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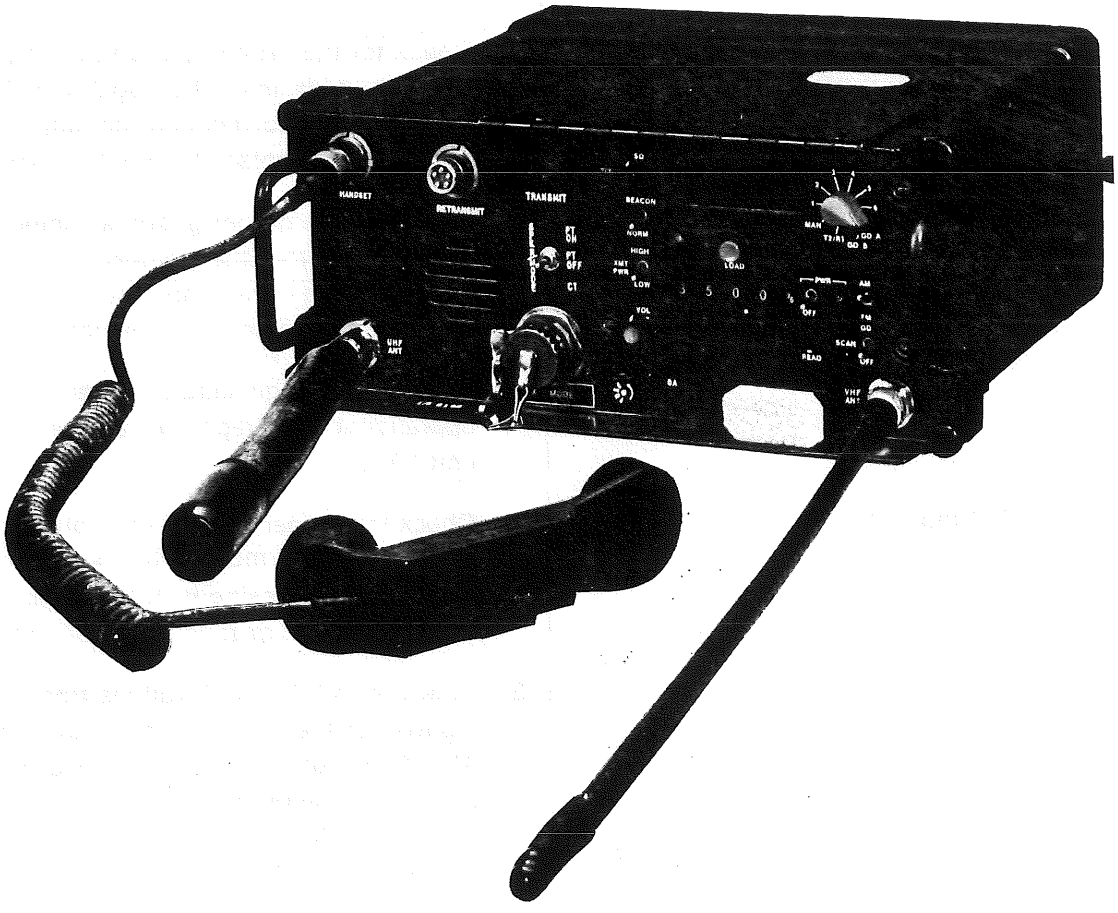
AN/URC-101
PORTABLE EMERGENCY TRANSCEIVER
OPERATION AND MAINTENANCE MANUAL

DOCUMENT NO. 68-P09980V

APRIL 1985



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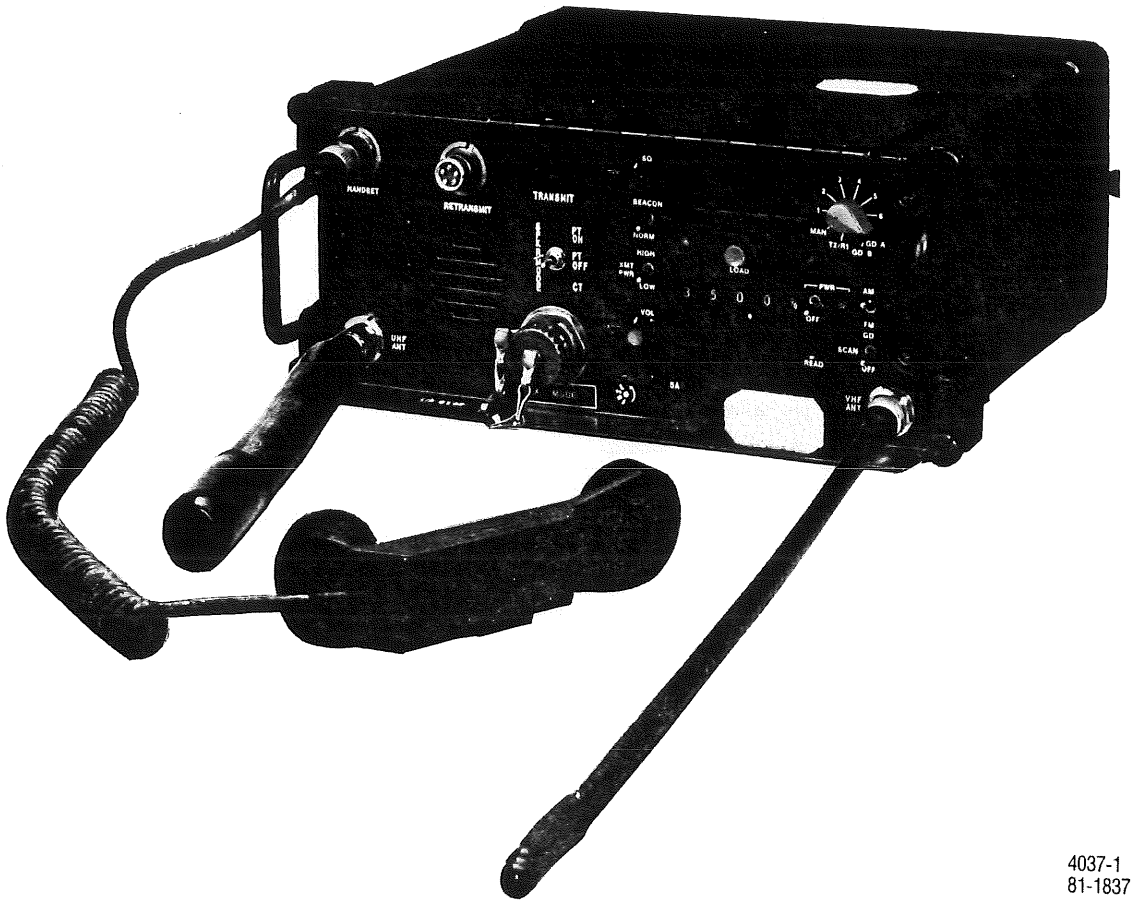

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Figure 1-1. AN/URC-101, Portable Emergency Transceiver System

SECTION 1

DESCRIPTION

1-1. SYSTEM DESCRIPTION

1-2. The AN/URC-101, Portable Emergency Transceiver, hereinafter referred to as the PET system, is shown in Figure 1-1. The PET system is a communication system comprised of a transceiver, control unit, power supply, VHF and UHF antennas, and a handset. A block diagram of the PET system is shown in Figure 1-2 and an interconnect diagram is shown in Figure 1-3.

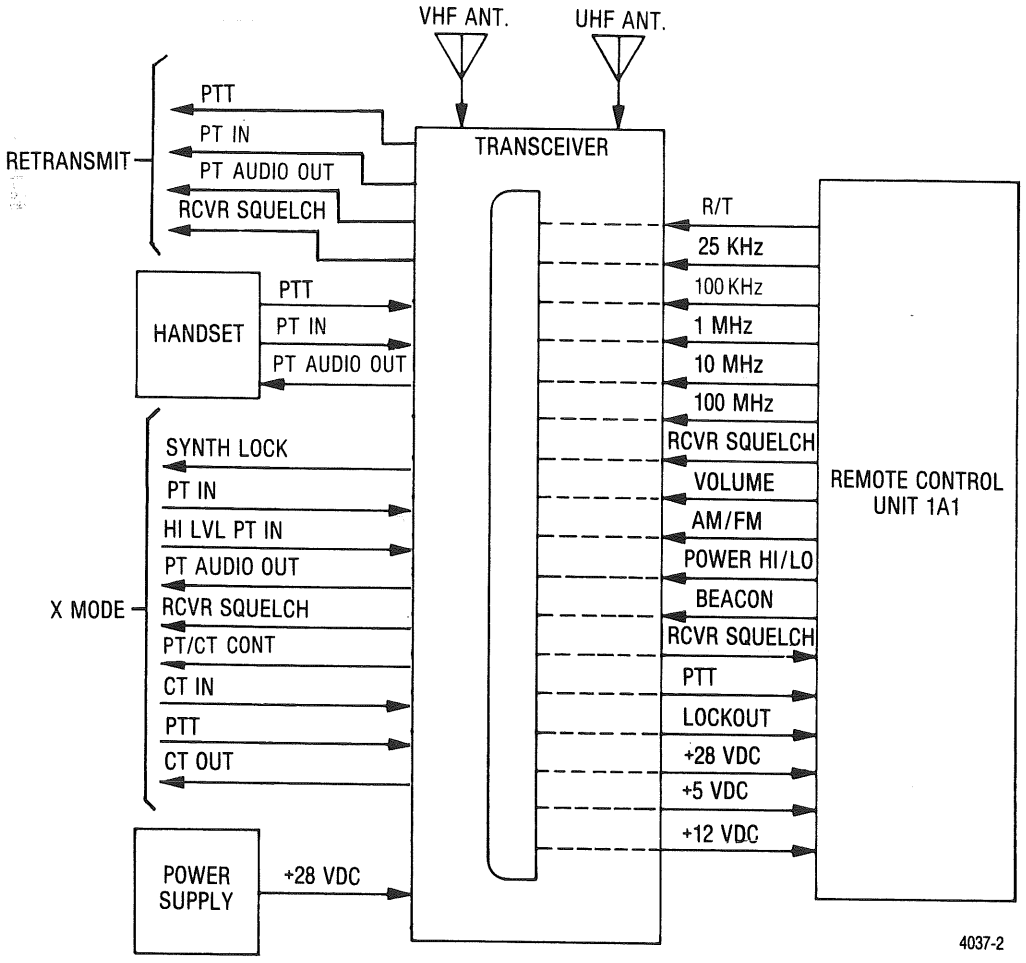


Figure 1-2. PET System Block Diagram

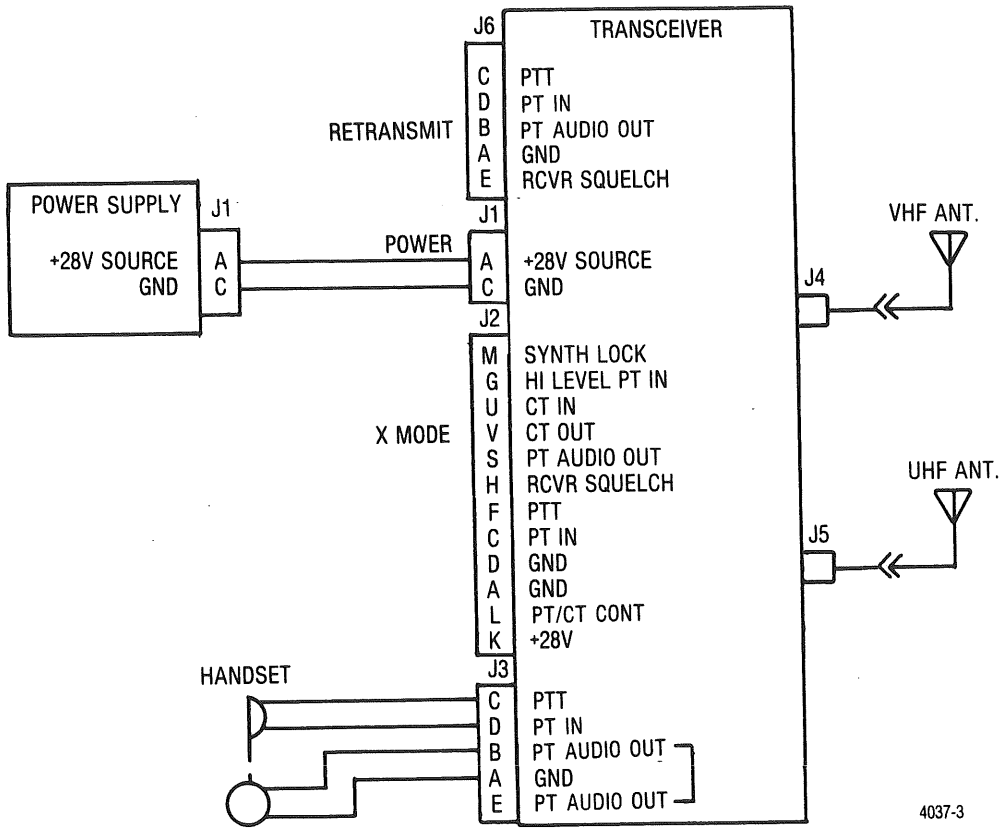


Figure 1-3. PET System Interconnect Diagram

1-3. Features of the PET system are summarized as follows

- fully synthesized receiver and transmitter
- 7000 UHF frequencies
- 1360 VHF frequencies
- 25 kHz channel spacing
- all solid state
- contains emergency beacon
- contains scanning feature
- AM and FM modulation capabilities
- Plain and Cipher texts capabilities
- internal or handset speaker

- remote operation capability
- 6 memory and 2 guard preset frequency storage locations
- no blower or external cooling required
- designed for backpack, vehicular and aircraft applications
- secure voice capability with COMSEC equipment
- capable of UHF satellite reception and transmission
- T2/R1 capability

1-4. The transceiver is an all solid-state voice (plain text, PT) or data (cipher text, CT) communication radio comprised of thirteen functional modules contained in a small portable case. The transceiver operates in the 116 to 150 MHz vhf band, and in the 225 to 400 MHz uhf band. It is tunable across both frequency ranges in 25 kHz increments.

1-5. Operating power is supplied to the transceiver by a power supply. The receiving and transmitting capabilities are controlled by signals generated from the control unit. Receiving and transmitting of rf signals is through the attached vhf and uhf antennas. The transceiver is keyed in the selected operating mode by the handset. The transceiver can also be controlled or tested by remote means through the X MODE connector mounted on the front of the transceiver case.

1-6. The transceiver contains only one receiver. However, in the scanning mode of operation the transceiver can monitor a main receiver frequency and two field-presettable guard frequencies. The transceiver scans all three frequencies until a transmission is detected on one frequency. The scan then stops and the transceiver monitors that frequency until completion of the message. After the message is finished, the transceiver resumes scanning.

1-7. The transmitter portion of the transceiver delivers 1.5, 5.0, or 20 watts of power, depending on the power level switch setting, the frequency transmitted (uhf or vhf) and the type of modulation (am or fm).

1-8. REMOTE CONTROL UNIT. The remote control unit is normally installed in the transceiver unit. However, if desired, it may be removed and mounted in the standard aircraft panel or elsewhere for remote operation of the transceiver. Features of the control unit are as follows:

- Pushbutton selection of all 8,360 frequencies
- Electronic memory for storing preset frequencies
- Single switch selection for up to eight preset frequency channels
- Electronic display of actual operating frequency
- Controls lighted for night operation
- Standard mounting for aircraft installation
- Guard light indication of received guard signal

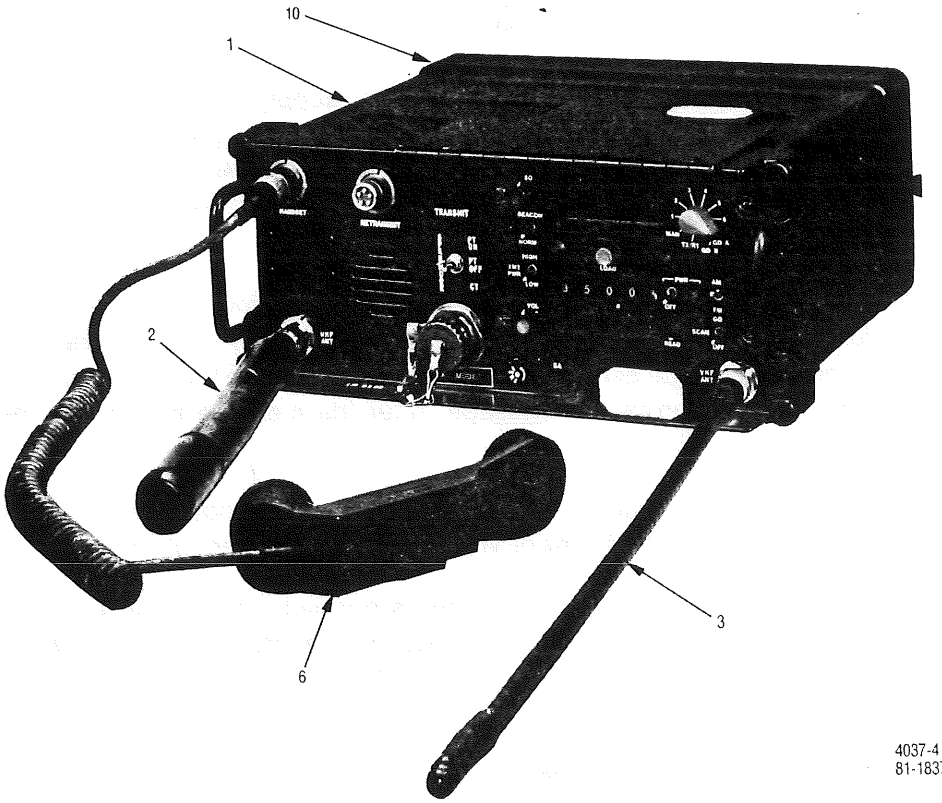
1-9. The control unit provides control of transceiver power, volume, squelch, transmitter power level, beacon, modulation (am or fm), scanning and frequency selection. The control unit also has the capability of loading up to eight frequencies into the memory for routine use. This allows the operator to select any one of the eight frequencies by changing the position of the frequency selection switch. Two of the eight frequencies are guard frequencies which are monitored during the scan mode of operation. The frequency being transmitted or received can be displayed and the panel backlighting turned on by depressing the READ pushbutton. The frequency display and panel lighting are normally off to conserve battery power.

1-10. ANTENNAS. Two antennas are supplied with the PET system (vhf and uhf). The vhf antenna is used when operating in the 116 to 150 MHz range. The uhf antenna is used when operating in the 225 to 400 MHz

range. Both antennas are flexible to minimize the possibility of breakage. During normal operation, both antennas are physically connected directly to the transceiver front panel. Also available, as options, are two base station antennas (uhf and vhf), a small portable uhf satellite antenna, and an aircraft blade antenna.

1-11. The handset provides the primary link between the operator and the PET system. The handset contains a push-to-talk (PTT) button that keys the transmitter when the operator wishes to transmit.

1-12. The PET system, with the major assemblies identified, is shown in Figure 1-4.



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PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature
			01-P04548L007	PET SYSTEM
001	1	94990	01-P04539L007	TRANSCEIVER ASSY
002	1	94990	85-P04534L001	ANT, UHF
003	1	94990	85-P04533L001	ANT, VHF
006	1		H-189/GR	HANDSET
010	1	94990	01-P08693V001	BATTERY PACK, PTMG120

Figure 1-4. PET System, Assembly Locations

1-13. REFERENCE DATA. The operating parameters of the PET transceiver are listed in Table 1-1. The transceiver physical characteristics are listed in Table 1-2 and the environmental limitations are listed in table 1-3.

Table 1-1. Operating Parameters

Function	Characteristics
Frequency	
VHF range	116.000 to 149.975 MHz
UHF range	225.000 to 399.975 MHz
Tuning increments	25 kHz
Stability	5 parts per million
Preset channels	8 total, 2 of which are guard channels
Audio response	
PT-AM/FM	300 to 3 kHz (±3 dB)
CT-AM/FM	10 to 10.24 kHz (±3 dB)
Operating modes	
Plain text (PT)	DSB-AM or FM
Cipher text (CT)	UHF AM or FSK (use either a TSEC/KY-57 or TSEC/KY-58)
T2/R1	Relay mode, receive on preset channel 1 and transmit on preset channel 2.
Beacon	Emergency sweep audio
Modulation	AM or FM
Scanning	2 guard channels plus 1 preset channel
Transmitter	
VHF	
High power output	5 Watts CW (±2 dB) AM/FM
Low power output	1.5 Watts CW (±2 dB) AM/FM
Beacon power output	
High power	5 Watts (±2 dB) AM/FM
Low power	1.5 Watts (±2 dB) AM/FM

Table 1-1. Operating Parameters (Cont)

Function	Characteristics
UHF	
High power output	5 Watts CW (±2 dB) AM 20 Watts CW (±2 dB) FM
Low power output	1.5 Watts CW (±2 dB) AM 5 Watts CW (±2 dB) FM
Beacon power output	
High power	5 Watts (±2 dB) AM 20 Watts (±2 dB) FM
Low power	1.5 Watts (±2 dB) AM 5 Watts (±2 dB) FM
Modulation Characteristics	
AM (PT or CT)-VHF/UHF	70% nominal at 1 kHz
FM-VHF	±4 kHz nominal deviation at 1 kHz
FM (PT) or FSK (CT)-UHF	±8 kHz nominal deviation at 1 kHz
Beacon (PT)	
AM	50% minimum
FM	±4 kHz nominal deviation VHF, ±8 kHz nominal deviation UHF
Miscellaneous	
Spurious output	60 dB below CW carrier (nominal)
Harmonic output	40 dB below CW carrier (nominal)
Output Impedance	50 Ohms (nominal)
Transmitter protection	No transmitter damage results from shorts or opens at antenna connector
Receiver	
Sensitivity	
VHF-AM (PT)	-100 dBm for $\frac{S+N+D}{N+D}$ of 10 dB with 30% modulation at 1 kHz
VHF-FM (PT)	-104 dBm for $\frac{S+N+D}{N+D}$ of 10 dB with ±4 kHz deviations at 1 kHz
UHF-AM (PT)	-104 dBm for $\frac{S+N+D}{N+D}$ of 10 dB with 30% modulation at 1 kHz

Table 1-1. Operating Parameters (Cont)

Function	Characteristics
UHF-FM (PT)	-115 dBm for $\frac{S+N+D}{N+D}$ of 10 dB with ±8 kHz deviation at 1 kHz.
UHF-AM (CT)	-110 dBm for $\frac{S+N+D}{N+D}$ of 10 dB with 70% modulation at 1 kHz
UHF-FM (CT)	-115 dBm for $\frac{S+N+D}{N+D}$ of 10 dB with ±8 kHz deviation at 1 kHz
Miscellaneous	
Noise figure UHF	6.0 dB (typical)
IF selectivity	6.0 dB down ±15 kHz
Spurious response	80 dB down (typical)
Image response	60 dB down (typical)
Squelch	Adjustable
Speaker audio power	50 mW nominal

Table 1-2. Physical Characteristics

Dimensions (w/o power supply)	
Height	5.2 inches
Width	11.8 inches
Depth	9.0 inches
Weight	16 pounds

Table 1-3. Environmental Characteristics

Temperature, operating	-20° C to +55° C (includes sun load)
Humidity	90% (short term)
Altitude	15,000 ft. operating

SECTION 2

OPERATION

2-1. GENERAL

2-2. Information for operating the PET system is provided in this section. The information includes a functional description of all operating controls and indicators, and procedures for manual and preset operations.

CAUTION

Caution should be exercised when servicing the radio and operating the transmitter with the antennas. The RF field radiated from the tip of the antenna could cause facial burns or eye damage if the antenna is held closer than 4 inches for extended periods while transmitting. When operating in the UHF FM HIGH power (20 watt) mode, the minimum distance should be 16 inches.

2-3. CONTROLS AND INDICATORS

2-4. All controls and indicators used for the operation of the transceiver are located on the transceiver and control unit front panels. Control functions are described in Tables 2-1 and 2-2, and their locations are shown in Figure 2-1.

Table 2-1. Transceiver Controls and Indicators

Control/Indication	Type	Function
HANDSET	Five pin connector	Provides connection for handset
RETRANSMIT	Five pin connector	Provides connection for retransmit capability
TRANSMIT	LED	Indicates that transmitter is producing power.
SPEAKER/MODE	3 position toggle switch	
PT ON		Switches the speaker on during plain text operation
PT OFF		Switches the speaker off during plain text operation (or CT operation with KY-65 equipment)
CT		Switches the PET to the cipher text mode of operation with the speaker off (applicable to KY-57 and KY-58 only)
UHF ANT	Type UHF coaxial connector	Provides connection for uhf antenna

Table 2-1. Transceiver Controls and Indicators (Cont)

Control/Indication	Type	Function
X MODE	19 Pin connector	Provides connections for test measurements, remote operations and connection to TSEC/KY-57/KY-58
Fuse 5A	5 amp, fast blow	Provides overcurrent protection for transceiver and remote control unit.
VHF ANT	Type N coaxial connector	Provides connection for vhf antenna

Table 2-2. Remote Control Unit Controls and Indicators

Control/Indicator	Type	Function
SQ	Potentiometer	Adjusts receiver squelch threshold sensitivity.
Frequency display	7-segment LED displays (6 total)	Displays current operating frequency when READ pushbutton switch is depressed.
Function selector	Ten-position rotary switch	
MAN		Allows both receive and transmit frequencies to be selected manually by pushbutton frequency selector switches.
1 through 6, GD A, GD B		Allows selection of frequencies preset into transceiver memory.
T2/R1		Selects preset frequency at function selector switch position 2 for transmitting and position 1 for receiving.
Beacon	SPDT toggle switch	
BEACON		Causes transceiver to continuously transmit carrier modulated with swept audio tone.
NORM		Places transceiver into normal operating mode.

Table 2-2. Remote Control Unit Controls and Indicators (Cont)

Control/Indicator	Type	Function
XMT PWR	SPDT toggle switch	
HIGH		Sets transmitter output to high power: VHF, AM/FM — 5 watts UHF, AM — 5 watts UHF, FM — 20 watts
LOW		Sets transmitter output to low power: VHF, AM/FM — 1.5 watts UHF, AM — 1.5 watts UHF, FM — 5 watts
Edge-Light (2)	Screw-in lamp with holder	Lights when READ pushbutton switch is depressed.
LOAD	Pushbutton switch	When depressed, enters frequency set by the pushbutton frequency selector switches into memory location corresponding to the positions 1 through 6, GD A, GD B, as selected by the function selector switch (SCAN must be OFF).
VOL	Potentiometer	Adjusts receiver audio output.
Frequency selectors	Five pushbutton switches	Selects operating frequency for manual operation, and preset frequencies for entry into memory when LOAD switch is depressed.
PWR	SPDT toggle switch	
Up position		Applies power to PET system.
OFF		Removes power from PET system.
Indicator	LED (green)	Lights when power is applied to PET system.
AM/FM	SPDT toggle switch	Selects either AM or FM modulation for receiving and transmitting.
READ	Pushbutton switch	When depressed, activates frequency display and panel edge-lights.

Table 2-2. Remote Control Unit Controls and Indicators (Cont)

Control/Indicator	Type	Function
SCAN	SPDT toggle switch	
GD		In receive mode, causes receiver to scan the frequencies stored in frequency positions GD A, GD B, and one of the remaining six positions as determined by setting of the function selector switch.
OFF		Disables scanning feature and enables transceiver to operate normally.

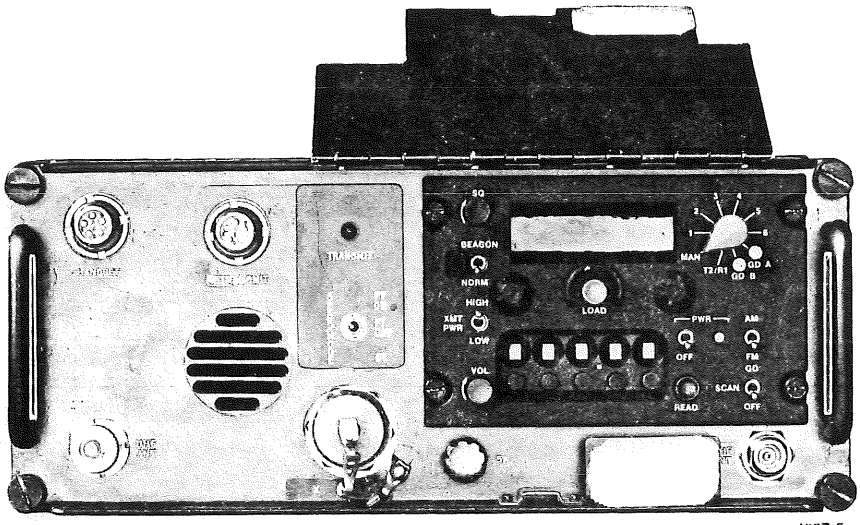

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Figure 2-1. Remote Control Unit and Transceiver Controls and Indicators

2-5. OPERATIONAL CHECKOUT

2-6. GENERAL. The transceiver can be used for normal operation once the installation described in Section 3 is complete. Programmed control of the PET system is provided by the control unit. The frequency tuning is performed either by manually setting the pushbutton frequency selector switches to one of the 8,360 possible frequencies or by selecting one of the preset frequencies stored in the control unit memory. The preset frequencies are stored in the memory after installation and may be reset anytime the PET is on (see paragraph 2-12). The nonvolatile characteristic of the memory allows power to be removed from the control unit without the loss of the preset frequencies. When power is restored, the preset frequencies, including guard channels, are available for use. This allows power supplies to be changed and the control unit can be removed for remoting purposes without the loss of the presets. Another feature of the remote control unit is an LED display of the frequency of operation when the READ pushbutton is

depressed. When transmitting and receiving on the same frequency, that frequency is displayed. When transmitting and receiving on two different frequencies, the receive frequency is displayed while receiving, and the transmit frequency is displayed when the transmitter is keyed. To conserve battery power, the display is illuminated only when the READ pushbutton is depressed.

2-7. The operating procedures given in the following paragraphs provide instructions for power turn-on and for utilizing the normal operating modes of the PET system.

2-8. TURN ON PROCEDURE

2-9. Refer to paragraph 2-3 for the location and functional description of the controls and indicators, and perform the following steps:

a. Verify that PET system is connected for operation in accordance with the installation instructions contained in Section 3.

b. At the control unit, set the PWR switch to the up position.

c. At the transceiver front panel:

(1) Set the SPEAKER/MODE switch to PT ON for front panel audio output. If audio is not desired from the front panel speaker, set the SPEAKER MODE switch to the PT OFF position.

(2) Adjust the VOL control until the noise level is audible in the handset or speaker (control unit SQ control must be in maximum ccw position).

d. At the control unit, adjust the SQ control for the desired squelch sensitivity.

2-10. MAIN FREQUENCY SELECTION

2-11. MANUAL SELECTION. Manual frequency selection is accomplished by selecting the manual operating mode and setting the pushbutton frequency selector switches to one of the 8,360 possible frequencies. The transceiver manual mode of operation is selected at the control unit as follows:

a. At the function selector switch, select the MAN position.

b. Set the desired operating frequency on the five-section pushbutton frequency selector switch.

NOTE

When the function selector switch MAN position is selected, the scanning feature (paragraph 2-18) of the PET system is disabled.

2-12. PRESET SELECTION. Preset frequency selection is accomplished by loading up to eight frequencies into the electronic memory. Once loaded, the preset frequencies may be routinely used as selected by changing the position of the control unit function selector switch. At the control unit, load the preset frequencies into memory as follows:

a. With the PET system on, set the function selector switch to position 1.

b. Select the desired frequency to be loaded into memory on the five-section pushbutton frequency selector switch.

c. Check that the SCAN switch is in the OFF position.

NOTE

If the switch is not in the OFF position, a random frequency may be inadvertently loaded into position 1, or GD A or GD B positions.

d. Depress the LOAD switch. This loads the selected frequency into the control unit memory. Any time the function selector switch is reset to position 1, the system automatically tunes to the preset frequency stored for that position.

e. Repeat steps b through d for presetting function selector positions 2 through 6, GD A, and GD B as required.

f. Check that the desired frequencies were properly loaded by pressing the READ button for each selection switch position and noting the frequency on the LED display.

2-13. RECEIVE AND TRANSMIT

2-14. RECEIVE. To receive on a main frequency, perform the following steps:

a. Turn the PET system on as instructed in paragraph 2-8.

b. At the control unit:

(1) Set the SCAN switch to OFF.

(2) Set the AM/FM switch to the type of modulation to be received.

(3) Select the desired operating frequency, either manually (paragraph 2-11) or by setting the function selector switch to one of eight preset frequencies (paragraph 2-12).

(4) Verify that frequency is correct by depressing the READ pushbutton and noting the frequency on the LED frequency display.

2-15. TRANSMIT. To transmit perform the following steps:

a. Verify that the proper antenna for the frequency being used (vhf or uhf) is attached to the PET system.

b. At the control unit:

(1) Set the SCAN switch to OFF.

(2) Set the AM/FM switch to the type of modulation to be transmitted.

(3) Set the XMT PWR switch to the HIGH or LOW position depending upon the transmit power desired (see Table 2-2, XMT PWR).

(4) Select the desired operating frequency, either manually (paragraph 2-11) or by setting the function selector switch to one of eight preset frequencies (paragraph 2-12).

(5) Depress the READ pushbutton and verify that the frequency shown on the LED frequency display is correct.

c. To transmit, depress the push-to-talk switch on the handset.

2-16. GUARD FREQUENCY SELECTION

2-17. The two guard channel receive frequencies (GD A and GD B) can be preset into the electronic memory as outlined in paragraph 2-12. Either guard frequency may be monitored by setting the function selector switch to the desired guard channel (GD A or GD B).

NOTE

If unit is in scan mode of operation and function selector switch is in either the GD A or GD B position, the unit operates only in these positions and does not scan. The amber LED lights when either GD A or GD B is selected and the receiver is unsquelched.

2-18. GUARD FREQUENCY SCANNING

2-19. While receiving on any one of the six main frequencies, as determined by the setting of the function selection switch (positions 1 through 6), the guard channels may be scanned for any messages. This is accomplished by setting the guard scanning switch (SCAN switch) to the GD position. The PET system then alternately monitors the selected main receiver frequency and the guard frequencies for a short period of time to determine if there is any message traffic on the frequency. When a message is detected, the scanning stops and that channel is monitored. If the message is received on the channel A, and GD A LED on the RCU panel lights. If the message is received on channel B, the BD G LED onthe RCU panel lights. If neither of the LED's light while receiving a message, the monitored frequency is one of the six main frequencies, as selected by the function selector switch.

2-20. After a message is completed, the transceiver continues to monitor the one channel for about four seconds before scanning is resumed. Once scanning is resumed it continues until another message is detected on one of the three frequencies.

NOTE

If the press-to-talk pushbutton is depressed for transmission whenever the SCAN mode is in operation, the transceiver transmits on the frequency selected by the function selector switch. If it is desired to respond on channel GD A or GD B, the function selector switch must be set to that guard channel before pressing the push-to-talk button. For continuing scan, the function selector switch should be returned to the main channel frequency. After transmission, the transceiver monitors the message frequency first before resuming scanning.

2-21. To initiate guard frequency scanning, perform the following steps:

a. Turn the PET system on as described in paragraph 2-8.

b. Set the BEACON/NORM switch to NORM.

c. Set the SCAN switch to OFF.

d. Enter preset frequencies as described in paragraph 2-12.

e. At the function selector switch, select any 1 through 6 position.

f. Adjust the volume (VOL) control as required.

g. While no signal is being received on the channel monitored, adjust squelch (SQ) control until receiver just squelches.

h. Set the SCAN switch to GD.

The PET system is now in the guard frequency scan mode of operation.

2-22. FUNCTION OF T2/R1 POSITION

2-23. The T2/R1 position on the function selector switch sets the transmitter frequency to the preset frequency of the selector switch position 2, and sets the frequency of the receiver to the preset frequency of selector switch position 1. To verify normal operation of the T2/R1 position of the function selector switch, terminate the transceiver into the proper antenna or load, and perform the following steps:

a. Turn the PET system on as described in paragraph 2-8.

b. At the control unit:

(1) Verify that the frequencies for function selector switch positions 1 and 2 are set as described in paragraph 2-12.

(2) Set the function selector switch to the T2/R1 position.

(3) Depress the READ pushbutton to illuminate the LED frequency display. Verify that the frequency set in preset position 1 is displayed.

c. Check transmit frequency by depressing the push-to-talk switch on the handset while keeping the READ pushbutton depressed, and verify that the frequency stored in preset position 2 is displayed.

2-24. BEACON

2-25. Setting the beacon switch to the BEACON position causes the PET system to transmit audio tones continuously. To prepare the PET system for the beacon mode of operation, perform the following steps:

a. Turn the PET system on as described in paragraph 2-8.

b. Select the desired operating frequency, either manually (paragraph 2-11) or by setting the function selector switch to one of eight preset frequencies (paragraph 2-12).

c. Set the AM/FM switch to desired modulation.

d. Depress the READ pushbutton and verify that the proper operating frequency is displayed on the LED frequency display.

e. Set the XMT PWR to HIGH or LOW for transmission (see table 2-2 for transmit power output).

NOTE

Transmitting time in beacon mode is extended in XMT PWR - LOW position.

f. Set the BEACON/NORM switch to the BEACON position. The PET system is now transmitting at the selected frequency. The carrier is modulated with a tone that sweeps from approximately 300 Hz to 3 kHz.

2-26. RELAY OPERATION.

2-27. In the relay mode of operation two PET transceivers are connected "back-to-back" so that signals received by one unit are retransmitted by the other unit on another frequency. Relay operations are described in the following steps:

a. Set up two PET transceivers as shown in Figure 2-2.

b. Select the desired frequency on PET number 1. Selection is either manually (para 2-11) or by the function selector switch to a preset frequency (para 2-12).

c. Select the desired modulation mode (AM or FM).

d. Set the transmit frequency on PET number 2 to a different frequency than PET number 1.

e. Set the modulation mode of PET number 2 as desired.

f. Adjust the volume on PET number 1. To accomplish this, connect a handset to PET number 1. Turn the squelch control CCW. Adjust the volume control while listening to the volume of the noise in the handset. The volume control should be adjusted to 1/2 to 3/4 of the full on position.

g. Adjust the squelch control (SQ) on PET number 1 so that no noise is present when there is no signal being received, but the desired audio can be heard when a signal is received.

h. Repeat steps b through g for PET number 2.

i. Select the operating frequencies and modulation modes on both units.

NOTE

Operating frequencies must have a minimum separation of 2 MHz. Physical separation should be greater than 50 feet and/or a metallic object between units.

When one PET receives a signal, the squelch output signal from it keys the transmit of the other PET. The PT AUDIO OUT output of the receive PET then drives the PT input of the transmit PET which modulates the transmitted carrier with the audio signal detected by the receive PET.

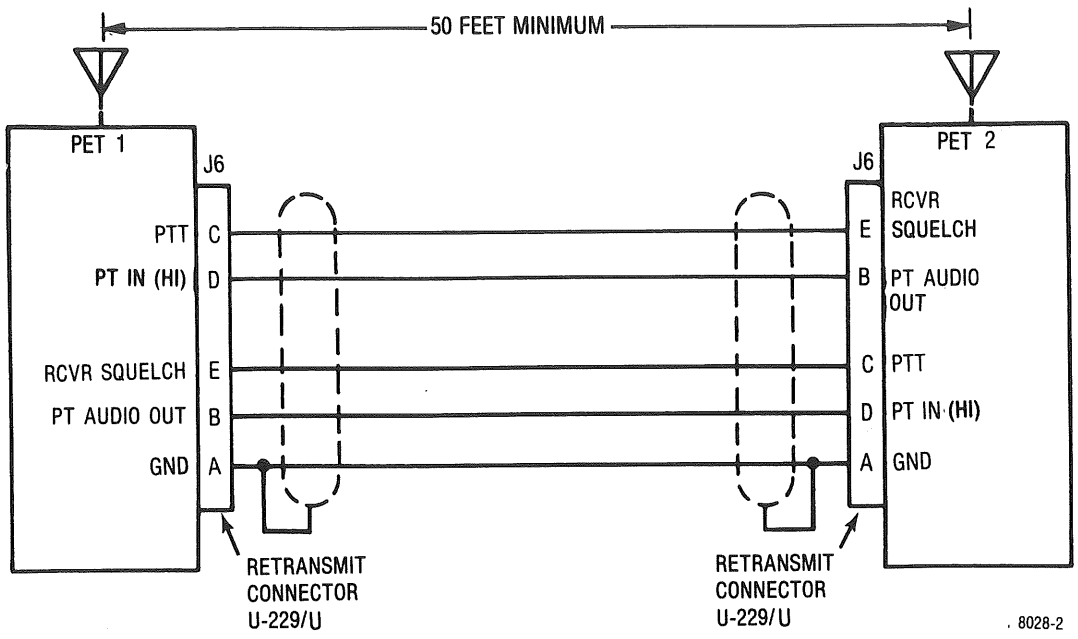

Figure 2-2. PET Relay Operation

NOTE

A repeater cable assembly, part number 30-P09976V001, is available from Motorola.

2-28. CIPHER TEXT (CT)

2-29. In paragraphs 2-8 through 2-27 the PET was in the plain text (PT) mode of operation. The operating procedures for the PT modes of operation also apply to the cipher text (CT) operating procedures. To operate the PET in the CT mode, place the SPKR/MODE switch in the CT position.

2-30. Ciper text operation is functional on both vhf and uhf frequencies on AM and UHF FM. Frequency and type of modulation is selected by PET front panel switch settings. CT operation may be on one of the guard channels or may be operated in the scan mode (see para 2-18). Also, CT operations can be performed in the T2/R1 mode, or in a repeater (relay) function. The beacon may be activated while in the CT mode of operation. In the CT mode of operation the PET front panel speaker is turned off.

2-31. Paragraphs 2-32 through 2-34 describe the operation of a PET transceiver with a KY-57, KY-58, or KY-65 in either the PT or CT modes of operation.

2-32. KY-57 INTERCONNECT

a. Connect the KY-57 and the PET as shown in Figure 2-3.

b. For Plain Text (PT) operation perform the following steps.

(1) Switch the KY-57 "MODE" to "PT"

(2) Switch the PET SPKR/MODE to either PT ON or PT OFF.

(3) Squelch and volume are adjusted on PET transceiver

c. For Cipher Text (CT) operation perform the following steps.

(1) Switch the KY-57 "MODE" to "CT"

(2) Switch the PET SPKR/MODE to CT

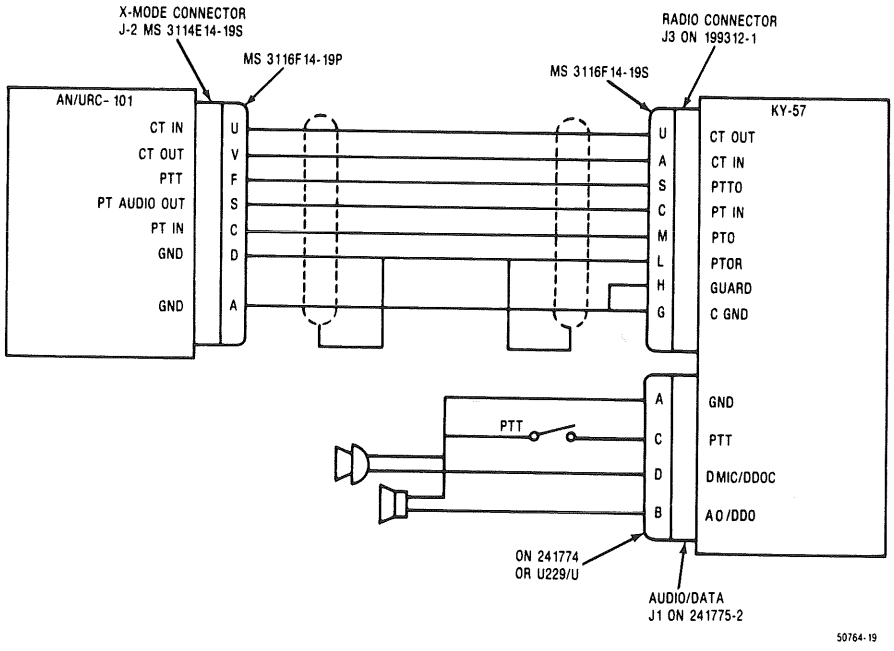

Figure 2-3. KY-57 Interconnect

2-33. KY-58 INTERCONNECT

a. Connect the KY-58 and the PET as shown in Figure 2-4.

b. Set the PET SPKR/MODE switch to either PT ON or PT OFF for both cipher text (CT) and plain text (PT) operation. The CT/PT function is controlled by the KY-58.

c. For Cipher Text (CT) operation switch the PET SPKR/MODE to CT.

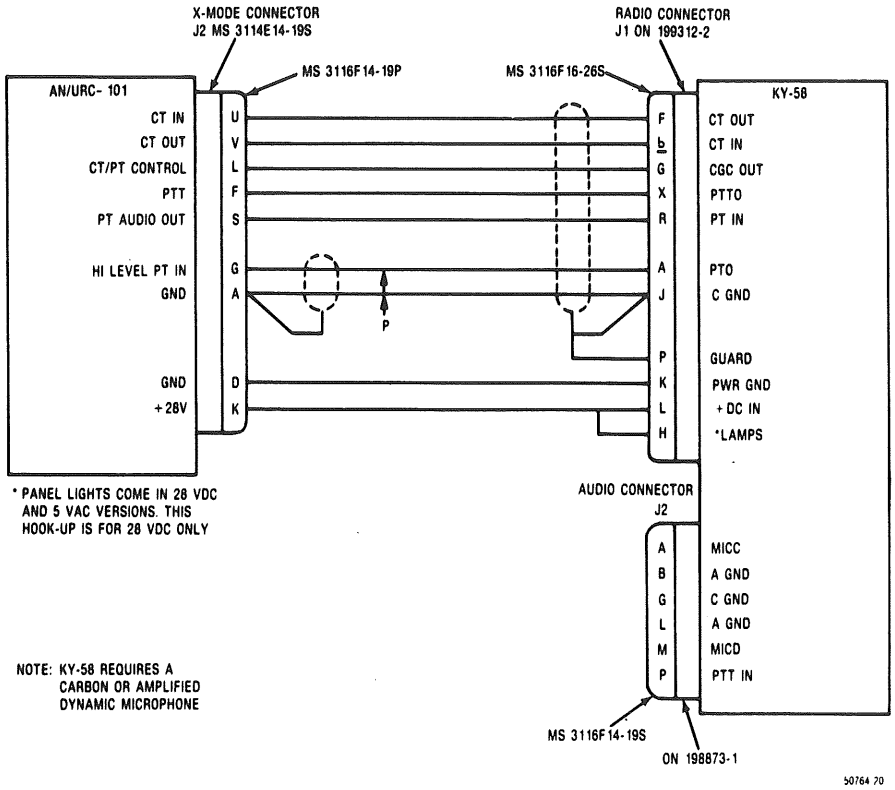

Figure 2-4. KY-58 Interconnect

2-34. KY-65 INTERCONNECT

a. Connect the KY-65 and PET as shown in Figure 2-5.

b. For PT (plain text) and CT (cipher text) operation, set the PET SPKR/MODE switch to PT OFF.

c. For PT operation, set the KY-65 to PLAIN.

d. For CT operation, set the KY-65 to CIPHER.

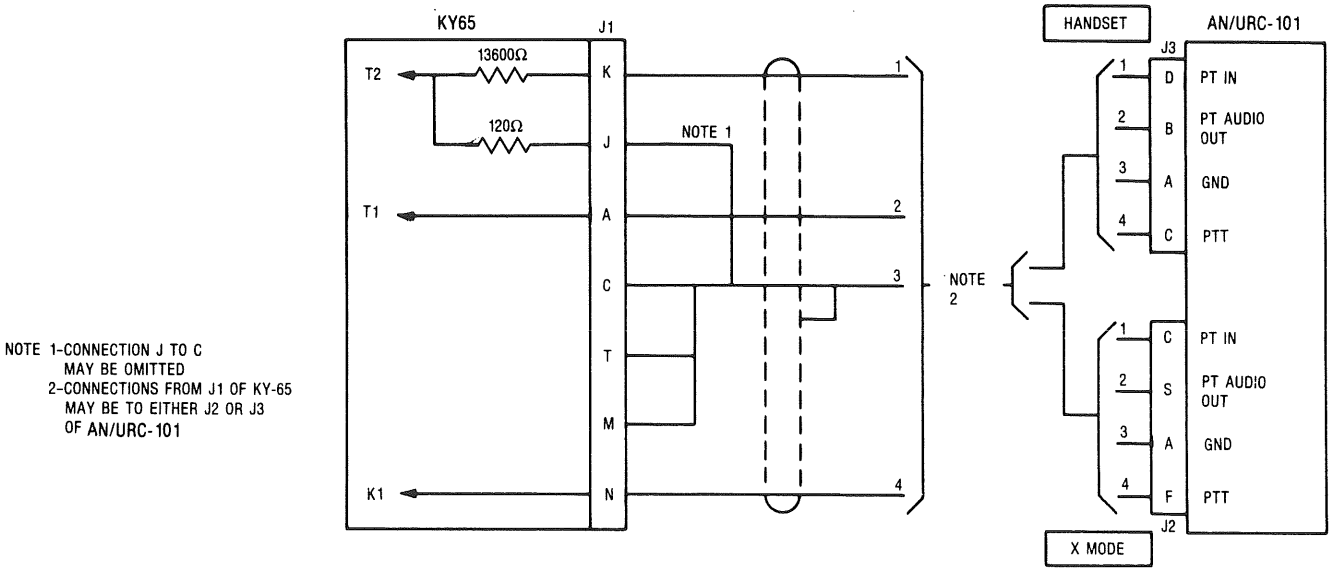

Figure 2-5. KY-65 Interconnect

SECTION 3

INSTALLATION

3-1. GENERAL

3-2. This section contains information necessary for installing the PET system. Included are examples of typical installations, including overall dimensions of the PET system.

3-3. INSTALLATION OPTIONS

3-4. The PET transceiver is designed for portability. One method of installation is to secure it to an accessory backpack carrier with a tray using heavy-duty belts, as shown in Figure 3-1.

3-5. Provisions are included for securing the transceiver to an accessory shock-mounted platform for vehicle or aircraft installations. Locations of the transceiver mounting hooks are shown in Figure 3-2. The platform, complete with shock mounts, may be obtained from the supplier.

NOTE

For maximum operating performance, the antennas should not be adjacent to large metal surfaces.

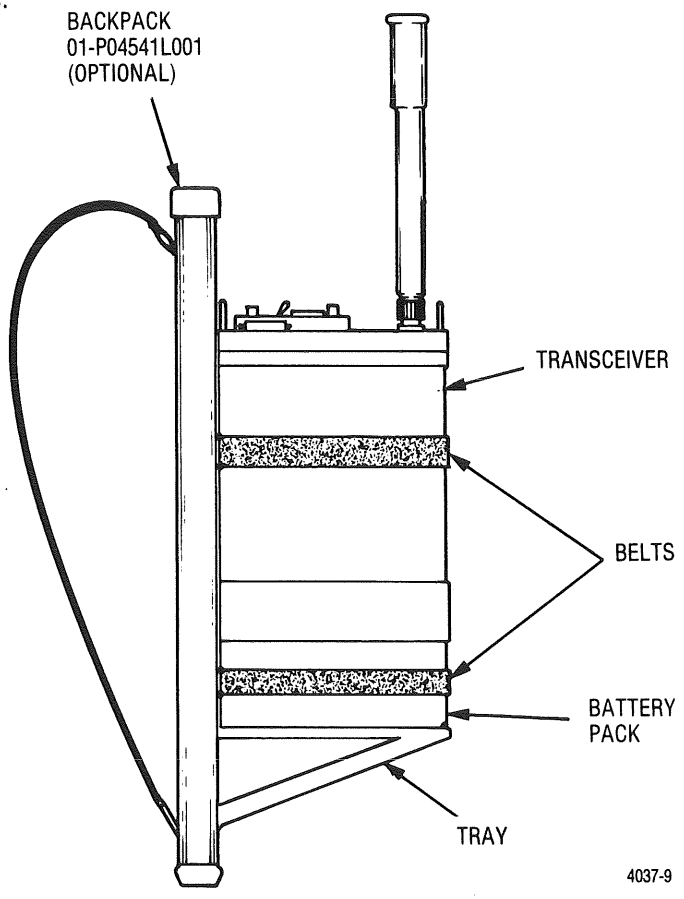

Figure 3-1. Installation of Transceiver Mounted on Backpack

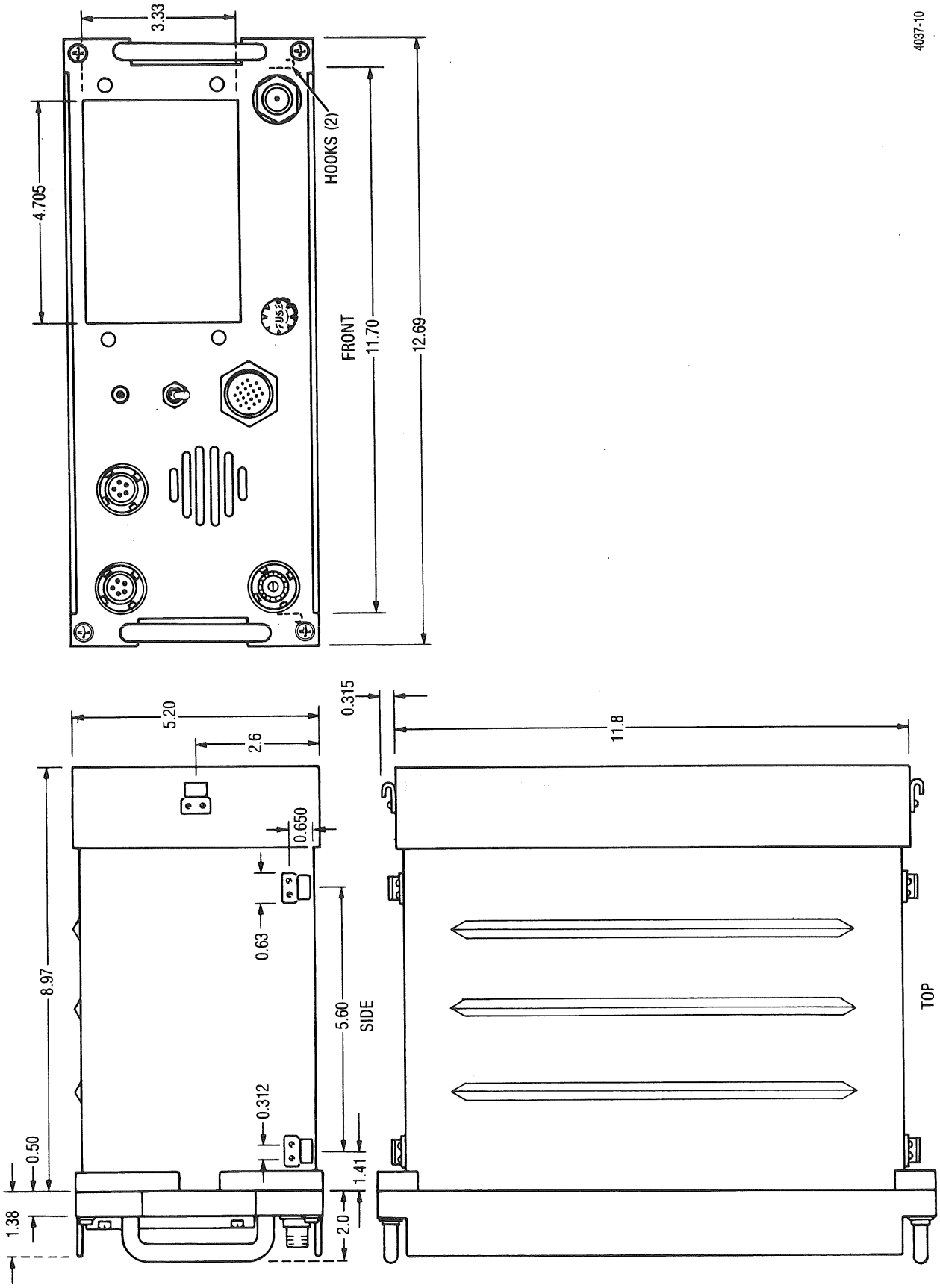

Figure 3-2. Installation Dimensions of Transceiver

3-6. REMOTE CONTROL UNIT

3-7. The remote control unit may be mounted a distance from the transceiver, using the accessory vehicular mounting kit or aircraft mounting kit.

3-8. ANTENNAS

3-9. To install the uhf and vhf antennas, plug each antenna into its respective connector. Secure both antennas by tightening retaining ring until snug (Do not rotate the antenna body).

3-10. HANDSET

3-11. The handset connector is keyed (or notched). To install, rotate connector until notches match and slide onto receptacle. Secure by pushing connector and turning about 1/4 turn until it snaps into place.

3-12. POWER SUPPLY

3-13. The external power supply is a necessary part of the PET transceiver. The power supply will have the necessary emi filtering not only on the case but also on the power input lines. Operating the PET by applying power directly to rear panel connector without electrical or mechanical filtering, could cause serious damage to the PET transceiver or could cause interference with other radios in the adjacent area.

3-14. The supplier has power supplies that have been designed to mate with the PET transceiver. Some of the various types are:

- AC to DC power supply
- DC to DC power supply
- Rechargeable ni-cad battery packs
- Nonrechargeable battery packs

3-15. To install the power supply on the PET transceiver perform the following steps;

a. Align the rear panel input connector on the PET to the mating connector on the power supply. Engage the two connectors together.

b. Fasten the two latches on the power supply to the two catches on the PET transceiver and snap in place.

c. To remove the power supply, perform the above steps in reverse order.

SECTION 4

SYSTEM MAINTENANCE

4-1. INTRODUCTION

4-2. The basic maintenance approach for repairing a defective PET transceiver is to return the entire transceiver to a maintenance shop for repair. Procedures in this chapter are to be used to localize the trouble to a defective module in the transceiver. After the defective assembly is identified, refer to procedures in the appropriate sections of this manual for further maintenance and troubleshooting information. To check the PET transceiver, start at the beginning of the performance tests (paragraph 4-5) and perform the tests in the sequence given.

CAUTION

Caution should be exercised when servicing the radio and operating the transmitter with the antennas. The RF field radiated from the tip of the antenna could cause facial burns or eye damage if the antenna is held closer than 4 inches for extended periods while transmitting.

4-3. TEST EQUIPMENT REQUIRED

4-4. This test equipment listed in Table 4-1, or its equivalent, is required to troubleshoot the transceiver. In addition, interface cables and adapters are required to connect test equipment to the transceiver and modules. These are listed in Table 4-2 along with extension cables and cards needed to provide access to individual assemblies while troubleshooting.

Table 4-1. Test Equipment Required

Description	Part No. or Model No.	Supplier	Qty.
Frequency Counter	HP 5383A	Hewlett Packard	1
Signal Generator	HP 8640B	Hewlett Packard	1
Distortion Analyzer	HP 334A	Hewlett Packard	1
Digital Voltmeter	HP 3465A	Hewlett Packard	1
RMS Voltmeter	HP 3400A	Hewlett Packard	1
30 dB, 100 watt Power Attenuator	769-30	Narda	1
3 dB Power Attenuator	766-3	Narda	1
Power Meter	HP 436A	Hewlett Packard	1

Table 4-1. Test Equipment Required (Cont)

Description	Part No. or Model No.	Supplier	Qty.
Modulation Meter	HP 8901A	Hewlett Packard	1
Audio Oscillator	HP 201C	Hewlett Packard	1
Oscilloscope	TEK 465	Tektronix	1
Power Supply 28V, 5A	HP 6291A	Hewlett Packard	1

NOTE

The tests outlined in paragraphs 4-5 through 4-47 are performed with the antennas disconnected.

Table 4-2. Adapters, Extender Cables, and Extender Cards

Description	Part Number	Supplier	Qty
Extender Card for Transmitter ALC	01-P07207L001		1
Extender Card for Control Logic and Memory Boards	01-P07208L001		1
Extender Cable for Synthesizer	30-P07209L001		1
Extender Cable for RCU	30-P07210L001		1
Extender Cable for Receiver	30-P07211L001		1
Extender Cable for VCOs	30-P07212L001		1
Card Puller	66-P08094B001		1
50-ohm cable with BNC male and UHF male connectors			1
50-ohm cable with BNC male and type N male connectors			1
BNC Jack to OSM Plug	21190	Omni Spectra	2
BNC Jack to OSM Jack	21170	Omni Spectra	2
Battery Connector	ON101703	U.S. Components	1
Handset Connector	U-229/U		1
Alignment Tool	66-P16059A001		1

4-5. PERFORMANCE TESTS

4-6. TEST SETUP. Connect the equipment as illustrated in Figure 4-1.

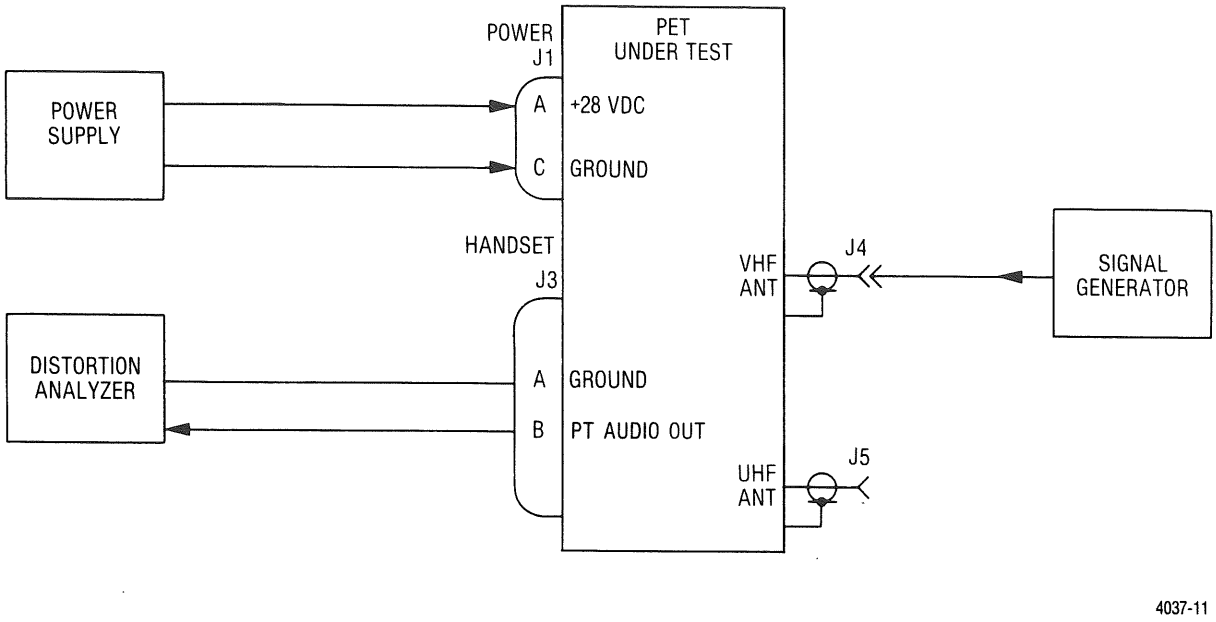

Figure 4-1. PET System Test Setup (Receiver PT Tests)

4-7. PRESET SELECTION

a. Load the frequencies listed in Table 4-3 into memory as described in paragraph 2-12.

b. Turn the transceiver power off at the RCU front panel, then back on.

c. Verify that the frequencies loaded into each channel are retained by depressing the READ switch and noting the frequency display for each channel.

Table 4-3. Channel Frequencies

Selector Switch Position	Frequency	Input/Output Antenna Port
1	121.100 MHz	VHF
2	132.225 MHz	VHF
3	143.350 MHz	VHF
4	244.475 MHz	UHF
5	275.500 MHz	UHF
6	316.625 MHz	UHF
GD A	347.750 MHz	UHF
GD B	388.875 MHz	UHF

4-8. RECEIVER (PT). Paragraphs 4-9 through 4-19 are for plain text operation.

4-9. PT FM 10 DB Sensitivity. The SINAD sensitivity is defined by the following equation.

$$\text{SINAD} = \frac{\text{Signal + Noise + Distortion}}{\text{Noise + Distortion}}$$

To check the 10 dB SINAD sensitivity, retain the test setup of Figure 4-1 and set the transceiver controls as follows:

- PWR — ON
- AM/FM — FM
- SCAN — OFF
- SQ — Fully CCW
- SPKR MODE — PT ON
- BEACON/NORM — NORM
- XMT PWR — HIGH
- Selector — 1
- VOL — Mid-range

4-10. Perform the following steps:

a. Apply a -47 dBm 121.100 MHz rf signal, frequency modulated with a 1 kHz tone at ±4 kHz deviation, to the VHF antenna port.

b. Adjust the VOL control to give 1.6 Vrms on the distortion analyzer. Adjust the distortion analyzer "SET LEVEL" reference to 0 dB.

c. With the analyzer in the "DISTORTION" position, reduce the input rf signal level to read -10 dB (reference 0.0 dB). It may be necessary to reset the distortion analyzer "SET LEVEL" 0 dB reference as the rf input level is reduced.

d. When -10 dB is obtained on the distortion analyzer, note the rf input level from the signal generator. The input level required for 10 dB SINAD should be no greater than -104 dBm.

e. Repeat steps a through d for the other VHF frequencies positions 2 and 3 as listed in Table 4-3.

f. Increase the modulation of the signal generator from ±4 kHz to ±8 kHz deviation. Be sure the input signal is applied to the UHF ANT connector, J5. Repeat steps a through d for the uhf frequency positions 4, 5, 6, GD A, and GD B as listed in Table 4-3. The input signal for fm uhf frequencies for 10 dB SINAD should be no greater than −115 dBm.

4-11. PT FM Audio Response. To check the fm audio response, perform the following steps:

a. Set the selector switch to position 6 for an operational frequency of 316.625 MHz.

b. Adjust the signal generator to 316.625 MHz at -60 dBm with 1 kHz fm at ±8 kHz deviation.

c. Place the distortion analyzer in the voltmeter mode. Adjust the VOL control on the RCU for approximately 1.6 Vrms audio output from the transceiver.

d. Adjust the "SET LEVEL" on the analyzer for reference only. Note the reference level in dB.

e. Measure the audio frequency response by adjusting the modulation frequency as follows and verify the specified output levels while maintaining a constant ±8 kHz deviation:

Modulation Frequency (Hz)	300	1000	3000
Audio output, dB reference to 1 kHz	±3 dB	0	±3 dB

4-12. PT FM Audio Distortion. To check the fm audio distortion, perform the following steps:

a. Set the selector switch to position 6 for an operation frequency of 316.625 MHz.

b. Adjust the signal generator for 316.625 MHz at -47 dBm with 1 kHz fm at ±8 kHz deviation.

c. Place the distortion analyzer in the voltmeter mode. Adjust the VOL control on the RCU for 1.6 Vrms audio output from the transceiver.

d. Measure the audio distortion. It should be less than 10%.

4-13. PT AM 10 dB SINAD Sensitivity. To check the AM 10 dB SINAD sensitivity, perform the following steps:

a. Adjust the signal generator to 121.100 MHz at -47 dBm with 1 kHz am at 30% modulation. Place the selector switch to position 1 and the input connector to the VHF ANT connector, J4.

b. Set the RCU AM/FM switch to AM and adjust the VOL Control to give 1.6 Vrms on the distortion analyzer.

c. With the analyzer in the "DISTORTION" position, reduce the rf input level to read -10 dB (reference 0.0 dB). It may be necessary to reset the distortion analyzer "SET LEVEL" to 0 dB reference as the rf input level is reduced.

d. When -10 dB is obtained on the distortion analyzer, note the rf input level from the signal generator. The input level required for 10 dB SINAD should be no greater than -100 dBm.

e. Repeat steps a through d for the other vhf frequencies (positions 2 and 3) as listed in Table 4-3.

f. Repeat steps a through d for the uhf frequency positions 4, 5, 6, GD A, and GD B as listed in Table 4-3. Be sure the input signal is applied to the UHF ANT connector, J5. The input signal for am uhf frequencies for 10 dB SINAD should be no greater than -104 dBm.

Table 4-4. Transmitter Power Output

Step	Selector Switch Position	Frequency in MHz	AM/FM	XMT PWR	Power Output* in Watts (dBm)
1	1	121.100	AM	HIGH	5.0 (+37)
2	1	121.100	FM	HIGH	5.0 (+37)
3	1	121.100	AM	LOW	1.5 (+32)
4	1	121.100	FM	LOW	1.5 (+32)
5	2	132.225	AM	HIGH	5.0 (+37)
6	2	132.225	FM	HIGH	5.0 (+37)
7	2	132.225	AM	LOW	1.5 (+32)
8	2	132.225	FM	LOW	1.5 (+32)
9	3	143.350	AM	HIGH	5.0 (+37)
10	3	143.350	FM	HIGH	5.0 (+37)
11	3	143.350	AM	LOW	1.5 (+32)
12	3	143.350	FM	LOW	1.5 (+32)
13	4	244.475	AM	HIGH	5.0 (+37)
14	4	244.475	FM	HIGH	20.0 (+43)
15	4	244.475	AM	LOW	1.5 (+32)
16	4	244.475	FM	LOW	5.0 (+37)
17	5	275.500	AM	HIGH	5.0 (+37)
18	5	275.500	FM	HIGH	20.0 (+43)
19	5	275.500	AM	LOW	1.5 (+32)
20	5	275.500	FM	LOW	5.0 (+37)
21	6	316.625	AM	HIGH	5.0 (+37)
22	6	316.625	FM	HIGH	20.0 (+43)
23	6	316.625	AM	LOW	1.5 (+32)
24	6	316.625	FM	LOW	5.0 (+37)
25	GD A	347.750	AM	HIGH	5.0 (+37)
26	GD A	347.750	FM	HIGH	20.0 (+43)
27	GD A	347.750	AM	LOW	1.5 (+32)
28	GD A	347.750	FM	LOW	5.0 (+37)
29	GD B	388.875	AM	HIGH	5.0 (+37)
30	GD B	388.875	FM	HIGH	20.0 (+43)
31	GD B	388.875	AM	LOW	1.5 (+32)
32	GD B	388.875	FM	LOW	5.0 (+37)

*All power output measurements ±2 dB.

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4-14. **PT AM Audio Response.** To check the am audio response, perform the following steps:

a. Set the selector switch to position 1 for an operational frequency of 121.100 MHz. Set the AM/FM switch to AM. Connect the signal to the VHF antenna port J4.

b. Adjust the signal generator to 121.100 MHz at −60 dBm with 30%, 1 kHz, am modulation.

c. Place the distortion analyzer in the voltmeter mode. Adjust the VOL control on the RCU for approximately 1.6 Vrms audio output from the transceiver.

d. Adjust the "SET LEVEL" on the analyzer to a convenient reference level. Note the reference level in dB.

e. Measure the audio frequency response by adjusting the modulation frequency as follows and verify the specified output levels while maintaining a constant 30% AM:

Modulation Frequency (Hz)	300	1000	3000
Audio Output, dB reference to 1 kHz	±3 dB	0	±3 dB

4-15. **PT AM Audio Distortion.** To check the am audio distoriton, perform the following steps:

a. Set the selector switch to position 1 for an operational frequency of 121.100 MHz.

b. Adjust the signal generator to 121.100 MHz at -47 dBm with 30%, 1 kHz, am modulation.

c. Place the distortion analyzer in the voltmeter mode. Adjust the VOL control on the RCU for 1.6 Vrms audio output from the transceiver.

d. Measure the audio distortion. It should be less than 10%.

4-16. **Receiver Hum and Noise.** To check the receiver hum and noise, perform the following steps:

a. Set the selector switch to position 1 for an operational frequency of 121.100 MHz. Set AM/FM switch to FM.

b. Adjust the signal generator to 121.100 MHz at −47 dBm with 1 kHz fm at ±4 kHz deviation.

c. Place the distortion analyzer in the voltmeter mode. Adjust the VOL control on the RCU for 2.24 Vrms audio output from the transceiver.

d. Adjust distortion analyzer "SET LEVEL" to a convenient reference.

e. Remove the modulation only and measure the residual audio level with respect to the reference. The hum and noise should be -26 dB minimum.

4-17. **Receiver Squelch Sensitivity.** To check the receiver squelch sensitivity, perform the following steps:

a. Set the operational frequency of the transceiver to 121.100 MHz and SQ control CCW.

b. Adjust the signal generator to 121.100 MHz and less than -130 dBm.

c. Place the distortion analyzer in the voltmeter mode. Set the meter range to 3 volts.

d. Adjust the squelch control clockwise just to the point of quieting, noted by a sudden drop in the voltmeter reading.

e. Increase the rf input signal level just to the point where squelch breaks (approximatey 0.5 μV).

4-18. Scanning. To check the scanning function, perform the following steps:

a. Set the selector switch to position 1 and remove the rf signal input.

b. Adjust squelch until unit just quiets.

c. Set the GD switch to the GD position.

d. Depress the READ button and notice that the unit scans position 1 and the GD A and GD B frequencies. Dwell time on each frequency should be approximately 0.5 seconds. If receiver unsquelches, readjust squelch until unit just quiets.

e. While keeping the READ button depressed, set the signal generator to 347.750 MHz at −90 dBm (into UHF ANT port, J5). The scanner should stop at GD A and GD A indicator should light.

f. Turn the rf signal off. The scan should resume after approximately 5 seconds.

g. Set the signal generator to 388.875 MHz at -90 dBm. The scanner should stop at GD B and the GD B indicator should light.

h. Turn the rf signal off and let the scan resume.

i. Set the signal generator to 121.100 MHz at −90 dBm (into VHF ANT port, J4). The scanner should stop at position 1 frequency of 121.100 MHz.

4-19. PT Receiver AGC. To check the plain text receiver AGC operation; perform the following steps:

a. Set the selector switch to position 6 for an operational frequency of 316.625 MHz. Set the AM/FM switch to AM.

b. Adjust the signal generator to 316.625 MHz at −47 dBm with 30%, 1 kHz am modulation and apply to UHF ANT port, J5. Adjust the VOL control for a comfortable listening level.

c. Place the signal generator output off and note that the tone immediately turns into receiver noise. This indicates a short am AGC time constant.

d. Set the AM/FM switch to FM. Adjust the signal generator for ±8 kHz deviation, 1 kHz for modulation. Adjust the VOL control for a comfortable listening level.

e. Place the signal generator output level off and note that the tone immediately turns into receiver noise. This indicates a short fm AGC time constant.

4-20. RECEIVER (CT). Paragraphs 4-21 through 4-28 are for cipher text operation:

NOTE

The cipher text portion of the PET transceiver was intended primarily as a UHF function only. Cipher text will function at vhf frequencies at possibly reduced performance, however, the performance test will outline uhf frequencies only.

4-21. CT FM 10 DB Sensitivity. To check the 10 dB SINAD sensitivity connect the test equipment as shown in Figure 4-2. Set the transceiver controls as follows:

- PWR — ON
- AM/FM — FM
- SCAN — OFF
- SQ — fully CCW
- SPKR MODE — CT
- BEACON/NORM — NORM
- XMT POWER — HIGH
- Selector — 4
- VOL - mid range

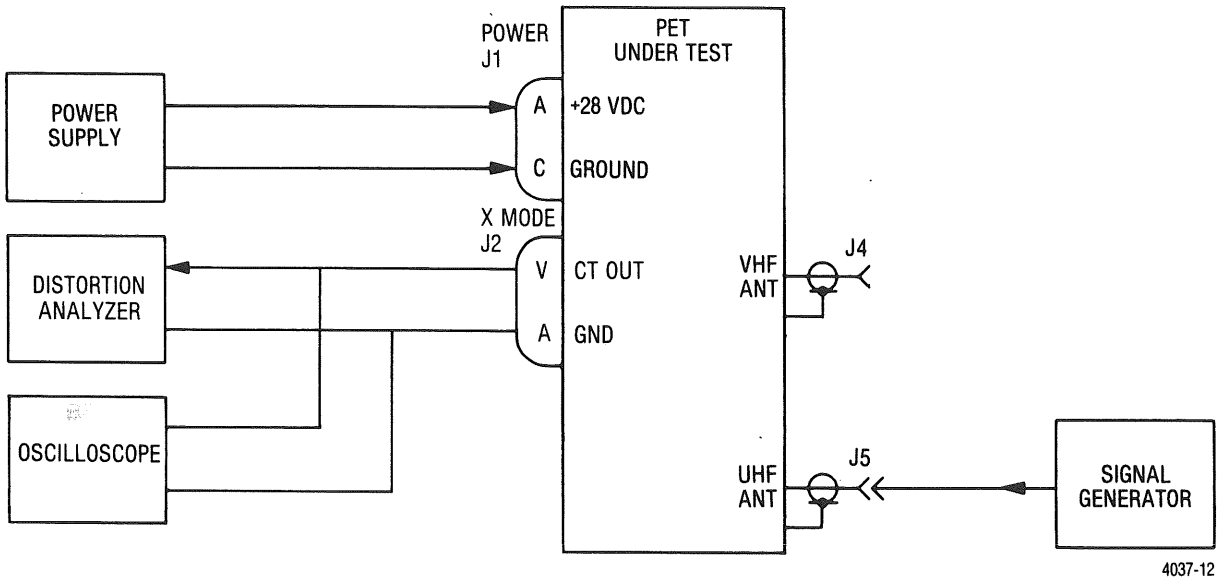


Figure 4-2. PET System Test Setup (Receiver CT Tests)

4-22 Perform the following steps:

a. Apply a -47 dBm 244.475 MHz rf signal, frequency modulated with a 1 kHz tone at ±8 kHz deviation.

b. Observe the oscilloscope and verify that the 1 kHz is 3.0 Vp-p nominal.

c. With the analyzer in the "DISTORTION" position, reduce the input rf signal level to read -10 dB (reference to 0.0 dB). It may be necessary to reset the distortion analyer "SET LEVEL" 0 dB reference as the rf input is reduced.

d. When -10 dB is obtained on the distortion analyzer, note the rf input level from the signal generator. The input level required for 10 dB SINAD should be no greater than -115 dBm.

e. Repeat steps a, c, and d for the other uhf frequency positions 5, 6, GD A, and GD B as listed in Table 4-3.

4-23. CT FM Audio Response. To check the fm audio response, perform the following steps:

a. Set the selector switch to position 6 for an operational frequency of 316.625 MHz.

b. Adjust the signal generator to 316.625 MHz at -60 dBm with 1 kHz at ±8 kHz deviation.

c. Adjust the "SET LEVEL" on the analyzer for a 0 dB reference.

d. Measure the audio frequency response by adjusting the modulation frequency as follows and verify the specified output levels while maintaining a constant ±8 kHz deviation:

Modulation Frequency (Hz)	10	1000	10240
Audio Output, dB reference to 1 kHz	+2, −4 dB	0	+2, −4 dB

4-24. CT FM Audio Distortion. To check fm audio distortion, perform the following steps:

a. Set the selector switch to position 6 for an operational frequency of 316.625 MHz.

b. Adjust the signal generator for 316.625 MHz at -47 dBm with 1 kHz fm at ±8 kHz deviation.

c. Measure the audio distortion. It should be less than 10%.

4-25. CT AM 10 dB SINAD Sensitivity. To check the am 10 dB SINAD sensitivity, perform the following steps:

a. Adjust the signal generator to 244.475 MHz at -47 dBm with 1 kHz, am at 70% modulation. Place the selector switch to position 4.

b. Set the RCU AM/FM switch to AM. Observe the oscilloscope and verify that the 1 kHz is 3.0 Vp-p nominal.

c. With the analyzer in the "DISTORTION" position; reduce the rf level to read -10 dB (reference 0.0 dB). It may be necessary to reset the distortion analyzer "SET LEVEL" to 0 dB reference as the rf input level is reduced.

d. When −10 dB is obtained on the distortion analyzer, note the rf input level from the signal generator. The input level required for 10 dB SINAD should be no greater than -110 dBm.

e. Repeat steps a, c, and d for the other uhf frequency positions 5, 6, GD A, and GD B as listed in Table 4-3.

4-26. CT AM Audio Response. To check the am audio response, perform the following steps:

a. Set the selector switch to position 6 for an operational frequency of 316.625 MHz.

b. Adjust the signal generator to 316.625 MHz at -60 dBm with 70%, 1 kHz, am modulation.

c. Adjust the "SET LEVEL" on the analyzer for a 0 dB reference.

d. Measure the audio frequency response by adjusting the modulation frequency as follows and verify the specified otuput levels while maintaining a constant 70% modulation:

Modulation Frequency (Hz)	10	1000	10240
Audio Output, dB reference to 1 kHz	+2, −4 dB	0	+2, −4 dB

4-27. CT AM Audio Distortion. To check the am audio distortion perform the following steps:

a. Set the selector switch to position 6 for an operational frequency of 316.625 MHz.

b. Adjust the signal generator for 316.625 MHz at -47 dBm with 70%, 1 kHz, am modulation.

c. Measure the audio distortion. It should be less than 10%.

4-28. **CT Receiver AGC.** To check the cipher text receiver AGC operation; perform the following steps:

a. Set the selector switch to position 6 for an operational frequency of 316.625 MHz. Set the AM/FM switch to AM.

b. Adjust the signal generator to 316.625 MHz at -47 dBm with 30%, 1 kHz am modulation.

c. Place the signal generator output off and note on the oscilloscope that a straight line appears and that the receiver noise comes up very slowly. This indicates a long am AGC time constant.

d. Set the AM/FM switch to FM. Adjust the signal generator for ±8 kHz deviation, 1 kHz fm modulation.

e. Place the signal generator output level off and note on the oscilloscope that the tone immediately turns into receiver noise. This indicates a short fm AGC time constant.

4-29. **TRANSMITTER (PT).** Paragraphs 4-30 through 4-35 are for plain text operation.

CAUTION

Do not change frequency while the transmitter is keyed. Also, to prevent damage to the power meter, frequency counter, and modulation meter, have the 30 dB,100 watt attenuator connected between the antenna outputs and the test equipment while transmitting.

4-30. **PT Output Power.** To check the output power, perform the following steps:

a. Connect the transceiver and test equipment as shown in Figure 4-3 except, leave the audio oscillator disconnected.

b. Perform steps 1 through 32 in Table 4-4. Key the transmitter at each step noting the proper selector switch position, AM/FM switch position and XMT PWR switch position. Measure the transmitter power output at each step. Connect the power meter to the proper antenna connection as required.

CAUTION

Do not key the transmitter while changing frequencies.

4-31. **PT Output Frequency.** To check the output frequency, perform the following steps:

a. Replace the power meter with the frequency counter (figure 4-3).

b. Set the selector switch to position GD B for operational frequency of 388.875 MHz.

c. Key the transmitter and measure the output frequency. It should be the selected operational frequency within 0.0005%. Unkey the transmitter.

d. Repeat step c for the remaining seven selector switch positions. Change to the proper antenna output when necessary.

CAUTION

Do not key the transmitter while changing frequencies.

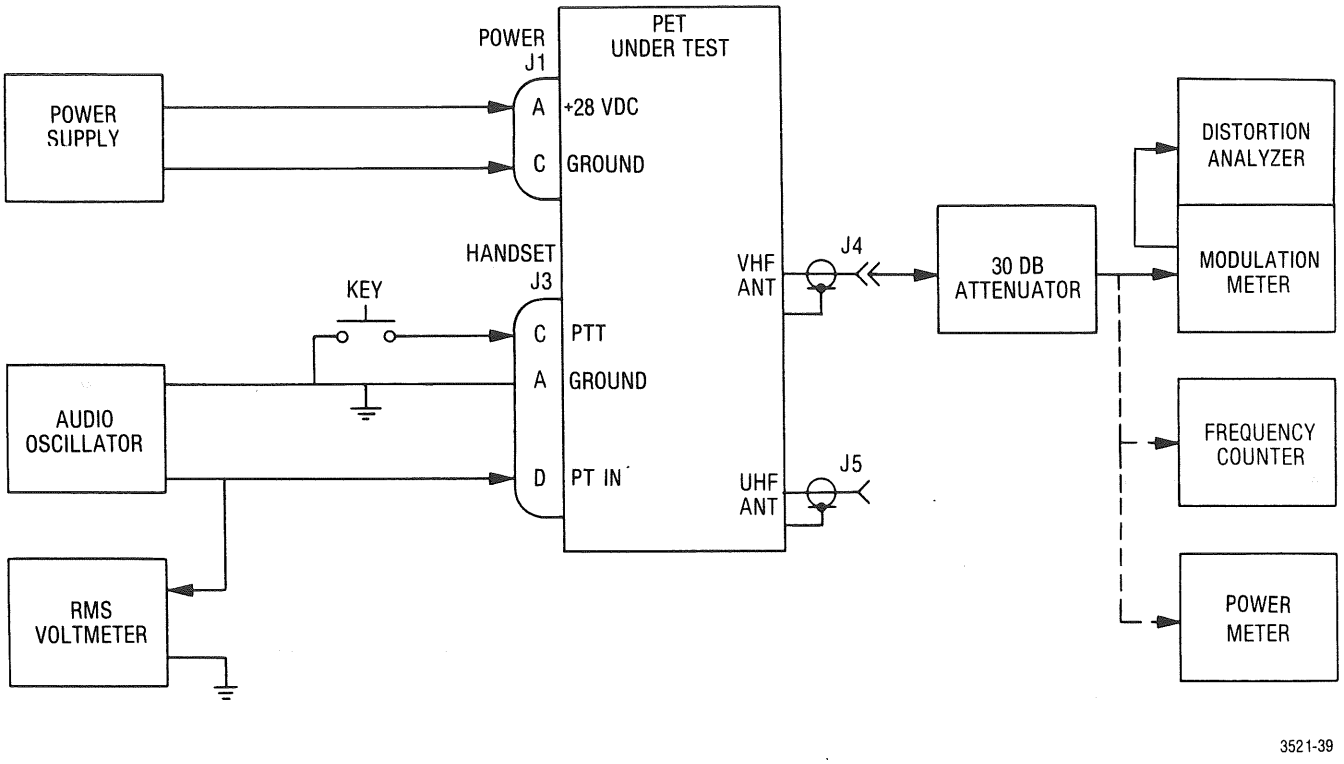


Figure 4-3. PET System Test Setup (Transmitter Tests PT)

4-32. PT Transmitter AM Modulation/Distortion. To check the AM modulation and distortion characteristics, perform the following steps:

a. Connect the audio oscillator to the microphone input connector and the modulation meter to the antenna connector as shown in Figure 4-3.

b. Set the RCU AM/FM switch to AM.

c. Adjust the audio oscillator frequency to 1 kHz at a level of 1.0 mVrms.

d. Set the selector switch to position 1 for an operational frequency of 121.100 MHz.

e. Key the transmitter and measure the percent of am modulation. It should be approximately 70%.

f. Measure the am distortion with the distortion analyzer. It should be less than 10%. Unkey the transmitter.

g. Repeat steps e and f for the remaining seven selector switch positions. Change to the proper antenna output when necessary.

4-33. PT Transmitter FM Modulation/Distortion. To check the FM modulation and distortion characteristics, perform the following steps: Repeat paragraph 4-32 with the following changes:

a. Place the AM/FM switch to FM.

b. Monitor fm deviation. It should be ±4 kHz nominal for vhf frequencies and ±8 kHz for uhf frequencies.

c. Measure fm distortion. It should be less than 10%.

4-34. Beacon. To check the beacon mode of operation, perform the following steps:

a. Connect the power meter to the VHF antenna output as shown in Figure 4-3.

b. Set the transceiver controls as follows:

- PWR — ON
- AM/FM — FM
- SCAN — OFF
- SQ — Fully CCW
- SPEAKER — PT ON
- BEACON/NORM — NORM
- XMTR PWR — HIGH
- Selector — 1
- VOL — Mid-range

c. Set the BEACON/NORM switch to BEACON. The output power should be approximately 5 watts with a variable audio frequency coming from the speaker and modulation indicated on the modulation meter.

d. Set the beacon switch to NORM.

4-35. T2/R1 Transmit/Receive Operation. To check the T2/R1 function, perform the following steps:

a. Depress the READ button. The frequency displayed should be 121.100 MHz which is the frequency stored in position 1.

b. Key the transceiver. The frequency displayed should be 132.225 MHz, which is the frequency stored in position 2.

4-36. TRANSMITTER (CT). Paragraphs 4-37 through 4-39 are for cipher text opertion.

NOTE

The cipher text portion of the PET transceiver was designed primarily as a uhf function. Cipher text will function at vhf frequencies, however, the performance test will outline uhf frequencies only.

4-37. CT Output Power. Repeat Paragraph 4-30 with the SPKR/MODE switch in the CT position.

4-38. CT AM Modulation Sensitivity. To check the am modulation sensitivity, perform the following steps:

a. Connect the transceiver and test equipment as shown in Figure 4-4.

b. Set the selector switch to position 4. Set the AM/FM switch to AM.

c. Adjust the audio oscilloscope to 1 kHz at 12 Vp-p as indicated on the oscilloscope.

d. Key the transmitter and verify that the modulation meter reads 70% minimum.

e. Repeat step d for selector switch positions 5, 6, GD A, and GD B.

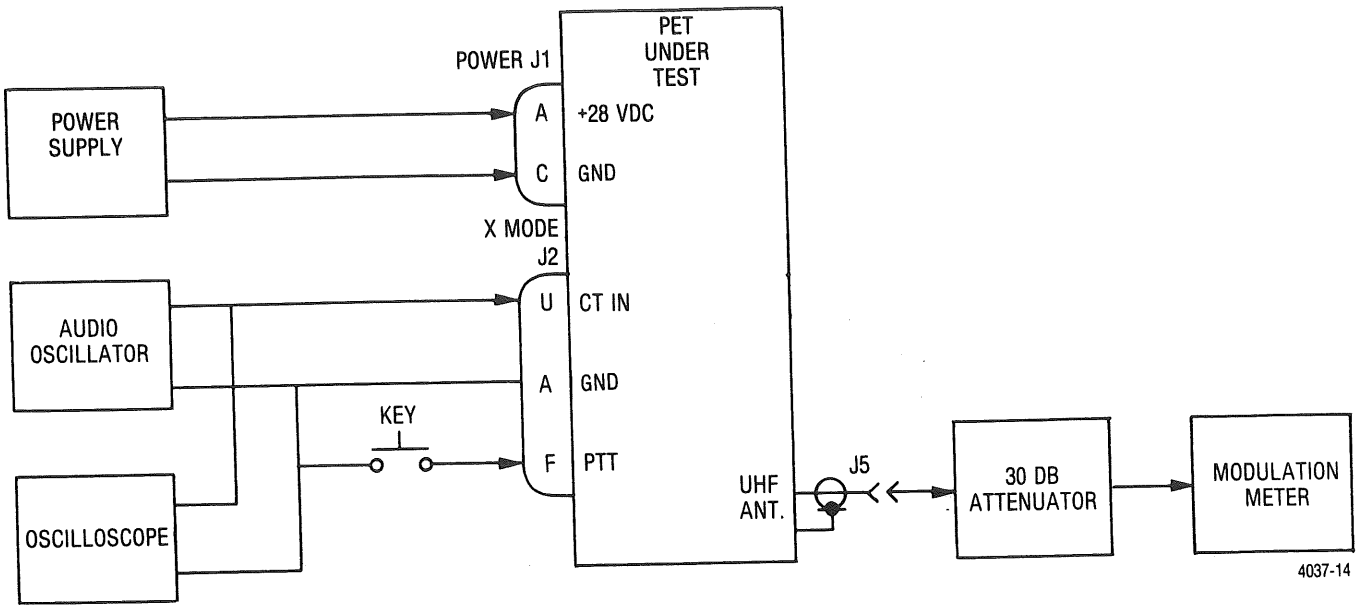


Figure 4-4. PET System Test Setup (Transmitter CT Tests)

4-39. CT FM Modulation Sensitivity. To check the fm modulation sensitivity repeat paragraph 4-38 with the following changes.

a. Place the AM/FM switch to FM.

b. Monitor fm deviation. It should measure ±6 kHz to ±12 kHz.

4-40. SYSTEM ALIGNMENT

Alignment steps in paragraphs 4-41 through 4-47 are performed in the PT mode.

4-41. To perform system alignment, the following steps must be performed:

a. Remove the power supply from the transceiver.

b. Remove the transceiver housing from the transceiver by removing the 4 screws in the corners of the front panel. Carefully lift the transceiver chassis from the housing.

c. To replace housing, perform the above sequence in reverse. Exercise care in reinstalling the housing over the transceiver chassis so as not to damage any components or pinch any wires.

4-42. TRANSMITTER OUTPUT POWER ADJUSTMENT. To adjust the transmitter output power, perform the following steps:

NOTE

When the transmitter output power alignment is performed, the transmitter VSWR adjustment (para 4-43 through 4-45) must be performed before operating the PET.

a. Connect the equipment as shown in figure 4-3, with the audio oscillator disconnected.

b. Set the power supply at +28 Vdc.

c. Adjust 1A6R68 and 1A6R74 both fully ccw (Figure 4-5).

d. Set the transceiver controls as follows:

- PWR — ON
- AM/FM — AM
- SCAN — OFF
- SQ — Fully CW
- Pushbutton frequency switches — 300.000 MHz
- BEACON/NORM — NORM
- XMT PWR — HIGH
- Selector — MAN
- VOL - Midrange

e. Using alignment tool 66-P16059A001 or small screwdriver, adjust 1A6R49 and 1A6R134 on the transmitter ALC module 1A6 (figure 4-5) to mid-range.

f. Key the transmtter and adjust 1A6R49 for 5 watts output on the power meter.

g. Place the AM/FM switch to FM. Adjust 1A6R134 for 20 watts output.

h. Place the AM/FM switch to AM and readjust 1A6R49 for 5 watts.

i. Place the AM/FM switch to FM and readjust 1A6R134 for 20 watts

j. It may be necessary to repeat steps h and i several times until no further improvement is noted. Unkey the transmitter.

4-43. Transmitter VSWR Adjustment. Perform the transmitter output power adjustment, paragraph 4-42, prior to performing the vhf or uhf vswr adjustments, paragraph 4-44 and 4-45.

4-44. VHF Frequencies. To adjust the transmitter vhf vswr, perform the following steps:

a. Connect the equipment as shown in Figure 4-3 with the audio oscillator disconnected.

b. Set the power supply at +28 V.D.C.

c. Set the transceiver controls as follows:

- PWR — ON
- AM/FM — AM
- SCAN — OFF
- SQ — Fully CW
- Pushbutton frequency switches — 130.000 MHz
- BEACON/NORM — NORM
- XMT PWR — HIGH
- Selector — MAN
- VOL — Midrange

d. Connect the digital voltmeter between point "A" on 1FL1 and the chassis as shown in Figure 4-6.

e. Key the transmitter and note the digital voltmeter reading.

f. Unkey the transmitter and remove the 30 dB attenuator from the transceiver front panel.

g. Connect a 3 dB attenuator directly to the transceiver front panel. (Do not connect the 3 dB attenuator through a cable to the transceiver front panel.) Leave the the other end of the 3 dB attenuator unterminated.

h. Key the transmitter and note that the digital voltmeter reads approximately the same as in step e above.

i. Adjust 1A6R74 (figure 4-5) in a clockwise direction until the digital voltmeter reading begins to drop. Turn 1A6R74 in a counter-clockwise direction to the point where the reading returns to the reading obtained in step h above.

j. Unkey the transmitter.

4-45. *UHF Frequencies.* To adjust the transmitter uhf vswr, perform the following steps:

a. Connect the equipment as shown in Figure 4-3 with the audio oscillator disconnected and the 30 dB pad connected to the UHF connector, J5.

b. Set the power supply at +28 V.D.C.

c. Set the transceiver controls as follows:

- PWR — ON
- AM/FM — AM
- SCAN — OFF
- SQ — Fully CW
- Pushbutton frequency switches—300.000 MHz
- BEACON/NORM — NORM
- XMT PWR — HIGH
- Selector — MAN
- VOL — Midrange

d. Connect the digital voltmeter between point "B" on 1FL2 and the chassis as shown in Figure 4-6.

e. Key the transmitter and note the digital voltmeter reading.

f. Unkey the transmitter and remove the 30 dB attenuator from the transceiver front panel.

g. Connect a 3 dB attenuator directly to the transceiver front panel (Do not connect the 3 dB attenuator thru a cable to the transceiver front panel.) Leave the other end of the 3 dB attenuator unterminated.

h. Key the transmitter and note that the digital voltmeter reads approximately the same as in step e above.

i. Adjust 1A6R68 (figure 4-5) in a clockwise direction until the digital voltmeter reading begins to drop. Turn 1A6R68 in a counter-clockwise direction to the point where the reading returns to the reading obtained in step h above.

j. Unkey the transmitter.

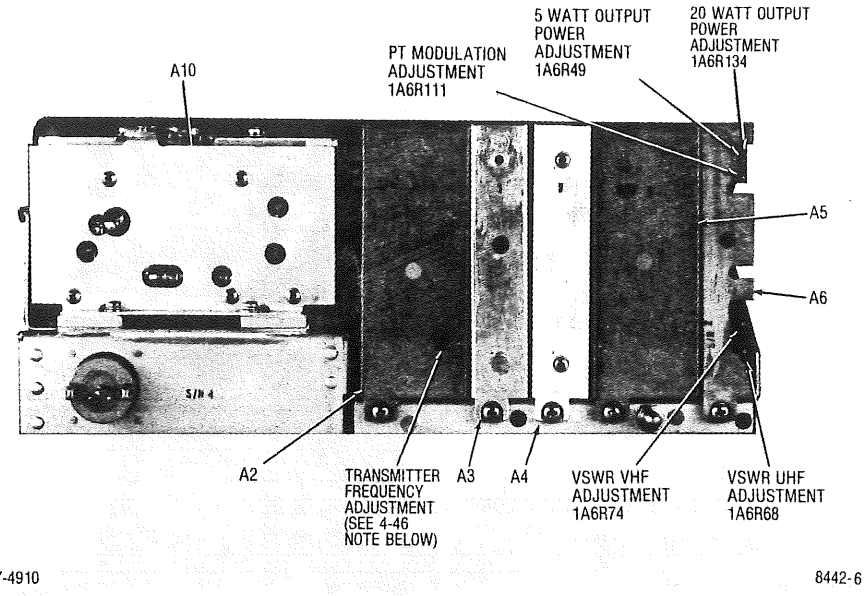


Figure 4-5. PET System Adjustment Locations

4-46. Transmitter Frequency Alignment. To align the transmitter frequency, perform the following steps:

a. Replace the power meter with the frequency counter.

b. Key the transceiver.

c. Using the alignment tool 66-P16059A001, adjust reference oscillator adjustment (figure 4-5) on synthesizer module 1A2 for a readout on the frequency counter of 300.000 MHz ± 150 Hz.

NOTE

On some radios, access to this adjustment is obtained by extending synthesizer module 1A2 and removing the module cover.

d. Unkey the transceiver.

4-47. Transmitter PT Modulation Adjustment. To adjust the transmitter frequency modulation, perform the following steps:

a. Replace the frequency counter with the modulation meter.

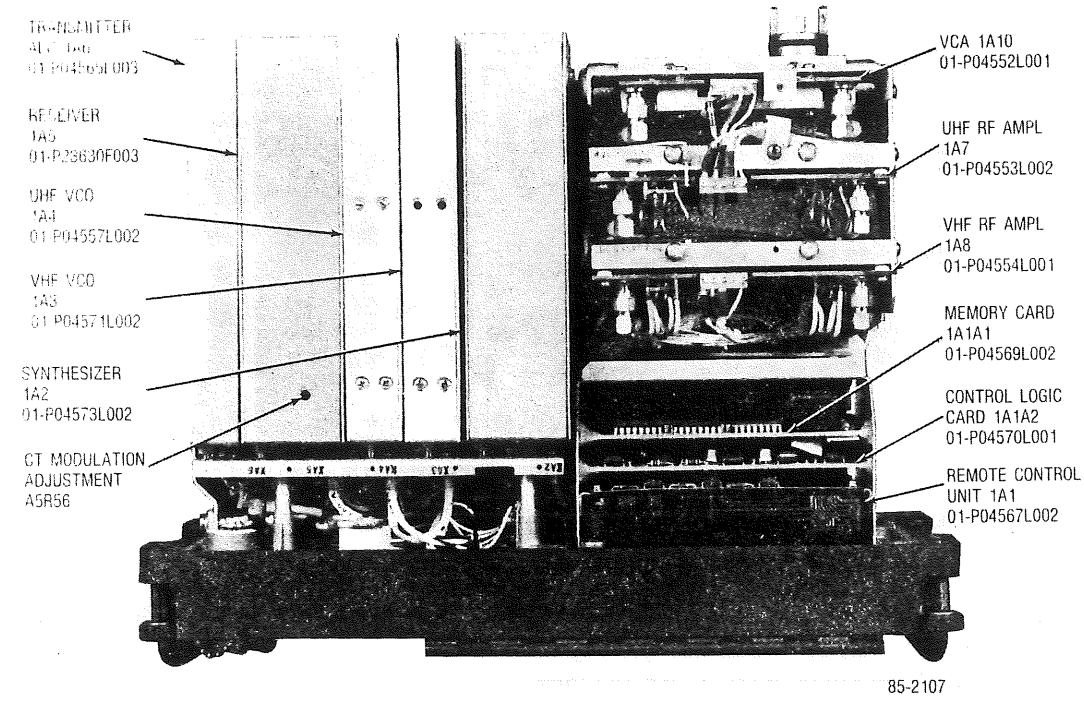
b. Set the pushbutton frequency switches for 350.000 MHz, HIGH power, FM mode, PT operation.

c. Adjust the audio oscillator frequency to 1 kHz and the level to 2.0 mVrms. Connect the audio oscillator to the handset jack.

d. Adjust A13R32 to midrange.

e. Key the transmitter and adjust 1A6R111 on the ALC module 1A6 until ±8 kHz deviation is obtained.

f. Unkey the transmitter.



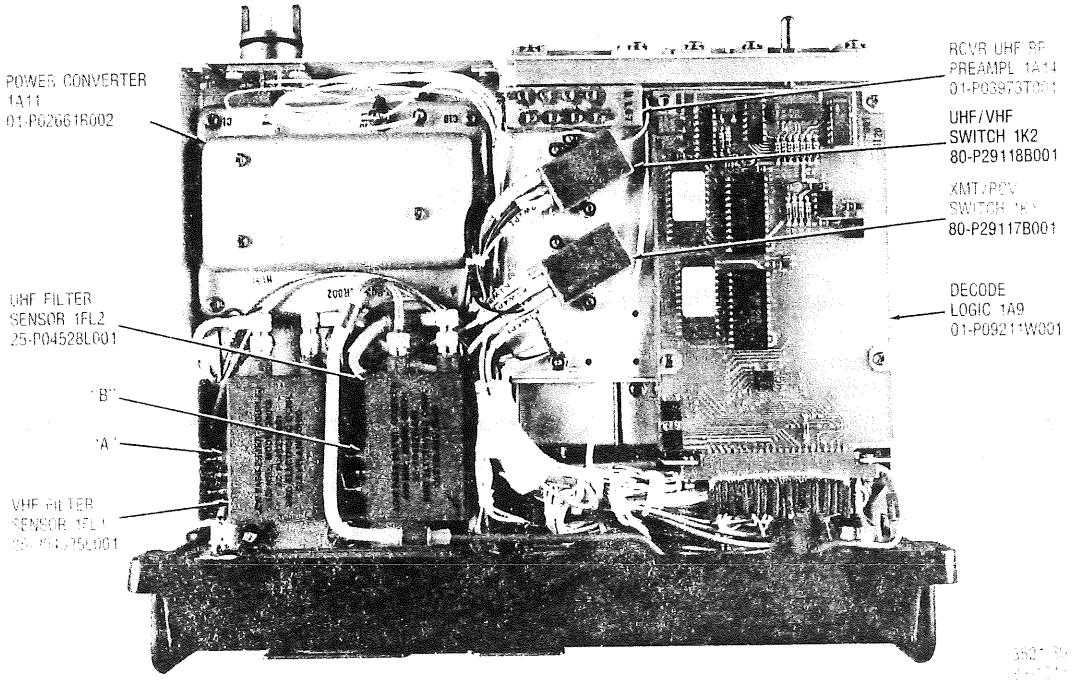


Figure 4-6. Module Assembly Locations

g. Set operation for CT.

h. Adjust the audio oscillator frequency to 1 kHz and the level to 4.24 V rms. Apply this signal to J2, pin U.

i. Key the transmitter and adjust A5R56 on the receiver module (A5) for ±8 kHz deviation.

j. Unkey the transmitter.

4-48. SYSTEM TROUBLESHOOTING

4-49. Table 4-5 provides system troubleshooting procedures. After the problem has been isolated to a module, consult the appropriate module section in this manual for further troubleshooting information. Access to modules and boards while still connected to the PET system is provided by the extender cards and cables listed in Table 4-2. See Figure 4-6 for module assembly locations.

Table 4-5. System Troubleshooting

Fault	Troubleshooting Procedure
1. Missing segment in RCU frequency display.	1. Check display integrated circuit and display driver on RCU flex harness. Repair as required.
2. Missing or incorrect RCU frequency display.	1. Check outputs of frequency pushbutton switches to memory card 1A1A1. 2. If OK, check outputs of control logic card to memory card 1A1A1. 3. If OK, check outputs of memory card 1A1A1. 4. Check flex harness assembly of the control unit 1A1 5. Repair as required
3. Volume control inoperative	1. Replace control unit 1A1. 2. If control unit checks OK, replace or repair receiver 1A5.
4. Squelch control inoperative	1. Replace control unit 1A1. 2. If control unit checks OK, replace or repair receiver 1A5.
5. Beacon inoperative	1. Check for proper beacon enable signal at transmitter ALC module 1A6. If not present, replace or repair control unit 1A1. 2. If beacon enable is present, repair or replace ALC module 1A6.

Table 4-5. System Troubleshooting (Cont.)

Fault	Troubleshooting Procedure
6. XMT PWR control inoperative	1. Check for proper levels with the switch in the HIGH and LOW positions at the transmit ALC module 1A6. If the proper levels are not present, replace or repair control unit 1A1. 2. If proper levels are present, replace or repair ALC module 1A6.
7. READ control inoperative	1. Replace or repair control unit 1A1.
8. Guard scan (SCAN) control not functioning properly	1. Carefully read the operating instructions on the guard channels and scanning beginning at paragraph 2-16 in section 2. Be sure the system is being adjusted and operated properly. If the scanning problem is not operator error, then proceed with the following steps. 2. Check for the proper guard scanning inputs and outputs from control logic card 1A1A2. If the inputs are correct and the outputs are not, repair or replace the control logic card. 3. Check for the proper guard scanning inputs and outputs from the memory card 1A1A1. If the inputs are correct and the outputs are not, repair or replace the memory card. 4. If the control logic card and memory card are operational, then repair or replace control unit 1A1.
9. AM/FM control inoperable	1. Check for proper AM/FM control levels at transmitter ALC module 1A6 with the AM/FM switch in both positions. If the levels are not correct, replace or repair control unit 1A1. 2. Check the VCA CONT voltage from the ALC module for the audio signal in AM and the FM AUDIO HI output for the audio signal in fm. If either of these outputs is not present at the appropriate time, replace or repair transmitter ALC module 1A6.
10. No plain text am modulation present at transmitter output	1. Perform the steps for problem 9. 2. If the problem is not corrected, replace or repair VCA module 1A10.

Table 4-5. System Troubleshooting (Cont.)

Fault	Troubleshooting Procedure
11. No plain text fm modulation present at transmitter output	1. Perform the steps for problem 9. 2. If no fm modulation is present in uhf range (225-400 MHz), repair or replace UHF VCO module 1A4. 3. If no fm modulation is present in vhf range (116-150 MHz), repair or replace VHF VCO module 1A3.
12. Unable to load any one or all of the preset channels on the selector switch.	1. Check for proper FREQ SEL levels at the input to control logic card 1A1A2 and for the proper LOAD levels at the input to memory card 1A1A1. If not correct, repair or replace control unit 1A1. 2. Check for the proper ENABLE levels out of control logic card 1A1A2. If not correct, repair or replace the card. 3. If control unit and control logic card are operational, replace or repair memory card 1A1A1.
13. Unit does not transmit when keyed in either uhf or vhf range. Receiver operates normally.	1. Check that the frequency selected is within the permissible operating range. 2. Check that power supply is functioning. 3. Replace handset. 4. Check PTT levels into control logic card 1A1A2. If incorrect, repair transceiver or repair control unit 1A1. 5. Check the R/T output levels from control logic card 1A1A2. If incorrect, repair or replace the control logic card. 6. Check the inputs and outputs of transmitter alc module 1A6 for proper levels. If the proper levels are not obtained, repair or replace the module. 7. Check the UHF VCO output level at WIPI (cable connected to vca 1A10 J2). If not present when transceiver is keyed, replace or repair UHF VCO module 1A4.

Table 4-5. System Troubleshooting (Cont.)

Fault	Troubleshooting Procedure
	8. Check the XMT SIG output level from VCA module 1A10J3. If not present when transceiver is keyed, replace or repair VCA 1A10. 9. Select a vhf frequency and verify a good rf output level from VHF RF amplifier 1A8 at J3 when the transceiver is keyed. Then monitor the XMT/RCV relay 1K1 output at K1WIPI (filter/sensor FL1 input) when the transceiver is keyed. If there is not output, replace relay 1K1.
14. Unit does not transmit in uhf range but does transmit in vhf range. Receiver operates normally.	1. Verify +5 vdc at the VHF CONT input of VHF/UHF relay 1K2 when the transceiver is keyed at a uhf frequency. If not at +5 Vdc, repair or replace the ALC module 1A6. 2. Verify a good rf output level from the VCA 1A10 at J3 when the transceiver is keyed. Then check the VHF/UHF relay 1K2 output at K2W3P1 (UHF RF amplifier input 1A7J2) when the transceiver is keyed. If there is no output, replace relay 1K2. 3. Check the output signal level from UHF RF amplifier 1A7 at J3 when the transceiver is keyed. If the signal is not present, replace or repair amplifier 1A7. 4. Check the uhf input level to filter/sensor FL2 by monitoring K1W4P1 at FL 2 input connector. If the signal is not present when the transceiver is keyed, replace 1K1. 5. If the rf input to the filter/sensor is correct but there is no output, replace filter sensor FL2.
15. Unit does not transmit in vhf range but does transmit in uhf range. Receiver opeates normally.	1. Verify 0 Vdc at the VHF CONT input of VHF/UHF relay 1K2 when the transceiver is keyed at a vhf frequency. If not at 0 Vdc, repair or replace ALC module 1A6.

Table 4-5. System Troubleshooting (Cont.)

Fault	Troubleshooting Procedure
	2. Verify a good rf output level from the VCA 1A10 at J3 when the transceiver is keyed. Then check the VHF/UHF relay 1K2 output at K2W2P1 (VHF amplifier input 1A8J2) when the transceiver is keyed. If there is no output replace relay 1K2.
	3. Check the output signal from VHF RF amplifier 1A8 at J3 when the transceiver is keyed. If the signal is not present, replace amplifier 1A8.
	4. Check the vhf input level to filter/sensor FL1 by monitoring KIW1P1 at FL1 input connector. If the signal is not present when the transceiver is keyed, replace 1K2.
	5. If the rf input to the filter/sensor is satisfactory but there is no output, replace filter/sensor FL1.
16. Transmitter output frequency different than dialed.	1. Check that the coded frequency into synthesizer 1A2 from control unit 1A1 agrees with the frequency dialed. If it does not agree, replace or repair the control unit or memory board 1A1A1 within the control unit.
	2. If the code is correct, replace or repair synthesizer 1A2.
	3. If the problem still is not corrected, repair or replace the appropriate VCO (UHF VCO 1A4 for uhf frequencies, VHF VCO 1A3 for vhf frequencies.
17. Degraded or no receiver plain text audio response.	1. Check audio levels to and from the VOL control potentiometer on the control unit 1A1. If volume level is satisfactory from the receiver 1A5 but not returning to the receiver, repair or replace the control unit.
	2. If the audio level to the VOL control is not satisfactory or if the audio from the VOL control is satisfactory, repair or replace receiver 1A5.
18. Loss of receiver sensitivity, noise normal when unsquelched, transmitter functions normally.	1. Repair or replace receiver 1A5.
	2. Repair or replace UHF RF preamp 1A14 (UHF only).

Table 4-5. System Troubleshooting (Cont.)

Fault	Troubleshooting Procedure
	3. Check +5 Vdc and +12 Vdc outputs from power converter 1A11. If noisy or the wrong level(s), repair or replace the power converter. 4. Check path loss through relay 1K1. If excessive, replace relay 1K1. 5. If the sensitivity loss occurs only in vhf or in uhf, replace or repair the appropriate vco (VHF VCO 1A3 or UHF VCO 1A4).
19. Loss of receiver sensitivity and transmitter output power.	1. Check that power supply is functioning. 2. Check front panel line fuse. 3. Check +5 Vdc and +12 Vdc from power converter 1A11. If the levels are not correct, repair or replace the power converter. 4. Replace the following modules one at a time until the transceiver operates. Then repair the defective module. a. Synthesizer 1A2 b. UHF VCO 1A4 c. Remote control unit 1A1 d. Decode logic board 1A9
20. Transmitter output power does not increase to 20W in uhf fm.	1. Verify XMT PWR switch in High position. 2. Repair or replace ALC 1A6.
21. Transmitter output power does not decrease to 5W in uhf am.	1. Perform the steps for problem 20
22. Transmitter output power on vhf channels is 20W.	1. Repair or replace ALC 1A6.
23. No cipher text am modulation present at transmitter output. Plain text OK.	1. Repair or replace ALC 1A6. 2. Repair or replace receiver module 1A5.

Table 4-5. System Troubleshooting (Cont.)

Fault	Troubleshooting Procedure
24. No cipher text fm modulation present at transmitter output. Plain text OK.	1. Perform steps for problem 23. 2. Repair or replace VHF, 1A3, or UHF, 1A4, (VCO's)
25. Receiver will not receive cipher text, am or fm. Plain text OK.	1. Repair or replace receiver 1A5.
26. Transmit LED indicator on front panel will not illuminate. Transmitter, however is transmitting.	1. Repair or replace ALC 1A6. 2. Repair or replace Decode Logic 1A9. 3. Replace Transmit LED.

SECTION 5

TRANSCEIVER

5-1. INTRODUCTION

5-2. This section contains general and detailed descriptions of the major components that make up the transceiver shown in Figure 5-1. Included are physical descriptions, locations of parts and major assemblies, detailed functional descriptions based on block level and schematic diagrams, and maintenance troubleshooting information.

Figure 5-1. Transceiver

5-3. PHYSICAL DESCRIPTION

5.4. The transceiver is packaged in an aluminum case and accommodates a power supply, uhf and vhf antennas, and handset, A retransmit connector is also provided for repeater operations. An X mode connector is provided for test monitoring or cipher text operations. The transceiver packaging concept, location of major assemblies, and parts list are shown in Figures 5-3 and 5-4. As shown the transceivers consist primarily of the following major assemblies:

- Remote Control Unit (RCU) — 1A1
- Synthesizer — 1A2

- VHF VCO — 1A3
- UHF VCO — 1A4
- Receiver — 1A5
- Transmitter ALC — 1A6
- UHF RF Amplifier — 1A7
- VHF RF Amplifier — 1A8
- Decoder — 1A9
- Voltage Controlled Attenuator (VCA) — 1A10
- Power Converter — 1A11
- Receiver UHF RF Preamp — 1A14
- VHF Filter Sensor — FL1
- UHF Filter Sensor — FL2
- XMT/RCV Relay — K1
- VHF/UHF Relay — K2
- Thermal Sensor — S3
- Speaker
- +28 VDC Power Input Connector — J1
- X MODE Connector — J2
- HANDSET Connector — J3
- VHF ANT Connector — J4
- UHF ANT Connector — J5
- RETRANSMIT Connector — J6

5-5. FUNCTIONAL DESCRIPTION

5-6. The following paragraphs provide detailed descriptions of the functions involved in the overall transceiver operation. Reference is to the block diagram shown in Figure 5-2 and interconnect diagram shown in Figure 5-5. For descriptions of individual assemblies that make up the transceiver, refer to the appropriate section in this manual for that particular assembly.

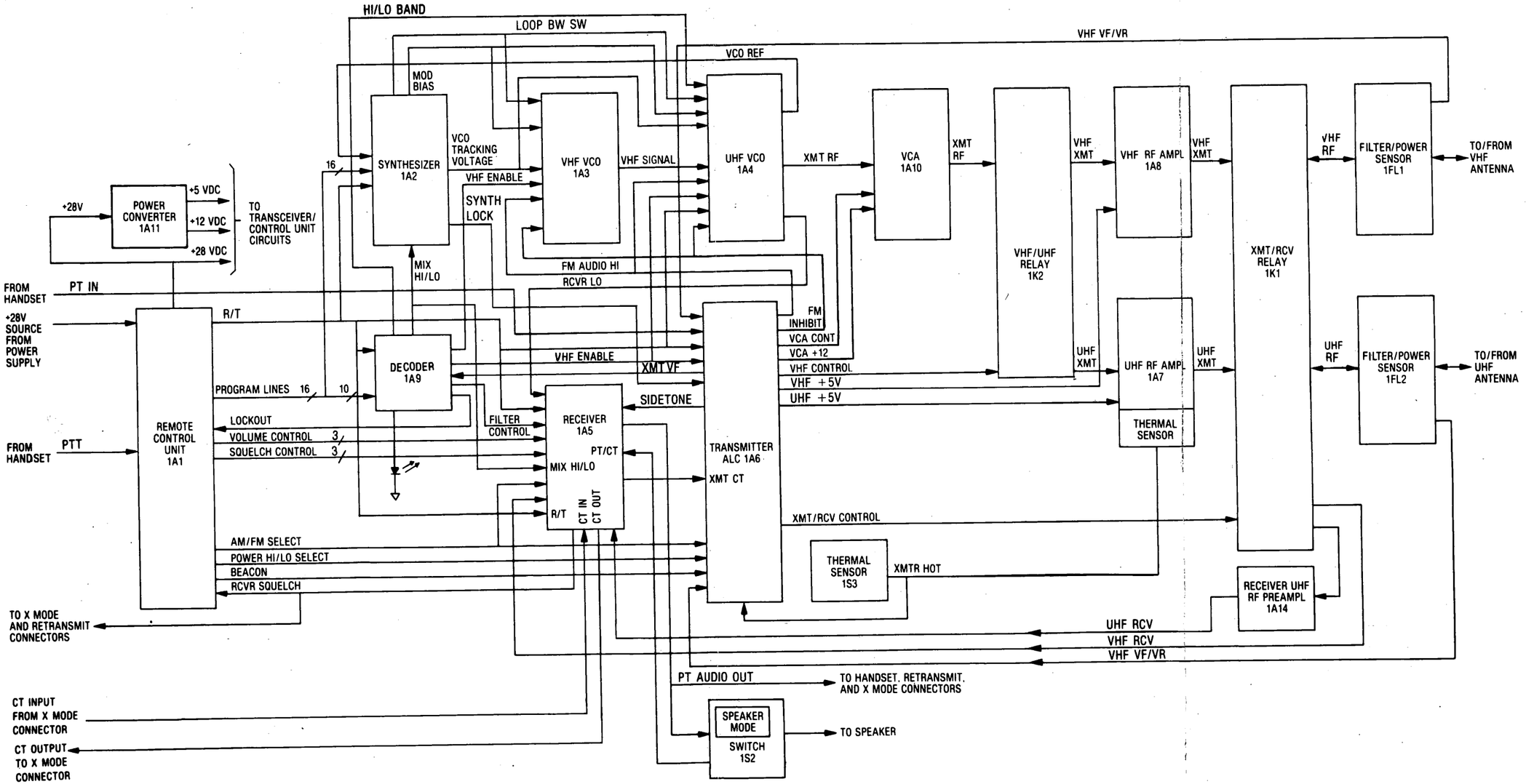


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Figure 5-2. Transceiver Block Diagram

PARTS LIST

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1	94990	01-P04550L007	FRONT PANEL ASSEMBLY	
003	1	94990	15-P07066L001	CASE	MUST BE PAINTED
004	1	94990	75-P07091L001	PAD, COMPRESSION	
006	5		MS51957-15	SCREW	4-40X3/8
008	4		NAS620C4L	WASHER	NO.4
009	4	55566	259-SS-26	SCREW, CAPTIVE	.250-28X1
011	4		NAS620-416L	WASHER	.250
012	5		MS51957-30	SCREW	6-32X1/2
013	4		AN515-6R48	SCREW	6-32X3
014	2		MS51957-26	SCREW	6-32X1/4
016	3		MS51957-14	SCREW	4-40X5/16
019	11		MS15795-805	WASHER	NO.6
020	4		MS15795-803	WASHER	NO.4
021	11		MS35338-136	WASHER	NO.6
022	8		MS35338-135	WASHER	NO.4
026	1		**43-P07203L001**	**SPACER, PROTECTIVE**	
036	16.5 IN.			O-RING, BULK	.070
037	1	94990	42-15031A61	CLAMP	
040	AR	18565	10-05-1577-1250	GASKET, RF1	
041	1		**33-P24258F001**	LABEL MODULE IDENT	AN/URC-101
049	1	94990	33-P09994V001	NAMEPLATE	
050	4	03038	LP57D26P3	SCREW, LKG	.086-56X.18
055	4		NAS620C2	WASHER, FLAT	.086
A 001	1	94990	01-P04567L002	RCU ASSEMBLY	
A 002	1	94990	01-P04573L002	SYNTHEIZER ASSEMBLY	
A 003	1	94990	01-P04571L002	VHF VCO ASSEMBLY	
A 004	1	94990	01-P04557L002	UHF VCO ASSEMBLY	
A 005	1	94990	**01-P23630F003**	RECEIVER ASSEMBLY	
A 006	1	94990	01-P04565L003	TRANSMITTER ALC ASSEMBLY	
A 007	1	94990	01-P04553L002	UHF RF AMPLIFIER ASSEMBLY	
A 008	1	94990	01-P04554L001	VHF RF AMPLIFIER ASSEMBLY	
A 009	1		01-P09211W001	DECODE LOGIC ASSEMBLY	
A 010	1	94990	01-P04552L001	VCA ASSEMBLY	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
55566	RAF Electronic Hardware Inc.	260 Hathaway Dr. Stratford, CT 06497
85480	W. W. Brady Co.	727 W. Glendale Ave. Milwaukee, WI 53209
94990	Motorola Inc. Government Electronics Group	8201 E. McDowell Rd. Scottsdale, AZ 85252
018565	Chomerics	77 Dragon Court Woburn, MA 01801

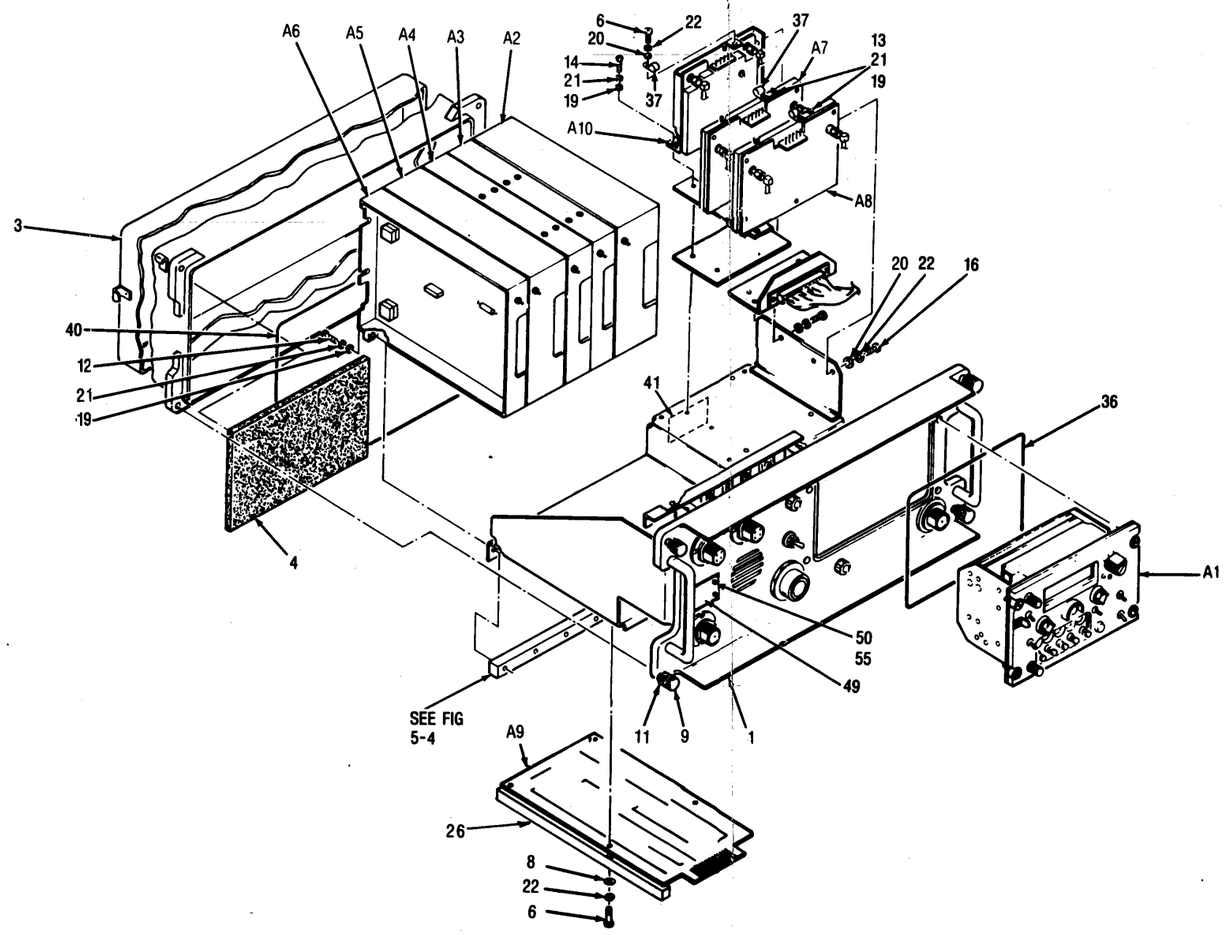

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Figure 5-3. Transceiver, Showing Location of Components and Major Assemblies

PARTS SUPPLIERS

Code Ident.	Name	Address
00779	AMP Inc	P O Box 3608 Harrisburg PA 17105
00929	Microlab FXR	10 Microlab Road Livingston NJ 07039
01686	RCL Electronic Division of AMF Inc	195 McGregor St Manchester NH 03102
02289	Hi-G Co Inc	Spring St and Rt 75 Winsor Locks CT 06096
06540	Amatom Electronic Hardware Div of Mite Corp	446 Blake St New Haven CT 06515
14711	General Connectors Corp	3205-3223 Burton Ave Burbank CA 91510
26805	Omni Spectra Americon Microwave Connector Div	140 Fourth Ave Waltham MA 02154
31223	Micro Plastics Inc	20821 Dearborn St Chatsworth CA 91311
50012	Motorola Communications Group	1313 Algonquin Rd Schaumburg, IL 60196
71468	ITT Cannon Electric	666 Dyer Rd Santa Ana, CA 92702
75382	Kulka Electric Corp	633-643 S Fulton Ave Mt Vernon, NY 10550
72915	Littelfuse Inc	800 E Northwest Hwy Des Plaines, IL 60016
78189	Illinois Tool Works Inc Shakeproof Division	Division St and Charles Rd Elgin IL 60120
82647	Texas Instruments Inc Control Products Division	34 Forest St Attleboro, MA 02703
83285	D M Steward Mfg Co Inc	510 E 36th St Chattanooga, TN 37401
94990	Motorola Inc Government Electronics Div	8201 E McDowell Rd Scottsdale, AZ 85252
95146	Alco Electronic Products Inc	P O Box 1348 Lawrence, MA 01842
97954	U S Components Inc	1320 Zerega Ave Bronx NY 10462
99813	JAN Hardware Mfg Co Inc	47-27 36th St Long Island City, NY 11101
018565	Chomerics	77 Dragon Court Woburn, MA 01801

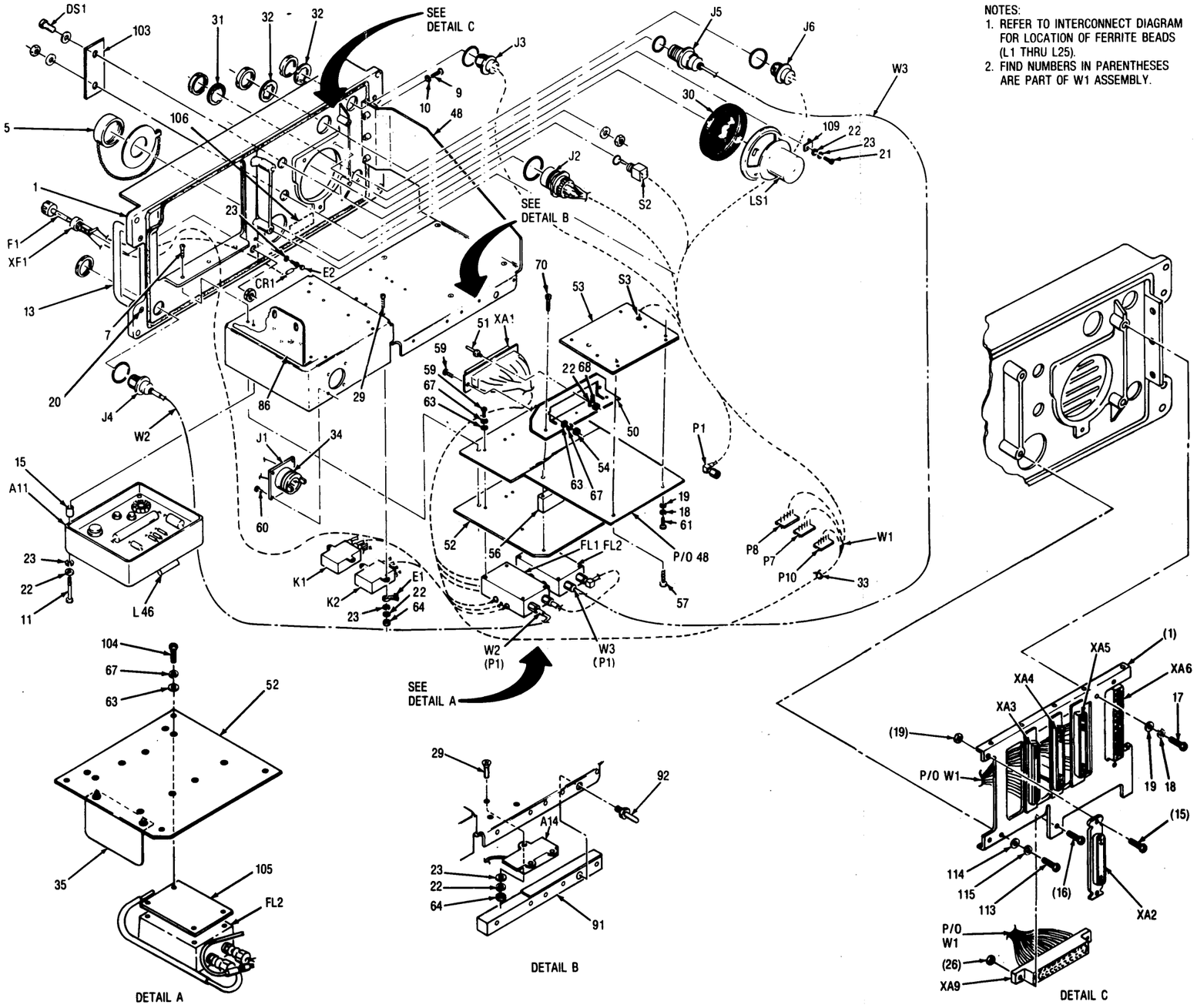


Figure 5-4. Front Panel and Chassis Parts (Sheet 1 of 2)

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
			FRONT PANEL AND CHASSIS ASSY		
001	1		64-P03966W001	PANEL, FRONT	CASTING / PAINT
005	1		MS3181-14N	CAP, PROTECTIVE	
007	3		MS24693-C273	SCREW, FH	10-32X5/8
009	3		MS51957-45	SCREW	8-32X1/2
010	3		MS15795-807	WASHER	NO.8
011	4		MS51957-121	SCREW, PH	.1120-40X1.125
013	2	06540	10346-A-1032-2	HANDLE	AL7115-14
015	4		43-P07142L001	SPACER	
017	2		MS51957-124	SCREW, PH	6-32X1-1/8
018	5		MS35338-136	WASHER, LOCK	NO.6
019	5		MS15795-805	WASHER, FLAT	NO.6
020	4		MS24693-C274	SCREW, FH	10-32X3/4
021	3		MS51957-15	SCREW	.1120-40X.375
022	14		MS15795-803	WASHER	NO.4
023	13		MS35338-135	WASHER	NO.4
029	6		MS24693-C3	SCREW, FH	4-40X5/16
030	1		35-P07105L001	SCREEN, SPEAKER	
031	1	78189	1228-02	WASHER, LOCK, INT	NO 5/8, CAD PLATED
032	2	78189	1232-04	WASHER, LOCK, INT	NO. 3/4, CAD PLATED
033	12		MS3367-4-9	CABLE TIE, NYLON	NATURAL
034	1		MS9021-020	O RING	
035	1		07-P07255L001	BRACKET, FILTER	
048	1		27-P07086L001	CHASSIS	
050	1		07-P07119L001	BRACKET, CONN	
051	1	94990	22-P07123L001	GUIDE PIN	
052	1	94990	64-P07128L001	PLATE ASSEMBLY	
053	1		26-P08702V001	HEAT SINK	
054	2		MS35649-224	NUT, HEX	2-56
056	1		43-P07130L001	SPACER, HEATSINK	
057	1		03-14052B61	SCREW, LKG, FH	6-32X5/16
059	4		03-15013G29	SCREW, PH	2-56X5/16
060	4		05-P07103L001	RIVET, SHOULDER	
061	3		MS51957-28	SCREW	6-32X3/8
063	14		NAS620C2	WASHER, FLAT	NO.2
064	6		MS35649-244	NUT	4-40
067	14		MS35338-134	WASHER, LOCK	NO.2
068	1		MS21042L04	NUT, LKG	.112-40
070	3		MS51958-67	SCREW, PH	.190-32X1
086	1		07-P07189L001	BRACKET, MODULE SUPPORT	
091	1		42-P07087L001	BAR	
092	1		22-P07129L001	PIN, GUIDE-CHASSIS	
103	1	94990	33-P03948T001	PLATE, INFO-XMTR/SPKR	MARKING
104	4		03-15013G31	SCREW	2-56X7/16
105	1		43-P08684V001	SPACER	
106	1		33-P03965T001	LABEL, X MODE	
109	3		42-P07190L001	CLIP, SPEAKER	
113	2		NAS1352-06-20P	SCREW	.1380-32X1.250
114	2		MS51848-47	WASHER, FLAT	.138
115	2		NAS620C6	WASHER, LOCK	.138
A 011	1		01-P02661R002	POWER CONVERTER	
A 014	1		01-P03973T001	RCVR UHF RF PREAMP ASSY	
CR001	1		1N4003	DIODE	
DS001	1	05464	1903R	LED ASSY	RED
E 002	1	94990	29-P14396A007	TERMINAL	
F 001	1		F02A250V5A	FUSE	250V-5A
FL001	1		25-P04525L001	VHF FILTER SENSOR	
FL002	1		25-P04528L001	UHF FILTER SENSOR	
J 001	1	94990	28-P03970T001	CONNECTOR, MALE	
K 001	1		80-P29117B001	RELAY ASSEMBLY	DPDT COAXIAL
K 002	1		80-P29118B001	RELAY ASSEMBLY	SPDT COAXIAL
L 044	2	83285	10273	FERRITE BEAD	
L 046	1		MS75084-12	COIL	10UH
LS001	1	50012	50-P24176F001	SPEAKER, WATERPROOF	2.25 DIA., 50 OHM
S 002	1		40-P24086F002	SWITCH, TOGGLE	
S 003	1	82647	3BTF3-38	THERMAL SWITCH	CLOSE 85C, OPEN 60C
W 001	1		30-P07063L0014	HARNESS ASSEMBLY	
W 002	1		30-P04561L002	CABLE ASSY, RF-VHF ANTENNA	
W 003	1		30-P04562L003	CABLE ASSY, RF-UHF ANTENNA	
XF001	1	75915	342004PA	FUSEHOLDER	
			HARNESS ASSY W1		
001	1		64-P29013B001	PANEL, CONNECTOR ASSY	
015	8	94990	03-15013G30	SCREW	2-56X3/8
016	4		MS51957-17	SCREW	4-40X1/2
019	8		MS21042L02	NUT	.086-56
026	4		MS21042L04	NUT	.1120-40
E 001	1	75382	600Y	TERMINAL	
J 002	1		MS3114E14-19S	CONNECTOR	
J 003	1	14711	GC183F-1-050	CONNECTOR-HANDSET	
J 006	1	14711	GC183F-1-050	CONNECTOR-RETRANSMIT	
L 001	2	94990	74-15169A01	FERRITE BEAD	
L 002	2	94990	74-15169A01	FERRITE BEAD	
L 003	2	94990	74-15169A01	FERRITE BEAD	
L 004	2	94990	74-15169A01	FERRITE BEAD	
L 005	2	83285	10273	FERRITE BEAD	
L 006	3	94990	74-15169A04	FERRITE BEAD	
L 007	3	94990	74-15169A04	FERRITE BEAD	
L 008	3	94990	74-15169A04	FERRITE BEAD	
L 011	3	94990	74-15169A04	FERRITE BEAD	
L 012	3	94990	74-15169A04	FERRITE BEAD	
L 013	3	94990	74-15169A04	FERRITE BEAD	
L 015	3	94990	74-15169A04	FERRITE BEAD	
L 016	3	94990	74-15169A04	FERRITE BEAD	
L 017	3	94990	74-15169A04	FERRITE BEAD	
L 022	1	94990	74-15169A01	FERRITE BEAD	
L 023	1	94990	74-15169A01	FERRITE BEAD	
L 024	1	94990	74-15169A01	FERRITE BEAD	
L 025	1	94990	74-15169A01	FERRITE BEAD	
L 027	2		74-15169A01	FERRITE BEAD	
L 028	2		74-15169A01	FERRITE BEAD	
L 029	2		74-15169A01	FERRITE BEAD	
L 030	2		74-15169A01	FERRITE BEAD	
L 031	2		74-15169A01	FERRITE BEAD	
P 001	1	16179	0SM521-3	CONNECTOR	
P 007	1	00779	85830-5	CONTACT	
P 008	1	00779	85830-5	CONTACT	
P 010	1	00779	85830-5	CONTACT	
R 002	1		RCR07G103JS	RESISTOR	10K-5-1/4
XA001	1	71468	DDMR-50S	CONNECTOR	
XA002	1	71468	DCMR27W2S	CONNECTOR	
XA003	1	71468	DCMR17W5S	CONNECTOR	
XA004	1	71468	DCMR17W5S	CONNECTOR	
XA005	1	71468	DCMR25W3S	CONNECTOR	
XA006	1	31223	MP-0100-22-DP3	CONNECTOR	
XA009	1	31223	MP-0100-22-DP3	CONNECTOR	

Figure 5-4. Front Panel and Chassis Parts (Sheet 2 of 2)

SECTION 6

REMOTE CONTROL UNIT 1A1

6-1. INTRODUCTION

6-2. This section contains general and detailed descriptions of the major components that make up the remote control unit as shown in Figure 6-1. Included are physical descriptions of the control unit, locations of parts and major assemblies, detailed functional descriptions based on block level and schematic diagrams, and maintenance and troubleshooting information.

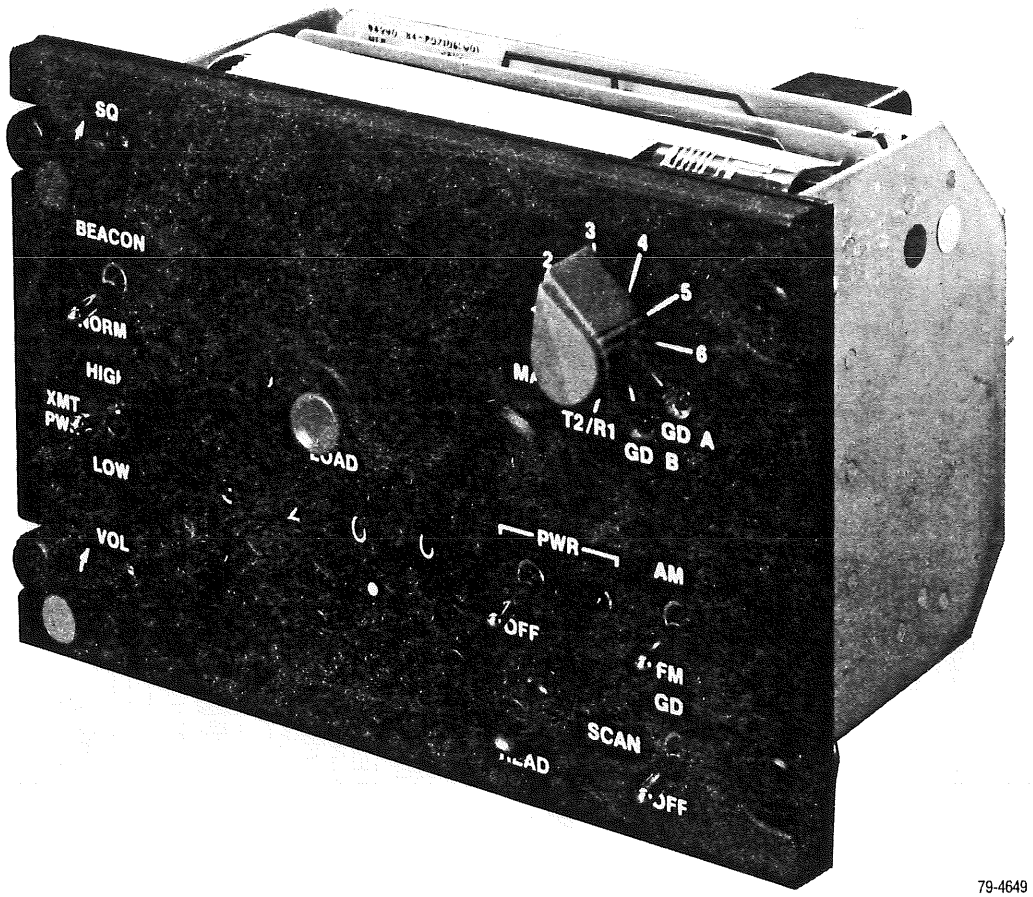


Figure 6-1. Remote Control Unit 1A1

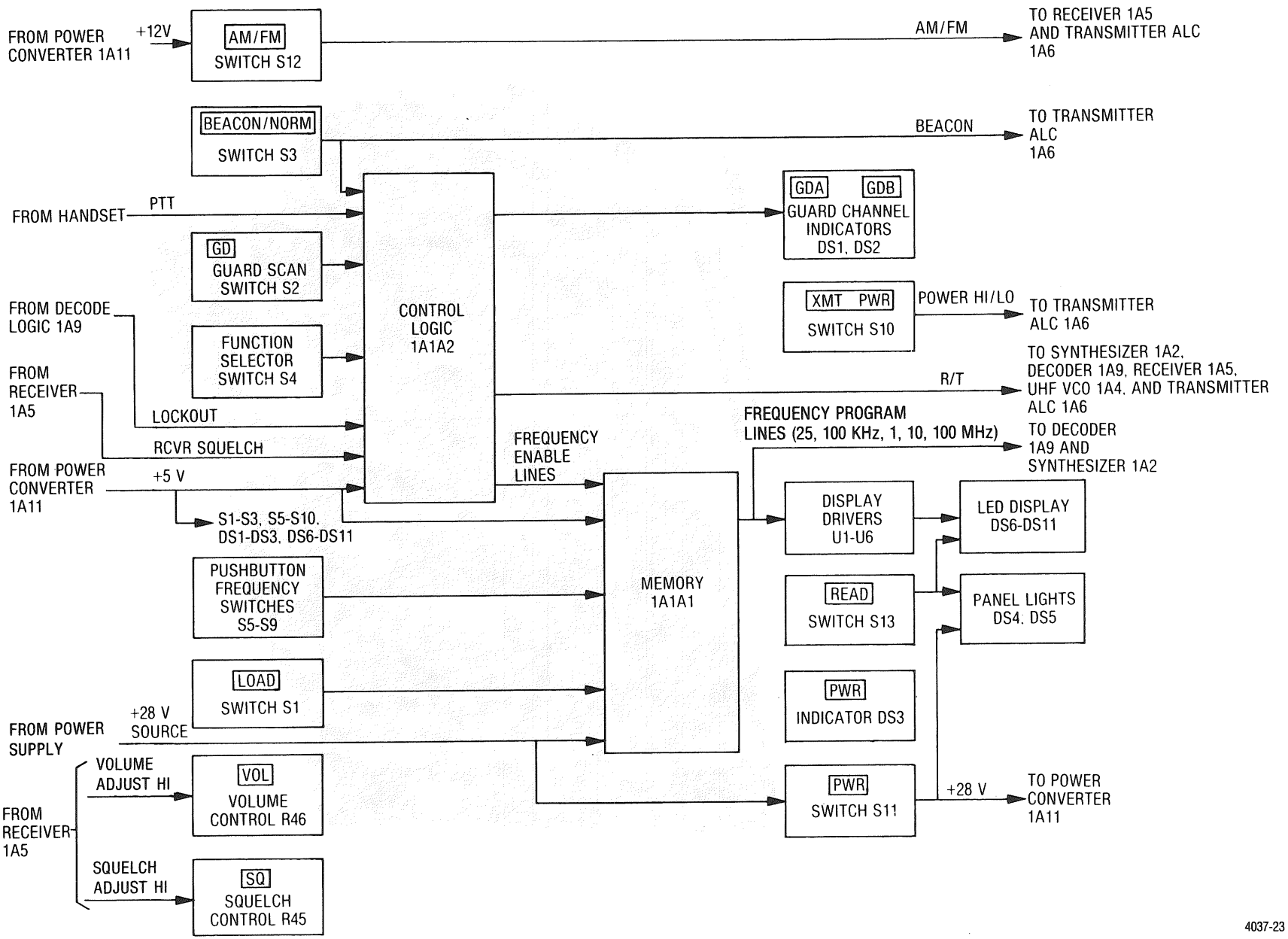


Figure 6-2. Remote Control Unit 1A1 Block Diagram

6-3. PHYSICAL DESCRIPTION

6-4. The remote control unit is packaged in an aluminum chassis that plugs into the transceiver. The entire assembly is secured into the transceiver chassis by four DZUS fasteners. A remote configuration may also be used as described in Section 1. The control unit consists primarily of a front panel, flexible harness assembly, memory board 1A1A1, and control logic board 1A1A2. An edge-lighted panel is also provided that can be illuminated for night operation. There is one 50-pin connector (J1) located at the rear of the control unit that interfaces with the transceiver. All interface and power signals are routed through this connector. Descriptions of the memory board and control logic board are contained in Sections 7 and 8, respectively.

6-5. FUNCTIONAL DESCRIPTION

6-6. The following paragraphs provide a detailed functional description of flexible harness and circuits which make up the control units as referenced to the block diagram shown in Figure 6-2 and interconnect diagram shown in Figure 6-3.

6-7. FLEXIBLE HARNESS. The flexible harness assembly is shown in Figure 6-4. The harness provides almost all of the interface wiring and connections within the control unit. Mounted on the harness are the front panel controls and indicators including the frequency selector pushbutton switches and corresponding LED drivers and displays. The harness also includes the two circuit board receptacles (XA1 and XA2), and a 50-pin rear interface connector (J1). The harness is positioned and secured in the control unit assembly by attaching hardware.

6-8. CIRCUIT DESCRIPTION. Operation of the control unit is initiated by the front panel switches and selectors. Most signals interface with either control logic board 1A1A2 or memory board 1A1A1. The exceptions are:

- The am/fm switch output is routed directly to receiver 1A5 and transmitter ALC 1A6. A +12V level corresponds to fm and a ground level corresponds to am.
- The volume (VOL) and squelch (SQ) control signals are received from and returned to receiver 1A5. The volume control adjusts the audio output level. The squelch control adjusts the input level at which the receiver unsquelches.
- The XMT PWR HIGH/LOW signal is applied directly to the transmitter ALC 1A6. The signal sets the transmitted power to high or low power as desired (see Table 2-2, Transmit Power).
- PWR ON/OFF control and PWR indicator. When the PWR control is in the upper (on) position, +28V is applied to power converter 1A11 which energizes the entire transceiver. The +5V output from the power converter then lights the green PWR light emitting diode.
- When READ switch S13 is depressed, the operating frequency is displayed (DS6 through DS11) and the edge-lighted panel lights (DS4 and DS5).

6-9. The control logic board receives various inputs, combines and/or compares them, and then provides different signal levels depending upon the states of the inputs. If a BEACON (ground level) signal from S3 or a push-to-talk (PTT) signal (ground level) from the handset is applied to the control logic board, a transmit (low) output is provided on the R/T line. If both the beacon and PTT inputs are high, then a high is present on the R/T line placing the transceiver in the receive mode.

6-10. Function selector switch S4 on the front panel determines the operating frequency. When position 1 is selected, the control logic board enables the frequency stored in the memory board for position 1. When positions 2 thru 6 are selected the frequency stored for those positions are enabled. When placed in the T2/R1 position, the control logic board enables the frequency stored in position 1 in the receive mode and the frequency stored in position 2 in the transmit mode. The MAN position on switch S4 causes the MAN CH ENABLE output of the control logic board to place the memory board in the bypass mode. In this mode, the levels from pushbutton switches S5, S6, S7, S8, and S9 go straight through the memory board and are applied to BCD-to-7 segment decoders U1 through U6. When the control logic board receives a LOCKOUT signal from decode logic board 1A9, indicating an out-of-band frequency has been selected, the control logic board inhibits the transmit command to the transceiver. If scan switch S2 is placed in the GD position, the control logic board initiates scanning. As the control logic scanning clock cycles, three of the eight FREQ ENABLE lines to the memory board sequentially go high. The lines that go high are GD A ENABLE, GD B ENABLE and one of the six FREQ ENABLE lines depending upon the selector switch S4 setting.

6-11. The memory board contains memory locations to store the codes for up to eight frequencies. The memory board then provides as outputs, the frequency code in the position stored as selected by the corresponding FREQ ENABLE line. In this manner, the transceiver alternately monitors each of the three frequencies. If a message is detected, then a low level appears on the RCVR SQUELCH line from receiver 1A5. The level causes the control logic board to stop the scan and remain on the frequency received. At the conclusion of the message, the RCVR SQUELCH goes low and the control logic board resumes scanning.

6-12. The input signals to memory board 1A1A1 consist of the frequency enables from the control logic board, BCD coded levels from pushbutton switches S5 through S9, and MEM LOAD from LOAD switch S1. The memory board stores the coded frequency from the pushbutton switches in the position indicated by the frequency enable lines when LOAD switch S1 is depressed. The board then supplies the coded outputs over the frequency program lines to decoder 1A9 and synthesizer 1A2. The particular frequency supplied corresponds to the frequency position enabled by the control logic board. The frequency outputs are also applied to BCD-to-7 segment decoders/display drivers U1 through U6 which drive the LED displays DS6-DS11. When READ switch S13 is depressed, the LED displays light to show the operating frequency. The panel lights DS4 and DS5 are also turned on to illuminate the panel lettering at the same time the READ switch is depressed.

6-13. REMOTE CONTROL UNIT MAINTENANCE AND TROUBLESHOOTING

6-14. Procedures for performing remote control unit (RCU) maintenance are described in the following paragraphs. Included are procedures for disassembly and replacement of major assemblies within the RCU and troubleshooting.

6-15. DISASSEMBLY AND REPLACEMENT PROCEDURES

6-16. The purpose of disassembling the RCU is to provide access to the internal parts for troubleshooting

and/or replacement. The RCU is exposed by loosening four captive screws holding the transceiver chassis assembly in the transceiver case and then removing the transceiver from the case. The memory board A1 and control logic board can be removed from the RCU using card puller 66-P08094B001 without further disassembly of the RCU. For maintenance and troubleshooting of the memory and control logic cards, refer to Sections 7 and 8, respectively. If further disassembly of the RCU is required for troubleshooting and repair, proceed as follows:

a. Remove RCU from the transceiver front panel by loosening four Dzus fasteners securing RCU to front panel. Then push RCU out from transceiver by applying pressure to rear of RCU chassis.

b. Remove both circuit cards from RCU.

c. At RCU front panel, loosen Allen head screws securing function selector switch knob (red) to shaft. Remove knob.

d. Unscrew and remove two edge light assemblies, securing front panel nomenclature plate to RCU chassis. Remove plate.

e. Remove four screws securing RCU chassis to front panel.

f. Remove screws and nuts securing 50 pin rear connector to chassis.

g. Remove four screws securing circuit card receptacles to chassis.

h. Remove six remaining screws securing flexible harness to chassis.

i. Remove ten screws securing frequency selector switches to front panel. The flexible harness is now unfolded and exposed for any further maintenance that may be required.

j. Reassemble in reverse order of preceding steps.

6-17. TROUBLESHOOTING

CAUTION

The RCU must not be connected to the PET when removing the Memory Board 1A1A1. The +28V line may short to the +5V line during removal as the +28 volts is present even with the POWER switch OFF.

6-18. After a malfunction is isolated on the RCU, first check that the problem does not originate on the control logic or memory cards. These two boards may be removed, placed on an extender card, and tested as outlined in Sections 7 and 8. If the cards are not malfunctioning, disassemble the RCU to the extent required to isolate the problem and repair the RCU. The disassembled RCU may be connected to the transceiver using the extender cable, 30-P07210L001. Refer to paragraph 6-16 for disassembly instructions. Also, refer to interconnection diagram, Figure 6-3, for voltage levels. Replace defective components using parts locating diagram, Figure 6-4, for identification.

CAUTION

Avoid excessive handling and bending of the flexible harness. Rough handling may result in fine cracks in the conductive tracks of the harness resulting in intermittent or electrically open circuits which are extremely hard to locate. If such a crack is discovered, bypass the crack with an insulated jumper from component lead to component lead or feed-thru hole.

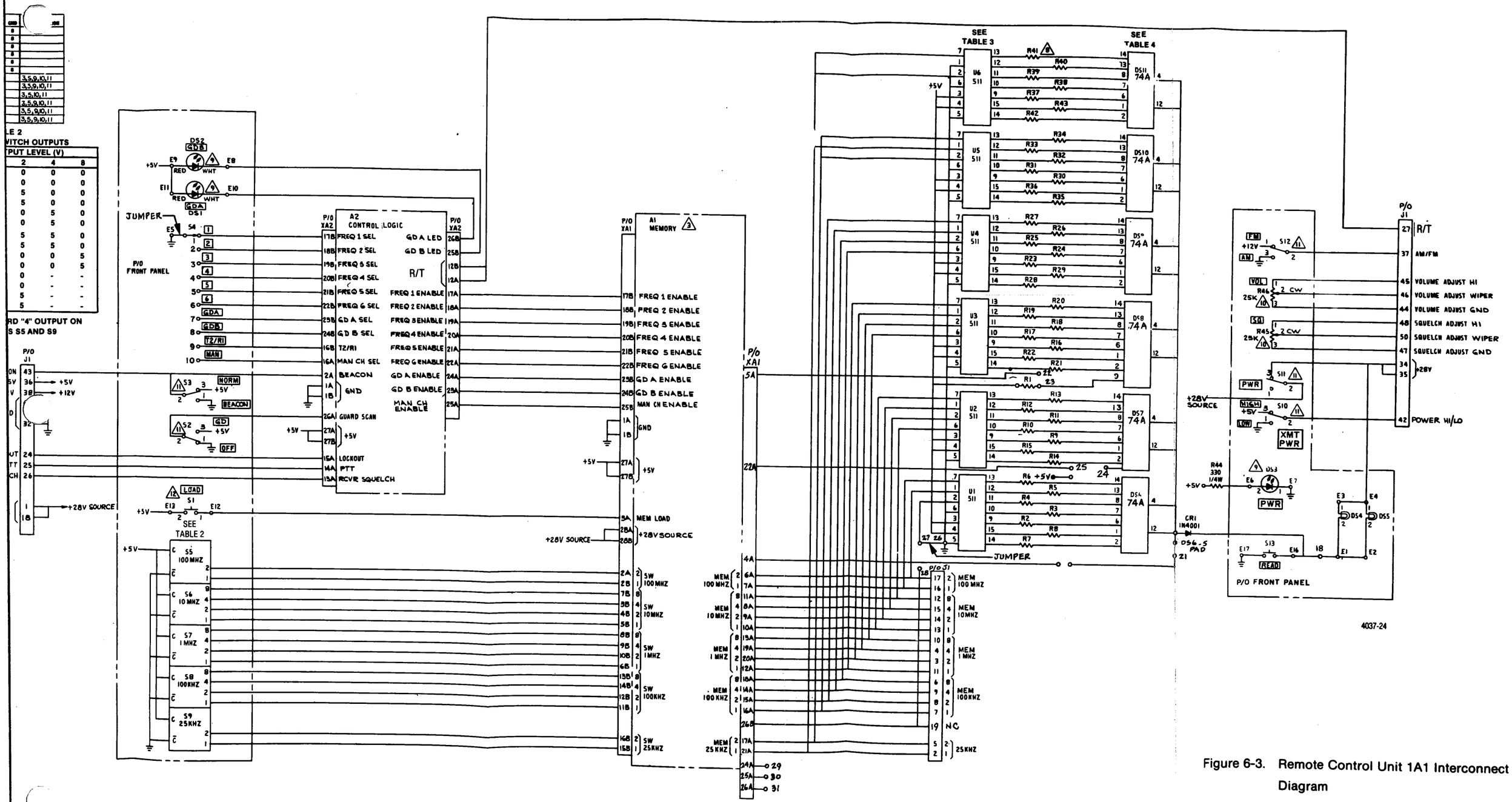


Figure 6-3. Remote Control Unit 1A1 Interconnect Diagram

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH 3A1.
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P045671001 ASSEMBLY
   01P045681001 ASSEMBLY 01P07112L001 ASSY
3. FOR SCHEMATICS REFER TO:
   A1 63-P04594L
   A2 63-P04593L
4. UNLESS OTHERWISE SPECIFIED
   ALL RESISTORS ARE IN OHMS, 1/8 W 5 PCT
   ALL CAPACITORS ARE IN UF
   ALL VOLTAGES ARE DC
5. POSITIVE LOGIC CONVENTION PREVAILS THROUGHOUT THIS DIAGRAM.
6. INTEGRATED CIRCUIT DEVICES ARE IDENTIFIED ON THE DRAWING BY THE UNDERLINED PORTION OF THE TYPE NUMBER IN TABLE I. PINS NOT SHOWN ON DRAWING ARE SPECIFIED IN THE TABLE.
7. R1 THRU R43 ARE 270 OHMS.
8. ▭ DENOTES FRONT PANEL MARKING.
9. PIN LOCATION IS AS SHOWN:

10. PIN LOCATION IS AS SHOWN:

11. PIN LOCATION IS AS SHOWN:

12. PIN LOCATION IS AS SHOWN:

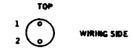


TABLE I

REF DES	DEVICE TYPE	+5V	GND	NO CONNECTION
U1	MC14511BCP	16	8	
U2	MC14511BCP	16	8	
U3	MC14511BCP	16	8	
U4	MC14511BCP	16	8	
U5	MC14511BCP	16	8	
U6	MC14511BCP	16	8	
DS6	MAN 74A-C			3,5,9,10,11
DS7	MAN 74A-C			3,5,9,10,11
DS8	MAN 74A-C			3,5,9,10,11
DS9	MAN 74A-C			3,5,9,10,11
DS10	MAN 74A-C			3,5,9,10,11
DS11	MAN 74A-C			3,5,9,10,11

TABLE 2
PUSHBUTTON SWITCH OUTPUTS

NUMBER	OUTPUT LEVEL (V) 1	2	4	8
0	0	0	0	0
1	5	0	0	0
2	0	5	0	0
3	5	5	0	0
4	0	0	5	0
5	5	0	5	0
6	0	5	5	0
7	5	5	5	0
8	0	0	0	5
9	5	0	0	5
00	0	0	-	-
25	5	0	-	-
50	0	5	-	-
75	5	5	-	-

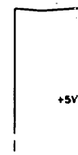
NOTE: DISREGARD "4" OUTPUT ON SWITCHES S5 AND S9

TABLE 3
U1 THROUGH U6 TRUTH TABLE

DECIMAL NO.	INPUT PINS (V) 7	1	2	6	OUTPUT PINS (V) 9 (E)	10 (D)	11 (C)	12 (B)	13 (A)	14 (G)	15 (F)
0	0	0	0	0	5	5	5	5	5	0	5
1	5	0	0	0	0	0	5	5	0	0	0
2	0	5	0	0	5	5	0	5	5	5	0
3	5	5	0	0	0	5	5	5	5	5	0
4	0	0	5	0	0	0	5	5	0	5	5
5	5	0	5	0	0	5	5	0	5	5	5
6	0	5	5	0	5	5	5	0	0	5	5
7	5	5	5	0	0	0	5	5	5	0	0
8	0	0	0	5	5	5	5	5	5	5	5
9	5	0	0	5	0	0	5	5	5	5	5

TABLE 4
DS6 THROUGH DS11 CODE CHART

INPUT PIN HIGH AT 5V	SEGMENT LIGHTED (READ BUTTON DEPRESSED)	SEGMENT CODE
1	F	
2	G	
6	E	
7	D	
8	C	
9	DP	
13	B	
14	A	



PARTS SUPPLIERS

Code Ident.	Name	Address
03797	Genisco Technology Corp. Eldema Division	18435 Susana Rd. Compton, CA 90221
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
08730	Vemaline Products Co. Inc.	455 West Main St. Wyckoff, NJ 07481
14283	Matrix Science Corp.	435 Maple Ave. Torrance, CA
15513	Data Display Products	5428 W. 104th St. Los Angeles, CA 90009
31223	Micro Plastics Inc.	20821 Dearborn St. Chatsworth, CA 91311
58361	General Instrument Corp. Optoelectronics Div.	3400 Hillview Ave. Palo Alto, CA 94304
72619	Dialight Division Amprex Electronic Corp.	203 Harrison Pl. Brooklyn, NY 11237
81073	Grayhill Inc.	561 Hillgrove Ave. La Grange, IL 60525
85480	W. W. Brady Co.	727 Glendale Ave. Milwaukee, WI 53209
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252
95146	Alco Electronic Products Inc.	P.O. Box 1348 Lawrence, MA 01842
99813	JAN Hardware Mfg. Co. Inc.	47-27 36th St. Long Island City, NY 11101

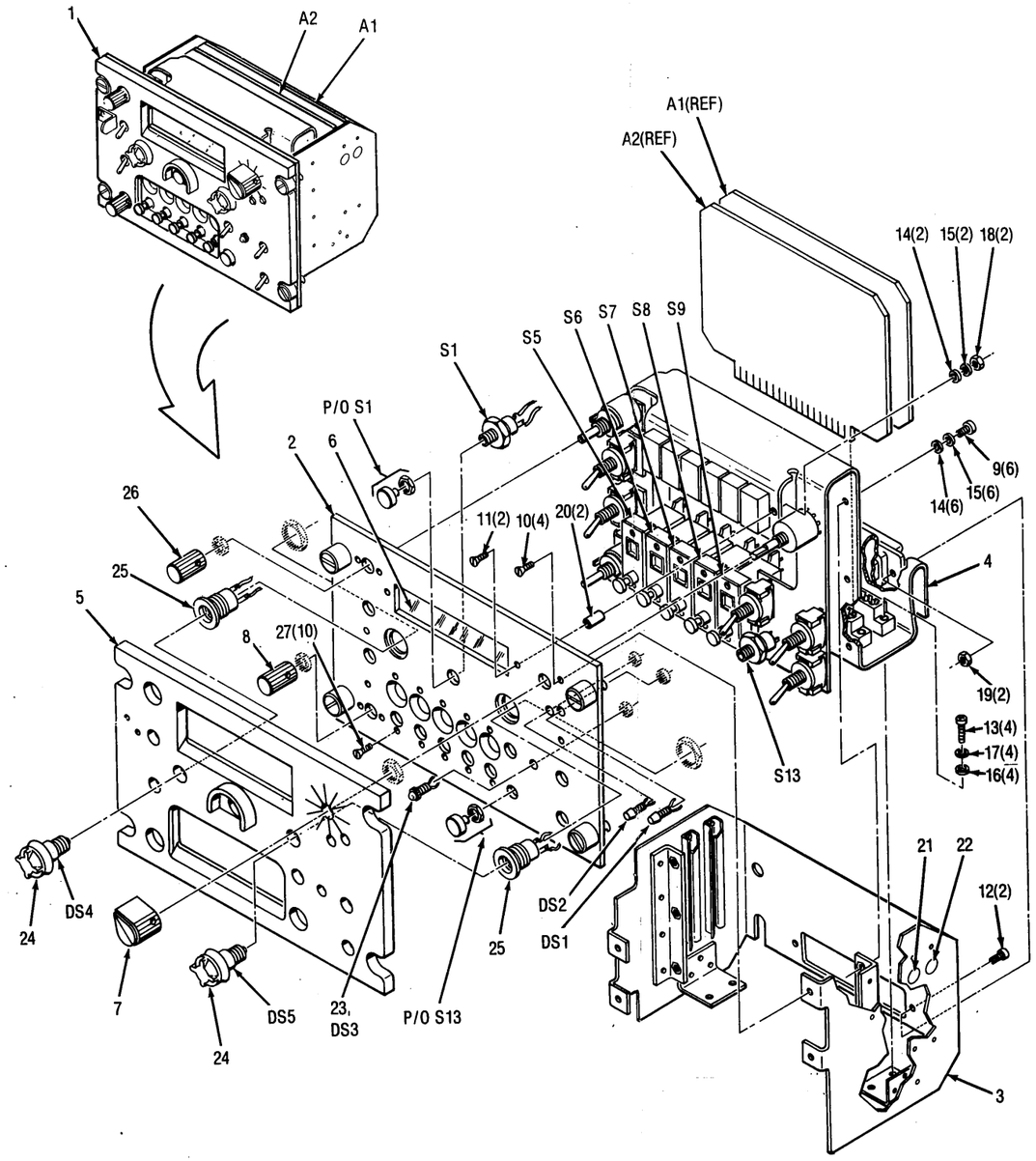


Figure 6-4. Remote Control Unit 1A1 Showing Location of Components and Major Assemblies (Sheet 1 of 2)

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04567L002	REMOTE CONTROL ASSY	
001	1	94990	01-P04568L001	FRONT PANEL ASSY	
002	1	94990	64-P07108L001	FRONT PANEL ASSY	
003	1	94990	27-P07107L001	CHASSIS,RCU	
004	1	94990	01-P07112L001	FLEX CABLE ASSEMBLY	
005	1	94990	64-P07109L001	PANEL,EDGE LIGHTED	
006	1	94990	61-P07169L001	WINDOW DISPLAY	
007	1	94990	36-P29140B001	KNOB. RED	
008	1	08730	C1022-2-A-LT/BLU	KNOB W/BLUE INSERT	
009	6		03-15013G27	SCREW	2-56X3/16
010	4		NAS662C2-3	SCREW	2-56X3/16
011	2		NAS662C2-10	SCREW	2-56X5/8
012	2		MS51957-13	SCREW	4-40X1/4
013	4		MS51957-16	SCREW	4-40X7/16
014	8		MS15795-802	WASHER	NO.2
015	8		MS35338-134	WASHER	NO.2
016	4		MS15795-803	WASHER	NO.4
017	4		MS35338-135	WASHER	NO.4
018	2		MS35649-224	NUT	2-56
019	2		MS35649-244	NUT	4-40
020	2		NAS42D3-21	SPACER	
021	1	85480	QD-25-RD	COLOR DOT-RED	
022	1	85480	QD-25-YL	COLOR DOT-YELLOW	
023	1	15513	PS200-B	SOCKET,LED	
024	2	72619	271-0111	HOLDER,LAMP	
025	2	72619	359-8430-09-502	MOUNTING BASE,LAMP	
026	1	08730	C1022-2-A-GRN	KNOB W/GREEN INSERT	
027	10		NAS662C2-4	SCREW,FH	2-56X1/4
029	1	94990	84-P07113L001	FLEX CABLE	
030	4	31223	04-0003-000	KEY,POLARIZING	
031	2		MS35333-125	WASHER, LOCK	1/4 I.D.
A 001	1	94990	01-P04569L002	MEMORY ASSEMBLY	
A 002	1	94990	01-P04570L001	LOGIC ASSEMBLY	
CR001	1		1N4001	DIODE	
DS001	1	03797	JD8111-001-220-AC	LED	AMBER
DS002	1	03797	JD8111-001-220-AC	LED	AMBER
DS003	1	15513	180-BCG	LED	GREEN
DS004	1		MS25237-387	LAMP	28V-.04A
DS005	1		MS25237-387	LAMP	28V-.04A
DS6-11	6	58361	MAN74A-CAT.C	LED DISPLAY	
J 001	1	14283	MD308G50P3410	CONNECTOR	
R1-43	43		RCR05G271JS	RESISTOR	270-5-1/8
R 044	1		RCR07G331JS	RESISTOR	330-5-1/4
R 045	1		GP1T048P253RA	RESISTOR,VARIABLE	
R 046	1		GP1T048P253RA	RESISTOR, VARIABLE	
S 002	1	95146	40-P24086F001	SWITCH, TOGGLE	
S 003	1	95146	40-P24086F001	SWITCH, TOGGLE	
S 004	1	94990	40-P03959T002	SWITCH, 10 POSITION	3/4INSFT.WITHFLAT 4INSFT.WITHFLAT
S 001	1	81073	30-251R	SWITCH,PUSH BUTTON	RED
S 005	1	94990	40-P07111L002	SWITCH	
S6-S8	3	94990	40-P07111L001	SWITCH	
S 009	1	94990	40-P07111L003	SWITCH	
S 010	1	95146	40-P24086F001	SWITCH,TOGGLE	
S 011	1	95146	40-P24086F001	SWITCH,TOGGLE	
S 012	1	95146	40-P24086F001	SWITCH,TOGGLE	
S 013	1	81073	30-251B	SWITCH,PUSH BUTTON	BLACK
XA001	1	31223	MP-0100-28-DS1	CONNECTOR	
XA002	1	31223	MP-0100-28-DS1	CONNECTOR	

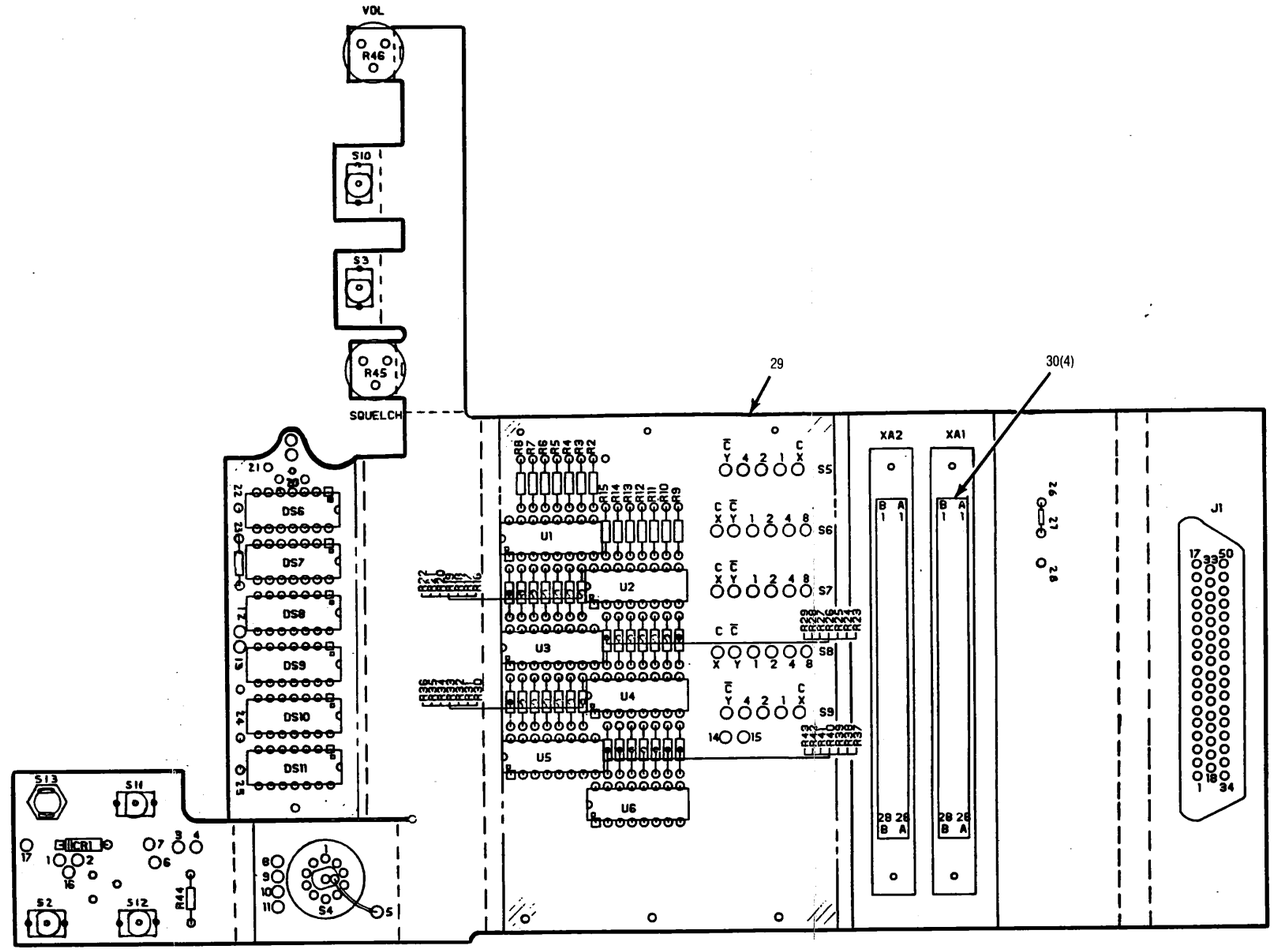


Figure 6-4. Remote Control Unit 1A1 Showing Location of Components and Major Assemblies (Sheet 2 of 2)

SECTION 7

MEMORY 1A1A1

7-1. PURPOSE AND GENERAL DESCRIPTION

7-2. The memory board 1A1A1, shown in Figure 7-1, stores the eight preset frequencies selected for use by the function selector switch at positions 1 through 6, GD A, and GD B. The board also allows the frequency selected by the pushbutton switches to pass straight through the board in the manual mode (MAN) position of the function selector switch. The board consists of four random access memories (RAM's) U1 through U4 and associated components. Each RAM has the capacity to store four 8-bit words. Since the RAM's are used in pairs, the total storage capacity is eight 16-bit words.

7-3. DETAILED DESCRIPTION

7-4. The memory board operates primarily in the following three modes:

- Memory Load
- Preset Frequency Generation
- Manual

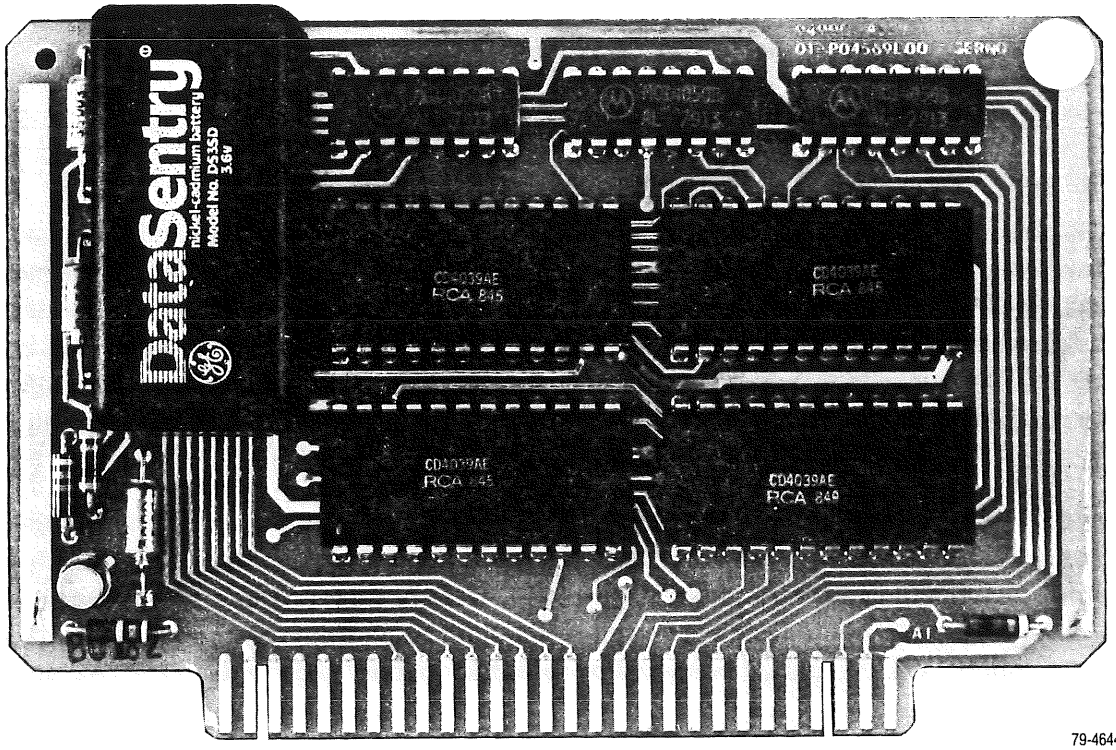


Figure 7-1. Memory 1A1A1

Refer to block diagram Figure 7-2, and schematic diagram Figure 7-3 during the following descriptions.

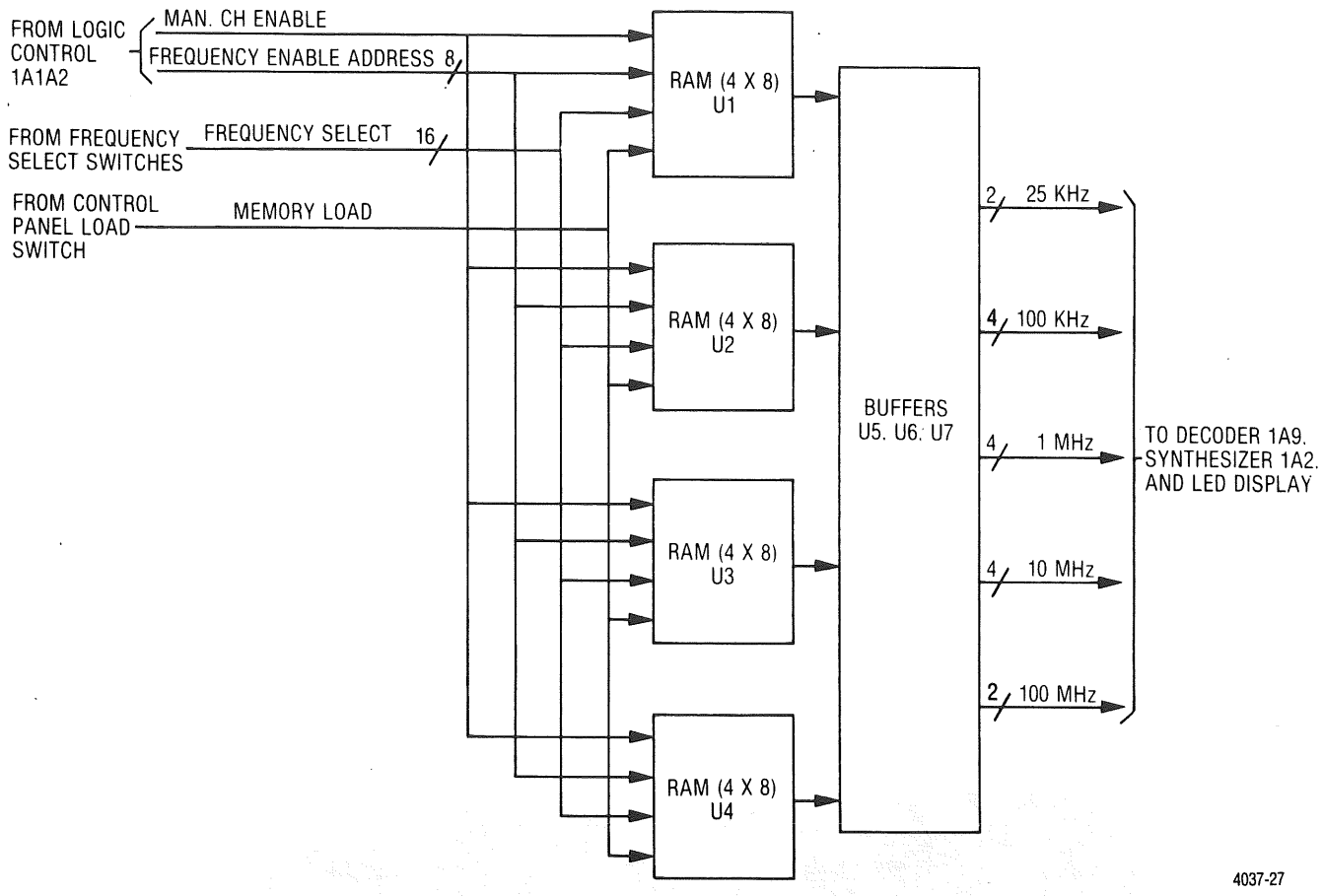


Figure 7-2. Memory 1A1A1 Block Diagram

7-5. MEMORY LOAD. During memory load operations, the frequency to be stored is selected at the control unit frequency pushbutton switches. The outputs of these switches are applied to the memory board RAM's over the sixteen frequency program lines. The desired storage location is selected by the control unit function selector switch (1 through 6, GD A, or GD B). After selection, the LOAD switch is depressed, the MEM LOAD line goes high, cycling a memory write operation, and the program line inputs are stored into memory. The operation is repeated for each function switch position except for MAN and T2/R1 positions.

7-6. PRESET FREQUENCY GENERATION. The preset frequency bits stored during the memory load operation are retrieved by selecting the corresponding position on the control unit function switch. This enables the corresponding address line (FREQ 1-6 ENBL, GD A or GD B ENBL) placing the preset frequency data on the output lines of the RAM's. The selected output signals are then conditioned by associated non-inverting buffers U5, U6, and U7 before being routed to decoder 1A9, synthesizer 1A2, and front panel LED frequency display.

7-7. MANUAL. When manual operation (MAN) is selected on the control unit function selector switch, the MAN CH ENABLE line goes high. This places the RAM's in a memory shunt (bypass) mode. The frequency switch inputs received over the frequency program lines are routed directly through the RAM's

without disturbing any stored data in memory. The outputs are then routed through the buffers and placed on the corresponding memory board output lines.

7-8. MEMORY MAINTENANCE AND TROUBLESHOOTING

CAUTION

The RCU must not be connected to the PET when removing the Memory Board 1A1A1. The +28V line may short to the +5V line during removal as the +28 volts is present even with the POWER switch OFF.

7-9. After concluding that a malfunction exists in the RCU, the memory board should be checked to determine if the problem exists on the board. Prepare the memory card for troubleshooting by performing the following:

a. Loosen the four captive screws holding the transceiver chassis assembly in its case. Remove the transceiver from the case.

b. Using card puller 66-P08094B001, remove the memory board from the RCU.

c. Mount the memory board on extender card 01-P07208L001 and insert the extender card into the memory board position in the RCU.

CAUTION

The component side of the memory board should be toward the rear of the RCU. Troubleshoot the memory board using the waveforms and voltage levels shown on the schematic diagram of Figure 7-3. Replace defective components using the parts locating diagram of Figure 7-4 as a guide.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A1A1.
2. FOR REFERENCE DRAWINGS REFER TO: 01-P04569L ASSEMBLY.
3. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ±5 PCT, 1/4 WATT. ALL CAPACITORS ARE IN UF. ALL VOLTAGES ARE DC.
4. TERMINATIONS CODED WITH THE SAME NUMBER ARE ELECTRICALLY CONNECTED.
5. POSITIVE LOGIC CONVENTION PREVAILS THROUGHOUT THIS DIAGRAM.
6. INTEGRATED CIRCUIT DEVICES ARE IDENTIFIED ON THE DRAWING BY THE UNDERLINED PORTION OF THE TYPE NUMBER IN TABLE 1. PINS NOT SHOWN ON DRAWING ARE SPECIFIED IN TABLE.
7. OUTPUTS WILL BE +5 V OR 0 V AND WILL REFLECT WHAT IS STORED IN MEMORY IF ONE OF THE FREQ ENABLE INPUTS IS AT +5 VDC. IF MAN. CH ENABLE IS GROUND, OUTPUTS WILL REFLECT SW 1, 2, 4, 8 INPUTS.

TABLE 2

SW DIGIT	SW INPUT (V)			
	1	2	4	8
0	0	0	0	0
1	5	0	0	0
2	0	5	0	0
3	5	5	0	0
4	0	0	5	0
5	5	0	5	0
6	0	5	5	0
7	5	5	5	0
8	0	0	0	5
9	5	0	0	5

TABLE 1

REF DES	DEVICE	+5V MEM	+5V	GND	NO CONNECTION
U1	CD4039AE	24	—	12	
U2	CD4039AE	24	—	12	
U3	CD4039AE	24	—	12	
U4	CD4039AE	24	—	12	
U5	MC14050BCP	—	1	8	9, 10, 11, 12, 13, 16
U6	MC14050BCP	—	1	8	13, 16
U7	MC14050BCP	—	1	8	13, 16

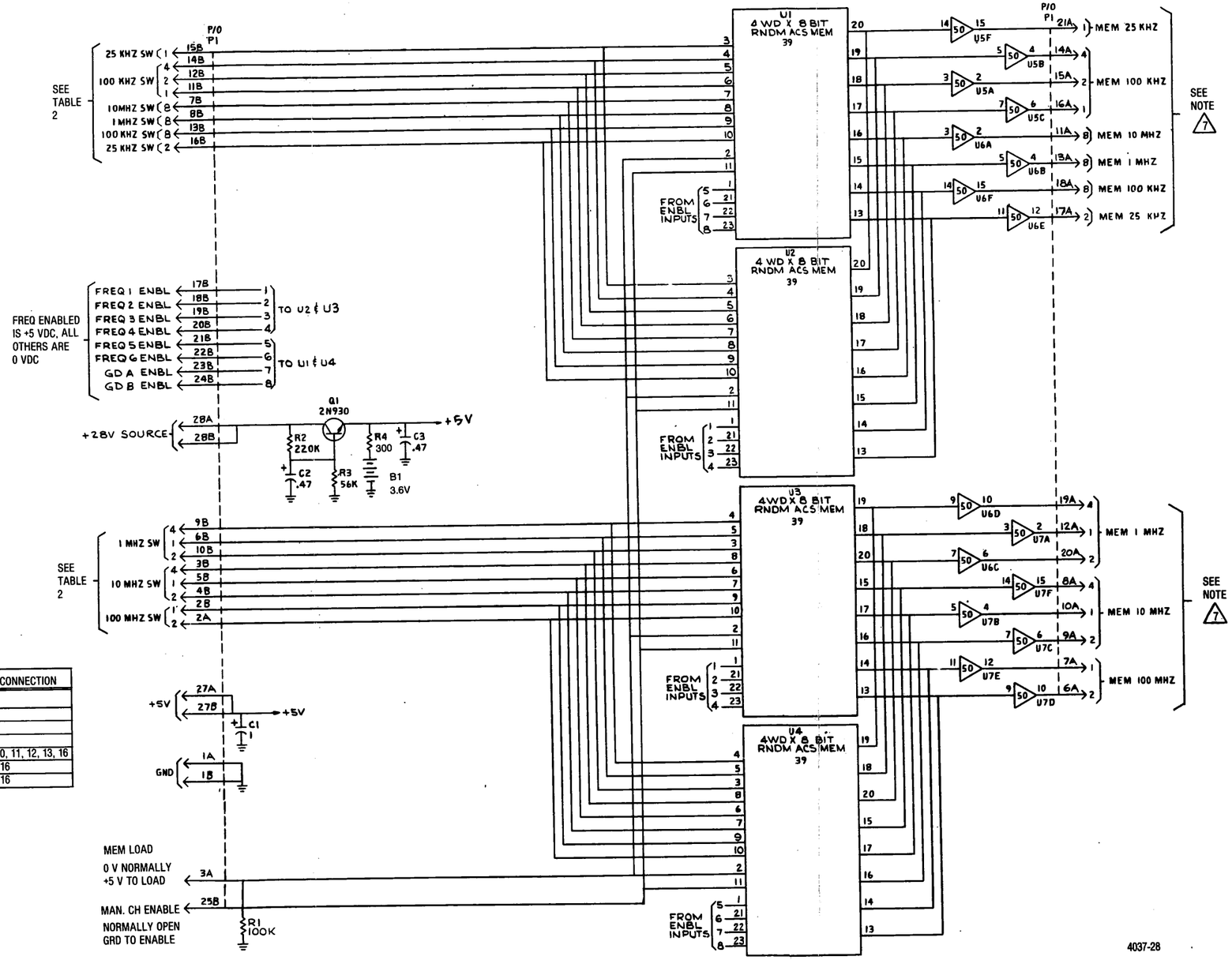


Figure 7-3. Memory 1A1A1 Schematic Diagram

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
001	1	94990	84-P07106L002	PWB,MEMORY	
C 001	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 002	1		M39003/01-2350	CAPACITOR	.47UF-10-50
C 003	1		M39003/01-2350	CAPACITOR	.47UF-10-50
Q 001	1		JAN2N930	TRANSISTOR	
R 001	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 002	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 003	1		RCR07G563JS	RESISTOR	56K-5-1/4
R 004	1		RCR07G301JS	RESISTOR	300-5-1/4
U1-U4	4	18722	CD4039AE	INTEGRATED CIRCUIT	
U5-U7	3	04713	MC14050BCP	INTEGRATED CIRCUIT	
B1	1	19209	DS3GT	BATTERY	3.6V

PARTS SUPPLIERS

Code Ident.	Name	Address
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
18722	RCA Corp. Solid State Div.	Crestwood Rd. Mountaintop, PA 18707
85480	W. W. Brady Co.	727 Glendale Ave. Milwaukee, WI 53209
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252
19209	General Electric	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

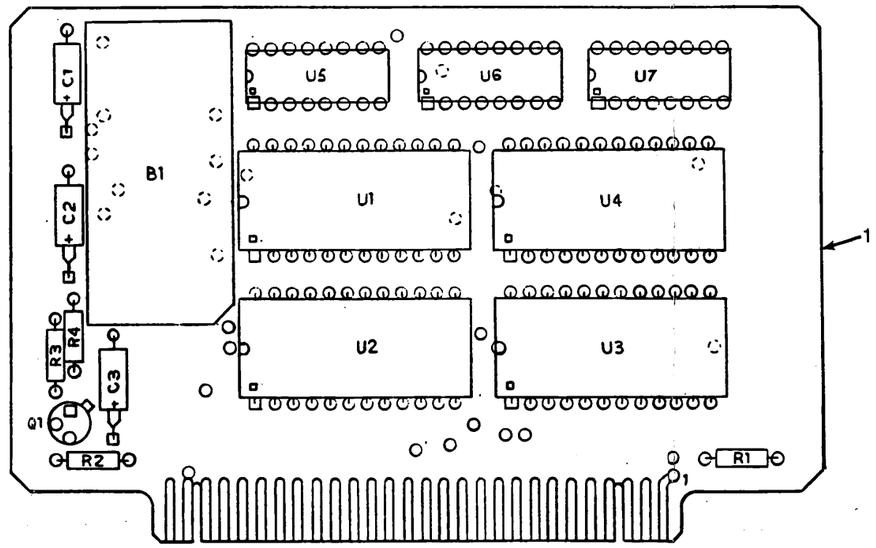


Figure 7-4. Memory 1A1A1 Parts Locating Diagram

SECTION 8

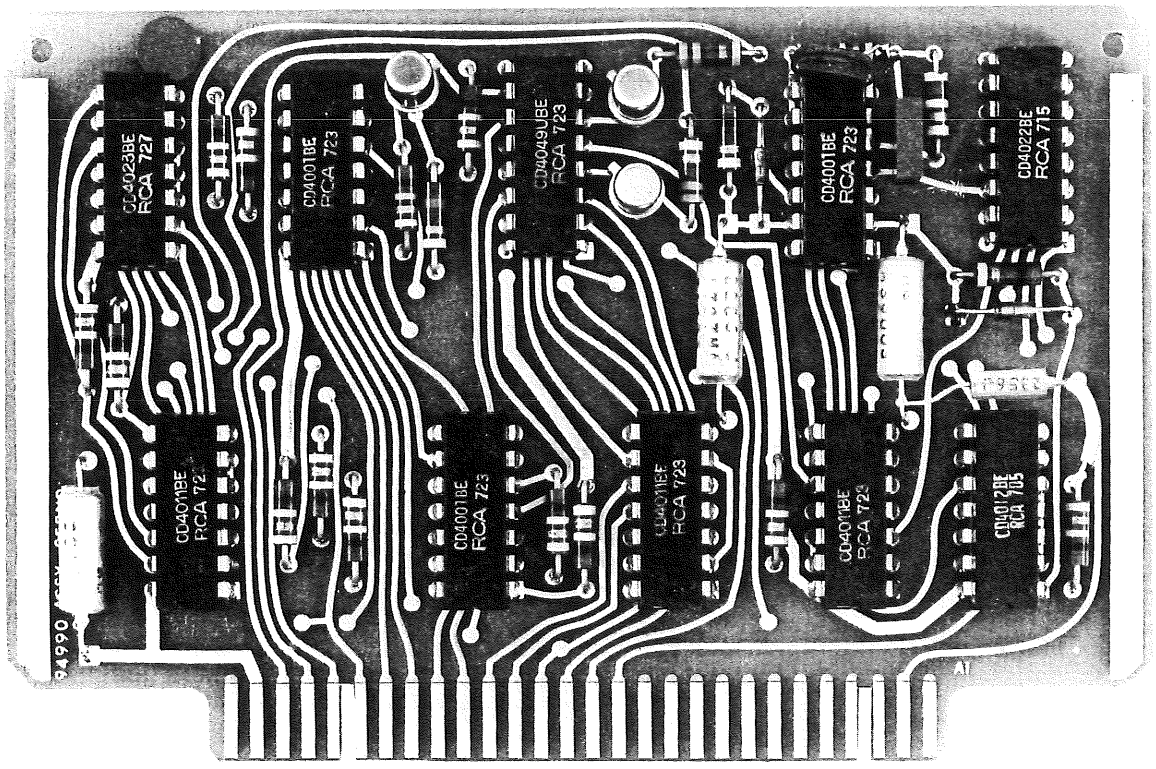
CONTROL LOGIC 1A1A2

8-1. PURPOSE AND GENERAL DESCRIPTION

8-2. The control logic board shown in Figure 8-1, generates PET control signals based on the operating modes and functions selected at the control unit front panel. The board provides individual preset and guard frequency enables, frequency enables under control of a scanning clock, manual frequency enable, and transmit and receive mode selection. The board consists of mode selection logic, scanning clock, delay and enable circuits, and associated gates and drivers.

8-3. DETAILED DESCRIPTION

8-4. The following paragraphs contain detailed descriptions of control logic board 1A1A2 as referenced to the block diagram shown in Figure 8-2 and schematic diagram shown in Figure 8-4.



77-4887

Figure 8-1. Control Logic Board 1A1A2

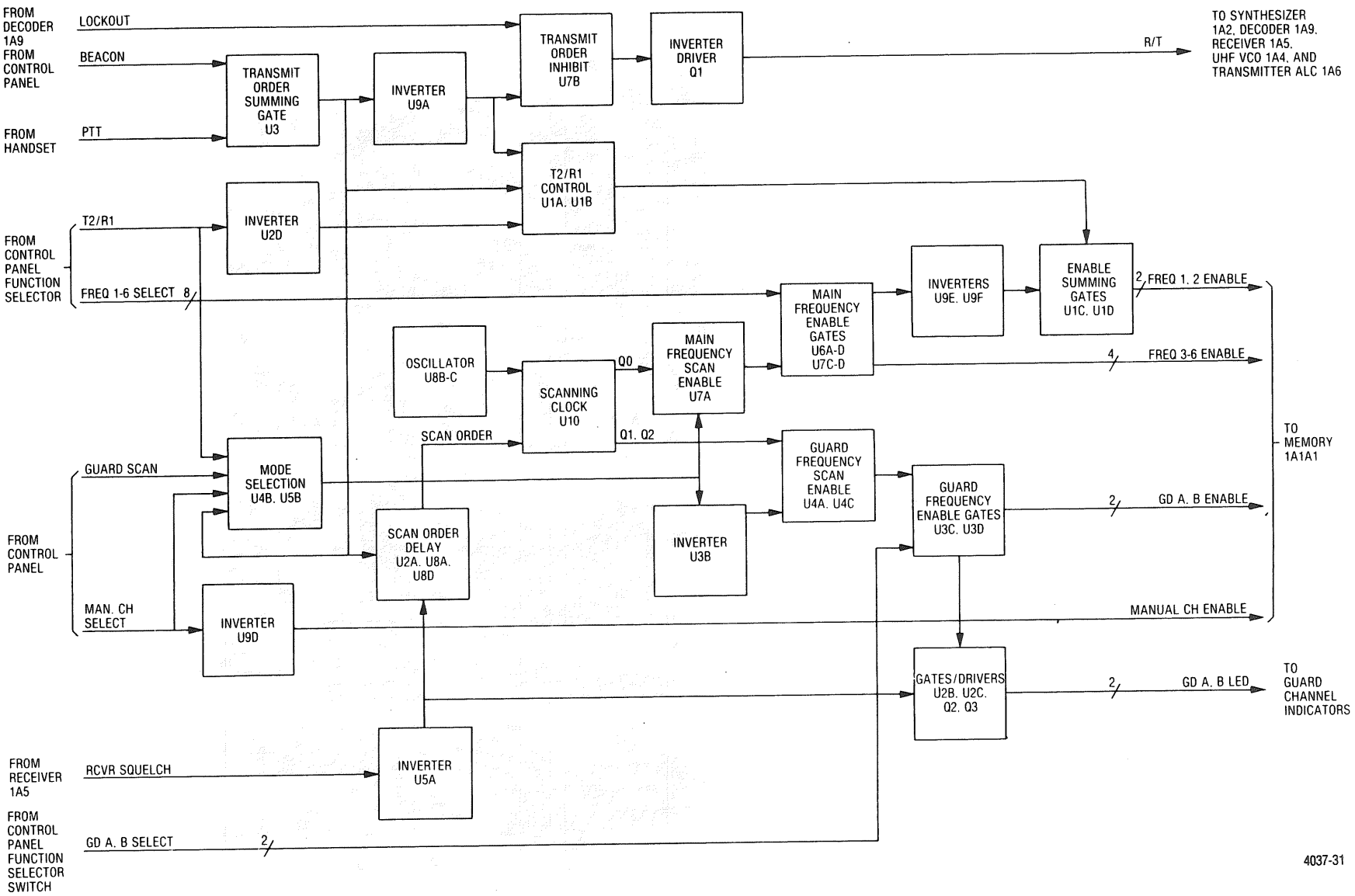


Figure 8-2. Control Logic 1A1A2 Block Diagram

8-5. MANUAL (MAN). When the manual operating mode is selected (function selector switch to MAN position), a low is applied to inverter U9D over the MAN CH SELECT input. This signal also provides a low to gate U5B disabling the scanning clock control logic. The low is then inverted by U9D to produce a high MANUAL CH ENABLE output at pin P1-25A for use in memory board 1A1A1.

8-6. SCAN. In scan mode, the SCAN switch is set to the GD position and 1 of 6 preset frequencies is selected at the function selector switch. This enables the transceiver to scan the two guard frequencies (GD A and GD B) and one preset frequency, provided three other conditions are met as follows:

- BEACON switch is set to NORM position
- The PTT input is high corresponding to the receive mode
- The function selector switch is not in the T2/R1, or MAN positions

Under these conditions, four highs are applied to the inputs of U5B which in turn provide a low enabling gate U7A. The low output of U5B is also inverted by U3B and applied to gates U4A and U4C. With the RCVR SQUELCH line high at pin P1-13A, gate U2A applies a low to the clock inhibit input of scanning clock U10. The low at U10-13 then allows the clock to count as triggered by pulses from free running oscillator U8B and U8C. The counting sequence of scanning clock U10 and the relationship of its Q0, Q1, Q2, and Q3 outputs are as follows:

- The first trigger pulses causes Q0 output to go high
- The second pulse causes Q1 to go high and Q0 to return low
- The third pulse causes Q2 to go high and Q1 to return low
- Since Q3 is bootstrapped around U10 to the reset input, the fourth pulse causes Q0 to go high again.

When output Q0 is high, lows are supplied to frequency enable gates U6A through U6D and U7C through U7D by the inverting action of U7A. The frequency select input (FREQ 1-6 SELECT) then enables the selected gate producing a high at the corresponding frequency enable output. When the Q1 output of U10 goes high, U4A output goes low causing GD A ENABLE at P1-24A to go high. Likewise, when the Q2 output of U10 goes high, U4C output goes low causing GD B ENABLE at P1-23A to go high. As U10 sequences through its Q0, Q1, and Q2 counts, the FREQ "X" ENABLE, GD A ENABLE, and GD B ENABLE lines, respectively, go high. The scan cycle is then repeated after resetting by the Q3 output pulse.

8-7. Scan Time Delay. The scan time delay circuit consists of inverter U5A, gates U8A, U8D, and U2A, and associated time delay components. The circuit is basically enabled by gates U8A and U8D which are controlled by the BEACON, PTT, and RCVR SQUELCH inputs to the board. Gates U8A and U8D incorporate time delays. Gate U8A causes the scanning to stop immediately when a message is received as indicated by the RCVR SQUELCH input. It delays resumption of the scan to allow for momentary pauses in the received message and/or to allow the PET operator to reply to the message. If the PET operator responds to the message by depressing the PTT button on the handset for transmitting, the transmission frequency will be the one selected by the function selector switch. A low on the PTT line (corresponding to transmit) causes the output of U8D to go low immediately, stopping the scan. At the end of the transmission the PTT line again goes high and the transceiver reverts back to the receive mode at the frequency of the original

received message. The U8D delaying action causes that frequency to be monitored a short time for a possible response before resuming scanning. An example of the delay circuit is shown in Figure 8-3. As shown, the NOR gate in the circuit functions as an inverter. When the input goes high, a low appears at the output with no time delay. At the same time capacitor C2 is charged through diode CR1 and a high is also applied to the second gate input. The delay is produced when the upper input to the gate goes low, capacitor C2 discharges across resistor R17 and holds the second input to the gate high for approximately 5 seconds, thus delaying the output low-to-high transition of the gate.

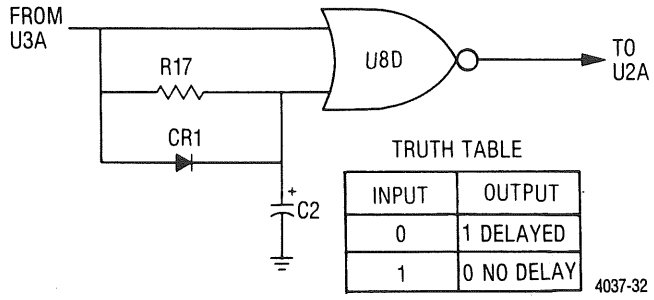


Figure 8-3. Scan Time Delay Circuit

8-8. MANUAL GUARD CHANNEL SELECTION. When either GD A or GD B positions are selected on the function selector switch, the SCAN switch must be in the OFF position (refer to Chapter 2). This disables the scanning circuit by causing a high output from gate U5B. Both GD A and GD B circuits are identical in operation. If GD A is selected, a low is applied to the input of gate U3C. This signal, coupled with the high level from gate U4A, causes the output of gate U3C to go high providing a GD A ENABLE and also a high into gate U2C. Whenever a low appears at the RCVR SQUELCH input (no squelch), a high is generated out of gate U5A. This high, plus the already present high from U3C, causes the output of gate U2C to go low turning on driver Q3 and subsequently lighting the GD A LED.

8-9. TRANSMIT ON TWO/RECEIVE ON ONE (T2/R1). In the T2/R1 mode, a low is applied to inverter U2D and gate U5B. The low to U5B disables the receive scanning function. The inverted output from U2D is applied to gate U1A and U1B. At the same time, since the scan is disabled, two highs are applied to gates U1D and U1C from inverters U9E and U9F.

8-10. For receiving, since the BEACON and PTT input are open, a low is provided by gate U3A to inverter U9A and gate U1B. The low to U1B coupled with the already present high from U9F causes a low FREQ 2 ENABLE out of U1C disabling channel two. At the same time, a high from U9A causes the U1A output to go low. This generates a high FREQ 1 ENABLE out of gate U1D to enable channel one.

8-11. In the transmit mode, the PTT line goes low and applies a high from gate U3A to inverter U9A. The resulting low from U9A produces a high from gate U1A, thus causing the FREQ 1 ENABLE to go low. The output of gate U1B then goes low and that coupled with the high from U9F produces a high FREQ 2 ENABLE output. In addition, with a normally low LOCKOUT signal, gate U7B via inverter U9A turns driver Q1 ON and OFF to generate low transmit signal or high receive signal. This signal is used to control the transmit and receive mode to various cards within the transceiver.

8-12. LOCKOUT. The purpose of the lockout circuit is to prevent transmitting when an out-of-band frequency is selected (refer to chapter 16). The LOCKOUT signal is generated by decoder board 1A9. The

signal is normally low, however when an out-of-band frequency is selected, a high is generated and applied to gate U7B forcing its output to go low. This turns off transistor Q1 and places the R/T output into the receive mode (high level). The transmit mode is then blocked until an in-band frequency is selected allowing the LOCKOUT signal to return to its normal low.

8-13. CONTROL LOGIC MAINTENANCE AND TROUBLESHOOTING

8-14. After concluding a mulfunction exists in the RCU, the control logic board should be checked to determine if the problem exists on the board. Prepare the control logic card for troubleshooting by performing the following:

a. Loosen the four captive screws holding the transceiver chassis assembly in its case, then remove the transceiver from the case.

b. Using card puller 66-P08094B001, remove the control logic board from the RCU.

c. Mount the control logic card on extender card 01-P07208L001 and insert the extender card into the control logic board position in the RCU.

CAUTION

The component side of the control logic card should be toward the rear of the RCU.

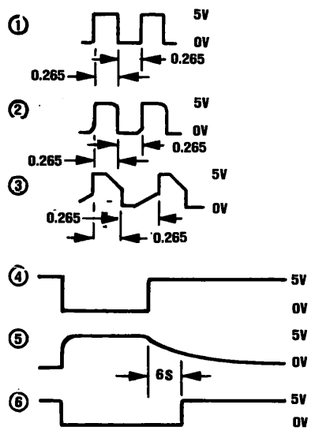
Troubleshoot the control logic board using the waveforms and voltage levels shown on the schematic diagram, Figure 8-4. Replace defective components using parts locating diagram, Figure 8-5, as a guide.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH A1A2.
2. FOR REFERENCE DRAWINGS REFER TO: 01-P04570L ASSEMBLY
3. UNLESS OTHERWISE SPECIFIED: ALL RESISTORS ARE IN OHMS, ± 5 PCT, 1/4 WATT. ALL CAPACITORS ARE IN UF. ALL VOLTAGES ARE DC.
4. INTEGRATED CIRCUIT DEVICES ARE IDENTIFIED ON THE DRAWING BY THE UNDERLINED PORTION OF THE TYPE NUMBER LISTED IN TABLE 1. PINS NOT SHOWN ON DRAWING ARE SPECIFIED IN THE TABLE.

TABLE 1

REF DES	DEVICE TYPE	+5V	GND	NO CONNECTION
U1	MC14011BCP	14	7	
U2	MC14011BCP	14	7	
U3	MC14011BCP	14	7	
U4	MC14023BCP	14	7	
U5	MC14012BCP	14	7	6, 8
U6	MC14001BCP	14	7	
U7	MC14001BCP	14	7	
U8	MC14001BCP	14	7	
U9	MC14049BCP	1	8	13, 16
U10	MC14022BCP	16	8	4,5,6,9,10,11,12



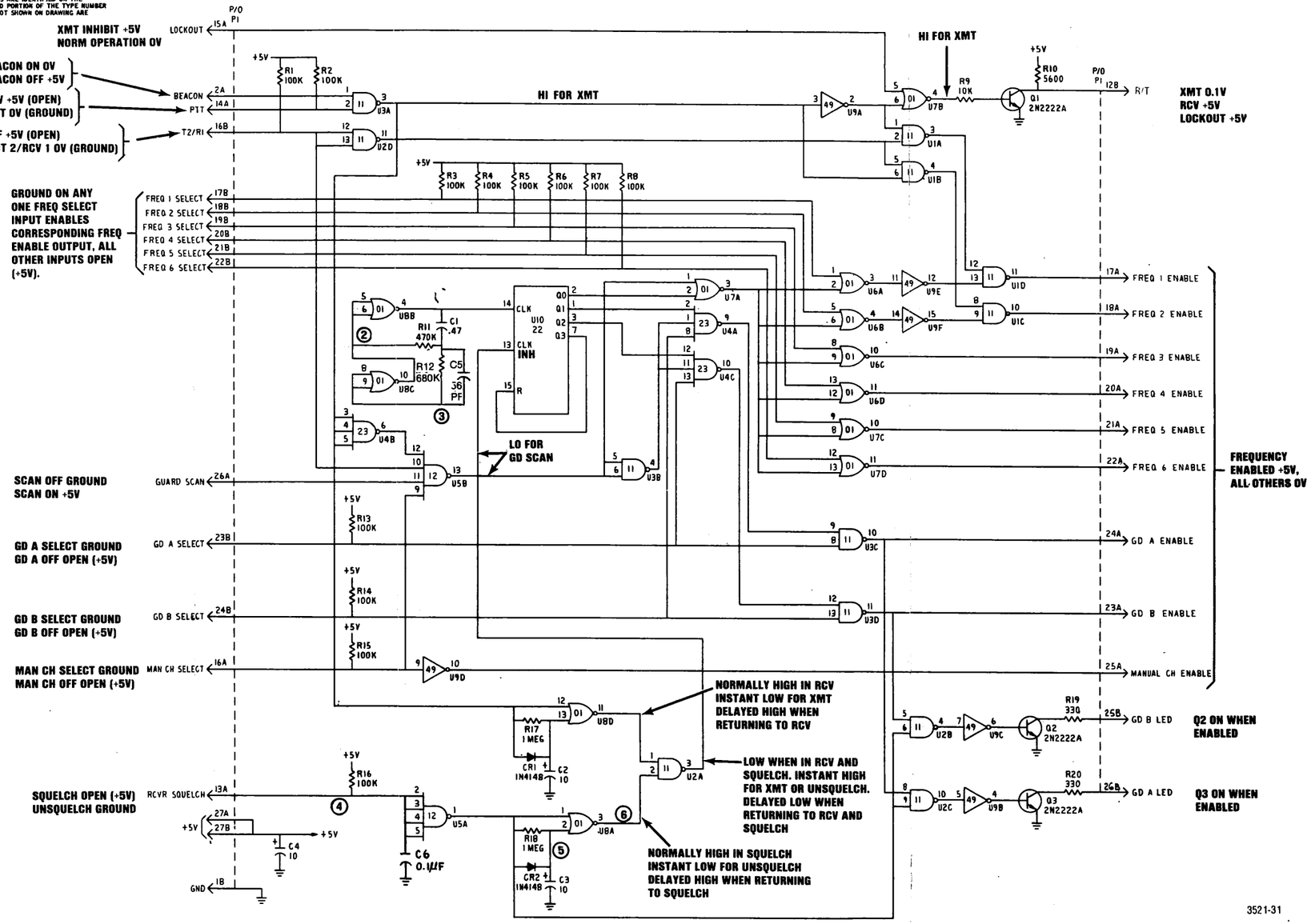


Figure 8-4. Control Logic 1A1A2 Schematic Diagram

PARTS LIST

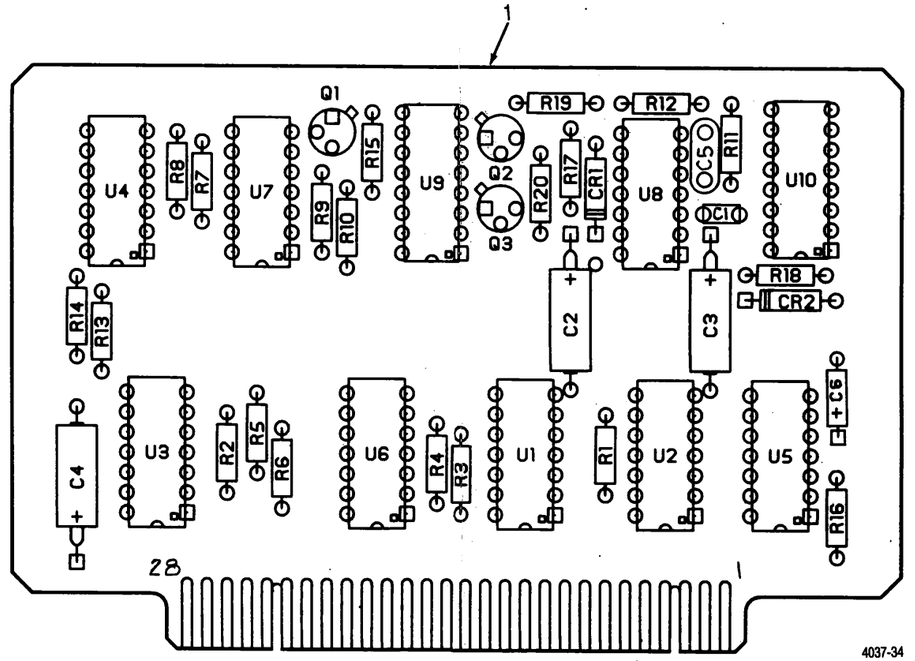
Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
001	1	94990	84-P04620L001	PWB, LOGIC	
C001	1		M39014/02-1399	CAPACITOR	.47UF-10-50
C2-C5	3		M39003/01-2286	CAPACITOR	10UF-10-20
C005	1		CM04ED560J03	CAPACITOR	56PF-5-500
CR001	1		JAN1N4148	DIODE	
CR002	1		JAN1N4148	DIODE	
Q1-Q3	3		JAN2N2222A	TRANSISTOR	
R1-R8	8		RCR07G104JS	RESISTOR	100K-5-1/4
R009	1		RCR07G103JS	RESISTOR	10K-5-1/4
R010	1		RCR07G562JS	RESISTOR	5600-5-1/4
R011	1		RCR07G474JS	RESISTOR	470K-5-1/4
R012	1		RCR07G684JS	RESISTOR	680K-5-1/4
R13-16	4		RCR07G104JS	RESISTOR	100K-5-1/4
R017	1		RCR07G105JS	RESISTOR	1M-5-1/4
R018	1		RCR07G105JS	RESISTOR	1M-5-1/4
R019	1		RCR07G331JS	RESISTOR	330-S-1/4
R020	1		RCR07G331JS	RESISTOR	330-5-1/4
U1-U3	3	04713	MC14011BCP	INTEGRATED CIRCUIT	
U004	1	04713	MC14023BCP	INTEGRATED CIRCUIT	
U005	1	04713	MC14012BCP	INTEGRATED CIRCUIT	
U6-U8	3	04713	MC14001BCP	INTEGRATED CIRCUIT	
U009	1	04713	MC14049BCP	INTEGRATED CIRCUIT	
U010	1	04713	MC14022BCP	INTEGRATED CIRCUIT	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
85480	W. W. Brady Co.	727 W. Glendale Ave. Milwaukee, WI 53209
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252



4037-34

Figure 8-5. Control Logic Board 1A1A2, Parts Location Diagram

SECTION 9

SYNTHESIZER 1A2

9-1. PURPOSE AND GENERAL DESCRIPTION

9-2. The synthesizer module 1A2 (shown in Figure 9-1) consists of two boards, 1A2A1 and 1A2A2. In conjunction with the VCO's, the synthesizer forms a phase-locked loop frequency synthesizer capable of generating frequencies at 25 kHz spacing in the VHF or UHF frequency range. The synthesizer loop achieves the same frequency accuracy and stability for each of the channels as exists for the master reference frequency generated by a temperature-compensated crystal-oscillator (TCXO) located on card 1A2A2 of the synthesizer assembly.

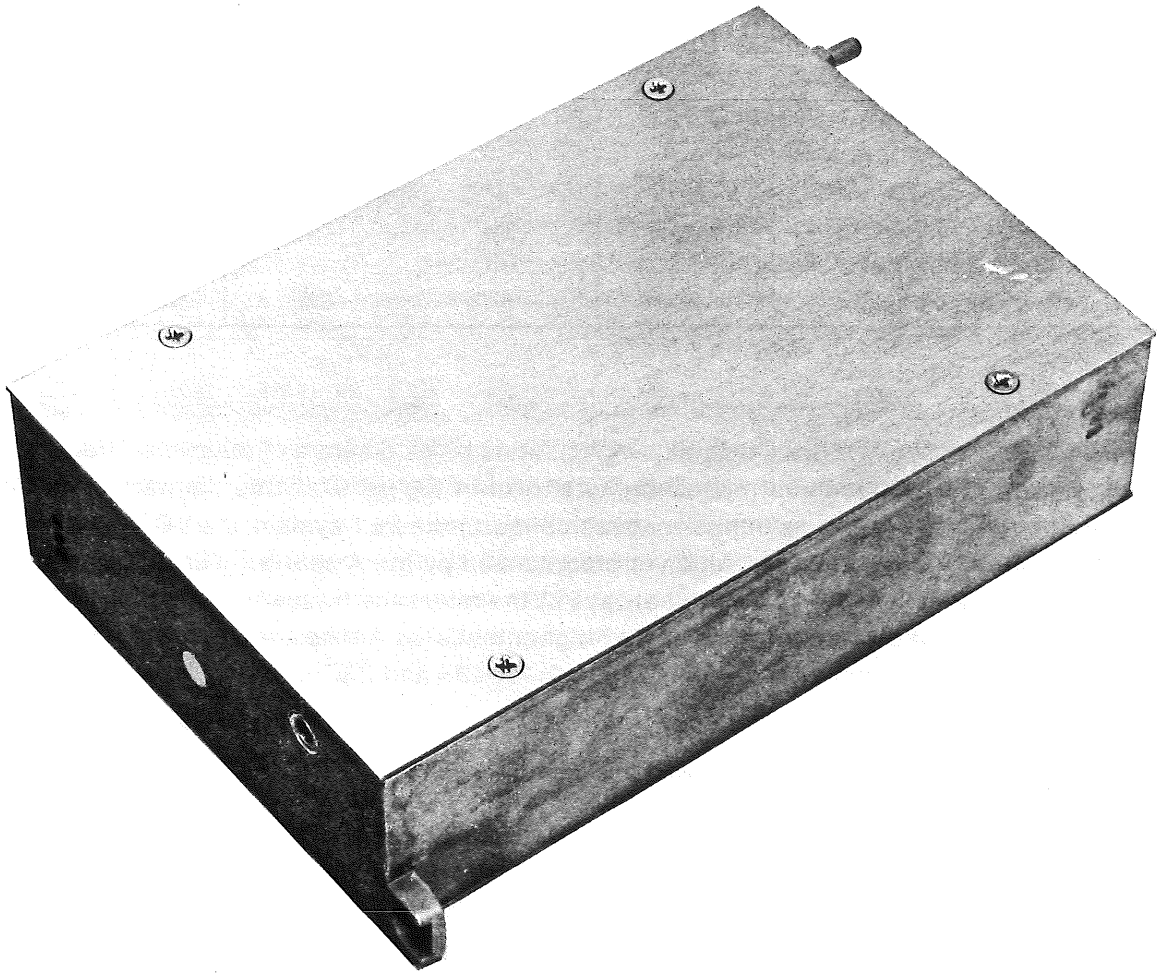


Figure 9-1. Synthesizer 1A2

9-3. The synthesizer provides a VCO tracking voltage and a loop bandwidth switch signal to the VHF and UHF VCO modules (1A3 and 1A4, respectively). It also supplies a Synth Lock signal to transmitter ALC module 1A6, and the XMODE connector located on the transceiver case.

9-4. The synthesizer operates on the selected VCO RF input signal generated by either vco module in both transmit and receive modes. Other control signals to the synthesizer are the R/T input from remote control unit 1A1 and the MIX HI/LO signal from decoder 1A9. The module generates a VCO tracking voltage based upon the VCO frequency divided by a number determined by the frequency program line inputs from control unit 1A1 as referenced to the frequency standard generated by crystal oscillator Y1. Tables 9-1 and 9-2 list the modes of operation and the related synthesizer outputs based on the selected frequencies.

Table 9-1. Synthesizer Operating Modes and Offset Frequencies

Freq. Band	Transmit	Receive	Mix Offset High	Mix Offset Low	Synthesizer Output
VHF	X				DIAL
VHF		X	X		DIAL +29 MHz
UHF	X				DIAL
UHF		X	X		DIAL +29 MHz
		X		X	DIAL −29 MHz

9-5. FREQUENCY SYNTHESIS SCHEME. A simplified block diagram of the overall frequency synthesis scheme, known as two-modulus prescaling, is shown in Figure 9-2. This diagram shows components which are in both the VCO and synthesizer assemblies. In the PET system, the VCO output is applied to a prescaler (counter) the modulus of which is programmed by the A counter. The prescaler output feeds a divide-by-N counter which has an output always at the reference frequency (25 kHz) when the loop is in lock. In operation, the prescaler divides by its higher modulus A times, and then by its lower modulus N minus A times. For this synthesizer, $P=40$, $M=1$, $0 \leq A \leq 39$ and $225 \leq N \leq 399$ for UHF, $116 \leq N \leq 149$ for VHF. The following definitions apply:

P — Corresponds to lower division of the two-modulus prescaler.

M — Corresponds to difference of two divisors of the two-modulus prescaler.

A — Number corresponding to least significant digits on frequency selector (Table 9-3).

N — Defined above.

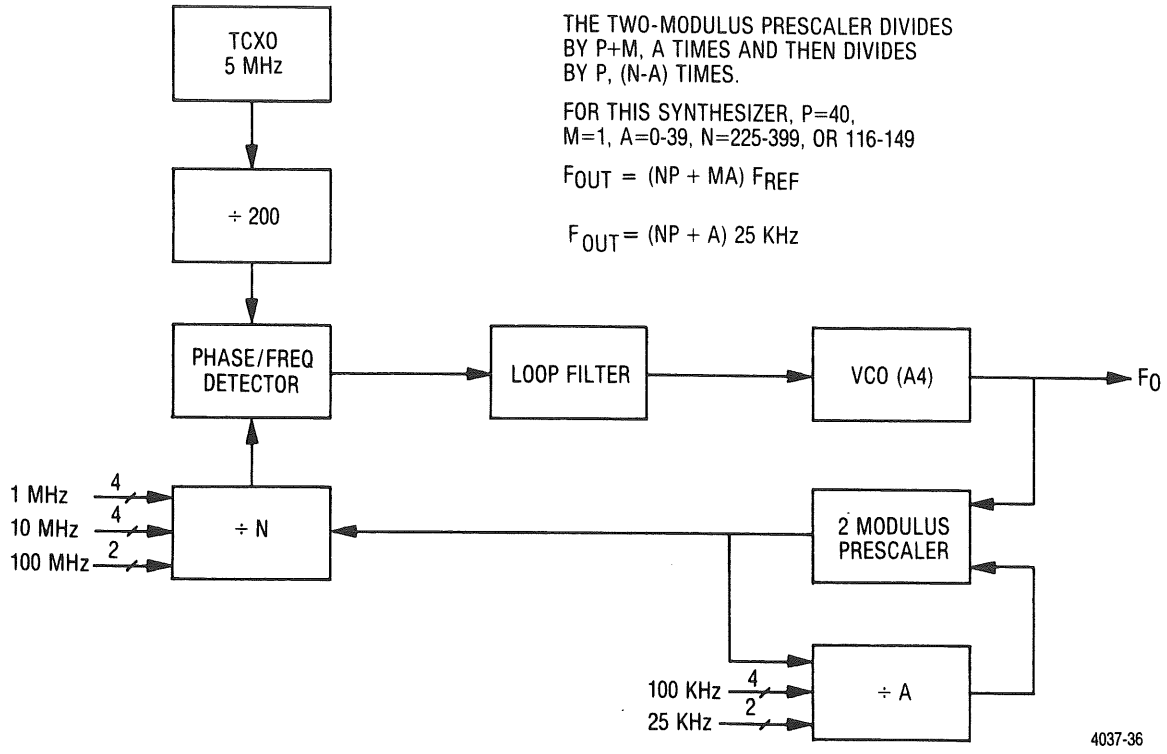


Figure 9-2. Frequency Synthesis Scheme Simplified Block Diagram

Note that the number N is the same as the three most significant digits of the frequency selected at the front panel of the control unit. Thus, the BCD output from the switches directly programs the N counter without any interface logic. One of the reasons for choosing the two modulus prescaling synthesis system is so that the 100 kHz and 25 kHz switch outputs can program the A counter. (See paragraph 9-9). Given the parameters described previously, the equation for VCO output frequency as a function of P, M, N, and A is:

$$F_{out} = [(P + M)A + P(N - A)]\, F_{ref}$$

$$= (PA + MA + PN - PA)\, F_{ref}$$

$$= (NP + MA)\, F_{ref}$$

$$= (NP + A)\, F_{ref}$$

$$= (NP + A)\ 25\ kHz$$

With a minimum frequency step of 25 kHz, there are 1360 possible discrete frequencies between 116.000 MHz and 149.975 MHz in the VHF band and 7000 discrete frequencies between 225.000 MHz and 399.975 MHz in the UHF band.

Table 9-2. Synthesizer Operating Modes and Input/Output Frequencies

R/T	Selector Freq. (MHz)		Mix Offset High/Low	Synthesizer Output Freq. (MHz)	VCO Band
Receive	VHF	116-131.975	High Side	145-160.975	
		132-149.975	High Side	161-178.975	
	UHF	225-242.975	Low Side	196-213.975	Low Band
		243-259.975	High Side	272-288.975	Low Band
		260-277.975	Low Side	231-246.975	Low Band
		278-294.975	High Side	307-323.975	High Band
		295-312.975	Low Side	266-283.975	Low Band
		313-329.975	High Side	342-358.975	High Band
		330-347.975	Low Side	301-318.975	High Band
		348-364.975	High Side	377-393.975	High Band
		365-382.975	Low Side	336-353.975	High Band
		383-399.975	High Side	412-428.975	High Band
Transmit	VHF	116-149.975		116-149.975	
	UHF	225-299.975		225-299.975	Low Band
		300-399.975		300-399.975	High Band

Table 9-3. Frequency Selector Switch Binary to BCD Conversion for Input to A Counter

Selector			Binary Input						BCD Output To A Counter					
			100 kHz				25 kHz		U12		U8			
A Count	100 kHz	25 kHz	8	4	2	1	2	1	S2	S1	S4	S3	S2	S1
0	0	00	0	0	0	0	0	0	0	0	0	0	0	0
1	0	25	0	0	0	0	0	1	0	0	0	0	0	1
2	0	50	0	0	0	0	1	0	0	0	0	0	1	0

Table 9-3. Frequency Selector Switch Binary to BCD Conversion for Input to A Counter (Cont)

Selector			Binary Input						BCD Output To A Counter					
A Count	100 kHz	25 kHz	100 kHz 8	4	2	1	25 kHz 2	1	U12 S2	S1	U8 S4	S3	S2	S1
3	0	75	0	0	0	0	1	1	0	0	0	0	1	1
4	1	00	0	0	0	1	0	0	0	0	0	1	0	0
5	1	25	0	0	0	1	0	1	0	0	0	1	0	1
6	1	50	0	0	0	1	1	0	0	0	0	1	1	0
7	1	75	0	0	0	1	1	1	0	0	0	1	1	1
8	2	00	0	0	1	0	0	0	0	0	1	0	0	0
9	2	25	0	0	1	0	0	1	0	0	1	0	0	1
10	2	50	0	0	1	0	1	0	0	1	0	0	0	0
11	2	75	0	0	1	0	1	1	0	1	0	0	0	1
12	3	00	0	0	1	1	0	0	0	1	0	0	1	0
13	3	25	0	0	1	1	0	1	0	1	0	0	1	1
14	3	50	0	0	1	1	1	0	0	1	0	1	0	0
15	3	75	0	0	1	1	1	1	0	1	0	1	0	1
16	4	00	0	1	0	0	0	0	0	1	0	1	1	0
17	4	25	0	1	0	0	0	1	0	1	0	1	1	1
18	4	50	0	1	0	0	1	0	0	1	1	0	0	0
19	4	75	0	1	0	0	1	1	0	1	1	0	0	1
20	5	00	0	1	0	1	0	0	1	0	0	0	0	0
21	5	25	0	1	0	1	0	1	1	0	0	0	0	1
22	5	50	0	1	0	1	1	0	1	0	0	0	1	0
23	5	75	0	1	0	1	1	1	1	0	0	0	1	1
24	6	00	0	1	1	0	0	0	1	0	0	1	0	0
25	6	25	0	1	1	0	0	1	1	0	0	1	0	1
26	6	50	0	1	1	0	1	0	1	0	0	1	1	0
27	6	75	0	1	1	0	1	1	1	0	0	1	1	1
28	7	00	0	1	1	1	0	0	1	0	1	0	0	0
29	7	25	0	1	1	1	0	1	1	0	1	0	0	1
30	7	50	0	1	1	1	1	0	1	1	0	0	0	0
31	7	75	0	1	1	1	1	1	1	1	0	0	0	1
32	8	00	1	0	0	0	0	0	1	1	0	0	1	0
33	8	25	1	0	0	0	0	1	1	1	0	0	1	1
34	8	50	1	0	0	0	1	0	1	1	0	1	0	0
35	8	75	1	0	0	0	1	1	1	1	0	1	0	1
36	9	00	1	0	0	1	0	0	1	1	0	1	1	0
37	9	25	1	0	0	1	0	1	1	1	0	1	1	1
38	9	50	1	0	0	1	1	0	1	1	1	0	0	0
39	9	75	1	0	0	1	1	1	1	1	1	0	0	1

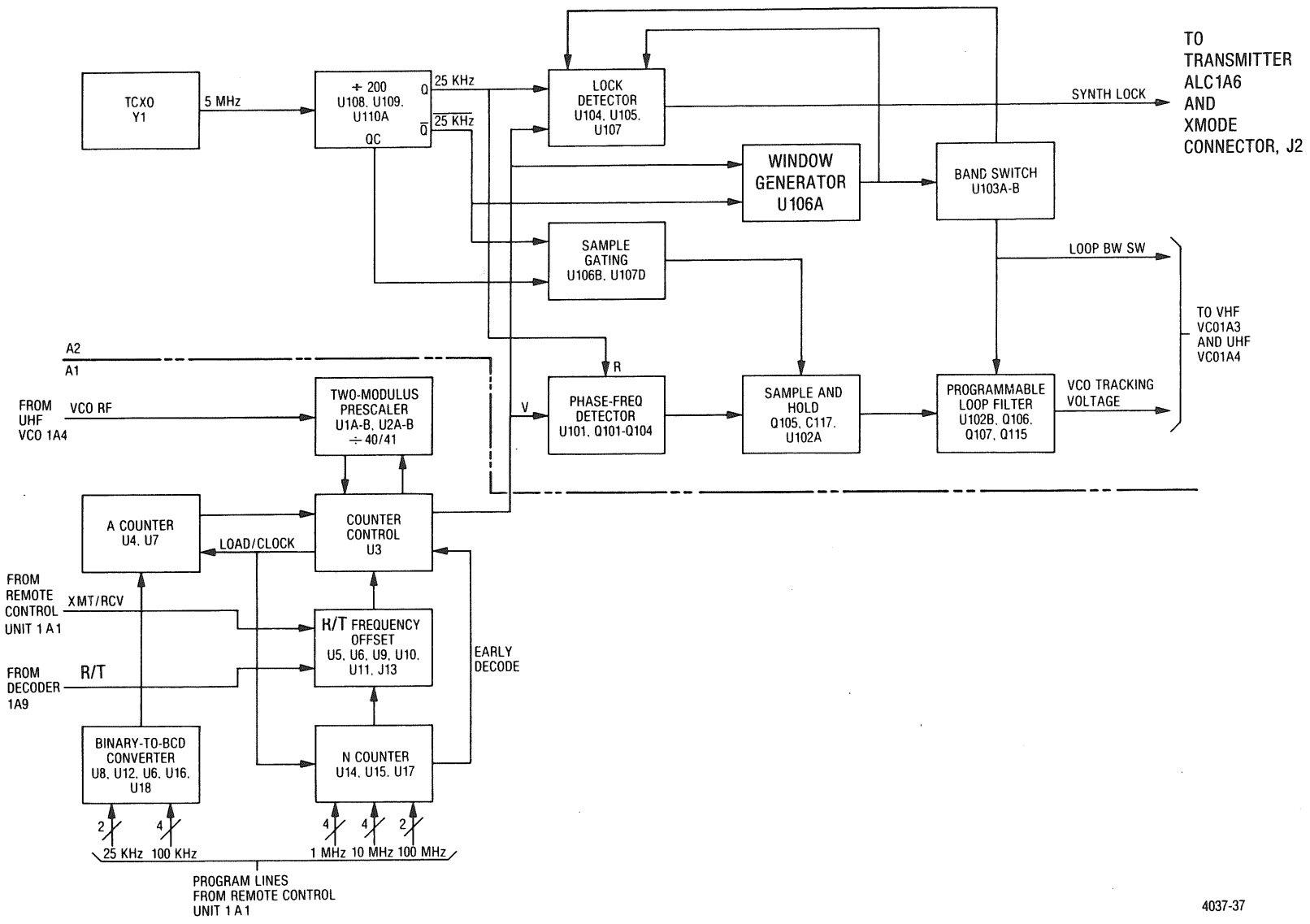


Figure 9-3. Synthesizer 1A2 Block Diagram

9-6. DETAILED DESCRIPTION

9-7. The following paragraphs contain a functional description of the synthesizer based on the block diagram shown in Figure 9-3 and schematic diagram shown in Figure 9-5.

9-8. TCXO REFERENCE FREQUENCY. The basic frequency for the synthesizer is supplied by TCXO Y1 located on assembly 1A2A2. The TCXO provides a continuous 5 MHz output with an accuracy of 4.0 ppm. The TCXO output is divided by the divide-by-200 function consisting of counter U108, U109 and U110A. The resulting 25 kHz output provides a reference to the lock detector U104, U105 and U107 and the phase frequency detector U101 and Q101 through Q104. The complement output of 25 kHz from the ÷200 counter is applied to window generator U106A and the sample gating circuit consisting of devices U106B and U107D.

9-9. PRESCALER. The prescaler consists of two modulus prescaler U1A, counters U2A and U2B (÷4), and converter U1B. The purpose of the prescaler network is to divide the VCO RF input signal by 40 or 41 under control of counter control U3.

9-10. During operation, a sine wave input (VCO RF) from VCO A4 is supplied through coaxial connector P1A2 to two-modulus prescaler U1A. The two-modulus prescaler provides a prescaled squarewave output to the first counter stage (÷2) based on programmed control signals received at pins E1, E2 and E5 from the counter stages and counter control U3. The first and the second counter stages U2A and U2B form a divide-by-4 which when combined with the normal divide-by-10/11 of the two-modulus prescaler produce a divide-by-40/41 network. The output of last counter stage U2B is routed to MECL-to-TTL converter U1B where the signal is converted and supplied to the counter control U3 "f_{IN}" input.

9-11. BINARY-TO-BCD CONVERTER. The binary-to-BCD converter provides six-bit binary-to-BCD conversion for the 25 kHz and 100 kHz inputs from the control unit frequency selector switches. The conversion is necessary because the A counter requires a BCD input and the 25 kHz and 100 kHz inputs combined are interpreted as a six-bit binary number. Examples of the conversion for the entire frequency range for both the 25 kHz and 100 kHz inputs are shown in Table 9-3. When interpreting the table, also refer to the block diagram of the binary-to-BCD converter shown in Figure 9-4 and the schematic diagram of the synthesizer in Figure 9-5.

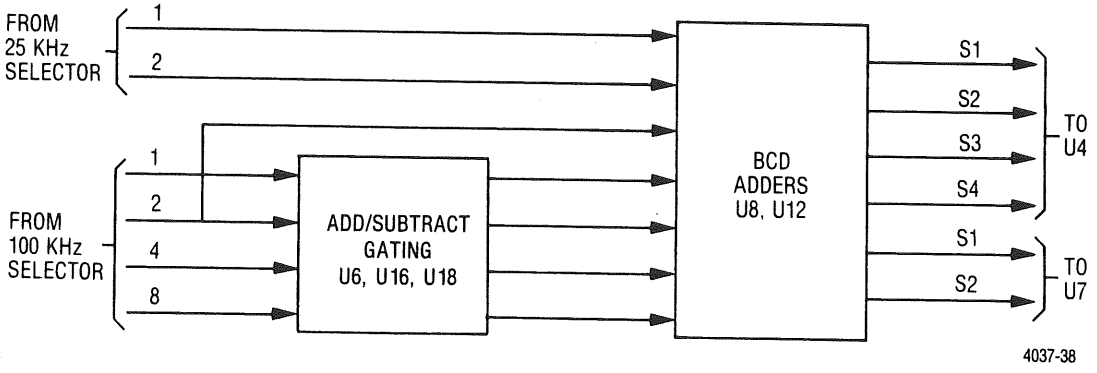


Figure 9-4. Binary-to-BCD Converter Block Diagram

9-12. A COUNTER. The A counter consists of BCD counters U4 and U7. The purpose of the A counter is to control the modulus of the modulus prescaler. The A counter operates in the decrement mode only. The counter is supplied with a BCD number (0 to 39) generated by the 25 kHz and 100 kHz frequency selector switches via the binary-to-BCD converter. The number is loaded into the A counter when the load pulse from Q1 makes a low transition. After the load pulse goes back to high, the counter then decrements on the positive edge of each succeeding clock pulse until U4 — QA thru QD outputs reach 0000 and the count in U7 reaches zero. When the last counter pulse goes low at QD, the ripple clock output at device U7 generates a low pulse which, through inverter U6B places a high at control counter U3-B2. This enables the modulus prescaler to go from the divide by 41 to the divide by 40 mode.

9-13. As a further example of operation, if the last digits of the operating frequency selected are 225 or less, the inputs to counter U7 are both low and counter U4 is loaded with a number between 0 and 9. Thus, when counter U4 has decremented to zero, the ripple clock output is automatically supplied to counter control U3. If the last digits of the frequency selected are 250 kHz or higher, a number is present on the data lines to counter U7. For this condition, each time counter U4 decrements to zero, the last count from U4 (clock input to U7 from QD) causes U7 to decrement by 1 until zero is reached. The next decrement cycle by U4 then causes the ripple clock output pulse. If for example, the number 39 corresponding to 975 kHz is programmed to the A counter, counter U7 decrements three digits and counter U4 completes four decrement cycles on the original input. Refer to Table 9-3 for the A counter addressing scheme.

9-14. N COUNTER. The N counter consists of three decade counters U15, U14 and U17. The counters operate on 1 MHz, 10 MHz, and 100 MHz inputs coded in BCD as received from the control unit. The N counter is controlled by the same load and clock signals that load and clock the A counter, however, only counter U15 receives the initial clock pulses. Additional clocking is cascaded between the three counters as the counters decrement. The N counter provides output signals to both counter control U3 and the frequency offset logic. The two MSB's from counter U15 go directly to the counter control. This configuration is used to preload and early decode the frequency selection input to the N counter so the system can be reclocked with the load line already set. (See paragraph 9-15 for further explanation on the preloading.) This compensates for any inherent delays caused by speed differences between incoming VCO RF and the digital counters.

9-15. COUNTER CONTROL. Counter control U3 determines when the A counter has reached zero by detecting all lows on the Z0 thru Z3 inputs and a high on the B2 input. When this occurs the EN OUT signal goes low, thereby changing the modulus of the prescaler from 41 to 40. This explains how the "divide by the higher modulus (41) A times" part of the synthesis scheme (paragraph 9-5) is performed. To complete the synthesis, we must now "divide by the lower modulus (40) N minus A times". Since both A and N are clocked by the same source, when A reaches zero, the N counter contains N minus A counts. Thus, U3 must detect when the N counter reaches zero and generate a pulse at f_{out} to complete the cycle. In the transmit mode, the MSB of the N counter at U15-QD is monitored. This is to early decode (preset) and compensate for time lag as previously mentioned. As the counter decrements, the last two counts are summed by NAND gate U9. The ripple clock output of U14 and U17 then cause a high level out of U5A to bus input B1 of counter control U3 producing a low output pulse at f_{out}. This low is propagated to the LOAD inputs of the A and N counters causing the preset information to appear at the Q outputs. When the next f_{in} clock pulse is applied to U3, the f_{out} goes high. Since the load pulse over-rides the CLK inputs on the A and N counters, the clock pulse occurring during this period does not decrement the counters. The next clock pulse then starts a new cycle.

9-16. R/T FREQUENCY OFFSET. The circuits contained in R/T frequency offset function operate in both the transmit and receive modes. In the transmit mode, the MIX HI/LO circuits are locked out and the resetting of the counter control and two-modulus prescaler is accomplished from the ripple clock outputs of the N counter. In the receive mode, the VCO must operate 29 MHz away from the selected frequency to create a 29 MHz intermediate frequency. To accomplish this in the receive mode, the ripple clock gating circuits are disabled and the prescaler and counter control resetting is controlled from the offset gates (+29 MHz and −29 MHz) which are tied to the outputs of the N counters most significant digits (10 MHz and 100 MHz).

9-17. TRANSMIT MODE. When the transmit mode is selected, a low is applied to the inputs of gates U11B, U5B, U10B, and U5D. Gate U5B is disabled routing counter U15-QA directly through gates U11B and U11A to U3-PO. The MIX HI/LO line is locked out by the high present at gate U11D. This also applies a low to EXCLUSIVE OR U13A giving count pulse U15-QB a direct non-inverting input to U3-P1. The summation pulse from U9 is also locked out at gate U5D. A high from inverter U10B enables gate U5C providing a path for the ripple clock output directly to U3-B1. When the counters have decremented to zero for a given transmit cycle, the high at U3-B1 allows an output at U3-f_{out} thus reloading the N counter and starting a new decrement cycle at the next clock pulse. This continues until the receive mode is selected.

9-18. RECEIVE MODE. In the receive mode, a high is applied to the inputs of gates U11B, U5B, U10B and U5D. Gate U11B is disabled and count U15-QA is routed directly through U5B, U6D, and U11A to U3-P0. A low is also applied to the input of gate U5C disabling the ripple clock circuit used for the transmit mode. A high is applied to U5D enabling a path for a bus enable pulse from U9 to U3-B1. Either a HI or LO mix is selected (refer to Table 9-1). If HI mix is selected (+29 MHz), a low is applied to exclusive OR gate U13A providing a non-inverting signal between U15-QB and U3-P1. A low is also applied to exclusive OR gates U13B, U13C, and U13D. This provides a non-inverting signal from counters U14 and U17 to summation gate U9. As the counters decrement from the frequency selected and reach a count from U14 and U17, corresponding to 29 MHz, all ones are provided through the associated gates to the inputs of U9. With this condition present, U9 generates a low causing a high bus enable level from gate U5A to U3-B1. The high at U3-B1 permits a clock pulse at U3-f_{out} which causes the N counter and A counter to reset to the frequency selected. Since the counters are reset "29 MHz early", the synthesized frequency is 29 MHz higher than the frequency selected by the pushbutton switches on the RCU. In this manner with a HI mix signal, a fixed high side frequency 29 MHz greater than the frequency selector switch setting is generated. This applies to both the UHF and VHF modes.

9-19. A LO mix is only available in the UHF receive mode. For a LO mix (−29 MHz) signal, a high is applied to the inputs of exclusive OR gates U13B, U13C, and U13D. Some outputs from counters U14 and U17 are then inverted. After the counters have decremented from the selected frequency to zero, gate U9 still does *not* initiate a high bus enable pulse to U3 because of the inverted outputs from U14 and U17. Consequently, the counters are not reloaded and continue to decrement until a count corresponding to −29 MHz is reached. At this time all highs are applied to U9 producing a high bus enable pulse to U3-B1. The high at U3-B1 permits a clock pulse at U3-f_{out} which causes N counter and A counter to reset to the frequency selected. Since the counters are reset "29 MHz late", the synthesized frequency is 29 MHz lower than the frequency selected. In this manner with a LO mix signal, a fixed low side frequency 29 MHz lower than the frequency selector switch setting is generated.

9-20. PHASE/FREQUENCY DETECTOR. The f_{out} signal from counter control U3 is routed through driver Q1 to U101-V. The reference is a 25 kHz squarewave derived from the 5 MHz TCXO oscillator by the ÷200 counter chain comprised of two ÷ 10 counters U108 and U109 and one ÷ 2 counter U110A. In

most phase lock loops, the loop servo action causes the reference and signal inputs to the phase detector to be nearly in phase. However, a deliberate DC offset is inserted in this loop at the noninverting input of U102B to cause a 90-degree phase difference between the R and V inputs of U101. Phase-frequency detector U101 derives the phase information from the trailing edges of the R and V inputs and does not depend on the duty cycle of either input. The output at Q101 and Q102 collectors is a 25 kHz squarewave having about a 25% duty cycle whose average (dc) value is the voltage required to keep the VCO at the proper frequency and phase. This signal is applied to integrator R110 and C102 which produces a triangular waveform. The triangular waveform is applied to buffer amplifier Q103-Q104 which has a very high input impedance to minimize its effects on integrator R110-C102 and very low output impedance for driving the sample and hold.

9-21. SAMPLE AND HOLD. The sample and hold circuit is formed by devices Q105, C117, and U102A. Its function is to suppress the reference component (25 kHz) harmonics while passing the dc and low frequency information. The sample and hold circuit is switched by MOSFET Q105 via transistor Q112 and gates U106B and U107D. Basic time for the sample and hold circuit is supplied by ÷ 2 counter U110A and ÷ 10 counter U109. The output of the sample and hold circuit is supplied to the programmable loop filter.

9-22. PROGRAMMABLE LOOP FILTER. The programmable loop filter consists of devices U102B, MOSFETS Q106, Q107 and Q115, and associated components. The filter is programmable in the sense that its constant can be switched to a short value (narrowband) when the loop is in lock or to a large value (wideband) when the loop is out of lock. The narrowband filter consists of components R115, C106, R117, feedback resistor R119, C107 and R144. The wideband circuit consists of components R116, Q107, Q106, Q115, R120, C107 and R145. The wide/narrow band switching is performed by U106A and band switch circuit components U103, Q109 and Q110. When the loop is locked, the phase of the two inputs to U106A is controlled in such a way that one of the two is always high. This causes the output to be continuously low (U103A and U103B not triggered and Q110 off). If a phase or frequency error is detected at the inputs to U106A, the output will contain pulses that trigger both U103A and U103B. This is because the device is positive edge rather than level triggered. The period of U103A is 60 ms and U103B is 300 ms. When an out-of-lock condition occurs, the Q output of U103A goes high for 60 ms placing the loop in the wideband mode for that period of time and then returning to the narrowband mode for 300 − 60 = 240 ms (min). If the loop has locked, the cycle ends. If it is still out of lock, the process repeats. When the loop goes back into the narrowband mode a phase transient occurs because of the switching action in the loop filter. The 240 ms blanking period caused by U103B prevents the phase transient from retriggering U103A. Retriggering by the phase transient could cause the loop to oscillate.

9-23. LOCK DETECTOR. The synthesizer lock indicator is used by the transmitter to prevent rf power from being applied to the final amplifiers when the synthesizer is out of lock. Failure of the output RF power transistor in the RF amplifier could occur should this happen. Therefore, great care is taken to ensure that this does not happen, even under certain kinds of fault conditions in the synthesizer circuitry. As an example, when the synthesizer is in-lock, the output of U106A is continuously low as previously mentioned. As long as this is a dc level, U104 remains untriggered and thus Q remains high. This is one of the three conditions which must be satisfied for SYNTH LOCK to remain true. Because the 5 MHz oscillator divider can fail in the high state, the output of U106A can be locked low even in a failure mode. Therefore, transition detectors determine that all signals are present. This function is performed by U105. As long as edges from the 25 kHz reference and the divider signals are present, both halves remain continuously retriggered and the other input of U107C remains continuously high.

9.24. SYNTHESIZER ASSEMBLY MAINTENANCE AND TROUBLESHOOTING

9-25. After a malfunction is isolated to the synthesizer assembly, remove the module from the transceiver as instructed in paragraph 5-28. Reconnect the synthesizer to the transceiver using extender cable 30-P07209L001. Troubleshoot the synthesizer assembly in reference to the waveforms and voltage levels shown on the schematic diagram, Figure 9-4. Replace defective components using parts locating diagrams of Figures 9-6, 9-7, and 9-8 as a guide.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A2
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P04573L MODULE ASSEMBLY
   01-P04574L A2 PWB ASSEMBLY
   01-P04575L A1 PWB ASSEMBLY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4 WATT, 5 PCT
   ALL CAPACITORS ARE IN UF
   ALL INDUCTORS ARE IN UH
4. TERMINATIONS CODED WITH THE SAME LETTER(S) ARE ELECTRICALLY CONNECTED.
5. INTEGRATED CIRCUIT DEVICES ARE IDENTIFIED ON THE DRAWING BY THE UNDERLINED PORTION OF THE TYPE NUMBER IN TABLE 1. PINS NOT SHOWN ON DRAWING ARE SPECIFIED IN THE TABLE.
6. POSITIVE LOGIC CONVENTION PREVAILS THROUGHOUT THIS DIAGRAM.
7. VALUE TO BE SELECTED IN TEST
8. PIN LOCATION IS AS SHOWN:

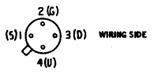
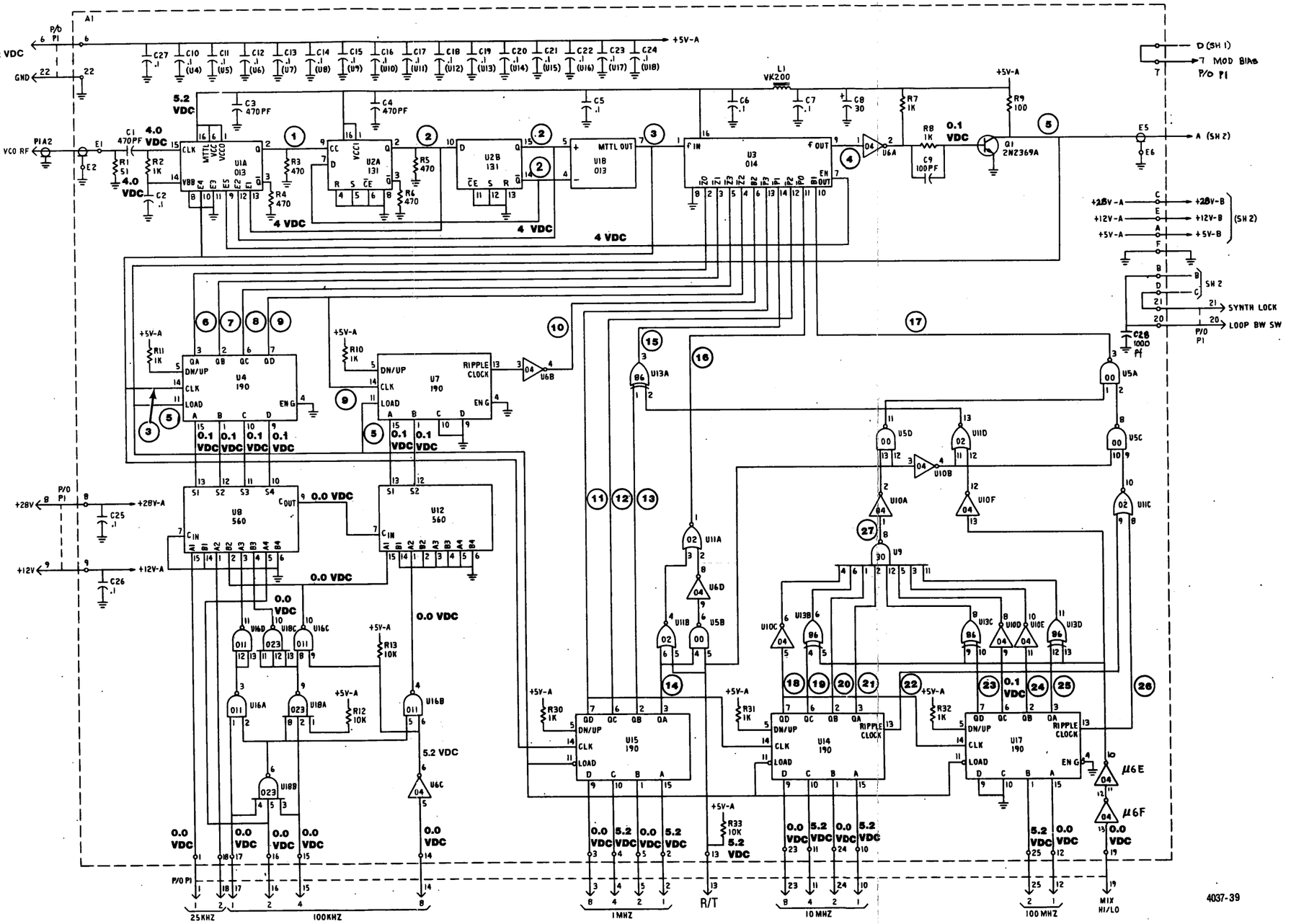


TABLE I

REF DES	TYPE NO.	PWR	A +5V	B +5V	C +5V	A GND	B GND	NO CONNECTION
U1	MC12013CP	SEE DWG	—	—	—	—	—	
U2	MC10131P	SEE DWG	—	—	—	—	—	
U3	MC12014P	SEE DWG						15
U4	SN74LS190N		16			8		12, 13
U5	SN74LS00N		14			7		10, 11, 12, 13
U6	SN74LS04N		14			7		
U7	SN74LS190N		16			8		2,3,6,7,12
U8	MC14560BCP		16			8		
U9	SN74LS30N		14			7		9, 10, 13
U10	SN74LS04N		14			7		
U11	SN74LS02N		14			7		
U12	MC14560BCP		16			8		9,10,11
U13	SN74LS86N		14			7		
U14	SN74LS190N		16			8		6, 12
U15	SN74LS190N		16			8		4, 12, 13
U16	MC14011BCP		14			7		
U17	SN74LS190N		16			8		12
U18	MC14023BCP		14			7		
U101	MC4044P				14		7	6,10,11,12
U102	MC1558L	SEE DWG						1,3,4,10,11, 13
U103	SN74LS123N			16			8	4, 12
U104	SN74LS122N			14			7	8,9,10,12
U105	SN74LS123N			16			8	4, 12
U106	SN74LS00N			14			7	8,9,10,11,12,13
U107	SN74LS00N			14			7	
U108	SN74L920N			10			5	4,8,9,13
U109	SN74L990N			10			5	4, 9, 13
U110	SN74LS73N			11			4	5,6,7,8,9,10



FREQUENCY INPUTS ARE PROGRAMMED FOR 255.000 MHz AT RCU

4037-39

Figure 9-5. Synthesizer 1A2 Schematic Diagram (Sheet 1 of 3)

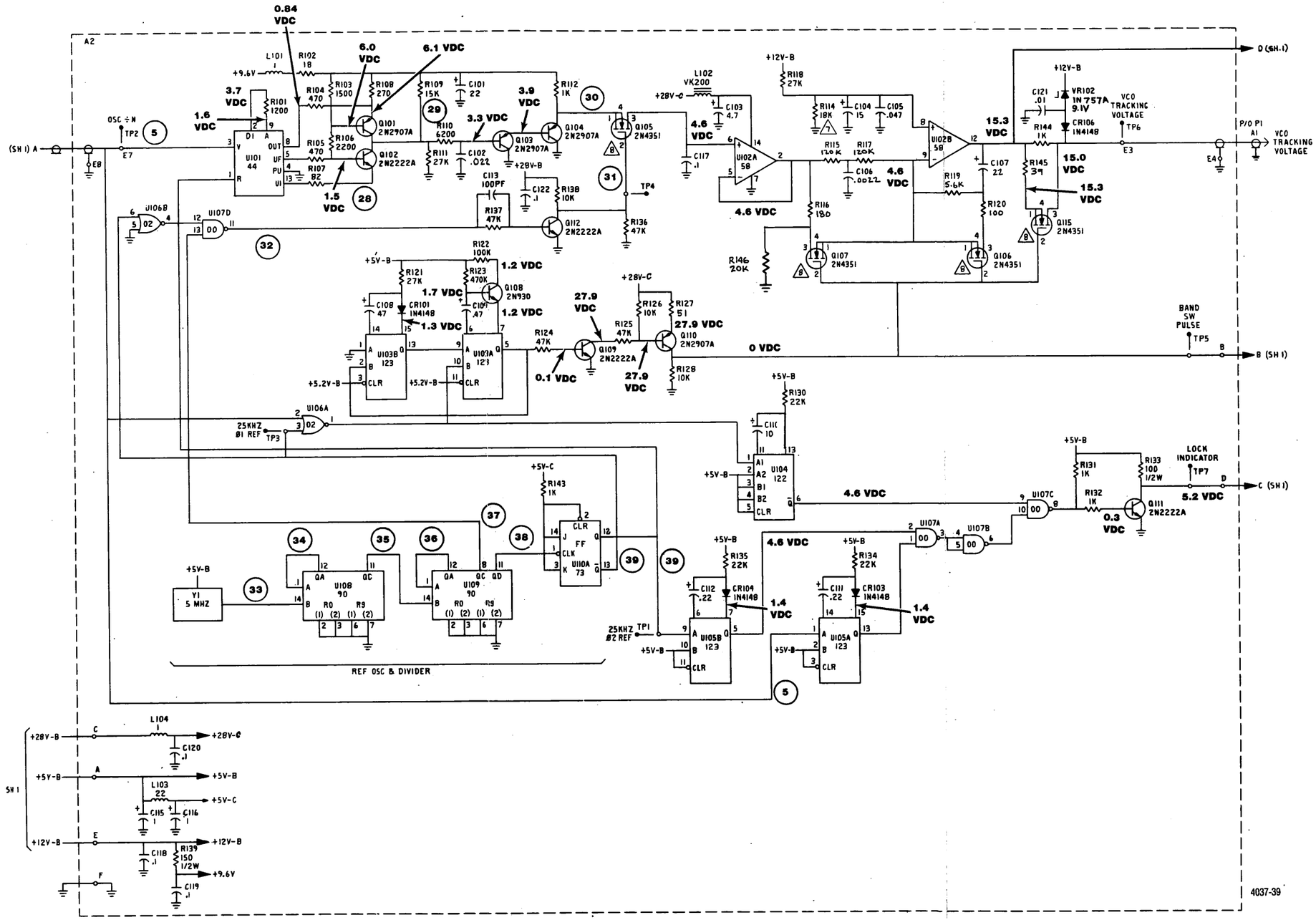


Figure 9-5. Synthesizer 1A2 Schematic Diagram (Sheet 2 of 3)

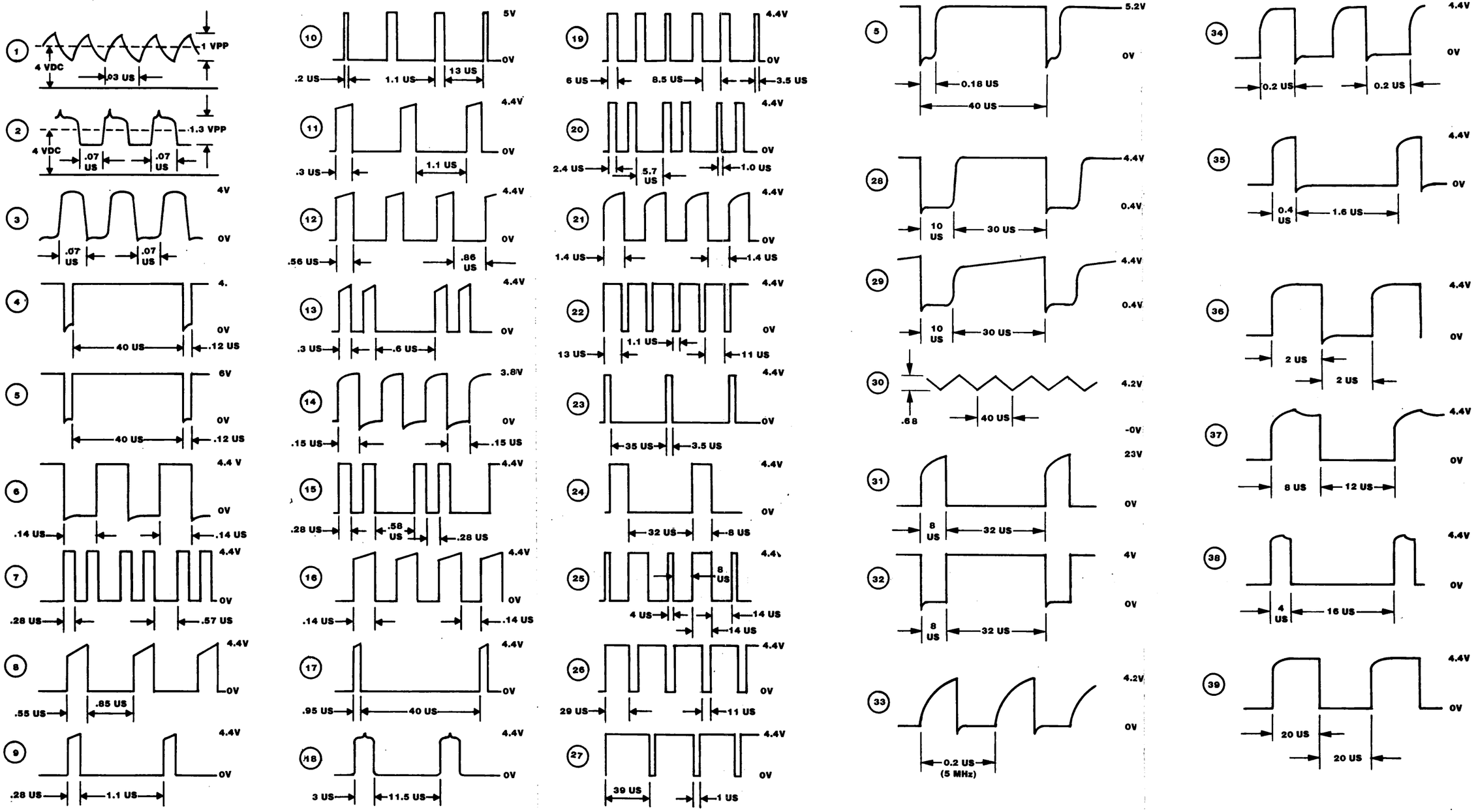


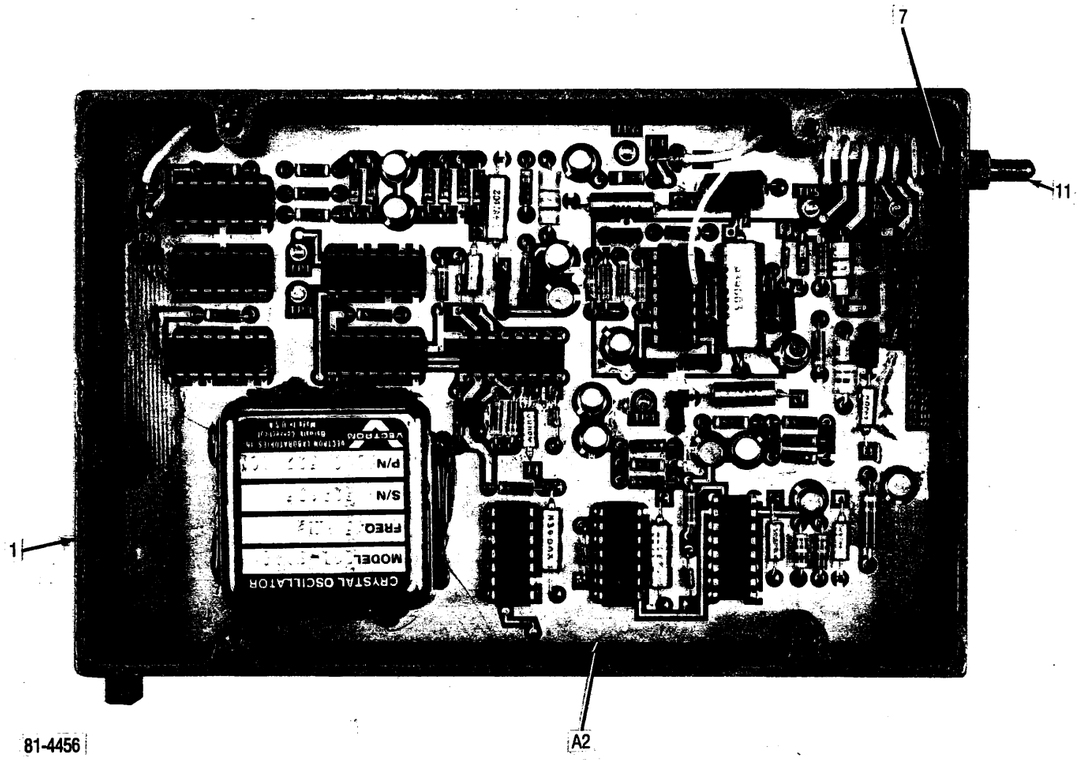
Figure 9-5. Synthesizer 1A2 Schematic Diagram (Sheet 3 of 3)

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

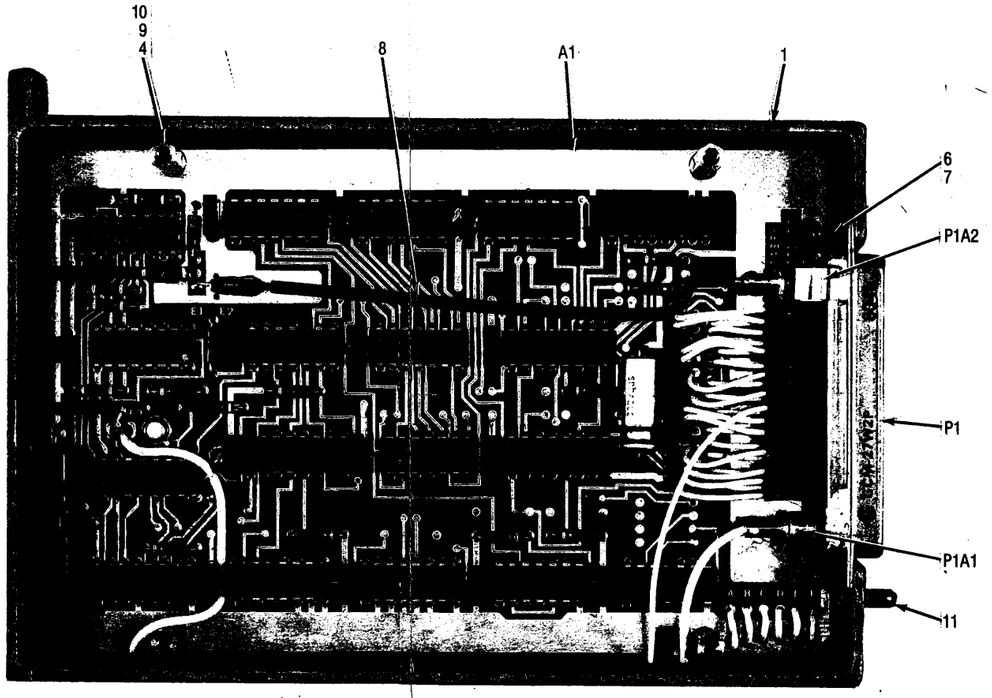
Code Ident.	Name	Address
71468	ITT Cannon Electric	666 Dyer Rd. Santa Ana, CA 92702
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252



81-4456

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04573L002	SYNTHESIZER ASSY	
001	1	94990	27-P07102L001	FRAME,SYNTHESIZER	
002	1		33-P23644F001	LABEL, CAUTION/ FREQ ADJ.	
003	2	94990	64-P07135L001	PANEL,SIDE	
004	4	94990	43-P08658J001	SPACER	
005	8	94990	03-14052B52	SCREW	4-40X1/4
006	2		MS24693-C3	SCREW	4-40X5/16
007	3		MS21042L04	NUT	.112-40
008	AR	94990	30-P16137A001	CABLE,SEMI-RIGID	
009	4		NAS620C4L	WASHER,FLAT	NO.4
010	4		MS35338-135	WASHER,LOCK	NO.4
011	1	94990	22-P07123L001	GUIDE PIN	
A 001	1	94990	01-P04575L001	PWB ASSEMBLY NO.1	
A 002	1	94990	01-P04574L001	PWB ASSEMBLY NO.2	
P 001	1	71468	DCM27W2P	CONNECTOR	
P 1A01	1	71468	DM53740-1	CONTACT	
P 1A02	1	71468	DM53740-1	CONTACT	



81-4457

Figure 9-6. Synthesizer 1A2, Parts Locating Diagram

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04575L001	SYNTHESIZER ASSY 1	
001	1	94990	84-P04617L001	PWB,SYNTHESIZER	
C 001	1		M39014/01-1391	CAPACITOR	470PF-10-200
C 002	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 003	1		M39014/01-1391	CAPACITOR	470PF-10-200
C 004	1		M39014/01-1391	CAPACITOR	470PF-10-200
C 005	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 006	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 007	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 008	1	56289	TE-1158	CAPACITOR	30UF-1075-16
C 009	1		M39014/01-1379	CAPACITOR	100PF-10-200
C10-27	18		M39014/02-1391	CAPACITOR	.1UF-10-100
C 28	1		MS9014/01-1397	CAPACITOR	1000-10-20
L 001	1	02114	VK200-10/3B	COIL	
Q 001	1		JAN2N2369A	TRANSISTOR	
R 001	1		RCR07G510JS	RESISTOR	51-5-1/4
R 002	1		RCR07G102JS	RESISTOR	1000-5-1/4
R3-R6	4		RCR07G471JS	RESISTOR	470-5-1/4
R 007	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 008	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 009	1		RCR07G101JS	RESISTOR	100-5-1/4
R 010	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 011	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 012	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 013	1		RCR07G103JS	RESISTOR	10K-5-1/4
R30-33	4		RCR07G102JS	RESISTOR	1000-5-1/4
U 001	1	04713	MC12013CP	INTEGRATED CIRCUIT	
U 002	1	04713	MC10131P	INTEGRATED CIRCUIT	
U 003	1	04713	MC12014P	INTEGRATED CIRCUIT	
U 004	1	01295	SN74LS190N	INTEGRATED CIRCUIT	
U 005	1	01295	SN74LS00N	INTEGRATED CIRCUIT	
U 006	1	01295	SN74LS04N	INTEGRATED CIRCUIT	
U 007	1	01295	SN74LS190N	INTEGRATED CIRCUIT	
U 008	1	04713	MC14560BCP	INTEGRATED CIRCUIT	
U 009	1	01295	SN74LS30N	INTEGRATED CIRCUIT	
U 010	1	01295	SN74LS04N	INTEGRATED CIRCUIT	
U 011	1	01295	SN74LS02N	INTEGRATED CIRCUIT	
U 012	1	04713	MC14560BCP	INTEGRATED CIRCUIT	
U 013	1	01295	SN74LS86N	INTEGRATED CIRCUIT	
U 014	1	01295	SN74LS190N	INTEGRATED CIRCUIT	
U 015	1	01295	SN74LS190N	INTEGRATED CIRCUIT	
U 016	1	04713	MC14011BCP	INTEGRATED CIRCUIT	
U 017	1	01295	SN74LS190N	INTEGRATED CIRCUIT	
U 018	1	04713	MC14023BCP	INTEGRATED CIRCUIT	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
01295	Texas Instruments Inc. Semiconductor Group	13500 N. Central Expressway Dallas, TX 75222
02114	Ferroxcube Corp.	359 Mt. Marion Rd. Saugerties, NY 12477
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
56289	Sprague Electric Co.	North Adams, MA 01247
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252

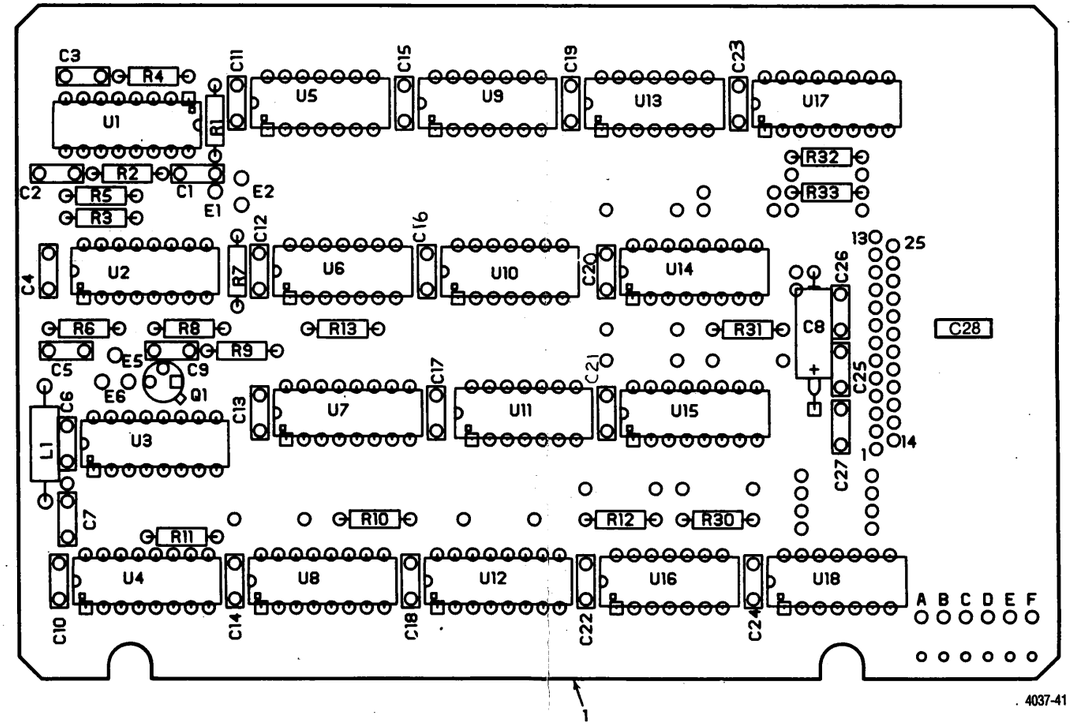


Figure 9-7. Synthesizer Circuit Card 1A2A1, Parts Locating Diagram

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04574L002	SYNTHESIZER ASSY 2	
001	1	94990	84-P09917V001	PWB, SYNTHESIZER	
002	4	94990	43-P06563B002	SPACER	
C 101	1		M39003/01-2271	CAPACITOR	22UF-10-15
C 102	1		M39014/02-1342	CAPACITOR	0.022 UF-10-100
C 103	1		M39003/01-2368	CAPACITOR	4.7UF-10-50
C 104	1		M39003/01-2289	CAPACITOR	15UF-10-20
C 105	1		M39014/02-1387	CAPACITOR	.047UF-10-100
C 106	1		M39014/02-1326	CAPACITOR	0.0022 UF-10-200
C 107	1		M39003/01-2306	CAPACITOR	22 UF-10-35
C 108	1		M39003/01-2244	CAPACITOR	47UF-10-6
C 109	1		M39003/01-2350	CAPACITOR	.47UF-10-50
C 110	1		M39003/01-2286	CAPACITOR	10UF-10-20
C 111	1		M39003/01-2344	CAPACITOR	.22UF-10-50
C 112	1		M39003/01-2344	CAPACITOR	.22UF-10-50
C 113	1		M39014/01-1379	CAPACITOR	100PF-10-200
C 115	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 116	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 117	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 118	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 119	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 120	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 121	1		M39014/02-1378	CAPACITOR	.01UF-10-200
C 122	1		M39014/02-1391	CAPACITOR	.1UF-10-100
CR101	1		JAN1N4148	DIODE	
CR102	1		JAN1N4148	DIODE	
CR103	1		JAN1N4148	DIODE	
CR104	1		JAN1N4148	DIODE	
CR106	1		JAN1N4148	DIODE	
L 101	1		MS18130-8	COIL	1UH
L 102	1	02114	VK200-10/3B	COIL	
L 103	1		MS14046-8	COIL	22UH
L 104	1		MS18130-8	COIL	1UH
Q 101	1		JAN2N2907A	TRANSISTOR	
Q 102	1		JAN2N2222A	TRANSISTOR	
Q 103	1		JAN2N2907A	TRANSISTOR	
Q 104	1		JAN2N2907A	TRANSISTOR	
Q 105	1		2N4351	TRANSISTOR	
Q 106	1		2N4351	TRANSISTOR	
Q 107	1		2N4351	TRANSISTOR	
Q 108	1		JAN2N930	TRANSISTOR	
Q 109	1		JAN2N2222A	TRANSISTOR	
Q 110	1		JAN2N2907A	TRANSISTOR	
Q 111	1		JAN2N2222A	TRANSISTOR	
Q 112	1		JAN2N2222A	TRANSISTOR	
Q 115	1		2N4351	TRANSISTOR	
R 101	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 102	1		RCR07G180JS	RESISTOR	18-5-1/4
R 103	1		RCR07G152JS	RESISTOR	1500-5-1/4
R 104	1		RCR07G471JS	RESISTOR	470-5-1/4
R 105	1		RCR07G471JS	RESISTOR	470-5-1/4
R 106	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 107	1		RCR07G820JS	RESISTOR	82-5-1/4
R 108	1		RCR07G271JS	RESISTOR	270-5-1/4
R 109	1		RCR07G153JS	RESISTOR	15K-5-1/4
R 110	1		RCR07G022JS	RESISTOR	6200-5-1/4
R 111	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 112	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 114	1		RCR07G912JS	RESISTOR	9.1K-5-1/4
R 115	1		RCR07G124JS	RESISTOR	120K-5-1/4
R 116	1		RCR07G181JS	RESISTOR	180-5-1/4
R 117	1		RCR07G124JS	RESISTOR	120K-5-1/4
R 118	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 119	1		RCR07G562JS	RESISTOR	5600-5-1/4
R 120	1		RCR07G101JS	RESISTOR	100-5-1/4
R 121	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 122	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 123	1		RCR07G474JS	RESISTOR	470K-5-1/4
R 124	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 125	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 126	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 127	1		RCR07G510JS	RESISTOR	51-5-1/4
R 128	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 130	1		RCR07G223JS	RESISTOR	22K-5-1/4
R 131	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 132	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 133	1		RCR20G101JS	RESISTOR	100-5-1/2
R 134	1		RCR07G223JS	RESISTOR	22K-5-1/4
R 135	1		RCR07G223JS	RESISTOR	22K-5-1/4
R 136	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 137	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 138	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 139	1		RCR20G151JS	RESISTOR	150-5-1/2
R 143	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 144	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 145	1		RCR07G390JS	RESISTOR	39-5-1/4
R146	1		RCR07G203JS	RESISTOR	20K-5-1/4
TP1-7	7		SE16XC01S	TERMINAL	
U 101	1	04713	MC4044P	INTEGRATED CIRCUIT	
U 102	1	04713	MC1558L	INTEGRATED CIRCUIT	
U 103	1	01295	SN74LS123N	INTEGRATED CIRCUIT	
U 104	1	01295	SN74LS122N	INTEGRATED CIRCUIT	
U 105	1	01295	SN74LS123N	INTEGRATED CIRCUIT	
U 106	1	01295	SN74LS02N	INTEGRATED CIRCUIT	
U 107	1	01295	SN74LS00N	INTEGRATED CIRCUIT	
U 108	1	01295	SN74LS90N	INTEGRATED CIRCUIT	
U 109	1	01295	SN74LS90N	INTEGRATED CIRCUIT	
U 110	1	01295	SN74LS73N	INTEGRATED CIRCUIT	
VR102	1		JAN 1N757A	DIODE	
Y 001	1	94990	58-P04522L002	OSCILLATOR	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
01295	Texas Instruments Inc. Semiconductor Group	13500 N. Central Expressway Dallas, TX 75222
02114	Ferroxcube Corp	359 Mt. Marion Rd. Saugerties, NY 12477
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252

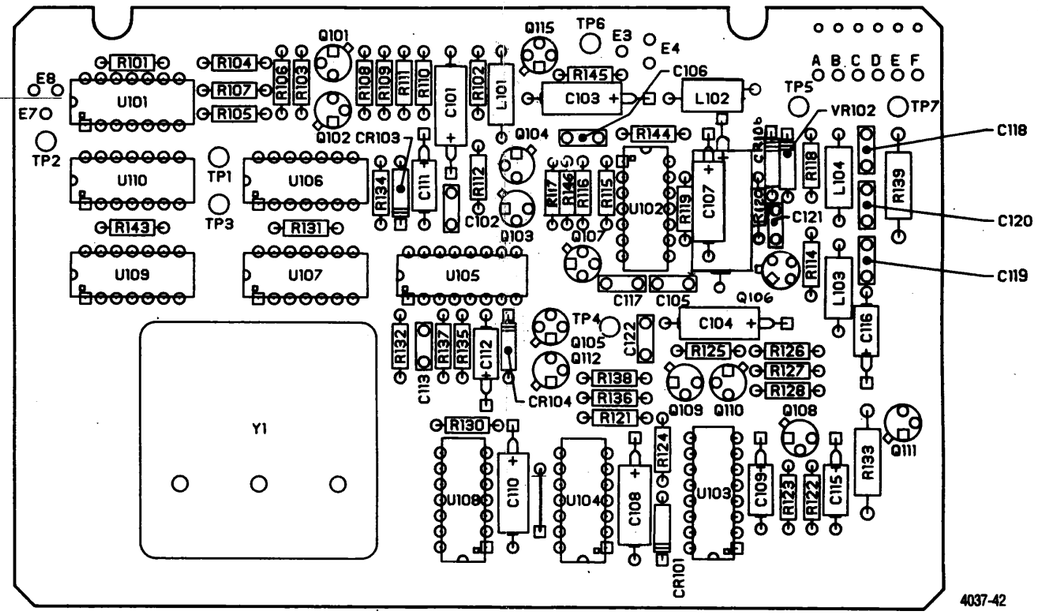


Figure 9-8. Synthesizer Circuit Card 1A2A2, Parts Locating Diagram

SECTION 10
VHF VCO 1A3

10-1. PURPOSE AND GENERAL DESCRIPTION

10-2. The vhf vco 1A3, shown in Figure 10-1, is a cavity tuned vco and operates in both am and fm mode. It generates a 116 MHz to 178.975 MHz signal to drive vca 1A10 in the transmit mode and receiver 1A5 in the receive mode. In either transmit or receive mode the vhf vco generates an rf phase lock loop signal to synthesizer 1A2. The vco frequency is locked to the 5 MHz reference oscillator in the synthesizer and is the actual transmit frequency in the transmit mode. The output to the receiver is offset by the 29 MHz if frequency in the receive mode. In the fm transmit mode, the vco output frequency is controlled by the vco tracking voltage from the synthesizer and fm audio inputs from the transmitter ALC. In both the am transmit and receive modes, the output is based only on the vco tracking voltage. The signal from the vhf vco is routed through and switched by the output circuits of uhf vco 1A4. Functionally, the vco consists of a dc power enable switch, switchable bandwidth filter, fm selector, voltage-controlled oscillator, impedance matching pad, and a power amplifier.

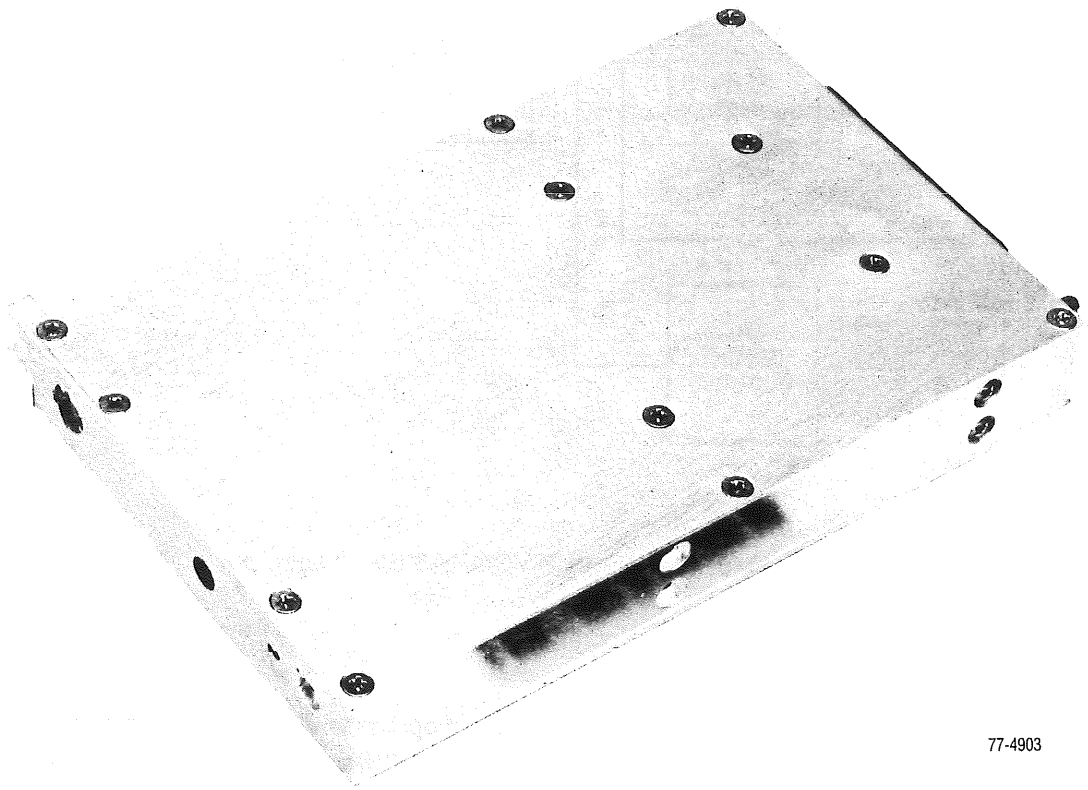


Figure 10-1. VHF VCO 1A3

10-3. DETAILED DESCRIPTION

10-4. The following paragraphs provide a detailed functional description of vhf vco 1A3. The vco block diagram and schematic diagram are shown in Figures 10-2 and 10-3,respectively.

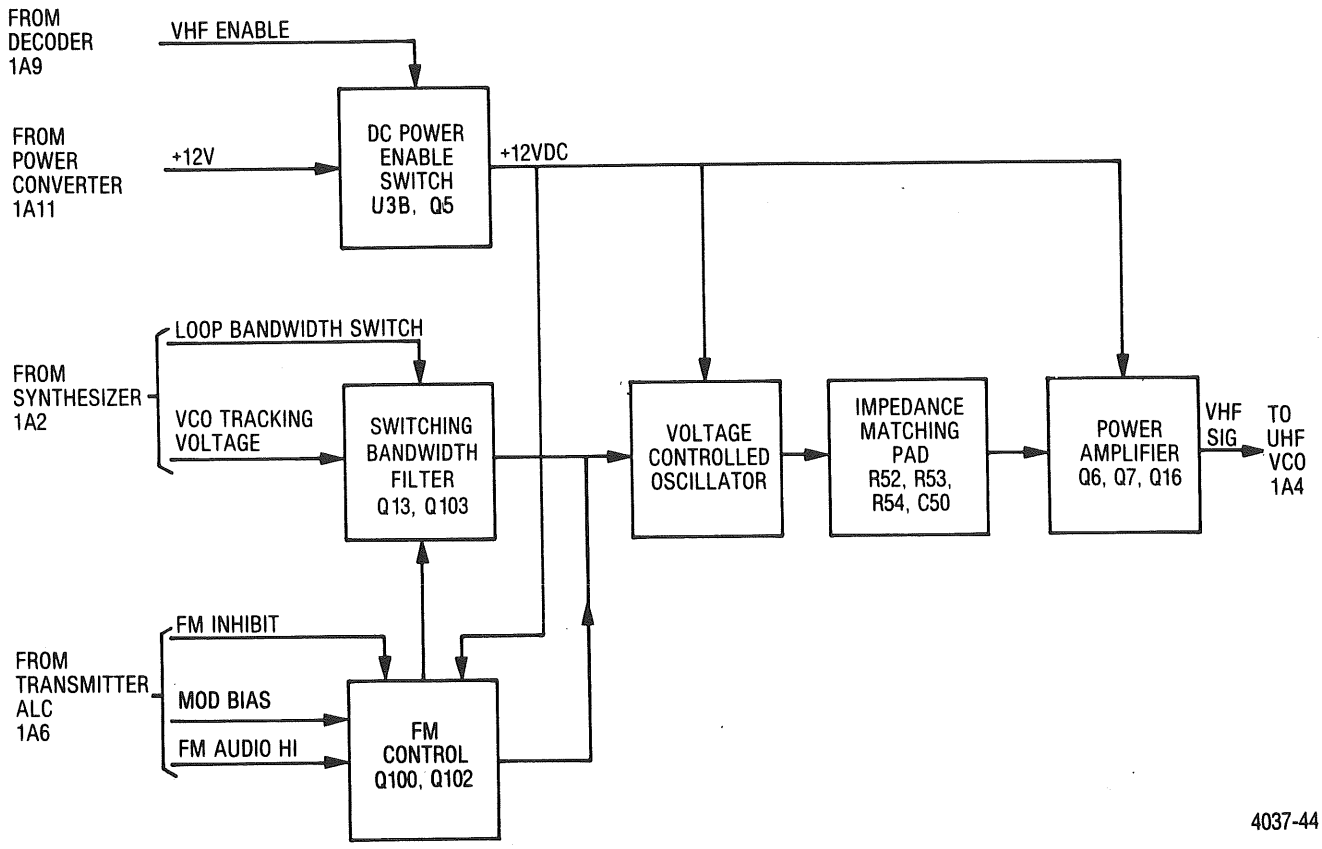


Figure 10-2. VHF VCO 1A3 Block Diagram

10-5. VHF VCO SELECTION. The vco module is placed into operation when a high (+5V) VHF ENABLE signal from decoder 1A9 is applied to pin P1-5. The signal is inverted by U3B which causes transistor Q5 to apply +12 Vdc to the vco, power amplifier, and fm control. The vhf vco then operates in either the am or fm mode as described in the following paragraphs.

10-6. AM Mode. In the am mode of operation, the FM INHIBIT input at P1-4 goes low and Q102 opens disabling the FM AUDIO HI input at pin P1-2.

10-7. Loop Bandwidth. The VCO TRACKING VOLTAGE input at P1-A3 is applied to a switchable filter which consists of switch Q13, Q103 and associated components. The filter performs both wideband and narrowband filtering. In the wideband mode where the loop is attempting to acquire lock, switch Q13 and Q104 are turned on by a +28V pulse at pin P1-1 for approximately 50 ms. This short circuits the narrowband filter consisting of R8, C7, R7, and C8. When the loop is locked, Q13 and Q103 are turned off by changing the level at pin P1-1 to zero volts. This causes the narrowband filter to be inserted into the loop. The reason for switching the loop bandwidth momentarily is to provide fast acquisition when the loop is out of lock and good noise performance when in lock. The dc error voltage which passes through the filter is applied to the tuning varactors CR18 through CR21 in the vco cavity.

10-8. The vco tracking voltage generated, after lock is achieved, is applied to the tuning varactors. The resulting oscillator output from the tuned cavity is applied through an impedance-matching pad consisting of R52, R53, R54 and C50, to the power amplifier. The amplifier consists of transistors Q6, Q7, and Q16 and serves two purposes: it amplifies the vco output approximately 14 dB to the levels required by the transmitter or receiver mixers and provides the high reverse isolation necessary to prevent the am in the transmitter from modulating the vco. Transistor Q6 senses the average current through R19 and feedback stabilizes the bias of power driver Q7. The output of Q7 is applied through capacitor C16 producing a VHF SIG output level to UHF VCO 1A4 of approximately 100 mw (+20 dBm).

10-9. FM Mode. During fm mode, the FM INHIBIT input at P1-4 goes high turning on switch Q102 through resistor R115. This provides a circuit path for the incoming FM AUDIO HI signal at P1-2 as generated by transmitter alc module 1A6. The switching bandwidth filter circuit operates the same as in the am mode. Once lock is acquired, the tracking voltage is routed through the narrowband filter to junction E14. At the same time, the mod bias voltage level turns on transistor Q100. As the mode bias voltage varies, the combination of Q100 and resistors R105, R101, and R111 (select-in-test resistors) help to maintain a constant fm deviation over the VCO frequency range. The collector current of Q100 will vary depending upon the level of the mod bias. This current is applied to R112 and CR100 whereby the greater the current from Q100 the more CR100 conducts and its impedance decreases. Likewise the inverse occurs when the Q100 current decreases. Resistor R112 and diode CR100 form a variable attenuator to the fm audio signal that is routed through Q102 to junction E14 where it is summed with the dc tracking voltage. The resulting signal is then applied to the vco varactors. The varactors cause the oscillator frequency to vary about its nominal value at the audio rate thus achieving frequency modulation. The operation for the remainder of the functions in the circuit is identical to that described for the am mode.

10-10. VHF VCO MAINTENANCE AND TROUBLESHOOTING

10-11. After a malfunction is isolated to the vhf vco, remove the module from the transceiver as instructed in Section 5, paragraph 5-29. Reconnect the vco to the transceiver using extender cable 30-P07212L001. Troubleshoot the vco in reference to the waveforms and voltage levels shown on the schematic diagram, Figure 10-3. Replace defective components using parts locating diagram, Figure 10-4, as a guide.

10-12. SELECTED COMPONENTS. A small change in control voltage to the varactor diodes CR18-CR21 results in a different frequency change at one end of the operating frequency band than at the other, therefore, the relationship between the vco tracking voltage and the vco output frequency is not quite linear. Select resistors R101, R105, and R111 and associated components minimize the effects of the nonlinearity by modifying the audio signal before superimposing the signal on the tracking voltage. The select resistors are chosen to meet the following operational criteria.

With 100 mv rms 1 kHz signal at the FM AUDIO HI input:

a. Select R111 for 4.0 ± 0.5 kHz deviation at 128 MHz.

b. Select R105 for 4.0 kHz deviation as close as possible at 149.975 MHz.

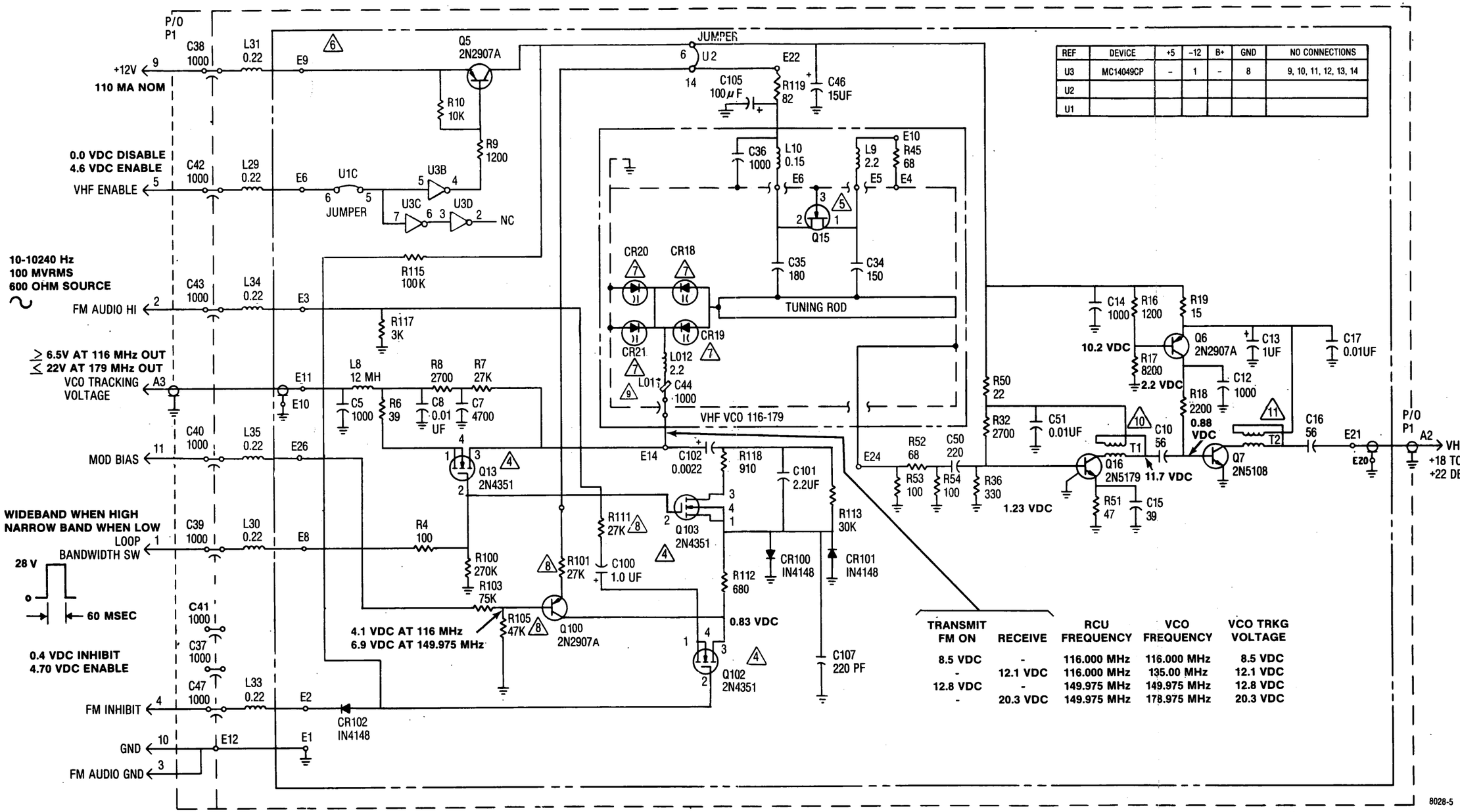
c. Select R101 for 4.0 kHz deviation as close as possible at 116 MHz.

d. Some interaction between components will normally occur. Recheck deviations and reselect resistors, as required.

10-13. STAKING. The components in the vco cavity should be firmly staked with coil adhesive E-44-F manufactured by Insl-X Products Co., Yonkers, N.Y., FSCM 75038. Bead L11 should not come in contact with the VCO frame.

NOTE

The adhesive minimizes residual fm due to vibration. Use of a substitute compound may degrade performance.



REF	DEVICE	+5	-12	B+	GND	NO CONNECTIONS
U3	MC14049CP	-	1	-	8	9, 10, 11, 12, 13, 14
U2						
U1						

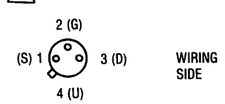
TRANSMIT FM ON	RECEIVE	RCU FREQUENCY	VCO FREQUENCY	VCO TRKG VOLTAGE
8.5 VDC	-	116.000 MHz	116.000 MHz	8.5 VDC
-	12.1 VDC	116.000 MHz	135.00 MHz	12.1 VDC
12.8 VDC	-	149.975 MHz	149.975 MHz	12.8 VDC
-	20.3 VDC	149.975 MHz	178.975 MHz	20.3 VDC

8028-5

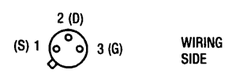
NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A3.
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P04571L002 ASSEMBLY
   01-P07157L002 SUBASSEMBLY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 5 PCT, 1/4 WATT
   ALL CAPACITORS ARE IN PF
   ALL INDUCTORS ARE IN UH
   ALL VOLTAGES ARE DC

4. PIN LOCATION IS AS SHOWN:

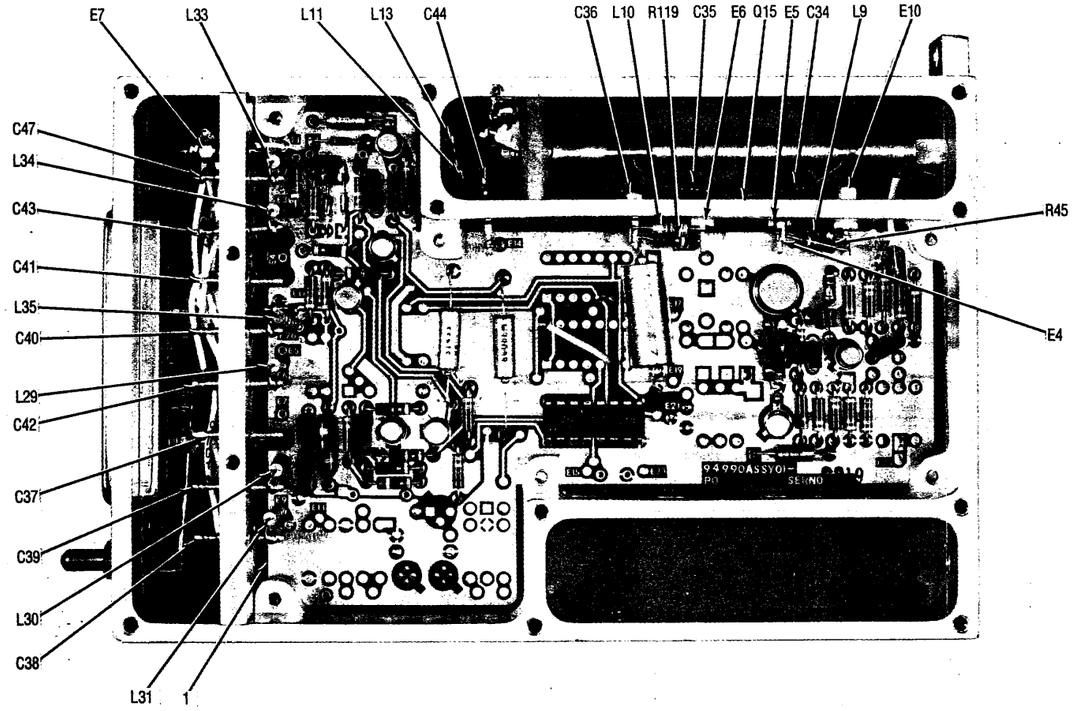


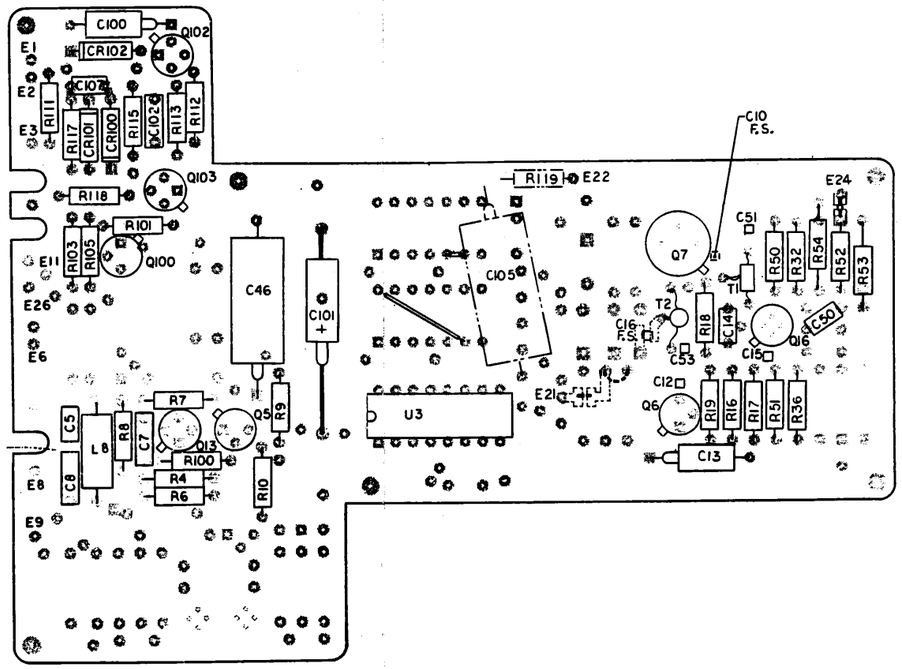
5. MOTOROLA PART NO. 48-P23672F001
   PIN LOCATION IS AS SHOWN:



6. DELTA WITHIN DATUM LINES INDICATES PRINTED WIRING BOARD CIRCUITRY. ALL OTHER COMPONENTS ARE AFFIXED TO MODULE.
7. MOTOROLA PART NO. 48-P05965K001.
8. SELECT AT TEST. COMPONENT NOMINAL VALUE SHOWN.
9. MOTOROLA PART NO. 74-15169A01
10. MOTOROLA PART NUMBER 24-P06611B016.
11. MOTOROLA PART NUMBER 24-P06611B017.
12. VOLTAGES ARE NOMINAL VALUES FOR CONDITIONS STATED

Figure 10-3. VHF VCO 1A3 Schematic Diagram





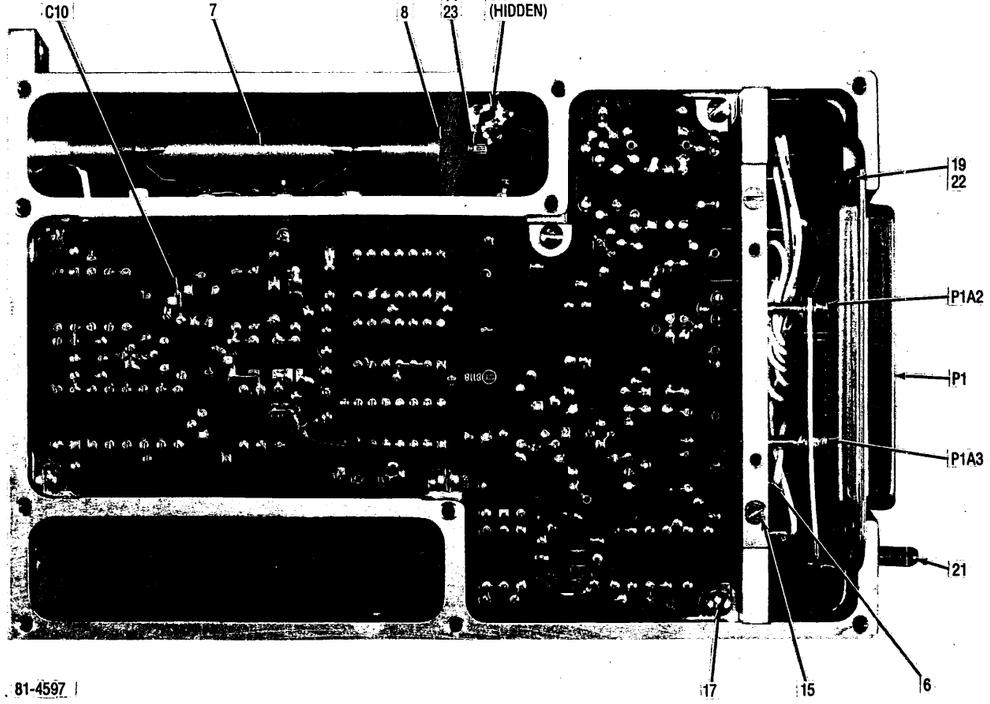


Figure 10-4. VHF VCO 1A3 Parts Location Diagram (Sheet 1 of 2)

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04571L002	VHF VCO ASSY	
001	1	94990	01-P07157L002	PWB ASSY, VHF VCO	
002	1	94990	27-P07065L001	FRAME, VCO	
003	1	94990	64-P07159L001	SIDE PANEL-VCO	SILVER PLATE
004	1	94990	64-P07159L002	SIDE PANEL-VCO	SILVER PLATE
005	1	94990	64-P07160L001	PLATE, FILTER-BOTTOM	SILVER PLATE
006	1	94990	64-P07161L001	PLATE, FILTER-TOP	SILVER PLATE
007	1	94990	47-P07100L003	TUNING ROD	
008	1	94990	14-P07104L001	INSULATOR	
009	1	94990	29-P05987K001	TERMINAL	
010	1	94990	29-P05987K002	TERMINAL	
011	1	94990	29-P05987K003	TERMINAL	
012	2	94990	03-15013G36	SCREW	2-56x1
014	1		MS16997-9	SCREW	4-40x0.250
015	2	94990	03-14052C09	SCREW	2-56x5/16
016	5	94990	03-14049B52	SCREW	4-40x1/4
017	6		LP500D4-5LE	SCREW	
018	24		MS24693-C1	SCREW	4-40x3/16
019	2		MS24693-C3	SCREW	4-40x5/16
021	1	94990	22-P07123L001	GUIDE PIN	
022	3		MS21042L04	NUT	0.112-40
023	1		MS35338-40	WASHER	NO. 4
024	3		MS35338-134	WASHER	NO. 2
025	4		NAS620C2	WASHER	NO. 2
026	1		MS77068-1	TERMINAL	
027	1	98291	229-5001	TERMINAL	
046	1	83330	81-1513	TERMINAL, FEEDTHRU	
099	1	94990	84-P09919V001	PWB UHF/VHF VCO	
C 034	1		CM04FD151J03	CAPACITOR	150PF-5-500
C 035	1		MC04FD181J03	CAPACITOR	180PF-5-500
C 036	1	33095	54-803-004-102P	CAPACITOR, STUD	1000PF
C 037	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 038	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 039	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 040	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 041	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 042	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 043	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 044	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 047	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 005	1		M39014/01-1397	CAPACITOR	1000PF-10-200
C 007	1		M39014/02-1372	CAPACITOR	4700PF-10-200
C 008	1		M39014/02-1378	CAPACITOR	0.01UF-10-200
C 010	1	29990	ATC100A560JP50(X)	CAPACITOR	56PF-5-50
C 012	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 013	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 014	1		M39014/01-1397	CAPACITOR	1000PF-10-200
C 015	1	29990	ATC100A390JP50(X)	CAPACITOR	39PF-5-50
C 016	1	29990	ATC100A560JP50(X)	CAPACITOR	56PF-5-50
C 046	1		M39003/01-2289	CAPACITOR	15UF-10-20
C 050	1		M39014/ 01-1385	CAPACITOR	220PF-10-200
C 051	1		CDR02BX103BKSM	CAPACITOR	0.01UF-10-100
C 053	1		CDR02BX103BKSM	CAPACITOR	0.01UF-10-100
C 100	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 101	1		M39003/01-2362	CAPACITOR	2.2UF-10-50
C 102	1		M39014/02-1326	CAPACITOR	2200PF-10-200
C 105	1		M39003/01-2301	CAPACITOR	100UF-10-20

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
C 107	1		M39014/01-1345	CAPACITOR	220PF-10-200
CR 018 THRU CR 021	4	94990	48-P05965K001	DIODE	
CR 100	1		JAN1N4148	DIODE	
CR 101	1		JAN1N4148	DIODE	
CR 102	1		JAN1N4148	DIODE	
E 004	1	94990	29-15100A15	TERMINAL	
E 005, E 006	2	98291	011-1001-00-0-479	TERMINAL, FEED THRU	
E 010	1	98291	013-2007-00-0-479	TERMINAL	
L 008	1	43543	WEE-12000	INDUCTOR	12MH
L 009	1		MS75084-4	COIL	2.2 H
L 010	1		MS75083-3	COIL	0.15 H
L 011	1	94990	74-15169A01	BEAD	
L 013	1		MS75084-4	COIL	2.2 H
L 029	1		MS75083-5	COIL	0.22 H
L 030	1		MS75083-5	COIL	0.22 H
L 031	1		MS75083-5	COIL	0.22 H
L 033	1		MS75083-5	COIL	0.22 H
L 034	1		MS75083-5	COIL	0.22 H
L 035	1		MS75083-5	COIL	0.22 H
Q 005	1		JAN2N2907A	TRANSISTOR	
Q 006	1		JAN2N2907A	TRANSISTOR	
Q 007	1		2N5108	TRANSISTOR	
Q 013	1		2N4351	TRANSISTOR	
Q 015	1	94990	48-P23672F001	TRANSISTOR	
Q 016	1		2N5179	TRANSISTOR	
Q 100	1		JAN2N2907A	TRANSISTOR	
Q 102	1		2N4351	TRANSISTOR	
Q 103	1		2N4351	TRANSISTOR	
P 001	1	71468	DCM17WSP	CONNECTOR	
P 1A02	1	71468	DM53740-1	CONTACT	
P 1A03	1	71468	DM53740-1	CONTACT	
R 004	1		RCR07G101JS	RESISTOR	100-5-1/4
R 006	1		RCR07G390JS	RESISTOR	39-5-1/4
R 007	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 008	1		RCR07G272JS	RESISTOR	2700-5-1/4
R 009	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 010	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 016	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 017	1		RCR07G822JS	RESISTOR	8200-5-1/4
R 018	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 019	1		RCR07G150JS	RESISTOR	15-5-1/4
R 032	1		RCR07G272JS	RESISTOR	2700-5-1/4
R 036	1		RCR07G331JS	RESISTOR	330-5-1/4
R 045	1		RCR07G680JS	RESISTOR	68-5-1/4
R 050	1		RCR07G220JS	RESISTOR	22-5-1/4
R 051	1		RCR07G470JS	RESISTOR	47-5-1/4
R 052	1		RCR07G680JS	RESISTOR	68-5-1/4
R 053	1		RCR07G101JS	RESISTOR	100-5-1/4
R 054	1		RCR07G101JS	RESISTOR	100-5-1/4
R 100	1		RCR07G274JS	RESISTOR	270K-5-1/4
R 101	1		RCR07G273JS	RESISTOR	27K-5-1/4 NOMINAL
R 101	S01		RCR07G243JS	RESISTOR	24K-5-1/4
R 101	S01		RCR07G303JS	RESISTOR	30K-5-1/4
R 103	1		RCR07G753JS	RESISTOR	75K-5-1/4

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
R 105	1		RCR07G473JS	RESISTOR	47K-5-1/4 NOMINAL
R 105	S01		RCR07G513JS	RESISTOR	51K-5-1/4
R 105	S01		RCR07G433JS	RESISTOR	43K-5-1/4
R 111	1		RCR07G273JS	RESISTOR	27K-5-1/4 NOMINAL
R 111	S01		RCR07G243JS	RESISTOR	24K-5-1/4
R 111	S01		RCR07G303JS	RESISTOR	30K-5-1/4
R 112	1		RCR07G681JS	RESISTOR	680-5-1/4
R 113	1		RCR07G303JS	RESISTOR	30K-5-1/4
R 115	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 117	1		RCR07G302JS	RESISTOR	3000-5-1/4
R 119	1		RCR07G911JS	RESISTOR	910-5-1/4
R 119	1		RCR07G820JS	RESISTOR	82-5-1/4
T 001	1	94990	24-P06611B016	TRANSFORMER ASSY	
T 002	1	94990	24-P06611B017	TRANSFORMER ASSY	
U 003	1		MC14049CP	INTEGRATED CIRCUIT	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or Industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
29990	American Technical Ceramics Division of Phase Industries	1 Norden Lane Huntington Station, NY 11746
33095	Spectrum Control Inc.	152 E. Main St. Fairview, PA 16415
43543	Nytronics Inc. Transformer Co. Div.	61 Gates Ave. Geneva, NY 14456
71468	ITT Cannon Electric	666 Dyer Rd. Santa Ana, CA 92701
88245	Litton Systems Inc. USECO Division	13536 Saticoy Street Van Nuys, CA 91409
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252
98291	Sealectro Corp.	225 Hoyt St. Mamaroneck, NY 10544

Figure 10-4. VHF VCO 1A3 Parts Location Diagram (Sheet 2 of 2)

SECTION 11
UHF VCO 1A4

11-1. PURPOSE AND GENERAL DESCRIPTION

11-2. The uhf vco 1A4, shown in Figure 11-1, operates in both am and fm and contains two cavity-tuned vco's. It generates a 225-400 MHz signal for vca 1A10 in the transmit mode, a 196-429 MHz signal for receiver 1A5 in the receive mode, and an rf phase lock loop signal to synthesizer 1A2 for both transmit and receive modes. The frequencies of the cavities are locked to the 5 MHz reference oscillator in the synthesizer. One cavity operates from 196 to 300 MHz (low band) and the other operates from 300 MHz to 429 MHz (high band). The vco output is the actual transmit frequency in the transmit mode, while the output to the receiver is offset by the 29-MHz if frequency in the receive mode. In the fm transmit mode, the vco output signals are based on the vco tracking voltage from the synthesizer and fm audio inputs from the transmitter alc. In the am transmit and both receive modes, the vco outputs are based only on the vco tracking voltage.

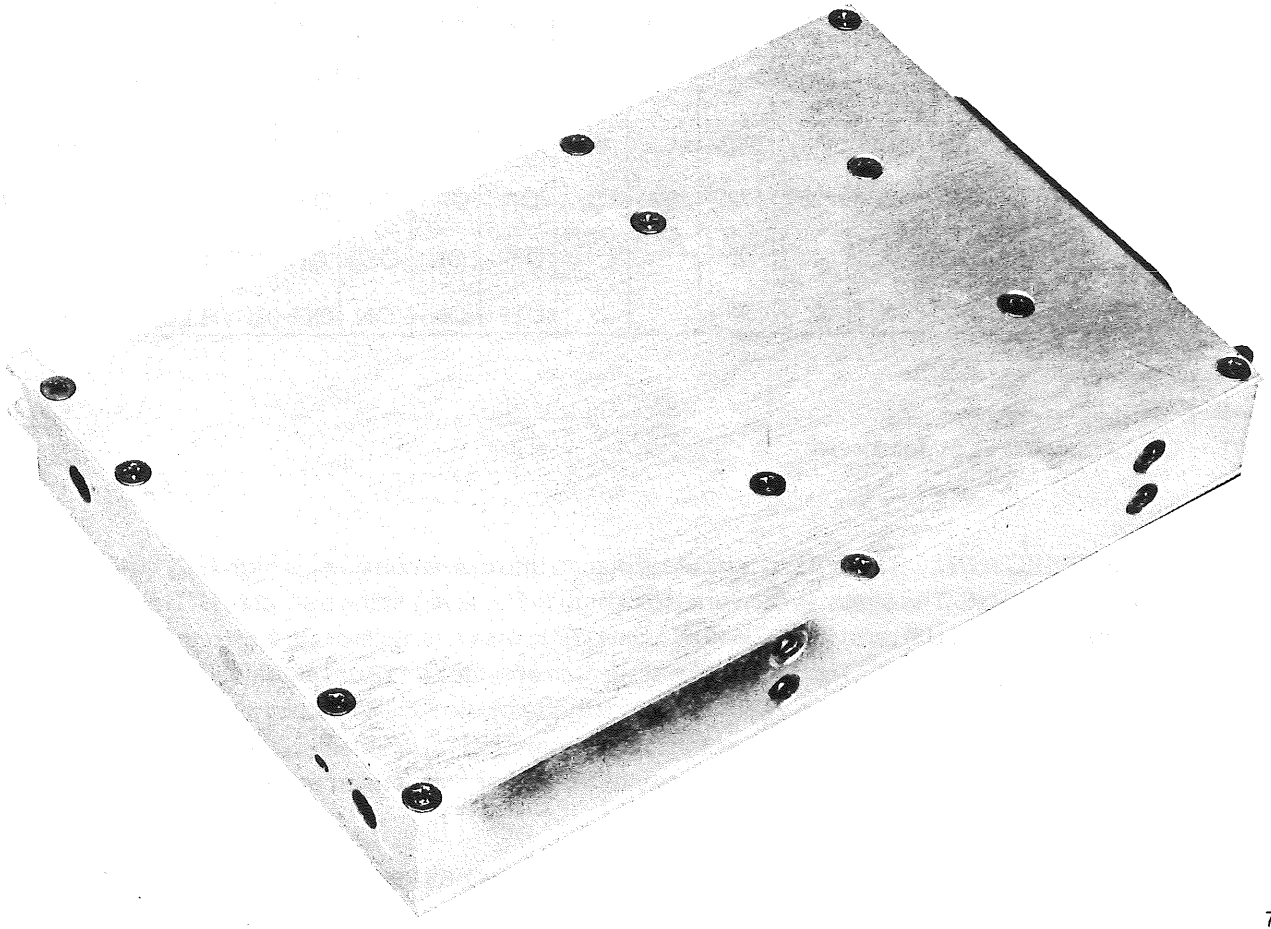


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Figure 11-1. UHF VCO 1A4

11-3. The rf output of vhf vco 1A3 is routed through the uhf vco module 1A4. Therefore, signals are provided at the same outputs in the vhf mode as in the uhf mode. The purpose of this configuration is to minimize rf

cables, control wires, and switching circuits. Functionally, the uhf vco module consists of two voltage-controlled oscillators (highband and lowband), switchable bandwidth filter, power amplifier, buffer amplifier, selection and switching circuits, and control logic.

11-4. DETAILED DESCRIPTION

11-5. The following paragraphs provide a detailed functional description of uhf vco 1A4. Referenced supporting information is provided by Table 11-1, control logic functions, block diagram Figure 11-2, and schematic diagram Figure 11-3.

Table 11-1. UHF VCO 1A4 Control Logic Functions

Module Inputs			Selector/Switch States										Module Outputs	
			High Band/Low Band Selector Switch U2						Diode Switches					
HI/LO Band	UHF Enable	R/T	1	2	3	4	5	6	UHF/ CR4	VHF CR5	XMT/ CR6	RCV CR8	Signals Selected	Mode
+5V	+5V	0V	+12V	+12V	+12V	+12V	+12V	OV	ON	OFF	OFF	ON	XMT RF/VCO RF	UHF
0V	+5V	0V	0V	+12V	+12V	+12V	0V	+12V	ON	OFF	OFF	ON	XMT RF/VCO RF	UHF
+5V	+5V	+5V	+12V	+12V	+12V	+12V	+12V	0V	ON	OFF	ON	OFF	RCVR LO/VCO RF	UHF
0V	+5V	+5V	0V	+12V	+12V	+12V	0V	+12V	ON	OFF	ON	OFF	RCVR LO/VCO RF	UHF
X	0V	0V	X	X	X	X			OFF	ON	OFF	ON	XMT RF/VCO RF	VHF
X	0V	+5V	X	X	X	X			OFF	ON	ON	OFF	RCVR LO/VCO RF	VHF

HI BAND = +5V
UHF ENABLED = +5V
R/T = 0V for transmit, +5V for receive

11-6. UHF VCO SELECTION. The uhf vco module is placed into operation when a high (+5V) UHF ENABLE signal is received at pin P1-5. The signal is converted to a high (+12V level) at the output of U1C for inversion to provide lows at the outputs of U3B and U3C. The low from U3B turns on transistor Q5 which in turn provides all highs to inputs 2, 3, and 4 of gate U2. Transistor Q5 output also provides a +12 uhf signal for distribution within the vco module. The low from U3C applies a low to the cathode of diode CR4 biasing it on. The same low is converted by U3A to a high which is applied to the cathode of diode CR5 biasing it off. This configuration prevents any signals from entering the output of the power amplifier (comprised of Q6, Q7, and Q16) when in the uhf mode.

11-7. If high band is selected (frequency above 300 MHz), a high (+ 5V) level is applied to the HI/LO BAND input at pin P1-8. This provides a high (+12V) level at the output of level converter U1A which is applied to pin 1 of U2. As a result, the output at U2 pin 6 goes low and pin 5 goes high. This reverse biases diode CR3 and forward biases diode CR2 causing the high band vco output to be selected for input to the power amplifier. If low band is selected, a low is applied to U1A which places a low at pin 1 of U2. This causes U2 pin 5 to go low and pin 6 to go high, reverse biases CR2, forward biases CR3, and selects the low band vco as an input to the power amplifier.

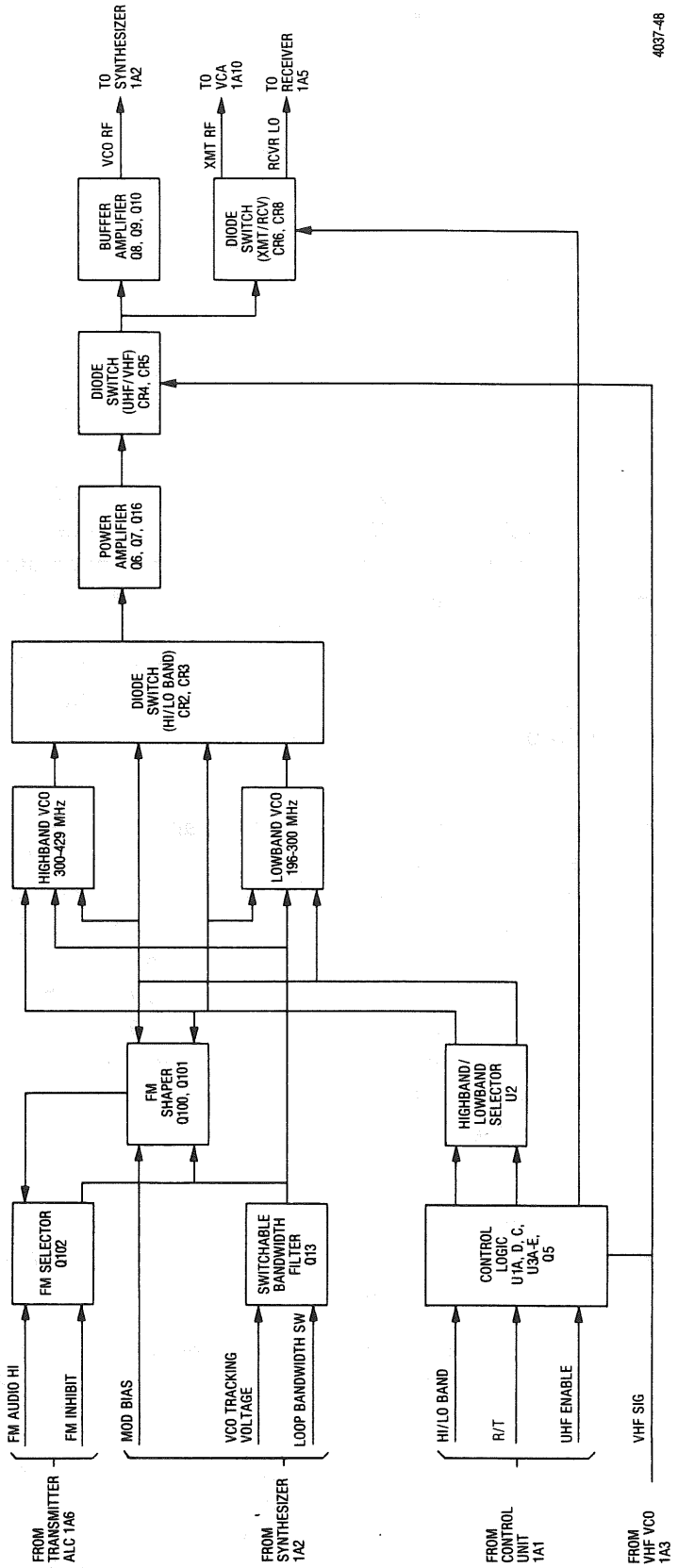

Figure 11-2. UHF VCO 1A4 Block Diagram

11-8. Either the transmit or receive mode is also selected. If transmit is selected, a low is applied to level converter U1D at pin P1-6. This grounds the +12V level at the output of U1D and provides a low to inverter U3D. The resulting high from U3D then reverse biases diode CR6 and forward biases CR8 with the low provided by U3E this selecting the XMT RF output at pin P1-A5. If receive is selected, a high is applied at P1-6, a low is applied from U3D to CR6, and a high from U3E to CR8. This forward biases CR6 and reverse biases CR8 providing a power amplifier RCVR LO output at pin P1-A4.

11-9. AM AND FM OPERATION. After selection of the uhf vco and the operating conditions are established, operation of the vco module is in either the am or fm modes as described in the following paragraphs.

11-10. AM Mode. In the am mode of operation, the fm inhibit input at pin P1-4 goes low and Q102 opens disabling the FM AUDIO HI input at pin P1-2 and subsequently the fm shaper circuit consisting of transistor Q100 and Q101.

11-11. Loop Bandwidth. The VCO TRACKING VOLTAGE input at pin P1-A3 is applied to the switchable bandwidth filter which consists of switch Q13, Q103, and associated components. The filter performs both wideband and narrowband filtering. In the wideband mode, when the loop is attempting to acquire lock, switch Q13 and Q103 are turned on by a +28V pulse at pin P1-1 for approximately 60 ms. This short circuits the narrowband filter consisting of R8, C7, R7, and R113. When the loop is locked, Q13 and Q103 are turned off by changing the level at pin P1-1 to zero volts. This causes the narrowband filter to be inserted into the loop. The reason for switching the loop bandwidth momentarily is to provide fast acquisition when the loop is out of lock. The dc tracking voltage that passes through the filter is applied to the tuning varactors in either the highband or lowband cavities.

11-12. The vco tracking voltage generated after lock is achieved is applied to the tuning varactors comprised of varactors CR16 and CR17 for the highband vco, and CR18 through CR21 for the lowband vco. The selection of either a highband or lowband vco is described in previous paragraphs. The resulting oscillator output from either tuned cavity is applied to the power amplifier consisting of transistors Q6, Q7, and Q16. The amplifier serves two purposes: it amplifies the vco output approximately 14 dB to the levels required by the transmitter or receiver mixer, and it provides the high reverse isolation necessary to prevent the am in the transmitter from modulating the vco. Transistor Q6 senses the average current through R19 and feedback - stabilizes the bias of power driver Q7. The output of Q7 is applied through capacitor C16 into a 50-ohm coaxial impedance. The output to either the receiver or transmitter (RCVR LO or XMT RF) is determined by the diode selector switch as previously described. Both outputs provide a stable +20 dBm output level.

11-13. VCO RF Feedback Loop Buffer Amplifier. A constant +5 dBm VCO RF output at pin P1-A1 is fed back to synthesizer 1A2 to phase lock the loop. The output is driven by the buffer amplifier consisting of transistors Q8, Q9, and Q10. The amplifier operates on signals received by either the power amplifier in the uhf mode or the vhf input as determined by the diode selector switches.

11-14. FM Mode. During fm mode, the FM INHIBIT input at P1-4 goes high turning on Q102. This provides a circuit path for the incoming FM AUDIO HI signal at P1-2 as generated by transmitter alc 1A6. The fm selector circuit provides the switched output to the output of the switchable bandwidth filter and a direct fm signal to the fm shaper which consists of transistors Q100 and Q101 and associated select-in-test resistors. The purpose of the shaper circuit is to maintain a more constant fm deviation over the vco frequency range. The resistor values shown for R101, R105, R106, R110, and R111 are nominal values and can vary between assemblies. The collector current of Q100 will vary depending upon the level of the mod bias. This current is applied to R112 and CR100 whereby the greater the current from Q100 the more CR100 conducts and its impedance decreases. Likewise the inverse occurs when

the Q100 current decreases. Resistor R112 and diode CR100 form a variable attenuator to the fm audio signal that appears at E14 and E15. The resulting vco tracking voltage is summed with the fm audio input and is applied to either the input of high band vco at E15 or the input of low band vco at E14. The remainder of the functions for the circuit in this mode are identical with that of the am mode.

11-15. VHF SELECTION. The vco module utilizes the buffer amplifier, diode switches, and control logic to route rf from vhf vco 1A3 through the uhf vco module to the synthesizer, transmitter, and receiver. The vco is placed in this mode when the UHF ENABLE input at P1-5 goes low. This in turn causes the output of U3A to go low forward biasing diode CR5. The VHF SIG input at P1-A2 is then routed out the VCO RF output at pin P1-A1 and either the XMT RF output at P1-A5 or RCVR LO at P1-A4, depending on whether the transmit or receive mode is selected.

11-16. UHF VCO MAINTENANCE AND TROUBLESHOOTING

11-17. After a malfunction is isolated to the uhf vco, remove the module from the transceiver as instructed in Section 5, pargaraph 5-30. Reconnect the vco to the transceiver using extender cable 30-P07212L001. Troubleshoot the vco in reference to the waveforms and voltage levels shown on the schematic diagram, Figure 11-3. Replace defective components using parts locating diagram, Figure 11-4, as a guide.

11-18. SELECT COMPONENTS. A small change in control voltage to the varactor diodes in the cavities results in a different frequency change at one end of the operating frequency band than at the other, therefore, the relationship between VCO TRACKING VOLTAGE and the vco output frequency is not quite linear. Select resistors R101, R105, R106, R110, and R111 and other associated components minimize the effects of the nonlinearity by modifying the audio signal before superimposing the signal on the tracking voltage. The resistors are selected to provide the following operational criteria with 100 mv rms 1 kHz signal at the FM AUDIO HI input:

a. Select R111 for 8.0 ± 0.5 kHz deviation at 350 MHz.

b. Select R106 for 8.0 ± 0.5 kHz deviation at 300 MHz.

c. Select R110 for 8.0 ± 0.5 kHz deviation at 399.975 MHz.

d. Check the emitter current of Q101, in Receive mode. It should be greater than 0.25 ma at 399.975 MHz.

e. If the emitter current is not greater than 0.25 ma, select R110 for 0.25 ma minimum and repeat steps a through d. Repeat until steps c and d are achieved.

f. Select R101 for 8.0 ± 0.5 kHz deviation at 225 MHz.

g. Select R105 for 8.0 ± 0.5 kHz deviation at 299.975 MHz.

h. Check the emitter current of Q100, in the transmit mode. It should be greater than 0.25 ma at 299.975 MHz.

i. If the emitter current is not greater than 0.25 ma, select R105 for 0.25 ma minimum and repeat steps f and g. Repeat until steps g and h are achieved.

11-19. STAKING. The components in the vco cavities should be firmly staked with coil adhesive E-44-F manufactured by Insl-X Products Co., Yonkers, N.Y., FSCM 75038. Beads L14 and L15 should not come in contact with the VCO frame.

NOTE

The adhesive minimizes residual fm due to vibration. Use of a substitute compound may degrade performance.

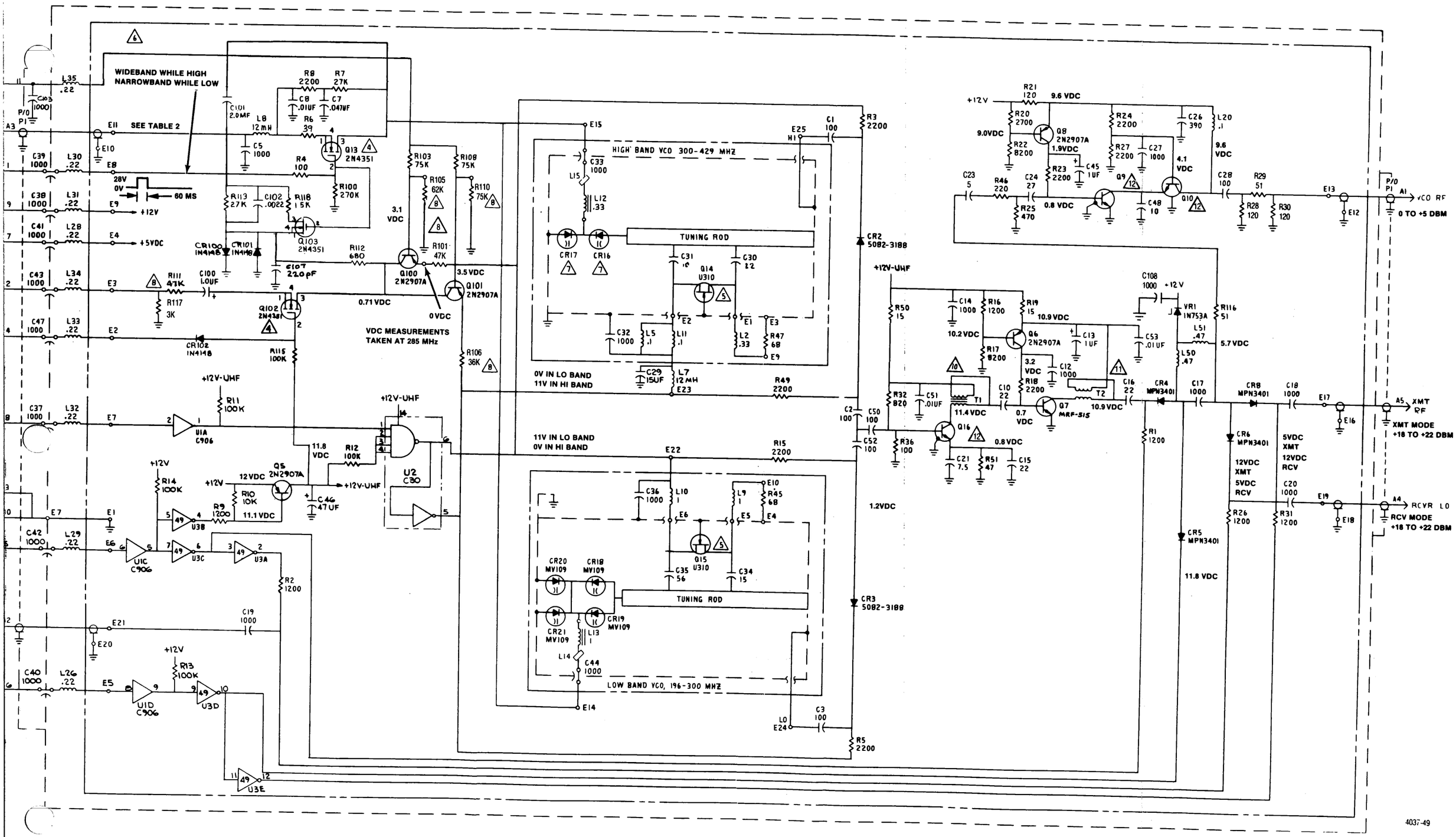

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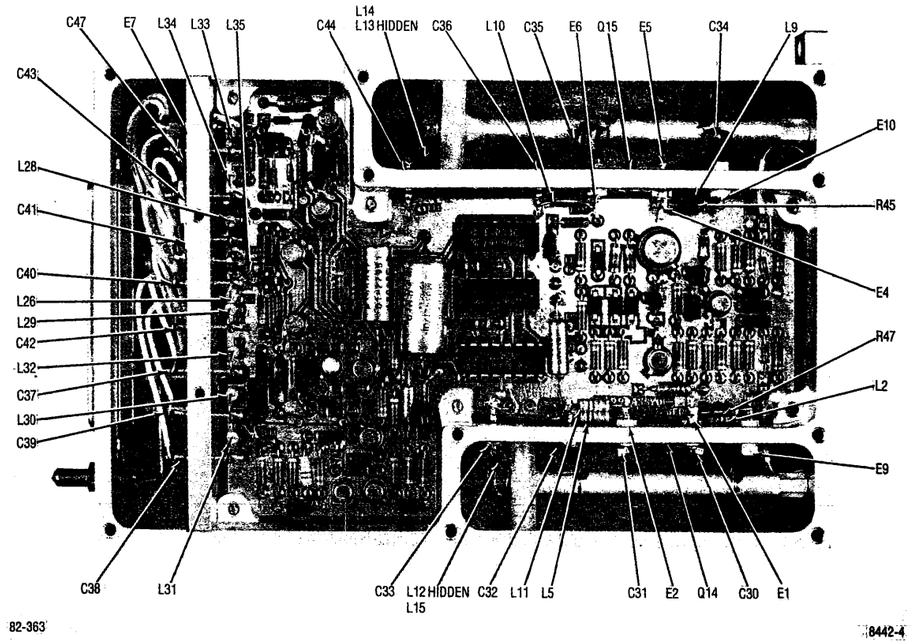
Figure 11-3. UHF VCO 1A4 Schematic Diagram

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04557L002	UHF VCO ASSY	
001	1	94990	27-P07065L001	FRAME, VCO	
002	1	94990	01-P04566L002	UHF VCO PWB ASSEMBLY	
003	1	94990	64-P07159L001	SIDE PANEL-VCO	SILVER PLATE
004	1	94990	64-P07159L002	SIDE PANEL-VCO	SILVER PLATE
005	1	94990	64-P07160L001	PLATE, FILTER-BOTTOM	SILVER PLATE
006	1	94990	64-P07161L001	PLATE, FILTER-TOP	SILVER PLATE
007	1	94990	47-P07100L001	TUNING ROD	
008	1	94990	47-P07100L002	TUNING ROD	
009	2	94990	14-P07104L001	INSULATOR	
010	1	94990	29-P08983J001	TERMINAL	
011	1	94990	29-P08983J002	TERMINAL	
012	1	94990	22-P07123L001	GUIDE PIN	
013	4	94990	03-15013G36	SCREW	2-56x1
014	24		MS24693-C1	SCREW	4-40x3/16
015	6		AN500D4-SLE	SCREW	
016	2		MS24693-C3	SCREW	4-40x5/16
017	2	94990	03-14052C09	SCREW	2-56x5/16
018	6	94990	03-14049B52	SCREW	4-40x1/4
020	2		MS16997-9	SCREW	4-40x0.250
022	3		MS21042L04	NUT	0.112-40
099	1	94990	84-P09919V001	PWB UHF/VHF VCO	
023	2		MS35338-40	WASHER #4	
024	5		MS35338-134	WASHER #2	
025	6		NAS620C2	WASHER #2	
037	1		MS77068-1	TERMINAL	
045	1	83330	81-1513	TERMINAL, FEED THRU	
C 001	1	29990	ATC100A101JP50(X)	CAPACITOR	100PF-5-50
C 002	1		M39014/01-1379	CAPACITOR	100PF-10-200
C 003	1	29990	ATC100A101JP50(X)	CAPACITOR	100PF-5-50
C 005	1		M39014/01-1397	CAPACITOR	1000PF-10-200
C 007	1		M39014/02-1387	CAPACITOR	0.047UF-10-100
C 008	1		M39014/02-1378	CAPACITOR	0.01UF-10-200
C 010	1	29990	ATC100A220JP50(X)	CAPACITOR	22PF-5-50
C 012	1	94990	CDR03BX563AKSR	CAPACITOR	1000PF-10-100
C 013	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 014	1		M39014/01-1397	CAPACITOR	1000PF-10-200
C 015	1	29990	ATC100A220JP50(X)	CAPACITOR	22PF-5-50
C 016	1	29990	ATC100A220JP50(X)	CAPACITOR	22PF-5-50
C 029	1		M39003/01-2289	CAPACITOR	15UF-10-20
C 030	1		CM04CD100D03	CAPACITOR	10PF-0.5PF-500
C 031	1		CM04ED270J03	CAPACITOR	27PF-5-500
C 032	1	33095	54-803-004-102P	CAPACITOR, STUD	1000PF
C 033	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 034	1		CM04CD150J03	CAPACITOR	15PF-5-500
C 035	1		CM04ED560J03	CAPACITOR	56PF-5-500
C 036	1	33095	54-803-004-102P	CAPACITOR, STUD	1000PF
C 037	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 038	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 039	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 040	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 017	1	94990	CDR03BX563AKSR	CAPACITOR	1000PF-10-100
C 018	1	94990	CDR03BX563AKSR	CAPACITOR	1000PF-10-100
C 019	1	94990	CDR03BX563AKSR	CAPACITOR	1000PF-10-100
C 020	1	94990	CDR03BX563AKSR	CAPACITOR	1000PF-10-100
C 021	1	29990	ATC100A7R5CP50(X)	CAPACITOR	7.5PF-0.25PF-50
C 023	1		CMR04C5R0D0DP	CAPACITOR	5PF-0.5PF-500
C 024	1		M39014/01-1369	CAPACITOR	27PF-10-200
C 026	1	94990	21-P14473A110	CAPACITOR	390PF-20-50
C 027	1	94990	CDR03BX563AKSR	CAPACITOR	1000PF-10-100
C 028	1		M39014/01-1379	CAPACITOR	100PF-10-200
C 029	1		M39003/01-2289	CAPACITOR	15UF-10-20
C 030	1		21-P16318A046	CAPACITOR	22PF-.5PF-50
C 031	1		21-P16318A038	CAPACITOR	10PF-5-50
C 032	1	33095	54-803-004-102P	CAPACITOR, STUD	1000PF
C 033	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 034	1		CM04CD150J3	CAPACITOR	15PF-5-500
C 035	1		CM04ED560J03	CAPACITOR	56PF-5-500
C 036	1	33095	54-803-004-102P	CAPACITOR, STUD	1000PF
C 037 THRU C 044	8	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 045	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 046	1		M39003/01-2295	CAPACITOR	47UF-10-20
C 047	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 048	1	29990	ATC100A100JP50(X)	CAPACITOR	10PF-5-50
C 050	1		M39014/01-1379	CAPACITOR	100PF-10-200
C 051	1	94990	21-P14473A127	CAPACITOR	0.01UF-20-50
C 052	1		M39014/01-1379	CAPACITOR	100PF-10-200
C 053	1	94990	21-P14473A127	CAPACITOR	0.01UF-20-50
C 041	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 042	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 043	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 044	1	33095	54-794-002-102P	CAPACITOR, FEED THRU	1000PF
C 100	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 101	1		M83421/01-1275M	CAPACITOR	2.0UF-5-30
C 102	1		M39014/02-1326	CAPACITOR	2200PF-10-200
C 103	1		M39014/01-1357	CAPACITOR	1000PF-10-20
C 107	1		M39014/01-1345	CAPACITOR	220PF-10-200
C 108	1		M39014/01-1357	CAPACITOR	1000PF-10-200
CR002	1	28480	5082-3188	DIODE	
CR003	1	28480	5082-3188	DIODE	
CR004	1	04713	MPN3401	DIODE	
CR005	1	04713	MPN3401	DIODE	
CR006	1	04713	MPN3401	DIODE	
CR008	1	04713	MPN3401	DIODE	
CR100	1		JAN1N4148	DIODE	
CR101	1		JAN1N4148	DIODE	
CR102	1		JAN1N4148	DIODE	
CR016	1	94990	48-P08756J001	DIODE	
CR017	1	94990	48-P08756J001	DIODE	
CR018 THRU CR021	4	04713	MV109	VARACTOR	
E 001	1	98291	011-1001-00-0-479	TERMINAL, FEED THRU	
E 002	1	98291	011-1001-00-0-479	TERMINAL, FEED THRU	
E 003	1	94990	29-15100A15	TERMINAL	
E 004	1	94990	29-15100A15	TERMINAL	
E 005, E 006	2	98291	011-1001-00-0-479	TERMINAL, FEED THRU	
E 007	1	98291	229-5001	TERMINAL	
E 009, E 010	2	98291	013-2007-00-0-479	TERMINAL	
L 002	1		MS75083-7	COIL	0.33UH
L 005	1		MS75083-1	COIL	0.1UH
L 007	1	43543	WEE-12000	INDUCTOR	12MH
L 008	1	43543	WEE-12000	INDUCTOR	12MH
L 009	1		MS75083-13	COIL	1UH
L 010	1		MS75083-13	COIL	1UH
L 011	1		MS75083-1	COIL	0.1UH
L 012	1		MS75083-7	COIL	0.33UH



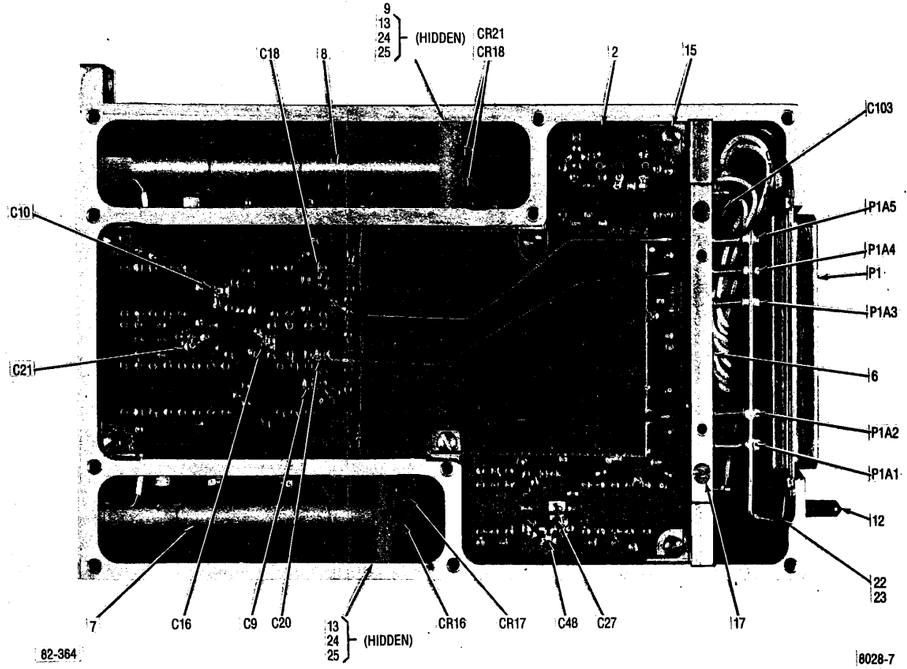


Figure 11-4. UHF VCO 1A4 Parts Location (Sheet 1 of 2)

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
L 013	1		MS75083-13	COIL	1UH
L 014	1	94990	74-15169A01	FERRITE BEAD	
L 015	1	94990	74-15169A01	FERRITE BEAD	
L 020	1		MS75083-1	COIL	0.1UH
L 026	1		MS75083-5	COIL	0.22UH
L 028	1		MS75083-5	COIL	0.22UH
L 029	1		MS75083-5	COIL	0.22UH
L 030	1		MS75083-5	COIL	0.22UH
L 031	1		MS75083-5	COIL	0.22UH
L 032	1		MS75083-5	COIL	0.22UH
L 033	1		MS75083-5	COIL	0.22UH
L 034	1		MS75083-5	COIL	0.22UH
L 035	1		MS75083-5	COIL	0.22UH
P 001	1	71468	DCM17W5P	CONNECTOR	
P 1A01	1	71468	DM53740-1	CONTACT	
P 1A02	1	71468	DM53740-1	CONTACT	
P 1A03	1	71468	DM53740-1	CONTACT	
P 1A04	1	71468	DM53740-1	CONTACT	
P 1A05	1	71468	DM53740-1	CONTACT	
Q 014	1	94990	48-P23690F001	TRANSISTOR	
Q 015	1	94990	48-P23690F001	TRANSISTOR	
L 050	1		MS75083-9	COIL	0.47UH
L 051	1		MS75083-9	COIL	0.47UH
Q 005	1		JAN2N2907A	TRANSISTOR	
Q 006	1		JAN2N2907A	TRANSISTOR	
Q 007	1		MRF-515	TRANSISTOR	
Q 008	1		JAN2N2907A	TRANSISTOR	
Q 009	1		48-P06024K001	TRANSISTOR	
Q 010	1		48-P06024K001	TRANSISTOR	
Q 013	1		2N4351	TRANSISTOR	
Q 016	1		48-P06024K001	TRANSISTOR	
Q 100	1		JAN2N2907A	TRANSISTOR	
Q 101	1		JAN2N2907A	TRANSISTOR	
Q 102	1		2N4351	TRANSISTOR	
Q 103	1		2N4351	TRANSISTOR	
R 001	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 002	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 003	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 004	1		RCR07G101JS	RESISTOR	100-5-1/4
R 005	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 006	1		RCR07G390JS	RESISTOR	39-5-1/4
R 007	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 008	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 009	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 010	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 011	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 012	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 013	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 014	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 015	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 016	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 017	1		RCR07G822JS	RESISTOR	8200-5-1/4
R 018	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 019	1		RCR07G150JS	RESISTOR	15-5-1/4
R 020	1		RCR07G272JS	RESISTOR	2700-5-1/4
R 021	1		RCR07G121JS	RESISTOR	120-5-1/4
R 022	1		RCR07G822JS	RESISTOR	8200-5-1/4
R 023	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 024	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 025	1		RCR07G471JS	RESISTOR	470-5-1/4
R 026	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 027	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 028	1		RCR07G121JS	RESISTOR	120-5-1/4
R 029	1		RCR07G510JS	RESISTOR	51-5-1/4
R 030	1		RCR07G121JS	RESISTOR	120-5-1/4
R 031	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 032	1		RCR07G821JS	RESISTOR	820-5-1/4
R 036	1		RCR07G101JS	RESISTOR	100-5-1/4
R 045	1		RCR07G680JS	RESISTOR	68-5-1/4
R 046	1		RCR07G221JS	RESISTOR	220-5-1/4
R 047	1		RCR07G680JS	RESISTOR	68-5-1/4
R 049	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 050	1		RCR07G150JS	RESISTOR	15-5-1/4
R 051	1		RCR07G470JS	RESISTOR	47-5-1/4
R 100	1		RCR07G274JS	RESISTOR	270K-5-1/4
R 101	1		RCR07G473JS	RESISTOR	47K-5-1/4 NOMINAL
R 101	S0		RCR07G433JS	RESISTOR	43K-5-1/4
R 101	S0		RCR07G513JS	RESISTOR	51K-5-1/4
R 103	1		RCR07G753JS	RESISTOR	75K-5-1/4
R 105	S01		RCR07G623JS	RESISTOR	62K-5-1/4
R 105	1		RCR07G563JS	RESISTOR	56K-5-1/4 NOMINAL
R 105	S01		RCR07G683JS	RESISTOR	68K-5-1/4
R 106	1		RCR07G363JS	RESISTOR	36K-5-1/4 NOMINAL
R 106	S01		RCR07G333JS	RESISTOR	33K-5-1/4
R 106	S01		RCR07G393JS	RESISTOR	39K-5-1/4
R 108	1		RCR07G753JS	RESISTOR	75K-5-1/4
R 110	S01		RCR07G753JS	RESISTOR	75K-5-1/4
R 110	S01		RCR07G683JS	RESISTOR	68K-5-1/4
R 110	S01		RCR07G823JS	RESISTOR	82K-5-1/4
R 110	1		RCR07G433JS	RESISTOR	43K-5-1/4 NOMINAL
R 111	S01		RCR07G243JS	RESISTOR	24K-5-1/4
R 111	S01		RCR07G303JS	RESISTOR	30K-5-1/4
R 111	S01		RCR07G333JS	RESISTOR	33K-5-1/4
R 111	1		RCR07G273JS	RESISTOR	27K-5-1/4 NOMINAL
R 111	S01		RCR07G203JS	RESISTOR	43K-5-1/4
R 111	S01		RCR07G223JS	RESISTOR	51K-5-1/4
R 112	1		RCR07G681JS	RESISTOR	680-5-1/4
R 113	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 115	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 116	1		RCR07G510JS	RESISTOR	51-5-1/4
R 117	1		RCR07G302JS	RESISTOR	3000-5-1/4
R 118	1		RCR07G152JS	RESISTOR	1500-5-1/4
T 001	1	94990	24-P06611B016	TRANSFORMER ASSY	
T 002	1	94990	24-P06611B005	TRANSFORMER ASSEMBLY	
U 001	1	04713	MM74C906N	INTEGRATED CIRCUIT	
U 002	1	04713	MM88C30N	INTEGRATED CIRCUIT	
U 003	1	04713	MC14049BCP	INTEGRATED CIRCUIT	
VR001	1		JAN1N753A	DIODE	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
28480	Hewlett-Packard Co.	1501 Page Mill Rd. Palo Alto, CA 94304
29990	American Technical Ceramics Division of Phase Industries	1 Norden Lane Huntington Station, NY 11746
33095	Spectrum Control Inc.	152 E. Main St. Fairview, PA 16415
43543	Nytronics Inc. Transformer Co. Div.	61 Gates Ave. Geneva, NY 14456
71468	ITT Cannon Electric	666 Dyer Rd. Santa Clara, CA 92702
88245	Litton Systems Inc. USECO Division	13536 Saticoy Street Van Nuys, CA 91409
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252
98291	Sealectro Corp	225 Hoyt St. Mamaroneck, NY 10544

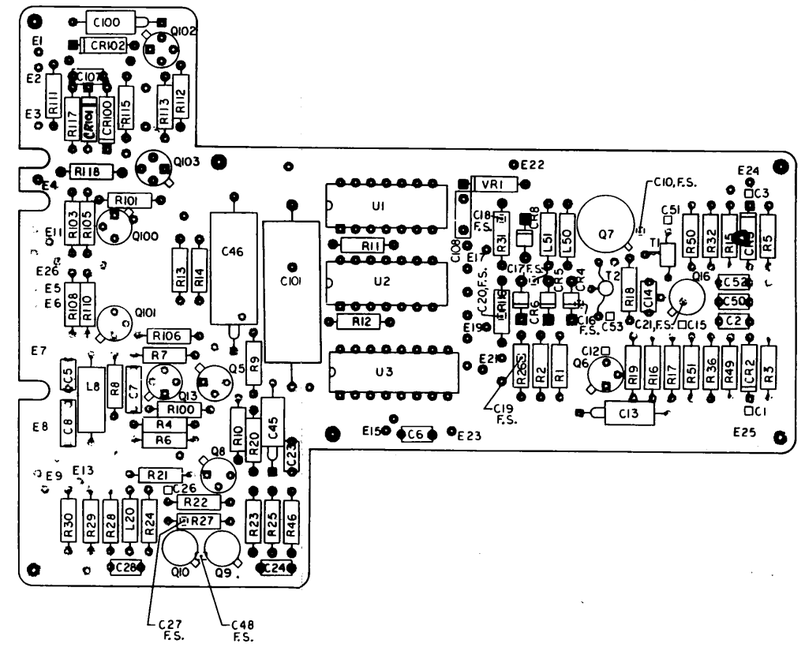
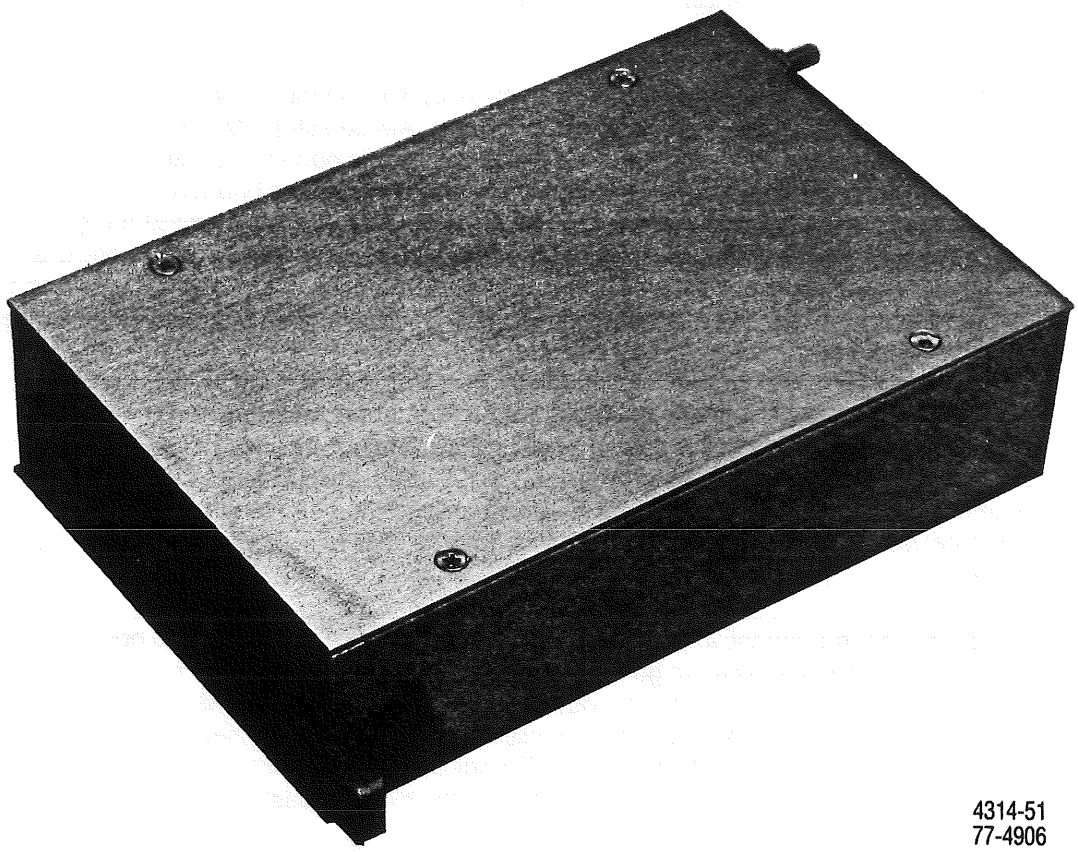


Figure 11-4. UHF VCO 1A4 Parts Location (Sheet 2 of 2)

SECTION 12
RECEIVER 1A5

12-1. PURPOSE AND GENERAL DESCRIPTION

12-2. Receiver module 1A5 shown in Figure 12-1, consists of rf filter board 1A5A2 and if/audio board 1A5A1. The purpose of the two subassemblies is to provide rf filtering for the received VHF or UHF frequency, generate an if frequency and produce an AM or FM audio output. The if strip is a dual conversion type. The first if frequency is 29 MHz and is generated by mixing the received rf signal with the local oscillator generated in the synthesizer loop in the



4314-51
77-4906

Figure 12-1. Receiver 1A5

radio. A 28.3 MHz crystal oscillator is contained inside the receiver module. The 29 MHz first if is mixed with the 28.3 MHz second L.O. to produce the 700 KHz second if. The second if is then demodulated AM or FM. The receiver also provides a squelch output.

12-3. The receiver module contains the wideband audio filter (10 Hz to 10,240 Hz) which is used in the transceiver cipher text (CT) mode of operation. In the ct receive mode of operation the AM or FM audio signal is routed through the filter and out to the x-mode connector on the transceiver front panel. In the ct transmit mode of operation the audio signal is routed in from the x-mode connector, through the ct filter and out to the transmitter/ALC 1A6 module.

12-4. In the PT transmit mode a sidetone signal is routed from the transmitter/ALC 1A6 module through the audio amplifier to the handset.

12-5. DETAILED DESCRIPTION

12-6. The following paragraphs contain detailed descriptions of both filter board 1A5A2 and receiver board 1A5A1 based on the block diagram shown in Figure 12-2 and schematic diagram Figure 12-5.

12-7. FILTER BOARD 1A5A2. The filter board consists of solid state switch assemblies U1 and U2, bandpass filters FL1 through FL7, and associated components. During operation, the frequency is selected at the control unit selector switches or one of the function switch preset frequencies. The decoder board 1A9 decodes the selected frequency and places a +12V dc level on the corresponding filter control line to switches U1 and U2. The switches for the selected filter then close, thereby routing the rf signal through the filter to the if/audio board rf input. Only one filter can be selected at a time. The resistors connected to the switch inputs are used for isolation between switches U1 and U2. The inductors and associated capacitors on the control lines are used to decouple the rf picked up from the adjacent rf lines.

12-8. IF/AUDIO BOARD 1A5A1. The major circuits that make up the if/audio board consist of an rf amplifier, first if mixer, first if amplifier, second L.O. generator, second L.O. mixers, AM detector, FM demodulator, associated AGC and squelch circuits. The board also contains a cipher text j(CT) filter, audio power amplifier, audio switch and various logic functions necessary for proper audio signal routing. In the receive mode, the board processes the rf signal from the receiver filter board and the L.O. signal from the UHF VCO 1A4 to produce a recovered AM or FM audio signal. In the plain text (PT) transmit mode, a sidetone signal generated in the transmit/ALC 1A6 module is amplified and routed to the handset or speaker. In the ct transmit mode, audio information present at the ct in pin on the X-MODE connector is filtered and routed to the 1A6 module. The modes of operation of the receiver module is controlled by signals generated in the RCU and decode logic 1A9 board.

12-9. RECEIVE MODE. In the receive mode, rf input from the filter board is applied to rf amplifier U1 at a level of −10 dBm maximum. The amplifier provides a gain of about 16 dB. The output of the rf amplifier and the LO input received from UHF VCO 1A4 are both applied to mixer Z6. The LO frequency is either 29 MHz above or below the received rf and is at a level of approximately +18 dBm. The resulting output of the mixer (29 MHz) is coupled to an impedance-matching network. The purpose of this network is to match the impedance of the mixer to the crystal filter FL1 at all frequencies.

12-10. The signal continues through the impedance matching network and the 29 MHz 6 pole crystal filter FL1 to U2. U2 is a monolithic device with a maximum gain of about 55 dB at 29 MHz. An AGC current applied to pin 2 will cause from 0 dB to 60 dB gain reduction. The gain reduction in U2 is necessary in order to keep the if amplifiers in U6 and U7 from saturating when a strong rf signal is applied. The signal then passes through the 29 MHz 2 pole crystal filter, FL2. After FL2, the signal is split into three different paths. Some of the signal passes through a 3 dB resistive attenuator and out of the module via A1 of P2. Some of the signal is passed into U6 and some into U7.

12-11. U6 is a complete FM if system on a monolithic chip. See Figure 12-3. It contains an if amplifier, a local oscillator needed to generate the second if frequency, a mixer and an FM demodulator. The FM demodulator in U6 is a phase locked loop type consisting of a phase detector, loop filter and VCO. The VCO is phase locked to the second if of 700 KHz. Any frequency variation in the rf carrier produces a corresponding variation in the VCO frequency. The phase detector produces an error voltage to keep the VCO phase locked to the second if. Variation in this error voltage is directly proportional to the variation of the frequency of the rf carrier. The error voltage is buffered inside U6 and brought out as recovered audio.

12-12. U7 is a complete AM if system on a monolithic chip. See Figure 12-4. It contains a two stage if amplifier with agc, a mixer, agc generator and AM detector. The local oscillator signal generated in U6 is amplified by Q4 and is applied to the on-chip mixer of U7 in order to generate the 700 KHz second if frequency within U7. The chip generates its own internal agc signal and a delayed agc signal. The delayed agc signal is passed to the current mirror created by Q6. The circuit is set so the amount of current flowing into pin 7 of Q6 is the same as the amount flowing out of pin 5 of U7. Op amp U9B produces a voltage at its output proportional to the amount of current sunk by Q6. This voltage is converted to a current by R7 and is passed into the agc control line of U2, completing the agc loop.

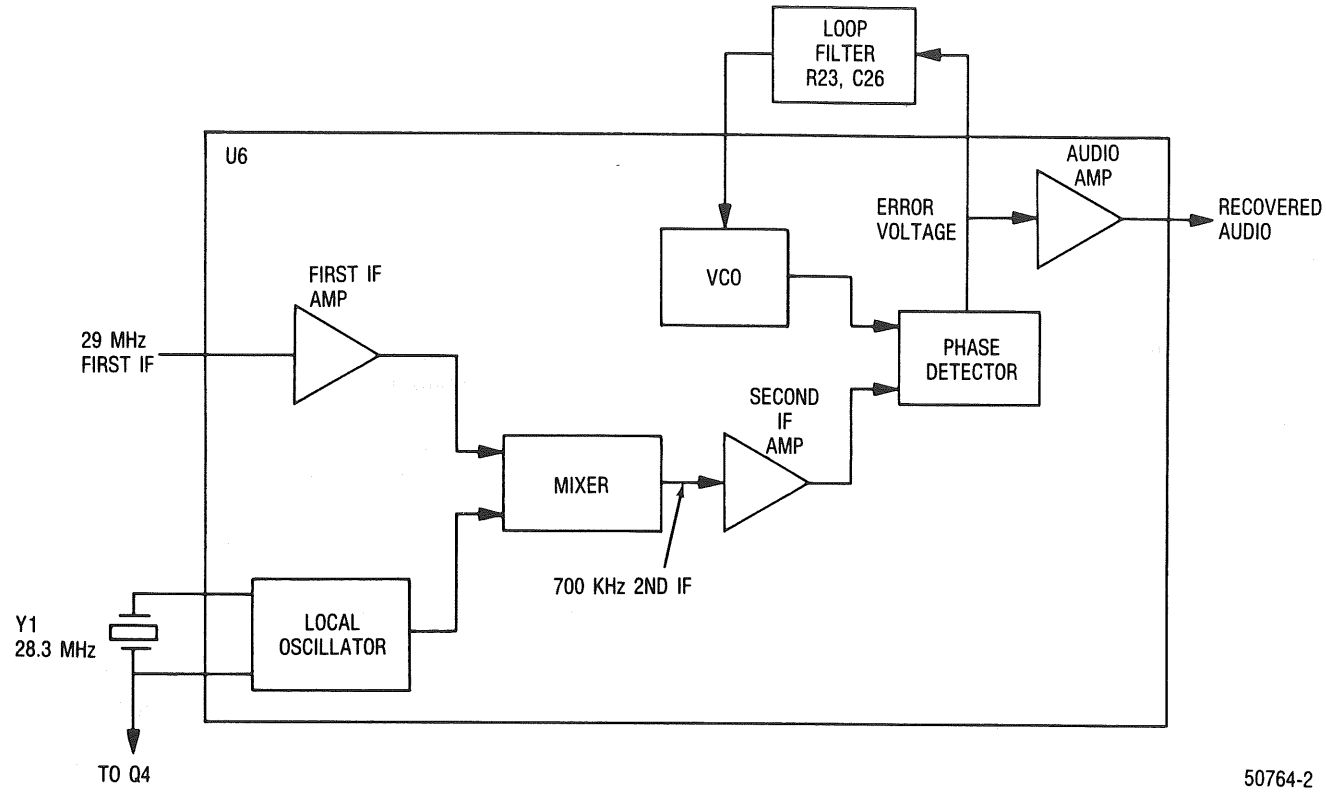


Figure 12-3. Simplified U6 Block Diagram

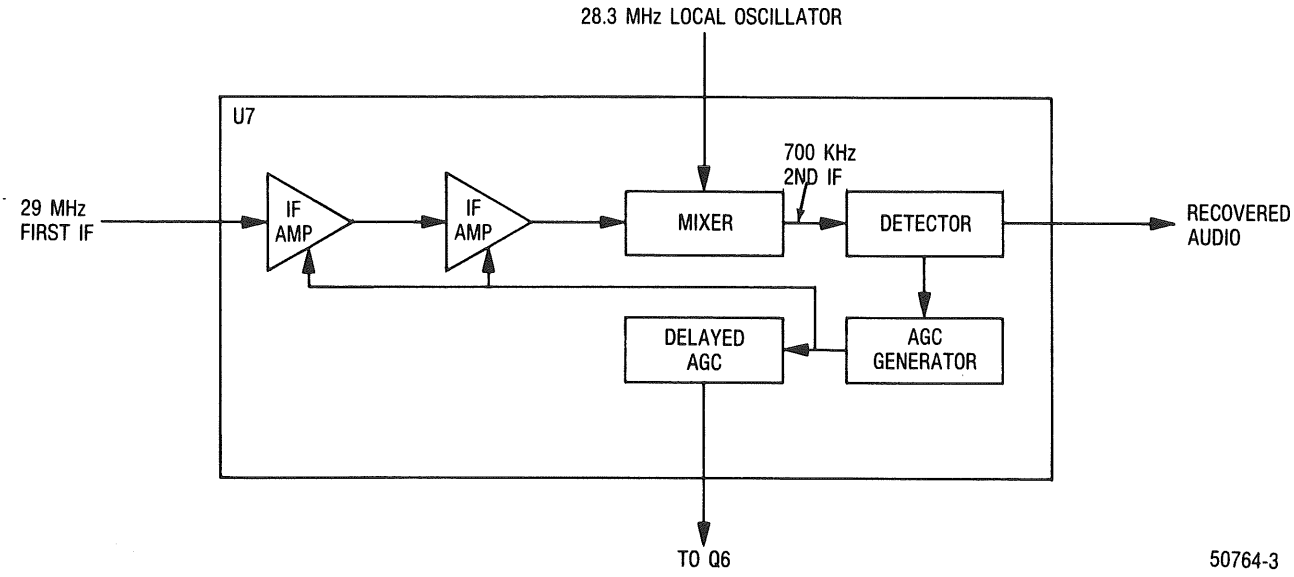


Figure 12-4. Simplified U7 Block Diagram

12-13. The receiver has two agc response times, a fast one for plain text (PT) communications and a slow one for cipher text (CT) communications. The slower AGC response is needed to keep the low frequency response usable in the AM CT mode of operation. The fast AGC time constant is set by C45. The slow AGC time constant is set by paralleling C46 with C45. This is accomplished by applying 11 volts to pin 2 of Q8. Q8 is used as a low resistance switch in the AM CT mode.

12-14. On initial power up, C45 and C46 must be charged up to about 1 Vdc in order for the receiver to work. The combination of CR19, CR20, CR21, C69, R74, R75, R76, R77 and U3E provide a short burst of current to C45 and C46 to reduce the turn on time of the receiver.

12-15. SQUELCH. The purpose of the squelch circuit is to prevent from having an audio output of noise when the receiver RF input is below a certain level. The squelch circuit uses the amplitude of audio frequency noise around 9 kHz coming out of the FM demodulator U6 to detect RF signal presence. With no RF, there is a certain amount of noise at the audio output of U6. As the RF level is increased, the level of noise drops gradually down to zero. The noise of U6 is buffered by Q7, high pass filtered by R41, R83, RT1 and C50, amplified by U8D, bandpass filtered by U8C and Z2, and peak detected by C55, CR10 and C54. The dc voltage across C54 is proportional to the noise and inversely proportional to RF level. It is compared by U8A to a voltage reference which is inversely proportional to the wiper voltage of the front panel SQUELCH pot. When the voltage across C54 is below the reference voltage across R13, the output of U8A switches high. This turns on Q5 which provides a ground at RCVR SQUELCH. This also brings pin 8 of U10 below 1 Vdc. With pin 8 below 1 volt, U10 will be enabled to amplify the audio signals. With pin 8 above 1V, U10 is put in a low current standby mode. No audio amplification takes place in this mode. R36 adds a little positive feedback to provide 5-10 dB of RF hysteresis in order to keep the receiver from chattering on and off at the RF threshold. The RCVR SQUELCH output can be used for keying another PET transceiver or for monitoring the operation of the squelch circuit. A ground on the RCVR SQUELCH line disables the guard frequency scan clock in the control unit logic control card 1A1A2 when the PET transceiver is in the guard mode of operation. An open on the RCVR SQUELCH line (corresponding to a squelch receiver) permits resumption of the frequency scanning if in the guard scan mode.

12-16. LOGIC CONTROL. The Logic Control block selects the proper signal routing inside the receiver. It consists of hex inverter U3, triple three input NOR gate U4 and quad two input NOR gate U5. Table 12-1 shows the high outputs of U4 and U5 for the various commands to the receiver module.

Table 12-1. Logic Control Truth Table

	FM HI RCV +12V	FM LO RCV +12V	AM RCV +12V	CT AM +12V	PT XMT +12V	CT XMIT +12V	CT RCV +12V
R/$\overline{T}$	+5V	+5V	+5V	–	0V	0V	+5V
MIX $\overline{HI}$/LO	0V	+5V	–	–	–	–	–
$\overline{AM}$/FM	+12V	+12V	0V	0V	–	–	–
PT/$\overline{CT}$	–	–	–	0V	+12V	0V	0V

12-17. AUDIO SWITCH. The audio switch selects one of five possible signals to be routed through the CT filter and audio power amplifier. It consists of five CMOS transmission gates. The information regarding which gate to turn on comes from the logic control described in 12-16.

12-18. CT FILTER. Once an audio signal is selected, it is amplified by noninverting amplifier U11D, and low-pass filtered by the CT filter. The CT filter is a four pole Butterworth type constructed by cascading 2 two pole active low pass filters. The high Q pole pair is created by U11C and Z5. The low Q pole pair is created by U11B and Z4. Each active filter has a dc gain of about 2.

12-19. The output of the CT filter is sent to the VOLUME CONTROL on the front panel. While in the receive mode. it is also sent to the CT OUT pin on the X-MODE connector or the transmit/ALC 1A6 module while in the transmit mode.

12-20. AUDIO POWER AMPLIFIER. The signal coming back from the wiper on the volume control is passed through a high pass filter set up by C59 and R58, non-inverting buffer U11A and the audio power amplifier/low pass filter combination U10 and Z3. The audio signal is then capacitively coupled through C57 to the front panel speaker and handset.

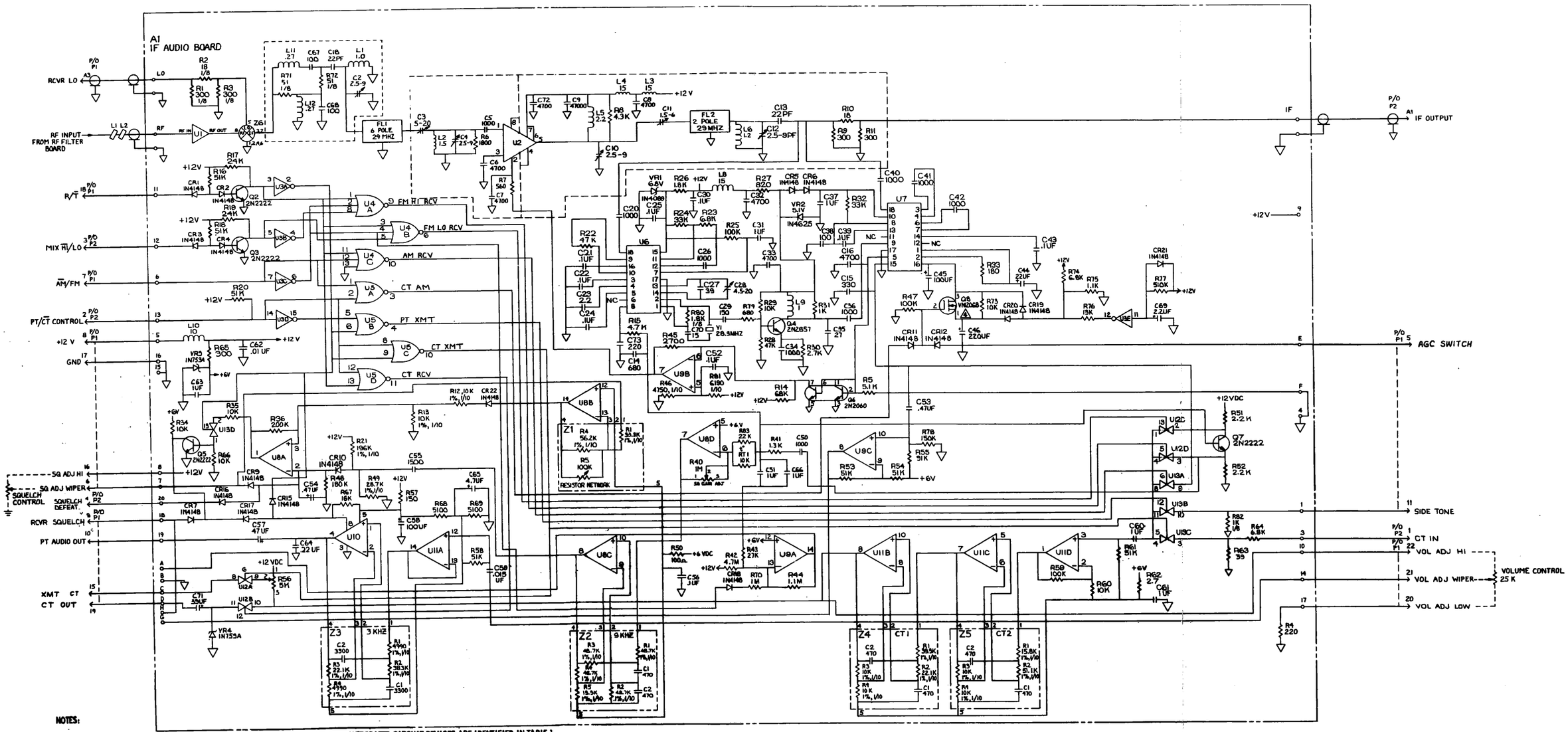
12-21. TRANSMIT. In the transmit mode the audio power amplifier is continuously enabled by pulling pin 8 of U10 below 1 volt. The squelch line is disabled high by switching U13D off.

12-22. PT TRANSMIT. In the PT transmit mode, U13B is switched on and a sidetone signal generated in the transmit/ALC 1A6 module is routed through the CT filter and audio power amplifier.

12-23. CT TRANSMIT. In the CT transmit mode, U13C and U12A are switched on. The CT input signal from the X-MODE connector is then routed through the CT filter, through adjustable resistor R56 and out to the 1A6 module.

12-24. RECEIVER MAINTENANCE AND TROUBLESHOOTING

12-25. After a malfunction is isolated to the receiver, remove the module from the transceiver as instructed in Section 5, paragraph 5-31. Reconnect the receiver to the transceiver using extender cable 30-P07211L001. Troubleshoot the receiver in reference to the waveforms and voltage levels shown on the schematic diagram, Figure 12-5. Replace defective components using as a guide parts locating diagrams Figures 12-6, 12-7, 12-8, and 12-9.



NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A5.
2. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTANCE VALUES ARE IN OHMS, ± 5 PCT 1/4 WATT.
   ALL CAPACITANCE VALUES ARE IN PF
   ALL INDUCTANCE VALUES ARE IN UH
   ALL VOLTAGES ARE DC.
3. INTEGRATED CIRCUIT DEVICES ARE IDENTIFIED IN TABLE 1. PINS NOT SHOWN ON DRAWING ARE SPECIFIED IN THE TABLE.
4. PIN LOCATION FOR Q8 IS AS SHOWN

Figure 12-5. Receiver 1A5 Schematic Diagram (Sheet 1 of 2)

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTANCE VALUES ARE IN OHMS, ±5 PCT, 1/4 WATT.
   ALL CAPACITANCE VALUES ARE IN PF.
   ALL INDUCTANCE VALUES ARE IN UH.
   ALL VOLTAGES ARE DC.

2 JUMPER WIRE.

3 FILTER BAND PASS VALUES

REF DES.	MHz
FL 7	116-132
FL 6	132-150
FL 5	225-260
FL 4	260-295
FL 3	295-330
FL 2	330-365
FL 1	365-400

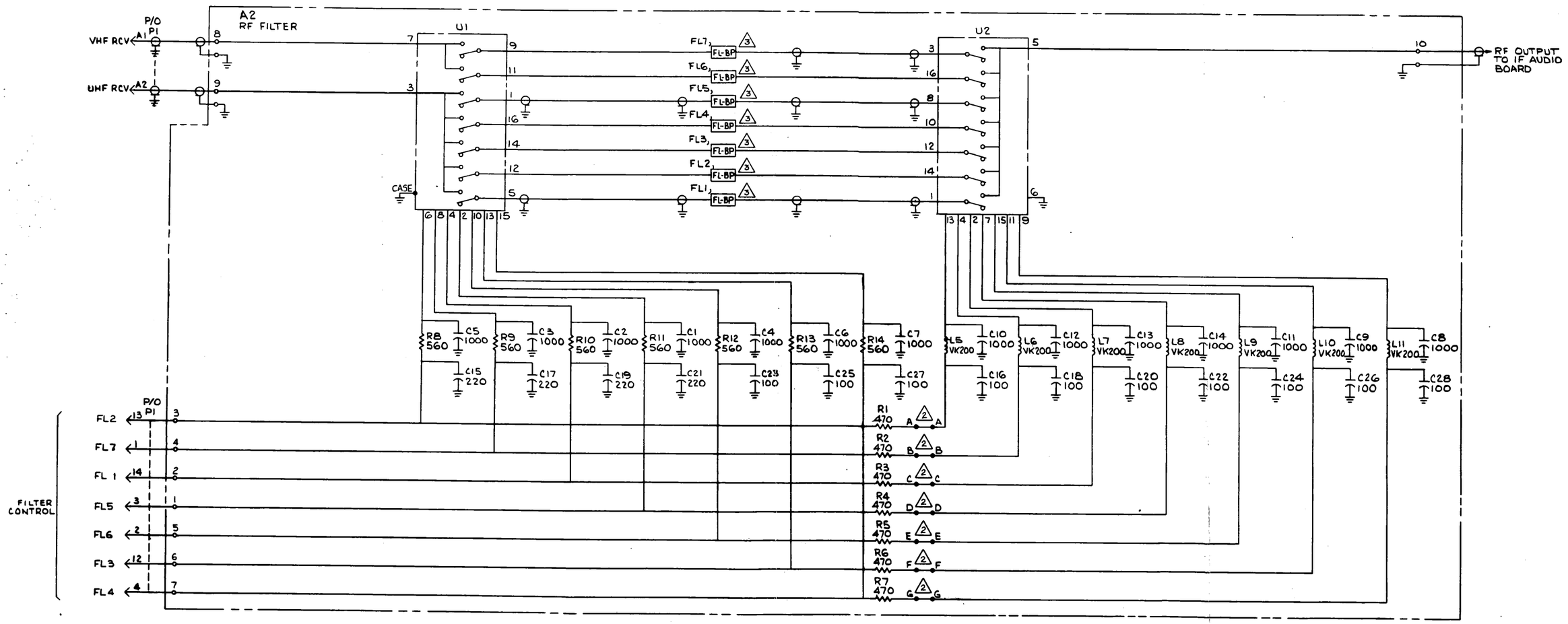
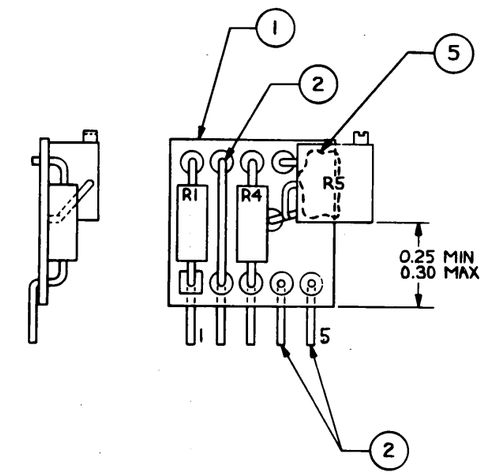
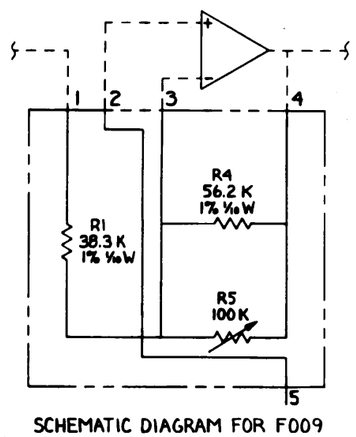


Figure 12-5. Receiver 1A5 Schematic Diagram (Sheet 2 of 2)

Z1

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		84-P23641F001	PRINTED WIRING BOARD	
002	AR			WIRE	#22
003	AR		SN63WRP3	SOLDER	
004	AR		11-14167A10	INK	WHITE
005	AR	71984	RTV3145	ADHESIVE	
R 001	1		RNC55H3832FS	RESISTOR	38.3K-1-1/10
R 004	1		RNC55H5622FS	RESISTOR	56.2K-1-1/10
R 005	1		RJ26FX104	RESISTOR	100K-10-1/4



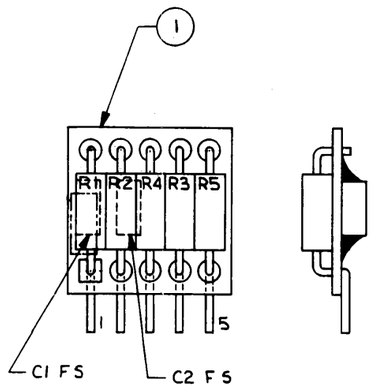


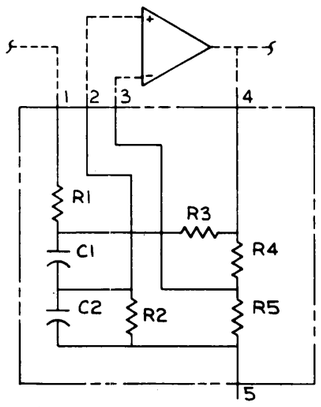
SCHEMATIC DIAGRAM FOR F009

	PART NO.	COLOR CODE
Z1	01-P23640F009	WHITE
Z2	01-P23640F008	GRAY
Z3	01-P23638F001	BROWN
Z4	01-P23638F002	RED
Z5	01-P23638F003	ORANGE

Z2

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		84-P23641F001	PRINTED WIRING BOARD	
002	AR		SN62WRP3	SOLDER	
003	AR		SN63WRP3	SOLDER	
004	AR		11-14167A09	INK	GRAY
C 001	1		CDR03BP471BJSR	CAPACITOR	470PF-5-100
C 002	1		CDR03BP471BJSR	CAPACITOR	470PF-5-100
R 001	1		RNC55H4872FS	RESISTOR	48.7K-1-1/10
R 002	1		RNC55H4872FS	RESISTOR	48.7K-1-1/10
R 003	1		RNC55H4872FS	RESISTOR	48.7K-1-1/10
R 004	1		RNC55H4872FS	RESISTOR	48.7K-1-1/10
R 005	1		RNC55H1332FS	RESISTOR	13.3K-1-1/10





SCHEMATIC DIAGRAM FOR F008
SEE PARTS LIST FOR VALUES

Z3

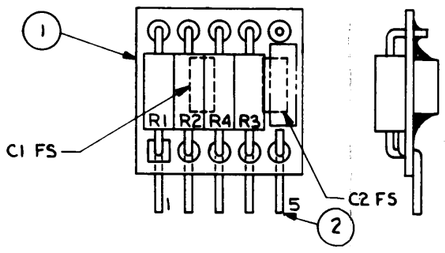
Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		84-P23639F001	PRINTED WIRING BOARD	
002	AR			WIRE	#22
003	AR		SN62WRP3	SOLDER	
004	AR		SN63WRP3	SOLDER	
005	AR		11-14167A02	INK	BROWN
C 001	1		CDR04BP332BJSM	CAPACITOR	3300PF-5-100
C 002	1		CDR04BP332BJSM	CAPACITOR	3300PF-5-100
R 001	1		RNC55H4991FS	RESISTOR	4990-1-1/10
R 002	1		RNC55H3832FS	RESISTOR	38.3K-1-1/10
R 003	1		RNC55H2212FS	RESISTOR	22.1K-1-1/10
R 004	1		RNC55H4991FS	RESISTOR	4990-1-1/10

Z4

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		84-P23639F001	PRINTED WIRING BOARD	
002	AR			WIRE	#22
003	AR		SN62WRP3	SOLDER	
004	AR		SN63WRP3	SOLDER	
005	AR		11-14167A03	INK	RED
C 001	1		CDR03BP471BJSM	CAPACITOR	470PF-5-100
C 002	1		CDR03BP471BJSM	CAPACITOR	470PF-5-100
R 001	1		RNC55H3832FS	RESISTOR	38.3K-1-1/10
R 002	1		RNC55H2212FS	RESISTOR	22.1K-1-1/10
R 003	1		RNC55H1002FS	RESISTOR	10K-1-1/10
R 004	1		RNC55H1002FS	RESISTOR	10K-1-1/10

Z5

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		84-P23639F001	PRINTED WIRING BOARD	
002	AR			WIRE	#22
003	AR		SN62WRP3	SOLDER	
004	AR		SN63WRP3	SOLDER	
005	AR		11-14167A04	INK	ORANGE
C 001	1		CDR03BP471BJSM	CAPACITOR	470PF-5-100
C 002	1		CDR03BP471BJSM	CAPACITOR	470PF-5-100
R 001	1		RNC55H1582FS	RESISTOR	15.8K-1-1/10
R 002	1		RNC55H5112FS	RESISTOR	51.1K-1-1/10
R 003	1		RNC55H1002FS	RESISTOR	10K-1-1/10
R 004	1		RNC55H1002FS	RESISTOR	10K-1-1/10



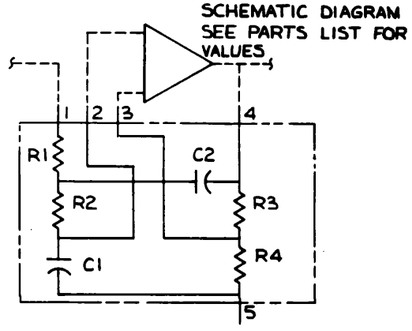
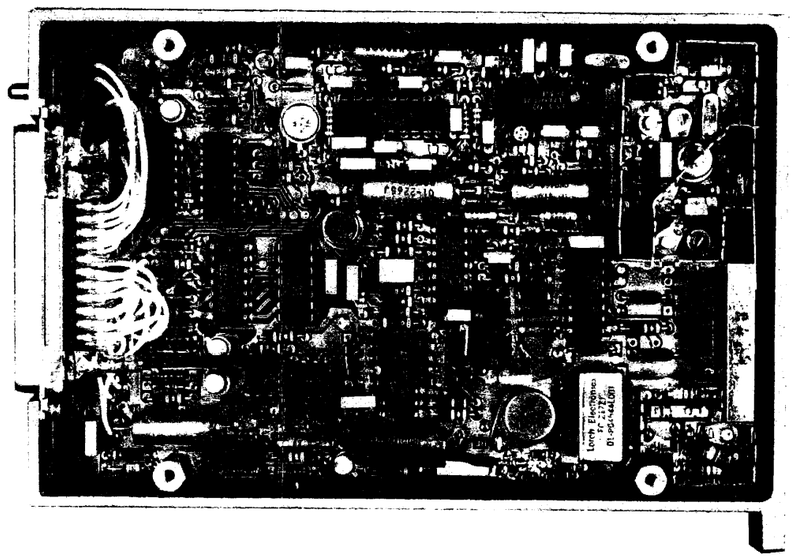
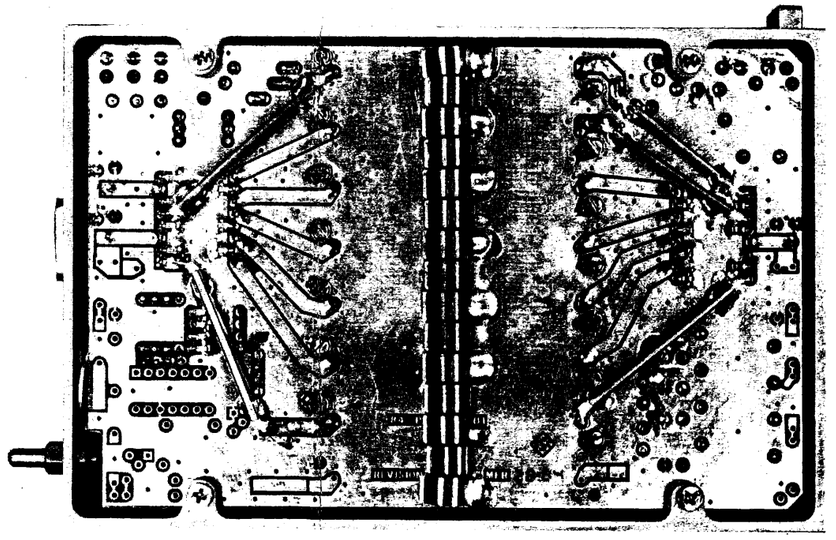


Figure 12-6. Receiver 1A5 Audio Filter and Resistor Sub-Assemblies

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		27-P07156L003	FRAME, RECEIVER	
002	2		64-P07135L001	PANEL, SIDE	
003	1		22-P07123L001	GUIDE PIN	
004	4		MS24693-C2	SCREW	4-40X1/4
005	4		MS24693-C3	SCREW	4-40X5/16
006	4		MS24693-C11	SCREW	4-40X1-1/8
007	1		MS21042L04	NUT	.112-40
009	AR		30-15068A35	CABLE, RG188	WHITE
010	AR			WIRE	#22
011	AR		RT-3-N0.2	INSULATION SLEEVING	.300 BLK
012	AR		SN63WRP3	SOLDER	
013	AR	71984	RTV3145	ADHESIVE	
014	AR		11-P14459A002	ADHESIVE, FUNGI	GREEN E-44-F
015	AR		11-14167A01	INK	BLACK
016	4		01-P23630F051	GROUND STRAP	
017	AR		M23053/5-104-0	INSULATION SLEEVING	.125 BLK
018	AR			WIRE	#24 BRN
A 001	1		01-P23636F001	IF AUDIO ASSEMBLY	
A 002	1		01-P23256B003	RF FILTER ASSEMBLY	
L 001	1	83285	10273	FERRITE BEAD	
L 002	1	83285	10273	FERRITE BEAD	
W 1P1	1		30-P23991F001	LEAD ASSEMBLY RCVR	
W 2P2	1		30-P23992F001	LEAD ASSEMBLY RCVR	



85-2111



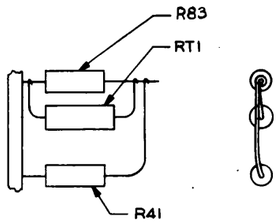
50764-4

85-2112

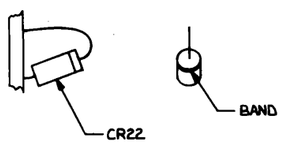
Figure 12-7. Receiver Parts Location

NOTES:

1. UNLESS OTHERWISE SPECIFIED, SOLDER ALL COMPONENTS USING SOLDER, FIND NO. 3.
2. SOLDER ALL CHIP CAPACITORS USING SOLDER, FIND NO. 8.
3. STAKE JUMPER WIRES, FIND NO. 16, TO BOARD WITH ADHESIVE, FIND NO. 18, AS NECESSARY.
4. ON JUMPER WIRES USE PLATED THROUGH HOLES WHERE AVAILABLE, OTHERWISE WRAP AROUND COMPONENT LEAD.



DETAIL A



DETAIL B

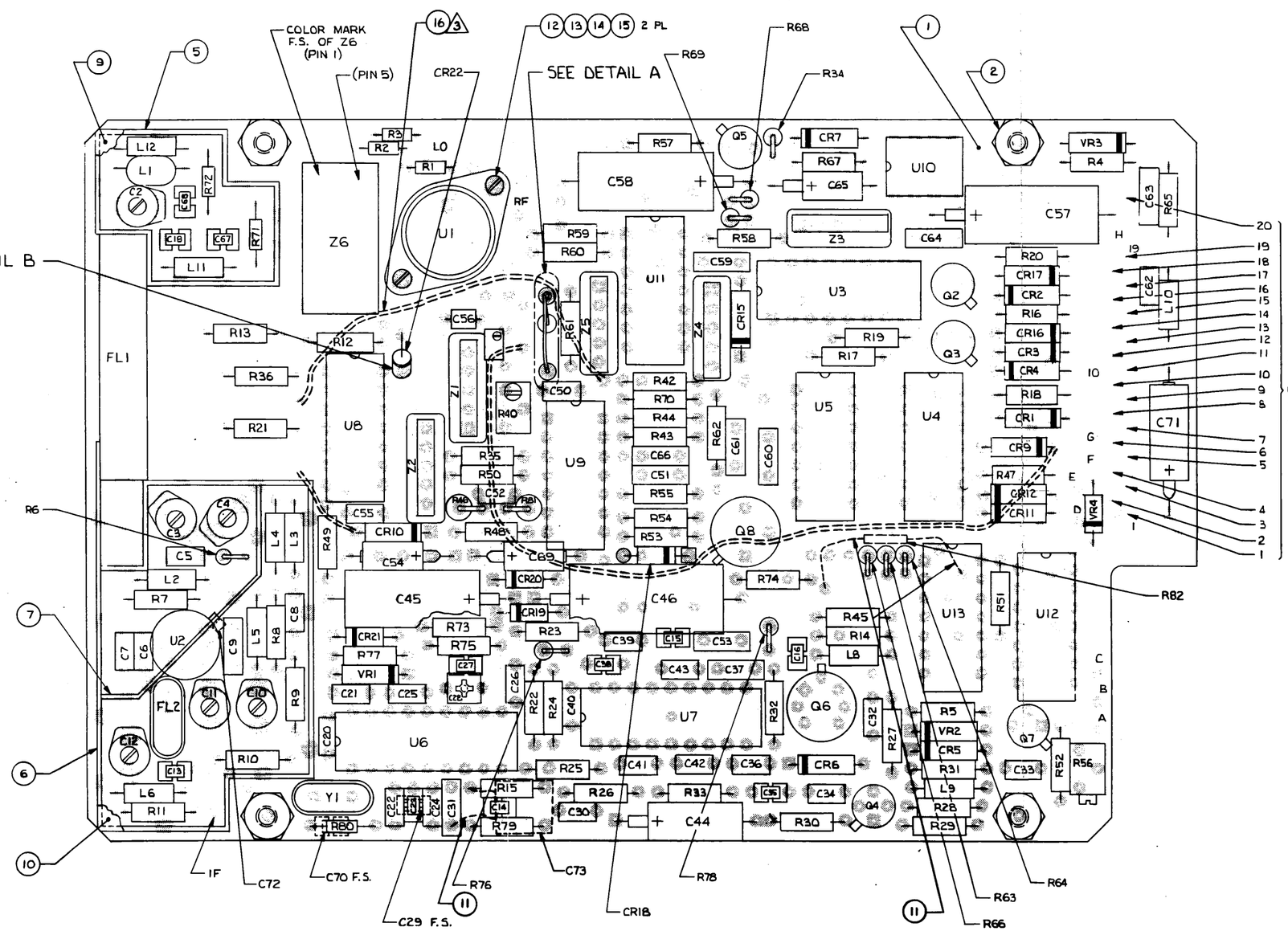


Figure 12-8. Receiver Circuit Card 1A5A1 Parts Location (Sheet 1 of 2)

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		84-P23637F001	PRINTED WIRING BOARD	IF AUDIO, RCVR
002	4		43-P07178L001	SPACER	
003	AR		SN63WRMAP3	SOLDER	
005	1		26-P23847F001	FENCE	
006	1		26-P23646F001	FENCE	
007	1		26-P23687F001	DIVIDER	
008	AR		SN62WRMAP3	SOLDER	
009	1		26-P23848F001	SHIELD, COVER	
010	1		26-P23647F001	SHIELD, COVER	
011	AR			INSULATION SLEEVING	#22 WHT
012	2		03-15013G20	SCREW	.0600-80X.1875
013	2		NAS671C0	NUT	.0600-80
014	2		04-15067B71	WASHER, LOCK	NO
015	2		NAS620C0	WASHER, FLAT	.060
016	AR		M22759/11-24-9	WIRE	#24 WHT
017	AR			WIRE	#22
018	AR	71984	RTV3145	ADHESIVE	
C 002	1		20-P24023F003	CAPACITOR, VARIABLE	2.5-9PF
C 003	1		20-P24023F004	CAPACITOR, VARIABLE	5-20PF
C 004	1		20-P24023F003	CAPACITOR, VARIABLE	2.5-9PF
C 005	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 006	1		M39014/01-1569	CAPACITOR	4700PF-10-100
C 007	1		M39014/01-1569	CAPACITOR	4700PF-10-100
C 008	1		M39014/01-1569	CAPACITOR	4700PF-10-100
C 009	1		M39014/02-1345	CAPACITOR	.047UF-10-100
C 010	1		20-P24023F003	CAPACITOR, VARIABLE	2.5-9PF
C 011	1		20-P24023F002	CAPACITOR, VARIABLE	1.5-6PF
C 012	1		20-P24023F003	CAPACITOR, VARIABLE	2.5-9PF
C 013	1		21-P16318A046	CAPACITOR	22PF-5-50
C 014	1		CDR01BX681BKSR	CAPACITOR	680PF-10-100
C 015	1		CDR01BX331BKSR	CAPACITOR	330PF-10-100
C 016	1		CDR01BX472AKSR	CAPACITOR	4700PF-10-50
C 018	1		21-P16318A046	CAPACITOR	22PF-5-50
C 020	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 021	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 022	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 023	1		21-P16318A022	CAPACITOR	2.2PF-.25PF-50
C 024	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 025	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 026	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 027	1		21-P16318A052	CAPACITOR	39PF-5-50
C 028	1		TZB04R200BC	CAPACITOR, VARIABLE	4.5-20PF
C 029	1		CDR01BP151BJSR	CAPACITOR	150PF-5-100
C 030	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 031	1		M39014/02-1419	CAPACITOR	1UF-10-50
C 032	1		M39014/01-1569	CAPACITOR	4700PF-10-100
C 033	1		M39014/01-1569	CAPACITOR	4700PF-10-100
C 034	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 035	1		21-P16318A048	CAPACITOR	27PF-5-50
C 036	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 037	1		M39014/02-1419	CAPACITOR	1UF-10-50
C 038	1		21-P16318A062	CAPACITOR	100PF-5-50
C 039	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 040	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 041	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 042	1		M39014/01-1357	CAPACITOR	1000PF-10-200
C 043	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 044	1		M39003/01-2271	CAPACITOR	22UF-10-15
C 045	1		M39003/01-2261	CAPACITOR	100UF-10-10
C 046	1		M39003/01-2265	CAPACITOR	220UF-10-10
C 050	1		M39014/01-1277	CAPACITOR	1000PF-10-200
C 051	1		M39014/02-1419	CAPACITOR	1UF-10-50
C 052	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 053	1		M39014/02-1280	CAPACITOR	.47UF-10-50
C 054	1		M39003/01-2350	CAPACITOR	.47UF-10-50
C 055	1		M39014/01-1360	CAPACITOR	1500PF-10-100
C 056	1		M39014/01-1593	CAPACITOR	.1UF-10-50
C 057	1		M39003/01-2295	CAPACITOR	47UF-10-20
C 058	1		M39003/01-2301	CAPACITOR	100UF-10-20
C 059	1		M39014/02-1340	CAPACITOR	.015UF-10-100
C 060	1		M39014/02-1419	CAPACITOR	1UF-10-50
C 061	1		M39014/02-1419	CAPACITOR	1UF-10-50
C 062	1		M39014/01-1575	CAPACITOR	.01UF-10-100
C 063	1		M39014/02-1419	CAPACITOR	1UF-10-50
C 064	1		M39014/02-1356	CAPACITOR	.22UF-10-50
C 065	1		M39003/01-2254	CAPACITOR	4.7UF-10-10
C 066	1		M39014/02-1419	CAPACITOR	1UF-10-50
C 067	1		21-P16318A062	CAPACITOR	100PF-5-50
C 068	1		21-P16318A062	CAPACITOR	100PF-5-50
C 069	1		M39003/01-2283	CAPACITOR	2.2UF-10-20
C 070	1		21-P16318A042	CAPACITOR	15PF-5-50
C 071	1		M39003/01-2259	CAPACITOR	39UF-10-10
C 072	1		CDR01BX472AKSM	CAPACITOR	4700PF-10-50
C 073	1		M39014/01-1345	CAPACITOR	220PF-10-200
CR001	1		JAN1N4148	DIODE	
CR002	1		JAN1N4148	DIODE	
CR003	1		JAN1N4148	DIODE	
CR004	1		JAN1N4148	DIODE	
CR005	1		JAN1N4148	DIODE	
CR006	1		JAN1N4148	DIODE	
CR007	1		JAN1N4148	DIODE	
CR009	1		JAN1N4148	DIODE	
CR010	1		JAN1N4148	DIODE	
CR011	1		JAN1N4148	DIODE	
CR012	1		JAN1N4148	DIODE	
CR015	1		JAN1N4148	DIODE	
CR016	1		JAN1N4148	DIODE	
CR017	1		JAN1N4148	DIODE	
CR018	1		JAN1N4148	DIODE	
CR019	1		JAN1N4148	DIODE	
CR020	1		JAN1N4148	DIODE	
CR021	1		JAN1N4148	DIODE	
CR022	1		JAN1N4148	DIODE	
FL001	1		25-P03968T001	FILTER, 6 POLE	
FL002	1		25-P07116L001	FILTER, 2 POLE	
L 001	1		24-P07200L003	INDUCTOR	1.0 UH
L 002	1		MS75084-2	COIL	1.5UH
L 003	1		MS75084-14	COIL	15UH
L 004	1		MS75084-14	COIL	15UH
L 005	1		MS75084-04	COIL	2.2UH
L 006	1		MS75084-1	COIL	1.2UH
L 008	1		MS75084-14	COIL	15UH
L 009	1		MS75083-13	COIL	1UH
L 010	1		MS75084-12	COIL	10UH
L 011	1		MS75083-6	COIL	.27UH
L 012	1		MS75083-6	COIL	.27UH
Q 002	1		JAN2N2222A	TRANSISTOR	
Q 003	1		JAN2N2222A	TRANSISTOR	
Q 004	1		JAN2N2857	TRANSISTOR	
Q 005	1		JAN2N2222A	TRANSISTOR	
Q 006	1		2N2060	TRANSISTOR	
Q 007	1		JAN2N2222A	TRANSISTOR	
Q 008	1		VN1206B	TRANSISTOR	
R 001	1		RCR05G301JS	RESISTOR	300-5-1/8
R 002	1		RCR05G180JS	RESISTOR	18-5-1/8
R 003	1		RCR05G301JS	RESISTOR	300-5-1/8
R 004	1		RCR07G221JS	RESISTOR	220-5-1/4
R 005	1		RCR07G512JS	RESISTOR	5100-5-1/4
R 006	1		RCR07G182JS	RESISTOR	1800-5-1/4
R 007	1		RCR07G561JS	RESISTOR	560-5-1/4
R 008	1		RCR07G432JS	RESISTOR	4300-5-1/4
R 009	1		RCR07G301JS	RESISTOR	300-5-1/4
R 010	1		RCR07G180JS	RESISTOR	18-5-1/4
R 011	1		RCR07G301JS	RESISTOR	300-5-1/4
R 012	1		RNC55H1002FS	RESISTOR	10K-1-1/10
R 013	1		RNC55H1002FS	RESISTOR	10K-1-1/10
R 014	1		RCR07G683JS	RESISTOR	68K-5-1/4
R 015	1		RCR07G472JS	RESISTOR	4700-5-1/4
R 016	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 017	1		RCR07G243JS	RESISTOR	24K-5-1/4
R 018	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 019	1		RCR07G243JS	RESISTOR	24K-5-1/4
R 020	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 021	1		RNC55H1963FS	RESISTOR	196K-1-1/10
R 022	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 023	1		RCR07G682JS	RESISTOR	6800-5-1/4
R 024	1		RCR07G333JS	RESISTOR	33K-5-1/4
R 025	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 026	1		RCR07G182JS	RESISTOR	1800-5-1/4
R 027	1		RCR07G821JS	RESISTOR	820-5-1/4
R 028	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 029	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 030	1		RCR07G272JS	RESISTOR	2700-5-1/4
R 031	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 032	1		RCR07G333JS	RESISTOR	33K-5-1/4
R 033	1		RCR07G181JS	RESISTOR	180-5-1/4
R 034	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 035	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 036	1		RCR07G204JS	RESISTOR	200K-5-1/4
R 040	1		RJ26FW105	RESISTOR	1M-10-1/4
R 041	1		RCR07G132JS	RESISTOR	1300-5-1/4
R 042	1		RCR07G475JS	RESISTOR	4.7M-5-1/4
R 043	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 044	1		RCR07G115JS	RESISTOR	1.1M-5-1/4
R 045	1		RCR07G272JS	RESISTOR	2700-5-1/4
R 046	1		RNC55H4751FS	RESISTOR	4750-1-1/10
R 047	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 048	1		RCR07G184JS	RESISTOR	180K-5-1/4
R 049	1		RNC55H2872FS	RESISTOR	28.7K-1-1/10
R 050	1		RCR07G101JS	RESISTOR	100-5-1/4
R 051	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 052	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 053	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 054	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 055	1		RCR07G913JS	RESISTOR	91K-5-1/4
R 056	1		RJ26FX502	RESISTOR	5000-10-1/4
R 057	1		RCR07G151JS	RESISTOR	150-5-1/4
R 058	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 059	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 060	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 061	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 062	1		RCR07G2R7JS	RESISTOR	2.7-5-1/4
R 063	1		RCR07G390JS	RESISTOR	39-5-1/4
R 064	1		RCR07G682JS	RESISTOR	6800-5-1/4
R 065	1		RCR07G301JS	RESISTOR	300-5-1/4
R 066	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 067	1		RCR07G163JS	RESISTOR	16K-5-1/4
R 068	1		RCR07G512JS	RESISTOR	5100-5-1/4
R 069	1		RCR07G512JS	RESISTOR	5100-5-1/4
R 070	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 071	1		RCR05G510JS	RESISTOR	51-5-1/8
R 072	1		RCR05G510JS	RESISTOR	51-5-1/8
R 073	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 074	1		RCR07G682JS	RESISTOR	6800-5-1/4
R 075	1		RCR07G112JS	RESISTOR	1100-5-1/4
R 076	1		RCR07G133JS	RESISTOR	13K-5-1/4
R 077	1		RCR07G514JS	RESISTOR	510K-5-1/4
R 078	1		RCR07G154JS	RESISTOR	150K-5-1/4
R 079	1		RCR07G681JS	RESISTOR	680-5-1/4
R 080	1		RCR05G182JS	RESISTOR	1800-5-1/8
R 081	1		RNC55H6191FS	RESISTOR	6190-1-1/10
R 082	1		RCR05G102JS	RESISTOR	1000-5-1/8
R 083	1		RCR07G223JS	RESISTOR	22K-5-1/4
RT001	1		RTH42ES103K	THERMISTOR	10K-10-1/4
U 001	1		AM143	INTEGRATED CIRCUIT	
U 002	1		MC1590	INTEGRATED CIRCUIT	
U 003	1		MC14049UBAL	INTEGRATED CIRCUIT	
U 004	1	04713	MC14025BAL	INTEGRATED CIRCUIT	
U 005	1	04713	MC14001BAL	INTEGRATED CIRCUIT	
U 006	1		SL6601CDG	INTEGRATED CIRCUIT	
U 007	1		SL6700CDG	INTEGRATED CIRCUIT	
U 008	1		MC3303L	INTEGRATED CIRCUIT	
U 009	1		MC3303L	INTEGRATED CIRCUIT	
U 010	1		SL6310CDG	INTEGRATED CIRCUIT	
U 011	1		MC3303L	INTEGRATED CIRCUIT	
U 012	1		51-P24074F001	INTEGRATED CIRCUIT	
U 013	1		51-P24074F001	INTEGRATED CIRCUIT	
VR001	1		JAN1N4099	DIODE	
VR002	1		JAN1N4625	DIODE	
VR003	1		JAN1N753A-1	DIODE	
VR004	1		JAN1N759A-1	DIODE	
Y 001	1		52-P07485D001	CRYSTAL	28.3MHZ
Z 001	1		01-P23640F009	PRINTED WIRING BOARD ASSY	
Z 002	1		01-P23640F008	PRINTED WIRING BOARD ASSY	
Z 003	1		01-P23638F001	FILTER ASSEMBLY, 3KHZ	
Z 004	1		01-P23638F002	FILTER ASSEMBLY, CT1	
Z 005	1		01-P23638F003	FILTER ASSEMBLY, CT2	
Z 006	1		01-P04544L001	MIXER	

Figure 12-8. Receiver Circuit Card 1A5A1 Parts Location (Sheet 2 of 2)

NOTES:
1. REFERENCE DRAWINGS
   SCHEMATIC DIAGRAM 53-P23257B
2. ALL CHIP CAPACITORS AND COAX CABLES ARE LAP SOLDERED TO BACK OF PRINTED WIRING BOARD USING FIND NUMBER 8.

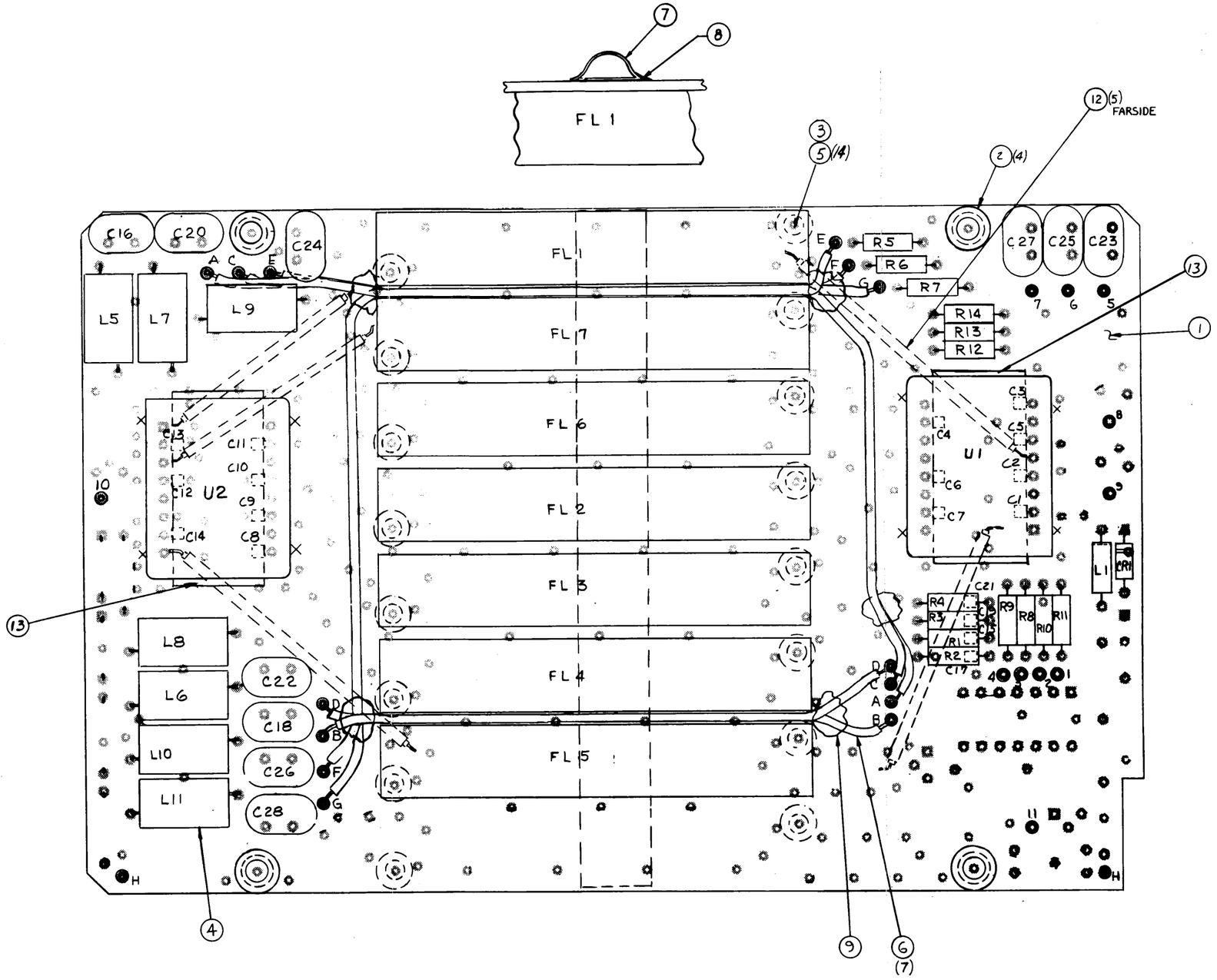


Figure 12-9. Receiver Circuit Card 1A5A2 Parts Location (Sheet 1 of 2)

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
001	1		84-P23258B001	PWB, RF FILTER ASSY	
002	4		43-P07188L001	SPACER	
003	AR			GLYPTAL	
004	AR		M23053/5-206-C	INSULATION SLEEVING	.250 CLR
005	14		03-15013G27	SCREW	.0860-56X.188
006	AR			WIRE	#24 WHT
007	AR	30817	97-520-A	STRIP, RFI	
008	AR		SN62WRMAP3	SOLDER	
009	AR	71984	RTV3145	ADHESIVE	
010	AR		SN63WRP3	SOLDER	
011	AR	96900	8173	ADHESIVE	
012	AR		M17/133-RG405	CABLE, SEMI-RIGID	.086
013	AR		14-P23953F001	INSULATOR-SHIM	
014	AR			WIRE	#24
C 001	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 002	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 003	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 004	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 005	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 006	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 007	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 008	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 009	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 010	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 011	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 012	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 013	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 014	1		CDR01BX102BKSR	CAPACITOR	1000PF-10-100
C 015	1		CDR01BX221BKSR	CAPACITOR	220PF-10-100
C 016	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 017	1		CDR01BX221BKSR	CAPACITOR	220PF-10-100
C 018	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 019	1		CDR01BX221BKSR	CAPACITOR	220PF-10-100
C 020	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 021	1		CDR01BX221BKSR	CAPACITOR	220PF-10-100
C 022	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 023	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 024	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 025	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 026	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 027	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 028	1		CM04FD101J03	CAPACITOR	100PF-5-500
FL001	1		25-P04521L001	FILTER	365-400MHZ
FL002	1		25-P04521L002	FILTER	330-365MHZ
FL003	1		25-P04521L003	FILTER	295-330MHZ
FL004	1		25-P04521L004	FILTER	260-295MHZ
FL005	1		25-P04521L005	FILTER	225-260MHZ
FL006	1		25-P04521L006	FILTER	132-150MHZ
FL007	1		25-P04521L007	FILTER	116-132MHZ
L 005	1	02114	VK200-10/3B	COIL	
L 006	1	02114	VK200-10/3B	COIL	
L 007	1	02114	VK200-10/3B	COIL	
L 008	1	02114	VK200-10/3B	COIL	
L 009	1	02114	VK200-10/3B	COIL	
L 010	1	02114	VK200-10/3B	COIL	
L 011	1	02114	VK200-10/3B	COIL	
R 001	1		RCR07G471JS	RESISTOR	470-5-1/4
R 002	1		RCR07G471JS	RESISTOR	470-5-1/4
R 003	1		RCR07G471JS	RESISTOR	470-5-1/4
R 004	1		RCR07G471JS	RESISTOR	470-5-1/4
R 005	1		RCR07G471JS	RESISTOR	470-5-1/4
R 006	1		RCR07G471JS	RESISTOR	470-5-1/4
R 007	1		RCR07G471JS	RESISTOR	470-5-1/4
R 008	1		RCR07G561JS	RESISTOR	560-5-1/4
R 009	1		RCR07G561JS	RESISTOR	560-5-1/4
R 010	1		RCR07G561JS	RESISTOR	560-5-1/4
R 011	1		RCR07G561JS	RESISTOR	560-5-1/4
R 012	1		RCR07G561JS	RESISTOR	560-5-1/4
R 013	1		RCR07G561JS	RESISTOR	560-5-1/4
R 014	1		RCR07G561JS	RESISTOR	560-5-1/4
U 001	1		58-P07061L001	RF SWITCH	
U 002	1		58-P07061L002	RF SWITCH	

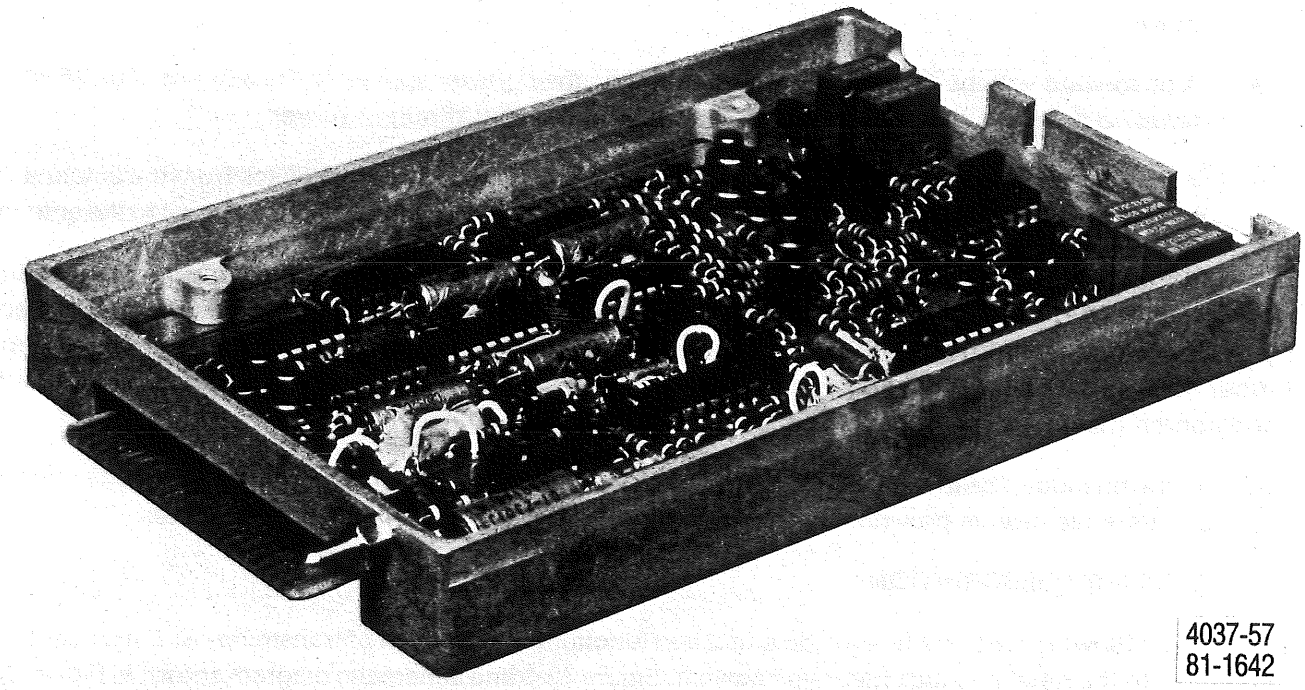
Figure 12-9. Receiver Circuit Card 1A5A2 Parts Location (Sheet 2 of 2)

SECTION 13

TRANSMITTER ALC 1A6

13-1. PURPOSE AND GENERAL DESCRIPTION

13-2. The transmitter alc module 1A6, shown in Figure 13-1, performs multiple functions. One of the primary functions is automatic level control (alc) of the transceiver power output. This is accomplished by controlling the attenuation of voltage controlled attenuator 1A10. The module also routes the incoming audio from the handset or beacon signal generator to the am or fm circuitry depending on the modulation mode selected. In addition, the board receives and provides various operating signals depending upon the operational mode of the PET system.



4037-57
81-1642

Figure 13-1. Transmitter ALC 1A6

13-3. The transmitter alc module operates in the transmit mode and is inhibited in the receive mode. The primary circuits of the module, shown in the simplified block diagram located in Figure 13-2, include a beacon signal generator, modulation switch logic, and power control network. The beacon signal is activated from the control unit front panel. The beacon signal generator provides a constant repetitive signal to the modulation switch. Either am or fm can be selected for the transceiver beacon signal output.

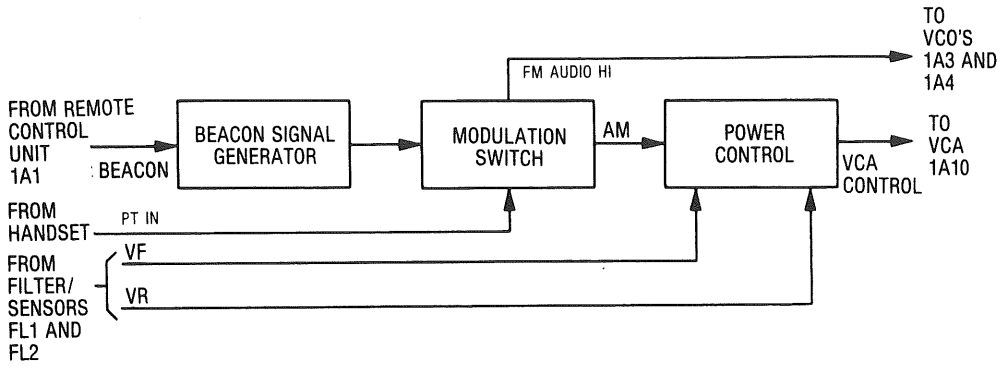


Figure 13-2. Transmitter ALC 1A6 Simplified Block Diagram

13-4. The modulation switch accepts normal audio from the handset when the beacon is off. The input is switched to provide either an am or fm output. The am output is applied to the power control network. The power control provides a vca dc control signal (0-15 Vdc) with an audio component superimposed in the am mode. The nominal level of the control signal is derived from the comparison of three voltages as follows:

- A dc voltage from R49 and R134 that tends to increase the control voltage which increases the rf output power.
- A dc forward voltage (VF) which is proportional to the rf power applied to the antenna. The VF voltage tends to decrease the control voltage thus decreasing the rf output power.
- A dc reflected voltage (VR) which is proportional to the rf power reflected back from the antenna. The VR voltage decreases the control voltage which results in a large decrease in rf power to the antennas.

The VF and VR voltages are derived by filter-sensors 1FL1 and 1FL2 (vhf and uhf). During normal operation, the dc voltage from R49 and R134 increases the output power of the transmitter until the power output selected by the PWR HI/LO control setting is reached (Table 4-4). At this time the VF voltage from the sensor offsets any further increase in the control voltage (VR is negligible). Voltage VR appears when there is an abnormal condition on the antenna port such as no antenna or a broken antenna.

13-5. In the fm mode, the fm audio output from the modulation switch is applied directly to the vhf or uhf vco, and a dc reference level is provided at the vca control output to maintain constant rf power.

13-6. DETAILED DESCRIPTION

13-7. The following paragraphs provide a detailed functional description of transmitter ALC module 1A6 as referenced to the detailed block diagram shown in Figure 13-3 and schematic diagram shown in Figure 13-5.

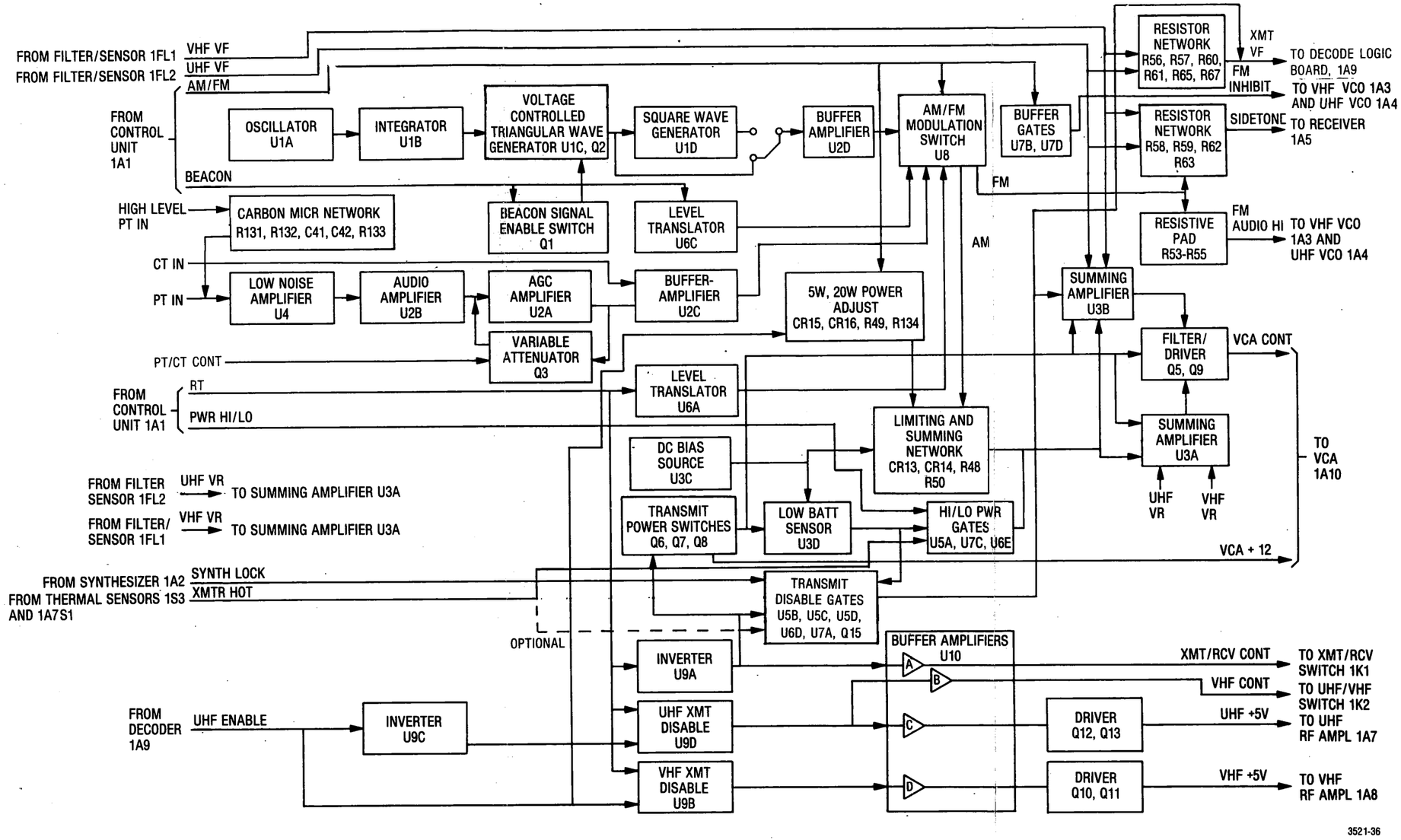


Figure 13-3. Transmitter ALC 1A6 Detailed Block Diagram

13-8. R/T ENABLE. Either a low (0 vdc) level corresponding to transmit or a high (+5 vdc) level corresponding to receive is applied to the ALC module over the R/T input at pin P1-13B. When a low transmit level is applied, lows are supplied to non-inverting amplifier U6A, and gates U9A, U9B, and U9D. The low at the input of U9A provides a high to gate U5C to enable the synthesizer lock function. The high is also applied to buffer U10A which then provides a high XMT/RCV CONT level to the transmit/receive switch K1 placing it in the transmit mode. Diode CR11, located on the output side of U10A, is used for reverse voltage protection. In addition, the high from U9A turns on transistor Q8, which subsequently turns on transistors Q6 and Q7. Transistor Q7 provides the +28V-XMT power for distribution within the ALC module. Transistor Q6 turns on the VCA +12V output at pin P1-6B which is used to activate VCA 1A10.

13-9. When the ALC module receives a high at the R/T input at P1-13B (receive mode), modulation switch U8 is inhibited, and gates U5C, U9B and U9D are disabled preventing the ALC module from operating. A low at the XMT/RCV control output at P1-14A is then provided to switch K1 placing it into the receive mode.

13-10. UHF/VHF ENABLE. A low R/T input signal also controls the enabling of either the UHF +5V or VHF +5V output signals at pins P1-16A and P1-15A depending on whether a uhf or vhf frequency is selected at the control unit. These signals activate their respective rf amplifier (1A7 or 1A8). The rf amplifier selected depends on the condition of the UHF ENABLE input at pin P1-16B. If uhf is selected at the control unit, a high is received, signifying a uhf enable. A low is then generated by gate U9C which in turn causes gate U9D to generate a high through buffer U10C to the base of Q12. A high is also applied through buffer U10B and out the VHF CONT output at pin P1-15B to place the external vhf/uhf switch K2 in the uhf transmit mode. The high at the base of Q12 turns on transistor Q13 which in turn generates a UHF +5V output at pin P1-16A. This signal is used to activate uhf rf amplifier 1A7. At the same time, the low generated by gate U9B turns off transistors Q10 and Q11 and causes a low VHF +5V output at pin P1-15A. This level disables vhf rf amplifier 1A8.

13-11. If vhf is selected, a high is placed on the VHF +5V output at pin P1-15A enabling vhf rf amplifier 1A8. A low VHF CONT signal at pin P1-15B also places vhf/uhf switch K2 in the vhf mode. This then causes the UHF +5V output to go low disabling uhf rf amplifier 1A7.

13-12. PLAIN TEXT AUDIO INPUT. An audio level of approximately 0.6 mVrms from the handset is fed into the transmitter alc module over the PT IN input at pin P1-8A. Audio can also be applied from the test/remote connector J2 over the HI LEVEL PT IN input at pin P1-4A. The signals are routed through low noise amplifier U4, audio amplifiers U2A and U2B and buffer amplifier U2C. Amplifier U4 amplifies the 0.6 mVrms to 16.3 mVrms (46 mV peak-to-peak) at 1.0 kHz. The output of amplifier U4 is fed to amplifier U2B where the audio signal is again amplified to 1.35 volts peak-to-peak. Like U4, amplifier U2B uses capacitive feedback to attenuate noise and high frequencies. The output of U2B is fed through a variable attenuator network consisting primarily of resistor R26 and diode CR3 (the diode performs as a resistor) to audio amplifier U2A. The attenuator network drops the U2B output to approximately 650 mV peak-to-peak, which is amplified to 5.2 volts peak-to-peak by amplifier U2A.

13-13. The audio output of U2A is applied to the variable attenuator control transistor Q3. Increasing the current through CR3 lowers its effective resistance and the audio voltage applied to Q3 increases, and reduces the effective drive to U2A. As the audio output of U2A decreases, Q3 supplies less current to CR3 thereby increasing the effective resistance of diode CR3. The increased resistance then provides more drive to U2A. In this manner, the variable attenuator network maintains the audio output of U2A at a constant 1.84 Vrms. A portion of the audio output of U2A is tapped by adjustable resistor R111 to provide an input of 0.75V peak-to-peak to buffer amplifier U2C. An audio output of 1.6 Vrms peak-to-peak is then provided from the buffer amplifier to analog switch U8. This results in an output, in the FM mode, of 100 mv rms with a load of 1.5 K ohms. At the 100 mv level the deviation in vhf is ±4 kHz, and uhf is ±8 kHz. In the AM mode the modulation will be 70%.

13-14. The function of analog switch U8 is to provide either am or fm outputs (X and Y respectively) based on BEACON and AM/FM input signals as selected from the RCU front panel. The BEACON switch input is routed through level converter (+5V to +12V) U6C to the B input of U8. The AM/FM input is applied to the A input of U8. Signals received from the control unit are as follows:

Signal	Level	Mode	Pin
Beacon	+5V (+12V)	OFF	P1-3A
	+0V	ON	P1-3A
AM/FM	+12V	FM	P1-2A
	+0V	AM	P1-2A

Switch U8 is either inhibited or enabled by the R/T input from P1-13B through U6A. When this input is in the receive mode (high), a +12V level is applied inhibiting U8 which prevents any audio signal presented at the X and Y inputs from appearing at the U8 outputs. When in the transmit mode (low), a ground level is applied enabling U8 outputs. Complete operating modes of switch U8 including inputs and outputs are as follows:

	U8 Inputs		U8 Outputs	
Inhibit	B	A	Switch "On"	Signal
0V	0V	0V	X	Beacon - AM
0V	0V	+12V	Y	Beacon - FM
0V	+12V	0V	X	XMT - AM
0V	+12V	+12V	Y	XMT - FM
+12V	X	X	None	RCV

The AM/FM control signal is also routed through buffer gates U7D and U7B to provide a low FM INHIBIT output at P1-13A to the vco's when the am mode is selected.

13-15. CIPHER TEXT AUDIO INPUT. The cipher text signal from the receiver module 1A5 is fed into the transmitter alc module over the XMT CT input at pin P1-2B. The signal is routed through buffer amplifier U2C. The output of U2C is processed the same as plain text signals.

13-16. When cipher text is selected, a low (0V) is placed on the PT/CT CONT input at pin P1-3B. This low drives Q3 fully on and turns attenutor diode CR3, fully on for maximum attenuation. This improves the transmit signal-to-noise ratio in the cipher text mode by effectively bypassing the high gain stages, U4 and U2B.

13-17. BEACON. The transceiver automatically enters the transmit mode when the beacon mode is selected. The beacon may be operated in the am or fm modes and at either a high or low power setting. The beacon circuit consist of oscillator U1A, integrator U1B, voltage-controlled triangular-wave generator U1C and Q2, and square wave generator U1D. The beacon circuit is energized by enable switch Q1 which controls the dc power to U1. The beacon is turned on when a low is applied at P1-3A by setting the BEACON/NORM switch on the control unit to the BEACON position.

13-18. Waveforms generated by each stage of the beacon circuit are shown in Figure 13-4. During operation, Q1 applies the dc power to U1. The pulsed output of fixed frequency oscillator U1A is applied to integrator U1B which converts the pulse pattern to triangular waveforms. The combination of U1C, U1D, and Q2 act as a voltage-controlled oscillator with the output of integrator U1B as the control voltage. The output frequency of U1C increases from approximately 300 Hz to 1 kHz as the control voltage goes from 0V to 4.4V. The triangular

waveform output of U1C is applied to U1D where it is converted to a square wave. The final output of the beacon stage is through buffer stage U2D which provides a constant peak-to-peak waveform to switch U8. Either the square wave or the triangular wave output may be selected for application to buffer stage U2D. For the square wave input, a jumper is installed between connections 4 and 6 on the alc board. For the triangular wave input, a jumper is installed between 5 and 6. The two jumper connections change the transmitted audio tone of the beacon signal.

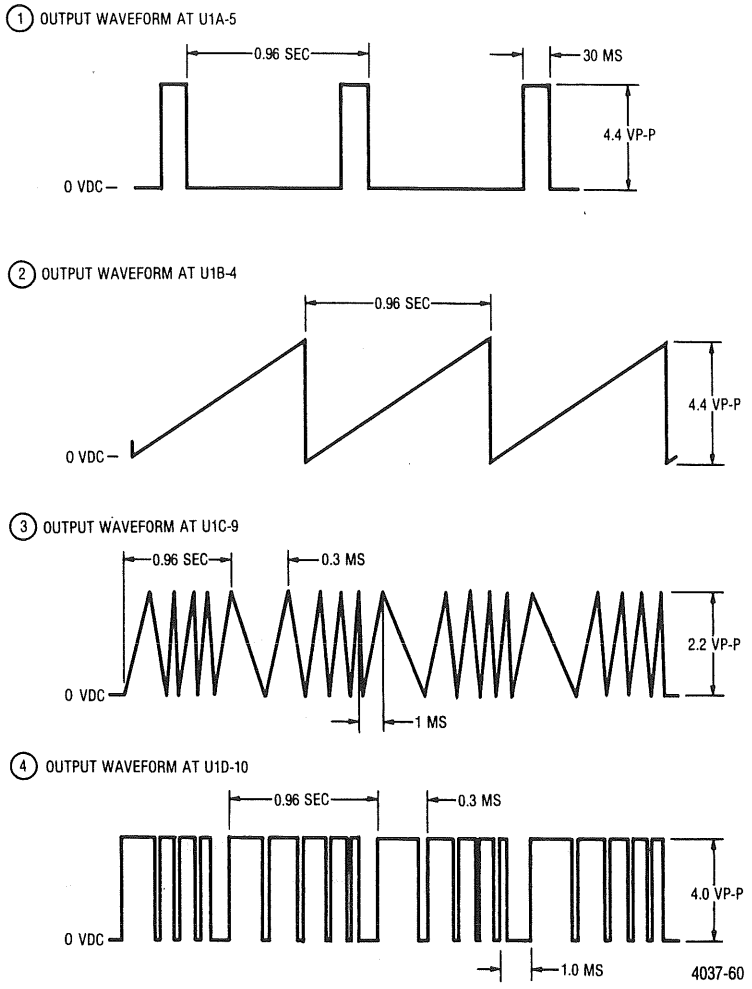


Figure 13-4. Beacon Signal Generator Output Waveforms

13-19. ALC POWER LOOP. Automatic level control of the output rf power is provided by vca (voltage controlled attenuator) module 1A10. The transmitter alc module provides the VCA CONT signal at pin P1-19B to the vca. Amplifiers U3A and U3B process various inputs to determine the control voltage level. This level is applied to drivers Q5 and Q9 before being fed to the vca module.

13-20. The rf output is initially set at 5 watts by adjusting variable resistor R49 with no am modulation. The voltage reference for R49 is VR1 zener voltage buffered by unity gain amplifier U3C. The wiper arm voltage of R49 is applied to summing amplifier U3B which increases the voltage before being fed to the vca by drivers Q5 and Q9. The voltage from R49 tends to increase the output rf power. The tendency is counterbalanced by a forward voltage (VF) feedback signal which is proportional to the output power. Resistor R49 is adjusted to a level that, when counterbalanced by VF, provides 5 watts of power to the antenna.

13-21. While R49 is the 5 watt adjustment, R134 is the 20 watt adjustment for the FM UHF channels only. When the transceiver is in VHF AM or FM, or when the transceiver is in UHF AM, diodes CR15 and CR16 are turned on thereby shunting the resistance of R134. When the transceiver is in UHF FM, then both CR15 and CR16 are turned off and the resistance of R134 is placed in series with R49. The voltage on the arm of R49 will now increase thereby increasing the voltage to the summing amplifier U3B. This increased voltage allows the transmitter output to go from 5 watts to 20 watts.

13-22. The VF voltage is routed from either vhf filter/power sensor 1FL1 in the VHF mode or uhf filter/power sensor 1FL2 in the UHF mode. Not only do 1FL1 and 1FL2 generate VF voltages proportional to the power delivered to the antennas, they also generate VR voltages proportional to the powers reflected back from the antennas. The VR voltage is applied to summing amplifier U3A. Under normal operating conditions, VR is very low and close to zero volts corresponding to very little power being reflected back from the antennas. With these conditions, U3A does not affect the nominal VCA CONT signal voltage of approximately 8 volts for a 5 watt output from U3B. Under abnormal conditions, VR increases causing the output of U3A to decrease. If VR becomes large enough, the output of U3A becomes less than U3B and forward biases CR6. The net effect is to attenuate the output of U3B as seen by Q5 which results in a lower VCA CONT voltage. The lower voltage increases the rf attenuation reducing the rf signal drive to the antenna until the abnormal conditions are corrected. Variable resistors R68 and R74 control the uhf and vhf reflected voltage thresholds at which amplifier U3A begins to offset the rf power.

13-23. High or low transmitter power (1.5/5 watts or 5/20 watts) is controlled by R49 or R134 as previously described by controlling high/low power gates U5A, U7C, and U6E. When R49 and R134 are adjusted for 5 watts and 20 watts, the PWR HI/LO input at pin P1-10B goes high. This input is inverted by U5A and summed with the low battery sensor output (see paragraph 13-24) then inverted again by U7C. The high output of U7C causes an open at the output of U6E thereby allowing all the signal from R49 or R134 to be applied to U3B. In the low power mode, the PWR HI/LO input is low which causes the output of U7C to be low. As a result, U6E output is also low creating a voltage divider consisting of R50 and R47. In this case, only a portion of the voltage from R49 or R134, as determined by the voltage divider, is applied to the summing amplifier. This reduces the VCA CONT voltage which in turn reduces the output power to 1.5 watts or 5 watts.

13-24. LOW BATTERY SENSOR. The low battery sensor circuit consists of inverter amplifier U3D. The amplifier operates on a reference voltage of 4.93 Vdc generated by dc bias source U3C. The amplifier monitors the primary +28 Vdc battery voltage which is dropped to a level of 6.48 Vdc across resistor R43, for input to U3D. With these conditions, a ground level (low) is supplied to the input of high/low power gate U7C. This allows normal selection of high or low transmitter power levels via the PWR HI/LO input at pin P1-10B. If degradation of the power supply voltage occurs and the 6.48V level drops below the 4.93 Vdc reference level, the output of U3D goes upward until a high is applied to the input of U7A. This forces the output of U7A low and this low is applied to the input of U5B. This will prevent the transmitter from operating during a low battery condition. (21.5 VDC)

13-25. AUDIO OUTPUT. The beacon or audio signal is provided over either the am (X) or fm (Y) output of U8, depending upon whether the am or fm mode is selected, as described in the following paragraphs.

13-26. AM Mode. When am is selected, the audio output from U8 is applied to the limiting and summing network consisting of diodes CR13 and CR14 and resistors R48 and R50. Diodes CR13 and CR14 limit the audio amplitude to prevent over-modulating the carrier. The limiter output is summed with the reference level voltage from R49 at the junction of R48 and R50. In the am mode the am audio signal is superimposed on the reference level to summing amplifiers U3A and U3B. As a result, the VCA CONT voltage varies about the initial dc setting at an audio rate which causes the vca to vary the rf attenuation at an audio rate. The end effect is an amplitude-modulated rf signal.

13-27. FM Mode. If the fm mode is selected, the FM AUDIO signal (Y output of U8) is applied through the resistance pad consisting of resistors R53 through R55 and capacitor C21 to the FM AUDIO HI output at pin P1-18A. The signal is applied directly to VHF VCO 1A3 or UHF VCO 1A4 depending on which vco is selected. A fm audio signal is also provided to receiver 1A5 through the resistor network consisting of resistors R58, R59, R62 and R63 at the SIDETONE output at pin P1-19A. Since amplitude modulation (am) is not used for the fm mode, a constant voltage is supplied over the VCA CONT output to establish a constant 5-watt power level for the fm signal.

13-28. SYNTHESIZER LOCK. The synthesizer lock function prevents the transmitter from operating when the synthesizer is not in a lock condition (refer to Section 9). The circuit consists of gates U5C, U5D, U5B, and non-inverting amplifier U6D. Under normal operating conditions (synthesizer locked) a high is present at the SYNTH LOCK input at pin P1-14V and a low is present at the output of U6D. This allows normal operation of summing amplifier U3B based upon its other inputs. If a synthesizer goes out of lock, the SYNTH LOCK input goes low causing the output of U6D to go high. The high output at U6D forces amplifier U3B output to the base of Q5 to go low. The VCA CONT output then goes low causing VCA 1A10 to go into a maximum attenuation mode.

13-29. THERMAL PROTECTION. Thermal sensor S3 mounted on the transceiver chassis, and the thermal sensor S1 mounted on the UHF amplifier module (1A7) protects the transmitter portion of the transceiver from possible damage caused by overheating. This is accomplished when the operating temperature of the transmitter goes above approximately 104° C, the sensors will clamp the XMTR HOT input at pin P1-11B to ground. The thermal protection circuit can be jumpered on the ALC board to either shut down the transmitting capabilities or force the transmitter into a low power mode. The jumper is installed between board connections 3 and 2 for low power control and connections 3 and 1 for shutting down the transmitter. If the low power is selected, the circuit operates the same as in the power high/low circuit by applying a low to the input of gate U5A. If transmitter shut down is selected, the circuit operates the same as the synthesizer lock function by applying a low to the input of gate U5B. The thermal switches reset automatically to allow normal operation when the temperature returns to approximately 88° C.

13-30. TRANSMITTER ALC MAINTENANCE AND TROUBLESHOOTING

13-31. After a malfunction is isolated to the transmitter ALC, remove the module from the transceiver as instructed in Section 5, paragraph 5-32. Reconnect the ALC module to the transceiver using extender card 01-P07207L001. Troubleshoot the ALC module in reference to the waveforms and voltage levels shown on the schematic diagram, Figure 13-5. Replace defective components using parts locating diagram, Figure 13-6, as a guide.

13-32. ADJUSTMENT OF VARIABLE COMPONENTS. Adjust the variable components for the following indications:

a. See Section 4, paragraph 4-42 for the proper adjustments of R49 and R134.

b. See Section 4, paragraph 4-43 through 4-45 for the proper adjustments of R68 and R74.

c. See Section 4, paragraph 4-47 for the proper adjustment of R111.

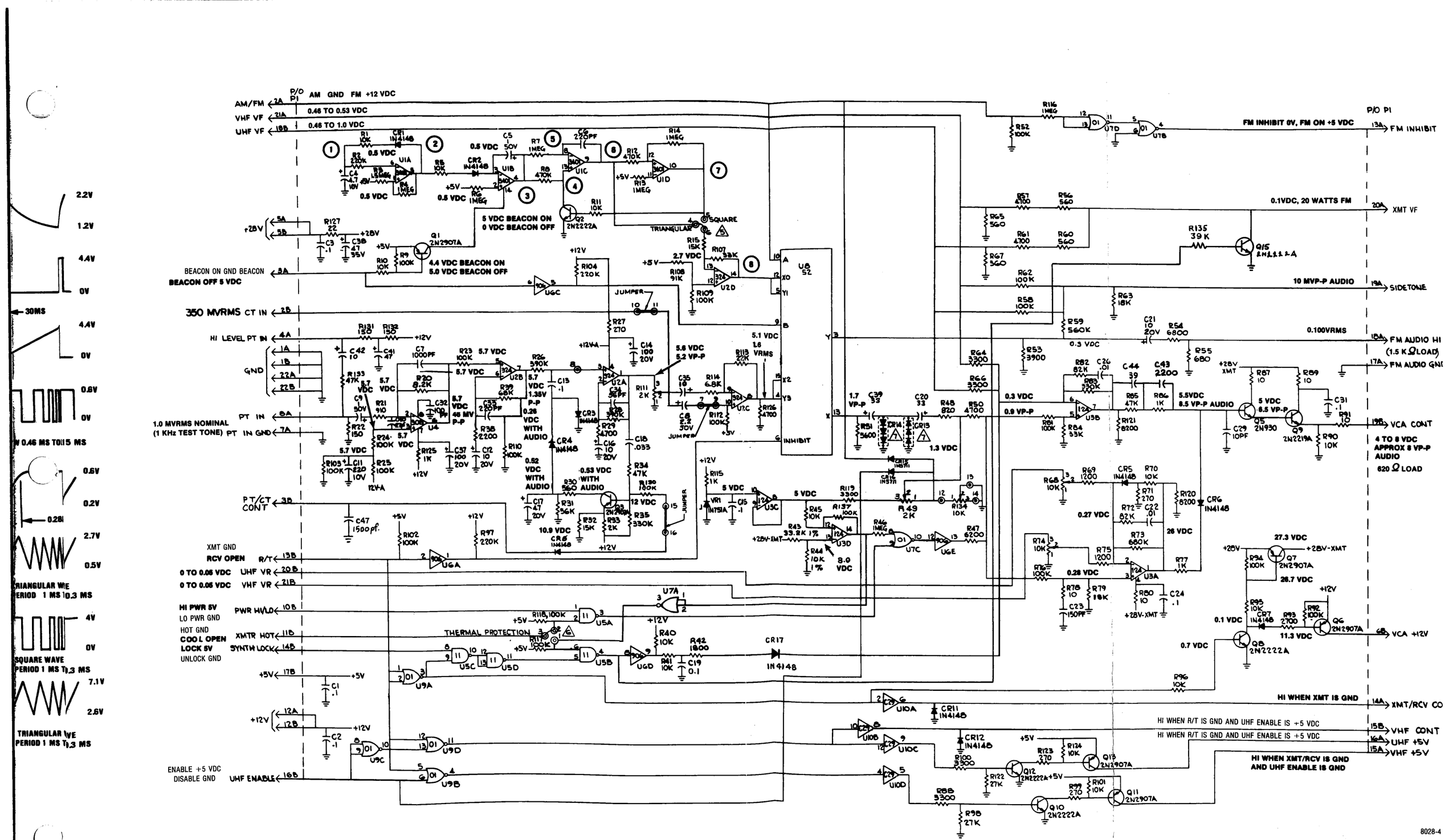


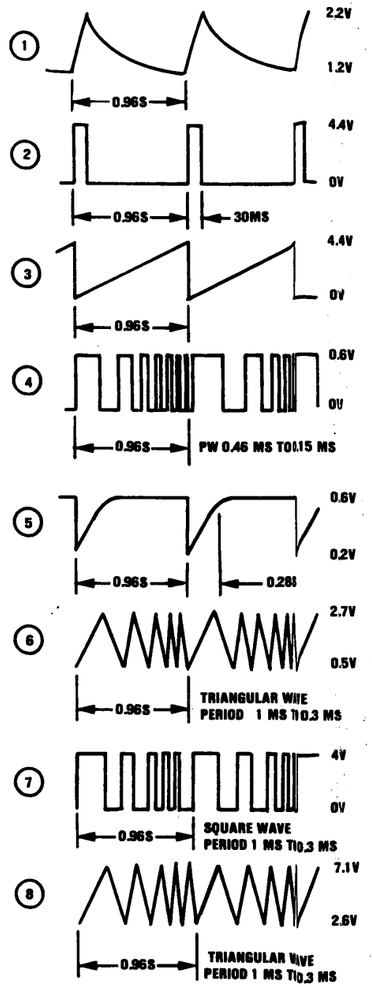
Figure 13-5. Transmitter ALC 1A6 Schematic Diagram

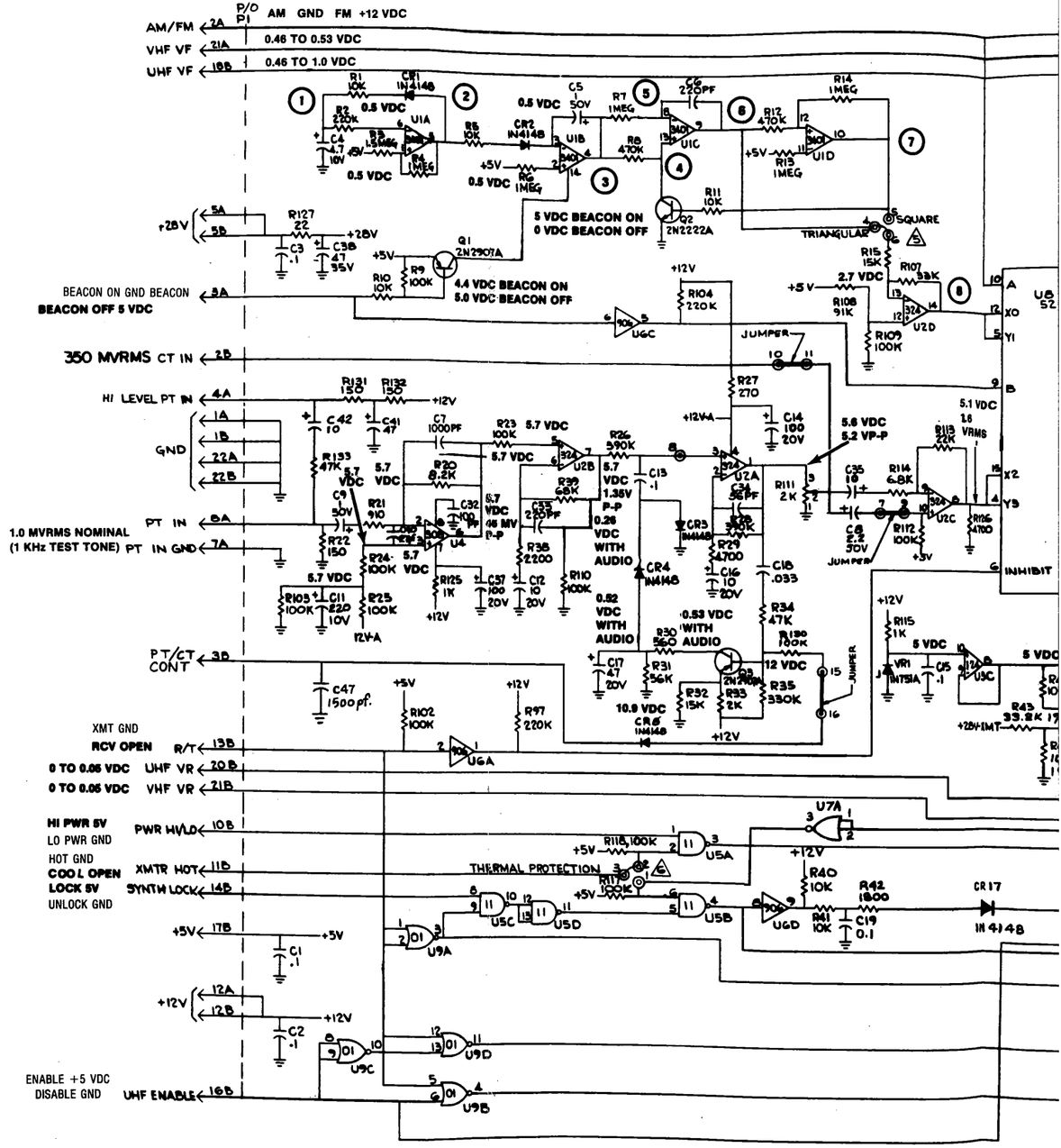
NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A6.
2. FOR REFERENCE DRAWING REFER TO; 01-P04565L003 ASSEMBLY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, ±5 PCT, 1/4 WATT.
   ALL CAPACITORS ARE IN UF.
   ALL VOLTAGES ARE DC.
4. INTEGRATED CIRCUIT DEVICES ARE IDENTIFIED ON THE DRAWING BY THE UNDERLINED PORTION OF THE TYPE NUMBER LISTED IN TABLE. PINS NOT SHOWN ON DRAWING ARE SPECIFIED IN TABLE.

REF DES	DEVICE TYPE	+5	+12V	GND	NO CONNECTION
U1	MC3401P	--	--	7	
U2	LM324N	--	--	11	
U3	LM124N	--	--	11	
U4	LM308N	--	--	4	1,5
U5	MC14011BCP	14	--	7	
U6	MM74C906N	14	--	7	3,4,10,11
U7	MC14001BCP	14	--	7	1,2,3
U8	MC14052BCP	--	16	7,8	1,2,11,14
U9	MC14001BCP	14	--	7	
U10	MM88C29N	14		7	1,3,11,13

5. CONNECTION BETWEEN 6 AND 4 OR 6 AND 5 DETERMINE SOUND CHARACTERISTICS IN BEACON MODE. 4 AND 6 ARE CONNECTED AT FACTORY.
6. THERMAL PROTECTION OPTIONS:
   A. 3 CONNECTED TO 1 PREVENTS RF TRANSMISSION AT HIGH TEMPERATURE.
   B. 3 CONNECTED TO 2 REDUCES TRANSMITTED POWER TO LO POWER.
   3 IS CONNECTED TO 2 AT FACTORY.
7. MOTOROLA PART NO. 48-83329G04.
8. **VOLTAGE AND CURRENT LEVELS ARE NOMINAL VALUES FOR CONDITIONS STATED.**





PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04565L003	TRANSMITTER ALC	
001	1	94990	01-P04565L040	PWB ALC ASSY	UNIVERSAL
002	1	94990	27-P07099L001	FRAME,TRANSMITTER	
003	4		MS51957-14	SCREW	4-40X5/16
004	4		NAS620C4L	WASHER	NO.4
005	1		22-P07123L001	GUIDE PIN	
006	4		MS35338-135	WASHER	NO.4
007	1		MS21042L04	NUT	.112-40
C1-C3	3		M39014/02-1391	CAPACITOR	.1UF-10-100
C 004	1		M39003/01-2254	CAPACITOR	4.7UF-10-10
C 005	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 006	1		CM04FD221J03	CAPACITOR	220PF-5-500
C 007	1		M39014/01-1397	CAPACITOR	1000PF-10-200
C 008	1		M39003/01-2283	CAPACITOR	2.2 F-10-20
C 009	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 011	1		M39003/01-2265	CAPACITOR	220UF-10-10
C 012	1		M39003/01-2286	CAPACITOR	10UF-10-20
C 013	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 014	1		M39003/01-2289	CAPACITOR	15UF-10-20
C 015	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 016	1		M39003/01-2286	CAPACITOR	10UF-10-20
C 017	1		M39003/01-2295	CAPACITOR	47UF-10-20
C 018	1		M39014/02-1385	CAPACITOR	.033UF-10-100
C 019	1		M39014/02-1390	CAPACITOR	0.1UF-10-200
C020	1		M39003/01-2292	CAPACITOR	33UF-10-20
C 021	1		M39003/01-2286	CAPACITOR	10 F-10-15
C 022	1		M39014/02-1378	CAPACITOR	.01UF-10-200
C 023	1		CM04FD151J03	CAPACITOR	150PF-5-500
C 024	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 026	1		M39014/02-1378	CAPACITOR	.01UF-10-200
C042	1		M39003/01-2286	CAPACITOR	10UF-10-20
C 029	1		CM04CD100D03	CAPACITOR	10PF-.5PF-500
C 031	1		M39014/02-1391	CAPACITOR	.1UF-10-100
C 032	1		CM04FD101J03	CAPACITOR	100PF-5-500
C 033	1		CM04FD221J03	CAPACITOR	220PF-5-500
C 034	1		CM04ED560J03	CAPACITOR	56PF-5-500
C 035	1		M39003/01-2286	CAPACITOR	10 F-10-20
C 037	1		M39003/01-2295	CAPACITOR	47UF-10-20
C 038	1		M39003/01-2312	CAPACITOR	47UF-10-35
C 039	1		M39003/01-2292	CAPACITOR	33UF-40-20
C 040	1		CM04ED270J03	CAPACITOR	27PF-5-500
C 041	1		M39003/01-2295	CAPACITOR	47 F-10-20
C 043	1		M39014/02-B26	CAPACITOR	2200PF-10-200
C 044	1		CM04ED390J03	CAPACITOR	39PF-5-500
C047			M39014/02-1322	CAPACITOR	1500pf-10-200
CR1-8	8		JAN1N4148	DIODE	
CR011	1		JAN1N4148	DIODE	
CR012	1		JAN1N4148	DIODE	
CR013	1	01537	48-83329G04	DIODE	
CR014	1	01537	48-83329G04	DIODE	
CR15,16	2		1N5711	DIODE	
CR17	1		JAN1N4148-1		
Q 001	1		JAN2N2907A	TRANSISTOR	
Q 002	1		JAN2N2222A	TRANSISTOR	
Q 003	1		JAN2N2907A	TRANSISTOR	
Q 005	1		JAN2N930	TRANSISTOR	
Q 006	1		JAN2N2907A	TRANSISTOR	
Q 007	1		JAN2N2907A	TRANSISTOR	
Q 008	1		JAN2N2222A	TRANSISTOR	
Q 009	1		JAN2N2219A	TRANSISTOR	
Q 010	1		JAN2N2222A	TRANSISTOR	
Q015	1		JAN2222A	TRANSISTOR	

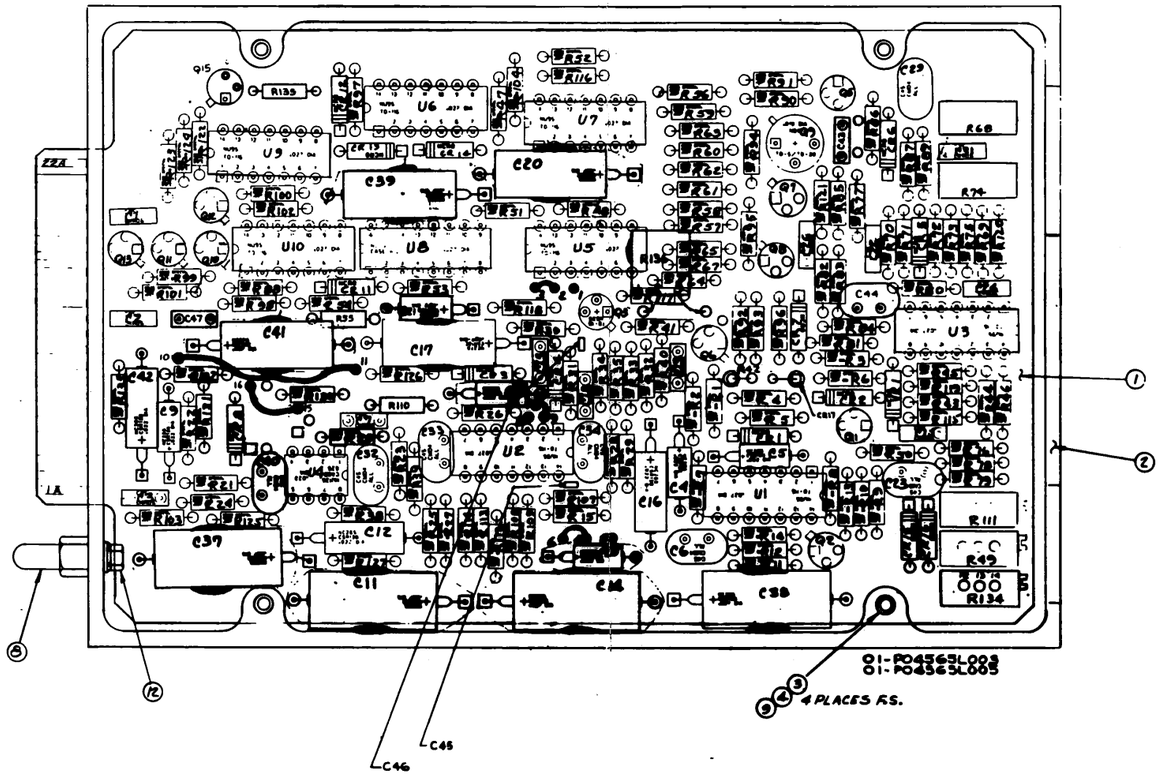


Figure 13-6. Transmitter ALC 1A6 Parts Location Diagram (Sheet 1 of 2)

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
Q 011	1		JAN2N2907A	TRANSISTOR	
Q 012	1		JAN2N2222A	TRANSISTOR	
Q 013	1		JAN2N2907A	TRANSISTOR	
R 001	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 002	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 003	1		RCR07G155JS	RESISTOR	1.5M-5-1/4
R 004	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 005	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 006	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 007	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 008	1		RCR07G474JS	RESISTOR	470K-5-1/4
R 009	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 010	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 011	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 012	1		RCR07G474JS	RESISTOR	470K-5-1/4
R 013	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 014	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 015	1		RCR07G153JS	RESISTOR	15K-5-1/4
R 020	1		RCR07G822JS	RESISTOR	8.2K-5-1/4
R 021	1		RCR07G911JS	RESISTOR	910-5-1/4
R 022	1		RCR07G151JS	RESISTOR	150-5-1/4
R23-25	3		RCR07G104JS	RESISTOR	100K-5-1/4
R 026	1		RCR07G394JS	RESISTOR	390K-5-1/4
R 027	1		RCR07G271JS	RESISTOR	270-5-1/4
R 028	1		RCR07G394JS	RESISTOR	390K-5-1/4
R 029	1		RCR07G472JS	RESISTOR	4700-5-1/4
R 030	1		RCR07G561JS	RESISTOR	560-5-1/4
R 031	1		RCR07G563JS	RESISTOR	56K-5-1/4
R 032	1		RCR07G153JS	RESISTOR	15K-5-1/4
R 033	1		RCR07G202JS	RESISTOR	2000-5-1/4
R 034	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 035	1		RCR07G334JS	RESISTOR	330K-5-1/4
R 038	1		RCR07G222JS	RESISTOR	2200-5-1/4
R 039	1		RCR07G683JS	RESISTOR	68K-5-1/4
R 040	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 041	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 042	1		RCR07G182JS	RESISTOR	1.8K-5-1/4
R 043	1		RCR07G823JS	RESISTOR	82K-5-1/4
R 044	1		RCR07G333JS	RESISTOR	33K-5-1/4
R 045	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 046	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 047	1		RCR07G622JS	RESISTOR	6200-5-1/4
R 048	1		RCR07G821JS	RESISTOR	820-5-1/4
R 049	1		RT22C2X202	RESISTOR	2000-5-3/4
R 050	1		RCR07G472JS	RESISTOR	4700-5-1/4
R 051	1		RCR07G562JS	RESISTOR	5600-5-1/4
R 052	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 053	1		RCR07G392JS	RESISTOR	3900-5-1/4
R 054	1		RCR07G682JS	RESISTOR	6800-5-1/4
R 055	1		RCR07G681JS	RESISTOR	680-5-1/4
R 056	1		RCR07G561JS	RESISTOR	560-5-1/4
R 057	1		RCR07G472JS	RESISTOR	4700-5-1/4
R 058	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 059	1		RCR07G564JS	RESISTOR	560K-5-1/4
R 060	1		RCR07G561JS	RESISTOR	560-5-1/4
R 061	1		RCR07G472JS	RESISTOR	4700-5-1/4
R 062	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 063	1		RCR07G183JS	RESISTOR	18K-5-1/4
R 064	1		RCR07G332JS	RESISTOR	3300-5-1/4
R 065	1		RCR07G561JS	RESISTOR	560-5-1/4
R 067	1		RCR07G561JS	RESISTOR	560-5-1/4
R 068	1		RT22C2X103	RESISTOR	10K-5-3/4
R 069	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 070	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 071	1		RCR07G271JS	RESISTOR	270-5-1/4
R 072	1		RCR07G823JS	RESISTOR	82K-5-1/4
R 073	1		RCR07G684JS	RESISTOR	680K-5-1/4
R 074	1		RT22C2X103	RESISTOR	10K-5-3/4
R 075	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 076	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 077	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 078	1		RCR07G100JS	RESISTOR	10-5-1/4
R 079	1		**RCR07G183JS**	RESISTOR	**18K-5-1/4**
R 080	1		RCR07G100JS	RESISTOR	10-5-1/4
R 081	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 082	1		RCR07G823JS	RESISTOR	82K-5-1/4
R 083	1		RCR07G334JS	RESISTOR	330K-5-1/4
R 084	1		RCR07G333JS	RESISTOR	33K-5-1/4
R 085	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 086	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 087	1		RCR07G100JS	RESISTOR	10-5-1/4
R 088	1		RCR07G332JS	RESISTOR	3300-5-1/4
R 089	1		RCR07G100JS	RESISTOR	10-5-1/4
R 090	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 091	1		RCR07G100JS	RESISTOR	10-5-1/4
R 092	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 093	1		RCR07G272JS	RESISTOR	2700-5-1/4
R 094	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 095	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 096	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 097	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 098	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 099	1		RCR07G271JS	RESISTOR	270-5-1/4
R 100	1		RCR07G332JS	RESISTOR	3300-5-1/4
R 101	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 102	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 103	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 104	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 107	1		RCR07G333JS	RESISTOR	33K-5-1/4
R 108	1		RCR07G913JS	RESISTOR	91K-5-1/4
R 109	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 110	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 111	1		RT22C2X202	RESISTOR	2000-5-3/4
R 112	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 113	1		RCR07G223JS	RESISTOR	22K-5-1/4
R 114	1		RCR07G682JS	RESISTOR	6800-5-1/4
R 115	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 116	1		RCR07G105JS	RESISTOR	1M-5-1/4
R 117	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 118	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 119	1		RCR07G332JS	RESISTOR	3300-5-1/4
R 120	1		RCR07G822JS	RESISTOR	8200-5-1/4
R 121	1		RCR07G822JS	RESISTOR	8200-5-1/4
R 122	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 123	1		RCR07G271JS	RESISTOR	270-5-1/4
R 124	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 125	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 126	1		RCR07G472JS	RESISTOR	4700-5-1/4
R 127	1		RCR07G220JS	RESISTOR	22-5-1/4
R 130	1		RCR07G154JS	RESISTOR	100K-5-1/4
R 131	1		RCR07G151JS	RESISTOR	150K-5-1/4
R 132	1		RCR07G151JS	RESISTOR	150-5-1/4
R 133	1		RCR07G473JS	RESISTOR	47K-5-1/4
R 134	1		RT22C2X103	RESISTOR	10K-5-3/4
R 135	1		RCR07G393JS	RESISTOR	39K-5-1/4
R 136	1		RT22C2X103	RESISTOR	10K-5-3/4
U 001	1	04713	MC3401P	INTEGRATED CIRCUIT	
U 002	1	27014	LM324N	INTEGRATED CIRCUIT	
U 003	1	27014	LM124N	INTEGRATED CIRCUIT	
U 004	1	27014	LM308N	INTEGRATED CIRCUIT	
U 005	1	04713	MC14011BCP	INTEGRATED CIRCUIT	
U 006	1	04713	MM74C906N	INTEGRATED CIRCUIT	
U 007	1	04713	MC14001BCP	INTEGRATED CIRCUIT	
U 008	1	04713	MC14052BCP	INTEGRATED CIRCUIT	
U 009	1	04713	MC14001BCP	INTEGRATED CIRCUIT	
U 010	1	04713	MM88C29N	INTEGRATED CIRCUIT	
VR001	1		JAN1N751A	DIODE	

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
01537	Motorola Communications and Electronics Inc.	2553 N. Edgington St. Franklin Park, IL 60131
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
27014	National Semiconductor Corp.	2900 Semiconductor Dr. Santa Clara, CA 95051
81095	Traid-Utrad Div. Litton Systems Inc.	118 W. 35th St. National City, CA 92050
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252

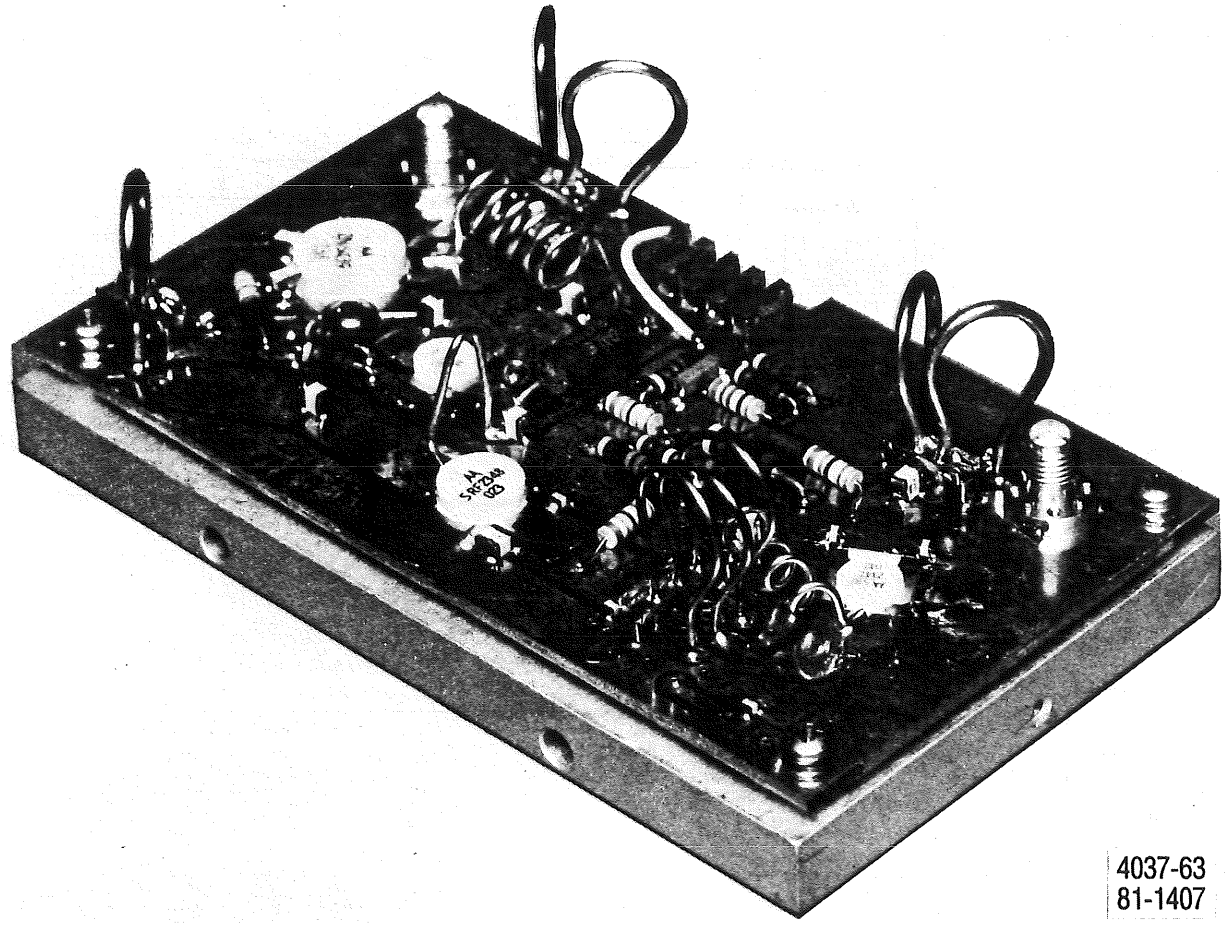
Figure 13-6. Transmitter ALC 1A6 Parts Location Diagram (Sheet 2 of 2)

SECTION 14

UHF RF AMPLIFIER 1A7

14-1. PURPOSE AND GENERAL DESCRIPTION

14-2. The uhf rf amplifier 1A7 (fig. 14-1) receives its signal input from vca 1A10 through vhf/uhf switch 1K2 and amplifies it for transmission. The amplifier provides a total gain of approximately 19 dB. The output is applied to the uhf antenna via XMT/RCV switch 1K1 and low pass filter/power sensor 1FL2. The module consists of three amplifier stages and associated impedance matching and bias networks. Basic control of the module is provided by the bias networks which are powered by the +28 VDC and VHF +5V inputs.



4037-63
81-1407

Figure 14-1. UHF RF Amplifier 1A7

14-3. DETAILED DESCRIPTION

14-4. The following paragraphs provide a detailed functional description of uhf rf Amplifier 1A7 as referenced to the block diagram shown in Figure 14-2 and schematic diagram shown in Figure 14-3.

14-5. The input signal to the amplifier module consists of a uhf signal operating in the range of 225 to 400 MHz at a level of 38 mW peak. This input signal from connector J2 is routed to the 9:1 impedance transformation network consisting of inductors L10 and L11. The purpose of this network is to transform the 50-ohm input impedance at J2 to approximately 5.6 ohms at the beginning of the microstrip (single conductor supported above a ground plane). Capacitor C3 couples the signal from the inductors to the microstrip. The inductance of the microstrip coupled with capacitors C4 and C5 match the impedance of inductors L10 and L11 to the input impedance of transistor Q1. The output signal of the Q1 stage is conditioned by bias and impedance matching networks. The bias network consists of inductor L2, capacitors C9 and C10, and resistor R3. The purpose of R3 is to cause lower "Q" while maintaining a high inductance to create a broadband amplifier. The output of Q1 is conducted over a second microstrip to the impedance transformation network consisting of inductors L12 through L14 and capacitors C12 and C14. The impedance transformation network matches the output impedance of amplifier Q1 to the Q2 amplifier input microstrip impedance. Capacitors C15 through C18 together with the inductance of the microstrip line further matches the output of the impedance transformation network to the input impedance of amplifier Q2.

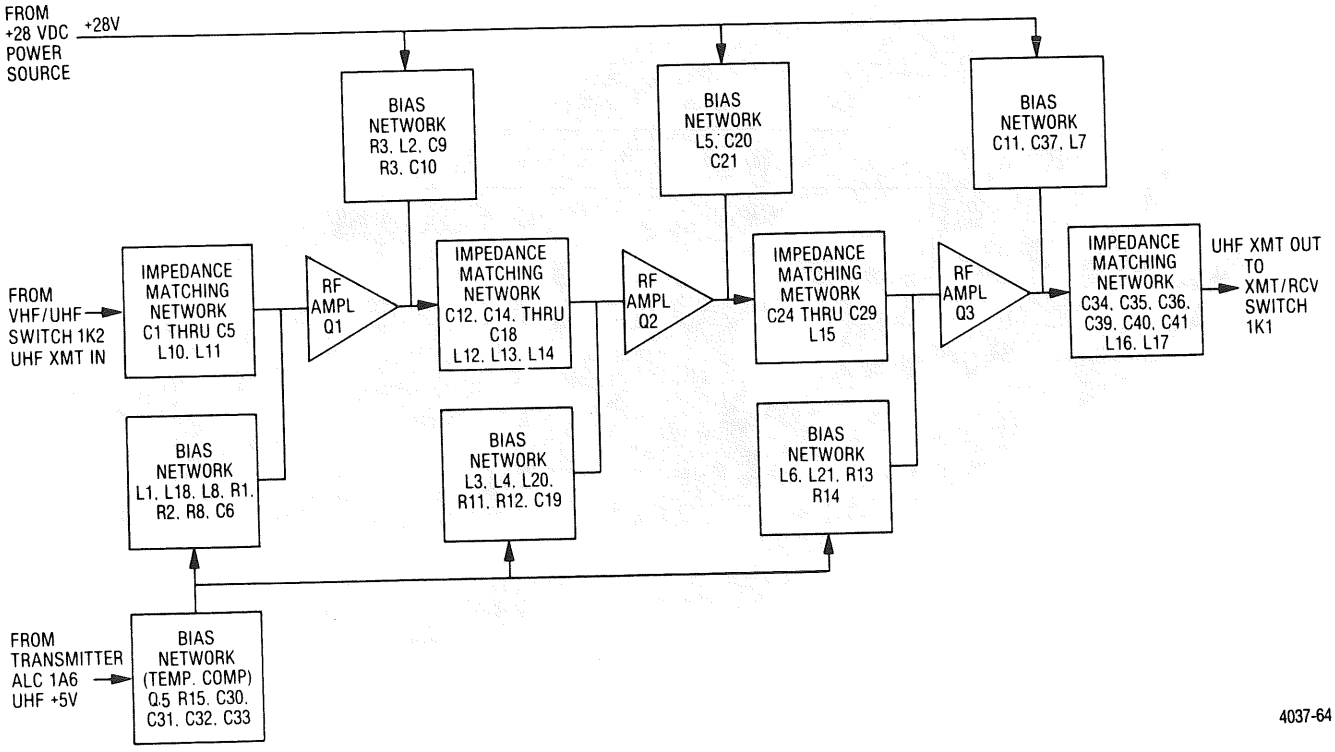


Figure 14-2. UHF RF Amplifier 1A7 Block Diagram

14-6. The collector bias of Q2 is provided through the bias network consisting of inductor L5 and capacitor C21. The rf output of amplifier Q2 is applied to an impedance transformation network composed of capacitors C24 and C25 and inductor L15 via a fourth microstrip line. The transformation network matches the output of amplifier Q3 to the input impedance of the last amplifier stage. Capacitors C26 through C29 together with the series inductance of the fifth microstrip further translates the output impedance of the transformation network to the input impedance at the base of Q3.

14-7. The output power of the third and final stage of Q3 is in the range of 5 watts average. Collector bias for Q3 is provided by a network consisting of inductor L7 and capacitors C11 and C37. The Q3 output is applied to a sixth microstrip which, together with C34 through C36, matches the output impedance of Q3 to the input impedance of transformation network L16, L17, C39, C40 and C41. This network raises the microstrip output impedance to 50 ohms at J3. The total output power of the amplifier is rated at 30W peak (44.8 dBm) at an output frequency of 225 to 400 MHz.

14-8. TEMPERATURE COMPENSATION. The temperature compensation network consists of binet (bias network) Q5 and associated bias networks connected to the input of each amplifier stage. The purpose of the network is to prevent thermal runaway of the amplifier stages. To accomplish this, the bias to the three amplifier stages is controlled by the temperature sensing of Q5, which consists of a diode with a positive temperature coefficient and other components. It is physically located near Q3 in the amplifier module since Q3 provides the most rf power and operates the warmest. When the binet senses temperature increases in the transistor amplification stages, it decreases the bias current to the transistors until temperature stability is reached, thus preventing thermal runaway.

14-9. UHF RF AMPLIFIER MAINTENANCE AND TROUBLESHOOTING

14-10. After a malfunction is isolated to the uhf rf amplifier, troubleshoot the amplifier using the waveforms and voltage levels shown on the schematic diagram, Figure 14-3. Replace defective components using parts locating diagram, Figure 14-4, as a guide.

14-11. SELECT COMPONENTS. With no rf input at J2, choose the select resistors for the following indications:

a. Select R13 to provide a 60 mAdc collector current through Q3.

b. Select R8 to provide a 25 mAdc collector current through Q1. Monitor Q1 collector current across R3.

c. Select R12 to provide a 35 mAdc collector current through Q2.

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH 1A7
2. FOR REFERENCE DRAWINGS REFER TO, 01-PD4553A,001 ASSEMBLY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, ± 5 PCT., 1/4 WATT
   ALL CAPACITORS ARE IN PF
   ALL INDUCTORS ARE IN UH
   ALL VOLTAGES ARE DC.
4. VALUES SELECTED IN TEST
5. ALL COMPONENTS NOT BEARING A VALUE OR TYPE DESIGNATION ON THE FACE OF THE DRAWING ARE LISTED IN TABLE 1.
6. —— DENOTES STRIPLINE

TABLE 1

REFERENCE DESIGNATION	MOTOROLA PART NO.
L2	24-P07149L003
L5, L22	24-P07149L008
L7	24-P07149L004
L10, L11, L16, L17	24-P08932J001
L12, L13, L14	24-P07192L002
L15	24-P07192L001
L18, L20, L21	74-15169A01

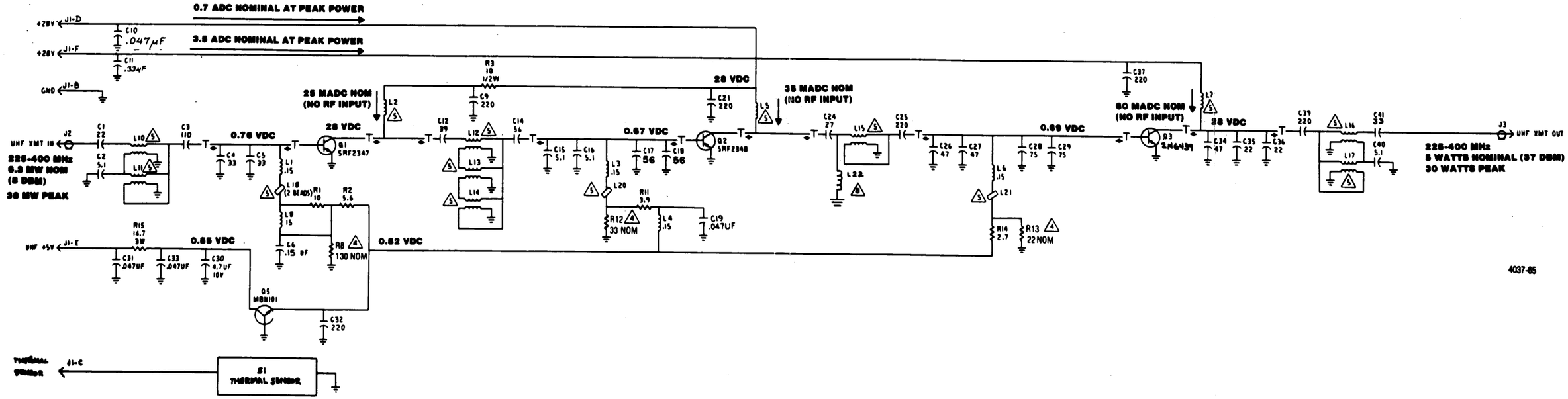


Figure 14-3. UHF RF Amplifier 1A7 Schematic Diagram

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04553L003	UHF RF AMPLIFIER ASSEMBLY	
001	1		84-P04547L001	PWB, RF AMPLIFIER	
002	1	94990	26-P08705V001	HEAT SINK	
003	4	94990	43-P06563B008	SPACER	
004	2	94990	07-P04545L002	BRACKET-XFMR	
005	1	94990	07-P04545L003	BRACKET-XFMR	
006	1	94990	07-P04545L001	BRACKET-XFMR	
007	3		MS35649-284	NUT	8-32
008	2		MS51957-14	SCREW	4-40X5 16
009	4		MS51957-15	SCREW	4-40X3 8
010	6	94990	03-15013G20	SCREW	0-80X3 16
011	6		MS35338-135	WASHER	NO 4
012	6		NAS620C4L	WASHER	NO 4
014	2		MS35338-137	WASHER	NO 8
015	2		NAS620C8	WASHER	NO 8
C 001	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 002	1	29990	ATC100A5R1CP50	CAPACITOR	5 1PF- 25PF-50
C 003	1	29990	ATC100B111JP300	CAPACITOR	110PF-5-300
C 004	1	29990	ATC100A330JP50	CAPACITOR	33PF-5-50
C 005	1	29990	ATC100A330JP50	CAPACITOR	33PF-5-50
C 006	1	94990	21-P14473A141	CAPACITOR	15UF-20-50
C009	1	29990	ATC100B331JP200	CAPACITOR	330PF-5-200
C 010	1	94990	M39014/01-1547	CAPACITOR	.047UF-10-50
C011	1	94990	M39014/02-1397	CAPACITOR	.33UF-10-50
C012	1	29990	ATC100A390JP50	CAPACITOR	39PF-5-50
C 014	1	29990	ATC100B560JP500	CAPACITOR	56PF-5-500
C 015	1	29990	ATC100A5R1CP50	CAPACITOR	5 1PF- 25PF-50
C 016	1	29990	ATC100A5R1CP50	CAPACITOR	5 1PF- 25PF-50
C 017	1	29990	ATC100B560JP500	CAPACITOR	56PF-5-500
C 018	1	29990	ATC100B560JP500	CAPACITOR	56PF-5-500
C 019	1	94990	21-P14473A135	CAPACITOR	.047UF-20-50
C021	1	29990	ATC100B331JP200	CAPACITOR	330PF-5-200
C 024	1	29990	ATC100B270JP500	CAPACITOR	27PF-5-500
C 025	1	29990	ATC100B221JP200	CAPACITOR	220PF-5-200
C 026	1	29990	ATC100A470JP50	CAPACITOR	47PF-5-50
C 027	1	29990	ATC100A470JP50	CAPACITOR	47PF-5-50
C 028	1	29990	ATC100B750JP500	CAPACITOR	75PF-5-500
C 029	1	29990	ATC100B750JP500	CAPACITOR	75PF-5-500
C 030	1		M39003/01-2254	CAPACITOR	4.7UF-10-10
C 031	1	94990	21-P14473A135	CAPACITOR	047UF-20-50
C 032	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C 033	1	94990	21-P14473A135	CAPACITOR	047UF-20-50
C 034	1	29990	ATC100A470JP50	CAPACITOR	47PF-5-50
C 035	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 036	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 037	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C 039	1	29990	ATC100B221JP200	CAPACITOR	220PF-5-200
C 040	1	29990	ATC100A5R1CP50	CAPACITOR	5 1PF- 25PF-50
C 041	1	29990	ATC100B330JP500	CAPACITOR	33PF-5-500
C 042	1	29990	ATC 100B120JP500	CAPACITOR	12PF-5-500
J1B-F	5	00779	85493-3	RECEPTACLE	
J2,J3	2	94990	28-P14486A302	CONNECTOR	
L 001	1		MS75083-3	COIL	15UH
L 002	1	94990	24-P07198L003	COIL	
L2,L4	2		MS75083-3	COIL	15UH
L 005	1	94990	24-P07198L006	COIL	
L 006	1		MS75083-3	COIL	15UH
L 007	1	94990	24-P07198L004	COIL	
L 008	1		MS75084-14	COIL	15UH
L 010	1	94990	24-P08932J001	TRANSFORMER	
L 011	1	94990	24-P08932J001	TRANSFORMER	
L12-15	4	94990	24-P07192L002	COIL	
L 016	1	94990	24-P08932J001	TRANSFORMER	
L 017	1	94990	24-P08932J001	TRANSFORMER	
L 018	2	94990	74-15169A01	FERRITE BEAD	
L 020	1	94990	74-15169A01	FERRITE BEAD	
L 021	1	94990	74-15169A01	FERRITE BEAD	
L022	1		24-P07198L008	COIL	
Q 001	1	04713	SRF2347	TRANSISTOR	
Q 002	1	04713	SRF2348	TRANSISTOR	
Q 003	1	04713	2N6439	TRANSISTOR	
Q 005	1	04713	MBN101	BINET	
R 001	1		RCR07G100JS	RESISTOR	10-5-1/4
R 002	1		RCR07G5R6JS	RESISTOR	5.6-5-1/4
R 003	1		RCR20G100JS	RESISTOR	10-5-1/2
R008	AR		RCR07G131JS	RESISTOR	130-5-1/4 NOM
R011	1		RCR07G3R9JS	RESISTOR	3.9-5-1/5
R012	AR		RCR07G330JS	RESISTOR	33-5-1/4 NOM
R013	AR		RCR07G220JS	RESISTOR	22-5-1/4 NOM
R014	1		RCR07G2R7JS	RESISTOR	2.7-5-1/4XM
R015	1		RW79U14R7F	RESISTOR	
S001	1	82647	3BTF3-45	THERMAL SWITCH	

PARTS SUPPLIERS

Code Ident.	Name	Address
00779	AMP Inc	P O Box 3608 Harrisburg, PA 17105
04713	Motorola Inc Semiconductor Products Div	5005 E McDowell Rd Phoenix AZ 85036
29990	American Technical Ceramics Division of Phase Industries	1 Norden Lane Huntington Station NY 11746
94990	Motorola Inc Government Electronics Group	8201 E McDowell Rd Scottsdale AZ 85252

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

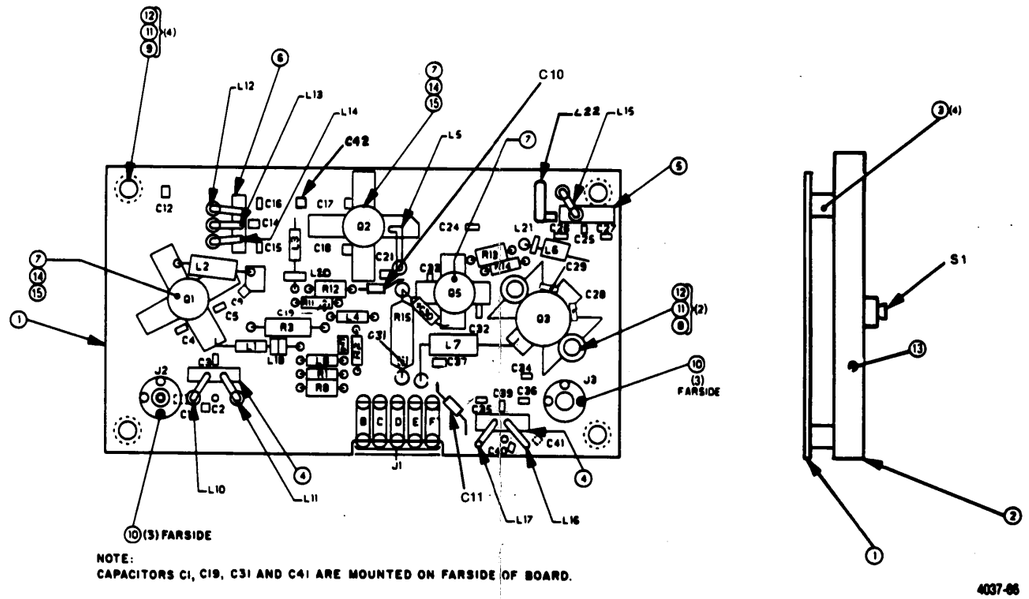


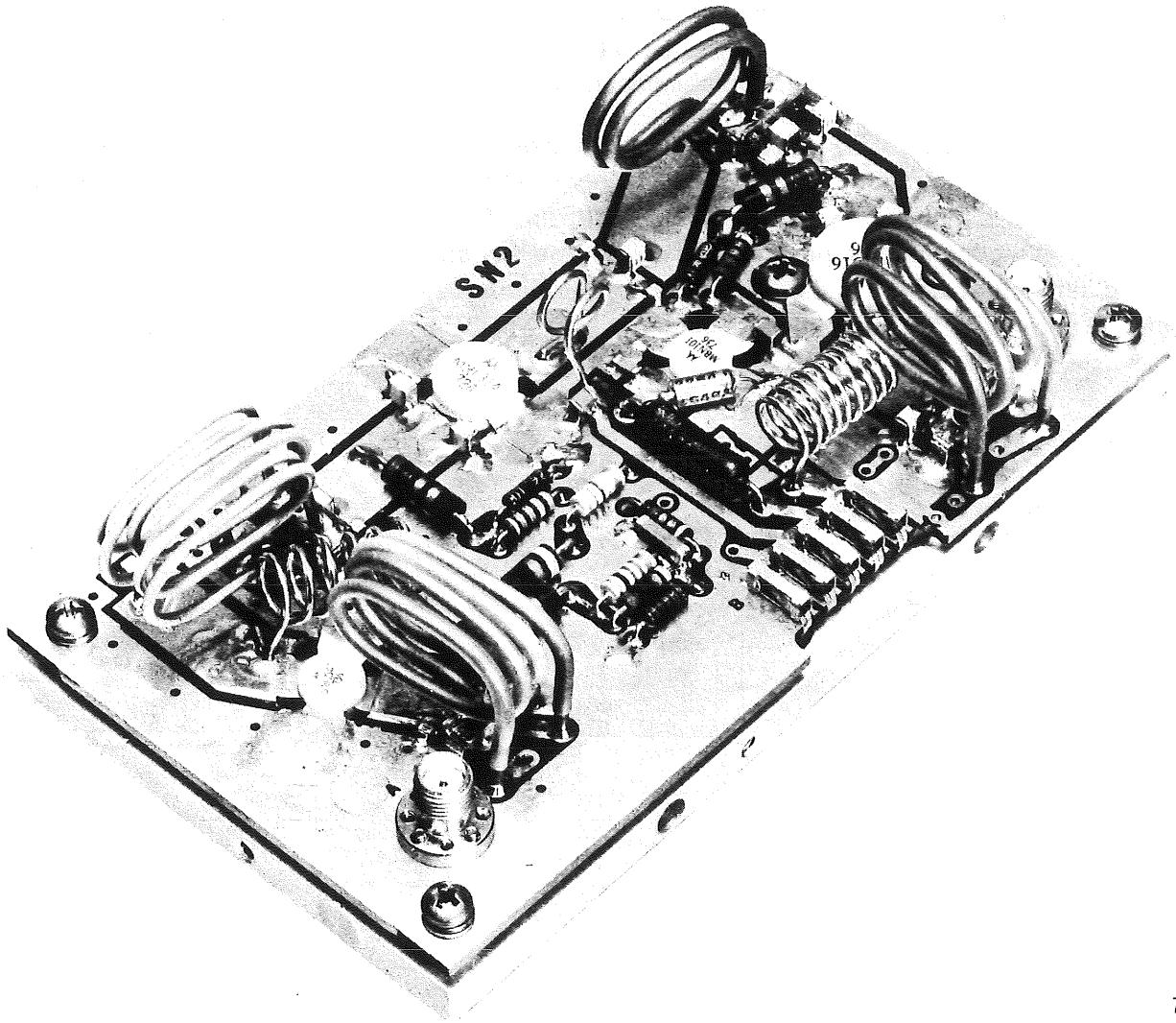
Figure 14-4. UHF RF Amplifier 1A7 Parts Locating Diagram

SECTION 15

VHF RF AMPLIFIER 1A8

15-1. PURPOSE AND GENERAL DESCRIPTION

15-2. The vhf rf amplifier 1A8 (figure 15-1) receives its input from vca 1A10 through vhf/uhf switch 1K2 and amplifies it for transmission. The amplifier provides a total gain of approximately 29 dB and output to the vhf antenna through XMT/RCV switch 1K1 and low pass filter/power sensor 1FL1. The module consists of three amplifier stages and associated impedance matching and bias networks, basic control of the module being provided by the bias networks which are powered by the +28 VDC and VHF +5V inputs.



77-4865

Figure 15-1. VHF RF Amplifier 1A8

15-3. DETAILED DESCRIPTION

15-4. The following paragraphs provide a detailed functional description of vhf rf amplifier 1A8 shown in the block diagram of Figure 15-2 and schematic diagram of Figure 15-3.

15-5. The input signal to the amplifier module consists of a vhf signal in the range of 116 to 150 MHz at a level of 38 mW peak. This input signal from connector J2 is routed to the 9:1 impedance transformation network consisting of inductors L10 and L11 which transforms the 50-ohm input impedance at J2 to approximately 5.6 ohms at the beginning of the microstrip (single conductor supported above a ground plane). Capacitor C3 couples the signal from the inductors to the microstrip. The inductance of the microstrip coupled with capacitors C4 and C5 match the impedance of inductors L10 and L11 to the input impedance of transistor Q1. The output signal of the Q1 stage is conditioned by bias and impedance matching networks. The bias network consists of inductor L2, capacitors C9 and C10, and resistor R3. The purpose of R3 is to cause lower "Q" while maintaining a high inductance to create a broadband amplifier. The output of Q1 is conducted over a second microstrip to the impedance transformation network consisting of inductors L12 through L14 and capacitors C12 and C14. The impedance transformation network matches the output impedance of amplifier Q1 to the Q2 amplifier input microstrip impedance. Capacitors C15 through C18 together with the inductance of the microstrip line further match the output of the impedance transformation network to the input impedance of amplifier Q2.

15-6. The collector bias of Q2 is provided through the bias network consisting of inductor L5 and capacitor C21. Amplifier Q2 output is applied to an impedance transformation network composed of capacitors C24 and C25 and inductor L15 via a fourth microstrip line. The transformation network matches the output of amplifier Q3 to the input impedance of the last amplifier stage. Capacitors C26 through C29 together with the series inductance of the fifth microstrip further translates the output impedance of the transformation network to the input impedance at the base of Q3.

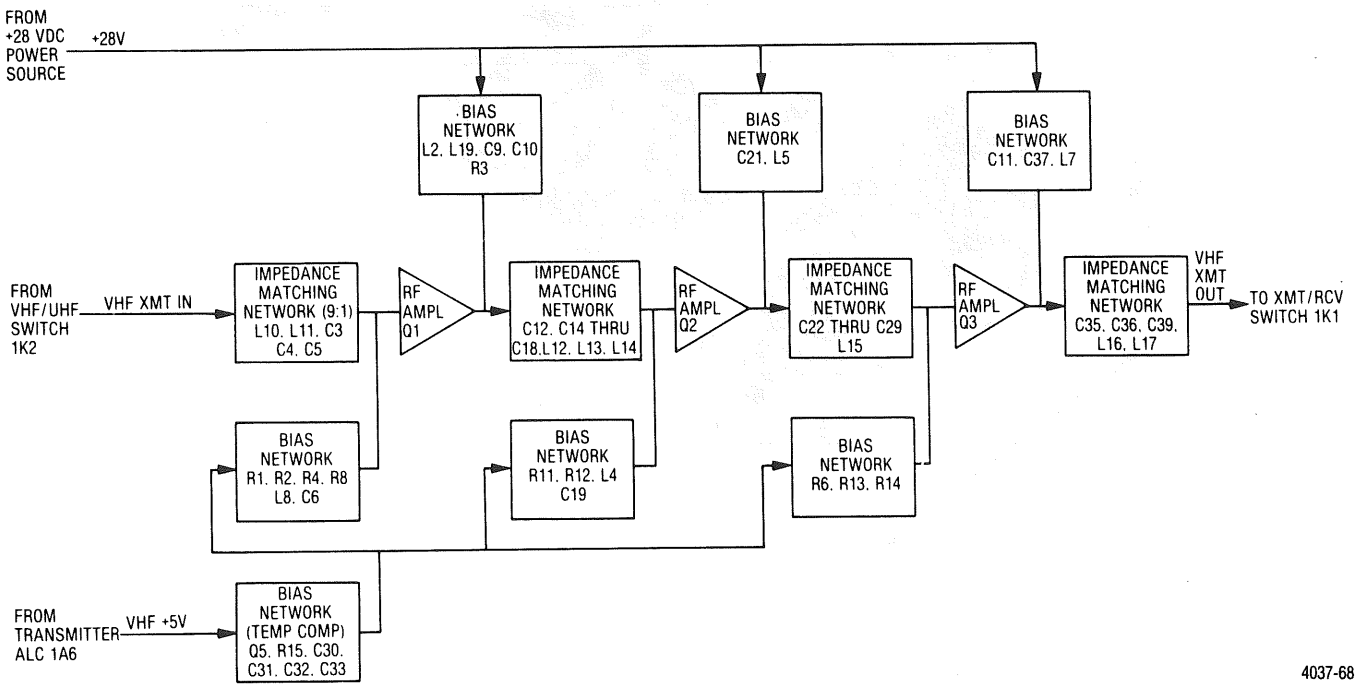


Figure 15-2. VHF RF Amplifier 1A8 Block Diagram

15-7. The output power of the third and final stage Q3, is in the range of 5 watts average. Collector bias for Q3 is provided by a network consisting of inductor L7 and capacitors C11 and C37. The Q3 output is applied to a sixth microstrip which, together with C35 and C36, matches the output impedance of Q3 to the input impedance of transformation network C39, L16 and L17. This network raises the microstrip output impedance to 50 ohms at J3. The total output power of the amplifier is rated at 30W peak (44.8 dBm) at an output frequency of 116 to 150 MHz.

15-8. TEMPERATURE COMPENSATION. The temperature compensation network consisting of binet (bias network) Q5 and associated bias networks connected to the input of each amplifier stage prevents thermal runaway of the amplifier stages. The bias to the three amplifier stages is controlled by the temperature sensing of Q5, which consists of a diode with a positive temperature coefficient and other components. It is physically located near Q3 in the amplifier module since Q3 provides the most rf power and operates the warmest. When the binet senses temperature increases in the transistor amplification stages, it decreases the bias current to the transistors until temperature stability is reached, thus preventing thermal runaway.

15-9. VHF RF AMPLIFIER MAINTENANCE AND TROUBLESHOOTING

15-10. After a malfunction is isolated to the VHF rf amplifier, troubleshoot the amplifier in reference to the waveforms and voltage levels shown on the schematic diagram, Figure 15-3. Replace defective components using parts locating diagram, Figure 15-4, as a guide.

15-11. SELECT COMPONENTS. With no rf signal at J2, choose the select resistors for the following levels:

a. Select R13 for a 60 mAdc collector current through Q3.

b. Select R8 for a 7.5 mAdc collector current through Q1. Monitor the collector current of Q1 across R3.

c. Select R12 for a 25 mAdc collector current through Q2.

NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH A8
2. FOR REFERENCE DRAWINGS REFER TO 01-P09594L09S ASSEMBLY
3. ALL RESISTORS ARE ±5 PCT., 1/4 WATT
   ALL CAPACITORS ARE 50 PF
   ALL INDUCTORS ARE 50 UH
   ALL VOLTAGES ARE DC
4. SELECT 50 TEST RESISTORS ARE IN OHMS
5. THE FOLLOWING ARE MOTOROLA PARTS

REFERENCE DESIGNATION	MOTOROLA PART NO
L2	24-PC7148L907
L5	24-P07149L006
L7	24-P07149L005
L10, L16	24-P06432R08I
L11, L17	24-P06432R08Z
L12, L18	24-P07193L001
L13	24-P07193L002
L15	24-P07193L003
L19	24-1548AC4

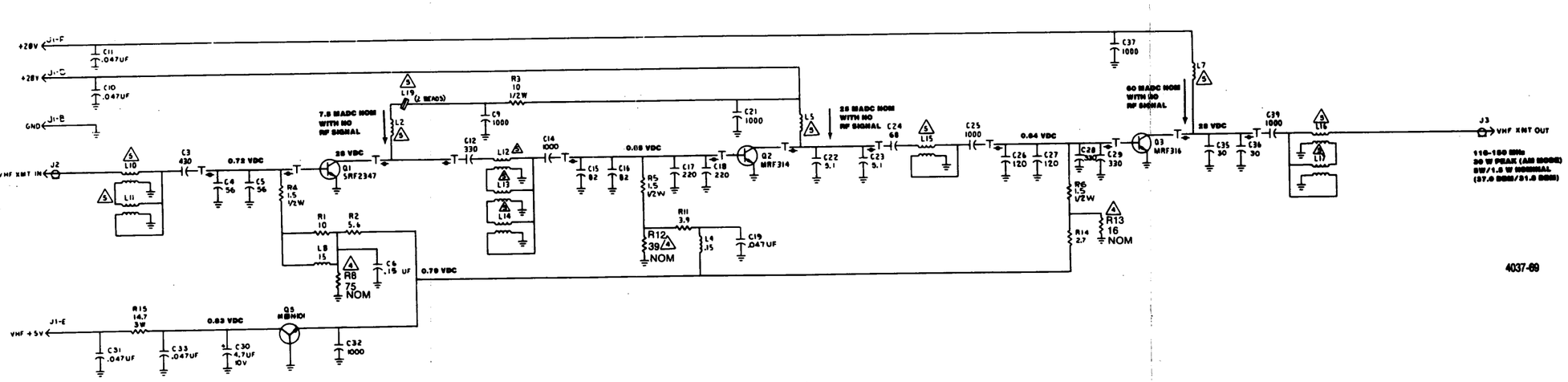


Figure 15-3. VHF RF Amplifier 1A8 Schematic Diagram

PARTS LIST

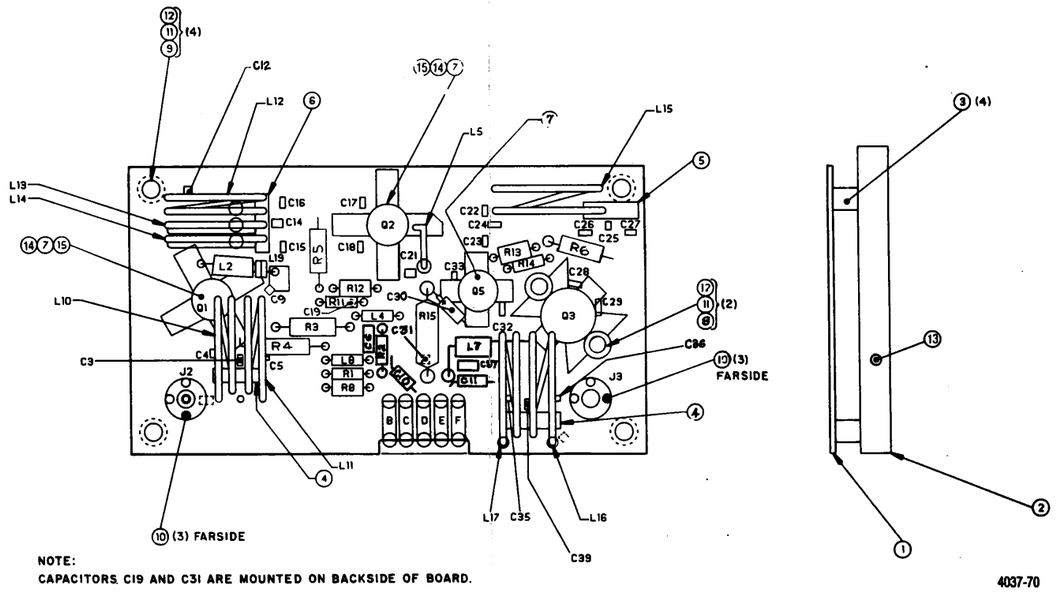
Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04554L001	VHF RF AMPLIFIER	
001	1	94990	84-P04547L001	PWB,RF AMPLIFIER	
002	1	94990	**26-P08705V001**	HEAT SINK	
003	4	94990	43-P06563B008	SPACER	
004	2	94990	07-P04545L002	BRACKET-XFMR	
005	1	94990	07-P04545L003	BRACKET-XFMR	
006	1	94990	07-P04545L001	BRACKET-XFMR	
007	3		MS35649-284	NUT,HEX	8-32
008	2		MS51957-14	SCREW	4-40X5/16
009	4		MS51957-15	SCREW	4-40X3/8
010	6	94990	03-15013G20	SCREW	0-80X3/16
011	6		MS35338-135	WASHER	NO.4
012	6		NAS620C4L	WASHER	NO.4
013	1	85480	QD-25-YL	COLOR DOT-YELLOW	
014	2		MS35338-137	WASHER	NO.8
015	2		NAS620C8	WASHER	NO.8
C 003	1	29990	ATC100B431JP200	CAPACITOR	430PF-5-200
C 004	1	29990	ATC100A560JP50	CAPACITOR	56PF-5-50
C 005	1	29990	ATC100A560JP50	CAPACITOR	56PF-5-50
C 006	1	94990	21-P14473A141	CAPACITOR	.15UF-20-50
C 009	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 010	1	94990	M39014/01-1547	CAPACITOR	.047UF-10-50
C 011	1	94990	M39014/01-1547	CAPACITOR	.047UF-10-50
C 012	1	29990	ATC100B331JP200	CAPACITOR	330PF-5-200
C 014	1	29990	ATC100B102KP50	CAPACITOR	1000PF-10-50
C 015	1	29990	ATC100A820JP50	CAPACITOR	82PF-5-50
C 016	1	29990	ATC100A820JP50	CAPACITOR	82PF-5-50
C 017	1	29990	ATC100B221JP200	CAPACITOR	220PF-5-200
C 018	1	29990	ATC100B221JP200	CAPACITOR	220PF-5-200
C 019	1	94990	21-P14473A135	CAPACITOR	.047UF-20-50
C 021	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 022	1	29990	ATC100A5R1CP50	CAPACITOR	5.1PF-.25PF-50
C 023	1	29990	ATC100A5R1CP50	CAPACITOR	5.1PF-.25PF-50
C 024	1	29990	ATC100B680JP500	CAPACITOR	68PF-5-500
C 025	1	29990	ATC100B102KP50	CAPACITOR	1000PF-10-50
C 026	1	29990	ATC100B121JP300	CAPACITOR	120PF-5-300
C 027	1	29990	ATC100B121JP300	CAPACITOR	120PF-5-300
C 028	1	29990	ATC100B331JP200	CAPACITOR	330PF-5-200
C 029	1	29990	ATC100B331JP200	CAPACITOR	330PF-5-200
C 030	1		M39003/01-2254	CAPACITOR	4.7UF-10-10
C 031	1	94990	21-P14473A135	CAPACITOR	.047UF-20-50
C 032	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 033	1	94990	21-P14473A135	CAPACITOR	.047UF-20-50
C 035	1	29990	ATC100B300JP500	CAPACITOR	30PF-5-500
C 036	1	29990	ATC100B300JP500	CAPACITOR	30PF-5-500
C 037	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 039	1	29990	ATC100B102KP50	CAPACITOR	1000PF-10-50
J1B-F	5	00779	85493-3	RECEPTACLE	
J2-J3	1	94990	28-P14486A302	CONNECTOR	
L 002	1	94990	24-P07198L004	COIL,RF	
L 004	1		MS75083-3	COIL	.15UH
L 005	1	94990	24-P07198L006	COIL	
L 007	1	94990	24-P07198L005	COIL	
L 008	1		MS75084-14	COIL	15UH
L 010	1	94990	24-P07089L001	TRANSFORMER,RH	
L 011	1	94990	24-P07089L002	TRANSFORMER,LH	
L 012	1	94990	24-P07193L001	TRANSFORMER,RF-VHF	
L 013	1	94990	24-P07193L002	TRANSFORMER,RF-VHF	
L 014	1	94990	24-P07193L001	TRANSFORMER,RF-VHF	
L 015	1	94990	24-P07193L003	TRANSFORMER,RF-VHF	
L 016	1	94990	24-P07089L002	TRANSFORMER,RH	
L 017	1	94990	24-P07089L001	TRANSFORMER,LH	
L 019	2	94990	74-15169A04	FERRITE BEAD	
Q 001	1	04713	SRF2347	TRANSISTOR	
Q 002	1	04713	MRF314A	TRANSISTOR	
Q 003	1	04713	MRF316	TRANSISTOR	
Q 005	1	04713	MBN101	BINET	
R 001	1		RCR07G100JS	RESISTOR	10-5-1/4
R 002	1		RCR07G5R6JS	RESISTOR	5.6-5-1/4
R 003	1		RCR20G100JS	RESISTOR	10-5-1/2
R4-R6	3	01121	EB15G5	RESISTOR	1.5-5-1/2
R 008	AR		RCR07G750JS	RESISTOR	75-5-1/4 NOM
R 011	1		RCR07G3R9JS	RESISTOR	3.9-5-1-4
R 012	AR		RCR07G390JS	RESISTOR	39-5-1/4 NOM
R 013	AR		RCR07G160JS	RESISTOR	16-5-1/4 NOM
R 014	1		RCR07G2R7JS	RESISITOR 2.7-5-1/4	
R 015	1		RW79U14R7F	RESISTOR	14.7-1-3

PARTS SUPPLIERS

Code Ident.	Name	Address
00779	AMP Inc.	P.O. Box 3608 Harrisburg, PA 17105
01121	Allen-Bradley Co.	1201 South 2nd St. Milwaukee, WI 53204
04713	Motorola Inc. Semiconductor Products Div	5005 E. McDowell Rd. Phoenix, AZ 85036
29990	American Technical Ceramics Division of Phase Industries	1 Norden Lane Huntington Station, NY 11746
85480	W. W. Brady Co.	727 W. Glendale Ave. Milwaukee, WI 53209
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.



NOTE:
CAPACITORS C19 AND C31 ARE MOUNTED ON BACKSIDE OF BOARD.

4037-70

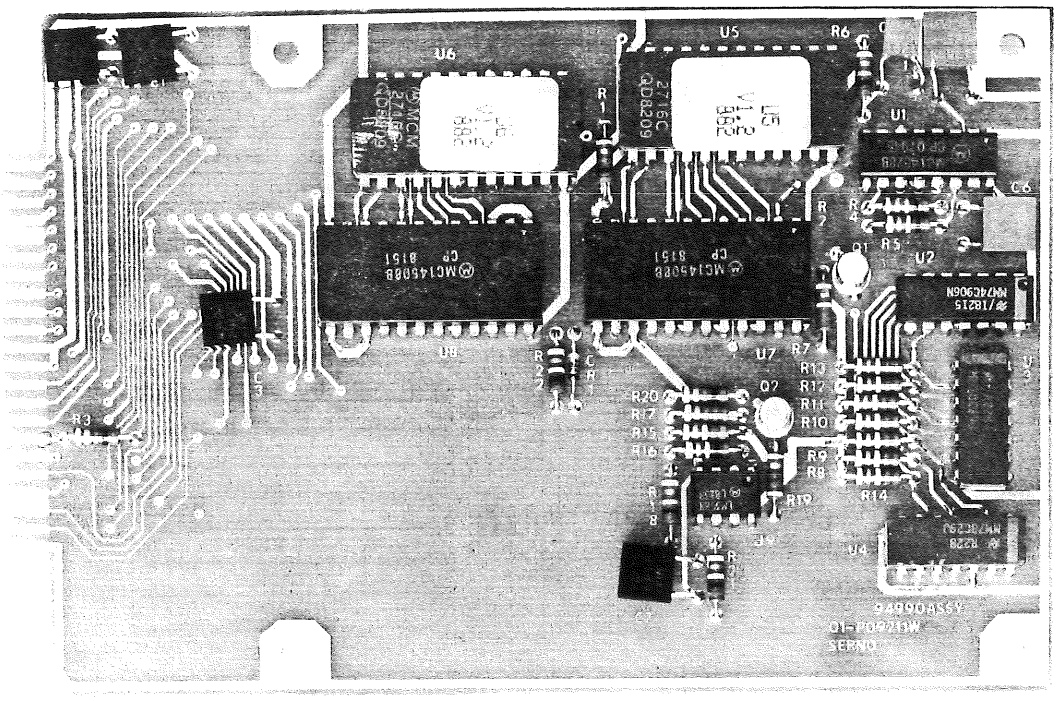
Figure 15-4. VHF RF Amplifier 1A8 Parts Location Diagram

SECTION 16
DECODER 1A9

16-1. PURPOSE AND GENERAL DESCRIPTION

16-2. The Decoder module 1A9 (Figure 16-1) provides basic control of the PET radio. The decode logic contained on the module functions in both the transmit and receive modes. The module operates on the frequency program BCD input levels received over the ten input lines from the remote control unit and provides various output levels based on the operating mode (transmit or receive) and the frequencies selected. A lockout level is also provided to prevent transmitting on out-of-band frequencies.

16-3. The module consists of EPROM's U5 and U6, latch packages U7 and U8, and associated timing and drive circuitry. Additional circuitry is provided to drive the XMT LED when the transceiver is in the transmit mode.



82-4455

Figure 16-1. Decoder 1A9

16-4. DETAILED DESCRIPTION

16-5. The following paragraphs provide a detailed functional description of the Decoder. Supporting reference information is provided in the block diagram. Figure 16-2, and the schematic diagram, Figure 16-3. Table 16-1 provides a logic function description.

16-6. RECEIVE. In the receive mode, the EPROM's U5 and U6 are addressed by the R/T, 1 MHz, 10 MHz, and 100 MHz input lines from the RCU 1A1. The addresses then set up the appropriate outputs of U5 and U6. When clocked by the timing circuit of U1, these outputs are applied to the latches of U7 and U8. The outputs of U8 are used to select uhf/vhf operating modes and the HI/LO MIX processes. The outputs of U7 are transformed from +5V levels to +12V levels by U2 and are given increased drive current by the drivers of U3 and U4. These outputs are then used to select the appropriate filters in the Receiver module 1A5.

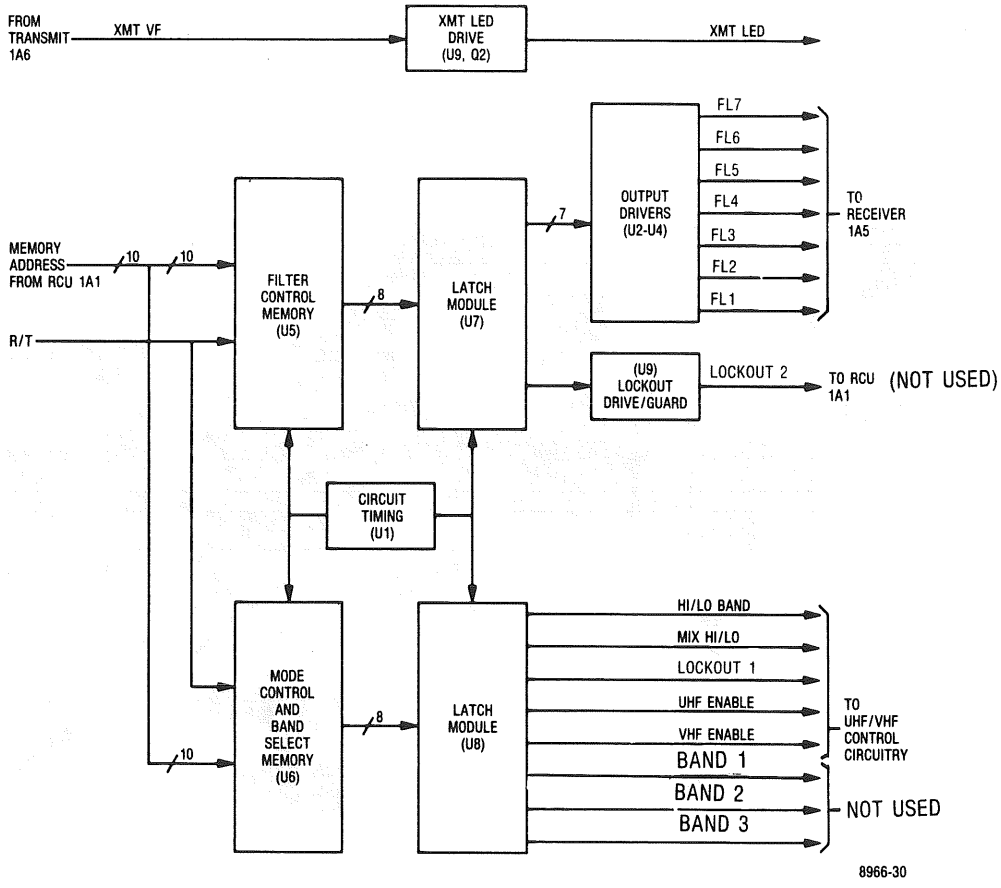


Figure 16-2. Decoder 1A9 Block Diagram

16-7. TRANSMIT. Selection of the transmit mode is controlled by the R/T input from the RCU. Operation of the Decoder for transmit is the same as for receive except that the filter control signals and the HI/LO MIX control signals are not used.

16-8. LOCKOUT. The LOCKOUT function is used to prevent the transeiver from operating whenever an out-of-band frequency is selected. In the AN/URC-101 transceivers, the LOCKOUT 1 signal is used to provide transmitter lockout. The LOCKOUT 2 signal is not used.

Table 16-1. Decoder Logic Functions

OPERATING BAND	INPUTS		OUTPUTS												
			ENABLE				FILTER CONTROL FILTER/PIN							
	R/T PIN 3B	SELECTOR FREQUENCY (MHz)	UHF (PIN 16A)	VHF (PIN 13A)	MIX HI/LO (PIN 7B)	BAND HI/LO (PIN 6A)	FL7/ 17B	FL6/ 20A	FL5/ 20B	FL4/ 18B	FL3/ 21B	FL2/ 18A	FL1/ 21A	LOCKOUT PIN 2B
Out of Band	—	0-115.975	—	—	—	—	—	—	—	—	—	—	—	+5V
VHF	+5V	116-131.975	0V	+5V	0V	Not Used	+12V	0V	OV	0V	0V	0V	0V	0V
VHF	+5V	132-149.975	0V	+5V	0V	Not Used	0V	+12V	0V	OV	0V	0V	0V	0V
Out of Band	—	150-224.975	—	—	—	—	—	—	—	—	—	—	—	+5V
UHF	+5V	225–242.975	+5V	0V	+5V	0V	0V	0V	+12V	0V	0V	0V	0V	0V
↓	↓	243–259.975	↓	↓	0V	0V	0V	0V	+12V	0V	0V	0V	0V	↓
↓	↓	260–277.975	↓	↓	+5V	0V	0V	0V	0V	+12V	0V	0V	0V	↓
↓	↓	278-294.975	↓	↓	0V	+5V	0V	0V	0V	+12V	0V	0V	0V	↓
↓	↓	295–312.975	↓	↓	+5V	0V	0V	0V	0V	0V	+12V	0V	0V	↓
↓	↓	313–329.975	↓	↓	0V	+5V	0V	0V	0V	0V	+12V	0V	0V	↓
↓	↓	330–347.975	↓	↓	+5V	+5V	0V	0V	0V	0V	0V	+12V	0V	↓
↓	↓	348–364.975	↓	↓	0V	+5V	0V	0V	0V	0V	0V	+12V	0V	↓
↓	↓	365–382.975	↓	↓	+5V	+5V	0V	0V	0V	0V	0V	0V	+12V	↓
UHF	+5V	383–399.975	+5V	0V	0V	+5V	0V	0V	0V	0V	0V	0V	+12V	0V
Out of Band	—	0-115.975	—	—	—	—	—	—	—	—	—	—	—	+5V
VHF	0V	116-131.975	0V	+5V	Not Used	Not Used	—	—	—	—	—	—	—	0V
VHF	0V	132-149.975	0V	+5V	Not Used	Not Used	—	—	—	—	—	—	—	0V
Out of Band	—	150-224.975	—	—	—	—	—	—	—	—	—	—	—	+5V
UHF	0V	225–299.975	+5V	0V	Not Used	0V	—	—	—	—	—	—	—	0V
UHF	0V	300–399.975	+5V	0V	Not Used	+5V	—	—	—	—	—	—	—	0V

R/T = 0V for Transmit
5V for Receive

0V = High Mix, 0V = Low Band
+5V = Low Mix, +5V = High Band

Lockout goes to +5V for out of band frequencies

CAUTION

Do not change the frequency of operation when transmitting or the transceiver may be damaged.

16-9. TIMING. The timing circuit of U1 is used to clock the EPROM's (U5 and U6) and the latches (U7 and U8). The clock pulse occurs approximately every 110 microseconds and has a one microsecond width. The pulse causes U5 and U6 to be fully enabled so that their outputs may be applied to the latches of U7 and U8. This scheme allows the EPROM's to be in stand-by mode for 99% of the time which results in substantial power savings.

16-10. XMT LED. THE XMT LED indicator is driven by one of the amplifier circuits of U9 in conjunction with transistor Q2. The input to the drive circuit is the forward voltage level generated by the Transmit ALC 1A6 via the XMT VF line when the transceiver is transmitting.

16-11. DECODER MAINTENANCE AND TROUBLESHOOTING. If a malfunction is isolated to the Decoder Logic module, troubleshoot using the schematic diagram, Figure 16-3. Replace defective components using parts location diagram, Figure 16-4 as a guide.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH 1A9.
2. FOR REFERENCE DRAWINGS REFER TO: ASSEMBLY 01-P09211W001.
3. ALL RESISTORS ARE IN OHMS ±5%, 1/4 WATT. ALL CAPACITORS ARE IN UF. ALL VOLTAGES ARE IN DC.
4. U5 IS MCM2716C EPROM PROGRAMMED IN ACCORDANCE WITH 51-P28771B001.
5. U6 IS MCM2716C EPROM PROGRAMMED IN ACCORDANCE WITH 51-P28772B001.

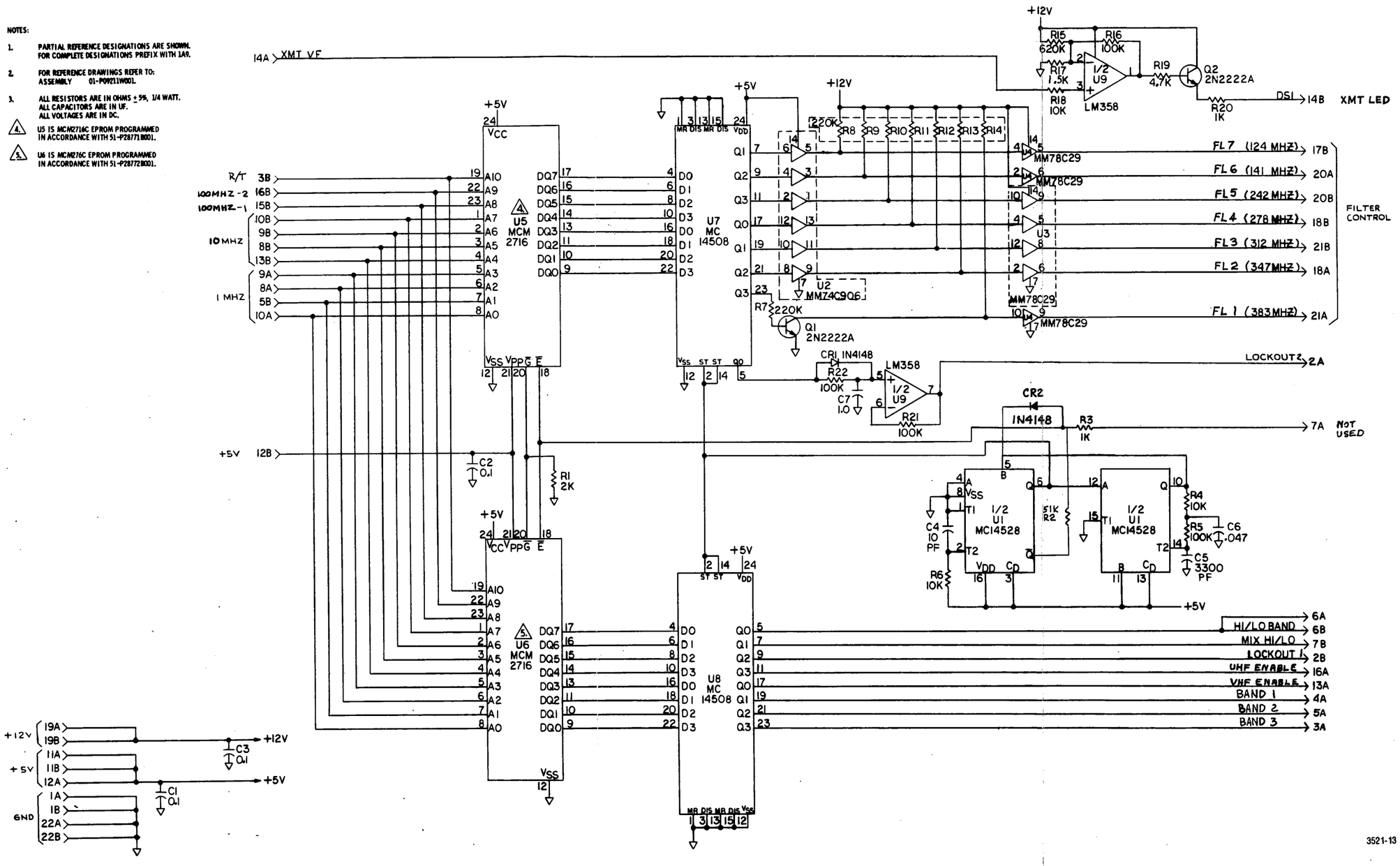


Figure 16-3. Decoder 1A9 Schematic Diagram

Find No.	Qty. Req.	Code Ident	Part No.	Nomenclature	Part Value
			01-P09211W001	DECODE LOGIC ASSY	
001	1		84-P09213W001	PRINTED WIRING BOARD	
002	AR		SN63WRMAP3	SOLDER	
003	AR		11-14167A01	INK	BLACK
C 001	1		M39014/02-1350	CAPACITOR	.1UF-10-100
C 002	1		M39014/02-1350	CAPACITOR	.1UF-10-100
C 003	1		M39014/02-1350	CAPACITOR	.1UF-10-100
C 004	1		M39014/01-1321	CAPACITOR	10PF-10-200
C 005	1		M39014/02-1329	CAPACITOR	3300PF-10-200
C 006	1		M39014/02-1345	CAPACITOR	.047UF-10-100
C 007	1		M39014/02-1419	CAPACITOR	1UF-10-50
CR001	1		IN4148	DIODE	
CR002	1		IN4148	DIODE	
Q 001	1		JAN2N2222A	TRANSISTOR	
Q 002	1		JAN2N2222A	TRANSISTOR	
R 001	1		RCR07G202JS	RESISTOR	2000-5-1/4
R 002	1		RCR07G513JS	RESISTOR	51K-5-1/4
R 003	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 004	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 005	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 006	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 007	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 008	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 009	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 010	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 011	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 012	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 013	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 014	1		RCR07G224JS	RESISTOR	220K-5-1/4
R 015	1		RCR07G624JS	RESISTOR	620K-5-1/4
R 016	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 017	1		RCR07G152JS	RESISTOR	1500-5-1/4
R 018	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 019	1		RCR07G472JS	RESISTOR	4700-5-1/4
R 020	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 021	1		RCR07G104JS	RESISTOR	100K-5-1/4
R 022	1		RCR07G104JS	RESISTOR	100K-5-1/4
U 001	1		MC14528BCPDS	INTEGRATED CIRCUIT	
U 002	1		MM74C906N/A+	INTEGRATED CIRCUIT	
U 003	1		MM78C29N/A+	INTEGRATED CIRCUIT	
U 004	1		MM78C29N/A+	INTEGRATED CIRCUIT	
U 005	1		51-P28771B001	MICROCIRCUIT, EPROM MCM2716C, PRGRM	
U 006	1		51-P28772B001	MICROCIRCUIT, EPROM MCM2716C, PRGRM	
U 007	1		MC14508BCPDS	INTEGRATED CIRCUIT	
U 008	1		MC14508BCPDS	INTEGRATED CIRCUIT	
U 009	1		LM358NDS	INTEGRATED CIRCUIT	

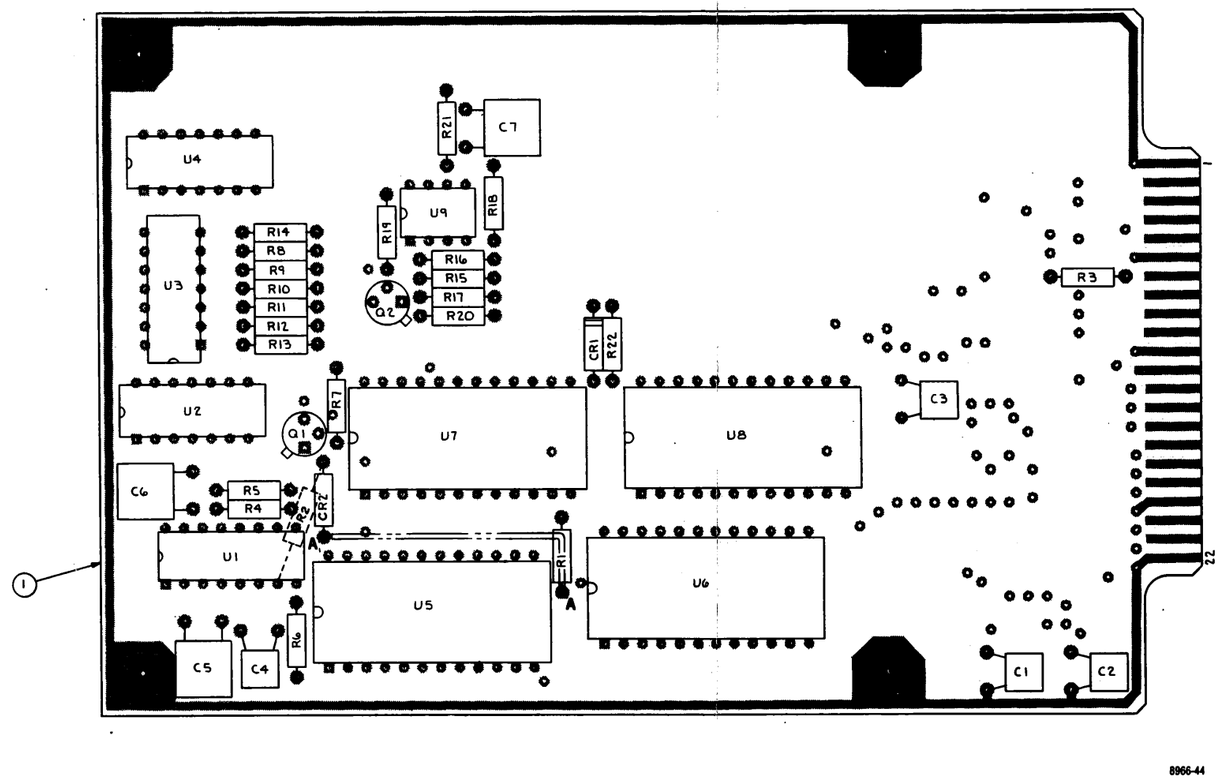


Figure 16-4. Decoder 1A9 Parts Location

SECTION 17

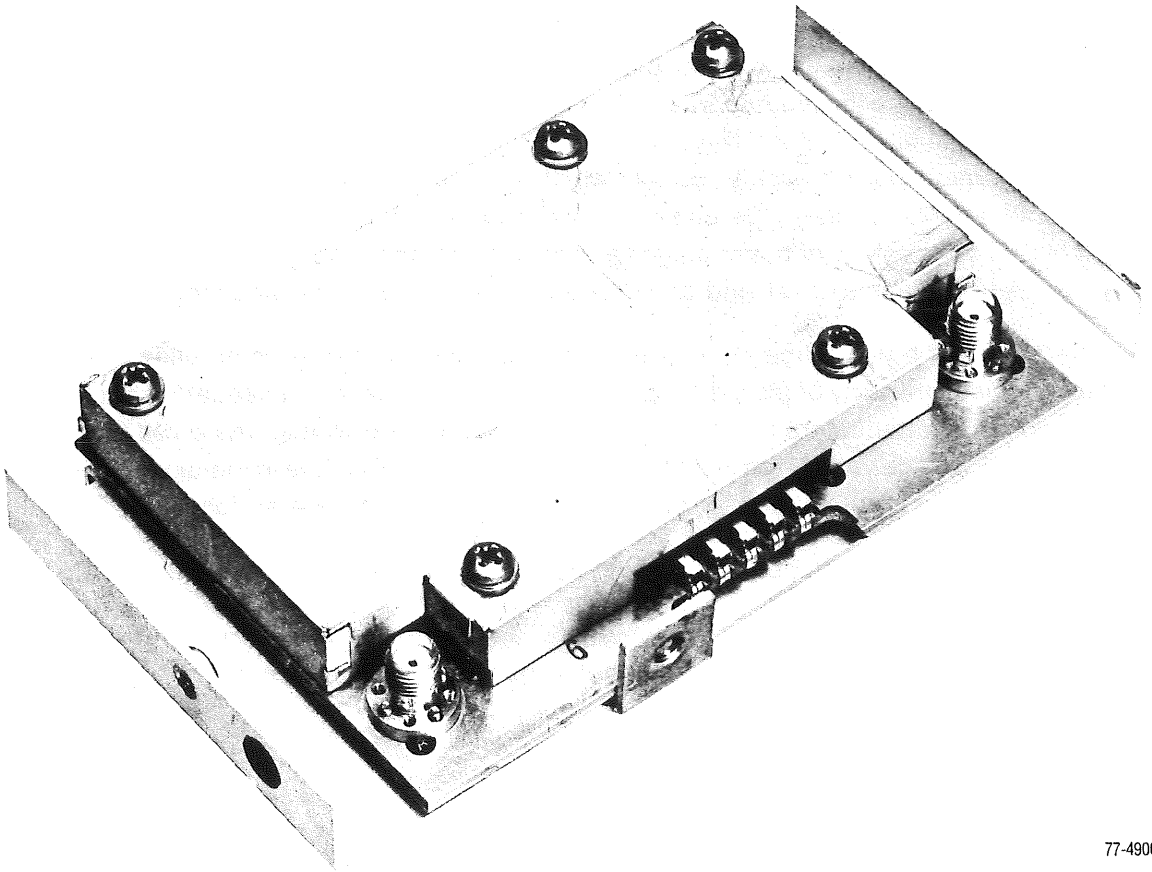
VOLTAGE CONTROLLED ATTENUATOR 1A10

17-1. PURPOSE AND GENERAL DESCRIPTION

17-2. The voltage-controlled attenuator (vca) 1A10 module shown in Figure 17-1, provides controlled attenuation of the rf signal received from uhf vco 1A4. The amount of attenuation is determined by the vca control voltage generated by transmitter alc 1A6 module. Functionally, module 1A10 consists of a pad, impedance-matching network, constant current source and buffer amplifier, and associated filters and attenuators. The output of the module is supplied to vhf/uhf switch K2 for distribution to the uhf or vhf rf amplifiers.

17-3. DETAILED DESCRIPTION

17-4. The following paragraphs provide a detailed functional description of vca 1A10 as referenced to the block diagram shown in Figure 17-2 and schematic diagram shown in Figure 17-4.



77-4900

Figure 17-1. Voltage Controlled Attenuator 1A10

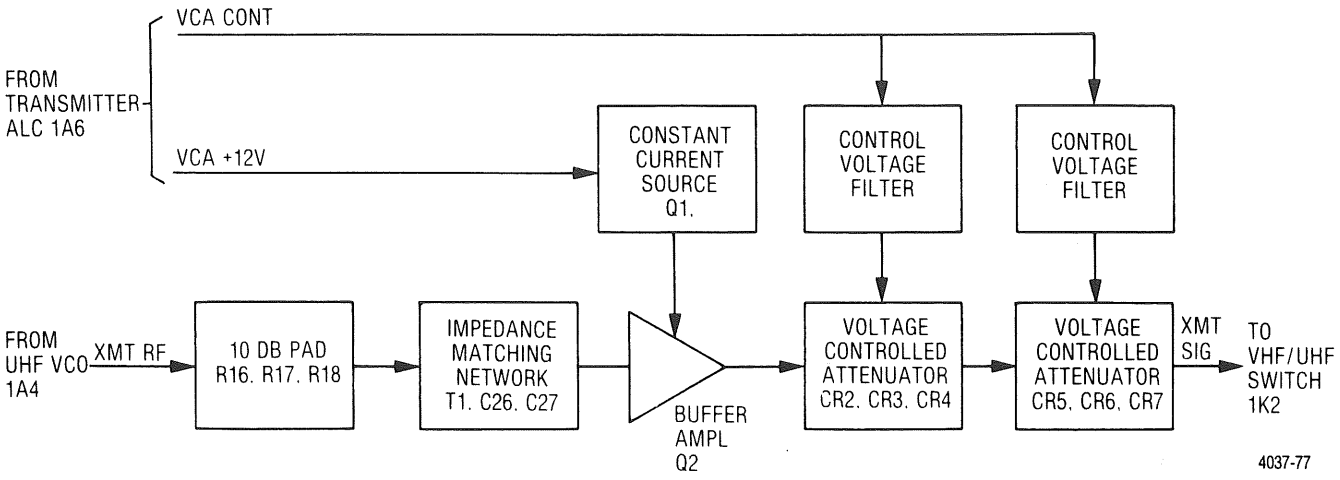


Figure 17-2. Voltage Controlled Attenuator 1A10 Block Diagram

17-5. Operation of the vca module is determined by the vca +12V input at J1-F. In receive mode, the voltage is not supplied and the module is disabled. In the transmit mode, +12 Vdc is supplied to constant current source Q1 activating the module. The rf to be transmitted is received by the module at coaxial connector J2 at a maximum level of +20 dBm. The rf is then routed through the 50-ohm microstrip, 10 dB pad, and impedance matching network to buffer amplifier Q2. The impedance matching network consists of transformer T1 and capacitors C26 and C27. The network transforms the 50-ohm input impedance to 12-ohms (4.2:1) for the base of buffer stage Q2. The buffer stage is supplied a constant current of approximately 55 mA from transistor Q1 and provides a gain of 10 dB to the incoming rf.

17-6. The output of buffer stage Q2 is routed through the two voltage-controlled attenuators. The first attenuator consists primarily of diodes CR2, CR3, and CR4. The second attenuator consists of diodes CR5, CR6 and CR7. Both attenuators are controlled by the vca control voltage received from transmitter ALC module 1A6. The voltage varies from zero to a maximum of +15 Vdc. The minimum and maximum ranges of loss in relation to vca input voltage for both attenuators combined, are as follows:

VCA Control Voltage	Loss
0V	Minimum 60 dB (maximum attenuation)
+15VDC	Maximum 3 dB (minimum attenuation)

Since both attenuator circuits are identical, the second circuit shown in Figure 17-3 is discussed in the following paragraph as a typical example.

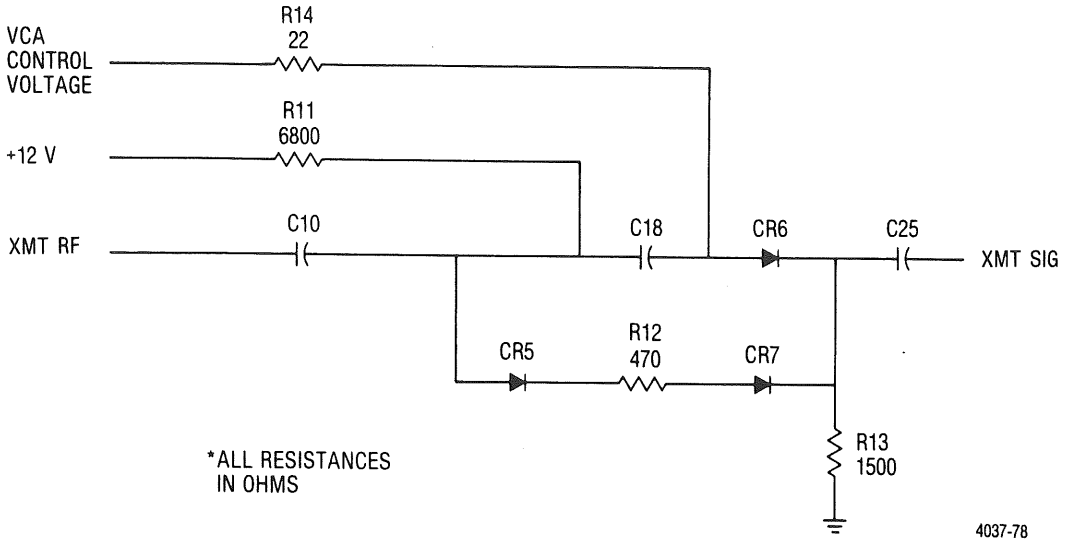


Figure 17-3. 30 dB Attenuator, Typical Circuit

17-7. When the vca control voltage is at zero, diode CR6 is reverse biased and rf conduction is through a high attenuation path formed by diodes CR5, CR7 and resistor R12. This circuit provides maximum attenuation of 30 dB. As the vca control voltage is increased, CR5 and CR7 are gradually reverse biased and CR6 is gradually forward-biased. Gradual forward biasing of CR6 allows more and more rf signal to be conducted through it. This also allows rf conduction to be gradually transferred from the high attenuation path of CR5, CR7, and R12 to the low attenuation path of CR6 as the vca voltage increases. At maximum vca voltage, diode CR6 is fully on while diodes CR5 and CR7 are fully off. Under these conditions, all the rf signal goes through CR6. Resistor R13 provides a dc path to ground for the vca bias and control voltages. The resistors, capacitors, and inductors on the bias and control voltage lines provide dc current limiting and rf decoupling.

17-8. VCA MAINTENANCE AND TROUBLESHOOTING

17-9. After a malfunction is isolated to the vca, troubleshoot the vca in reference to the waveforms and voltage levels shown on the schematic diagram, Figure 17-4. Replace defective components using parts locating diagram, Figure 17-5, as a guide.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATION PREFIX WITH 1A10
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P04552L ASSEMBLY
3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS, 1/4 WATT, 5 PCT
   ALL CAPACITORS ARE IN PF.
   ALL INDUCTORS ARE IN UH.
   ALL VOLTAGES ARE DC.
4. ——— DENOTES 50 OHM IMPEDANCE STRIPLINE.
5. MOTOROLA PART NO. 24-P08755J001.
6. THE NUMBER ASSOCIATED WITH CR2 THRU CR7 IS A HEWLETT-PACKARD CO. PART NUMBER.
7. MOTOROLA PART NO. 24-P06611B016.

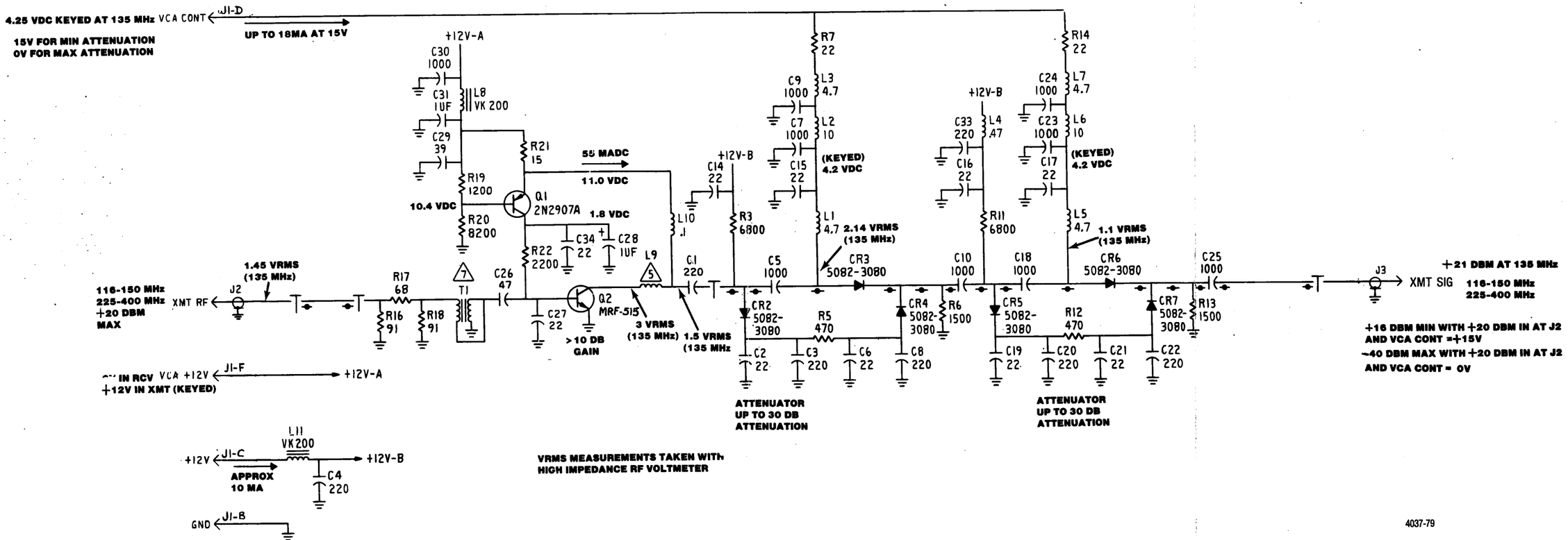


Figure 17-4. Voltage Controlled Attenuator 1A10 Schematic Diagram

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P04552L001	VCA ASSY	
001	1	94990	84-P04610L001	PWB,VCA	
002	1	94990	26-P07092L001	HEAT SINK,VCA	
003	5	94990	43-P06563B008	SPACER	
004	5		MS51957-15	SCREW	4-40X3/8
005	10		MS15795-803	WASHER	NO.4
006	10		MS35338-135	WASHER	NO.4
007	5	94990	43-15054A14	SPACER	4-40X.375
008	5		MS51957-12	SCREW	4-40X3/16
009	1	94990	26-P07201L001	SHIELD	
010	6	94990	03-15013G20	SCREW	0-80X3/16
011	1	85480	QD-25-BL	COLOR DOT-BLUE	
C 001	1	29990	ATC100B221JP200	CAPACITOR	220PF-5-200
C 002	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 003	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C 004	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C 005	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 006	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 007	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 008	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C 009	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 010	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C14-17	4	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 018	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 019	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 020	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C 021	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 022	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C23-25	3	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 026	1	29990	ATC100A470JP50	CAPACITOR	47PF-5-50
C 027	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
C 028	1		M39003/01-2356	CAPACITOR	1UF-10-50
C 029	1	29990	ATC100A390JP50	CAPACITOR	39PF-5-50
C 030	1	29990	ATC700B102MP50	CAPACITOR	1000PF-20-50
C 031	1		M39014/02-1403	CAPACITOR	1UF-10-50
C 033	1	29990	ATC100B221MP200	CAPACITOR	220PF-20-200
C 034	1	29990	ATC100A220JP50	CAPACITOR	22PF-5-50
CR2-7	6	28480	5082-3080	DIODE	
J1B-F	5	00779	85493-3	RECEPTACLE	
J 002	1	26805	2066-1322	CONNECTOR	
J 003	1	26805	2066-1322	CONNECTOR	
L 001	1		MS18130-16	COIL	4.7UH
L 002	1		MS14046-4	COIL	10UH
L 003	1		MS18130-16	COIL	4.7UH
L 004	1		MS18130-4	COIL	.47UH
L 005	1		MS18130-16	COIL	4.7UH
L 006	1		MS14046-4	COIL	10UH
L 007	1		MS18130-16	COIL	4.7UH
L 008	1	02114	VK200-10/3B	COIL	
L 009	1	94990	24-P08755J001	COIL	
L 010	1		MS75083-1	COIL	.1UH
L 011	1	02114	VK200-10/3B	COIL	
Q 001	1		JAN2N2907A	TRANSISTOR	
Q 002	1		MRF-515	TRANSISTOR	
R 003	1		RCR07G682JS	RESISTOR	6800-5-1/4
R 005	1		RCR07G471JS	RESISTOR	470-5-1/4
R 006	1		RCR07G152JS	RESISTOR	1500-5-1/4
R 007	1		RCR07G220JS	RESISTOR	22-5-1/4
R 011	1		RCR07G682JS	RESISTOR	6800-5-1/4
R 012	1		RCR07G471JS	RESISTOR	470-5-1/4
R 013	1		RCR07G152JS	RESISTOR	1500-5-1/4
R 014	1		RCR07G220JS	RESISTOR	22-5-1/4
R 016	1		RCR07G910JS	RESISTOR	91-5-1/4
R 017	1		RCR07G680JS	RESISTOR	68-5-1/4
R 018	1		RCR07G910JS	RESISTOR	91-5-1/4
R 019	1		RCR07G122JS	RESISTOR	1200-5-1/4
R 020	1		RCR07G822JS	RESISTOR	8200-5-1/4
R 021	1		RCR07G150JS	RESISTOR	15-5-1/4
R 022	1		RCR07G222JS	RESISTOR	2200-5-1/4
T 001	1	94990	24-P06611B016	TRANSFORMER	

PARTS SUPPLIERS

Code Ident.	Name	Address
00779	AMP Inc.	P.O. Box 3608 Harrisburg, PA 17105
02114	Ferroxcube Corp.	359 Mt. Marion Rd. Saugerties, NY 12477
26805	Omni Spectra Americon Microwave Connector Div.	140 Fourth Ave. Waltham, MA 02154
28480	Hewlett-Packard Co.	1501 Page Mill Rd. Palo Alto, CA 94304
29990	American Technical Ceramics Division of Phase Industries	1 Norden Lane Huntington Station, NY 11746
85480	W. W. Brady Co.	727 W. Glendale Ave. Milwaukee, WI 53209
94990	Motorola Inc. Government Electronics Div.	8201 E. McDowell Rd. Scottsdale, AZ 85252

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

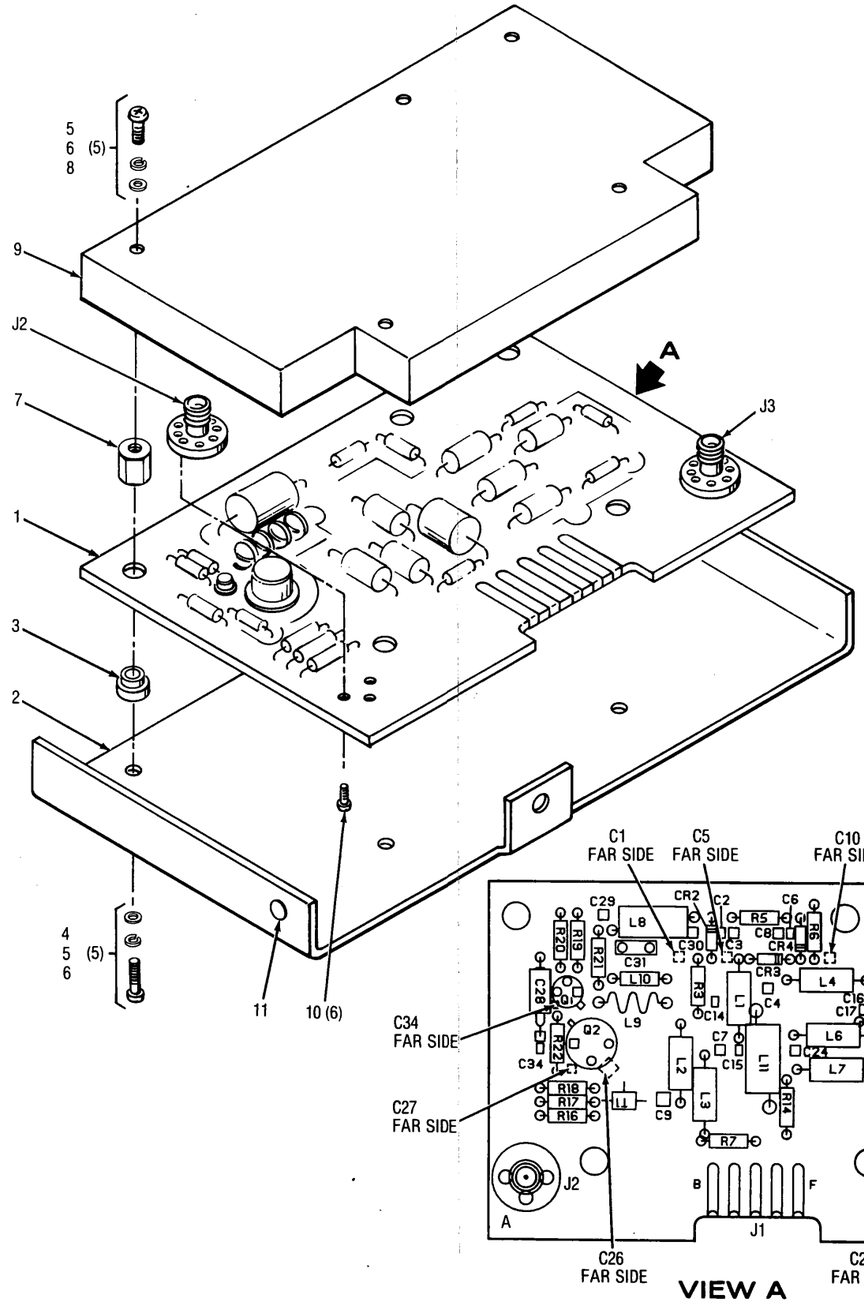


Figure 17-5. VCA 1A10 Parts Location

SECTION 18

POWER CONVERTER 1A11

18-1. PURPOSE AND GENERAL DESCRIPTION

18-2. The power converter, shown in Figure 18-1, converts the +28 Vdc supplied by the power supply into two regulated outputs of +5 Vdc and +12 Vdc for distribution to circuits within the transceiver and the PET system's RCU. It also provides both overvoltage and overcurrent protection to these circuits. The converter consists of two voltage regulators and associated control and sensing circuits.

18-3. DETAILED DESCRIPTION

18-4. The following paragraphs discuss the detailed operation of both the +5 Vdc and +12 Vdc regulator circuits of the converter as referenced to the block diagram shown in Figure 18-2 and schematic diagram shown in Figure 18-4.

18-5. +5 VDC REGULATOR

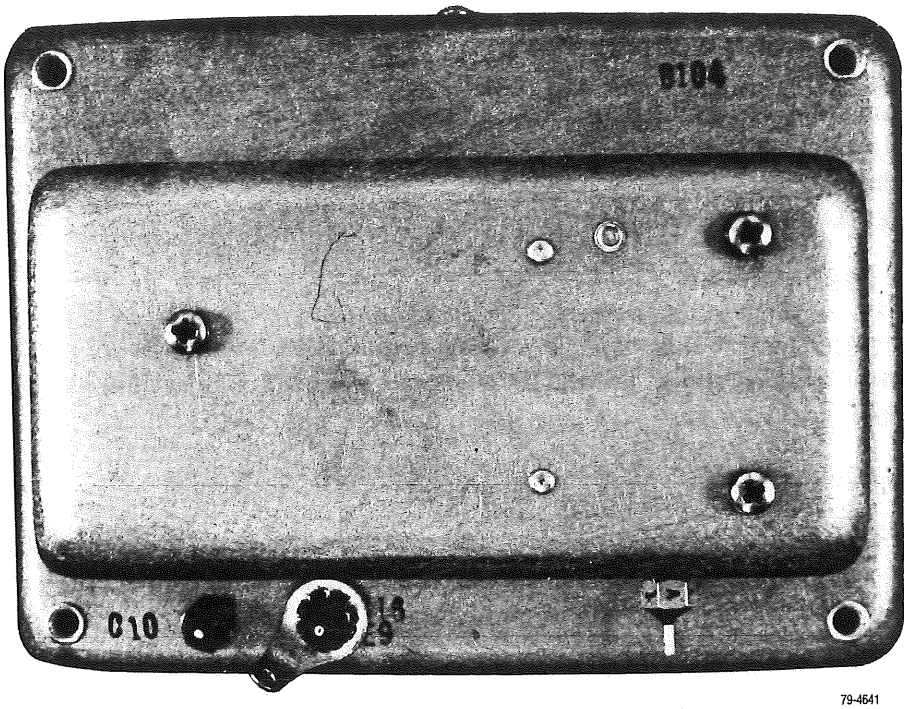
18-6. The +5 Vdc regulator circuits consists of switching transistors Q1 and Q2, control circuit U1 and voltage control loop consisting of operational amplifier U4 and its associated components. The circuit also includes overcurrent protection, consisting of operational amplifier U3 and its associated components and overvoltage protection consisting of zener diode VR1.

18-7. The converter circuit operates in two primary modes: normal and overcurrent. In the normal mode, filtered +28 Vdc power is applied to the emitter of Q1. Q1 and driver transistor Q2 are switched on and off by control circuit U1 at the duty cycle necessary to maintain a constant +5 Vdc at the output capacitor C9. This duty cycle is set by the voltage control loop consisting of U4 and its associated component. The output voltage is sensed and fed back by C23, R15 and R37 to U4 where it is compared to a reference voltage generated by U1 and divider network R7 and R8. The difference is amplified to generate the control voltage applied to U1. R37 sets this difference and hence the required control voltage. The comparison operation performed by U1 to generate the duty cycle demanded by the control voltage is shown in the waveforms of Figure 18-3. Response of the loop is set by R10, R33 and C5. The resultant output is a constant +5 Vdc to the PET circuits.

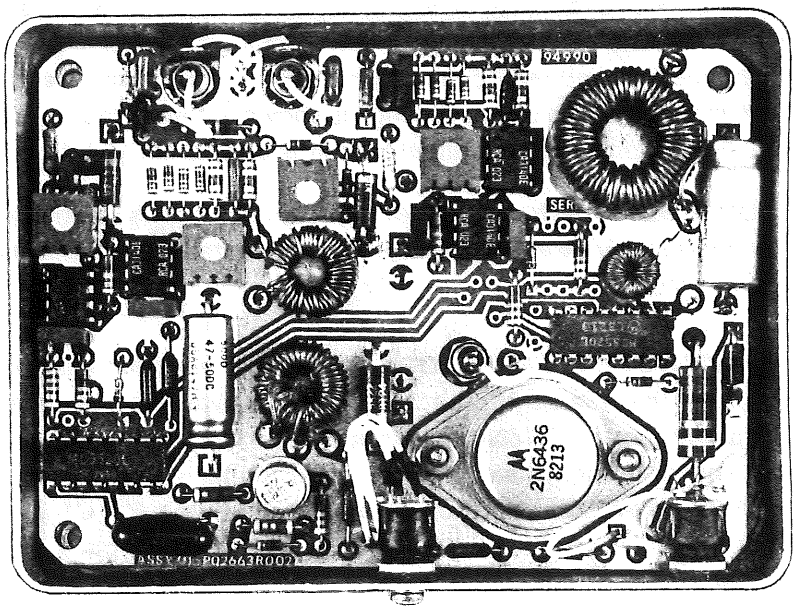
18-8. FREQUENCY CONTROL. The frequency of control circuit U1's internally generated ramp (and hence the output frequency) is set by R6 and C4. This frequency is stable and independent of influence by the remainder of the regulator circuit.

18-9. OVERCURRENT/OVERVOLTAGE PROTECTION. When the regulator is operating in normal mode, pin 3 of U3 is at a lower voltage than pin 2 by proper setting of R36. When an overcurrent condition exists, the voltage drop across R25 (approximately 0.15 Vdc) causes pin 2 to go lower than pin 3. This positive differential input voltage drives the output of U3 high, disabling the voltage control loop and thus turns Q1 and Q2 off. This removes the drop across R25. When U3's output drops below 6 Vdc at pin 6 of U1, Q1 and Q2 turn on and the cycle repeats. This circuit is nominally set to limit at 1.5A. C18 prevents U3 from latching up due to transients especially upon initial power-up.

18-10. Diode VR1 limits the voltage applied to the transceiver to 6 Vdc in event of a power converter failure. Should the overvoltage condition persist, diode VR1 fails as a short circuit to further protect the transceiver circuits.



79-4641



83-1670

Figure 18-1. Power Converter 1A11

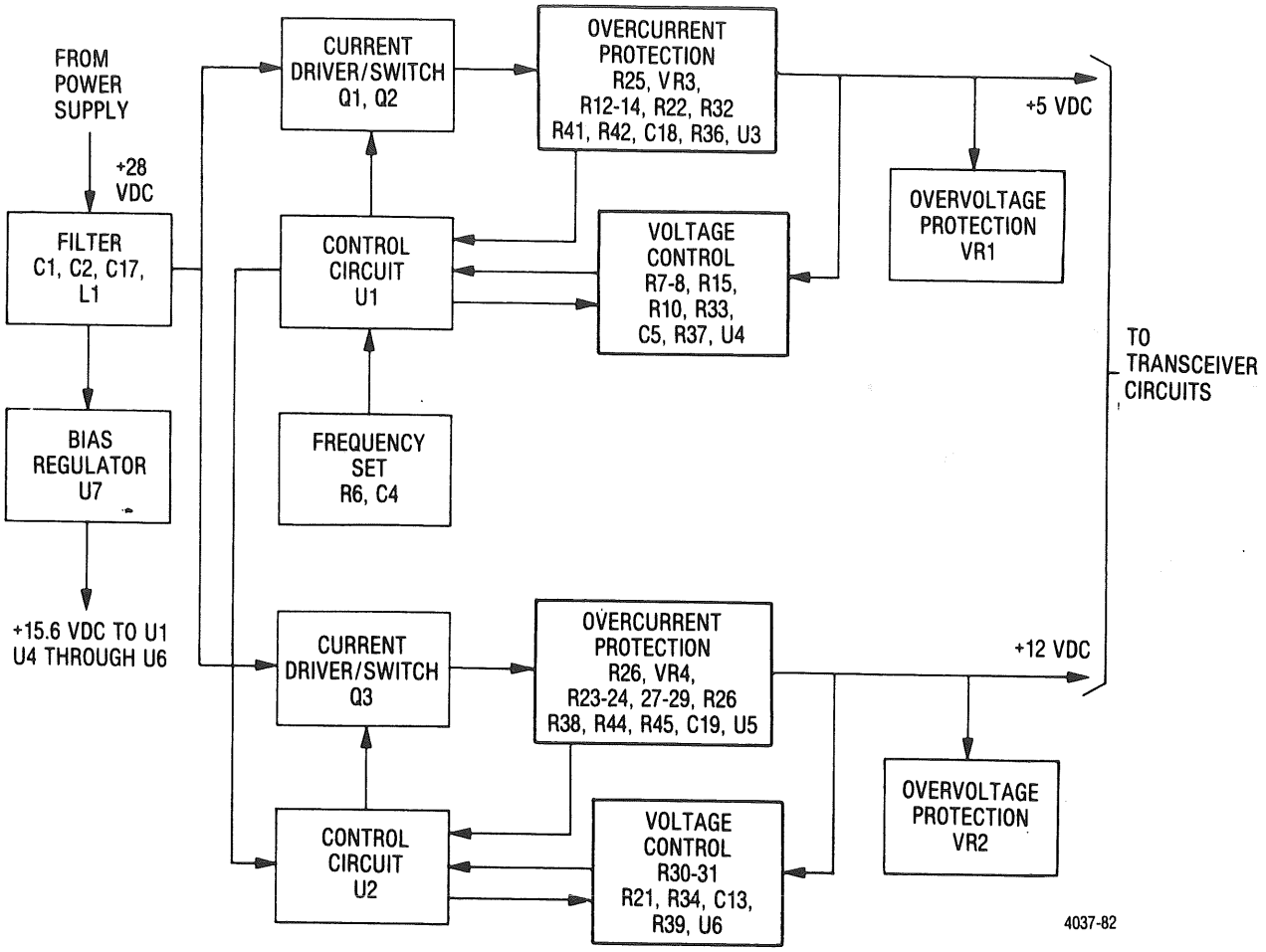


Figure 18-2. Power Converter 1A11 Block Diagram

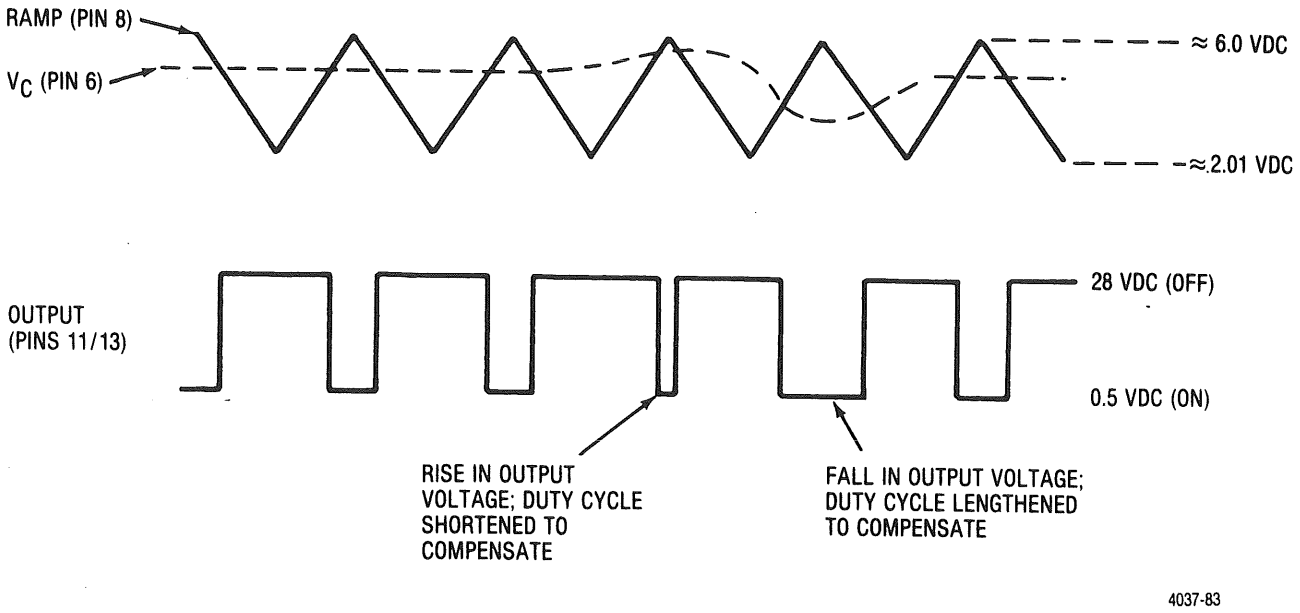


Figure 18-3. Control of Regulator Duty Cycle (U1)

18-11. +12 VDC REGULATOR

18-12. The +12 Vdc regulator consists of switching transistor Q3, control circuit U2 and voltage control loop consisting of operational amplifier U6 and its associated components. R21, R34 and C13 control loop response and C24, R30, R31 and R39 provide voltage sensing and feedback. Operation of the circuit is identical to that of the +5 Vdc regulator with the exception of the reference voltage used for comparison. R39 sets the necessary control voltage for +12 Vdc output. Overcurrent protection is provided by U5 and its associated components with current sensing by R26. This circuit is nominally set to limit at 750 mA. Diode VR2 prevents the +12 Vdc line from exceeding 14.4 Vdc.

18-13. POWER CONVERTER MAINTENANCE AND TROUBLESHOOTING

18-14. After a malfunction is isolated to the power converter, remove the module from the transceiver as instructed in Section 5, Paragraph 5-30; do not unsolder wires. With the power converter still electrically attached to the transceiver, troubleshoot the converter using the waveforms and signal levels shown on the schematic diagram, Figure 18-4. Replace the defective components using the parts location diagram, Figure 18-5, as a guide.

NOTES:

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. FOR COMPLETE DESIGNATIONS PREFIX WITH 1A11.

2. FOR REFERENCE DRAWINGS REFER TO:
   01-P02661R002 ASSEMBLY
   01-P03969T001 PWB ASSEMBLY

3. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTORS ARE IN OHMS ± 5 PCT, 1/4 WATT.
   ALL CAPACITORS ARE IN UF.
   ALL INDUCTORS ARE IN UH.
   ALL VOLTAGES ARE DC.

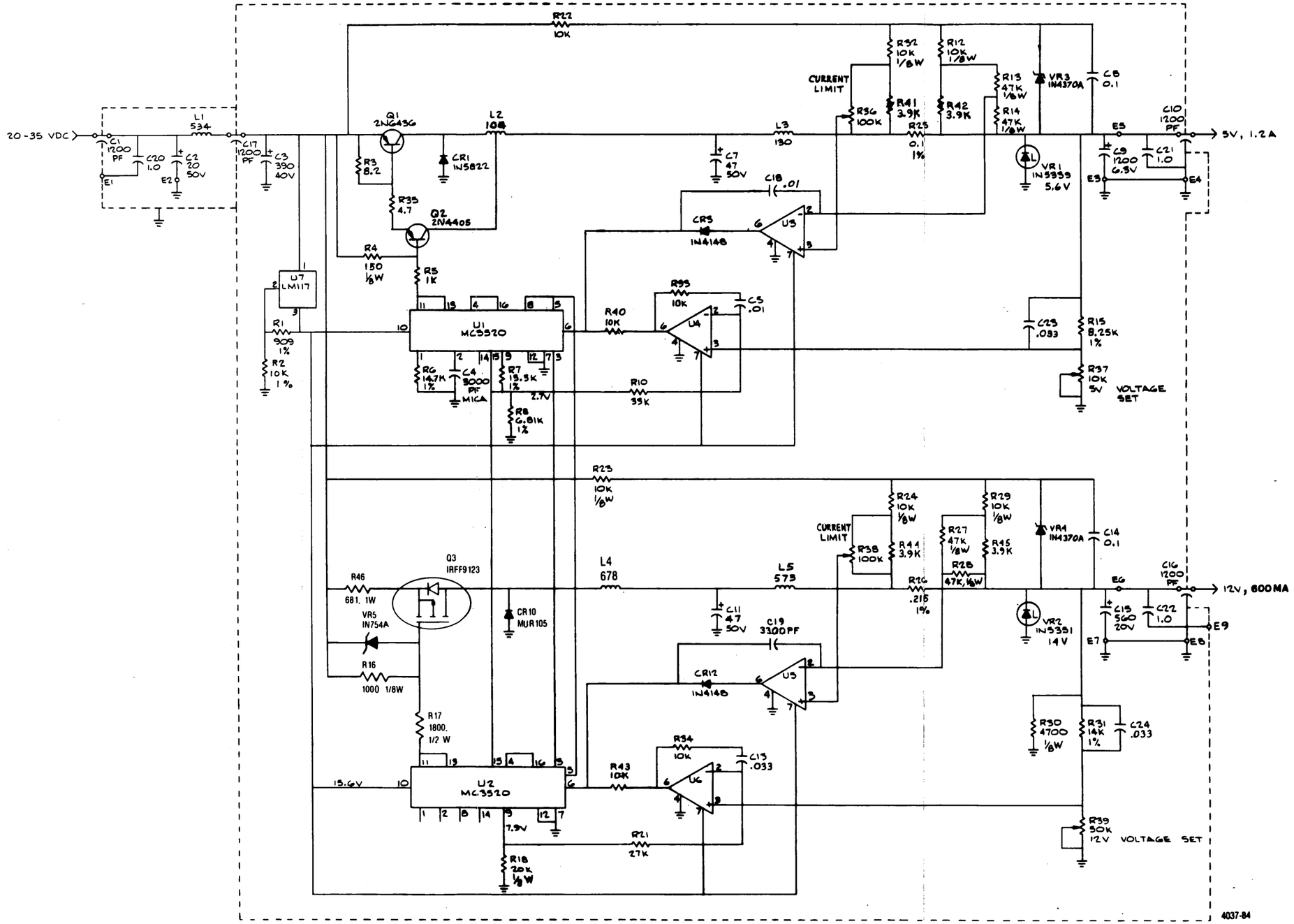


Figure 18-4. Power Converter 1A11 Schematic Diagram

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
			01-P02661R002	POWER CONVERTER	
001	1		84-P03952T001	PWB, POWER CONVERTER	
	1		01-P03969T001	PWB ASSY, POWER CONVERTER	
002	1		43-P07098L001	SPACER	
	1		15-P02665R002	COVER	
003	4		43-P07098L002	SPACER	
	1		15-P02667R002	HOUSING	
004	2		MS51957-15	SCREW	4-40x3/8
	3		MS51957-19	SCREW	4-40x3/4
005	2		NAS620C4L	WASHER	NO. 4
	5		MS35338-135	WASHER	NO. 4
006	2		MS35338-135	WASHER	NO. 4
	5		NAS620C4L	WASHER	NO.4
007	2		MS35649-244	NUT	4-40
	2	05820	260-4TH5B	HEAT SINK, TRANSISTOR	
	2		MS51957-13	SCREW	4-40x1/4
	1		14-P06720V001	INSULATOR	
	4		5610-37-40	WASHER, INSULATING	NO. 6
C 001	1		21-14071A14	CAPACITOR	1200PF-AMV-350
C 002	1	56289	TE-1305	CAPACITOR	20UF-10+75-50
C 003	1	56289	672D397H040DS5J	CAPACITOR	390UF-40V
C 004	1		CMR06F302J0DP	CAPACITOR	3000PF-5-500
C 005	1		M39014/01-1575	CAPACITOR	0.01UF-10-100
C 007	1	56289	500D476H050CC7	CAPACITOR	47UF-50V
C 008	1		M39014/01-1593	CAPACITOR	0.1UF-10-50
C 009	1	56289	672D128H6R3DS5J	CAPACITOR	1200UF-6.3V
C 010	1		21-14071A14	CAPACITOR	1200PF-AMV-350
C 011	1	56289	500D476H050CC7	CAPACITOR	47UF-50V
C 013	1		M39014/02-1343	CAPACITOR	0.033UF-10-100
C 014	1		M39014/01-1593	CAPACITOR	0.1UF-10-50
C 015	1	56289	672D567H020DS5J	CAPACITOR	560UF-20V
C 016	1		21-14071A14	CAPACITOR	1200PF-AMV-350
C 017	1		21-14071A14	CAPACITOR	1200PF-AMV-350
C 018	1		M39014/01-1575	CAPACITOR	0.01UF-10-100
C 019	1		M39014/02-1329	CAPACITOR	3300PF-10-200
C 020	1		2CZ5U105X0050C4	CAPACITOR	1 F
C 021	1		2CZ5U105X0050C4	CAPACITOR	1 F
C 022	1		2CZ5U105X0050C4	CAPACITOR	1 F
C 023	1		M39014/02-1343	CAPACITOR	0.033UF-10-100
C 024	1		M39014/02-1343	CAPACITOR	0.033UF-10-100
CR001	1		1N5822	DIODE	
CR003	1		JAN1N4148-1	DIODE	
CR010	1		MUR105	DIODE	
CR012	1		JAN1N4148-1	DIODE	
E 001	1		MS77070-5	TERMINAL	
E 004	1	79963	813-224	SOLDER LUG	
E 008, E 009	2	79963	813-224	SOLDER LUG	
L 001	1		24-P02666R001	COIL	0.531MH
L 002	1		24-P02666R006	COIL	0.104MH
L 003	1		24-P02666R003	COIL	0.13MH
L 004	1		24-P02666R007	COIL	0.678 MH
L 005	1		24-P02666R005	COIL	0.573MH
Q 001	1		2N6436	TRANSISTOR	
Q 002	1		2N4405	TRANSISTOR	
Q 003	1		IRFF9123	TRANSISTOR	
R 001	1		RNC55H9090FS	RESISTOR	909-1-1/10
R 002	1		RNC60H1002FS	RESISTOR	10K-1-1/8
R 003	1		RCR07G8R2JS	RESISTOR	8.2-5-1/4
R 004	1		RCR05G151JS	RESISTOR	150-5-1/8
R 005	1		RCR07G102JS	RESISTOR	1000-5-1/4
R 006	1		RNC60H1472FS	RESISTOR	14.7K-1-1/8
R 007	1		RNC60H1332FS	RESISTOR	13.3K-1-1/8

PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
R 008	1		RNC55H6811FS	RESISTOR	6810-1-1/10
R 010	1		RCR07G333JS	RESISTOR	33K-5-1/4
R 012	1		RCR05G103JS	RESISTOR	10K-5-1/8
R 013	1		RCR05G473JS	RESISTOR	47K-5-1/8
R 014	1		RCR05G473JS	RESISTOR	47K-5-1/8
R 015	1		RNC55H8251FS	RESISTOR	8250-1-1/10
R 016	1		RCR05G102JS	RESISTOR	1000-5-1/8
R 017	1		RCR20G182JS	RESISTOR	1800-5-1 2
R 018	1		RCR05G203JS	RESISTOR	20K-5-1/8
R 021	1		RCR07G273JS	RESISTOR	27K-5-1/4
R 022	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 023	1		RCR05G103JS	RESISTOR	10K-5-1/8
R 024	1		RCR05G103JS	RESISTOR	10K-5-1/8
R 025	1		RWR81SR100FR	RESISTOR	0.1-1-1
R 026	1		RWR81SR215FR	RESISTOR	0.215-1-1
R 027	1		RCR05G473JS	RESISTOR	47K-5-1/8
R 028	1		RCR05G473JS	RESISTOR	47K-5-1/8
R 029	1		RCR05G103JS	RESISTOR	10K-5-1/8
R 030	1		RCR05G472JS	RESISTOR	4700-5-1/8
R 031	1		RNC55H1402FS	RESISTOR	14K-1-1/10
R 032	1		RCR05G103JS	RESISTOR	10K-5-1/8
R 033	1		RCR07G102JS	RESISTOR	10K-5-1/4
R 034	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 035	1		RCR07G4R7JS	RESISTOR	4.7-5-1/4
R 036	1		18D83452F20	RESISTOR, VARIABLE	100K-20-1/2
R 037	1		18D83452F14	RESISTOR, VARIABLE	10K-20-1/2
R 038	1		18D83452F20	RESISTOR, VARIABLE	100K-20-1/2
R 039	1		18D83452F18	RESISTOR, VARIABLE	50K-20-1/2
R 040	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 041	1		RCR07G392JS	RESISTOR	3900-5-1/4
R 042	1		RCR07G392JS	RESISTOR	3900-5-1/4
R 043	1		RCR07G103JS	RESISTOR	10K-5-1/4
R 044	1		RCR07G392JS	RESISTOR	3900-5-1/4
R 045	1		RCR07G392JS	RESISTOR	3900-5-1/4
R046	1		RWR81SR661FR	RESISTOR	.681-1-1
U 001	1	04713	MC3520L	INTEGRATED CIRCUIT	
U 002	1	04713	MC3520L	INTEGRATED CIRCUIT	
U 003	1	18714	CA3140E	MICRO CIRCUIT	
U 004	1	18714	CA3140E	MICRO CIRCUIT	
U 005	1	18714	CA3140E	MICRO CIRCUIT	
U 006	1	18714	CA3140E	MICRO CIRCUIT	
U 007	1	27014	LM217H	INTEGRATED CIRCUIT	
VR001	1		1N5340B	DIODE, ZENER	6.0V
VR002	1		1N5351B	DIODE, ZENER	14V
VR003	1		JAN1N4370A	DIODE, ZENER	2.4V
VR004	1		JAN1N4370A	DIODE, ZENER	2.4V
VR005	1		JANIN754A	DIODE, ZENER	6.8V

NOTE

Absence of a code in the Code Ident. column indicates the item is a Military Part number, or industry standard number.

PARTS SUPPLIERS

Code Ident.	Name	Address
04713	Motorola Inc. Semiconductor Products Div.	5005 E. McDowell Rd. Phoenix, AZ 85036
18714	RCA Corp. Solid State	Fostoria Rd. Findley, OH 45840
27014	National Semiconductor Corp.	2900 Semiconductor Dr. Santa Clara, CA 95051
56289	Sprague Electric Co.	North Adams, MA 01247
79963	Zierick Mfg. Co.	Radio Circle Mt. Kisco, NY 10549

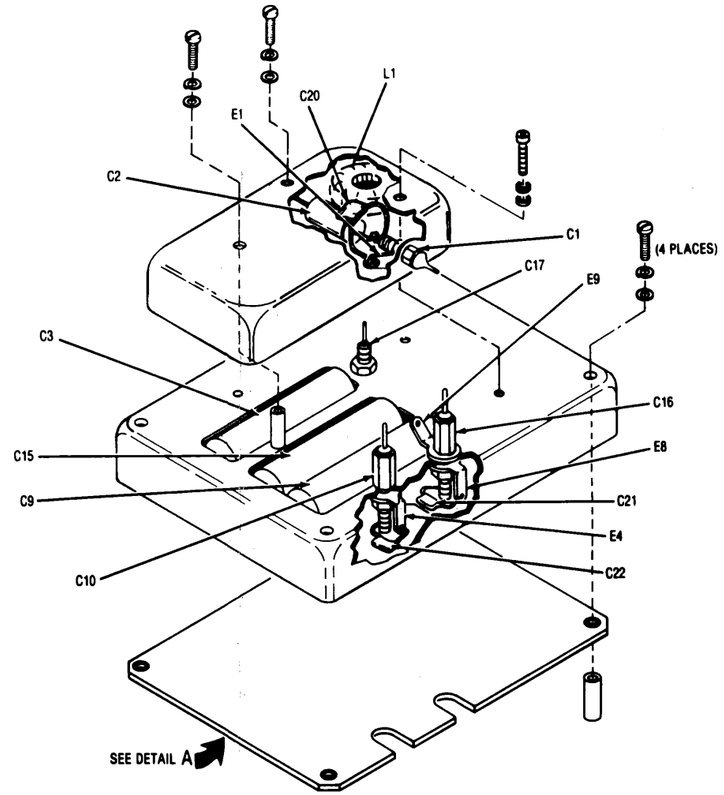


Figure 18-5. Power Converter 1A11 Parts Location Diagram

SECTION 19
RECEIVER UHF RF PREAMP 1A14

19-1. INTRODUCTION

19-2. This section contains the detailed description of the Receiver UHF RF Preamp 1A14 shown in Figure 19-2. This module is installed and wired to the bottom of the transceiver chassis. The preamp is a tuned rf filter and amplifier that delivers approximately 12 dB of gain from 225 to 400 MHz. This additional rf gain improves the receiver UHF sensitivity for satellite communications with an external satellite antenna connected to the UHF ANT connector on the transceiver front panel.

19-3. OPERATION. As shown in Figure 19-1, capacitors C1 through C5 and inductors L1 through L4 all form a high pass filter starting at 225 MHz. The UHF filter power sensor, FL2, on the transceiver chassis forms the upper frequency, 400 MHz cutoff. Together the preamp 1A14 and the UHF sensor FL2 form a 225 to 400 MHz bandpass filter. The uhf signal received from the antenna passes through the UHF filter power sensor FL2 to the XMT/RCV relay K1 to the high pass filter of 1A14 and is finally applied to U1 of the preamp 1A14. U1 delivers approximately 12 dB of gain which is applied to the UHF RCV input of the receive 1A5.

19-4. RECEIVER UHF RF PREAMP MAINTENANCE AND TROUBLESHOOTING

19-5. After a malfunction is isolated to the preamp 1A14, remove the module but do not disconnect any wires or cables as instructed in Section 5, paragraph 5-39. Troubleshoot the module using the schematic diagram in Figure 19-1. Replace defective components using the location diagram in Figure 19-2.

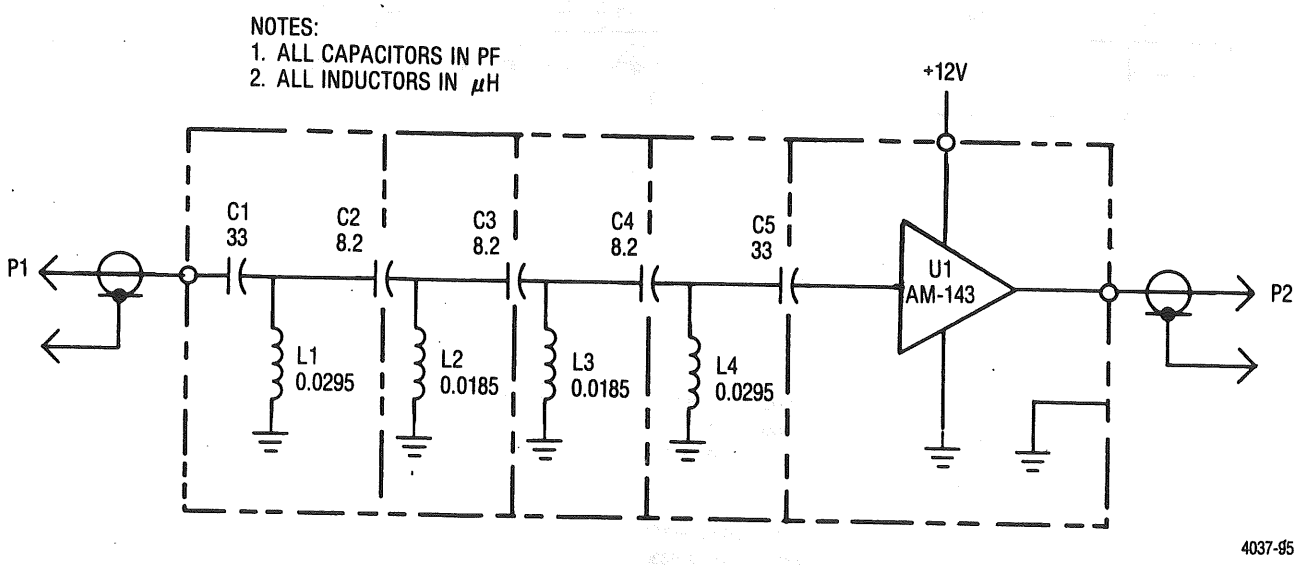
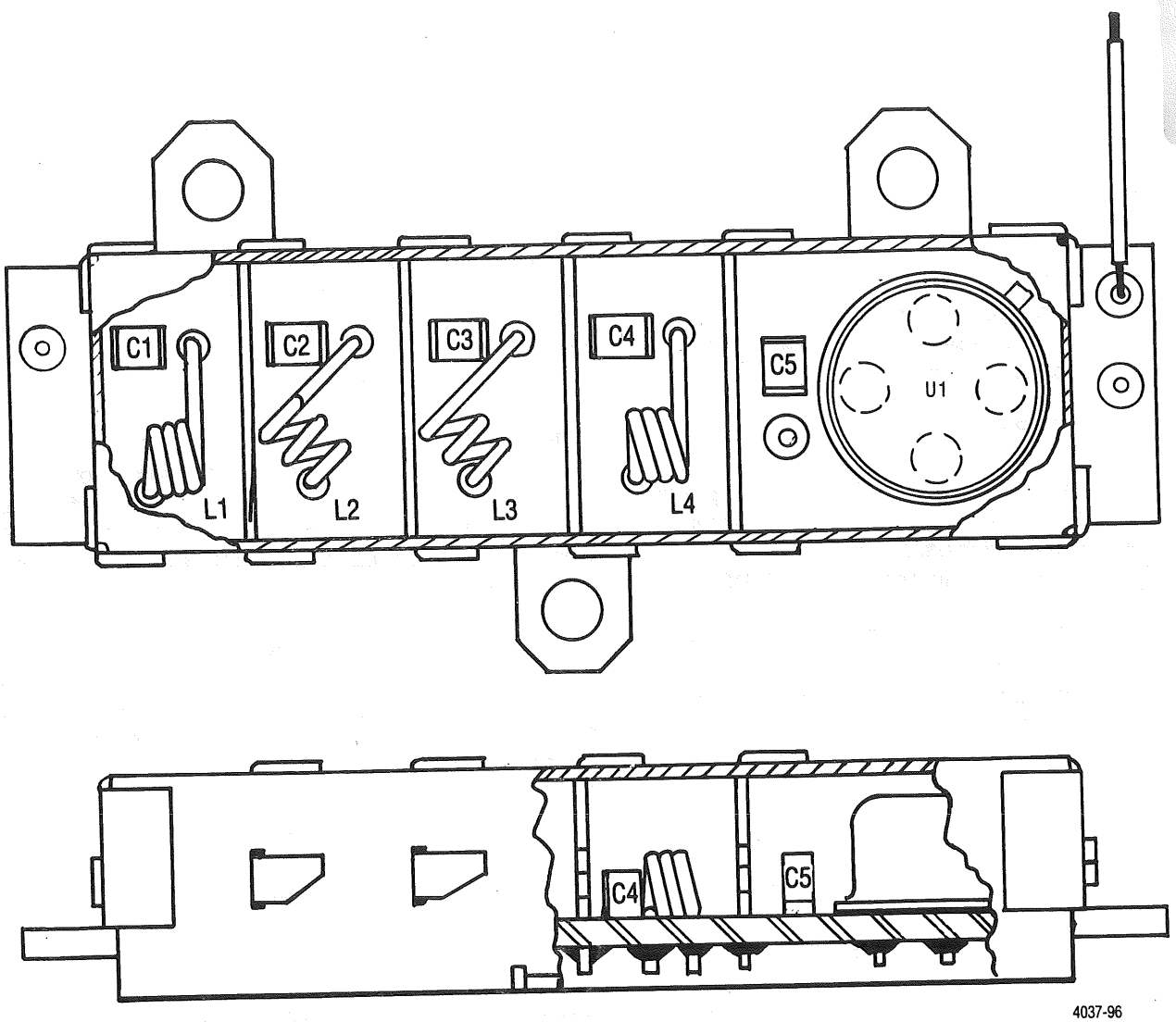


Figure 19-1. Receiver UHF RF Preamp 1A14 Schematic Diagram



PARTS LIST

Find No.	Qty. Req.	Code Ident.	Part Number	Nomenclature	Part Value
		94990	01-P03973T001	RCVR UHF RF	
001	1	94990	84-P03971T001	PRINTED WIRING BOARD	
002	1	94990	26-P03972T001	SHIELD	
003	1	94990	26-P03972T002	SHIELD	
004	1	94990	26-P03972T003	SHIELD	
005	1	94990	26-P03972T004	SHIELD	
006	1	94990	26-P03972T005	SHIELD	
C 001	1	29990	ATC100B330JP500	CAPACITOR	33PF-5-500
C 002	1	29990	ATC100B8R2KP500	CAPACITOR	8.2PF-10-500
C 003	1	29990	ATC100B8R2KP500	CAPACITOR	8.2PF-10-500
C 004	1	29990	ATC100B8R2KP500	CAPACITOR	8.2PF-10-500
C 005	1	29990	ATC100B330JP500	CAPACITOR	33PF-5-500
L 001	1	94990	24-P09960V001	INDUCTOR	
L 002	1	94990	24-P09960V002	INDUCTOR	
L 003	1	94990	24-P09960V002	INDUCTOR	
L 004	1	94990	24-P09960V001	INDUCTOR	
U 001	1	21912	AM-143	AMPLIFIER	

Figure 19-2. Receiver UHF RF Preamp 1A14 Parts Location Diagram