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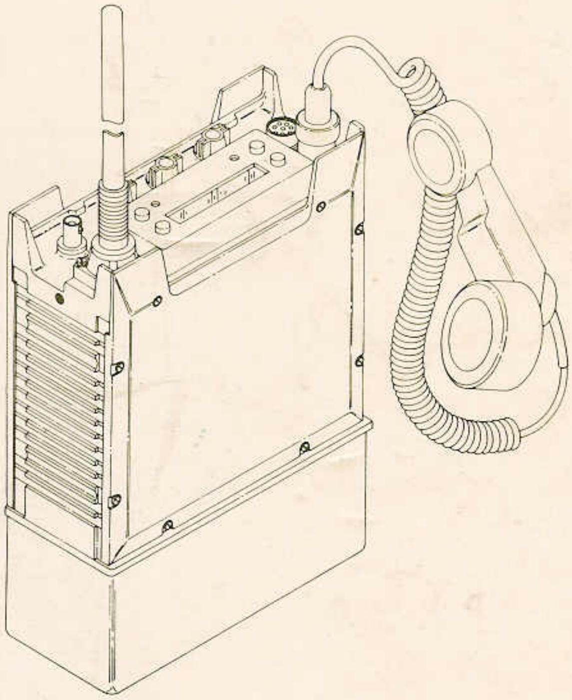

ERC-310

MANPACK TRANSCEIVER

OPERATION AND MAINTENANCE MANUAL

CORRECTIONS TO ERC-310 MANUAL

February 17, 1981

1. Page 1-5, Sec. 1-6 Reference Data
    a. Number of preset channels should be 4 not 3.
2. Page 3-5/3-6, Sec. 3-3
    a. Line a - Should be position 1 not N.
    b. Line b - Should be position 1 not N.
3. Page 6-12, Sec. 6-6.4.2
    a. Should be image rejection, not selection.
4. Page 6-21, Sec. 6-9.2
    a. Need to insert step to remove wires to BNC.
5. Page 6-21, Sec. 6-9.3
    a. Should read - display will slip out.
6. Figure 8-1
    a. Change RY + TY to RX + TX.
7. Figure 8-4
    a. External power relay wired wrong.
    b. D8 is backwards.
    c. R1 - 47KΩ.
8. Figure 8-6
    a. D8 is backwards.
    b. 10M lines - only two.
    c. Antenna matching line to transistor is wrong.
9. Index 1
    a. Audio module instead of analog module.
10. Index 2
    a. ERC-310 instead of ERC-31.
11. Figure 8-21
    a. U1B output pin is pin 4 not pin 10.
12. Figure 8-2
    a. Synthesizer module missing reference numbers.
13. Page 4-5
    a. 1st complete paragraph, last sentence should read "to provide an attentuation of 24db at 5.4kHz".
14. Figure 8-23
    a. See test manual for numerous changes.
15. Figure 8-11
    a. TP1 not labeled.
16. Figure 8-6
    a. D8 backwards.
    b. R5-8K2.
    c. Aux 8305 needs jumper from audio out to audio in.
17. Figure 8-19
    a. See test manual for changes.
18. Figure 8-22
    a. R2-10KΩ.
    b. C3-.47uf.
    c. C7-.1uf.
19. Figure 8-17
    a. See test manual for changes.
20. Figure 8-18
    a. See test manual for changes.
21. Figure 8-15
    a. 22p cap after Q1 should be C14.
22. Figure 8-16
    a. See test manual for numerous changes.
23. Figure 8-8
    a. See test manual for numerous changes.
24. Figure 8-10
    a. C20 chould be .47u.
    b. C3 should be .47u.

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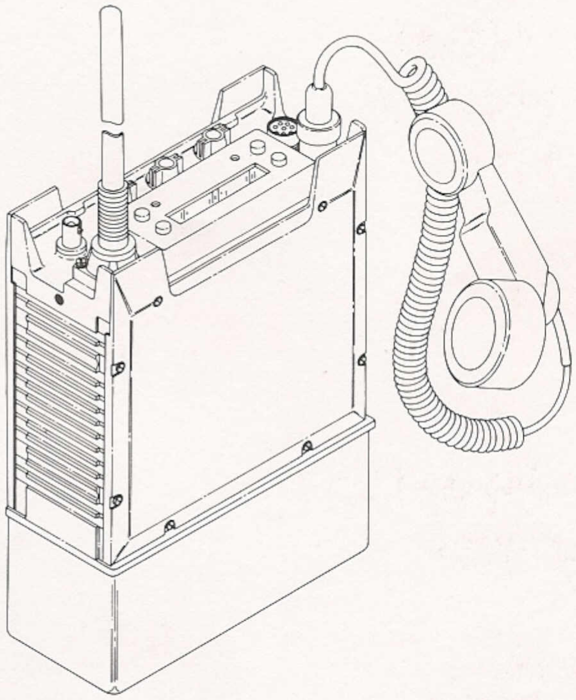


ERC-310

MANPACK TRANSCEIVER

OPERATION AND MAINTENANCE MANUAL

CHAPTER 1
GENERAL INFORMATION

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

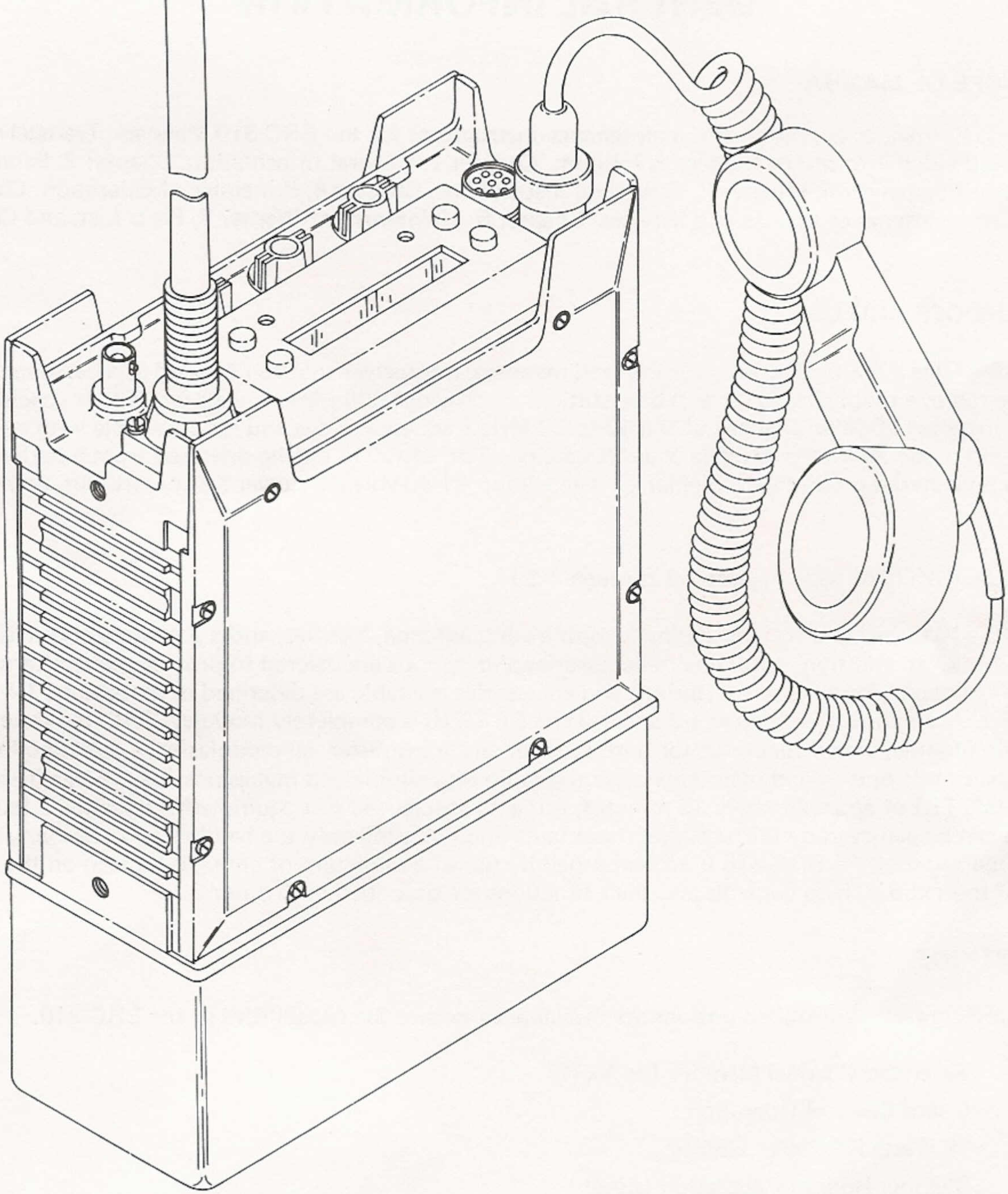


Figure 1-1. ERC-310 Manpack Transceiver, Overall View

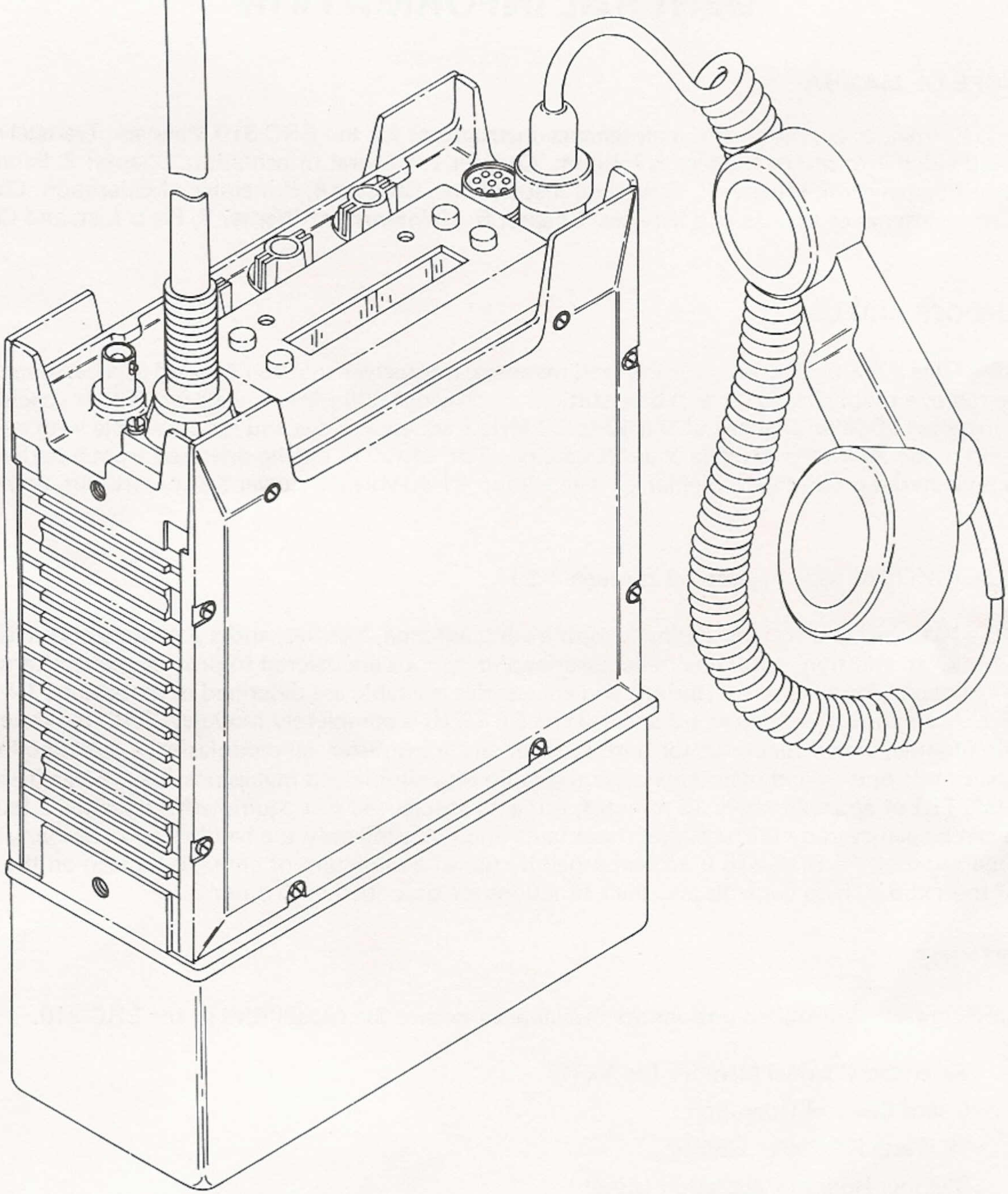


Figure 1-1. ERC-310 Manpack Transceiver, Overall View

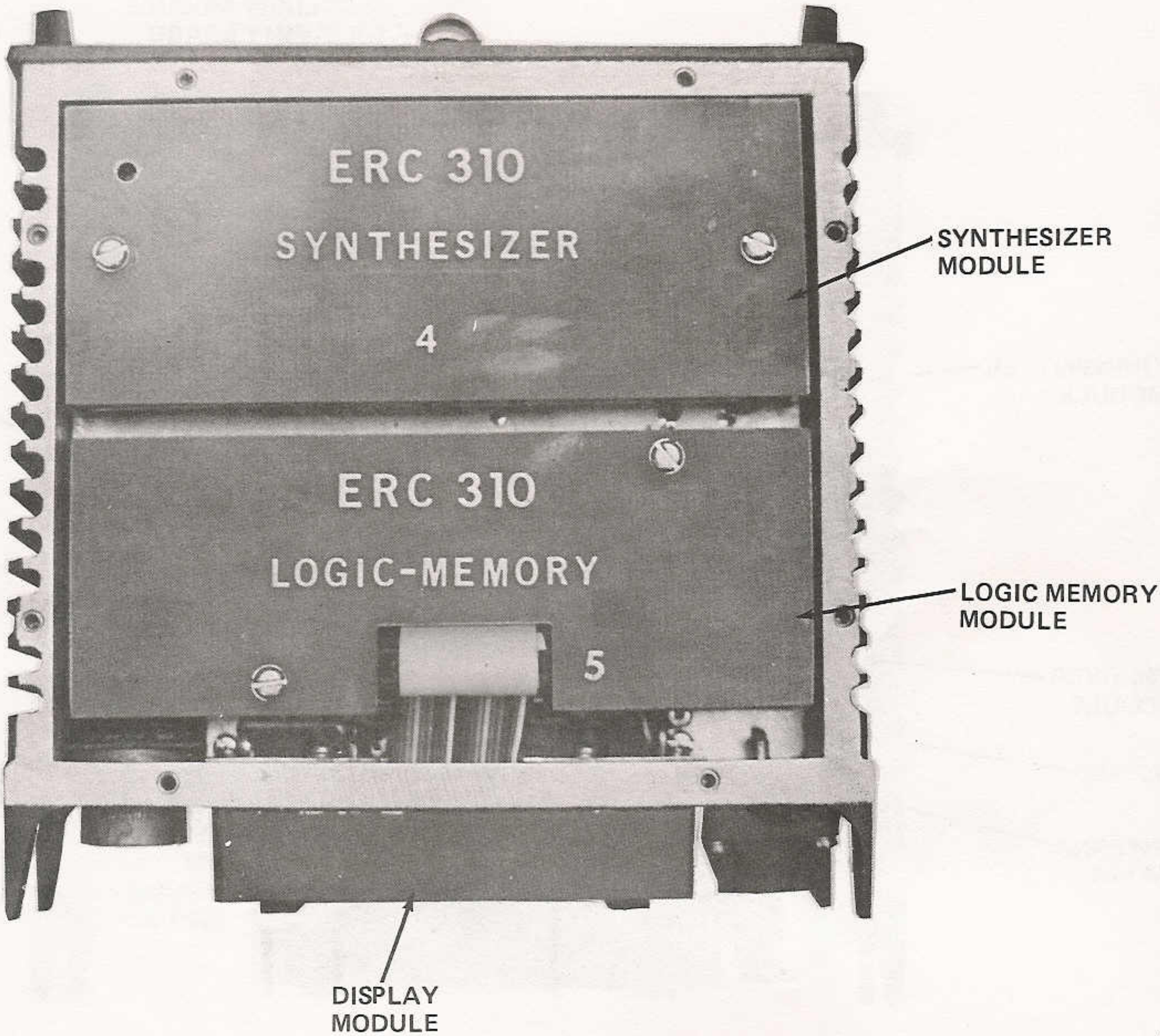


Figure 1-2. ERC-310 Manpack Transceiver, Top View

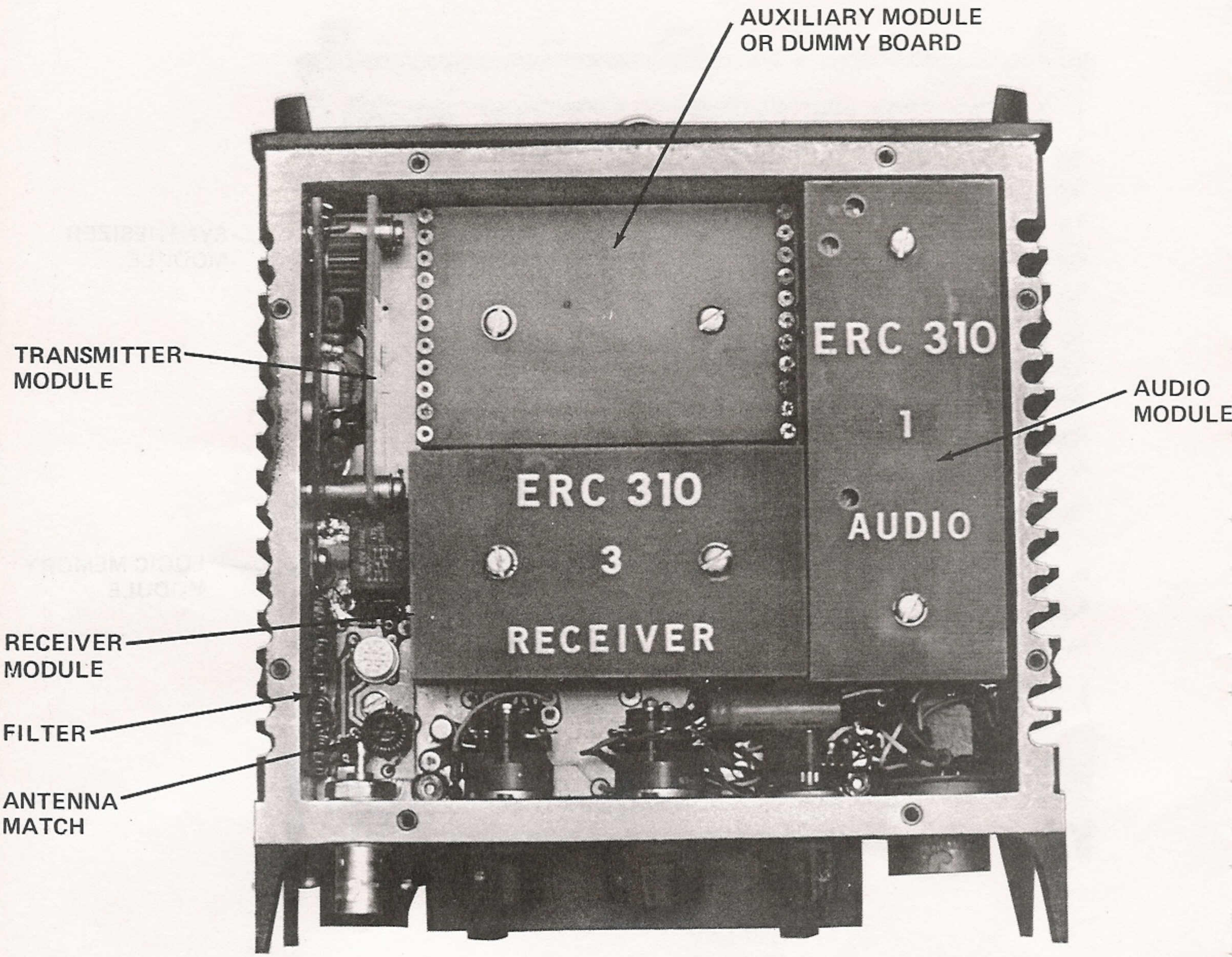


Figure 1-3. ERC-310 Manpack Transceiver Bottom View

1-5. ACCESSORIES

The following accessories are available to provide alternative methods of deploying the ERC-310:

- Carrying Case (webbing and harness)
- External Power Cable (2 meters)
- Headset and Boom Microphone
- Semi-base (Discone) Antenna with Cable (10 meters)
- Rebroadcast Cable (1 meter)
- Field Battery Charger (11-30 volts DC)
- AC Adapter for Field Charger (110-220 volts AC)
- Solar Battery Charger
- Base Station Power Supply Unit (110-220 volts AC)

1-6 REFERENCE DATA

General

Frequency Range	30 to 80 MHz (any 20 MHz segment)
Channel Spacing	25 kHz
Number of Channels	800
Number of Pre-set Channels	3
Mode of Operation	F3, simplex
Frequency Stability	Better than 2.5 kHz
Operating Voltage	10 to 30 VDC
Battery Pack	NiCad; 13.2 VDC – 2 AH
Battery Life	15 hours on a 10:90 Duty Cycle
Configuration	Manpack Vehicular Base Station
Rebroadcast	Via Multicore Cable

Transmitter

RF Power Output	1.5 W min. into 50-ohms @ 10 V increasing to 5.0 W @ 24 V
Spurious Attenuation	>70 dB
Harmonic Attenuation	>60 dB
Modulation Deviation	5 kHz (Voice) 1.5 kHz (Tone)
Modulation Distortion	<8% @ 1 kHz
Modulation Frequency	300 to 2700 Hz within 3 dB
Response	5.4 kHz – 20 dB
Modulation Limiting	Speech Processor with Whisper facility (automatic)
Transmit Current Drain (12V)	800 mA

Receiver

Sensitivity	0.4 uV for 10 dB SINAD
Adjacent Channel Rejection	>75 dB
Image Rejection	>75 dB
IF Rejection	>75 dB
Audio Output	4mW into 600 ohms
Distortion	<8% @ 1 kHz
Receive Current Drain (12V)	80 mA

Mechanical and Environmental

Weight (including battery)	<5-1/2 lbs. (2-1/2 kg)
Temperature Range	-40°C to + 65°C (operating) –55°C to + 75°C (storage)
Humidity	95% R.H. @ 55°C
Altitude	4500 meters (operating) 9000 meters (transport)
Immersion	2 hours @ 1 meter
Vibration	MIL-STD-810
Bumping	DEF-133

CHAPTER 2
SERVICE UPON RECEIPT AND INSTALLATION

CHAPTER 2
SERVICE UPON RECEIPT AND INSTALLATION

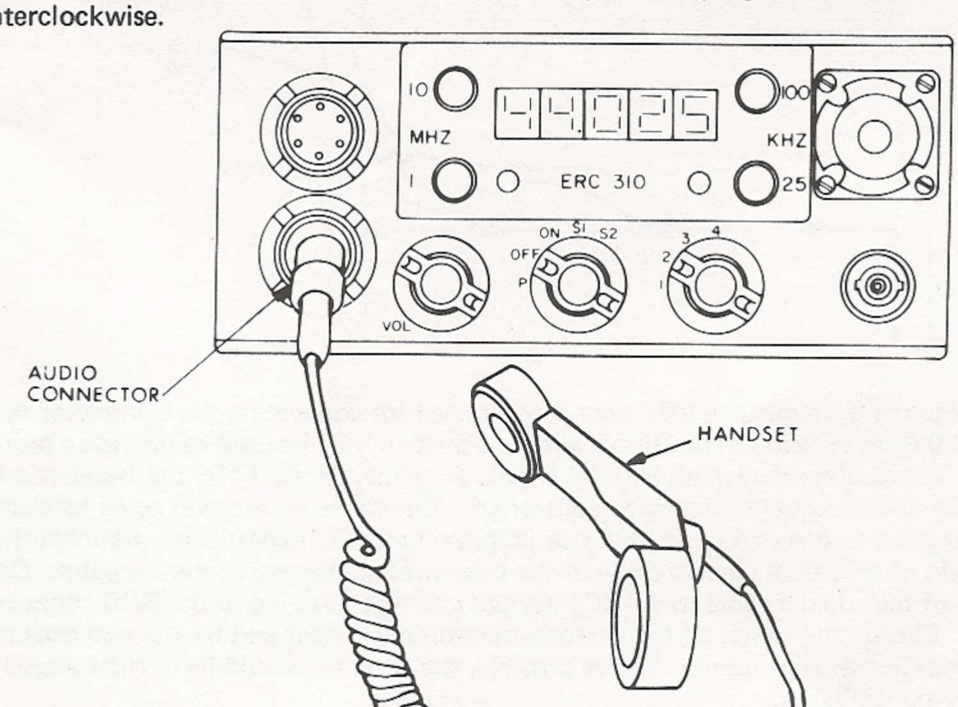
2-1. UNPACKING AND INSPECTION

Immediately upon receipt of the ERC-310, inspect the packing box and the unit for signs of possible shipping damage. Ascertain if the transceiver is performing satisfactorily as outlined in the Operating Instructions, Chapter 3. If the transceiver is damaged or fails to operate properly, file immediate claim with the carrier who is responsible to deliver your shipment undamaged. Failure to check for and report damage immediately may result in monetary loss to you.

It is recommended you keep the shipping carton. In the event storage or reshipment becomes necessary it will come in handy.

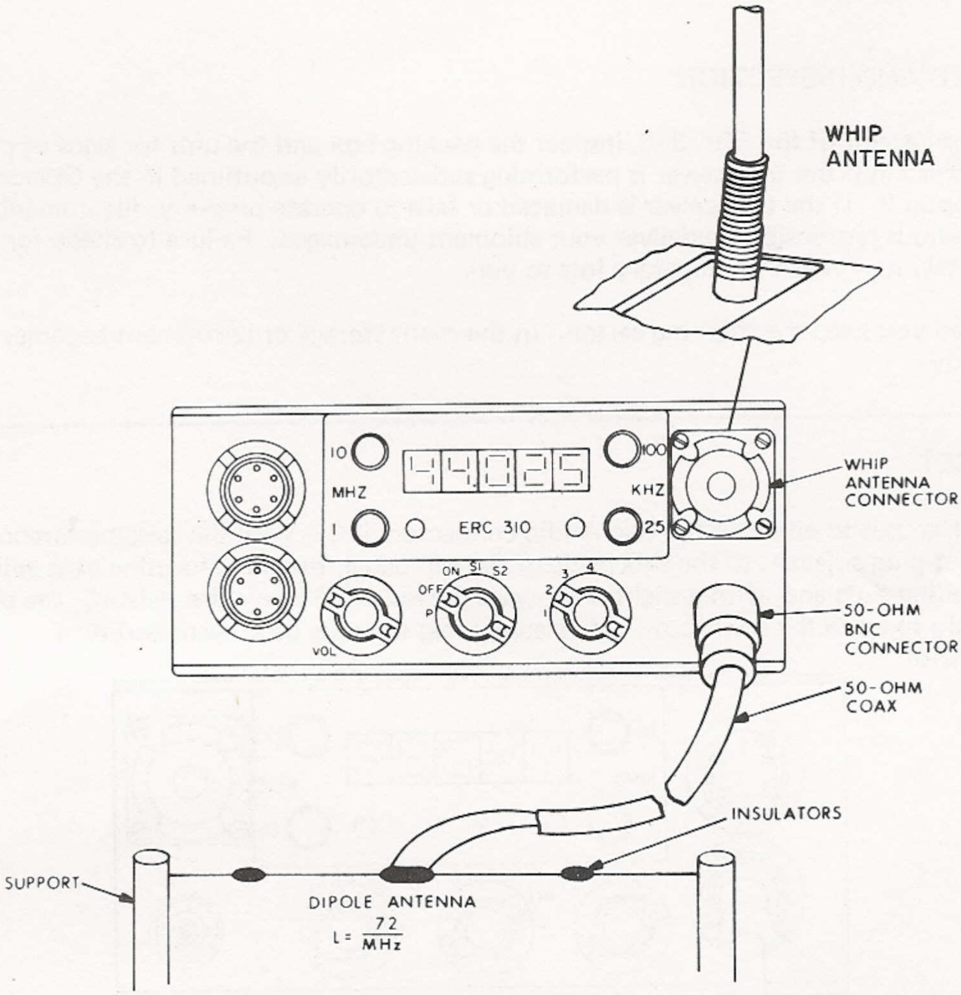
2-2. HANDSET

Connect the Handset to either of the two Audio connectors (10). With the raised reference mark on the Handset plug adjacent to the short side of the top panel, the three locating pegs will fit into the corresponding slots and, with a slight downward pressure and clockwise twisting, the plug will be securely fixed to the connector. To release, press the plug downward and turn counterclockwise.



2-3. ANTENNA INSTALLATION

2-3.1 Whip Antenna. In normal use, a Whip Antenna is inserted into the Whip Antenna connector. Note: At no time should an antenna be connected to both connectors simultaneously.

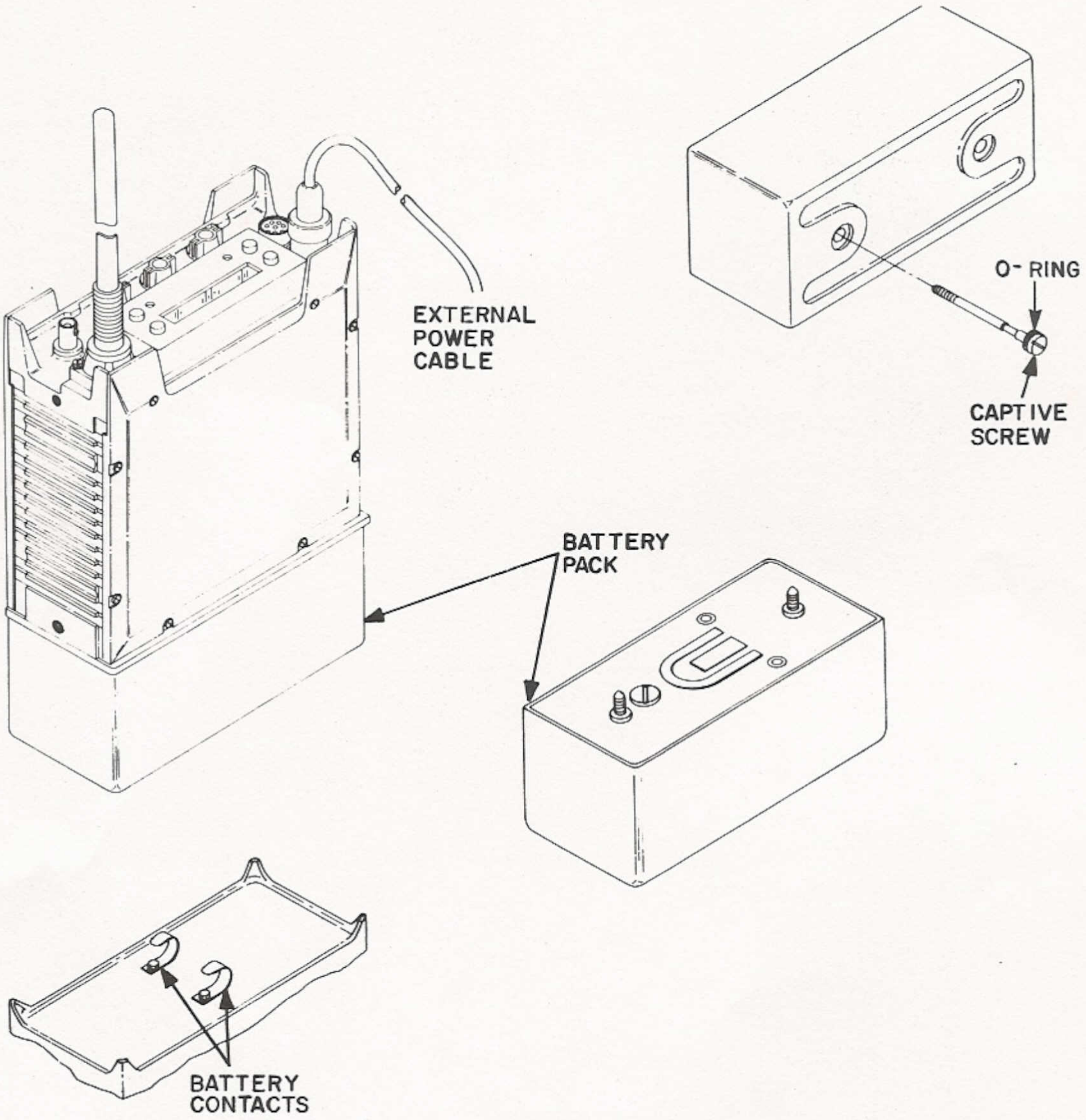


2-3.2 Alternate Antenna System. The BNC connector is used for connecting the transceiver to any other type of 50-Ohm antenna. The Dipole Antenna System may be used to provide a more efficient antenna. To calculate the length and the Dipole Antenna, divide 72 by the frequency in MHz and cut a piece of wire equal to the calculated length. Cut the wire into two equal sections and connect each section to one end of an insulator (approximately 6 inches long). Connect the conductor and shield of a 50-ohm coaxial cable to the two wires connected to the insulator. Connect the other end of the coaxial cable to a BNC plug and connect this plug to the BNC connector on the transceiver. Elevate the center of the antenna to a suitable height and fix the two ends of the antenna to convenient anchor points. Where possible, the antenna should be at right angles to the direction of the transmission.

2-4. POWER REQUIREMENTS

2-4.1 External Power Source. The transceiver can be connected directly to a vehicular or base station 11-30 - volt DC source without a power supply adapter using the external power cable. Connect one end of the cable to either of the two front panel audio connectors as shown below and the other end to the power source.

NOTE: On above 18 VDC cannot be used continuously on transmit.



2-4.2 NiCad Battery Pack. The NiCad Battery pack provides DC voltage for manpack operation of the transceiver. Mate the contacts on the battery pack with battery contacts on rear of transceiver. Secure the captive screw on rear of battery pack.

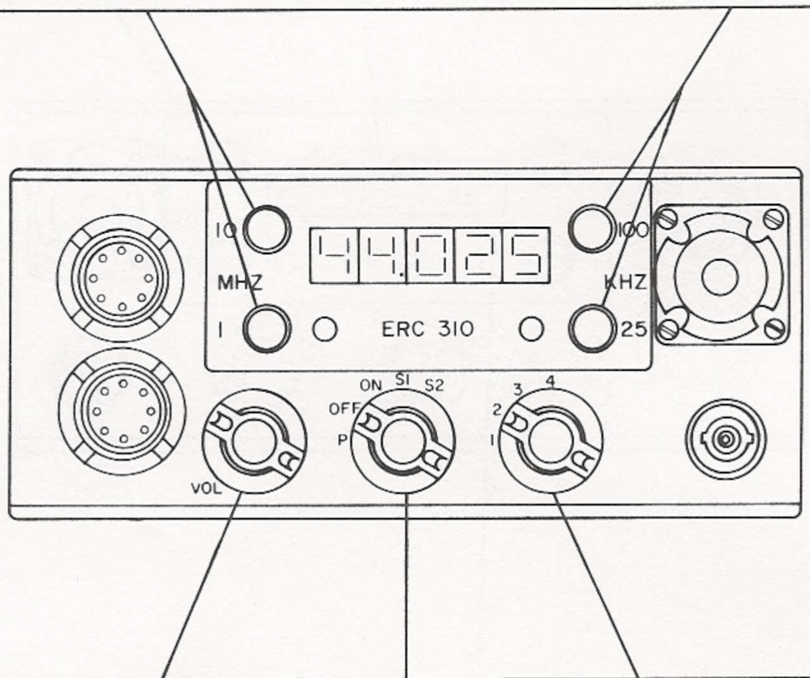
CHAPTER 3
OPERATING INSTRUCTIONS

CHAPTER 3
OPERATING INSTRUCTIONS

3-1. OPERATOR CONTROLS, INDICATORS, AND CONNECTORS

3-1.1 Controls.

Frequency Selection Pushbuttons — Preset transceiver frequency of operation in 10 MHz, 1 MHz, 100 kHz, or 25 kHz steps. Depressing any of the pushbuttons illuminates the display for approximately 5 seconds.



Volume Control — Adjusts receiver audio level.

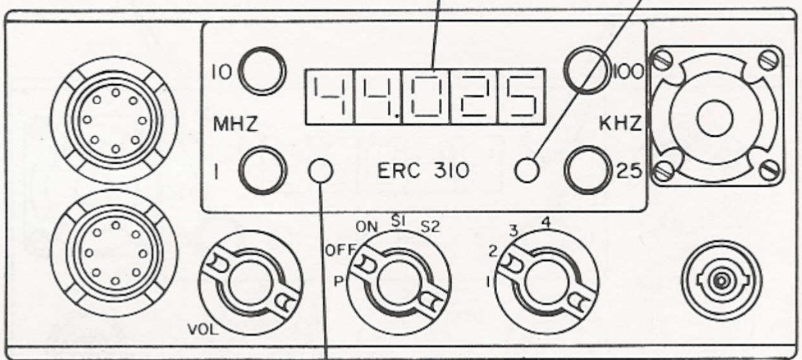
Memory Switch — Selects up to four preset frequencies.

Function Switch — (Program Mode) allows programming up to four specific frequencies into the radio's memory prior to a mission. OFF disconnects radio from the supply voltage. ON allows radio to operate with no squelch. S1 selects tone squelch — audio will be heard if the receiver receives a signal modulated by a 150 Hz tone; otherwise radio remains mute. S2 selects noise squelch — audio will be heard when the RF signal has 6 to 15 dB SINAD (internally presettable); otherwise radio remains mute.

3-1.2 **Indicators and Sensor.**

Battery Condition Indicator – Operates when Display is on to indicate battery condition. Lights to indicate battery state of charge is adequate to assure usable communications. When not illuminated, it indicates that battery is either in a state of discharge or near discharge.

Display – Displays frequency present by Frequency Selection pushbuttons.

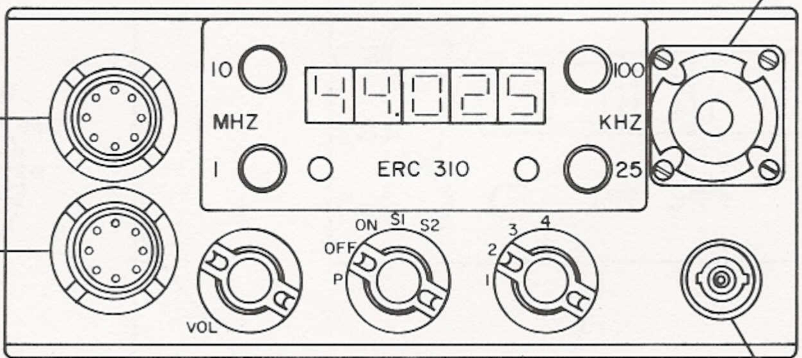


Display Intensity Sensor – Determines display brightness. In strong sunlight, display intensity is increased; in darkness, display intensity is decreased.

3-1.3 Connectors

Audio Connectors — Provides connection to Handset, External Power Cable and Rebroadcast Cable, and other accessories.

Whip Antenna Connector — Provides connection of Whip Antenna.



50-Ohm BNC Connector — Provides connection of Discone, Dipple, or other 50-Ohm Antenna.

3-2 MODES OF OPERATION

The transceiver is capable of operating in the following modes of operation.

a. Normal preset frequency mode of operation

b. Guard channel operation (option)

c. Frequency hopping operation (option).

CHAPTER 4
PRINCIPLES OF OPERATION

CHAPTER 4
PRINCIPLES OF OPERATION

CHAPTER 4
PRINCIPLES OF OPERATION

Section I. TRANSCEIVER OVERALL FUNCTIONING

4-1. INTRODUCTION.

The ERC-310 is a fully synthesized manpack transceiver providing 800 channels, at 25 KHz spacing, of voice communication in any 20 MHz band of the 30 to 80 MHz frequency range. The 20 MHz operating band of the transceiver is factory installed to any desired 20 MHz band between 30 and 80 MHz (i.e., 30-50 MHz, 35-55 MHz, 40-60 MHz, 50-70 MHz, 60-80 MHz, etc.). The transceiver can be supplied with up to three modes of operation: normal preset channel operation is standard; guard channel operation and semi-duplex operation are optional. A factory installed option is available to provide 400 channels at 50 KHz spacing in lieu of the standard 800 channels at 25 KHz spacing.

4-2. TRANSCEIVER OVERALL BLOCK DIAGRAM FUNCTIONING. (See figure 8-1.)

The ERC-310 can be operated from a battery pack or can be connected directly to a vehicular or base station 24-volt DC power source without a power supply adapter. The applicable power source is connected to the audio module which contains the main power supply for the radio and to a voltage regulator on the logic memory module which provides the operating voltage for the logic memory module circuitry and for the display module. External power is applied to the transceiver via one of the front panel Audio connectors. A front panel Battery Condition Indicator lights to indicate that battery charge is adequate to assure usable communications. When not illuminated, it indicates that battery is either in a state of discharge or near discharge.

Prior to using the radio in the normal preset frequency mode of operation, the operator programs up to four specific frequencies into the radio's memory prior to a mission. This is accomplished by placing the Memory Select switch in the program (P) position and using the Frequency Select pushbuttons to enter a specific frequency for each position of the Memory Select switch. When communications on a predetermined channel is desired, the operator then merely selects the preset number on the Memory Select switch and the radio is immediately on the frequency programmed to that position earlier. A factory installed option can provide up to 10 Memory Channels. Actuation of the Frequency Select pushbuttons when the Function Select switch is on any position other than P will not affect the programmed frequencies.

The receiver module contains the entire receiver with the exception of the audio amplifiers. It is broadband, operating between 30 and 80 MHz and limits the operating band to a 20 MHz segment selected by the user. Although operating in the 30 to 80 MHz band, the receiver has been tested to operate virtually flat to 500 MHz.

The audio module is used for both receiver and transmitter functions. On receive the audio module delivers approximatelly 4 milliwatts into a 600 ohm headset. The audio module also includes tone and noise squelch generators, selectable by the Function switch. The ON position of the function switch allows the radio to operate with no squelch. Position S1 of the Function switch selects tone squelch, in which audio will be heard if the receiver receives a signal modulated by a 150 Hz tone; otherwise the radio remains mute. Position S2 of the Function switch selects noise squelch, in which audio will be heard when the RF signal has 6 to 16 dB SINAD signal (internally presettable); otherwise radio remains mute on transmit. The audio module amplifies and clips the audio output from the handset microphone. The signal is then filtered and mixed with a 150 Hz tone to provide sidetone on the transmitted signal. The composite speech and 150 Hz tone signal is applied to a modulator equalizer in the synthesizer module. Auxiliary inputs and outputs are provided on the audio module which are available if delta modulators are used for speech scrambling. Squelch information is also available from the audio module for automatic rebroadcast, or to control the guard channel of the semi-duplex mode.

The frequency synthesizer employs state-of-the art digital technology in a phase-locked loop scheme to control frequency over the selected 20 MHz operating band. The frequency synthesizer module also includes a modulation equalizer which equalizer frequency deviation within ±500 Hz over the 20 MHz frequency band. This represents ±10% when related to the 5 KHz standard deviation. Stability of the synthesizer between -40 and +65^{o}C is better than 2.5 KHz, which is adequate for a 25 KHz channel spacing system.

The transmitter module amplifies the transmit signal from the synthesizer and delivers a minimum of 1.5 watts to the antenna at the rated supply voltage of 12 VDC. When the supply voltage is raised to 24 volts, the power output is approximately 5 watts.

The logic module controls the BCD inputs to the synthesizer. Because of the interface requirements for semi-duplex and guard channel, conventional switches have been replaced with a total electronic frequency entry. Entry of frequency information for normal preset channel operation is accomplished via four Frequency Select pushbuttons located on the display module: 10 MHz, 1 MHz, 100 KHz, and 25 KHz. Depressing any of the pushbuttons illuminates the display for approximately 5 seconds. Pressing the pushbutton causes the 7-segment display to clock through the frequency selections at a rate of three steps per second (in the "P" mode). Releasing the pushbutton causes that particular frequency to be automatically stored in the memory located on the logic Memory module. By use of the four pushbuttons, any frequency within the operating band can be stored in the memory. The memory has four addresses which provides three operating channels and one guard channel or four operating channels.

When considering a type of voice secure system to supply, delta modulation is the prime choice. There are devices on the market today and the trend seems to be that delta modulation becomes more and more viable in personal communications. A delta modulation speed scrambler of a low to medium security level could be provided in the space allocated for the auxiliary module.

When operating in the guard channel mode, memory position 4 is programmed for an emergency or command frequency. When the operator is operating the radio in the normal mode and a signal appears on the guard channel, an audible indication is given to the operator. The operator will break off his normal communication, switch the Memory Select Switch to position 4 and be in immediate contact on the emergency channel. This feature is mainly useful in networks where a tactical net is operational on one frequency and the commander of more than one net allocates a guard channel so he can communicate with all troops simultaneously.

Section II. MAJOR FUNCTION BLOCK DIAGRAM ANALYSIS

4-3. INTRODUCTION

This section provides a block diagram discussion of the radio and is keyed to appropriate major function block diagrams. The discussion is arranged as follows: transmit functioning (paragraph 4-4), receive functioning (paragraph 4-5), frequency selection and display functioning (paragraph 4-6), and frequency synthesizer functioning (paragraph 4-7).

4-4. TRANSMIT FUNCTIONING. (See figure 8-2). The transmit mode of operation is initiated by depressing the push-to-talk (PTT) switch on the handset connected to the front panel Audio connector. This closes a relay in the radio which provides operating voltage to all transmit circuitry and feeds the output of the transmitter module to the antenna via the filter module and antenna match, if applicable. The sequence of operation for the transmit function is described below:

With the PTT switch depressed, the microphone output is applied to a speech compresser on the audio module top board where the compressed audio is amplified and then clipped at 3 dB above the compression level to guarantee that noise peaks which passed through the compressor are not appearing at the modulator. The audio from the speech compressor is then passed through a high pass filter and low pass filter on the audio module bottom board which are used in both the receive and transmit modes. These filters suppress frequencies below 300 Hz and above 2.7 KHz to clean audio signal.

The filtered audio is then fed to a summing network on the audio module top board where it is mixed with a 150 Hz tone generated by the tone squelch circuit. The composite speech and 150 Hz tone signal is applied through the Deviation control to the modulation equalizer on the synthesizer module bottom board. The modulation equalizer acts as a variable resistor which is controlled by the course tune voltage to attenuate the audio used for frequency modulation depending on frequency. This results in an even frequency modulation deviation over the band transmitted on. The coarse tune generator on the synthesizer module top board sets the transmit VCO to the approximate transmit frequency, after which the fine tune phase lock loop takes over.

The PC input from the phase comparator and program counter of the phase lock loop is applied to the transmit VCO via the loop filter. The loop filter filters out sidebands as well as give the loop the required modulation performance. The transmit VCO is also modulated, according to frequency, by the output of the modulation equalizer on the synthesizer module bottom board.

The transmit VCO output is amplified in a broadband amplifier which receives an input from a lock detector on the synthesizer module bottom board (figure 8-3). If an out-of-lock condition exists, the gain of the broadband amplifier is reduced and the radio will not transmit. The output from the broadband amplifier is then fed to the transmitter module via a harmonic filter.

The transmitter module comprises a two-stage broadband amplifier with input and output matching networks. It amplifies the transmit signal from the synthesizer and delivers a minimum of 1.5 watts to the antenna at the rated supply voltage of 12 volts DC. When the supply voltage is raised to 24 volts, the power output is approximately 5 watts.

The transmitter module output is fed through relay contacts to the filter module which is a nine-stage low pass filter. From the filter module, the transmitted signal is either fed directly to the 50 ohm BNC connector or through the antenna match to the whip antenna connector.

4-5. RECEIVE FUNCTIONING. (See figure 8-2.) When the push-to-talk (PTT) switch on the handset is released, the radio is in the receive mode and any signal present on the frequency to which the radio is set will be heard in the handset. The sequence of operation for the receive function is described below:

In normal use, a whip antenna is inserted into the Whip Antenna connector. The signal received by the whip antenna is fed through the antenna match, filter module, and normally closed relay contacts to the receiver module. The radio can also be connected to any other type of 50 ohm antenna. In this case, the received signal is fed directly from the 50 ohm BNC connector to the filter module. The filter module establishes the upper frequency limit of the receiver.

The receiver input is passive, and there is no RF amplification or tuning required. The incoming RF signal to the receiver module passes through a high pass filter which attenuates all frequencies below 30 MHz by a minimum of 60 dB.

Because the receiver will receive any signal between 30 MHz and 500 MHz, the problems of image rejection and two signal jamming received primary consideration in the design. As mentioned earlier, the high pass filter of the receiver module cuts off below 30 MHz which is the lowest operating frequency of the radio. Image rejection is accomplished with the filter module which also serves as the transmitter low pass filter. Both filters, the low pass in the filter module and the high pass in the receiver are Chebishev filters with Cauer parameters. They have slope factors of approximately 1 to 1.11 to provide extremely steep filter skirts. The filter module provides a rejection of 60 dB at 57 MHz and increases to approximately 75 dB at high frequencies.

A classic way of jamming a manpack radio is generation of two jamming signals with a difference between their frequencies equal to the IF frequency of the radio. For example, a signal of 30 MHz and a signal of 57 MHz generates the 27 MHz IF and renders the radio useless for operation. The ERC-310 is immune to this type of jamming because the receiver bandwidth of 20 MHz does not allow two signals with a difference of 27 MHz to enter the receiver. This "anti-jam" technique is an important feature for tactical applications of the radio.

Another major problem which plagues most receivers is that of cross-modulation or inter-modulation. This phenomena, caused by non-linear mixing products in the front end of a receiver, is virtually non-existent in the ERC-310 because of the unique, totally passive front end employed. There is no RF amplification before the first mixer and signals must exceed approximately 100 millivolts which is an unusually high signal level to be encountered, before any non-linearties occur in the mixer.

The filtered RF signal is then mixed in the first mixer with the receiver tuning signal from the frequency synthesizer. The first mixer is a double balanced, low noise Schottky mixer which will not overload until levels exceed -10 dBm. It has a noise figure of 5 dB and an insertion loss of 5.5 dB.

The first mixer is followed by a low noise IF amplifier (27 MHz) with a gain of 9 dB to compensate for the insertion loss of the mixer and the crystal filter which follows the IF amplifier. The 27 MHz crystal filter is a 10-pole, lattice filter, which provides an adjacent rejection (which in this case is 25 KHz) of 75 dB.

The crystal filter is followed by another low noise IF stage of 27 MHz, which has just enough gain to overcome the noise of the second mixer. The second mixer mixes the 27 MHz IF signal down to the second with a crystal oscillator frequency IF of 455 KHz. The 455 KHz signal is then broadband amplified in a two-stage amplifier. The second amplifier, on the receiver module top board, incorporates a quadrature detector. Frequency stability of the second mixer crystal oscillator is not a critical factor because the IF is broadband and the detector circuit will accept a large variation in frequency. This is an important feature, especially over the wide temperature range in which the radio operates. The detected audio signal is then routed to the audio module for further amplification and filtering.

In the audio module, the detected audio signal is fed through a low pass filter and receive preamplifier on the top board, and a high pass filter and low pass filter, on the bottom board. The high pass and low pass filters are used in both the receive and transmit modes. On receive, all frequencies below 300 Hz are attenuated by the high pass filter. The 150 Hz sub-carrier squelch tone is attenuated by approximately 36 dB so it becomes nearly inaudible. This is a distinct improvement over other military radios where the 150 Hz tone in the headset is quite disturbing. The low pass filter limits the upper frequency of the audio and its 3 dB point is at 2.7 KHz, rolling off to provide an attenuation at of 24 dB at 5.4 KHz.

The bias voltage for the high pass filter, low pass filter, and audio amplifier on the audio module bottom board is provided by a bias generator on the audio module top board. The audio module top board also contains two independent squelch systems, a 150 Hz tone squelch and a noise squelch. The noise squelch, which operates on a signal to noise ratio, is internally preset. Also, to be unaffected by modulation, the noise squelch circuitry operates on noise above 5 KHz only. The 150 Hz tone squelch activates the receiver when the noise squelch is tripped and the presence of a 150 Hz tone is detected.

The squelch gate on the audio module bottom board controls selection of the desired squelch and controls rebroadcast switching. Selection of no squelch or noise/tone squelch is made by the Function switch as follows: ON position allows the radio to operate with no squelch; position S1 selects tone squelch ; and position S2 selects noise squelch.

The filtered signal is fed through the volume control to an audio amplifier, on the audio module bottom board, which delivers approximately 4 milliwatts into a 600 ohm headset. The volume control adjusts the receiver audio level.

The coarse tune generator on the synthesizer module top board sets the receive VCO to the approximate receive frequency, after which the fine tune phase lock loop loop takes over. The receive VCO oscillator 27 MHz higher than the transmit VCO.

The DC input from the phase comparator in the program counter of the phase lock loop is applied to the receive VCO via the loop filter. The receive VCO output signal is amplified to a level of approximately 1 milliwatt by a broadband amplifier. The receive tuning signal is then passed through a high pass filter which filters out any spurious signal which would fall on the receive band and a matching network which provides a reasonable match to the first mixer in the receiver module.

4-6. FREQUENCY SELECTION AND DISPLAY FUNCTIONING. **(See figure 8-3.)** Frequency selection and the display of selected frequency by the radio is accomplished as follows:

Entry of frequency information for normal preset channel operation is accomplished by four Frequency Select pushbuttons - 10 MHz, 1 MHz, 100 KHz, and 25 KHz - located on the display module. The Frequency Select pushbuttons control the operation of a clock circuit on the logic memory bottom board which is clocked by a 3.125 KHz clock from the synthesizer. The clock generator generates an Enable which controls on/off time of the display, via a strobe generator on the logic memory top board, and feeds selected frequency into the memory via a synthesizer divider which is slaved to the memory.
By use of four pushbuttons, any frequency within the operating band of the radio can be stored in the memory.

"Writing" of frequency information into the memory can only be accomplished with the Function switch in the Program (P) position. With the Function switch in the P position, depressing a pushbutton causes frequency select information to be clocked into the memory at a rate of three steps per second. Releasing the pushbutton causes that particular frequency to be automatically stored in the memory.

The memory has four addresses, selected by the Memory switch, which provides three operating channels and one guard channel or four operating channels. When operating on one of the preset frequency positions, operation of the frequency select pushbuttons does not affect the stored information. Frequencies are changed only when the program (P) mode has been selected by the Function switch.

The size of the Memory can be increased to 10 channels at the factory. When the radio is switched off, the memory will stay alive for approximately six months by small NiCad batteries integral to the module.

The frequency select information entered into the memory is applied simultaneously to the synthesizer (paragraph 4-7) and to the display control on the logic memory top board, which controls the BCD inputs to the display. When any of the Frequency Select pushbuttons is depressed, the strobe generator provide a strobe to the BCD. Seven segment decodes which causes the frequency selected to be displayed for approximately 5 seconds.

The ERC-310 uses intensity modulation to adjust display brightness to the ambient light conditions. This is accomplished by the use of an LDR light sensor control the strobe pulse width of the display.

4-7. FREQUENCY SYNTHESIZER FUNCTIONING. (See figure 8-3.) The frequency synthesizer is a single loop, downconversion type synthesizer which employs state-of-the-art techniques such as separate transmit and receive VCO's, two offset crystal oscillators for down mixing, and pre-tune information which is generated out of the loop. The sequence of operation for the frequency synthesizer function is described below:

As shown in figure 8-2, the synthesizer uses two separate VCO's, one for transmit and one for receive. The transmit VCO generates any desired frequency between 30 and 80 MHz in 20 MHz segments. The receive VCO provides any frequency between 57 and 107 MHz. After passing through the transmit or receive function broadband amplifier, the signals are summed and amplified on the synthesizer top board. The transmit or receive VCO signal, as applicable, is then mixed down by mixing with a transmit or receive crystal oscillator which oscillates 3 MHz lower than the lowest VCO frequency to generate a frequency between 3 and 23 MHz.

The mixed signal is then passed through a low pass filter which filters the downmixing product from the double balanced mixer and feeds the signal "D" to the synthesizer bottom board.

On the synthesizer bottom board, the downmixed signal is fed to an input transformer which applies a balanced signal to the linear amplifier. The linear amplifier amplifies the downmixed signal to a logic level. The limiter limits the level of the signal to the ÷8 prescaler so that it does not exceed logic level.

The ÷8 prescaler divides the downmixed 3 to 23 MHz signal by eight to provide a 375 KHz to 2.875 KHz signal to the ÷ N prescaler. The signal results in 800 channels at 25 KHz spacing for the 20 MHz band selected.

The ÷ N prescaler is especially designed for synthesizer applications and is programmed with the program lines from the selection function (paragraph 4-6.) The resultant 3.125 KHz output of the ÷ N prescaler is the final loop frequency. This signal is compared in a phase comparator and quadrature detector with a 2.5 MHz reference signal provided by a 5 MHz crystal reference oscillator and a ÷2 reference prescaler. The PC (phase comparator) signal is used to fine tune the transmit and receive VCO's, via the loop filter on the synthesizer top board (figure 8-2). The 3.125 KHz output is the clock signal which is used by the frequency select function (paragraph 4-6). The phase comparator and quadrature detector also provides an output to the lock detector and amplifier and generates a signal which reduces transmitter power output if an out-of-lock condition exists.

4-8. POWER REQUIREMENTS. The ERC-310 can operate either from the 13.2 VDC, 2AH battery pack or can be connected directly to a vehicular or base station 11 to 30 volt DC source without a power supply adapter using the external power cable.

4-9. POWER SUPPLY AND DISTRIBUTION. (See figure 8-4).

4-10. INPUT POWER. The battery pack voltage or the voltage from the external power source is applied through contacts of relay K1 to Function switch S1-A. From the Function switch, the voltage is applied to the audio module, and the logic memory module.

4-11. MAIN POWER SUPPLY. The main power supply for the radio is located on the audio module. It uses a μA78 voltage regulator, U3, which is preset to provide an output voltage of +9VDC at pin 1. This regulated +9VDC is the operating voltage for all circuits of the radio except the circuits on the logic memory module and the display. The voltage at pin 1 of U3 is set at +9VDC by R1, R2, R35, and R36. The output voltage is filtered by C3, C4, R3, and C22.

4-12. LOGIC MEMORY MODULE POWER SUPPLY. The logic memory module uses a μA78 voltage regulator, U7, to provide regulated +9VDC to the logic memory module and to the display. The battery input voltage is applied to pin 4 of U7 via an input filter comprising RFC1, C2, C3, and C4. The output voltage from pin 1 is filterd by RFC4, C7, C8, and C9. Resistors R15 and R16 set the output voltage at +9VDC. Battery voltage is sensed by U1A, one gate of a Schmitt trigger NAND gate, which is set by R2 to trigger at +11 VDC. Thus, if the battery voltage is above +11 VDC, the Battery State Indicator on the display module will light. If the battery voltage is below +11 VDC, the Battery State Indicator will be extinguished.

4-13. SCHOTTKY VOLTAGE REGULATOR. The low power Schottky voltage regulator on the synthesizer module bottom board is the only circuit in the radio that does not operate from +9 VDC. The +9 VDC regulated voltage from the audio module is dropped to +5 VDC by diode D1 on the synthesizer module bottom board and provided to the Schottky prescaler via RFC2.

Section IV. CIRCUIT ANALYSIS

4-14. GENERAL

Paragraphs 4-15 and 4-16 describe the system logic and unique logic elements used in the radio. Paragraphs 4-18 through 4-25 provide a circuit analysis of each module. The descriptions in these paragraphs are keyed by means of a number to the corresponding functional circuit on the referenced schematic diagram. Paragraph 4-18 provides a detailed circuit analysis of the overall radio and of each individual module.

4-15. SYSTEM LOGIC

The ERC-310 uses the positive voltage level (+5 volts or +9 volts) as the logical "1" state (high level) and ground level as the logical "0" state (low level). Although the logical "0" state is said to be ground or zero volt, the level is usually within 0.4 volt of zero. If any signal is at the logical "1" state or "high", the reverse or complement of the signal is "0" or low.

4-16. UNIQUE LOGIC ELEMENTS

Figure 8-5 gives logic symbols, truth tables, and other descriptive information for each unique logic element used in the radio.

4-17. ERC-310 TRANSCEIVER. (See figure 8-6.)

Paragraphs 4-18 through 4-25 provide a detailed circuit analysis of each module comprising the radio. Items not mounted on modules are either mounted on the motherboard or the front panel. The motherboard has only the receiver/transmit switch relay, the external power relay, and some decoupling and circuit protection as active circuitry. Otherwise, it is only the sockets for module pins. The front panel mounts the audio connector, 50-BNC connector, VOL (volume) control, Memory switch, and Function switch. Refer to Chapter 3, for a description of front panel controls, indicators and connectors.

Connection to the handset, external power source, and rebroadcast cable are made via the Audio connector. When the handset PTT switch is depressed, the receive/transmit relay (K2) is energized. This provides operating power to the transmit circuits of the radio. With the PTT switch released, the normally closed contacts of K2 provides operating power to the receive circuits of the radio.

Relay K1 is the external power relay, and is energized when an external power source is used. If not energized, the battery voltage is routed through the relay contacts to the power supplies on audio module and logic memory module.

Transister Q1 is a transistor switch which is switched by the logic memory module when the 10 MHz Frequency Select pushbutton is depressed. This switches the tap on the torrid coil of the antenna match.

4-18. AUDIO MODULE 1. The audio module is of two board construction. It is used for both transmit and receive functions. Refer to paragraphs 4-18.1 and 4-18.2 for a description of audio module top and bottom boards, respectively.

4-18.1 Audio Module Top Board. (See figure 8-7). The audio module top board contains two independent squelch systems (a 150 Hz tone squelch and a noise squelch), a bias generator, the compressor for the microphone (which has a whisper facility), a low pass filter, and the receive preamplifier.

1. **Tone Squelch Circuit.** The tone squelch circuit, consisting of Q3 and U2-5, -6, -7, is operational during both receive and transmit modes of operation. Q3 is a selective 150 Hz amplifier. During transmit, Q3 oscillates at a 150 Hz rate due to internal feedback. The 150 Hz tone is fed through potentiometer R17 to a summing network, R22 and R23, where it is mixed with the MOD AUDIO IN signal from the audio module bottom board and WIDEBAND input from the AUXILIARY MODULE (if used). The resultant combined speech and 150 Hz signal is fed through Deviation R24. The MOD OUT signal is fed to the modulation equalizer on the snythesizer module bottom board. During receive, the +9V RX input to the circuit lowers the gain and Q of Q3 and oscillations stop. Incoming 150 Hz tones will then be selectively amplified by U2-5, -6, -7 and rectified by a voltage doubler comprising D2, D3. The TONE output from the voltage doubler is fed to the receive squelch gate on the audio module bottom board. The 150 Hz tone squelch activates the receiver when the noise squelch is tripped and the presence of a 150 Hz tone is defected.

2. **Noise Squelch Circuit.** The noise squelch circuit, consisting of U2-8, -9, -10, operates on the signal-to-noise ratio of the signal provided by the receive preamplifier. The noise squelch circuit is a tuned filter with a frequency selectivity of approximately 9 KHz, determined by the combination of C13, C14, and R19. It amplifies noise (above 5 KHz only) but is unaffected by speech signals. The output of U2-8, -9, -10, which is the limiting amplifier for the noise signal, is rectified by a voltage doubler comprising D4 and D5. The noise squelch signal is then fed to the receive squelch gate on the audio module bottom board. The noise squelch threshold is preset by R21.

3. **Bias Generator.** The bias generator, consisting of U2-12, -13, -14, supplies a fixed DC bias voltage (VCC/2) to the audio module bottom board.

4. **Speech Compressor.** The speech compressor consisting of U3-5, -6, -7, operates as a high gain amplifier for the microphone signal. Transistors Q1 and Q2, connected between the output (pin 7) and input (pin 5) of U3 acts as a variable voltage divider on the input. The dynamic range of the compressor is as follows: 3 MV (2 dB compression), 8 MV (full compression), 1V (0 dB), with 8 MV compared with 0 dB. The AUDIO OUT signal present at U3-7 is fed to the high pass filter on the audio module bottom board.

5. **Low Pass Filter.** The low pass filter, consisting of C2, C3, C24, and R1, limits the upper frequency of the receive audio (RX IN) and its 3 dB point is at 2.7 KHz, rolling off to provide an attenuation of 24 dB at 5.4 KHz. The filtered audio is applied to the noise squelch circuit and the receiver preamplifier.

6. **Receive Preamplifier.** The receive preamplifier, U2-1, -2, -3, amplifies the filtered receive audio from the low pass filter and feeds the amplified AUDIO OUT signal to the high pass filter on the audio bottom board. The WIDEBAND OUT signal from the receive preamplifier is fed to the auxiliary module.

4-18.2 Audio Module Bottom Board. (See figure 8-9). The audio module bottom board contains a clipping circuit, high pass filter, low pass filter, receive squelch gate, audio amplifier, rebroadcast switching circuit, and a voltage regulator.

① **Clipping Circuit.** The clipping circuit, consisting of D1 and D2, limits the input audio signal to 0.7V to clip off noise peaks or speech peaks.

② **High Pass Filter.** The high pass filter, consisting of the first two stages of U1, receives audio either from the receive preamplifier (receive mode) or the speech compressor (transmit mode) on the audio module top board. The high pass filter has a cutoff frequency of 300 Hz and approximately 26 dB attenuation at 150 Hz. On receive, all frequencies, below 300 Hz are attenuated by the high pass filter. The 150 Hz subcarrier squelch tone is attenuated by approximately 36 dB so it becomes nearly inaudible. This is a distinct improvement over such military radios where the 150 Hz tone in the headset is quite disturbing . On transmit, the high pass filter suppresses frequencies below 300 Hz and above 2.7 KHz to provide a clean audio signal.

③ **Low Pass Filter.** The low pass filter, consisting of the third stage of U1, is an active low pass filter which limits the upper frequency of the audio. Its 3 dB point is at 2.7 KHz, rolling off to provide an attenuation of 24 dB at 5.4 KHz. The low pass filter is controlled or switched off by the receiver squelch gate. In transmit mode, the MOD AUDIO OUT of the low pass filter is fed to the modulation equalizer on the synthesizer module bottom board. In receive mode, the audio output from the low pass filter is fed through the VOLUME control to the audio amplifier.

④ **Receive Squelch Gate.** The receive squelch gate circuitry consists of a transistor switch, Q2, which controls the low pass filter and a Schmitt trigger, U2, which controls operation of Q2 and the rebroadcast switching circuit. When enabled by appropriate tone squelch (T/S) or noise squelch (N/S) inputs selected by the Function switch, the Schmitt trigger operates the transistor switch when incoming squelch information (TONE or NOISE) from the audio module top board is above a preset level. During transmit mode, diode D3 is connected to +9 VTX, thereby inhibiting the rebroadcast function.

⑤ **Audio Amplifier.** The fourth section of U1 (U1-8, -9, -10) operates as an audio amplifier. During receive mode, this amplifier delivers approximately 4 milliwatts into a 600-ohm headset. On transmit, this amplifier generates the side tone. During transmit mode, Q3 reduces the gain of the audio amplifier by approximately 10 dB. Frequency response of the total active filter and audio section is as follows:

150 Hz (-26 dB), 300 Hz (-3 dB),
400 Hz (0 dB), 1000 Hz (0 dB),
1500 Hz (0 dB), 2000 Hz (0 dB),
2.4 KHz (-1 dB), 2.7 KHz (-3 dB),
5.4 KHz (-22 dB)

(6) **Rebroadcast Switching.** The rebroadcast switching circuit uses an open collector transistor switch, Q1, to operate the receive-transmit switch in the other radio. Diode D3 inhibits the rebroadcast function during the transmit mode.

(7) **Voltage Regulator.** Voltage regulator U3 is the main power supply for the radio. It is preset to provide an output voltage of +9VDC at pin 1. The regulated +9VDC is the operating voltage for all circuits of the radio except the circuits on the logic memory module and the display. The voltage at pin 1 of U3 is set at +9VDC by R1, R2, R35, and R36. The output voltage is filtered by C3, C4, R3, and C22.

4-19. TRANSMITTER MODULE 2. (See figure 8-11.) The transmitter module is of single board construction. It is used for the transmit function only and contains an input matching network, broadband amplifier, VMOS amplifier, and output matching network. The transmitter module has been tested between frequencies of 30 MHz and 200 MHz and its amplitude is practically flat.

(1) **Input Matching Network.** The input matching network, consisting of R1, R2, R3 and C1, provides an impedance match between the transmit harmonic filter on the synthesizer module bottom board and the transmitter module input.

(2) **Broadband Amplifier.** The driver stage of the transmitter uses a standard class B broadband silicon transistor Q1. The bias for this stage is provided by the combination of D1 and R4. The output signal from the broadband amplifier is fed into the VMOS stage.

(3) **VMOS Amplifier.** The power output stage of the transmitter uses a vertical MOS (VMOS) power transistor, Q2, which has profound advantages when used as a broadband amplifier. It basically operates as a vacuum tube with extremely good broadband capabilities while exhibiting good broadband noise performance. There are other advantages when using a VMOS device. First, the transistor is immune to damage by antenna mis-match. Mis-matches from short circuit to open circuit, over all phase angles, will cause no damage to the power amplifier. Therefore, antenna protection circuitry is not necessary. Another advantage of VMOS is that the supply voltage can vary between 10 volts and approximately 35 volts. Use of this type of device permits the radio to be connected directly to a vehicle battery (24 VDC) without the use of a power supply unit. The power amplifier is connected directly, while all other circuitry in the radio is powered by internal voltage regulators. The power output of the radio increases to approximately 5 watts in this configuration without the necessity for re-tuning. The VMOS stage is biased by R6, R7, and R8 to approximately 450 milliamperes at quiescent current. The VMOS stage is neutralized to give better performance.

(4) **Output Matching Network.** The output impedance of VMOS stage Q2 is transferred to 50 ohms by transformer T2 and the combination L1/C10.

4-20. RECEIVER MODULE 3. The receiver module is of two band construction. It is used for the receive function only. The receive module is broadband, operating in any 20 MHz operating band between 30 and 80 MHz. The module contains the entire receiver, with the exception of the audio amplifiers, and employs double conversion with a first IF of 27 MHz and a second IF of 455 MHz. Although operating in the 30 to 80 MHz band the receiver has been tested and is virtually flat to 500 MHz. Refer to paragraphs 4-20.1 and 4-20.2 for a description of receiver module top and bottom boards, respectively.

4-20.1 Receiver Module Top Board. (See figure 8-13.) The receiver module top board contains a high gain amplifier and quadrature detector U1, which amplifies and detects the 455 KHz IF signal from the receiver module bottom board. The detected output is fed to the low pass filter on the audio module bottom board. Alignment of this stage is accomplished by adjusting indicator L1 for maximum output.

4-20.2 Receiver Module Bottom Board. (See figure 8-15.) The receiver module bottom board contains a high pass filter, broadband double balanced mixer, three IF amplifier stages, a crystal filter, and a crystal oscillater.

1. **High Pass Filter.** The high pass filter, consisting of L1, L2, L3, C1-C10, attenuates all frequencies below 30 MHz by a minimum of 60 dB and in the case of the IF (27 MHz), attenuation is 65 dB.

2. **First Mixer.** The first mixer, U1 is a double balanced, low noise TFM-2 Schottky mixer which mixes the received signal with the receiver side of the synthesizer. The output of the first mixer is fed to the first 27 MHz IF amplifier. This particular mixer has a noise figure of 5 dB and an insertion loss of 5 dB. It will not overload until levels exceed 10 dBm.

3. **First IF Amplifier.** The first IF amplifier, Q1, is a low noise 27 MHz amplifier which has a gain of 9 dB to compensate for the insertion loss of the first mixer and the crystal filter which follows the amplifier. The device used in this stage is a low noise, field effect transistor (FET). The source of Q1 is tuned by the combination L4, C4, and C15 which provides matching to the crystal filter.

4. **27 MHz Crystal Filter.** The 27 MHz crystal filter, U2, is a 10-pole, lattice filter which provides an adjacent channel rejection (which in this case is 25 KHz) of 75 dB. The crystal filter is followed by the second IF amplifier.

5. **Second IF Amplifier.** The second IF amplifier, Q2, is another low noise 27 MHz IF amplifier, which has just enough gain to overcome the noise of the second mixer. The source of Q2 is tuned by L5 and C18.

6. **Second Mixer.** The second mixer, Q3, is a dual gate MOSFET which mixes the 27 MHz IF signal with a 27.455 MHz signal generated by the crystal oscillater to produce the second IF signal of 455 KHz. The 455 KHz IF signal is then fed to the third IF amplifier.

7. **Third IF Amplifier.** The third IF amplifier U3, is part of a broadband two-stage 455 KHz amplifier. The second stage of this IF amplifier is on the receiver module top board and includes a quadrature detector. The output of U3 is tuned to 455 KHz by T3 and fed to the top board.

8. **Crystal Oscillator.** The crystal oscillator, consisting of Q4 and X1, generates a crystal controlled 27.455 MHz signal which is mixed in the second mixer with the 27 MHz IF signal. Frequency stability of the second mixer crystal oscillator is not a critical factor because the IF is broadband and the detector circuit will accept large variations in frequency. This is an important feature, especially over the wide temperature range in which the radio operates.

4-21. SYNTHESIZER MODULE 4. The synthesizer module is of two board construction. It is used for both transmit and receive functions. The synthesizer module employs state-of-the-art techniques such as separate voltage controlled oscillators (VCOs) and offset crystal oscillators to achieve the low current drain required by small personal radios. It is a single loop synthesizer which uses the down mixing principle in order to allow the use of CMOS throughout. The only exception is the use of a low power Schottky pre-scaler. Refer to paragraphs 4-21.1 and 4-21.2 for a description of synthesizer top and bottom boards, respectively.

4-21.1 Synthesizer Module Top Board. (See figure 8-17). The synthesizer module top board is the analog board of the module, containing the loop filter, separate VCOs for transmit and receive, transmit broadband amplifier and harmonic filter, receive broadband amplifier and high pass filter, a receiving matching network, summing network, broadband amplifier, down mixer, filter, and transmit/receive crystal oscillators.

① **Loop Filter.** The loop filter, consisting of R1, R2, R3, R5, R6, R7, C1, C2, C4, and C5, filters out sidebands and gives the loop the modulation performance. A voltage taken from the junction of R4/C3 is applied to the course tune generator. The PC input is the fine tune input from the phase lock (synthesizer) loop.

② **Course Tune Generator.** The course tune generator consists of dual operational amplifier, U1. A voltage from the junction of R4/C3 in the loop filter will produce an output from the course tune generator which pretunes the transmit and receive VCOs to approximate frequency. After this, the fine tune input (PC) from the phase lock loop takes over.

③ **Transmit VCO.** Transistor stage Q1 is the VCO for the transmit section of the radio. Its frequency is controlled by the combination of inductor L1 and three varicaps, D1, D2, and D3. D1 is the fine tune varicap and receives its input from the phase lock loop via the loop filter. D2, in response to the MOD IN input from the modulation equalizer on the synthesizer module bottom board, frequency modulates the VCO with the audio signal. D3 is the course tune varicap and receives its input from the course tune generator. The output of Q1 is fed to transmit broadband amplifier Q2, Q3.

④ **Transmit Broadband Amplifier.** The transmit broadband amplifier, Q2 and Q3, is a two-stage broadband amplifier which amplifies the signal from the transmit VCO and feeds the amplified signal to the transmit harmonic filter. Transistor Q3 receives a LOCK DET input from the lock detector on the synthesizer module bottom board. If the radio is out-of-lock, the LOCK DET input will reduce the gain of Q3 and the transmit function will be inhibited.

⑤ **Transmit Harmonic Filter.** The transmit harmonic filter, consisting of L3, C36, L4, and C38, reduces the harmonics from the transmit signal fed to the transmitter module. TX OUT is the output to the transmitter module.

⑥ **Receive VCO.** Transistor stage Q6 is the VCO for the receive section of the radio. Its frequency is controlled by the combination of inductor L2 and two varicaps, D4 and D5. D4 is the course tune varicap and receives its input from the course tune generator. D5 is the fine tune varicap and receives its input from the phase lock loop via the loop filter. The output of Q6 is fed to receive broadband amplifier Q7. (The receive VCO frequency is 27 MHz higher than the transmit VCO.)

(7) **Receive Broadband Amplifier.** The receive broadband amplifier, Q7, amplifies the received signal to a level of approximately 1 milliwatt.

(8) **High Pass Filter.** The high pass filter, consisting of L5, L6, C50, C52, and C54, filters out any spurious signals which fall in the receive band.

(9) **Receiver Matching Network.** The receiver matching network, consisting of R46, R47, and R48, provides a reasonable match of the synthesizer module to the receiver module. The RX OUT is output to the receiver module.

(10) **Summing Network.** The summing network, consisting of R33 and R35, combines the output of Q2 (transmit) and Q7 (receive) and feeds the combined signal to the broadband amplifier, Q4/Q5.

(11) **Broadband Amplifier.** The broadband amplifier, consisting of Q4 and Q5, amplifies the signal from the summing network to a level sufficient to minimize spurious products. The amplified signal is fed to the down mixer, U2.

(12) **Down Mixer.** The down mixer, U2, uses a TFM-2 double balanced mixer to mix the combined receive/transmit signal from broadband amplifier Q5 with the output of crystal oscillator Q9 (transmit) or crystal oscillator Q8 (receive). The output of U2 is fed through a low filter to the output.

(13) **Low Pass Filter.** The low pass filter, consisting of L9, L10, C63, C64, and C65, filter the down mixing product from the double balanced mixer and feeds the signal "D" to the synthesizer bottom board. The frequency of this signal is 3 to 23 MHz.

(14) **Transmit Crystal Oscillator.** The transmit crystal oscillator, consisting of X1 and Q9, provides a 27 MHz output to the down mixer.

(15) **Receive Crystal Oscillator.** The receive crystal oscillator, consisting of X2 and Q8, provides a 54 MHz output to the down mixer.

4-21.2 Synthesizer Module Bottom Board. (See figure 8-19.) The synthesizer module bottom board contains all logic circuitry of the synthesizer module. It contains an input transformer, linear amplifier, limiter, ÷8 prescaler, ÷N prescaler, an adder, a reference oscillator, a reference prescaler, phase comparator and programmable counter, lock detector and amplifier, Schottky voltage regulator, and a modulation equalizer.

(1) **Input Transformer.** Input transformer T1 receives the mixed down 3 to 23 MHz signal, D, from the synthesizer top board and applies a balanced signal to the linear amplifier.

(2) **Linear Amplifier.** Linear amplifier U9 is an operational amplifier which amplifies the mixed 3 to 23 MHz signal, D, to a logic level. The amplified signal from U9 is applied to the prescaler.

(3) **Limiter.** Diodes D2, D3, and D4 limit the level of the signal to the Schottky prescaler, U7, so as not to exceed logic level.

(4) **Divide-By-Eight Prescaler.** Comprises a divide-by-four Schottky prescaler, U7A and U7B, and a CMOS divide-by-two prescaler, U6A, to divide the down mixed 3 to 23 MHz frequency by eight. The resultant 375 KHz to 2.875 MHz signal from U6A is fed to the divide-by-N counter. The divide-by-four prescaler, U7A and U7B, uses low power Schottky J-K flip-flops to generate the speed required. The divide-by-two prescaler, U6A, is a CMOS prescaler.

(5) **Divide-By-N Prescaler.** The divide-by-N prescaler, U1, is a divide-by-N counter chip designed for counter applications. This chip is programmed by the program lines coming from the logic module bottom board and from the adder circuit, U2 and U3. The program lines offset the 3 MHz part of the signal. Thus, rather than counting from 3 to 23 MHz, the divide-by-N prescaler is programmed to count from 0 to 20 MHz. The output of U1 is fed to the phase comparator and programmable counter, U4.

(6) **Adder.** U2 and U3 are NBCD (natural binary coded decimal) adders. Each adder chip adds two 4-bit numbers in NBCD code. All inputs and outputs are active high. The carry out (pin 9) of U2 is connected to the carry in (pin 7) of U3.

(7) **Reference Oscillator.** The reference oscillator, consisting of U5C, U5R, and X1, is a crystal controlled oscillator which provides a 5 MHz reference signal to the reference prescaler.

(8) **Reference Prescaler.** U6B is a divide-by-two prescaler which divides the 5 MHz output of the reference oscillator by two. The resultant 2.5 MHz output for U6B is fed into the counter in U4 which generates the crystal controlled 3.125 KHz for the phase discriminator.

(9) **Phase Comparator and Programmable Counter.** The phase comparator in the programmable counter, U4, compares the signal from the divide-by-N prescaler with the reference signal from the reference prescaler. Pin 13 of U4 is the loop output (PC) which is fed to the loop filter on the synthesizer top board. Pin 12 is the lock detector output which initiates the out-of-lock or in-lock condition. The 3.125 KHz output at pin 2 provides timing of the clock generator on the synthesizer bottom board.

(10) **Lock Detector and Amplifier.** Diode D5 detects the output, pin 12, of the phase comparator in the programmable counter, U14. This DC level is amplified and buffered by hex buffers, U5E and U5F. If an out-of-lock condition occurs, the LOCK DET output to the transmit broadband amplifier on the synthesizer module top board prevents the transmitter from transmitting if an out-of-lock condition occurs.

(11) **Schottky Voltage Regulator.** Diode D1 provides +5 volts DC to operate the low power Schottky prescaler, U2, which is the only integrated circuit operating on 5 volts. The +5 volts DC from D1 is fed to U2 via RFC2.

(12) **Modulation Equalizer.** The modulation equalizes, consisting of U8 and Q1, equalizes frequency deviation of the transmitted signal within ±500 Hz over the 20 MHz frequency band. This represents ±10% when related to the 5 KHz standard deviation. The modulation is adjustable by R13 and is controlled by the VCO course tune voltage for synthesizer module top board and attenuates the audio used for the frequency modulation, depending on frequency, in order to give an even frequency deviation over the band transmitted on.

4-22. LOGIC MEMORY MODULE 5. The logic module is of two board construction. It is used for both transmit and receive functions. Refer to paragraphs 4-22.1 and 4-22.2 for a description of logic memory module top and bottom boards, respectively.

4-22.1 Logic Memory Module Top Board. (See figure 8-21.) The logic memory module top board contains a voltage regulator, strobe generator, and display control.

① **Voltage Regulator.** U7 is a µA768GHM voltage regulator which is set for +9 volts out. It supplies the display and the logic Memory module. U1A is one gate of a NAND Schmitt trigger used to indicate the state of the battery. The threshold for the Schmitt trigger is set at 11 volts DC. Thus, a voltage approximately 11 volts or lower will on the Battery State LED on the display module.

② **Strobe Generator.** The combination of U11C, U11B, and U11D form a strobe generator which is an astable multivibrator with variable pulse width. The pulse width is controlled from the LDR-1 light sensor in the display module. Frequency of the multivibrator is approximately 15 KHz. The multivibrator will only start if it is supplied with an Enable from the logic memory module top board. The strobe frequency is fed into the blanking input of U6 in the display module and also fed the clock input of decode counter/decoder, U2, which is the digit select for the display.

③ **Display Control.** U2 is a decade counter/decoder which is the digit select for the display. U2 is enabled by the output of U1C and clocked by the output of U1B. The outputs of U2, fed via R8 through R12 control the digit drivers in the display module as well as the multiplexer circuitry of U4, U5, and U6. U4, U5, and U6 are tri-state gates which multiplex the contents of the memory on the logic memory module bottom board which comes in four channels into a single channel 4-bit information, going to the display module. Inverters U3A, U3B, U3C, U3D, and U3E are used to invert the logic level from U2 to the multiplex gates.

4-22.2 Logic Memory Module Bottom Board. (See figure 8-23.) The logic memory module bottom board contains a write circuit, clock generator, synthesizer divider, memory, and battery and battery charging circuit.

① **Writing Circuit.** When the Function switch is in the P (programming) position, the WRITE input to U11, pin 6 is logical "O", producing a "1" at U11, pin 9. When the clock generator generates an output pulse of U9, pin 14, NAND gates U11-10 and U11-11 will enable the memory to write in data.

② **Clock Generator.** The clock generator, U9, is a 14-bit counter which controls the frequency entry and timing of the display. It is a 14-bit binary counter which is advanced one count on the negative-going edge of the clock pulse. The 3.125 KHz clock pulse provided by the lock detector is divided by U9 to produce a clock frequency entry of approximately .33 Hz for the counters. After approximately 5 seconds, a reset pulse resets the clock generator, causing the display to turn off and resets flip-flop U10 which stops the clocking of the counter, disables the write function of the memory, and times out the display. U5 is a hex contact bounce eliminator. It receives inputs from the four Frequency Select pushbuttons on the display module and is used to clean up bounce of the switches. Depressing one of the switches initiates two functions: the corresponding output of U5 will enable either of the four counters, U3, U4, U6, or U7, for frequency selection and reset U10 to start the clocking process of the counters, as well as switch on the display. If the Function switch is in any position other than P, the frequency selected will be displayed but the write circuit will not be enabled, so the displayed frequency cannot be changed and the content of the memory cannot be altered.

③ **Synthesizer Divider.** The synthesizer divider uses four BCD up/down counters. These counters are slaved to the memory so that they always start at the frequency which is stored in the memory channel selected. U3 counts up to 4 for the 25 KHz spacing. After 4, it resets to 0. U4 is a straight decade counter, selecting the 100 KHz steps. U6 is a straight decade counter, selecting the 1 MHz steps. U7 only counts 1 and 2 and resets for the 10 MHz selection. U8 inverts the outputs of U7 in order to give a "1" in channel 1 or bit 1 or a "0" in bit 2 and vice versa. This is information required to synthesize programming.

④ **Memory.** The memory stores the frequency selected by the 10 MHz, 1 MHz, 100 KHz, and 25 KHz pushbuttons. By use of the four pushbuttons, any frequency within the operating band of the radio can be stored in the memory. The memory comprises two 4-word by 8-bit random access memories. The memory has four addresses which provide three operating channels and one guard channel or four operating channels. The addresses are selected by the Channel Select switch. In the switched off condition of the radio, these memories are powered by a small NiCad battery, B1-3. The output of the memory controls the synthesizer divider, U3, U4, U6, and U7.

⑤ **Battery and Charging Circuit.** NiCad battery B1-3 powers the memory, when the radio is turned off, for approximately six months. The battery is trickle charged every time the radio is switched on.

4-23. DISPLAY MODULE. (See figure 8-25.) The display module is of single board construction. It is used for both transmit and receive functions. The basic function of the display module is to display the frequency in 10 MHz, 1 MHz, 100 KHz, and 25/50/75 KHz steps and to display battery condition. It contains display drivers, 7-segment display, BCD to 7-segment decoders, Frequency Select pushbuttons, Battery State indicator, and a light sensor.

① **Display Drivers.** Transistors Q1 through Q5 are NPN transistors which drive the 7-segment displays, U1 through U5. These transistors are controlled by the logic memory module top board.

② **7-Segment Display.** The 7-segment display, consisting of U1 through U5, displays frequency in 10 MHz, 1 MHz, 100 KHz, and 25/50/75 KHz steps. The 7-segment display is driven by the display drivers.

③ **Frequency Select Pushbuttons.** Preset radio frequency of operation in 10 MHz, 1 MHz, 100 KHz, or 25 KHz steps. Depressing any of the pushbuttons illuminates the display for approximately 5 seconds.

④ **Battery Condition Indicator.** The battery condition indicator, CR1, operates when display is on to indicate battery condition. Lights to indicate battery state of charge is adequate (approximately 11 volts) to assure usuable communications. When not illuminated, it indicates that battery is either in a state of discharge or near discharge.

⑤ **Display Intensity Sensor.** The display intensity sensor, LDR-1, senses ambient light and provides an output to strobe generator or logic memory module top board to Control display intensity.

⑥ **BCD to 7- Segment Decoder.** The BCD to 7-segment decoder, U6, converts the BCD representation of the frequency into a 7-segment output for application to the 7-segment display. Only provides output as long as strobe pulse from the logic memory module top board is provided (5 seconds).

4-24. FILTER MODULE. The filter module is of single board construction. It is secured to the frame of the radio to ensure good earthing. It consists of a nine-stage low pass filter. Its loss in the pass band is extremely low and the final attenuation of the filter is 70 dB starting from 60 MHz. The filter is also used as the upper frequency limit of the receiver. The output of the filter is fed directly to the 50 ohm BNC connector and to the antenna matching module.

4-25. ANTENNA MATCHING MODULE. The antenna matching module is a torroid coil which is in series with the whip antenna to resonate the antenna misband of the selected 20 MHz segment. The coil is tapped and a transistor switch switches the tap when the 10 MHz Frequency Select pushbutton is depressed.

CHAPTER 5
PREVENTIVE MAINTENANCE

CHAPTER 5
PREVENTIVE MAINTENANCE

5-1. PREVENTIVE MAINTENANCE CHECKS AND SERVICES.

Perform preventive maintenance checks as follows:

a. Prior to each operation, check the battery voltage by observing the Battery Condition indicator on the radio front panel. The Battery Condition indicator operates when one of the frequency select pushbuttons is depressed, causing the display to light.

b. Make sure that all front panel knobs are secure. Tighten setscrews if necessary.

CAUTION

When using an external power source connected directly to the battery terminals. Make sure polarity is not reversed. Otherwise, the radio will be damaged.

c. Every six months, check condition of the NiCad battery on the logic memory board.

d. Check all switches for proper operation.

e. Check handset and antenna for secure connections.

5-2. CLEANING.

Inspect the exterior of the radio. The exterior surfaces should be free of dirt, grease, and fungus. Remove grease, fungus, and ground-in dirt from the case using an approved cleaning solvent. Remove dust and other dirt from plugs and receptacles. Clean the panel and display with a soft, lint-free cloth. If dirt is difficult to remove, dampen the cloth with mild soap and water.

CHAPTER 6
MAINTENANCE

CHAPTER 6
MAINTENANCE

Section I. FIELD MAINTENANCE

6-1. GENERAL.

This section provides field maintenance procedures for the ERC-310. It consists of a performance test of the overall radio (paragraph 6-2), troubleshooting to the assembly level (paragraph 6-8), and removal and replacement of major assemblies (paragraph 6-9).

6-2. ERC-310 RADIO PERFORMANCE TEST

6-3. TEST EQUIPMENT REQUIRED. Test equipment required to test the ERC-310 radio is listed below:

a. SMDU test unit – Rohde and Schwarz 242.2010.51 and 249.3611.52, or equivalent.

b. DC power supply – Power Designs 6050A, or equivalent.

c. Audio test box – ETI part no. TD 0023.

d. Spectrum analyzer – Hewlett-Packard 8552B, 8553B, 141T, or equivalent.

e. Multimeter – Fluke 8000A, or equivalent.

6-4. TEST EQUIPMENT CONNECTIONS. Make the following test equipment connections to prepare the ERC-310 radio for test:

NOTE

Refer to figures 6-1 and 6-2 for location of controls and indicators for the SMDU and SMDU power test adapter.

a. Connect cable from BNC connector on the ERC-310 radio to TEST ITEM jack on the SMDU.

b. Connect cable from MOD GEN jack of the SMDU to the audio test box AUDIO IN connector.

c. Connect cable from AUDIO OUT jack of the audio test box to the SMDU AF VOLTMETER jack.

d. Connect cable from RF jack of the SMDU to the spectrum analyzer INPUT jack.

e. Connect DC power supply to the audio test box VOLTAGE jacks.

f. Remove jumper wire from the audio test box CURRENT jacks.

g. Connect multimeter MA INPUT and COMMON jacks to the audio test box CURRENT jacks.

1. SYNCHRON button
2. CH SPACING switch
3. RESOL X10 button
4. AF INT button
5. 20-525 MHz button
6. RF INT button
7. Meter
8. MOD button
9. INT/EXT button
10. 10/100 KHz knob
11. FIXED VARIABLE button
12. FM button
13. RANGE switch
14. FREQ knob
15. NF/AF VOLTM button
16. DEV METER ON button
17. READY LED
18. 3-10 KHz button
19. 1-3 KHz button
20. 1 KHz button
21. 0.1-0.3 KHz button
22. SINAD button
23. CRANK-type knob
24. Fine Scale of RF Output knob
25. POWER switch
26. RF OUTPUT scale
27. Signal Generator Frequency knobs
28. 0.14-50 button
29. 63.5-88 button
30. Digital Frequency Readout

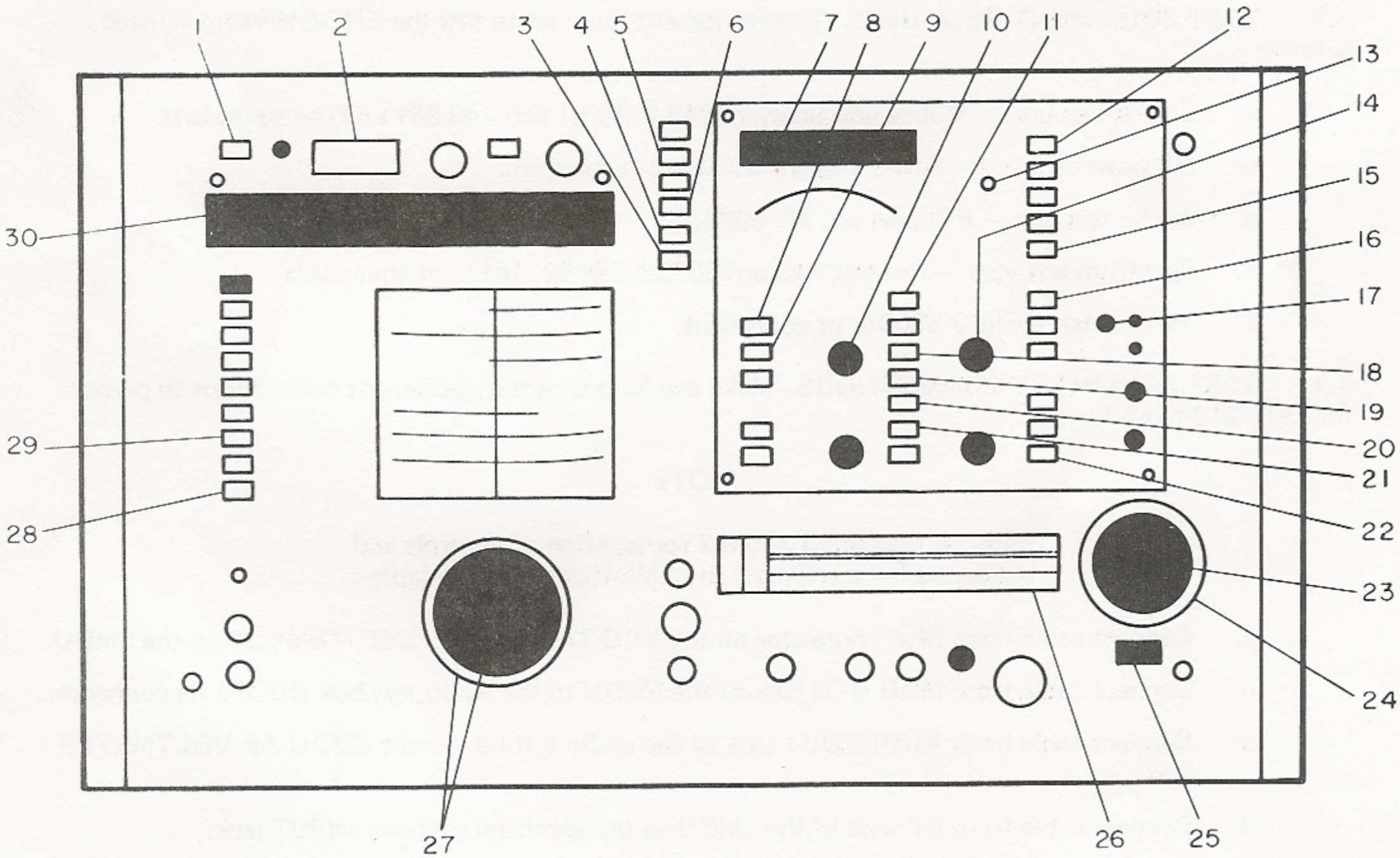
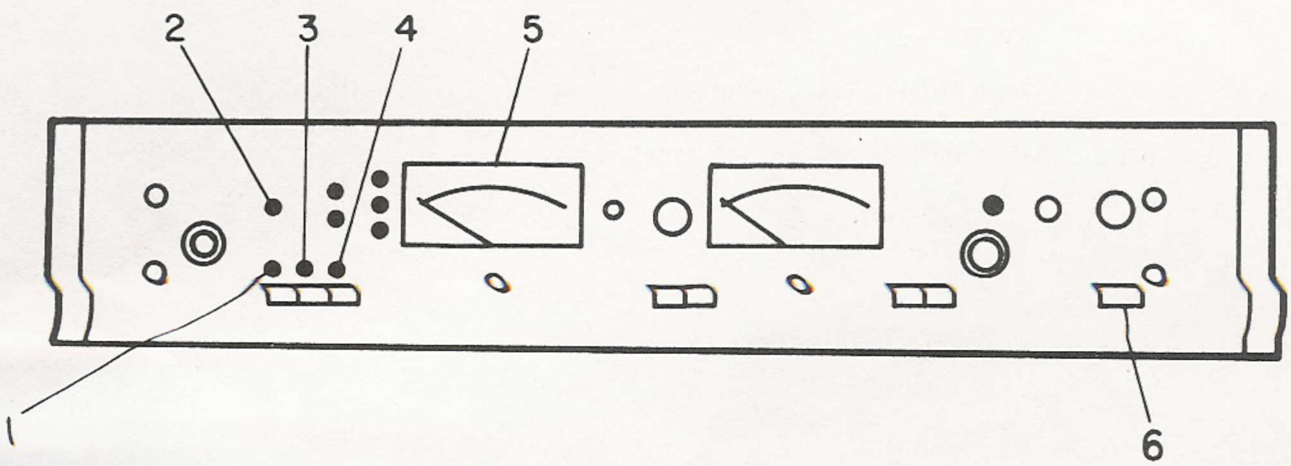


Figure 6-1. SMDU Controls and Indicators



LEGEND

1. L2 button
2. AK10 switch
3. L3 button
4. L4 button
5. Power meter L5
6. AK15 button

Figure 6-2. SMDU Power Test Adapter Controls and Indicators

6-5. INITIAL EQUIPMENT SETTINGS. Set test equipment switches and controls as follows:

a. Set the DC power supply switches and controls as follows:

Switch/Control	Setting
VOLTAGE switch	60V
CURRENT LIMIT switch	5A
POWER switch	ON
CURRENT adjust control	Mid-range
METER switch	V
VOLTAGE adjust control	11 volts DC

b. Set the SMDU switches and controls as follows:

Switch/Control	Setting
0.14-50 button	Depressed
SYNCHRON button	Depressed
CH SPACING switch	25
RF INT button	Depressed
Signal Generator Frequency knobs	Adjust for 30.050 indication on digital frequency readout
20-525 MHz EXT button	Depressed
L3 button	Depressed
1 KHz button	Depressed
MOD GENERATOR button	Released
RANGE switch	AUTO
All other buttons not noted	Released

c. Set the audio test box PTT/OFF switch to OFF position.

d. Set the audio test box VOLUME control to 90% counterclockwise.

e. Set the spectrum analyzer switches and controls as follows:

Switch/Control	Setting
FREQUENCY switch	30.050 MHz
BANDWIDTH switch	100 KHz
SCAN WIDTH switch	5 MHz/Division
SCAN TIME switch	2 MS
REFERENCE LEVEL switch	10
LINEAR SENSITIVITY switch	0
VIDEO FILTER switch	MIN
SCAN TRIGGER switch	AUTO
SCAN MODE switch	INT
2 dB/10 dB/LIN switch	10 dB

f. Turn on all test equipment.

6-6. TEST PROCEDURES. Test procedures for the ERC-310 radio include Short and Current Consumption Checks (paragraph 6-6.1), Channel Programming (paragraph 6-6.2), Transmitter Measurements (paragraph 6-6.3), and Receiver Tests (paragraph 6-6.4).

6-6.1 Short and Current Consumption Checks. Perform short and current consumption checks for the ERC-310 radio as described in paragraphs 6-6.1 and 6-6.2.

CAUTION

Thoroughly read all steps of the short and current consumption checks before performing procedures. Failure to perform procedure exactly as described may cause damage to the radio.

6-6.1.1 Short Check. Perform short check as follows:

a. Using multimeter (set to ohms function), check for open circuit across battery contacts.

b. Set the audio test box PTT/OFF switch to OFF.

CAUTION

If either transmit or receive current is excessive, or power supply faults, turn off power supply immediately to prevent damage. Isolate power problem before continuing.

c. On the multimeter, depress the DCMA FUNCTION button and the 2000 MA RANGE button.

d. Set the power supply POWER switch to ON.

e. Set the ERC-310 Function switch to ON.

f. Observe multimeter indication. Multimeter indication should be approximately 350 MA for 5 seconds, then drop to 125 MA maximum.

g. Set the audio test box PTT/OFF switch to PTT.

h. Observe multimeter indication. Multimeter indication should be approximately 1 ampere maximum.

i. Turn off power supply.

6-6.1.2 **Current Consumption Check.** Perform current consumption check as follows:

a. Set the audio test box PTT/OFF switch to OFF.

CAUTION

If either transmit or receive current is excessive, or power supply faults, turn off power supply immediately to prevent damage. Isolate power problem before continuing.

b. On the multimeter, depress the DCMA FUNCTION button and the 2000 MA RANGE button.

c. Set the power supply POWER switch to ON.

d. Set the ERC-310 Function switch to ON.

e. Observe multimeter indication. Multimeter indication should be approximately 350 MA for 5 seconds, then drop to 125 MA maximum.

f. Set the audio test box PTT/OFF switch to PTT.

g. Observe multimeter indication. Multimeter indication should be approximately 1 ampere maximum. Record current consumption.

h. Turn off power supply.

6-6.2 **ERC-310 Preset Channel Programming.** Program the ERC-310 as follows

a. Set the ERC-310 Function switch to ON.

b. Check that the ERC-310 display illuminates then extinguishes after approximately 5 seconds.

c. Set the Function switch to P.

d. Set the ERC-310 Memory switch to 1.

e. Depress and hold the ERC-310 25 KHz Frequency Select pushbutton until 10 KHz and 1KHz digits indicates "50".

f. Depress and hold the 100 KHz Frequency Select pushbutton until 100 KHz digit indicates "0".

g. Depress and hold the 1 MHz Frequency Select pushbutton until 1 MHz digit indicates "0".

h. Depress and hold the 10 MHz Frequency Select pushbutton until 10 MHz digit indicates "3".

i. Set the Memory switch to 2.

j. Preset channel 2 of the radio to 37.050 MHz using the four Frequency Select pushbuttons.

k. Set the Memory switch to 3.

l. Preset channel 3 of the radio to 43.050 MHz using the four Frequency Select pushbuttons.

m. Set the Memory switch to 4.

n. Preset channel 4 of the radio to 49.050 MHz using the four Frequency Select pushbuttons.

o. Set the Function switch to ON.

p. Depress one of the four Frequency Select pushbuttons, then set the Function switch to P.

q. Successively set the Memory switch to positions 1, 2, 3, and 4 while observing the display. Frequency displayed should be as follows:

Memory Switch Position	Frequency Displayed
1	30.050
2	37.050
3	43.050
4	49.050

6-6.3 Transmitter Measurements. Perform transmitter measurements as described in paragraphs 6-8.1 and 6-8.2.

6-6.3.1 Frequency Stability. Perform frequency stability measurements as follows:

a. Set the ERC-310 function switch to ON.

b. Set the ERC-310 Memory switch to 4.

c. Set the audio test box PTT/OFF switch to PTT.

d. Observe the SMDU digital frequency readout. Indication should be 49.050 MHz ±2.5 KHz.

e. Set the audio test box PTT/OFF switch to OFF.

f. Set the Function switch to OFF.

6-6.3.2 RF Power Out. Perform the RF power out test as follows:

a. Set the ERC-310 Function switch to ON.

b. Set the ERC-310 Memory switch to 1.

c. Set the audio test box PTT/OFF switch to PTT.

d. Observe the SMDU digital frequency readout. Indication should be 30.050 MHz ±2.5 KHz.

e. Observe the ERC-310 output power on the SMDU POWER meter. Indication should be 1.5 watts minimum for all channels.

f. Set the Memory switch to 2.

g. Observe the SMDU digital frequency readout. Indication should be 37.050 MHz ±2.5 KHz.

h. Repeat step e above.

i. Set Memory switch to 3.

j. Observe the SMDU digital frequency readout. Indication should be 43.050 MHz ±2.5 KHz.

k. Repeat steps c through e above.

l. Set Memory switch to 4.

m. Observe the SMDU digital frequency readout. Indication should be 49.050 MHz ±2.5 KHz.

n. Repeat step e above

o. Set the audio test box PTT/OFF switch to OFF.

p. Set the Function switch to OFF.

6-6.3.3 RF Power Out (24V). Perform the RF power out (24V) test as follows:

a. Set the power supply METER switch to V.

b. Adjust the power supply VOLTAGE control for an indication of 11 volts DC on the meter.

c. Repeat paragraph 6-6.3.2, steps a through n.

d. Adjust the power supply VOLTAGE control for an indication of 22 volts DC on the meter.

6-6.3.4 Modulation Deviation. Perform the modulation deviation test as follows:

a. Set SMDU switches and controls as follows:

Switch/Control	Setting
MOD button	Depressed
DEV METER ON button	Depressed
RF INT button	Depressed

Switch/Control	Setting
Signal Generator Frequency knobs	Adjust for 25.000 indication on digital frequency readout.
FM button	Depressed

b. Set the ERC-310 Function switch to ON.

c. Set the ERC-310 Memory switch to 1.

d. Set the audio test box PTT/OFF switch to PTT. Observe that the SMDU READY LED lights.

e. Observe the indication on the SMDU meter. With MOD button depressed, "tone and voice" deviation should be 5-7.5 KHz maximum.

f. Release the SMDU MOD button and observe the meter. "Tone" deviation should be 1.7-2.7 KHz.

g. Set the Memory switch to 2.

h. Adjust the SMDU Signal Generator Frequency knobs for a 30.000 MHz indication on the digital frequency readout.

i. Repeat steps e and f above.

j. Set the Memory switch to 3.

k. Adjust the SMDU Signal Generator Frequency knobs for a 35.000 MHz indication on the digital frequency readout.

l. Repeat steps e and f above.

m. Set Memory switch to 4.

n. Adjust the SMDU MHz knobs for a 40.000 MHz indication on the digital frequency readout.

o. Repeat steps e and f above.

p. Set the audio test box PTT/OFF switch to OFF.

q. Set the Function switch to OFF.

r. Release SMDU MOD button.

s. Depress the SMDU 20-525 MHz button.

t. Release the SMDU DEV METER ON button.

u. Depress the SMDU NF/AF VOLTM button.

6-6.3.5 Harmonic Attenuation. Perform the harmonic attenuation test as follows:

a. Depress the L4 button on the SMDU power test adapter.

b. Set the ERC-310 Function switch to ON.

c. Set the ERC-310 memory switch to 1.

d. Set the audio test box PTT/OFF switch to PTT.

e. Tune the spectrum analyzer to ensure that first and second harmonics are at least -60 dBm.

f. Set the ERC-310 Memory switch to 2.

g. Repeat steps d and e.

h. Set the ERC-310 Memory switch to 3.

i. Repeat steps d and e.

j. Set the ERC-310 Memory switch to 4.

k. Repeat steps d and e.

l. Set the audio test box PTT/OFF switch to OFF.

m. Set the Function switch to OFF.

n. Depress the button L3 on the SMDU power test adapter.

6-6.3.6 Spurious Attenuation. Perform the spurious attenuation test as follows:

a. Depress the L4 button on the SMDU power test adapter.

b. Set the ERC-310 Function switch to ON.

c. Set the ERC-310 Memory switch to 1.

d. Set the audio test box PTT/OFF switch to PTT.

e. Tune the spectrum analyzer to ensure that any spurious within 30-50 MHz range are at least -70 dBm.

f. Set the Memory switch to 2.

g. Repeat steps d and e.

h. Set the Memory switch to 3.

i. Repeat steps d and e.

j. Set the Memory switch to 4.

k. Repeat steps d and e.

l. Set the audio test box PTT/OFF switch to OFF.

m. Set the Function switch to OFF.

n. Depress the adapter L3 button on the SMDU power test.

6-6.4 Receiver Tests. Perform receiver tests as described in paragraphs 6-6.4.1 through 6-6.4.10.

6-6.4.1 Receiver Sensitivity. Perform the receiver sensitivity test as follows:

a. Set the SMDU switches and controls as follows:

Switch/Control	Setting
MOD button	Depressed
RF INT button	Depressed
IM button	Depressed
SINAD button	Depressed
10/100 KHz knob	Adjust for 5 KHz indication on SMDU meter
NF/AF VOLTM button	Depressed

b. Depress button L2 on the SMDU power test adapter.

c. Set the ERC-310 Function switch to ON.

d. Set the ERC-310 Memory switch to 1.

e. Set the SMDU Signal Generator Frequency knobs for a 30.050 MHz indicator on digital frequency readout.

f. Adjust the SMDU crank-type knob for a .4 microvolt indication on the RF Output scale. Reading at smaller marking on meter.

g. Observe the dB indication on the SMDU meter. Red lines attached to red LEDs on meter = reference point; i.e., +6 dB. Receiver sensitivity should be 10 dB SINAD minimum.

h. Set the ERC-310 Memory switch to 2.

i. Set the Signal Generator Frequency knobs for a 37.050 MHz indication on digital frequency readout.

j. Repeat steps e through g.

k. Set the Memory switch to 3.

l. Adjust the SMDU Signal Generator Frequency knobs for a 43.050 MHz indication on digital frequency readout.

m. Repeat steps e through g.

n. Set the Memory switch to 4.

o. Set the SMDU Signal Generatory frequency knobs for a 49.050 MHz indication on digital frequency readout.

p. Repeat steps e through g.

q. Release the SMDU SINAD button.

r. Set the ERC-310 Function switch to OFF.

6-6.4.2 Image Selection. Perform the image selection test as follows:

a. Set the ERC-310 Function switch to ON.

b. Set the ERC-310 Memory switch to 1.

c. Adjust the SMDU Signal Generatory Frequency knobs for a 30.050 MHz indication on digital frequency readout.

d. Depress the SMDU MOD and SINAD buttons.

e. Adjust the SMDU crank-type knob for -10 dB indication on the meter (0 at 30% = 12 dB).

f. Depress the SMDU 63.5-88 button.

g. Adjust the SMDU Signal Generator Frequency knobs for an 84.050 MHz indication on digital frequency readout.

h. Set the SMDU fine scale of the RF Output knob for 0 dB at pointer.

i. Adjust the SMDU crank-type knob for 10 dB change on meter 15.

j. Read image rejection from the SMDU fine scale of the RF output knob in dB. Image rejection should be 60 dB minimum.

k. Set the ERC-310 Function switch to OFF.

l. Release the SMDU MOD on 2 SINAD buttons.

m. Depress the SMDU 0.14-50 button.

6-6.4.3 IF Rejection. Perform the IF rejection test as follows:

a. Set the SMDU Signal Generator Frequency knobs for a 27.000 MHz indication on digital frequency readout.

b. Set the ERC-310 Memory switch to 2.

c. Set the SMDU fine scale RF output knob for 0 dB at pointer.

d. Adjust the SMDU crank-type knob for 10 dB change on meter. IF rejection should be -60 dB minimum.

e. Set the ERC-310 Function switch to OFF.

f. Depress the SMDU NF/AF VOLTM button.

6-6.4.4 RF Limiting. Perform the RF limiting test as follows:

a. Turn the ERC-310 Volume control fully clockwise.

b. Set the ERC-310 Function switch to ON.

c. Adjust the SMDU crank-type knob for 1 microvolt output on RF Output scale.

d. Set the ERC-310 Memory switch to 1. Adjust the SMDU signal generator frequency knobs for 30.050 MHz indication on digital frequency readout.

e. Depress the SMDU MOD and NF/AF VOLTM buttons.

f. While observing the SMDU meter, increase RF level slowly to 2V. Level on meter should remain almost constant throughout scale. Any variance should be noted.

g. Set the ERC-310 Function switch to OFF.

6-6.4.5 Audio Distortion. Perform the audio distortion test as follows:

a. Set the ERC-310 Memory switch to 1.

b. Turn the ERC-310 Volume control for 1V RMS indication on meter 15.

c. Depress the SMDU NF/AF VOLTM button.

d. Adjust the SMDU crank-type knob for a 1 millivolt indication on RF Output scale.

e. Set the ERC-310 Function switch to ON.

f. Depress the SMDU DIST 1 KHz button.

g. Observe audio distortion in % on SMDU meter. Distortion should be less than 8%.

h. Release the SMDU DIST 1 KHz button.

i. Set the ERC-310 Function switch to OFF.

6-6.4.6 Audio Response. Perform the audio response test as follows:

a. Set the ERC-310 Function switch to ON.

b. Set the SMDU signal generator frequency knobs for a 30.050 MHz indication on digital frequency readout.

c. Set the ERC-310 Memory switch to 1.

d. Depress the SMDU NF/AF VOLTM, FM, AF INT, and Resol x 10 buttons.

e. Adjust Volume control (on ERC-310) for a 0 dB needle indication on the 1000 MV range of meter 15.

f. Depress the SMDU 1-3 KHz button.

g. Frequency displayed on digital frequency readout will be 2.7 KHz.

h. Observe dB scale on meter 15 (-6 dB maximum). Each range below 1000 MV = -10 dB at 0.

i. Depress the SMDU 0.3 button.

j. Frequency displayed on digital frequency readout will be .300 MHz.

k. Observe dB scale on meter 15 (-6 dB maximum).

l. Depress SMDU 3-10 KHz and fixed-variable buttons.

m. Adjust SMDU frequency knob until digital frequency readout reads 5.4 KHz.

n. Observe dB scale on meter 15 (-12 to -22 dB).

o. Depress SMDU 1-3 KHz button.

p. Adjust SMDU frequency knob until digital frequency readout reads 2 KHz.

q. Observe dB scale on meter 15 (-6 dB maximum).

r. Depress SMDU FM and 0.1-0.3 KHz buttons.

s. Adjust SMDU frequency knob until digital frequency readout reads .150 KHz.

t. Depress SMDU NF/AF VOLTM button.

u. Observe dB scale on meter 15 (-20 to -26 dB).

v. Release SMDU fixed-variable, AF INT and Resol X10.

w. Depress SMDU 1 KHz button.

6-6.4.7 Audio Output. Perform the audio output test as follows:

a. Set the SMDU Function switch to ON.

b. Set the SMDU Memory switch to 1.

c. Depress the F SMDU RF INT button.

d. Depress the NF/AF VOLTM button.

e. Turn the ERC-310 Volume control fully clockwise.

f. Observe output on meter. Meter indication should be 1.5V maximum (+.2V).

g. Set the ERC-310 Function switch to OFF.

6-6.4.8 Noise Squelch. Perform the noise squelch test as follows:

a. Set the SMDU Function switch to ON.

b. Set the ERC-310 Memory switch to 1.

c. Depress the SMDU MOD and INT/EXT buttons.

d. Set the ERC-310 Function switch to S2.

e. Adjust the SMDU crank-type knob for -145 dB indication on RF output scale. Then adjust knob until squelch breaks (tone heard). Verify that the audio test box REBRO LED lights when squelch breaks.

f. Observe level in microvolts on the SMDU RF output scale, using smaller marking.

g. Set the ERC-310 Function switch to OFF.

6-6.4.9 Tone Squelch. Perform the tone squelch test as follows:

a. Set the ERC-310 Function switch to S1.

b. Depress the SMDU FM button.

c. Depress the SMDU AF INT button.

d. Depress the SMDU MOD generator button.

e. Depress the SMDU 0.1-0.3 button.

f. Adjust the SMDU FREQ knob for a 150 Hz indication on the digital frequency readout.

g. Adjust the SMDU 10/100 KHz knob for a 1.5 KHz indication on meter.

h. Depress the SMDU NF/AF VOLTM button.

i. Adjust the SMDU crank-type knob for a -145 dB indication on RF output scale. Then adjust knob until squelch breaks (tone heard).

j. Observe level in microvolts on the SMDU RF output scale, using smaller marking. Verify that the audio test box REBRO LED lights when squelch breaks.

k. Set the ERC-310 Function switch to OFF.

l. Adjust the SMDU 10/100 KHz knob for a 5 KHz indication on meter.

m. Set the ERC-310 Function switch to ON.

n. Depress the SMDU 1 KHz button.

o. Release the SMDU MOD GENERATOR button.

p. Depress the SMDU RF INT button.

6-6.4.10 **Noise Quieting.** Perform the noise quieting test as follows:

a. Release the SMDU MOD and INT/EXT buttons.

b. Set the ERC-310 Function switch to ON.

c. Adjust the SMDU crank-type knob for a -145 dB indication on RF output scale.

d. While observing the SMDU meter, adjust the crank-type knob until a drop is noted on the meter. Read scale in microvolts.

e. Set the ERC-310 Function switch to OFF.

6-7. FIELD MAINTENANCE. Troubleshooting and disassembly procedures for the ERC-310 are given in paragraphs 6-8 and 6-9, respectively. Repair of a defective module is covered by shop maintenance.

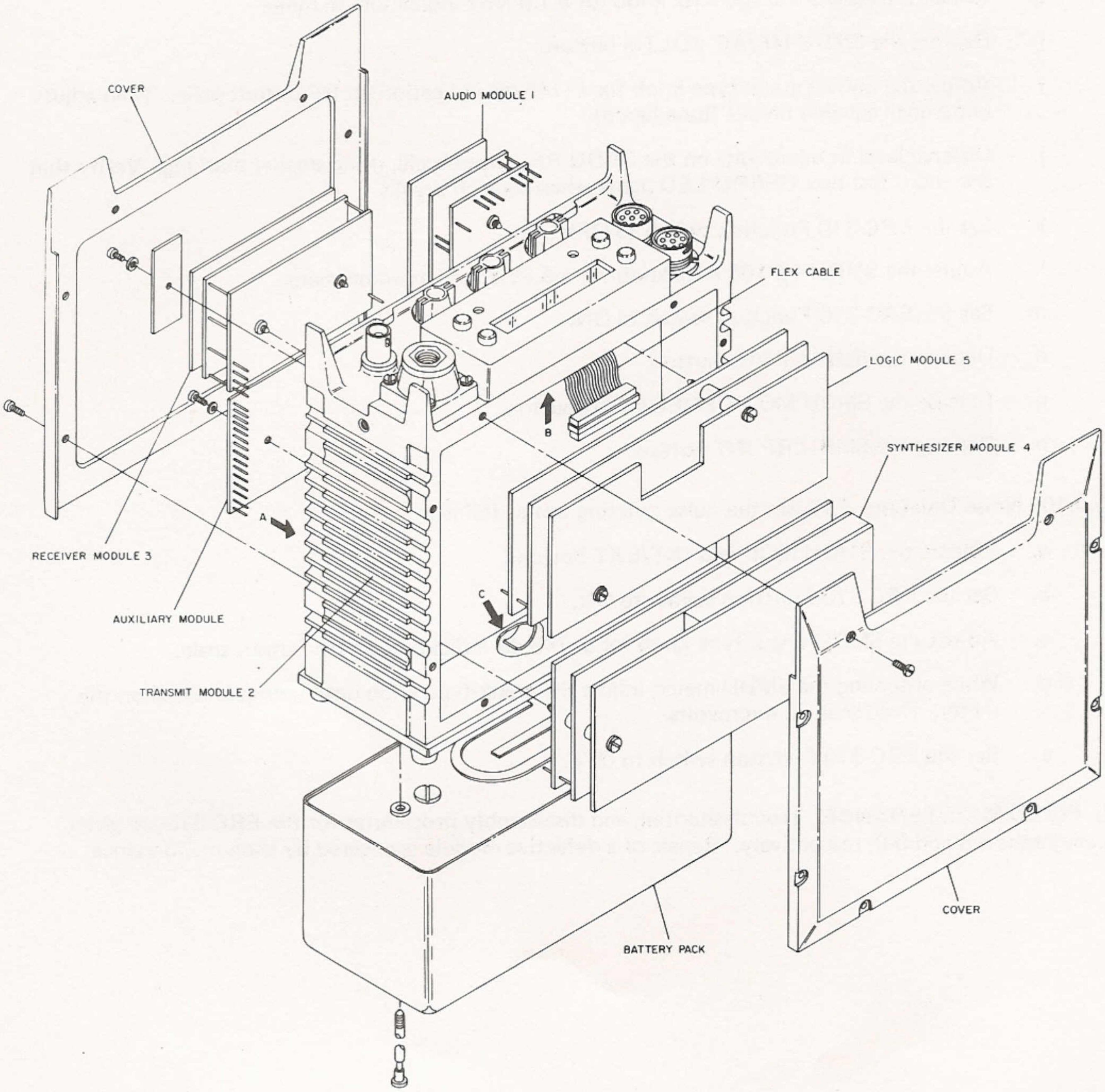
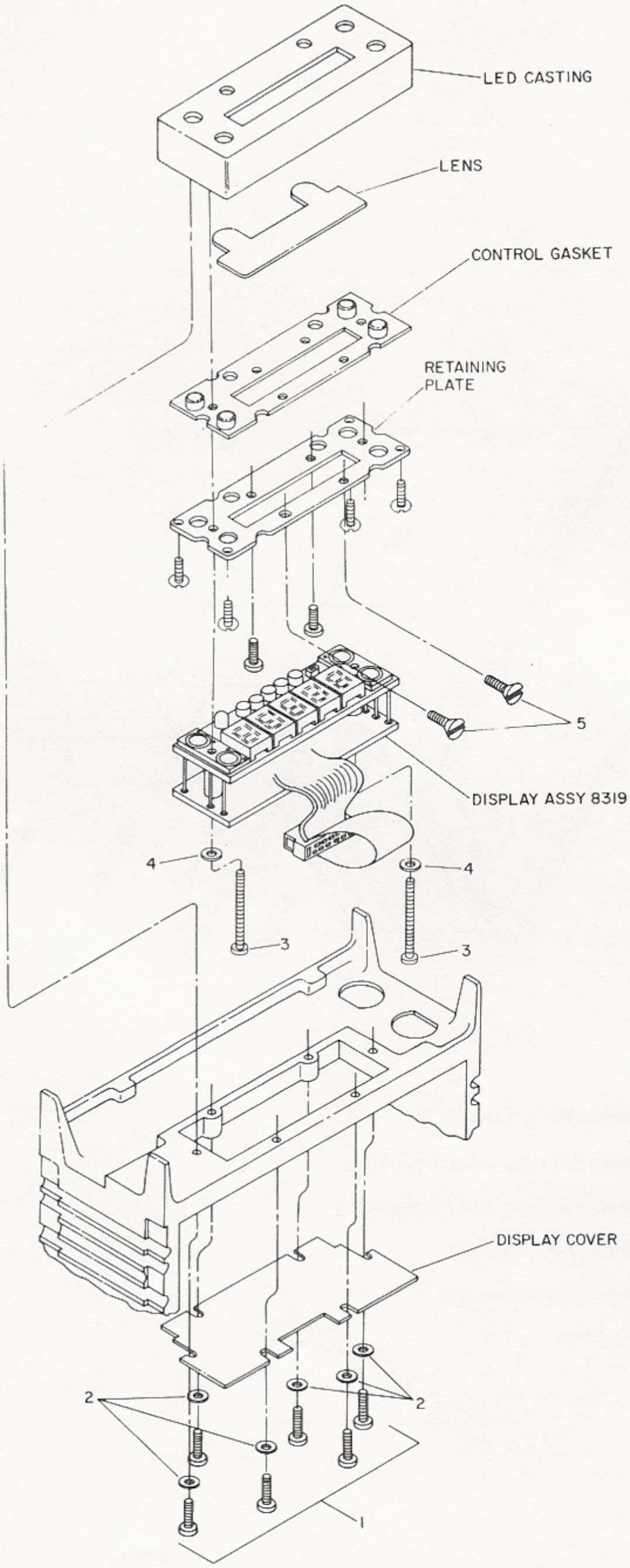


Figure 6-3. ERC-310 Exploded View (Sheet 1 of 3)



① Screw, Pan Head, 2.5mm X 6 X 6

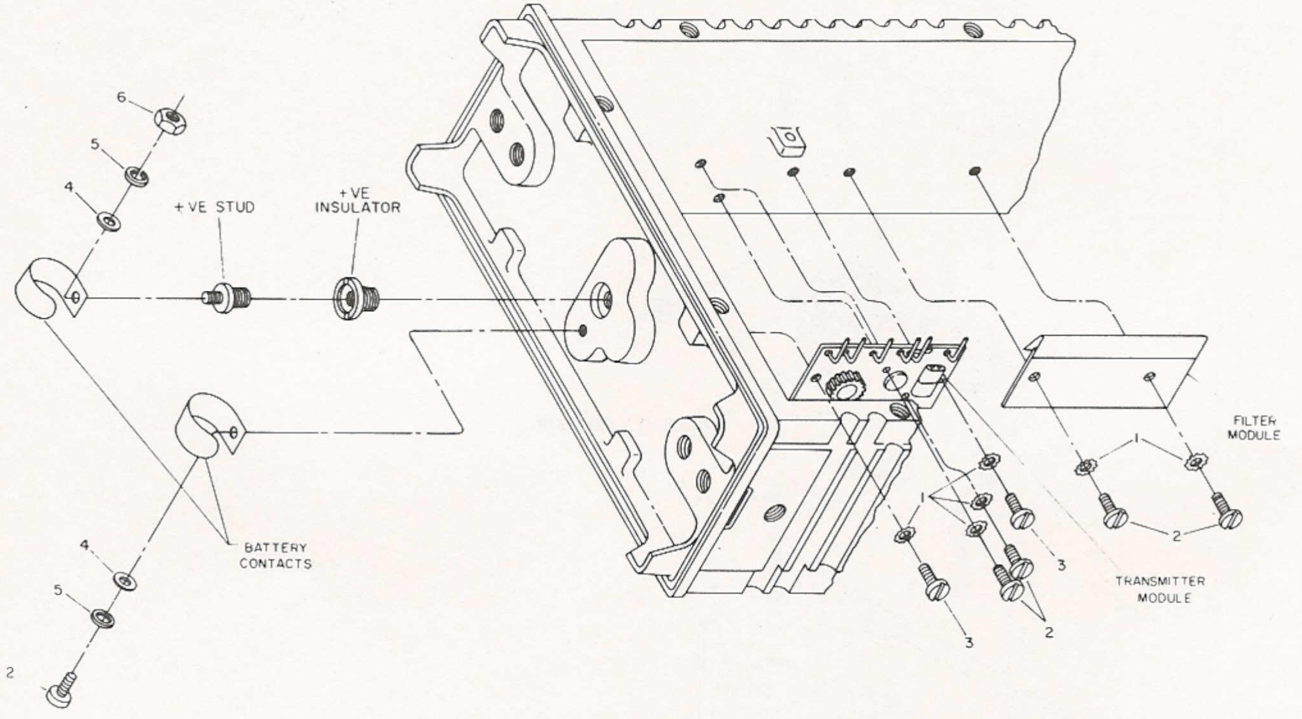
② Washer, Wavy, 2.5mm X 6

③ Screw, Pan Head, X20 X 2

④ Washer, Wavy, 2.6mm X 2

⑤ Screw, Flat Head, 2.5mm X 5mm X 8

Figure 6-3. ERC-310 Exploded View (Sheet 2 of 3)



① Washer, Wavy, 2.6mm X 6

② Screw, Pan Head, 3mm X 6mm X 5

③ Screw, Pan Head, 3mm X 20mm X 2

④ Washer, Flat, 3mm X 2

⑤ Washer, Lock, 3mm X 2

⑥ Nut, 3mm

Figure 6-3. ERC-310 Exploded View (Sheet 3 of 3)

6-8. ERC-310 RADIO TROUBLESHOOTING. Refer to the following chart for troubleshooting of the ERC-310 Radio.

ERC-310 TROUBLESHOOTING CHART

PROBLEM	POSSIBLE CAUSE	REMEDY
Malfunction of squelches	1. Bad audio module 2. Squelches out of alignment	1. Change audio module 2. Re-align squelches according to paragraph 6-27.7 of manual.
Rebro not working	1. Bad audio module 2. Rebro line shorted in audio plug assembly	1. Change audio module 2. Change audio plug assembly
Radio dead when battery is used for power	1. Shorted battery terminals 2. Bad external power/battery relay 3. Open line from function switch 4. Shorted line from function switch	1. Locate and remove short 2. Change relay 3. Locate and repair open 4. Locate and remove short
Carrier but no modulation on output	1. Bad handset 2. Bad audio module 3. Bad synthesizer module	1. Change handset 2. Change audio module 3. Change synthesizer module
Transmit power not constant throughout band	1. Bad antenna matching board 2. Shorted antenna socket 3. Synthesizer signal wrong 4. Bad whip antenna	1. Change antenna matching 2. Remove short 3. Change synthesizer 4. Change whip antenna
Display not right, some digits out, some wrong	1. 9V from logic-memory not going through channel switch and back to logic-memory 2. Channel select line(s) shorted	1. Reset logic-memory module 2. Locate and remove short
No transmit power out	1. Synthesizer module output to Tx not locking 2. Coaxial cable from synthesizer Tx out to transmitter open or shorted 3. No 9V transmit power to transmitter 4. Bad synthesizer module 5. Bad transmitter module	1. Change synthesizer module 2. Repair open line; locate short and remove 3. Check Tx/Rx relay 4. Change synthesizer 5. Change transmitter module
No transmitter power out	1. Shorted transmit output 2. Bad radio filter board 3. Open transmit output 4. Open or shorted antenna matching 5. Handset ptt switch faulty 6. Ptt line to relay open	1. Locate and remove short 2. Change filter board 3. Locate open and repair 4. Change antenna matching 5. Change handset 6. Check and repair fault

ERC-310 TROUBLESHOOTING CHART (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY
Display does not light when power is switched on	1. Dead battery pack 2. Bad external power cable 3. Input voltage shorted to ground 4. Display not correctly connected to logic-memory module 5. Display module bad 6. Logic-memory bad	1. Recharge battery pack 2. Repair power cable 3. Locate and remove short 4. Correct connection to logic-memory module 5. Replace display module 6. Change logic-memory module
Display lights all zeros and will not go out	1. Lack of 9 volts from audio module to synthesizer module 2. 9V from audio to synthesizer shorted to ground	1. Replace audio module 2. Locate and remove short
Display lights correct frequency read out but does not go out	1. Lack of 3.125 kHz clock signal from synthesizer module to logic 2. Shorted 3.125 kHz line 3. Open 3.125 kHz line 4. Clock not getting into logic-memory 5. Synthesizer not producing 3.125 kHz	1. Check 9V to synthesizer module 2. Locate and remove short 3. Check and repair continuity 4. Change logic-memory module 5. Change synthesizer module
Display will not program	1. Logic not getting signal 2. Display too loose in head for membrane to make contact 3. Bad membrane switch	1. Replace logic module 2. Adjust screws holding display into head 3. Replace display module
Display runs when in program mode	1. Shorted membrane switch 2. Display too tight in head 3. Shorted logic-memory	1. Replace display module 2. Adjust screws holding display into head 3. Replace logic-memory module
No receiver signal	1. Bad receiver module 2. No power to receiver module 3. Shorted receiver input 4. Bad radio filter board 5. No Rx frequency from synthesizer module	1. Change receiver module 2. Change audio module 3. Locate and remove short 4. Replace filter board 5. Replace synthesizer module
No receiver signal	1. Bad audio module 2. Shorted antenna socket 3. Shorted or open antenna matching board 4. 27.455 MHz oscillator out	1. Change audio module 2. Locate and remove short 3. Locate and remove short or change antenna matching 4. Adjust Rx module L6 for center of receiver signal

ERC-310 TROUBLESHOOTING CHART (Continued)

PROBLEM	POSSIBLE CAUSE	REMEDY
Poor receiver sensitivity	1. Receiver module out of alignment 2. Receiver bad 3. Poor signal amplitude from synthesizer module	1. Align receiver according to paragraph 6-39.4 of manual 2. Change receiver module 3. Replace synthesizer module
No audio output	1. Shorted volume control 2. Bad audio module 3. Shorted audio out line 4. Bad handset 5. Bad receiver module	1. Locate and remove short 2. Change audio module 3. Locate and remove short 4. Change handset 5. Change receiver module

6-9. REMOVAL AND REPLACEMENT OF MAJOR ASSEMBLIES. Removal and replacement of the ERC-310 major assemblies is described in paragraphs 6-9.1 through 6-9.5.

6-9.1 Removal of Lid Castings. (See figure 6-3.1.)

a. Place ERC 310 Transceiver on flat surface.
b. Loosen and remove 8 only 3mm x 6mm S/S Screws (ETI Part #4120).
c. Remove 8 only 3mm Wavy Washers (ETI Part #4333).
d. Carefully lift Lid Casting (ETI Part #5312) to break seal, and remove to expose modules inside.

6-9.2 Removal of Modules. (See figure 6-3.1.)

a. Loosen Module Retaining Screws (ETI #5017).
b. Pull modules straight out.
c. For removing logic-memory module 5, disengage display flex cable before removing.
d. For removal of antenna matching board, always remove receiver module 3 first. Then loosen and remove 1 only 10mm x 3mm S/S Screw (ETI Part #4222).
e. Pull Antenna matching board up and back to remove.
f. To remove auxiliary module, remove 2 only 3mm x 10mm S/S Screw (ETI Part #4222) and 2 only 3mm Wavy Washers (ETI Part #4333). Then place 2 small hooks under edge of board and pull straight up.

6-9.3 Removal of Display Head. (See figure 6-3.2.)

a. Loosen and remove 6 only 2.5mm x 16mm S/S Screws (ETI Part #4212) and 6 only 2.5mm Lock Washers (ETI Part #4322) and remove Display Screen (ETI Part #5708).
b. Loosen and remove 2 only 3mm x 20mm S/S Screws (ETI Part #4122) and 2 only 2.5mm Wavy Washers (ETI Part #4332). Display module will not slip easily out of head.

6-9.4 Removal of Transmitter Module. (See figure 6-3.3.)

a. Loosen and remove 2 only 3mm x 20mm S/S Screws (ETI Part #4122) and 2 only 3mm Lock Washers (ETI Part #4323).
b. Loosen and remove 1 only Bottom Bushing (ETI Part #5012) and slide transmitter cover board out of way.

c. Loosen and remove 2 only 3mm x 6mm S/S Screws (ETI Part #4120) and 3mm Lock Washers (ETI Part #4323).
d. Remove transmitter module by pulling straight up out of radio casting.

6-9.5 Removal of Filter Board. (See figure 6-3.3.)

a. Desolder 3 wires, 2 from antenna match and BNC socket and one from TX/RX relay.
b. Loosen and remove 2 only 3mm x 4mm S/S Screws (ETI Part #4124) and 2 only 3mm Wavy Washers (ETI Part #4323).
c. Remove filter board from casting.

Section II

SHOP MAINTENANCE

6-10. GENERAL

This section provides shop maintenance for the ERC-310. Shop maintenance consists primarily of test and troubleshooting of the modules comprising the radio. Information contained in this section includes general maintenance techniques (paragraphs 6-11 through 6-15), general troubleshooting techniques (paragraphs 6-16 through 6-20), and test and troubleshooting procedures for each module (paragraphs 6-20 through 6-).

6-11. GENERAL MAINTENANCE TECHNIQUES

6-12. GENERAL PARTS REPLACEMENT. Most of the parts in the radio can be reached easily and replaced without special procedures. While replacing parts, observe the following precautions and special handling instructions.

a. When it becomes necessary to remove and replace a part in this solid-state equipment, use a pencil-type soldering iron with a 25-watt maximum capacity. If only ac-operated irons are available, use an isolating transformer. Do not use a soldering gun; damaging voltages can be induced in components.

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

c. Before a part is removed, note the position of the part and its leads. Install replacement parts in essentially the same position as the original part to avoid undesired coupling and spurious oscillations.

6-13. REPLACING PARTS ON PRINTED CIRCUIT BOARDS. Replace parts on printed circuit boards as follows:

NOTE

Refer to the applicable parts location illustration in Chapter 8 for location of parts on the printed circuit board.

a. Remove the defective part by cutting its leads near the mounting holes and holes in the part side of the board.

CAUTION

When replacing parts on printed circuit boards, do not apply heat directly to the conducting strip or damage can result. Do not apply heat longer than necessary.

b. Apply heat at the mounting holes until the solder is melted; remove the remaining pieces of the part wire leads.

c. Heat the solder in the mounting holes and remove solder with a stiff bristle brush.

d. Bend the leads of the replacement part to fit the mounting holes.

CAUTION

Never apply much pressure against a printed circuit board or force any part into position on the board.

e. Insert the leads in the mounting holes and press the part firmly against the board.

f. Cut the leads approximately one-eighth inch from the wiring side of the board.

g. Bend and press the leads against the printed circuit conducting strip.

h. Using a heat sink, solder the replacement part to the printed circuit conducting strip.

6-14. REPAIR OF PRINTED CIRCUIT BOARDS. Repair of printed circuit boards is limited to repair of small breaks or cracks in the conducting foil. If the conducting strip has large breaks or if a board is broken, it is much better to replace the subassembly rather than try to repair the board. Repair small breaks or cracks in the conducting foil as follows:

a. Lightly scrape away any coating covering the area of the conducting strip to be repaired.

b. Clean the area with a firm-bristle brush and cleaning solvent.

c. Repair the cracked or broken area of the conducting strip by flowing solder over the break.

d. If there is any indication that the strip might peel, bridge the break with a small section of bare wire (approximately 2 inches). Apply solder along the entire length of the wire to bond it solidly to the conducting strip. Considerable care must be exercised in applying the solder to prevent it from flowing onto or near an adjacent strip. Keep the solder within the limits of the strip that is being repaired.

6-15. MODULE DISASSEMBLY. Several of the ERC-310 modules are two-board modules. Figure 6-4 illustrates the manner in which these modules are disassembled.

6-16. GENERAL TROUBLESHOOTING TECHNIQUES

6-17. SIGNAL SUBSTITUTION. Signal substitution enables the technician to localize a trouble quickly to a stage or component. A signal generator and oscilloscope are units of test equipment that are used in signal substitution. While performing signal substitution procedures, do not exceed signal levels specified so that damage to transistors may be avoided.

6-18. WAVEFORM ANALYSIS. The ERC-310 modules contain digital circuits. Voltage readings taken in these circuits would be difficult to analyze since they would vary with circuit conditions (equipment operation). For these circuits, waveforms must be taken and compared to the appropriate reference waveform.

6-19. VOLTAGE MEASUREMENTS. The ERC-310 contains semiconductor devices (for example diodes, transistors, and integrated circuit components). When measuring voltages, use tape sleeving (spaghetti) to insulate the entire test prod, except for the extreme tip. A momentary short circuit can ruin the semiconductor device. Use the same or equivalent electronic multimeter specified.

6-20. RESISTANCE MEASUREMENTS. Make resistance measurements in the ERC-310 only as directed. Use the multimeter range specified, otherwise the indications obtained will be inaccurate.

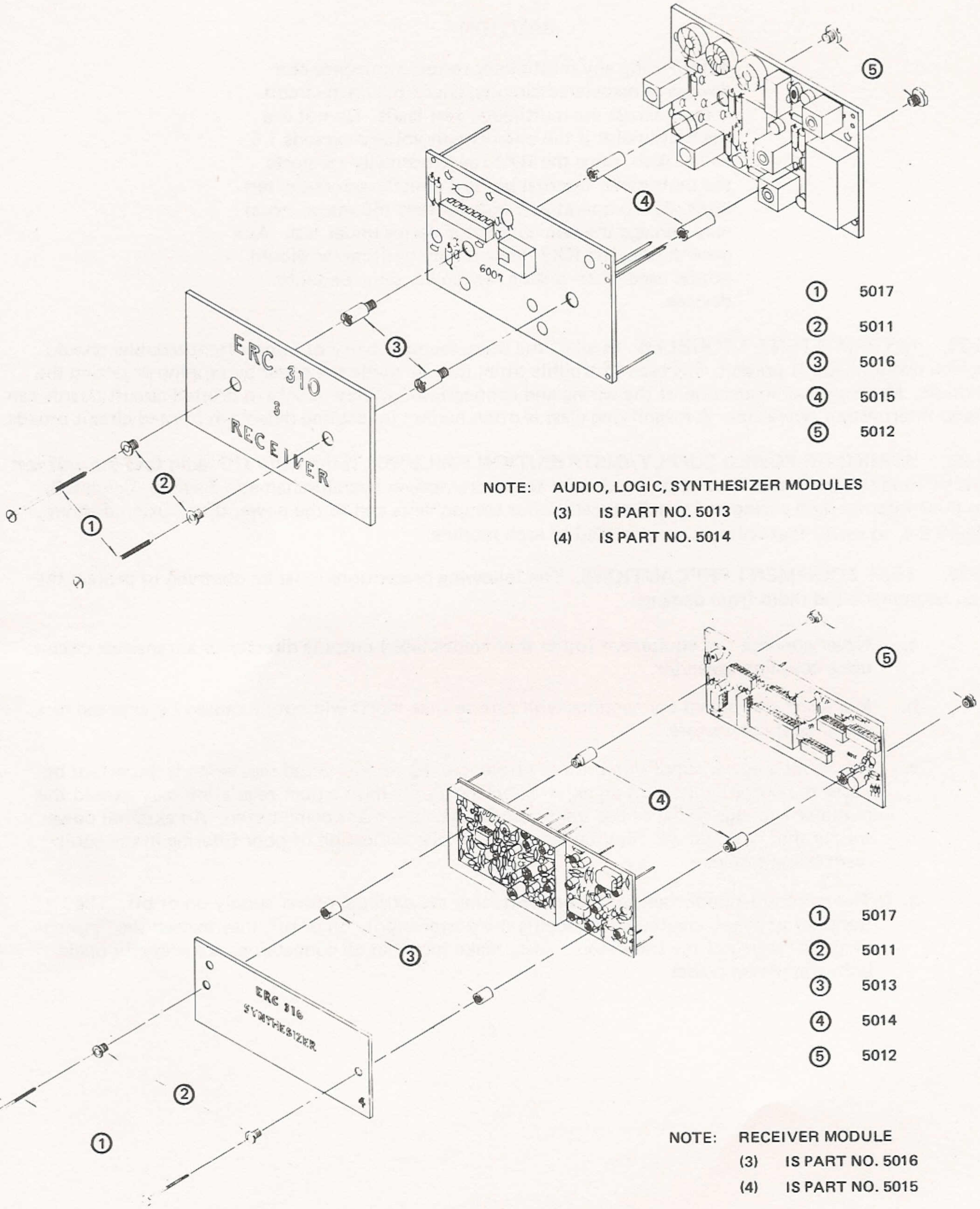


Figure 6-4. Typical Two Board Module, Disassembled View

CAUTION

Before using any multimeter to test semiconductor devices or associated circuits, check the open-circuit voltage across the multimeter test leads. Do not use the multimeter if the open-circuit voltage exceeds 1.5 volts. Also, since the RX1 range normally connects the multimeter internal battery directly across the test leads, the comparatively high current (50 ma or more) may damage the semiconductor device under test. As a general rule, the RX1 range of any multimeter should not be used when testing low power semiconductor devices.

6-21. 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 module. Make a visual inspection of the wiring and connections. Minute cracks in printed circuit boards can cause intermittent operation. A magnifying glass is often helpful in locating defects in printed circuit boards.

6-22. WIRING OR POWER SUPPLY/DISTRIBUTION FAILURE. If the ERC-310 radio fails the unit test and all modules are determined to be good, refer to the transceiver overall schematic diagram, figure 8-6, to trace inter-module wiring and check miscellaneous components and to the power distribution diagram, figure 8-4, to verify that voltages are provided to each module.

6-23. TEST EQUIPMENT PRECAUTIONS. The following precautions must be observed to protect the test equipment and radio from damage:

a. Never connect test equipment (other than multimeter) outputs directly to a transistor circuit; use a coupling capacitor.

b. Make test equipment connections with care so that shorts will not be caused by exposed test equipment connectors.

c. Never use a power supply that doesn't have low AC ripple. Good regulation is important because the output voltage of an external power supply having poor regulation may exceed the minimum voltage rating of the transistors in the equipment being tested. An external power supply that has poor AC filtering will create a false indication of poor filtering in the equipment being tested.

d. The radio must be turned off before switching the external power supply on or off. The transient voltages, created by switching the power supply on or off, may exceed the "punch-through" rating of the transistors. Also, make sure that all connections are properly made before applying power.

6-24. AUDIO MODULE PERFORMANCE TESTING.

Perform the procedure in paragraphs 6-25 through 6-29 to test an audio module if suspected of being faulty or to test a module after repair.

6-25. TEST EQUIPMENT REQUIRED. Test equipment required to test the audio module is listed below:

a. Audio module test fixture.

b. DC power supply - Power Designs Inc. Model 6050A, or equivalent (2 required).

c. Multimeter-Fluke 8000A, or equivalent.

d. Multi-Counter-Fluke 1925A, or equivalent.

e. Oscilloscope-Tektronix 475, or equivalent.

f. Distortion analyzer-Hewlett-Packard 331A, or equivalent.

g. Signal generator - Hewlett-Packard 8640B, or equivalent (2 required).

h. Known good bottom board - ETI 8308.

i. Known good top board - ETI 8309.

j. Jumper pins - Cambion 20 mm, or equivalent (14 required).

k. Audio generator - Heath SG-5210, or equivalent.

l. Coax cables - four with male BNC ends, two with male BNC and banana plugs.

m. Cable with handset plug and banana plugs.

n. Receiver module test fixture.

o. Receiver module - ETI 8603.

6-26. INITIAL SETUP. Connect equipment and make initial switch settings described below before performing the audio module performance tests, beginning with paragraph 6.22.

a. Set the audio module test fixture switches and controls as follows:

Switch/Control	Setting
TX/OFF/RX switch	RX
VOLUME control	MAX.
SQUELCH switch	No/S

b. Set the receiver test fixture ON/OFF switch to ON.

c. Set DC power supply No. 1 switches and controls as follows:

Switch/Control	Setting
VOLTAGE switch	60V
CURRENT LIMIT switch	.5A
CURRENT adjust control	Mid-range
POWER ON/RESET switch	POWER ON

d. Adjust the VOLTAGE control of power supply No. 1 for a 12 VDC output as indicated on the power supply meter. Then turn the power supply POWER ON/RESET switch to RESET.

e. Connect DC power supply No. 1 to the receiver test fixtures.

f. Set DC power supply No. 2 switches and controls as follows:

Switch/Control	Setting
VOLTAGE switch	60V
CURRENT LIMIT switch	.5A
CURRENT adjust control	Mid-range
POWER ON/RESET switch	POWER ON

g. Adjust the VOLTAGE control of power supply No. 2 for a 11 VDC output as indicated on the power supply meter. Then turn the power supply POWER ON/RESET switch to RESET.

h. Connect DC power supply No. 2 to the audio module test fixture.

i. Turn on the two signal generators, distortion analyzer, audio generator, multi-counter, multi-meter, and oscilloscope.

j. Set signal generator No. 1 switches and controls as follows:

Switch/Control	Setting
FM switch	INT
PEAK DEVIATION FM control	5 kHz
FM K/MHz pushbutton	Depressed
PEAK DEVIATION FM control	Adjust for 5 kHz deviation on meter
LEVEL VOLTS pushbutton	Depressed
MODULATION FREQUENCY control	1 kHz
INT/EXT pushbutton	Depressed
FREQUENCY control	35.500 MHz
LOCKON pushbutton	Depressed
ON/OFF switch	ON
OUTPUT LEVEL control	Adjust for 1 microvolt

k. Connect signal generator No. 1 to RF IN jack of receiver module test fixture.

l. Set signal generator No. 2 switches and controls as follows:

Switch/Control	Setting
FM switch	OFF
WH EXT pushbutton	Depressed
FREQUENCY control	62.500 MHz
LOCKON pushbutton	Depressed
RF switch	ON
OUTOUT LEVEL control	0 DRM (.22 volt)

m. Connect signal generator No. 2 SYN IN jack of receiver module test fixture.

n. Set the distortion analyzer FUNCTION switch to VOLTMETER.

o. Set the distortion analyzer METER RANGE switch to 3 VOLTS.

p. Connect the distortion analyzer to audio module test fixture AUDIO OUT jack.

q. Connect the multi-counter to CH-2 vertical signal output on rear of oscilloscope.

r. Connect the oscilloscope CH-2 INPUT to audio module test fixture MOD OUT jack.

s. Depress the multi-counter CHA FUNCTION pushbutton.

t. Depress the multi-counter AUTO RESOLUTION pushbutton.

u. Depress the oscilloscope VERT MODE CH2 pushbutton.

v. Set the oscilloscope VOLTS/DIV and TIME/DIV switches, as necessary, to observe waveform.

w. Set the audio generator MULTIPLIER switch to X100.

x. Set the audio generator FREQUENCY switches to 10-0-0.

y. Set the audio generator SINE WAVE AMPLITUDE switch to .01V (10 MV).

z. Insert the receiver module in bottom mounting board of receiver module test fixture.

6-27. BOTTOM BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the audio module bottom board are given in paragraphs 6-27.1 through 6-27.2.

6-27.1 Bottom Board Setup. Perform the following procedures to prepare the bottom board for test.

a. Insert the bottom board to be tested into bottom mounting board on the audio module test fixture.

b. Insert 14 jumper pins in sockets to complete electrical connection. (See Figure 8-10.)

c. Insert known good top board into top mounting board on the audio module test fixture.

6-27.2 BOTTOM BOARD CURRENT CHECK. Perform the bottom board current check as follows:

a. Remove jumper wire from audio module test fixture CURRENT CHECK jacks.

b. Connect leads between the audio module test fixture CURRENT CHECK jacks and MA INPUT and COMMON jacks of the multimeter. Observe polarity (red to red and black to black).

c. Depress the multimeter DCMA FUNCTION pushbutton.

d. Depress the multimeter 200 MA RANGE pushbutton.

CAUTION

Observe caution while performing step e to prevent damage to the equipment.

e. Turn on power supply No. 2 and observe current indication on the multimeter. Current consumption should be approximately 15 to 30 MA. If current consumption excessive or power supply faults, turn off power supply. Isolate faults before continuing.

f. Turn off power supply No. 2.

g. Disconnect the multimeter and replace current jumper wire.

6.27.3 Bottom Board Voltage Check. Perform the bottom board voltage check as follows:

a. Connect leads to V-Ω and COMMON jacks on multimeter.

b. Depress the multimeter DCV FUNCTION pushbutton.

c. Depress the multimeter 20V RANGE switch.

d. Connect multimeter leads between +9 VDC and GND jacks on the audio test fixture. Observe polarity.

CAUTION

Observe caution while performing steps e through h to prevent damage to the equipment.

e. Turn on power supply No. 2.

f. Select R35 on the audio module bottom board (figure 8-10) for an indication of 9 to 9.05 VDC on the multimeter.

g. Increase power supply No. 2 output voltage to 24 volts. Voltage indication on multimeter should remain constant at 9 to 9.05 VDC.

h. Decrease power supply No. 2 output voltage to 11 VDC.

i. Disconnect the multimeter.

6-27.4 Bottom Board RX Test. Perform the bottom board RX test as follows:

a. Turn on power supply No. 1.

b. Connect the receiver test fixture AUDIO OUT jack to the RX IN jack of the audio module test fixture.

c. Observe the distortion analyzer for 1.5V RMS ±.4 volts (3 dB). Note level.

d. Set the distortion analyzer FUNCTION switch to SET LEVEL and METER RANGE switch to 0 dB.

e. Set the OUTPUT LEVEL control of signal generator No. 1 to 1 mV.

f. Adjust the distortion analyzer SENSITIVITY selector and SENSITIVITY VERNIER to 0 dB.5 on meter.

g. Set the distortion analyzer FUNCTION switch to DISTORTION.

h. Adjust the distortion analyzer Frequency dial for maximum dip on meter.

i. Set the distortion analyzer METER RANGE switch to read level on meter distortion should be no more than 4%.

j. Return the distortion analyzer switches and controls to initial set up positions.

k. Disconnect the receiver test fixture from audio module test fixtures.

6-27.5 Bottom Board Audio Response Test. Perform the bottom board audio response test as follows:

a. Connect audio generator to the audio module test fixture RX IN jack.

b. Adjust the audio generator SINE WAVE OUTPUT control to obtain the same level as obtained in paragraph 6-27.4, step c. Level is read on distortion analyzer. Note level.

NOTE

Do not adjust level of the audio generator throughout remainder of this test.

c. Set the audio generator MULTIPLIER switch to X10.

d. Set the audio generator FREQUENCY switches to 30-0-0. There should be no more than 5 dB difference from level observed in step b above as read on the distortion analyzer.

e. Set the audio generator FREQUENCY switches to 10-5-0. Level should be 20 to 26 dB down from level observed in step b above as read on the distortion analyzer.

f. Set the audio generator MULTIPLIER switch to X100.

g. Set the audio generator FREQUENCY switches to 20-7-0. There should be no more than 5 dB difference from level observed in step b above as read on the distortion analyzer.

h. Set the audio generator FREQUENCY switches to 50-4-0. Level should be 12 to 22 dB down from level observed in step b above as read on the distortion analyzer.

i. Disconnect the audio generator from audio module test fixture.

j. Connect the receiver module test fixture to RX IN jack of audio module test fixture.

k. Return test equipment switches and controls to initial setup positions.

6-27.6 Bottom Board TX Test. Perform the bottom board TX test as follows:

a. Connect the audio generator SINE WAVE OUTPUT to HANDSET jack on audio module test fixture. Use handset plug to banana plug cable.

b. Set the audio module test fixture TX/OFF/RX switch to TX.

c. Observe level on distortion analyzer. Level should be 19 to 22 dB down from level observed in paragraph 6-27.4, c during bottom board RX test.

d. Set the distortion analyzer FUNCTION switch to SET LEVEL and METER RANGE switch to -10 dB.

e. Adjust the distortion analyzer SENSITIVITY selector and SENSITIVITY VERNIER to 0 dB.

f. Set the distortion analyzer FUNCTION switch to DISTORTION.

g. Adjust the distortion analyzer frequency dial for maximum dip on meter.

h. Change the distortion analyzer METER RANGE switch to -30 dB. Level should be no more than 4.5 using the 0-1 scale on the meter.

i. Disconnect the audio generator.

j. Return the distortion analyzer switches and controls to initial setup positions.

k. Set the audio module test fixture TX/OFF/RX switch to RX.

6-27.7 Bottom Board Squelch Test. Perform the bottom board squelch test as follows:

a. Set the audio module test fixture SQUELCH switch to T/S.

b. Depress the FM K/MHz pushbutton on signal generator No. 1.

c. Adjust the PEAK DEVIATION FM control on signal generator No. 1 for 1.5 kHz deviation indication on meter.

d. Depress the LEVEL VOLTS pushbutton on signal generator No. 1.

e. Set the MODULATION FREQUENCY control on signal generator No. 1 to X1 range.

f. Adjust the MODULATION FREQUENCY control knob on signal generator No. 1 to 150.

g. Adjust the OUTPUT LEVEL control on signal generator No. 1 for minimum signal out.

h. Adjust the OUTPUT LEVEL control until REBRO LED on the audio module test fixture lights level should be approximately .2 to .4 microvolt.

i. Adjust the OUTPUT LEVEL control to 1 millivolt. REBRO LED should remain illuminated.

j. Set the audio module test fixture SQUELCH switch to N/S.

k. Release the FM K/MHz pushbutton on signal generator no. 1.

l. Adjust the OUTPUT LEVEL control for minimum signal out.

m. Adjust the OUTPUT LEVEL control until REBRO LED on the audio module test fixture lights level should be approximately .3 to .8 microvolt.

n. Set the audio module test fixture SQUELCH switch to No/S.

o. Return switches and controls of signal generator no. 1 to initial setup positions.

NOTE

This completes the bottom board test procedures. Return all equipment to initial setup positions.

6-28. TOP BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the audio module top board are given in paragraphs 6-28.1 through 6-28.6.

6-28.1 Top Board Setup. Perform the following procedures to prepare the top board for test.

a. Insert the top board to be tested into top mounting board on the audio module test fixture.

b. Insert known good bottom board into bottom mounting board on the audio module test fixture.

c. Insert 14 jumper pins in sockets to complete electrical connection. (See figure 8-8.)

6-28.2 Top Board Current Check. Perform the top board current check by repeating paragraph 6-27.2, steps a through g.

6-28.3 Top Board Voltage Check. Perform the top board voltage check as follows:

a. Connect leads to V-Ω and COMMON jacks on multimeter.

b. Depress the multimeter DCV FUNCTION pushbutton.

c. Depress the multimeter 20V RANGE switch.

d. Check for approximately 4.5 volts at U2, pins 13 and 14. (See figure 8-8 for top board parts location.)

e. Disconnect multimeter.

6-28.4 Top Board Squelch Test. If "select on test" resisters have been selected, perform paragraph 6-27.1, steps a through o. If "select on test" resistors have not been selected. Perform the following procedure:

a. Set the audio module test fixture SQUELCH switch to T/S.

b. Set the audio module test fixture TX/OFF/RX switch to TX.

c. Insure that potentiometers R17 and R24 on the top board (figure 8-8) are fully clockwise.

d. Connect orange leads of squelch test box to S.O.T. posts for R12. (see figure 8-8.)

e. Connect yellow leads of squelch test box to S.O.T. post for R32. (See figure 8-8.)

f. On squelch box, turn knob no. 1 and R1 until a 150 Hz signal of 2 volts peak-to-peak is observed on the oscilloscope and multi-counter. Adjustment of the oscilloscope VOLTS/DIV and TIME/DIV switches may be necessary. There should be no clipping of the 150 Hz signal.

g. Measure resistance of selected resistor. Insert selected resistors into top board.

h. Check for same signal on the oscilloscope and multi-counter as observed in step f.

i. Set the audio module test fixture TX/OFF/RX switch to RX.

j. Connect purple leads of squelch test box to S.O.T. posts for R31. (See figure 8-8.)

k. Depress the FM K/MHz pushbutton on signal generator no. 1.

l. Adjust the PEAK DEVIATION FM knob on signal generator no. 1 for a 1.5 KHz deviation indication on the meter.

m. Depress the LEVEL VOLTS pushbutton on signal generator no. 1.

n. Set the MODULATION FREQUENCY control on signal generator no. 1 to X1 range.

o. Adjust the outside knob of the MODULATION FREQUENCY control on signal generator no. 1 to 152.

p. Adjust the OUTPUT LEVEL control on signal generator no. 1 for minimum signal out. Then increase OUTPUT LEVEL to .3 microvolt.

q. Adjust R2 on squelch test box until the audio module test fixture REBRO LED lights.

r. Adjust the OUTPUT LEVEL control on signal generator no. 1 for minimum signal out. Note that the REBRO light goes out. If REBRO LED stays lit, perform steps p through r until REBRO LED lights at approximately .2 microvolt and off with minimum signal in.

s. Measure resistance of R31. Select a resistor close to the value of R31 and insert resistor in top board.

t. Check that REBRO LED lights at .2 to .4 microvolt and goes out with minimum signal in. Increase signal level to 1 millivolt. REBRO LED should remain lit.

u. Release the FMK/MHz pushbutton on signal generator no. 1.

v. Set the audio module test fixture SQUELCH switch to N/S.

w. Adjust R21 of the top board to mid range. (See figure 8-8.)

x. Adjust the OUTPUT LEVEL control of signal generator no. 1 for minimum signal out.

y. Adjust the OUTPUT LEVEL control until the REBRO LED lights. Output level of the signal generator should be approximately .3 to .8 microvolt.

z. Set the audio module test fixture SQUELCH switch to No/S.

aa. Return the switches and controls of signal generator no. 1 to initial setup positions.

6-28.5 Top Board RX Test. Perform the top board RX test by repeating paragraph 6-27.4, steps a through d.

6-28.6 Top Board TX Test. Perform the top board TX test as follows:

a. Repeat paragraph 6-27.6, steps a through h of bottom board test procedure.

b. Note level of signal on oscilloscope. It should be a minimum of 2 volts peak to peak.

c. Return the distortion analyzer switches and controls to initial setup positions.

d. Set the audio generator SINE WAVE AMPLITUDE switch to 3V. Level should remain constant ± 10B of the level obtained in paragraph 6-27.6 step c of bottom board test procedure.

e. Return the audio generator switches and controls to initial setup positions.

f. Disconnect the audio generator.

g. Set the audio generator TX/OFF/RX switch to RX.

NOTE

This completes the top board test procedures. Return all equipment to initial setup positions.

6-29. AUDIO MODULE SETUP AND TEST PROCEDURES. Setup and test procedures for the audio module are given in paragraphs 6-29.1 through 6-29.6.

6-29.1 Audio Module Setup. Prepare the audio module for test by inserting into bottom mounting board on the audio module test fixture.

6-29.2 Audio Module Current Check. Perform the audio module current check by repeating paragraph 6-27.2, steps a through g.

6-29.3 Audio Module Voltage Check. Perform the audio module voltage check as follows:

a. Repeat paragraph 6-27.3, steps a through e of bottom board test.

b. Depress the multimeter DCV FUNCTION pushbutton.

c. Depress the multimeter 20V RANGE switch.

d. Connect multimeter leads between +9 VDC and GND jacks on the audio test fixture. Observe polarity.

e. Repeat paragraph 6-28.3, steps d and e of top board test.

6-29.4 Audio Module RX Test. Perform the audio module RX test by repeating paragraph 6-27.4, steps a through j of bottom board test.

6-29.5 Audio Module Audio Response Test. Perform the audio module audio response test by repeating paragraph 6-27.5 steps a through k.

6-29.6 Audio Module TX Test. Perform the audio module TX test by repeating paragraphs 6-28.6, steps a through g.

6-29.7 Audio Module Squelch Test. Perform the audio module TX test by repeating paragraph 6-27.7, steps a through o.

NOTE

This completes the audio module test procedure. Return all test equipment to initial setup positions and secure all test equipment.

6-30. AUDIO MODULE TROUBLESHOOTING. Troubleshooting of the audio module is accomplished by making voltage and waveform measurements in accordance with tables 6-1 and 6-2 for the audio module top board and bottom board, respectively. Make voltage and waveform measurements with the initial setup of figure 8-26 and paragraph 6-26. The initial setup should be modified by changing radio's frequency in accordance with the FREQ column of tables 6-1 and 6-2 and applying power/signals in accordance with NOTES column of tables 6-1 and 6-2. Following is a definition of the notes.

NOTE	DEFINITION
1	Troubleshooting performed with: a. +14 VDC input power applied. b. +9 VDC input power applied. c. 1 kHz signal input at 1 microvolt. d. Radio VOLUME control at maximum. e. No/S-T/S-N/S switch on test fixture set to No/S.
2	Troubleshooting performed with: a. +14 VDC input power applied. b. +9 VDC input power applied. c. 1 kHz signal input at 10 microvolts. d. Radio VOLUME control at maximum. e. No/S-T/S-N/S switch on test fixture set to No/S.
3	Troubleshooting performed only with +14 VDC input power supplied.
4	Troubleshooting performed with: a. +14 VDC input power applied. b. +9 VDC input power applied. c. 1 kHz signal input at 1 microvolt. d. Radio VOLUME control at maximum. e. N/S-T/S-N/S switch on test fixture set to No/S. f. Potentiometers R17 and R24 set to maximum clockwise position.

NOTE	DEFINITION
5	Troubleshooting performed with: a. +14 VDC input power applied. b. +9 VDC input power applied. c. 1 kHz signal input at 10 microvolts. d. Radio VOLUME control at maximum. e. No/S-T/S-N/S switch on test fixture set to No/S. f. Potentiometers R17 and R24 set to maximum clockwise position.
6	Troubleshooting performed with: a. +14 VDC input power applied. b. Potentiometers R17 and R24 set to maximum clockwise position.
7	Troubleshooting performed with: a. +14 VDC input power applied. b. +9 VDC input power applied.

Table 6-1. Audio Module Top Board Voltage and Waveform Measurements

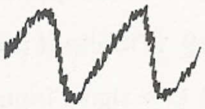
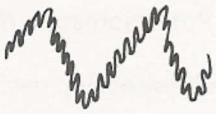
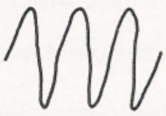
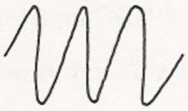
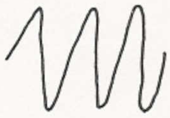
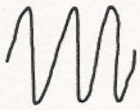
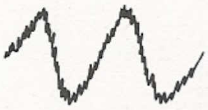
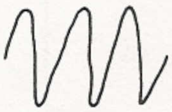
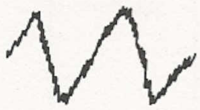
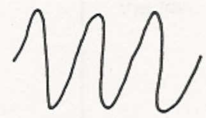
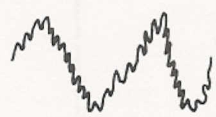
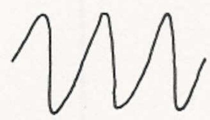
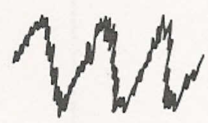
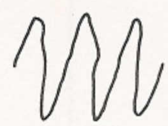
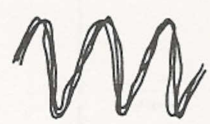
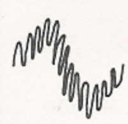
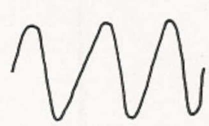
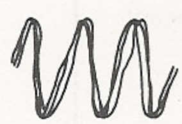
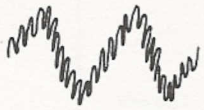
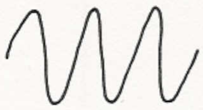
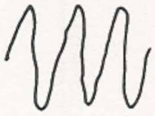
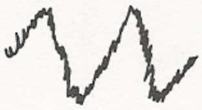
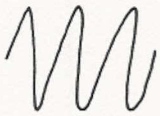
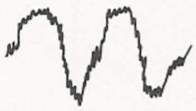
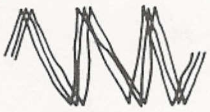
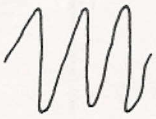
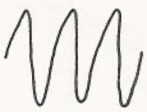
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
C3, D1, RFC-1		+3.24	100 mV	 + 3.39 / + 3.24 / + 3.09	1 kHz	1
C3, D1, RFC-1		+8.98				2
C3, D1, RFC-1		+6				3
C10, D2, D3		+4.1	300 mV	 + 4.6 / + 4.1 / + 3.6	150 Hz	1
C10, D2, D3		+2.39	2.1	 + 5.09 / + 2.39 / − .69	150 Hz	2
C10, D2, D3		+2.37	2.1	 + 5.37 / + 2.37 / − .63	150 Hz	3
C15, D4, D5		+1	.8	 + 2.75 / + 1 / − .25	Noise	1
C15, D4, D5		0		 + 60MV / 0 / − 60MV	1 kHz	2
C15, D4, D5		0				3
Q1	G	+4.51				1
Q1	G	+1.45				2
Q1	G	0				3
Q1	S	+4.45	0			1
Q1	S	+4.45	11 mV	 + 4.46 / + 4.45 / + 4.44	1 kHz	2
Q1	S	+4.45				3
Q1	D	+4.45				1
Q1	D	+4.45				3

Table 6-1. Audio Module Top Board Voltage and Waveform Measurements — Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q2	B	+4.12	120 mV	 + 4.32 + 4.12 + 3.92	1 kHz Mod.	1
Q2	B	+4.51	460 mV	 + 5.12 + 4.51 + 3.9	1 kHz	2
Q2	B	+4.17				3
Q2	E	+4.51				1
Q2	E	+4.51				2
Q2	E	+4.51				3
Q2	C	+.4				1
Q2	C	+1.45				2
Q2	C	0				3
Q3	G	+3.62				1
Q3	G	0				2
Q3	G	0				3
Q3	S	+4.51				1
Q3	S	+4.51				2
Q3	S	+4.51				3
Q3	D	+4.51				1
Q3	D	+4.51				2
R1, R2, C24		+4.51	19 mV	 + 4.54 + 4.51 + 4.48	1 kHz	1
R1, R2, C24		+6.53	40 mV	 + 6.58 + 6.52 + 6.46	1 kHz 1	2
R1, R2, C24		+4.51				3
R1, C1, C2		+4.51	24 mV	 + 4.56 + 4.57 + 4.46	1 kHz	1

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R10, R11, C25		+4.3	775 mV	 + 5.55 + 4.3 + 3.05	149 Hz	2
R10, R11, C25		+4.38	.78	 + 5.58 + 4.38 + 3.18	150 Hz	3
R11, R12		+4.1	200 mV	 + 4.35 + 4.1 + 3.85	150 Hz	1
R11, R12		+4.5	2.1	 + 7.15 + 4.15 + 1.15	150 Hz	3
R14, R21, C11		0	170 mV	 + .3 0 − .3	Noise	1
R14, R21, C11		0	30 mV	 + .45 0 − .45	1 kHz	2
R14, R21, C11		0				3
R16, R17		+2.86	280 mV	 + 3.36 + 2.86 + 2.36	1 kHz	4
R16, R17		+1.84	859 mV	 + 3.74 + 1.84 − .94	1 kHz Mod.	5
R16, R17		+2.7	.76V	 + 3.8 + 2.7 + 1.6	150 Hz	6
R17, R22, R23, R24		+2.86	280 mV	 + 3.36 + 2.86 + 2.36	1 kHz	4

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R17, R22, R23, R24		+2.92	850 mV	 + 4.82 + 2.92 + 1.02	1 kHz Mod.	5
R17, R22, R23, R24		+2.7	.76	 + 3.8 + 2.7 + 1.6	150 Hz	6
R19, C13, C14		0				1
R19, C13, C14		0	5 mV	 + 9MV 0 – 9MV	1 kHz	2
R19, C13, C14		0				3
R21, C13		0	80 mV	 + .15 – .15	Noise	1
R21, C13		0	143 mV	 + .21 0 – .21	1 kHz	2
R21, C13		0				3
R25, C5		+4.12	150 mV	 + 4.73 + 4.12 + 3.87	1 kHz	1
R25, C5		+4.51	350 mV	 + 5.01 + 4.51 + 4.01	1 kHz	2
R25, C5		+4.6				3
R27, R29, C18		+3.24	100 mV	 + 3.39 + 3.24 + 3.09	1 kHz	1
R27, R29, C18		+4.51	10 mV	 + 4.519 + 4.51 + 4.501	1 kHz	2
R27, R29, C18		+4.51				3
R34, C26		+9.03				3
R35, C20		0				1

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R35, C20		0				2
R35, C20		0				3
R39, C16, D5		+1.5	150 mV		Noise	1
R39, C16, D5		0				2
R39, C16, D5		+.6				3
U1	1	0				1
U1	1	1	+.84			2
U1	1	0				3
U1	2	0				1
U1	2	+.17				2
U1	2	0				3
U1	3	0				1
U1	3	+.19				2
U1	3	0				3
U1	4	0				1
U1	4	0				2
U1	5	+4.51				1
U1	5	+4.41	10 mV		1 kHz	2
U1	5	+4.45				3
U1	6	+4.47				1
U1	6	+4.51	10 mV		1 kHz	2
U1	6	+4.47				3
U1	7	+1.67	125 mV		1 kHz Mod.	1

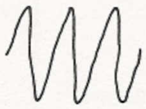
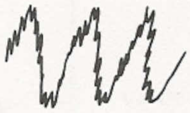
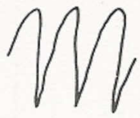
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
U1	7	+4.21	560 mV	 + 5.06 + 4.21 + 3.36	1 kHz	2
U1	7	+1.72				3
U1	8	+.52	80 mV	 + .67 + .52 + .37	1 kHz Mod.	1
U1	8	+8.98				2
U1	8	+.5				3
U2	1	+4.5	.5V	 + 5.25 + 4.5 + 3.75	1 kHz Mod.	1
U2	1	+.61	170 mV	 + .85 + .61 + .36	1 kHz	2
U2	1	+4.5				3
U2	2	+4.51	4 mV	 + 4.52 + 4.51 + 4.5	1 kHz	1
U2	2	+6.53	40 mV	 + 7.13 + 6.53 + 5.93	1 kHz	2
U2	2	+4.5				3
U2	3	+4.51				1
U2	3	+4.51				2
U2	3	+4.5				3
U2	4	+9.03				1
U2	4	+9.03				2
U2	4	+9.03				3
U2	5	+4.51				1
U2	5	+4.51	2.6 mV	 + 4.515 + 4.51 + 4.505	1 kHz	2

Table 6-1. Audio Module Top Board Voltage and Waveform Measurements – Continued

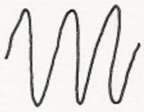
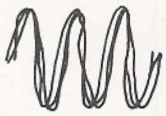
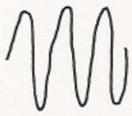
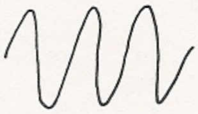
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U2	5	+4.51				3
U2	6	+4.51				1
U2	6	+4.51	2.6 mV	 + 4.515 + 4.51 + 4.505	1 kHz	2
U2	6	+4.51				3
U2	7	+.99	70 mV	 + 1.09 .99 – .89	1 kHz	1
U2	7	+4.27	2.26	 + 7.52 + 4.27 + 1.02	150 Hz	2
U2	7	+4.26	2.28	 + 7.36 + 4.26 + 1.16	150 Hz	3
U2	8	+4.48	120 mV	 + 4.62 + 4.48 + 4.33	1 kHz Mod.	1
U2	8	+4.48	36 mV	 + 4.54 + 4.48 + 4.42	1 kHz Mod.	2
U2	8	+4.48				3
U2	9	+4.51				1
U2	9	+4.51				2
U2	9	+4.51				3
U2	10	+4.51				1
U2	10	+4.51				2
U2	10	+4.51				3
U2	11	0				1
U2	11	0				2
U2	11	0				3
U2	12	+4.51				1
U2	12	+4.51				2
U2	12	+4.51				3

Table 6-1. Audio Module Top Board Voltage and Waveform Measurements — Continued

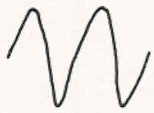
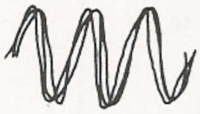
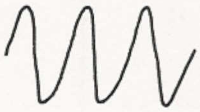
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U2	13, 14	+4.51				1
U2	13, 14	+4.51				2
U2	13, 14	+4.51				3
	MOD IN	0	10 mV	 + .009 0 – .009	1 kHz	2
	MOD OUT	+2.86	280 mV	 + 3.36 + 2.86 + 2.36	1 kHz	4
	MOD OUT	+2.7	.76	 + 3.8 + 2.7 + 1.6	150 Hz	6

Table 6-1. Audio Module Top Board Voltage and Waveform Measurements – Continued

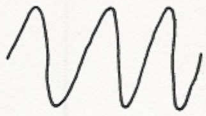
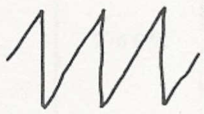
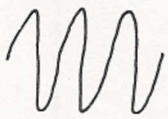
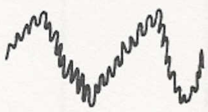
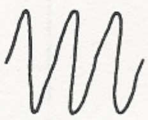
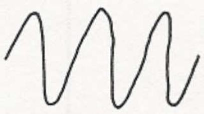
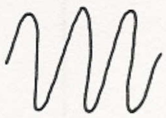
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R1, C1, C2		+6.52	40 mV	 + 6.58 + 6.52 + 6.46	1 kHz	2
R1, C1, C2		+4.51				3
R2, R13, C17		+4	0			1
R2, R13, C17		+.47	10 mV	 + .67 + .47 + .27	150 Hz	2
R2, R13, C17		+.44	.11	 + .64 + .44 + .24	150 Hz	3
R3, D1		+4.5				1
R3, D1		+8.49				2
R3, D1		+4.5				3
R5, C5		+.6	300 mV	 + 1.5 + .6 – .7	1 kHz	2
R5, C5		+4.5				3
R6, C8, C9		+4.4	150 mV	 + 4.6 + 4.4 + 4.2	1 kHz	1
R6, C8, C9		+4.4	775 mV	 + 5.65 + 4.4 + 3.15	152 Hz	2
R6, C8, C9		+4.4	.78	 + 5.6 + 4.4 + 3.2	150 Hz	1
R9, R14, C7		+4.4				1
R9, R14, C7		0				2
R9, R14, C7		0				3
R10, R11, C25		+4.5	50 mV	 + 4.37 + 4.3 + 4.23	150 Hz	1

Table 6-2. Audio Module Bottom Board Voltage and Waveform Measurements

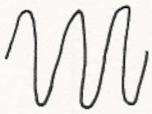
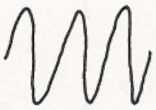
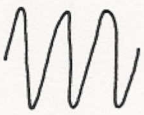
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C20, C21		+4.5				3
C21, D1, D2		0	144 mV	 +.23 / 0 / −.23	1 kHz Mod.	1
C21, D1, D2			300 mV	 +.45 / 0 / −.45	1 kHz	2
C21, D1, D2		0				3
Q1	B	+.69				1
Q1	B	0				2
Q1	B	+.69				3
Q1	E	0				1
Q1	E	0				2
Q1	E	0				3
Q1	C	+.1				1
Q1	C	+7.48				2
Q1	C	+.09				3
Q2	B	0				1
Q2	B	+.09				2
Q2	B	0				3
Q2	E	0				1
Q2	E	0				2
Q2	E	0				3
Q2	C	+4.5				1
Q2	C	+4.51	740 mV	 + 5.61 / + 4.51 / + 3.41	1 kHz	2
Q2	C	+4.51				3
Q3	B	+.46	60 mV	 +.55 / +.46 / +.37	1 kHz Mod.	1
Q3	B	+5.12	12 mV	 + 5.13 / + 5.12 / + 5.11	1 kHz	2

Table 6-2. Audio Module Bottom Board Voltage and Waveform Measurement — Continued

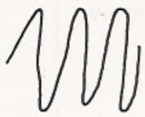
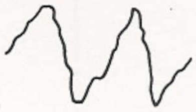
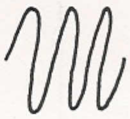
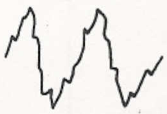
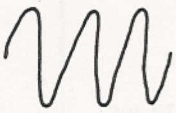
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q3	B	+.46				3
Q3	E	+4.51		 + 6.51 + 4.51 + 2.51	1 kHz Mod.	1
Q3	E	+4.5	12 mV	 + 4.51 + 4.5 + 4.49	1 kHz	2
Q3	E	+4.51				3
Q3	C	+4.51				1
Q3	C	+4.51	12 mV		1 kHz	2
Q3	C	+4.51				3
R3, C22		+8.61				1
R3, C22		+8.76				2
R3, C22		+8.76				3
R4, D3		+.18	.58 mV	 + .27 + .18 + .09	1 kHz Mod.	1
R4, D3		+8.44				2
R4, D3		+.18				3
R14, C7, C8		+4.5	175 mV	 + 4.81 + 4.5 + 4.19	1 kHz Mod.	1
R14, C7, C8		+4.5	367 mV	 + 5.05 + 4.5 + 3.95	1 kHz	2
R14, C7, C8		+4.5				3
R15, R18, C11		+4.5	330 mV	 + 5 + 4.5 + 4	1 kHz Mod.	1
R15, R18, C11		+4.5	700 mV	 + 5.5 + 4.5 + 3.5	1 kHz	2
R15, R18, C11		+4.5				3

Table 6-2. Audio Module Bottom Board Voltage and Waveform Measurements – Continued

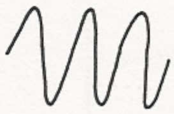
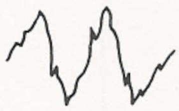
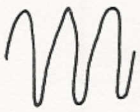
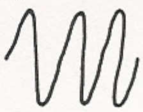
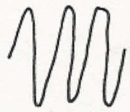
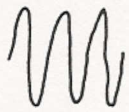
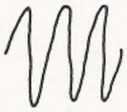
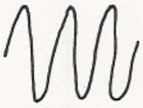
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R18, R19, C9		+4.5	370 mV	 + 5.1 + 4.5 + 3.9	1 kHz Mod.	1
R18, R19, C9		+4.5	800 mV	 + 5.7 + 4.5 + 3.3	1 kHz	2
R18, R19, C9		+4.5				3
R28, C19, C20		+4.5	140 mV	 + 4.72 + 4.5 + 4.28	1 kHz Mod.	1
R28, C19, C20		+4.51	300 mV	 + 4.96 + 4.51 + 4.06	1 kHz	2
R28, C19, C20		+4.51				3
R32, C18, C19		+4.50	130 mV	 + 4.7 + 4.5 + 4.3	1 kHz Mod.	1
R32, C18, C19		+4.5	300 mV	 + 4.95 + 4.5 + 4.05	1 kHz	2
R32, C18, C19		+4.5				3
U1	1	+4.51	350 mV	 + 5.11 + 4.51 + 3.91	1 kHz Mod.	1
U1	1	+4.51	790 mV	 + 5.71 + 4.51 + 3.31	1 kHz	2
U1	1	+4.51				3
U1	2	+4.51	AB	 + 4.81 + 4.51 + 4.21	1 kHz Mod.	1
U1	2	+4.51	350 mV	 + 5.01 + 4.51 + 4.01	1 kHz	2

Table 6-2. Audio Module Bottom Board Voltage and Waveform Measurements — Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U1	2	+4.51				3
U1	3	+4.51	170 mV	 + 4.8 + 4.51 + 4.22	1 kHz Mod.	1
U1	3	+4.51	350 mV	 + 5.01 + 4.51 + 4.01	1 kHz	2
U1	3	+4.51				3
U1	4	0			1 kHz Mod.	1
U1	4	+8.76				3
U1	4	+8.73				7
U1	5	+4.51	125 mV	 + 4.73 + 4.51 + 4.28	1 kHz Mod.	1
U1	5	+4.51				3
U1	5	+4.51	260 mV	 + 4.91 + 4.51 + 4.11	1 kHz	7
U1	6	+4.51	125 mV	 + 4.73 + 4.51 + 4.28	1 kHz Mod.	1
U1	6	+4.51				3
U1	6	+4.51	260 mV	 + 4.91 + 4.51 + 4.11	1 kHz	7
U1	7	+4.51	165 mV	 + 4.78 + 4.51 + 4.25	1 kHz Mod.	1
U1	7	+4.51				3
U1	7	+4.51	340 mV	 + 5.01 + 4.51 + 4.01	1 kHz	7

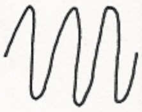
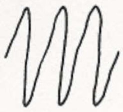
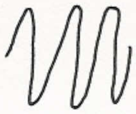
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
U1	8	+4.51	1.34	 + 6.51 + 4.51 + 6.51	1 kHz Mod.	1
U1	8	+4.51				3
U1	8	+4.5	120 mV	 + 4.67 + 4.5 + 4.33	1 kHz	7
U1	9	+4.51				1
U1	9	+4.51				3
U1	9	+4.51				7
U1	10	+4.51				1
U1	10	+4.51				2
U1	10	+4.51				3
U1	11	0				1
U1	11	0				2
U1	11	0				3
U1	12	+4.5		 + 5.1 + 4.5 + 3.9	1 kHz Mod.	1
U1	12	+4.5	700 mV	 + 5.5 + 4.5 + 3.5	1 kHz	2
U1	12	+4.5				3
U2	5	+4.51				1
U2	5	+4.51				2
U2	5	+4.51				3
U2	6	+4.51				1
U2	6	+4.51				2
U2	6	+4.51				3
U2	7	0				1
U2	7	0				2
U2	7	0				3
U2	8	0				1
U2	8	0				2

Table 6-2. Audio Module Bottom Board Voltage and Waveform Measurements – Continued

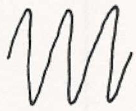
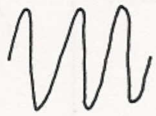
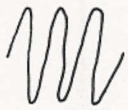
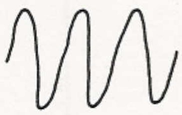
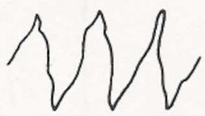
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U2	8	0				3
U1	13	+4.51	355 mV	 + 5.1 + 4.51 + 3.91	1 kHz Mod.	1
U1	13	+4.5	700 mV	 + 5.5 + 4.5 + 3.5	1 kHz	2
U1	13	+4.51				3
U1	14	+4.5	780 mV	 + 5.6 + 4.5 + 3.4	1 kHz	1
U1	14	+4.49	1.63	 + 6.69 + 4.49 + 2.09	1 kHz	2
U1	14	+4.5				3
U2	1, 2	+.1	30 mV	 +.145 +.1 +.055	1 kHz Mod.	1
U2	1, 2	+4.27			1 kHz	2
U2	1, 2	0				3
U2	3	+4.42				1
U2	3	0				2
U2	3	+4.42				3
U2	4	0				1
U2	4	+.09				2
U2	4	+4.42				3
U2	9	+3.08				1
U2	9	+3.9				2
U2	9	0	98 mV	 + .15 0 – .15	150 Hz	3
U2	10	+4.51				1
U2	10	+4.51				2
U2	10	+4.51				3

Table 6-2. Audio Module Bottom Board Voltage and Waveform Measurements – Continued

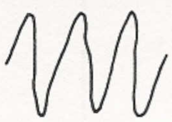
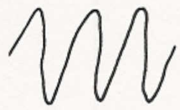
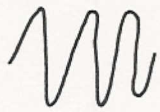
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
U2	11	+4.51				1
U2	11	+4.51				2
U2	11	+4.51				3
U2	12	0				1
U2	12	0				2
U2	12	0				3
U2	13	0				1
U2	13	0				2
U2	13	0				3
U2	14	+4.51				1
U2	14	+4.51				2
U2	14	+4.51				3
U3	1	+9.03				1
U3	1	+9.03				2
U3	1	+9.03				3
U3	2	+5.14				1
U3	2	+5.14				2
U3	2	+5.14				3
U3	3	0				1
U3	3	0				2
U3	3	0				3
U3	4	+14				1
U3	4	+14				2
U3	4	+14				3
BATT IN		+14				1
BATT IN		+14				2
BATT IN		+14				3
VOL IN		0	800 mV	 + 1.25 – 0 – 1.25	1 kHz Mod.	1
VOL IN			1.65	 + 2.4 0 + 2.4	1 kHz	2

Table 6-2. Audio Module Bottom Board Voltage and Waveform Measurements – Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
VOL OUT		0	800 mV	 + 1.25 / + 0 / − 1.25	1 kHz Mod.	1
VOL OUT			1.65	 + 2.4 / 0 / − 2.4	1 kHz	2
VOL OUT		0				3
VCC OUT		+9.03				1
VCC OUT		+9.03				2
VCC OUT		+9.03				3

6-31. TRANSMITTER MODULE PERFORMANCE TESTING.

Perform the procedures in paragraphs 6-32 and 6-33 to test a transmitter module as if suspected of being faulty or to test a module after repair.

6-32. TEST EQUIPMENT REQUIRED. Test equipment required to test the transmitter module is listed below:

a. Transmitter module test fixture - ETI part no. TD-0015.

b. DC power supply - Power Designs, Inc. Model 6050A, or equivalent.

c. Multimeter - Fluke 8000A, or equivalent.

d. Wattmeter - Motorola Model S1350A, or equivalent.

e. 50-watt load - Narda Model 765-10, or equivalent.

6-33. INITIAL SETUP. Connect equipment and make initial switch settings described below before performing the transmitter module performance tests of paragraph 6-35.

a. Set the transmitter module test fixture +9VTX switch to OFF.

b. Set the transmitter module test fixture FREQUENCY SELECT switches 30.000 MHz.

c. Set the DC power supply VOLTAGE switch to 60V.

d. Set the DC power supply CURRENT LIMIT switch to 5A.

e. Set the DC power supply CURRENT adjust control to mid-range.

f. Turn on the DC power supply.

g. Adjust the DC power supply VOLTAGE control for an 11 VDC output as indicated on the power supply meter then turn the DC power supply POWER ON/RESET switch to RESET.

h. Connect the DC power supply to the transmitter module test fixture.

i. Connect a 50-watt load to the wattmeter and connect wattmeter to TX RF OUT jack on the transmitter module test fixture.

j. Insert the transmitter module in transmitter module test fixture connector.

k. Screw the transmitter module to heat sink on the transmitter module test fixture using four jam screws.

6-34. TRANSMITTER MODULE TEST PROCEDURES. Test procedures for the transmitter module are given in paragraphs 6-34.1 through 6-34.3.

6-34.1 Transmitter Module Current Check. Perform the transmitter module current check as follows:

a. Remove the jumper from the CURRENT CHECK jacks on the transmitter module test fixture.

CAUTION

Observe caution while performing steps b through e to prevent damage to the equipment.

b. Connect leads between the transmitter module test fixture CURRENT CHECK jacks and MA INPUT and COMMON jacks of the multimeter. Observe polarity.

c. Depress the multimeter DCMA FUNCTION pushbutton.

d. Depress the multimeter 2000 MA RANGE pushbutton.

e. Turn on the DC power supply and observe current indication on the multimeter. Current consumption should be approximately 800 MA .

f. Set the transmitter module test fixture ON/OFF switch to ON.

g. Check for proper current consumption in accordance with step e above. If current consumption is excessive or power supply faults, turn off power supply. Isolate faults before continuing.

6-34.2 Transmitter Module Voltage Check. Perform the transmitter module voltage check as follows:

a. Turn off the DC power supply.

b. Set the transmitter module test fixture +9V TX switch to OFF.

c. Remove multimeter leads from CURRENT CHECK jacks on the transmitter module test fixture.

d. Insert the jumper between the CURRENT CHECK jacks on the transmitter module test fixture.

e. Depress the multimeter DC V pushbutton.

f. Depress the multimeter 20 MA pushbutton.

g. Connect leads to the multimeter V-Ω INPUT and COMMON jacks.

h. Turn on the DC power supply.

i. Set the transmitter module +9V TX switch to ON.

j. Measure voltage at TP1 on transmitter module. Refer to the transmitter module schematic diagram, figure 8-11, for location of test points. Voltage at TP1 should be +9 VDC.

k. Measure voltage at TP2 on transmitter module. Voltage at TP2 should be +11 VDC.

6-34.3 Power Output Tests. Perform the transmitter power output test as follows:

a. Check transmitter power output in watts on the wattmeter. Power output should be 2 watts minimum with 10 MW input.

b. Check entire 30 - 50 MHz band at 1 MHz steps for 1.5 watt minimum output using FREQUENCY SELECT switches on the transmitter module test fixture.

6-35. TRANSMITTER MODULE TROUBLESHOOTING. Troubleshooting of the transmitter module is accomplished by making voltage and waveform measurements in accordance with table 6-3. Make voltages and waveform measurements with the initial setup of figure 8-29 and paragraph 6-33. The initial setup should be modified by changing radio's frequency in accordance with the FREQ column of table 6-3 and applying power/signals in accordance with NOTES column of table 6-3. Following is a definition of the notes.

NOTE	DEFINITION
1	Troubleshooting performed with:
	a. 12V battery input.
	b. +9VDC TX input power applied.
	c. Synth set at 30 MHz.

Table 6-3. Transmitter Module

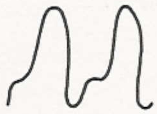
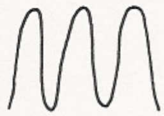
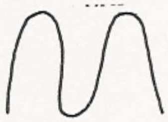
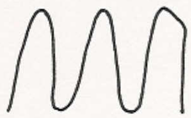
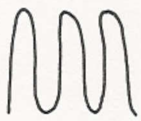
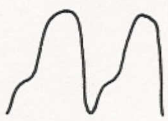
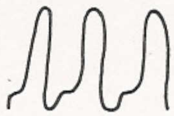
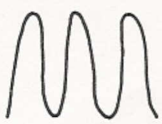
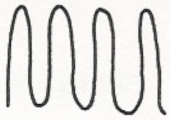
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
Q1	B	.63				1
Q1	E	+9.0				1
Q2	Input			 – 8.5V – 0V – 8.5V		1
Q2	Output			 – 11V – 0V – 11V		1
R1, R3, TX Input		3.8 p-p		 – 1.75V – 0V – 1.75V		1
R2, R3, C1		3.0 p-p		 – 1.5V – 0V – 1.5V		1
R4, D1, C2, RFC1		.63				1
R5, C4, RFC2, T1		9.0				1
R6, C3, RFC2		9.0				1
C1, Output		48 p-p		 – 24V – 0V – 24V		
C4, C7, RFC3, T2		12				
C5, T1		16 p-p		 – 8V – 0V – 8V		1
C6, RFC4		18 p-p		 – 9V – 0V – 9V		1
C8, C10		46 p-p		 23V 0V 23V		

Table 6-3. Transmitter Module – Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C8, T2		46 p-p		 – 23V – 0V – 23V		1
C12, T2, RFC4		12				
C13, RFC3		12				

6-36. RECEIVER MODULE PERFORMANCE TESTING.

Perform the procedures of paragraphs 6-37 through 6-44 to test a receiver module if suspected of being faulty or to test a module after repair.

6-37. TEST EQUIPMENT REQUIRED. Test equipment required to test the receiver module is listed below:

a. DC power supply -- Power Designs, Inc. Model 6050A, or equivalent.

b. Receiver module test fixture -- ETI part no. TP-0012.

c. Multimeter – Fluke Model 8000A, or equivalent.

d. Oscilloscope – Tektronix 475, or equivalent.

e. Signal generator – Hewlett-Packard 8640B, or equivalent (2 required).

f. Distortion Analyzer -- Hewlett-Packard 331A, or equivalent.

g. Tracking generator – Hewlett-Packard 8443A, or equivalent.

h. Display section – Hewlett-Packard 141T, or equivalent.

i. Spectrum analyzer RF section – Hewlett-Packard 8554B, or equivalent.

j. Spectrum analyzer IF section -- Hewlett-Packard 8552B, or equivalent.

k. Known good receiver bottom board --- ETI part no. 8306.

l. Known good receiver top board -- ETI part no. 8307.

m. Three jumper pins – Cambion 16mm, or equivalent.

n. Coax cables – three with angle BNC connectors both ends, one with male BNC (No banana plugs).

o. Coax cables – two special with male BNC connectors on one end.

p. BNC T—connector.

6-38. INITIAL SETUP. Connect equipment and make initial switch settings described below before performing the receiver module performance tests, beginning with paragraph 6-39.

a. Set the receiver test fixture ON/OFF switch to ON.

b. Turn on the spectrum analyzer display section, distortion analyzer, signal generators, oscilloscope, and multimeter.

c. Set the DC power supply switches and controls as follows:

Switch/Control	Setting
VOLTAGE switch	60V
CURRENT LIMIT switch	500 MA (.5A)
CURRENT adjust control	Mid-range
POWER ON/RESET switch	Power On

d. Adjust the VOLTAGE control on the DC power supply for a 12 VDC output as indicated on the power supply meter. Then turn the power supply POWER ON/RESET switch to RESET.

e. Connect the DC power supply to the receiver module test fixture. Observe polarity -- (red to red and black to black).

f. Connect the T—connector to the receiver module test fixture AUDIO OUT connector.

g. Set signal generator no. 1 switches and controls as follows:

Switch/Control	Setting
FM switch	INT
MODULATION FREQUENCY control	1 KHz
FM K/MHz pushbutton	Depressed
Peak DEVIATION FM control	Adjust for 5 KHz deviation on 0-5 scale of meter.
LEVEL VOLTS pushbutton	Depressed
INT/EXT pushbutton	Depressed
LOCK ON pushbutton	Released
RANGE switch	64-32
FREQUENCY control	35.500 MHz
LOCK ON pushbutton	Depressed
RF pushbutton	Depressed

h. Connect signal generator no. 1 to RF IN jack of receiver module test fixture.

i. Set signal generator no. 2 switches and controls as follows:

Switch/Control	Setting
FM switch	OFF
LEVEL VOLTS pushbutton	Depressed
RANGE switch	64-32
INT/EXT pushbutton	Depressed
EXPAND pushbutton	Released
FREQUENCY control	62.500 MHz
RF pushbutton	Depressed
OUTPUT LEVEL control	0 DBM

j. Adjust the outside knob of the OUTPUT LEVEL control to .3V (300 millivolts) as read on dB scale (bottom scale) of meter.

k. Connect signal generator no. 2 to SYN IN jack of receiver module test fixture.

l. Set the distortion analyzer FUNCTION switch to VOLTMETER.

m. Set the distortion analyzer METER RANGE switch to 3 VOLTS.

n. Connect distortion analyzer to one end of the T–connector on the receiver module test fixture AUDIO OUT jack.

o. Set the oscilloscope VERT MODE switch to CH2.

p. Set the oscilloscope VOLTS/DIV switch to 50 MV and the TIME/DIV switch to .2MS.

q. Connect oscilloscope CH2 INPUT to one end of the T–connector on receiver module test fixture AUDIO OUT jack.

r. Set the tracking generator FUNCTION switch to TRACK ANALYZER and the RF LEVEL to all zeros.

s. Set the spectrum analyzer switches and controls as follows:

Switch/Control	Setting
RESOLUTION BW control	300 KHz
FREQ SPAN/DIV control	1 MHz
FREQUENCY BAND 0-15 GHz pushbutton	Depressed
INPUT ATTEN control	10 dB
VIDEO FILTER control	10 KHz
TIME/DIV switch	5 MS
LOG REF LEVEL control	0 dB
SCAN MODE switch	INT
TRIGGER switch	AUTO
LINEAR SENSITIVITY control	0
2 dB LOG/10 dB LOG/LIN pushbuttons	10 dB LOG depressed
WRITING SPEED control	STD

6-39. BOTTOM BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the receiver module bottom board are given in paragraphs 6-39.1 through 6-39.4.

6-39.1 Receiver Filter Test. Perform the receiver filter test as follows:

a. Using special cable, connect tracking generator RF output to RF input of receiver bottom board. (See figure 8-16 for parts location).

b. Connect remaining special cable from junction of C4 and TFM-2 on receiver bottom board to spectrum analyzer RF input jack.

c. Connect the shield of the special cables to ground on bottom of receiver bottom board.

d. Adjust the spectrum analyzer FREQ SPAN/DIV fine tune control until 16.17 MHz is displayed on the tracking generator display.

e. Tune coil L1 (see figure 8-16) to center the marker on the bottom center of notch of signal on display section by spreading or compressing windings of the coil.

f. Adjust the spectrum analyzer FREQ SPAN/DIV fine tune control until 27.00 MHz is displayed on the tracking generator display.

g. Tune coil L2 (see figure 8-16) to center the marker on the bottom center of notch of signal on display section by spreading or compressing windings of the coil.

h. Adjust the spectrum analyzer FREQ SPAN/DIV fine tune control until 24.28 MHz is displayed on the tracking generator display.

i. Tune coil L3 (see figure 8-16) to center the marker on the bottom center of notch of signal on display section by spreading or compressing windings of the coil.

j. Set the spectrum analyzer FREQ SPAN/DIV fine tune control to .1 MHz.

k. Repeat steps d through i in order to fine tune the coils.

l. Set the spectrum analyzer FREQ SPAN/DIV fine tune control to 2 MHz.

m. Depress the spectrum analyzer 2 dB LOG pushbutton.

n. Adjust the spectrum analyzer FREQ SPAN/DIV fine tune control until 30.000 MHz is displayed on the tracking generator display.

o. Adjust the spectrum analyzer LINEAR SENSITIVITY control until the top point of the signal on the right side of the center marker is even with the top line on the display section. The marker should be lower than the first line down from the top (no more than 2 dB).

p. Depress the spectrum analyzer 10 dB LOG pushbutton.

q. Adjust the spectrum analyzer FREQ SPAN/DIV fine tune control until 27.000 MHz is displayed on the tracking generator display. The marker should be more than -45 dB down from the top line of display section.

r. Adjust the spectrum analyzer FREQ SPAN/DIV fine tune control to observe top point of each of the three bumps. They should be approximately -45 dB down from top line of the display section.

s. Seal all coils with wax.

t. Disconnect cables from receiver bottom board.

u. Disconnect cables from tracking generator and spectrum generator RF section.

6-39.2 Receiver Bottom Board Setup. Perform the following procedures to prepare the receiver bottom board for test:

a. Insert bottom board to be tested into bottom mounting board.

b. Insert three jumper pins into sockets to complete electrical connections (see figure 8-16).

c. Insert known good top board into top mounting board.

6-39.3 Receiver Bottom Board Current Check. Perform the receiver bottom board current check as follows:

a. Remove jumper wire from receiver module test fixture CURRENT CHECK jacks.

b. Connect leads between the receiver module test fixture CURRENT CHECK jacks and MA INPUT and COMMON jacks of the multimeter. Observe polarity (red to red and black to black).

c. Depress the multimeter DCMA FUNCTION pushbutton.

d. Depress the multimeter 200 MA RANGE pushbutton.

CAUTION

Exercise caution while performing steps e through g to prevent damage to the equipment

e. Turn on the power supply.

f. Set the receiver module test fixture ON/OFF switch to ON.

g. Observe current indication on the multimeter current consumption should be approximately 15 to 30 MA. If current consumption is excessive or power supply faults, turn off power supply. Isolate faults before continuing.

h. Turn off the power supply.

i. Disconnect the multimeter and replace current jumper wire.

j. Set the receiver module test fixture ON/OFF switch to OFF.

6-39.4 Receiver Bottom Board Alignment Procedures. Perform the receiver bottom board alignment procedures as follows:

a. Turn on the DC power supply.

b. Set the receiver test fixture ON/OFF switch to ON.

c. Set the signal generator OUTPUT LEVEL control to approximately .1V (100 MV).

d. Set the distortion analyzer FUNCTION switch to SET LEVEL.

e. Set the distortion analyzer METER RANGE switch to .03 (-2 dB).

f. Adjust the distortion analyzer SENSITIVITY selector and SENSITIVITY VERNIER to 0 dB on meter.

g. Set the distortion analyzer FUNCTION switch to DISTORTION.

h. Adjust L6 on receiver bottom board (see figure 8-16) for maximum dip on distortion analyzer.

i. Reduce setting of signal generator no. 1 OUTPUT LEVEL control until the pointer on the meter is at approximately -5 dB (top scale).

j. Adjust L4 and L5 (see figure 8-16) for maximum dip on distortion analyzer.

k. Reduce setting of signal generator no. 1 OUTPUT LEVEL control until the pointer on the meter is at approximately -5 dB (top scale).

l. Repeat steps h through k until the maximum dip possible is obtained on the distortion analyzer.

m. Adjust T2 and T3 (see figure 8-16) for maximum dip on the distortion analyzer.

n. Adjust the OUTPUT LEVEL control of signal generator no. 1 until -10 dB is indicated on the distortion analyzer.

o. Adjust L6 (see figure 8-16) to the left until level on the meter drops, then to the right until the level drops. Then set L6 to the midpoint of the two points.

p. Retune L4, L5, T2, and T3 in order.

q. Adjust the OUTPUT LEVEL control of signal generator no. 1 until -10 dB is indicated on the distortion analyzer. Output level of signal generator no. 1 should be .4 to .6 microvolts.

r. Turn off power supply and receiver module test fixture.

NOTE

This completes the receiver bottom board test procedures.

6-40. TOP BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the receiver module top board are given in paragraphs 6-40.1 through 6-40.3.

6-40.1 Receiver Top Board Test Setup. Perform the following procedures to prepare the receiver top board for test:

a. Insert top board to be tested into top mounting board.

b. Insert known good bottom board into bottom mounting board.

c. Insert three jumper pins into sockets to complete electrical connection. (See figure 8-14).

6-40.2 Receiver Top Board Current Check. Perform the receiver top board current check by repeating paragraph 6-40.3 steps a through h.

6-40.3 Receiver Top Board Alignment Procedures. Perform the receiver top board alignment procedures as follows:

a. Turn on the DC power supply.

b. Set the distortion analyzer FUNCTION switch to VOLTMETER.

c. Set the distortion analyzer METER RANGE switch to -10 dB.

d. Adjust setting of signal generator no. 1 OUTPUT LEVEL control to 1 MV.

e. Set the receiver module test fixture ON/OFF switch to ON.

f. Tune L1 on receiver top board (see figure 8-14) for maximum signal on distortion analyzer (approximately 60 MV).

g. Observe oscilloscope for a signal having an amplitude of approximately 200 MV (four divisions, top of signal to bottom of signal).

h. Turn power supply and receiver module test fixture off.

NOTE

This completes top board alignment procedures.

6-41. RECEIVER MODULE SETUP AND TEST PROCEDURES. Setup and test procedures for the receiver module are given in paragraphs 6-41.1 and 6-41.2.

6-41.1 Receiver Module Setup. Prepare the receiver module for test by inserting into receiver bottom mounting board.

6-41.2 Receiver Module Current Check. Perform the receiver module current check as follows:

a. Turn off the DC power supply.

b. Set the receiver test fixture ON/OFF switch to OFF.

c. Set the distortion analyzer METER RANGE switch to –10 dB.

e. Adjust the distortion analyzer SENSITIVITY selector and SENSITIVITY VERNIER to 0 dB on meter.

f. Set the distortion analyzer FUNCTION switch to DISTORTION.

g. Adjust the OUTPUT LEVEL control of signal generator no. 1 for a –10 dB indication on distortion analyzer. Output level on signal generator no. 1 should be .4 microvolts. If unable to obtain .4 microvolts, perform paragraph 6-39.3, steps c through g of the bottom board test procedures.

h. Adjust the OUTPUT LEVEL control of signal generator no. 1 to 1 MV.

i. Observe the oscilloscope for a signal having an amplitude of approximately 200 MV (four divisions, top of signal to bottom of signal).

NOTE

This completes receiver module test procedues. Secure all test equipment.

6-42. RECEIVER MODULE TROUBLESHOOTING. Troubleshooting of the receiver module is accomplished by making voltage and waveform measurements in accordance with tables 6-4 and 6-5 for the receiver module top board and bottom board, respectively. Make voltage and waveform measurements with the initial setup of Figure 8-30 and paragraph 6-38. The initial setup should be modified by changing radio's frequency in accordance with the FREQ column of tables 6-4 and 6-5 and applying power/signals in accordance with NOTES column of tables 6-4 and 6-5. Following is a definition of the notes.

NOTES	DEFINITION
1.	Troubleshooting performed with +9VDC input power applied. No signal.
2.	Troubleshooting performed with a. +9VDC input power applied. b. 30 MHz IF input signal. c. 60 MHz synth signal.
3.	Troubleshooting performed with a. +9VDC input power applied. b. 30 MHz IF input signal. c. 60 MHz synth signal. d. Noise input signal.

Table 6-4. Receiver Module Top Board Voltage and Waveform Measurements

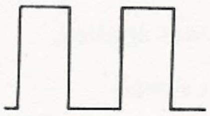
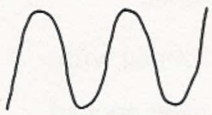
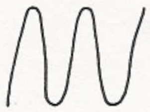
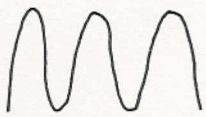
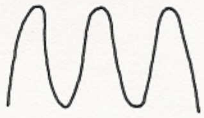
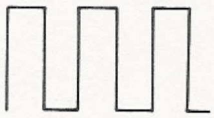
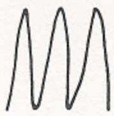
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U1	6			 - 2.8V OV	56.7 MHz	3
U1	7			 - 5V - OV - 4.5V	56.8 MHz	3
U1	8	+5.2				1
U1	8			 - IV OV - IV		3
U1	9	+3.48				1
U1	9			 - 5V - OV - 4.5V	56.8 MHz	3
U1	9			 - 5V - OV - 4.5V	56.7 MHz	3
U1	10	+1.92				1
U1	10			 - 2.8V OV	57.0 MHz	3
U1	11	+6.70				1
U1	13	+1.92				1
U1	14	$1.92				1
R2, RFC1		+9.0				1
C8, RFC2		+9.0				1
AF OUT				 - 4.5 MV - OV - 4.5 MV		2
						1
						1
						1

Table 6-5. Receiver Module Bottom Board Voltage and Waveform Measurements

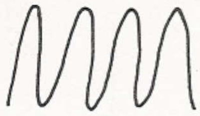
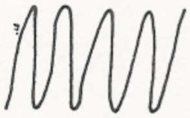
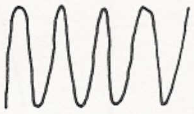
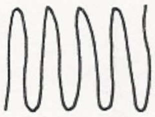
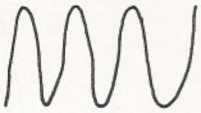
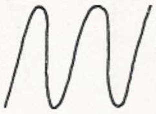
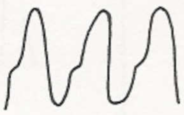
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q1	C	+9.1				1
Q1	D	+1.7				1
Q1	D			 - 6 MV OV - 6 MV		
Q2	S	+9				1
Q2	S			 - 10 MV OV - 10 MV		2
Q2	S			 - 24 MV - OV - 24 MV		3
Q2	D	+2.1				1
Q2	D			 24 MV OV 24 MV		2
Q3	G-1	+9				1
Q3	G-2			 - 24 MV OV - 24 MV		2
Q3	S	+9				1
Q3	S			 - 28 MV OV - 28 MV		2
Q3	D	+.8				1
Q4	B	+3.7				1
Q4	E	+4.3				1
Q4	C	+7.5				1
Q4	C			 100 MV OV 90 MV		2

Table 6-5. Receiver Module Bottom Board Voltage and Waveform Measurements – Continued

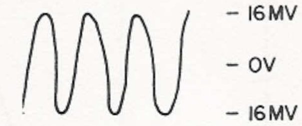
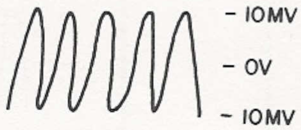
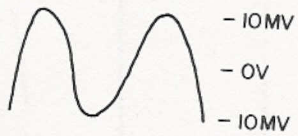
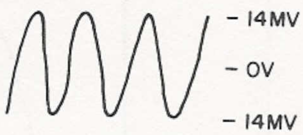
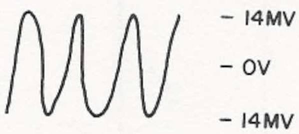
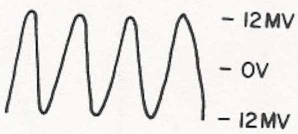
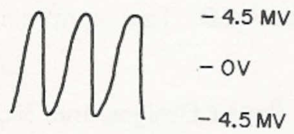
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U2						2
U3	4					1
U3	6	+6.41				1
U3	8	+3.3				1
U3	9	+6.4				1
U3	10	+2.4				1
R1, T1, C12		+1.7				1
R1, T1, C12						2
R6, C33, RFC4		+9.0				1
R6, C33, RFC5		+9.0				1
R7, RFC5		+9.0				1
R10, L6		+7.4				1
C1, C2, L1					540 KHz	2
C2, C3, C24, L2						2
C3, C4, C29, L3						2
C11, T1						2
C11, T1		+1.7				1
C23, T2, RFC4		+9.0				1

Table 6-5. Receiver Module Bottom Board Voltage and Waveform Measurements – Continued

DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
RFC3, L5		+9.0				1
IF OUT						2

6-43. SYNTHESIZER MODULE PERFORMANCE TESTING.

Perform the procedures of paragraphs 6-44 through 6-48 to test a synthesizer module if suspected of being faulty or to test a module after repair.

6-44. TEST EQUIPMENT REQUIRED. Test equipment required to test the synthesizer module is listed below:

a. DC Power Supply - Power Designs, Inc. Model 6050A, or equivalent.

b. Synthesizer module test fixture - ETI part no. TP-0014.

c. Multimeter - Fluke Model 8000A, or equivalent.

d. Oscilloscope - Tektronix 475, or equivalent.

e. Frequency counter - Fluke Model 1925A, or equivalent.

f. Spectrum analyzer - Hewlett-Packard 8559A, or equivalent.

g. Deviation meter - Marconi Instruments TF-2304, or equivalent.

h. Audio oscillator - Heath model SG-5218.

i. Known good bottom board ETI part no. 8312.

j. Known good top board - ETI part no. 8313.

k. Eight jumper pins - Cambion 20 mm, or equivalent.

l. Three coax cables - male ends.

6-45. INITIAL SETUP. Connect equipment and make initial switch settings described below before performing the synthesizer module performance tests, beginning with paragraph 6-47.

a. Set the synthesizer module test fixture FREQUENCY SELECT switches to 30.000 MHz.

b. Set the synthesizer module test fixture TX/OFF/RX switch to OFF.

c. Set the DC power supply switches and controls as follows:

Switch/Control	Setting
VOLTAGE switch	60V
CURRENT LIMIT switch	500MA (.5A)
CURRENT adjust control	Mid-range
POWER ON/RESET switch	POWER ON

d. Adjust the VOLTAGE control on the DC power supply for a +11 VDC output as indicated on the power supply meter. Then turn the power supply POWER ON/RESET switch to RESET.

e. Connect the DC power supply to the synthesizer module test fixture. Observe polarity — (red to red and black to black).

6-46. BOTTOM BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the synthesizer module bottom board are given in paragraphs 6-46.1 through 6-46.4.

6-46.1 Current Consumption and Input Voltage Check. Perform the bottom board current consumption and input voltage check as follows:

a. Insert the bottom board to be tested into bottom mounting board on the synthesizer module test fixture.

b. Insert eight jumper pins into bottom board sockets to complete electrical connection. (See figure 8-20).

c. Insert known good synthesizer top board into top mounting board on the synthesizer module test fixture.

d. Remove jumper wire from synthesizer module test fixture CURRENT CHECK jacks.

e. Connect leads between the synthesizer module test fixture CURRENT CHECK jacks and MA INPUT and COMMON jacks of the multimeter. Observe polarity — (red to red and black to black).

f. Depress the multimeter DCMA FUNCTION pushbutton.

g. Depress the multimeter 200 MA RANGE pushbutton.

CAUTION

Observe caution while performing steps h through i to prevent damage to the equipment.

h. Turn on the power supply.

i. Observe current indicator on the multimeter. Current consumption should be approximately 20 to 50 MA. If current consumption is excessive or power supply faults, turn off power supply. Insulate faults before continuing.

j. Turn off the power supply.

k. Disconnect the multimeter and replace current jumper wire.

l. Connect the multimeter leads between the V-r and COMMON jacks.

m. Depress the multimeter DCV FUNCTION switch.

n. Depress the multimeter 20V RANGE pushbutton.

o. Turn on the power supply.

p. With respect to ground, check voltages on each side of six RF chokes to ensure proper electrical connection (RFC-X1 and RFC-X2 will be approximately +5.5 VDC due to Zener diode). (Refer to figure 8-20 for choke location).

6-46-2. 5 MHz Oscillator Frequency Adjust. Perform the 5 MHz oscillator frequency adjustment as follows:

NOTE

Provision is made to use two capacitors in parallel to tune the 5 MHz oscillator. The first value should be approximately 27-39 PF. The second capacitor is used for fine tuning.

CAUTION

Observe caution while performing steps a through c to prevent damage to the equipment.

a. Connect the frequency counter input to oscilloscope CH2 vertical output on back of oscilloscope.

b. Using X10 probe connected to the oscilloscope CH2 vertical input, connect probe to pin 2 of U5 on the bottom board (see figure 8-16). Waveform on oscilloscope should be 9V P-P. Frequency should be approximately 5.00 MHz. Select value of C3 (see figure 8-16) to obtain 5.00 MHz ± 50 Hz.

c. Connect oscilloscope to the 3.125 KHz output jack on the synthesizer module test jig.

d. Adjustment of the multi-counter trigger level control will be necessary to read frequency. Frequency should be 3.125 KHz.

6-46.3 Frequency and Amplitude Tests. Perform the frequency and amplifude tests as follows:

a. Connect the oscilloscope CH2 vertical input to the TX OUT jack of the synthesizer module test fixture.

b. Set the synthesizer module test fixture TX/OFF/RX switch to TX. The test fixture LOCK DETECTOR LED should light.

c. Observe oscilloscope. The displayed waveform should be 2.5V P-P minimum.

d. Observe frequency counter. The displayed frequency should be 30.000 ± 300 Hz.

e. Select the following frequencies in MHz, using the FREQUENCY SELECT switches on the synthesizer module test fixture. Check waveform amplitude and frequency (all amplitudes should be 2.5V P-P minimum and will vary with frequency selected. Frequency counter should display frequency selected and displayed frequency should not vary).

30.000	39.100	39.950	49.400	43.000
31.000	39.200	39.975	49.300	42.000
32.000	39.300	49.975	49.200	41.000
33.000	39.400	49.950	49.100	40.000
34.000	39.500	49.925	49.000	
35.000	39.600	49.900	48.000	
36.000	39.700	49.800	47.000	
37.000	39.800	49.700	46.000	
38.000	39.900	49.600	45.000	
39.000	39.925	49.500	44.000	

f. Set the synthesizer module test fixture TX/OFF/RX switch to OFF.

g. Connect the oscilloscope CH2 vertical input to the RX OUT jack of the synthesizer module test fixutre.

h. Set the synthesizer module test fixture TX/OFF/RX switch to RX.

i. Select the following frequencies in MHz, using the FREQUENCY SELECT switches on the synthesizer module test fixture. Check waveform amplitude and frequency. Waveform amplitudes should be 1000 MV P-P and will vary with frequency selected. Output frequency will be the frequency in "Frequency Indicated" column and should be stable and not drift.

FREQUENCY SELECTED	FREQUENCY INDICATED
30.000	57.000
31.000	58.000
32.000	59.000
33.000	60.000
34.000	61.000
35.000	62.000
36.000	63.000
37.000	64.000
38.000	65.000
39.000	66.000
39.100	66.100
39.200	66.200
39.300	66.300
39.400	66.400
39.500	66.500
39.600	66.600
39.700	66.700
39.800	66.800
39.900	66.900
39.925	66.925
39.950	66.950
39.975	66.975
40.000	67.000
41.000	68.000

42.000	69.000
43.000	70.000
44.000	71.000
45.000	72.000
46.000	73.000
47.000	74.000
48.000	75.000
49.000	76.000
49.100	76.100
49.200	76.200
49.300	76.300
49.400	76.400
49.500	76.500
49.600	76.600
49.700	76.700
49.800	76.800
49.900	76.900
49.925	76.925
49.950	76.950
49.975	76.975

j. Perform modulation check in accordance with paragraph 6.46.4.

k. Seal all wire-wound transformers.

6-46.4 Modulation Check. Perform the modulation check as follows:

a. Connect the TX OUT jack on the synthesizer test fixture to the deviation meter INPUT.

b. Connect the audio oscillator OUTPUT to MOD IN jack on the synthesizer test fixture.

c. Set the audio generator FREQUENCY switches for an output frequency of 1KHz.

d. Turn audio oscillator on.

e. Set the TX/OFF/RX switch to TX.

f. Set the synthesizer module test fixture FREQUENCY SELECT switches to 49.050 MHz.

g. Set potentiometer R13 (see figure 8-20) on bottom board to mid-range.

h. Adjust the audio generator SINE WAVE AMPLITUDE control for a 5 kHz deviation reading on deviation meter (output approximately 1.5 to 2.0V P-P)

i. Set the synthesizer module test fixture FREQUENCY SELECT switches to 42.050 MHz. Deviation meter should indicate 5 KHz ± 500 Hz (adjustment of potentiometer R13 may be necessary to achieve ± 500 Hz across the band).

j. Set the synthesizer module test fixture FREQUENCY SELECT switches to 37.050 MHz. Deviation meter should indicate 5 MHz ± 500 Hz.

k. Set the synthesizer module test fixture FREQUENCY SELECT switches to 30.050 MHz. Deviation meter should indicate 5 KHz ± 500 Hz.

6-47. TOP BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the synthesizer module top board are given in paragraphs 6.47.1 through 6-47.3.

6-47.1 Current Consumption and Input Voltage Check. Perform the top board current consumption and input voltage check as follows:

a. Insert the top board to be tested into top mounting board on the synthesizer module test fixture.

b. Insert known good button board with jumper pins (17) into bottom mounting plate.

c. Remove jumper wire from synthesizer module test fixture CURRENT CHECK jacks.

d. Connect leads between the synthesizer module test fixture CURRENT CHECK jacks and MA INPUT and COMMON jacks of the multimeter. Observe polarity – (red to red and black to black).

e. Depress multimeter DCMA FUNCTION pushbutton.

f. Depress the multimeter 200 MA RANGE pushbutton.

CAUTION

Observe caution while performing steps g and h to prevent damage to the equipment.

g. Turn on the power supply.

h. Observe current indication on the multimeter. Current consumption should be approximately 20 to 50 MA. If current consumption is excessive or power supply faults, turn off power supply. Isolate faults before continuing.

i. Disconnect the multimeter and replace current jumper.

j. Connect the multimeter leads between the V-r and COMMON jacks.

k. Depress the multimeter Kr FUNCTION switch.

l. Depress the multimeter 2 RANGE pushbutton.

6-47.2 27 MHz and 54 MHz Frequency Adjust and Amplitude Check. Perform the 27 MHz and 54 MHz frequency adjust and amplitude check as follows:

a. Solder a 1Kohm potentiometer to R35 SOT posts

b. Solder a 5Kohm potentiometer to R33 SOT posts

c. Using multimeter, measure resistance across 1Kohm potentiometer and adjust potentiometer for 470 ohms

d. Using multimeter, measure resistance across 5Kohm potentiometer and adjust potentiometer for 1.5 ohms.

e. Connect the CH2 vertical output on back of oscilloscope to frequency counter INPUT.

f. Connect the oscilloscope X10 probe to the junctions of R56 and R52.

g. Turn on the power supply.

h. Set the synthesizer module test fixture TX/OFF/RX switch to TX. The 27 MHz oscillator should have an output amplitude of 600 MV P-P minimum as displayed on the oscilloscope.

i. Observe the frequency counter. Displayed frequency on the frequency counter should be 27.000 MHz ±300 Hz.

j. Adjust coils L8 and/or L11 (see figure 8-18) for frequency and amplitude of output by spreading or compressing the coil windings.

k. Set the synthesizer module test fixture TX/OFF/RX switch to RX.

l. Observe the oscilloscope display to verify that the 54 MHz oscillator has an output amplitude of 600 MV P-P minimum.

m. Observe that the frequency display on the frequency counter is 54.000 MHz ±540 Hz.

n. Adjust coils L7 and/or L12 (see figure 8-18) for frequency and amplitude of output by spreading or compressing the windings on the coils.

6-47.3 Frequency and Amplitude Test. Perform the frequency and amplitude test as follows:

a. Set the synthesizer module test fixture TX/OFF/RX switch to TX.

b. Set the synthesizer module test fixture FREQUENCY SELECT switches to 49.975 MHz.

c. Depress the multimeter DCV FUNCTION pushbutton.

d. Depress the multimeter 20V RANGE pushbutton.

e. Using the multimeter, measure voltage at the junction of resistor R6 and R7 (see figure 8-18) with respect to ground.

f. Adjust coil L1 for a voltage of +1.5VDC by spreading or compressing the windings on the coil.

g. Set the synthesizer module test fixture FREQUENCY SELECT switches to 30.000 MHz.

h. Using the multimeter, measure voltage at the junction of resistors R6 and R7 (see figure 8-18) with respect to ground. Voltage should be approximately +5.4 VDC. The test fixture LOCK DETECTOR LED should light.

i. Adjust 5Kohm potentiometer so that synthesizer locks on frequency across the entire 30-50 MHz band. Any adjustment of the 5Kohm potentiometers requires that steps e and f be repeated.

j. Connect the oscilloscope CH2 vertical input to the TX OUT jack on the synthesizer module test fixture.

k. Check that waveform amplitude is 2.5V P-P maximum at each of the following frequencies (amplitude will vary with frequency selected). Check that the frequency displayed on the frequency counter is the same as selected frequency (displayed frequency should be steady and not vary). Frequencies, in MHz, to be checked are as follows:

30.000	39.100	39.950	49.400	43.000
31.000	39.200	39.975	49.300	42.000
32.000	39.300	49.975	49.200	41.000
33.000	39.400	49.950	49.100	40.000
34.000	39.500	49.925	49.000	
35.000	39.600	49.900	48.000	
36.000	39.700	49.800	47.000	
37.000	39.800	49.700	46.000	
38.000	39.900	49.600	45.000	
39.000	39.925	49.500	44.000	

l. Set the synthesizer module TX/OFF/RX switch to RX.

m. Set the synthesizer module test fixture FREQUENCY SELECT switches to 49.975 MHz.

n. Using the multimeter, measure the voltage at the junction of resistors R6 and R7 (see figure 8-18) with respect to ground.

o. Adjust coil L2 for a voltage of 1.5 VDC by spreading or compressing the windings on the coil.

p. Set the synthesizer module test fixture FREQUENCY SELECT switches to 30.000 MHz.

q. Using the multimeter, measure the voltage at the junction of resistors R6 and R7 with respect to ground. Voltage should be approximately +5.4 VDC, the test fixture LOCK DETECTOR LED should light.

r. Adjust 1Kohm potentiometer so that synthesizer locks on frequency across the entire 30-50 MHz band. Any adjust of the 1Kohm potentiometer requires that steps n and o be repeated.

s. Connect the oscilloscope CH2 vertical input to the RF OUT jack on the synthesizer module test fixture.

t. Check that waveform amplitude is 1000 MV P-P minimum at each of the following frequencies (amplitude will vary with frequency selected). Check that the frequency displayed on the frequency counter is the same as selected frequency (displayed frequency should be steady and not vary). Frequencies, in MHz, to be checked are as follows:

SELECTED FREQUENCY	DISPLAYED FREQUENCY
30.000	57.000
31.000	58.000
32.000	59.000
33.000	60.000
34.000	61.000
35.000	62.000
36.000	63.000
37.000	64.000
38.000	65.000
39.000	66.000
39.100	66.100
39.200	66.200
39.300	66.300
39.400	66.400
39.500	66.500
39.600	66.600
39.700	66.700
39.800	66.800
39.900	66.900
39.925	66.925
39.950	66.950
39.975	66.975
40.000	67.000
41.000	68.000
42.000	69.000
43.000	70.000
44.000	76.100
45.000	72.000
46.000	73.000
47.000	74.000
48.000	75.000
49.000	76.000
49.100	71.100
49.200	76.200
49.300	76.300
49.400	76.400
49.500	76.500
49.600	76.600
49.700	76.700
49.800	76.800
49.900	76.900
49.925	76.925
49.950	76.950
49.975	76.975

u. Perform modulation check procedures of paragraph 6-46.4.

v. Install synthesizer shields and check for spurious frequency attenuation.

w. Connect the synthesizer module test fixture RF OUT jack to the spectrum analyzer INPUT.

x. Ensure that the synthesizer module test fixture TX/OFF/RX switch is in RX position.

y. Set the synthesizer module test fixture FREQUENCY SELECT switches to 30.000 MHz.

z. Adjust L5 and L6 by spreading or comparing the windings on the coils to obtain maximum level at 30.000 MHz.

aa. Check all frequencies in paragraph 6-47.3, step f and ensure that any spurs are -60 dBm minimum.

ab. Connect the spectrum analyzer to the synthesizer module test fixture TX OUT jack.

ac. Set the synthesizer module test fixture TX/OFF/RX switch to TX.

ad. Check all frequencies in paragraph 6-47-3, step k and ensure that all spurs are -60 dBm.

ae. Turn off the DC power supply.

af. Measure resistance of 1Kohm and 5Kohm potentiometers. Select closest value of fixed resistor for each. Solder resistors to repective SOT potentiometers.

ag. Ensure that synthesizer locks across the band in both TX and RX modes.

6-48. SYNTHESIZER MODULE TESTING. Perform the following procedures to test the synthesizer module.

a. Place assembled module into bottom mounting board on the synthesizer module test fixture.

b. Perform top board test procedures, except for SOT resistor steps (insertion of potentiometer not required).

c. Upon completion of test procedures, seal all coils, RF chokes, and crystals.

d. After sealant has dried, perform the procedures of paragraph 6-47.3, steps e, f, n, and o to ensure proper tuning.

6-49. SYNTHESIZER MODULE TROUBLESHOOTING. Troubleshooting of the synthesizer module is accomplished by making voltage and waveform measurements in accordance with tables 6-6 and 6-7 for the synthesizer module top board and bottom board, respectively. Make voltage and waveform measurements with the initial setup of figure 6-31 and paragraph 6-45. The initial setup should be modified by changing radio's frequency in accordance with the FREQ column of table 6-6 and 6-7 and applying power/signals in accordance with NOTES column of tables 6-6 and 6-7. Following is a definition of the notes.

NOTE	DEFINITION
1.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. 30.000 MHz input signal applied. d. 50 Ω load to TX output.
2.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. 35.000 MHz input signal applied. d. 50 Ω load to TX output.
3.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. 40.000 MHz input signal applied. d. 50 Ω load to TX output.
4.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. 45.000 MHz input signal applied. d. 50 Ω load to TX output.
5.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. 49.975 MHz input signal applied. d. 50 Ω load to TX output.

NOTE	DEFINITION
6.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. All frequencies selected. d. 50 Ω load to TX output.
7.	Troubleshooting performed with +9VDC input power applied. No signal inputs.
8.	Troubleshooting performed with: a. +9VDC input power applied. b. 30.000 MHz input.
9.	Troubleshooting performed with: a. +9VDC RX off. b. +9VDC TX input power applied. c. 30.000 MHz inputs. d. 50 Ω load to TX output.
10.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC RX input power applied. c. 30.000 MHz input signal.
11.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC RX input power applied. c. 35.000 MHz input signal.
12.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC RX input power applied. c. 40.000 MHz input signal.

NOTE	DEFINITION

13. Troubleshooting performed with:

    a. +9VDC input power applied.

    b. +9VDC RX input power applied.

    c. 45.000 MHz input signal

14. Troubleshooting performed with:

    a. +9VDC input power applied.

    b. +9VDC RX input power applied.

    c. 49.975 MHz input signal.

15. Troubleshooting performed with:

    a. +9VDC input power applied.

    b. Test fixture TX/OFF/RX switch set to OFF.

16. Troubleshooting performed with:

    a. +9VDC input power applied.

    b. +9VDC TX input power applied.

    c. 2V peak-to-peak, 1 KHz modulation input.

    d. 30.000 MHz input signal.

17. Troubleshooting performed with:

    a. +9VDC input power applied.

    b. +9VDC TX input power applied.

    c. 2V peak-to-peak, 1 KHz modulation input.

    d. 35.000 MHz input signal.

18. Troubleshooting performed with:

    a. +9VDC input power applied.

    b. +9VDC TX input power applied.

    c. 2V peak-to-peak, 1 KHz modulation input.

    d. 40.000 MHz input signal.

NOTE	DEFINITION
19.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. 2V peak-to-peak, 1 KHz modulation input. d. 45.000 MHz input signal.
20.	Troubleshooting performed with: a. +9VDC input power applied. b. +9VDC TX input power applied. c. 2V peak-to-peak, 1 KHz modulation input. d. 49.975 MHz input signal.

Synthesizer Bottom Board Frequency Select Logic Chart for U1, U2, U3

	U3 Pin 1	U3 Pin 3	U3 Pin 13	U3 Pin 12	U3 Pin 11	U3 Pin 10
10 MHz Switch Digit 3	+9V	0V	0V	0V	0V	0V
10 MHz Switch Digit 4	0V	+9V	+9V	0V	0V	0V

X X X X X X X X X X X X X X X X X X X

1 MHz Switch	U2 15	U2 1	U2 3	U2 5	U2 13	U2 12	U2 11	U2 10
Digit 0	0V	0V	0V	0V	9V	9V	0V	0V
Digit 1	9V	0V	0V	0V	0V	0V	9V	0V
Digit 2	0V	9V	0V	0V	9V	0V	9V	0V
Digit 3	9V	9V	0V	0V	0V	9V	9V	0V
Digit 4	0V	0V	9V	0V	9V	9V	9V	0V
Digit 5	9V	0V	9V	0V	0V	0V	0V	9V
Digit 6	0V	9V	9V	0V	9V	0V	0V	9V
Digit 7	9V	9V	9V	0	0V	0V	0V	0V
Digit 8	0V	0V	0V	9V	9V	0V	0V	0V
Digit 9	9V	0V	0V	9V	0V	9V	0V	0V

X X X X X X X X X X X X X X X X X X X

25 kHz Switch	U1 3	U1 4
Digits 00	0V	0V
Digits 25	9V	0V
Digits 50	0V	9V
Digits 75	9V	9V

X X X X X X X X X X X X X X X X X X X

100 kHz Switch	U1 22	U1 21	U1 20	U1 19
Digit 0	0V	0V	0V	0V
Digit 1	+9V	0V	0V	0V
Digit 2	0V	9V	0V	0V
Digit 3	9V	9V	0V	0V
Digit 4	0V	0V	9V	0V
Digit 5	9V	0V	9V	0V
Digit 6	0V	9V	9V	0V
Digit 7	9V	9V	9V	0V
Digit 8	0V	0V	0V	9V
Digit 9	9V	0V	0V	9V

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements

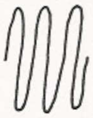
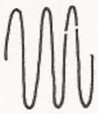
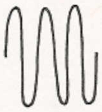
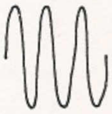
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
Q1	B	+4.45		 + 5.0 + 4.5 + 4.0	30.000 MHz	1
Q1	B	+4.45		 + 5.0 + 4.5 + 4.0	35.000 MHz	2
Q1	B	+4.45		 + 5.0 + 4.5 + 4.0	40.000 MHz	3
Q1	B	+4.45		 + 4.8 + 4.4 + 4.0	45.000 MHz	4
Q1	B	+4.45		 + 4.8 + 4.4 + 4.0	49.975 MHz	5
Q1	E	+4.02		 + 4.14 + 4.0 + 3.86	30.000 MHz	1
Q1	E	+4.19		 + 4.27 + 4.1 + 3.93	35.000 MHz	2
Q1	E	+4.23		 + 4.45 + 4.2 + 3.95	40.000 MHz	3
Q1	E	+4.23		 + 4.37 + 4.2 + 4.03	45.000 MHz	4
Q1	E	+4.46		 + 4.4 + 4.2 + 4.0	49.975 MHz	5
Q1	C	+9	0			6

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

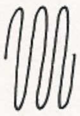
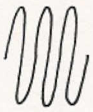
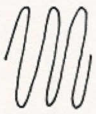
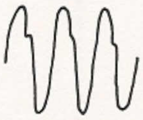
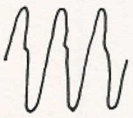
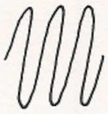
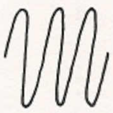
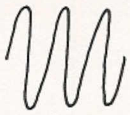
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q2	B	+3.27		 +3.2 +3.1 +3.0	30.000 MHz	1
Q2	B	+3.27		 +3.25 +3.1 +2.95	35.000 MHz	2
Q2	B	+3.27		 +3.27 +3.1 +2.93	40.000 MHz	3
Q2	B	+3.27		 +3.3 +3.1 +2.9	45.000 MHz	4
Q2	B	+3.27		 +3.22 +3.1 +2.98	49.975 MHz	5
Q2	B	+3.29		 +3.4 +3.3 +3.2	30.000 MHz	1
Q2	B	+3.29		 +3.45 +3.3 +3.15	35.000 MHz	2
Q2	B	+3.29		 +3.47 +3.3 +3.13	40.000 MHz	3
Q2	B	+3.29		 +3.5 +3.3 +3.1	45.000 MHz	4
Q2	B	+3.29		 +3.5 +3.3 +3.1	49.975 MHz	5
Q2	E	+2.55		 +2.65 +2.5 +2.35	30.000 MHz	1

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

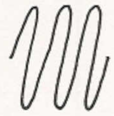
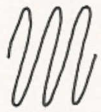
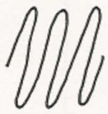
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q2	E	+2.55		 +2.67 / +2.5 / +2.33	35.000 MHz	2
Q2	E	+2.55		 +2.7 / +2.5 / +2.3	40.000 MHz	3
Q2	E	+2.55		 +2.7 / +2.5 / +2.3	45.000 MHz	4
Q2	E	+2.55		 +2.7 / +2.5 / +2.3	49.975 MHz	5
Q2	C	+9.04		 +10.0 / +9.0 / +8.0	30.000 MHz	1
Q2	C	+9.0		 +10.0 / +9.0 / +8.0	35.000 MHz	2
Q2	C	+9.0		 +10.0 / +8.50 / +7.0	40.000 MHz	3
Q2	C	+9.0		 +10.0 / +8.75 / +7.5	45.000 MHz	4
Q2	C	+9.0		 +10.0 / +8.75 / +7.5	49.975 MHz	5
Q3	B	0		 +1.0 / 0.0 / −1.0	30.000 MHz	1
Q3	B	0		 +1.2 / 0.0 / −1.4	35.000 MHz	2

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

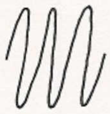
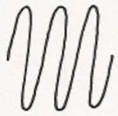
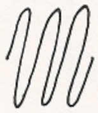
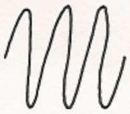
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q3	B	0		 +1.4 0.0 – 1.4	40.000 MHz	3
Q3	B	0		 +1.4 0.0 – 1.4	45.000 MHz	4
Q3	B	0		 +1.6 0.0 – 1.6	49.975 MHz	5
Q3	E	+0.38				1
Q3	E	+0.55				2
Q3	E	+0.55				3
Q3	E	+0.52				4
Q3	E	+0.42				5
Q3	C	+8.98		 + 9.2 + 9.0V + 8.8	30.000 MHz	1
Q3	C	+8.98		 + 10.0 + 9.0 + 8.0	35.000 MHz	2
Q3	C	+8.98		 + 9.75 + 9.0 + 8.75	40.000 MHz	3
Q3	C	+8.98		 + 9.2 + 9.0 + 8.8	45.000 MHz	4
Q3	C	+8.98		 + 9.2 + 9.0 + 8.0	49.975 MHz	5
Q4	G	0		 + 80 MV 0.0 – 80 MV	30.000 MHz	1

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

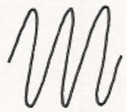
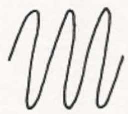
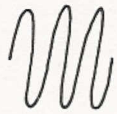
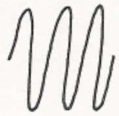
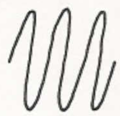
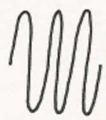
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q4	G	0		 + 90 MV 0.0 − 90 MV	35.000 MHz	2
Q4	G	0		 + 100 MV 0.0 − 100 MV	40.000 MHz	3
Q4	G	0		 + 90 MV 0.0 − 90 MV	45.000 MHz	4
Q4	G	0		 + 70 MV 0.0 − 70 MV	49.975 MHz	5
Q4	G	+.95				6
Q4		+9.0		 + 9.09 + 9.0 + 8.91	30.000 MHz	1
Q4		+9.0		 + 9.08 + 9.0 + 8.92	35.000 MHz	2
Q4		+9.0		 + 9.08 + 9.0 + 8.92	40.000 MHz	3
Q4		+9.0		 + 9.08 + 9.0 + 8.92	45.000 MHz	4
Q4		+9.0		 + 9.05 + 9.0 + 8.95	49.975 MHz	5
Q4		0		 + 75 MV 0.0 − 75 MV	57.000 MHz	1

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

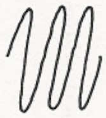
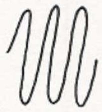
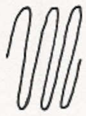
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
Q4		0		 + 50MV 0.0 – 50MV	62.000 MHz	2
Q4		0		 + 50MV 0.0 – 50MV	67.000 MHz	3
Q4		0		 + 50 MV 0.0 – 50MV	72.000 MHz	4
Q4		0		 + 50 MV 0.0 – 50 MV	76.975 MHz	5
Q4		+.95				6
Q4		+9.0		 + 9.05 + 9.0 + 8.95	57.000 MHz	1
Q4		+9.0		 + 9.04 + 9.0 + 8.96	62.000 MHz	2
Q4		+9.0		 + 9.04 + 9.0 + 8.96	67.000 MHz	3
Q4		+9.0		 + 9.05 + 9.0 + 8.95	72.000 MHz	4
Q4		+9.0		 + 9.05 + 9.0 + 8.95	76.975 MHz	5
Q4		+9	0			7
Q4		0	0			7
Q4		+.94	0			7

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q5	B	+3.29		 + 3.3 + 3.2 + 3.1	30.000 MHz	1
Q5	B	+3.29		 + 3.3 + 3.2 + 3.1	35.000 MHz	2
Q5	B	+3.29		 + 3.3 + 3.2 + 3.1	40.000 MHz	3
Q5	B	+3.29		 + 3.3 + 3.2 + 3.1	45.000 MHz	4
Q5	B	+3.29		 + 3.3 + 3.2 + 3.1	49.975 MHz	5
Q5	B	+2.58				6
Q5	B	+3.30		 + 3.35 + 3.30 + 3.25	57.000 MHz	1
Q5	B	+3.30		 + 3.33 3.30 + 3.27	62.000 MHz	2
Q5	B	+3.30		 + 3.32 + 3.30 + 2.28	67.000 MHz	3
Q5	B	+3.30		 + 3.34 + 3.30 + 3.26	72.000 MHz	4
Q5	B	+3.30		 + 3.34 + 3.30 + 3.26	76.975 MHz	5
Q5	B	+3.3	0			7
Q5	E	+2.57				1

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

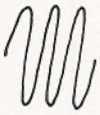
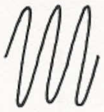
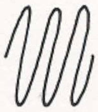
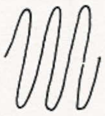
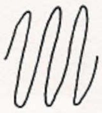
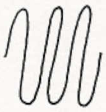
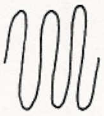
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
Q5	E	+2.57				2
Q5	E	+2.57				3
Q5	E	+2.57				4
Q5	E	+2.57				5
Q5	E	+2.56	0			7
Q5	C	+9.0		 + 9.3 + 9.0 + 8.0	30.000 MHz	1
Q5	C	+9.0		 + 9.3 + 9.0 + 8.0	35.000 MHz	2
Q5	C	+9.0		 + 9.3 + 9.0 + 8.0	40.000 MHz	3
Q5	C	+9.0		 + 9.3 + 9.0 + 8.0	45.000 MHz	4
Q5	C	+9.0		 + 9.3 + 9.0 + 8.0	49.975 MHz	5
Q5	C	+9.0		 + 9.3 + 9.0 + 8.7	57.000 MHz	1
Q5	C	+9.0		 + 9.25 + 9.0 + 8.75	62.000 MHz	2
Q5	C	+9.0		 + 9.2 + 9.0 + 8.8	69.000 MHz	3
Q5	C	+9.0		 + 9.2 + 9.0 + 8.8	72.000 MHz	4

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

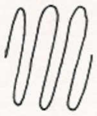
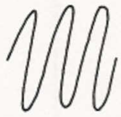
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q5	C	+9.0		 + 9.2 + 9.0 + 8.8	76.975 MHz	5
Q5	C	+9	0			7
Q6	B	+4.43		 + 4.6 + 4.3 + 4.0	57.000 MHz	1
Q6	B	+4.44		 + 4.6 + 4.3 + 4.0	62.000 MHz	2
Q6	B	+4.44		 + 4.6 + 4.3 + 4.0	67.000 MHz	3
Q6	B	+4.44		 + 4.6 + 4.3 + 4.0	72.000 MHz	4
Q6	B	+4.44		 + 4.6 + 4.3 + 4.0	76.975 MHz	5
Q6	E	+4.11		 + 4.2 + 3.9 + 3.6	57.000 MHz	1
Q6	E	+4.17		 + 4.4 + 4.0 + 3.6	62.000 MHz	2
Q6	E	+4.29		 + 4.6 + 4.2 + 3.8	67.000 MHz	3
Q6	E	+4.28		 + 4.6 + 4.2 + 3.8	72.000 MHz	4

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

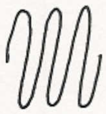
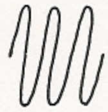
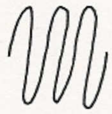
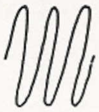
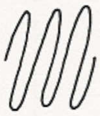
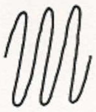
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q6	E	+4.26		 +4.6 +4.2 +3.8	76.975 MHz	5
Q6	C	+9.0				1
Q6	C	+9.0				2
Q6	C	+9.0				3
Q6	C	+9.0				4
Q6	C	+9.0				5
Q7	B	+6.70		 +3.6 +3.3 +3.0	57.000 MHz	1
Q7	B	+6.70		 +3.6 +3.3 +3.0	62.000 MHz	2
Q7	B	+6.72		 +3.4 +3.2 +3.0	67.000 MHz	3
Q7	B	+6.73		 +3.6 +3.3 +3.0	72.000 MHz	4
Q7	B	+6.74		 +3.6 +3.3 +3.0	76.975 MHz	5
Q7	E	+6.23		 +3.0 +2.8 +2.6	57.000 MHz	1
Q7	E	+6.15		 +3.0 +2.9 +2.8	62.000 MHz	2
Q7	E	+6.19		 +3.1 +3.0 +2.9	67.000 MHz	3

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

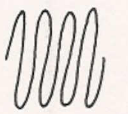
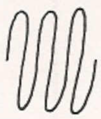
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
Q7	E	+6.22		 +3.1 +3.0 +2.9	72.000 MHz	4
Q7	E	+6.22		 + 3.1 + 3.0 + 2.9	76.975 MHz	5
Q7	C	+9.0		 + 9.3 + 8.8 + 8.3	57.000 MHz	1
Q7	C	+9.0		 + 9.3 + 8.8 + 8.3	62.000 MHz	2
Q7	C	+9.0		 + 9.3 + 8.8 + 8.3	67.000 MHz	3
Q7	C	+9.0		 + 9.3 + 8.8 + 8.3	72.000 MHz	4
Q7	C	+9.0		 + 9.3 + 8.8 + 8.3	76.975 MHz	5
Q8	B	+4.48		 + 9.5 + 9.0 + 8.5	53.998 MHz	6
Q8	E	+3.88		 + 4.02 + 3.88 + 3.74	54.000 MHz	6
Q8	E	+9.0		 + 4.60 + 4.48 + 4.35	54.000 MHz	6
Q8	E	+9.0		 + 4.58 + 4.48 + 4.38	54.000 MHz	6

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

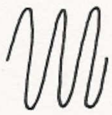
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q9	B	+4.43				6
Q9	E	+3.70		 +3.77 +3.70 +3.62	27.000 MHz	6
Q9	C	+9.0		 +9.35 +9.0 +8.65	27.000 MHz	6
U1	1	+2.95	0			1
U2	1	+4.18	0			2
U1	1	+4.99	0			3
U1	1	+5.94	0			4
U1	1	+8.28	0			5
U1	1	+8.3	0V			7
U1	1	+2.15	0			1
U1	1	+3.60	0			2
U1	1	+4.36	0			3
U1	1	+5.28	0			4
U1	1	+8.28	0			5
U1	2	+4.48	0			1
U1	2	+4.48	0			2
U1	2	+4.48	0			3
U1	2	+4.48	0			4
U1	2	+3.69	0			5
U1	2	+3.71	0V			7
U1	2	+4.52	0			1
U1	2	+4.49	0			2
U1	2	+4.26	0			3
U1	2	+4.41	0			4
U1	2	+3.71	0			5
U1	3	+4.45	0			6
U1	3	+4.46	0			6
U1	3	+4.46	0V			7
U1	4	0	0			7

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

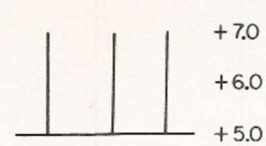
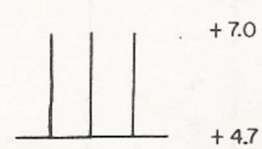
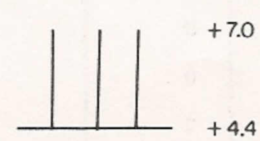
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U1	5	+5.07	0			1
U1	5	+4.59	0			2
U1	5	+4.39	0			3
U1	5	+3.95	0			4
U1	5	+1.77	0			5
U1	5	0	0			7
U1	5	+5.29	0			1
U1	5	+4.63	0			2
U1	5	+4.38	0			3
U1	5	+4.01	0			4
U1	5	+1.42	0			5
U1	6	+2.12	0			7
U1	6, 7	+5.08	0			1
U1	6, 7	+4.70	0			2
U1	6, 7	+4.43	0			3
U1	6, 7	+4.06	0			4
U1	6, 7	+2.11	0			5
U1	6, 7	+5.29	0			1
U1	6, 7	+4.78	0			2
U1	6, 7	+4.51	0			3
U1	6, 7	+4.19	0			4
U1	6, 7	+2.11	0			5
U1	7	+2.12	0			7
U1	8	+9	0			7
R1 PC INPUT		+5.48			3.125 kHz	1
R1 PC INPUT		+5.11			3.125 kHz	2
R1 PC INPUT		+4.84			3.125 kHz	3

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

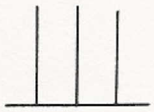
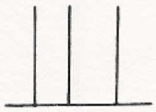
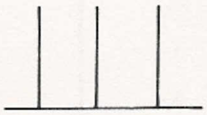
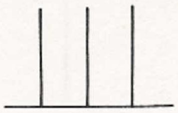
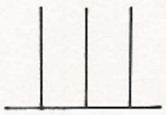
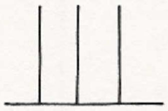
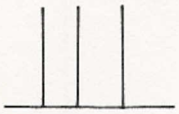
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
R1 PC INPUT		+4.44		 +7.0 / +4.0	3.125 kHz	4
R1 PC INPUT		+2.01		 +5.0 / +1.7	3.125 kHz	5
R1, R2, C1		+5.63	0			1
R1, R2, C1		+5.12	0			2
R1, R2, C1		+4.86	0			3
R1, R2, C1		+4.47	0			4
R1, R2, C1		+2.11	0			5
R1 PC INPUT		+5.3		 7.0 / +5.0	3.125 kHz	1
R1 PC INPUT		+4.78		 +6.6 / +4.6	3.125 kHz	2
R1 PC INPUT		+4.51		 +6.4 / +4.4	3.125 kHz	3
R1 PC INPUT		+4.17		 +6.0 / +4.0	3.125 kHz	4
R1 PC INPUT		+1.78		 +3.0 / +1.7	3.125 kHz	5
R1, C1, R2		+5.30	0			1
R1, C1, R2		+4.78	0			2
R1, C1, R2		+4.52	0			3
R1, C1, R2		+4.19	0			4
R1, C1, R2		+1.77	0			5
R2, R3, R4, R5		+5.62	0			1
R2, R3, R4, R5		+5.12	0			2

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
R2, R3, R4, R5		+4.86	0			3
R2, R3, R4, R5		+4.46	0			4
R2, R3, R4, R5		+2.11	0			5
R2, R3, R4, R5		+4.93	0			1
R2, R3, R4, R5		+4.69	0			2
R5, R6, C4		+4.03	0			4
R5, R6, C4		+1.72	0			5
R5, R6, C4		+5.62	0			1
R5, R6, C4		+5.11	0			2
R5, R6, C4		+4.86	0			3
R5, R6, C4		+4.45	0			4
R5, R6, C4		+2.12	0			5
R6, R7, C5, R12		+5.63	0			1
R6, R7, C5, R12		+5.12				2
R6, R7, C5, R12		+4.85				3
R6, R7, C5, R12		+4.47	0			4
R6, R7, C5, R12		+2.01	0			5
R6, R7, C5, R12		+5.62	0			1
R6, R7, C5, R12		+5.11	0			2
R6, R7, C5, R12		+4.86	0			3
R6, R7, C5, R12		+4.45	0			4
R6, R7, C5, R12		+2.11	0			5
R7, C6, D1		+5.62	0			1
R7, C6, D1		+5.11	0			2
R7, C6, D1		+4.86	0			3
R7, C6, D1		+4.45	0			4
R7, C6, D1		+2.11	0			5
R7, C6, D1		+5.20		 +5.6 +5.0 +4.6	30.000 MHz	1
R7, C6, D1		+4.92		 +5.0 +4.5 +4.0	35.000 MHz	2

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

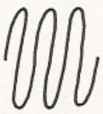
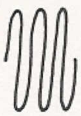
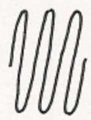
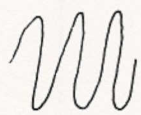
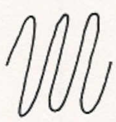
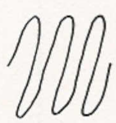
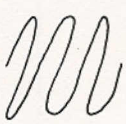
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R7, C6, D1		+4.55		 + 4.6 + 4.2 + 3.8	40.000 MHz	3
R7, C6, D1		+4.22		 + 4.2 + 3.9 + 3.6	45.000 MHz	4
R7, C6, D1		+1.76		 + 1.74 + 1.4 + 1.1	49.975 MHz	5
R8, C9, D1, D2			600 mvpp	 + 300 MV 0.0 – 300 MV	1 kHz	1
R8, C9, D1, D2			440 mvpp	 + 220 MV 0.0 – 220 MV	1 kHz	2
R8, C9, D1, D2			260 mvpp	 + 130 MV 0.0 – 130 MV	1 kHz	3
R8, C9, D1, D2			200 mvpp	 + 100 MV 0.0 – 100 MV	1 kHz	4
R8, C9, D1, D2			150 mvpp	 + 75 MV 0.0 – 75 MV	1 kHz	5
R8, R9		0	0			6
R9, C8, D2		0	0			6
R10, C9, C10, D1, D2		+8.96	0			6
R10, C9, C10, D1, D2		+8.93	0			6
R10, C9, C10, D1, D2		+8.98	0			7
R10, R13, R21, C17, RFC-9, RFC-4		+9V	0V			7

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R11, R14, R22, C21		+2.76	0			1
R11, R14, R22, C21		+3.87				2
R11, R14, R22, C21		+4.63				3
R11, R14, R22, C21		+5.69	0			4
R11, R14, R22, C21		+8.23	0			5
R11, R14, R22, C21		+8.23	0			7
R11, R14, R22, C21		+2.16	0			1
R11, R14, R22, C21		+3.61	0			2
R11, R14, R22, C21		+4.36	0			3
R11, R14, R22, C21		+5.30	0			4
R11, R14, R22, C21		+8.06	0			5
R11, C12, D3		+2.09		 +2.8 +2.4 +1.9	30.000 MHz	1
R11, C12, D3		+3.33		 +4.4 +3.9 +3.4	35.000 MHz	2
R11, C12, D3		+4.16		 +5.3 +4.9 +4.5	40.000 MHz	3
R11, C12, D3		+5.10		 +8.1 +7.8 +7.5	45.000 MHz	4
R11, C12, D3		+8.45		 +8.1 +7.8 +7.5	49.975 MHz	5

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

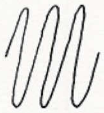
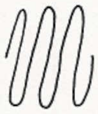
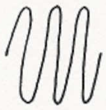
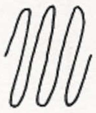
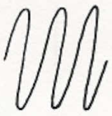
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
R11, C12, D3		+8.19	0			7
R12, C13, D5		+5.00		 + 5.0 + 4.75 + 4.5	57.000 MHz	1
R12, C13, D5		+4.70		 + 4.8 + 4.5 + 4.2	62.000 MHz	2
R12, C13, D5		+4.42		 + 4.6 + 4.3 + 4.0	67.000 MHz	3
R12, C13, D5		+3.82		 + 4.2 + 3.9 + 3.6	72.000 MHz	4
R12, C13, D5		0		 + 250 MV 0.0 + 250 MV	76.975 MHz	5
R12, C13, D5		+5.30	0			1
R12, C13, D5		+4.78	0			2
R12, C13, D5		+4.51	0			3
R12, C13, D5		+4.19	0			4
R12, C13, D5		+1.73	0			5
R12, C13, D5		0	0			7
R13, C14, C15, D5		+8.88	0			6
R13, C14, C15, D5		+8.93				6
R13, C14, C15, D5		+8.98	0			7
R14, C16, D4		+2.86		 + 3.4 + 3.0 + 2.6	57.000 MHz	1
R14, C16, D4		+4.17		 + 4.2 + 3.8 + 3.5	62.000 MHz	2

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

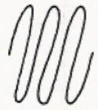
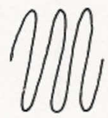
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R14, C16, D4		+4.92		 + 5.0 + 4.7 + 4.4	67.000 MHz	3
R14, C16, D4		+8.19		 + 8.2 + 8.0 + 7.8	72.000 MHz	4
R14, C16, D4		+8.19		 + 8.2 + 8.0 + 7.8	76.975 MHz	5
R16, R17, C19		+4.97	0			1
R16, R17, C19		+4.68	0			2
R16, R17, C19		+4.54	0			3
R16, R17, C19		+4.37	0			4
R16, R17, C19		+2.87	0			5
R16, R17, C19		+2.86	0			7
R18, R20, R21, C20		+4.50	0			6
R18, R21, C20		+4.48	0			7
R26, C27, RFC-2, T1		+9.02	0			6
R33, C30		0		 + 1.0 0.0 – 1.0	30.000 MHz	1
R33, C30		0		 + 1 0.0 – 1.5	35.000 MHz	2
R33, C30		0		 + 1.0 0.0 – 2.0	40.000 MHz	3
R33, C30		0		 + 1.0 0.0 – 1.5	45.000 MHz	4
R33, C30		0		 + 1.0 0.0 – 1.5	49.975 MHz	5

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R35, C49		0		+ 700 MV 0.0 – 700 MV	57.000 MHz	1
R35, C49		0		+ 450 MV 0.0 – 450 MV	62.000 MHz	2
R35, C49		0		+ 350 MV 0.0 – 350 MV	67.000 MHz	3
R35, C49		0		+ 450 MV 0.0 – 450 MV	72.000 MHz	4
R35, C49		0		+ 500 MV 0.0 – 500 MV	76.975 MHz	5
R39, C44, C45, T3, T4, RFL-4		+9	0			7
R41, T5, RFC-6		+9.0	0			6
R46, R48, C54		0		+ 300 MV 0.0 – 300 MV	57.000 MHz	1
R46, R48, C54		0		+ 300 MV 0.0 – 300 MV	62.000 MHz	2
R46, R48, C54		0		+ 300 MV 0.0 – 300 MV	67.000 MHz	3
R46, R48, C54		0		+ 300 MV 0.0 – 300 MV	72.000 MHz	4
R46, R48, C54		0		+ 400 MV 0.0 – 400 MV	76.975 MHz	5

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

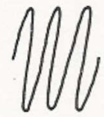
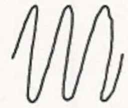
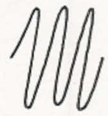
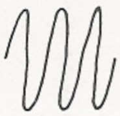
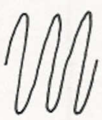
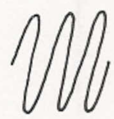
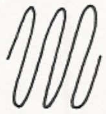
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R47, R48		0		 + 300 MV 0.0 − 300 MV	57.000 MHz	1
R47, R48		0		 + 225 MV 0.0 + 225 MV	62.000 MHz	2
R47, R48		0		 + 200 MV 0.0 − 200 MV	67.000 MHz	3
R47, R48		0		 + 250 MV 0.0 − 250 MV	72.000 MHz	4
R47, R48		0		 + 250 MV 0.0 − 250 MV	76.975 MHz	5
R49, C55, C59, L7, RFL-7		+9.0				6
R52, C56		0		 + 500 MV 0.0 − 500 MV	54.000 MHz	6
R52, pin 4 of mixer		0		 + 200 MV 0.0 − 200 MV	54.000 MHz	6
R53, C58, C60, L8, RFC-8		+8.97				6
R56, C62		0		 + 400 MV 0.0 − 400 MV	27.000 MHz	6
R56, pin 4 of mixer		0		 + 175 MV 0.0 − 175 MV	27.000 MHz	6
C6, C8, C12, L1		0		 + .5 0.0 V − .5	30.000 MHz	1

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

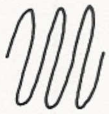
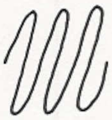
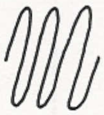
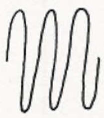
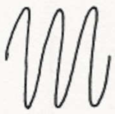
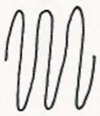
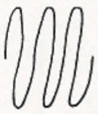
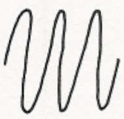
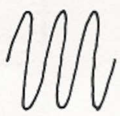
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C6, C8, C12, L1		0		 +.4 0.0 –.4	35.000 MHz	2
C6, C8, C12, L1		0		 +.35 0.0 –.35	40.000 MHz	3
C6, C8, C12, L1		0		 +.25 0.0 –.25	45.000 MHz	4
C6, C8, C12, L1		0		 +.25 0.0 –.25	49-975 MHz	5
C6, C8, C12, L1		0	0			7
C13, C16, C24, L2		0		 + 200 MV 0.0 – 200 MV	57.000 MHz	1
C13, C16, C24, L2		0		 + 200 MV 0.0 – 200 MV	62.000 MHz	2
C13, C16 C24, L2		0		 + 200 MV 0.0 – 200 MV	67.000 MHz	3
C13, C16 C24, L2		0		 + 250 MV 0.0 – 250 MV	72.000 MHz	4
C13, C16 C24, L2		0		 + 300 MV 0.0 – 300 MV	76.975 MHz	5
C13, C16		0	0			7
C29, T1		+8.96		 + 10.0 + 8.75 + 7.5	30.000 MHz	1
C29, T1		+8.96		 + 10.0 + 8.75 + 7.5	35.000 MHz	2

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

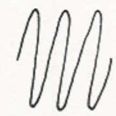
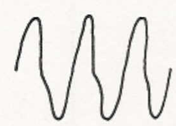
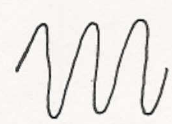
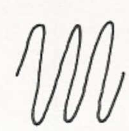
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C29, T1		+8.96		 + 10.0 + 8.75 + 7.5	40.000 MHz	3
C29, T1		+8.96		 + 10.0 + 8.75 + 7.5	45.000 MHz	4
C29, T1		+8.96		 + 10.0 + 8.75 + 7.5	49.975 MHz	5
C35, C36, T2, L3		+8.96		 + 10.0 + 9.0 V + 7.5	30.000 MHz	1
C35, C36 T2, L3		+8.96		 + 10.2 + 8.8 + 7.5	35.000 MHz	2
C35, C36, T2, L3		+8.96		 + 10.0 + 9.0 + 7.0	40.000 MHz	3
C35, C36, T2, L3		+8.96		 + 10.2 + 8.6 + 7.0	45.000 MHz	4
C35, C36, T2, L3		+8.96		 + 10.0 + 8.8 + 7.6	49.975 MHz	5
C36, C37, L38, L3, L4		+9.0		 + 10.0 + 9.0 + 8.0	30.000 MHz	1
C36, C37, L38, L3, L4		+9.0		 + 10.0 + 9.0 + 8.0	35.000 MHz	2
C36, C37, L38, L3, L4		+9.0		 + 10.0 + 9.0 + 8.0	40.000 MHz	3

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

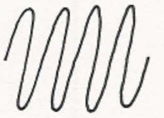
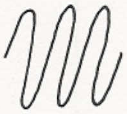
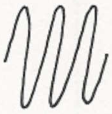
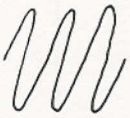
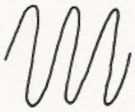
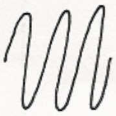
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
C36, C37, C38, L3, L4		+9.0		 + 10.0 + 9.0 + 8.0	45.000 MHz	4
C36, C37, C38, L3, L4		+9.0		 + 10.0 + 9.0 + 8.0	49.975 MHz	5
C38, C39, C40, L4		+9.0		 + 10.0 + 9.0 + 8.0	30.000 MHz	1
C38, C39, C40, L4		+9.0		 + 10.0 + 9.0 + 8.0	35.000 MHz	2
C38, C39, C40, L4		+9.0		 + 11.0 + 9.0 + 7.0	40.000 MHz	3
C38, C39, C40, L4		+9.0		 + 10.0 + 9.0 + 8.0	45.000 MHz	4
C38, C39, C40, L4		+9.0			49.973 MHz	5
C40		0		 + 1 0.0 − 1	30.000 MHz	1
C40		0		 + 1.4 0.0 − 1.4	35.000 MHz	2
C40		0		 + 1.6 0.0 − 1.6	40.000 MHz	3
C40		0		 + 1.4 0.0 − 1.4	45.000 MHz	4

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

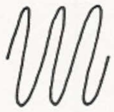
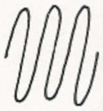
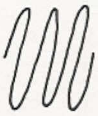
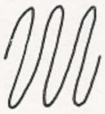
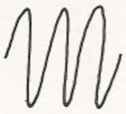
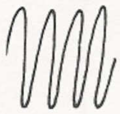
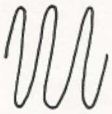
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C40		0		 + 1.2 0.0 – 1.2	49.975 MHz	5
C42, T3		+9	0			7
C46, T4		+9		 + 9.25 + 9.0 + 8.75	30.000 MHz	1
C46, T4		+9		 + 9.25 + 9.0 + 8.75	35.000 MHz	2
C46, T4		+9		 + 9.25 + 9.25 + 8.75	40.000 MHz	3
C46, T4		+9		 + 9.25 + 9.0 + 8.75	45.000 MHz	4
C46, T4		+9		 + 9.25 + 9.0 + 8.75	49.975 MHz	5
C46, pin 1		0		 + 250 MV 0.0 – 250 MV	30.000 MHz	1
C46, pin 1		0		 + 250 MV 0.0 – 250 MV	35.000 MHz	2
C46, pin 1		0		 + 250 MV 0.0 – 250 MV	40.000 MHz	3
C46, pin 1		0		 + 250 MV 0.0 – 250 MV	45.000 MHz	4
C46, pin 1		0		 + 250 MV 0.0 – 250 MV	49.975 MHz	5

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

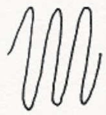
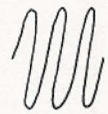
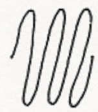
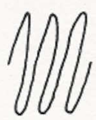
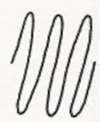
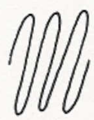
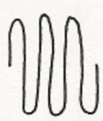
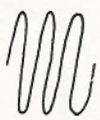
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C46, pin 1		0		 + 300MV 0.0 + 300MV	57.000 MHz	1
C46, pin 1		0		 + 300MV 0.0 – 200 MV	62.000 MHz	2
C46, pin 1		0		 + 300MV 0.0 + 300MV	67.000 MHz	3
C46, pin 1		0		 + 300MV 0.0 + 300MV	72.000 MHz	4
C46, pin 1		0		 + 300MV 0.0 + 300MV	76.975 MHz	5
C46, pin 1		0	0			7
C50, T5		+9.0		 + 9.3 + 8.8 + 8.3	57.000 MHz	1
C50, T5		+9.0		 + 9.3 + 8.8 + 8.3	62.000 MHz	2
C50, T5		+9.0		 + 9.3 + 8.8 + 8.3	67.000 MHz	3
C50, T5		+9.0		 + 9.3 + 8.8 + 8.3	72.000 MHz	4
C50, T5		+9.0		 + 9.3 + 8.8 + 8.3	76.975 MHz	5
C50, C51, C52		0		 + 450 MV 0.0 – 450 MV	57.000 MHz	1

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

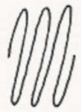
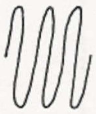
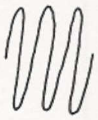
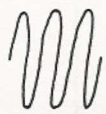
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
C50, C51, C52		0		 + 300 MV, 0.0, – 300 MV	62.000 MHz	2
C50, C51, C52		0		 + 325 MV, 0.0, – 325 MV	67.000 MHz	3
C50, C51, C52		0		 + 425 MV, 0.0, – 425 MV	72.000 MHz	4
C50, C51, C52		0		 + 500 MV, 0.0, – 500 MV	76.975 MHz	5
C51, L5		0		 + 600 MV, 0.0, + 600 MV	57.000 MHz	1
C51, L5		0		 + 300 MV, 0.0, – 300 MV	62.000 MHz	2
C51, L5		0		 + 400 MV, 0.0, – 400 MV	67.000 MHz	3
C51, L5		0		 + 500 MV, 0.0, – 500 MV	72.000 MHz	4
C51, L5		0		 + 500 MV, 0.0, – 500 MV	76.975 MHz	5
C52, C53, C54		0		 + 500 MV, 0.0, – 500 MV	57.000 MHz	1
C52, C53, C54		0		 + 300 MV, 0.0, – 300 MV	62.000 MHz	2

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

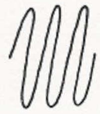
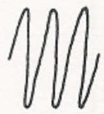
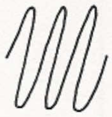
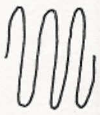
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C52, C53, C54		0		 + 325 MV 0.0 − 325 MV	67.000 MHz	3
C52, C53, C54		0		 + 425 MV 0.0 − 425 MV	72.000 MHz	4
C52, C53, C54		0		 + 500 MV 0.0 − 425 MV	76.975 MHz	5
C53, L6		0		 + 350 MV 0.0 − 350 MV	57.000 MHz	1
C53, L6		0		 + 600 MV 0.0 − 600 MV	62.000 MHz	2
C53, L6		0		 + 400 MV 0.0 − 400 MV	67.000 MHz	3
C53, L6		0		 + 500 MV 0.0 − 500 MV	72.000 MHz	4
C53, L6		0		 + 550 MV 0.0 − 550 MV	76.975 MHz	5
C56, L7		+9.0		 + 9.5 + 9.0 + 8.5	54.000 MHz	6
C62, L8		+9.0		 + 9.35 + 9.0 + 8.65	27.000 MHz	6
C63, L9, Pin 2		0		 + 75 MV 0.0 − 75 MV		1

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements – Continued

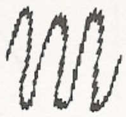
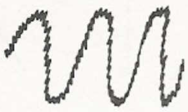
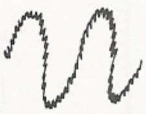
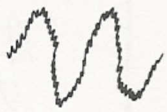
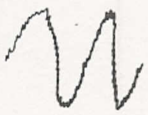
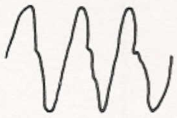
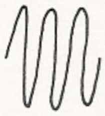
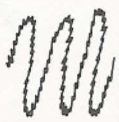
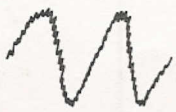
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C63, L9, pin 2		0		 +25MV 0.0 −25MV		2
C63, L9 pin 2		0		 +25MV 0.0 −25MV		3
C63, L9, pin 2		0		 +50MV 0.0 −50MV		4
C63, L9, pin 2		0		 +25MV 0.0 −25MV		5
C63, L9, pin 2		0				6
C64, L9, L10		0		 +100 MV 0.0 −100 MV	3.000 MHz	1
C64, L9, L10		0		 +70 MV 0.0 −70 MV	8.000 MHz	2
C64, L9, L10		0		 +50 MV 0.0 −50 MV	13.000 MHz	3
C64, L9, L10		0		 +50 MV 0.0 −50 MV	18.000 MHz	4
C64, L9, L10		0		 +80 MV 0.0 −80 MV	22.975 MHz	5
C64, L9, L10		0		 +75MV 0.0 −75MV	3.000 MHz	1
C64, L9, L10		0		 +210MV 0.0 −40MV	8.000 MHz	2

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

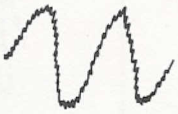
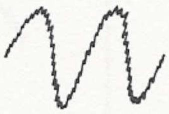
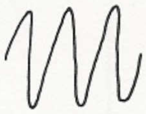
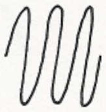
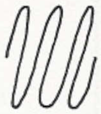
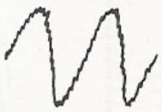
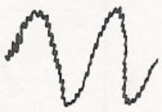
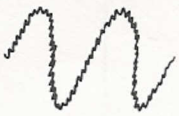
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
C64, L9, L10		0		 + 25 MV 0.0 − 25 MV	13.000 MHz	3
C64, L9, L10		0		 + 35 MV 0.0 − 35 MV	18.000 MHz	4
C64, L9, L10		0		 + 50 MV 0.0 − 50 MV	22.975 MHz	5
C65, C66, L10		0		 + 100 MV 0.0 − 100 MV	2.000 MHz	1
C65, C66, L10		0		 + 70 MV 0.0 − 70 MV	8.000 MHz	2
C65, C66, L10		0		 + 80 MV 0.0 − 80 MV	13.000 MHz	3
C65, C66, L10		0		 + 100 MV 0.0 − 100 MV	18.000 MHz	4
C65, C66, L10		0		 + 80 MV 0.0 − 80 MV	22.975 MHz	5
C65, C66, L10		0		 + 75 MV 0.0 − 75 MV	3.000 MHz	1
C65, C66, L10		0		 + 40 MV 0.0 − 40 MV	8.000 MHz	2
C65, C66, L10		0		 + 25 MV 0.0 − 25 MV	13.000 MHz	3

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

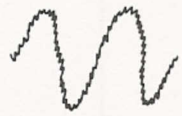
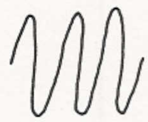
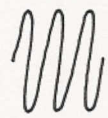
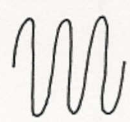
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C65, C66, L10		0		 + 60 MV 0.0 – 60 MV	18.000 MHz	4
C65, C66, L10		0		 + 50 MV 0.0 – 50 MV	22.975 MHz	5
C66, Output Side		+.75		 + 820 MV + 750 MV + 630 MV	3.000 MHz	1
C66, Output Side		+.75		 + 800 MV + 725 MV + 650 MV	8.000 MHz	2
C66, Output Side		+.75		 + 800 MV + 725 MV + 650 MV	13.000 MHz	3
C66, Output Side		+.75		 + 820 MV + 735 MV + 650 MV	18.000 MHz	4
C66, Output Side		+.75		 + 800 MV + 725 MV + 650 MV	22.975 MHz	5
C66, Output Side		+.76		 + .84 + .76 + .68	3.000 MHz	1
C66, Output Side		+.76		 + .80 + .76 + .72	8.000 MHz	2
C66, Output Side		+.76		 + .80 + .76 + .72	13.000 MHz	3
C66, Output Side		+.76		 +.81 + .76 + .71	18.000 MHz	4

Table 6-6. Synthesizer Module Top Board Voltage and Waveform Measurements — Continued

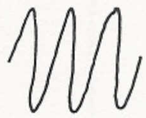
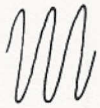
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
C66, Output Side		+.76		 +.81 +.76 +.71	22.975 MHz	5
L11, 27 MHz Crystal		+4.43		 + 4.58 + 4.48 + 4.38		6
L12, X2		+4.48			54.001 MHz	6
+9V INPUT to RVC-9		+9.0	0V			7
FINE TUNE RX:						
R6, R7		+5.13				10
R6, R7		+4.93				11
R6, R7		+4.71				12
R6, R7		+4.28				13
R6, R7		+2.05				14
COURSE TUNE RX:						
U1 1		+2.73				10
U1 1		+3.32				11
U1 1		+3.95				12
U1 1		+5.20				13
U1 1		+8.29				14

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements

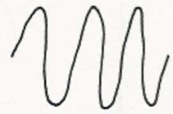
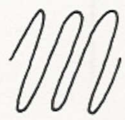
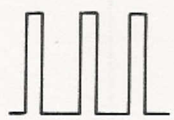
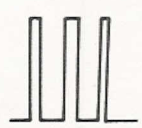
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q1		0.0				15
Q1			1.4 pp	 + 700 MV 0.0 − 700 MV	1 KHz	16
Q1			1.0 pp	 + 500 MV 0.0 − 500 MV	1 KHz	17
Q1			240m pp	 + 120 MV 0.0 − 120 MV	1 KHz	18
Q1			160m pp	 + 80 MV 0.0 − 80 MV	1 KHz	19
Q1			100m pp	 + 50 MV 0.0 − 50 MV	1 KHz	20
U1	2,3,etc.	0.0				8
U1	11,24	+9.0				8
U1	17,18	+9.0				8
U1	23	+.08		 + 9.0 0.0	3.125 KHz pulse width 2.6 μs	6
U2	1,3,etc.	0.0				8
U2	2,12, etc.	+9.0				8
U3	1,2,etc.	+9.0				8
U3	3,5,etc.	0.0				8
U4	2,3	+.04				7
U4	2,3	+.04		 + 9V + 0V	3.125 KHz pulse width 1.4 μs	8
U4	4,10,11, 15,16	+9.0				7
U4	5,6,7,8, 12,13, 14	0.0				7

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

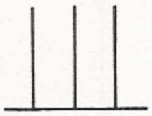
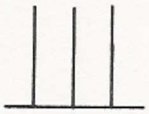
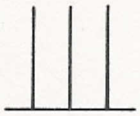
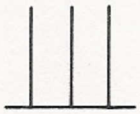
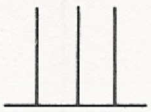
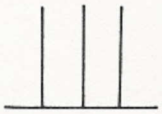
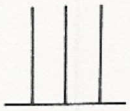
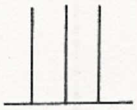
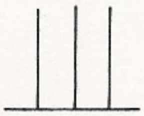
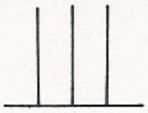
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U4	12	+9.0 and 0.0				6
U4	13	+5.35		 7.0 / + 5.2	3.125 KHz	9
U4	13	+4.82		 + 7.0 / + 4.7	3.125 KHz	2
U4	13	+9.56		 + 6.0 / + 4.4	3.125 KHz	3
U4	13	+4.24		 + 6.0 / + 4.1	3.125 KHz	4
U4	13	+2.05		 + 3.5 / + 2.0	3.125 KHz	5
U4	13	+5.11		 + 7.0 / + 5.0	3.125 KHz	10
U4	13	+4.72		 + 7.0 / + 4.6	3.125 KHz	11
U4	13	+4.46		 + 6.5 / + 4.3	3.125 KHz	12
U4	13	+4.09		 + 6.0 / + 4.0	3.125 KHz	13
U4	13	+1.80		 + 3.0 / + 1.7	3.125 KHz	14

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

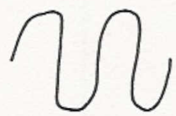
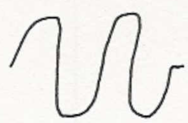
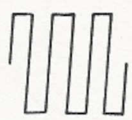
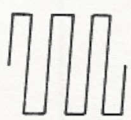
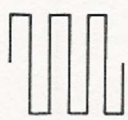
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U5	2	+3.83			3.125 KHz	7
U5	2	+3.83		 + 9.0 + 4.5 0.0	5.000 MHz	8
U5	6	+3.65		 + 9.0 + 4.5 0.0	5.000 MHz	8
U5	7	+3.77		 + 5.0 + 2.5 0.0V	4.999 MHz	8
U5	11	+8.0/0.0				6
U5	12	0.0/+9.0				6
U5	12	+9.0				7
U5	15	0				7
U5	15	+9.0/0.0				6
U5	11	+.43				7
U6	1,5	+4.47				7
U6	2,6	+5.48				7
U6	2	+5.48		 + 9V 0V	2.500 MHz	8
U6	10,14	0				7
U6	11,15	+9.0				7
U6	13	+4.49				7
U6	13	+4.48		 + 8.0 + 1.0	750 KHz	1
U6	13	+4.42		 + 8.0 + 1.0	2.000 MHz	2
U6	13	+4.28		 + 8.0 + 1.0	3.250 MHz	3

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

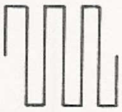
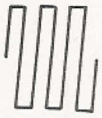
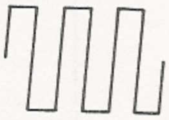
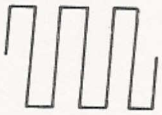
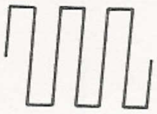
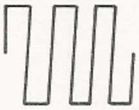
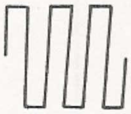
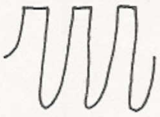
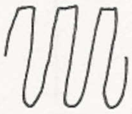
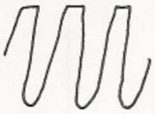
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U6	13	+3.89		 +8.0 / +1.0	4.500 MHz	4
U6	13	+3.33		 +8.0 / +1.0	5.743 MHz	5
U6	15	+4.50		 +9.0 / 0.0	375 KHz	1
U6	15	+4.50		 +9.0 / 0.0	1.000 MHz	2
U6	15	+4.47		 +9.0 / 0.0	1.625 MHz	3
U6	15	+4.43		 +9.0 / 0.0	2.250 MHz	4
U6	15	+4.50		 +9.0 / 0.0	2.871 MHz	5
U7	2,3,4 6,7, 10,14	+5.4				7
U7	5	+.92		 +1.7 / 0.0	3.000 MHz	1
U7	5	+1.13		 +1.8 / 0.0 / +.3	8.000 MHz	2
U7	5	+1.25		 +1.8 / 0.0 / +.2	13.000 MHz	3

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

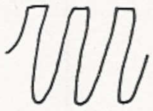
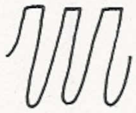
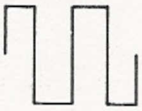
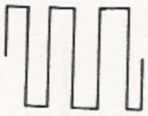
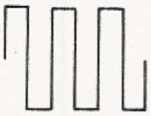
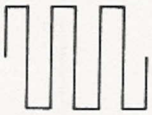
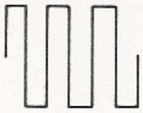
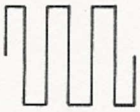
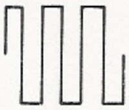
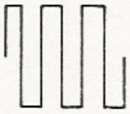
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U7	5	+1.24		 +1.8 / 0.0 / +.2	18.000 MHz	4
U7	5	+1.18		 +1.8 / 0.0	22.975 MHz	5
U7	8	+1.18		 +4.0 / 0.0	1.500 MHz	1
U7	8	+1.18		 +4.0 / 0.0	4.000 MHz	2
U7	8	+1.84		 + 4.0 / 0.0	6.500 MHz	3
U7	8	+1.80		 + 4.0 / 0.0	9.000 MHz	4
U7	8	+1.82		 +4.0 / 0.0	11.407 MHz	5
U7	8	+.09				7
U7	12	+.07				7
U7	12	+1.68		 + 4.0 / 0.0	750 KHz	1
U7	12	+1.68		 + 4.0 / 0.0	2.000 MHz	2
U7	12	+1.68		 +4.0 / 0.0	3.250 MHz	3

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

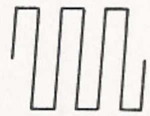
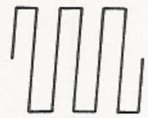
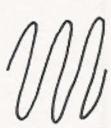
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U7	12	+1.72		 + 4.0 / 0.0	4.500 MHz	4
U7	12	+1.70		 + 4.0 / 0.0	5.743 MHz	5
U8	2	+2.94				15
U8	2	+2.82				1
U8	2	+2.82				2
U8	2	+2.82				3
U8	2	+2.82				4
U8	2	+2.93				5
U8	3	+2.81				6
U8	3	+2.81				15
U8	6	+.03				15
U8	6	+3.22				1
U8	6	+2.70				2
U8	6	+2.34				3
U8	6	+1.72				4
U8	6	+.03				5
U9	1	+.76				7
U9	1	+.76		 + 980 MV / + 600 MV	3.000 MHz	1
U9	1	+.76		 + 900 MV / + 600 MV	8.000 MHz	2
U9	1	+.76		 + 900 MV / + 500 MV	13.000 MHz	3
U9	1	+.76		 + 900 MV / + 500 MV	18.000 MHz	4

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

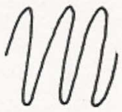
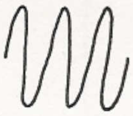
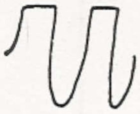
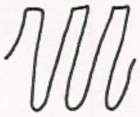
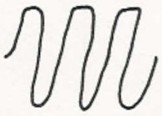
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U9	1	+.76		+900 MV  +550 MV	22.975 MHz	5
U9	1	+.76		+900 MV  +650 MV	3.000 MHz	10
U9	1	+.76		+800 MV  +650 MV	8.000 MHz	11
U9	1	+.76		+800 MV  +650 MV	13.000 MHz	12
U9	1	+.76		+850 MV  +625 MV	18.000 MHz	13
U9	1	+.76		+800 MV  +600 MV	22.975 MHz	14
U9	2,3,5,7	0				7
U9	4	+.76				7
U9	4	+.76				6
U9	6	+5.3				7
U9	6	+4.46		+ 5.2  + 3.5	3.000 MHz	1
U9	6	+4.64		+ 5.2  + 3.8	8.000 MHz	2
U9	6	+4.41		+ 5.2  + 3.6	13.000 MHz	3

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
U9	6	+4.56		 + 5.2 + 3.6	18.000 MHz	4
U9	6	+4.77		 + 5.2 + 4.0	22.975 MHz	5
U9	8	+2.9				7
U9	9	+5.24				7
U9	10	+3.91				7
R1,R2,C3,X1		+3.92		 + 7.0 + 3.5 0.0	4.999 MHz	8
R3,D4		+.08				7
R6,C9,D2		+1.12				7
VCO Control Voltage Input to R9		+8.26				15
VCO Control Voltage Side of R9		+2.08				1
VCO Control Voltage Side of R9		+2.99				2
VCO Control Voltage Side of R9		+3.69				3
VCO Control Voltage Side of R9		+4.82				4
VCO Control Voltage Side of R9		+8.26				5
R11,R13		+2.21				15
R12,R13		+4.15				15
R12,RFL-6		+9.03				15
R14, C18		0.0				15
Modulation Output Side of R14		0.0				15

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements — Continued

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
R14,C18			1.5 pp	+ 250 MV 0.0 − 750 MV	1 KHz	16
R14,C18			1.0 pp	+ 250 MV 0.0 + 250 MV	1 KHz	17
R14,C18			240m pp	+ 120 MV 0.0 − 120 MV	1 KHz	18
R14,C18			160m pp	+ 80 MV 0.0 − 80 MV	1 KHz	19
R14,C18			100m pp	+ 50 0.0 − 50 MV	1 KHz	20
Modulation Output Side of R14			600m pp	+ 300 MV 0.0 − 300 MV	1 KHz	16
Modulation Output Side of R14			440m pp	+ 220 MV 0.0 − 220 MV	1 KHz	17
Modulation Output Side of R14			260m pp	+ 130 MV 0.0 − 130 MV	1 KHz	18
Modulation Output Side of R14			200m pp	+ 100 MV 0.0 − 100 MV	1 KHz	19
Modulation Output Side of R14			150m pp	+ 75 MV 0.0 − 75 MV	1 KHz	20
R15,C17		0.0				15
C5,RFC-2		+5.4				7

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

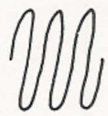
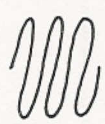
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
C6,RFC-4		+9.0				7
C7,RFC-3		+5.4				7
C19,RFC-6		+9.03				15
D2,D3		+.75				7
D3,D4		+.38				7
Input to T1		+.76				7
Input to T1		+.76		 + 800 MV + 700 MV + 600 MV	3.000 MHz	1
Input to T1		+.76		 + 800 MV + 700 MV + 600 MV	8.000 MHz	2
Input to T1		+.76		 + 800 MV + 700 MV + 600 MV	13.000 MHz	3
Input to T1		+.78		 + 840 MV + 720 MV + 600 MV	18.000 MHz	4
Input to T1		+.76		 + 800 MV + 700 MV + 600 MV	22.975 MHz	5
Input to T1		+.76		 + 850 MV + 650 MV	3.000 MHz	10
Input to T1		+.76		 + 800MV + 700MV	8.000 MHz	11
Input to T1		+.76		 + 800 MV + 700 MV	13.000 MHz	12

Table 6-7. Synthesizer Bottom Board Voltage and Waveform Measurements – Continued

DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
Input to T1		+.76		 +800MV +700MV	18.000 MHz	13
Input to T1		+.76		 +800MV +700MV	22.975 MHz	14

6-50. LOGIC MEMORY MODULE PERFORMANCE TESTING

Perform the procedures of paragraphs 6-51 through 6-55 to test a logic memory module if suspected of being faulty or to test a module after repair.

6-51. TEST EQUIPMENT REQUIRED. Test equipment required to test the logic display module is listed below:

a. Logic memory test fixture - ETI part no. TD-0016.

b. DC Power Supply - Power Designs Inc. Model 6050A, or equivalent.

c. Multimeter - Fluke 8000A, or equivalent.

6-52. INITIAL SETUP. Connect equipment and make initial switch settings described below before performing the logic memory module performance tests, beginning with paragraphs 6-53.

a. Set the logic memory module test fixture switches and controls as follows:

Switch/Control	Setting
WRITE ENABLE switch	OFF
MEMORY switch	1
DISPLAY SELECT switches	CABLE #1

b. Set the DC power supply switches and controls as follows:

Switch/Control	Setting
VOLTAGE switch	60V
CURRENT LIMIT switch	5A
CURRENT adjust control	Mid-range
POWER on/RESET switch	POWER ON

c. Adjust the power supply VOLTAGE control for an 11 VDC output as indicated on the power supply meter. Then turn the power supply POWER ON/RESET switch to RESET.

6-53. TOP BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the logic memory module top board are given in paragraphs 6-53.1 through 6-53.6. See figure 8-32 for test setup.

6-53.1 Top Board Setup. Perform the following procedures to prepare the top board for test.

a. Insert the top board to be tested into top board mounting board on the logic memory module test fixture.

b. Insert known good bottom board into bottom board mounting plate.

c. Insert 20 jumper pins into bottom board to insure electrical connection. (See figure 8-24.)

d. Attach 20-pin plug to the logic memory top board to be tested.

6-53.2 Top Board Current Check. Perform the top board current check as follows:

a. Remove jumper wire from logic memory module test fixture CURRENT CHECK jack.

b. Connect leads between the logic memory module test fixture CURRENT CHECK jacks and MA INPUT and COMMON jacks of the multimeter. Observe polarity (red to red and black to black.)

c. Depress the multimeter DCMA FUNCTION pushbutton.

d. Depress the multimeter 2000MA RANGE pushbutton.

CAUTION

Observe caution while performing steps e and f to prevent damage to the equipment.

e. Turn on the power supplied and observe current indication on the multimeter. Current consumption should be 10MA without display lighted.

f. Depress the logic memory module 10M FREQUENCY SELECT pushbutton to light display. Multimeter should indicate approximately 250 MA with display lighted. If multimeter reads excessive current consumption or if power supply faults, isolate faults before continuing, turn off power supply.

g. Turn off the power supply.

h. Disconnect multimeter and replace current jumper wire.

6-53.3 Top Board Voltage Check. Perform the top board voltage check as follows:

a. Connect leads to V_r and COMMON jacks or multimeter.

b. Depress the multimeter DCV FUNCTION pushbutton.

c. Depress the multimeter 20V RANGE switch.

d. Turn on DC power supply.

e. Check for approximately +8.5 Vdc at test points 1, 2, and 3 of the logic memory top board to be tested. See schematic diagram (figure 8-21) for location of test points.

f. Increase DC input voltage to 24 Vdc.

g. Check for approximately +8.5 Vdc at test points 1, 2, and 3 of the logic memory top board to be tested. See schematic diagram (figure 8-21) for location of test points.

h. Return DC input voltage to +11 Vdc.

i. Turn off DC power supply.

6-53.4 Top Board Clock Test. Perform the top board clock test as follows:

a. Turn on the DC power supply.

b. Depress the logic memory module 10M FREQUENCY SELECT pushbutton. All five eight-segment digits should illuminate for approximately 5 seconds.

NOTE

Due to clock and strobe illumination of display, it will be necessary to press the FREQUENCY SELECT pushbutton to illuminate display when desired.

c. Turn off the power supply.

6-53.5 Top Board Logic Circuit Test. Perform the top board logic circuit test as follows:

a. Turn on the DC power supply.

b. Set the logic memory module test fixture MEMORY switch to position 1.

c. Set the logic memory module test fixture WRITE ENABLE switch to ON.

d. Depress the logic memory module test fixture 25K FREQUENCY SELECT pushbutton. Check that 1K and 10K digits on the display indicate 00, 25, 50, and 75 only.

e. Depress the logic memory module test fixture 100 K FREQUENCY SELECT pushbutton. Check that 100 K digit on the display indicates 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

f. Depress the logic memory module test fixture 1M FREQUENCY SELECT pushbutton. Check that 1M digit on the display indicates 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

g. Depress the logic memory module test fixture 10M FREQUENCY SELECT pushbutton. Check that 10M digit on the display indicates 3 and 4 only.

h. Using four FREQUENCY SELECT pushbuttons on the logic memory module test fixture. Set preset channel for 30.050 MHz.

i. Set the logic memory module test fixture MEMORY switch to Position 2 and repeat steps d through g.

j. Using four FREQUENCY SELECT pushbuttons on the logic memory module test fixture, set preset channel N for 37.050 MHz.

k. Set the logic memory module test fixture MEMORY switch to Position 3 and repeat steps d through g.

l. Using for FREQUENCY SELECT pushbuttons on the logic memory module test fixture, set preset channel N for 43.050 MHz.

m. Set the logic memory module test fixture MEMORY switch to Position 4 and repeat steps d through g.

n. Using four FREQUENCY SELECT pushbuttons on the logic memory module test fixture set preset channel N for 49.050 MHz.

o. Set the logic memory module test fixture WRITE ENABLE switch to OFF.

p. Depress a FREQUENCY SELECT pushbutton on the logic memory module test fixture to illuminate display.

q. Check preset channels for proper frequency: 1=30.050 MHz, 2=37.050 MHz, 3=42.050 MHz, and 4=49.050 MHz.

r. Turn off the power supply.

6-53.6 Top Board Battery Check LED Adjustment. Perform the top board battery check LED adjustment as follows:

a. Turn on the DC power supply.

b. Adjust the power supply VOLTAGE control to +11 VDC.

c. Depress a FREQUENCY SELECT pushbutton or the logic memory module test fixture to illuminate display.

d. Adjust R17 (see figure 8-22) until BATTERY CHECK LED goes out.

e. Adjust R17 again until the BATTERY CHECK LED just illuminates.

f. Turn off the power supply.

6-54 BOTTOM BOARD SETUP AND TEST PROCEDURES. Setup and test procedures for the logic memory module bottom board are given in paragraphs 6-54.1 through 6-54.3. Refer to figure 8-32 for test setup.

6-54.1 Bottom Board Setup. Perform the following procedures to prepare the bottom board for test.

a. Insert the bottom board to be tested into bottom board mounting plate on the logic memory module test fixture.

b. Insert known good top board into top board mounting plate.

c. Insert 20 jumper pins into bottom board to insure electrical connection. (See figure 8-24.)

d. Attach 20-pin plug to the logic memory top board to be tested.

6-54.2 Bottom Board Test Procedures. Perform the bottom board test procedures as follows:

a. Set the DC power supply VOLTAGE control for an 11 VDC output as indicated on the power supply meter.

b. Repeat paragraph 6-53.2, steps a through h and 6-53.5, steps a through r.

6-54.3 Bottom Board Memory Holding Battery Test. Perform the bottom board memory holding battery test as follows:

a. Depress the multimeter DCV FUNCTION pushbutton.

b. Depress the multimeter 20V RANGE pushbutton.

c. Using the multimeter, check for voltage of at least 3.5 VDC at test point 4 on bottom board to ground. This test should be done with power supply off. Refer to the bottom board schematic diagram (figure 8-23) to locate the test point.

6-55. LOGIC MEMORY MODULE TEST PROCEDURES. Perform the procedures of paragraphs 6-55.1 and 6-55.2 to test a logic memory module.

6-55.1 Initial Setup. Perform the following procedure to prepare the logic memory module for test:

a. Insert the logic memory module into bottom mounting board on the logic memory module test fixture.

b. Attach ribbon plug 2 to 20-pin plug on top board.

6-55.2 Module Test Procedure. Perform the following procedure to test the logic memory module.

a. Set the logic memory module DISPLAY SELECT switches to CABLE # 2.

b. Repeat paragraph 6-53.2, steps a through h, 6-53.5, steps a through r, and 6-54.3, steps a through c.

NOTE

This completes the logic memory module test procedure. Secure test equipment.

6-56. LOGIC MEMORY MODULE TROUBLESHOOTING. Troubleshooting of the logic memory module is accomplished by making voltage and waveform measurements in accordance with tables 6-8 and 6-9 for the logic memory module top board and bottom board, respectively. Make voltage and waveform measurements with the initial setup of figure 8-32 and paragraph 6-52. The initial setup should be modified by changing radio's frequency in accordance with the FREQ column of tables 6-8 and 6-9 and applying power/signals in accordance with NOTES column of tables 6-8 and 6-9. Following is a definition of the notes:

NOTES	DEFINITION
1	Troubleshooting performed with +11 VDC input power applied.
2	Troubleshooting performed with +11 VDC input power applied and display lighted.
3	Troubleshooting performed with +11 VDC input power applied and display lighted. Voltage goes low when display is lighted.

Table 6-8. Logic Memory Top Board Voltage and Waveform Measurements

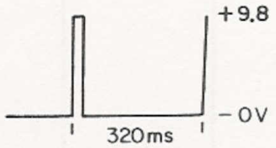
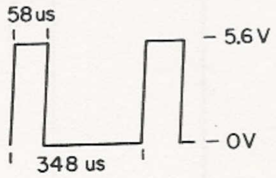
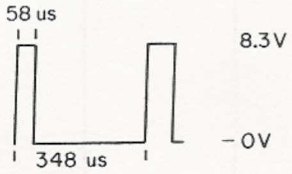
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U1	1	+4.5				1
U1	2	+8.3				2
U1	3	+8.3				1
U1	3	+6.7				2
U1	4	+8.3				1
U1	4	+7.7				2
U1	5	+8.3				1
U1	8,9	+7.8				1
U1	10	+8.3				2
U1	11	+8.3				2
U1	11	+.8				2
U1	12	+8.3				2
U1	13	+8.4				1
U1	13	+4.5				2
U2	1				2.875 kHz	1
U2	2				2.875 kHz	2
U2	3	+8.3				2
U2	3				2.875 kHz	2

Table 6-8. Logic Memory Top Board Voltage and Waveform Measurements - Continued

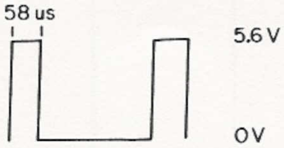
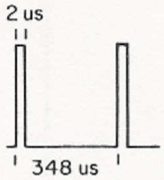
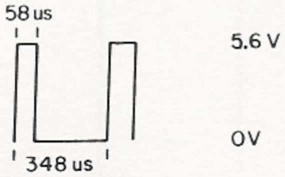
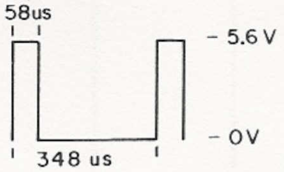
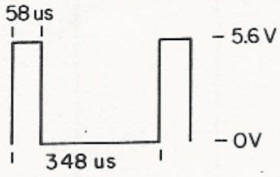
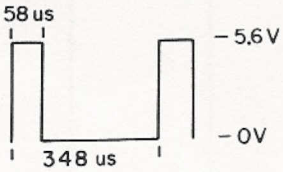
DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
U2	4				2.875 kHz	2
U2	5				2.875 kHz	2
U2	7				2.875 kHz	2
U2	10				2.875 kHz	2
U2	13	+8.0				1
U2	14	+8.5				1
U2	15	+7.4				1
U3	1	+8.5				1
U3	2	+8.5				1
U3	3				2.875 kHz	2
U3	4	+8.5				1
U3	5				2.875 kHz	2

Table 6-8. Logic Memory Top Board Voltage and Waveform Measurements - Continued

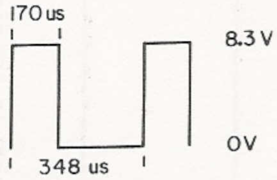
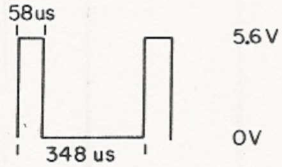
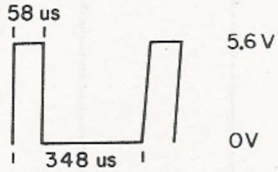
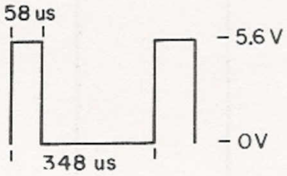
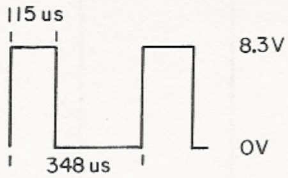
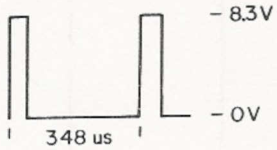
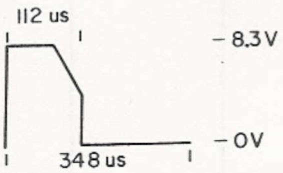
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U3	6	+8.5				1
U3	7				2.875 kHz	2
U3	9				2.875 kHz	2
U3	10	+8.5				1
U3	11				2.875 kHz	2
U4	1	+8.5				1
U4	2	+7.9				1
U4	3				2.875 kHz	2
U4	5				2.875 kHz	2
U4	7				2.875 kHz	2
U5	3				2.875 kHz	2

Table 6-8. Logic Memory Top Board Voltage and Waveform Measurements - Continued

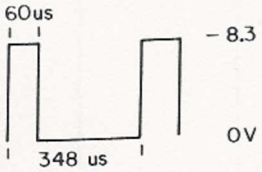
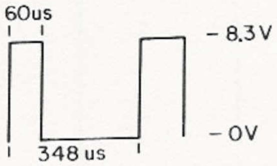
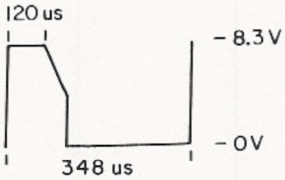
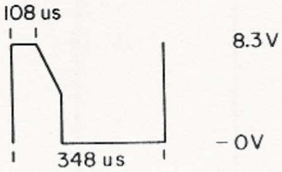
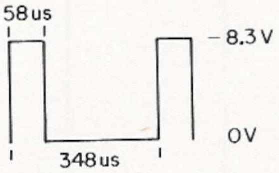
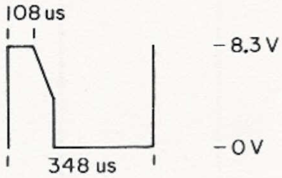
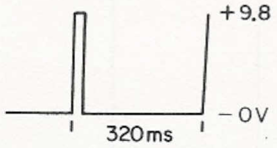
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U5	5				2.875 kHz	2
U5	11				2.875 kHz	2
U5	13				2.880 kHz	2
U6	3				2.875 kHz	2
U6	5				2.875 kHz	2
U6	13					1
U7	1	+8.3				1
U7	2	+4.9				1
U7	4	+14				1
C6, RFC-3		+8.3				1

Table 6-9. Logic Memory Bottom Board Voltage and Waveform Measurements

DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
U3	1	+8.3				1
U3	7	+8.3				1
U3	10	+8.3				1
U3	16	+8.3				1
U4	1	+8.3				1
U4	7	+8.3				1
U4	10	+8.3				1
U4	16	+8.3				1
U5	1	+8.3				1
U5	3	+8.3				1
U5	4	+8.3				1
U5	5	+8.3				1
U5	6	+8.3				1
U5	7	+3.3				1
U5	9	+3.1				1
U5	10	+8.3				1
U5	11	+8.3				1
U5	12	+8.3				1
U5	13	+8.3				1
U6	1	+8.3				1
U6	7	+8.3				1
U6	10	+8.3				1
U6	16	+8.3				1
U7	1	+8.3				1
U7	7	+8.3				1
U7	10	+8.3				1
U8	1	+8.3				1
U8	6	+8.3				1
U8	9	+8.3				1
U8	10	+8.3				1
U8	11	+8.3				1
U8	12	+8.3				1
U8	14	+8.3				1

Table 6-9. Logic Memory Bottom Board Voltage and Waveform Measurements - Continued

DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
U9	10				3.125 kHz	1
U9	11	+8.0				2
U10	10	+8.3				1
U10	15	+7.8				3
U11	3	+8.3				1
U11	5	+8.3				1
U11	6	+8.3				1
U11	10	+8.3				1
U11	12	+8.3				1
U11	13	+8.3				1
U11	14	+8.3				1

6-57. DISPLAY MODULE PERFORMANCE TESTING.

Perform the procedures in paragraphs 6-57 and 6-58 to test a display module if suspected of being faulty or to test a module after repair.

6-58. TEST EQUIPMENT REQUIRED. Test equipment required to test the display module is listed below:

a. Display module test fixture - ETI part no. TD-0011.

b. DC power supply. Power Designs Inc. Model 6050A, or equivalent.

c. Multimeter - Fluke 8000A, or equivalent.

6-59. INITIAL SETUP. Connect equipment and make initial switch settings described below before performing the display module performance tests, beginning with paragraph 6-59. Refer to figure 8-33 for test setup.

a. Set the DC power supply VOLTAGE RANGE to 60V.

b. Set the DC power supply OUTPUT VOLTAGE to 12V.

c. Set the DC power supply AMPERAGE RANGE to .5 amperes.

d. Set the DC power supply AMPERAGE LIMIT to approximately 3/4 scale.

e. Connect the DC power supply to the V IN jacks on the display test jig.

f. Connect the multimeter to CURRENT jacks on the display test jig.

g. On the multimeter, set the FUNCTION switch to MA (milliamperes) and the RANGE switch to 2000 MA.

h. Connect the multimeter black lead to COMMON jack and red lead to MA jack on the display test jig.

CAUTION

Underlined test procedures below require caution to prevent damage to the equipment.

6-60. DISPLAY MODULE TEST PROCEDURES.

6-60.1 Current Tests. Perform the display module current tests as follows:

a. Connect display to be tested to 20 pin plug on test jig.

b. <u>On multimeter - current consumption should read approximately 10 MA without display lighted.</u>

c. <u>On display - press any of the four membrane switches to light display.</u>

d. <u>On multimeter - current consumption should read approximately 250 MA.</u>

e. <u>If at any time during test, current consumption should become excessive, shut off power supply completely.</u>

f. <u>Locate and repair power problem before continuing.</u>

6-60.2 Digit and Membrane Switch Test. Perform the display module digit and membrane switch test as follows:

a. Turn on power supply.

b. Press any membrane on display.

c. All digits on display should light, including LED.

d. Release membrane switch.

e. Digits should remain lit for approximately five seconds.

f. Press 10M membrane.

g. 10M digit on display should write 3, 4, 3, 4 . . .

h. Press 1M membrane.

i. 1M digit on display should write 1, 2, 3 . . . 9.

j. Press 100K membrane.

k. 100K digit on display should write 1, 2, 3 . . . 9.

l. Press 25K membrane.

m. 25K digits on display should write 25, 50, 75, 00 . . .

6-60.3 LDRI Test. Perform display module LRI test as follows:

a. On multimeter - set function to measure ohms.

b. On multimeter - set range to 20.

c. Connect multimeter leads to LDRI jacks on test jig.

d. Resistance should read 100 ohms-500 ohms, depending on the amount of light in the room.

e. Completely cover LDRI to block out as much light as possible.

f. Resistance should now read approximately 4K ohms or greater, depending on blockage of light to LDRI.

NOTE

Display module testing complete, secure test equipment.

6-6l. DISPLAY MODULE TROUBLESHOOTING. Troubleshooting of the display module is accomplished by making voltage and waveform measurements in accordance with tables 6-10 and 6-11 for the display module top board and bottom board, respectively. Make voltage and waveform measurements with the initial setup of figure 8-33 and paragraph 6-59. The initial setup should be modified by changing radio's frequency in accordance with the FREQ column of tables 6-10 and 6-11 and applying power/signals in accordance with NOTES column of tables 6-10 and 6-11. Following is a definition of the notes:

NOTE	DEFINITION
1	Troubleshooting performed with: a. +8 VDC input power applied. b. Display lighted and set at 30.000 MHz.

Table 6-10. Display Module Top Board Voltage and Waveform Measurements

DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
Q1	C	+6.8				1
Q1	C	+4.5				1
Q2	C	+7.2				1
Q2	C	+6.5				1
Q3	C	+6.7				1
Q3	C	+4.0				1
Q4	C	+6.7				1
Q4	C	+2.7				1
Q5	C	+7.0				1
Q5	C	+3.4				1

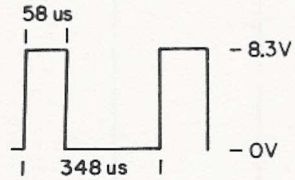
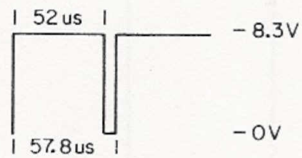
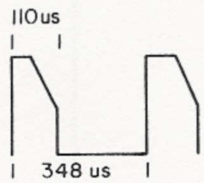
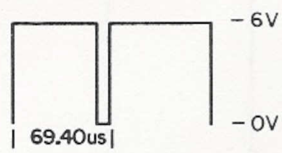
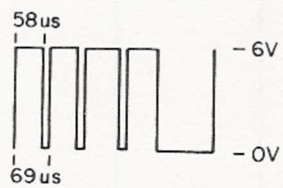
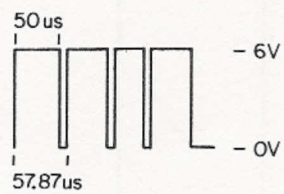
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U1	1				2.880 kHz	1
U1	3	+8.3				1
U1	4	+8.3				1
U1	4				17.275 kHz	1
U1	7				2.880 kHz	1
U1	9				14.410 kHz	1
U1	9	+8.3				1
U1	9				14.390 kHz	1
U1	10				17.275 kHz	1
U1	10	+8.3				1

Table 6-11. Display Module Bottom Board Voltage and Waveform Measurements - Continued

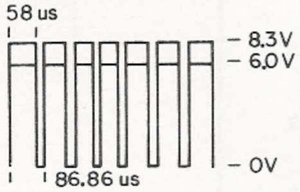
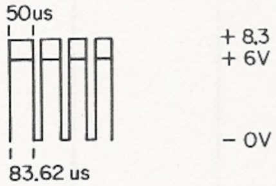
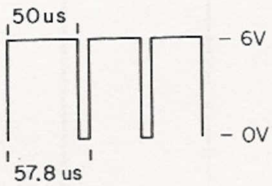
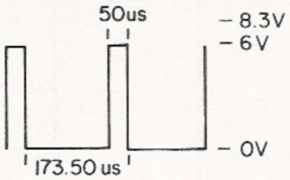
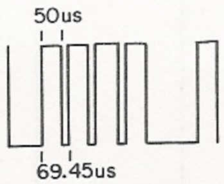
DEVICE	PIN NO.	QUIESCENT DC	QUIESCENT AC	WAVEFORM	FREQ.	NOTES
U1	11	+8.3				1
U1	11				11.550 kHz	1
U1	12	+8.3				1
U1	12				11.50 kHz	1
U1	13				15.37 kHz	1
U1	13	+8.3				1
U1	13	+8.3				1
U1	14	+8.3				1
U1	14				5.765 kHz	1
U1	15	+8.3				1
U1	16	+8.3				1
U1	15					1
Output R2		+8.3				1

Table 6-11. Display Module Bottom Board Voltage and Waveform Measurements - Continued

DEVICE	PIN NO.	QUIESCENT		WAVEFORM	FREQ.	NOTES
		DC	AC			
Output R3		+8.3				1
Output R4		+8.3				1
Output R7		+8.3				1

CHAPTER 7
PARTS LIST

CHAPTER 7
PARTS LIST

7-1. INTRODUCTION

The parts list for the ERC-310 manpack transceiver is arranged as follows:

TABLE 7-1. RADIO SET ERC 310 PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8601	ASSEMBLY, CASE	
	1	8602	MODULE, TRANSMITTER	
	1	8603	MODULE, RECEIVER	
	1	8604	MODULE, AUDIO	
	1	8605	MODULE, LOGIC	
	1	8606	MODULE, SYNTHESIZER	
	8	8320	ASSEMBLY, ANTENNA MATCHING	
	1	8303	ASSEMBLY, FILTER	
	2	4122	SCREW, 3 MM X 20 MM ST/ST	
	16	4222	SCREW, 3 MM X 10 MM ST/ST	
	16	4333	WASHERS, 3 MM, WAVY, ST/ST	
	2	5312	LID, CASTING	
	1	8305	ASSEMBLY, DUMMY	

TABLE 7-2. MAIN FRAME ASSY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
J1	1	3103	SOCKET, BNC	
R1	1	0104	RESISTOR, VARIABLE	
S1	1	3002	SWITCH, 2 POLE, 6 POSITION	
S2	1	3003	SWITCH, 1 POLE, 4 POSITION	
	1	8301	ASSEMBLY, MOTHERBOARD, TOP	
	1	8302	ASSEMBLY, MOTHERBOARD, BOTTOM	
	1	8607	ASSEMBLY, DISPLAY	
	1	5701	LUG, BNC	
	2	5704	CONTACT, BATTERY	
	1	5504	"O" RING, ANTENNA SOCKET	
	1	5505	"O" RING, ANTENNA MOUNT	
	3	5316	CASTING, KNOB	
	1	5304	CASTING, CASE	
	2	5026	BUNGS, VENT	
	1	5005	STUD, TVE	
	1	5006	INSULATOR, TVE	
	16	4372	INSERT, 3 MM	
	2	4351	SOLDER TAGS	
	2	4332	WASHER, WAVY, 2.5 MM	
	1	3104	SOCKET, ANTENNA	
	4	4374	INSERT, 4 MM	
	4	4375	INSERT, 5 MM	
	6	4212	SCREW, 2.5 MM X 16 MM, ST/ST	
	1	4303	NUT, FULL, 3 MM	
	2	4124	SCREW, 3 MM X 4 MM, ST/ST	
	1	4120	SCREW, 3 MM X 6 MM, ST/ST	
	2	4221	SCREW, 3 MM X 10 MM, ST/ST	
	6	4211	SCREW, 2.5 MM X 10 MM, ST/ST	
	12	4322	WASHER, LOCK, 2.5 MM, ST/ST	
	4	4323	WASHER, LOCK, 3 MM, ST/ST	
	2	4313	WASHER, FLAT, 3 MM, ST/ST	
	3	4336	WASHER, WAVY, 6 MM	
	1	5708	SCREEN, DISPLAY	
	1	8316	ASSEMBLY, AUDIO PLUG	
	8	3501	BEAD	

TABLE 7-3. CASE ASSY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8317	CASE, SUB ASSY	
	1	8320	AUDIO PLUG ASSY	
	1	8321	DISPLAY ASSY	
	1	5708	DISPLAY SCREEN	
	2	5714	DUST COVER AUDIO	
	1	5715	DUST COVER BNC	
	1	0104	POT 10 K	
	1	3002	SWITCH, 6 P	
	1	3003	SWITCH, 4 P	
	1	3103	BNC SOCKET	
	1	3104	ANT SOCKET	
	6	4212	2.5 MM X 16 SCREW	
	4	4332	2.5 MM WAVY WASHER	
	3	4336	6 MM WAVY WASHER	
	2	5026	VENT BUNGS	
	2	5316	KNOBS	
	1	5317	KNOBS VOLUME	
	1	5504	O-RING	
	6	4322	2.5 LOCK WASHER	
	1	5701	ENC EARTH LUG	
	4	4211	2.5 X 10 MM SCREW	

TABLE 7-4. CASE SUB ASSY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	5304	CASTING CASE, PAINTED	
	1	5006	+VE INS	
	1	5005	+VE STUD	
	1	5035	INSULATOR, SOLDER TAG	
	2	5704	BATTERY, CONTACT	
	1	4303	NUT 3 MM	
	3	4124	SCREW 3 MM X 4	
	2	4354	SOLDER TAG	
	3	4323	WASHER	

TABLE 7-5. MOTHERBOARD, TOP ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	6001	PRINTED CIRCUIT BOARD, MOTHERBOARD, TOP	
	61	3105	SOCKET	
	9	1045	CAPACITOR, 10 NF, X 7R, 10%, 100V	
	4	5010	RETAINER, MODULE	
	4	5021	NUT, LOCK, MODULE RETAINER	

TABLE 7-6. MOTHERBOARD BOTTOM ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1	4	1045	CAPACITOR, 10N, X7R, 10%, 100V	
D1	1	2401	DIODE, 1N4001	
D2, 3-8	7	2402	DIODE, 1N4148	
K1, 2	2	3802	RELAY	
Q1	1	2213	TRANSISTOR, 2N2222A	
R2	1	0014	RESISTOR, 100, 1/4 WATT, 1%	
R3	1	0019	RESISTOR, 220, 1/4 WATT, 1%	
R4, 5	2	0053	RESISTOR, 47K, 1/4 WATT, 1%	
	1	6002	PRINTED CIRCUIT BOARD, MOTHERBOARD BOTTOM	
	1	4516	COAX, RG174, 2.5 IN.	
	1	4517	COAX, RG174, 3.1 IN.	
	1	4518	COAX, RG174, 5 IN.	
	1	4501	WIRE, WHITE, 1.5 IN.	
	1	4504	WIRE, YELLOW, 1.5 IN.	
	1	4505	WIRE, BLUE, 1.5 IN.	
	1	4506	WIRE, GREEN, 1.5 IN.	
	1	4507	WIRE, ORANGE, 1.5 IN.	
	2	4508	WIRE, RED, 2 IN.	
	3	4509	WIRE, WHITE, 2 IN.	
	3	4510	WIRE, BLACK, 2 IN.	
	2	4511	WIRE, YELLOW, 2 IN.	
	2	4512	WIRE, ORANGE, 2 IN.	
	2	4513	WIRE, BLUE, 2 IN.	
	3	4514	WIRE, GRAY, 2 IN.	
	2	4515	WIRE, GREEN, 2 IN.	
	6	5023	NUT, NICKEL PLATED	
	2	5008	SPACER, NICKEL PLATED	
	7	5010	RETAINER, MODULE, NICKEL PLATED	
	7	5021	NUT, LOCK, MODULE RETAINER	
	1	5710	SCREEN, FILTER	
	55	3105	SOCKET	
	15	5001	PIN, 6 MM	

TABLE 7-7. AUDIO MODULE PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8308	AUDIO, BOTTOM, ASSEMBLY	
	1	8309	AUDIO, TOP, ASSEMBLY	
	1	6019	BOARD, COVER, AUDIO	
	2	5011	BUSHING, TOP	
	2	5012	BUSHING, BOTTOM	
	2	5013	SPACER, THREADED	
	2	5014	STUD, THREADED	
	2	5017	SCREW, MODULE RETAINING	

TABLE 7-8. AUDIO TOP ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1,4 5,7 11,15, 16,18	8	1065	CAPACITOR, 1μF, 20%, 35V	
C2, 13,21, 24	4	1034	CAPACITOR, 1NF, X7R, 10%, 100V	
C3, 22, 23	3	1045	CAPACITOR, 10NF, X7R, 10%, 100V	
C6, 12	2	1063	CAPACITOR, 0.47μF, 20%, 35V	
C8,9	2	1059	CAPACITOR, 2N2, NPO, 2%, 100V	
C10	1	1066	CAPACITOR, 2.2μF, 20%, 16V	
C14, 19	2	1041	CAPACITOR, 4N7, X7R, 10%, 100V	
C17	1	1068	CAPACITOR, 4.7μF, 20%, 16V	
C20	1	1077	CAPACITOR, 10μF, 10%, 16V	
C25	1	1060	CAPACITOR, 4N7, NPO, 2%, 100V	
C26	1	1070	CAPACITOR, 10μF, 20%, 16V	
D1-5	5	2402	DIODE, 1N4148	
Q1	1	2214	FET, RED	
Q2	1	2210	TRANSISTOR, 2N2894	
Q3	1	2208	FET, 2N4861	
R1, 16, 22, 26	4	0028	RESISTOR, 1K, 1/4 WATT, 1%	
R2, 18	2	0033	RESISTOR, 2K7, 1/4 WATT, 1%	
R3, 33, 34	3	0048	RESISTOR, 22K, 1/4 WATT, 1%	
R4, 28	2	0055	RESISTOR, 68K, 1/4 WATT, 1%	
R5	1	0029	RESISTOR, 1K2, 1/4 WATT, 1%	
R6	1	0062	RESISTOR, 240K, 1/4 WATT, 1%	
R8	1	0018	RESISTOR, 200, 1/4 WATT, 1%	
R9	1	0022	RESISTOR, 390, 1/4 WATT, 1%	
R10	1	0066	RESISTOR, 470K, 1/4 WATT, 1%	
R11	1	0065	RESISTOR, 390K, 1/4 WATT, 1%	
R13, 39	2	0043	RESISTOR, 12K, 1/4 WATT, 1%	
R14	1	0045	RESISTOR, 15K, 1/4 WATT, 1%	
R15, 35	2	0014	RESISTOR, 100, 1/4 WATT, 1%	
R17	1	0103	RESISTOR, PRESET, 10K	
R19, 23, 27	3	0037	RESISTOR, 4K7, 1/4 WATT, 1%	

TABLE 7-8. AUDIO TOP ASSEMBLY PARTS LIST (Con't)

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
R20, 30, 37	3	0042	RESISTOR, 10K, 1/4 WATT, 1%	
R21	1	0102	RESISTOR, PRESET, 5K	
R24	1	0101	RESISTOR, PRESET, 1K	
R25	1	0020	RESISTOR, 270, 1/4 WATT, 1%	
R29	1	0058	RESISTOR, 120K, 1/4 WATT, 1%	
R36	1	0067	RESISTOR, 560K, 1/4 WATT, 1%	
R38	1	0040	RESISTOR, 6K8, 1/4 WATT, 1%	
RFC1	1	3504	CHOKE, 2.2 μH	
U1	1	2008	INTEGRATED CIRCUIT, LM 1558J	
U2	1	2021	INTEGRATED CIRCUIT, MC 3303P	
	1	6009	PRINTED CIRCUIT BOARD, AUDIO, TOP	
	5	5002	PIN, 12.5 MM	
	9	5003	PIN, 16 MM	
	8	3402	SOLDER TURRET	
	3	3404	SPACER, TRANSISTOR	

TABLE 7-9. AUDIO BOTTOM ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C2,15	2	1061	CAPACITOR, 0.1µF, 20%, 35V	
C3,20	2	1063	CAPACITOR, 0.47µF, 20%, 35V	
C4,5 6,16, 23	5	1045	CAPACITOR, 10NF, X7R, 10%, 100V	
C7,8 18,19	4	1053	CAPACITOR, 47NF, X7R, 10%, 100V	
C10, 19	2	1042	CAPACITOR, 5N6, X7R, 10%, 100V	
C11	1	1054	CAPACITOR, 56NF, X7R, 10%, 100V	
C12, 14	2	1068	CAPACITOR, 4.7µF, 20%, 16V	
C13, 17	2	1065	CAPACITOR, 1µF, 20%, 35V	
C21	1	1073	CAPACITOR, 33µF, 20%, 16V	
C22	1	1070	CAPACITOR, 10µF, 20%, 16V	
D1,2, 3	3	2402	DIODE, 1N4148	
Q1,2, 3	3	2213	TRANSISTOR, 2N2222A	
R1	1	0037	RESISTOR, 4K7, 1/4 WATT, 1%	
R2	1	0038	RESISTOR, 5K6, 1/4 WATT, 1%	
R3	1	0011	RESISTOR, 56, 1/4 WATT, 1%	
R4,5, 7,8, 10,12, 25	7	0048	RESISTOR, 22K, 1/4 WATT, 1%	
R6	1	0054	RESISTOR, 56K, 1/4 WATT, 1%	
R9, 11,21	3	0057	RESISTOR, 100K, 1/4 WATT, 1%	
R13, 20	2	0053	RESISTOR, 47K, 1/4 WATT, 1%	
R14, 16,24, 32	4	0044	RESISTOR, 13K, 1/4 WATT, 1%	
R15	1	0030	RESISTOR, 1K5, 1/4 WATT, 1%	
R17, 30,33	3	0052	RESISTOR, 39K, 1/4 WATT, 1%	
R18, 19,27	3	0042	RESISTOR, 10K, 1/4 WATT, 1%	
R22	1	0035	RESISTOR, 3K9, 1/4 WATT, 1%	
R23, 28	2	0028	RESISTOR, 1K, 1/4 WATT, 1%	
R26	1	0055	RESISTOR, 68K, 1/4 WATT, 1%	
R29, 31	2	0043	RESISTOR, 12K, 1/4 WATT, 1%	
R34	1	0014	RESISTOR, 100, 1/4 WATT, 1%	
RFC1, 2	2	8026	RFC	
U1	1	2021	INTEGRATED CIRCUIT, MC 3303P	

TABLE 7-9. AUDIO BOTTOM ASSEMBLY PARTS LIST (Con't)

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
U2	1	2013	INTEGRATED CIRCUIT, MC 14011BCP	
U3	1	2012	INTEGRATED CIRCUIT, μA 78MGHM	
	1	6008	PRINTED CIRCUIT, AUDIO, BOTTOM	
	1	3401	HEAT SINK, TO-39	
	2	3402	SOLDER TURRET	
	3	3404	SPACER, TRANSISTOR	
	8	5001	PIN, 6 MM	
	14	3105	SOCKET	
	1	3403	SPACER, TRANSISTOR	

TABLE 7-10. TRANSMITTER MODULE PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8304	TRANSMITTER ASSEMBLY	
	1	6017	TRANSMITTER, COVER	
	4	5012	BUSHING, TOP, 2 MM	
	2	5013	SPACER, THREADED, 9MM	
	1	3403	SPACER, TRANSISTOR	

TABLE 7-11. TRANSMITTER ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1	1	1025	CAPACITOR, 180PF, NPO, 10%, 100V	
C2,3, 4,9, 11,13	6	1045	CAPACITOR, 10N, X7R, 10%, 100V	
C5,8	2	1041	CAPACITOR, 4N7, X7R, 10%, 100V	
C6	1	1020	CAPACITOR, 68PF, N150, 2%, 63V	
C7	1	1065	CAPACITOR, 14F, 20%, 35V	
C10	1	1015	CAPACITOR, 27PF, N150, 2%, 63V	
C12	1	1022	CAPACITOR, 100PF, NPO, 10%, 100V	
D1	1	2402	DIODE, 1N4148	
L1	1	8027	COIL ASSEMBLY	
Q1	1	2209	TRANSISTOR, 2N3866	
Q2	1	2211	FET, VMP4	
R1,2	2	0021	RESISTOR, 330, 1/4 WATT, 1%	
R3	1	0003	RESISTOR, 15, 1/4 WATT, 1%	
R4,8	2	0032	RESISTOR, 2K2, 1/4 WATT, 1%	
R5	1	0024	RESISTOR, 510, 1/4 WATT, 1%	
R6	1	0030	RESISTOR, 1K5, 1/4 WATT, 1%	
R7	1	0020	RESISTOR, 270, 1/4 WATT, 1%	
RFC1	1	8028	CHOKE	
RFC2	1	8029	CHOKE	
RFC3	1	8030	CHOKE	
RFC4	1	3504	CHOKE, 2.2μH	
T1	1	8031	TRANSFORMER ASSEMBLY	
T2	1	8032	TRANSFORMER ASSEMBLY	
	1	3401	HEAT SINK	
	6	5002	PIN, 12.5 MM	

TABLE 7-12. RECEIVER MODULE PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8306	ASSEMBLY, RECEIVER, BOTTOM	
	1	8307	ASSEMBLY, RECEIVER, TOP	
	1	6018	BOARD, COVER, RECEIVER	
	2	5011	BUSHING, TOP	
	2	5012	BUSHING, BOTTOM	
	2	5015	SPACER, THREADED	
	2	5016	STUD, THREADED	
	2	5017	SCREW, MODULE RETAINING	

TABLE 7-13. RECEIVER TOP ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1,2 7	3	1053	CAPACITOR, 47NF, X7R, 10%, 100V	
C3,8	2	1045	CAPACITOR, 10NF, X7R, 10%, 100V	
C4	1	1068	CAPACITOR, 4.7μF, 20%, 16V	
C5,6	2	1026	CAPACITOR, 220PF, NPO, 10%, 100V	
C9	1	1065	CAPACITOR, 1μF, 20%, 35V	
C10	1	1022	CAPACITOR, 100PF, NPO, 10%, 100V	
L1	1	8040	COIL ASSEMBLY	
R1	1	0010	RESISTOR, 51, 1/4 WATT, 1%	
R2	1	0023	RESISTOR, 470, 1/4 WATT, 1%	
RFC1	1	3504	CHOKE, 2.2μH	
U1	1	2019	INTEGRATED CIRCUIT, 5041P	
	1	6007	PRINTED CIRCUIT BOARD, RECEIVER, TOP	
	1	5709	SCREEN, RECEIVER	
	3	5004	PIN, 20 MM	
	4	5003	PIN, 16.5 MM	

TABLE 7-14. RECEIVER BOTTOM ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1,23	2	1021	CAPACITOR, 82PF, N150, 2%, 63V	
C2,7	2	1020	CAPACITOR, 68PF, N150, 2%, 63V	
C3	1	1006	CAPACITOR, 4P7, N150, ±0.25 PF, 63V	
C4	1	1014	CAPACITOR, 22PF, N150, 2%, 63V	
C5	1	1027	CAPACITOR, 270PF, NPO, 10%, 100V	
C6,15	2	1024	CAPACITOR, 150PF, NPO, 10%, 100V	
C8	1	1009	CAPACITOR, 8P2, N150, ±0.25 PF, 63V	
C9	1	1022	CAPACITOR, 100PF, NPO, 10%, 100V	
C10, 21	2	1010	CAPACITOR, 10PF, N150, 2%, 63V	
C11, 16	2	1034	CAPACITOR, 1N, X7R, 10%, 100V	
C12, 13,17, 19,31	5	1045	CAPACITOR, 10N, X7R, 10%, 100V	
C18	1	1013	CAPACITOR, 18PF, N150, 2%, 63V	
C20, 32	2	1016	CAPACITOR, 33PF, N150, 2%, 63V	
C22, 23,24, 25,26, 27,28, 33	8	1053	CAPACITOR, 47N, X7R, 10%, 100V	
C30	1	1041	CAPACITOR, 4N7, X7R, 10%, 100V	
L1	1	8020	TORROID ASSEMBLY	
L2	1	8022	TORROID ASSEMBLY	
L3	1	8021	TORROID ASSEMBLY	
L4,5	2	8023	TORROID ASSEMBLY	
L6	1	8024	COIL ASSEMBLY	
Q1,2	2	2206	TRANSISTOR, U310	
Q3	1	2205	TRANSISTOR, MFE131	
Q4	1	2203	TRANSISTOR, BFY90	
R1,2	2	0023	RESISTOR, 470, 1/4 WATT, 1%	
R3	1	0057	RESISTOR, 100K, 1/4 WATT, 1%	
R4,7, 8	3	0048	RESISTOR, 22K, 1/4 WATT, 1%	
R6	1	0029	RESISTOR, 1K2, 1/4 WATT, 1%	
R9	1	0034	RESISTOR, 3K3, 1/4 WATT, 1%	
R10	1	0030	RESISTOR, 1K5, 1/4 WATT, 1%	
R11	1	0047	RESISTOR, 20K, 1/4 WATT, 1%	
RFC1, 3,4,5	4	3504	CHOKE, 2.2μH	
RFC2	1	8019	RFC	
T1	1	8018	TRANSFORMER ASSEMBLY	
T2,3	2	3505	COIL ASSEMBLY	
U1	1	3301	MIXER, TFM-2	
U2	1	3801	FILTER, CRYSTAL, 27MHZ	
U3	1	2001	INTEGRATED CIRCUIT, MC 1550G	
X1	1	3704	CRYSTAL, 27.455 MHZ	

TABLE 7-14. RECEIVER BOTTOM ASSEMBLY PARTS LIST (Con't)

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	2	3402	TURRET, SOLDER	
	7	3105	SOCKET	
	4	5001	PIN, 6 MM	
	4	3404	SPACER, TRANSISTOR	
	1	6006	PRINTED CIRCUIT BOARD, RECEIVER, BOTTOM	

TABLE 7-15. SYNTHESIZER MODULE PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8312	SYNTHESIZER, BOTTOM, ASSEMBLY	
	1	8313	SYNTHESIZER, TOP, ASSEMBLY	
	1	6021	COVER, SYNTHESIZER	
	2	5011	BUSHING, TOP	
	2	5012	BUSHING, BOTTOM	
	2	5013	SPACER, THREADED	
	2	5014	STUD, THREADED	
	2	5017	SCREW, MODULE RETAINING	

TABLE 7-16. SYNTHESIZER TOP ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1, 10,15, 17,26, 30,33, 32,34, 41,43, 44,40, 60,46, 11,67, 49,59, 27,29	21	1045	CAPACITOR, 10NF, X7R, 10%, 100V	
C2,4	2	1067	CAPACITOR, 3.3μF, 20%, 16V	
C3, 9,14	3	1068	CAPACITOR, 4.7μF, 20%, 16V	
C5	1	1061	CAPACITOR, 0.1μF, 20%, 35V	
C6, 39,51	3	1022	CAPACITOR, 100PF, NPO, 10%, 100V	
C7	1	1011	CAPACITOR, 12PF, N150, 2%, 63V	
C8	1	1007	CAPACITOR, 5P6, N150, ± .25PF, 63V	
C12, 23,25, 62	4	1028	CAPACITOR, 330PF, NPO, 10%, 100V	
C13, 36,50, 52,53	5	1015	CAPACITOR, 27PF, N150, 2%, 63V	
C16, 42	2	1021	CAPACITOR, 82PF, N150, 2%, 63V	
C18, 19,21	3	1063	CAPACITOR, 0.47μF, 20%, 35V	
C20	1	1070	CAPACITOR, 10μF, 20%, 16V	
C22, 24	2	1016	CAPACITOR, 33PF, N150, 2%, 63V	
C28, 47	2	1025	CAPACITOR, 180PF, NPO, 10%, 100V	
C31, 35,48	3	1023	CAPACITOR, 120PF, NPO, 10%, 100V	
C37	1	1024	CAPACITOR, 150PF, NPO, 10%, 100V	
C38, 57,58	3	1020	CAPACITOR, 68PF, N150, 2%, 63V	
C45	1	1034	CAPACITOR, 1NF, X7R, 10%, 100V	
C54, 55	2	1017	CAPACITOR, 39PF, N150, 2%, 63V	
C56, 61,64	3	1029	CAPACITOR, 390PF, NPO, 10%, 100V	
C63, 65	2	1027	CAPACITOR, 270PF, NPO, 10%, 100V	
C66	1	1053	CAPACITOR, 47NF, X7R, 10%, 100V	
C68	1	1010	CAPACITOR, 10PF, N150, 2%, 63V	

TABLE 7-16. SYNTHESIZER TOP ASSEMBLY PARTS LIST (Con't)

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
D1,2, 5	3	2404	VARICAP, MV 109	
D3,4	2	2405	VARICAP, DKV 6515A	
L1	1	8009	TORROID ASSEMBLY	
L2	1	8010	TORROID ASSEMBLY	
L3	1	8005	TORROID ASSEMBLY	
L4	1	8006	TORROID ASSEMBLY	
L5	1	8007	TORROID ASSEMBLY	
L6	1	8008	TORROID ASSEMBLY	
L7	1	8001	TORROID ASSEMBLY	
L8	1	8003	TORROID ASSEMBLY	
L9,10	2	8011	TORROID ASSEMBLY	
L11	1	8004	TORROID ASSEMBLY	
L12	1	8002	TORROID ASSEMBLY	
Q1,2, 5,6, 7,8	6	2201	TRANSISTOR, 2N918	
Q3,9	2	2203	TRANSISTOR, BFY-90	
Q4	1	2204	FET, MFE 2000	
R1,2, 30	3	0023	RESISTOR, 470, 1/4 WATT, 1%	
R3, 25,43	3	0029	RESISTOR, 1K2, 1/4 WATT, 1%	
R4,8	2	0057	RESISTOR, 100K, 1/4 WATT, 1%	
R5	1	0014	RESISTOR, 100, 1/4 WATT, 1%	
R6	1	0030	RESISTOR, 1K5, 1/4 WATT, 1%	
R7, 12,17, 22	4	0048	RESISTOR, 22K, 1/4 WATT, 1%	
R9, 18,21	3	0049	RESISTOR, 27K, 1/4 WATT, 1%	
R10, 13,20	3	0053	RESISTOR, 47K, 1/4 WATT, 1%	
R11	1	0050	RESISTOR, 30K, 1/4 WATT, 1%	
R14	1	0051	RESISTOR, 33K, 1/4 WATT, 1%	
R15, 16	2	0042	RESISTOR, 10K, 1/4 WATT, 1%	
R19	1	0058	RESISTOR, 120K, 1/4 WATT, 1%	
R23, 24,31, 40,42, 49,50, 53,54	9	0037	RESISTOR, 4K7, 1/4 WATT, 1%	
R26, 39,41	3	0038	RESISTOR, 5K6, 1/4 WATT, 1%	
R27, 28,37, 44	4	0034	RESISTOR, 3K3, 1/4 WATT, 1%	

TABLE 7-16. SYNTHESIZER TOP ASSEMBLY PARTS LIST (Con't)

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
R29, 45,55	3	0025	RESISTOR, 560, 1/4 WATT, 1%	
R32	1	0022	RESISTOR, 390, 1/4 WATT, 1%	
R34	1	0016	RESISTOR, 150, 1/4 WATT, 1%	
R36	1	0027	RESISTOR, 820, 1/4 WATT, 1%	
R38	1	0028	RESISTOR, 1K, 1/4 WATT, 1%	
R46, 47	2	0021	RESISTOR, 330, 1/4 WATT, 1%	
R48	1	0003	RESISTOR, 15, 1/4 WATT, 1%	
R51	1	0032	RESISTOR, 2K2, 1/4 WATT, 1%	
R52, 56	2	0009	RESISTOR, 47, 1/4 WATT, 1%	
RFC1, 3	2	8017	CHOKE	
RFC2, 4,5,6, 7,8,9	7	3504	CHOKE, 2.2 μH	
T1,2	2	8037	TORROID ASSEMBLY	
T3,4	2	8012	TORROID ASSEMBLY	
T5	1	8013	TORROID ASSEMBLY	
U1	1	2008	INTEGRATED CIRCUIT, LM1558J	
U2	1	3301	MIXER, TFM-2	
X1	1	3702	CRYSTAL 27.000 MHZ	
X2	1	3703	CRYSTAL 54.000 MHZ	
	9	3404	SPACER, TRANSISTOR	
	1	5706	SCREEN, SYNTHESIZER, TOP	
	1	5707	SCREEN, SYNTHESIZER, BOTTOM	
	6	5002	PIN, 12.5 MM	
	11	5003	PIN, 16.5 MM	
	4	3402	SOLDER TURRET	

TABLE 7-17. SYNTHESIZER, BOTTOM ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1,8, 9,10, 12,13	6	1053	CAPACITOR, 47N, X7R, 10%, 100V	
C2	1	1013	CAPACITOR, 18PF, N150, 2%, 63V	
C4, 5,6, 11,16, 19	6	1045	CAPACITOR, 10N, X7R, 10%, 100V	
C7	1	1034	CAPACITOR, 1N, X7R, 10%, 100V	
C14	1	1029	CAPACITOR, 390PF, NPO, 10%, 100V	
C15, 17,18	3	1065	CAPACITOR, 14F, 20%, 35V	
C20	1	1070	CAPACITOR, 10UF, 20%, 16V	
D1	1	2403	DIODE, 1N748A, ZENER, 3.9V	
D2, 3,4,5	4	2402	DIODE, 1N4148	
Q1	1	2202	FET, VCR5P	
R1,4	2	0070	RESISTOR, 1MEG, 1/4 WATT, 1%	
R2	1	0030	RESISTOR, 1K5, 1/4 WATT, 1%	
R3	1	0041	RESISTOR, 8K2, 1/4 WATT, 1%	
R5	1	0017	RESISTOR, 180, 1/4 WATT, 1%	
R6	1	0047	RESISTOR, 20K, 1/4 WATT, 1%	
R7,8	2	0057	RESISTOR, 100K, 1/4 WATT, 1%	
R9	1	0049	RESISTOR, 27K, 1/4 WATT, 1%	
R10	1	0045	RESISTOR, 15K, 1/4 WATT, 1%	
R11	1	0028	RESISTOR, 1K, 1/4 WATT, 1%	
R12	1	0032	RESISTOR, 2K2, 1/4 WATT, 1%	
R13	1	0101	RESISTOR, PRESET, 1K	
R15	1	0035	RESISTOR, 3K9, 1/4 WATT, 1%	
RFC1	1	8016	RFC	
RFC2, 3,4,5	4	8015	RFC	
RFC6	1	3504	CHOKE, 2.2 UH	
T1	1	8014	TOROID ASSEMBLY	
U1	1	2007	INTEGRATED CIRCUIT, CD4059AE	
U2,3	2	2005	INTEGRATED CIRCUIT, MC14560B	
U4	1	2006	INTEGRATED CIRCUIT, MC14568B	
U5	1	2010	INTEGRATED CIRCUIT, MC14049UB	
U6	1	2004	INTEGRATED CIRCUIT, MC14027B	
U7	1	2003	INTEGRATED CIRCUIT, SN54LS73AJ	
U8	1	2002	INTEGRATED CIRCUIT, CA3160AE	
U9	1	2001	INTEGRATED CIRCUIT, MC1550G	
X1	1	3701	CRYSTAL, 5 MHZ	
	1	6012	PRINTED CIRCUIT BOARD, SYNTHESIZER, BOTTOM	
	17	3105	SOCKET	
	14	5001	PIN, 6MM	
	1	3404	SPACER, TRANSISTOR	

TABLE 7-18. LOGIC MODULE PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8311	ASSEMBLY, LOGIC, TOP	
	1	8310	ASSEMBLY, LOGIC, BOTTOM	
	1	6020	BOARD, LOGIC, COVER	
	2	5011	BUSHING, TOP	
	2	5012	BUSHING, BOTTOM	
	2	5013	SPACER, THREADED	
	2	5014	STUD, THREADED	
	2	5017	SCREW, MODULE RETAINING	

TABLE 7-19. LOGIC TOP ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1	1	1034	CAPACITOR, 1NF, X7R, 10%, 100V	
C2,6	2	1053	CAPACITOR, 47NF, X7R, 10%, 100V	
C3	1	1063	CAPACITOR, 0.47UF, 20%, 35V	
C4,5, 8	3	1045	CAPACITOR, 10NF, X7R, 10%, 100V	
C7	1	1061	CAPACITOR, 0.1UF, 20%, 35V	
C9	1	1070	CAPACITOR, 10UF, 20%, 10V	
D1,2	4	2402	DIODE, 1N4148	
R1, 13,14	3	0053	RESISTOR, 47K, 1/4 WATT, 1%	
R2	1	0103	RESISTOR, PRESET, 10K	
R3	1	0046	RESISTOR, 18K, 1/4 WATT, 1%	
R4	1	0049	RESISTOR, 27K, 1/4 WATT, 1%	
R5,6	2	0032	RESISTOR, 2K2, 1/4 WATT, 1%	
R7	1	0042	RESISTOR, 10K, 1/4 WATT, 1%	
R8-12	5	0029	RESISTOR, 1K2, 1/4 WATT, 1%	
R15	1	0034	RESISTOR, 3K3, 1/4 WATT, 1%	
R16	1	0037	RESISTOR, 4K7, 1/4 WATT, 1%	
R17	1	0070	RESISTOR, 1 MEG, 1/4 WATT, 1%	
RFC1, 4	2	8026	RFC	
RFC2, 3	2	3504	CHOKE, 2.2UH	
U1	1	2023	INTEGRATED CIRCUIT, MC14093B	
U2	1	2009	INTEGRATED CIRCUIT, MC14017B	
U3	1	2010	INTEGRATED CIRCUIT, MC14049UB	
U4,5, 6	3	2011	INTEGRATED CIRCUIT, CD4503MJ	
U7	1	2012	INTEGRATED CIRCUIT, UA78MGHM	
	1	6011	PRINTED CIRCUIT BOARD, LOGIC, TOP	
	5	5002	PIN, 12MM	
	15	5003	PIN, 16.5MM	
	1	3106	SOCKET	
	1	3401	HEAT SINK	
	1	3403	SPACER, TRANSISTOR	

TABLE 7-20. LOGIC BOTTOM ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
B1,2, 3	3	7301	BATTERY, 1.2V, NI-CAD	
C1	1	1045	CAPACITOR, 10NF, X7R, 10%, 100V	
D1	1	2402	DIODE, 1N4148	
R1	1	0037	RESISTOR, 4K7, 1/4 WATT, 1%	
R2,3, 4,5,6	5	0057	RESISTOR, 100K, 1/4 WATT, 1%	
U1,2	2	2016	INTEGRATED CIRCUIT, CD4039AE	
U3,4, 6,7	4	2018	INTEGRATED CIRCUIT, MC14510B	
U5	1	2017	INTEGRATED CIRCUIT, MC14490	
U8	1	2014	INTEGRATED CIRCUIT, MC14012B	
U9	1	2015	INTEGRATED CIRCUIT, CD4020B	
U10	1	2004	INTEGRATED CIRCUIT, MC14027B	
U11	1	2013	INTEGRATED CIRCUIT, CD4011BMJ	
	1	6010	PRINTED CIRCUIT BOARD, LOGIC, BOTTOM	
	6	5001	PIN, 6MM	
	20	3105	SOCKET	

TABLE 7-21. DISPLAY MODULE PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8314	DISPLAY, TOP, ASSEMBLY	
	1	8315	DISPLAY, BOTTOM, ASSEMBLY	

TABLE 7-22. DISPLAY ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	8319	DISPLAY MODULE	
	1	5702	LENS	
	1	5703	RETAINING PLATE	
	1	5501	GASKET, CONTROL	
	1	5506	GASKET, HEAD	
	1	5308	CASTING, HEAD	
	8	4011	SCREW, LSK, ST/ST, 2.5MM X5MM	
	2	4122	SCREW, CH, ST/ST, 3MM, X16MM	
	2	4332	WASHER, WAVY, 2.5MM	
	2	4401	HELICOIL, 3MM	

TABLE 7-23. DISPLAY, TOP ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
CR1	1	2407	LED, RED	
LDR1	1	0301	RESISTOR, VT901	
Q1-5	5	2213	TRANSISTOR, 2N2222A	
S1-4	2	3001	SWITCH, MEMBRANE	
U1-5	5	2406	LED, SEVEN SEGMENT, MAN 74A	
	1	6014	PRINTED CIRCUIT BOARD, DISPLAY, TOP	
	10	5002	PINS, 12.5MM	
	2	5019	TUBE, SPACERS, 6MM	

TABLE 7-24. DISPLAY, BOTTOM ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
R1-8	8	0011	RESISTOR, 56, 1/4 WATT, 1%	
U6	1	2022	INTEGRATED CIRCUIT, MC14511B	
	1	3107	PLUG ASSEMBLY	
	10	3105	SOCKET	
	1	6015	PRINTED CIRCUIT BOARD, DISPLAY, BOTTOM	

TABLE 7-25. FILTER (30-50 MHZ) ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1, 13	2	1008	CAPACITOR, 6P8, N150, ± 0.25PF,63V	
C2	1	1017	CAPACITOR, 39PF, N150, ± 0.25PF,63V	
C3	1	1004	CAPACITOR, 3P3, N150, ± 0.25PF,63V	
C4, 14	2	1019	CAPACITOR, 56PF, N150, ± 0.25PF, 63V	
C5	1	1015	CAPACITOR, 27PF, N150, ± 0.25PF, 63V	
C6,9	2	1010	CAPACITOR, 10PF, N150, 2%, 63V	
C7,10	2	1020	CAPACITOR, 68PF, N150, ± 0.25PF, 63V	
C8	1	1022	CAPACITOR, 100PF, NPO, 10%, 100V	
C11	1	1007	CAPACITOR, 5P6, N150, ± 0.25PF, 63V	
C12	1	1021	CAPACITOR, 82PF, N150, 2%, 63V	
L1	1	8033	COIL ASSEMBLY	
L2, 4	2	8034	COIL ASSEMBLY	
L3	1	8035	COIL ASSEMBLY	
	1	5710	SCREEN, FILTER	

TABLE 7-26. DUMMY BOARD ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	6005	PRINTED CIRCUIT BOARD	
	22	5002	PIN, 12MM	
	2	5034	TUBE SPACER	

TABLE 7-27. AUDIO PLUG BOARD PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
C1-7	7	1045	CAPACITOR, 10NF, X7R, 10%, 100V	
	1	6022	PRINTED CIRCUIT BOARD	
	1	4508	SLEEVING WIRE RED 2"	
	1	4509	SLEEVING WIRE WHITE 2"	
	1	4510	SLEEVING WIRE BLACK 2"	
	1	4511	SLEEVING WIRE YELLOW 2"	
	1	4512	SLEEVING WIRE ORANGE 2"	
	1	4513	SLEEVING WIRE BLUE 2"	
	1	4514	SLEEVING WIRE GRAY 2"	
	1	4515	SLEEVING WIRE GREEN 2"	
	8	3501	BEAD 21-030-B	
	2	3102	HONDA SOCKET CONNECTOR	
	7		BUSS WIRE 1-1/2"	
	7		INSULATOR 1-1/4"	

TABLE 7-28. LED MODULE MECHANICAL PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
	1	5702	LENS	
	1	5703	RETAINING PLATE	
	1	5501	GASKET, CONTROL	
	1	5308	CASTING, HEAD	
	8	4011	SCREW, CSK, ST/ST, 2.5 MM X 5 MM	

TABLE 7-29. ANTENNA MATCHING (30-50 MHZ) ASSEMBLY PARTS LIST

REF DES	QTY	ETI PART NO.	NAME AND DESCRIPTION	FIG. REF
D1	1	2402	DIODE, 1N4148	
K1	1	3804	RELAY, T0-5, DPDT	
L1	1	8036	TOROID ASSEMBLY	
R1	1	0032	RESISTOR, 1K, 1/4 WATT, 1%	
	1	6016	ANTENNA MATCHING BOARD	
	1	5034	SPACER, TUBE, 2 MM	
	1	4333	WAVY WASHER	
	1	4221	SCREW, PAN HEAD	
	3	5001	PIN, 6 MM	

CHAPTER 8
DRAWINGS

CHAPTER 8
DRAWINGS

8-1. INTRODUCTION

This drawing contains the following drawings for the ERC-310:

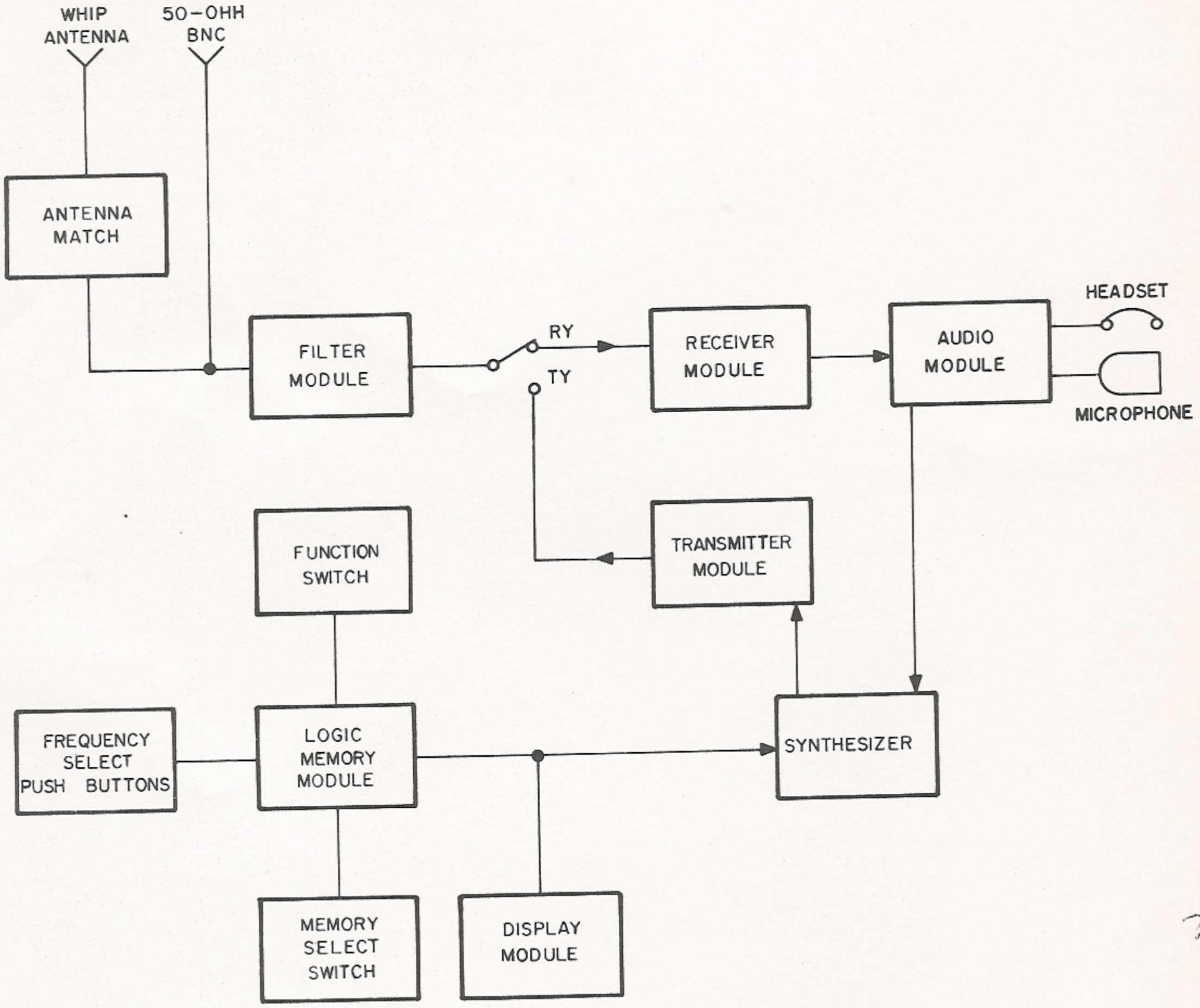


Figure 8-1. Transceiver Overall Block Diagram

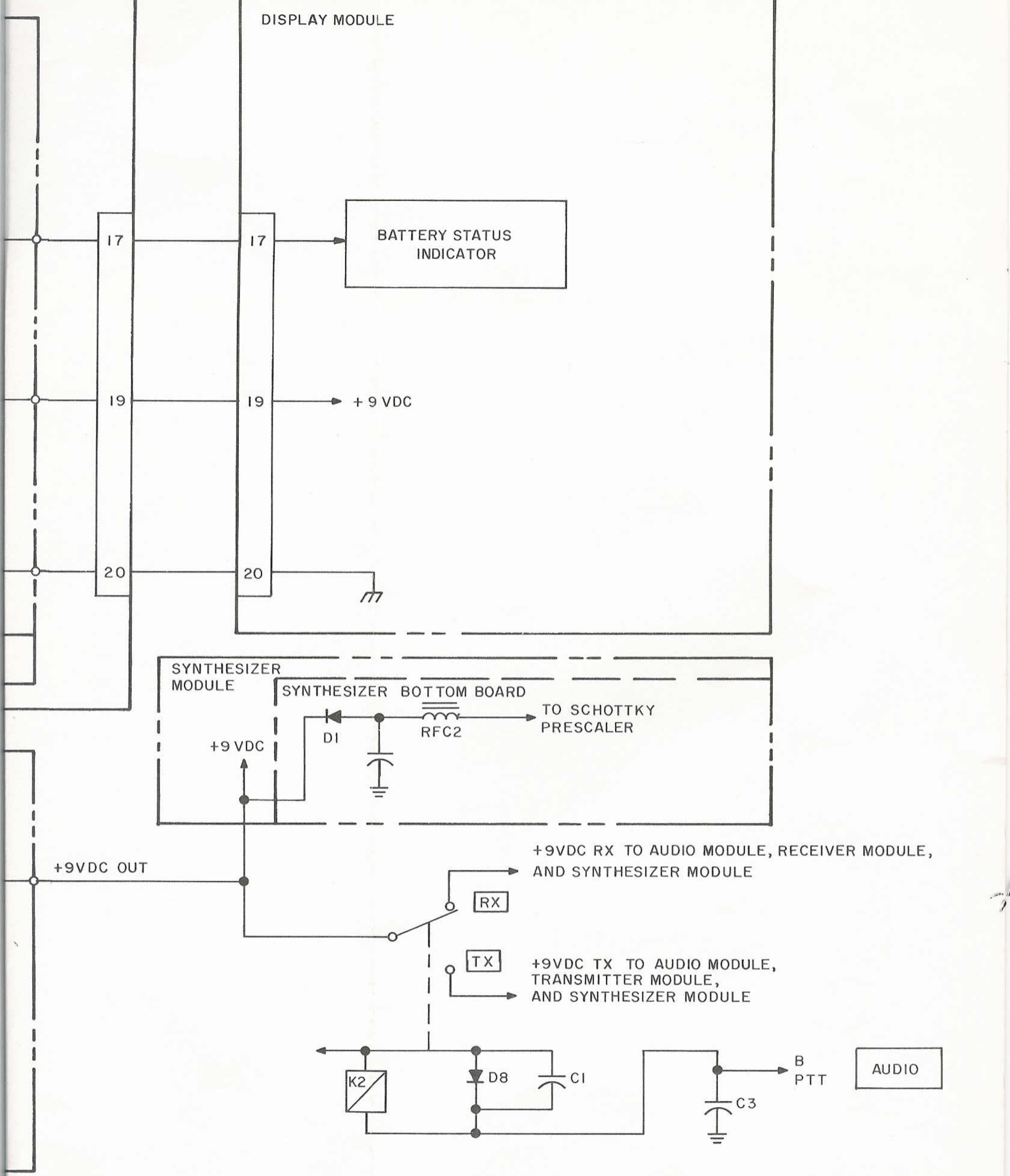
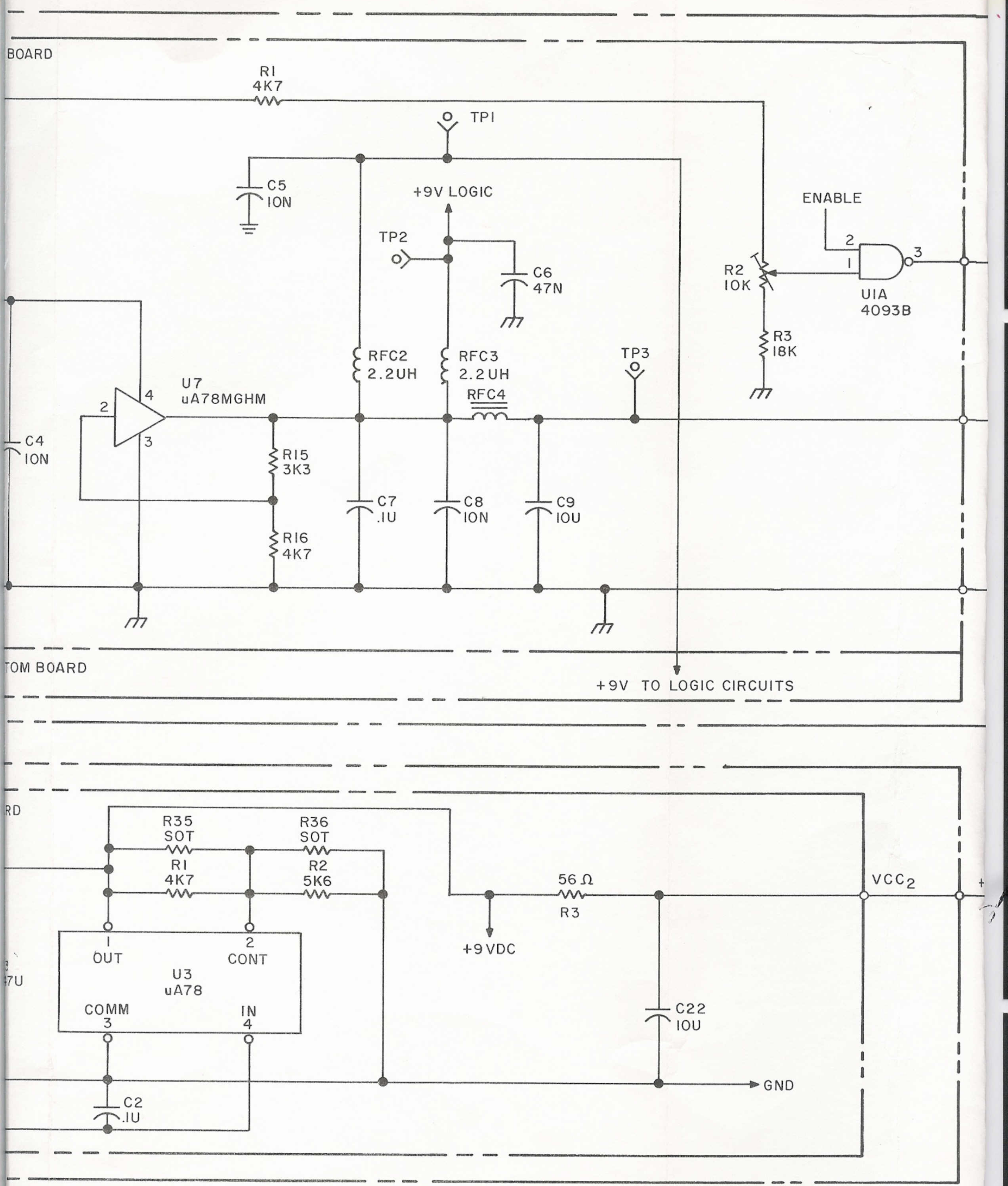
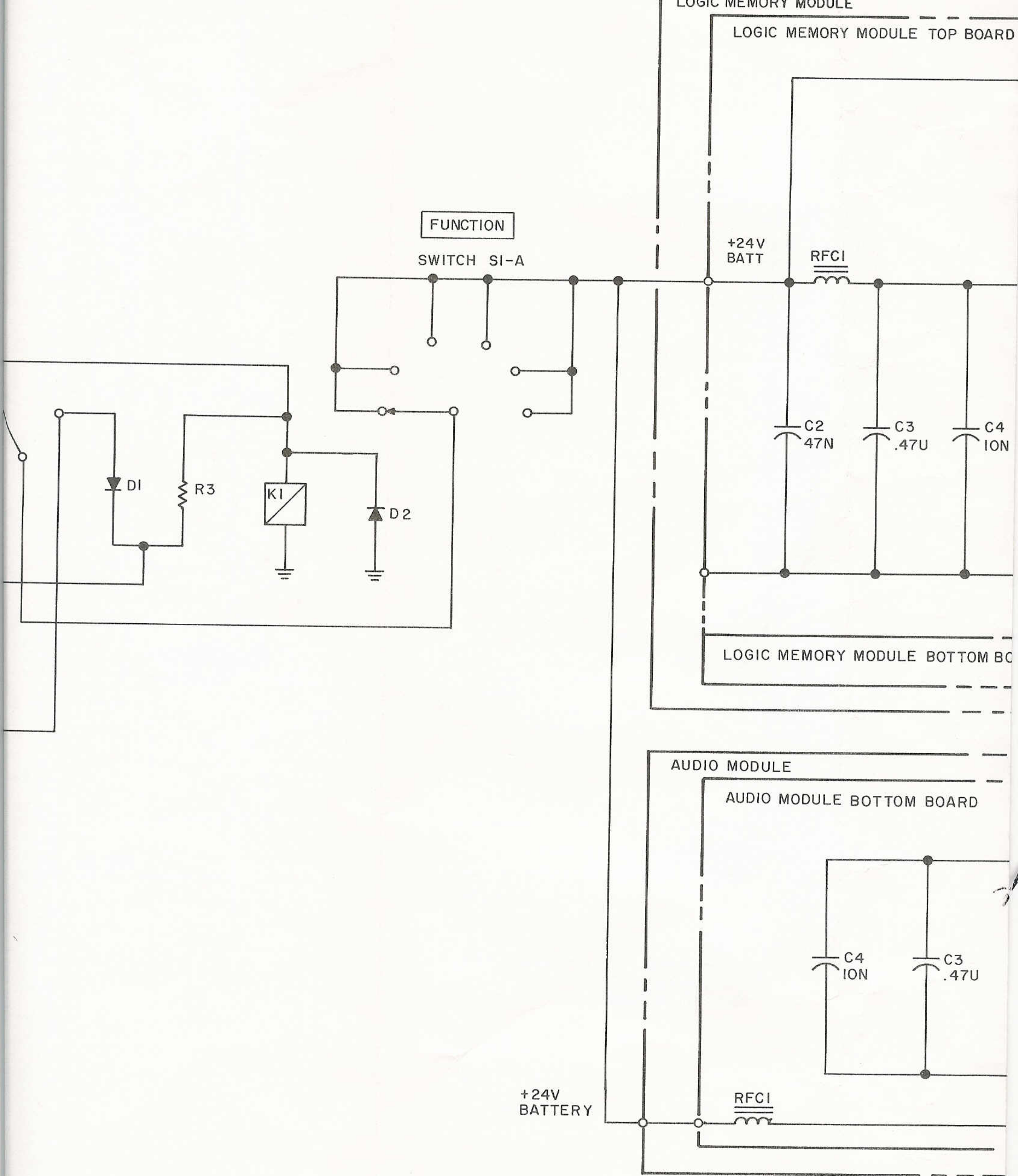
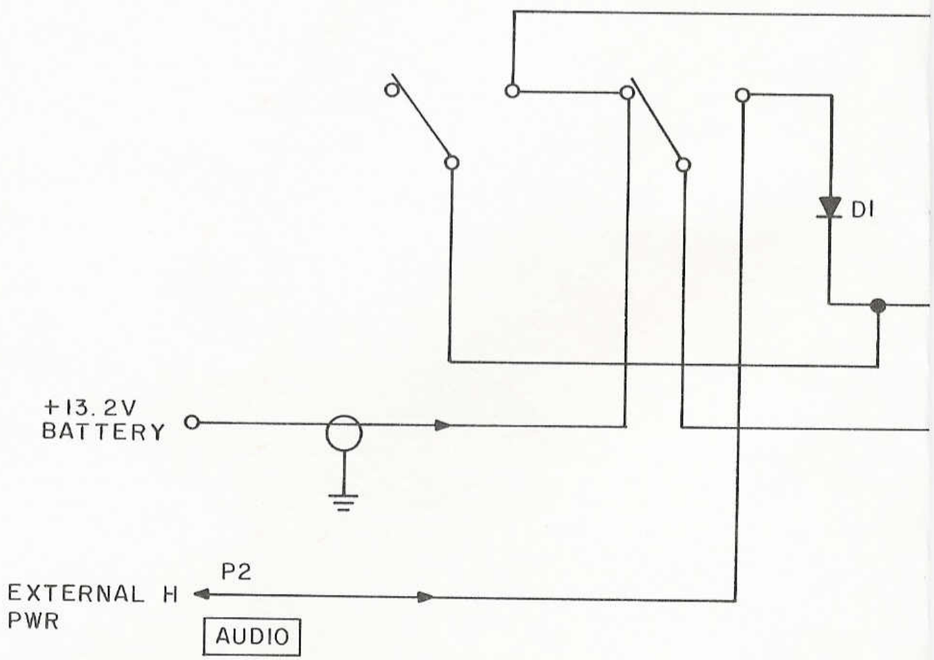


Figure 8-4. Power Distribution Diagram


BOARD
R1
4K7
TP1
C5
10N
+9V LOGIC
ENABLE
TP2
C6
47N
R2
10K
U1A
4093B
R3
18K
RFC2
2.2UH
RFC3
2.2UH
TP3
U7
uA78MGHM
RFC4
C4
10N
R15
3K3
C7
.1U
C8
10N
C9
10U
R16
4K7
TOM BOARD
+9V TO LOGIC CIRCUITS
RD
R35
SOT
R36
SOT
R1
4K7
R2
5K6
56 Ω
R3
VCC2
OUT
CONT
U3
uA78
COMM
IN
+9VDC
C22
10U
GND
C2
.1U
7U


LOGIC MEMORY MODULE
LOGIC MEMORY MODULE TOP BOARD
FUNCTION
SWITCH SI-A
+24V
BATT
RFCI
C2
47N
C3
.47U
C4
ION
DI
R3
KI
D2
LOGIC MEMORY MODULE BOTTOM BO
AUDIO MODULE
AUDIO MODULE BOTTOM BOARD
C4
ION
C3
.47U
+24V
BATTERY
RFCI


DI
+13.2V
BATTERY
P2
EXTERNAL H
PWR
AUDIO

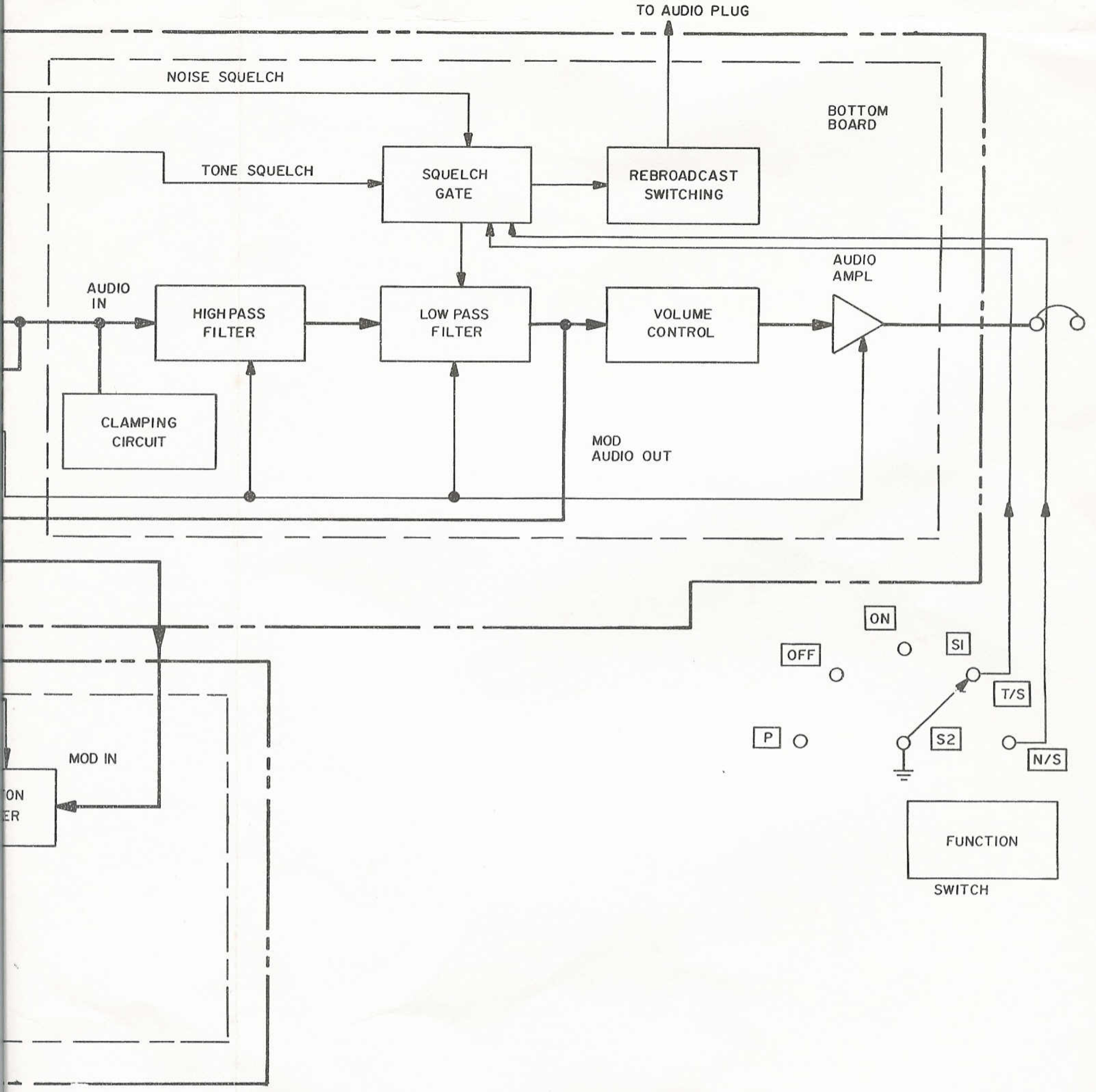
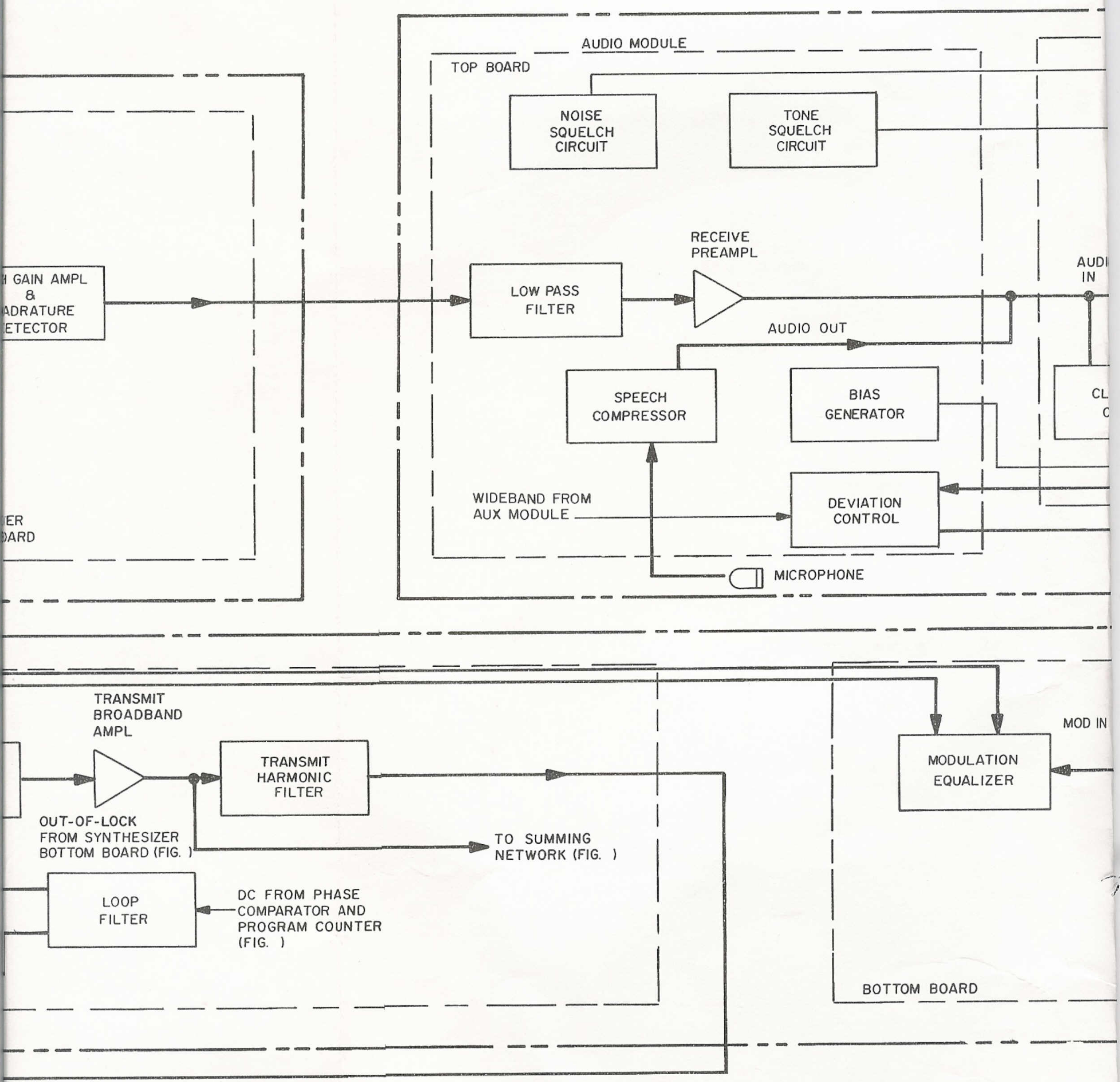
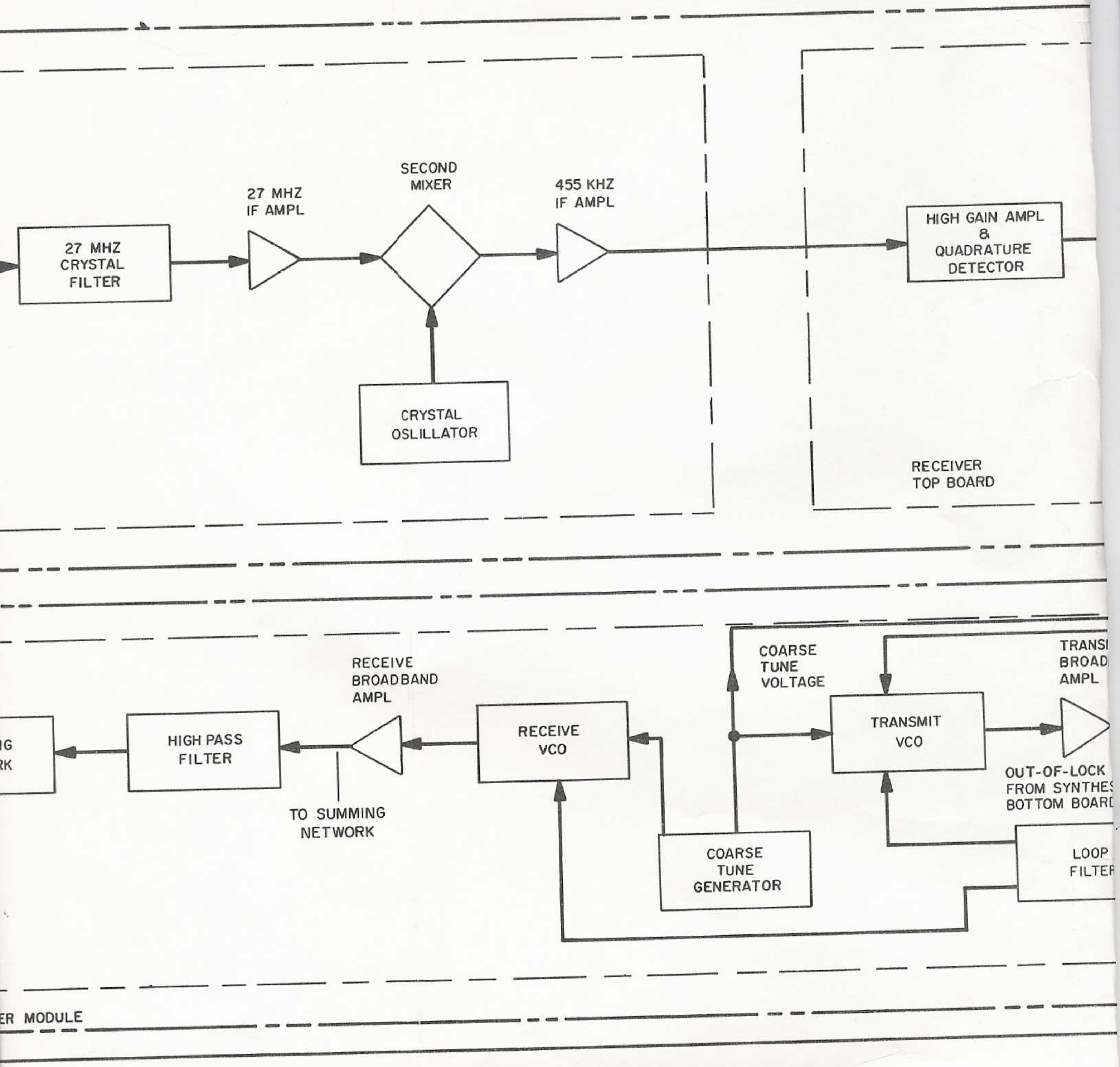


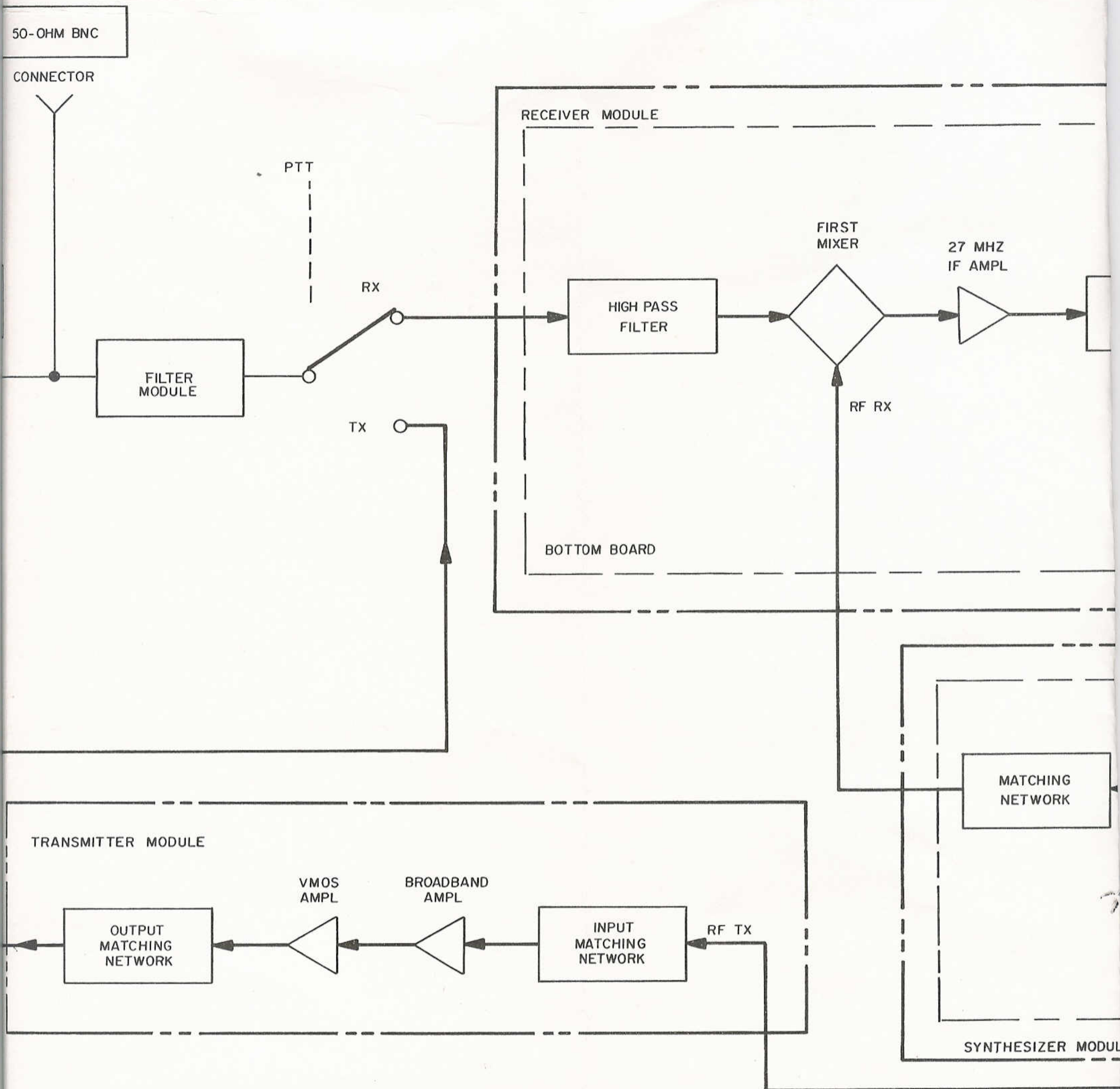
Figure 8-2. Transmit/Receive Function, Block Diagram

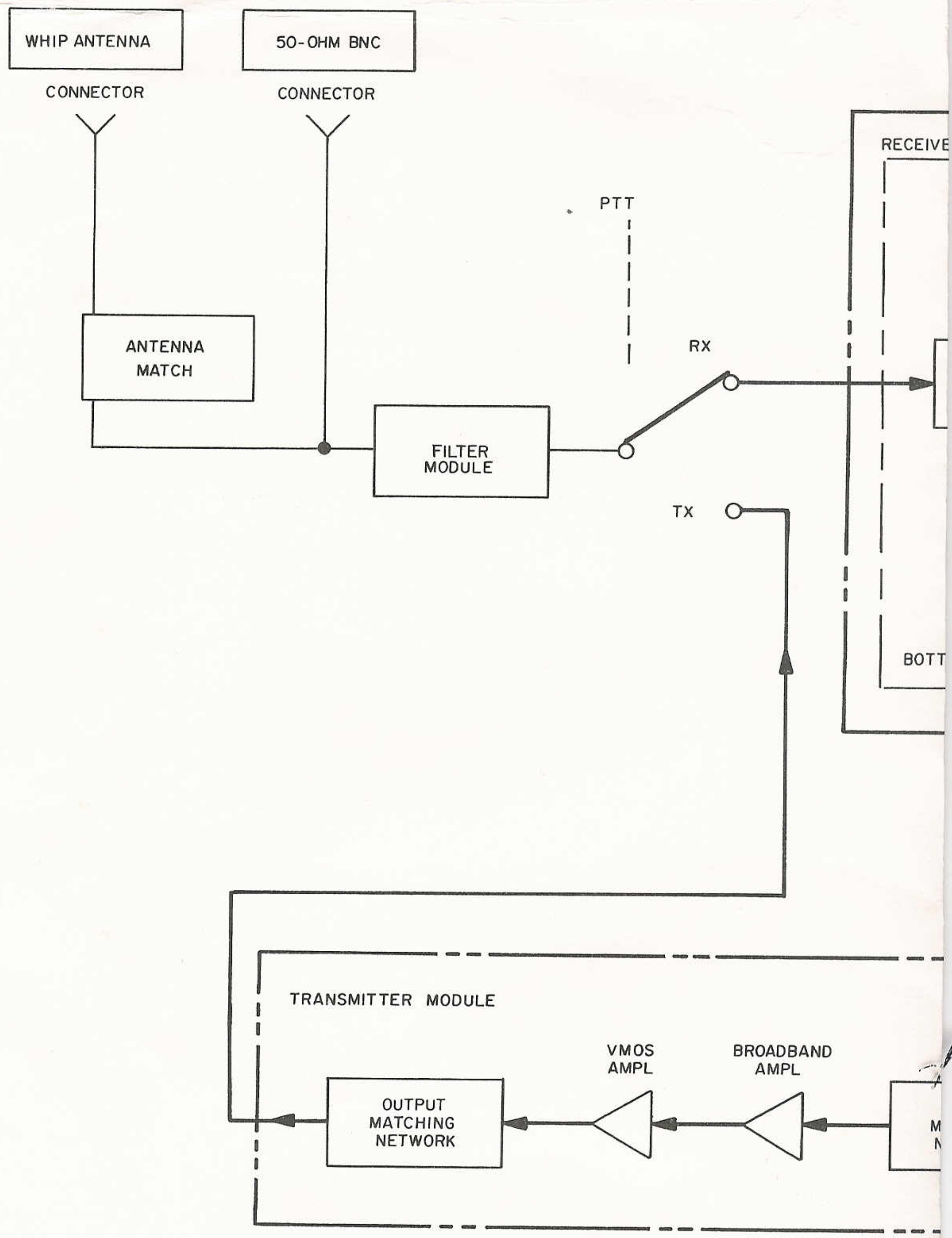


AUDIO MODULE
TOP BOARD
NOISE SQUELCH CIRCUIT
TONE SQUELCH CIRCUIT
RECEIVE PREAMPL
AUDI IN
GAIN AMPL & ADRATURE ETECTOR
LOW PASS FILTER
AUDIO OUT
SPEECH COMPRESSOR
BIAS GENERATOR
CL C
WIDEBAND FROM AUX MODULE
DEVIATION CONTROL
ER ARD
MICROPHONE
TRANSMIT BROADBAND AMPL
TRANSMIT HARMONIC FILTER
MOD IN
MODULATION EQUALIZER
OUT-OF-LOCK FROM SYNTHESIZER BOTTOM BOARD (FIG.)
TO SUMMING NETWORK (FIG.)
LOOP FILTER
DC FROM PHASE COMPARATOR AND PROGRAM COUNTER (FIG.)
BOTTOM BOARD



SECOND MIXER
27 MHZ IF AMPL
455 KHZ IF AMPL
27 MHZ CRYSTAL FILTER
HIGH GAIN AMPL & QUADRATURE DETECTOR
CRYSTAL OSLILLATOR
RECEIVER TOP BOARD
RECEIVE BROADBAND AMPL
COARSE TUNE VOLTAGE
IG
RK
HIGH PASS FILTER
RECEIVE VCO
TRANSMIT VCO
TO SUMMING NETWORK
OUT-OF-LOCK
COARSE TUNE GENERATOR
LOOP
ER MODULE


50-OHM BNC
CONNECTOR
PTT
RX
TX
FILTER MODULE
RECEIVER MODULE
HIGH PASS FILTER
FIRST MIXER
27 MHZ IF AMPL
RF RX
BOTTOM BOARD
MATCHING NETWORK
SYNTHESIZER MODUL
TRANSMITTER MODULE
VMOS AMPL
BROADBAND AMPL
OUTPUT MATCHING NETWORK
INPUT MATCHING NETWORK
RF TX


WHIP ANTENNA
CONNECTOR
50-OHM BNC
CONNECTOR
RECEIVE
PTT
RX
ANTENNA
MATCH
FILTER
MODULE
TX
BOTT
TRANSMITTER MODULE
VMOS
AMPL
BROADBAND
AMPL
OUTPUT
MATCHING
NETWORK

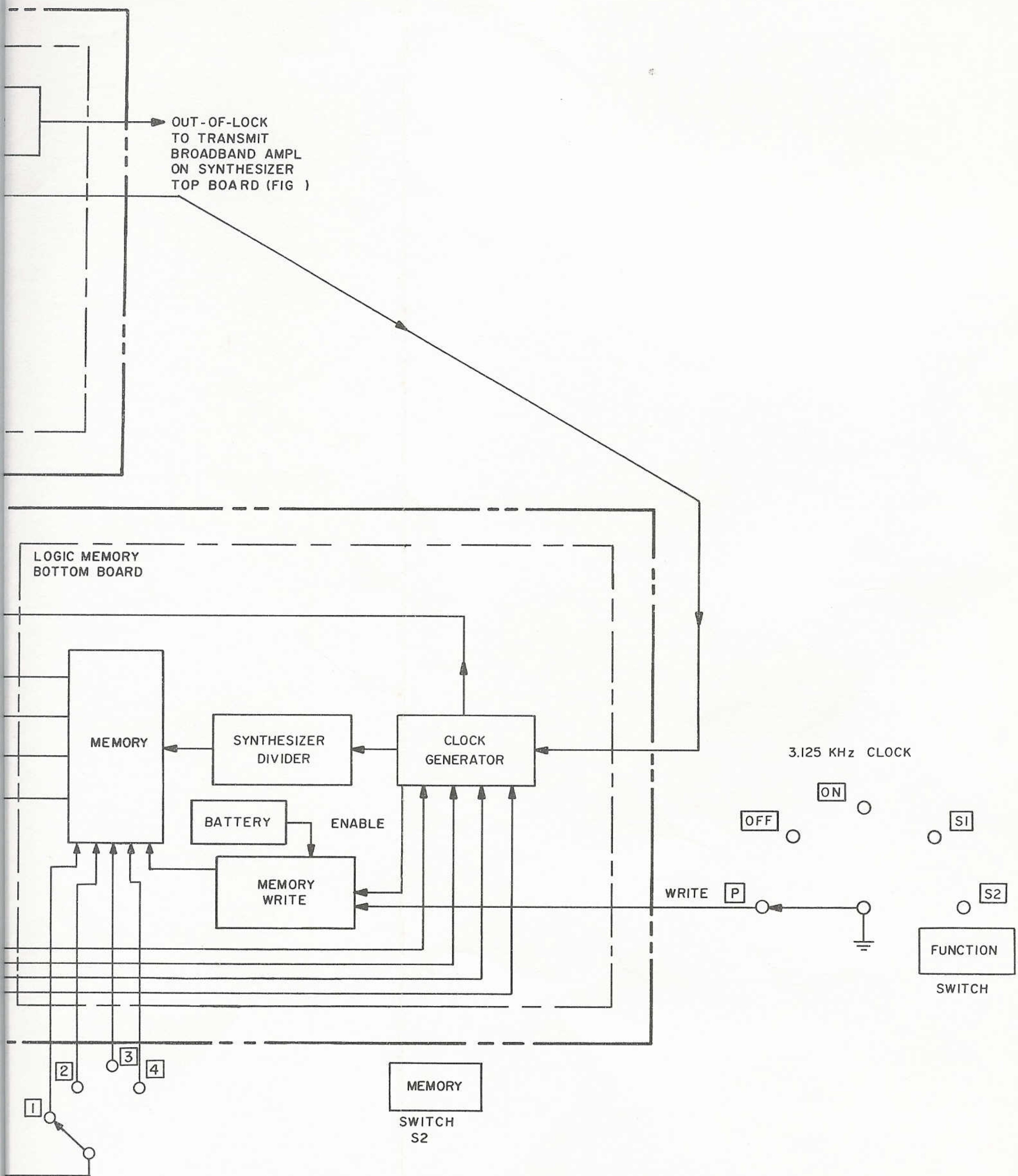
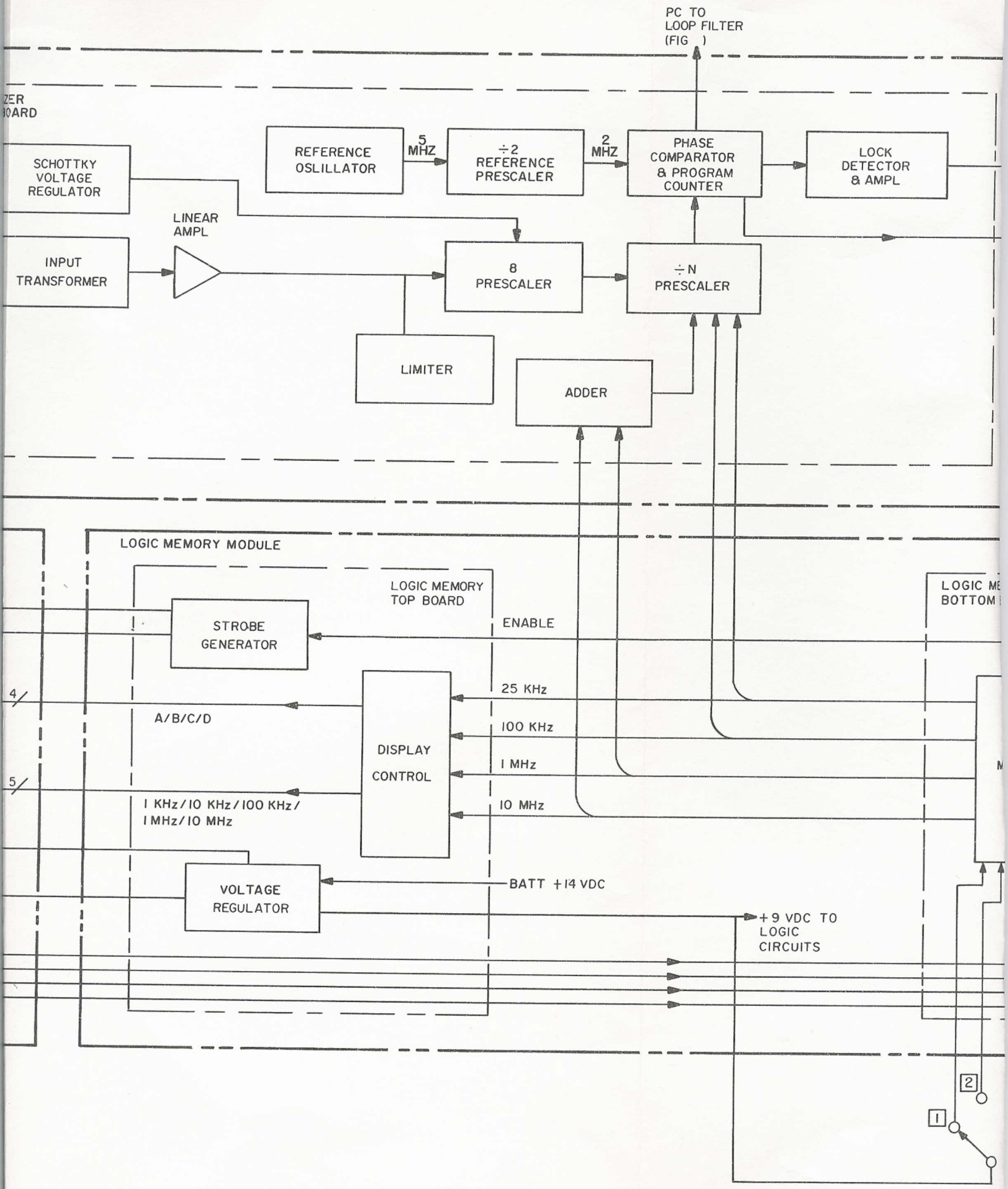
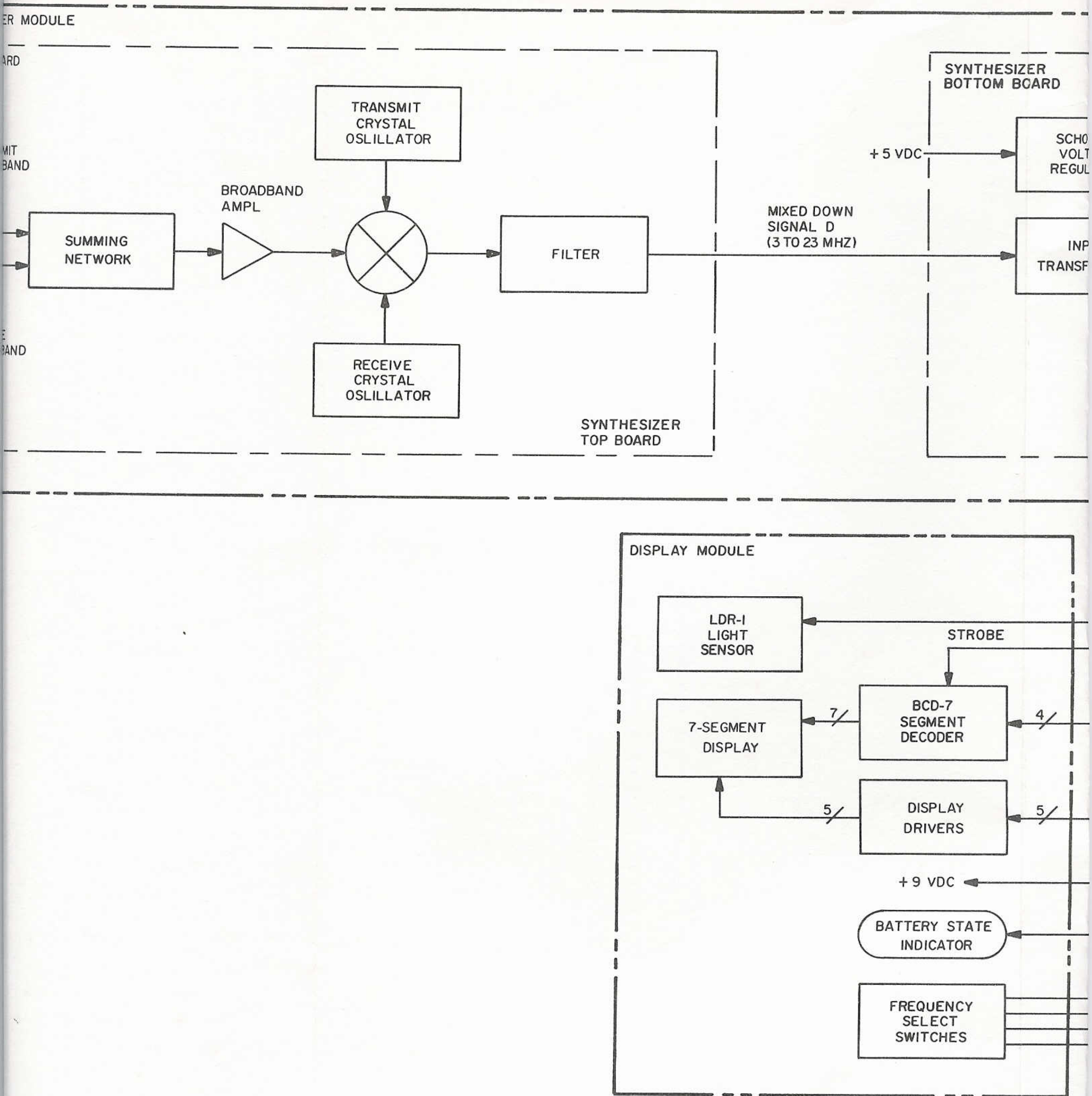


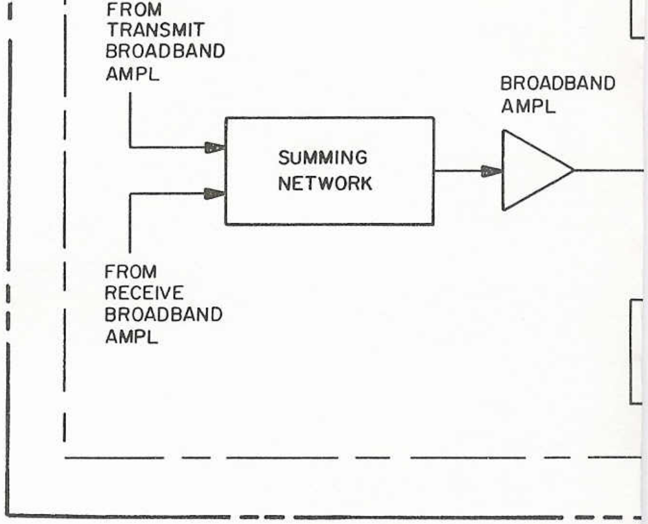
Figure 8-3. Frequency Selection, Display, and Synthesizer Functions, Block Diagram



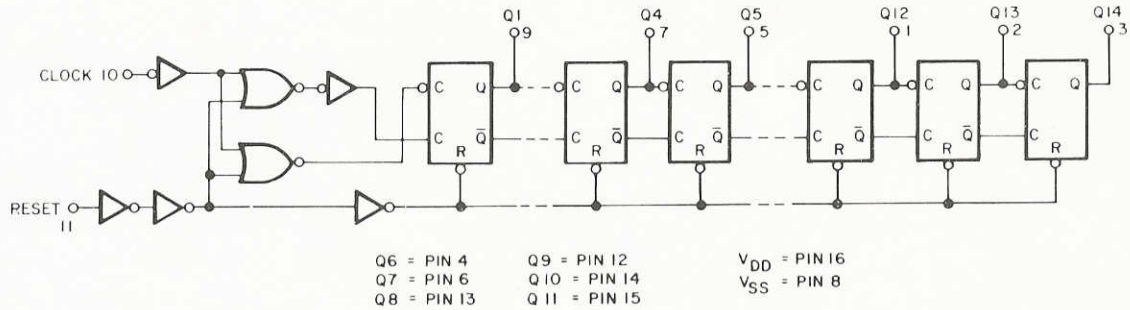
PC TO
LOOP FILTER
(FIG)
ZER
BOARD
SCHOTTKY VOLTAGE REGULATOR
REFERENCE OSLILLATOR
5 MHZ
÷2 REFERENCE PRESCALER
2 MHZ
PHASE COMPARATOR & PROGRAM COUNTER
LOCK DETECTOR & AMPL
LINEAR AMPL
INPUT TRANSFORMER
8 PRESCALER
÷N PRESCALER
LIMITER
ADDER
LOGIC MEMORY MODULE
LOGIC MEMORY TOP BOARD
LOGIC ME
BOTTOM
STROBE GENERATOR
ENABLE
4
A/B/C/D
DISPLAY CONTROL
25 KHz
100 KHz
1 MHz
10 MHz
5
1 KHz/10 KHz/100 KHz/
1 MHz/10 MHz
VOLTAGE REGULATOR
BATT +14 VDC
+9 VDC TO
LOGIC
CIRCUITS
2
1



TRANSMIT CRYSTAL OSLILLATOR
BROADBAND AMPL
SUMMING NETWORK
FILTER
RECEIVE CRYSTAL OSLILLATOR
SYNTHESIZER TOP BOARD
MIXED DOWN SIGNAL D (3 TO 23 MHZ)
SYNTHESIZER BOTTOM BOARD
+ 5 VDC
DISPLAY MODULE
LDR-I LIGHT SENSOR
STROBE
7-SEGMENT DISPLAY
7
BCD-7 SEGMENT DECODER
4
5
DISPLAY DRIVERS
5
+ 9 VDC
BATTERY STATE INDICATOR
FREQUENCY SELECT SWITCHES


FROM
TRANSMIT
BROADBAND
AMPL
BROADBAND
AMPL
SUMMING
NETWORK
FROM
RECEIVE
BROADBAND
AMPL

LOGIC DIAGRAM



The MC14020B 14-stage binary counter is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. This part is designed with an input wave shaping circuit and 14 stages of ripple-carry binary counter. The device advances the count on the negative-going edge of the clock pulse.

---

o 3
o 2
o 4
o 7
o 10
o 1
o 5
o 6
o 9
o 11
o 12

eed
ten
The
fre-

LOGIC DIAGRAM

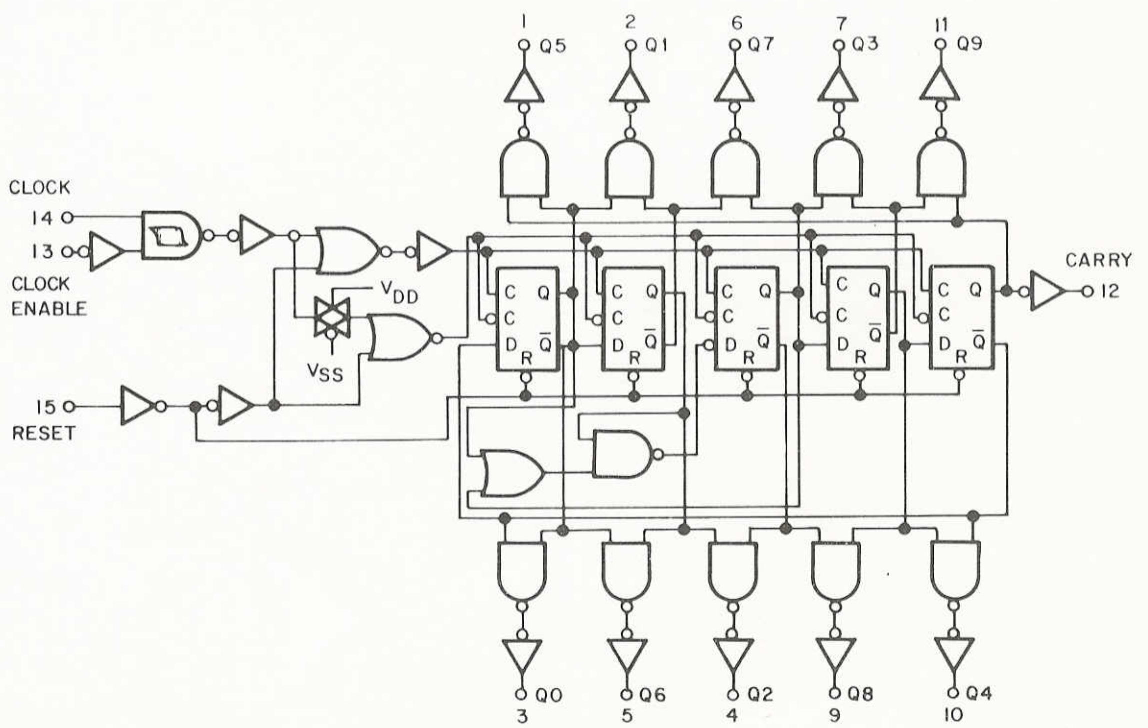
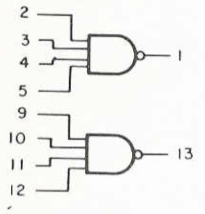


Figure 8-5. Integrated Circuit Data (Sheet 1 of 5 Sheets)

MC14012B
DUAL 4 – INPUT NAND GATE

LOGIC DIAGRAM



V_{DD} = PIN 14
V_{SS} = PIN 7

TRUTH TABLE

INPUT				OUTPUT
2	3	4	5	1
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	1	0	0	1
1	0	0	0	1
1	1	1	0	1
0	1	1	1	1
1	1	1	1	0

The MC14012B is a dual 4 - input NAND gate. Each gate produces a logical "0" output when all inputs are "1" and a "1" output if any of the inputs are "0".

TRUTH TABLE

$\overline{\text{CLOCK}}$	RESET	OUTPUT STATE
↑	0	No Change
↓	0	Advance to next state
X	1	All Outputs are low

X = Don't Care

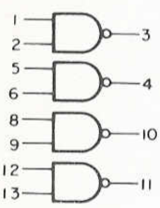
CLOCK

RESET
11

The MC140
in a single
binary count

GATE

LOGIC DIAGRAM



V_{DD} = PIN 14
V_{SS} = PIN 7

ate produces a logical "0" out-
puts are "0".

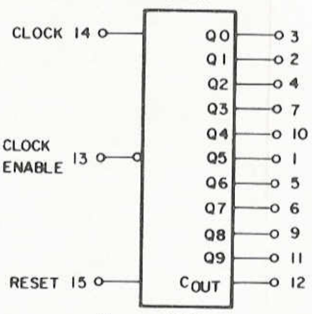
MC14017B
DECADE COUNTER/DIVIDER

FUNCTIONAL TRUTH TABLE
(Positive Logic)

CLOCK	CLOCK ENABLE	RESET	DECODE OUTPUT = n
0	X	0	n
X	1	0	n
X	X	1	Q0
↑	0	0	n+1
↓	X	0	n
X	↑	0	n
1	↓	0	n+1

X = Don't Care If n < 5 Carry = "1", Otherwise = "0"

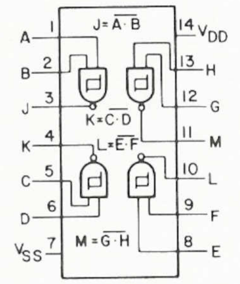
BLOCK DIAGRAM



V_{DD} = PIN 16
V_{SS} = PIN 8

The MC14017B is a five-stage Johnson decade counter with built-in code converter. High-speed operation and spike-free outputs are obtained by use of a Johnson decade counter design. The ten decoded outputs are normally low, and go high only at their appropriate decimal time period. The output changes occur on the positive-going edge of the clock pulse. This part can be used in frequency division applications as well as decade counter or decimal decode display applications.

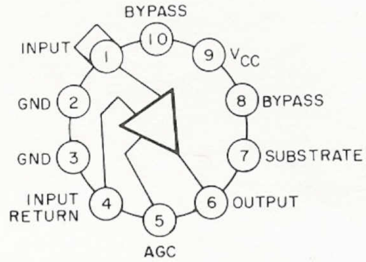
CD4093B
COS/MOS QUAD 2-INPUT NAND SCHMITT TRIGGERS



Functional Diagram

The CD4093B consists of four Schmitt-trigger circuits. Each circuit functions as a two-input NAND gate with Schmitt-trigger action on both inputs. The gate switches at different points for positive and negative-going signals. The difference between the positive voltage (V_p) and the negative voltage (V_N) is defined as hysteresis voltage (V_H).

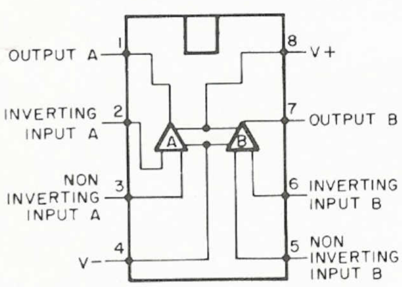
MC1550G
RF-IF AMPLIFIER



The MC1550G is an RF-IF amplifier monolithic integrated circuit providing constant input impedance over entire AGC range, high power gain (-30 dB @60 MHz, 0.5 MHz bandwidth), and good noise figure (-5 dB @60 MHz). Used in a common-emitter, common-base configuration.

LM1558J
DUAL OPERATION AMPLIFIER

DUAL-IN-LINE PACKAGE



The LM1558 is a general purpose dual operational amplifier.

MC14011BCP
QUAD 2 – INPUT NAND GAT

TRUTH TABLE

INPUT		OUTPUT
1	2	3
1	1	0
1	0	1
0	1	1
0	0	1

The MC14011BCP is a quad 2 - input NAND gate. Each gate pro put when all inputs are "1" and a "1" output if any of the inputs ar

CD4059AE
DIVIDE–BY–N COUNTER

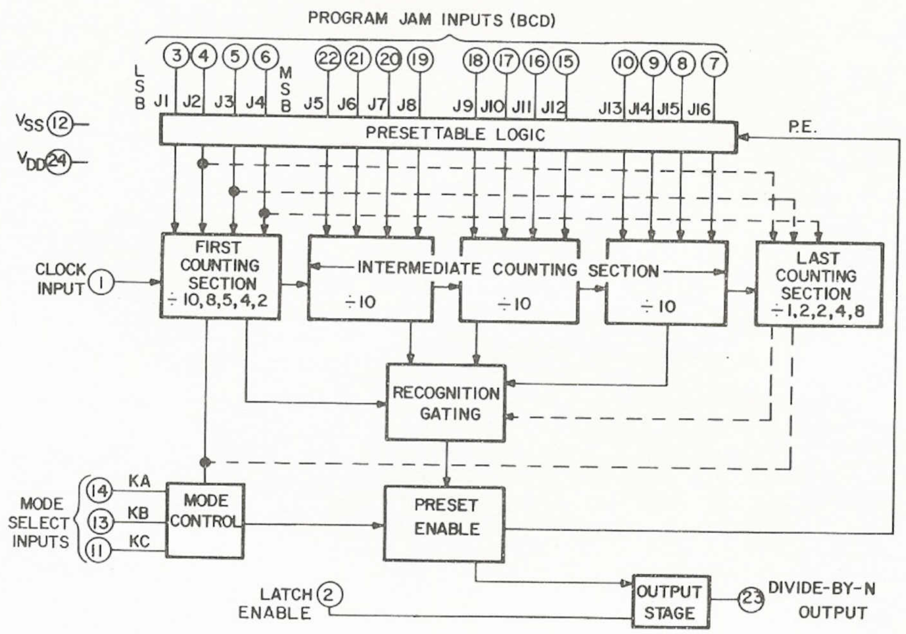


TABLE I

MODE SELECT INPUT			FIRST COUNTING SECTION			LAST COUNTING SECTION			DESIGN COUNTER RANGE		EXTENDED COUNTER RANGE
Ka	Kb	Kc	Divides by:	Can be preset to a maximum of:	Jam ▲ inputs used:	Divides by:	Can be preset to a maximum of:	Jam ▲ inputs used:	Min.	Max.	Max.
1	1	1	2	1	J1	8	7	J2,J3,J4	3	15,999	17,331
0	1	1	4	3	J1,J2	4	3	J3,J4	3	15,999	18,663
1	0	1	5#	4	J1,J2,J3	2	1	J4	3	9,999	13,329
0	0	1	8	7	J1,J2,J3	2	1	J4	3	15,999	21,327
1	1	0	10	9	J1,J2,J3,J4	1	0	–	3	9,999	16,659
X	0	0	MP			MP			–	–	–

X = Don't Care

▲ J1 = Least significant bit.

J4 = Most significant bit.

#Operation in the ÷5 mode (1st counting section) requires going through the Master Preset mode prior to going into the ÷5 mode. At power turn-on, kc must be a logic "O" for a period of 3 input clock pulses after V_{DD} reaches a minimum of 3 volts.

The CD4059AE is a divide-by-N counter that can be programmed to divide an input frequency by any number "N" from 3 to 15,999. The output signal is a pulse occurring at a rate equal to the input frequency divided by N. This single output has drive capability. This single output is preset by means of 16 jam (J) inputs. The three mode select inputs, Ka, Kb, and Kc, determine the modulus (divide-by-number) of the first and last counting sections in accordance with the above truth table. Every time the first (fastest) counting section goes through one cycle it reduces by 1 the number that has been preset (jammed) into the three decades of the intermediate counting section and into the last counting section, which consists of flip-flops that are not needed for operating the first counting section. For example, in the ÷2 mode only one flip-flop is needed in the first counting section. Therefore the last counting section has three flip-flops that can be preset to a maximum count of seven with a place value of thousands. If ÷10 is desired for the first section, set Ka = 1, Kb = 1, and Kc = 0; jam inputs J1, J2, J3, and J4 are used to preset the first counting section and there is no last counting section. The intermediate counting section consists of three cascaded BCD decade (÷10) counters presettable by means of jam inputs J5 through J16. The mode select inputs permit frequency synthesizer channel separations of 10, 12.5, 20, 25, or 50 parts. In addition, these inputs set the maximum value of N at 9999 (when the first counting section divides by 5 or 10) or 15,999 (when the first counting section divides by 8, 4, or 2).

CD4039AE
4-WORD BY 8-BIT RANDOM ACCESS NDRO MEMORY

rminal
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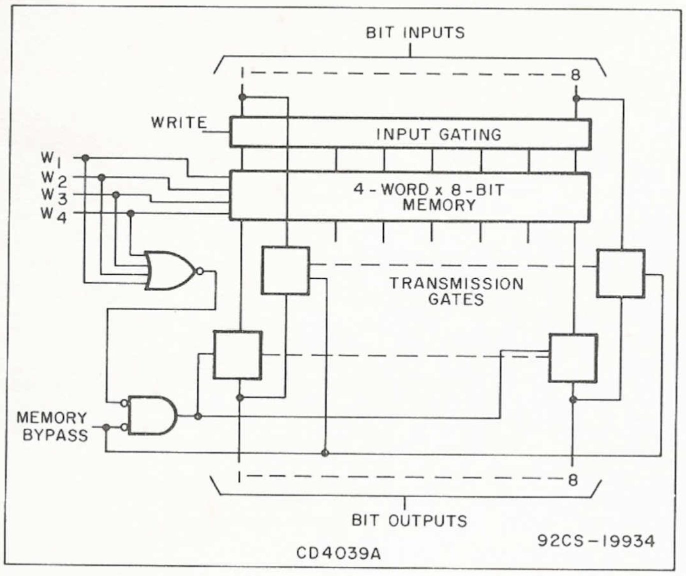
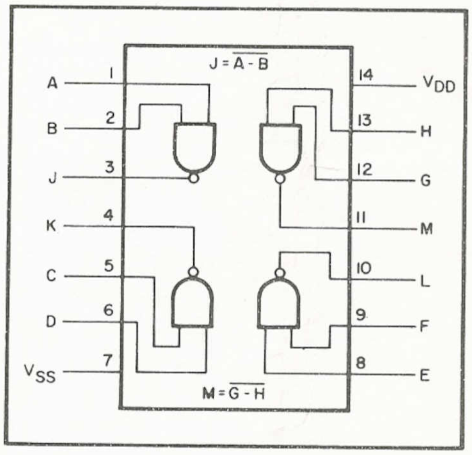
up to
voltage
of the
voltage
means
pin 2.
erload
circuit



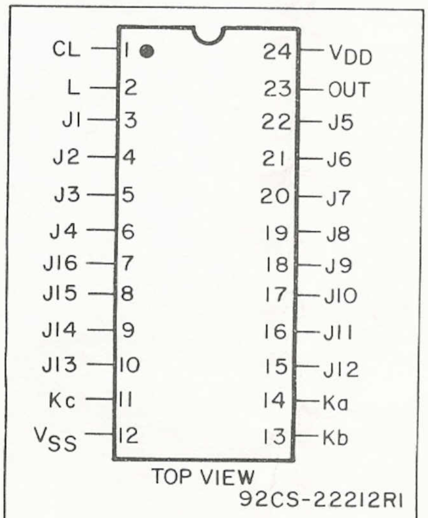
RITE IN 2)	READ INHIBIT (PIN 21)	MEMORY BYPASS (PIN 11)	CHIP INHIBIT (PIN 22)	OPERATING MODE
X	X	L	H	Chip Inhibited (Outputs float)
X	X	H	H	Input/Output Shunted to output; No Reading from Memory; Information in Memory Undisturbed
L	X	H	L	
H	X	H	L	Input/Output Shunted to output; No Reading from Memory; Write Data into Addressed Word
L	L	L	L	Read Data from Addressed Word Write Deactivated
L	H	L	L	Read/Write Deactivated (Outputs float)
H	L	L	L	Read from Memory while Writing Data into Addressed Word
H	H	L	L	Write Data into Addressed Word Read Deactivated (outputs float)

onolithic integrated circuit containing a 4-word X 8-bit Random Access
ide eight BIT INPUT lines, WRITE, and MEMORY BYPASS, Eight BIT
ded. The MEMORY BYPASS signal, when "high," allows shunting of
IT INPUT lines directly to the eight BIT OUTPUT lines without dis-
words. Individual address lines (W1, W2, W3, W4) are provided for each

CD4011A
QUAD 2-INPUT NAND GATE

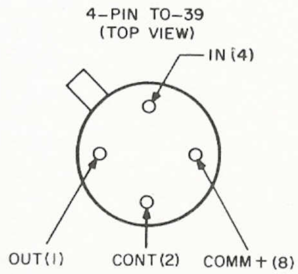


TRUTH TABLE		
INPUT		OUTPUT
1	2	3
1	1	0
1	0	1
0	1	1
0	0	1



TERMINAL DIAGRAM

μA78MGHM
4 TERMINAL POSITIVE ADJUSTABLE VOLTAGE REGULATOR



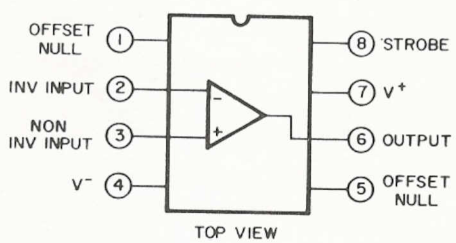
+ NOTE:
HEAT SINK TABS CONNECTED TO COMMON THROUGH DEVICE SUBSTRATE.

The μA78MGHM is a four-terminal adjustable voltage regulator providing continuous load currents of up to 500 mA at pin 1 with an input voltage of approximately 12V at pin 4 of the positive regulator. The output voltage at pin 1 is adjusted to 9V by the means of a potentiometer connected to pin 2. Employs internal thermal overload protection and internal short circuit current protection.

A1 PIN 1	A0 PIN 23	ADDRESSED WORD
L	L	Word 1
L	H	Word 2
H	L	Word 3
H	H	Word 4

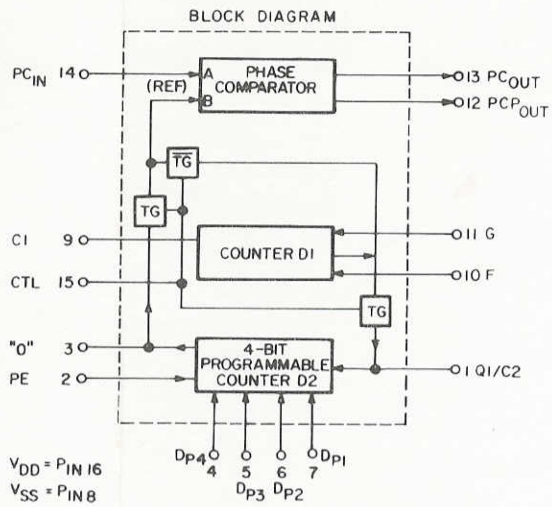
L = Low-Level Voltage
H = High-Level Voltage

WRITE (PIN 2)	READ INHIBIT (PIN 21)	ME BY (PI
X	X	
X	X	
L	X	
H	X	
L	L	
L	H	
H	L	
H	H	



The CD4039AE is a single monolithic integrated NDRO Memory. Inputs include eight BIT INPU OUTPUT lines are also provided. The MEMOR information from the eight BIT INPUT lines di turbing the state of the four words. Individual a memory word.

MC14568BCP
PHASE COMPARATOR AND PROGRAMMABLE COUNTERS



TRUTH TABLE

F PIN 10	G PIN 11	DIVISION RATIO OF COUNTER D1
0	0	4
0	1	16
1	0	64
1	1	100

The divide-by-zero state on the programmable divide-by-N 4-bit binary counter, D2, is illegal.

The MC14568BCP consists of a phase comparator, a divide-by-4, 16, 64, or 100 counter and a programmable divide-by-N 4-bit binary counter (all positive-edge triggered) constructed with MOS P-channel and N-channel enhancement mode devices (complementary MOS) in a single monolithic structure. The MC14568BCP has been designed for use in conjunction with a programmable divide-by-N counter for frequency synthesizers and phase locked loop applications requiring low power dissipation and/or high noise immunity.

SO41P
FM IF AMPLIFIER WITH DEMODULATOR

The SO41P is a symmetricl coincidence demodulator for the amplification, limiting, and demodulation of frequency-modulated signals.

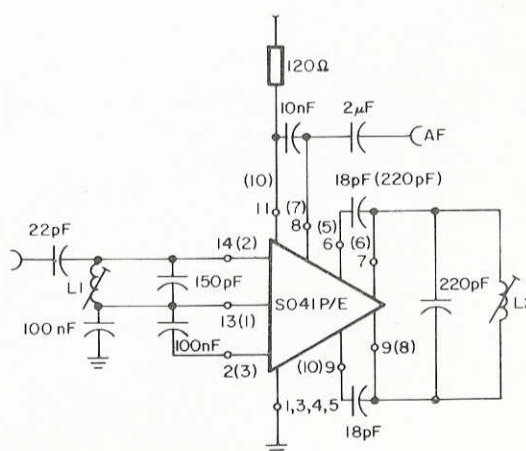
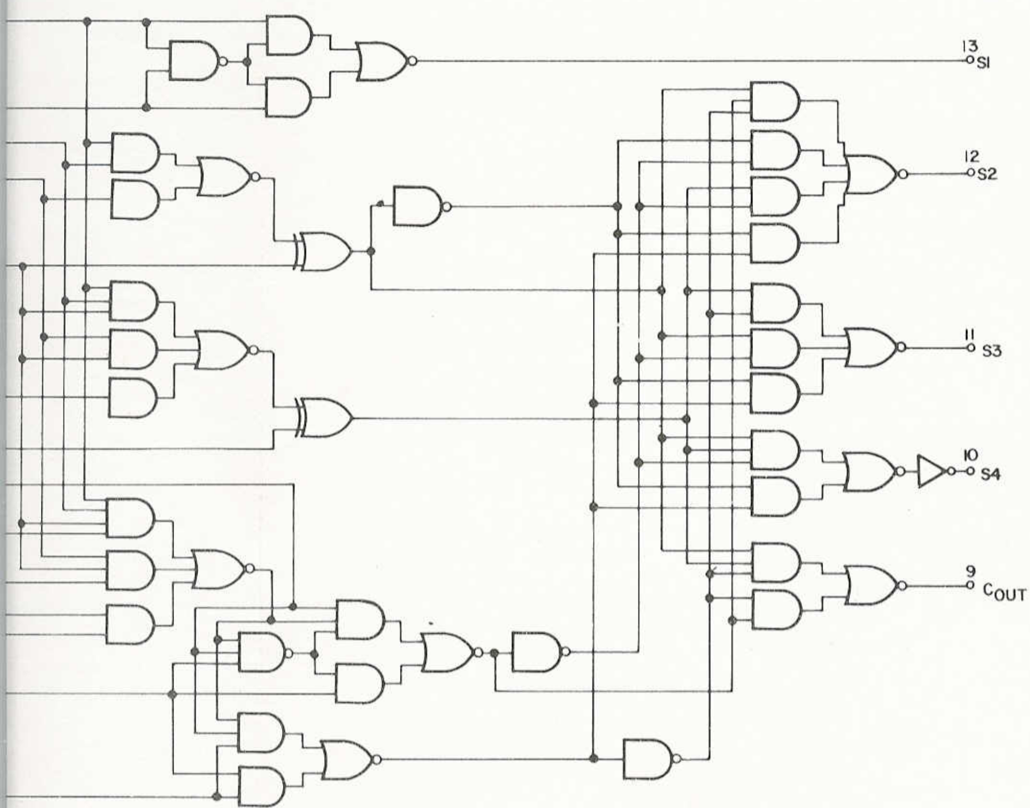


Figure 8-5. Integrated Circuit Data (Sheet 3 of 5 Sheets)

MC14560BCP
URAL BINARY CODED DECIMAL) ADDER

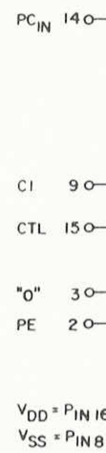
FUNCTIONAL EQUIVALENT LOGIC DIAGRAM



TRUTH TABLE*

	INPUT							OUTPUT				
3	A2	A1	B4	B3	B2	B1	C_{in}	C_{out}	S4	S3	S2	S1
)	0	0	0	0	0	0	0	0	0	0	0	0
)	0	0	0	0	0	0	1	0	0	0	0	1
	0	0	0	0	1	1	0	0	0	1	1	1
	0	0	0	0	1	1	1	0	1	0	0	0
	1	1	0	1	0	0	0	1	0	0	0	1
	1	1	0	1	0	0	1	1	0	0	1	0
)	0	0	0	1	0	1	0	1	0	0	1	1
	1	0	1	0	0	0	0	1	0	1	0	0
)	0	1	1	0	0	1	1	1	1	0	0	1

ruth table to show logic operation for representative input values.



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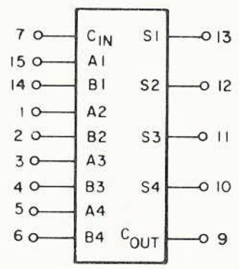
FM IF AMPL

The SO41P is a s
the amplification, l
modulated signals.

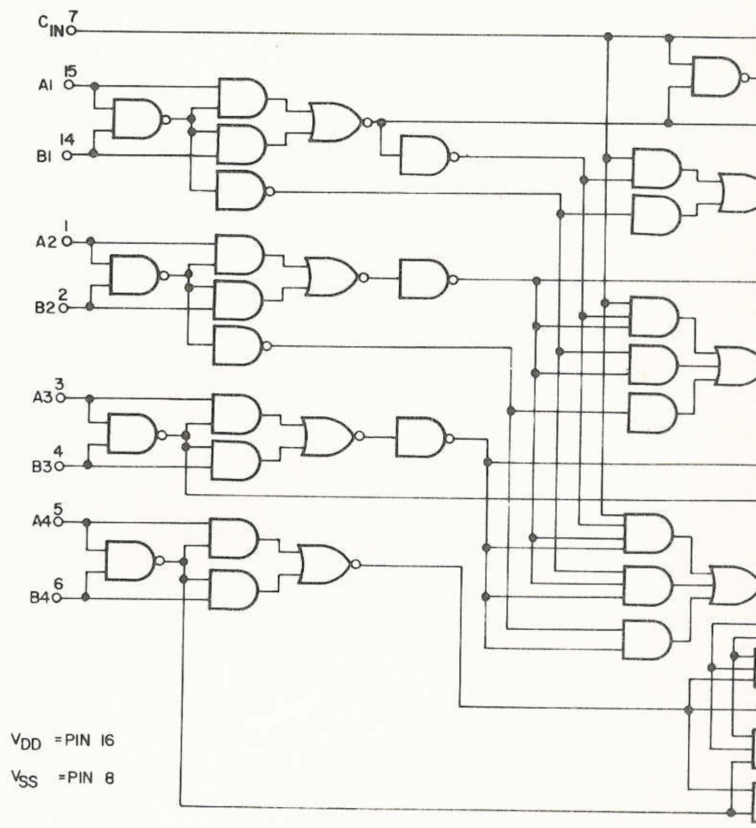
MC1456
NBCD (NATURAL BINARY C

BLOCK DIAGRAM



V_{DD} = PIN 16
V_{SS} = PIN 8

FUNCTIONAL E



V_{DD} =PIN 16
V_{SS} =PIN 8

The MC14560B adds two 4-bit numbers in NBCD (natural binary coded decimal) format, resulting in sum and carry outputs in NBCD code. All inputs and outputs are active high. The carry input for the least significant digit is connected to VSS for no carry in.

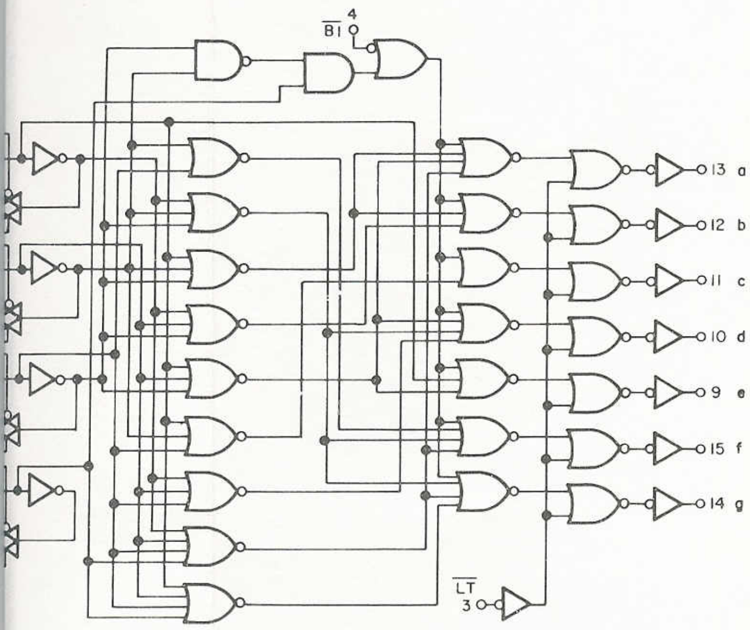
INPUT					
A4	A3	A2	A1	B4	B3
0	0	0	0	0	0
0	0	0	0	0	0
0	1	0	0	0	0
0	1	0	0	0	0
0	1	1	1	0	1
0	1	1	1	0	1
1	0	0	0	0	1
0	1	1	0	1	0
1	0	0	1	1	0

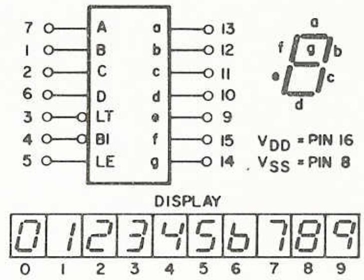
*Partial truth table to show logic operatio

MC14511B

VEN SEGMENT LATCH/DECODER/DRIVER

LOGIC DIAGRAM





TRUTH TABLE

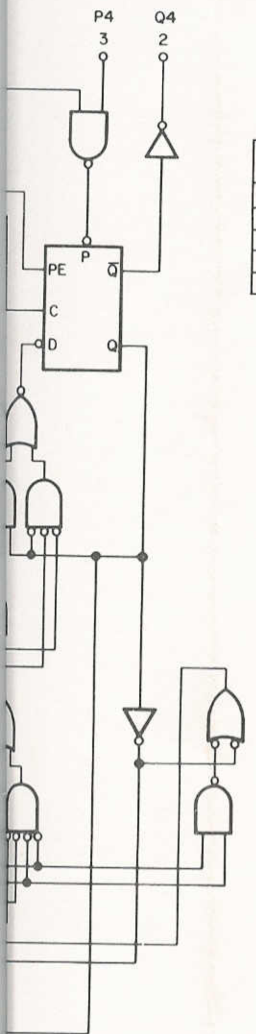
INPUTS							OUTPUTS							
LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	DISPLAY
X	X	0	X	X	X	X	1	1	1	1	1	1	1	8
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	0
0	1	1	0	0	0	1	0	1	1	0	0	0	0	1
0	1	1	0	0	1	0	1	1	0	1	1	0	1	2
0	1	1	0	0	1	1	1	1	1	1	0	0	1	3
0	1	1	0	1	0	0	0	1	1	0	0	1	1	4
0	1	1	0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	0	1	1	1	1	1	1	0	0	0	0	7
0	1	1	1	0	0	0	1	1	1	1	1	1	1	8
0	1	1	1	0	0	1	1	1	1	0	0	1	1	9
0	1	1	1	0	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	0	1	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	1	0	0	0	0	0	0	0	Blank
1	1	1	X	X	X	X				*				*

X = Don't Care

* Depends upon the BCD code previously applied when LE = 0

iver is constructed with complementary MOS (CMOS)
vers in a single monolithic structure. The circuit pro-
)-to-seven segment decoder, and an output drive capa-
e (LE) inputs are used to test the display, to turn-off
store a BCD code, respectively. It can be used with
t, fluorescent, gas discharge, or liquid crystal readouts

Figure 8-5. Integrated Circuit Data (Sheet 4 of 5 Sheets)

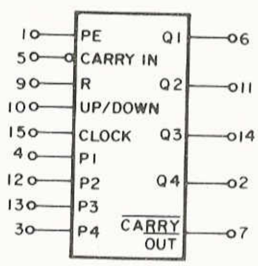


TRUTH TABLE

CARRY IN	UP/DOWN	PRESET ENABLE	RESET	ACTION
1	X	0	0	No Count
0	1	0	0	Count Up
0	0	0	0	Count Down
X	X	1	0	Preset
X	X	X	1	Reset

X = Don't Care

BLOCK DIAGRAM

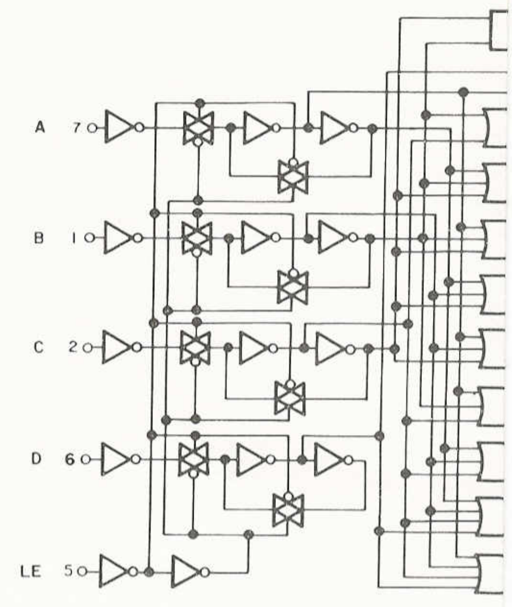


V_{DD} = PIN 16
V_{SS} = PIN 8

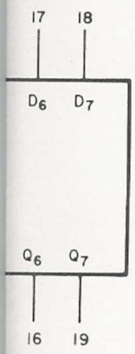
nt mode devices in a single
type T flip-flop capability.
ter finds primary use in up/
nd/or high noise immunity

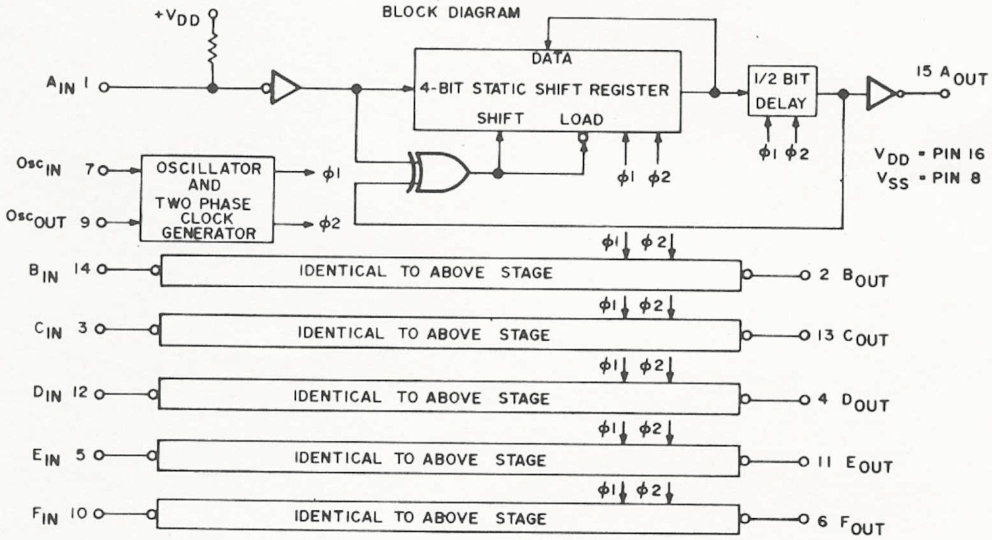
MC14
BCD-TO-SEVEN SEGMENT

LOG

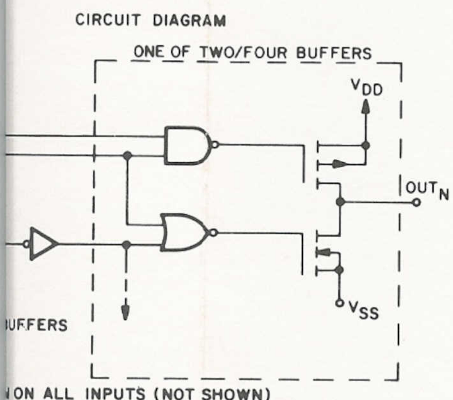


The MC14511B BCD-to-seven segment latch/decoder/driver is constructed wit enhancement mode devices and NPN bipolar output drivers in a single monoli vides the functions of a 4-bit storage latch, an 8421 BCD-to-seven segment dec bility. Lamp test ($\overline{LT}$), blanking ($\overline{BI}$), and latch enable (LE) inputs are used or pulse modulate the brightness of the display, and to store a BCD code, re seven-segment light emitting diodes (LED), incandescent, fluorescent, gas disc either directly or indirectly.





The MC14503B is a hex non-inverting buffer with 3-state outputs, and a high current source and sink capability. The 3-state outputs make it useful in common bussing applications. Two disable controls are provided. A high level on the Disable A input causes the outputs of buffers 1 through 4 to go into a high impedance state and a high level on the Disable B input causes the outputs of buffers 5 and 6 to go into a high impedance state.

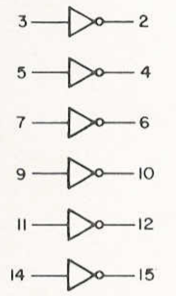


The MC14503B is a hex non-inverting buffer with 3-state outputs, and a high current source and sink capability. The 3-state outputs make it useful in common bussing applications. Two disable controls are provided. A high level on the Disable A input causes the outputs of buffers 1 through 4 to go into a high impedance state and a high level on the Disable B input causes the outputs of buffers 5 and 6 to go into a high impedance state.

Figure 8-5. Integrated Circuit Data (Sheet 5 of 5 Sheets)

MC14049B
HEX BUFFERS

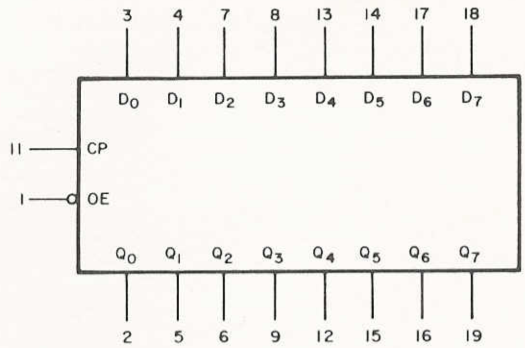
LOGIC DIAGRAM



NC = PIN 13, 16
V_{SS} = PIN 8
V_{CC} = PIN 1

The MC14049B hex inverter/buffer is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. These complementary MOS devices find primary use where low power dissipation and/or high noise immunity is desired. These devices provide logic-level conversion using only one supply voltage, V_{CC}. The input-signal high level (V_{IH}) can exceed the V_{CC} supply voltage for logic-level conversions. Two TTL/DTL Loads can be driven when the devices are used as CMOS-to-TTL/DTL converters (V_{CC} = 5.0 V, $V_{OL} \leqslant 0.4$ V, $I_{OL} \geqslant 3.2$ mA).

74S374/74LS374



Vcc = PIN 20
GND = PIN 10

The MC14503B
source and sink c
tions. Two disab
outputs of buffe
Disable B input

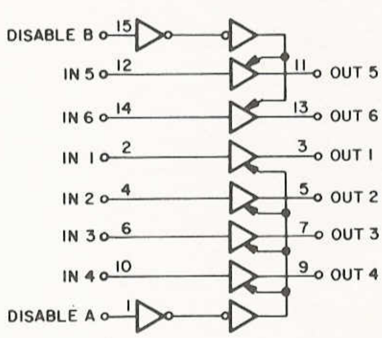
MC14503
HEX 3-STATE BUFFER

TRUTH TABLE

IN_n	APPROPRIATE DISABLE INPUT	OUT_n
0	0	0
1	0	1
X	1	High Impedance

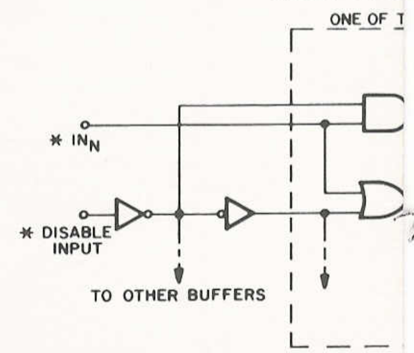
X = Don't Care

LOGIC DIAGRAM



V_{DD} = PIN 16
V_{SS} = PIN 8

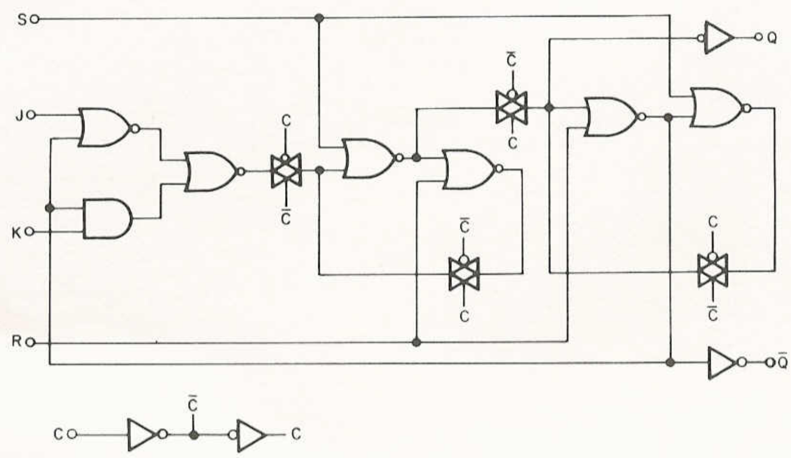
CIRCUIT DIAGRA

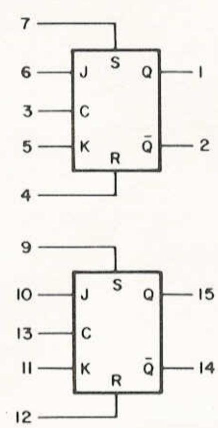


* DIODE PROTECTION ON ALL INPUTS (NOT

MC14027B
DUAL J-K FLIP-FLOP

LOGIC DIAGRAM
(1/2 OF DEVICE SHOWN)





V_{DD} = PIN 16
V_{SS} = PIN 8

TRUTH TABLE

INPUTS						OUTPUTS*		
C†	J	K	S	R	Q_n‡	Q_{n+1}	$\overline{Q_{n+1}}$	
_/‾	1	X	0	0	0	1	0	
_/‾	X	0	0	0	1	1	0	
_/‾	0	X	0	0	0	0	1	
_/‾	X	1	0	0	1	0	1	
‾_	X	X	0	0	X	Q_n	$\overline{Q_n}$	No Change
X	X	X	1	0	X	1	0	
X	X	X	0	1	X	0	1	
X	X	X	1	1	X	1	1	

X = Don't Care
† = Level Change
‡ = Present State
* = Next State

The MC14027B is a dual J-K flip-flop with independent J, K, Clock (C), Set (S), and Reset (R) inputs for each flip-flop. Logic state is retained indefinitely with the clock level either high or low. Information is transferred to the output only on the positive-going edge of the clock pulse.

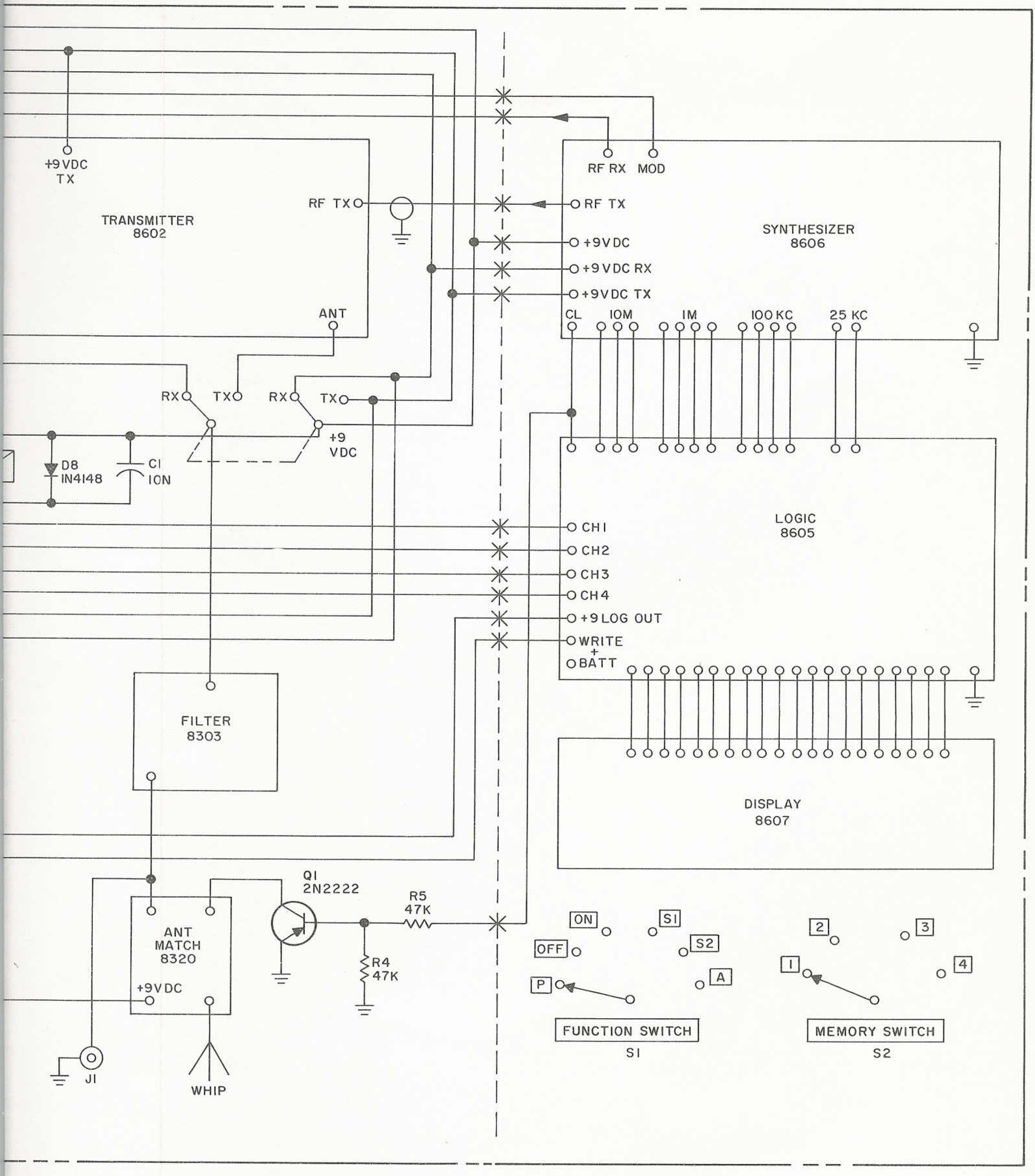
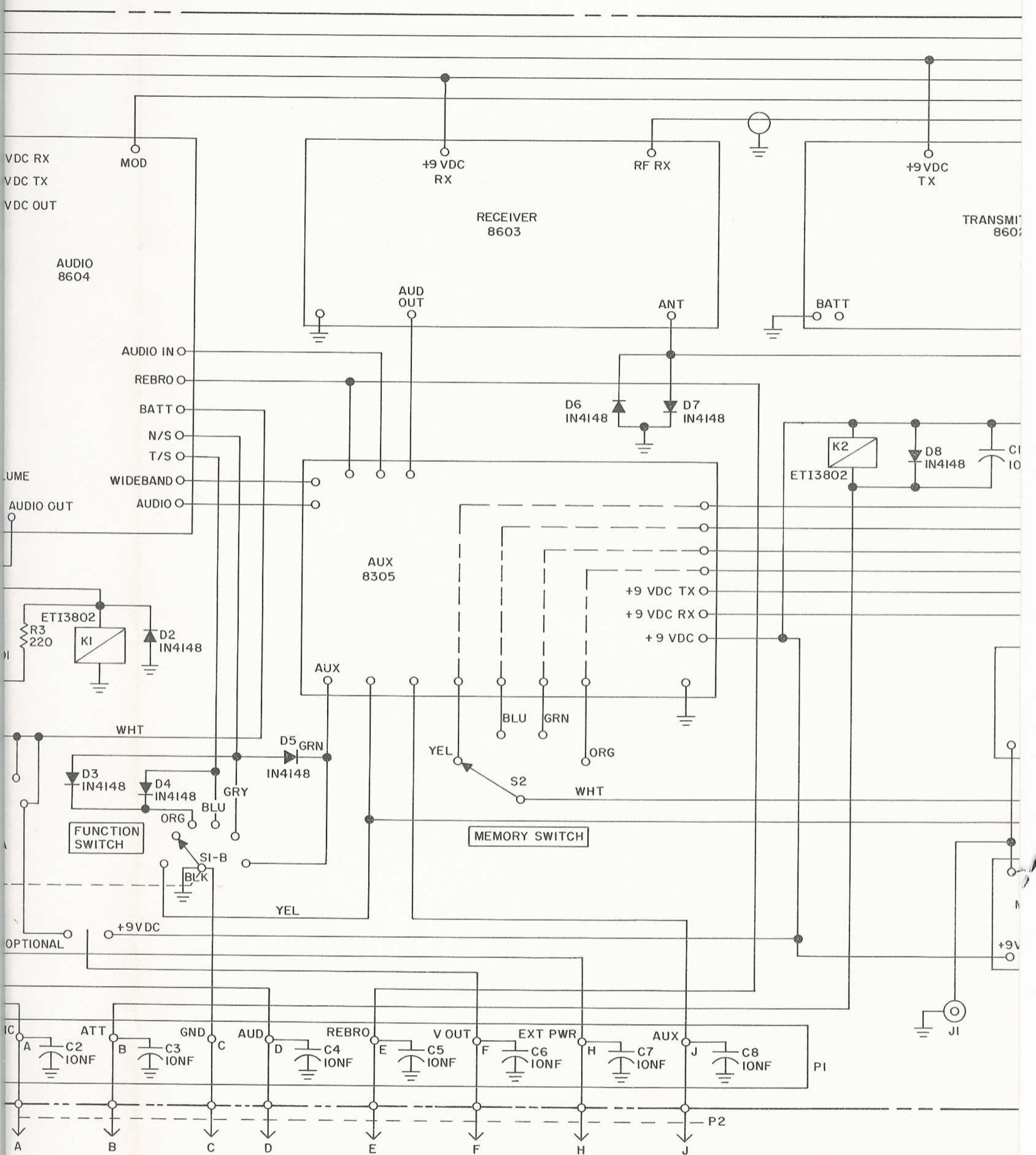
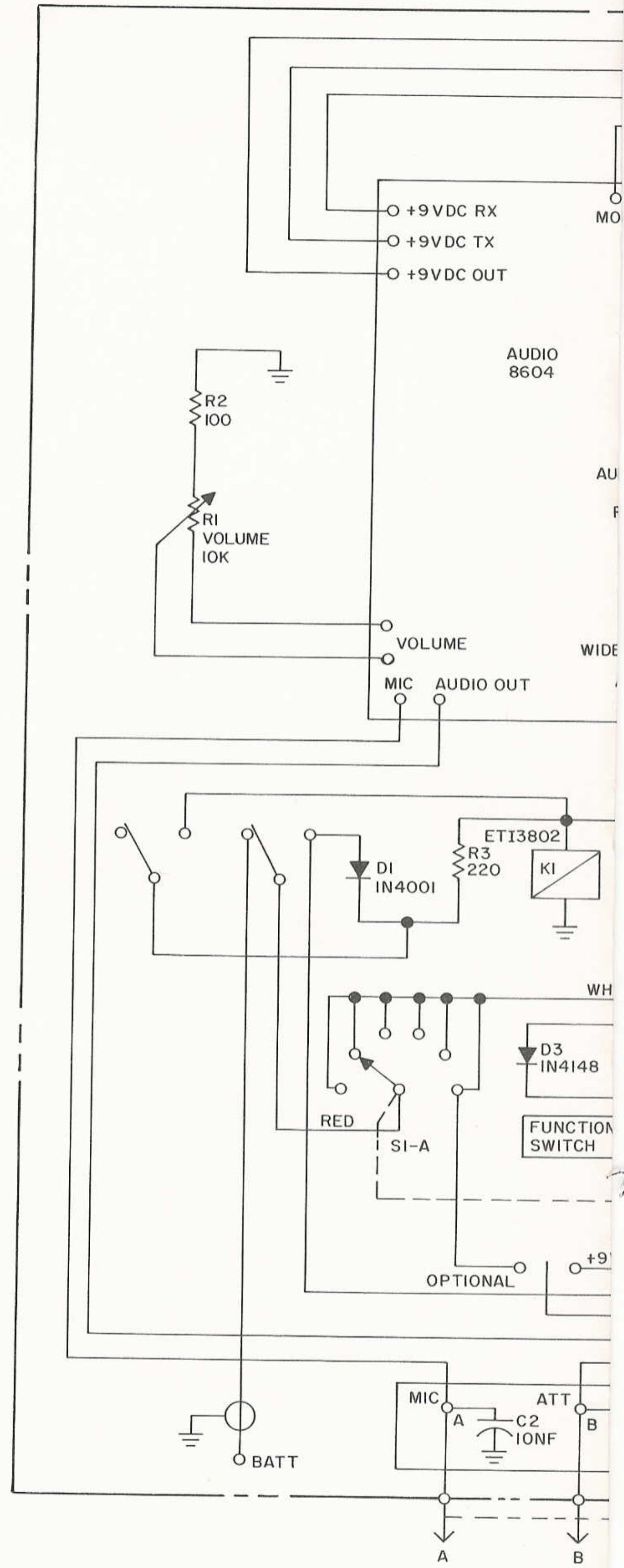


Figure 8-6. ERC-310 Manpack Transceiver, Overall Schematic Diagram



VDC RX
VDC TX
VDC OUT
MOD
AUDIO
8604
+9 VDC
RX
RF RX
RECEIVER
8603
+9 VDC
TX
TRANSMIT
860
AUD
OUT
ANT
BATT
AUDIO IN
REBRO
BATT
N/S
T/S
WIDEBAND
AUDIO
AUDIO OUT
D6
IN4148
D7
IN4148
K2
ETI3802
D8
IN4148
AUX
8305
+9 VDC TX
+9 VDC RX
+9 VDC
ETI3802
R3
220
KI
D2
IN4148
AUX
BLU
GRN
WHT
D5
GRN
IN4148
YEL
S2
ORG
WHT
D3
IN4148
D4
IN4148
GRY
BLU
ORG
FUNCTION
SWITCH
MEMORY SWITCH
SI-B
BLK
YEL
OPTIONAL
+9VDC
ATT
GND
AUD
REBRO
V OUT
EXT PWR
AUX
A
B
C
D
E
F
H
J
C2
IONF
C3
IONF
C4
IONF
C5
IONF
C6
IONF
C7
IONF
C8
IONF
PI
JI
P2


+9VDC RX
+9VDC TX
+9VDC OUT
MO
AUDIO
8604
R2
100
RI
VOLUME
IOK
AU
VOLUME
WIDE
MIC
AUDIO OUT
ETI3802
R3
220
DI
IN4001
KI
WH
D3
IN4148
RED
SI-A
FUNCTION
SWITCH
OPTIONAL
BATT
MIC
A
C2
IONF
ATT
B
A
B

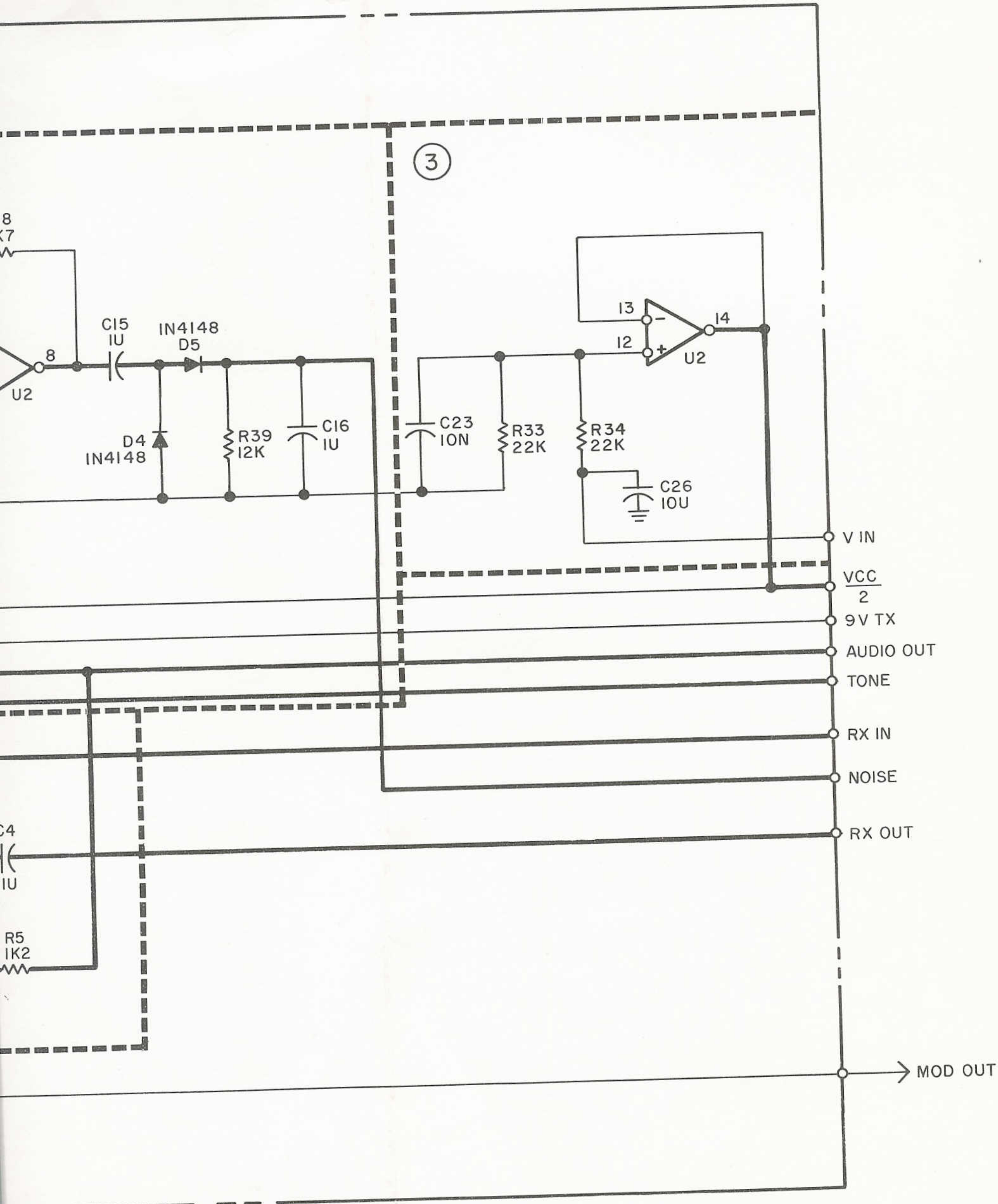
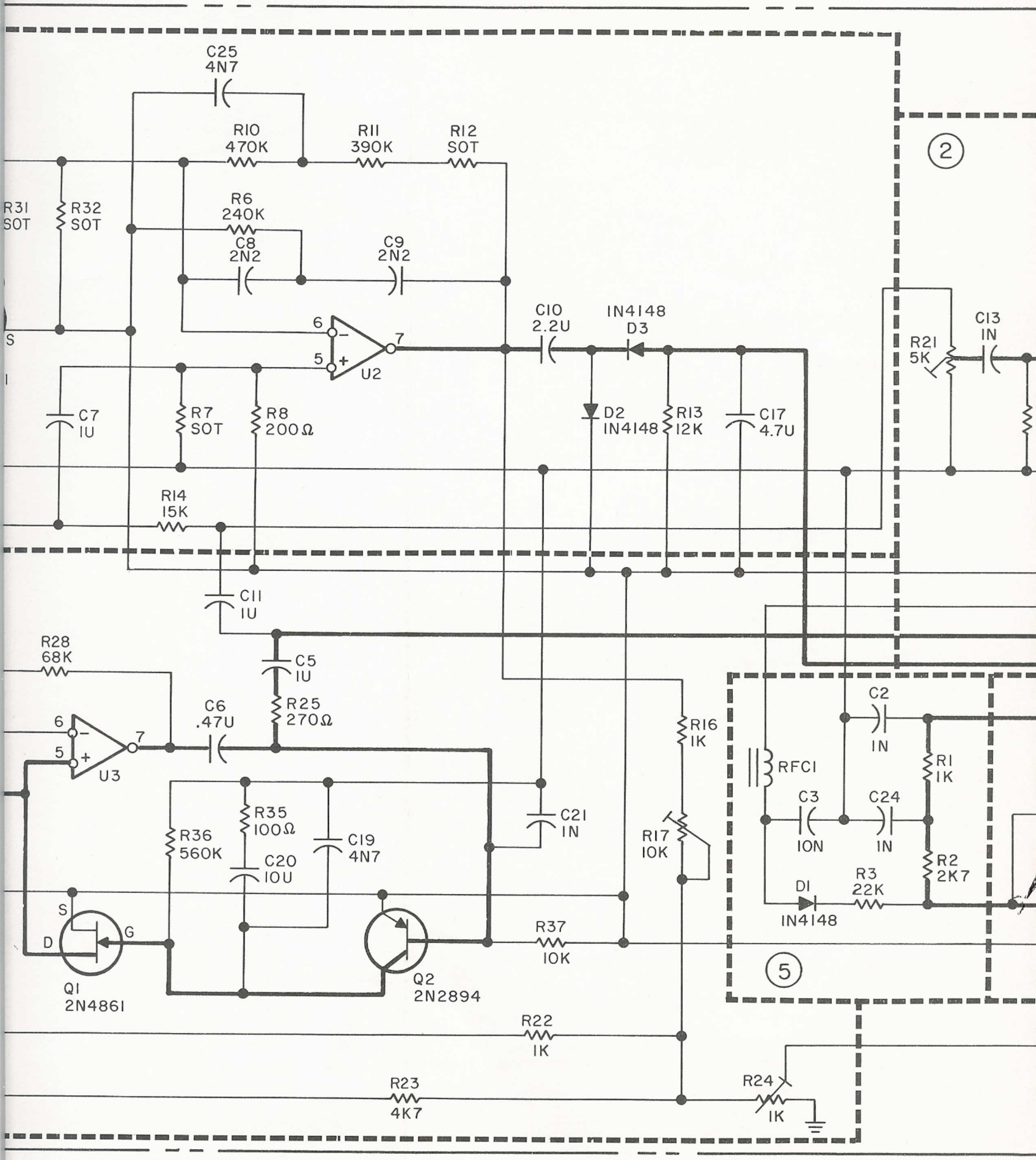
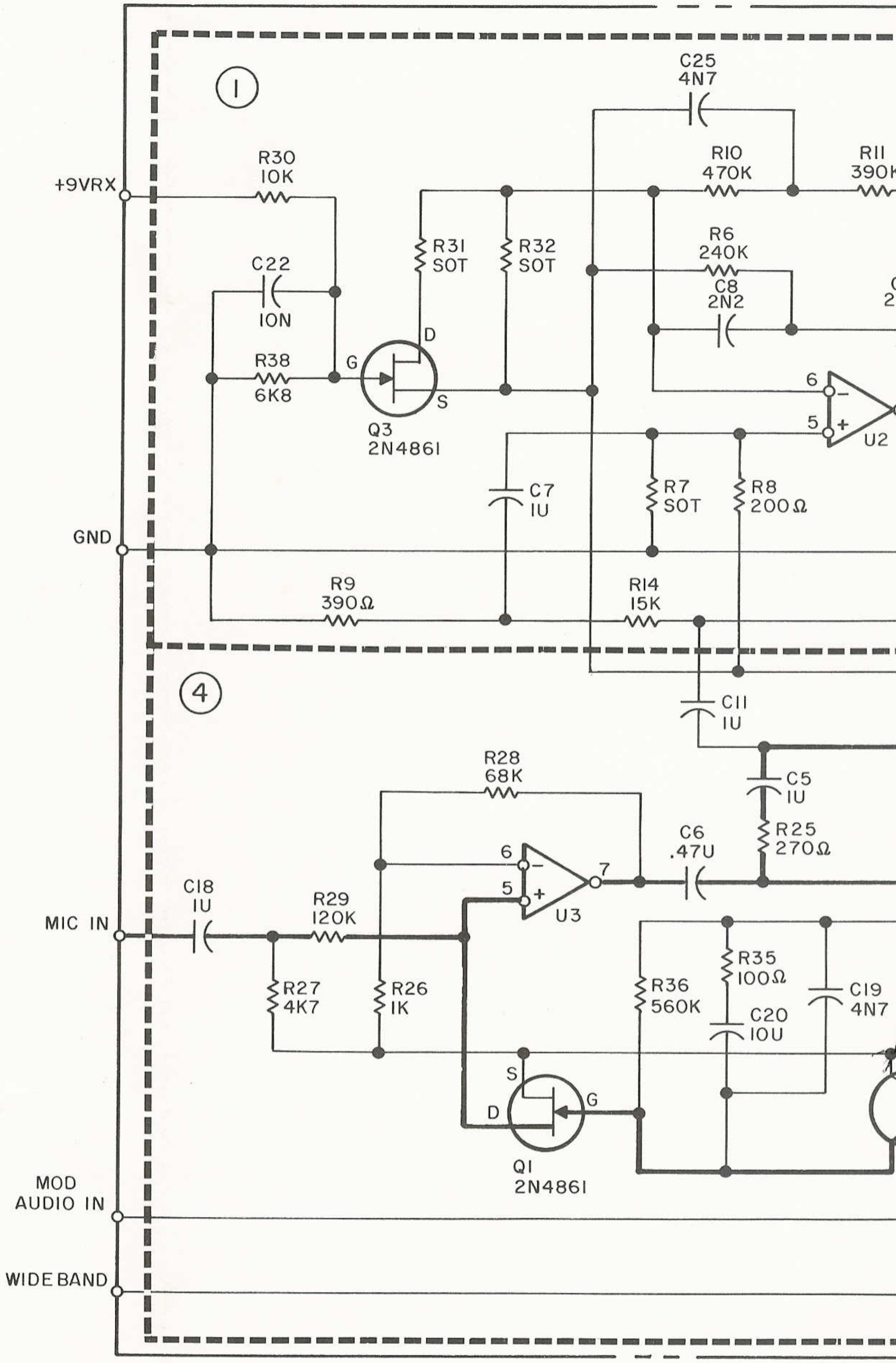


Figure 8-7. Audio Module 1, Top Board, Schematic Diagram



C25 4N7
R10 470K
R11 390K
R12 SOT
R31 SOT
R32 SOT
R6 240K
C8 2N2
C9 2N2
C10 2.2U
IN4148 D3
6
5
7
U2
C7 IU
R7 SOT
R8 200Ω
D2 IN4148
R13 12K
C17 4.7U
R21 5K
C13 IN
R14 15K
C11 IU
R28 68K
C5 IU
C6 .47U
R25 270Ω
U3
R16 IK
R36 560K
R35 100Ω
C19 4N7
C20 10U
C21 IN
R17 10K
S
D
G
Q1 2N4861
Q2 2N2894
R37 10K
R22 IK
R23 4K7
R24 IK
RFC1
C2 IN
C3 10N
C24 IN
R1 IK
R2 2K7
D1 IN4148
R3 22K
2
5



1
4
+9VRX
GND
MIC IN
MOD
AUDIO IN
WIDE BAND
R30
10K
C22
10N
R38
6K8
Q3
2N4861
G
D
S
R31
SOT
R32
SOT
C25
4N7
R10
470K
R11
390K
R6
240K
C8
2N2
6
5
U2
C7
1U
R7
SOT
R8
200Ω
R9
390Ω
R14
15K
C11
1U
R28
68K
C5
1U
R25
270Ω
C6
.47U
C18
1U
R29
120K
U3
7
R27
4K7
R26
1K
R36
560K
R35
100Ω
C20
10U
C19
4N7
Q1
2N4861

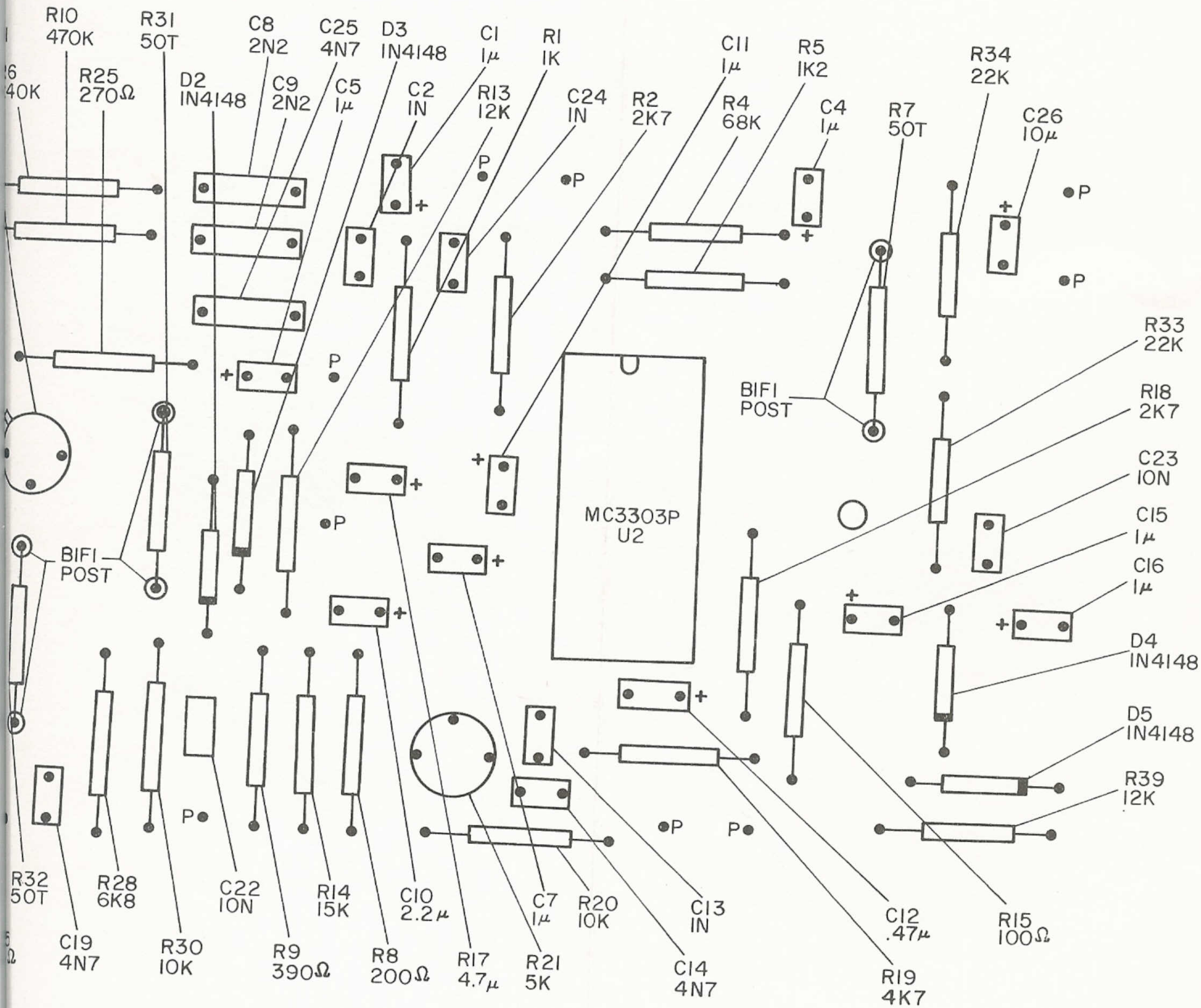
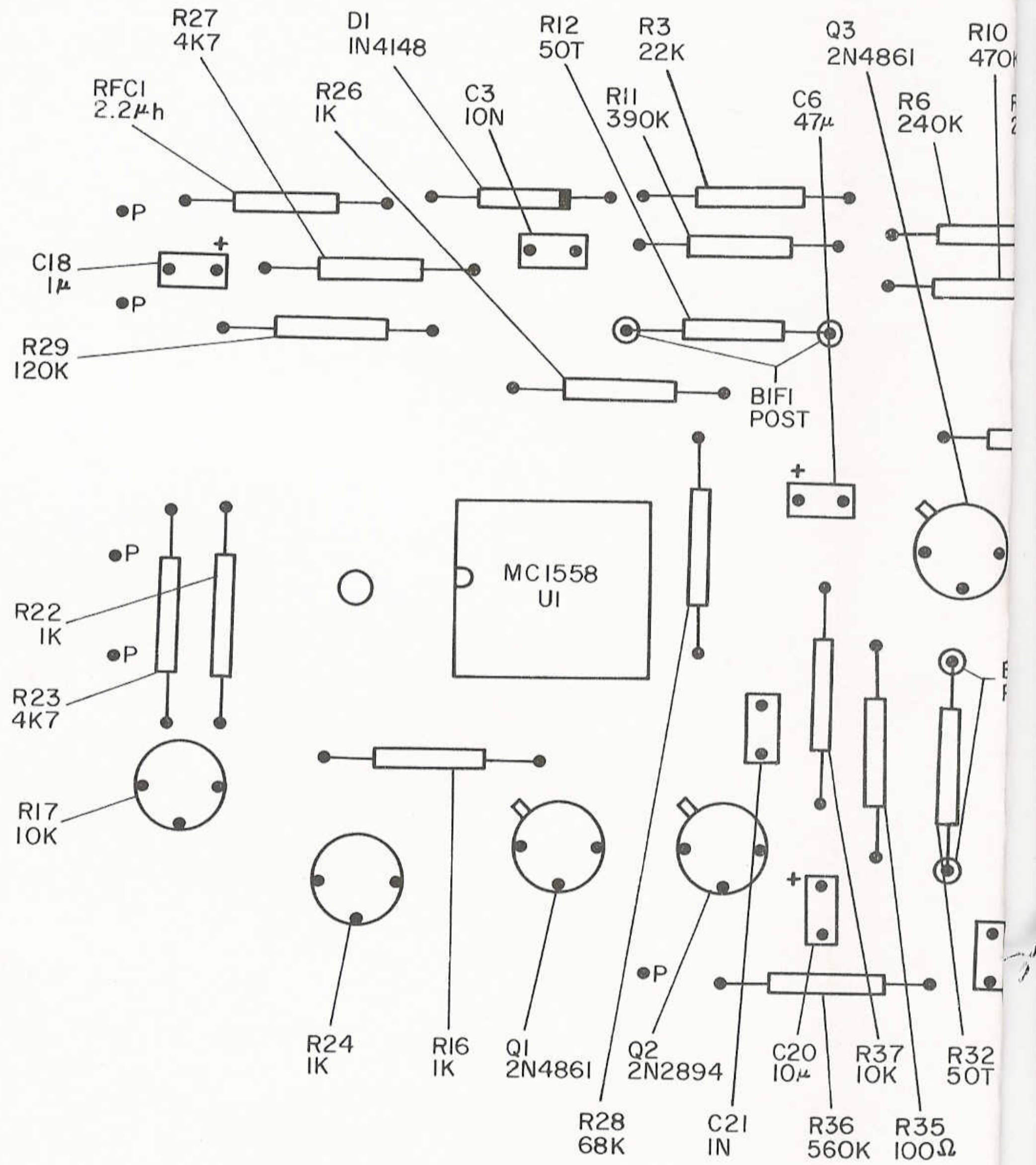


Figure 8-8. Audio Module 1, Top Board, Component Location Diagram


R27
4K7
DI
IN4148
RI2
50T
R3
22K
Q3
2N4861
RIO
470K
RFCI
2.2μh
R26
IK
C3
ION
RII
390K
C6
47μ
R6
240K
P
C18
1μ
P
R29
120K
BIFI
POST
MC1558
UI
P
R22
IK
P
R23
4K7
R17
IOK
P
R24
IK
RI6
IK
QI
2N4861
Q2
2N2894
C20
10μ
R37
IOK
R32
50T
R28
68K
C21
IN
R36
560K
R35
100Ω

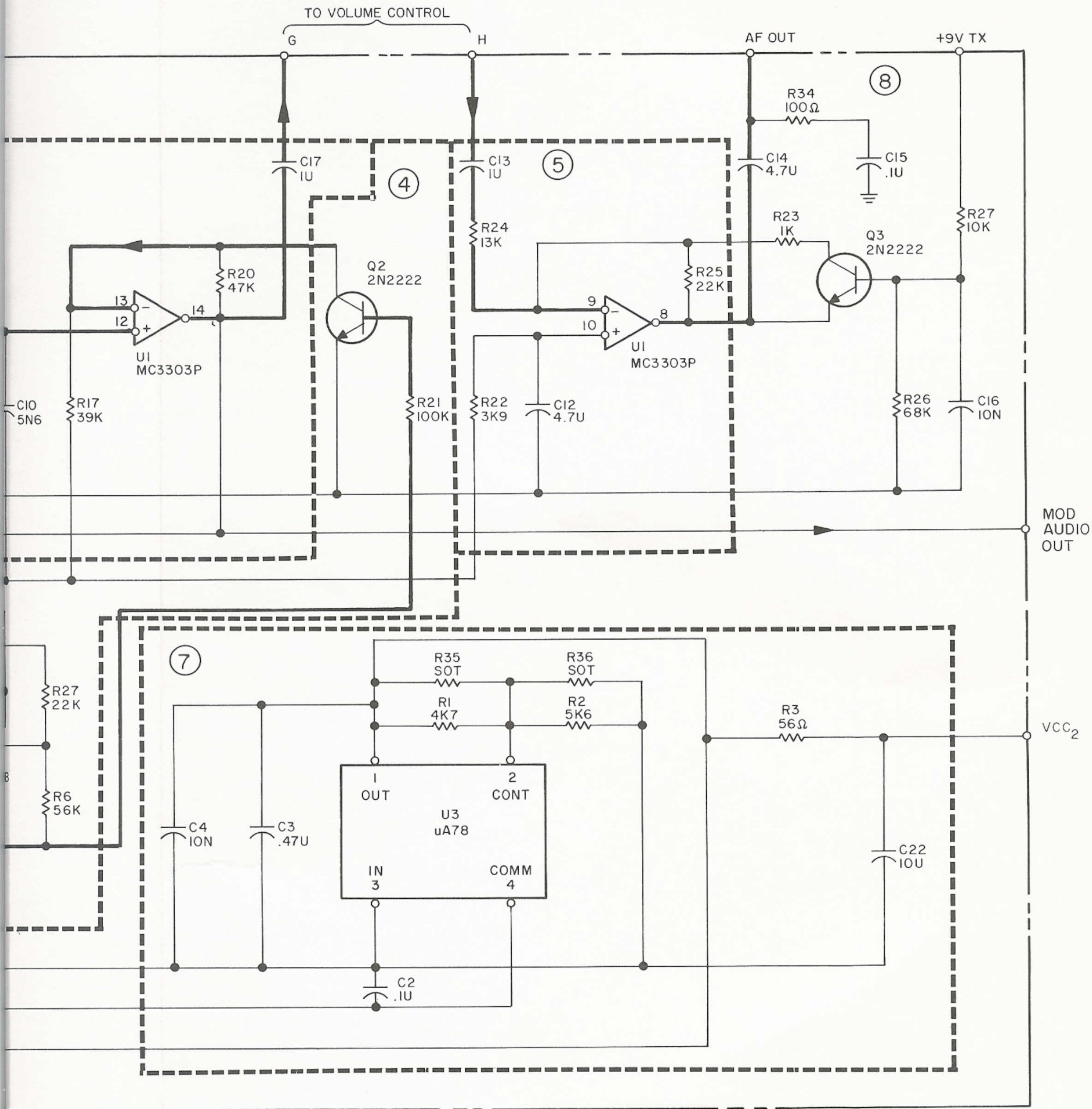
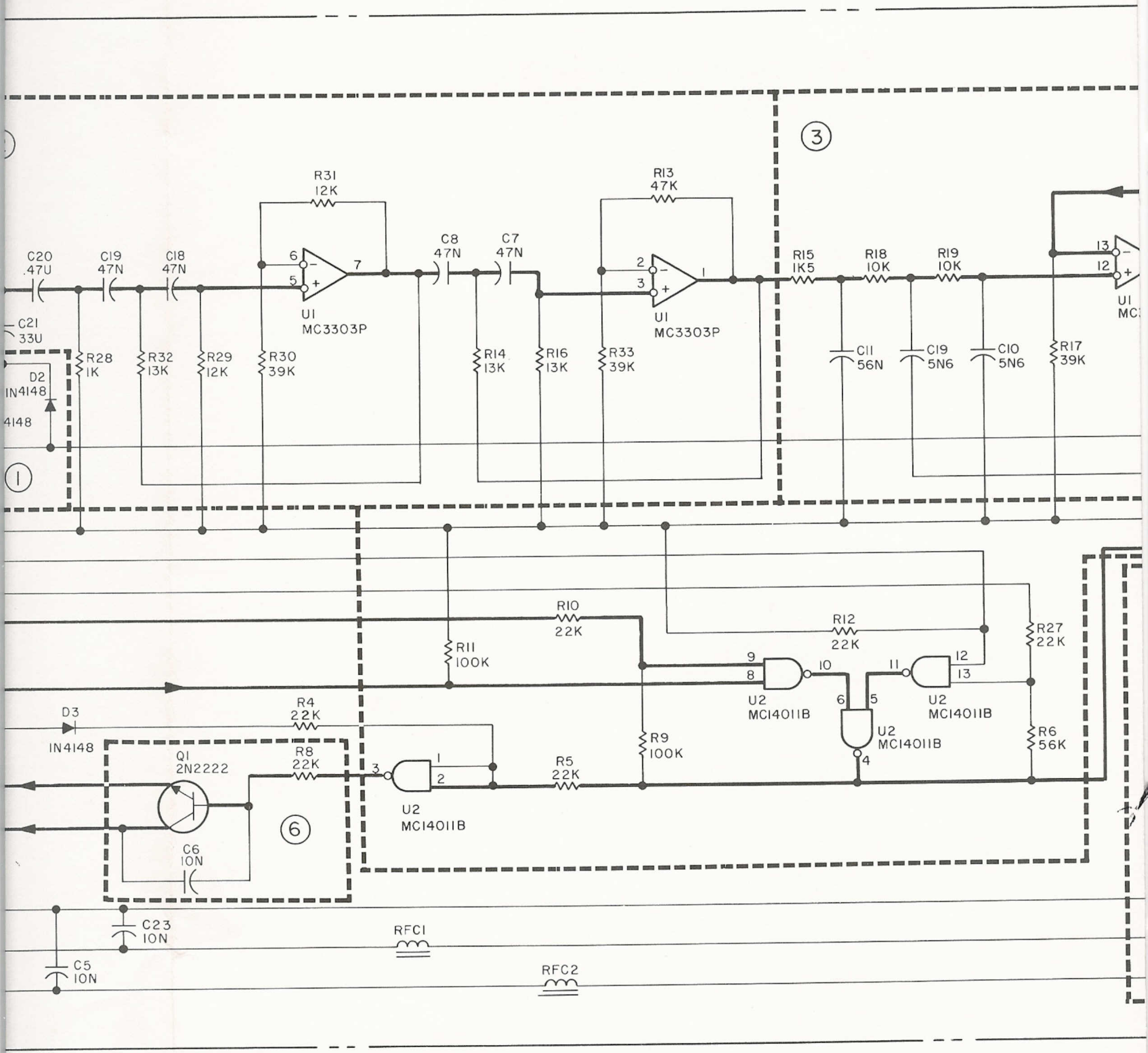
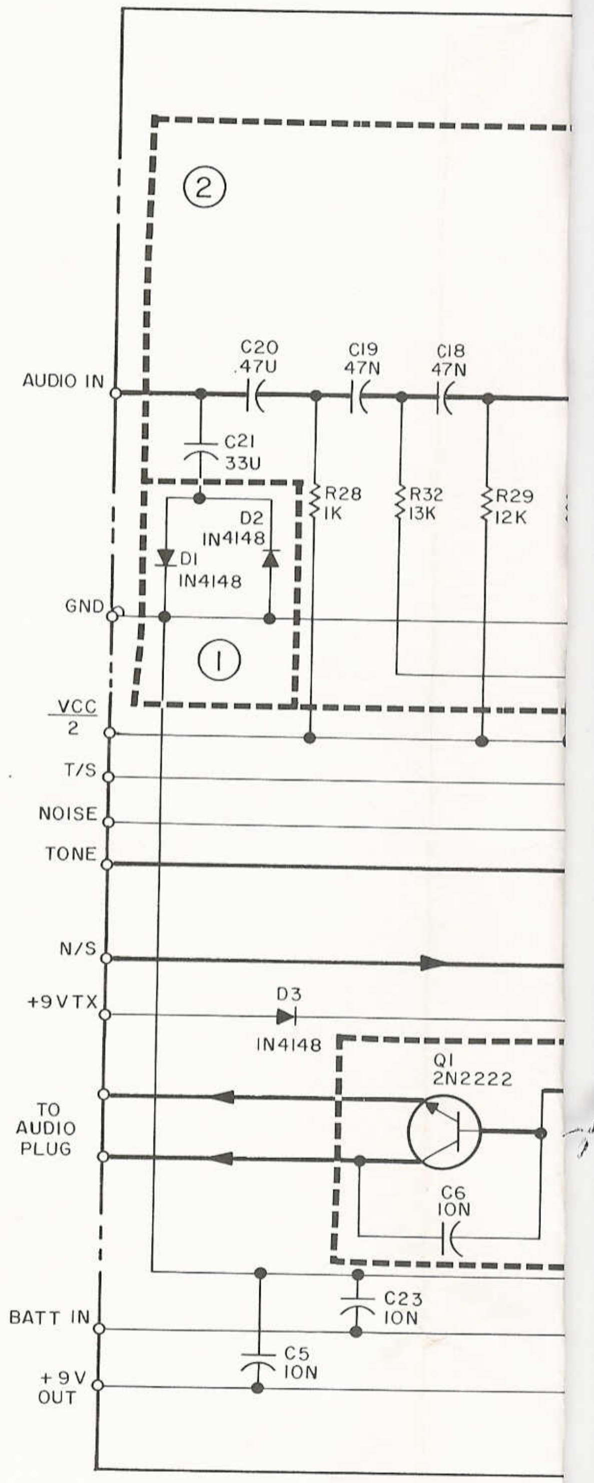


Figure 8-9. Audio Module 1, Bottom Board, Schematic Diagram



3
1
6
R31
12K
R13
47K
C20
.47U
C19
47N
C18
47N
C8
47N
C7
47N
R15
1K5
R18
10K
R19
10K
U1
MC3303P
C21
33U
D2
IN4148
R28
1K
R32
13K
R29
12K
R30
39K
R14
13K
R16
13K
R33
39K
C11
56N
C19
5N6
C10
5N6
R17
39K
R10
22K
R12
22K
R27
22K
R11
100K
U2
MC14011B
D3
IN4148
R4
22K
Q1
2N2222
R8
22K
R9
100K
R5
22K
R6
56K
C6
10N
C23
10N
C5
10N
RFC1
RFC2



②
AUDIO IN
C20
.47U
C19
47N
C18
47N
C21
33U
R28
1K
R32
13K
R29
12K
D2
IN4148
D1
IN4148
GND
①
VCC
2
T/S
NOISE
TONE
N/S
+9VTX
D3
IN4148
Q1
2N2222
TO
AUDIO
PLUG
C6
10N
C23
10N
BATT IN
C5
10N
+9V
OUT

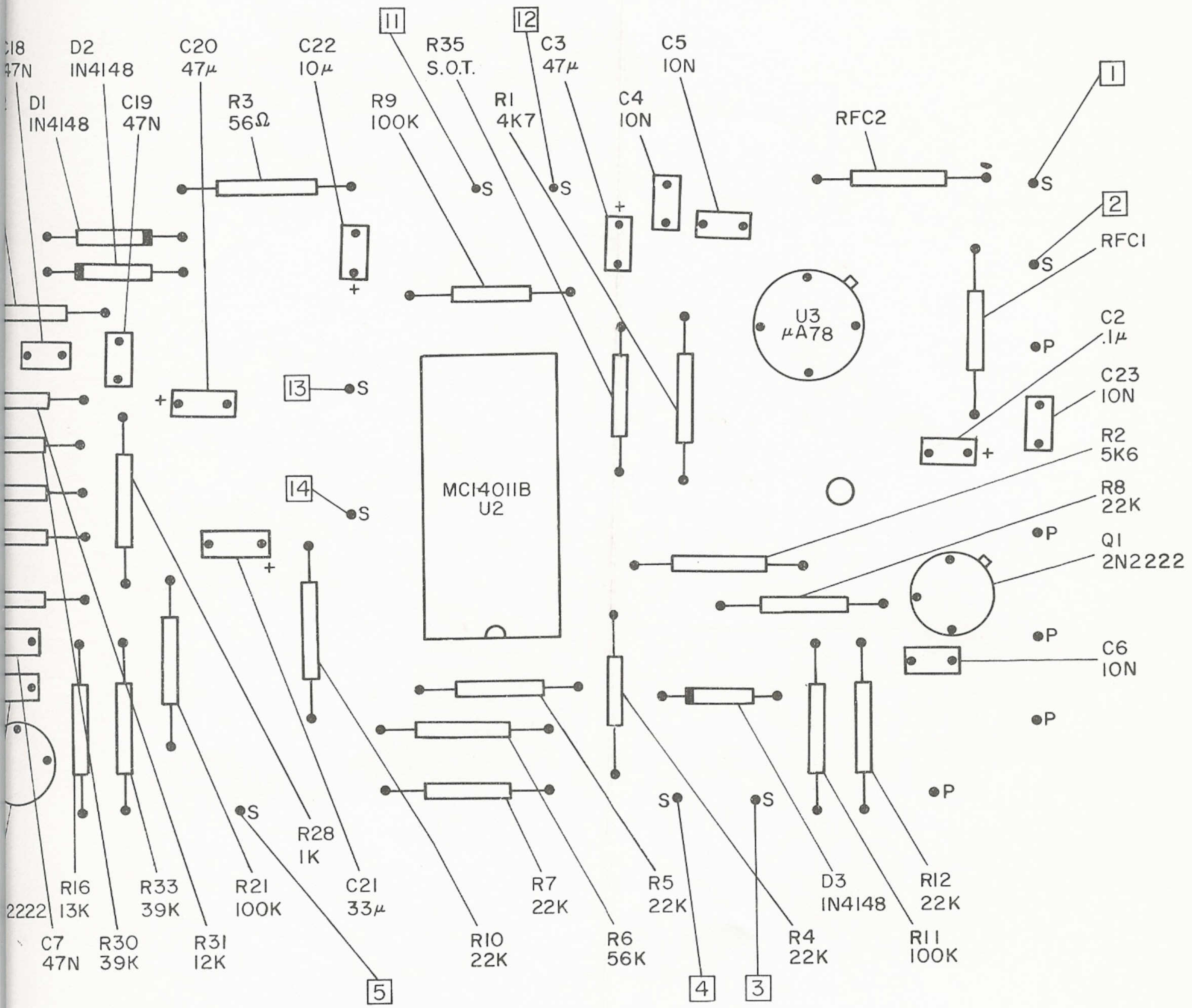
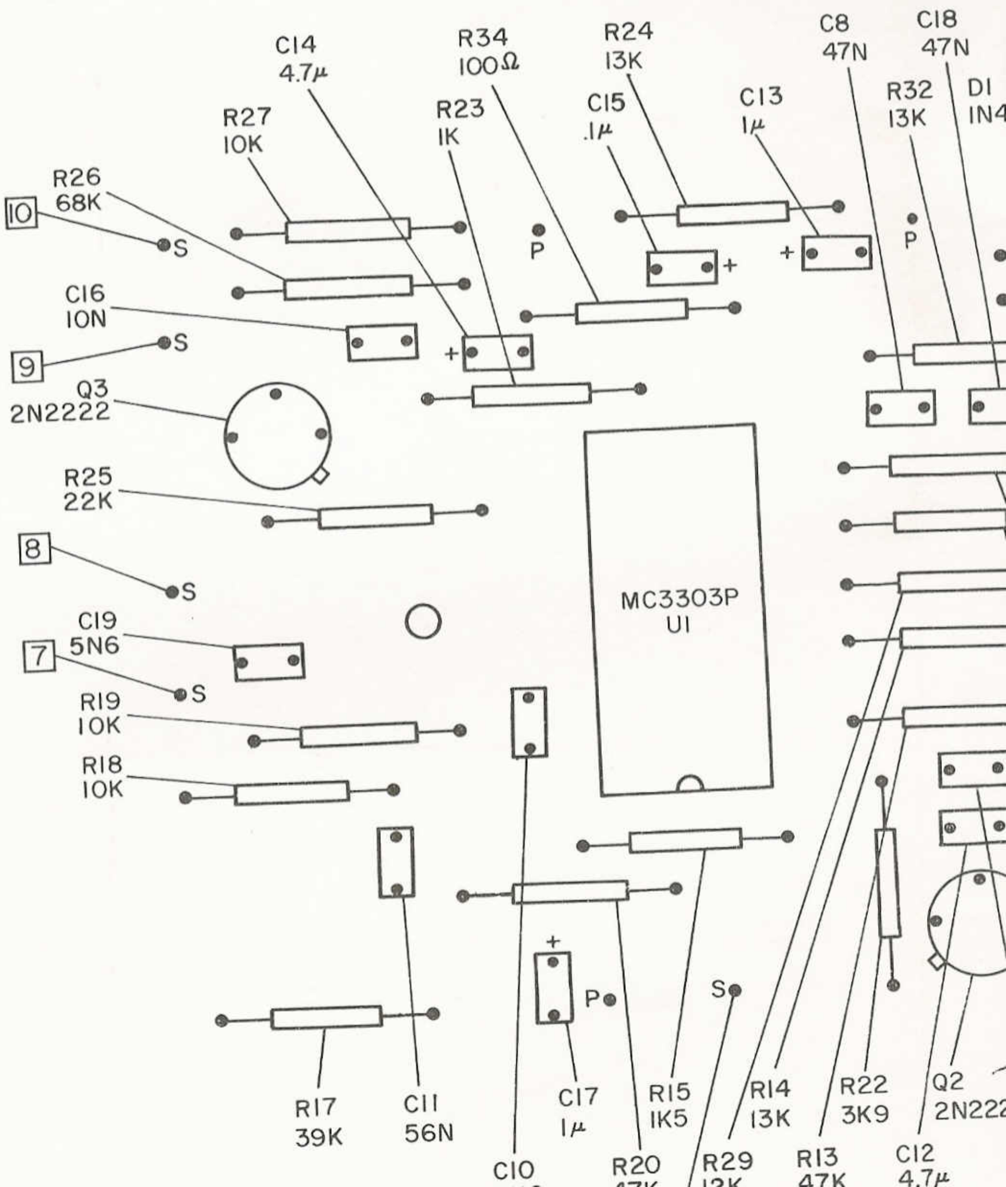


Figure 8-10. Audio Module 1, Bottom Board, Component Location Diagram


C14
4.7μ
R34
100Ω
R24
13K
C8
47N
C18
47N
R27
10K
R23
1K
C15
.1μ
C13
1μ
R32
13K
D1
R26
68K
10
S
P
P
C16
10N
9
S
Q3
2N2222
R25
22K
8
S
MC3303P
U1
C19
5N6
7
S
R19
10K
R18
10K
P
S
R17
39K
C11
56N
C17
1μ
R15
1K5
R14
13K
R22
3K9
Q2
C10
R20
R29
R13
C12

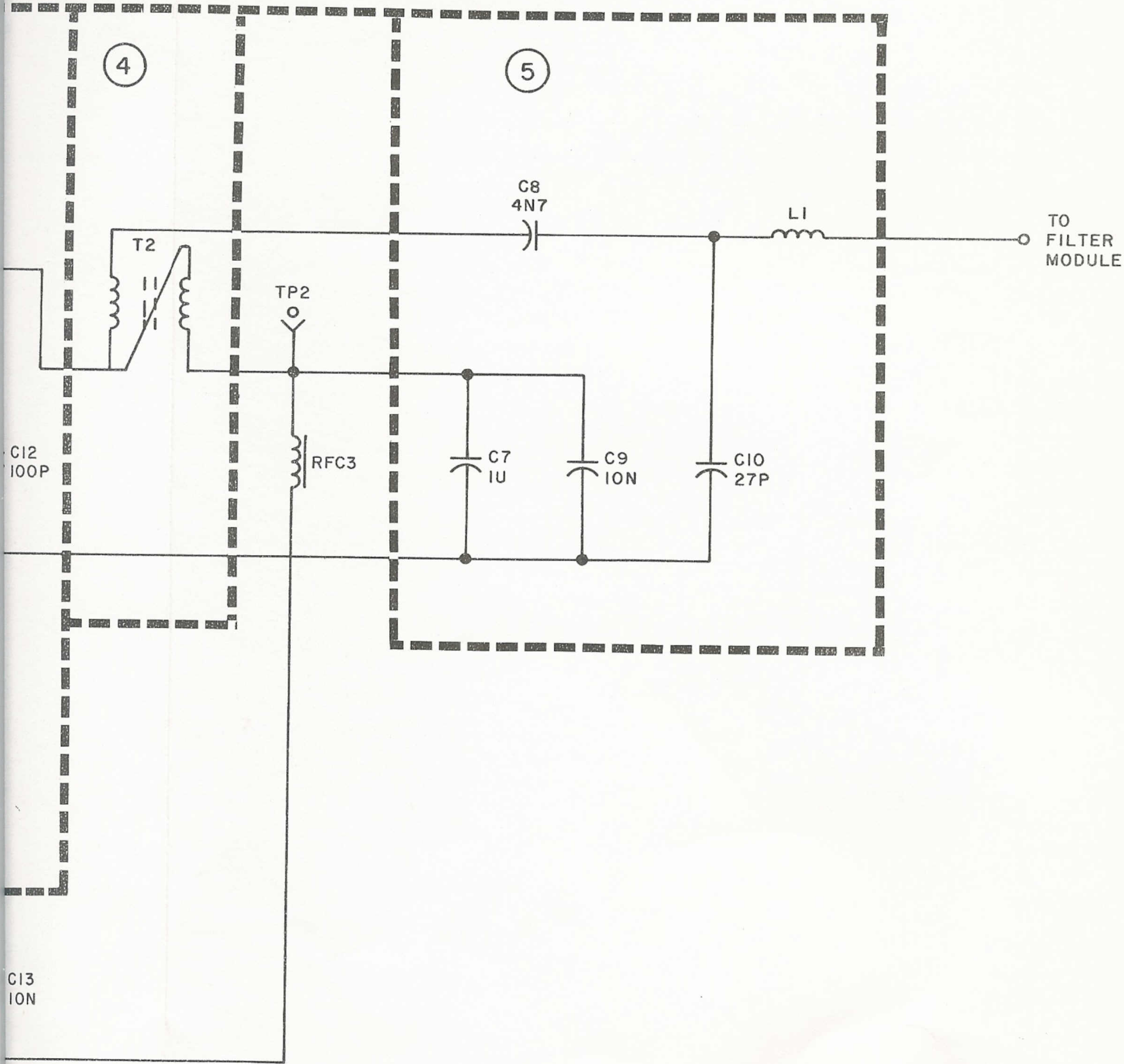
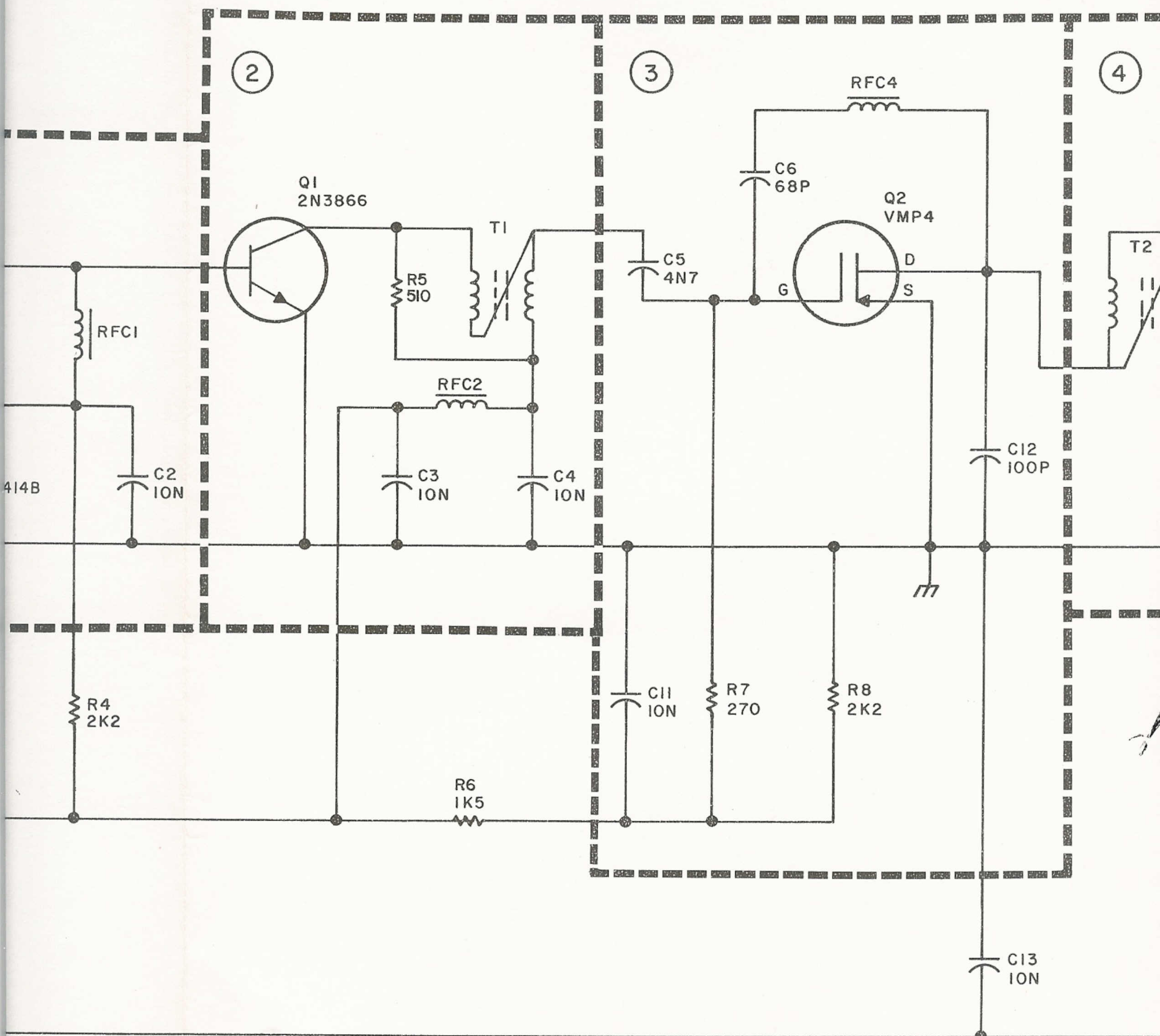
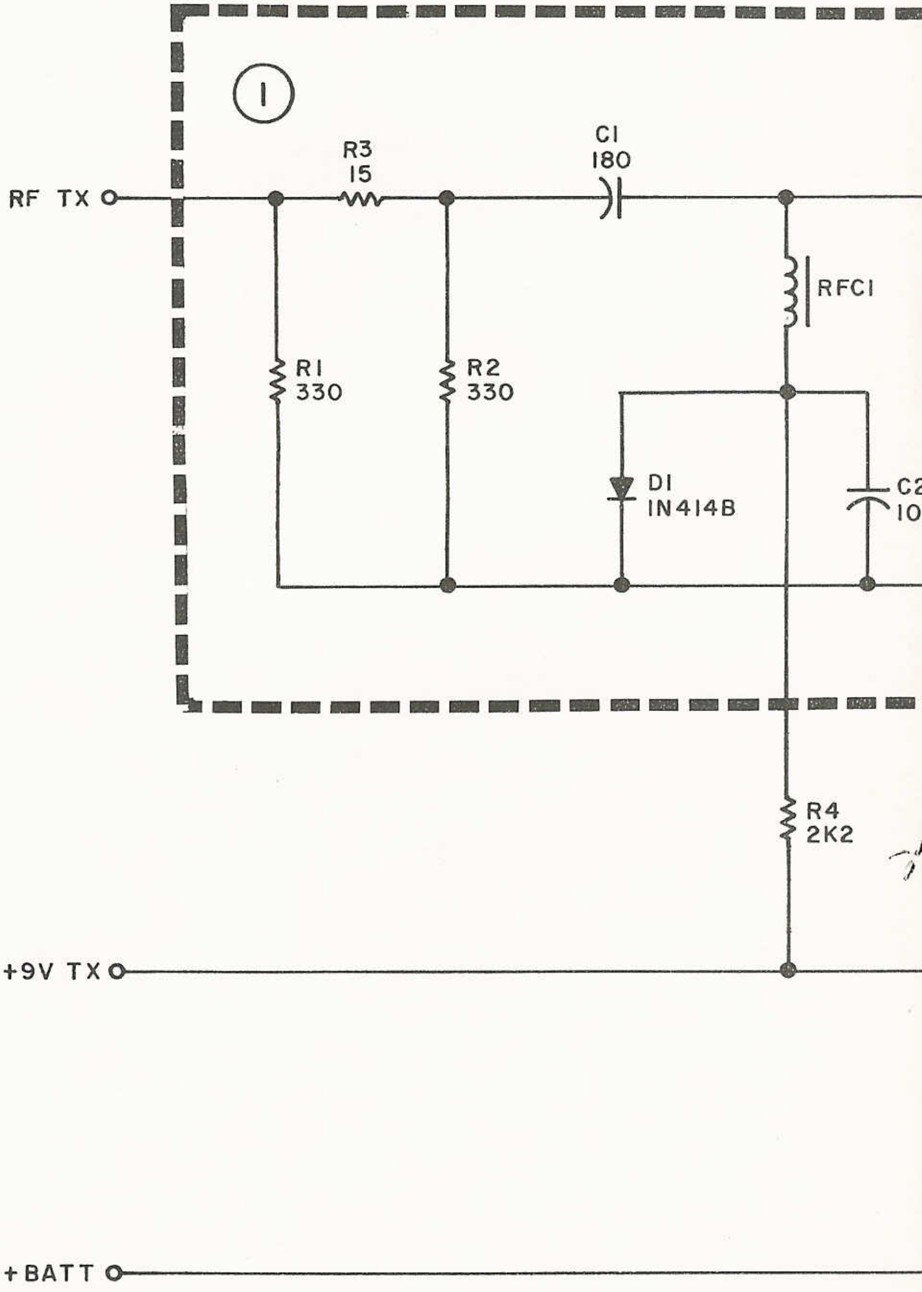


Figure 8-11. Transmitter Module 2, Schematic Diagram



2
3
4
Q1
2N3866
T1
R5
510
RFC1
RFC2
C2
10N
C3
10N
C4
10N
414B
RFC4
C6
68P
Q2
VMP4
C5
4N7
G
D
S
T2
C12
100P
C11
10N
R7
270
R8
2K2
R4
2K2
R6
1K5
C13
10N



1
RF TX
R3
15
C1
180
RFC1
R1
330
R2
330
D1
1N4148
C2
10
R4
2K2
+9V TX
+BATT

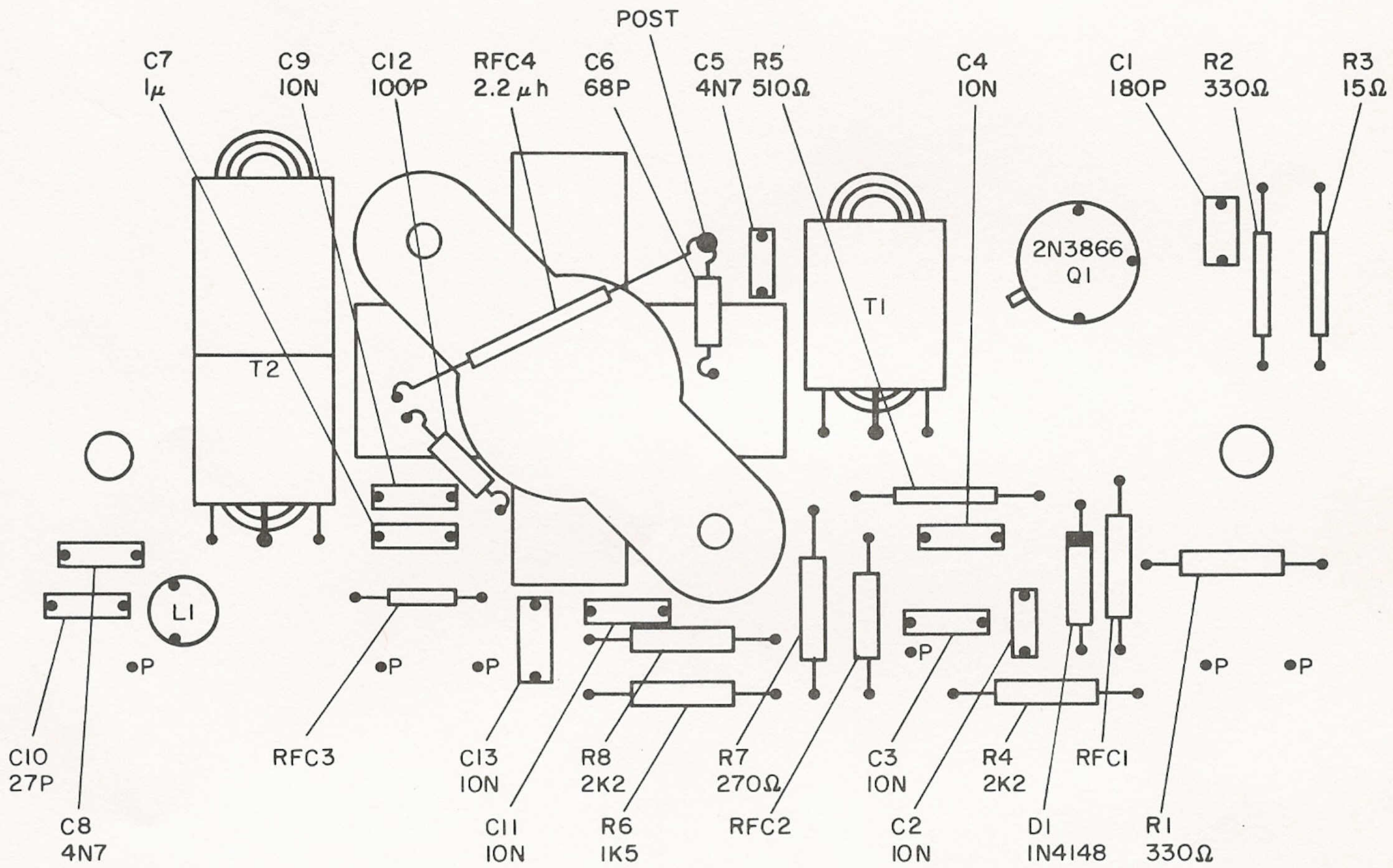
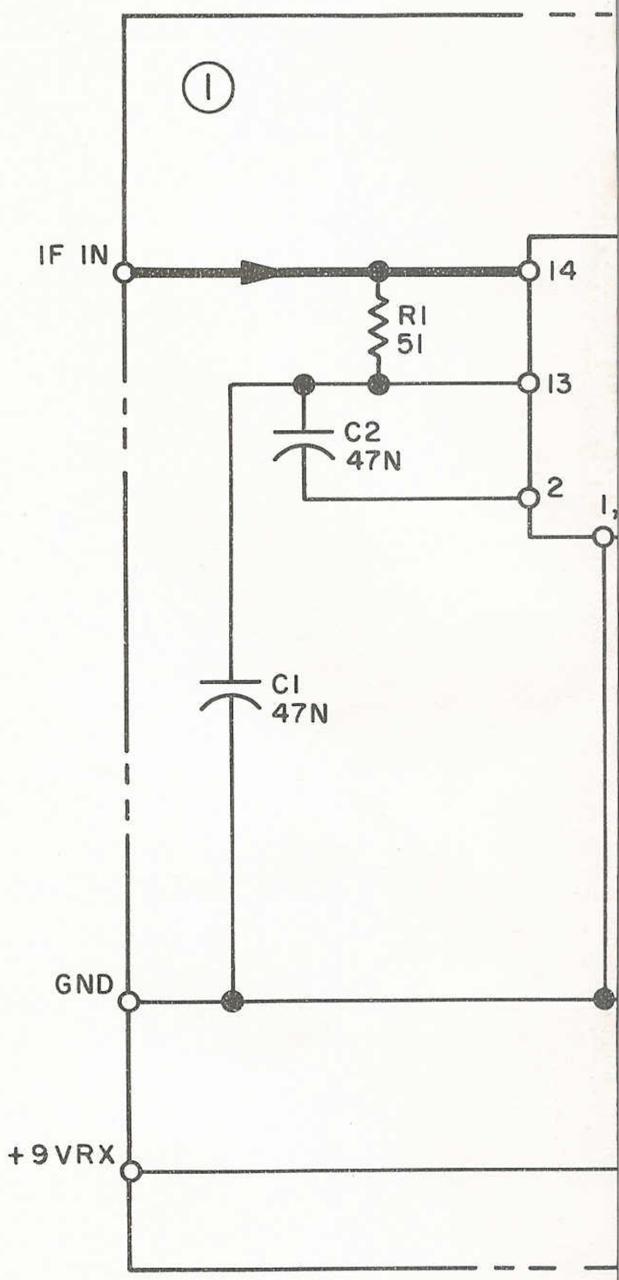


Figure 8-12. Transmitter Module 2, Component Location Diagram



1
IF IN
14
R1
51
13
C2
47N
2
1,
C1
47N
GND
+9VRX

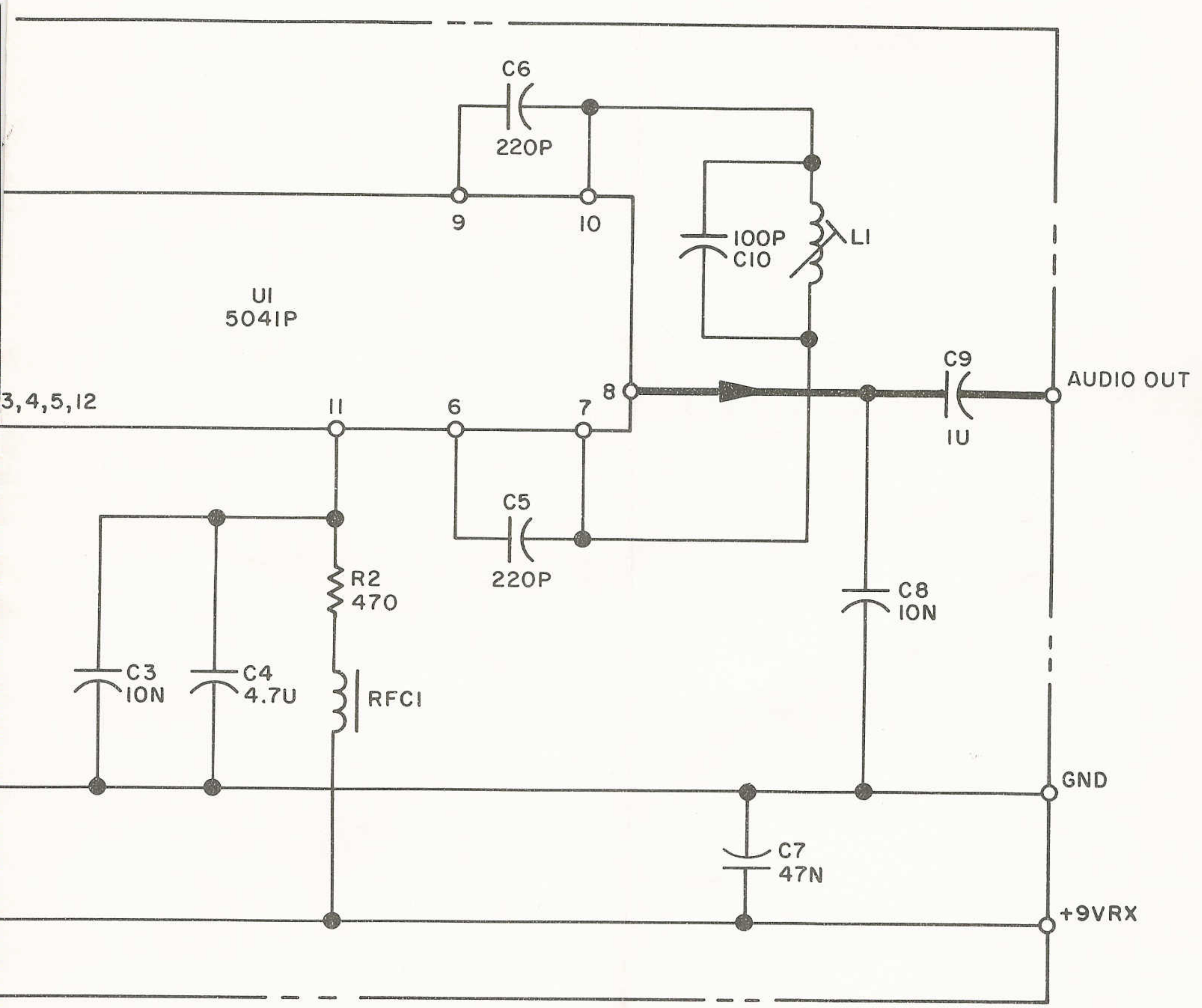


Figure 8-13. Receiver Module 3, Top Board, Schematic Diagram

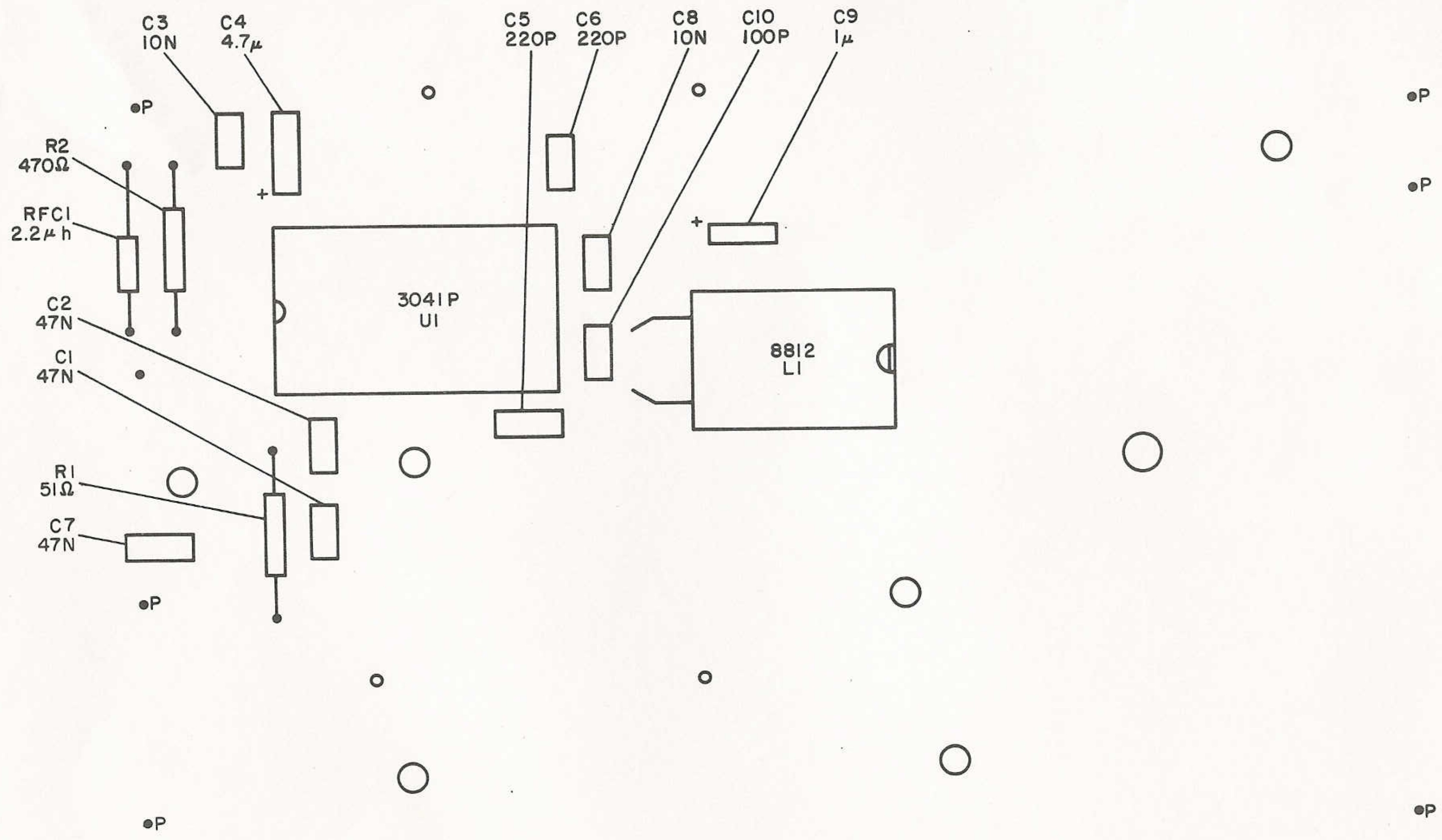


Figure 8-14. Receiver Module 3, Top Board, Component Location Diagram

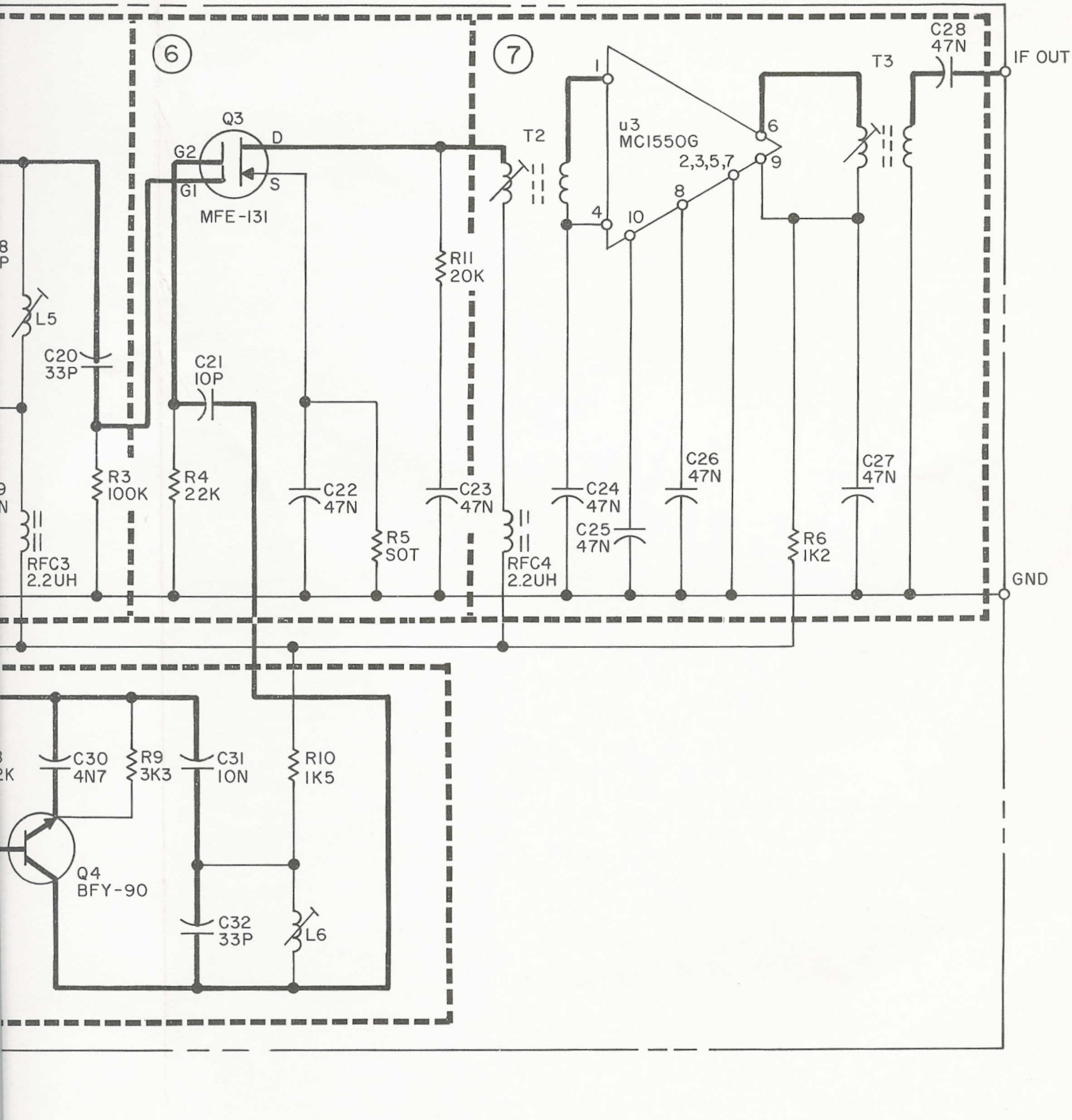
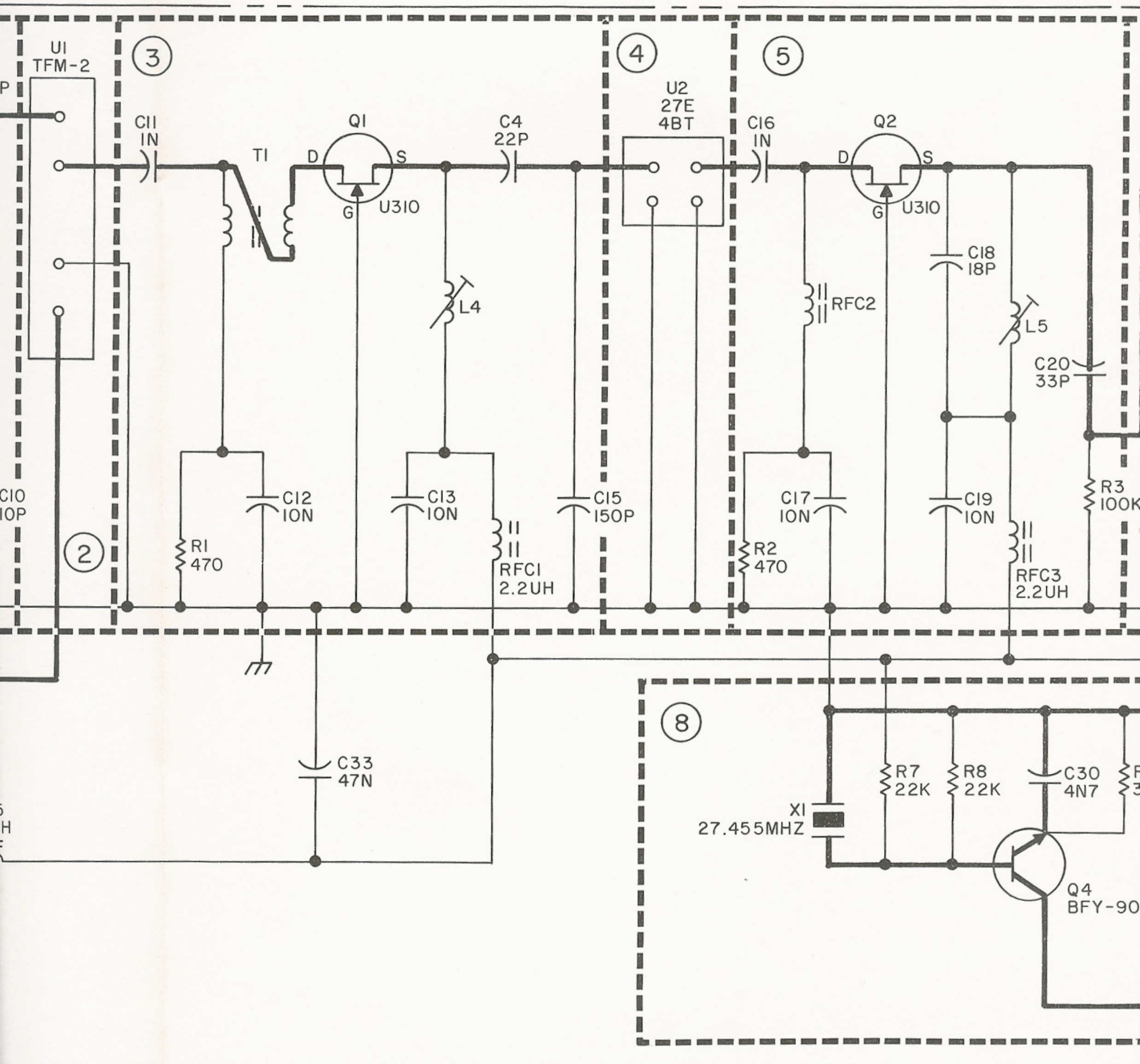
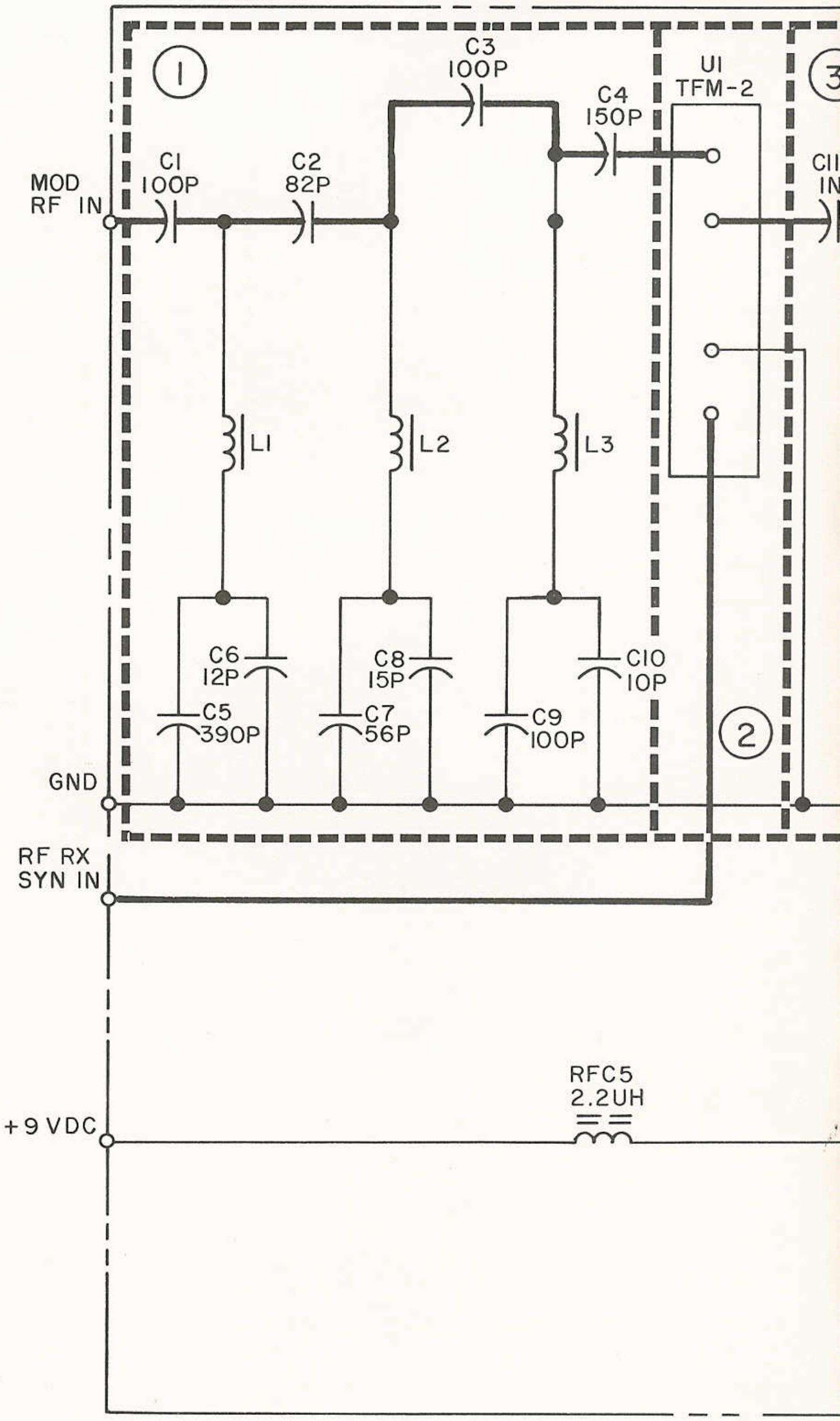


Figure 8-15. Receiver Module 3, Bottom Board, Schematic Diagram



UI
TFM-2
C11
IN
T1
Q1
D
S
G
U310
C4
22P
U2
27E
4BT
C16
IN
Q2
D
S
G
U310
C18
18P
RFC2
L4
L5
C20
33P
C10
10P
C12
10N
C13
10N
C15
150P
C17
10N
C19
10N
R3
100K
R1
470
R2
470
RFC1
2.2UH
RFC3
2.2UH
C33
47N
R7
22K
R8
22K
C30
4N7
X1
27.455MHZ
Q4
BFY-90



1
C3
100P
U1
TFM-2
3
C4
150P
MOD
RF IN
C1
100P
C2
82P
C11
IN
L1
L2
L3
C6
12P
C8
15P
C10
10P
C5
390P
C7
56P
C9
100P
2
GND
RF RX
SYN IN
RFC5
2.2UH
+9 VDC

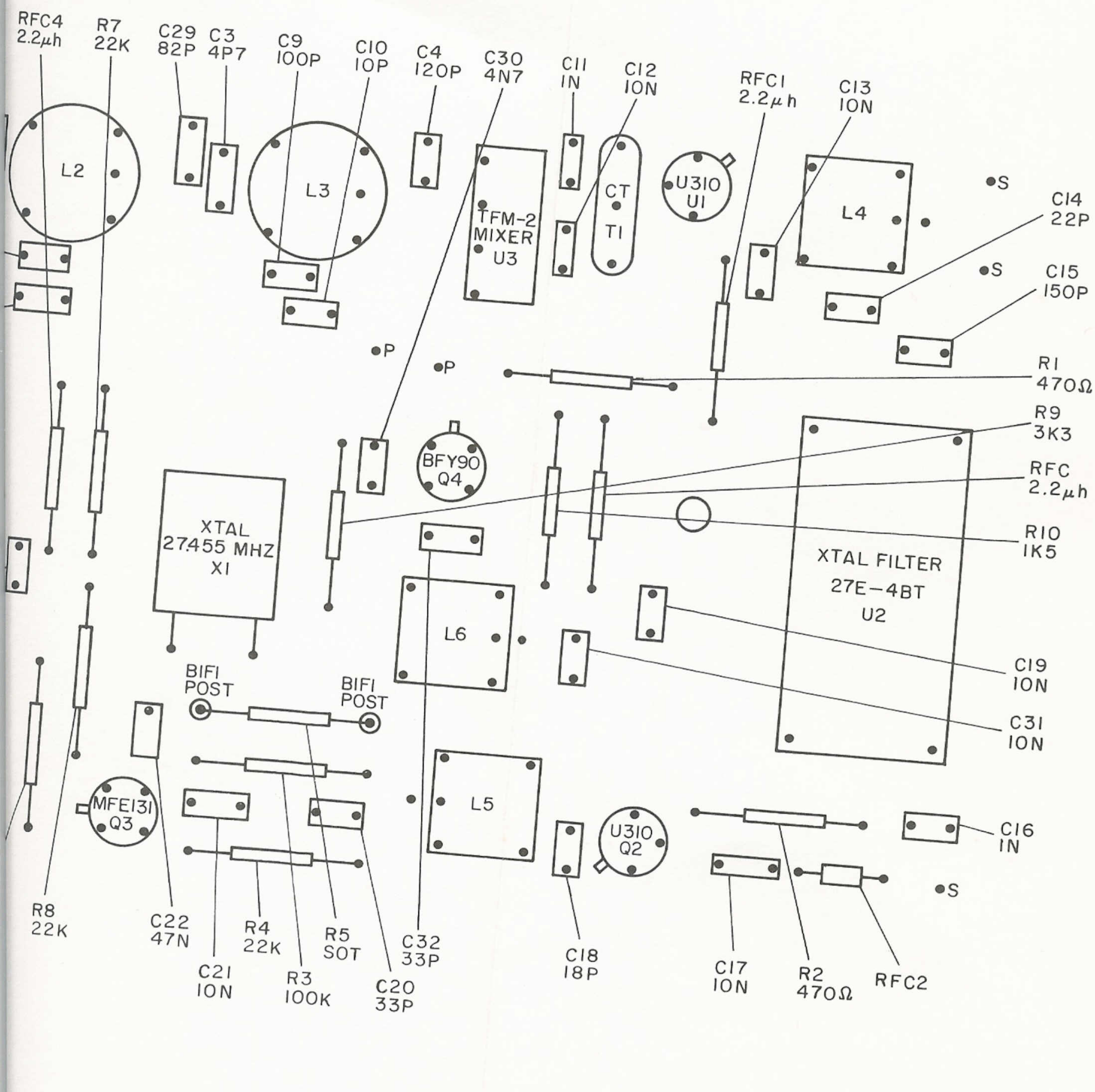
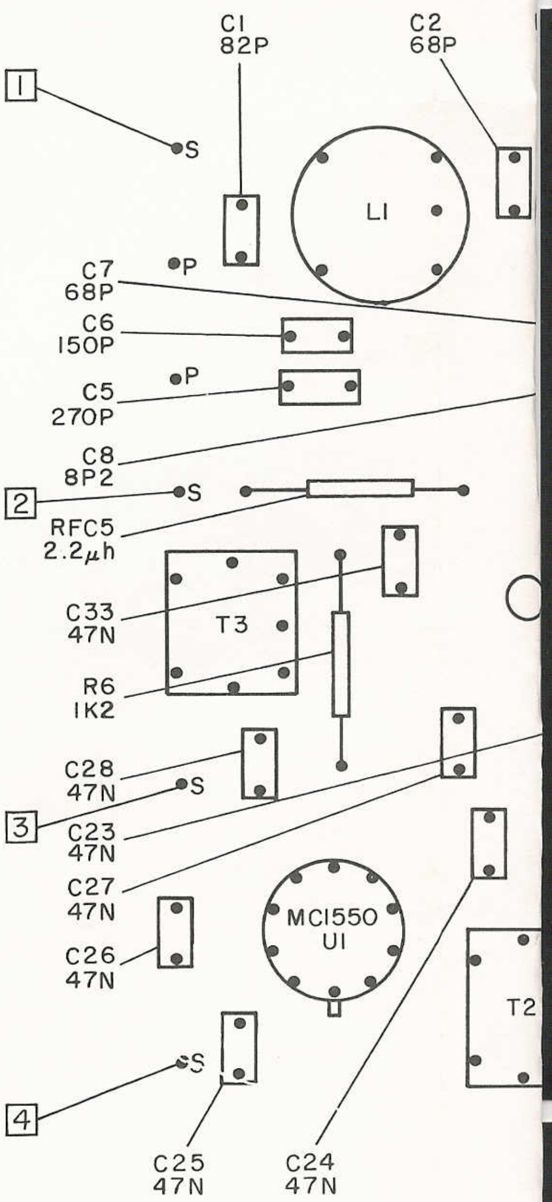


Figure 8-16. Receiver Module 3, Bottom Board, Component Location Diagram


1
C1
82P
C2
68P
S
L1
P
C7
68P
C6
150P
P
C5
270P
C8
8P2
2
S
RFC5
2.2μh
C33
47N
T3
R6
1K2
C28
47N
S
3
C23
47N
C27
47N
MC1550
U1
C26
47N
T2
S
4
C25
47N
C24
47N

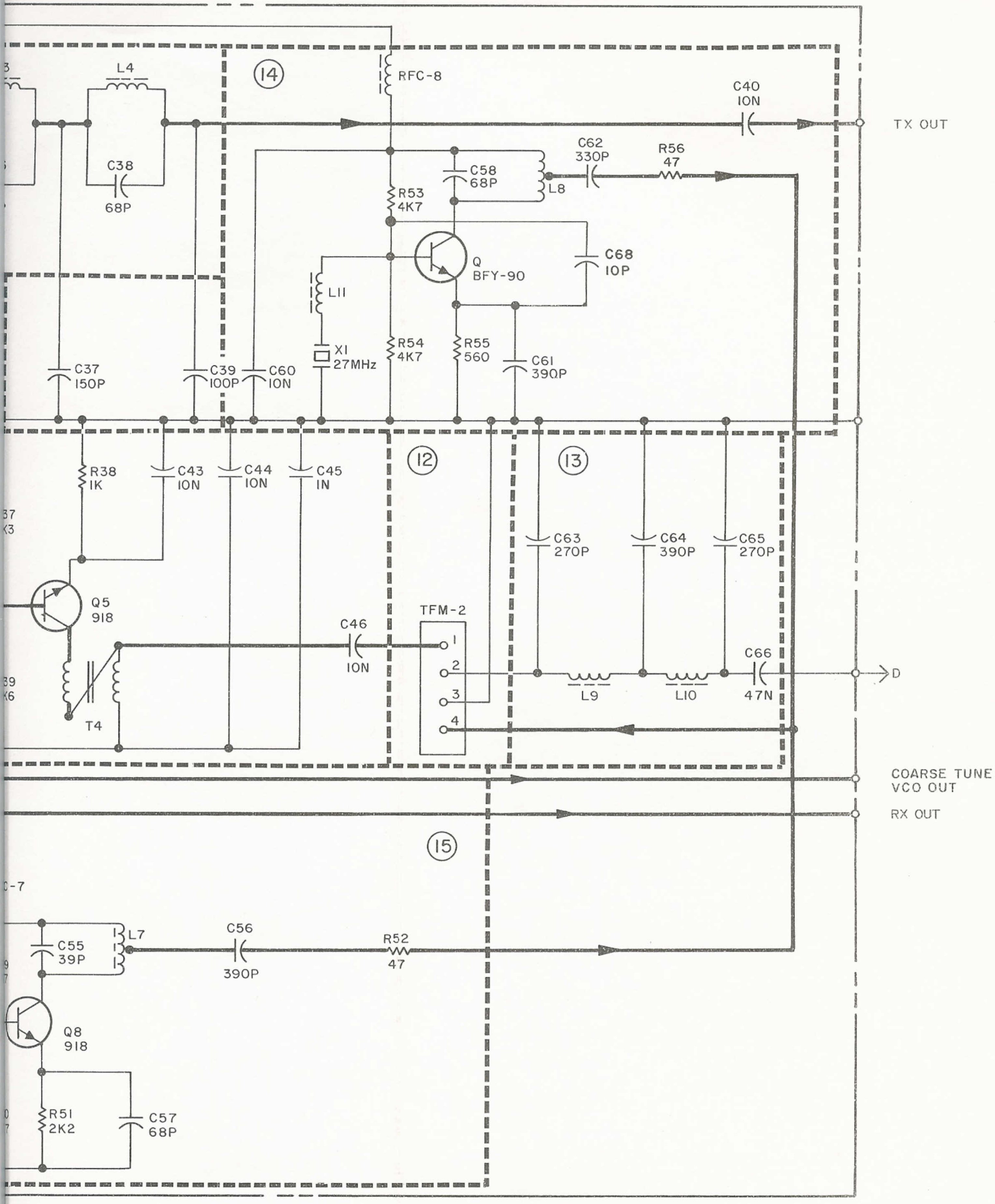
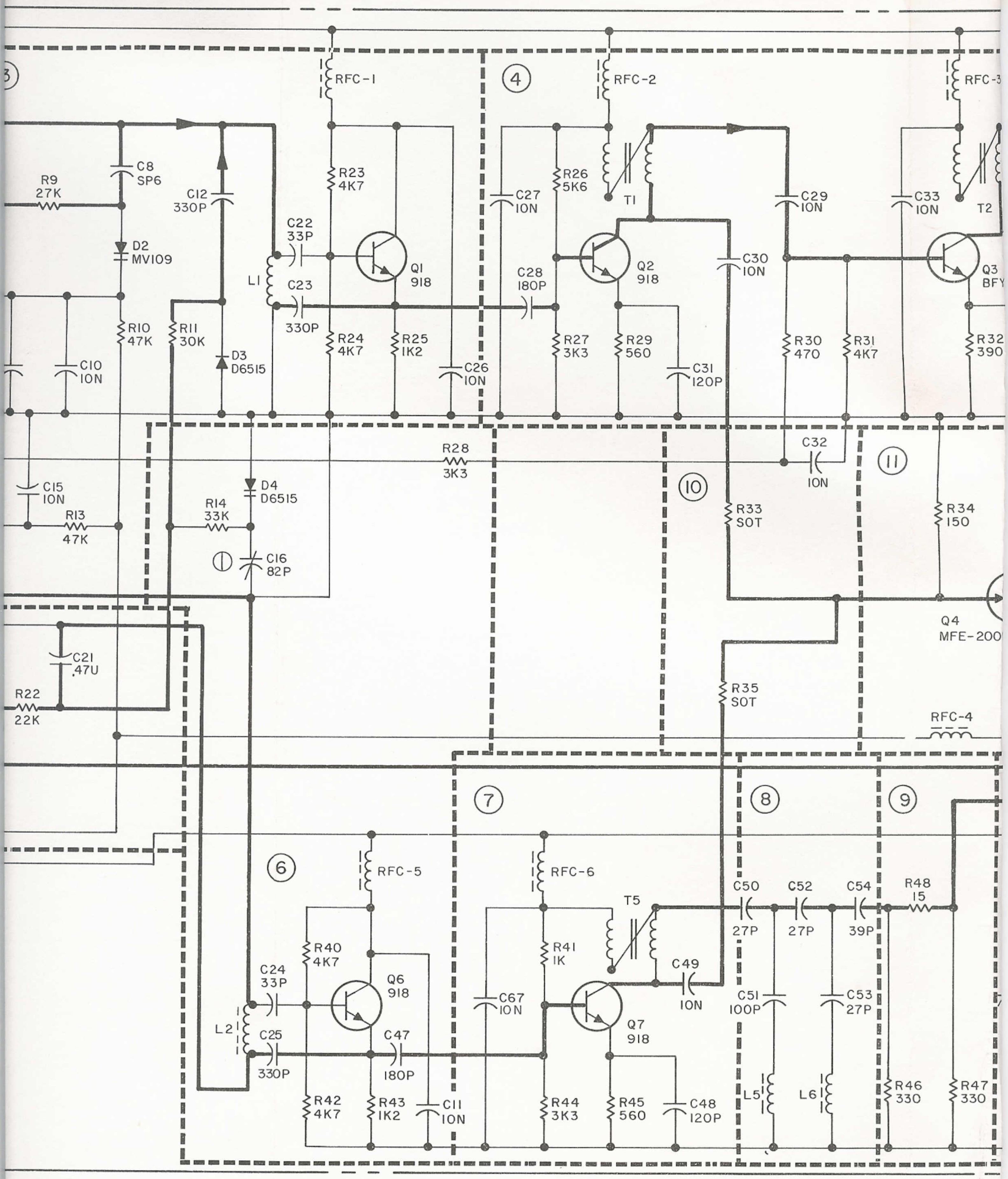
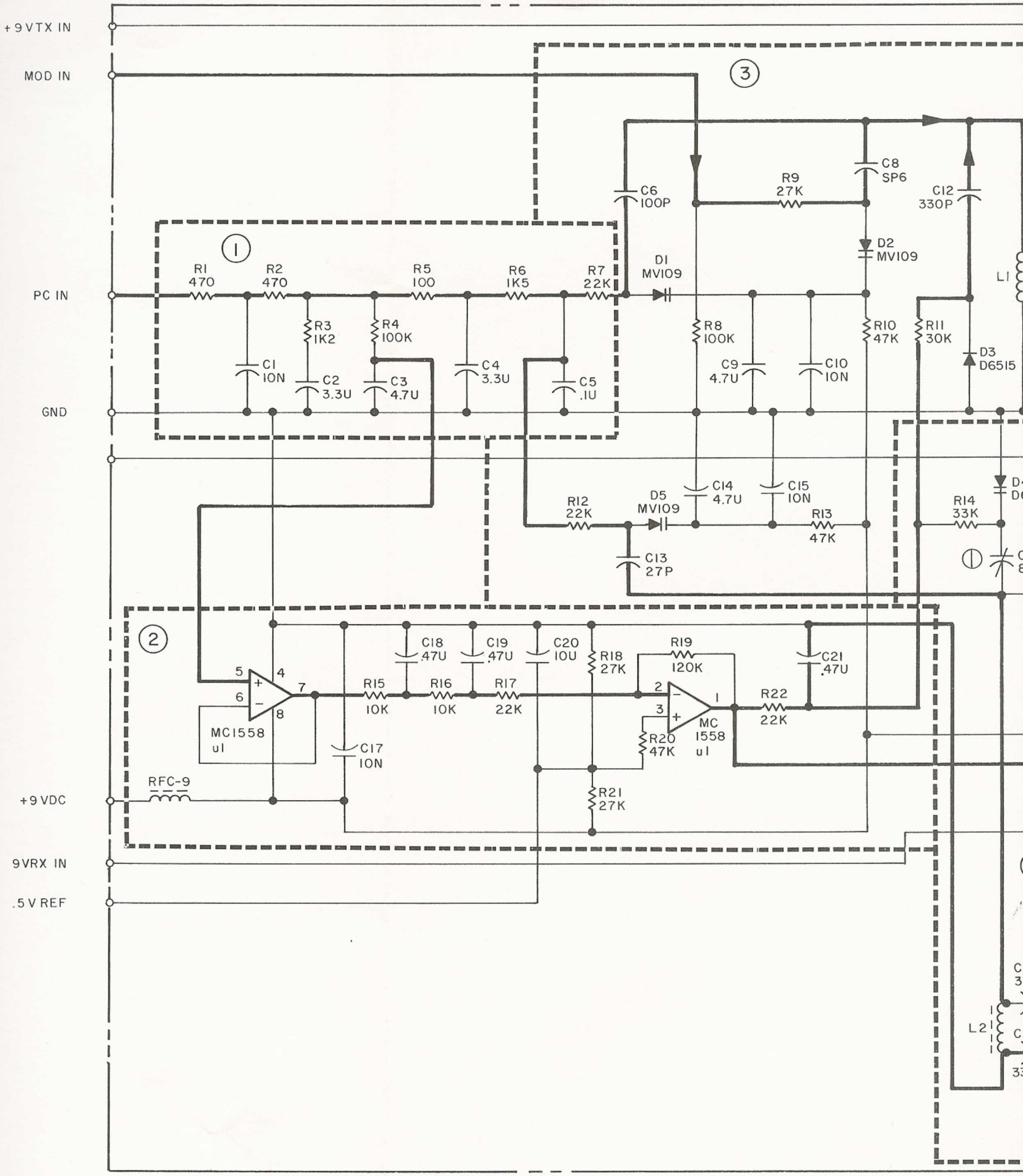


Figure 8-17. Synthesizer Module 4, Top Board, Schematic Diagram



RFC-1
RFC-2
RFC-3
4
C8
5P6
R9
27K
C12
330P
D2
MV109
C22
33P
C23
330P
L1
R23
4K7
Q1
918
R10
47K
R11
30K
D3
D6515
R24
4K7
R25
1K2
C10
10N
C26
10N
C27
10N
R26
5K6
T1
C28
180P
Q2
918
R27
3K3
R29
560
C31
120P
C29
10N
C30
10N
C33
10N
T2
Q3
BFY
R30
470
R31
4K7
R32
390
R28
3K3
C32
10N
10
11
C15
10N
R13
47K
D4
D6515
R14
33K
C16
82P
R33
SOT
R34
150
Q4
MFE-200
C21
.47U
R22
22K
R35
SOT
RFC-4
7
8
9
6
RFC-5
RFC-6
T5
C50
27P
C52
27P
C54
39P
R48
15
R40
4K7
R41
1K
C24
33P
Q6
918
C67
10N
C49
10N
C51
100P
C53
27P
Q7
918
L2
C25
330P
C47
180P
L5
L6
R42
4K7
R43
1K2
C11
10N
R44
3K3
R45
560
C48
120P
R46
330
R47
330


+9VTX IN
MOD IN
PC IN
GND
+9VDC
9VRX IN
.5V REF
R1 470
R2 470
R3 1K2
R4 100K
R5 100
R6 1K5
R7 22K
C1 10N
C2 3.3U
C3 4.7U
C4 3.3U
C5 .1U
C6 100P
D1 MV109
C8 SP6
R9 27K
D2 MV109
C12 330P
L1
R8 100K
C9 4.7U
C10 10N
R10 47K
R11 30K
D3 D6515
R12 22K
D5 MV109
C14 4.7U
C15 10N
R13 47K
C13 27P
R14 33K
C18 .47U
C19 .47U
C20 10U
R18 27K
R19 120K
C21 .47U
R15 10K
R16 10K
R17 22K
R22 22K
MC1558 u1
MC 1558 u1
C17 10N
R20 47K
R21 27K
RFC-9
L2

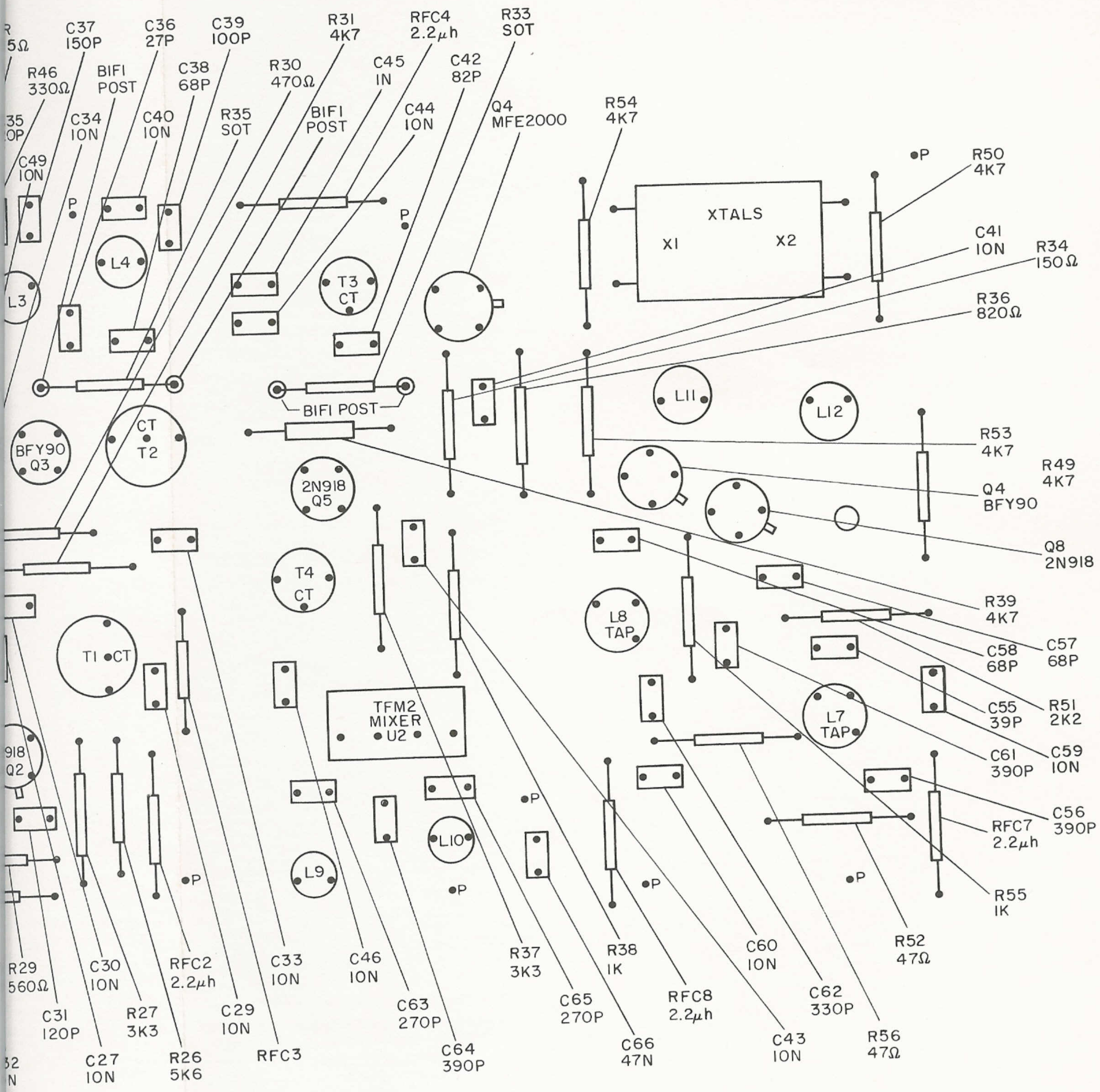
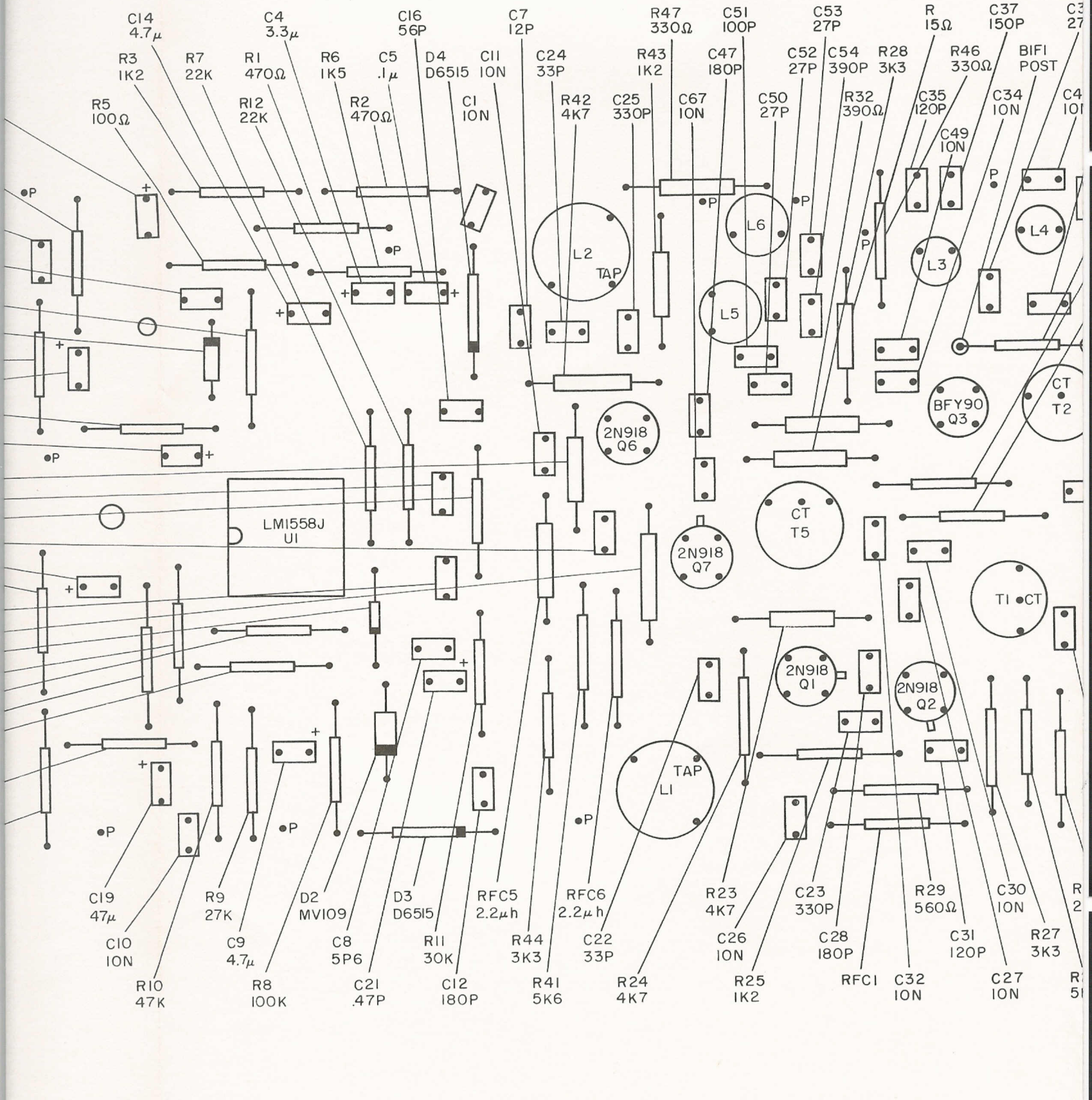


Figure 8-18. Synthesizer Module 4, Top Board, Component Location Diagram



C14 4.7µ
C4 3.3µ
C16 56P
C7 12P
R47 330Ω
C51 100P
C53 27P
R 15Ω
C37 150P
R3 1K2
R7 22K
R1 470Ω
R6 1K5
C5 .1µ
D4 D6515
C11 10N
C24 33P
R43 1K2
C47 180P
C52 27P
C54 390P
R28 3K3
R46 330Ω
BIFI POST
R5 100Ω
R12 22K
R2 470Ω
C1 10N
R42 4K7
C25 330P
C67 10N
C50 27P
R32 390Ω
C35 120P
C34 10N
C49 10N
L2 TAP
L6
L4
L3
L5
CT T2
BFY90 Q3
2N918 Q6
LM1558J U1
CT T5
2N918 Q7
T1 CT
2N918 Q1
2N918 Q2
TAP L1
C19 47µ
R9 27K
D2 MV109
D3 D6515
RFC5 2.2µh
RFC6 2.2µh
R23 4K7
C23 330P
R29 560Ω
C30 10N
C10 10N
C9 4.7µ
C8 5P6
R11 30K
R44 3K3
C22 33P
C26 10N
C28 180P
C31 120P
R27 3K3
R10 47K
R8 100K
C21 .47P
C12 180P
R41 5K6
R24 4K7
R25 1K2
RFC1
C32 10N
C27 10N

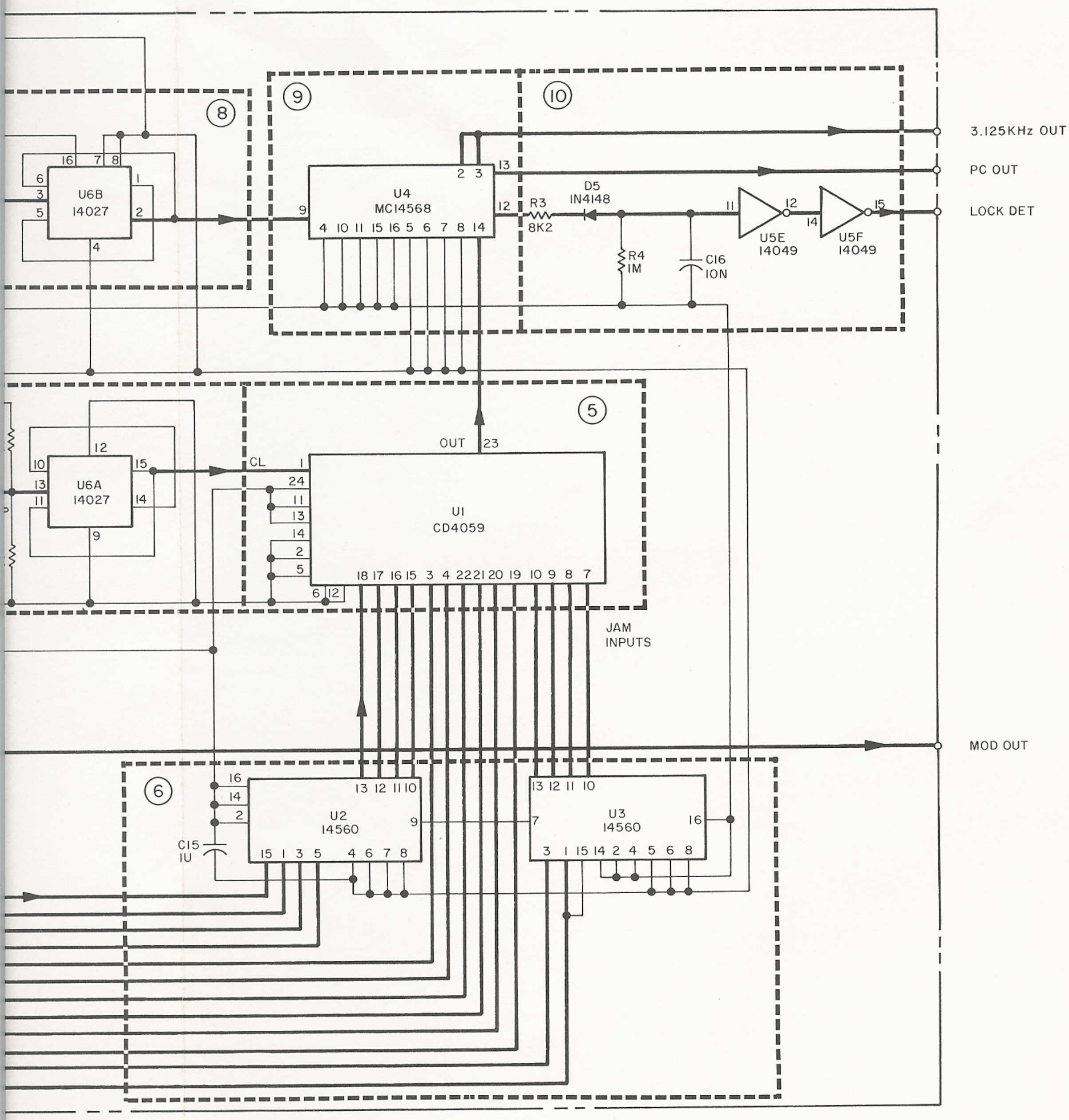
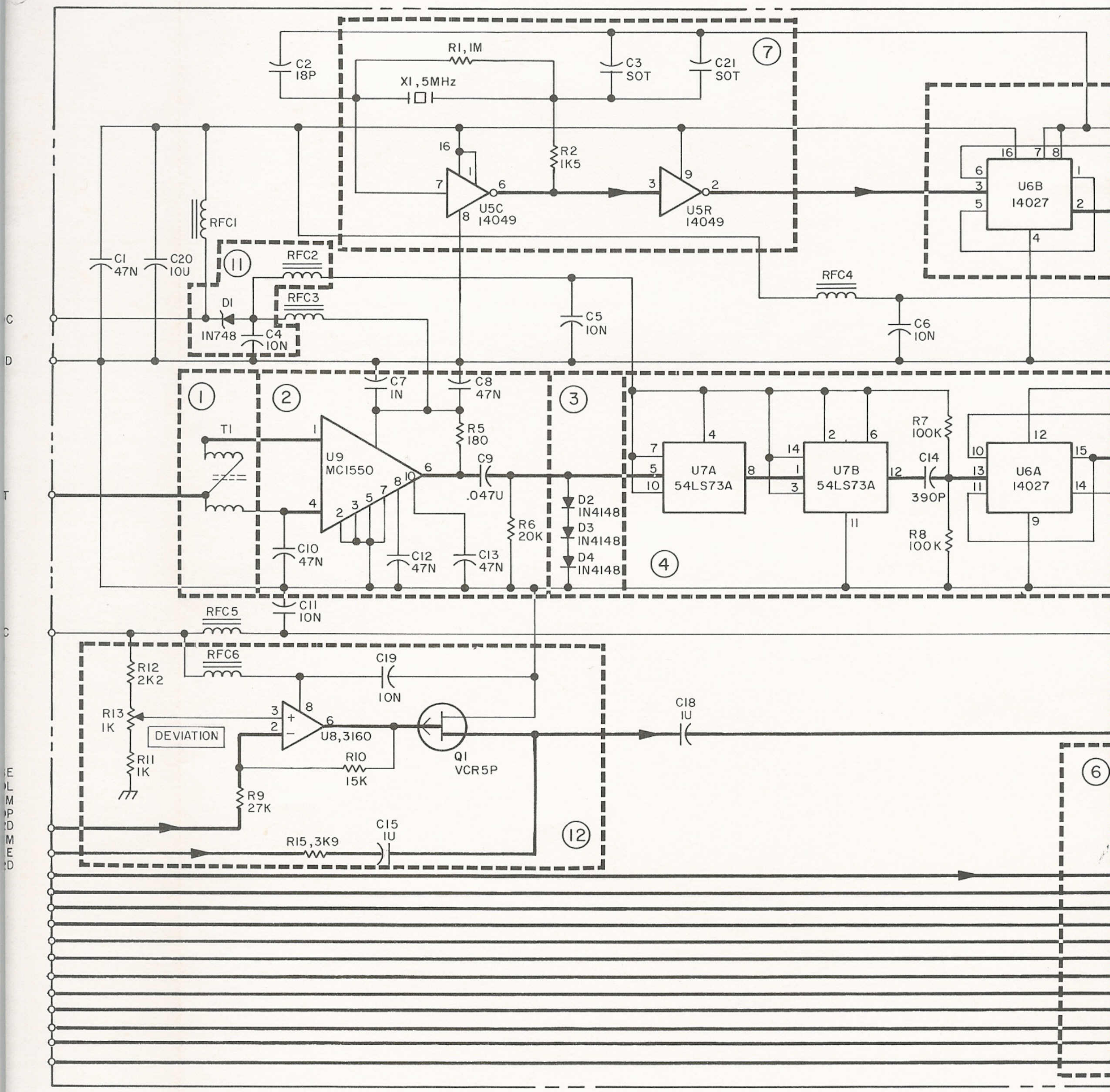
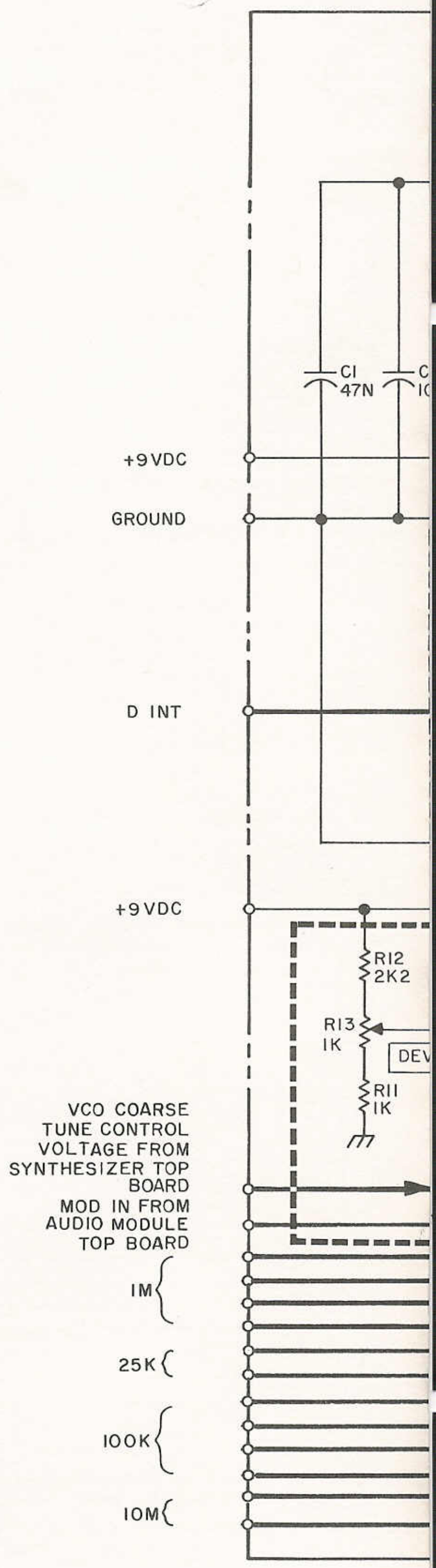


Figure 8-19. Synthesizer Module 4, Bottom Board, Schematic Diagram



C2
18P
RI, IM
XI, 5MHz
C3
SOT
C2I
SOT
7
R2
IK5
U5C
14049
U5R
14049
U6B
14027
RFCI
CI
47N
C20
IOU
11
RFC2
RFC3
DI
IN748
C4
ION
C5
ION
RFC4
C6
ION
C7
IN
C8
47N
1
2
3
4
TI
U9
MC1550
R5
180
C9
.047U
R6
20K
D2
IN4148
D3
IN4148
D4
IN4148
C10
47N
C12
47N
C13
47N
U7A
54LS73A
U7B
54LS73A
R7
100K
C14
390P
R8
100K
U6A
14027
C11
ION
RFC5
RFC6
C19
ION
R12
2K2
R13
IK
DEVIATION
RII
IK
U8,3160
QI
VCR5P
RI0
15K
R9
27K
C18
IU
C15
IU
RI5, 3K9
12
6



C1
47N
+9VDC
GROUND
D INT
+9VDC
R12
2K2
R13
1K
DEV
R11
1K
VCO COARSE TUNE CONTROL VOLTAGE FROM SYNTHESIZER TOP BOARD
MOD IN FROM AUDIO MODULE TOP BOARD
1M
25K
100K
10M

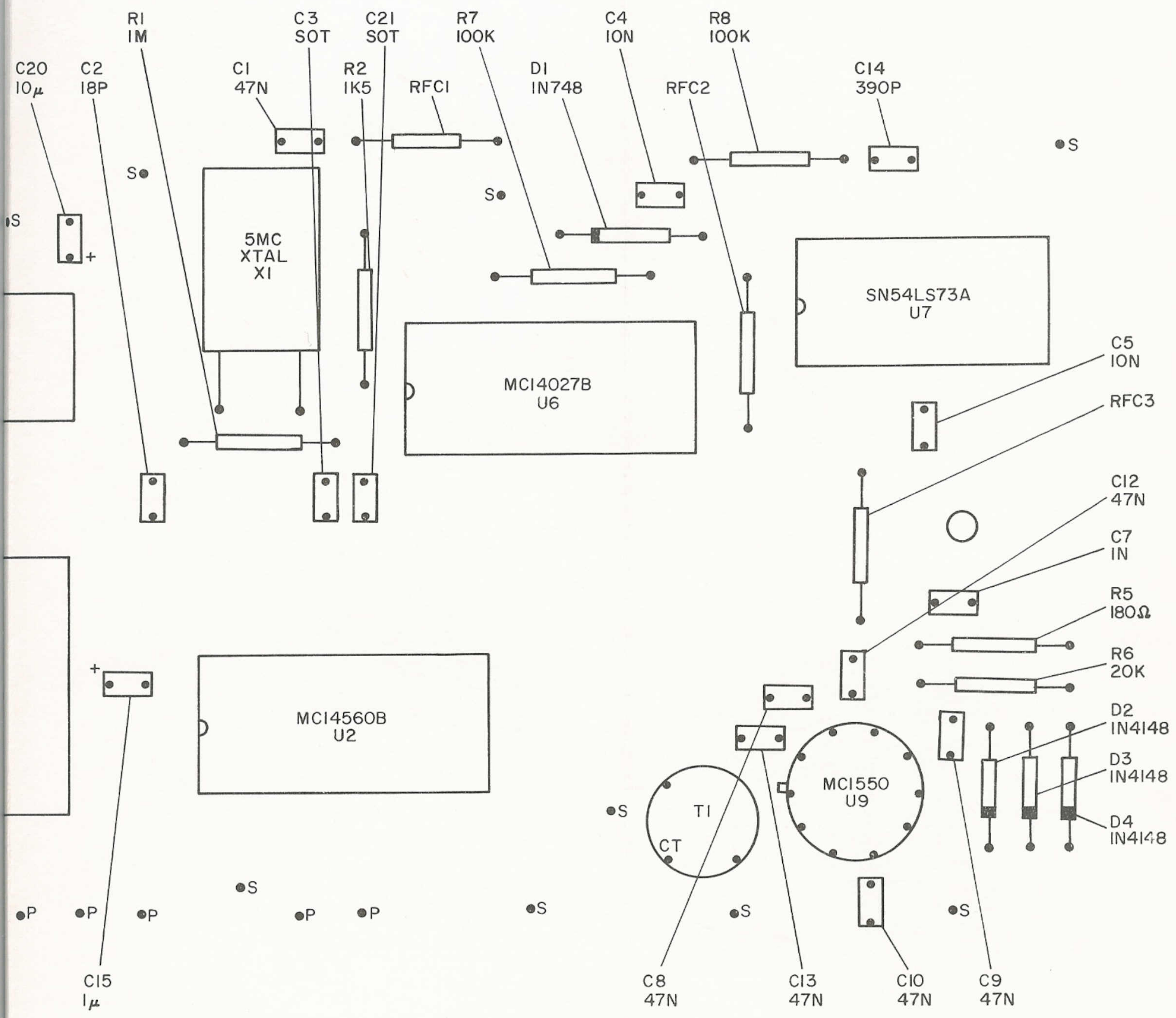
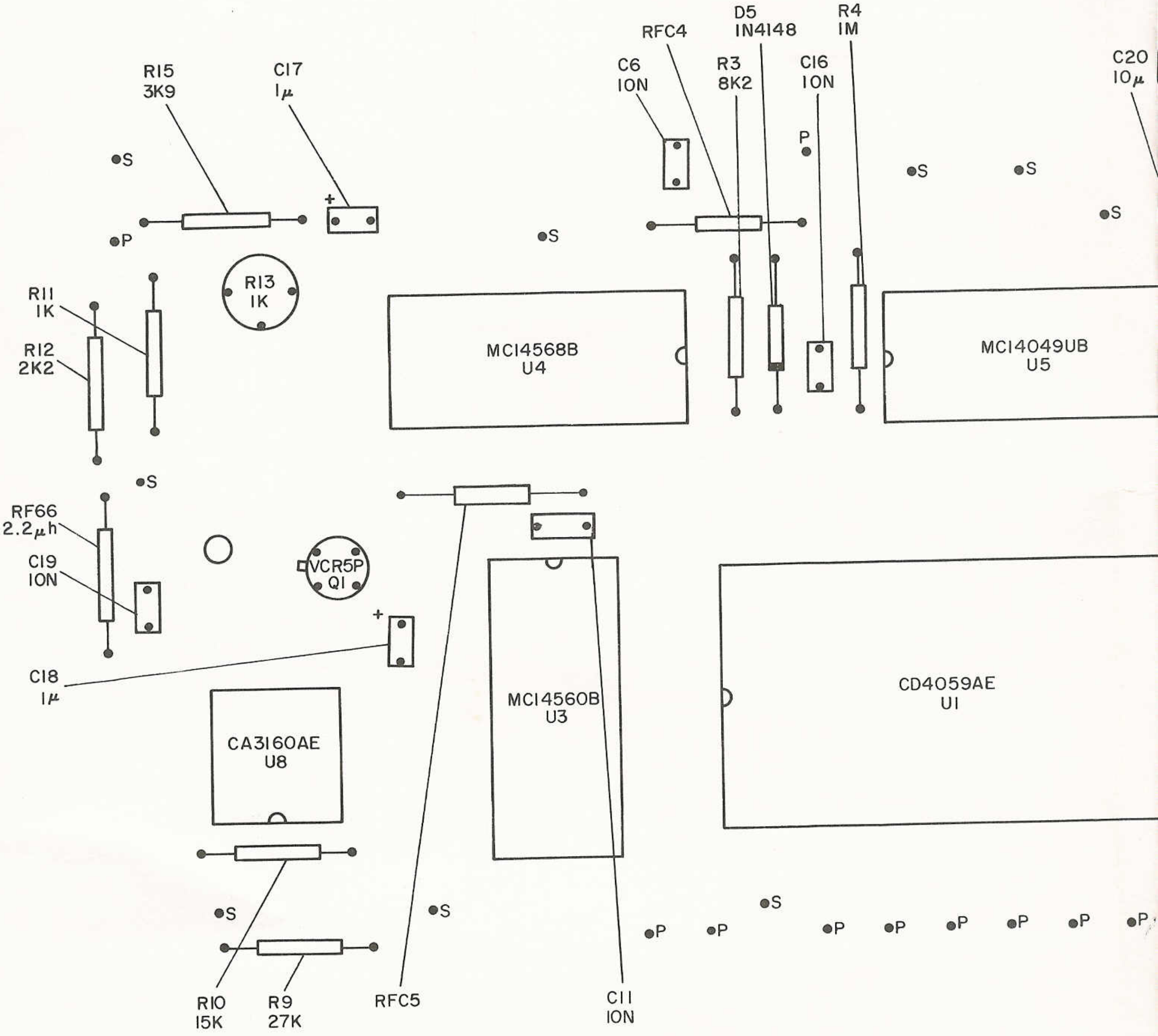


Figure 8-20. Synthesizer Module 4, Bottom Board, Component Location Diagram


R15
3K9
C17
1μ
RFC4
C6
10N
D5
1N4148
R3
8K2
C16
10N
R4
1M
C20
10μ
S
P
S
P
S
S
S
R11
1K
R13
1K
R12
2K2
MC14568B
U4
MC14049UB
U5
S
RF66
2.2μh
C19
10N
VCR5P
Q1
C18
1μ
CA3160AE
U8
MC14560B
U3
CD4059AE
U1
S
S
S
P
P
P
P
P
P
P
P
R10
15K
R9
27K
RFC5
C11
10N

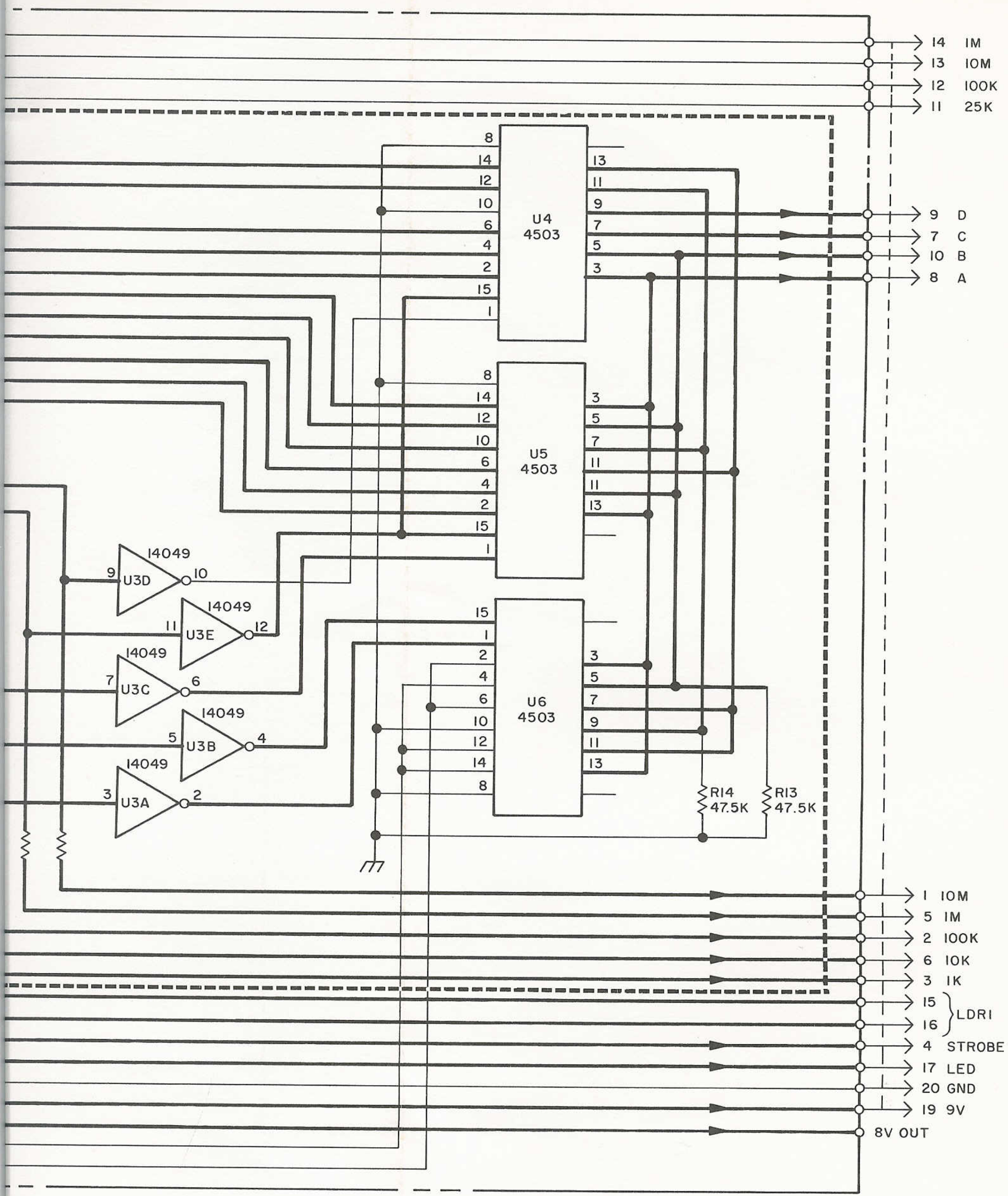
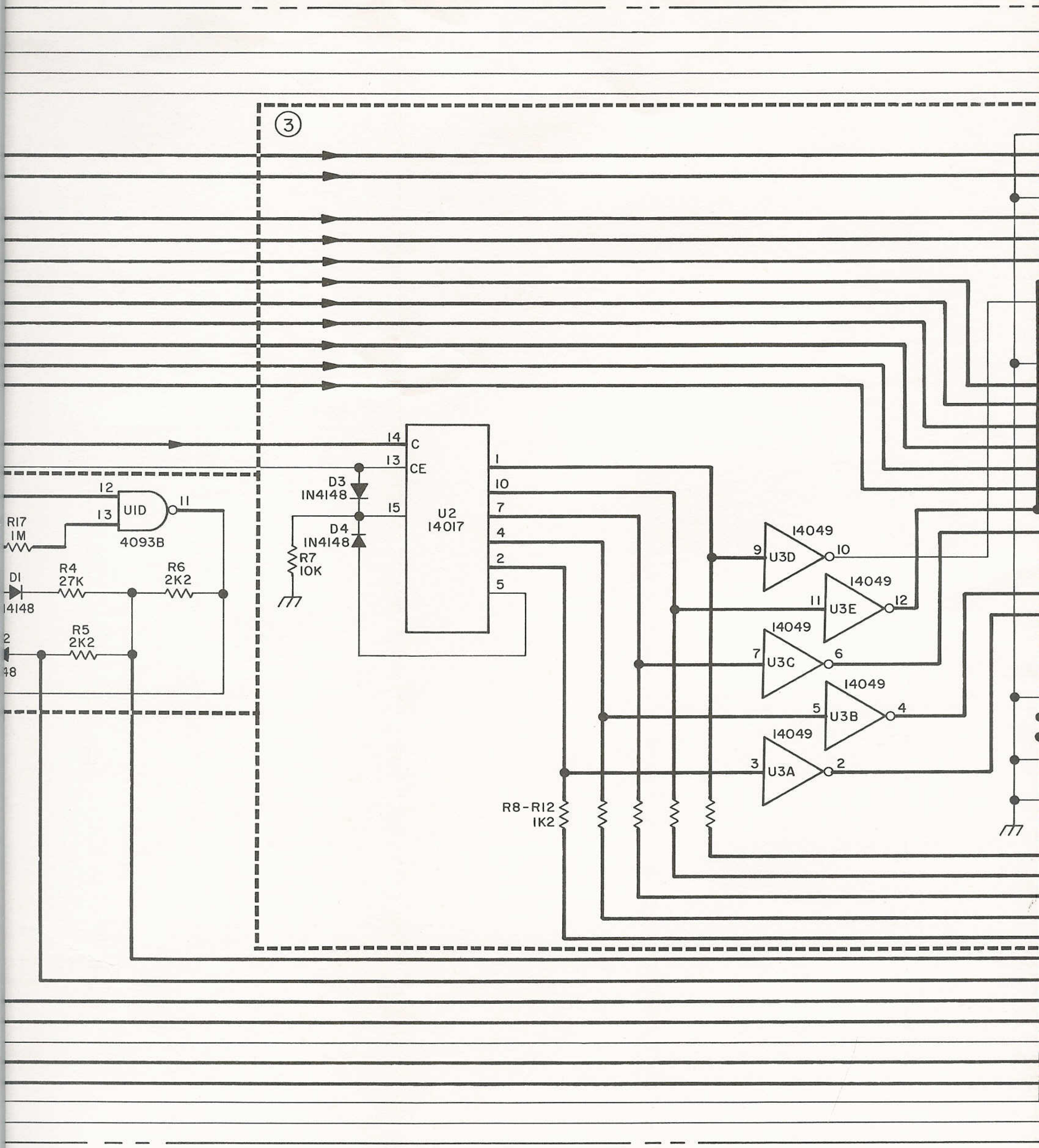
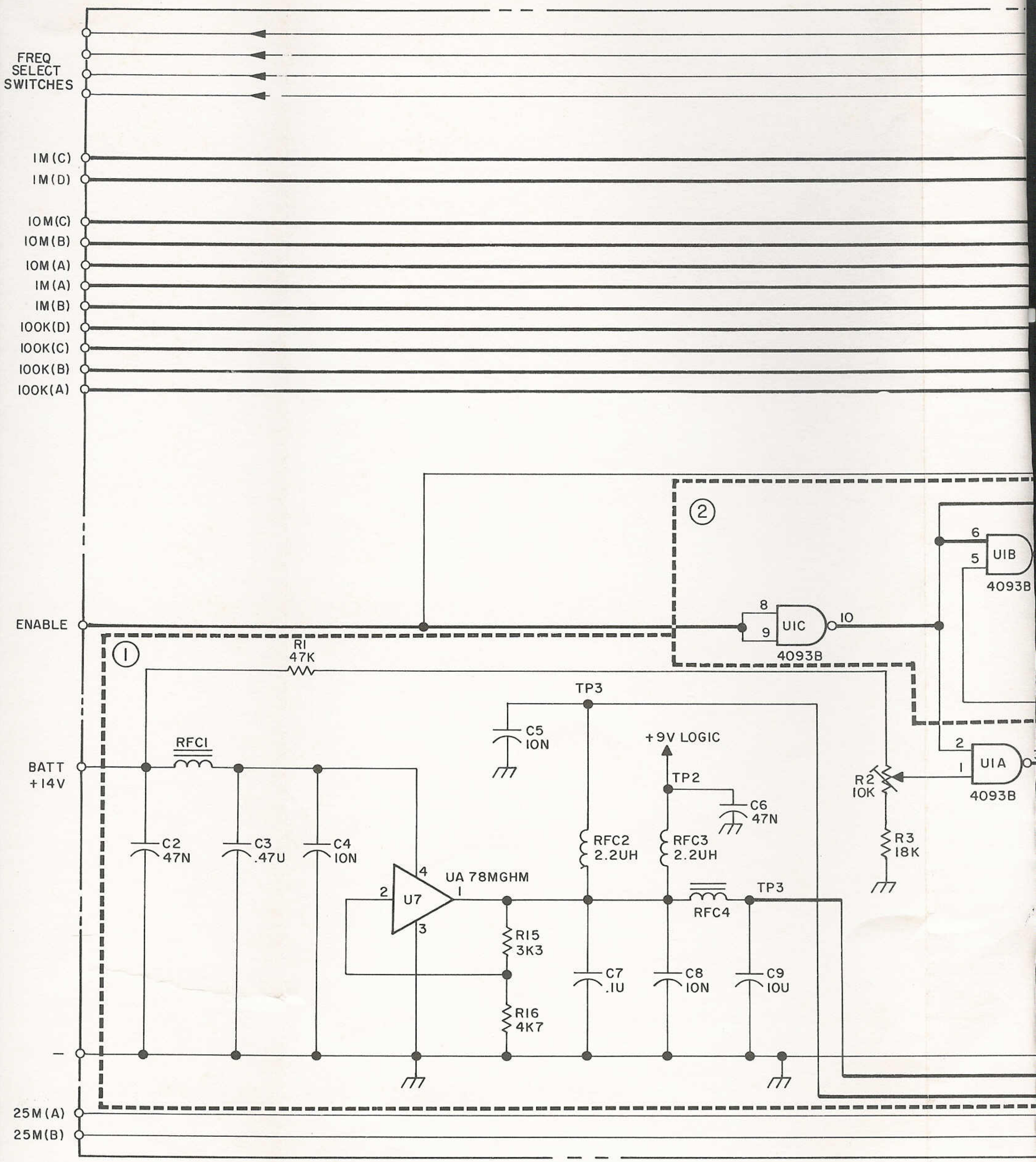
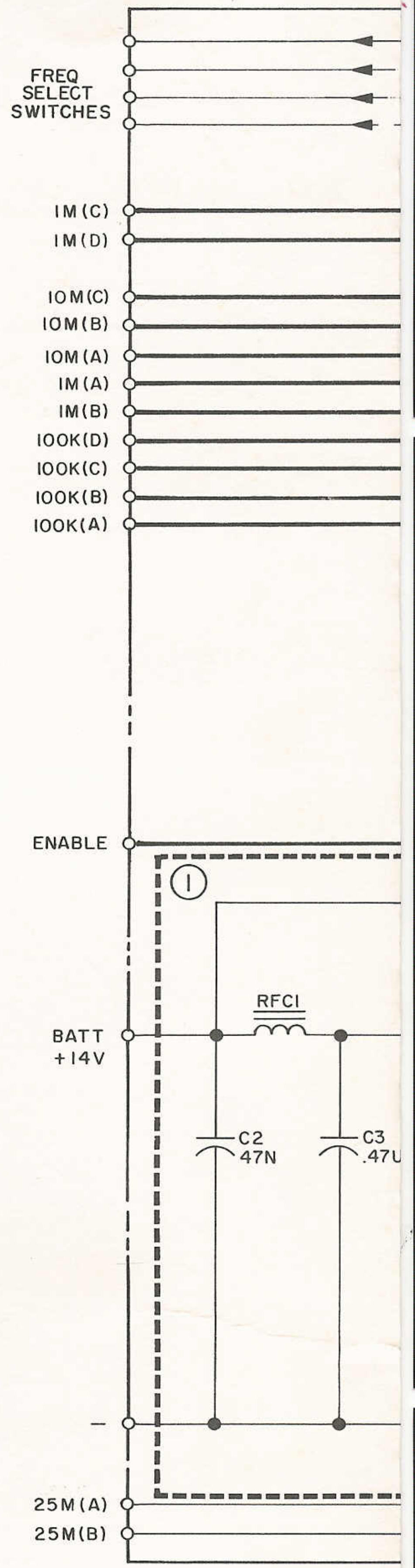


Figure 8-21. Logic Module 5, Top Board, Schematic Diagram


3
R17
1M
UID
4093B
DI
14148
R4
27K
R6
2K2
R5
2K2
D3
IN4148
D4
IN4148
R7
10K
C
CE
U2
14017
14049
U3D
U3E
U3C
U3B
U3A
R8-R12
IK2


FREQ SELECT SWITCHES
IM(C)
IM(D)
IOM(C)
IOM(B)
IOM(A)
IM(A)
IM(B)
IOOK(D)
IOOK(C)
IOOK(B)
IOOK(A)
ENABLE
BATT +14V
–
25M(A)
25M(B)
①
②
RI 47K
RFCI
C2 47N
C3 .47U
C4 ION
C5 ION
TP3
+9V LOGIC
TP2
C6 47N
U7
UA 78MGHM
R15 3K3
R16 4K7
RFC2 2.2UH
RFC3 2.2UH
RFC4
TP3
C7 .IU
C8 ION
C9 IOU
UIC
4093B
UIB
4093B
UIA
4093B
R2 IOK
R3 18K


FREQ
SELECT
SWITCHES
IM(C)
IM(D)
IOM(C)
IOM(B)
IOM(A)
IM(A)
IM(B)
IOOK(D)
IOOK(C)
IOOK(B)
IOOK(A)
ENABLE
1
RFCI
BATT
+14V
C2
47N
C3
.47U
−
25M(A)
25M(B)

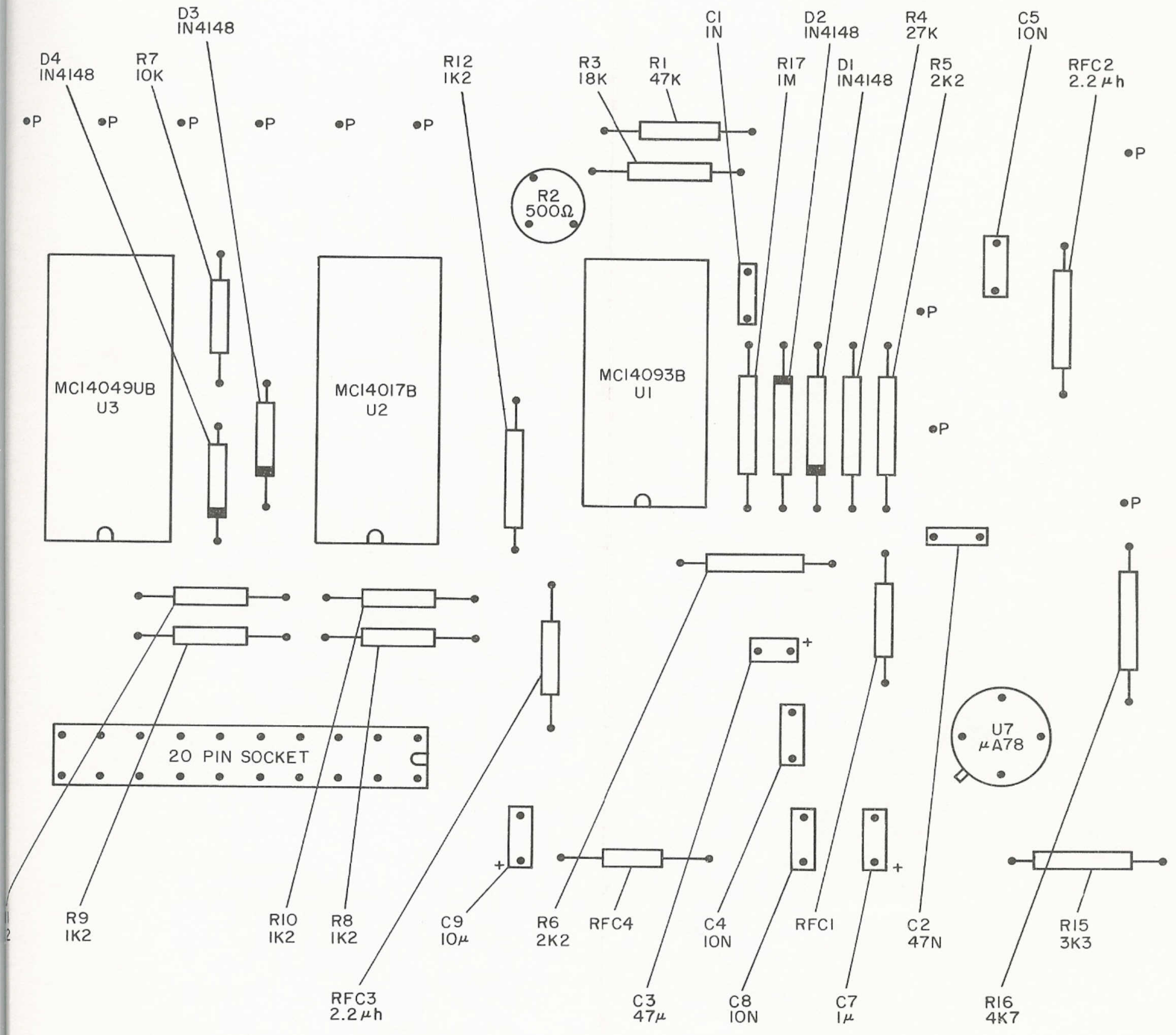
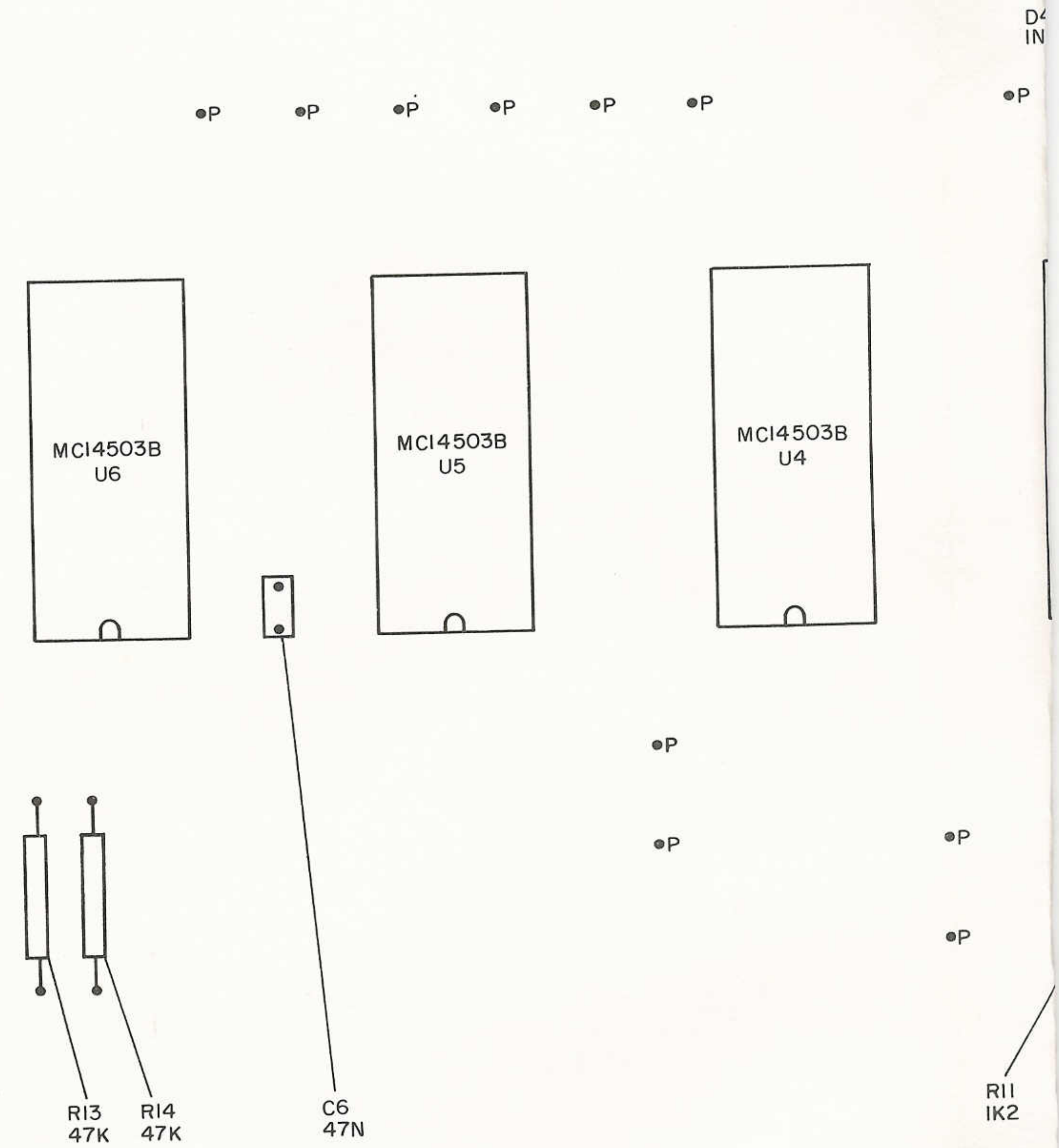


Figure 8-22. Logic Module 5, Top Board, Component Location Diagram


D4
IN
MC14503B
U6
MC14503B
U5
MC14503B
U4
R13
47K
R14
47K
C6
47N
R11
1K2

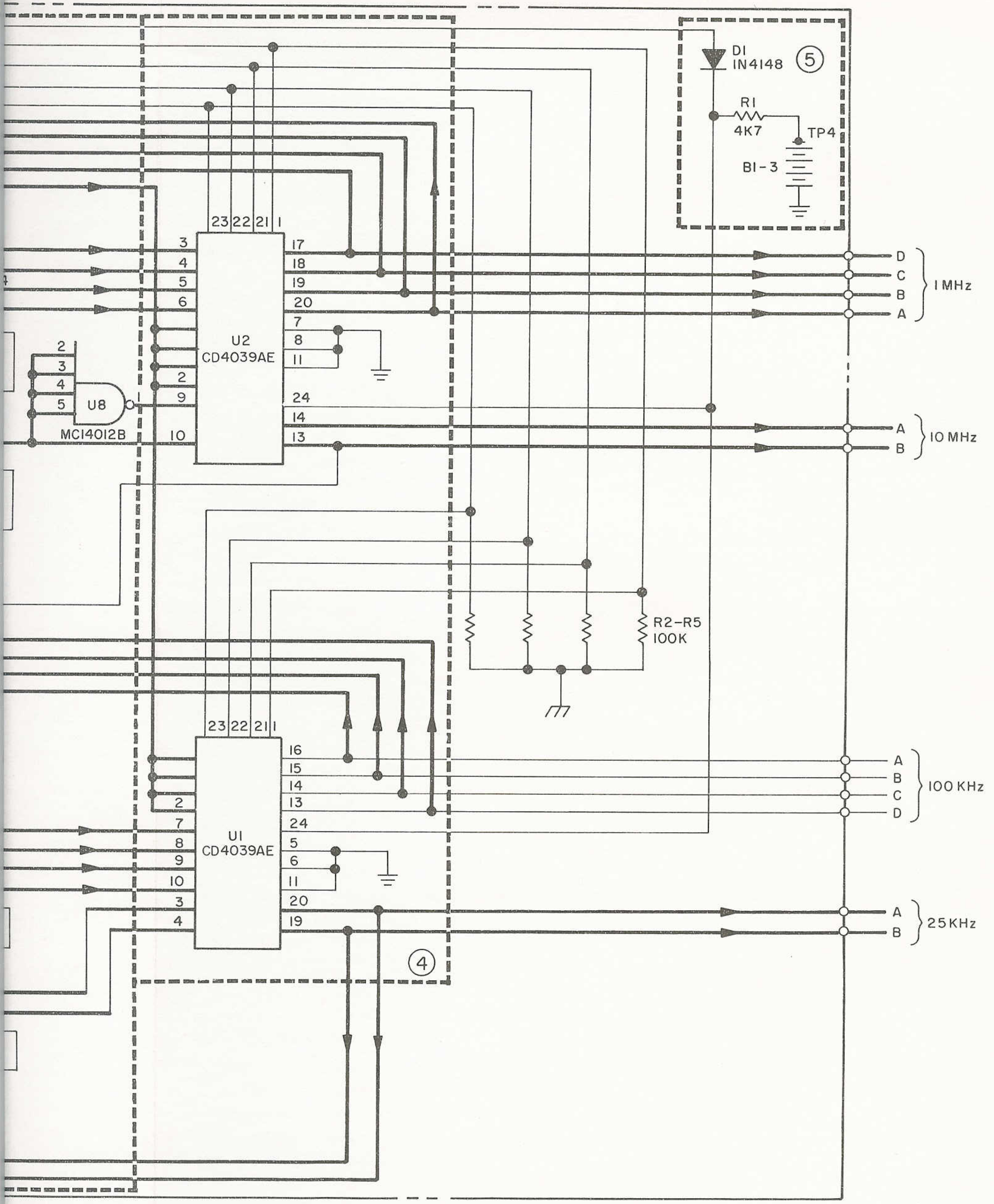
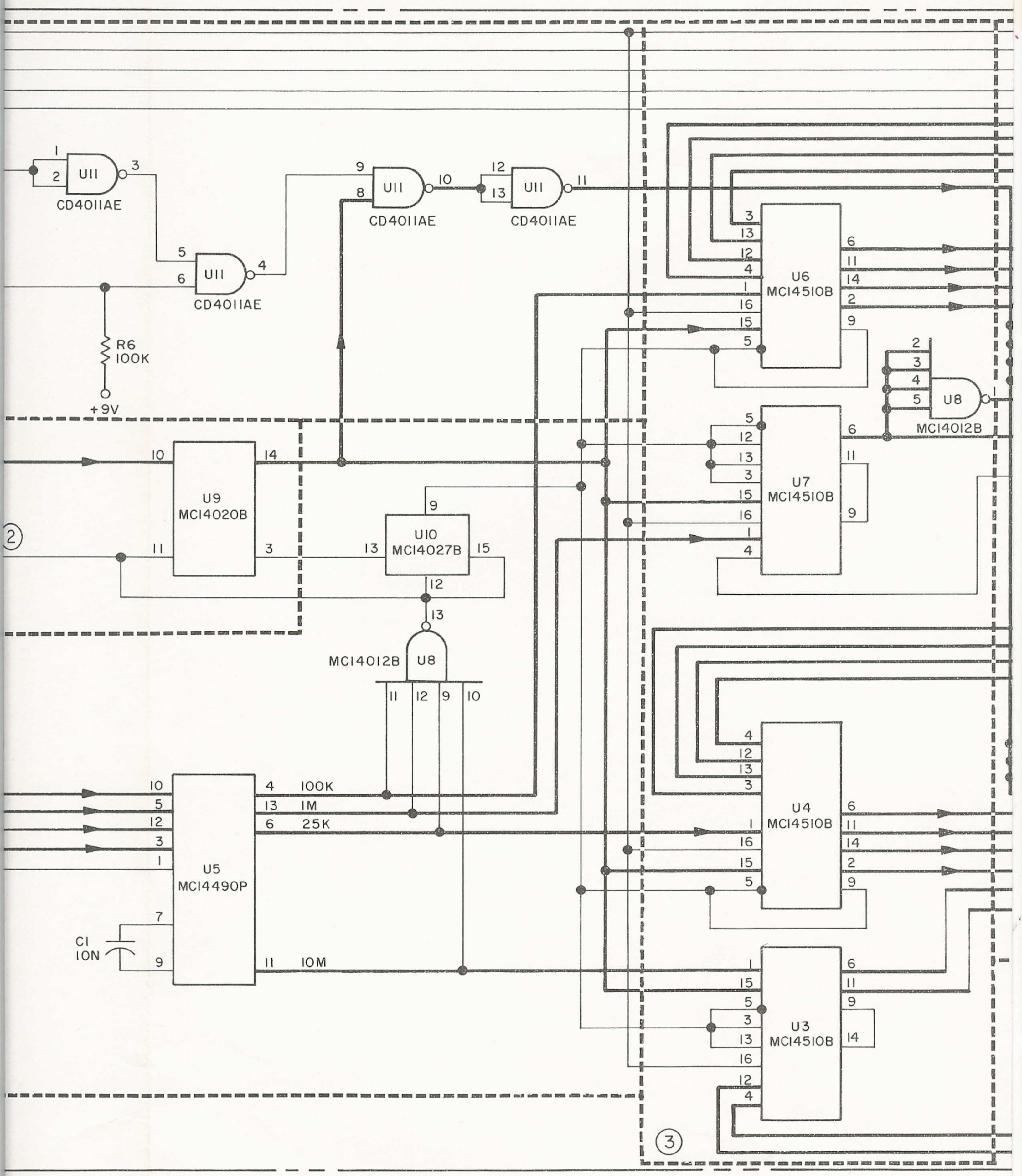
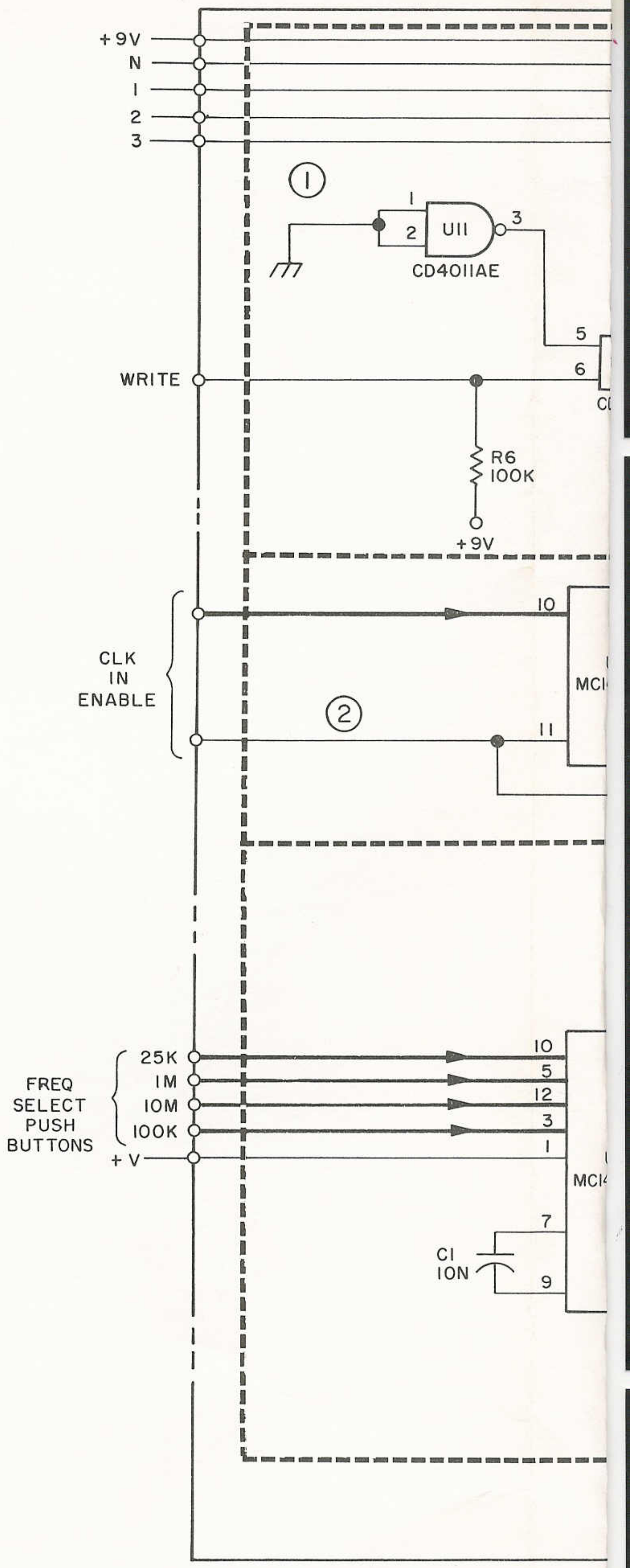


Figure 8-23. Logic Module 5, Bottom Board, Schematic Diagram



U11
CD4011AE
R6
100K
+9V
U9
MC14020B
U10
MC14027B
MC14012B
U8
U5
MC14490P
100K
1M
25K
10M
C1
10N
U6
MC14510B
U7
MC14510B
U4
MC14510B
U3
MC14510B


+9V
N
1
2
3
1
U11
CD4011AE
WRITE
5
6
R6
100K
+9V
CLK
IN
ENABLE
10
2
11
FREQ
SELECT
PUSH
BUTTONS
25K
1M
10M
100K
+V
10
5
12
3
1
7
9
C1
10N

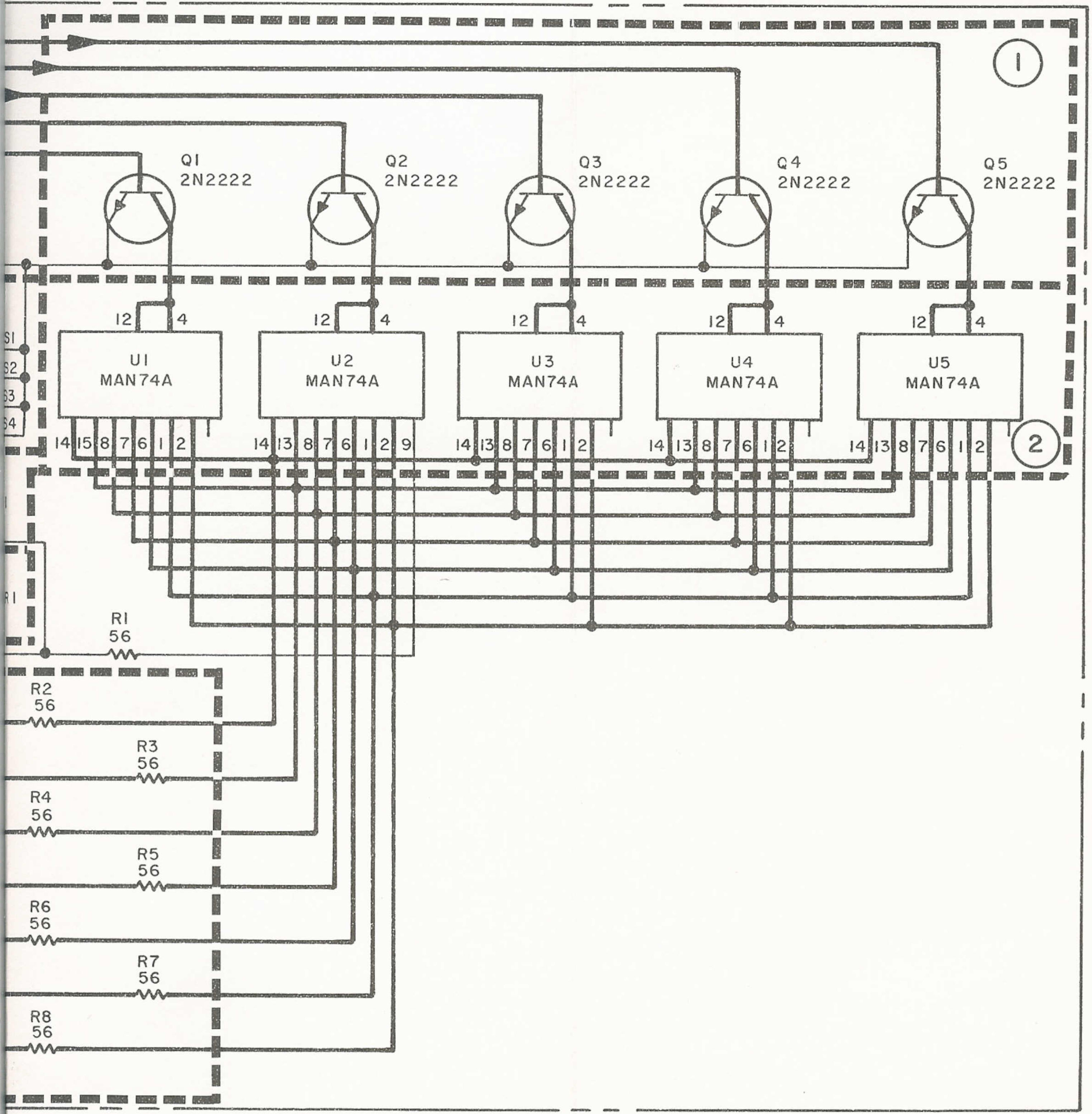
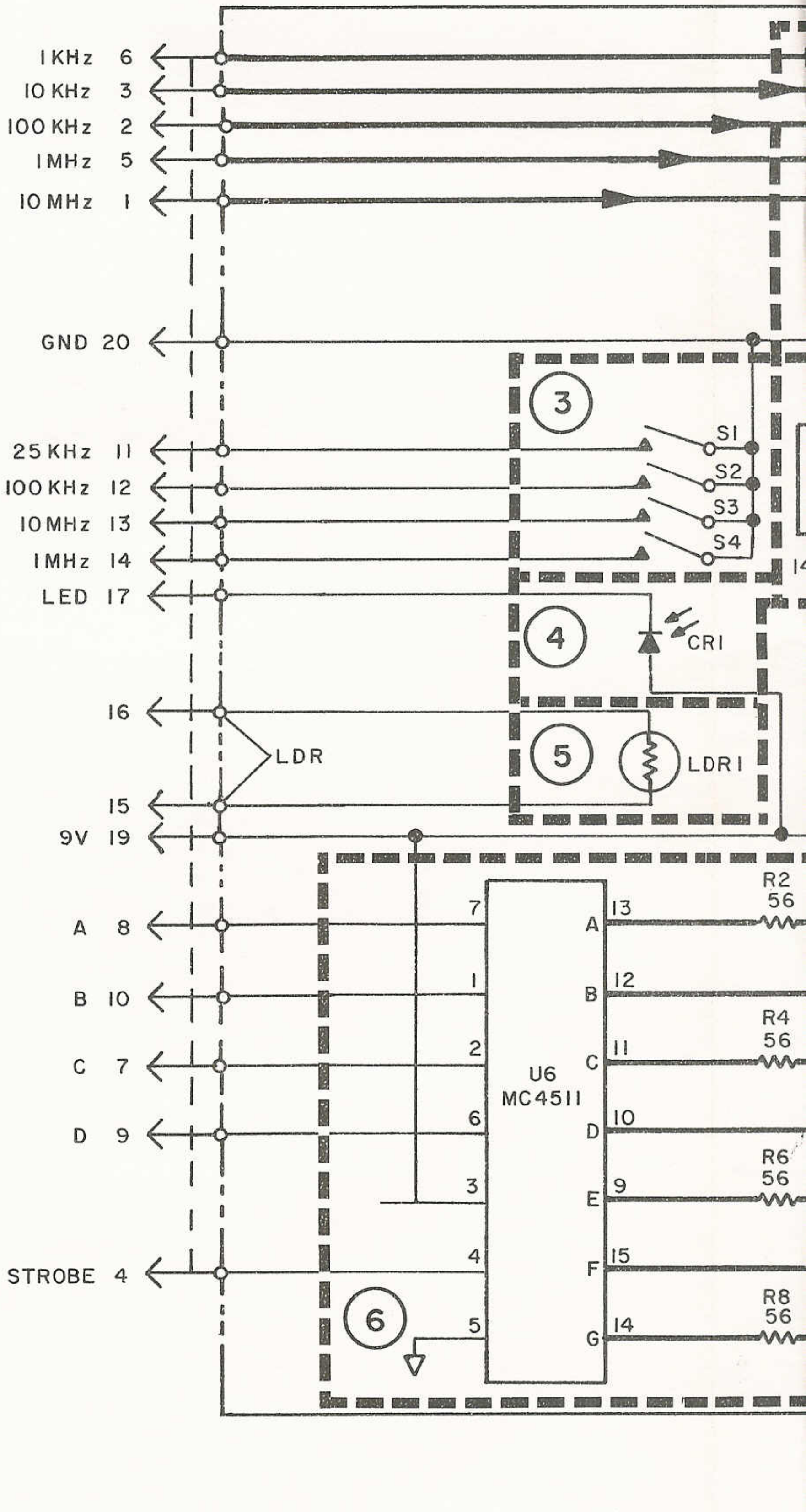


Figure 8-25. Display Module, Schematic Diagram


1KHz 6
10 KHz 3
100 KHz 2
1MHz 5
10 MHz 1
GND 20
3
S1
S2
S3
S4
25 KHz 11
100 KHz 12
10 MHz 13
1MHz 14
LED 17
4
CR1
16
LDR
5
LDR1
15
9V 19
A 8
B 10
C 7
D 9
STROBE 4
U6
MC4511
R2
56
R4
56
R6
56
R8
56
6

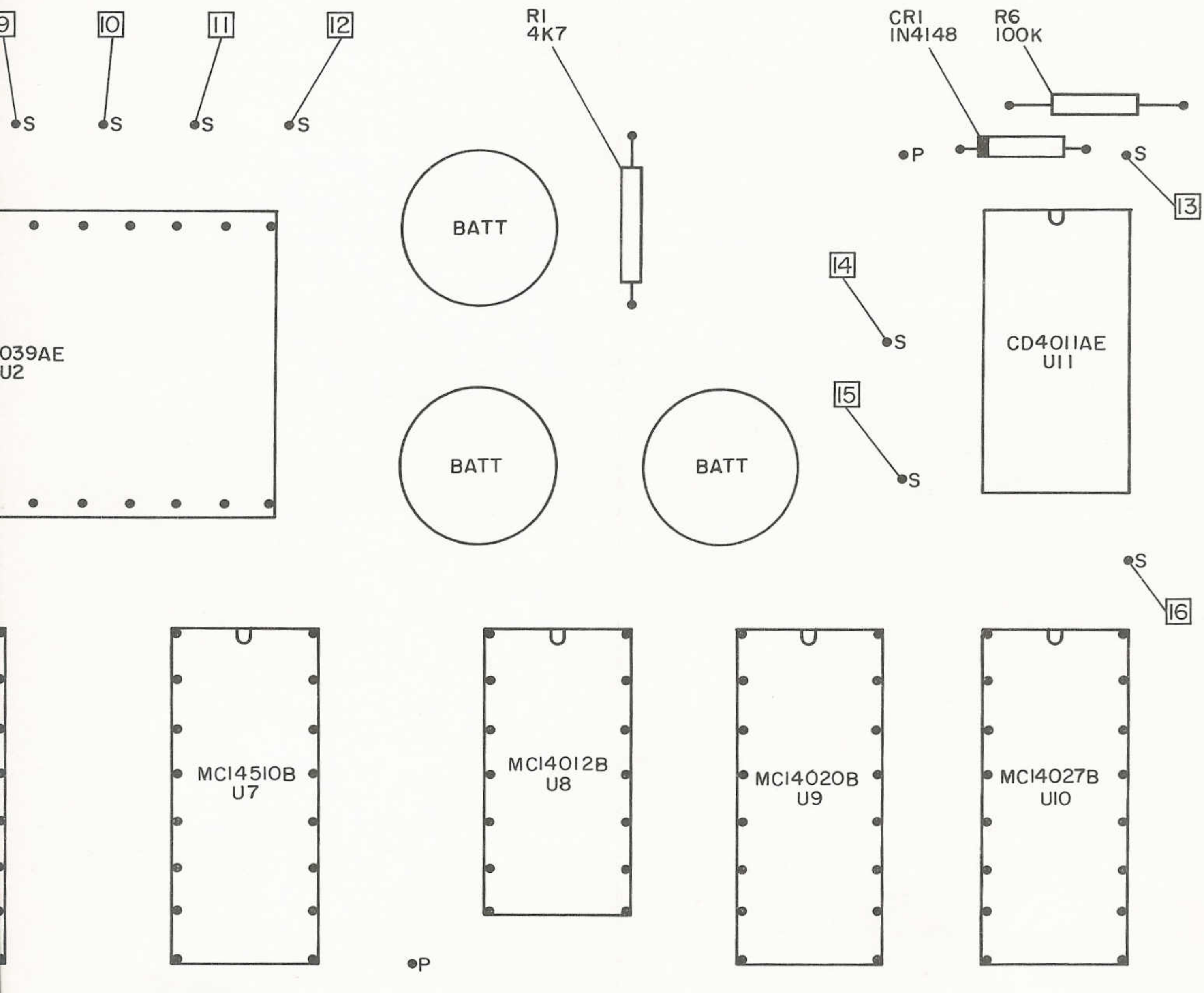
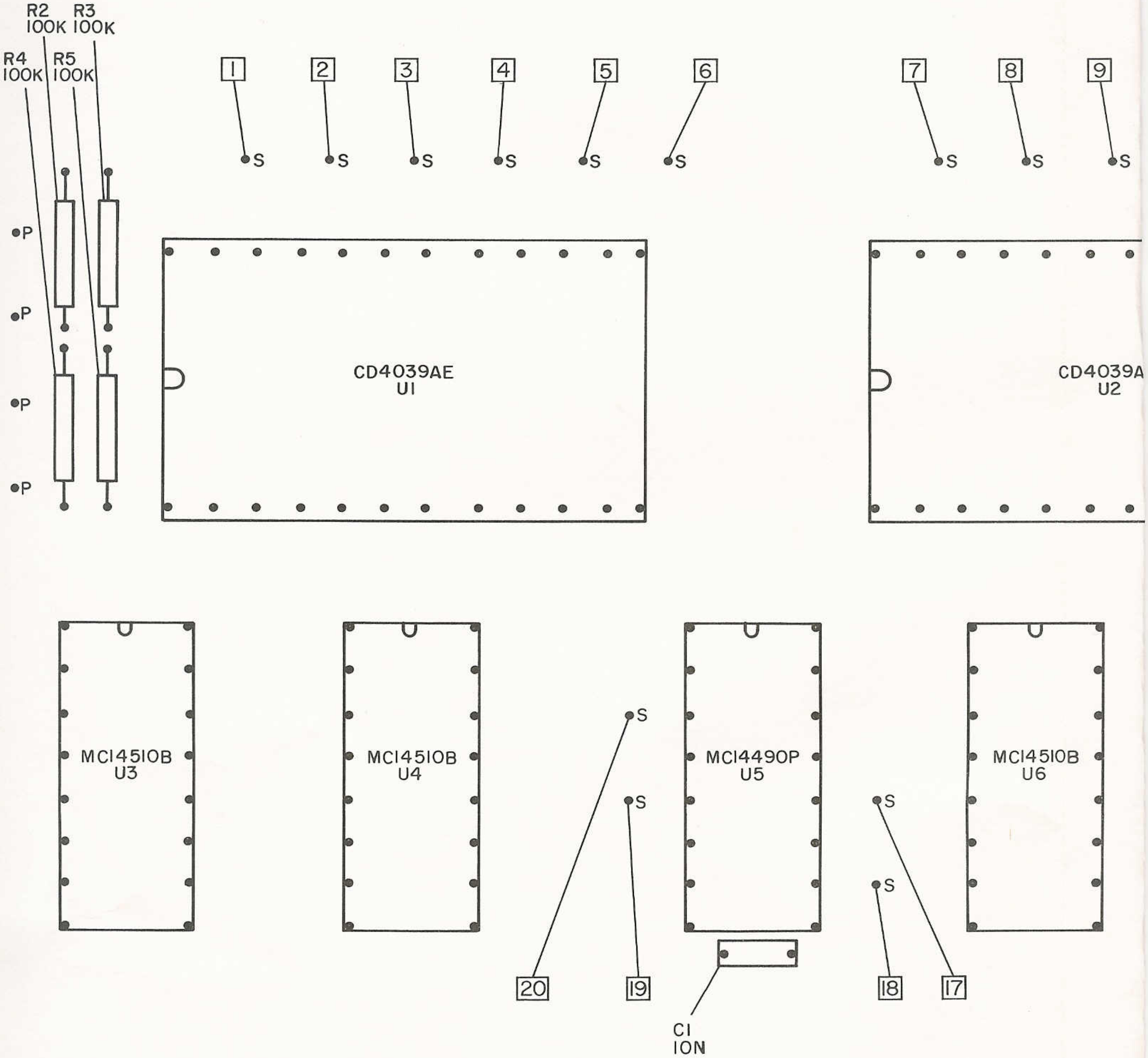


Figure 8-24. Logic Module 5, Bottom Board, Component Location Diagram



R2
100K
R3
100K
R4
100K
R5
100K
1
2
3
4
5
6
7
8
9
S
P
CD4039AE
U1
CD4039A
U2
MC14510B
U3
MC14510B
U4
MC14490P
U5
MC14510B
U6
20
19
18
17
C1
10N

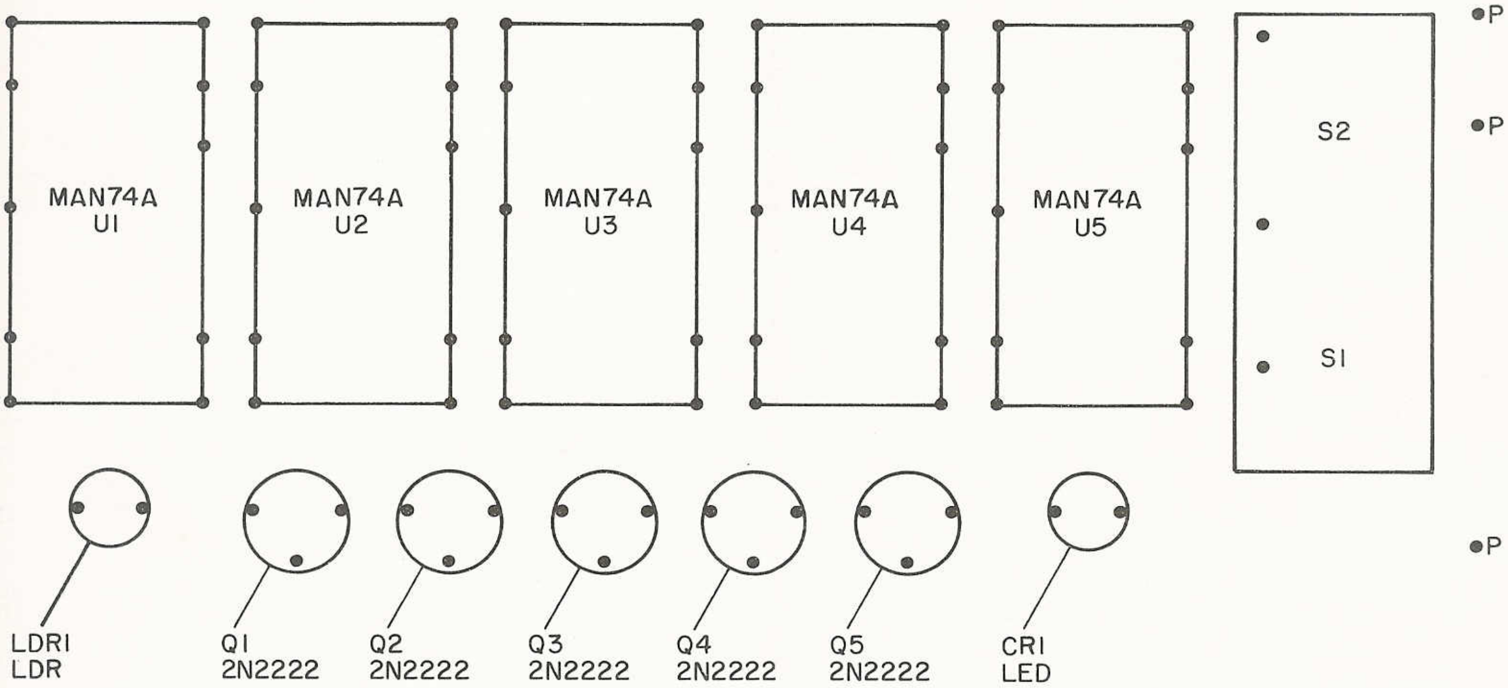
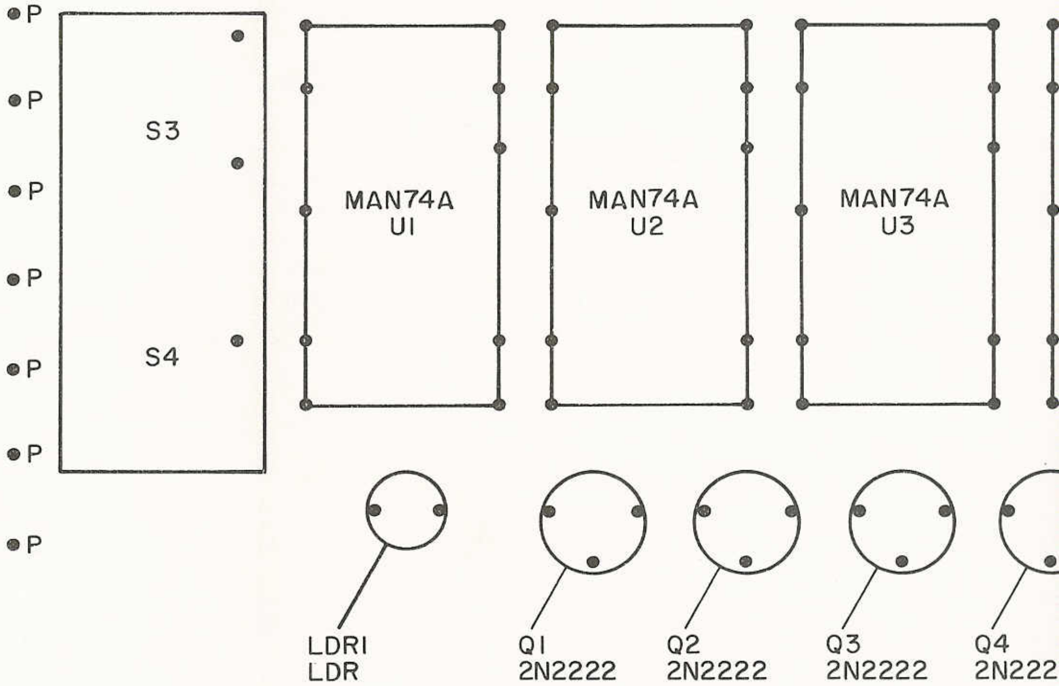


Figure 8-26. Display Module, Top Board, Component Location Diagrams



P
P
P
P
P
P
P
S3
S4
MAN74A
UI
MAN74A
U2
MAN74A
U3
LDRI
LDR
QI
2N2222
Q2
2N2222
Q3
2N2222
Q4
2N222

Figure 8-26. D

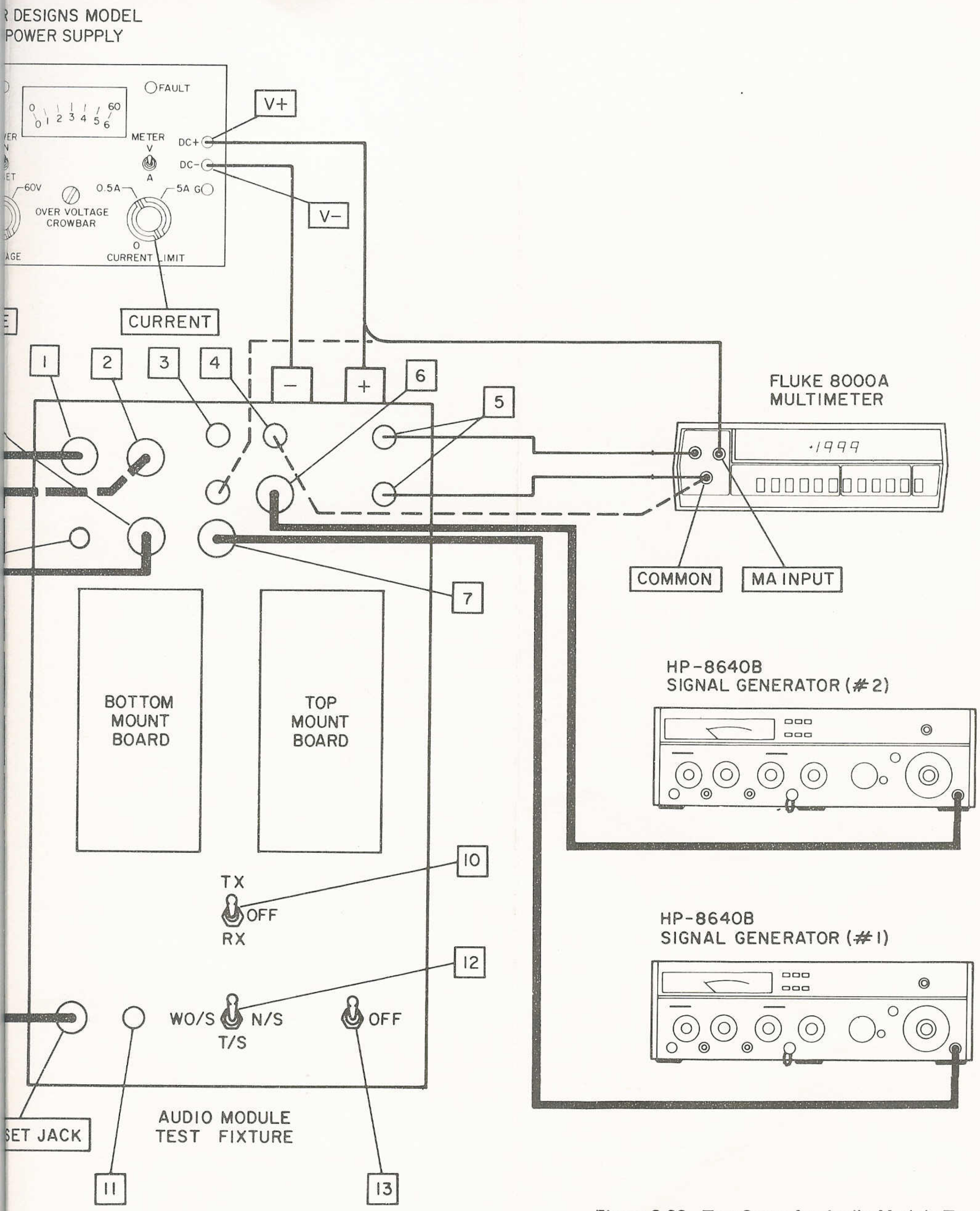
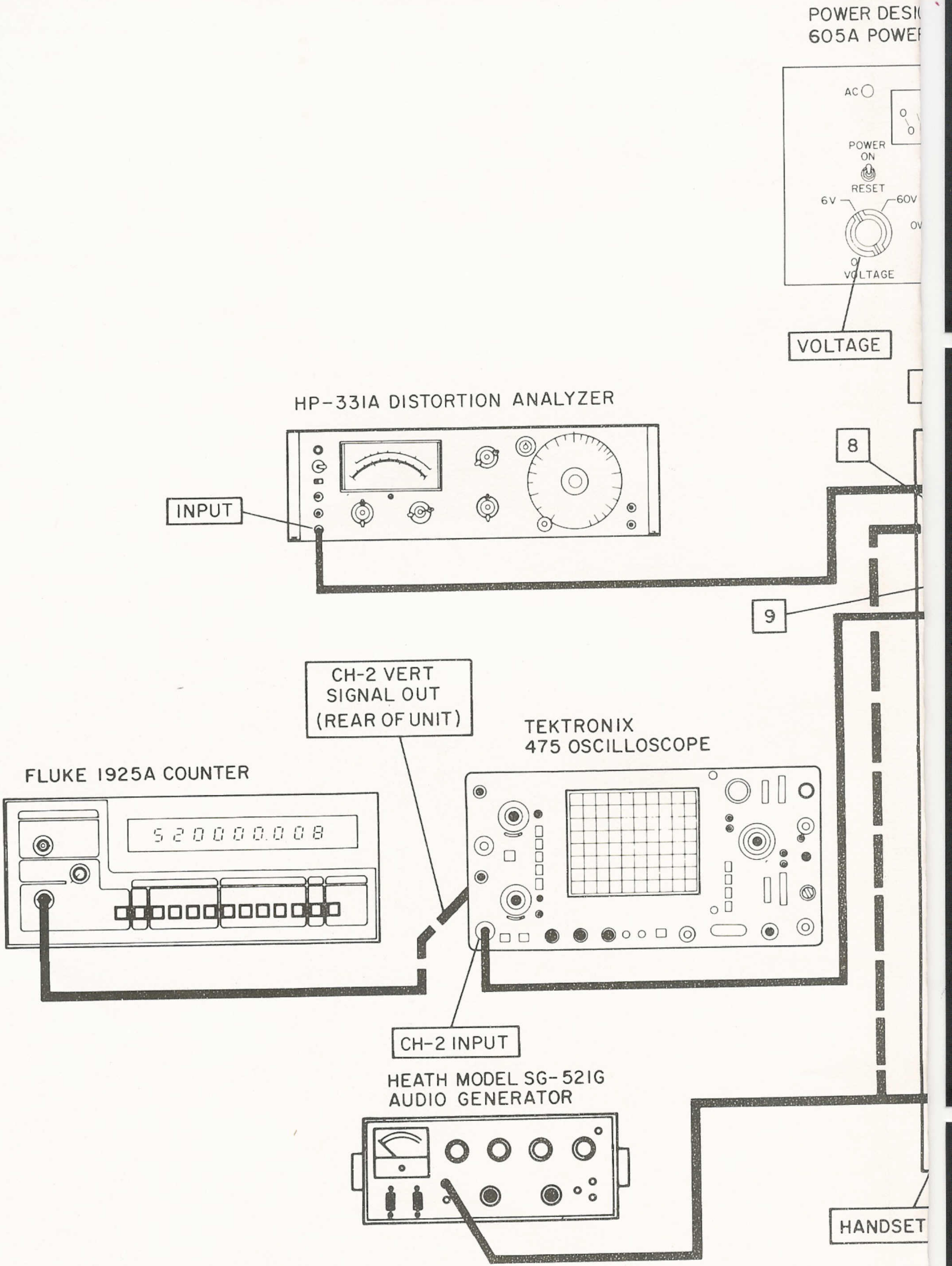


Figure 8-28. Test Setup for Audio Module Test



POWER DESI
605A POWE
AC
POWER ON
RESET
6V
60V
VOLTAGE
VOLTAGE
HP-331A DISTORTION ANALYZER
INPUT
8
9
CH-2 VERT SIGNAL OUT (REAR OF UNIT)
TEKTRONIX 475 OSCILLOSCOPE
FLUKE 1925A COUNTER
520000.008
CH-2 INPUT
HEATH MODEL SG-521G AUDIO GENERATOR
HANDSET

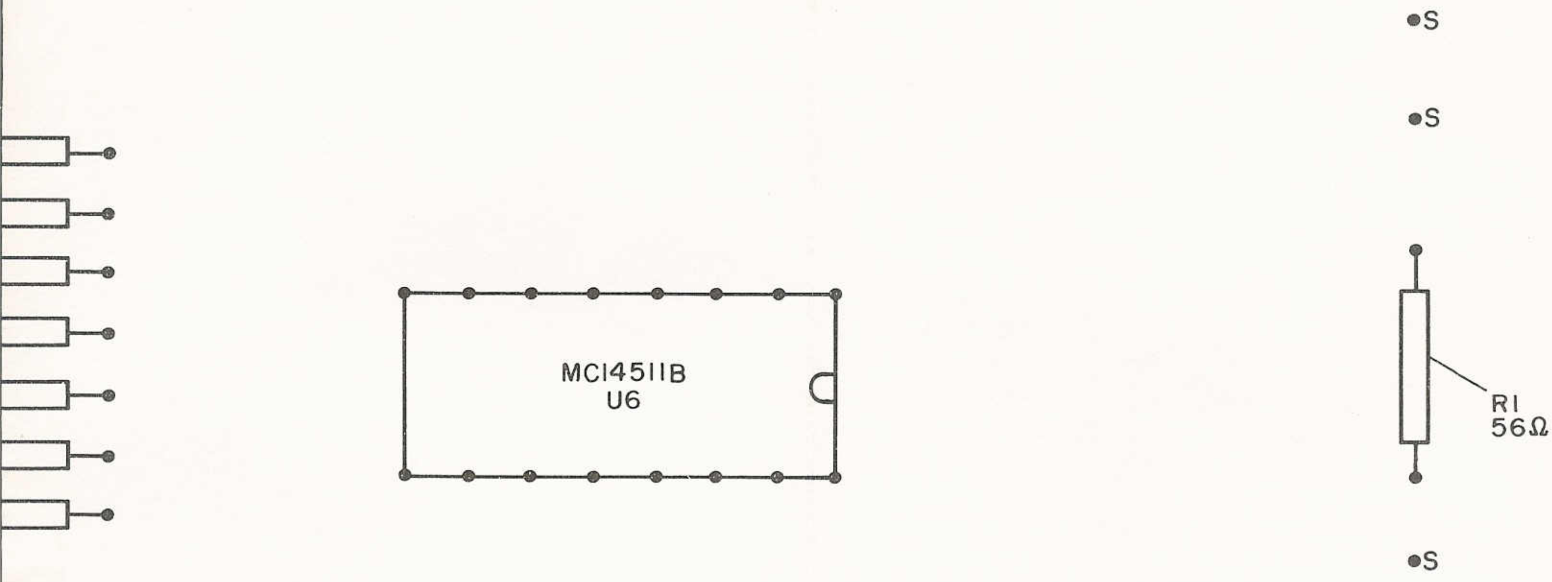


Figure 8-27. Display Module, Bottom Board, Parts Location Diagram

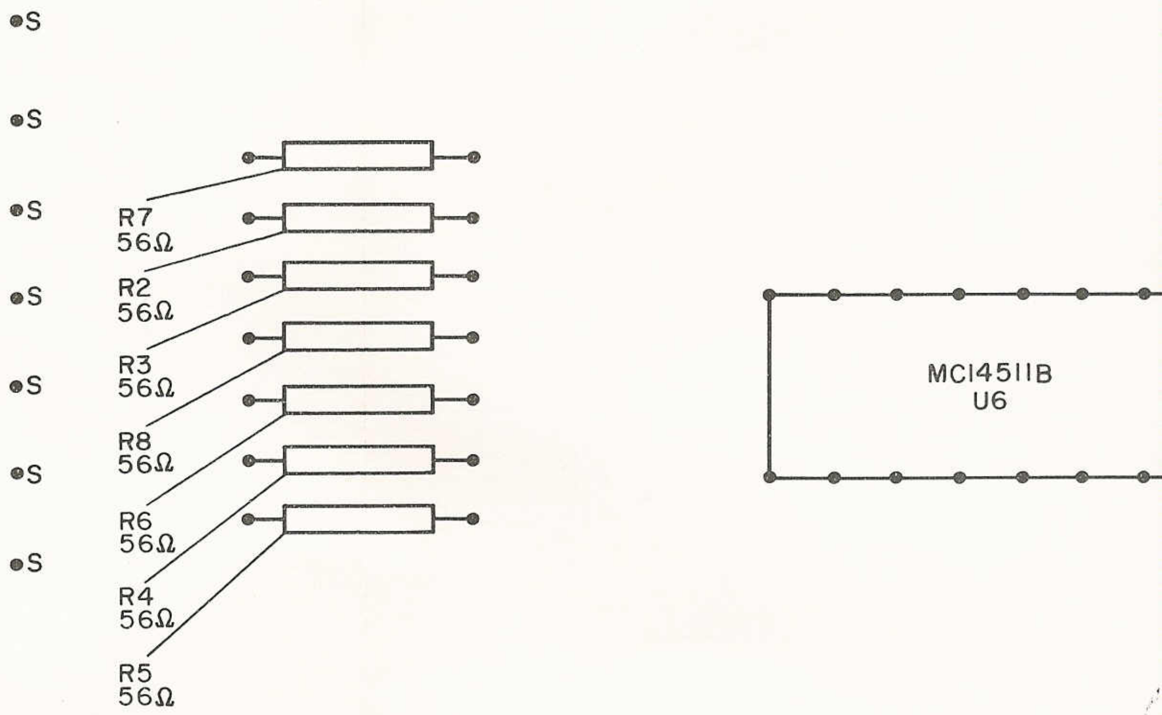

S
S
S
S
S
S
S
R7
56Ω
R2
56Ω
R3
56Ω
R8
56Ω
R6
56Ω
R4
56Ω
R5
56Ω
MC14511B
U6

Figure 8-

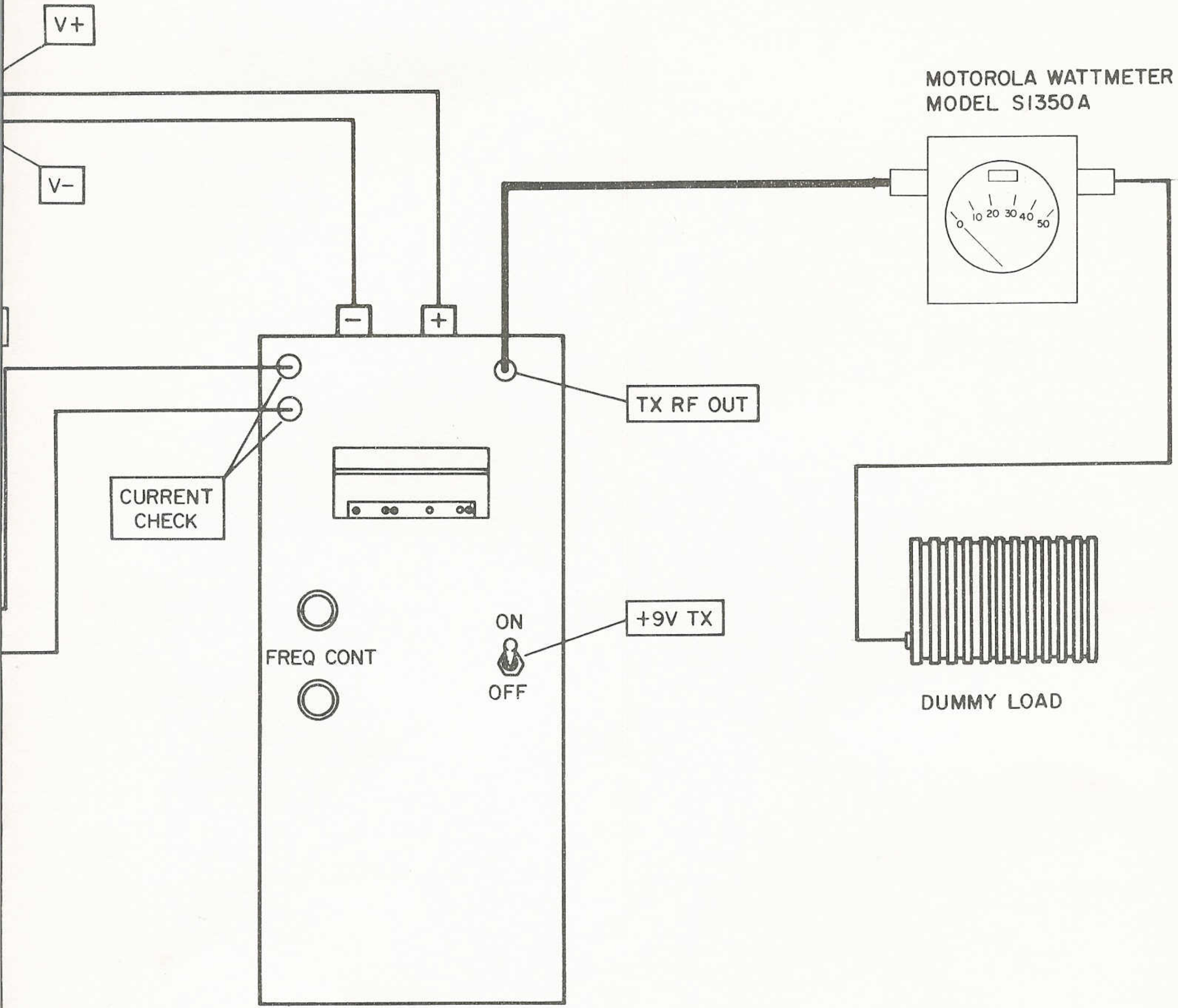


Figure 8-29. Test Setup for Transmitter Module Test

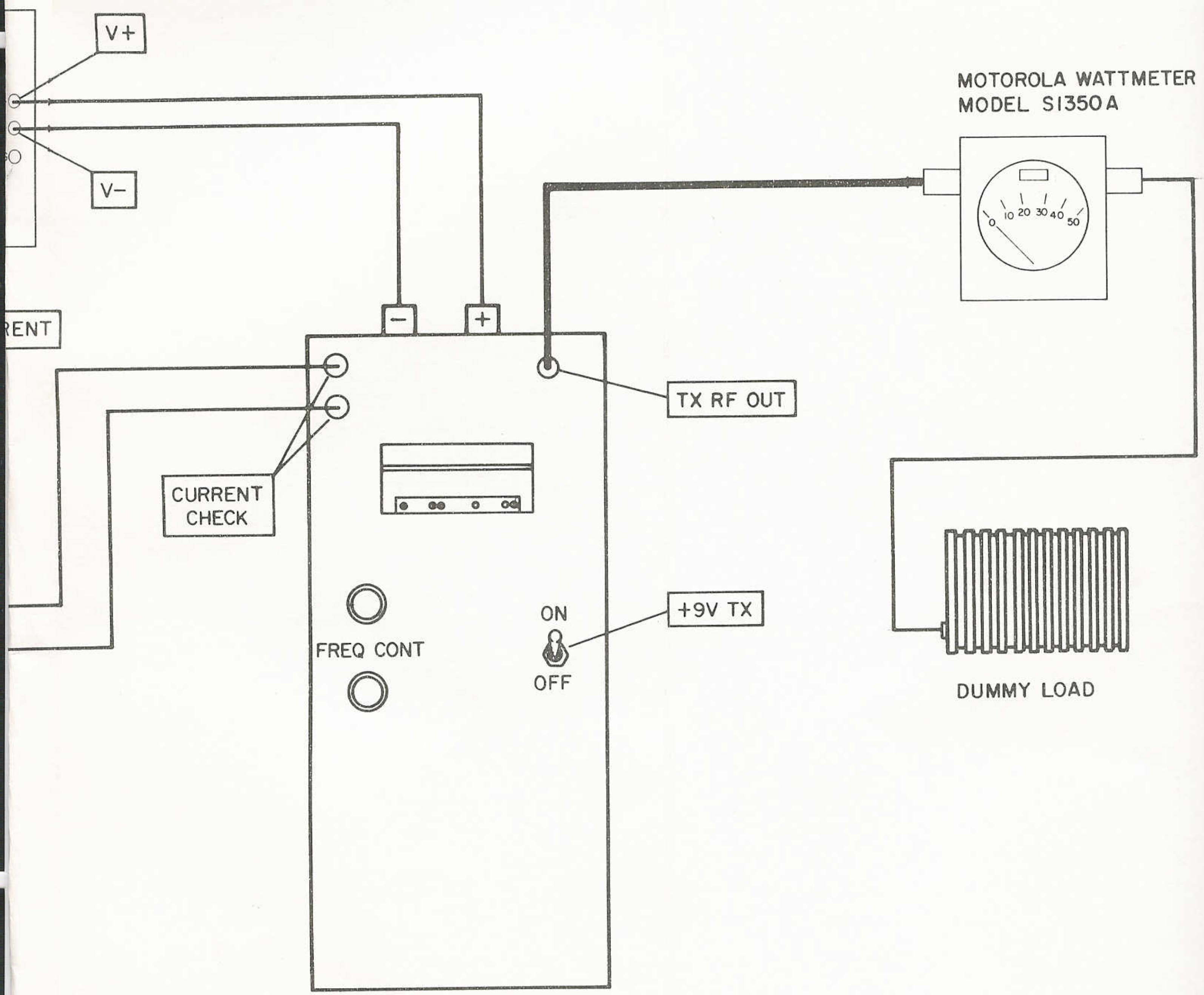


Figure 8-29. Test Setup for Transmitter Module Test

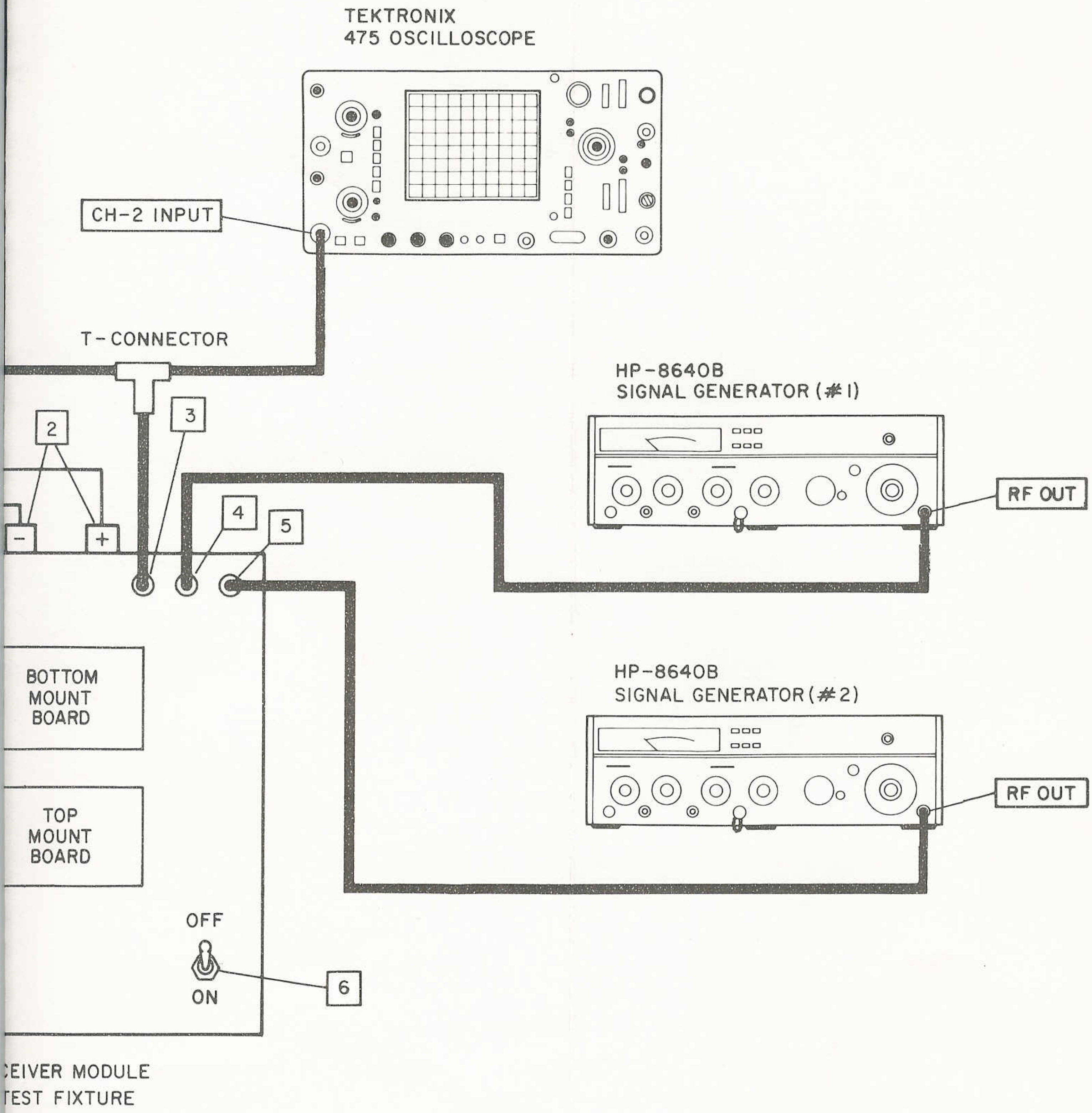
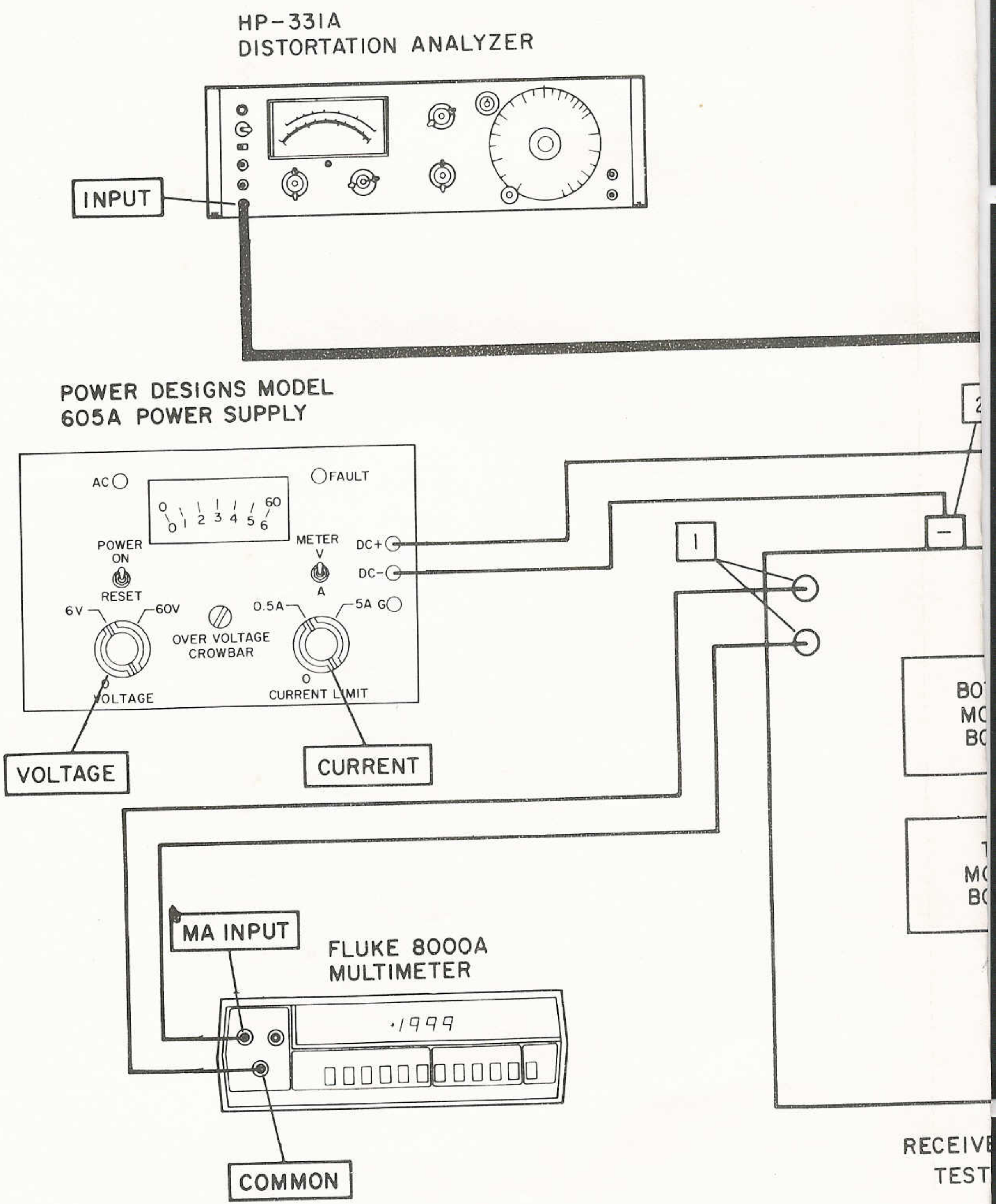


Figure 8-30. Test Setup for Receiver Module Test


HP-331A
DISTORTATION ANALYZER
INPUT
POWER DESIGNS MODEL
605A POWER SUPPLY
AC
FAULT
POWER
ON
RESET
METER
V
A
DC+
DC-
6V
60V
0.5A
5A
G
OVER VOLTAGE
CROWBAR
VOLTAGE
CURRENT LIMIT
VOLTAGE
CURRENT
1
MA INPUT
FLUKE 8000A
MULTIMETER
.1999
COMMON
RECEIVE
TEST

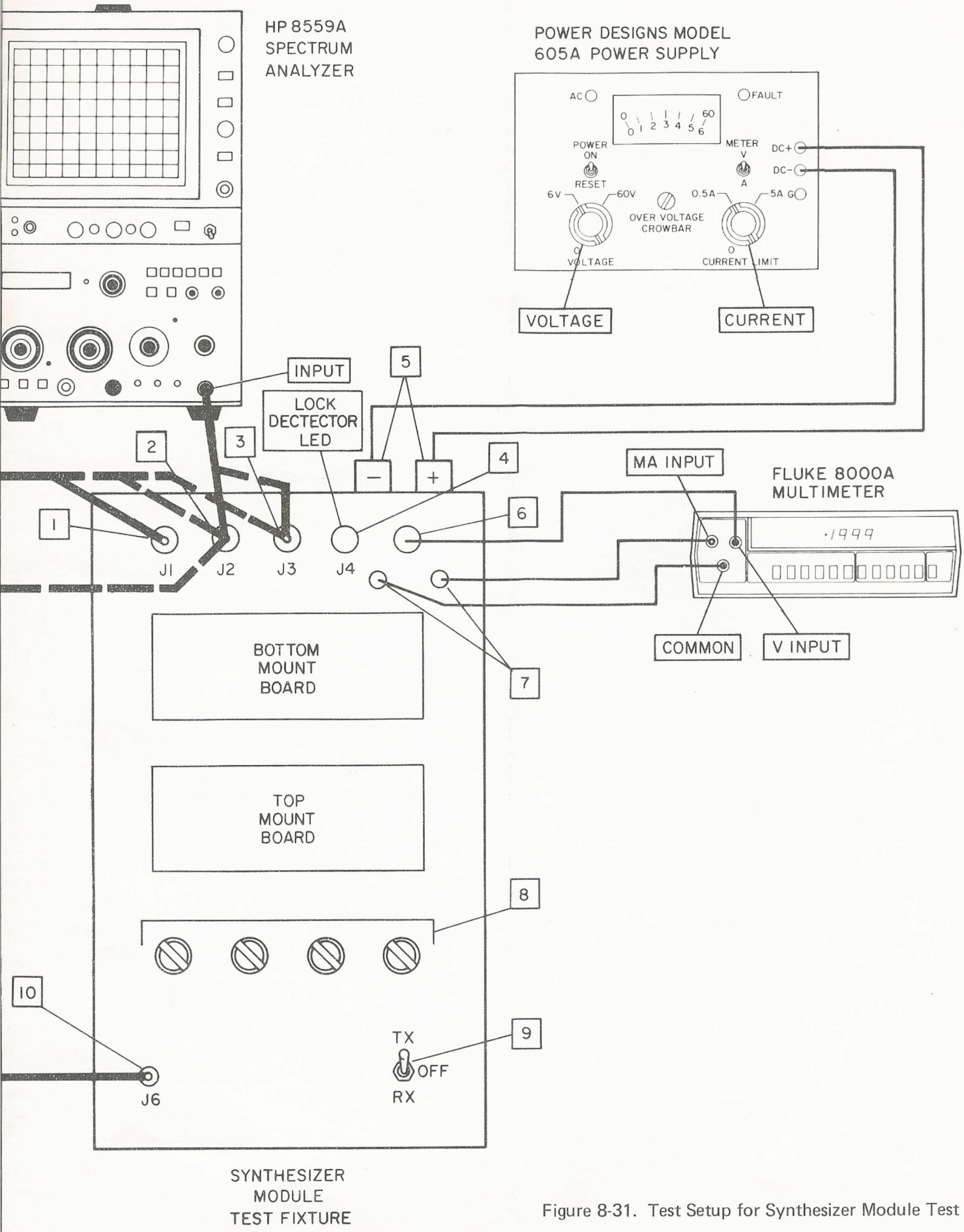
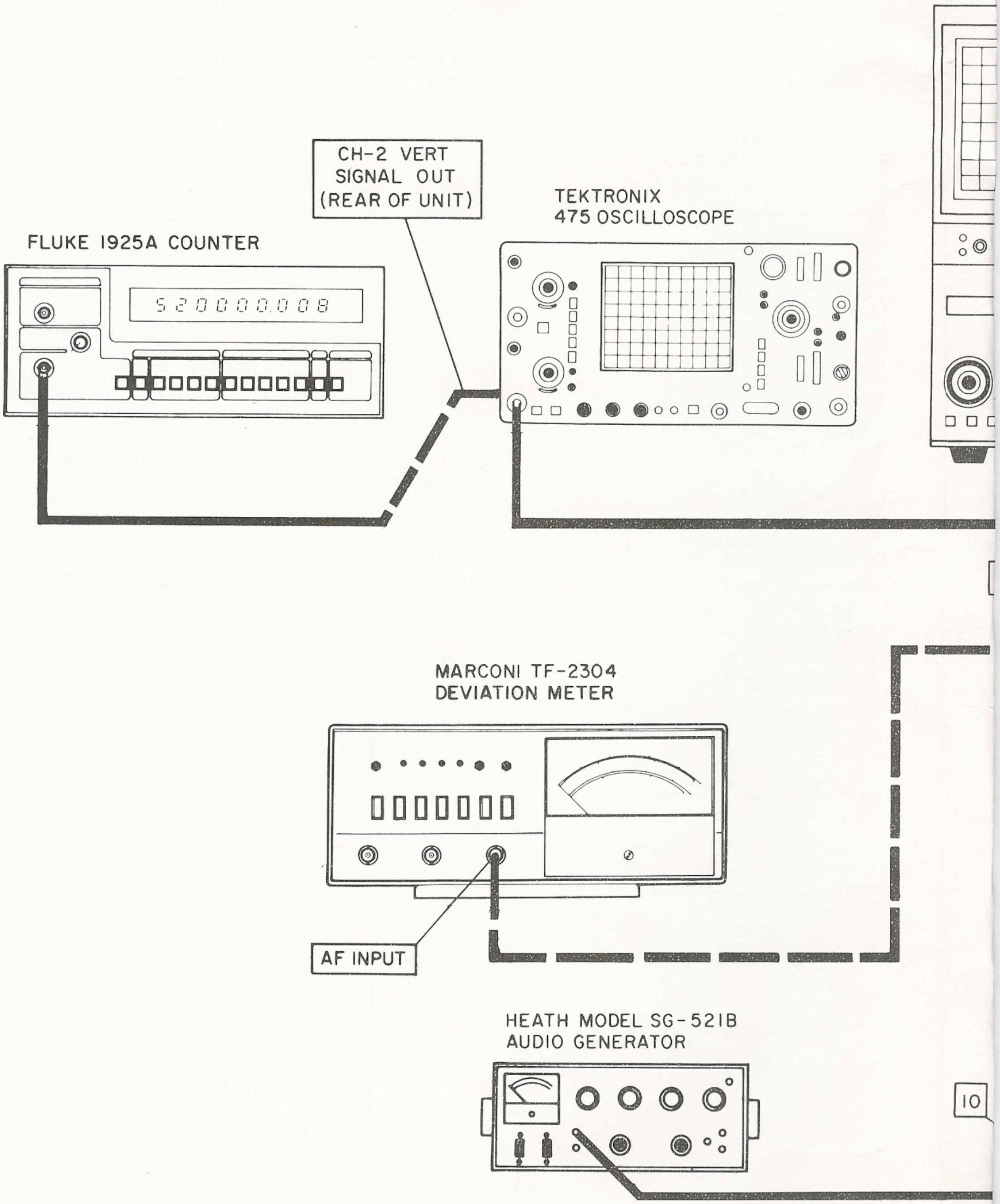


Figure 8-31. Test Setup for Synthesizer Module Test


CH-2 VERT
SIGNAL OUT
(REAR OF UNIT)
TEKTRONIX
475 OSCILLOSCOPE
FLUKE 1925A COUNTER
520000.008
MARCONI TF-2304
DEVIATION METER
AF INPUT
HEATH MODEL SG-521B
AUDIO GENERATOR
10

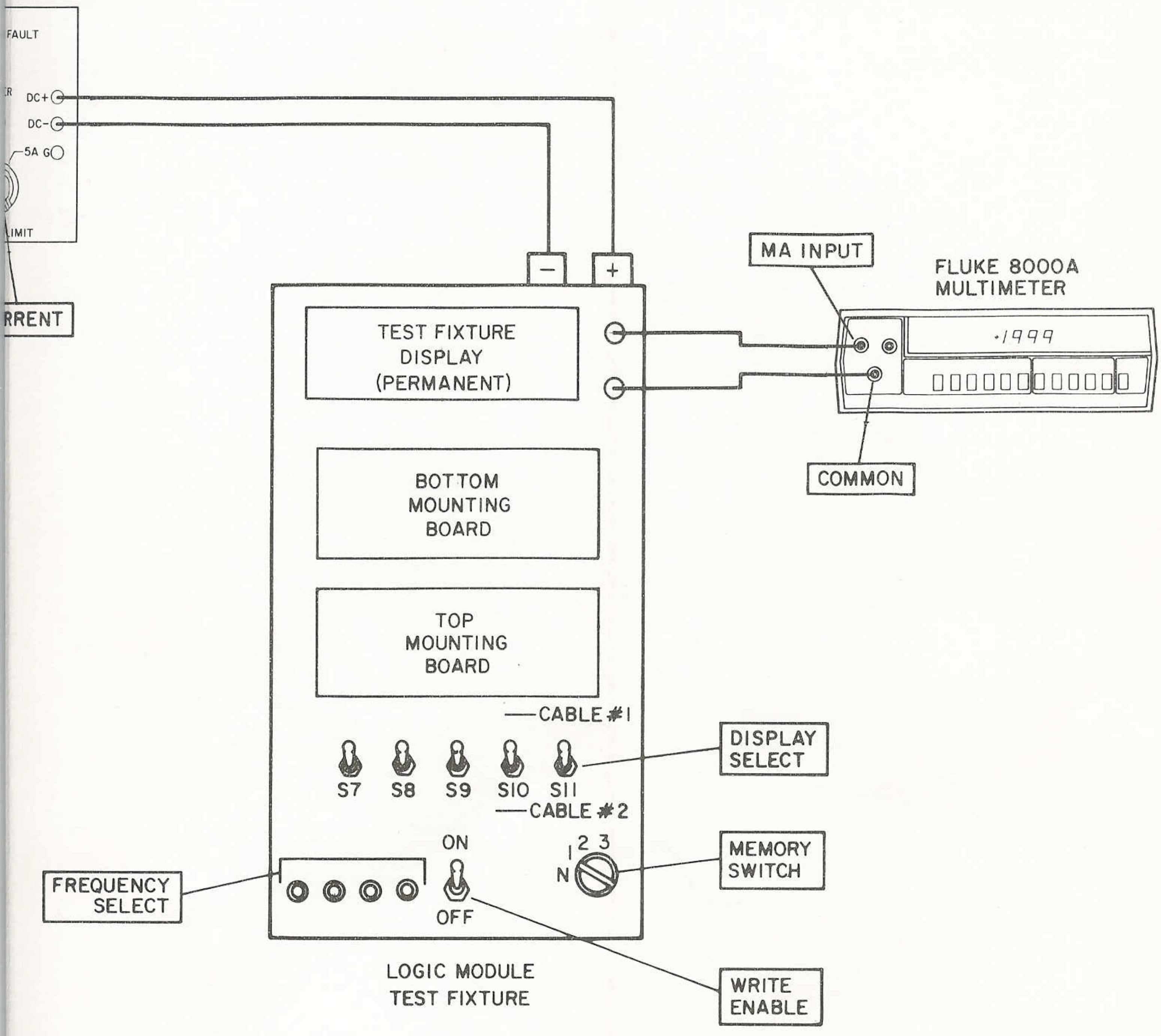
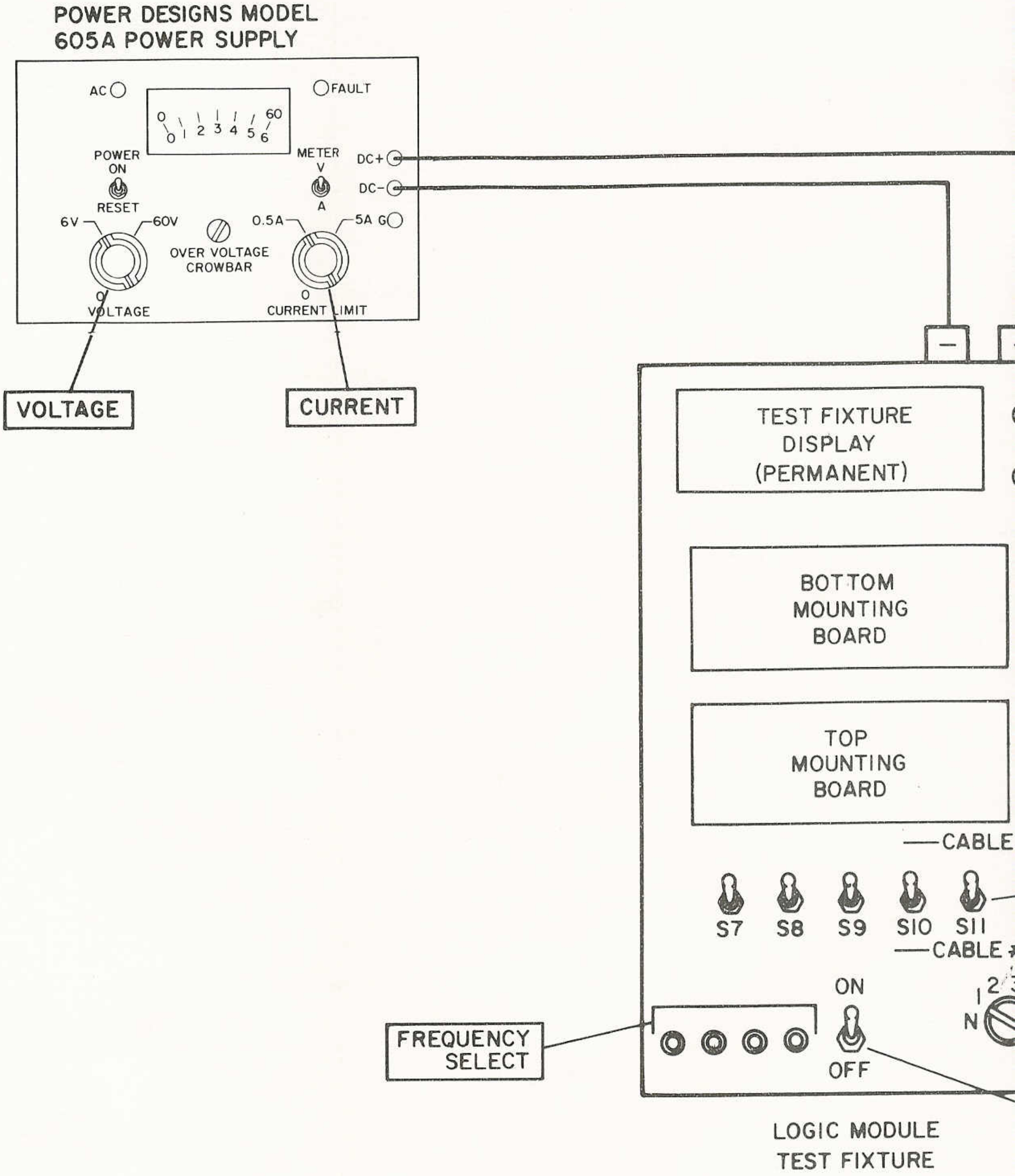


Figure 8-32. Test Setup for Logic Memory Module Test


POWER DESIGNS MODEL
605A POWER SUPPLY
AC
FAULT
0
1
2
3
4
5
6
60
POWER
ON
RESET
METER
V
A
DC+
DC−
6V
60V
0.5A
5A
G
OVER VOLTAGE
CROWBAR
0
VOLTAGE
0
CURRENT LIMIT
VOLTAGE
CURRENT
TEST FIXTURE
DISPLAY
(PERMANENT)
BOTTOM
MOUNTING
BOARD
TOP
MOUNTING
BOARD
CABLE
S7
S8
S9
S10
S11
CABLE
ON
OFF
FREQUENCY
SELECT
N
LOGIC MODULE
TEST FIXTURE

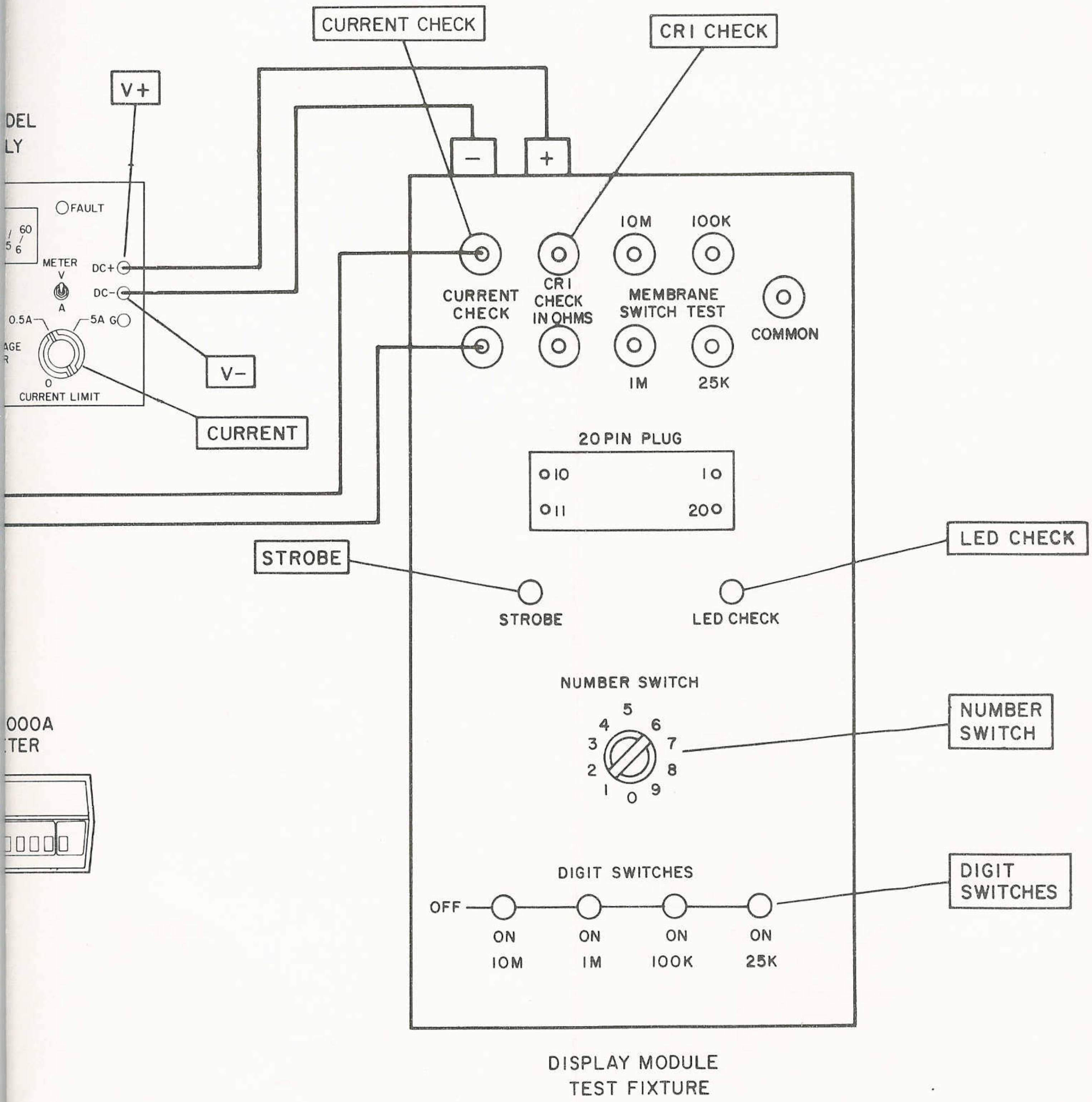
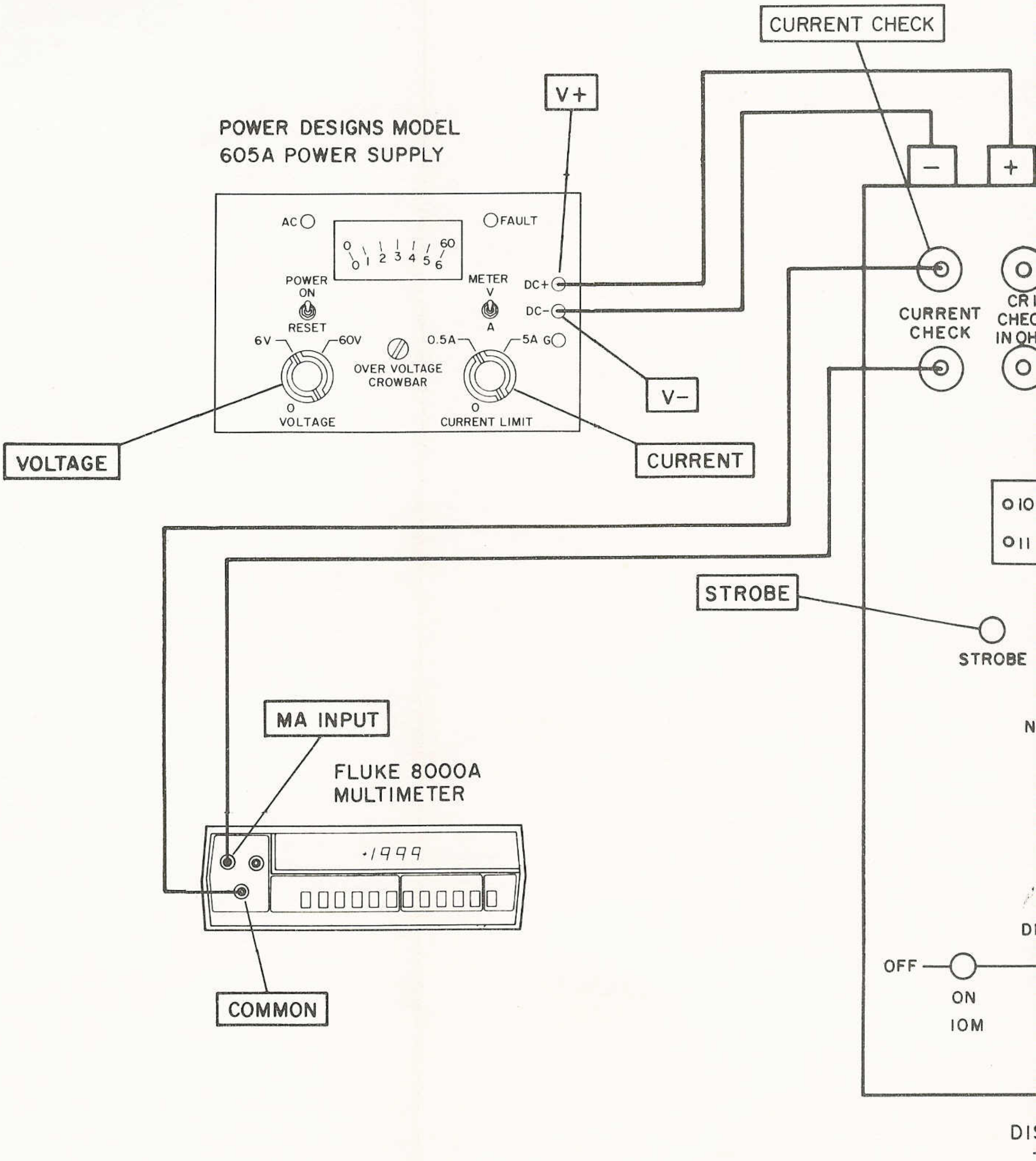


Figure 8-33. Test Setup for Display Module Test


CURRENT CHECK
V+
POWER DESIGNS MODEL
605A POWER SUPPLY
AC
FAULT
POWER
ON
RESET
METER
V
A
DC+
DC−
6V
60V
0.5A
5A
G
OVER VOLTAGE
CROWBAR
0
VOLTAGE
0
CURRENT LIMIT
V−
VOLTAGE
CURRENT
−
+
CURRENT
CHECK
STROBE
STROBE
MA INPUT
FLUKE 8000A
MULTIMETER
.1999
COMMON
OFF
ON
IOM

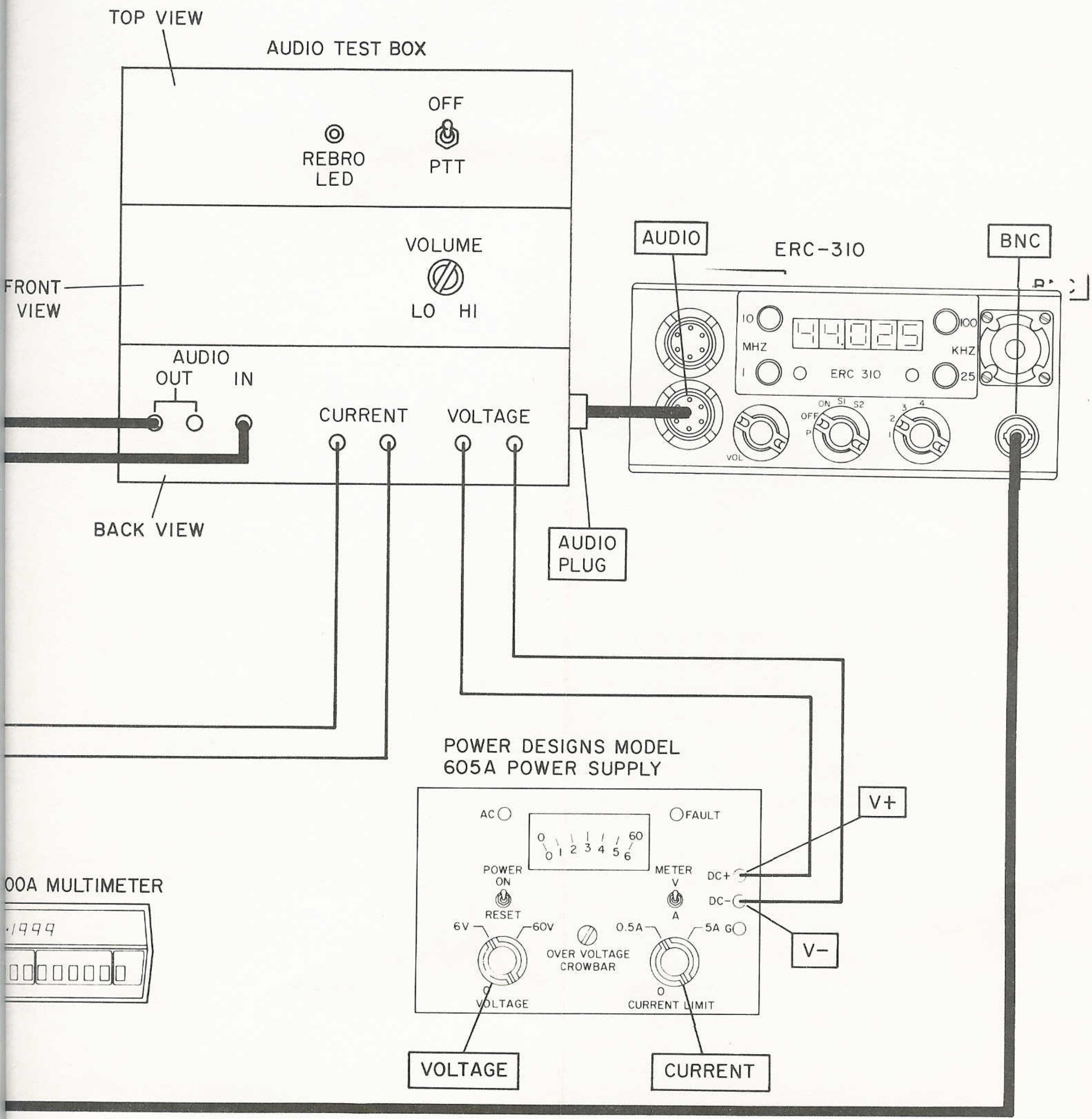
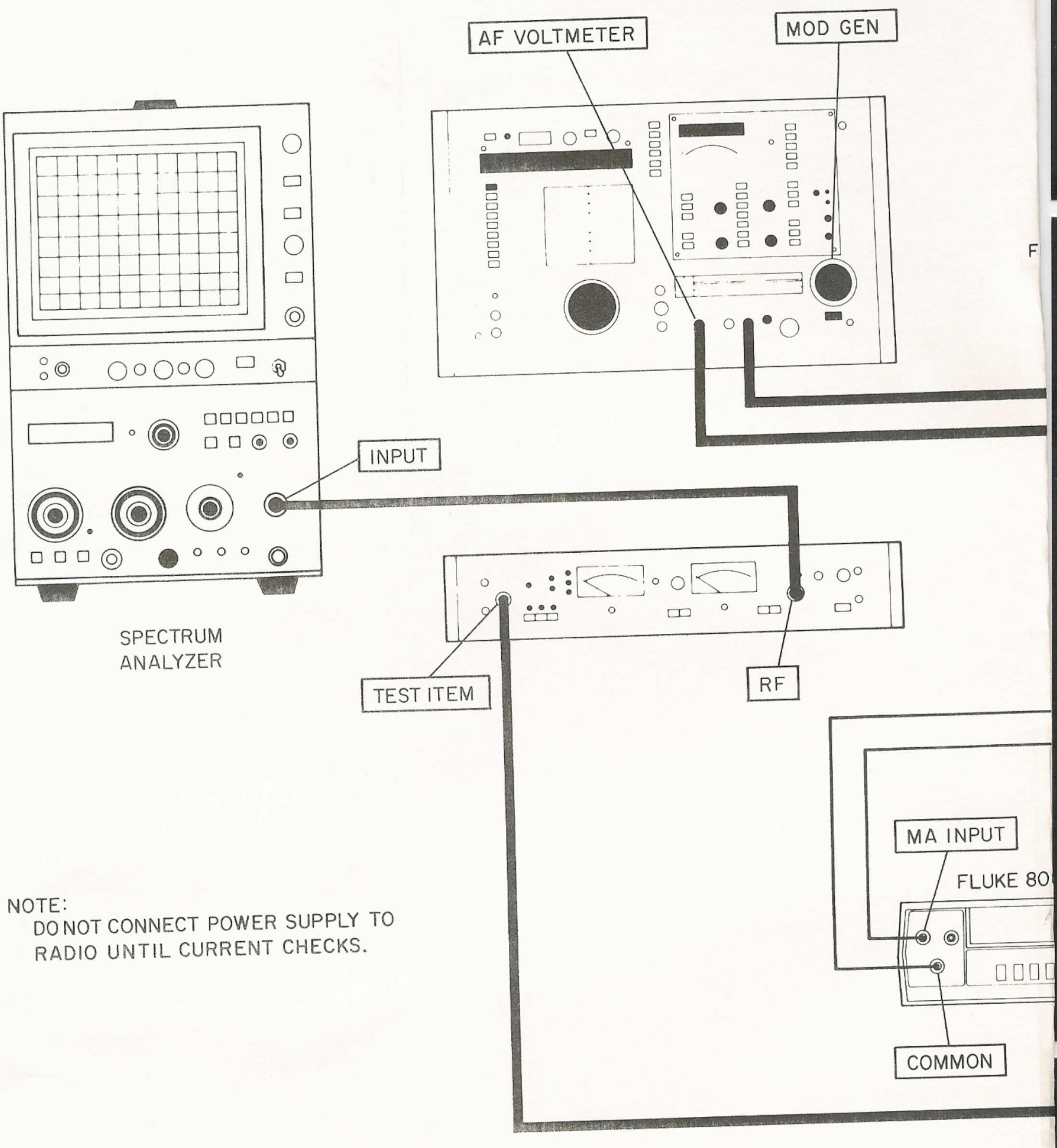
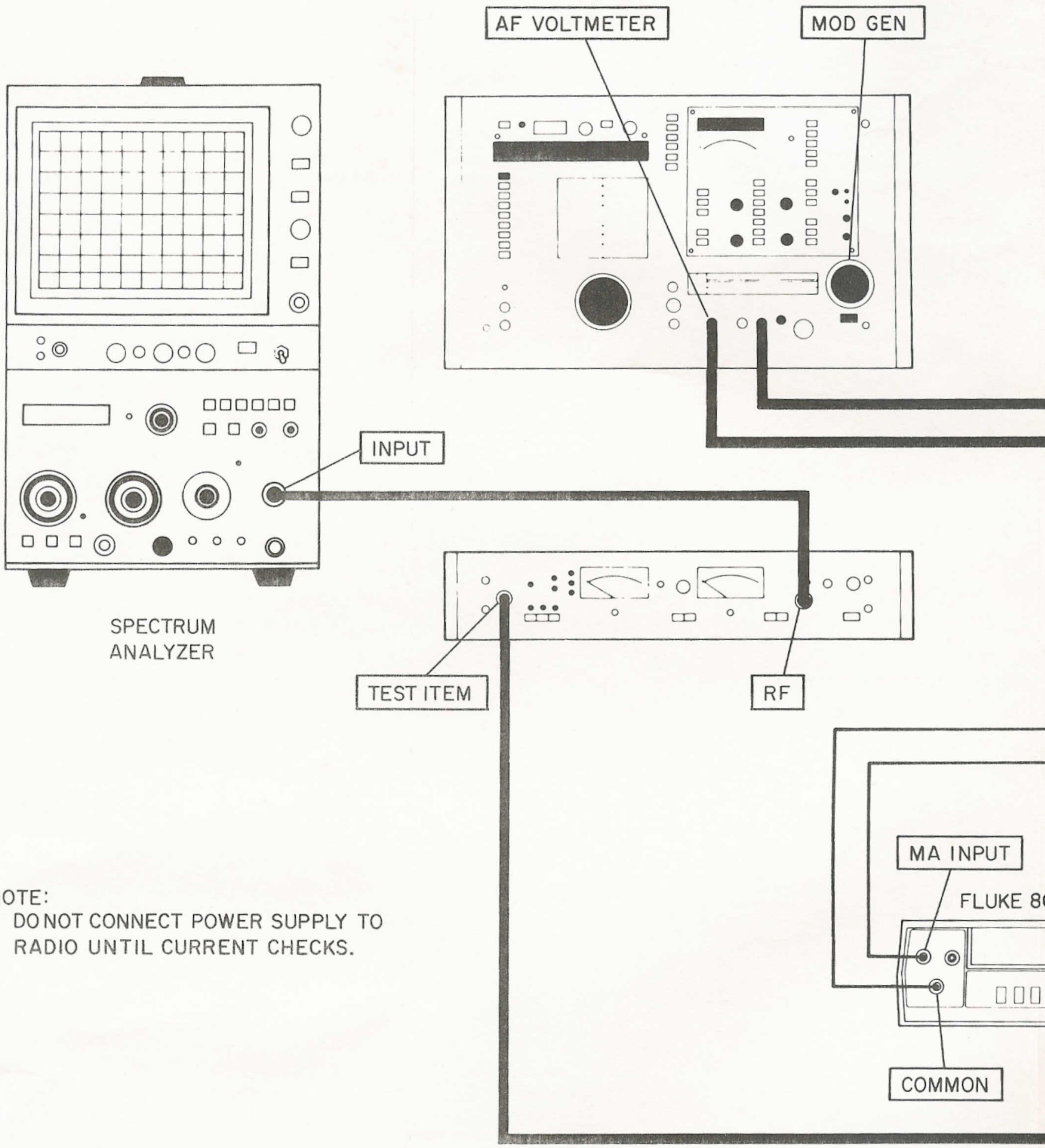


Figure 8-34. Test Setup for Unit Test



NOTE:
DO NOT CONNECT POWER SUPPLY TO
RADIO UNTIL CURRENT CHECKS.



NOTE:
DO NOT CONNECT POWER SUPPLY TO RADIO UNTIL CURRENT CHECKS.

ALPHABETICAL INDEX

ALPHABETICAL INDEX

ALPHABETICAL INDEX (Continued)

ALPHABETICAL INDEX (Continued)

ALPHABETICAL INDEX (Continued)

ALPHABETICAL INDEX (Continued)

Subject	Paragraph, Figure, Table Number

P

Parts List:

ALPHABETICAL INDEX (Continued)

ALPHABETICAL INDEX (Continued)

ALPHABETICAL INDEX (Continued)

ALPHABETICAL INDEX (Continued)

3-3. NORMAL PRESET FREQUENCY MODE OF OPERATION (Continued)

Refer to the illustration on the opposite page to perform the normal preset frequency mode of operation:

a. Set the Memory switch to position P.

b. Set the Function switch to P.

c. Use the Frequency Selection pushbuttons to preset the desired frequency for Memory switch position 1.

d. Repeat procedure for positions 2, 3, and 4, as desired of the Memory switch.

NOTE

Prior to each daily operation, the Battery Condition indicator should be observed to check battery condition.

e. Use the Memory switch to select the desired frequency.

f. Use the Function switch to select squelch operation as follows: ON (no squelch), S1 (tone squelch), or S2 (noise squelch).

g. Any signal present on the frequency to which the transceiver is set will be heard in the handset. Use the Volume control to adjust audio to desired level.

h. To transmit, press the switch on the Handset and talk into the Handset. Release the switch to return to receive condition.

3-4. REPLACING BATTERY PACK

Replace the Battery Pack by unscrewing the captive screw securing the Battery Pack to the bottom of the transceiver. When replacing with a spare Battery Pack, make sure O-rings are in place.

3-5. CHARGING BATTERY PACK

The NiCad Battery Pack has two banana jacks to allow connecting to a source of approximately 18 VDC for charging. The Battery Pack should be charged at a charging rate of 500 ma for 5 hours or 200 ma for 13 hours. Excessive charging periods must be avoided as high pressures can be built up on the individual cells of the Battery Pack and permanent damage could occur. Before charging battery, ensure that vent on battery pack is undone.

a quadrature detector. Frequency stability of the second mixer crystal oscillator is not a critical factor because the IF is broadband and the detector circuit will accept a large variation in frequency. This is an important feature, especially over the wide temperature range in which the radio operates. The detected audio signal is then routed to the audio module for further amplification and filtering.

In the audio module, the detected audio signal is fed through a low pass filter and receive preamplifier on the top board, and a high pass filter and low pass filter, on the bottom board. The high pass and low pass filters are used in both the receive and transmit modes. On receive, all frequencies below 300 Hz are attenuated by the high pass filter. The 150 Hz sub-carrier squelch tone is attenuated by approximately 36 dB so it becomes nearly inaudible. This is a distinct improvement over other military radios where the 150 Hz tone in the headset is quite disturbing. The low pass filter limits the upper frequency of the audio and its 3 dB point is at 2.7 KHz, rolling off to provide an attenuation at of 24 dB at 5.4 KHz.

The bias voltage for the high pass filter, low pass filter, and audio amplifier on the audio module bottom board is provided by a bias generator on the audio module top board. The audio module top board also contains two independent squelch systems, a 150 Hz tone squelch and a noise squelch. The noise squelch, which operates on a signal to noise ratio, is internally preset. Also, to be unaffected by modulation, the noise squelch circuitry operates on noise above 5 KHz only. The 150 Hz tone squelch activates the receiver when the noise squelch is tripped and the presence of a 150 Hz tone is detected.

The squelch gate on the audio module bottom board controls selection of the desired squelch and controls rebroadcast switching. Selection of no squelch or noise/tone squelch is made by the Function switch as follows: ON position allows the radio to operate with no squelch; position S1 selects tone squelch ; and position S2 selects noise squelch.

The filtered signal is fed through the volume control to an audio amplifier, on the audio module bottom board, which delivers approximately 4 milliwatts into a 600 ohm headset. The volume control adjusts the receiver audio level.

The coarse tune generator on the synthesizer module top board sets the receive VCO to the approximate receive frequency, after which the fine tune phase lock loop loop takes over. The receive VCO oscillator 27 MHz higher than the transmit VCO.

The DC input from the phase comparator in the program counter of the phase lock loop is applied to the receive VCO via the loop filter. The receive VCO output signal is amplified to a level of approximately 1 milliwatt by a broadband amplifier. The receive tuning signal is then passed through a high pass filter which filters out any spurious signal which would fall on the receive band and a matching network which provides a reasonable match to the first mixer in the receiver module.

4-6. FREQUENCY SELECTION AND DISPLAY FUNCTIONING. (See figure 8-3.) Frequency selection and the display of selected frequency by the radio is accomplished as follows:

Entry of frequency information for normal preset channel operation is accomplished by four Frequency Select pushbuttons - 10 MHz, 1 MHz, 100 KHz, and 25 KHz - located on the display module. The Frequency Select pushbuttons control the operation of a clock circuit on the logic memory bottom board which is clocked by a 3.125 KHz clock from the synthesizer. The clock generator generates an Enable which controls on/off time of the display, via a strobe generator on the logic memory top board, and feeds selected frequency into the memory via a synthesizer divider which is slaved to the memory.
By use of four pushbuttons, any frequency within the operating band of the radio can be stored in the memory.