CLARIFY/PUSH TO CALIBRATE control be adjusted for a zero beat in the headset.

**CAUTION**

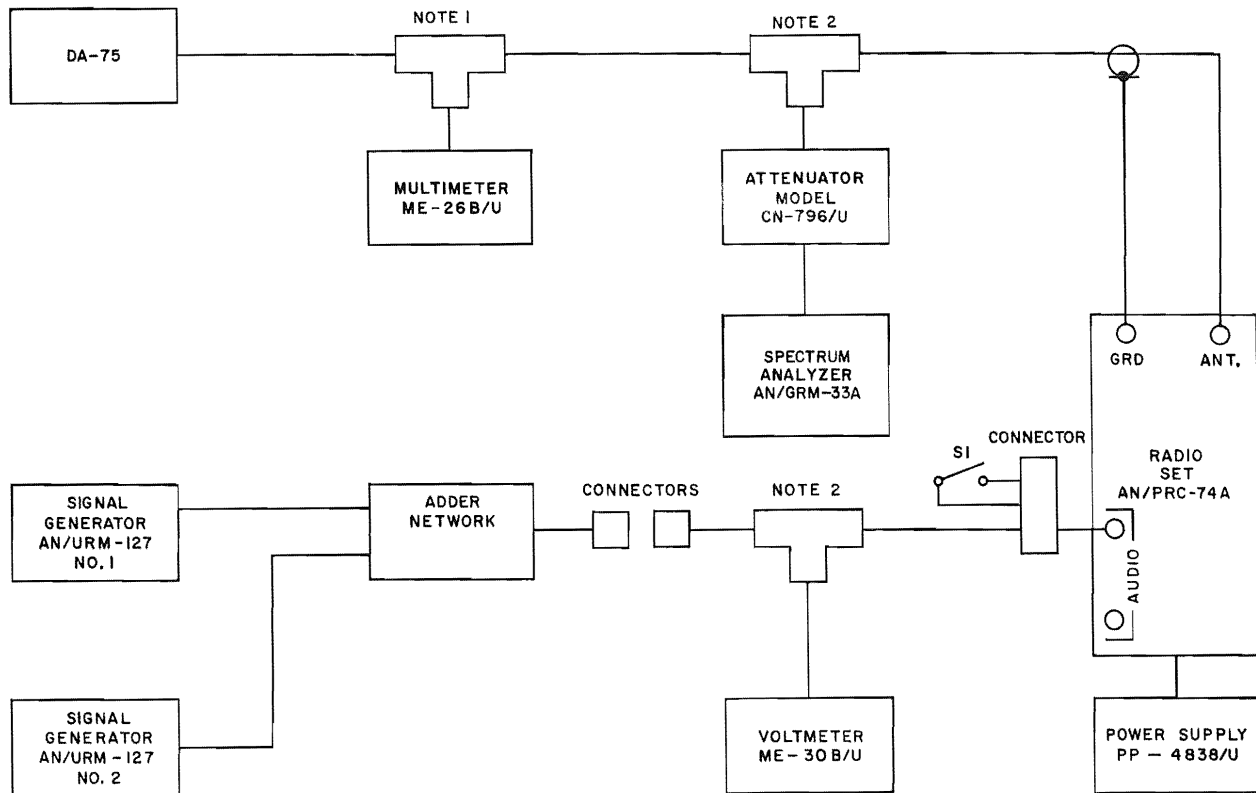
Do not attempt to tune the transmitter without the 50-ohm dummy load connected the transmitter output.

*a. Power Output.*

- (1) Except for the signal generators and adder network, connect the test equipment and power supply as shown in figure 5.1-4.
- (2) Set the power supply to 12 volts.
- (3) Tune the radio set to 2111 kc.
- (4) Hold the OFF-ON-TUNE switch at TUNE, and record the transmitter rf output voltage as indicated on the multimeter.
- (5) The output voltage shall be within 24.5 and

30.0 volts rms (12 to 18 watts peak envelope power).

(6) Repeat steps (1) through (5) above at 3888 kc, 4222 kc, 6777 kc, 7333 kc, and 11666 kc.



NOTES:  
 1. PROBE T-CONNECTOR  
 2. T-CONNECTOR UG-274A/U

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Figure 5.1-4. Intermodulation distortion, power output, carrier suppression tests.

*b. Carrier Suppression.*

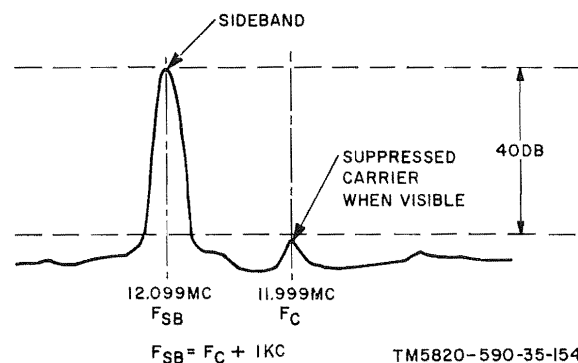
(1) Tune the AN/GRM-33A/u to the output frequency of the radio set.

(2) Set the analyzer AMPLITUDE SCALE switch to LOG and the IF ATTENUATOR switch to 20 db.

(3) Set the radio set ON-OFF-TUNE switch to TUNE. Adjust the CN-376/U and the analyzer attenuator and gain controls to position the peak of the sideband signal at the zero db line on the scale.

(4) Set the analyzer IF ATTENUATOR switch to 0 db. The suppressed carrier signal shall not exceed the 20-db line.

(5) Hum and noise signals shall not exceed the 10-db line.



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Figure 5.1-5. Carrier suppression display.

*c. Two-Tone Power Output.*

(1) Using the test setup shown in figure 5.1-4,

tune the radio set to 2.111 mc; disconnect the output lead of signal generator No. 2. Using the frequency meter, set signal generator No. 1 to 1,500 cps; then adjust the output control to produce 600 microvolts at the output of the adder network, as measured with the voltmeter.

(2) Connect signal generator No. 2 as shown in figure 5.1-4.

(3) Disconnect signal generator No. 1.

(4) Using 2,000 mc, repeat the procedure described in (1) above for signal generator No. 2.

(5) Connect both signal generators to the adder network.

(6) Set switch S1 to ON.

(7) The rf output, as indicated on the multimeter, shall be within 24.5 and 30.0 volts (12 to 18 watts PEP).

*d. Intermodulation Distortion.*

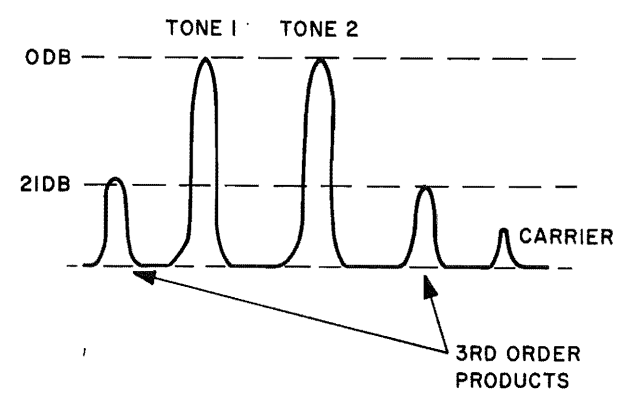
(1) With the radio set tuned to 2.111 mc, tune the spectrum analyzer to the output frequency, and observe that the difference between the peak amplitudes of the 1500- and 2100-cps sidebands does not exceed 4 db.

(2) Refer to figure 5.1-6 and note the third order intermodulation products. Compare this illustration with the display on the spectrum analyzer.

(3) The signal amplitudes of the 3rd order intermodulation products must be at least 20 db below the peaks of the 1st order sidebands.

(4) Disconnect the adder network from the radio set.

(5) Repeat procedures given in a through d(4) above at 2.888, 3.222, 4.777, 5.333, 7.666, 8.444, and 11.555 mc.



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Figure 5.1-6. Intermodulation distortion display.

*e. Sidetone, Telegraph Key, and CW Hold Operation.*

(1) Connect the test equipment and power supply as shown in figure 5.1-7.

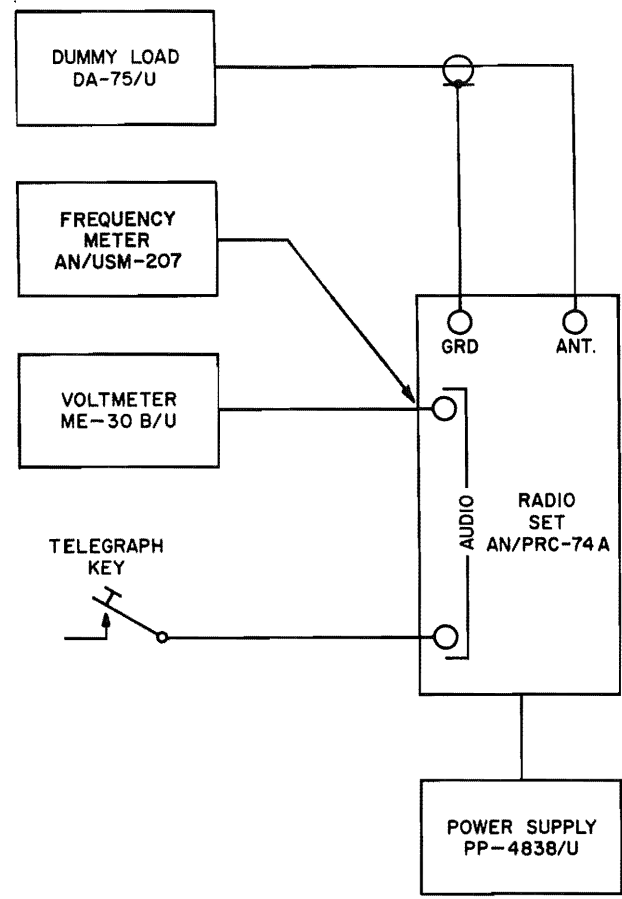
(2) Connect telegraph key or switch to the AUDIO connector and key the transmitter.

(3) The voltmeter indication should not be less than 0.2 volt.

(4) In radio sets bearing serial numbers 370 and below, the audio frequency shall be within 1400 to 1800 cps, and in radio sets bearing serial numbers 371 and above, the audiofrequency shall be within 1,800 to 2,200 cps.

(5) Unkey the transmitter. The radio set should return to the receive mode within 1 to 3 seconds.

(6) On radio sets bearing serial number 371 and up, measure the voltage at pin F and ground at each AUDIO connector. The voltage should be 12 volts dc  $\pm$  10%.



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Figure 5.1-7. Sidetone operation.

f. Transmitter Frequency Check.

NOTE

Be sure that each time a new frequency is selected, the CLARIFY/PUSH TO CALIBRATE control is adjusted for a zero beat in the head set.

(1) Connect the test equipment and power supply as shown in figure 5.1-8.

(2) Set the power supply output to 12 volts.

(3) Set the radio set to 2111 kc, as shown in the following table, and tune the transmitter.

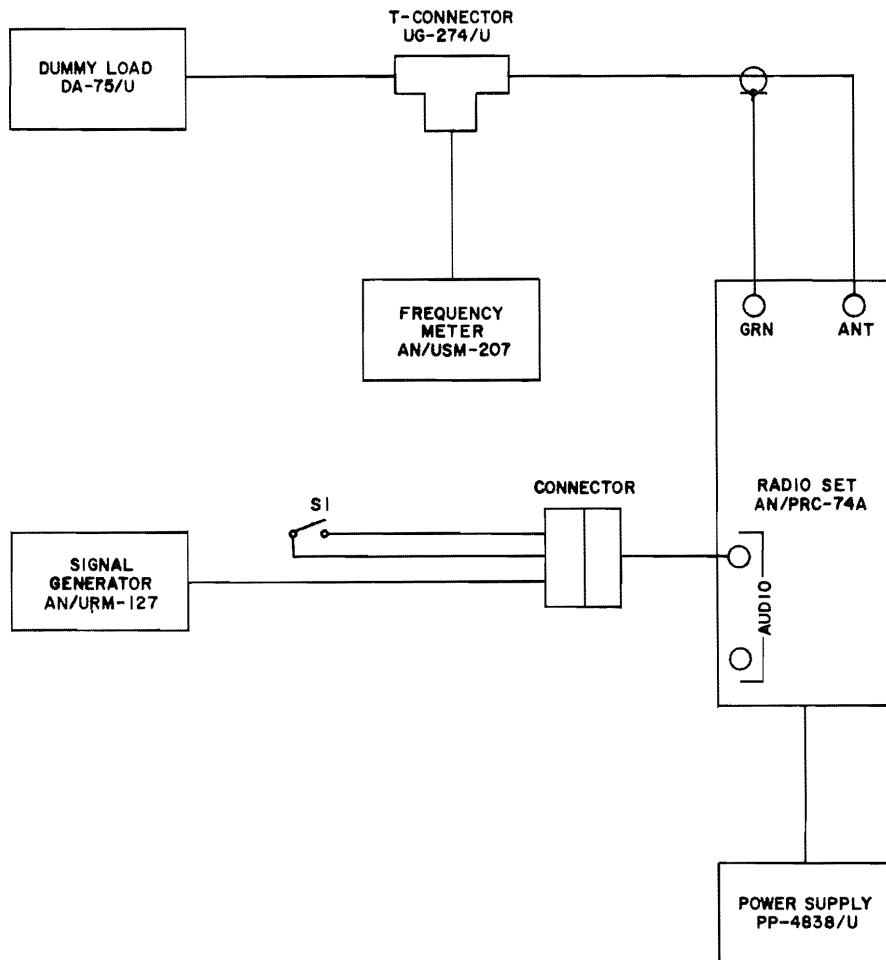
(4) Set the signal generator to  $1,000 \pm 1$  cps. Note that the radio-frequency indications will depend in part on the accuracy of the 1-kc modulating tone.

(5) Close switch S1 and note transmitter frequency on the frequency meter. The output frequency is equal to the sum of the rf and the

modulating frequency.

(6) Repeat the tuning procedure and measurement for the remaining frequencies in the chart below:

Transmitter frequency kc	Frequency meter readout ( $af + rf + deviation$ ) Low limit kc	High limit kc
2111	2111.878	2112.122
3222	3222.878	3223.122
4333	4333.878	4334.122
5444	5444.878	5445.122
6555	6555.878	6556.122
7666	7666.878	7667.122
8777	8777.878	8778.122
9888	9888.878	9889.122
10999	10999.878	11000.122
11000	11000.878	11001.122
11999	11999.878	12000.122



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Figure 5.1-8. Transmitter frequency check.

### 5.1-5. Power Supply Module Regulation

a. *General.* The purpose of this test is to determine that the power supply module regulation is adequate under conditions of varying supply voltage and loads.

b. *Test Setup.* Connect the test equipment as shown in figure 5.1-9 and perform the following steps:

**CAUTION**

Do not turn off the transceiver when the differential VTVM is connected. See the differential VTVM instruction manual for correct operation.

(1) Set S2 to position 2 (80 ohms). Set S3 to position 1 (900 ohms). Set the power supply to 10.5 volts, and set S1 to R.

(2) Turn OFF-ON-TUNE control to ON. Measure the 9-volt output at wire number 7 (removed from TB201-7) with the differential VTVM. The voltage shall be within 8.6 to 9.8 volts.

(3) Repeat steps (1) and (2) above, using the source voltages, loads, and S1 setting specified in the following chart.

Source vdc	S1 Position	S3 Position	Load resistor ohms	Output volts dc
10.5	R	1	900	8.6 to 9.8
	R	2	60	8.6 to 9.8
	T	3	20	8.6 to 9.8

Source vdc	S1 Position	S3 Position	Load resistor ohms	Output volts dc
12.0	R	1	900	8.6 to 9.8
	R	2	60	8.8 to 9.3
	T	3	20	8.6 to 9.8
17.0	R	1	900	8.6 to 9.8
	R	2	60	8.6 to 9.8
	T	3	20	8.6 to 9.8

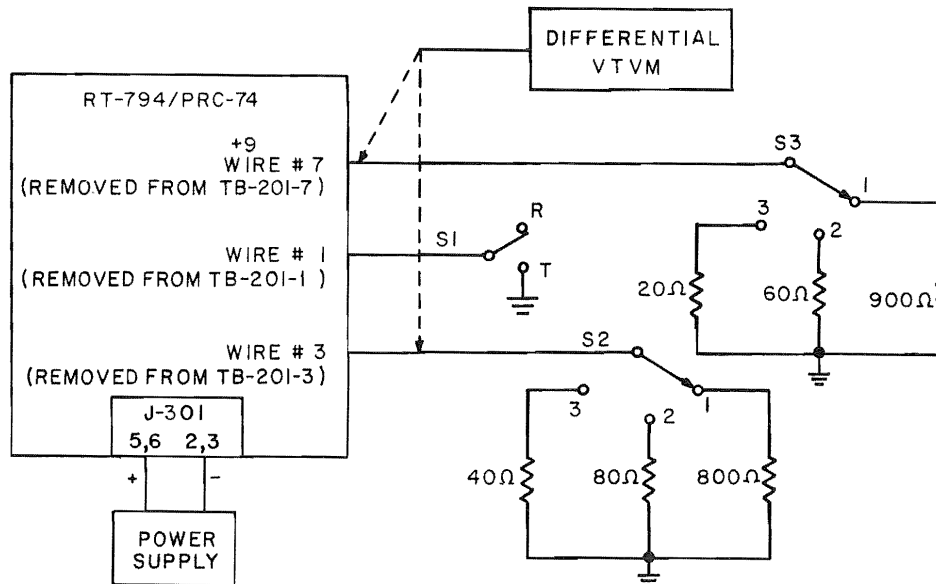
(4) Disconnect differential VTVM from wire number 7. Turn OFF-ON-TUNE control to OFF.

(5) Set S2 to position 1 (800 ohms). Set S3 to position 2 (60 ohms). Set the power supply to 10.5 volts.

(6) Repeat step (5) above, using the source voltages, loads, and S2 setting specified in the following chart. S1 shall remain at position T.

(7) Disconnect differential VTVM from wire number 3. Turn OFF-ON-TUNE switch to OFF.

Source vdc	S2 position	Load resistor ohms	Output volts dc serial number 1 to 370	Output volts dc serial number 371 and up
10.5	1	800	36 to 44	37.5 to 45.5
	2	80	36 to 44	37.5 to 45.5
	3	40	36 to 44	37.5 to 45.5
12.0	1	800	36 to 44	37.5 to 45.5
	2	80	38 to 42	39.5 to 43.5
	3	40	36 to 44	37.5 to 45.5
17.0	1	800	36 to 44	37.5 to 45.5
	2	80	36 to 44	37.5 to 45.5
	3	40	36 to 44	37.5 to 45.5



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Figure 5.1-9. Power supply module regulation test setup.

**5.1-6. Power Supply PP-4514/PRC-74 Tests**

*a. Radio Power Supply Assembly.*

(1) Connect the equipment as shown in figure 5.1-10.

(2) Connect cables W1 and W4 to connector J1 on Power Supply PP-4514/PRC-74 and to the 28-vdc power supply.

(3) Set METER switch to RADIO VOLTS, and POWER switch to ON.

(4) Adjust the output load resistor for a load current of 6.5 amperes.

(5) The panel meter and the differential voltmeter should indicate  $+14 \pm 3$  volts dc. The ripple voltage should not exceed 1.0 volt pp (0.35 vrms).

(6) Vary the input voltage between 22.0 and 30.5 volts. The output voltage should indicate

$+14 \pm 3$  volts dc.

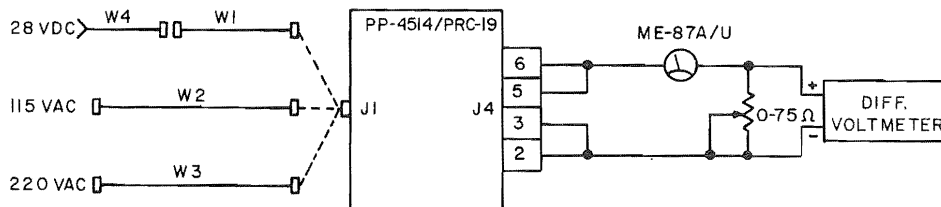
**NOTE**

When performing the procedures in step (7) below, it may be necessary to momentarily reduce the load current to restart the regulator circuit.

(7) Momentarily connect a jumper between pins 2 and 5 of connector J4. The panel meter indication should drop to zero volt. Remove the jumper and observe that the panel meter indication is  $+14 \pm 3$  volts dc.

(8) Disconnect cable W1 and connect cable W2 for 90- to 125-volt ac operation. Perform steps (3) through (6) above.

(9) Disconnect cable W2 and connect cable W3 for 170 to 250 volts ac operation. Perform steps (3) through (6) above.



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Figure 5.1-10. Power supply assembly test setup.

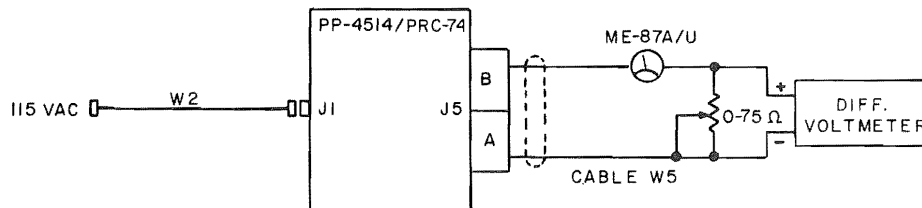
*b. Battery Charger Assembly.*

(1) Connect the equipment as shown in figure 5.1-11.

(2) Set CHARGER switch to ON. The CHARGING CURRENT control should vary the output over a range of 1 to 5 amperes  $\pm 10$  percent. The output voltage at 5 amperes should be  $118 \pm 4$  volts dc.

(2) Set METER switch to CHARGE AMPS. The meter shall indicate within 0.5 amperes of the load ammeter.

(3) Momentarily short circuit the output leads. The panel meter should drop to zero volt during the short and return to the original value when the short is removed.



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Figure 5.1-11. Battery charger test setup.





## CHAPTER 6

### DEMOLITION TO PREVENT ENEMY USE

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#### 6-1. Authorized for Demolition

The demolition procedures paragraph 6-2 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon the order of the commanding officer.

#### 6-2. Methods of Destruction

Use any of the following methods to destroy the radio set:

*a. Smash.* Smash the controls, transistors, coils, switches, capacitors and meter; use

sledges, axes, handaxes, pickaxes, hammers, or crowbars.

*b. Cut.* Cut all power leads and antenna connections; use axes, handaxes, or machetes.

*c. Burn.* Burn cords and technical manuals; use gasoline, kerosene, oil, flamethrowers, or incendiary grenades.

*d. Bend.* Bend panel and cabinet.

*e. Explode.* If explosives are necessary, use firearms, grenades, or TNT.

*f. Dispose.* Bury or scatter the destroyed parts in slit trenches, foxholes, or throw them into streams.



## CHAPTER 7

### SCHEMATIC AND BLOCK DIAGRAMS

#### 7-1. General

This chapter contains the foldout schematic and block diagrams for Radio Set AN/PRC-74. All text pertaining to the function of the radio set is in chapter 1.

#### 7-2. Troubleshooting Data

The following information will aid the repairman in the location of the correct schematic diagrams and parts locations.

##### *a. Frequency Synthesizer Module.*

- (1) Block diagram ..... Fig. 7-6
- (2) Schematic diagram ..... Fig. 7-7
- (3) Bottom view ..... Fig. 3-3
- (4) Bottom view, circuit boards removed ..... Fig. 3-4
- (5) Top view, circuit board A5 removed ..... Fig. 3-5
- (6) Top view, circuit boards removed ..... Fig. 3-6
- (7) Top view ..... Fig. 3-32
- (8) Exploded view ..... Fig. 3-24
- (9) Switch disassembly ..... Fig. 3-25
- (10) Troubleshooting test setup ..... Fig. 3-2
- (11) Alignment test setup ..... Fig. 3-33
- (12) RF voltage levels ..... Fig. 3-31

##### *b. Rf Module.*

- (1) Block diagram ..... Fig. 1-1
- (2) Schematic diagram ..... Fig. 7-8
- (3) Top view ..... Fig. 3-9
- (4) Left-hand view ..... Fig. 3-10
- (5) Right-hand view ..... Fig. 3-11
- (6) Bottom view ..... Fig. 3-35
- (7) Exploded view ..... Fig. 3-26
- (8) Troubleshooting test setup ..... Fig. 3-8
- (9) Alignment test setup ..... Fig. 3-34

##### *c. IF Audio Module.*

- (1) Block diagram ..... Fig. 7-9
- (2) Schematic diagram ..... Fig. 7-10
- (3) Front view, component boards removed ..... Fig. 3-13
- (4) Rear view, component boards removed ..... Fig. 3-36
- (5) Exploded view ..... Fig. 3-27
- (6) Test setup ..... Fig. 3-12

##### *d. Power Amplifier Module (HAC Part No. 1541057-100).*

- (1) Schematic diagram ..... Fig. 7-11
- (2) Oblique view ..... Fig. 3-17
- (3) Right-hand side ..... Fig. 3-18
- (4) Right side, component board removed ..... Fig. 3-19
- (5) Left-hand side ..... Fig. 3-20
- (6) Exploded view ..... Fig. 3-29
- (7) Test setup ..... Fig. 3-16

##### *d.1 Power Amplifier Module (HAC Part No. 15410571-101).*

- (1) Schematic diagram ..... Fig. 7-11.1
- (2) Oblique view ..... Fig. 3-20.2
- (3) Right side ..... Fig. 3-20.3
- (4) Right side, component board removed ..... Fig. 3-20.4
- (5) Left side ..... Fig. 3-20.5
- (6) Exploded view ..... Fig. 3-29.1
- (7) Test setup ..... Fig. 3-20.1

##### *e. Frequency Generator Module.*

- (1) Schematic diagram ..... Fig. 7-12
- (2) Rear view ..... Fig. 3-15
- (3) Front view ..... Fig. 3-37
- (4) Exploded view ..... Fig. 3-28
- (5) Test setup ..... Fig. 3-14

*f. Power Supply Module.*

- (1) Schematic diagram ..... Fig. 7-13
- (2) Front view ..... Fig. 3-22
- (3) Rear view ..... Fig. 3-23
- (4) Exploded view ..... Fig. 3-30
- (5) Test setup ..... Fig. 3-21

*g. Gain Control Circuits.*

- (1) Schematic diagram ..... Fig. 7-14
- (2) Circuit board TB203 ..... Fig. 2-6

*h. External Power Supply and Battery Charger.*

- (1) Schematic diagram ..... Fig. 7-15
- (2) Front panel ..... Fig. 2-7
- (3) Power supply module ..... Fig. 2-8
- (4) Battery charger module ..... Fig. 2-9
- (5) Case ..... Fig. 2-10

*i. Radio Set.*

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- (2) Operational modes, block diagram Fig. 7-2
- (3) Receive function, block diagram .. Fig. 7-3
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- (8) Radio set, modules removed ..... Fig. 2-11
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- (11) Radio set transmit test..... Fig. 4-3
- (12) Radio set, receive and transmit mode test setup..... Fig. 2-2
- (13) IF and frequency generator fault isolation test setup ..... Fig. 2-4
- (14) Transmit mode fault isolation test setup ..... Fig. 2-5

## APPENDIX

### REFERENCES

---

TM 11-5057	Frequency Meter AN/USM-26
TM 11-5527	Multimeters TS-352/U, TS-352A/U, and TS-352B/U.
TM 11-5551A	R. F. Signal Generator Set AN/URM-25A.
TM 11-5820-590-12	Organizational Maintenance Manual: Radio Set AN/PRC-74.
TM 11-6625-200-12	Operator and Organizational Maintenance Manual: Multimeter ME-26A/U, ME-26B/U, and ME-26C/U.
TM 11-6625-203-12	Operator and Organizational Maintenance: Multimeter AN/URM-105 Including Multimeter ME-77/U.
TM 11-6625-261-12	Operator's and Organizational Maintenance Manual: Audio Oscillators TS-382A/U, TS-382B/U, TS-382D/U, TS-382E/U, and TS-382F/U.
TM 11-6625-446-15	Operator, Organizational, Field and Depot Maintenance Manual: Wattmeter AN/URM-120.
TM 11-6625-524-14	Operator, Organizational and Field Maintenance Manual: Voltmeter, Electronic AN/URM-145.
TM 11-6625-573-15	Operator, Organizational, Field and Depot Maintenance Manual: Signal Generator AN/GRM-50.



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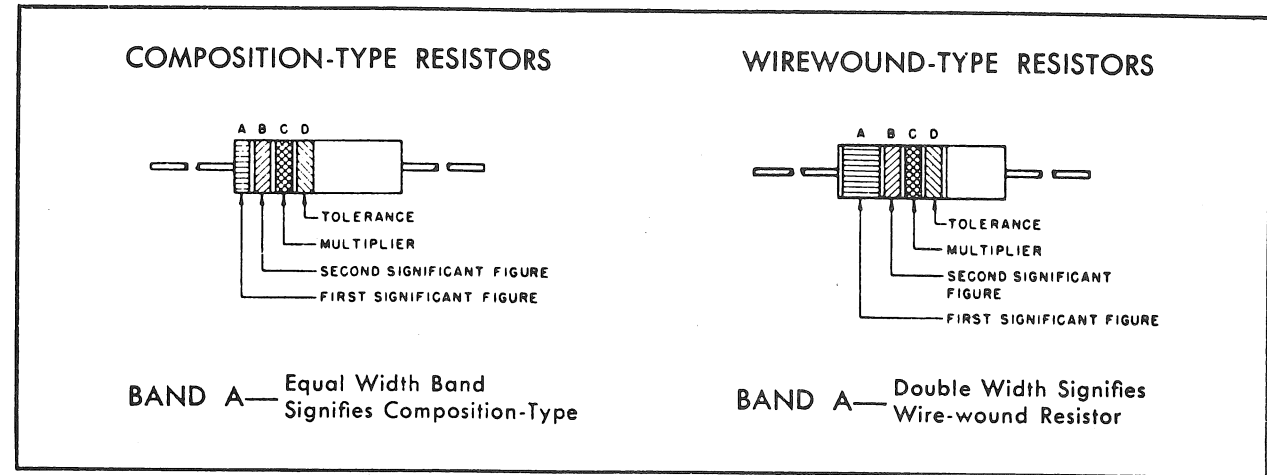
	Paragraph	Page
IF audio module analysis -----	1-29	1-15
Parts replacement techniques:		
Direct support maintenance -----	2-11	2-14
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Troubleshooting -----	2-1	2-7
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Depot testing -----	5-7	5-3
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Troubleshooting -----	3-6	3-18
Troubleshooting data -----	7-2	7-1
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Power supply module:		
Assembly -----	3-20	3-41
Depot testing -----	5-9	5-4
Disassembly -----	3-19	3-39
Troubleshooting -----	3-7	3-20
Troubleshooting data -----	7-2	7-1
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	Paragraph	Page
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Receive test -----	4-4	4-5
Transmit test -----	4-5	4-7
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Frequency synthesizer module -----	3-2	3-2
Gain control circuit test -----	2-9	2-9
General instructions -----	2-1	2-1
IF module -----	3-4	3-9
Organization of troubleshooting procedures -----	2-2	2-1
Power amplifier module -----	3-6	3-18
Power supply module -----	3-7	3-20

	Paragraph	Page
Radio set:		
Receive mode test -----	2-4	2-3
Transmit mode test -----	2-5	2-3
Receiver -----	2-6	2-3
RF module -----	3-3	3-3
Test equipment and special items required for module troubleshooting -----	3-1	3-1
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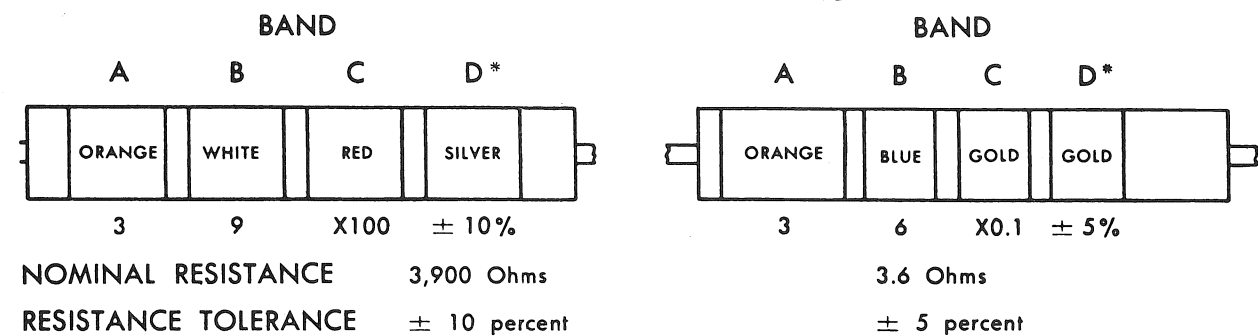
## COLOR CODE MARKING FOR MILITARY STANDARD RESISTORS



### COLOR CODE TABLE

BAND A		BAND B		BAND C		BAND D*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1		
BROWN	1	BROWN	1	BROWN	10		
RED	2	RED	2	RED	100		
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000	SILVER	± 10
GREEN	5	GREEN	5	GREEN	100,000	GOLD	± 5
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	SILVER	0.01		
WHITE	9	WHITE	9	GOLD	0.1		

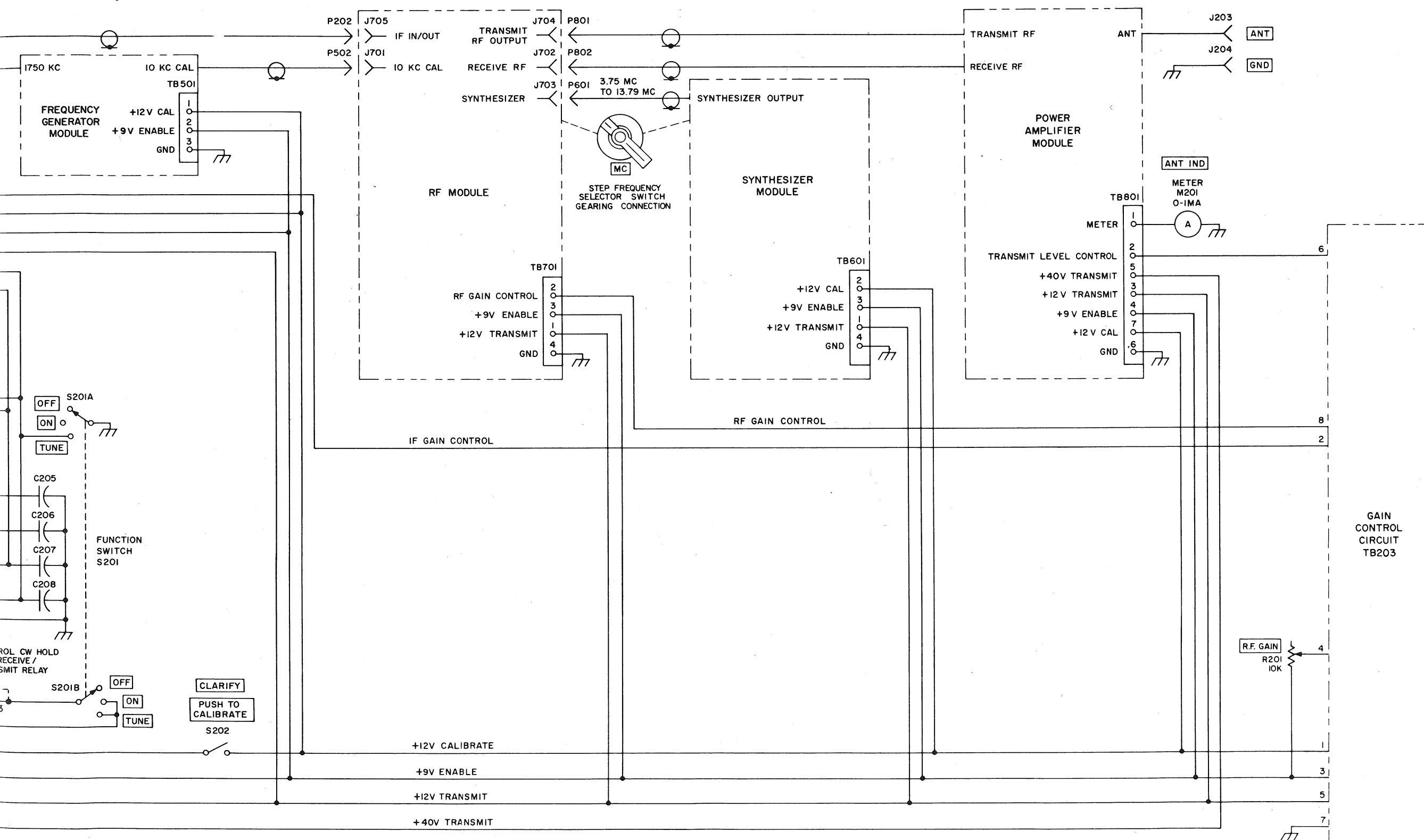
### EXAMPLES OF COLOR CODING



\*If Band D is omitted, the resistor tolerance is ± 20%, and the resistor is not Mil-Std.

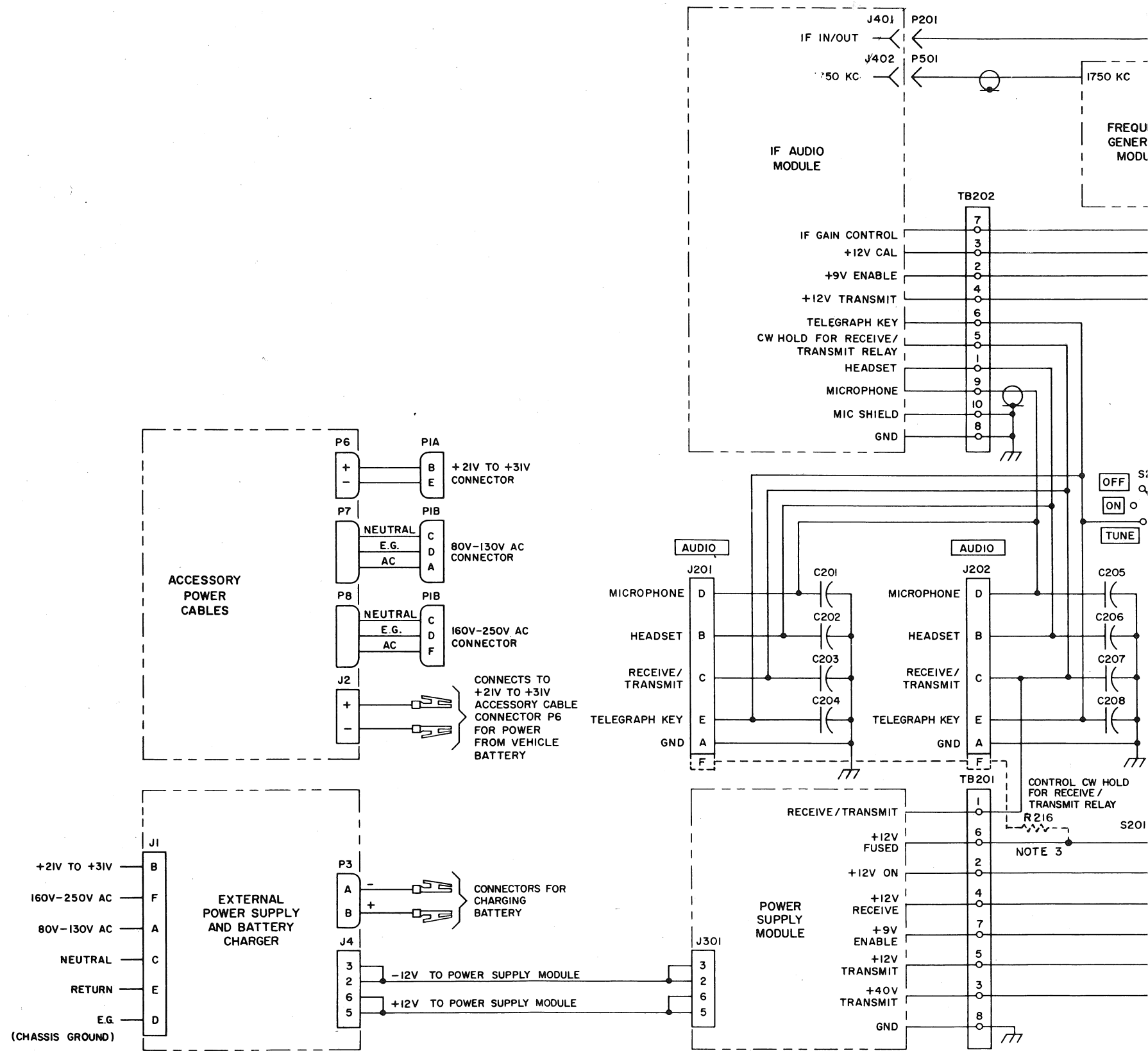
STD-R2

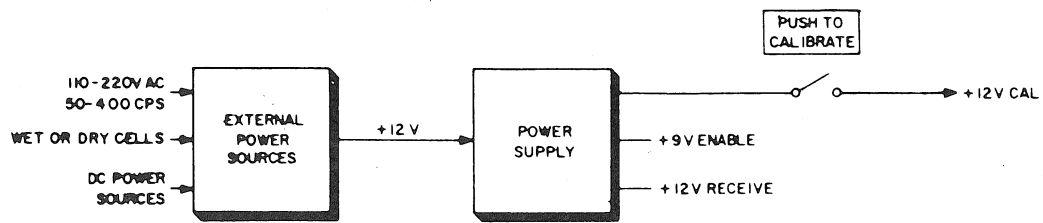
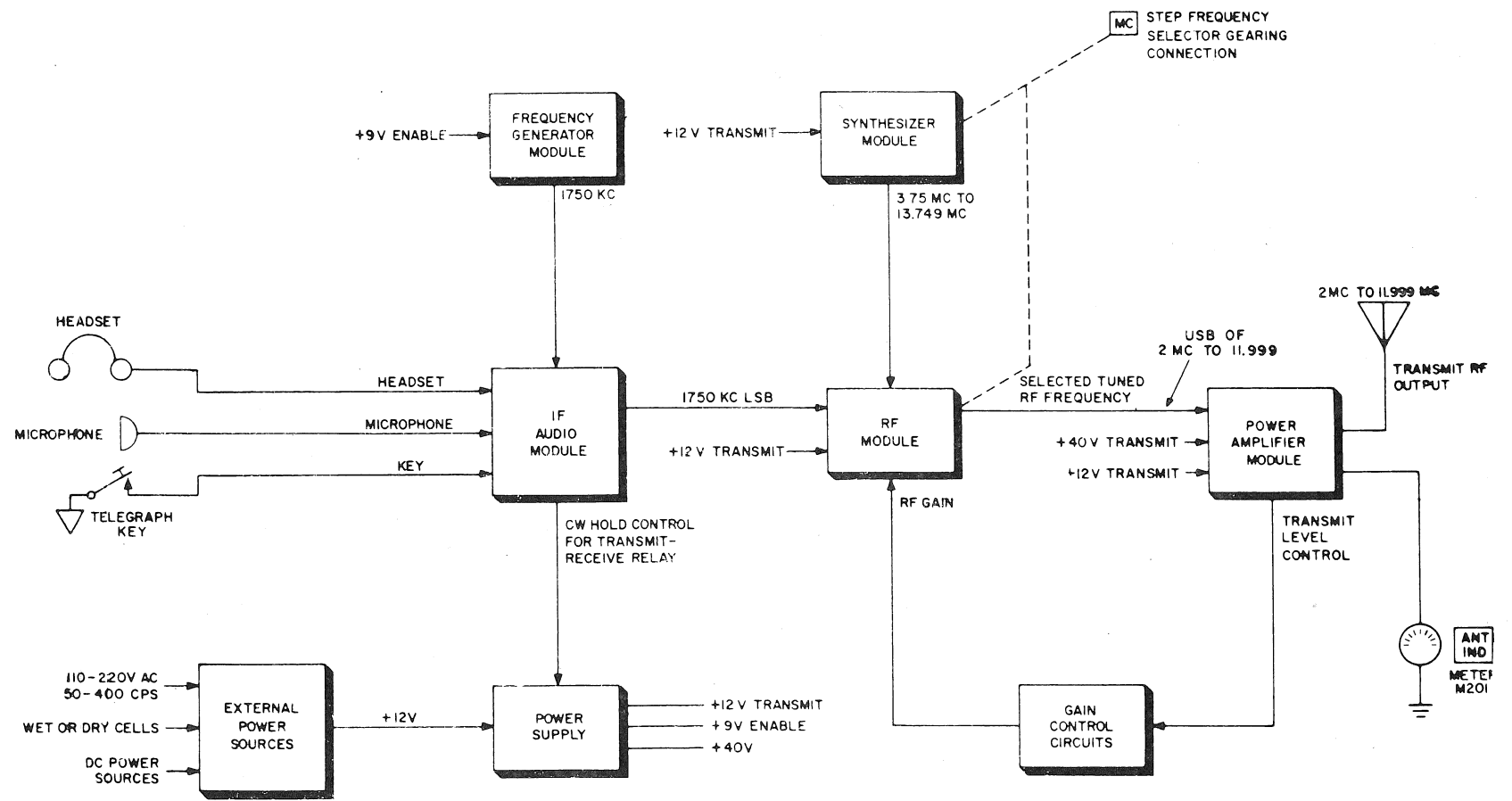
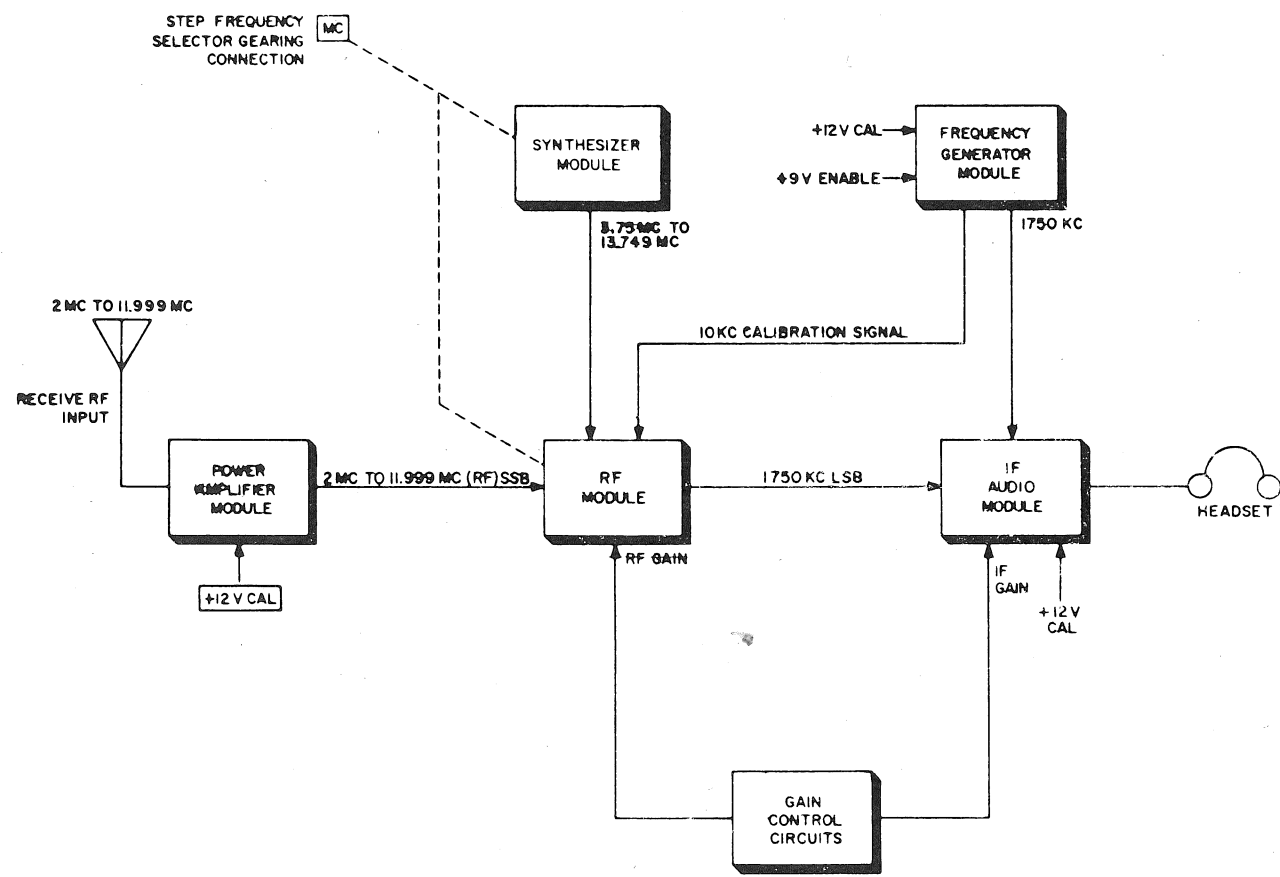
Figure 4-4. Color code marking for MIL STD resistors.



- NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN 0.01UF.
  2.    INDICATES EQUIPMENT MARKING
  3. ALL AN/PRC-74A MODELS AND EQUIPMENTS MODIFIED BY MW011-5820-590-35/1 HAVE THESE CONNECTIONS.

Figure 7-1. Radio Set AN/PRC-74 and AN/PRC-74A system interconnection diagram.





A. RECEIVE MODE

B. TRANSMIT MODE

NOTE:  
 □ INDICATES EQUIPMENT MARKING

Figure 7-2. Radio Set AN/PRC-74, operational modes block diagram.



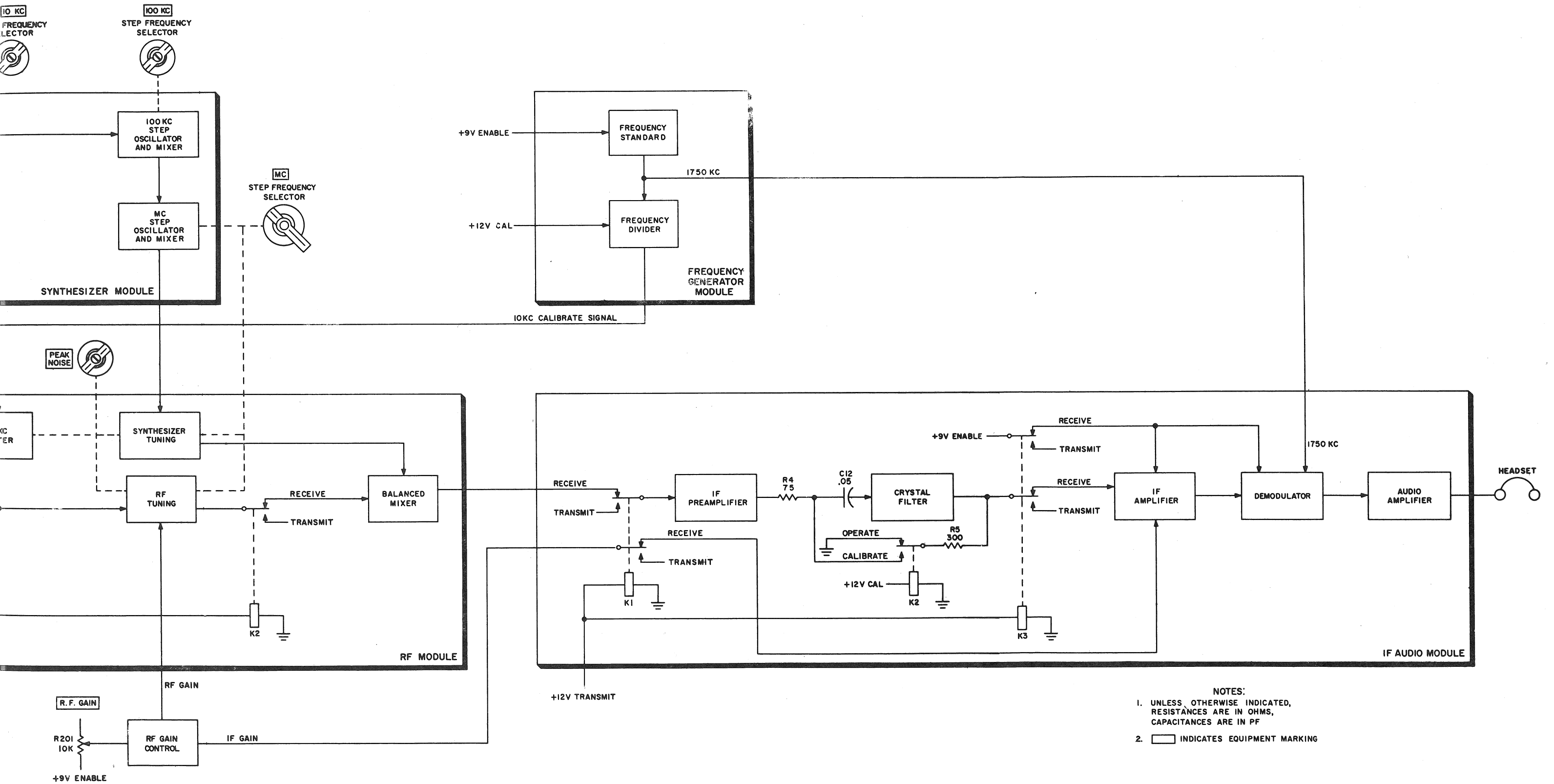
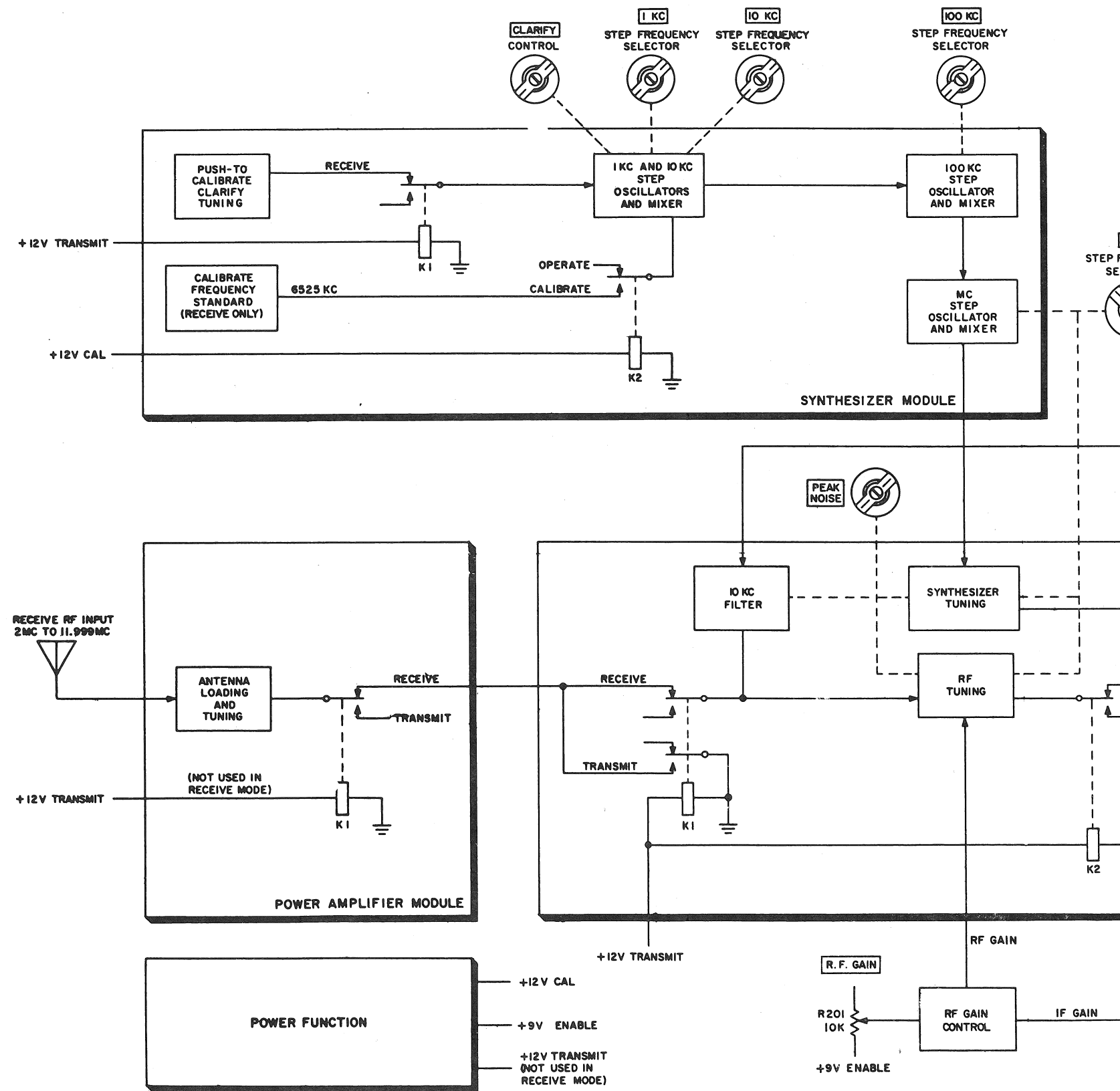


Figure 7-3. Receive function, block diagram.



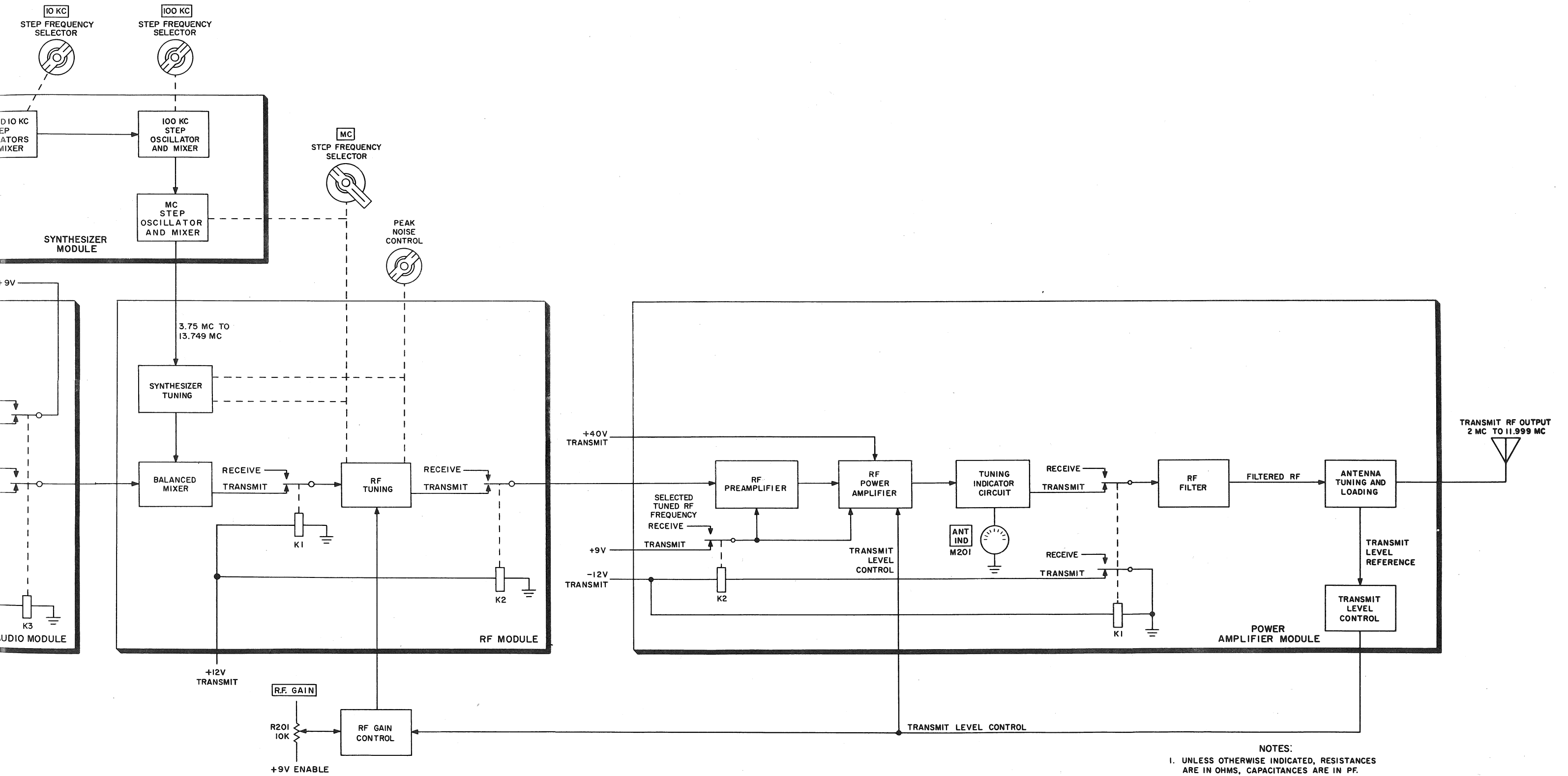


Figure 7-4. Transmit function, block diagram.

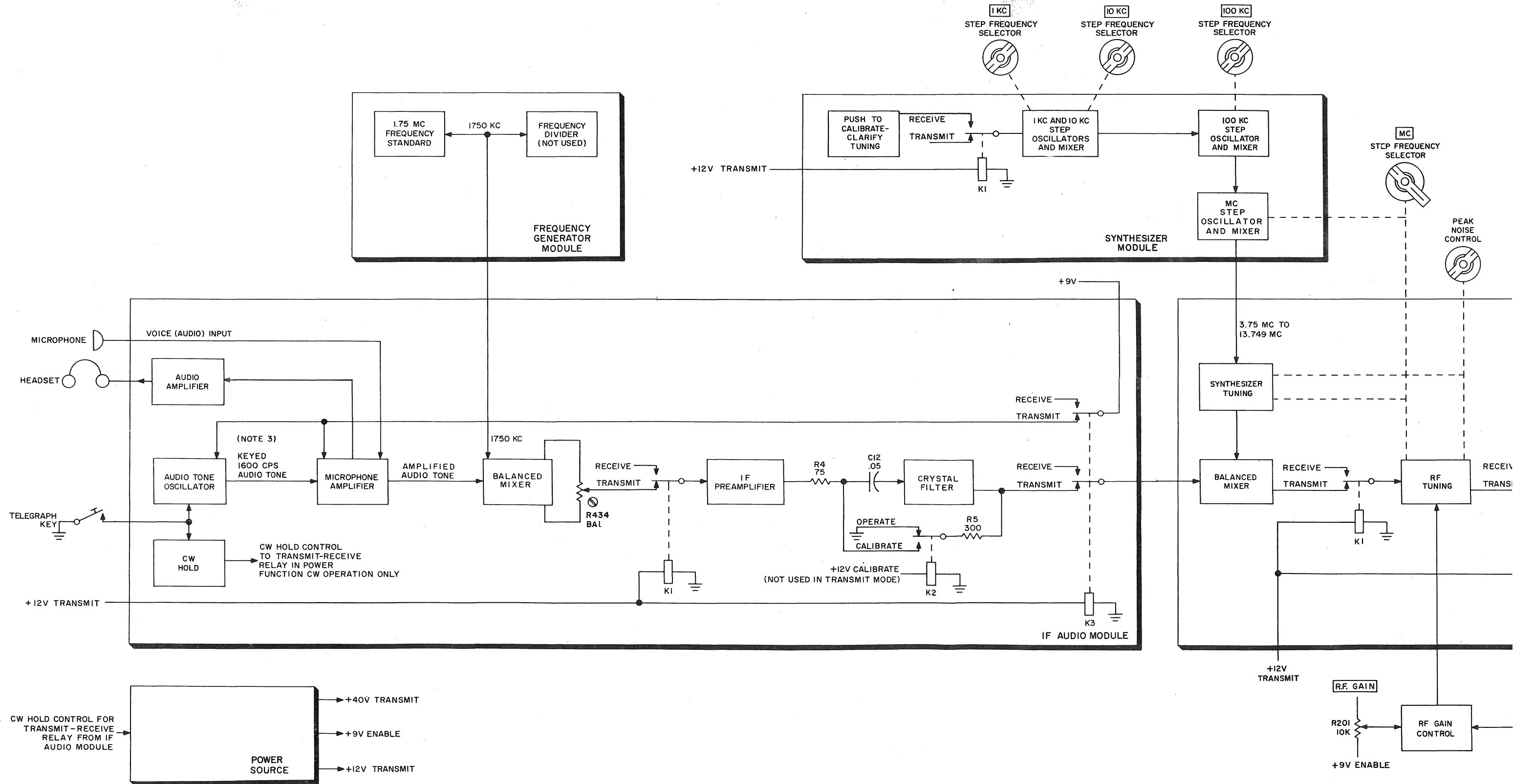


Figure 7-4. Transmit function, block diagram.

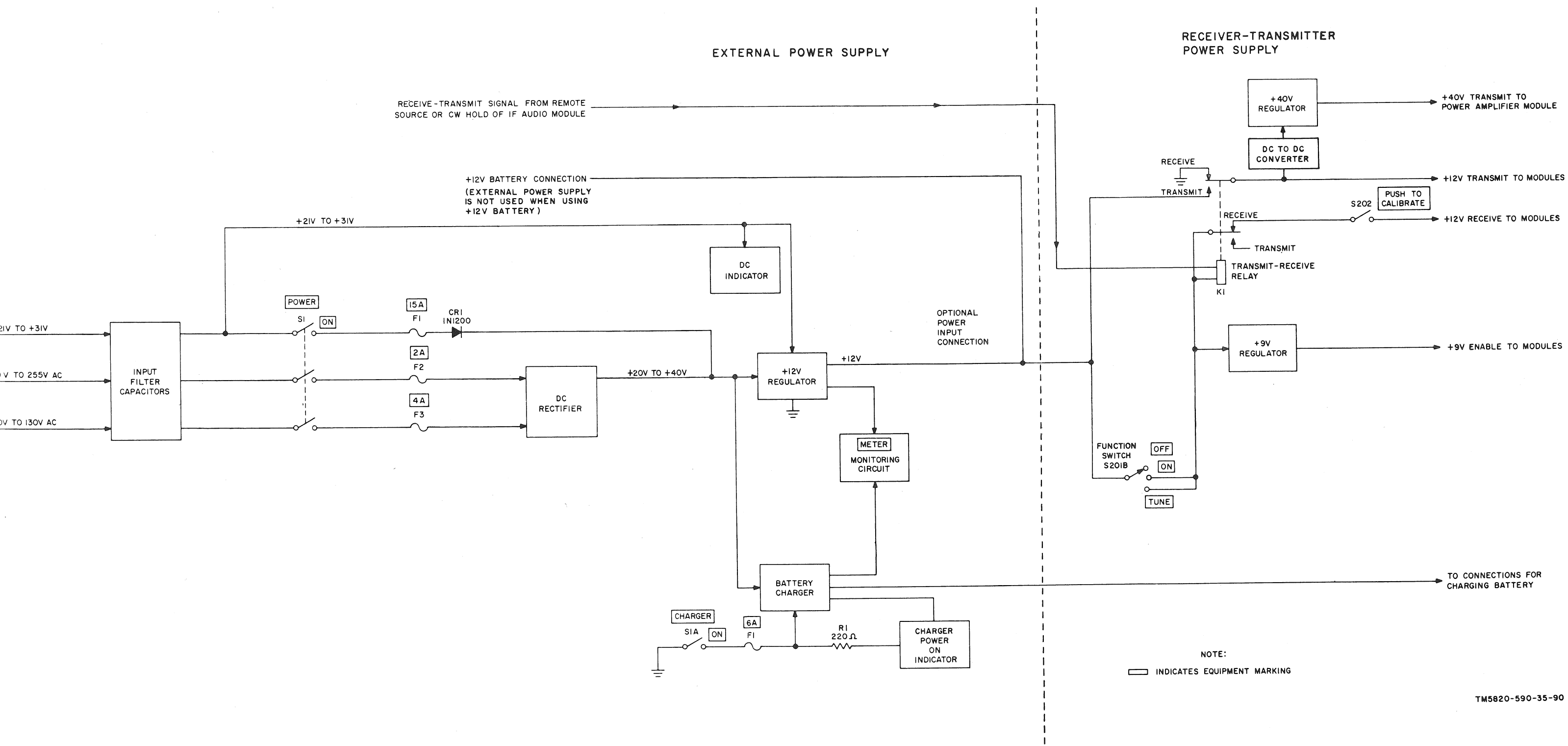


Figure 7-5. Power source, block diagram.

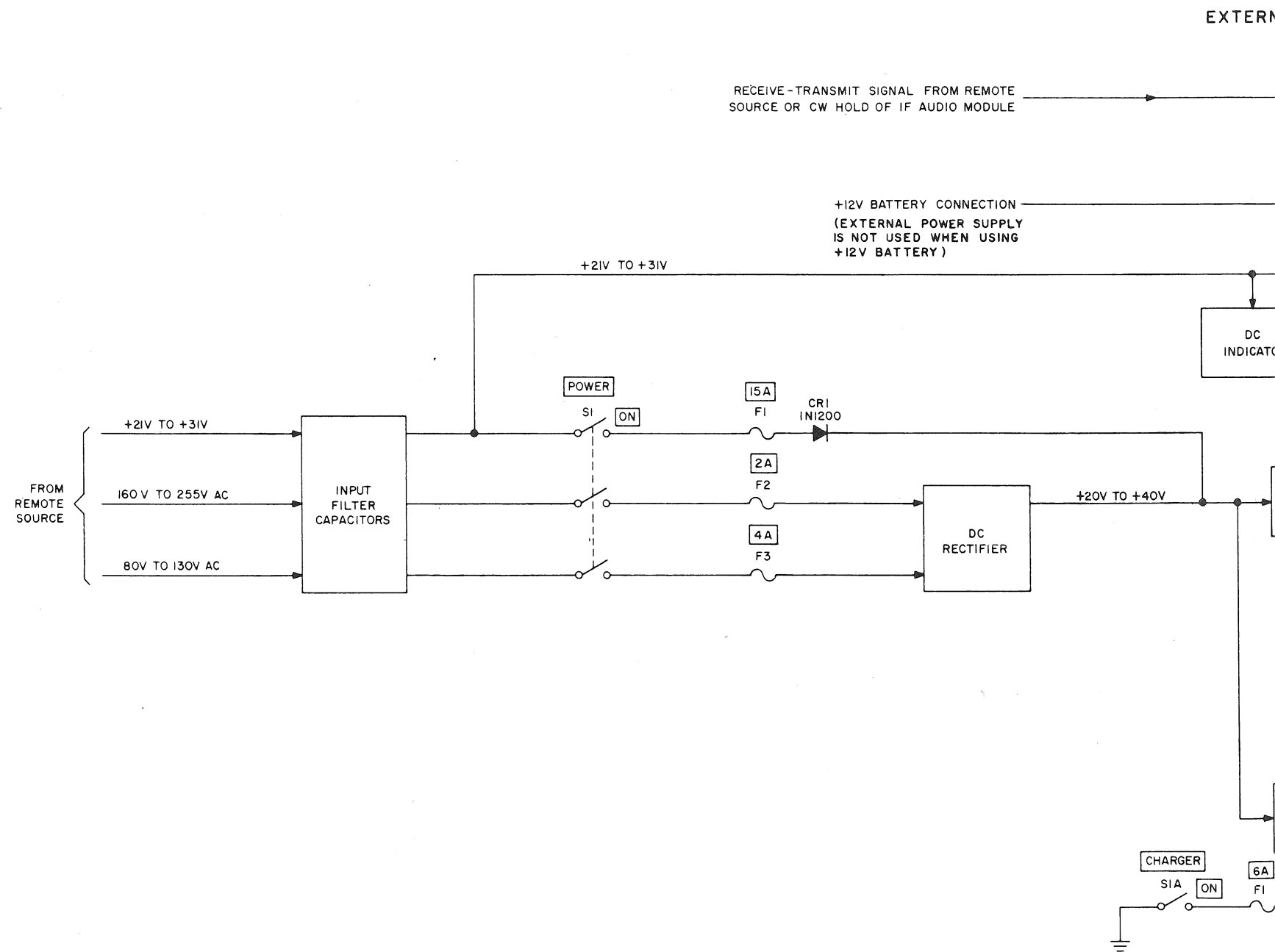


Figure 7-5. Power

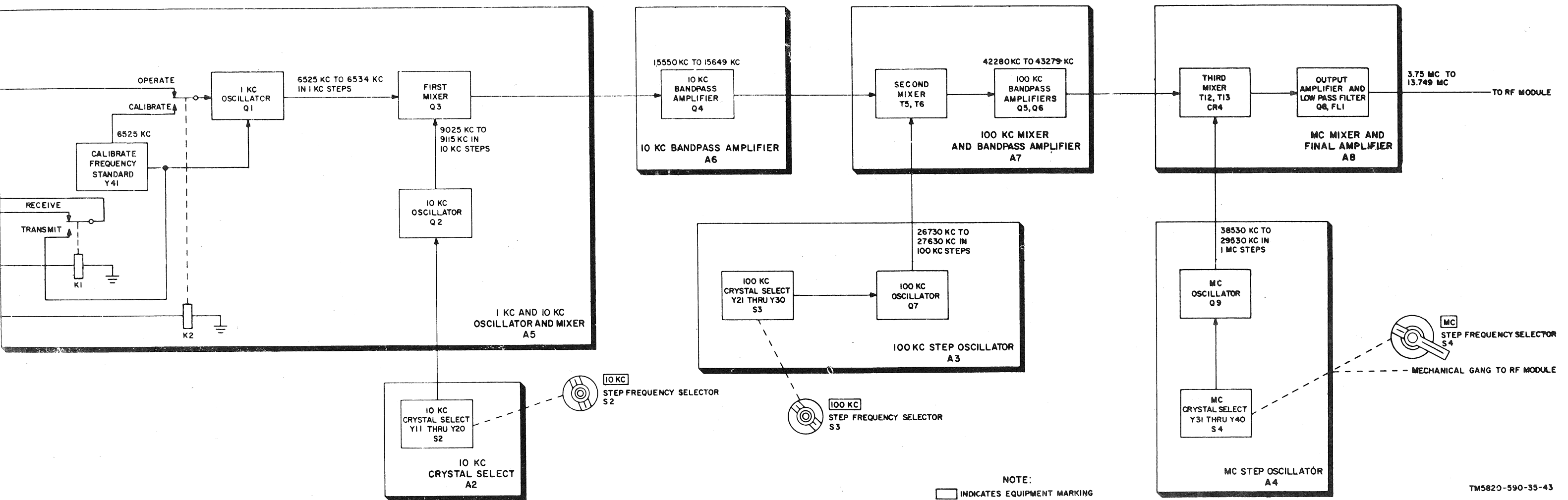
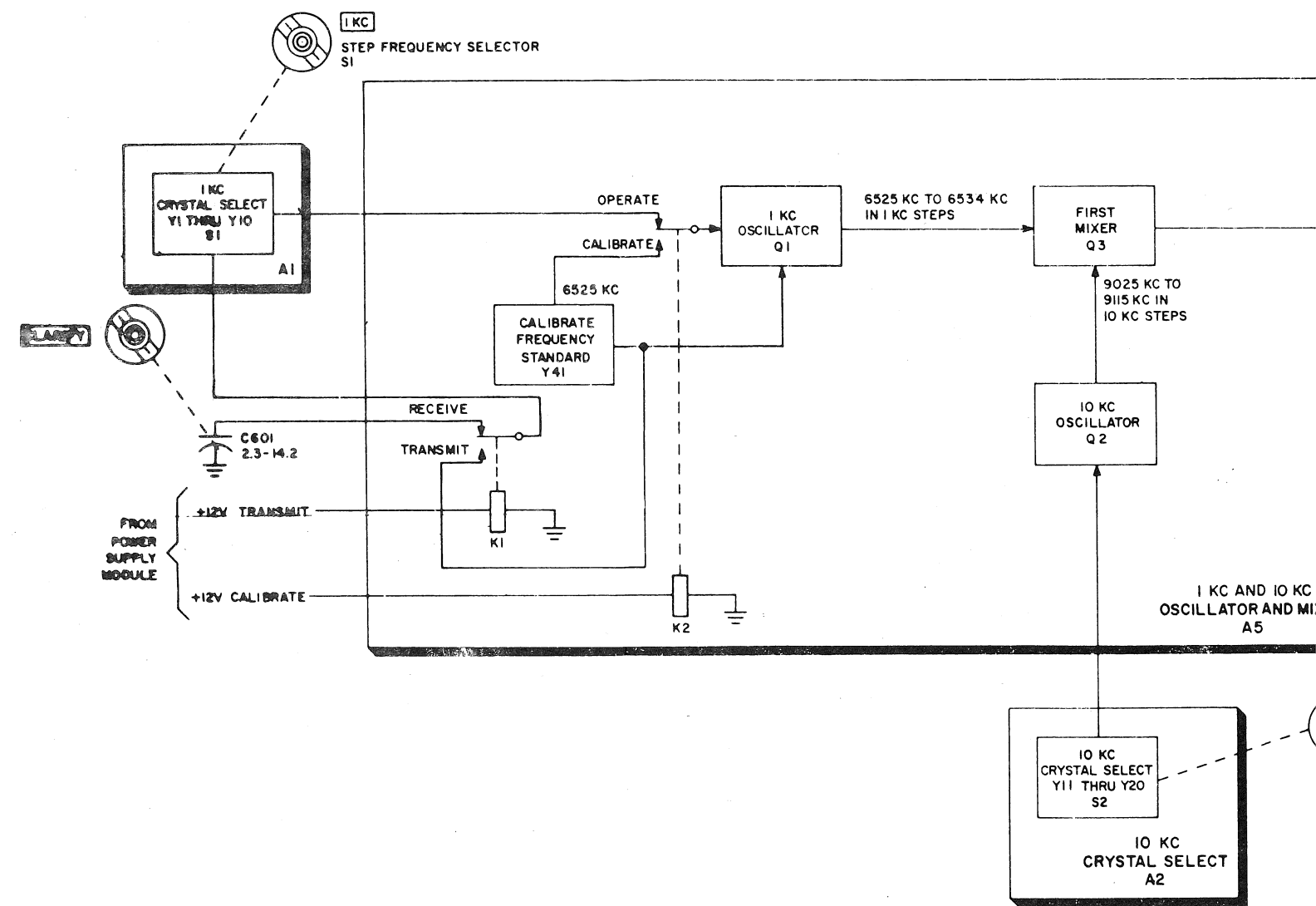
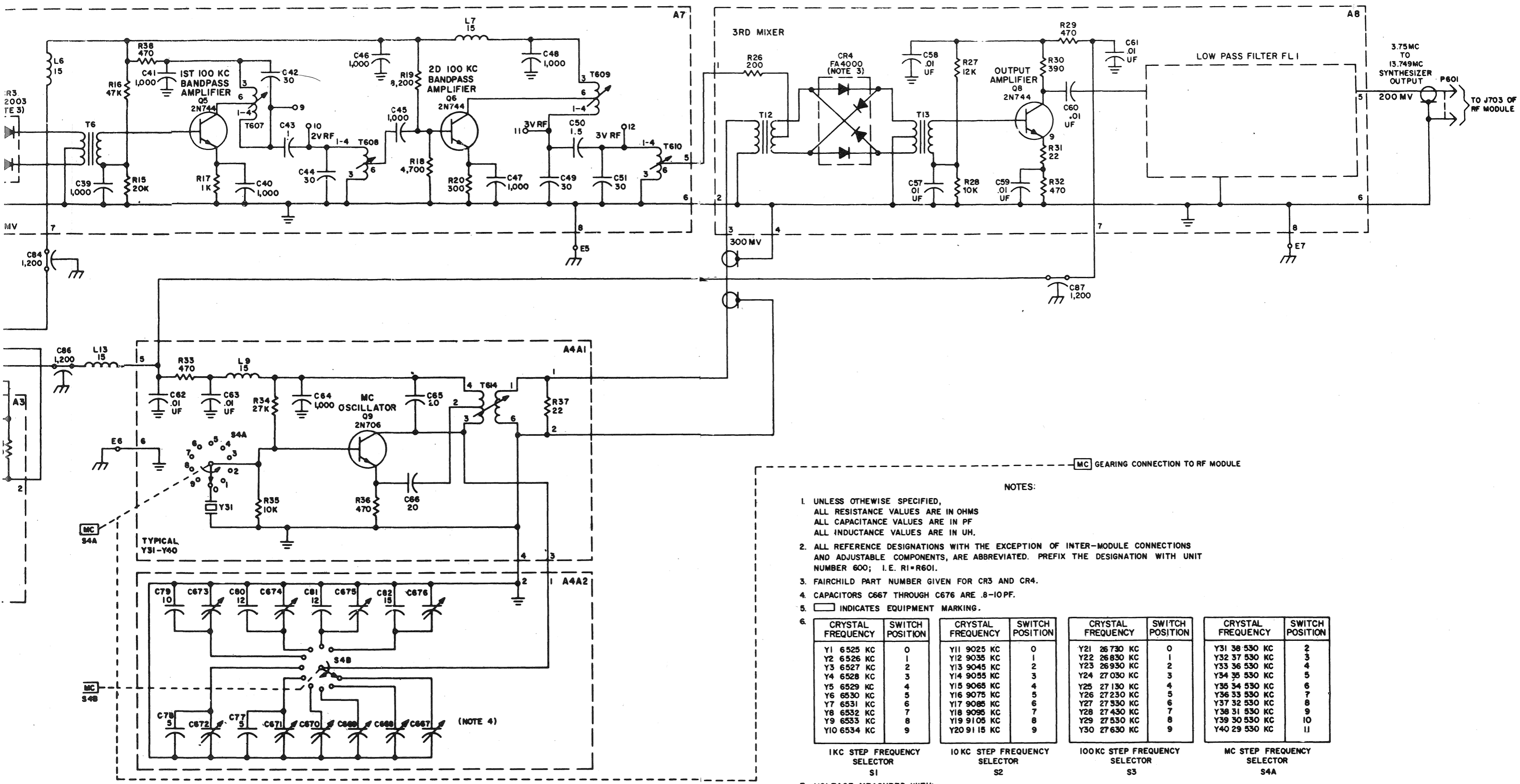


Figure 7-6. Synthesizer module, block diagram.



Figure





- NOTES:
- UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS ALL CAPACITANCE VALUES ARE IN PF ALL INDUCTANCE VALUES ARE IN UH.
  - ALL REFERENCE DESIGNATIONS WITH THE EXCEPTION OF INTER-MODULE CONNECTIONS AND ADJUSTABLE COMPONENTS, ARE ABBREVIATED. PREFIX THE DESIGNATION WITH UNIT NUMBER 600; I.E. R1=R601.
  - FAIRCHILD PART NUMBER GIVEN FOR CR3 AND CR4.
  - CAPACITORS C667 THROUGH C676 ARE .8-10PF.
  - INDICATES EQUIPMENT MARKING.

CRYSTAL FREQUENCY	SWITCH POSITION	CRYSTAL FREQUENCY	SWITCH POSITION	CRYSTAL FREQUENCY	SWITCH POSITION	CRYSTAL FREQUENCY	SWITCH POSITION
Y1 6525 KC	0	Y11 9025 KC	0	Y21 26730 KC	0	Y31 36530 KC	2
Y2 6526 KC	1	Y12 9035 KC	1	Y22 26830 KC	1	Y32 37530 KC	3
Y3 6527 KC	2	Y13 9045 KC	2	Y23 26930 KC	2	Y33 38530 KC	4
Y4 6528 KC	3	Y14 9055 KC	3	Y24 27030 KC	3	Y34 39530 KC	5
Y5 6529 KC	4	Y15 9065 KC	4	Y25 27130 KC	4	Y35 40530 KC	6
Y6 6530 KC	5	Y16 9075 KC	5	Y26 27230 KC	5	Y36 41530 KC	7
Y7 6531 KC	6	Y17 9085 KC	6	Y27 27330 KC	6	Y37 42530 KC	8
Y8 6532 KC	7	Y18 9095 KC	7	Y28 27430 KC	7	Y38 43530 KC	9
Y9 6533 KC	8	Y19 9105 KC	8	Y29 27530 KC	8	Y39 44530 KC	10
Y10 6534 KC	9	Y20 9115 KC	9	Y30 27630 KC	9	Y40 45530 KC	11

7. VOLTAGE MEASURED WITH;  
a. DC-TRIPLETT MODEL 630  
b. RF-ELECTRONIC VOLTMETER AN/URM-145

Synthesizer module, schematic diagram.

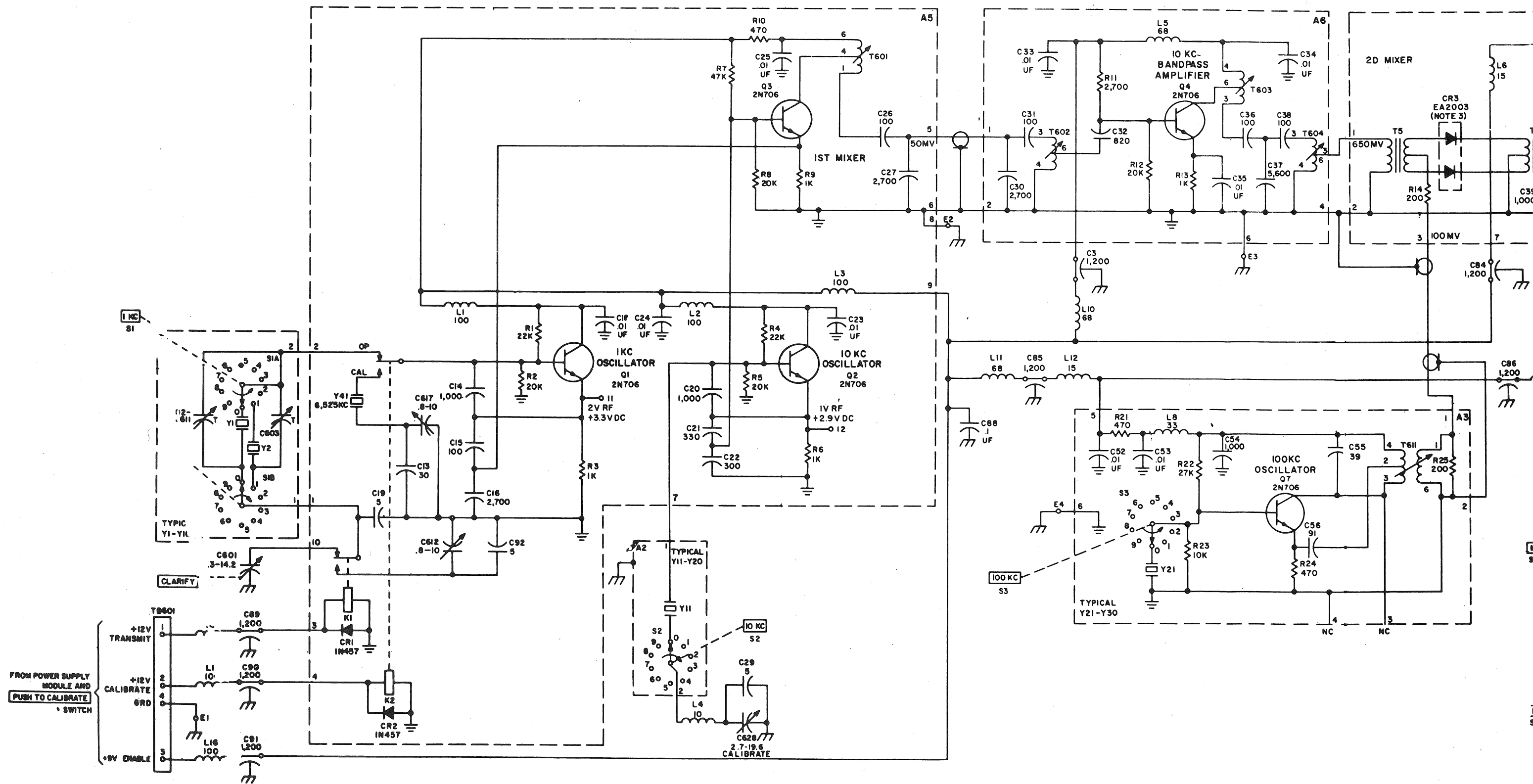


Figure 7-7. Synthesizer mo

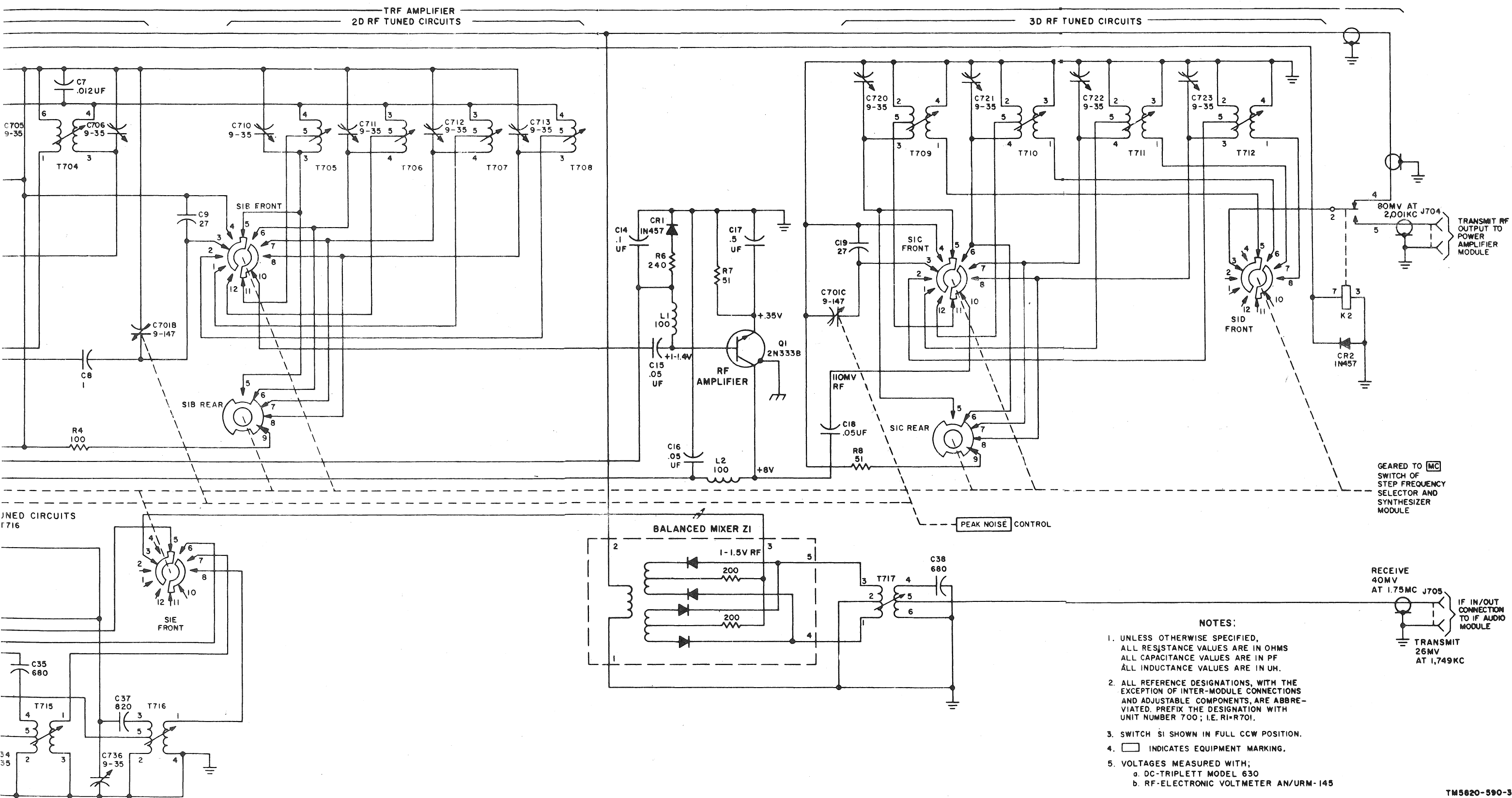


Figure 7-8. RF module, schematic diagram.

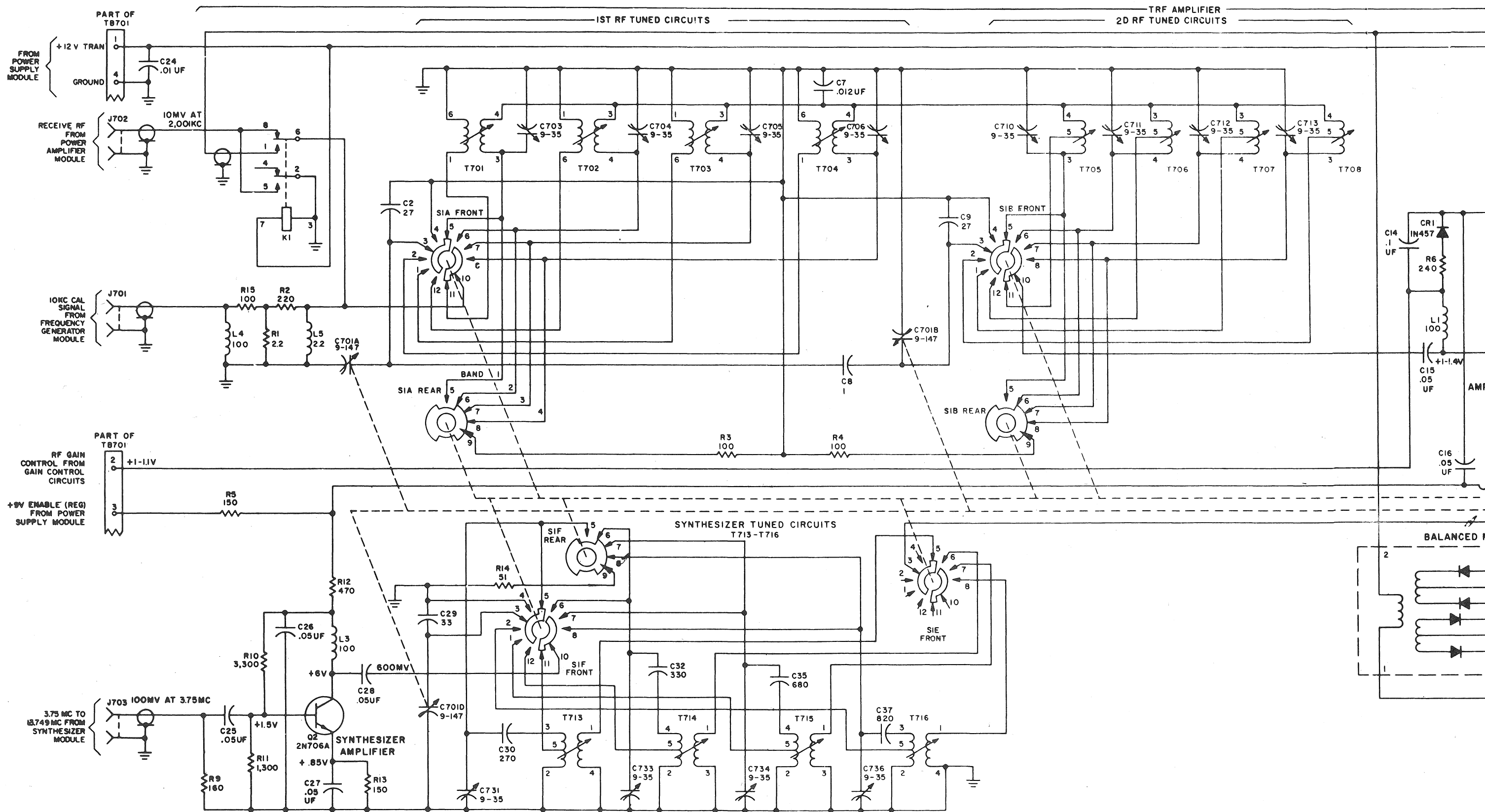


Figure 7-8. RF module, schematic diagram.

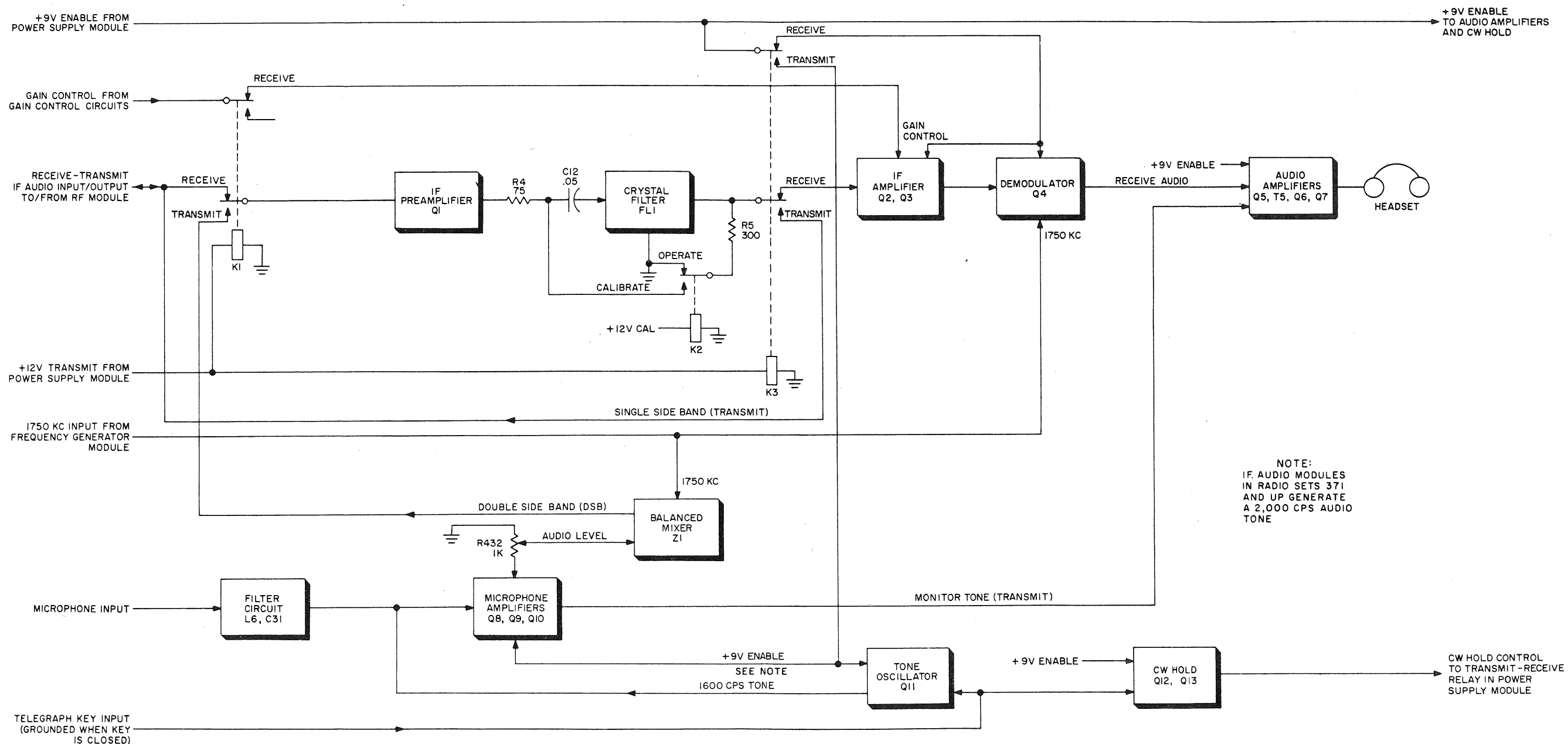
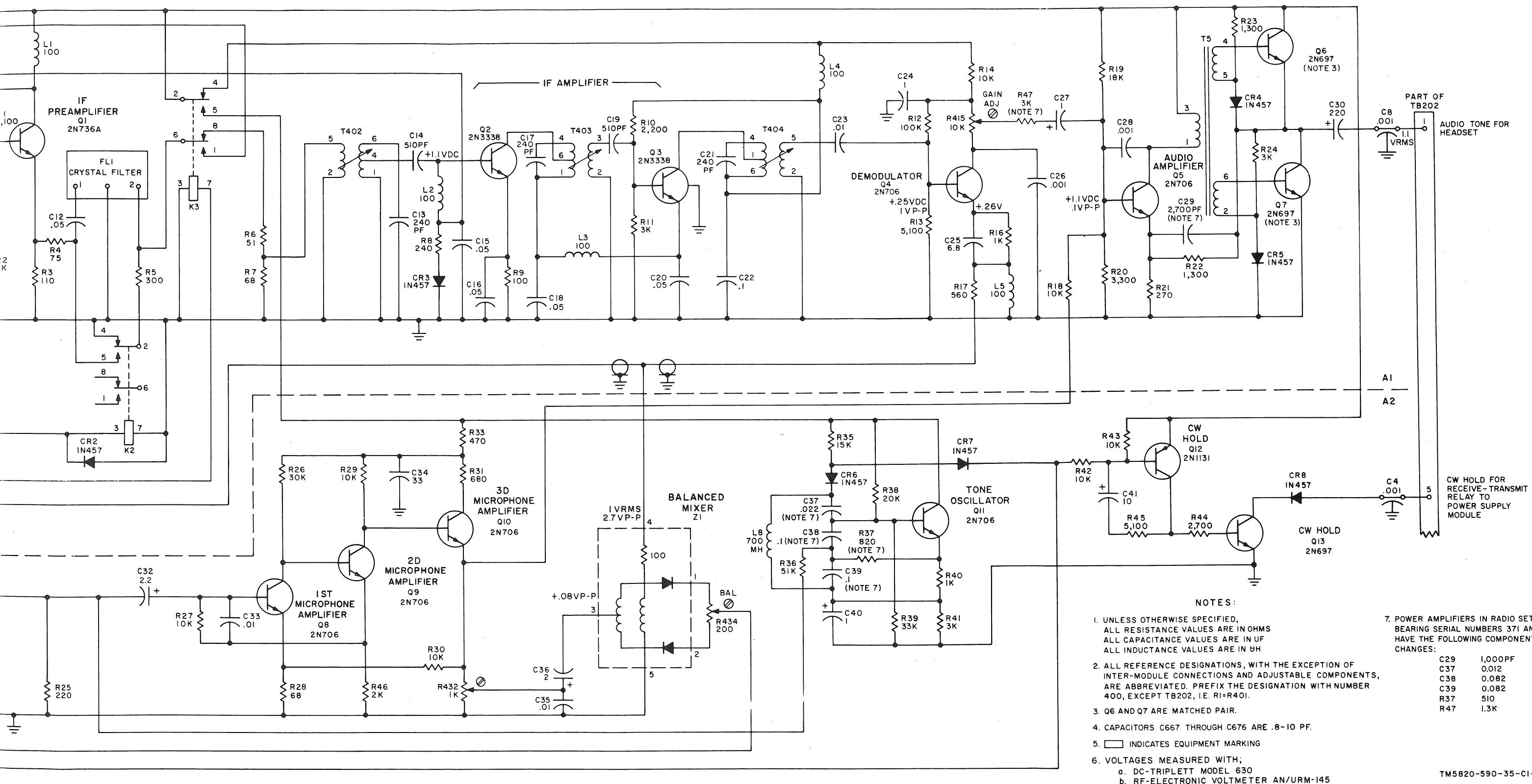


Figure 7-9. IF audio module, block diagram.

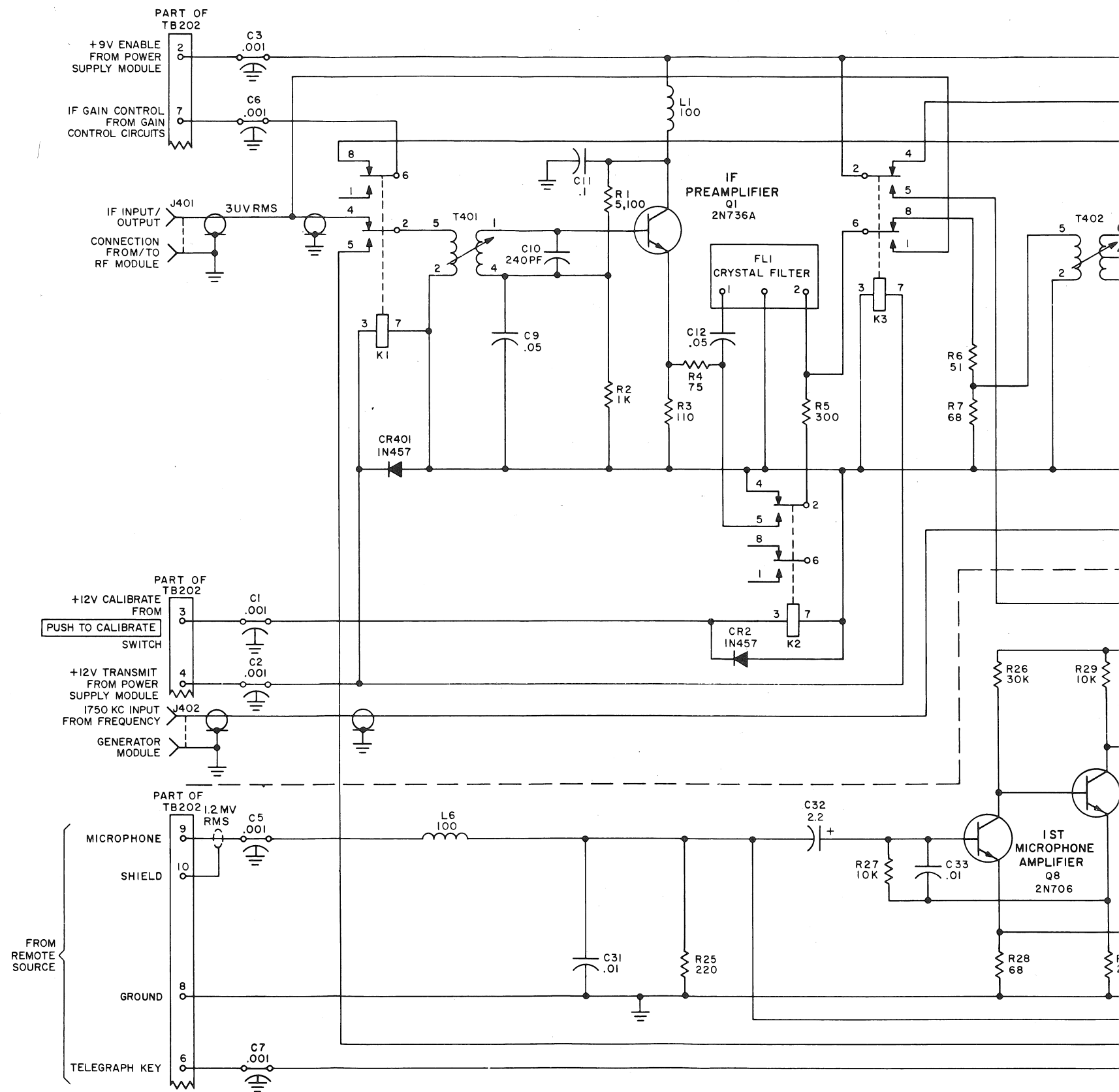


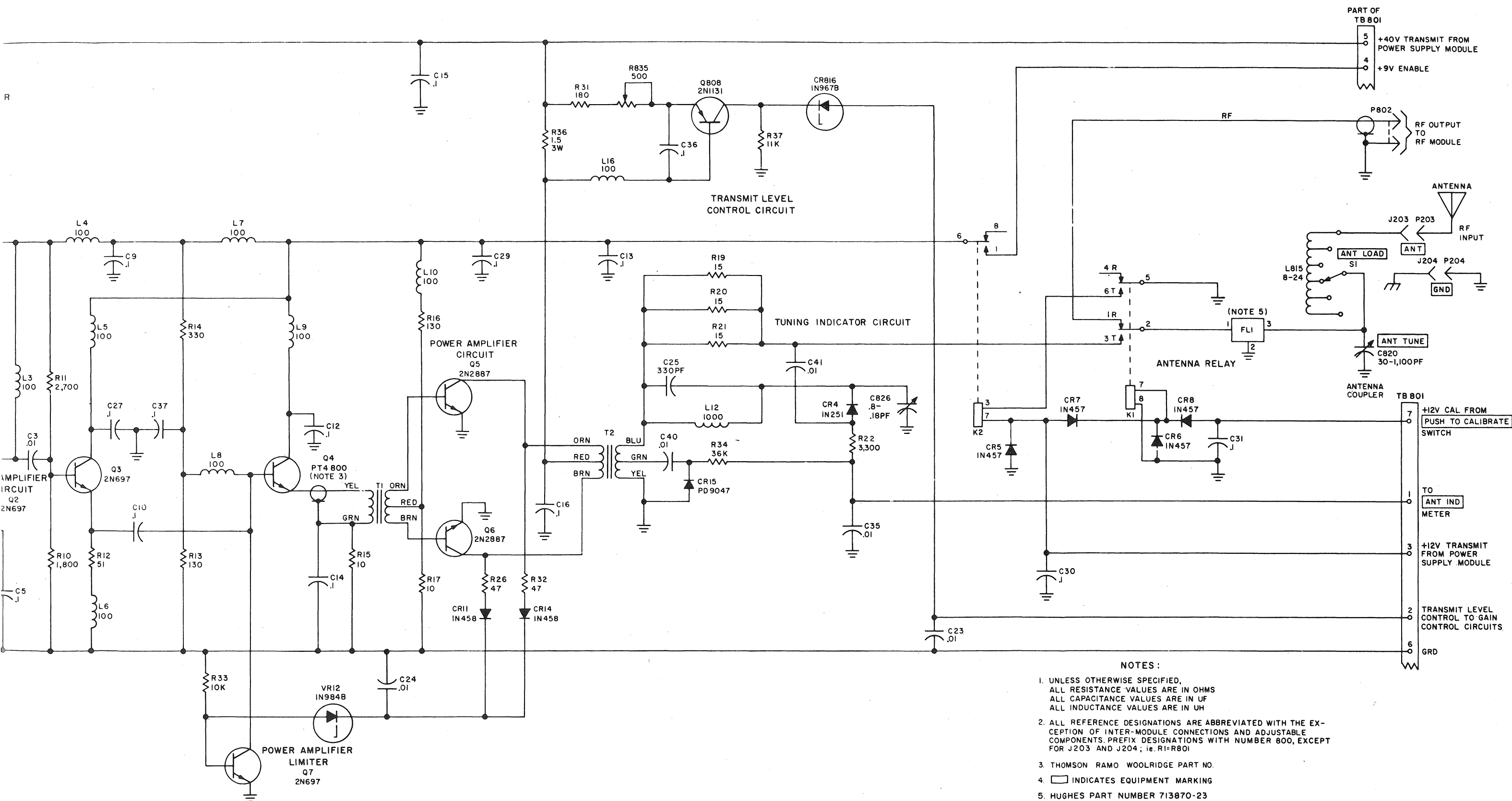
- NOTES:**
- UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS ALL CAPACITANCE VALUES ARE IN UF ALL INDUCTANCE VALUES ARE IN MH
  - ALL REFERENCE DESIGNATIONS, WITH THE EXCEPTION OF INTER-MODULE CONNECTIONS AND ADJUSTABLE COMPONENTS, ARE ABBREVIATED. PREFIX THE DESIGNATION WITH NUMBER 400, EXCEPT TB202, I.E. R1=R401.
  - Q6 AND Q7 ARE MATCHED PAIR.
  - CAPACITORS C667 THROUGH C676 ARE .8-10 PF.
  - INDICATES EQUIPMENT MARKING
  - VOLTAGES MEASURED WITH;
    - DC-TRIPLETT MODEL 630
    - RF-ELECTRONIC VOLTMETER AN/URM-145
  - POWER AMPLIFIERS IN RADIO SETS BEARING SERIAL NUMBERS 371 AND UP HAVE THE FOLLOWING COMPONENT CHANGES:
 

C29	1,000PF
C37	0.012
C38	0.082
C39	0.082
R37	510
R47	1.3K

Figure 7-10. IF. audio module, schematic diagram.

TM 5820-590-35-C1-23





- NOTES:**
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS ALL CAPACITANCE VALUES ARE IN UF ALL INDUCTANCE VALUES ARE IN UH
  2. ALL REFERENCE DESIGNATIONS ARE ABBREVIATED WITH THE EXCEPTION OF INTER-MODULE CONNECTIONS AND ADJUSTABLE COMPONENTS. PREFIX DESIGNATIONS WITH NUMBER 800, EXCEPT FOR J203 AND J204; ie. R1-R801
  3. THOMSON RAMO WOOLRIDGE PART NO.
  4. INDICATES EQUIPMENT MARKING
  5. HUGHES PART NUMBER 713870-23

Figure 7-11. Power amplifier module, schematic diagram



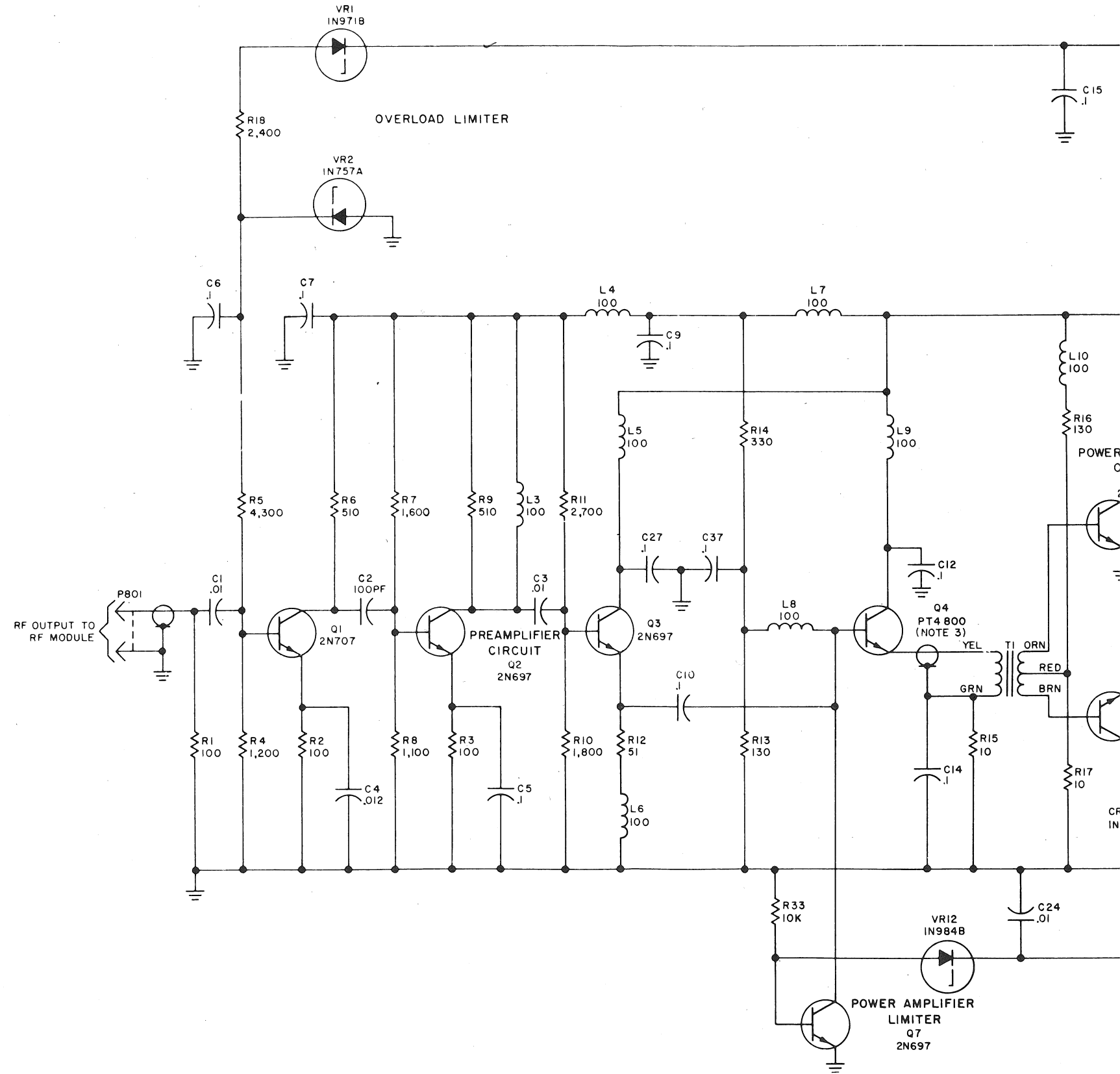
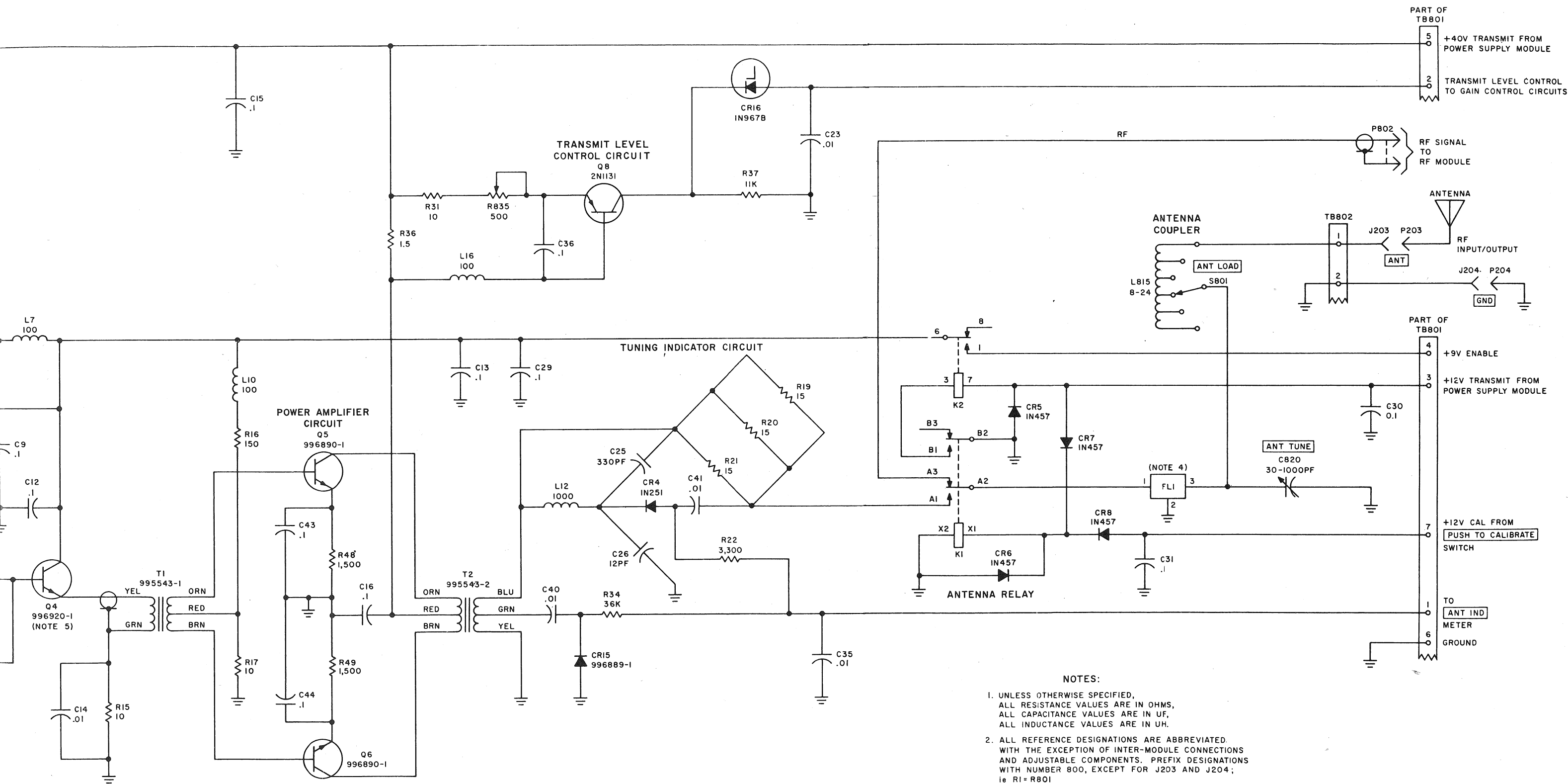
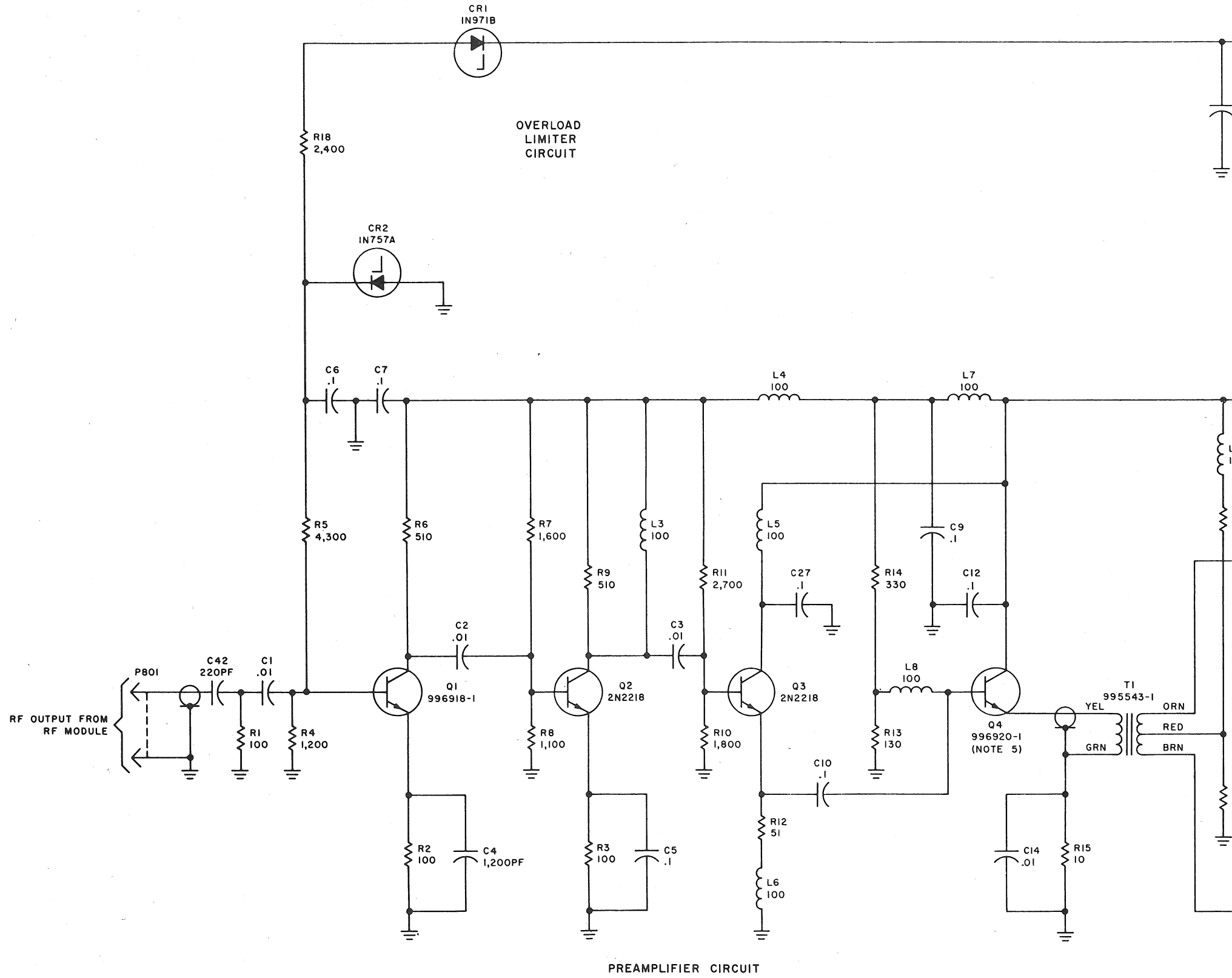


Figure 2



- NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN UF, ALL INDUCTANCE VALUES ARE IN UH.
  2. ALL REFERENCE DESIGNATIONS ARE ABBREVIATED. WITH THE EXCEPTION OF INTER-MODULE CONNECTIONS AND ADJUSTABLE COMPONENTS. PREFIX DESIGNATIONS WITH NUMBER 800, EXCEPT FOR J203 AND J204; ie R1=R801
  3.   INDICATES EQUIPMENT MARKING
  4. HUGHES PART NUMBER 713870-23
  5. SERIAL NUMBER 276 AND UP USE 723060-35

Figure 7-11.1 Power amplifier module, schematic diagram (HAC Part No. 1541057-101).



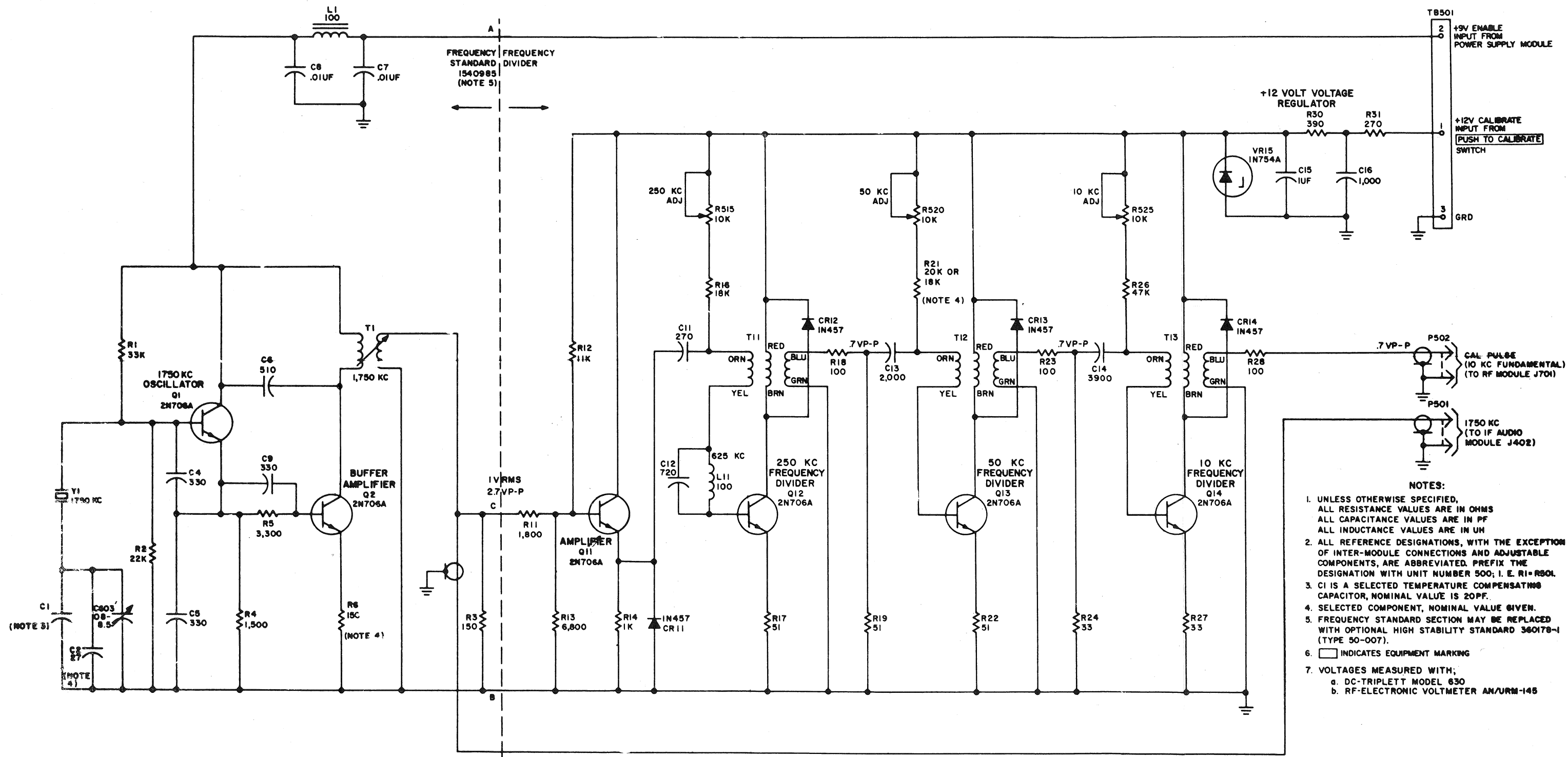


Figure 7-12. Frequency generator module, schematic diagram.

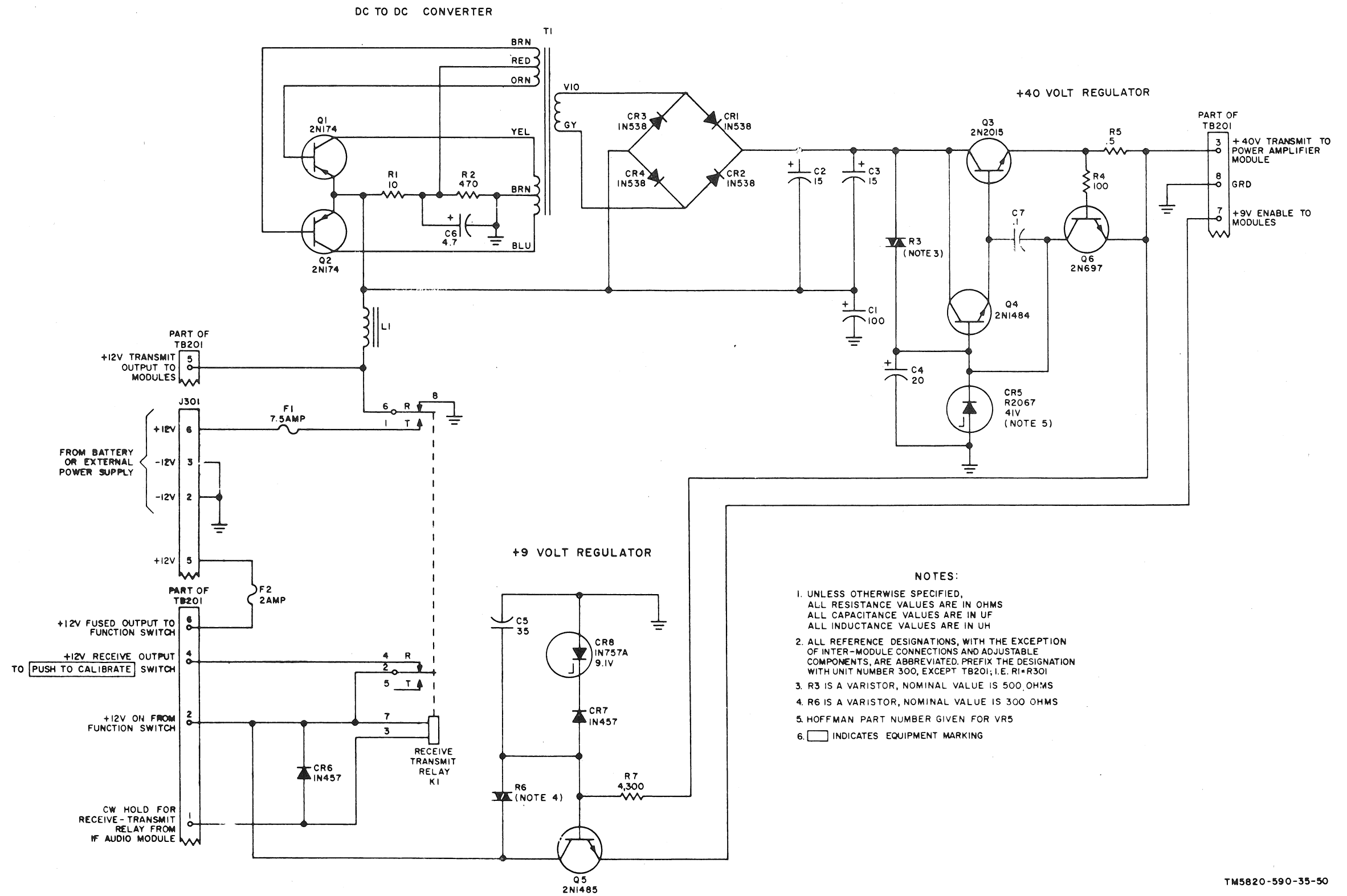
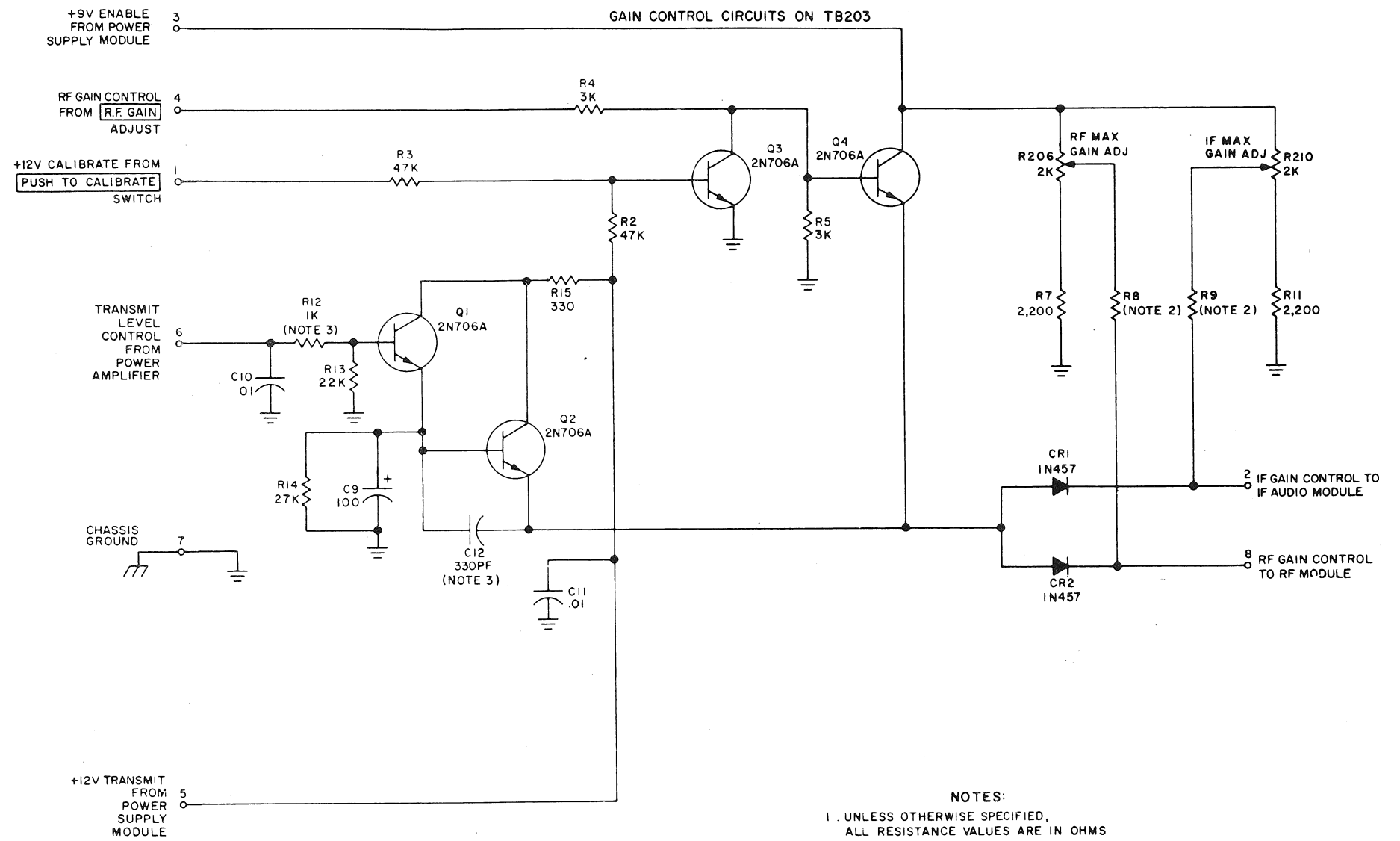


Figure 7-13. Power supply module, schematic diagram.

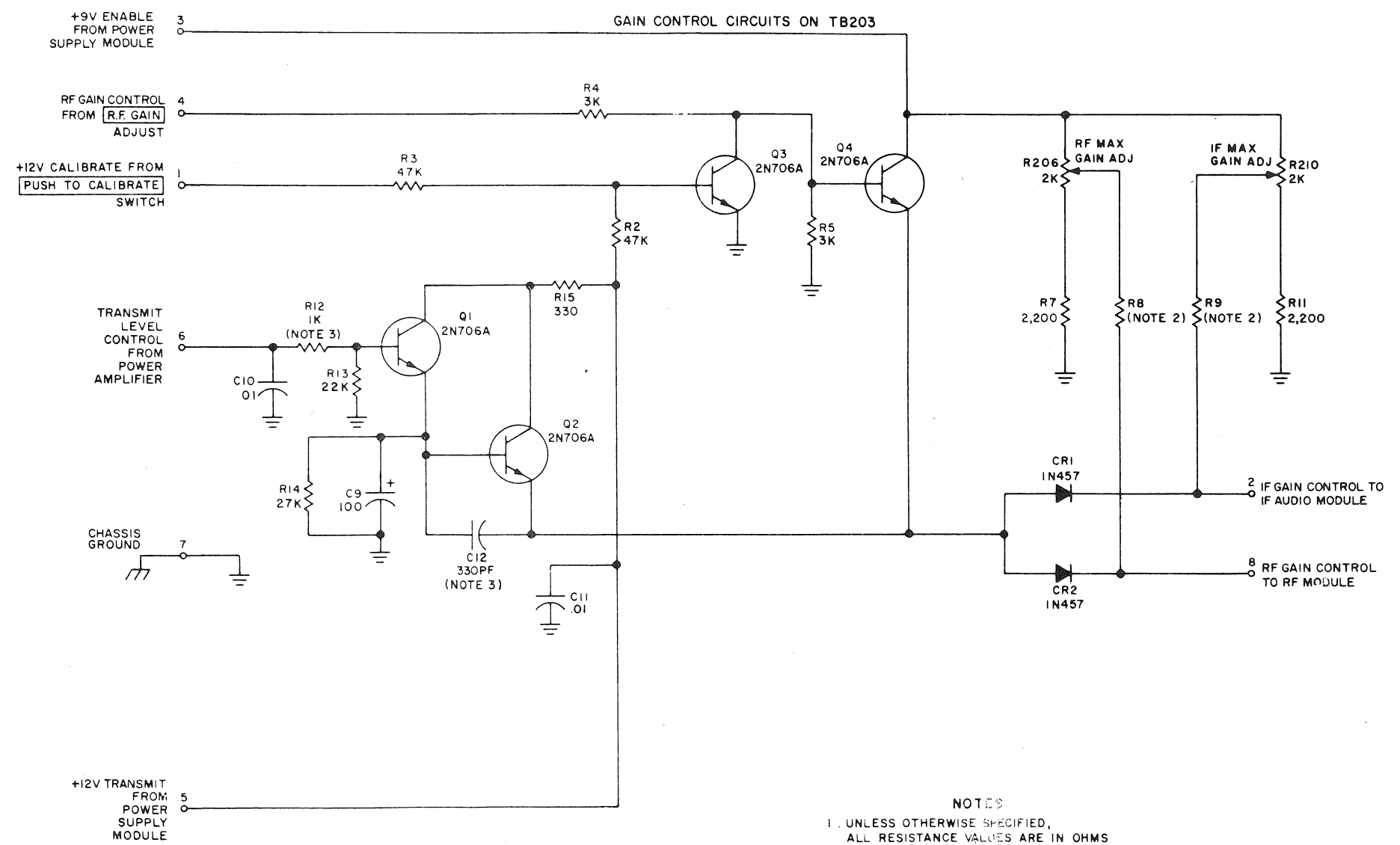


**NOTES:**

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS ALL CAPACITANCE VALUES ARE IN UF
2. R8 AND R9 ARE 1,800 SENSITORS
3. R12 AND C12 ONLY ON SERIAL NUMBER 110 AND UP
4. ALL REFERENCE DESIGNATIONS, WITH THE EXCEPTION OF INTER-MODULE CONNECTIONS AND ADJUSTABLE COMPONENTS, ARE ABBREVIATED PREFIX THE DESIGNATION WITH UNIT NUMBER 200; I.E. R11=R211
5.  INDICATES EQUIPMENT MARKING

TM5820-590-35-52

Figure 7-14. Gain control circuits, schematic diagram.



**NOTES**

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS ALL CAPACITANCE VALUES ARE IN UF
2. R8 AND R9 ARE 1,800 SENSITORS
3. R12 AND C12 ONLY ON SERIAL NUMBER 110 AND UP
4. ALL REFERENCE DESIGNATIONS, WITH THE EXCEPTION OF INTER-MODULE CONNECTIONS AND ADJUSTABLE COMPONENTS, ARE ABBREVIATED. PREFIX THE DESIGNATION WITH UNIT NUMBER 200, I.E. R11-R211
5.  INDICATES EQUIPMENT MARKING

TM5820-590-35-52

Figure 7-14. Gain control circuits, schematic diagram.

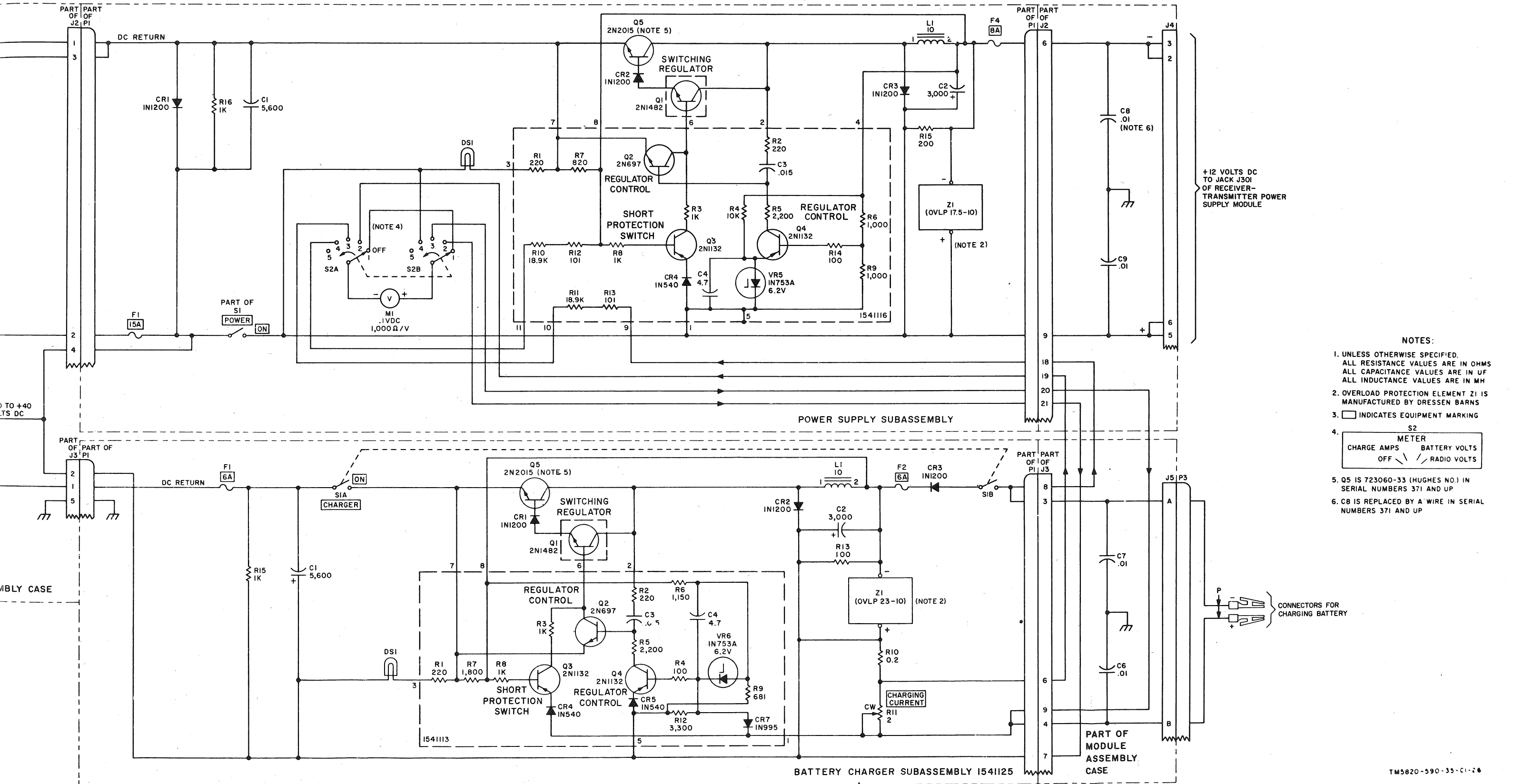


Figure 7-15. External power supply and battery charger, schematic diagram.



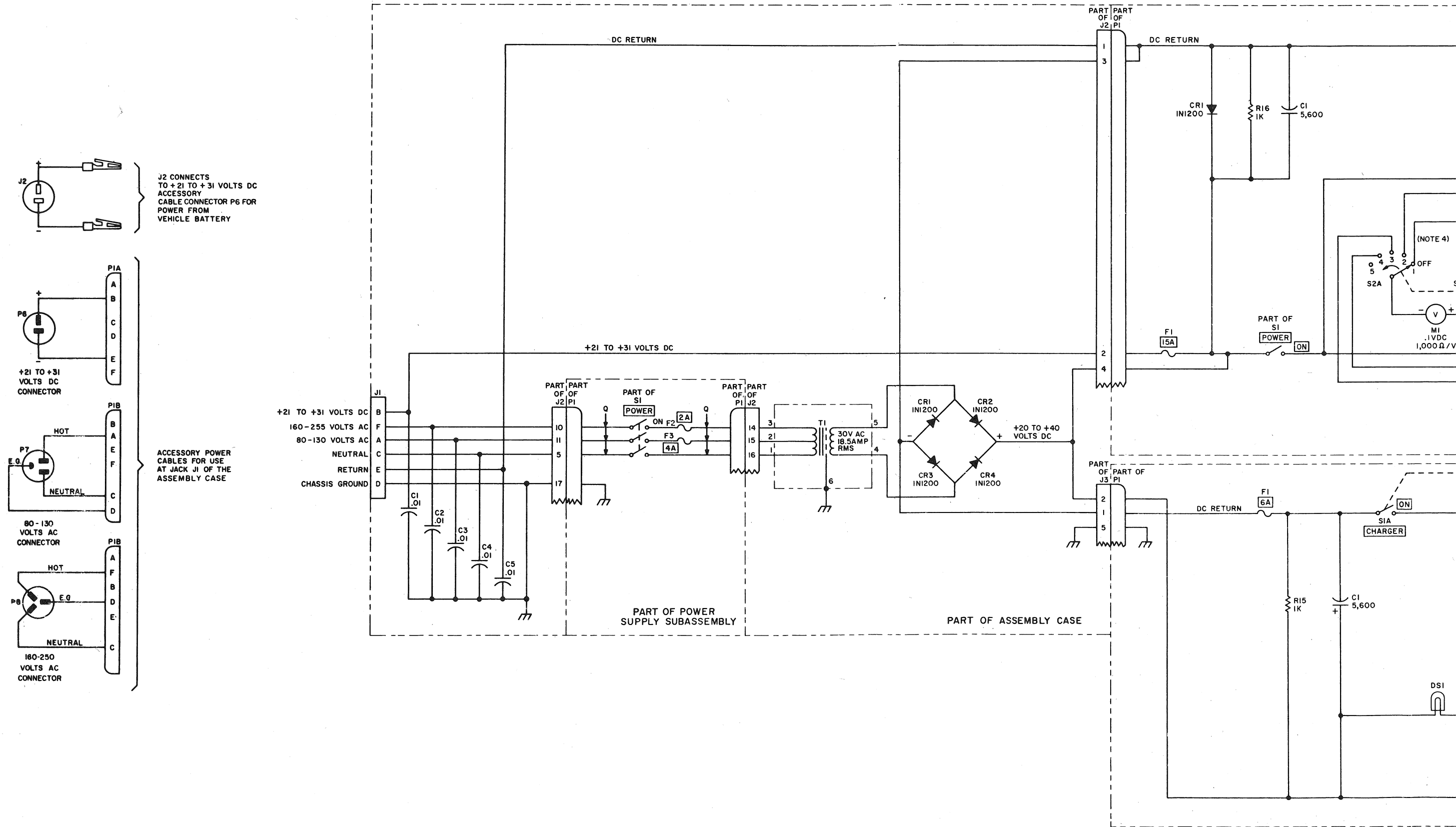
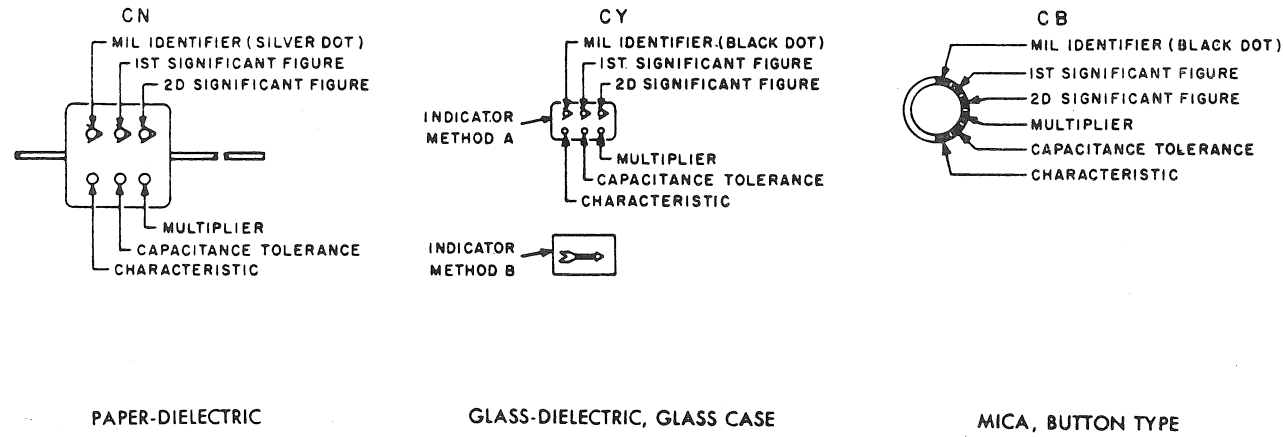


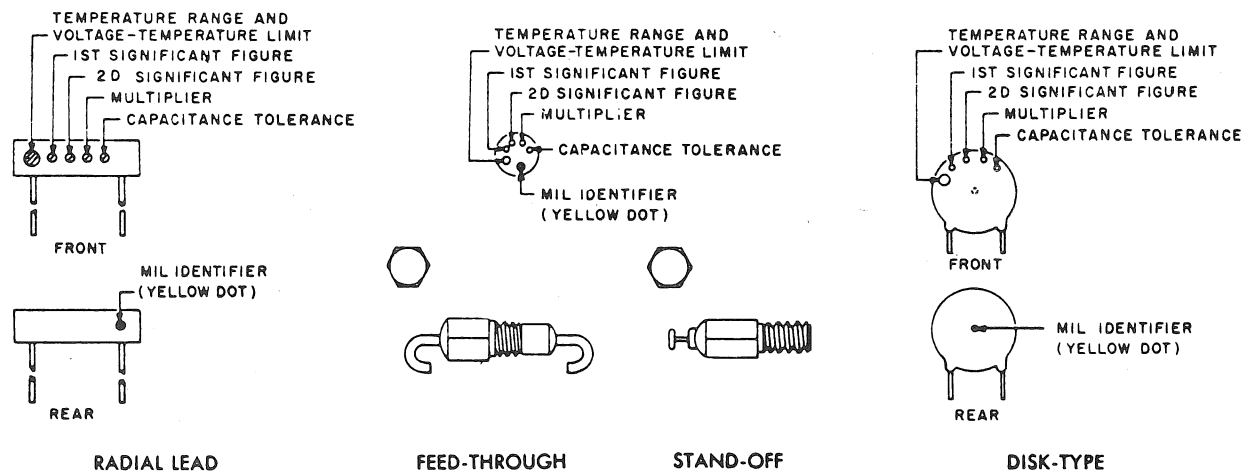
Figure 7-15. External power supply and battery charger, schematic

# COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

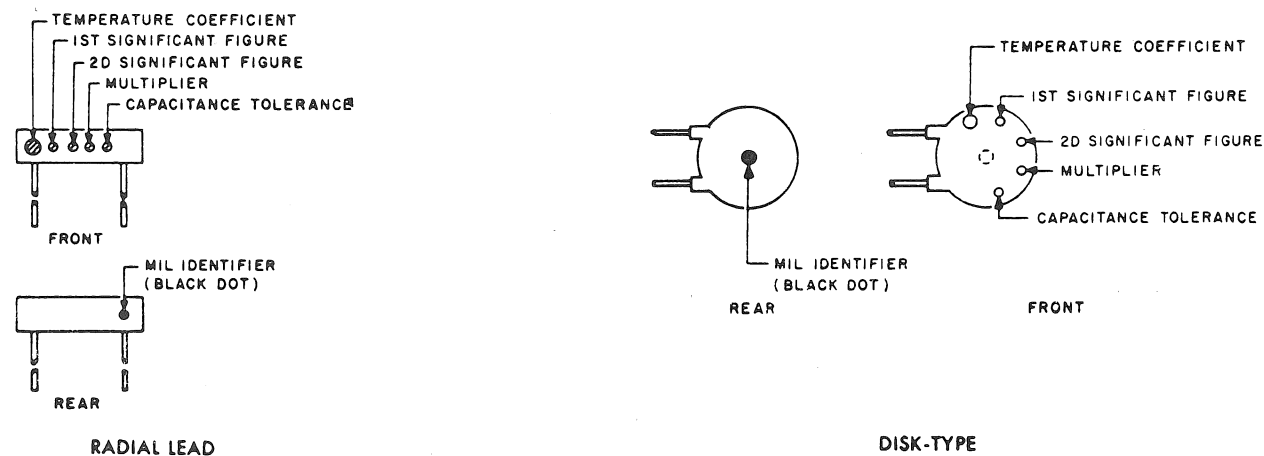
Various-Dielectrics, Styles CM, CN, CY, and CB



Ceramic-Dielectric (General Purpose) Style CK



Ceramic-Dielectric (Temperature Compensating) Style CC



## COLOR CODE TABLES

TABLE I - For use with Group I, Styles CM, CN, CY and CB

COLOR	MIL ID	1st SIG FIG	2nd SIG FIG	MULTIPLIER <sup>1</sup>	CAPACITANCE TOLERANCE				CHARACTERISTIC <sup>2</sup>				DC WORKING VOLTAGE	OPERATING TEMP. RANGE	VIBRATION GRADE
					CM	CN	CY	CB	CM	CN	CY	CB	CM	CM	CM
BLACK	CM, CY CB	0	0	1			± 20%	± 20%		A				-55° to +70°C	10-55 cps
BROWN		1	1	10					B	E		B			
RED		2	2	100	± 2%		± 2%	± 2%	C		C			-55° to +85°C	
ORANGE		3	3	1,000		± 30%			D			D	300		
YELLOW		4	4	10,000					E					-55° to +125°C	10-2,000 cps
GREEN		5	5		± 5%				F				500		
BLUE		6	6											-55° to +150°C	
PURPLE (VIOLET)		7	7												
GREY		8	8												
WHITE		9	9												
GOLD				0.1			± 5%	± 5%							
SILVER	CN				± 10%	± 10%	± 10%	± 10%							

TABLE II - For use with Group II, General Purpose, Style CK

COLOR	TEMP. RANGE AND VOLTAGE - TEMP. LIMITS <sup>3</sup>	1st SIG FIG	2nd SIG FIG	MULTIPLIER <sup>1</sup>	CAPACITANCE TOLERANCE	MIL ID
BLACK		0	0	1	± 20%	
BROWN	AW	1	1	10	± 10%	
RED	AX	2	2	100		
ORANGE	BX	3	3	1,000		
YELLOW	AV	4	4	10,000		CK
GREEN	CZ	5	5			
BLUE	BY	6	6			
PURPLE (VIOLET)		7	7			
GREY		8	8			
WHITE		9	9			
GOLD						
SILVER						

TABLE III - For use with Group III, Temperature Compensating, Style CC

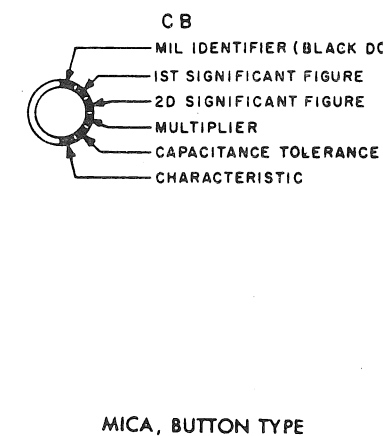
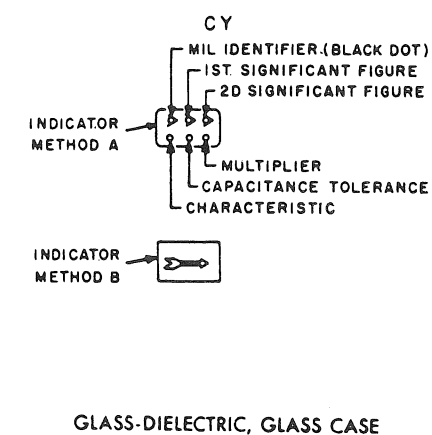
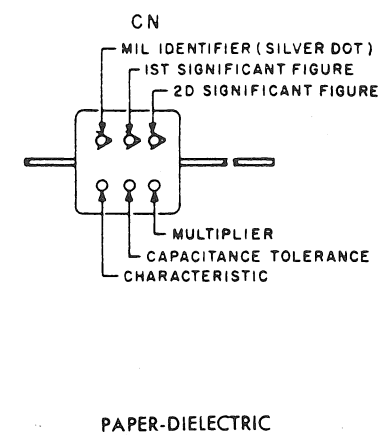
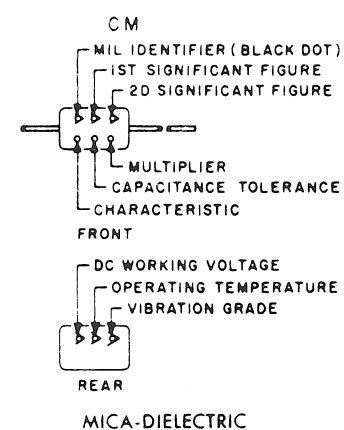
COLOR	TEMPERATURE COEFFICIENT <sup>4</sup>	1st SIG FIG	2nd SIG FIG	MULTIPLIER <sup>1</sup>	CAPACITANCE TOLERANCE		MIL ID
					Capacitances over 10uuf	Capacitances 10uuf or less	
BLACK	0	0	0	1		± 2.0uuf	CC
BROWN	-30	1	1	10	± 1%		
RED	-80	2	2	100	± 2%	± 0.25uuf	
ORANGE	-150	3	3	1,000			
YELLOW	-220	4	4				
GREEN	-330	5	5		± 5%	± 0.5uuf	
BLUE	-470	6	6				
PURPLE (VIOLET)	-750	7	7				
GREY		8	8	0.01			
WHITE		9	9	0.1	± 10%		
GOLD	+100					± 1.0uuf	
SILVER							

- The multiplier is the number by which the two significant (SIG) figures are multiplied to obtain the capacitance in uuf.
- Letters indicate the Characteristics designated in applicable specifications: MIL-C-5, MIL-C-91, MIL-C-11272, and MIL-C-10950 respectively.
- Letters indicate the temperature range and voltage-temperature limits designated in MIL-C-11015.
- Temperature coefficient in parts per million per degree centigrade.

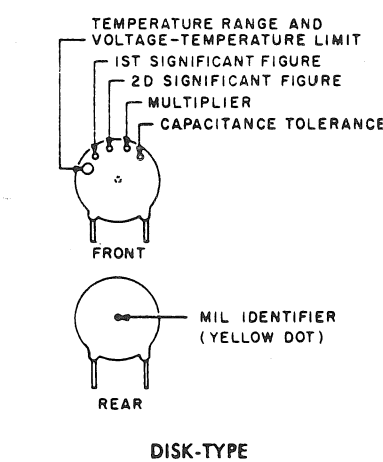
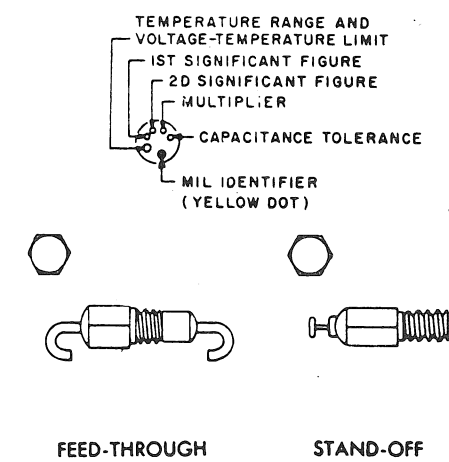
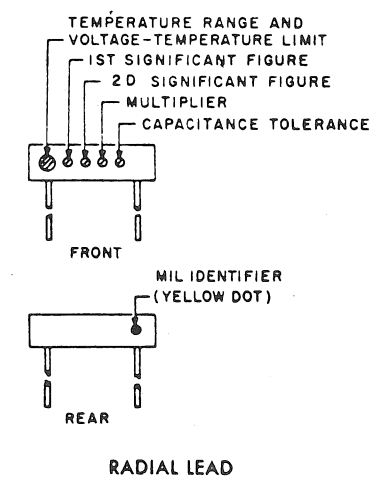
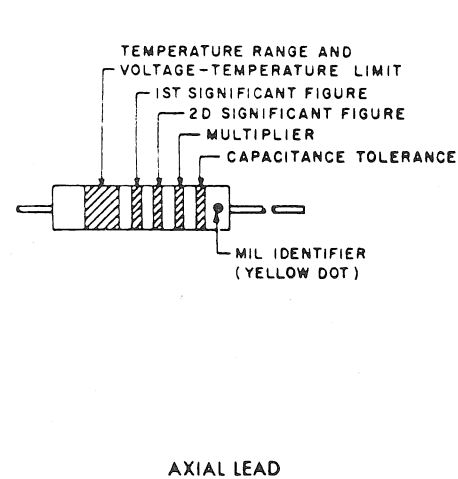
Figure 7-16. Color code marking for MIL STD capacitors.

COLOR CODE MARKING FOR MILITARY STANDARD CAPACITORS

GROUP I Capacitors, Fixed, Various-Dielectrics, Styles CM, CN, CY, and CB



GROUP II Capacitors, Fixed Ceramic-Dielectric (General Purpose) Style CK



GROUP III Capacitors, Fixed, Ceramic-Dielectric (Temperature Compensating) Style CC

