MOTOROLA

PORTABLE REPEATER

Instruction Manual

68P81021C95-O

FOREWORD

SCOPE OF INSTRUCTION MANUAL

This manual offers descriptive data and service information for the equipment listed. Service diagrams, parts lists, and printed circuit board details are either a part of this instruction manual, or contained in a supplementary service manual.

NOMENCLATURE

Motorola equipment is specifically identified by the model number on the nameplate.

NOTE

Be sure to use the entire model number when making inquiries about your equipment.

Identifiers have been assigned to chassis and kits. Use these identifiers when requesting information or ordering replacements.

PRODUCTION CHANGES

When production and engineering changes are incorporated into the equipment, a revision number is assigned to the chassis or kit affected; -1, -2, -3, etc.

The chassis number complete with revision number, if any, is stamped on the chassis at the time of production. The revision number becomes an integral part of the chassis identifier. Revisions, if any, are listed on the schematic diagram.

INSTRUCTION MANUAL REVISIONS

Changes which occur after an instruction manual is printed are described in the Instruction Manual Revision. These bulletins give the reader complete information on the change including pertinent parts listing data.

NATIONAL SERVICE ORGANIZATION

Motorola provides a nationwide service organization. Through its maintenance and installation program, Motorola makes available the finest service to those desiring reliable continuous communications on a contract basis.

Motorola's National Service Organization is the largest service organization specializing in mobile communications. It includes over 800 independently owned and operated service stations, strategically located and manned by a staff of several thousand FCC licensed personnel.

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For your contract service requirements, please contact your local Motorola representative or write to:

National Service Manager
Motorola Communications Group
1301 Algonquin Road, Schaumburg, IL 60172

SAFETY INFORMATION

The United States Department of Labor, through the provisions of the Occupational Safety and Health Act of 1970 (OSHA), has established an electromagnetic energy safety standard which applies to this equipment. Proper use of this radio will result in exposure below the OSHA limit.

DO NOT operate the transmitter of a mobile radio when someone outside the vehicle is within two feet (0.6 meter) of the antenna.

DO NOT operate the transmitter of any radio unless all RF connectors are secure and any open connectors are properly terminated.

DO NOT hold the transmit (PTT) switch on when not actually desiring to transmit.

DO NOT allow children to play with any radio equipment containing a transmitter.

DO NOT operate a transmitter near unshielded electrical blasting caps or in an explosive atmosphere unless it is a type especially qualified for such use.

LIST OF ILLUSTRATIONS

MODEL CHART

CODE:

[X] = ONE SUPPLIED

[A] = ALTERNATE ITEM SUPPLIED; CHOICE DEPENDANT ON OPERATING FREQUENCY

[+] = QUANTITY SUPPLIED AS REQUIRED

P44SYS3180BT	P44SXS3180BT	P44SYS1180BT	P44SXS1180BT	P43SYS3180BT	P43SXS3180BT	P43SYS1180BT	P43SXS1180BT	ITEM	DESCRIPTION
UHF PL REPEATER	UHF PL REPEATER (DVP)	UHF REPEATER	UHF REPEATER (DVP)	VHF PL REPEATER	VHF PL REPEATER (DVP)	VHF REPEATER	VHF REPEATER (DVP)		
				A	A	A	A	PRD1001A	RECEIVER BOARD AND CABLE (136-150.8 MHz)
				A	A	A	A	PTD1021A	TRANSMITTER BOARD AND CABLE (136-150.8 MHz)
				A	A	A	A	PRD1002A	RECEIVER BOARD AND CABLE (150.8-162 MHz)
				A	A	A	A	PTD1022A	TRANSMITTER BOARD AND CABLE (150.8-162 MHz)
				A	A	A	A	PRD1003A	RECEIVER BOARD AND CABLE (162-174 MHz)
				A	A	A	A	PTD1023A	TRANSMITTER BOARD AND CABLE (162-174 MHz)
A	A	A	A					PRE1000A	RECEIVER BOARD AND CABLE (403-430 MHz)
A	A	A	A					PTE1021A	TRANSMITTER BOARD AND CABLE (403-430 MHz)
A	A	A	A					PRE1001A	RECEIVER BOARD AND CABLE (440-470 MHz)
A	A	A	A					PTE1022A	TRANSMITTER BOARD AND CABLE (440-470 MHz)
A	A	A	A					PRE1002A	RECEIVER BOARD AND CABLE (470-512 MHz)
A	A	A	A					PTE1023A	TRANSMITTER BOARD AND CABLE (470-512 MHz)
				+	+	+	+	KXN1040B	CHANNEL ELEMENT, VHF RECEIVE
				+	+	+	+	KXN1041A	CHANNEL ELEMENT, VHF TRANSMIT
+	+	+	+					KXN1067B	CHANNEL ELEMENT, UHF RECEIVE/TRANSMIT
X	X	X	X					NLE6973A	OFFSET OSCILLATOR, UHF (24.4 MHz)
X	X	X	X	X	X	X	X	NMN6071B-SP5	SPEAKER - MICROPHONE
X	X	X	X	X	X	X	X	PAN6000A	ANTENNA
X		X	X	X	X	X	X	PBN6007A	PACKING
				A	A	A	A	PFD6000A	DUPLEXER (134-142 MHz)
				A	A	A	A	PFD6001A	DUPLEXER (142-150.8 MHz)
				A	A	A	A	PFD6002A	DUPLEXER (150.8-162 MHz)
				A	A	A	A	PFD6003A	DUPLEXER (162-174 MHz)
X	X	X	X					PFE6000A	DUPLEXER, UHF
X	X	X	X	X	X	X	X	PHN6004A	CASE
				X	X	X	X	PKD6000A	RF CABLING, VHF
X	X	X	X					PKE6000A	RF CABLING, UHF
X	X	X	X	X	X	X	X	PKN6015A	AC POWER CORD
X	X	X	X	X	X	X	X	PKN6016A	DC POWER CORD
X	X	X	X	X	X	X	X	PKN6017A	INTERCONNECT CABLE
		X			X		X	PLN1015A	CONTROL BOARD (DVP)
X			X	X		X		PLN1036A	CONTROL BOARD (CLEAR)
X	X	X	X	X	X	X	X	PLN6170A	NAMEPLATE
		X			X			PLN6173A	ESCUTCHEON AND KNOB (DVP, PL)
			X				X	PLN6169A	ESCUTCHEON AND KNOB (DVP)
			X			X		PLN6265A	ESCUTCHEON AND KNOB (CLEAR)
X				X				PLN6266A	ESCUTCHEON AND KNOB (CLEAR, PL)
X	X	X	X	X	X	X	X	PLN6294A	BOTTOM PLATE
X	X	X	X	X	X	X	X	PLN6296A	TOP PANEL
X	X	X	X	X	X	X	X	PLN6297A	EXTERIOR HARDWARE
X	X	X	X	X	X	X	X	PNN6001A	INTERNAL BATTERY
X	X	X	X	X	X	X	X	PPN6001A	POWER SUPPLY (115 V)
				A	A	A	A	PTD1001A	POWER AMPLIFIER (150.8-174 MHz)
				A	A	A		PTD1031A	POWER AMPLIFIER (136-150.8 MHz)
A	A	A	A					PTE1001A	POWER AMPLIFIER (440-512 MHz)
				X	X			PLN6174A	PL SWITCH
A	A	A	A					PTE1031A	POWER AMPLIFIER (403-430 MHz)
									EPF-10313-O

CONTENTS

SPECIFICATIONS

GENERAL (ALL MODELS)	VHF	UHF
Coded/Clear Model Series:	P43SXS	P44SXS
Clear-Only Model Series:	P43SYS	P44SYS
Channel Spacing:	30 kHz	25 kHz
Squelch:	Carrier/"Private-Line"	
Number of Frequencies:	8	
Size (excluding handle):	13" x 18" x 7" (470-512 MHz models with 3 MHz separation 13" x 18" x 7¾")	
Weight (including accessories):	34 lbs.	
Operating Range:	–30°C to +60°C; +25°C ref.	
Power Supply:	120 ±20% Vac (50-60 Hz), 13.8 Vdc, Internal backup battery, (240 Vac, 50-60 Hz optional)	
Current Drain*	**115 Vac**	**13.8 Vdc**
High Power Tx:	2 A	9 A
Low Power Tx:	0.5 A	1.5 A
Standby:	0.5 A	0.2 A
*With non-repeater channel, add 0.3 A at 13.8 Vdc.		
Emergency Battery		
Capacity:	1 hour min. (at continuous duty)	
Charge Time:	14 hours max.	

Frequency Range (MHz)	VHF 136-174 MHz	UHF 406-420, 450-470 MHz	UHF 470-512 MHz
Repeat Freq. Separation (R-T):	3 MHz min.	5 MHz min.	3 MHz min.
Repeat Freq. Spread, Receiver:	300 kHz	300 kHz	300 kHz
Repeat Freq. Spread, Transmitter:	300 kHz	300 kHz	300 kHz

SECURITY (CODED/CLEAR MODELS ONLY)	
Scrambler Type:	Digital
Coding Method:	Multi-register non-linear combiner
Number of Codes:	2.36×10^{21} unique codes
Synchronization:	Self-synchronizing (no preamble required)
Code Key Initialization:	Random
Code Key Generation:	External hand-held microprocessor-controlled code inserter
Code Storage:	Volatile electronic memory
Number of Codes Per Radio:	One
Analog-to-Digital Conversion:	Continuously-variable slope delta modulation (CVSD)
Voice Sample Rate:	12 kilobits/sec.

TRANSMITTER	VHF	UHF
Rf Power Output Repeater Channel (High/Low):	20/1.4 Watts	12/0.8 Watts
Frequency Spread (duplexer by-passed):	12 MHz	6 MHz
Spurious and Harmonics:	–71 dB	–59 dB
Rf Frequency Stability:	±0.0005% at 25°C ref.	±0.0005% at 25°C ref.
Modulation		
Clear:	16F3, 15F2, 16F9	16F3, 15F2, 16F9
Coded:	20F3Y	20F3Y
Fm Noise:**	60 dB	60 dB
Audio Response:**	+1–3 dB from 6 dB/octave pre-emphasis from 1000 Hz to 3 kHz	+1–3 dB from 6 dB/octave pre-emphasis from 1000 Hz to 3 kHz
Audio Distortion:**	5%	5%

RECEIVER	VHF	UHF
Modulation Acceptance:**	±7.5 kHz	±7.5 kHz
Sensitivity**		
20 dB Quieting Rptr:	0.75 uV	0.75 uV
12 dB SINAD Rptr:	0.525 uV	0.525 uV
Selectivity (EIA SINAD):	90 dB	85 dB
Intermodulation (EIA SINAD):	80 dB	75 dB
Frequency Stability (–30°C to +60°C; +25°C ref.):	±0.0005%	±0.0005%
Spurious and Image Rejection:	80 dB	80 dB
Audio Output:**	500 mW	500 mW

**Specifications applies to clear mode only. Performance in the coded mode has been tailored to deliver optimum intelligibility and voice recognition.

FCC DESIGNATIONS***	VHF	UHF
Transmitter	CC3367	CC4325
Receiver	RC0280	RC0282

***DVP unit licensable under FCC rules and regulations Part 90 for police and fire services. Clear-only units licensable under FCC rules and regulations Parts 21, 74, 90, and 95. For international use, local PTT regulations apply.

SECTION 1
DESCRIPTION

1-1. INTRODUCTION

The portable repeater is designed to meet the needs of radio users who have unique coverage requirements. When highly mobile units cannot be effectively serviced by fixed repeaters, the portable equipment provides an alternative in systems use so that as these units move about, they can carry this compact repeater with them. The unit can then be set up quickly and easily, establishing a base/repeater site within minutes. The limited coverage of a direct portable-to-portable system can thereby be expanded to that of a full repeater system. The complete repeater and all its accessories are contained in a single case measuring only 18 inches by 13 inches by 7 inches, and can be carried and set up by one person.

1-2. OPERATING FEATURES

a. Coded (DVP) or Clear Mode

The repeater is fully compatible with both clear fm and DVP (digital voice protection) scrambler systems. In the repeat mode, it will handle either coded or clear messages automatically without operator switching.

b. Low and High Power Modes

Rf power output is switchable between low and high power modes of operation. In vhf models, power outputs of 1.4 and 20 watts are available, while in uhf models, power outputs of 0.8 and 12 watts are available. Full voltage-standing-wave-ratio (VSWR) protection is provided in all models.

c. Universal Power Supply Capabilities

Multiple power supply inputs permit the repeater to be adapted to a variety of field situations with differing power sources. Either a 12-volt dc source or a 115-volt ac, 50-60 Hz source can be accommodated. Optionally available is a 230-volt ac, 50-60 Hz input capability.

d. Emergency Internal Battery

An internal 8-volt battery is provided so that in the event of an ac power failure, the repeater will revert automatically to low power operation. Upon return to primary ac power availability, the unit will return to high power output and begin recharging the battery.

e. Local Speaker-Microphone

This feature permits local control of the repeater for dispatch operation. Local control has priority over the repeater path.

f. Eight-Channel Operation

Up to eight channels are provided with any combination of repeater, simplex, and base channels. The unit can be configured to operate as a repeater, talk simplex to field units, or talk through another repeater as if it were a field unit.

g. Magnetic Mount Antenna

The magnetic mount antenna can be mounted on the removable case lid and located at a site removed from the repeater (for example, a hotel window or roof). This generally improves coverage over a fixed antenna position.

h. Weather-Resistant Case

The briefcase-sized closed weather-resistant case allows the repeater to be operated from roof tops or other exposed sites, increasing its flexibility in meeting various site environments.

i. Switch-Around Relays

The switch-around relays are available as an optional item (option H950) and provide for the switching of rf signals around the duplexer, when transmitting or receiving on a frequency that the duplexer would otherwise reject.

j. Optional Items

The Model Chart lists all the standard items normally supplied with the various repeater models. Several optional items are also available in which items are added or substituted for the standard items; refer to Table 1-1 for a complete list of these options.

Table 1-1. Portable Repeater Options

OPTION	DESCRIPTION	BAND	ADD	DELETE
H112AH	Omit Antenna	–		PAN6000A Antenna
H142AJ	Omit Speaker-Microphone	–		NMN6071B-SP5 Speaker-Microphone
H207AJ	Omit Internal Battery	–		PNN6001A Battery
H303AA	Add Dual Code (PL)	–	PLN6177A Esc. & Knob (DVP, PL, 2 Code) PLN6268A Dual Code Switch	PLN6173A Esc. & Knob (DVP, PL)
H303AB	Add Dual Code (C.S.)	–	PLN6264A Esc. & Knob (DVP, C.S., 2 Code) PLN6268A Dual Code Switch	PLN6169A Esc. & Knob (DVP, C.S.)
H304AA	Add Proper Code Detect	–	TRN6794A PCD Module	
H305AA	External Duplexer	Vhf	PKN6027A Rf Cable, Ext. Duplexer	PKD6000A Rf Cable, Repeat PFD6000A, PFD6001A, PFD6002A, PFD6003A Duplexer, Vhf
H305AB	External Duplexer	Uhf	PKN6027A Rf Cable, Ext. Duplexer	PKE6000A Rf Cable, Repeat PFE6000A Duplexer, Uhf
H748AB	Add Spare Encode/Decode Hybrid Module	–	TRN6777A Encode/Decode Hybrid Module	
H934AC	Omit Rf High Power	Uhf		PTE1000A, PTE1031A P.A. Assembly
H934AD	Omit Rf High Power	Vhf		PTD1001A, PTD1031A P.A. Assembly
H937AB	Delete Ac Supply	–	PKN6023A Int. Cable, dc only	PKN6017A Int. Cable PKN6015A Ac Power Cord PPN6001A Power Supply
H947AA	Add 240 Vac	–	PLN6167A 240 V Transformer	
H949AA	Substitute 3 MHz Offset	Uhf	NLE6972A Offset Osc., 26.4 MHz PFE6001A Duplexer, 3 MHz PHN6005A Case, Large PLN6295A Bottom Brkt, Large	NLE6973A Offset Osc., 24.4 MHz PFE6000A Duplexer, 5 MHz PHN6004A Case, Small PLN6294A Bottom Brkt, Small
H950AA	Duplexer Switch-Around Relays	Uhf	PLN1037A Switch-Around Relay Bank PKE6003A Rf Cable, Switch-Around	PKE6000A Rf Cable, Repeat
H950AB	Duplexer Switch-Around Relays	Vhf	PKD6003A Rf Cable, Switch-Around PLN1037A Switch-Around Relay Bank	PKD6000A Rf Cable, Repeat
H954AA	Base-Only Operation	Vhf	PKN6026A Rf Cable, Base-Only PLN1044A Base-Only Relay	PKD6000A Rf Cable, Repeat PFD6000A, PFD6001A, PFD6002A, PFD6003A Duplexer, Vhf
H954AB	Base-Only Operation	Uhf	PKN6026A Rf Cable, Base-Only PLN1044A Base-Only Relay	PKE6000A Rf Cable, Repeat PFE6000A Duplexer, Uhf

SECTION 2
OPERATION

2-1. CONTROLS AND FUNCTIONS

Figures 2-1 through 2-3 illustrate the various operational controls and functions provided on the repeater for setup and operation. A complete description of each control, switch, indicator, and connector is given in the following paragraphs.

a. **Controls and Switches (Figure 2-1)**

- On/Off/Charge Switch

  This power switch has three positions. In the On position, the repeater power is on and, if external power is present, the battery is charged. In the Off position, all power is off; however, in coded (DVP) units the code is maintained by a small internal code storage battery. In the Charge position, the ac power is applied and the battery is charged, but no power is supplied to other parts of the repeater.

- 115/230 V Switch

  This recessed slide switch selects the appropriate ac primary power source. Once the switch is set by moving it with a small screwdriver or other object, it will remain in the selected position without any danger of accidental movement. In either position of this switch, if external dc power is used, it will power the repeater accordingly.

- Frequency (Channel) Select Switch

  This is an 8-position rotary switch which selects the desired operating channel. Functionally, this switch also provides for connecting dc operating voltages to the receiver and transmitter and protective diodes are used for isolation between channel elements and the repeater (Rptr) On/Off switch; i.e., by cutting out a diode, a specific channel position can be designated as a base-station-only channel (repeater function is inhibited).

  Other functions controlled by this switch are transmitter and/or receiver duplexer switch-around options. In this case, a diode can be removed at the factory so that a specific channel is programmed to use the transmitter (or receiver) duplexer leg for repeater operation. By leaving the diode for that channel in, the transmitter (or receiver) duplexer leg is bypassed by energizing the necessary relays during transmit (or receive).

- Squelch Control

  This control mutes (squelches) background noise and reduces unwanted signals. Depending on repeater model, the squelch control can be jumpered for carrier squelch or for PL squelch or for both. In the latter case, the repeater will not key until both squelches are open.

- Volume Control

  Controls the audio volume level of the local speaker.

- Hi/Lo Power Switch

  Selects either high or low rf power output for repeater or base operation.

- Rptr On/Off Switch

  This switch is active only for a channel which has been programmed for repeater operation. It inhibits the repeater key function when the switch is in the Off position.

- PL On/Off Switch

  This switch is present only in PL models. With the switch in the Off position, the unit reverts to carrier squelch operation, allowing, for example, channel monitoring. However, it controls more than just the one normal function; i.e., the correct PL tone is required for both receive and repeat operations. Also, with the Proper Code Option (H304), the PL function may be programmed to require reception of the correct DVP code to enable repeater operation. The PL tone will always be transmitted in clear transmissions, independent of this switch position.

- Code 1/2 Switch

  This switch is a local control function that selects the code that is transmitted or received. Code 2 is a subcode of code 1. When loading the code, a verification tone is heard in either position of this switch.

- Pvt/Std Mode Switch

  This switch is a local control function that is active during transmit operation only. It selects either clear (Std) or coded (Pvt) mode of operation.

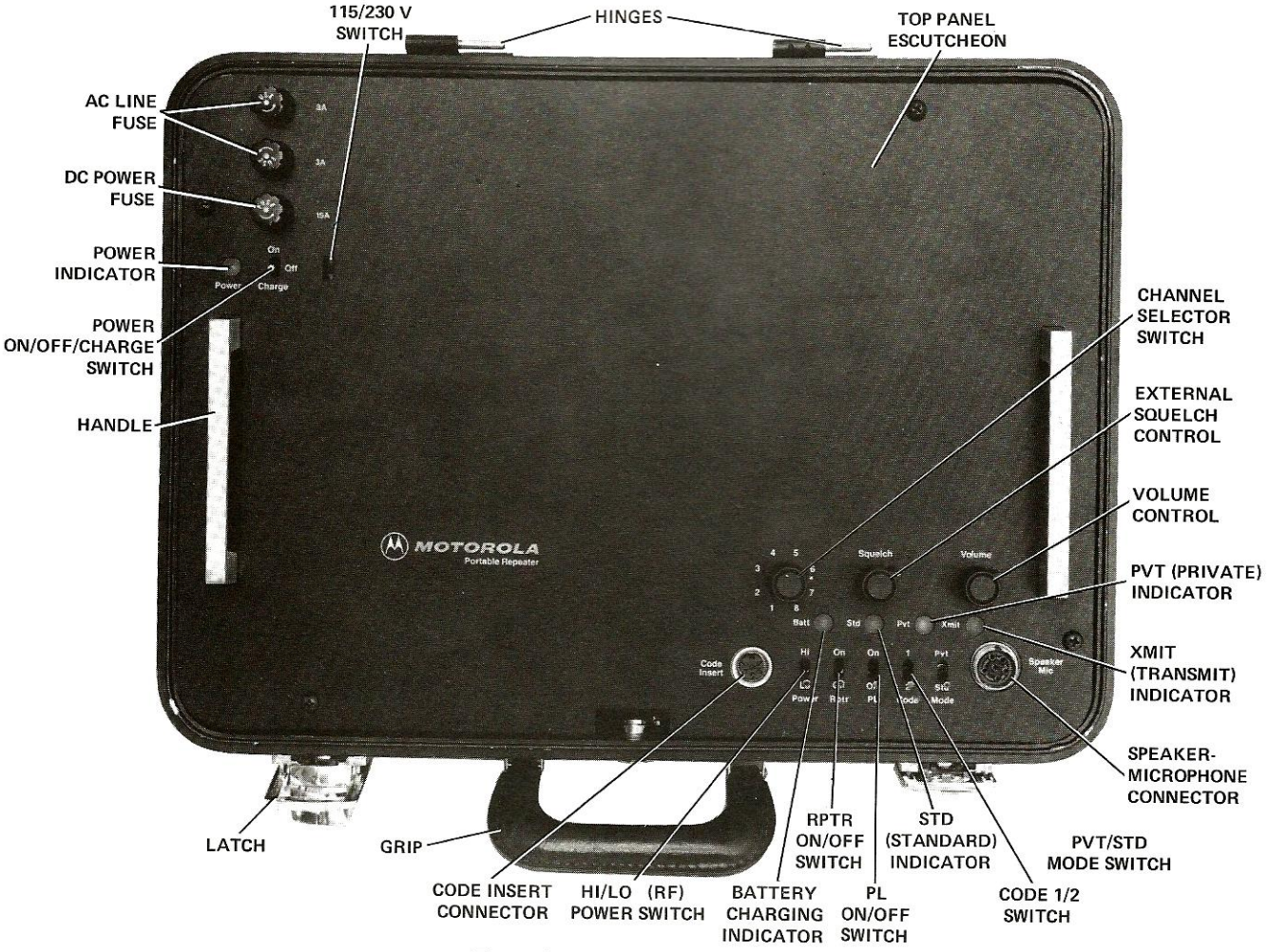


Figure 2-1. Top Panel Controls

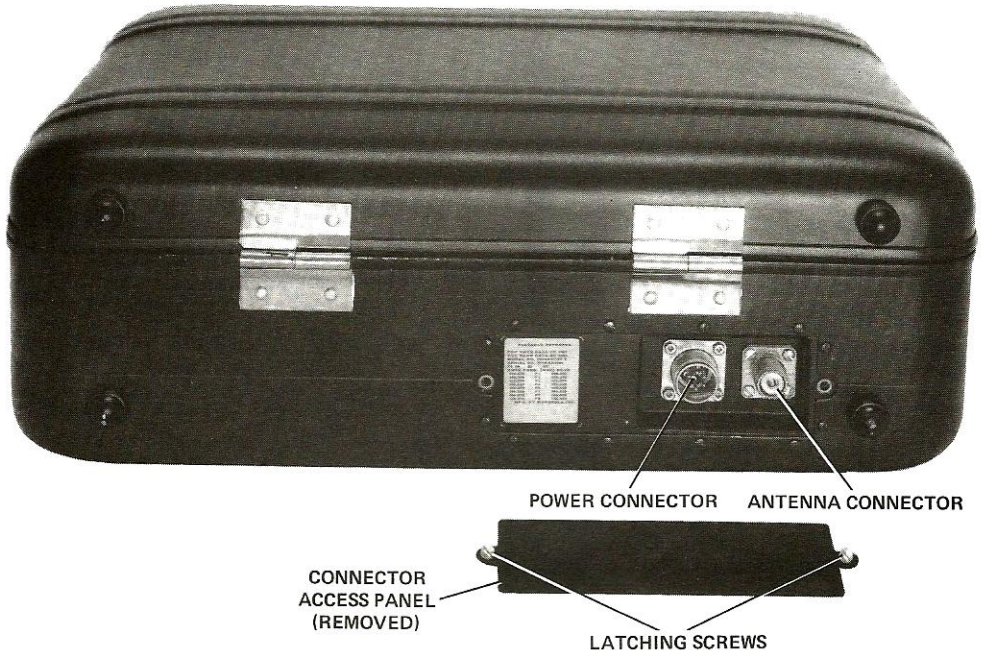


Figure 2-2. Rear Panel Connectors

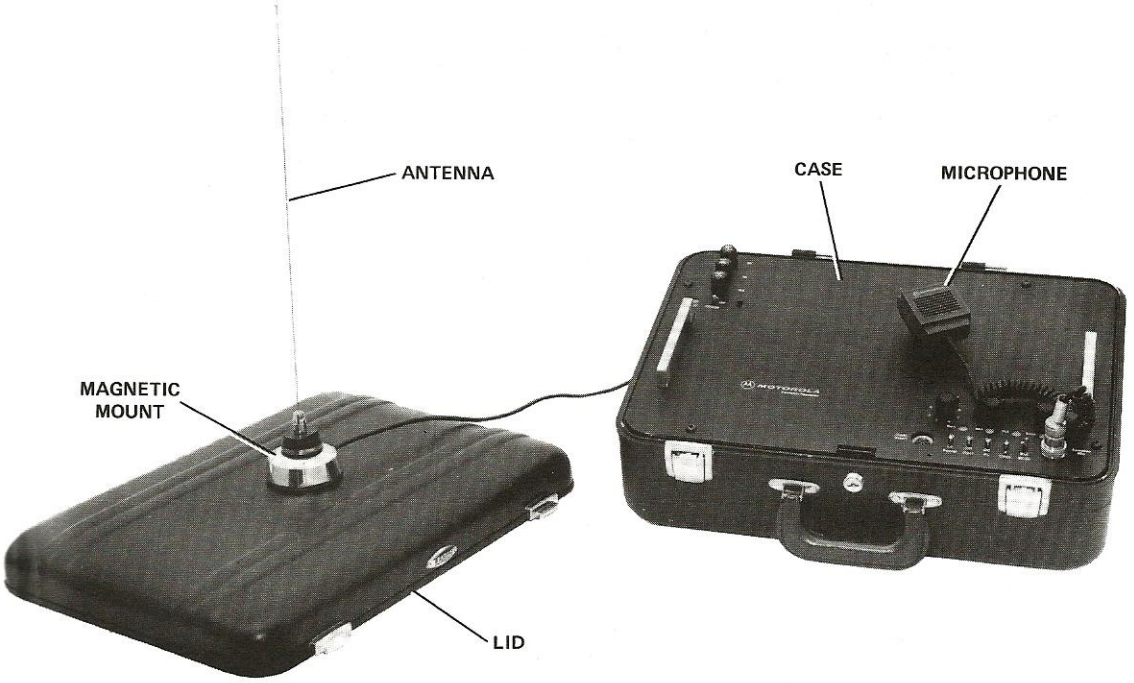


Figure 2-3. Magnetic Mount Antenna

b. Indicators (Figure 2-1)

- Power Indicator

  Lights when the On/Off/Charge switch is in the On or Charge position.

- Batt Indicator

  Lights when the On/Off/Charge switch is in the On or Charge position and the battery is being charged. Light goes out when battery is fully charged.

- Std Indicator

  Lights when the unit is operating in the clear (Std) receive mode (independent of PL operation).

- Pvt Indicator

  Lights when the unit is operating in the coded (Pvt) receive mode (independent of proper code).

- Xmit Indicator

  Lights whenever the unit is transmitting.

c. Connectors (Figures 2-1 and 2-2)

- Power Input Connector

  This is a 5-contact connector on the rear panel. Input primary ac or dc power is applied to the repeater through this connector.

- Antenna Connector

  This is an rf connector on the rear panel for connecting the antenna to the repeater.

- Speaker/Mic Connector

  This is a 6-contact connector on the top panel for connecting the local speaker-microphone. When the unit is used as a base station, an operator can transmit by pressing the push-to-talk (PTT) switch on the microphone.

- Code Insert Connector

  This is a 5-contact connector on the top panel for connecting DVP code programming input cable.

2-2. OPERATING PROCEDURES

a. Set the On/Off/Charge switch to the Off position.

b. Connect input operating power to the rear panel connector. If ac line power is used, set the 115/230 V switch to the appropriate position, corresponding to the available ac power source.

NOTE

In an emergency situation in the absence of a suitable ac or dc input power source, the unit's internal 8-volt battery may be used to power the repeater for up to one hour transmitting time at low power output. In a standby mode, up to eight hours operating time is available from the battery.

c. Connect the antenna cable to the rf connector on the rear panel. Verify that the antenna whip wire is cut to proper length for frequency of use. For best performance, place the antenna as high as practicable and provide the best possible ground plane. The detachable case top may be used if no better ground plane is available; see Figure 2-3. By providing a good antenna location, adequate range may be obtained even in low power output applications.

d. Connect the speaker/microphone unit to the Speaker/Mic connector on the top panel of the repeater case.

e. For coded (DVP) models, connect the programming cable from the code generating unit to the Code Insert connector on the top panel of the repeater. Program the unit per instructions supplied with the P1001 Code Generator.

NOTE

In order to hear the verification tone when programming a DVP unit, the Speaker/Mic unit must be connected.

f. Set the controls on the top panel as follows:

On/Off/Charge Switch:	On
Frequency (Channel) Select Switch:	Set to desired channel
Squelch Control:	Maximum counter-clockwise position that keeps the Std indicator extinguished
Volume Control:	Set to desired listening level
Hi/Lo Power Switch:	Set to Lo position unless it is determined that high transmitter power output is required
Rptr On/Off Switch:	Set to On if a repeat operation is desired (functional only if a repeater channel is selected)
PL On/Off Switch:	Set to On position; channel may be monitored by setting switch to the Off position
Code 1/2 Switch:	Set to desired code select position
Pvt/Std Mode Switch:	Set to Pvt position if transmitting locally and coded transmissions are desired. Switch has no effect during receive or repeat operation.

SECTION 3
THEORY OF OPERATION

3-1. GENERAL

The portable repeater consists of the following principal functional components; refer to Figure 3-1:

- Rf Power Amplifier
- Rf Switch-Around Relays
- Duplexer
- Transmitter
- Receiver
- Power Supply
- 8-Volt Battery
- 9-Volt Regulator
- Main Control Board

Briefly, the main function performed by each of the component blocks illustrated in Figure 3-1 can be stated as follows. The rf power amplifier receives an rf output from the transmitter of about two watts and amplifies it to about 30 watts. The duplexer allows the transmitter and receiver to share the same antenna and contains two notch filters to prevent the transmitter from de-sensing the receiver in repeater operation.

Normal ac line power for the unit (nominally 117 volts) is converted to a primary power of 13.8 volts dc for operating the unit. A back-up 8-volt battery is also provided for use in the absence of ac primary power. The 9-volt regulator is used in the battery charging circuit, radio board and some control board functions. Overall control, switching, and timing functions are handled by a combination of digital and analog circuitry on the main control board. Part A of Figure 3-1 shows the functional units used in the vhf models, while part B shows the uhf counterparts. Complete schematic diagrams for all major units of both models are contained at the back of this manual; refer to Figures 5-1 through 5-17. These diagrams should be referenced during the following detailed circuit descriptions.

3-2. PRIMARY POWER SOURCE

The repeater is designed to operate from an external ac line (117 or 230 volts) or an external dc source of 13.8 volts. A simplified diagram of the primary power supply is shown in Figure 3-2. For ac operated units, power is applied via a connector on the back of the case. The fused (3 amperes) input line is then connected to a slide switch which selects either 117- or 230-volt operation. A step-down autotransformer is switched into the circuit in the 220-volt position of the slide switch. The On/Off/Charge switch connects the input power to the power supply circuit in the On or Charge position of the 3-position toggle switch. Protection against ac line surges is provided by the gas tube surge suppressor which is designed to breakdown between 300 and 500 volts. Any abnormal line variations are thereby short-circuited around the power supply.

The power supply converts the ac input power to a dc output rated at 13.8 volts and 9 amperes. Conversion efficiency is better than 80%. As shown in Figure 3-2, the dc voltage is routed through the power connector and 15-ampere fuse to provide both a continuous operating voltage, for the rf amplifier, and a switched voltage, for the rest of the repeater circuits.

In case of loss of primary power, an 8-volt internal battery provides back-up operating power. In this mode, the Hi-Lo Power switch is inactive and only low power operation is possible. The red Batt indicator lights to indicate that the internal battery is being charged. This occurs automatically whenever external power is provided and the On-Off-Charge power switch is in the On or Charge position.

3-3. DUPLEXER

Six helical resonant cavities make up the duplexer. Three are connected between the transmitter and the antenna ports and three are connected between the receiver and the antenna. Each cavity can be tuned to act as a short circuit at a particular frequency. Figure 3-3 illustrates a duplexer arrangement in which the transmitter carrier frequency is higher than the receiver carrier frequency; for the opposite case, the transmitter and receiver ports are simply reversed.

The transmitter cavities are tuned to be series resonant at the receiver carrier frequency, which maximizes the attenuation of transmitter sideband noise. To minimize insertion loss of the transmitter carrier power, the transmitter cavities are tuned to be parallel resonant at the transmitter carrier frequency. Tuning the receiver cavities to be series resonant at the transmitter carrier frequency and parallel resonant at the receiver carrier frequency maximizes attenuation of the transmitter carrier and minimizes insertion loss of the receiver signal.

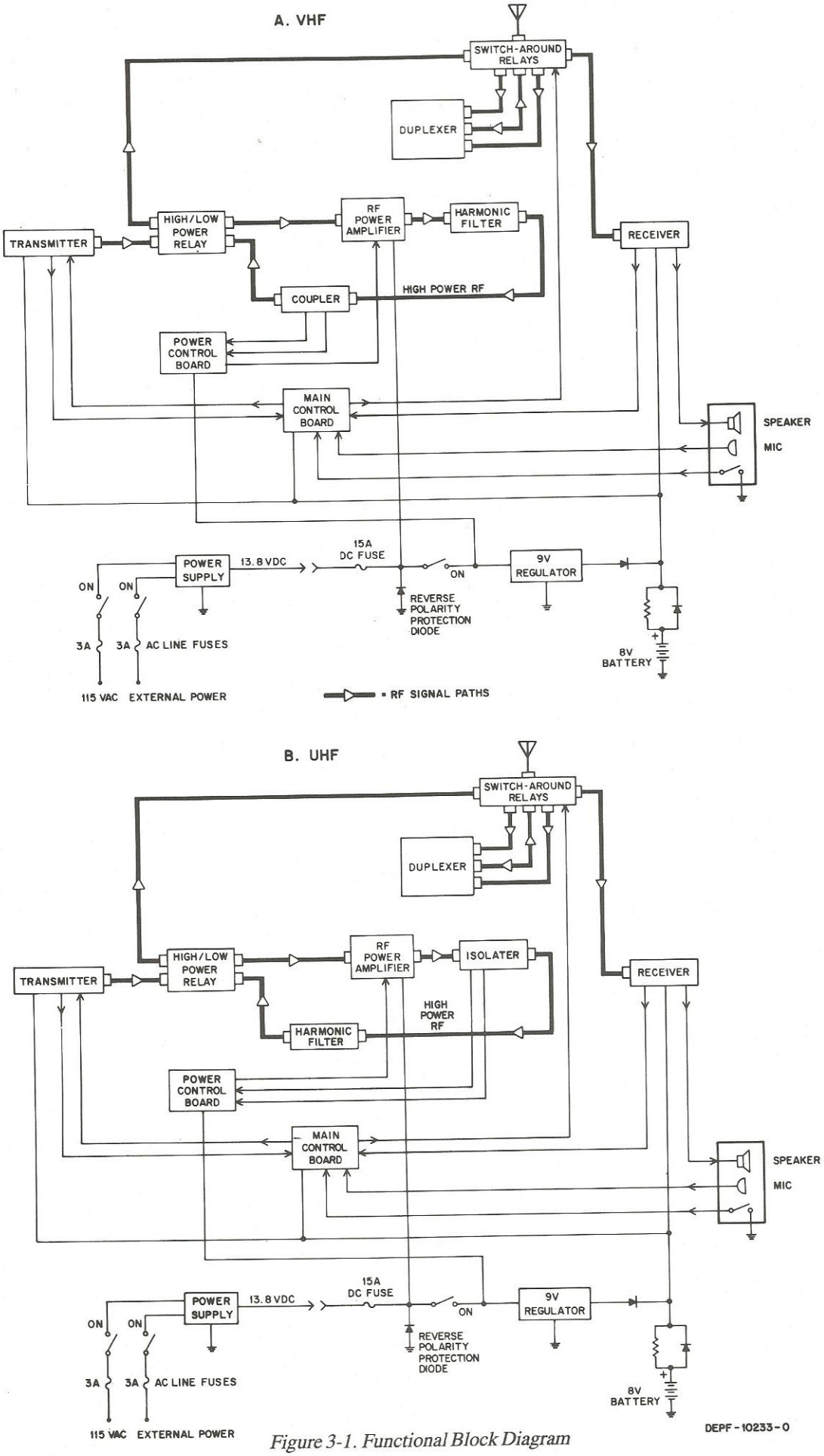


Figure 3-1. Functional Block Diagram

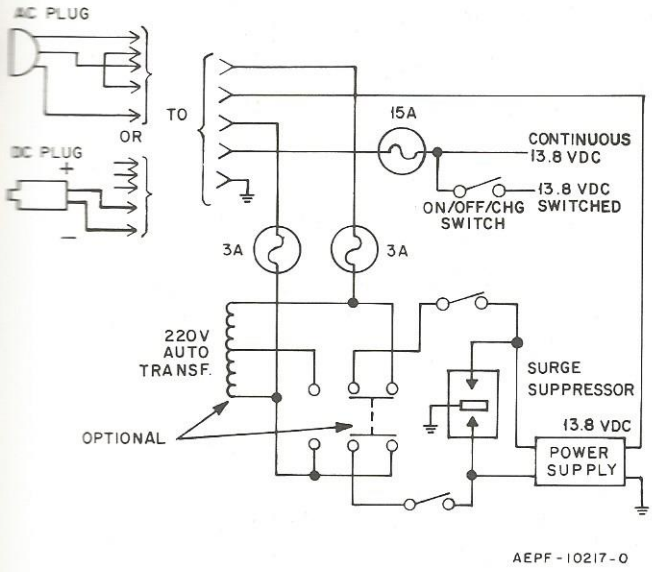


Figure 3-2.
Power Supply Simplified Schematic Diagram

The overall effect of this arrangement is to allow transfer of transmitter power to the antenna, and to allow the received signal at the antenna to reach the receiver, with only 1.5 dB loss. At the same time, the transmitter carrier and sideband noise are prevented from reaching the receiver with at least a 75 dB attenuation factor.

3-4. SWITCH-AROUND RELAYS (OPTIONAL)

There are five switch-around reed-type relays that switch rf signals around the duplexer, when transmitting or receiving on a frequency that the duplexer would otherwise reject. As shown in the simplified diagram in Figure 3-4, the relays are configured as SPST devices with the diagonal contact normally closed and the other contact normally open. They are activated by logic signals originating on the main control board.

When none of the relays are energized, the duplexer is in the rf signal path of the receiver and transmitter and the radio is configured as a repeater. When relays K1 and K2 are energized, the transmitter is switched around the duplexer and the radio can transmit on any frequency. When relays K3, K4, and K5 are energized, the receiver is switched around the duplexer and the radio can receive on any frequency. There is no case when all five relays are energized simultaneously.

The operation of the relays is controlled by the frequency select switch, the programming diodes in the TX-SA IN and RX-SA IN fields on the main control board, and the keyed 9 V line from the transmitter. The TX-SA IN diodes are left in place if the transmitter is to be switched around the duplexer, while the RX-SA IN diodes are in if the receiver is to be switched. For repeater operation, on some position of the frequency select switch, both diodes in that position must be removed.

Operation of the relay control circuit is such that if the RX-SA IN diode selected by the frequency select switch is installed and the transmitter is not keyed, then relays K3, K4, and K5 are energized and the receiver is switched around the duplexer. Otherwise, these relays are not energized. If the TX-SA IN diode selected by the frequency select switch is installed and the transmitter is keyed, then K1 and K2 are energized and the transmitter is switched around the duplexer.

3-5. RF POWER AMPLIFIER

The rf power amplifier consists of a high-low power relay, a two-transistor amplifier, an isolator (uhf only), a harmonic filter, and a power control board. These components are mounted on an enclosed heat sink bolted to the bottom of the repeater case. A partial schematic diagram of the rf amplifier circuitry is shown in Figure 3-5. A two-watt output from the transmitter is connected to the power relay which is a reed relay with three contacts arranged in a Z configura-

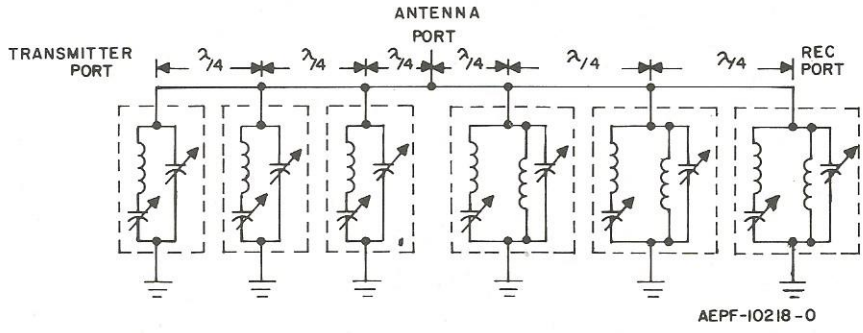


Figure 3-3. Duplexer Simplified Schematic Diagram

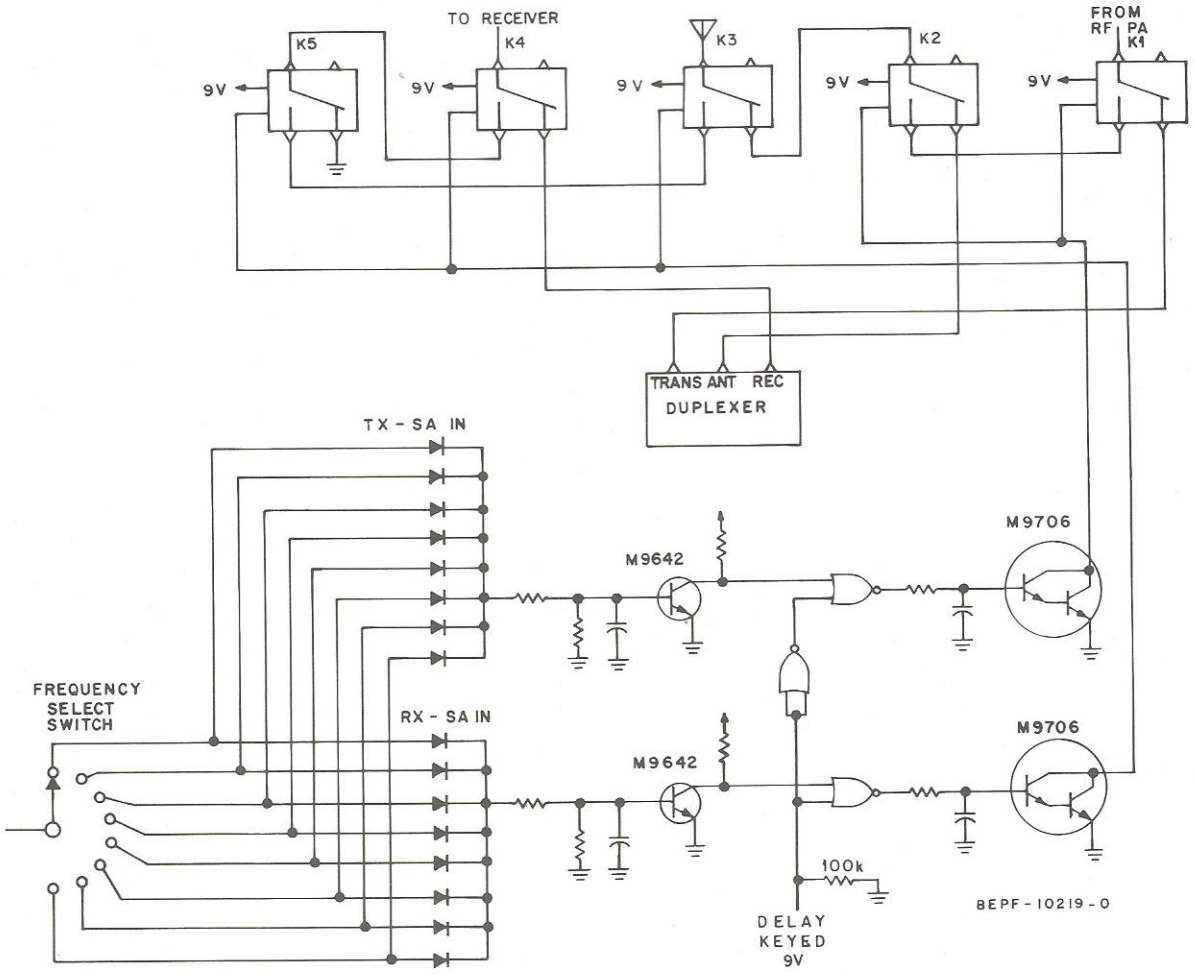


Figure 3-4.
Switch-Around Relays Simplified Schematic Diagram

tion; i.e., the diagonal contact is normally closed and the other two are normally open. When the relay is unenergized, the signal is connected to the power amplifier which, in turn, provides 40 watts of rf power to the isolator (uhf only) or directly to the harmonic filter (vhf only).

On uhf models, the isolator provides two sense voltages that represent forward and reflected power, as well as isolation between the power amplifier and the load. It is essentially a ferrite circulator with three ports and can be tuned to provide a 50-ohm impedance match with the following harmonic filter. The filter is a seven-pole, low-pass passive circuit that attenuates the carrier harmonics. From the filter, the signal is fed back through the power relay which, when energized, provides a path to the amplifier output.

Circuits on the power control board include a thermistor input and provide for forward and reverse power sense voltages and a delayed push-to-talk (PTT) signal. An output from this board controls the power amplifier so that when the delayed PTT line is high, the output of the power amplifier is reduced to a minimum. This action provides for a "soft" start-up of the power amplifier when it is keyed. When the transmitter is keyed, the delayed PTT line goes low and results in raising the output voltage until the rf power output is at the desired level. In this condition, the radio operates in normal fashion.

If some malfunction occurs and causes a high VSWR on the power amplifier output line, then the reverse power sense voltage increases until it triggers a circuit on the power

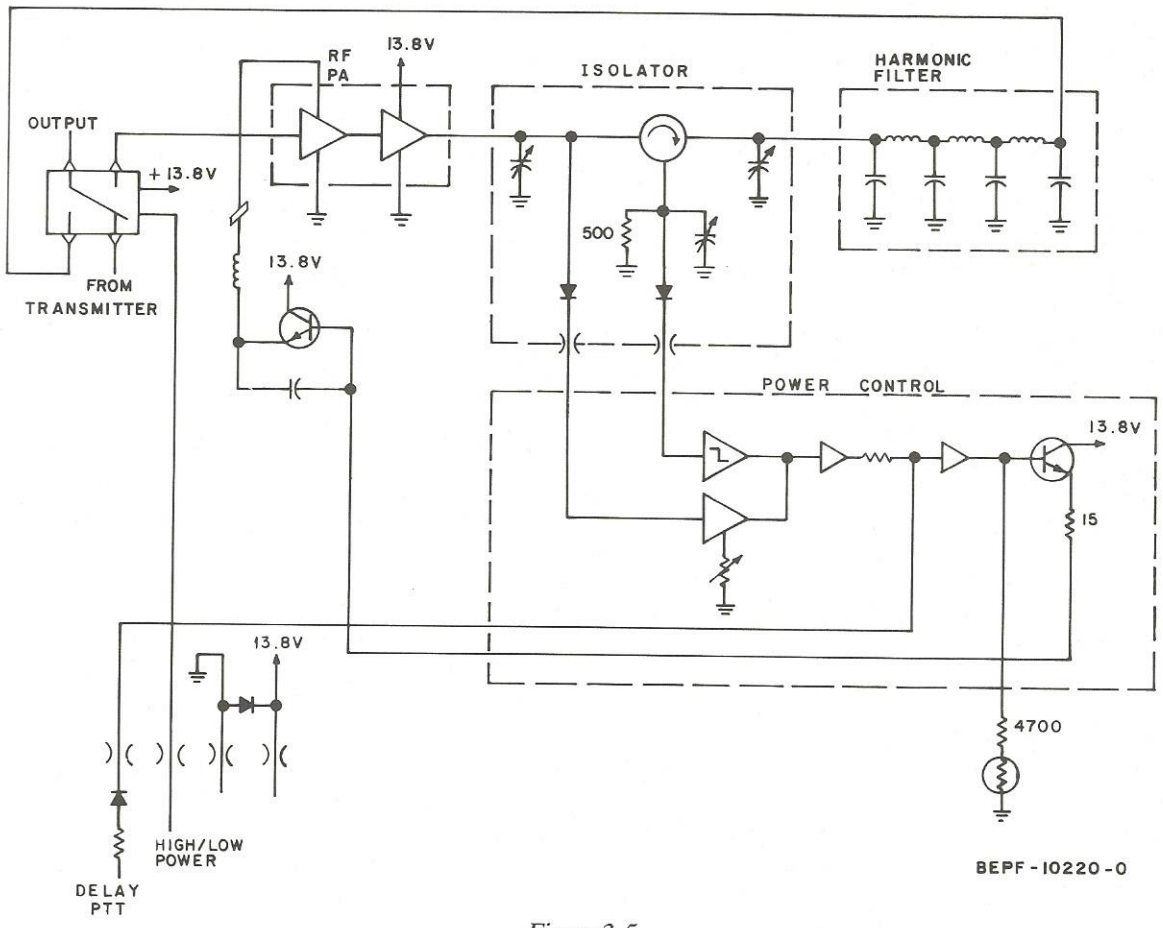


Figure 3-5.
Rf Power Amplifier Circuits Simplified Schematic Diagram

control board which reduces the output power level. This action continues as long as the high VSWR condition persists. Also, abnormally high temperature levels in the power amplifier are detected by the input thermistor circuit on the power control board. This results in decreased output power until the temperature level returns to normal.

A reverse protection diode protects the radio against any inadvertent polarity reversals when it is operated from an external 13.8-volt dc supply. Normally the diode is reverse biased and does not conduct. If the polarity is reversed, the diode conducts enough current to blow the 15-ampere dc fuse.

For vhf models, the isolator is not used. Instead, a coupler circuit is used between the harmonic filter output and feedback path to the power control relay. This is a passive circuit that functions as a power sensing bridge that detects forward power and reflected power from the load.

Figure 3-6 shows the overall rf signal paths for both the vhf and uhf models and should help in readily discerning the differences between the two units.

3-6. EIGHT-VOLT BATTERY AND NINE-VOLT REGULATOR CIRCUITS

Back-up power is provided by an eight-volt, lead-acid, gel-type battery. A nine-volt regulator circuit (contained within a TO-3 package) provides the charging source for the battery; refer to Figure 3-7 for a partial schematic diagram of the regulator circuit.

When the On/Off/Charge switch is in the On position or the Charge position, the regulator has 13.8 volts (from the main power supply) connected to it. This voltage is then regulated to about 9.8 volts at the output where there are two diode paths. One diode circuit path provides power to the

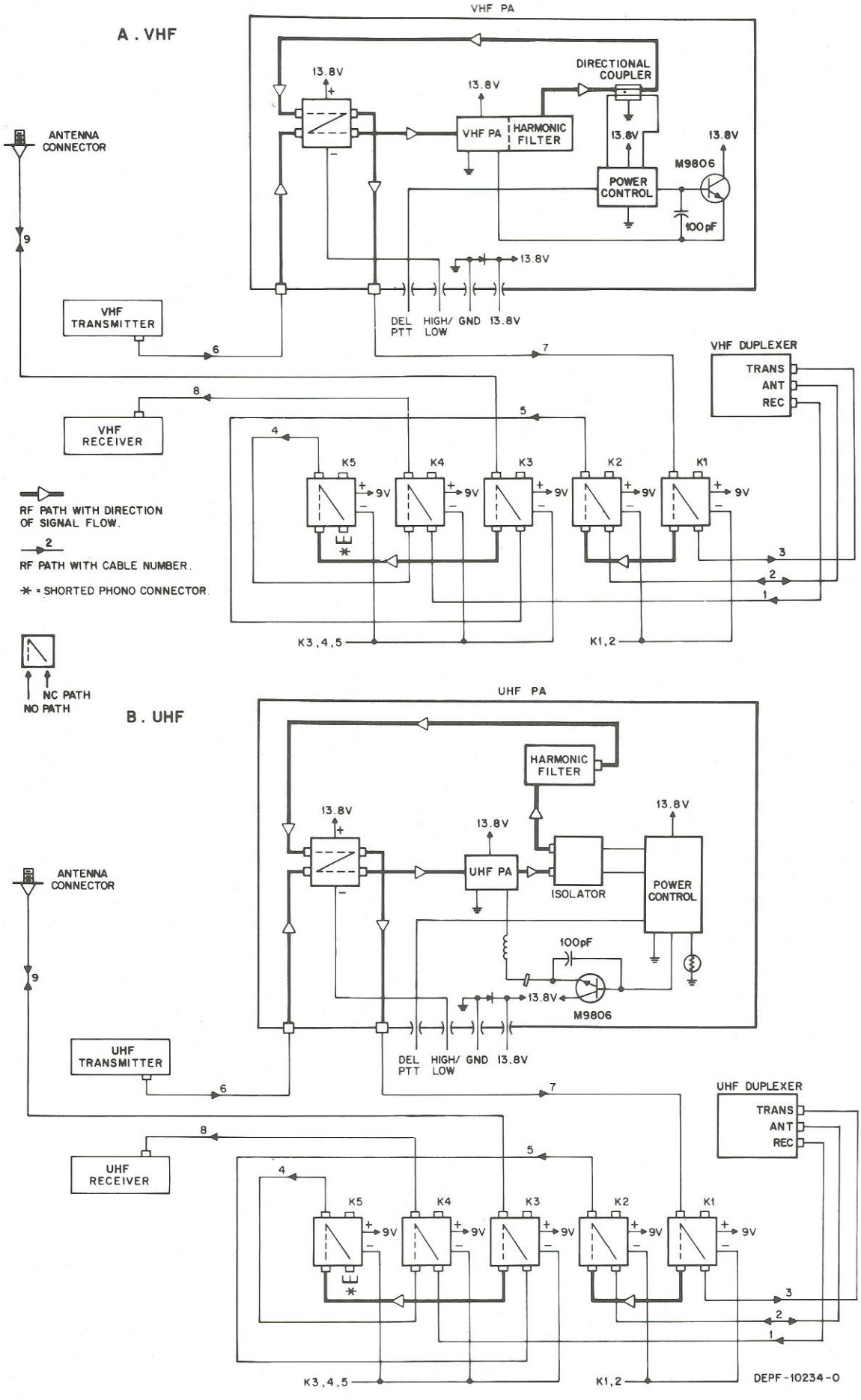


Figure 3-6. RF Signal Paths for Vhf and Uhf Units With Optional Switch-Around Relays

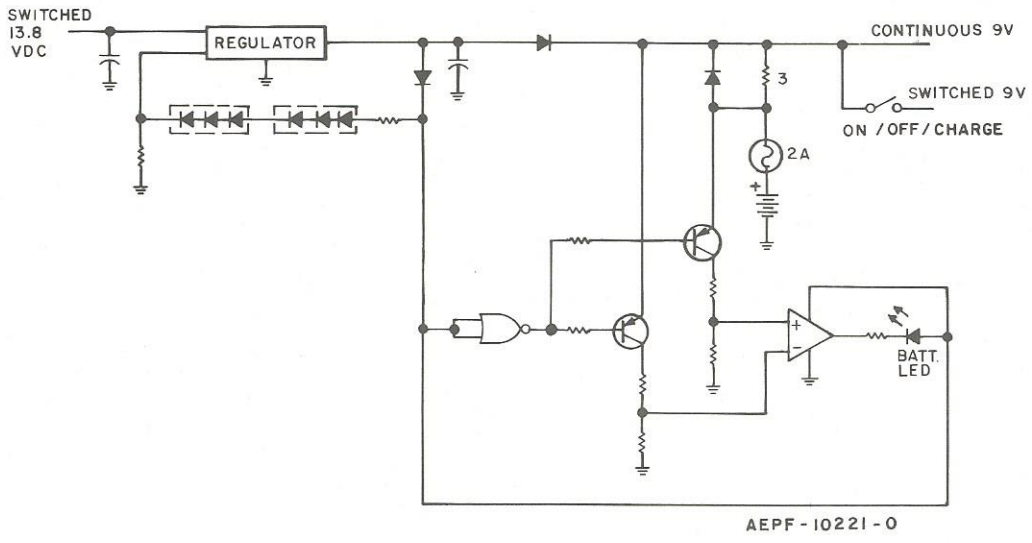


Figure 3-7. Regulator Circuit Simplified Schematic Diagram

Batt indicator while the other diode provides power to the battery charging circuit, the switch-around relays, the main control board, the transmitter, and the receiver.

The eight-volt battery is charged through a three-ohm resistor to limit the charge current and provide a current sense for the battery indicator circuit. This circuit senses the voltage drop across the resistor and turns on the Batt (LED) indicator as long as the voltage drop is more than 150 millivolts.

The continuous 9-volt output is available to charge the battery as long as the On/Off/Charge switch is in the On or Charge position. The switched 9-volt output from the regulator circuit is supplied to other circuits in the radio and is available only when the On/Off/Charge switch is in the On position.

3-7. VHF RECEIVER

The vhf receiver consists of an input rf amplifier or filter, the appropriate number of channel elements (depending on the number of carrier frequencies or channels in the radio), a preselector, two i-f filters and amplifiers, a discriminator crystal and detector hybrid module, and an audio power amplifier. Optional tone PL circuit modules may be included on the receiver board; refer to Figure 5-2.

The received signal at the antenna is coupled through the antenna jack to relay K101 which directs the rf signal, through coaxial cable, to U1 (rf amplifier or filter). Preselector A1 consists of a four-pole bandpass filter, mixer U2, multiplier U3, and the three-pole bandpass filter. The input rf signal from U1 is applied to the four-pole bandpass filter and then to mixer stage U2. The other input to the mixer is obtained from multiplier circuit U3 and the three-pole bandpass filter. The injection signal from U3 is equivalent to twice the frequency of the appropriate channel element output (local oscillator signal f_o). Unwanted harmonics in this signal are removed by the three-pole bandpass filter. The mixer output signal is the first i-f frequency at 21.4 MHz.

Crystal filters FL1 and FL2 form a bandpass filter centered at 21.4 MHz and have an overall bandwidth of about 13 kHz with a maximum insertion loss of 2 dB. The first i-f amplifier (U4) is a hybrid module with a frequency bandpass between 10 and 30 MHz and a gain of 45 dB. Dc operating voltage for this stage is applied only during the receive operating mode. The output from U4 is applied to crystal filters FL3 and FL4, which operate the same as FL1 and FL2 and provide additional i-f bandpass selectivity. Amplifier U5 provides both amplification and limiting of the i-f signal. A gain of 90 dB is obtained and any amplitude modulation in the signal is removed, providing a constant level output. Because of the high overall gain of the module, limiting occurs even with low noise level inputs.

The amplified i-f signal from U5 is applied to crystal discriminator FL5, which is a three-pole device that provides two complementary outputs corresponding to the input signal frequency changes. When combined with detector module U6, the combination of the crystal filter and detector forms the complete discriminator circuit that produces the recovered audio output signal. Necessary decoding, filtering, and preamplification of the signal is done on the control board. Audio power amplifier module U8 then provides amplified complementary outputs capable of driving a 24-ohm speaker. There are approximately 500 milliwatts of power available at the speaker, with less than five percent distortion.

The tone PL squelch control circuits are special detectors capable of detecting the corresponding codes at the discriminator output. These circuits consist of three thick-film hybrid modules (U121, U122, and U123). Together, these circuits decode subaudible (below 300 Hz) PL tones in the receive mode.

3-8. UHF RECEIVER

The uhf receiver consists essentially of the same components as that described in the preceding paragraph 3-7 for the vhf receiver. The only functional difference between the two receivers is in the input preselector. A complete schematic diagram of the uhf receiver circuits is given in Figure 5-8.

The uhf input preselector circuit module (A1) contains a group of pretuned helical resonators (Z1 through Z7), an rf amplifier (U1), a mixer (U2), and a multiplier (U3). The helical resonators provide for selectivity and image rejection, while the multiplier boosts the rf injection signal from the receive channel elements to six times the channel element frequency. The output from the mixer circuit then provides the 21.4 MHz first i-f signal to crystal filters FL1 and FL2. From this point on the operation of this receiver is the same as the vhf receiver (refer to paragraph 3-7 for circuit description).

3-9. VHF TRANSMITTER

The vhf transmitter consists of the appropriate number of channel elements (depending on the number of channels in the unit), a phase-lock-loop (PLL) processor, a voltage-controlled oscillator (VCO), rf amplifiers, a filter/detector, and an automatic level control (ALC) circuit. A schematic diagram of the transmitter circuit board is given in Figure 5-4.

Modulation of the rf signal occurs in the channel element. Associated with the channel element is a crystal oscillator, a varactor modulator, temperature compensation circuits, and a separate output buffer amplifier. The output buffer amplifier is turned on by the application of regulated 4.6 volts that is generated in the PLL module (U102).

The PLL processor and VCO generate the transmitter carrier frquency which is controlled by the reference frequency from the transmit channel elements. When the transmitter is first keyed, the PLL module applies a signal to the VCO that causes it to sweep across the vhf band. When the VCO frequency reaches the desired frequency (determined by the channel element outputs), the PLL locks and stops sweeping the VCO. This condition is detected in the PLL module and an output is produced that turns on the ALC circuit (U108). The ALC circuit then turns on the rf amplifier driver. After a sufficient delay, an output of the PLL module turns on a gate in the VCO, which in turn, causes the rf signal at the carrier frequency to be applied to the rf amplifier driver.

The rf output from the last rf amplifier (U105) is applied to the rf filter/detector module (U107). Harmonic signals are filtered and sent to the rf power amplifier board. The detector circuit samples the rf signal, rectifies the sample, adds it to the dc level from the power adjust control (R107), and produces a corresponding dc output voltage which is fed back to the ALC module. There, it is compared to the regulated 4.6 volts supplied by the PLL processor. The difference amplifier in the ALC module produces a dc control voltage at pin 5 which is a positive voltage less than 7.0 volts. This voltage level controls the gain of the class A amplifier in the rf amplifier driver in U104 and, consequently, the power output level of the transmitter. Since this control voltage depends upon the rf output (once the power adjust control is set), it will vary and maintain the power output level set by the potentiometer.

The transmitter tone PL circuit is similar to the receiver tone PL circuit except that it is biased for transmit operation and it generates a tone instead of decoding one. The PL circuits also have the function of delaying the PTT signal so that a reverse burst of PL tones may be transmitted.

3-10. UHF TRANSMITTER

The uhf transmitter consists essentially of the same components as that described in the preceding paragraph 3-9 for the vhf transmitter. The differences between the two transmitters is in the arrangement of the channel elements and the inclusion of the preselector (A1) on the uhf transmitter board; refer to Figure 5-10 for the schematic diagram of the transmitter.

The uhf transmitter channel elements operate somewhat differently than the vhf channel elements. For the regular case of 5 MHz spacing (offset) between the transmitter and receiver carrier frequencies, a 24.4 MHz offset oscillator is used in the transmitter to optimize duplexer performance in the repeat mode. For the special case of 3 MHz transmitter-receiver spacing (option H949AA), a 26.4 MHz offset oscillator is substituted in the transmitter.

In application, the transmitter offset channel element output supplies the modulation and the offset information to the transmitter PLL circuit. The receive channel elements are also included on the transmitter board so as to supply the proper rf signal for mixing with the output of the transmitter offset channel element. In this case, the third harmonic

output from the receive channel element (selected by the channel selector switch) is applied to the multiplier circuit in preselector A1 where it is doubled in frequency. This produces a $6f_o$ signal which is sent to the mixer circuit on the PLL processor module. From this point on the operation of the transmitter is the same as that of the vhf transmitter (refer to paragraph 3-9 for circuit description).

3-11. MAIN CONTROL BOARD

The complete schematic diagrams of the main control boards are given in Figure 5-15 (coded models) and Figure 5-17 (clear models). Partial schematic diagrams are also given throughout the following paragraphs to help explain the circuit functions performed on this board.

a. General

The main control board functions are roughly divided between digital voice protection (DVP) and clear mode functions. Among the DVP functions are clock recovery, code detector, end-of-message detector, continously-variable slope delta modulation (CVSD), encryption and decryption, proper code detect, alert tone generator, splatter filter, code detect dropout relay, end-of-messsage timers, and code insertion. The clear mode functions are those normally associated with a repeater. They are squelch control functions, dropout relay, time-out timer, speaker audio, microphone audio, receiver audio, and transmit PTT. There are also two circuits that affect both the DVP and clear mode functions; namely, the clock circuit and the power-on reset circuit.

b. Clock Circuit

A simplified diagram of the clock circuit is given in Figure 3-8. This circuit provides a time base for most of the timing functions in the repeater. For the DVP models, a 768 kHz crystal oscillator drives a clock recovery circuit and a portion of the code detector circuit. The outputs from clock recovery circuits U24 and U29 (C and $\overline{C}$) are 12 kHz square waves that are used as the basic timing signals for the repeater circuits. A reference clock signal (R) is derived by passing signal C through a divide-by-256 counter (U45). This latter signal is an 83-microsecond pulse that occurs every 21 milliseconds.

For the clear mode models, the crystal oscillator circuit is not used. Instead, jumper JU7 is installed and the output from multivibrator U46 provides the 12 kHz clock square wave directly.

c. Power-On Reset Circuit

Refer to Figure 3-9 for a simplified diagram of the power-on reset circuit. The purpose of this circuit is to provide an approximate 700-millisecond delay after the On/Off/Charge switch is turned to the On position. During this delay, the numerous delay, timer, and detector circuits are either reset or they time out and attain a quiescent state, eliminating any possible start-up transients. Resistor R82 and capacitor C25 form an RC time constant so that when power is turned on, the voltage across C25 rises gradually. As long as it is less than half the supply voltage, circuits U36 (pin 1) and U10 (pin 8) are reset.

The action at U36 resets the code detector and end-of-message detector outputs while setting pins 2 and 3 of U36 to the code insert mode. In this mode, a low level is applied to U32 pin 2, which inhibits the generation of any transmit PTT signals. The action at U10 resets drop-out delay U14 and flip-flop U34C and D, and places both squelch modules in the short squelch-tail mode. These actions reduce any turn-on transients in the squelch circuit.

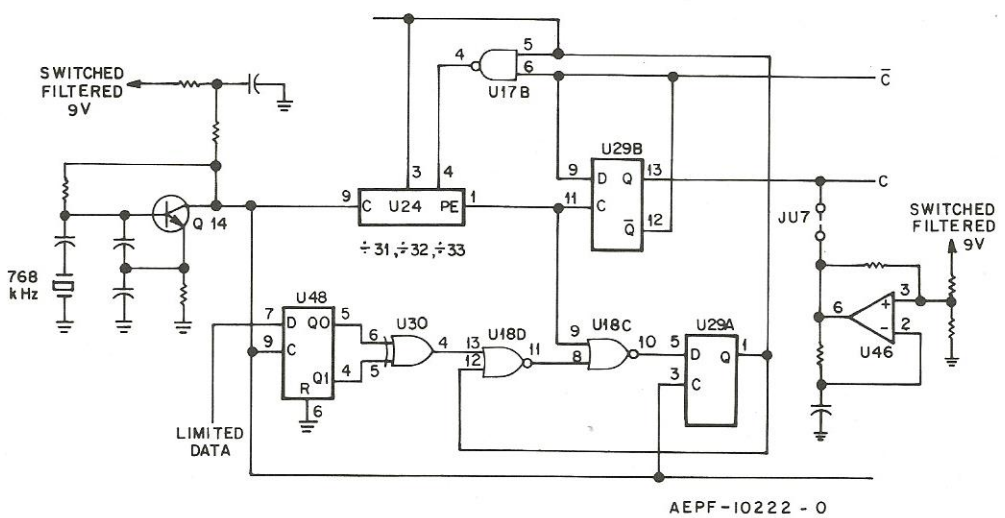


Figure 3-8. Clock Circuit Simplified Schematic Diagram

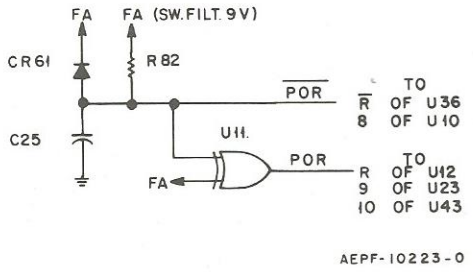


Figure 3-9.
Power-On Reset Circuit Simplified Schematic Diagram

Capacitor C25 is also connected to U11 (pin 8), which inverts the signal to produce a positive pulse that resets three other circuits; U12 (pin 7), U23 (pin 9), and U43 (pin 10). The action at U12 places the code detector drop-out delay into the zero state, eliminating any transients in the delay. Circuit U23 suppresses any PTT signals from the speaker-microphone circuit for the duration of the power-on-reset period, while U43 suppresses the turn-on signal to the audio power amplifier so that any transients are minimized.

d. Squelch Circuits

Refer to Figure 3-10 for a partial schematic diagram of the squelch circuits. This circuit is a dual-type squelch circuit similar to that used in base stations. A buffered discriminator signal (from U25) is applied to the top of potentiometers R44 and R45, whose variable contacts then become the inputs to squelch modules U41 and U40, respectively.

After first filtering the input signal to attenuate frequencies below 3 kHz, the modules amplify the signal and pass it to a threshold detector. If signal noise exceeds the threshold value, a switch is turned on and an external capacitor (C33/C32) discharges to less than one volt. This action causes the module output (pin 4) to be pulled high and the following transistor inverter/buffer (Q20/Q21) produces a low collector output. This is the state for a fully squelched radio. When the discriminator quiets, capacitors C33 and C32 charge, pin 4 on the squelch modules goes low, and the collectors of Q20 and Q21 go high, which is the fully unsquelched state.

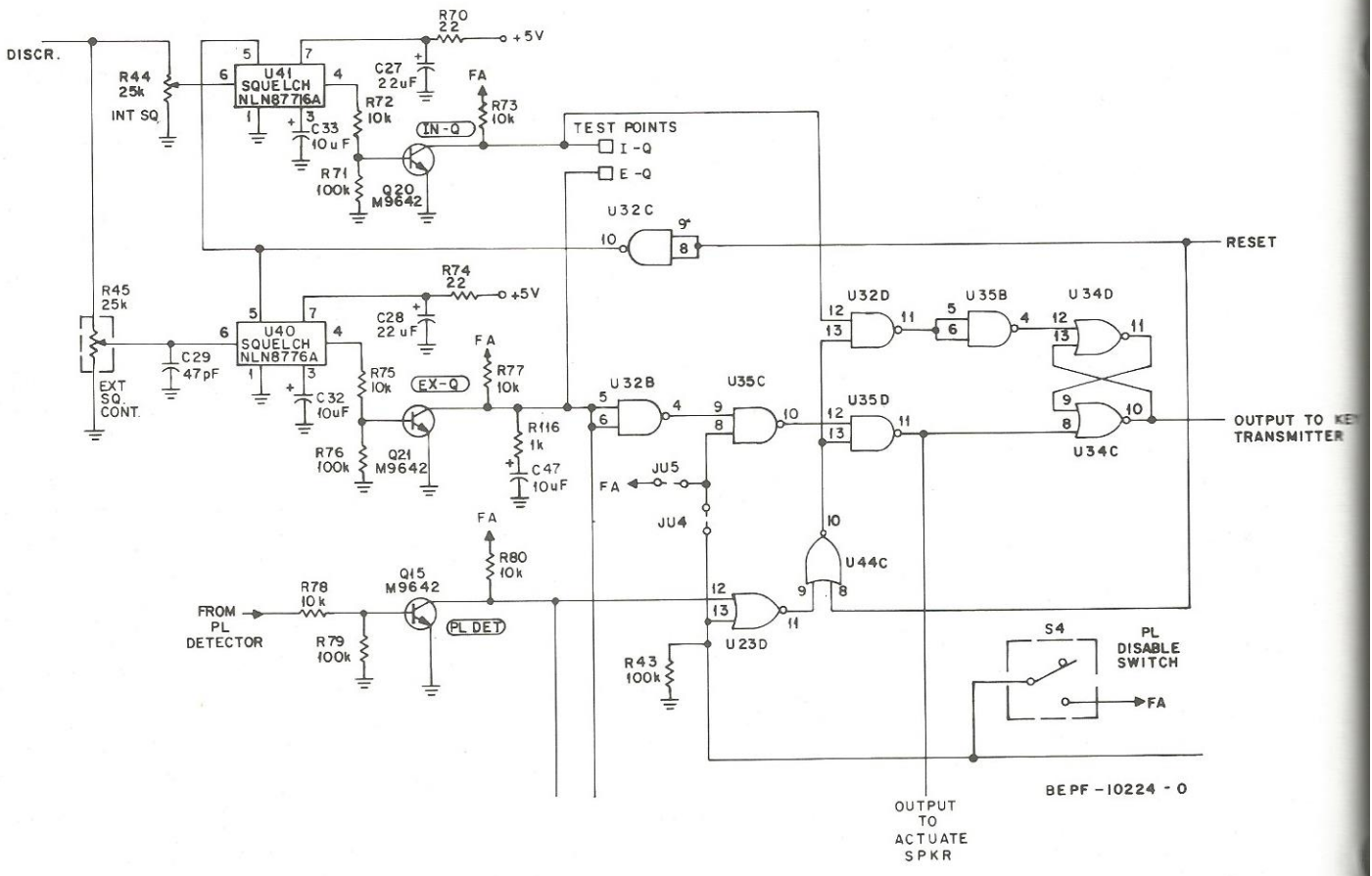


Figure 3-10. Squelch Circuit Simplified Schematic Diagram

The squelch potentiometers are normally adjusted so that external squelch control R45 is "feathered" (loose squelch), while internal squelch control R44 is tightened to provide about 20 dB of quieting. This means that the collector of Q21 may go high, while the collector of Q20 remains low. In this case, a carrier squelch radio will unsquelch the speaker to pass receiver audio, while keeping the transmitter squelched to prevent repeater operation. This dual squelch feature allows the operator to unsquelch the speaker with the external squelch control without causing the repeater to operate. It also allows a careless operator to cause the repeater to continuously operate in repeat mode (until the time-out timer delay is over), if he leaves the external squelch control adjusted too loose. It is recommended that the operator leave the external squelch control adjusted slightly tighter than necessary to prevent inadvertent repeater operation.

The operation of the combinational logic circuits formed by parts of U32, U34, and U35 is best described by a truth table showing the outputs for each state of the inputs; refer to Table 3-1. There are two outputs: U35 pin 11 and U34 pin 10. The U35 output controls the switches that turn on the local speaker (low signal actuates the speaker), while the U34 output controls the logic gates that key the transmitter (high signal actuates the transmitter). The inputs consist of the following signals:

Internal Quieting (I-Q)
External Quieting (E-Q)
PL Detect
States of Jumpers JU4 and JU5
PL On/Off Switch Output
Reset (U44 pin 8)

Table 3-1. Squelch Controls

		TYPE SQUELCH		AND		PL		CARRIER	
		PL SWITCH		ON	OFF	ON	OFF	ON	OFF
			JU4	OUT	OUT	IN	IN	IN	IN
U34–10	OUTPUT		JU5	IN	IN	OUT	OUT	IN	IN
U44–8	I–Q	E–Q	PL						
0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	X	0	0	0
0	0	1	0	0	X	0	X	X	X
0	0	1	1	X	X	X	X	X	X
0	1	0	0	0	0	0	0	0	0
0	1	0	1	0	0	1	0	0	0
0	1	1	0	0	1	0	1	1	1
0	1	1	1	1	1	1	1	1	1
1	X	X	X	0	0	0	0	0	0
U35–11	OUTPUT								
0	0	0	0	1	1	1	1	1	1
0	0	0	1	1	1	0	1	1	1
0	0	1	0	1	0	1	0	0	0
0	0	1	1	0	0	0	0	0	0
0	1	0	0	1	1	1	1	1	1
0	1	0	1	1	1	0	1	1	1
0	1	1	0	1	0	1	0	0	0
0	1	1	1	0	0	0	0	0	0
1	X	X	X	1	1	1	1	1	1

X = DON'T CARE
0 = LOW
1 = HIGH

Referring to Table 3-1, there are three kinds of squelch controls; AND, PL, and carrier. No matter which one is selected by jumpers JU4 and JU5, the reset signal (U44 pin 8) causes the two outputs to revert to the quiescent state. The AND squelch control (applicable only in PL radios) is selected by removing JU4 and leaving JU5 in. In this case, the local speaker is actuated only when the carrier power exceeds the threshold set by the external squelch control and PL is detected. Otherwise, the speaker is squelched. The transmitter is keyed only when the carrier power exceeds the thresholds of both the internal and external squelch controls and PL is detected. Once keyed, the transmitter remains keyed as long as the carrier power exceeds the threshold of the external squelch control and PL is detected; otherwise, the transmitter eventually de-keys.

PL squelch is selected by removing JU5 and leaving JU4 in. The local speaker is actuated only when the PL is detected, and the transmitter is keyed only when the carrier power exceeds the threshold value set by the internal squelch control. Once keyed, the transmitter remains keyed as long as PL is detected; otherwise, it de-keys. In this mode, the external squelch control has no effect except causing the Std indicator to light. However, if the PL On/Off switch is moved to the Off position, carrier squelch operation takes over and the external squelch control functions as described below.

Carrier squelch operation is selected either by moving the PL switch to the Off position or by leaving both jumpers in. The local speaker is actuated whenever the carrier power exceeds the threshold value set by the external squelch control. Keying the transmitter occurs only when the carrier power exceeds the thresholds of both the internal and external squelch controls. Once keyed, the transmitter remains keyed as long as the carrier power exceeds the external squlech control threshold setting; otherwise, the transmitter eventually de-keys.

e. **Drop-Out Delay Circuit**

Figure 3-11 depicts the drop-out delay circuit which takes the transmitter keying output of the squelch circuit and delays de-keying so that repeater access time is reduced. This is an especially important consideration in PL systems. If control input C at multiplexer gate U3 or U9 is high, X1 is connected to the X terminal; if the control input is low, X0 is connected to the X terminal.

When the squelch circuit output at U3 pin 11 goes high, it immediately causes the output (U4 pin 3) to go low and key the transmitter for repeater operation. It also causes the 12 kHz clock at U3 pin 13 to be switched to the clock input of U14, which then causes the counter to step until an output pin goes high. As shown in Figure 11, the particular output pin is selectable by a jumper connected at U14. When the selected output pin goes high, U11 pin 3 goes low and U14 stops counting.

When squelch returns, U3 pin 11 goes low and the slow reference clock signal (R) is routed to the clock input of U14. The counter then counts at a slower rate until the selected output goes low. While the selected counter output is high, the circuit output (U4 pin 3) is low. During this time, the repeater is in the drop-out delay period. The duration of the delay may be zero, 1.37 seconds, 2.73 seconds, 5.46 seconds, or 10.92 seconds depending on the jumper position at U14. When the counter output goes low, then U11 pin 3 goes low and the counter stops.

At any time the drop-out delay may be reset to the de-key state by resetting the counter. This happens anytime the repeater is disabled with the Rptr On/Off switch, or during the power-on reset interval. Also, this occurs whenever any activity occurs in the coded (DVP) mode of operation.

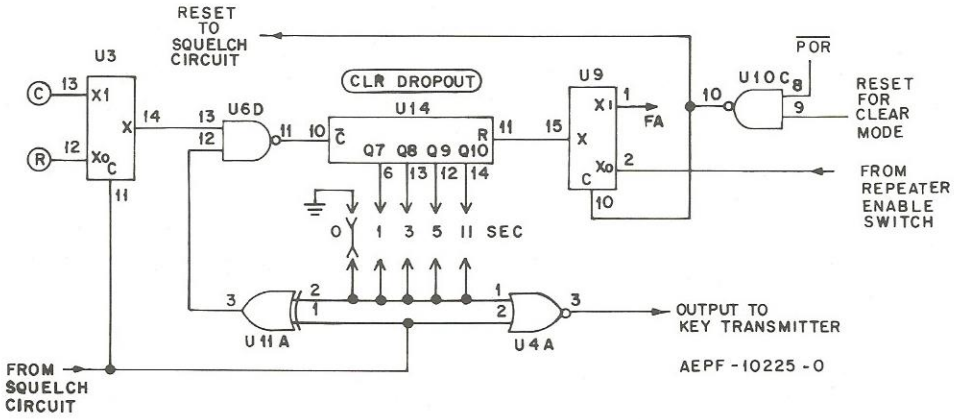


Figure 3-11. Drop-Out Delay Simplified Schematic Diagram

f. Time-Out Timer Circuit

The time-out timer (TOT) circuit (Figure 3-12) acts to limit continuous transmitting time. Actuating the push-to-talk (PTT) switch causes the TOT input to go low. When the TOT times out, its output goes high and inhibits the transmit PTT signal until it is reset. Counter U22 starts counting until the selected output goes high, at which time the transmit PTT signal is blocked. Depending on the jumper connections at U22, the timer delay can be 0.73 minutes, 1.46 minutes, 2.91 minutes, 5.83 minutes, or infinity.

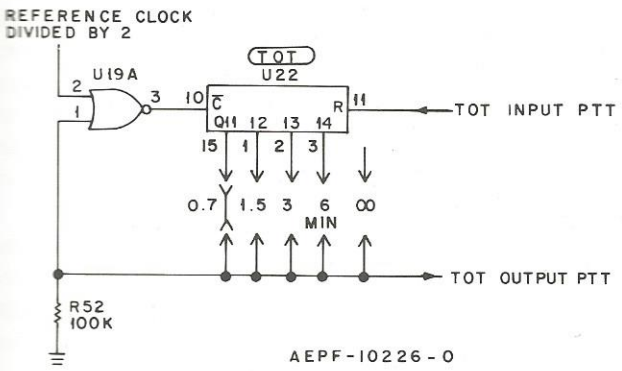


Figure 3-12.
Time-Out Timer Simplified Schematic Diagram

g. Transmit PTT Circuit

Figure 3-13 shows the transmit PTT circuit. This circuit is activated by a keying signal from the dropout delay circuit at U17 pin 13. This line goes low when the squelch circuit or dropout delay circuit is keying the transmitter. Normally, a delayed code detect signal applies a high level to U28 pin 1. If jumper JU3 is out, U17 pin 12 is controlled by U28 so that the proper code detect circuit can function. Depending on the state of the PL switch, either the delayed code detect signal or the proper code detect signal is used to apply a low level at U17 pin 12.

A low signal present at U17 (pin 12 or 13) is an indication of repeater operation. It results in a low level at U16 pin 9, the other input of which is controlled by the Rptr/On/Off switch. For repeater operation, the programming diode selected by the frequency select switch must be in and the Rptr/On/Off switch must be in the On position. This results in a low level at U16 pin 8, which allows the repeater to key. If the programming diode is out, or the Rptr switch is Off, then U16 pin 8 is high and the repeater is disabled. To key the repeater, U16 pin 10 must be switched to a high level.

A high level on U16 pin 12 results in a low level on pin 11 and, until the time-out timer times out, there is a high level at U16 pin 3. This latter signal goes to U32 pin 3, unless there is a code insert ground signal on pin 2. The ground signal is present during code insertion for a coded (DVP) radio or during the power-on reset interval, while also inhibiting the transmit PTT signal.

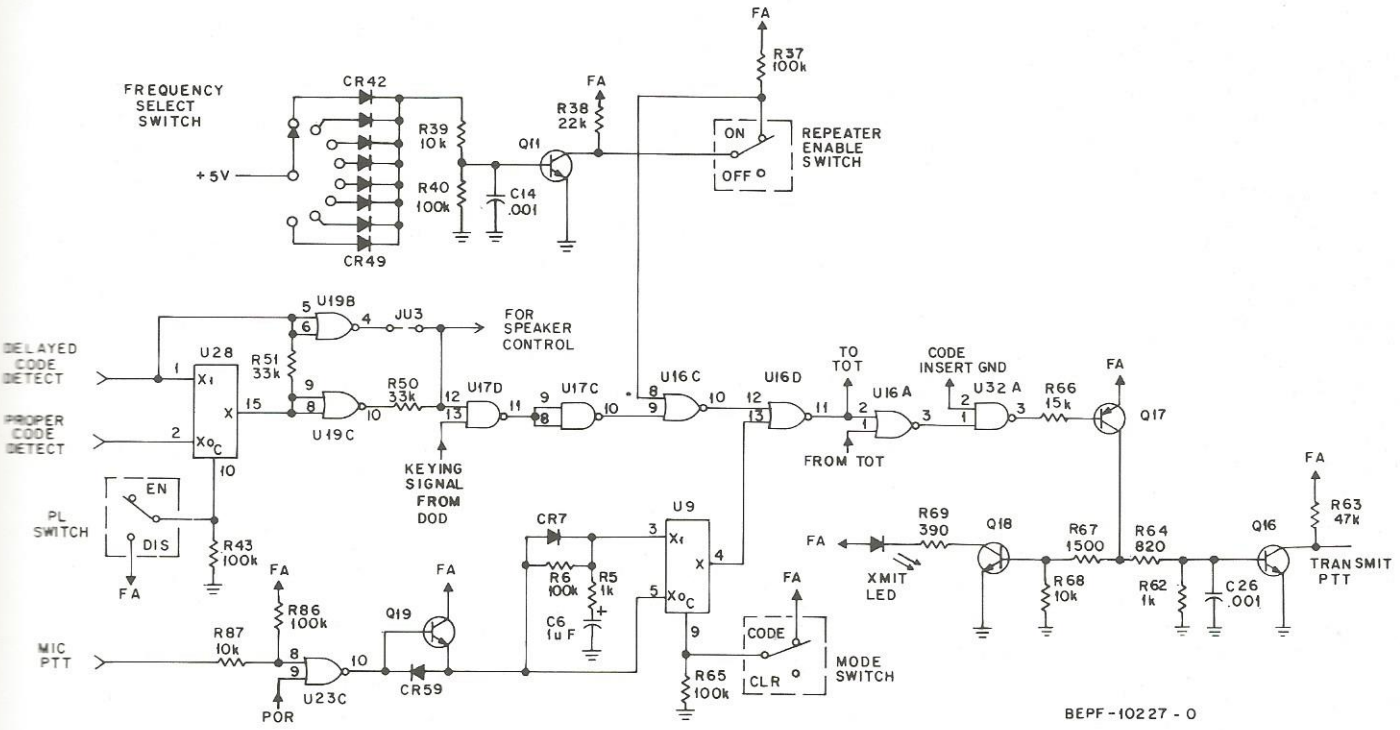


Figure 3-13. Transmit PTT Circuit Simplified Schematic Diagram

When U32 pin 3 goes low, Q17 is turned on, causing Q16 and Q18 to also turn on. The former transistor produces a transmit PTT signal for the transmitter, while the latter turns on the red Xmit indicator light. To key the transmitter with the microphone, the PTT switch produces a grounded MIC PTT line which provides a low level at U23 pin 8. This results in a high level on U23 pin 10, unless the power-on reset signal is asserted. The high on U23 pin 10, buffered by Q19, goes to U9. For a clear mode operation, or for coded radios with the mode switch in the Std (clear) position, the high level from Q19 produces a high level at U16 pin 13 (via U9) and keys the transmitter. For coded radios, if the mode switch is in the Pvt (code) position, the circuit formed by R5, R6, C6, and CR7 is inserted between Q19 and U16 to delay the de-keying of the transmitter for 70 milliseconds, after the MIC PTT signal goes high. This delay is used in carrier squelch coded radios to send the end-of-messsage signal. For PL coded radios, the delay is provided in the transmitter so that this circuit is unnecessary (R5 is removed).

h. Audio Circuits

A simplified diagram of the audio circuits is shown in Figure 3-14. The discriminator audio output is buffered by U25 and applied to audio preamplifier module U27, where the signal is deemphasized and PL tones are filtered. Circuit U47 amplifies the signal so that the transmitter modulation signal level is the same as the received modulation level. The SPDT switch at the output of U47 controls the instantaneous deviation control (IDC) signal. When the microphone PTT switch is closed, it switches the signal to the microphone audio path; otherwise, the repeater audio path is selected. IDC module U2, preemphasizes, limits, and filters the audio signal. Deviation adjustment is made by potentiometer R25; normally, this control should be set to provide a peak deviation (due to the audio only) of 4 kHz for PL radios, and 5 kHz for radios without PL. For microphone operation, the audio is fed through U47 (pin 14) to the switched input of U2.

For coded radios, the audio signal is further processed by the clock recovery circuit, encode/decode module U51, and continuously-variable slope delta modulation (CVSD) circuit U50. The input from U25 is limited in U26 and fed to the clock recovery circuit which phase-locks a 12 kHz clock signal to the transitions of the limited signal. The 12 kHz clock samples the limiter output using D-type flip-flop U48. From U48 pin 13, the re-clocked signal is switched to splatter filter U7. Potentiometer R10 adjusts the transmit audio to provide for 4 kHz deviation. Circuit U51 functions as a decryptor and generates an unscramble digital signal which is sent to U50. The detected output of U50 is filtered in U47 and fed to the speaker through R92 and the audio power amplifier.

In a coded radio operating in the clear mode, when the microphone PTT switch is actuated, a clear mode alert tone (750 Hz square wave) is generated and applied to the speaker for about 80 milliseconds. This tone alerts the operator that he is transmitting in the clear mode.

When transmitting from the microphone in a coded unit, the audio is amplified by U47 and applied to U50. The CVSD circuit in U50 then converts the audio signal into digital form and applies it to the encoder circuit (encryptor) in U51 from where it is fed through the splatter filter (U7) to the transmit audio output.

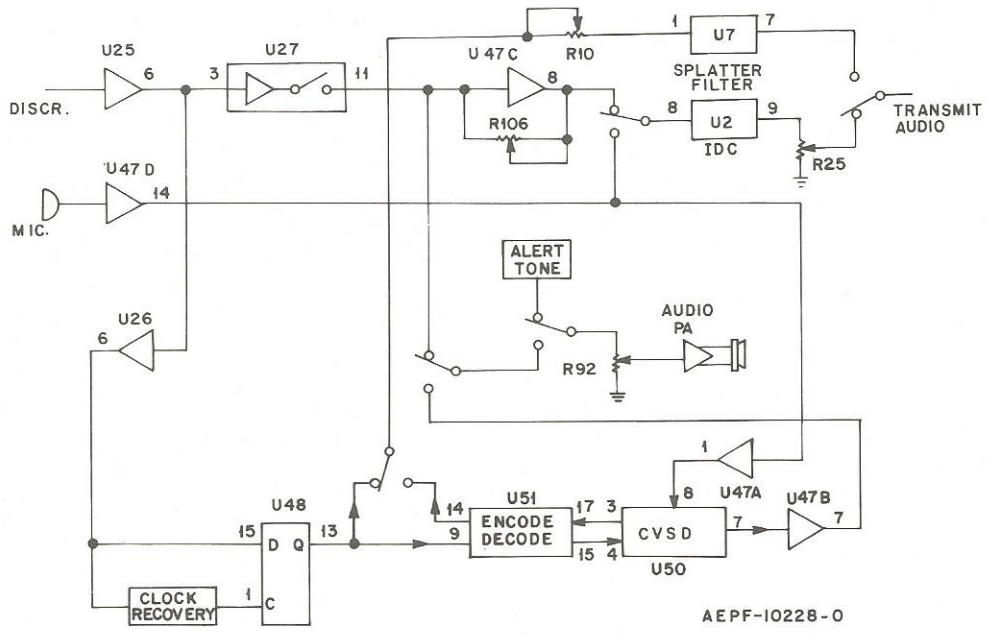


Figure 3-14. Audio Circuits Simplified Schematic Diagram

SECTION 4

MAINTENANCE

4-1. DISASSEMBLY PROCEDURES

a. **General Disassembly (Figures 2-1 and 4-1)**

(1) Open the case by releasing the two latches and raise the lid to a 90-degree position. Proceed to remove the lid from the unit by sliding it to the right until the hinges are disengaged. Set aside the lid for future use.

NOTE

It is advised that whenever the unit is in use, the lid should be removed from its hinges. This will prolong the life of the hinges.

(2) Remove four Phillips-head screws and washers from the top control panel.

(3) Remove three knobs (frequency select, volume, and squelch) by loosening the Allen-head set screws (two per knob).

(4) Lift off the escutcheon portion of the top panel.

(5) Lift off the top control panel, invert it, and carefully set it aside to the left of the bottom case.

b. **Control Board Removal (Figures 4-1, 4-2, and 4-3)**

(1) Remove five hex-head screws and lockwashers from control board cover and remove cover from three hinged brackets.

(2) Remove four pan-head screws from main control board.

(3) Flip top control panel over and remove four flat-heat screws from panel.

(4) Reinvert top control panel and remove complete control board assembly.

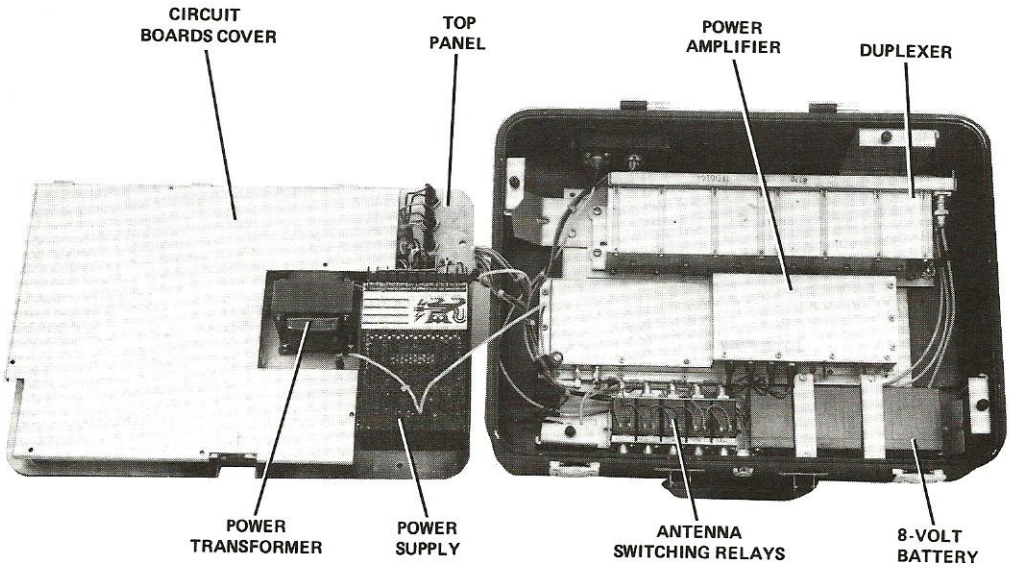


Figure 4-1. Top Panel Removed

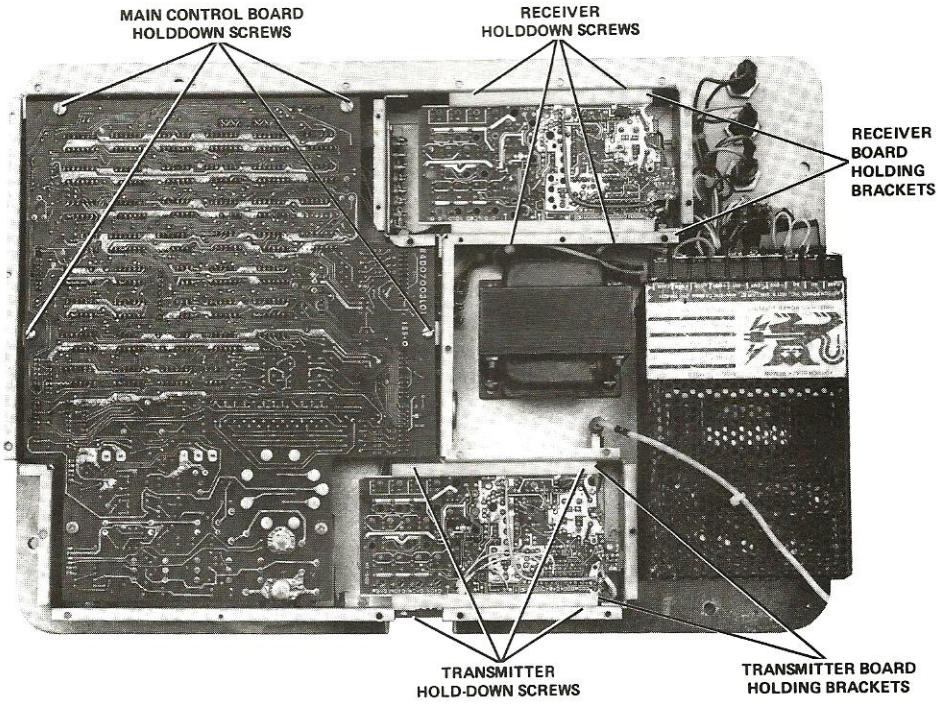


Figure 4-2. Cover Removed Showing Circuit Boards

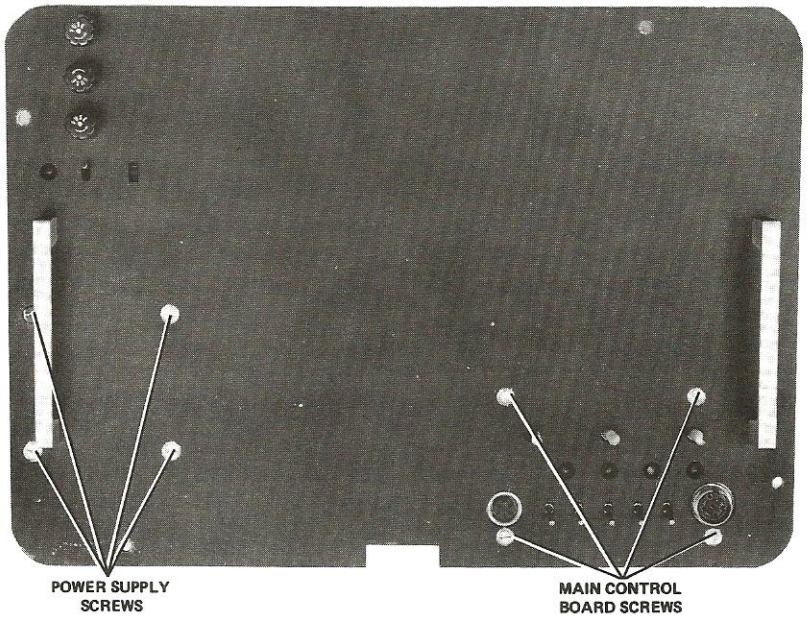


Figure 4-3. Top Panel Showing Screw Locations

c. **Power Supply Removal (Figure 4-5)**

(1) Remove four flat-head slotted screws from the top of the control panel (Figure 4-3) while holding power supply.

(2) Remove seven wires from power supply and lift from the unit.

d. **Transmitter and Receiver Board Removal (Figures 4-4 and 4-5)**

Remove the three screws that hold the transmitter/receiver plastic holding brackets in place. First remove three hex-head transmitter/receiver board hold-down screws located on the outer perimeter of the control board. Then, remove the bracket and board by tilting these up.

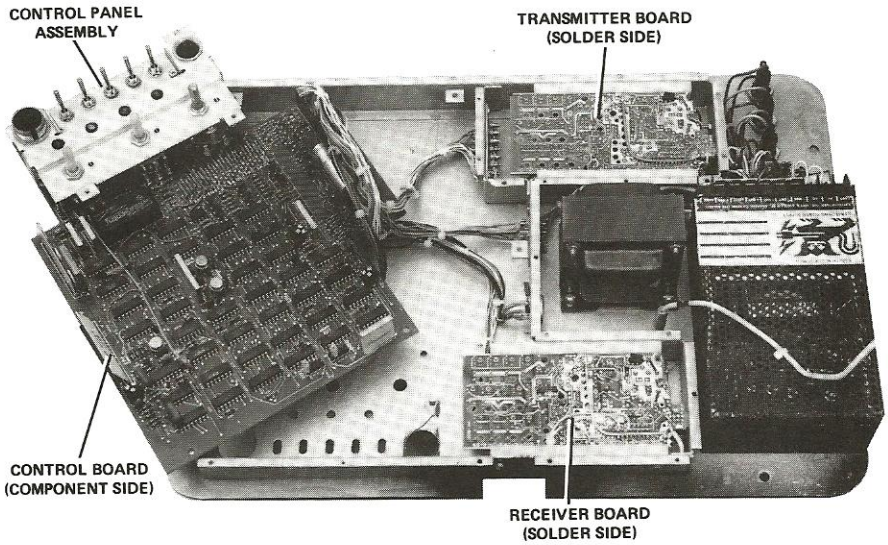


Figure 4-4. Main Control, Transmitter, and Receiver Boards

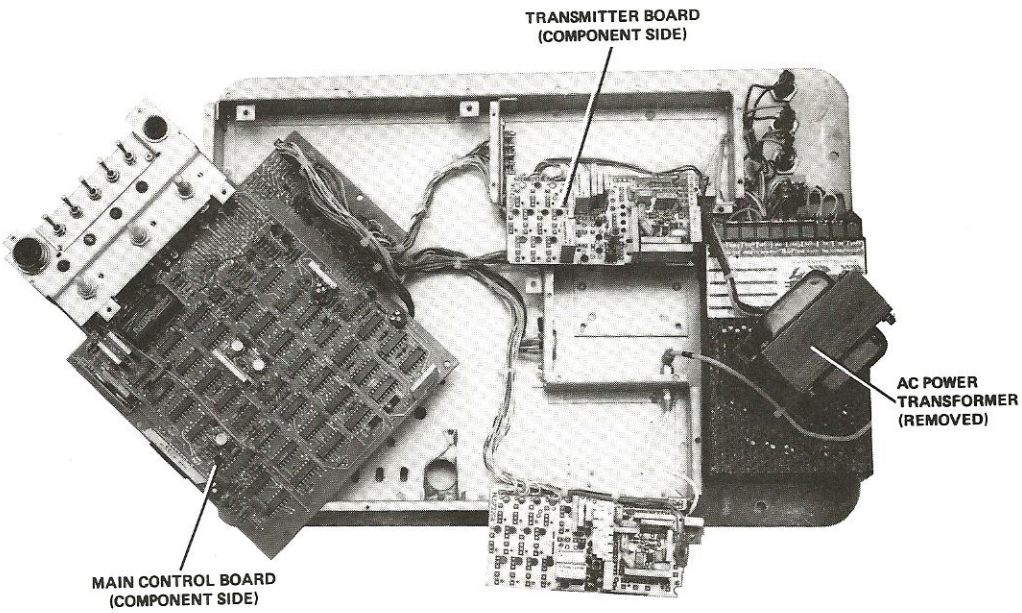


Figure 4-5. Power Transformer Removed

e. **Power Amplifier Removal (Figure 4-6)**

(1) Remove the power amplifier by first removing six slotted round-head screws.

(2) Slide back the protective covering (shrink tubing) and unsolder four control wires to the power amplifier.

(3) Disconnect the two "sma" connectors by unscrewing them.

(4) For further disassembly, remove the cover by removing 17 hex-head screws. See Figures 4-7 and 4-8.

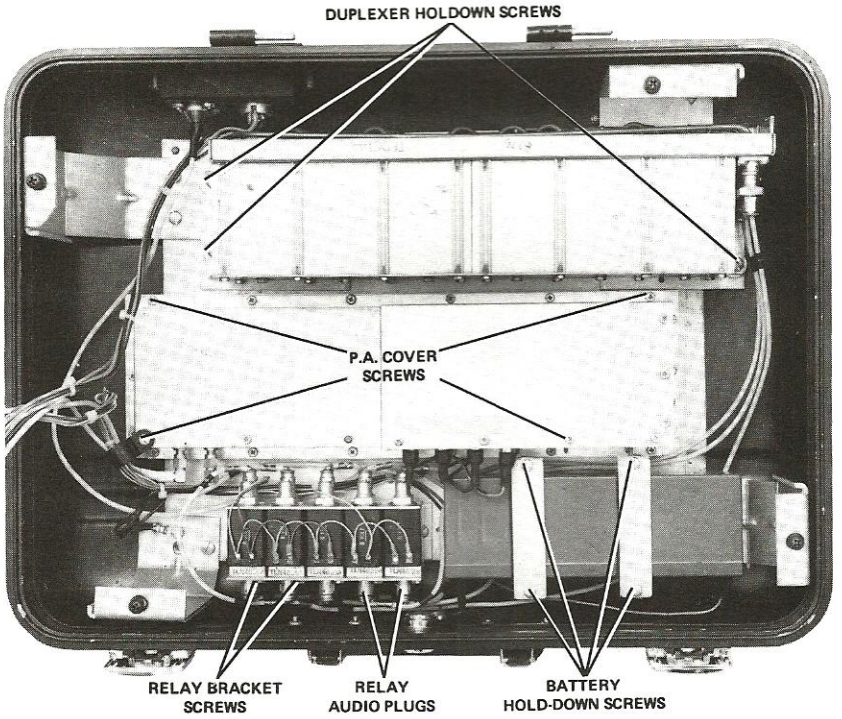


Figure 4-6.
Bottom of Case (Showing Power Amplifier, Duplexer, Antenna Switching Relays, and Battery)

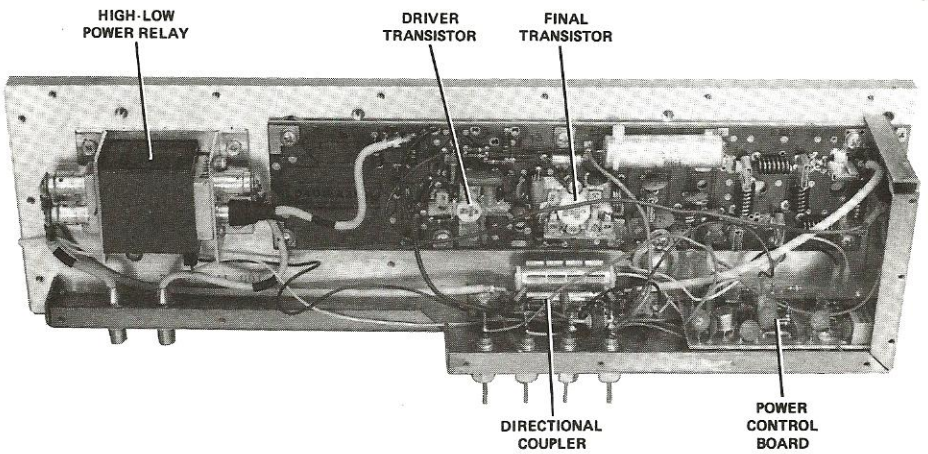


Figure 4-7. Vhf Power Amplifier

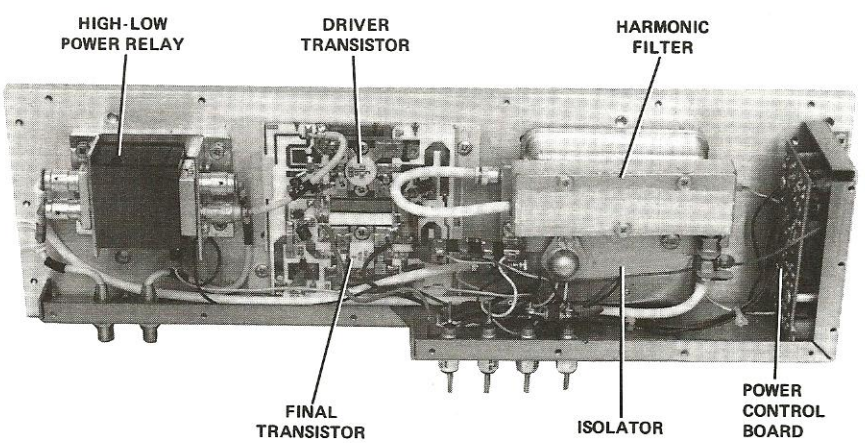


Figure 4-8. Uhf Power Amplifier

4-2. TEST EQUIPMENT

Refer to the list of test equipment in Table 4-1. Battery-operated test equipment is recommended when available. The listed items or equivalents may be used.

Table 4-1. Test Equipment

MOTOROLA MODEL NO.	NAME	CHARACTERISTICS	APPLICATION
R1200	Service Monitor	---	Signal generator and frequency/ deviation meter for wide-range troubleshooting and alignment.
R1011	Dc Power Supply	0 – 20 Vdc, 0 – 10 A current limited	Bench supply for 13.8 Vdc.
S1053	Ac Voltmeter	1 mV – 300 V, 10 megohm input impedance	Audio voltage measurements.
S1063 or R1001	Dc Multimeter Digital Multimeter	200 mV min. full-scale, 1 uA – 300 mA, 10 megohms input resistance, 0.2 ohm – 50 megohm res.	Dc voltage, current, and resistance measurements.
SLN6055 with SLN6083 terminations	Rf Probe	0.3 to 10 volts full-scale, 10 MHz to 400 MHz	Plugs into S1063 Dc Multimeter for making rf measurements.
or			
S1339	Rf Millivoltmeter	100 uV to 3 Vrf, 10 kHz to 1.2 GHz	
R1004	Dual-Trace Oscilloscope	10 MHz bandwidth, 10 mV/cm	Waveform measurements and digital circuit analysis.
S1350	Wattmeter	2 and 50 W ranges, terminating type	Transmitter power output measurements.
S1067	Audio Oscillator	---	Audio signal measurements.
SLN6225	Isolation Transformer	1:1 turns ratio	Audio signal measurements.
R1013	SINAD Meter	40 mV to 10 V rms input	Receiver sensitivity measurements.
S1357	Frequency Meter	1 Hz resolution	Frequency measurements.
	Dc Ammeter	10 A	Current consumption and power amplifier measurements.
ST1179	Module Pusher	---	To push module guide pins for easy extraction without damage.
ST1180	Rf Jack Wrench/ Preselector Spanner Wrench	---	To remove nuts securing preselector to receiver and transmitter boards.
6682186E01	Tuning Tool	---	Adjusts channel elements and preselector on receiver and transmitter boards.
ST1091	Vacuum Desoldering Tool	---	Component removal.
ST909	IC Extractor	---	Dual in-line package IC removal.
ST1190	"Dip Clip"	---	Permits attachment of test probes to dual in-line packages.

4-3. ALIGNMENT/ADJUSTMENT PROCEDURES

The receiver and transmitter boards are aligned at the factory to provide peak performance over a long period of time. Realignment may be required if components are replaced or have aged. To perform these procedures, it is only necessary to remove the top panel and cover plates as described in the "Disassembly Procedures".

a. **Vhf Receiver Alignment**

Refer to Figure 5-1 for the location of adjustments.

Preliminary Adjustments:

1. Turn PL switch off and Rptr On/Off switch to Off (if applicable).
2. Set squelch control to maximum ccw position.
3. Set frequency select switch to the channel nearest the center of the range.
4. Turn Z1 thru Z4 until they are flush with the circuit board.
5. Turn Z5 thru Z7 to their maximum cw position.

STEP	ADJUST	FOR	MEASURED AT	USING	NOTE
1	L4	Max Vdc (1.29 V min, 136-150.8 MHz; 1.1 V min, 150.8-174 MHz)	M1	Dc voltmeter (Dc multimeter)	
2	Z5 & Z6 out 2 turns	Increase in Vdc	M2	Dc voltmeter (Dc multimeter)	Repeat until Vdc increase occurs
3	Z5, Z6, & Z7	Max Vdc (0.8 V min)	M2	Dc voltmeter (Dc multimeter)	Do not repeat
4	Freq. dial on service monitor	Channel element CE1 freq. See NOTE		Service monitor	Connect a Motorola TEK-10 probe to the PRESELECTOR input on the service monitor
5	CE1	Zero error	M1	Error meter on service monitor	S1 set to F1
6	Z1, Z2, Z3, & Z4	Best quieting (lowest ac voltage) with freq. select sw. set to channel used in step 1	Speaker/Mic conn. pins 3 & 4	Ac voltmeter	Inject carrier freq. to produce 20 dB quieting. While tuning Z1 thru Z4, adjust the input to maintain 20 dB quieting
20 dB QUIETING TEST					
1	Volume control	1.73 Vac noise out	Speaker/Mic conn. pins 3 & 4	Ac voltmeter	Establishes reference noise level for no signal input
2	Signal generator	Carrier freq., 0 output level	Gen. output connector	Signal generator on service monitor	Connect signal gen.
3	Signal generator output level	Slowly increase until noise decreases 20 dB		Ac voltmeter	Signal must be less than 0.75 uV

c. **Uhf Receiver Alignment**

Refer to Figure 5-7 for the location of components.

Preliminary Adjustments:

1. Turn PL switch off and Rptr On/Off switch to Off (if applicable).
2. Set squelch control to maximum ccw position.
3. Set frequency select switch to the channel nearest the center of the range.
4. Turn Z1 thru Z7 until they are flush with the circuit board.

STEP	ADJUST	FOR	MEASURED AT	USING	NOTE
1	Z6 & Z7	Maximum Vdc (approx. 0.7 V)	M2	Dc voltmeter (Dc multimeter)	See Preliminary Adjustments
2	Freq. dial on service monitor	Carrier freq. of F1 (minus 21.4 MHz)	Pin 7 of preselector	Service monitor	Connect a Motorola TEK-10 probe to the PRESELECTOR input on the service monitor
3	CE1	Zero error	Pin 7 of preselector	Freq. meter on service monitor	Freq. select switch (FS) set at F1
4	Repeat steps 2 and 3 for each channel in the radio as applicable; CE2/F2, CE3/F3, CE4/F4, etc.				
5	Z1 thru Z5	Best quieting (lowest ac voltage) with freq. select sw. set to channel used in step 1	Speaker/Mic conn. pins 3 & 4	Ac voltmeter	Inject carrier freq. to produce 20 dB quieting. While tuning Z1 thru Z5, adjust the input to maintain 20 dB quieting
20 dB QUIETING TEST (Perform on each channel)					
1	Volume control	1.73 Vac noise out	Speaker/Mic conn. pins 3 & 4	Ac voltmeter	Establishes reference noise level for no signal input
2	Signal generator	Carrier freq., 0 output level	Gen. output connector	Signal generator on service monitor	Connect signal generator
3	Signal generator output level	Slowly increase until noise decreases 20 dB		Ac voltmeter	Signal must be less than 0.75 uV

d. **Uhf Transmitter Alignment**

Refer to Figure 5-9 for the location of components.

NOTES:

1. Align the preselector and channel elements by doing steps 1–4 of "Uhf Receiver Alignment" before adjusting channel elements CE101 or CE102.
2. Measurements are made with transmitter keyed and a 50-ohm load connected at antenna connector; Hi/Lo Power switch on Lo.

STEP	ADJUST	TEST EQUIPMENT USED		MEASUREMENT	
		TYPE	CONNECTED AT	CONDITIONS	DESCRIPTION & LEVEL
1	R107	Wattmeter	Gold "sma" connector at output of P.A. assembly	Set frequency select switch (FS) to lowest power channel	2.0 W
		Ammeter (Dc multimeter)	Dc supply		1.1 A
2	CE102	Freq. meter (on service monitor)	Radiated	FS set to position using CE102	Transmit carrier freq.

Switch Hi/Lo Power switch to Hi position. Reconnect the PA output to the rest of the radio and connect the wattmeter to the external antenna connector. Adjust the power out (using the PA Assembly power adjust control) to 12 W on the lowest power frequency channel.

NOTE

Do not all total dc current to the repeater to exceed 9 A; damage to the power supply could result.

e. **Main Control Board Adjustments**

Refer to Figure 5-13 or Figure 5-15 for the location of components.

- Clear Mode Deviation: Inject a one kHz tone at 25 mV into the Mic input (pin 2 of the Speaker/Mic connector); ac coupling must be used. Key the unit locally by grounding pin 1 of the Speaker/Mic connector. Set the Mode switch to the Std position and adjust R25 for ±5 kHz deviation. Note that on PL units with no input, the PL deviation should be ±500 to ±1000 Hz.

- Coded Mode Deviation: Set the Mode switch to the Pvt position and key the unit locally. Adjust R10 for ±4 kHz deviation.

- Internal Squelch: This squelch level determines the rf signal level required to activate the repeat function. Be sure not to key the unit with a signal generator connected directly to the antenna port of the unit. Inject sufficient signal to quiet the receiver by 20 dB. Monitor the solder side of the control board and turn R44 fully clockwise. The IQ test point should be at a low level. Turn R44 counterclockwise until the IQ test point goes high. The internal squelch should now be set for 20 dBQ.

- Repeater Level: This adjustment sets the repeat mode deviation. Care should be taken not to key the unit into the signal generator during this measurement. Disconnect the rf cable from the receiver port of the duplexer (Figure 4-6). Connect the signal generator to that cable and turn the generator up to completely quiet the receiver. Modulate the generator with a one kHz tone at 3 kHz deviation. Monitor the output of the transmitter with a monitor receiver. Move the PL switch to the Off position and the Rptr switch to the On position. With the unit keyed, set R106 for 3 kHz deviation of the transmitter if no PL is used; set the deviation for 4 kHz if PL is used.

f. **Adding Channel Elements to Blank Channels**

Base-only channels may be added by including a channel element in the appropriate position in both the receiver and transmitter (see Figures 4-9 through 4-12). Care should be taken to remove the corresponding diode on the main control board to prevent the unit from trying to repeat. Refer to diode programming chart on Figure 5-14 or Figure 5-16 (diodes CR42 through CR49 for channels F1 through F8, respectively). Note that repeater channels may be added in the same way, except that the appropriate diode must be left in to enable repeater operation on that channel. Frequencies used are limited to a 300 kHz bandwidth centered at the duplexer tuned frequency. For frequencies outside the 300 kHz bandwidth limitation, option H950 (duplexer switch-around relays) must be included.

4-4. TROUBLESHOOTING

a. **General**

The repeater is designed for high reliability and for rapid service when trouble does occur. The best troubleshooting aid is a thorough understanding of the unit and the function of each sub-assembly. The plug-in modular construction in the receiver, transmitter, and power amplifier sections eliminates the laborious, time consuming troubleshooting procedures previously required to find a defect. Since the plug-in modules can be rapidly replaced, the following procedures are provided to help quickly isolate troubles to a defective stage.

b. **Service Notes**

- The receiver and transmitter circuit boards are 4-layer boards with two layers of printed circuit bonded inside the board.

- FCC regulations state that:

(1) Radio transmitters may be tuned or adjusted only by persons holding a first or second class commercial radiotelephone operator's license or by personnel working under their immediate supervision.

(2) The rf power output of a radio transmitter shall be no more than that required for satisfactory technical operation considering the area to be covered and the local conditions.

(3) Frequency and deviation of a transmitter must be checked before it is placed in service and rechecked once each year thereafter.

c. **Receiver-Transmitter Module Removal Instructions**

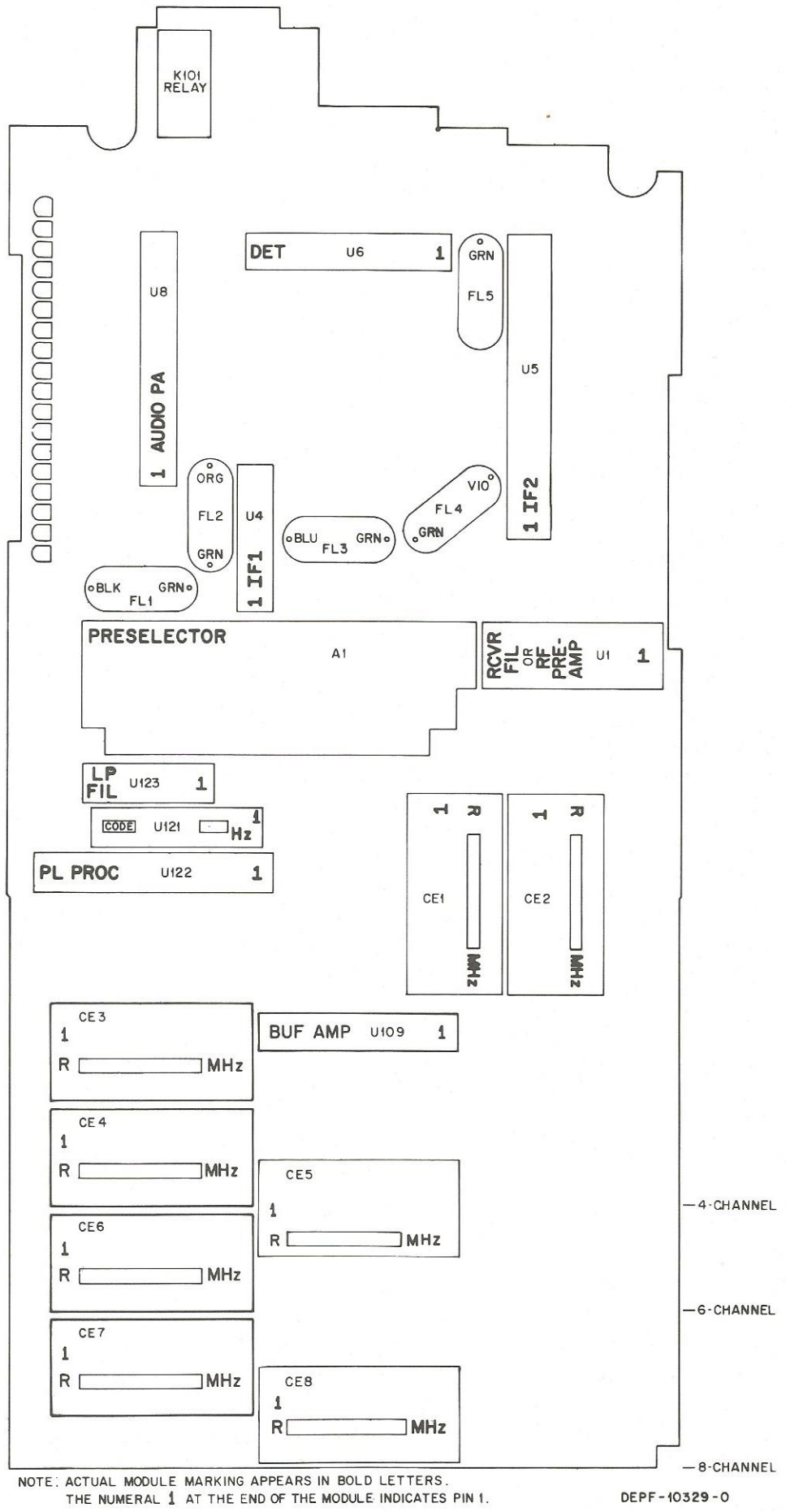
Module locations on the receiver and transmitter boards are shown in Figures 4-9 through 4-12. Use the module pusher tool and remove modules with care as follows:

MODULE	REMOVAL PROCEDURE
Preselector and Transmitter Filter U107	Remove the threaded nuts securing the module to the board. Then press on the threaded studs and pull the module straight out from the component side.
Channel Elements	Push on the guide pin and the warp coil form from the solder side of the board using the ST1179 Module Pusher. Then grasp the module with seizers and pull straight out from the component side.
U105	Grasp the module with seizers and pull straight out.
All other modules	Push on the guide pins from the solder side of the board using the ST1179 Module Pusher. Then grasp the module with seizers and pull straight out from the component side.

d. **Receiver Troubleshooting**

Refer to the troubleshooting diagram of the preselector circuit; Figure 4-13. A change in the dc voltage at test point M2 in both uhf and vhf preselectors is an indication of injection. The dc voltage reading at M2 should decrease by about 0.25 Vdc when the channel element output is shorted to ground using a 0.001 uF capacitor.

The vhf receiver injection frequency can be checked at M1 to ensure multiplier operation. Use a high impedance probe or capacitively couple the probe. A dc probe must be 1 kilohm or greater. The uhf receiver and transmitter injection frequency can be monitored at pin 7 of the preselector to ensure multiplier operation. The frequency out of the uhf and vhf multipliers is 21.4 MHz below the carrier frequency. In vhf units, a properly operting preselector will read a peak voltage of 1.1 volts minimum at M1 (1.29 volts for 136–150.8 MHz receivers) and a peak dc voltage of about 0.8 volt at M2. In uhf units, a properly operating preselector will read a peak dc voltage of about 0.7 volt at M2.



NOTE: ACTUAL MODULE MARKING APPEARS IN BOLD LETTERS.
THE NUMERAL 1 AT THE END OF THE MODULE INDICATES PIN 1.

DEPF-10329-0

Figure 4-9. Vhf Receiver Module Locations

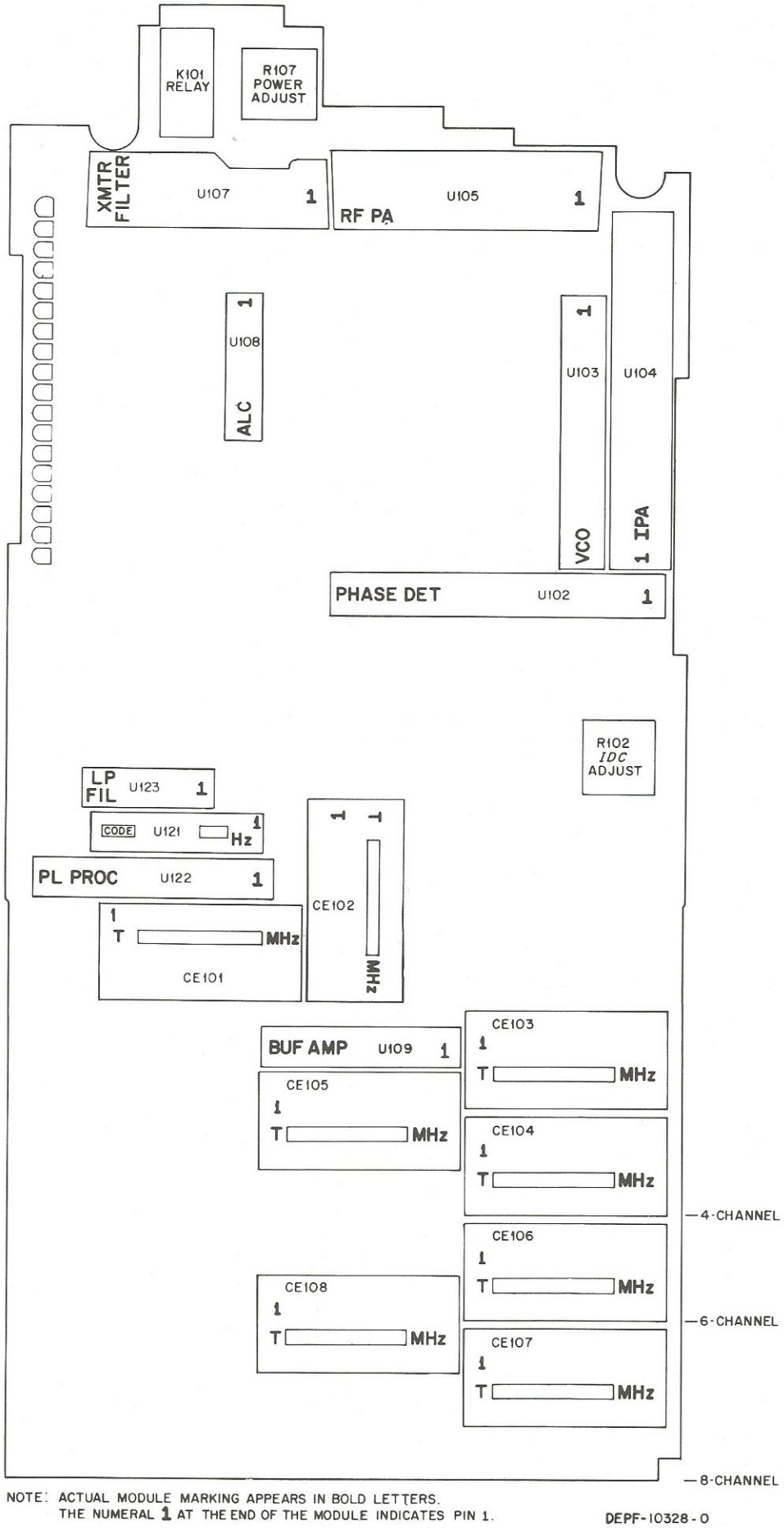
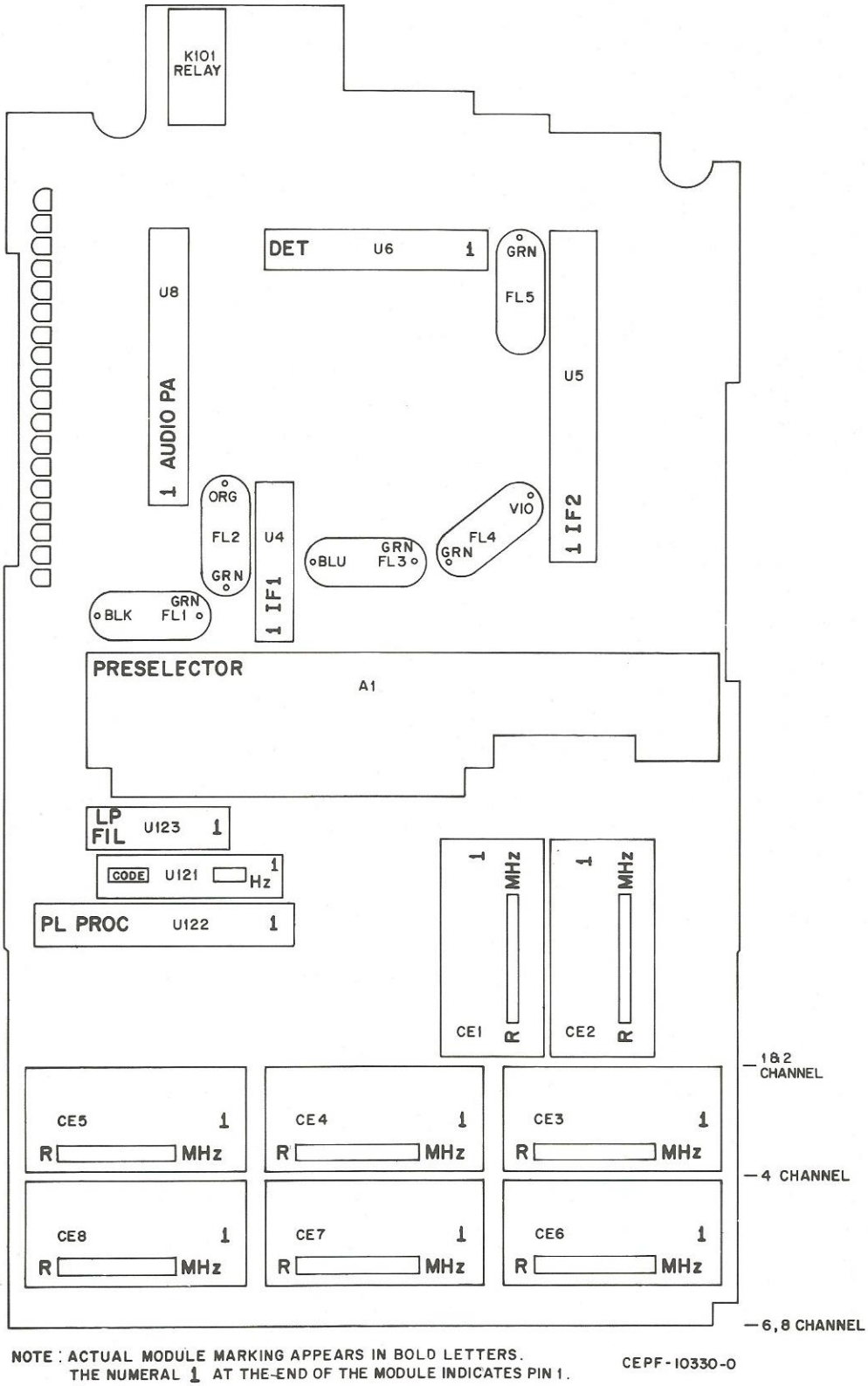


Figure 4-10. Vhf Transmitter Module Locations



NOTE : ACTUAL MODULE MARKING APPEARS IN BOLD LETTERS.
THE NUMERAL 1 AT THE-END OF THE MODULE INDICATES PIN 1.

CEPF-10330-0

Figure 4-11. Uhf Receiver Module Locations

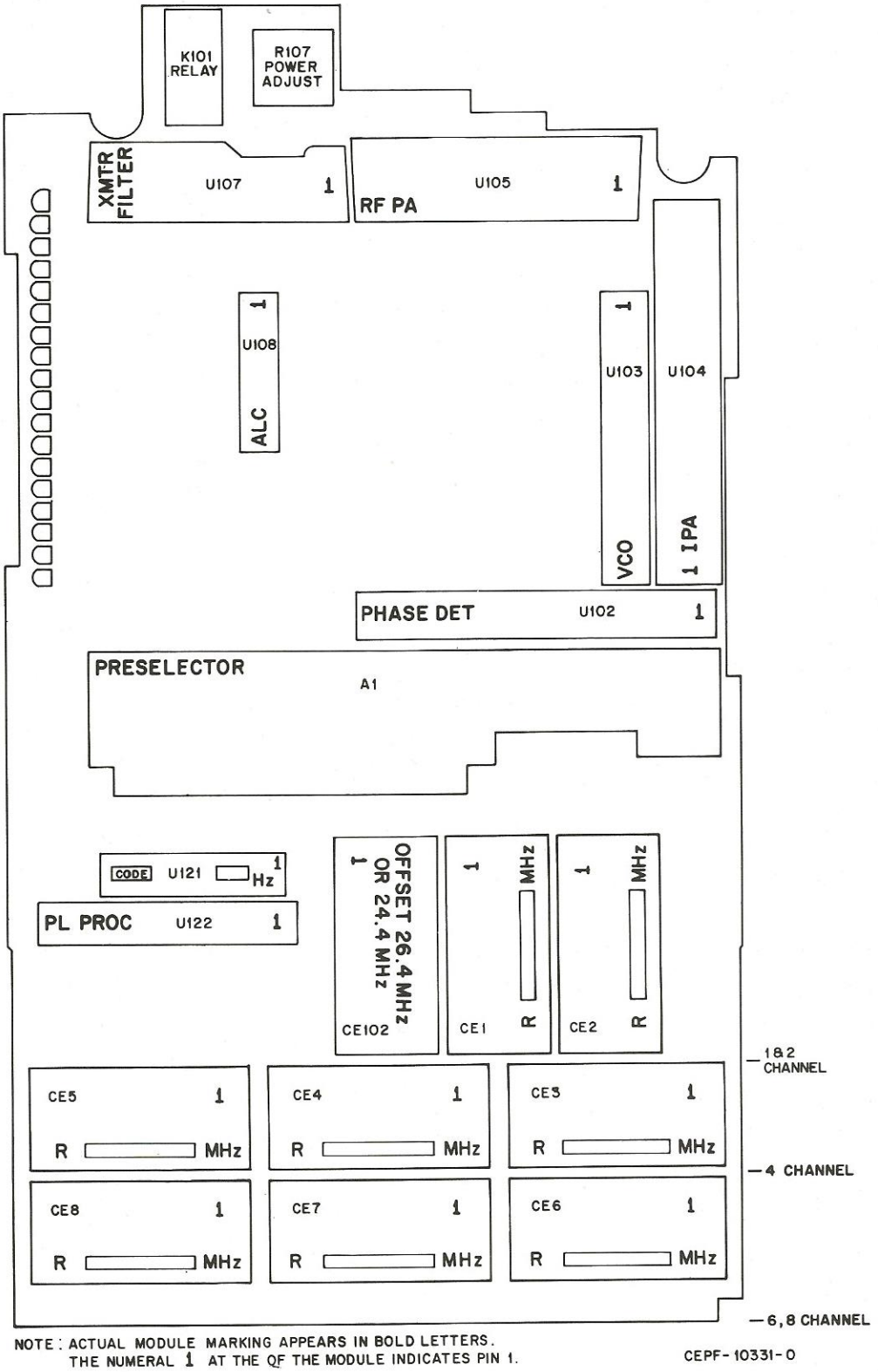


Figure 4-12. Uhf Transmitter Module Locations

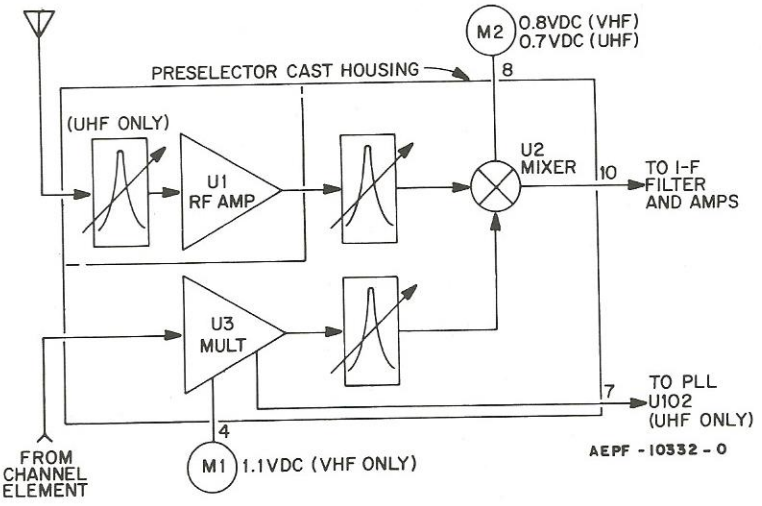


Figure 4-13. Preselector Troubleshooting Circuit Diagram

The i-f circuit consists of modules U4, U5, and crystal filters FL1 through FL5. The idealized gain of U4 and U5 combined is over 135 dB. Because of this high gain, the possibility of oscillation exists when test equipment is connected to pins on the modules. With a 21.4 MHz i-f input signal present, and with oscillation occurring, it cannot be determined which signal is being measured. This can lead to misinterpretation such that it would appear that the input signal is being amplified when, in fact, it is the self-sustained oscillation caused by connection of the test equipment that is being measured. To avoid this condition, remove module U5 when making measurements around U4.

Making rf measurements at U4 is affected by other factors. The crystal filters present a source impedance to U4 of about one kilohm at the i-f frequency of 21.4 MHz. The input capacitance of the test equipment (if larger than 10 pF) will present some reactance at 21.4 MHz and load the circuit enough to cause erroneous readings, in addition to possible oscillation. If trouble is suspected in U4 or U5, replace the suspected module with a known good module. If new modules do not solve the problem, replace the crystal filters.

NOTE

Crystal filters FL1/FL2 and FL3/FL4 are matched pairs. Refer to the parts list and always replace both filters as a pair. Observe the color dot marking orientation indicated on the circuit board layout.

Receiver noise levels are a valuable troubleshooting aid. These noise levels will change should a problem occur in the receiver. By knowing the normal and abnormal levels at key points in the receiver, a receiver problem can be quickly isolated.

Table 4-2 lists the normal and abnormal noise levels at both the discriminator output and the audio output to the speaker. The readings are taken with a standard ac voltmeter. The chart does not cover all possible failure modes; however, it will aid in troubleshooting most receiver problems.

Table 4-2. Typical I-F and Audio Voltages

CONDITION	DISCRIMINATOR OUTPUT	AUDIO OUTPUT
Normal	250 – 400 mV ac	4.5 V ac
U4 failed	10 – 40 mV ac	150 – 300 mV ac
U5 failed	less than 10 mV ac	less than 10 mV ac
U6 failed	less than 10 mV ac	less than 10 mV ac
U7 failed	250 – 400 mV ac	0 V
U8 failed	250 – 400 mV ac	0 V

Refer to the squelch circuit troubleshooting diagram in Figure 4-14. For carrier squelch models, approximately 30 mV of noise is required at pin 6 of U9 for squelch action. (Note that noise voltages are obtained with no rf signal to the receiver.) With the proper input to U9, the output should be 4 Vdc, turning off the audio stages. The dc voltage reading at pin 4 of U9 should also change from 0 Vdc to 4 Vdc as the squelch control is rotated clockwise. If the discriminator output is 250-400 mV ac and the change does not occur, replace U9.

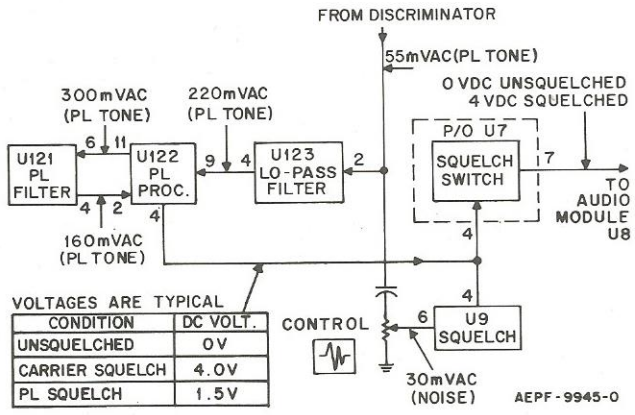


Figure 4-14. Squelch Circuit Troubleshooting Diagram

For tone "Private-Line" circuit troubleshootng, refer to the diagram in Figure 4-14 for minimum tone levels. (Note that PL voltages referenced are minimum values obtained with a 100 uV rf input signal with PL encoded modulation.) The dc voltage output at pin 4 of U122, the PL processor module, controls audio turn-off in the same manner as the noise squelch circuit. The dc voltage reading at pin 4 of U122 will also change from 0 Vdc to 1.5 Vdc as the PL operation is switched on.

Due to module design, the dc output of U122 is 1.5 Vdc and the dc output of U9 is 4 Vdc. Because either one of these outputs can control the squelch switch circuit, a dc voltage reading at pin 4 of U7 (first audio module) will be either 1.5 Vdc or 4 Vdc when the repeater is squelched. The squelch module can maintain 4 Vdc at pin 4 of U7 if a noisy signal is present at the discriminator (even if the PL circuitry has decoded and switched). To test PL circuitry, a strong rf signal (100 uV) should be used and the PL control should be set to off.

e. Transmitter Troubleshooting

Since transmitter currents are relatively large, monitoring the power supply current provides a quick analysis of overall transmitter operation. This is especially true with the rf power amplifier modules, which require about 350 mA or more when operating normally. With a wattmeter or dummy load connected at the output connector from the transmitter board, key the transmitter and observe the total current supplied to the repeater. Refer to Table 4-3 for possible defective modules on the transmitter board.

Table 4-3. Transmitter Troubleshooting by Current Measurement

TOTAL CURRENT READING IN mA		ANALYSIS
VHF	UHF	
Less than 200	Less than 200	There is probably no VCO output and power amplifiers U104 and U105 are turned off. Suspect a defective channel element, U102 or U103.
200	200	U104 is not turned on, which keeps U105 turned off even though there is a VCO output. Suspect defective U104, U107, or U108.
450	575	U104 is turned on, meaning that VCO output is present and ALC circuit is working. Suspect defective U105.
1000	1225	This is normal current for transmitter. U107 contains a passive filter and is suspect if power output is not present. Note: Current readings are nominal and may vary slightly. The following current values are drawn in average use: U101 10 mA U103 43 mA (vhf) U103 70 mA (uhf) U102 60 mA (vhf) U102 70 mA (uhf) CE101 – 108 6 mA

The phase-locked-loop (PLL) circuit uses two modules to generate the transmitter carrier frequency. PLL processor module U102 and VCO module U103 operate in a closed loop, with an output from U102 driving U103, and an output from U103 fed back to U102. Due to signal levels and loading between the two modules, there is no convenient way to determine which of the two modules has failed when trouble is experienced in this circuit. There are two conditions that occur during operation; search and lock. Search begins when the transmitter is keyed, and lock occurs almost instantly if the circuit is operating properly.

To determine if the VCO is locked on frequency or in the search condition, refer to the PLL and VCO troubleshooting diagram in Figure 4-15. Monitor the signal at pin 1 of U103 with an oscilloscope. This signal will be a triangular waveform at about 4 volts peak-to-peak if there is a problem and the VCO is not locked on frequency. If the sawtooth voltage, the channel element frequency (at pin 2 of U102), and dc operating voltages are all present, then U102 or U103 is probably defective. Since U102 contains the most circuitry, try substituting this module first. If the triangular voltage is still present, replace module U103. If lock is present, the dc voltages in the diagram should be measured.

NOTE

If the VCO is not locked on frequency, the rf amplifiers will be turned off and total transmitter current will be around 200 mA or less.

f. Power Amplifier Troubleshooting

The rf power amplifier circuitry generates as high-level (12–20 watts) rf signal. The circuit is broadband in nature and covers the entire vhf or uhf frequency range with minor circuit differences. The uhf circuitry is constructed upon alumina microstrips. Interstage matching is accomplished via quarter-wave transmission lines etched onto the substrate to step up the interstage impedance to 50 ohms. This design simplifies service troubleshooting by allowing direct measurement of stage power levels using an adaptor cable. The rf output of the amplifier is coupled to an rf isolator assembly, which provides a matched amplifier termination, even under adverse antenna load conditions (high VSWR).

If a transmitter malfunction has been isolated to the rf power amplifier circuits, the cause of the malfunction can be found by using a combination of visual checks and isolating defective components. Check visually for obvious physical objects, such as broken leads, broken or cracked microstrip boards, and broken or disconnected components. These defects should be corrected immediately. Then recheck the power amplifier performance. If the visual inspection reveals overheated components, do not replace the overheated parts until the cause of the overheating has been found and corrected. Otherwise, the new part may be damaged.

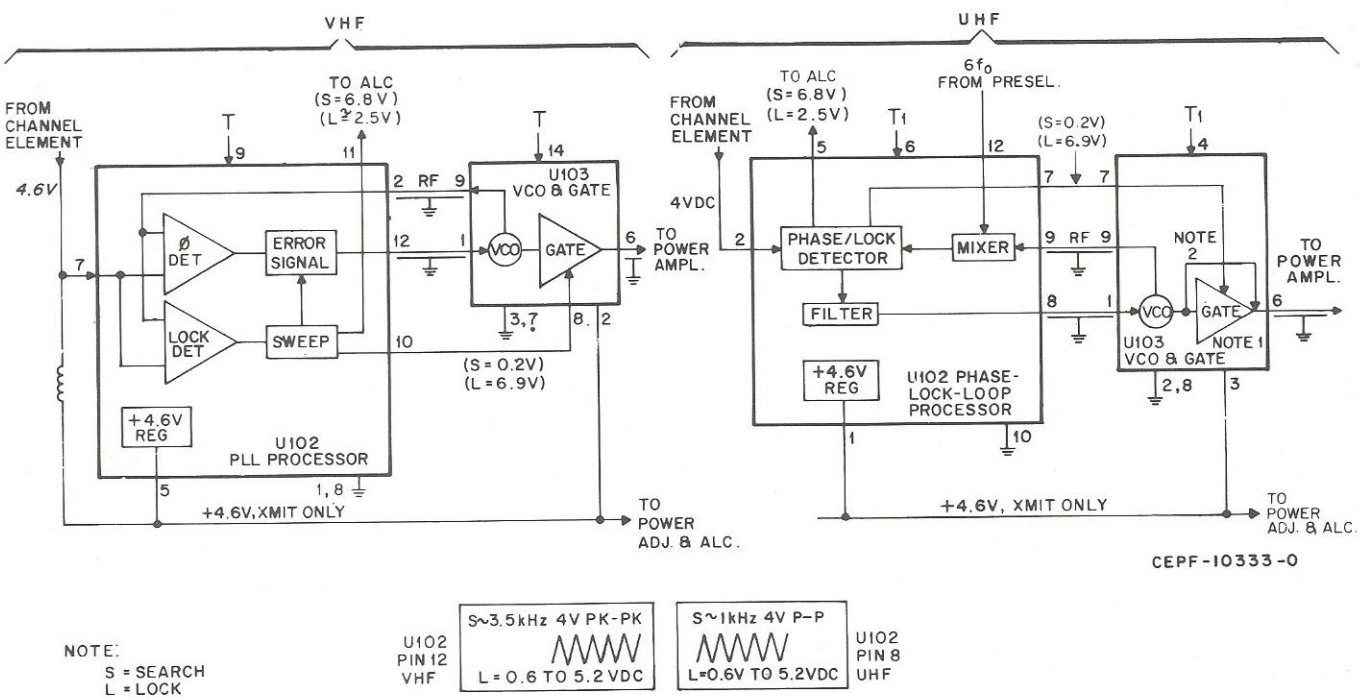


Figure 4-15. PLL/VCO Troubleshooting Diagram

Check for A+ voltage levels at the feed-through connections, and for proper voltages at the collectors of each transistor. Certain defects such as cracked microstrips, intermittent leads, etc., may not be obvious to a visual inspection. If the visual and voltage checks do not reveal the cause of sub-normal power amplifier performance, check the increases in current as compared to the total current requirements of the transmitter, as given in Table 4-3. For uhf units, disconnect the output of the power amplifier from the harmonic filter and connect an eight-inch 50-ohm coaxial cable with a 50-ohm dummy load rated at 50 watts or greater. If the current increases by 1.5 amperes, the driver transistor should be checked. If the current increase is greater than 1.5 amperes and the power output is less than 20 watts, a bias check and dc resistance checks should be performed on the final stage transistor and associated circuitry.

g. Main Control Board Troubleshooting

Refer to the following troubleshooting chart and Figures 5-13 through 5-16 for detailed analysis of possible faults occuring on the main control board.

MAIN CONTROL BOARD TROUBLESHOOTING CHART

SYMPTOM: Regulated 9-volt supply faulty

PROCEDURE:

(1) Disconnect receiver and transmitter cables, but leave regulator and main interconnect cables connected. If regulated 9 volts is now correct, receiver or transmitter is probably faulty.

(2) Disconnect 8-volt battery. If regulated 9 volts is now correct, battery is bad.

(3) Check main interconnect feed-through plate on both sides for shorts or broken wires.

(4) Check 9-volt regulator cable for possible short circuits or broken wires.

(5) Check for 13.8 ±0.2 volt on pin 1 of the regulator module (P3). Also check for 9.8 ±0.5 volt on pin 2 of P3. If either of the values are incorrect, check for a ground on pin 4 and 5.0 ±0 volt on pin 3 of P3. Check components CR51, CR1, CR2, R1, and R2.

(6) If the voltage on pin 2 of P3 is very low a short to ground on the continuous 9-volt line may be at fault.

(7) Check for 9.2 ±0.5 volt on pin 9 of the main interconnect cable. If incorrect, check components CR50, CR25, and R36.

(8) Check for 9.2 ±0.5 volt on pin 7 of the main interconnect cable. If incorrect, check for the On/Off/Charge switch.

SYMPTOM: Battery charge circuit faulty

PROCEDURE:

(1) Check for 9.2 ±0.5 volt on pin 9 of the main interconnect cable. If incorrect, a possible short to ground exists at pin 9.

(2) Check for 8.4 to 9.7 volts on pin 10 of the main interconnect cable. If incorrect, check 2 A fuse, R36, and CR25.

(3) Disconnect the red positive lead on the battery and insert an ammeter in the charge circuit. The charging current should vary from 10 to 200 mA (at 25°C) depending on the amount of charge in the battery. When fully charged (charge current less than 50 mA), the unit should transmit continuously for an hour and maintain an output voltage above 6 volts. If this is not the case, the battery is probably bad. Also, when discharged the battery should recharge in less than 14 hours (at 25°C).

(4) The Batt indicator light is illuminated for charge currents greater than 80.5 mA and is extinguished for currents less than 69.9 mA. If the indicator seems to not follow the above conditions, check components Q9, Q10, R29 through R34, R41, R48, R49, U15, and the LED itself.

(5) For DVP models, check the battery charge circuit as follows: Check for 5.1 ±0.3 volt on the cathode of VR1. With the unit off, check for 3.6 volts at the battery positive terminal and about 3 volts at pin 3 of U51. With the unit on, the voltage at pin 3 of U51 should be 5.0 ±0.4 volt.

SYMPTOM: Receiver operates improperly

PROCEDURE:

(1) Check for 9.2 ±0.5 volt on pins 10 and 11 of the receiver cable kit. Check for no grounds on pins 5 and 16 of the cable kit. If either of these conditions are not true, check the regulator circuit, the cable kit, and the connector.

(2) Check for 4.6 volts on pin 1 of the receiver cable kit. If it is not present, there is probably a short circuit or a bad hybrid module.

(3) Check for 4.4 volts on one of the frequency select (pins 1–4 or 17–20 of the receiver interconnect cable) to select a channel element (0 volt otherwise). The unit will operate properly if one channel element only is selected. If faulty operation is suspected, check 5-volt regulator (U1), the frequency select switch, diodes CR8 thru CR15, the receiver frequency select jumpering, and the receiver channel elements.

(4) Check the discriminator signal at pin 6 of the speaker/microphone connector, or at pin 6 of U25. For a no-signal input condition at the antenna, the discriminator signal should be noise. For a clear mode signal input at the antenna, the discriminator signal should be a clear demodulated signal. For a coded signal input at the antenna, the discriminator signal should resemble an eye pattern with at least a 40% eye opening and less than 30% crossover jitter. A failure here indicates that U25 or something connected to pin 6 of U25 is faulty.

(5) Check the squelch circuits by examining the E-Q and I-Q test points on the solder side of the main control board (under the volume potentiometer). The voltage present at E-Q is high (8 volts or more) when the discriminator is quieted more than the threshold set by the external squelch potentiometer (R45). The voltage at E-Q is low (1 volt or less) when the discriminator is noisier than the external squelch setting.

At test point I-Q, the voltage is high when the discriminator is quieted more than the threshold set by internal squelch trim potentiometer R44. It is low when the discriminator signal is noisier than the trim setting.

If a failure is suspected, check for 5 volts at the squelch modules (U40, U41 pin 7). Also, check the transistor buffers (Q20 or Q21).

(6) On PL models, check PL circuits Q15 and U23 pins 11, 12, and 13. Collector voltage at Q15 is high for a PL detect and low for no PL detect. On U23 pin 11, the voltage is high for no PL detect with PL switch On; this voltage is low for a PL detect or when the PL switch is Off. If voltages are incorrect, check the PL switch, U23, Q15, and jumpers JU4 and JU5 (at least one of these jumpers must be out in a PL model unit).

(7) Check the clear mode unsquelch signal on U35 pin 11. It should be low; i.e., when the PL switch is Off and the squelch is opened, the signal is at a low level. This signal goes high for a coded signal at the discriminator or when the unit transmits on a non-repeater channel.

Check the voltage at U35 pin 11 by quieting the receiver with the PL switch Off; the voltage should be low. For DVP models, the voltage at U35 pin 11 should be high and remain high when the unit is squelched. If this is not the case, check U32, U34, U35, U44, U10, U5, and U33.

(8) For DVP units, check the code detector and end-of-message detector. The voltage at the code detector test point (labeled CD and located on the solder side of the board between U21 and U30) should be high when a coded signal is present at the discriminator output. This voltage is low when the end-of-message, or just noise, is present. The voltage present at the end-of-message test point (labeled TOC and located near pin 8 of U2) should be high when receiving the end-of-messasge signal, but low otherwise. For incorrect results here, refer to the section on Code Detector Faulty.

(9) For DVP units, check the delayed code detect signal at pin 6 of U12. It should be high, except when receiving end-of-message, or a clear mode signal, or noise.

The delay for a coded signal from the time U36 pin 10 goes high to the time U12 pin 6 goes high is 670 microseconds. If end-of-message is detected, the delay from the time U36 pin 10 goes low to the time U12 pin 6 goes low is also 670 microseconds. If end-of-message is not detected, but U36 pin 10 goes low anyway (as when a coded transmission fades), then the delay until U12 pin 6 goes low is 300 milliseconds. If U12 pin 6 is operating improperly, then check for a 12 kHz clock signal at U28 pin 3 and for a 23.4 Hz clock signal at U28 pin 5. If improper clock signals are in evidence, check U6, U11, U12, U17, and U34.

(10) For DVP models, check the encode-decode module (U51), after first programming the unit. Feed a properly encrypted signal and monitor U51 pin 15. When receiving coded input signals, pin 15 should have decrypted code present. If a problem is suspected here, check for the following:

- more than 8 volts present at U51 pin 1.
- 5 volts present at pins 2, 3, and 4 of U51.
- low level at pin 5 of U51, unless code 2 is selected; for code 2 signals, 5 volts should be present.
- reclocked code is present on pin 9 of U51.
- high level at pin 10 and a low level at pin 13 of U51.

- 12 kHz clock at pin 11 and pin 16 (inverted) of U51.
- pin 18 of U51 at ground level.

If all of the above conditions are present, but U51 still produces faulty decryptions, U51 is probably defective. For problems affecting pins 9, 10, 11, 13, and 16, check the respective driving circuit.

(11) For DVP models, check for proper code detection. To do this, program the unit and provide a source of encrypted data. Input this data at 6 kHz so that the repeater receives the signal and applies it to the discriminator input. Signal code-detect (inverted) ($\overline{CD}$) at pin 4 of U52 should go low. If not, check JU2, R35, U11, U10, and U12.

The clock signal should be present at pin 3 of U52. A 6 kHz squarewave should be present at pin 1 of U52. (i.e., as long as the encrypting source is encrypting 6 kHz). If a fault here is suspected, check JU6 and the setting of the Code 1/2 switch (if applicable). If these appear to be correct, try replacing U51.

(12) For DVP models, if all the signals mentioned in step 9 are correct, pin 6 of U52 should be high. Modulate the signal with the end-of-message sequence and check for a high level at pin 4 of U52 and a low level at pin 6 of U52. A failure at pin 4 indicates either a code detector fault, or an end-of-message detector fault, or a faulty U12. A failure at pin 6 indicates a possible faulty U28, R51, or U19.

(13) For DVP models, check for a coded unsquelch level at pin 1 of U34. It should go high when the radio unsquelches. If JU1 is in place, pin 1 of U34 goes high for any code detect, and low otherwise. If JU1 is out, then pin 1 of U34 is high or low depending on a proper code detect and the PL switch. If the PL switch is On, then pin 1 of U34 goes high for a proper code detect and low otherwise. If the PL switch is Off, pin 1 of U34 goes high for a proper code detect and low otherwise. If erroneous readings occur and JU1 is in, check the delayed code detect as stated in part 9 above. For erroneous readings with JU1 out, check the proper code detector, U19, U28, R51, and R61.

(14) For DVP models, check the decrypted audio. This signal appears at pin 12 of U43. If there is no audio here, check the filter consisting of U47, R107 through R111, and C42 through C45. The dc voltages at pins 5, 6, and 7 of U47 should be 4.7 ±0.5 V. If the filter is functional, check the CVSD hybrid circuit (U50). Check for power on pin 2 and grounds on pins 1 and 6. In the receive mode, the voltage on pin 9 should be 1 V or less. Faults with pin 9 indicate a keying circuit malfunction. Check for decrypted code at pin 4 of U50 and check for the clock signal at pin 5 of U50. The dc output voltage at pin 7 of U50 should be 4.7 ±0.5 V. If nothing else works, try replacing U50.

(15) Check for clear audio at pin 13 of U43. The dc voltage should be 4.2 ±0.5 V and for 1 kHz (3 kHz of deviation), the ac voltage should be about 200 mV rms. For incorrect levels, check the audio preamp (U27). Check for power at pin 10 of U27 and check for grounds at pins 1, 5, and 6. Check for 4.6 V at pin 9 of U27. Check for the discriminator signal at pin 3 of U27. The voltage at pin 4 of U27 should be 0 V when the audio is squelched and 5 V when the audio is unsquelched. A faulty level on pin 4 is either a hybrid circuit failure, or pin 11 of U35 is providing the wrong signal.

(16) Check the audio PA inputs on the receiver interconnect cable at pins 7 and 15. Pin 15 should have audio (0 Vdc) that is controlled by the Volume control (R92). For incorrect levels at pin 15, check R92, U42, C30, and U43. For DVP models, check that pin 11 of U43 goes high for clear mode audio, and low for coded mode audio. The voltage at pin 7 is pulled low by Q6, in order to turn on the audio PA. If Q6 operates improperly, check that pin 11 of U9 is low. A fault on pin 11 of U9 is probably due to a problem with the keying circuit. If pin 11 of U9 is correct, then check U9, U34, and U35.

(17) Check for audio signals on the speaker terminals of the Speaker-Mic connector (pins 3 and 4). A lack of signal here indicates either a broken connection or a bad audio PA on the receiver.

SYMPTOM: Clock failure

PROCEDURE

(1) For clear models, check for the 12 kHz clock signal at pin 6 of U46. If it is not present, check for possible short circuits on the clock bus and for a faulty U46 and associated oscillator components.

(2) For DVP models, check the 768 kHz clock waveform at the collector of Q14. It should approximate a sinewave oscillating between 2 and 8 volts. If this is not the case, check Q14, Y1, and other associated oscillator components.

(3) For DVP models, check output at pin 1 of U24. This waveform should consist of 1.3 microsecond pulses spaced 42 microseconds apart. Suspect a faulty U24 if this timing is not present.

(4) For DVP models, check output at pin 1 of U29. This waveform should be reset to a low level each time a pulse is received from pin 1 of U24. It should then go high immediately after an edge pulse is generated at pin 4 of U30. If the signal at pin 1 of U29 remains low, there is probably a fault in the PTT circuit that supplies the high level at pin 4 of U29. In this case, check the transmitter keying circuit; otherwise, suspect U18 or U29.

If no edge pulses are received from pin 4 of U30, check the signal path from the discriminator to shift register U42.

(5) For DVP models, check 12 kHz clock signal (C) at pin 13 of U29 and the inverted clock signal ($\overline{C}$) at pin 12 of U29. If either of these signals appear to be faulty, check U29, make certain that JU7 is out, and check the other ICs connected to the clock line.

(6) Check for the presence of the reference clock signal pin 1 of U45. This waveform should be an 83-microsecond pulse occurring every 21 milliseconds. Check U45, JU7, and all ICs connected to the reference clock line if a fault is suspected.

SYMPTOM: Code detector failure

PROCEDURE

(1) Check for the presence of the 12 kHz clock signal at the clock test point (labeled C and located on the solder side of the board near U45 pin 9). The waveform here should be a squarewave with a period of 82 to 84.7 microseconds. If this timing is not evident, review the troubleshooting procedures given for Clock Failures.

(2) Check for the presence of the 21-millisecond clock reference signal at the reference test point (labeled R and located near U49 pin 16 on the solder side of the board). The waveform should be a positive 83-microsecond pulse spaced every 21 milliseconds. If this is not the case, review the procedures given under Clock Failure.

(3) Check for signal $\overline{C}$ at U29 pin 12.

(4) Check for the limited discriminator output at pin 6 of U26. If a fault is suspected check for a high level at pin 4 of U44. A failure here indicates a faulty PTT circuit. Otherwise, check U28, U26, and CR60.

(5) Check for the limited discriminator output at pin 7 of U48. If a fault is suspected, check U42 and U48.

(6) Check for the presence of edge pulses at pin 4 of U30. There should be 1.3-microsecond pulses spaced at approximately 83-microsecond intervals. The pulses should coincide with transitions out of the limiter (U26). Check U30 and U48.

(7) Check for clock synchronization. To do this, check the discriminator signal and the 12 kHz clock. Synchronization is achieved when the rising edges of the clock signal coincide with the point of maximum eye opening. For a failure here, review the procedures on Clock Failure.

(8) Check the re-clocked code on pin 13 of U48. This signal should have transitions coinciding with the leading edges of the clock waveform and should reproduce the limiter output at pin 6 of U26. Check U48 if this is not the case.

(9) Check the signals at pins 5 and 10 of U38, pin 11 of U4, and pin 10 of U30. They should exhibit the timing relationships with the clock waveform as described in step 7. If trouble is evident, check the respective ICs.

(10) Check the signal on pin 11 of U30. For code or discriminator noise the signal should appear as random bits. For end-of-message or clear mode discriminator signals, it should be low with less than a few percent of the bits at a high level. If a failure is suspected, check U30 and U37.

(11) Check the signals at U20 pin 12, U39 pin 13, and pin 10 of U6. They should have the timing relationships as previously indicated for the reference clock under Clock Failures.

(12) If the code detector or end-of-messasge detector does not work, and all the checks so far are positive, then check U1 and U36.

SYMPTOM: Faulty keying (PTT) circuit

PROCEDURE:

(1) Check the PTT switch on the speaker-mic connector (pin 1 or pin 8 of U23). This signal should be high unless the PTT switch is actuated, which should then give a low output. For a failure here, check the speaker-mic and the connector.

(2) Check the power-on-reset signal on pin 9 of U23. This signal is generated at pin 10 of U11 and should be low at all times, except for about one second after the On/Off/Charge switch is moved to the On position. For that one second interval, the power-on-reset signal re-

sets all 4 flip-flops in U36, resets all the delay counters (except the time-out timer and the TOC timer), prevents any audio PA turn-on signals at the receiver connector (pin 7), and inhibits any transmit PTT signal at the transmitter connector (pin 15). This signal also starts the oscillators and detectors and prevents any start-up transients. If a power-on-reset failure occurs, check CR61, R82, C25, and pins 8 through 10 of U11.

(3) Check the $\overline{\text{mic-PTT}}$ signal at pin 10 of U23 and at the emitter of Q19. This signal is high when the PTT switch is actuated and low otherwise. A failure here is probably due to a board short circuit or some component connected to the $\overline{\text{mic-PTT}}$ line. The following points connect to the $\overline{\text{mic-PTT}}$ line:

emitter of Q1
anode of CR59
pin 5 of U43
pin 4 of U29
pin 11 of U42
pins 5 and 6 of U44
pin 13 of U5
pin 5 of U33
pin 5 of U4
pin 5 of U9
R6
anode of CR7
pin 13 of U51
pin 9 of U50

(4) Check the mic-PTT signal at pin 4 of U44. This signal is low when the PTT switch is actuated and high otherwise. For a failure here, check U44 and CR60.

(5) Check for a keying signal on pin 13 of U16. This signal should be high when the PTT is actuated and low otherwise. For DVP carrier squelch models, there is a delay time formed by CR5, R5, R6, and C6 that should delay the dekeying transition by about 65 milliseconds when the mode switch is in the Pvt (coded) position. This delay is for end-of-message signal generation after a coded mode transmission. For units other than DVP carrier squelch models, this delay is either unnecessary or provided by the PL processor in the transmitter. For these units, R5 should be removed. For failures with this signal, check CR7, R5, R6, and C6.

(6) Check for a clear (Std) mode repeater keying signal at pin 10 of U34. This signal goes high whenever the clear mode repeater unsquelch criterion is satisfied. To achieve AND squelch, check that JU4 is out, JU5 is in, and the PL switch is On. With the unit set up in this configuration, both squelch circuits should be unsquelched and PL should be detected. For carrier squelch operation, both JU4 and JU5 should be in, or the PL switch should be in the Off position, such that both squelch circuits function to produce an unsquelched condition. To have PL squelch, check that JU4 is in, JU5 is out, and the PL switch is On. This configuration should lead to the internal squelch circuit producing an unsquelched condition and having PL detected. The squelch signal goes low when the squelch circuit operates and disables the speaker audio. For AND squelch operation, the circuit operates if PL is no longer detected, or if the external squelch operates. For carrier squelch situations, the circuit operates if the external squelch functions, while for PL squelch operation, the circuit operates if the PL is no longer detected. For DVP models, the squelch circuit is reset on coded signals by a high level applied to pin 8 of U44. The clear mode repeater keying signal should be checked with clear mode signals. For faulty operation, check U23, U32, U34, U3, and U44.

(7) Check the clear drop-out delay by looking at pin 3 of U4. This signal goes low whenever the clear mode repeater signal goes high. It remains low until the drop-out delay formed with U14 times out. The delay times are 0, 1.37, 2.73, 5.46, and 10.9 seconds, depending on jumper selection. If faulty, check the clock outputs at pins 12 and 13 of U3. Check U3, U4, U6, U11, and U14. The drop-out delay is cancelled by a reset signal whenever the repeater is disabled (by switching the repeater off), or whenever a coded signal is detected in DVP models. For malfunctions, on drop-out delay cancellation, check U5, U9, U10, and the repeater On/Off switch.

(8) For DVP models, check the TOC timer by looking at pin 14 of U12. This signal goes low whenever the unit detects a coded signal, or whenever there is a mic-PTT signal in the coded mode. The signal remains low for 150 milliseconds afterwards and is high otherwise. The purpose of the signal is to disable PL transmission while in the coded mode and to switch the transmit audio to the coded path. While pin 14 of U12 is low, the signal resets all of the clear mode squelch circuits. For DVP carrier squelch units, it also provides the delay for the repeater PTT signal so that the end-of-message signal may be transmitted. For faulty operation at pin 14 of U12, check the reference clock at pin 10 of U12, the Pvt/Std switch, and the inverted de-

layed code detect signal at pin 10 of U10. If these are correct, then the problem is with U10, U12, or U33.

(9) For DVP models, check for a coded mode repeater PTT indication at pin 4 of U19. This signal goes low for a code detect. For DVP PL models, JU2 should be in and pin 4 of U19 should exactly reproduce the inverted delayed code detect signal on pin 11 of U11. For DVP carrier squelch models, JU2 should be out and pin 4 of U10 should exactly reproduce the TOC timer signal at pin 4 of U12. For difficulties here, check U10, U19, U28, and R35.

(10) For DVP models, check for a coded mode repeater PTT signal at pin 12 of U17. The signal goes low for a coded mode repeater PTT signal and is high otherwise. For units with the proper code detect option, and JU3 out, the signal is derived from the proper code detector through U28, U19, and R50. For these units, the repeater keys only after a proper code detect. If JU3 is out, the coded mode repeater PTT signal is derived from pin 4 of U19. For malfunctions at pin 12 of U17, check U28, U19, and R50.

(11) Check for a repeater key at pin 10 of U16. This signal goes high to key the transmitter for repeater use, but stays low otherwise. If the repeater is failing to key because pin 10 of U16 is low, check pin 8 of U16. This point is low when the repeater is on, but is high otherwise. The repeater is on only when the channel selector is turned to a position with a Rptr-En diode (CR42 thru CR49) in and when the Rptr switch is on. For problems with the repeater enable signal, check CR42 thru CR49, R37 thru R40, C14, Q11, and the repeater switch. For other malfunctions with the repeater keying, check U16 and U17.

(12) Check the time-out timer (TOT) formed with U22 for proper operation. The times selectable by the TOT jumper are 0.728, 1.46, 2.91, or 5.83 minutes, or the TOT may be jumpered out by selecting the fifth jumper position. The TOT input is at pin 2 of U16 and the output is at pin 1 of U16. When pin 2 goes low for a PTT signal, the TOT begins counting. When it counts to the selected time, the output on pin 1 goes high to inhibit the PTT signal. For failures here, check U19, U22, and the clock input at pin 2 of U19.

(13) Check for a PTT signal at pin 3 of U32. This signal goes low to key the transmitter and is high otherwise. For a malfunction here, check pin 2 of U32. Pin 2 only goes low to inhibit the PTT during code insertion (also known as programming) for DVP radios and during the power-on-reset sequence. If faults at pin 3 occur, check U16 and U32.

(14) Check that the red Xmit indicator turns on for a PTT signal and that the transmit PTT signal on the transmitter interconnect cable (pin 15) goes low for a PTT signal. For failures, check Q16 through Q18, R62 through R69, C26, and CR58.

(15) Check for delayed keyed 9 V and delayed PTT signals on the transmitter interconnect cable (pins 2 and 3, respectively). The delayed PTT signal is connected through R3 and CR3 to the main interconnect cable and then to the rf PA. A high on the delayed PTT line resets the rf PA so that it starts up at a lower power level. A malfunction on the delayed PTT line is likely to cause the PA to operate incorrectly. Check the cables, R3, and CR3 for delayed PTT malfunctions. Delayed keyed 9 V goes high when keyed, and is low otherwise. For problems here, check the transmitter cable and the relay on the transmitter board.

(16) Check the signal at pin 15 on U43. This point should go high during the power-on-reset sequence, for a mic-PTT signal on repeater frequencies, and for delayed keyed 9 V on non-repeater frequencies. The signal should be low otherwise. This signal causes the audio PA to turn off when high (except for the alert tone on DVP models). If malfunctions occur, check the Rptr-En diode jumpering, U43, and the parts connected to Q11.

(17) On DVP models, check alert tone generator U13. When the unit is keyed with the mic-PTT switch and the Pvt/Std switch is in the Std position, there should be a brief alert tone in the speaker. This tone is gated by a signal on pin 10 of U5 and is generated at pin 7 of U13. Check U5, U13, R85, and R98 if any problems are encountered in this circuit.

SYMPTOM: Faulty transmitter operation

PROCEDURE:

(1) Check for the presence of 9.2 ±0.5 volt on pin 20 of the transmitter interconnect cable. Check for grounds on pins 5 and 16 of the cable and for 4.6 volts on pin 19. Check for short circuits, broken connections, and if 4.6 volts is missing, check pin 9 of U27.

(2) Check for the presence of 4.4 volts on pins 7 through 14 of the transmitter interconnect cable (frequency select lines). Only one channel element can be selected at any one time (4.4 volts; 0 volt otherwise). If problems are suspected here, check 5-volt regulator U1, frequency select switch, diodes CR16 through CR23, transmitter frequency select jumpers, transmitter cable, and the transmitter channel elements.

(3) Check the transmit-PTT signal on pin 15 of the transmitter interconnect cable. It should be low during transmitting operations and high otherwise.

(4) Check for delayed keyed 9 V and delayed PTT signals on the transmitter interconnect cable (pins 2 and 3, respectively). These signals are generated on the transmitter board, and for PL models they are delayed by the PL processor for reverse burst. For malfunctions, check the PL processor and the relay on the transmitter board.

(5) Check the transmit PL disable signal on the transmitter interconnect cable (pin 1). This signal goes low to disable PL transmission and is high otherwise. It is used in DVP PL units to prevent PL transmissions when in the coded mode. To check the signal, place the Pvt/Std switch in the Pvt position and actuate the mic-PTT switch. Pin 1 of the cable should go low and remain low for 150 milliseconds after the mic-PTT switch is released. With the switch in the Std position, the signal on pin 1 should remain high for a mic-PTT signal. If incorrect, check U4, R8, C1, and Q1. If they are functional, refer to part 8 in the "keying (PTT) circuit failure" section.

(6) Check for mic audio at pin 14 of U47. The dc voltages at pins 12 through 14 of U47 should be at half the supply voltage at pin 4 of U47. The audio level at pin 14 of U47 should be about 100 mV rms, for average speech levels into the microphone. If erroneous values are present, check R88, R96, C39, U47, and the coaxial cable. For incorrect dc voltages check R112, R113, and C38.

(7) Check for clear repeater audio signals at pin 8 of U47. The dc voltages on pins 8 through 10 of U47 should be at half the supply voltage at pin 4 of U47. The audio level at pin 8 of U47 should be at 100 mV rms for 3 kHz of deviation at the receiver. For incorrect voltages, check U47, R105, and R106.

(8) Check for clear audio on pin 8 of the IDC module (U2). The ac voltage should be the same as for pin 14 of U47 and pin 8 of U47. If faulty, check pins 11 through 14 of U42, R95, and C34.

(9) Check for clear audio at pin 5 of U3. The dc voltage should be 2.5 ±0.3 V and the ac voltage should be about 4 V peak-to-peak for 5 kHz of deviation. The audio should be limited and filtered by U2. If erroneous, check U2, R25, C10, R26 through R28, and C13.

(10) For DVP models, check the amplified audio on pin 1 of U47. It should be about 1 V rms for average speech volume into the microphone. The dc voltages at pins 1 through 3 of U47 should be at half the supply voltage at pin 4 of U47. For problems, check U47, R103, R104, C37, and C40.

(11) Check the transmit bits on pin 3 of the CVSD (U50). These bits should be related to the transmit audio input on pin 8. For silence on pin 8, the output on pin 3 is a 6 kHz square wave. For a loud signal on pin 8, the output should frequently go into slope overload (3 or more consecutive bits that are either all high or all low). For difficulty here, check for supply voltage on pin 2, ground at pins 1 and 6, and the clock signal at pin 5 of U50. To transmit, the voltage on pin 9 should be no more than 1 V less than the supply voltage on pin 2.

(12) Check for encrypted bits at pin 14 of U51. This signal should look like random bits when the Pvt/Std switch is in the Pvt position and the mic-PTT switch is actuated. The levels should be at 4.8 V when high and 0.2 V when low. When the mic-PTT switch is released the signal at pin 14 of U51 should be a 6 kHz square wave oscillating from 0.2 V to 4.8 V. The signal in all cases should be synchronized to the inverted clock signal; i.e., pin 14 can only change when there is a positive edge on pin 16. For erroneous readings at pin 14 of U51 during transmit check the following:

- more than 8 V is on pin 1
- a low level is on pin 5, unless code 2 is selected (for code 2 it should be 5 V)
- transmit code is on pin 17
- pin 10 is low and pin 13 is high
- pin 11 has a 12 kHz clock signal and pin 16 has a 12 kHz inverted clock signal
- pin 18 is at ground level

If all the above inputs are correct and U51 encrypts improperly, then the circuit is bad. For malfunctions on pins 1, 2, and 3, check the respective voltage regulators. For defective operation on pins 4 and 5, either the hybrid circuit is faulty or the circuit driving the hybrid module is faulty. For faults on pins 10, 11, 13, 16, or 17, check the respective driving circuit.

(13) For DVP models, check for the re-clocked code at pin 1 of U3. This signal should be the limited, re-clocked discriminator signal. It should be 5 V when high and 0.2 V when low. It should also be synchronized with

the inverted clock signal. For malfunctions, check for a re-clocked discriminator signal at pin 13 of U48. If the signal is not present, then the defect is probably due to a receiver failure. Otherwise, check U20, Q3, R9, and R11.

(14) For DVP models, check the coded signal at pin 15 of U3. When repeating a coded signal, pin 15 should be the same as pin 1. When transmitting encrypted microphone audio, pin 15 should be the same as pin 2. For problems in this area, check U3 and U4.

(15) Check the splatter filter output at pin 7 of U7. For coded signals, it should form an eye pattern that has an 88% eye opening. The dc voltage should be 2.5 V and the signal amplitude should be about 3.8 V peak-to-peak. For incorrect levels at these points, check R10 and U7.

(16) Check the transmit audio signal on the transmitter interconnect cable (pin 17). It should be a DVP signal when transmitting in the coded mode and clear audio when transmitting in the clear mode. If this signal is incorrect, check U3, Q2, R7, C5, and C7. If the transmit audio is correct, the fault is probably in the transmitter.

SYMPTOM: Code insertion (programming) failure

PROCEDURE:

(1) Check the signals at pins 2, 3, and 4 of U36 during the power-on-reset sequence (the second after the On/Off/Charge switch is turned on). Pins 2, 3, and 4 should be low, high, and high, respectively. After the power-on-reset interval, while no programmer is plugged into the code insert socket, the signals on pins 2, 3, and 4 should be high, low, and high, respectively. In these cases, without the programmer plugged in, check for the following:

- if pin 4 is wrong, check R93, R94, and C31
- if pin 2 or 3 is wrong, check U36 and the power-on-reset circuit.

(2) Check the signals at pins 2 and 3 of U36 when the programmer is plugged into the code insert socket. In this case pin 2 should be low and pin 3 should be high. For malfunctions, check the code insert socket, R93, R94, C31, and U36.

(3) With the programmer plugged in, the red Xmit indicator should be off. If it does not turn off, check for a low at pin 2 of U32, a high at pin 3 of U32, Q17, and Q18.

(4) With the programmer plugged in, check for an audio PA turn-on signal at pin 7 of the receiver interconnect cable. This should be pulled low, as long as the programmer is plugged into the code insert socket. For a malfunction in this circuit, look for a high at pin 2 of U32, a low at pin 2 of U35, a low at pin 11 of U9, and a high at pin 6 of U9. A failure in U34 or U35 is probably due to an IC or board failure. If pin 11 of U9 is not low, there is a defect in the keying circuit. Other problems are due to Q6 or U9.

(5) Check the programmer operation by looking at the code insert data, the write enable line, and key signals. These are abbreviated as CID, $\overline{WE}$, and KEY (pins 1, 2, and 3 of the code insert plug, respectively). To test the programmer, plug it into the code insert socket, turn it on, push the RDY button (the display should display a zero) and actuate the PTT button on the programmer. Signal CID should be a sequence of 12 kbps data, starting from the time the RDY button is pushed. The $\overline{WE}$ signal should be high, until the PTT button is actuated. It should then go low for a short interval (12.6 ms), during which time the KEY line has bits; the rest of the time the KEY line is inactive. After the short $\overline{WE}$ interval, the CID signal has encrypted 1.5 kHz that is used as a confirmation code. Signals CID, $\overline{WE}$, and KEY are at 5 V when high and a 0 V when low. All three signals are necessary for correct code insertion. If they are improper, the programmer is probably defective.

(6) Check for a buffered CID signal at pins 4 and 5 of U42. The transistor buffer formed by R91, R89, R90, and Q22 amplifies the CID signal so that it varies between ground and supply voltage (rather than 5 V). If erroneous, check Q22 and U42.

(7) On the encode-decode hybrid module (U51), check for the supply voltage at pin 1 and 5 V on pins 2 and 3. Check the respective voltage regulator, if incorrect. Check for the $\overline{WE}$ signal at pin 4, as described in part 5 above. A low on pin 5 ensures that the encode-decode hybrid circuit is in code 1 mode, so that the confirmation tone can be properly decoded. For wrong data on pin 5, check the Code 1/Code 2 switch, JU6, and CR56.

Check for the KEY signal on pin 8, as described in part 5 above. Reclocked CID signals on pin 9 and a high on pin 10 should be present; otherwise, U51 cannot accept the code being inserted. Pin 13 should be low. For errors at pin 10 or 13, check the keying circuit. Look for clock and inverted clock signals on pins 11 and 16, respectively. For a difficulty in the clock signals, refer to the section on clock failure. The hybrid output on pin 15 should be a properly decrypted confirmation

tone. It should appear as a 1.5 kHz square wave, after a good code insertion. A bad insertion should give a garbled output on pin 15. In addition to the mere presence of the signals, the $\overline{WE}$, KEY, and reclocked CID signals on pins 4, 8, and 9, respectively must all be synchronized with the clock signal (that is, transitions in the signals coincide with positive transitions). It should also be noted that reclocked CID at pin 9 of U51 is synchronized with the inverted clock signal. For synchronization problems refer to the clock failure section. If all the hybrid inputs are correct, but the output on pin 15 is still garbled, replace the encode-decode hybrid module.

(8) Lastly, check the code detector and confirmation tone. During code insertion, there should be a code detect present, as evidenced by a high at pin 10 of U36 and the lighting of the yellow Pvt indicator. If these do not work, refer to the part on code insertion failure. The confirmation tone, once it appears at pin 15 of U51, should be present at the CVSD, pin 7 of U47, pin 1 of U43, pin 15 of U42, the Volume potentiometer, the audio PA, and the local speaker. For defects with the confirmation tone, check this path for the source of trouble.

SYMPTOM: Switch-around relays operate improperly

PROCEDURE:

(1) Check the voltage on the collector of Q7. It should be 0.2 V whenever the frequency selector switch is on a channel having the receiver switched around the duplexer. This voltage is high if the receiver switch-around channels are not being selected. For malfunctions here, check R17, R18, R20, C11, CR26 through CR33, and Q7.

(2) Check the voltage on the collector of Q8. It should be 0.2 V whenever the frequency selector switch is on a channel with the transmitter switched around the duplexer. This voltage is high if the transmitter switch-around channels are not selected. For incorrect operation, check R16, R21, R23, C12, CR34 through CR41, and Q8.

(3) Check the signals at pins 10 and 11 of U8. Pin 10 should go high when on a receiver switch-around channel and when the transmitter is not keyed; pin 10 is low otherwise. Pin 11 is high when on a transmitter switch-around channel and when the transmitter is keyed; it is low otherwise. For defects in this area, check U8 and look for delayed keyed 9 V at pins 1, 2, and 8 of U8.

(4) Check R19, R22, C8, C9, Q4, Q5, CR5, and CR6. These circuits actually switch the relays under the proper circumstances.

SYMPTOM: LED indicators faulty

PROCEDURE:

(1) If the Batt indicator is faulty, refer to the section on the battery circuit. If the Xmit indicator is faulty, refer to the section on keying failure.

(2) Look for the code detect signal at pin 5 of U5 and the end-of-message detect signal at pin 6 of U5. These points go high when code or end-of-message are detected; they are low otherwise. For faults here, refer to the section on code detector failure.

(3) Look for a discriminator quieting indication at pin 6 of U16 and check for a PL detect at pin 5 of U16. These points go high when a clear mode signal quiets the discriminator, because a PL detection has occurred. For faults, refer to the section on receiver failure.

(4) Look for delayed keyed 9 V at pin 9 of U33 and an inverted repeater enable signal at pin 8 of U33. The delayed keyed 9 V goes high when the transmitter is keyed and is low otherwise. A fault here is probably a keying failure. The inverted repeater enable signal goes high when the frequency selector switch is switched to a non-repeater channel. It goes low for repeater channels. For malfunction, check CR42 through CR49, R38 through R40, C14, and Q11.

(5) Check that pin 3 of U33 goes high for a code detect or an end-of-message detect when the transmitter is keyed on a non-repeater channel. If not, check U5 and U33.

(6) Check that pin 11 of U33 goes high when the transmitter is keyed on a non-repeater channel. If not, check U33.

(7) Check for a high on pin 4 of U23 when the receiver detects code or an end-of-message signal. A failure here indicates a fault in U5 or U23.

(8) Check for a high at pin 3 of U23 when the receiver is either quieted or gets a PL detect signal. For a failure here, check U16 and U23.

(9) If the yellow Pvt indicator is faulty, check R53, R114, Q13, and the LED. If the green Std indicator is faulty, check R42, R115, C46, Q12, and the green LED.

4-5. SERVICE PROCEDURES

a. Component Removal

Most components are located on printed circuit boards. Special care should be taken during troubleshooting to be as certain as possible that the suspected component is actually causing the unit to malfunction. This will eliminate unnecessary soldering and removal of parts which may damage or weaken other components or the printed circuit board itself.

CAUTION

Components are soldered to the printed circuit plating which extends through the holes of the board to the plating on the opposite side. Read this section for proper use of a soldering iron to prevent damage when removing components.

Transistors are dependable components and do not often need to be replaced. Therefore, service people should not replace transistors before they are thoroughly tested. The transistor terminal voltages should be checked first. If these voltages are not reasonably close to the values specified in this manual, the associated components should be checked. If all voltages are correct, the signal should be traced through the circuit to show any possibility of breaks in the signal path.

When removing resistors, capacitors, and similar components, heat the connection to be loosened until the solder is molten. Then brush away or shake off as much of the molten solder as possible. If the leads are bent over use a soldering aid tool or a knife to straighten them. It may be necessary to apply the soldering iron while doing this. While applying the soldering iron, wiggle the component gently to free it. Then lift it from the board. Be sure that the component lead is free before trying to remove it or the printed circuit wiring might be damaged. Clean the circuit wiring around the holes with solvent. Install the new component and solder it in place. Never let the solder flux bridge the gap between the wiring pattern. This can reduce the resistance between circuits to only a few megohms which will cause leakage and disrupt certain electronic circuits. Use solvent to clean away any flux left after soldering.

b. Repair

In the past, service people have been led to believe that printed circuits are extremely fragile and that an exceptionally low wattage soldering iron must be used to prevent the heat from lifting the plating. This is a misconception. Experience has shown that using a soldering iron with low heat output in many cases has actually caused the damage that the service person was trying to prevent.It is absolutely necessary to raise the temperature of the connection until the solder flows freely around the component lead. This usually takes a considerable length of time with a very low heat iron. During this time heat is conducted away from the connection by the printed wiring, causing them, in some instances, to break away from the board. If a component is to be removed, its soldered connections must be raised to a temperature that permits free flow of solder. Otherwise, the component's leads may not be freed from the plating in the hole, which will be pulled out of the board as the component is removed. The soldering iron supplied with the Motorola Printed Circuit Repair Kit is recommended for most work on printed circuit boards. This high-heat iron need be applied only a very short time to heat a connection to the point where solder flows freely. It is obvious that an iron this hot should not be held on a connectiion longer than necessary. Extended periods of high heat will cause the foil to peel loose from the board.

The tip of the iron has a tapered point to permit its exact application to the desired connection in the compact equipment. Always keep the iron tip well tinned and clean.

Breaks in the printed wiring can be repaired by bridging the gap with solder. Remove the resin coating covering the printed wiring with solvent before soldering. Large areas of the printed wiring that have peeled loose can be repaired with a piece of hook-up wire. The wire should follow along the path of the original printed wiring. This avoids any lead dressing problem in critical circuits.

c. Tools

Motorola has available several items which can be used to aid in the replacement of parts and the repair of printed circuit boards. These tools are described in the following paragraphs:

- Magnifying Glass

  The miniaturization of electronic circuits requires precise work both in manufacture and in field service. Adequate concentration of light and magnification aid servicing work by enabling a visual examination of connections and miniature parts. The ST-650 or ST-652 Magnifying Glass (with built-in light source) is a most satisfactory device for use in servicing equipment in the shop. This large illuminated magnifying glass makes it easy to see any portion of the small components found on the printed circuit board.

- Printed Circuit Repair Kit

  The ST-639 Printed Circuit Repair Kit supplies most of the basic tools needed for work on printed circuitry and miniature components.

NOTE

The needle point tiplet for the soldering element may be filed to an even finer point to avoid damaging the compact printed circuitry.

d. CMOS Integrated Circuit Handling Precautions

Many of the integrated circuit devices used in communications equipment are of the CMOS (complementary metal-oxide semiconductor) type. Because of their high open-circuit impedance, CMOS IC's are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltages in the hundreds of volts range, such as are encountered in operating equipment. Circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. However, CMOS circuits can be damaged by improper handling of the modules even when installed in a system. To avoid damage to circuits, observe the following handling, shipping, and servicing precautions:

- Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch both hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.
- Whenever possible, avoid touching any electrically-conductive parts of the circuit module with your hands.
- Normally, circuit modules can be inserted or removed with power applied to the unit. However, as a precaution the schematic diagram should be checked to ensure that this will not cause any problem electrically.
- When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.
- All electrically-powered test equipment should be grounded. Apply the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.
- If a circuit module is removed from the equipment, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is already connected to ground through a resistance of about 100 k ohms.
- When soldering, be sure the soldering iron is grounded.
- Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an IC device), be sure to discharge any static buildup as described above. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.
- When replacing a CMOS IC device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.
- All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.
- Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a similar material (aluminum foil may be used). Never use non-conductive material for packaging these modules.

e. Receiver and Transmitter Circuit Board Repair

The four-layer board used for both the receiver and transmitter circuits presents some new considerations when soldering and unsoldering components. The printed-through holes may interconnect two, three, or all four layers of printed circuitry. Care should be exercised to avoid pulling the plated circuit out of the hole. Also, on some units the interconnect circuits may be attached to the back side of the board. If parts under the interconnect circuit must be replaced, it may be necessary to unsolder part of the interconnect circuit covering the desired area on the board.

When soldering near the module socket pins, use care to avoid accidentally getting solder in the guide pin socket, which is open on the end. Insert the module pusher tool into the hole while soldering. Also, be careful not to form solder bridges between module socket pins. Inspect your work for shorts due to solder bridges. Figure 4-16 illustrates typical four-layer board construction.

f. Rf Power Amplifier Repair

Because of the unique power amplifier construction, it is recommended that the tools used be similar to those listed in Table 4-4. Except for the silver solder and the Wakefield

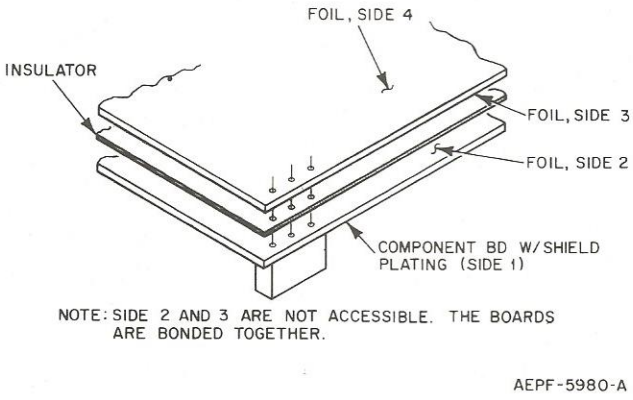


Figure 4-16.
Typical Four-Layer Board Construction

thermal compound, which are normally supplied with replacement transistors, use of these tools is not mandatory. You will find, however, that these tools will make quality power amplifier repairs easier to perform. The soldering iron tips are designed to make transistor removal and chip capacitor removal and replacement easier.

Table 4-4. Tools for Power Amplifier Repair

DESCRIPTION	MOTOROLA PART NO.
Solder remover	ST-726
Soldering iron, 60 W	ST-1144
Soldering iron tip, 60 W	ST-1144
Special tip for PA transistor removal	ST-1161
Special tip for chip capacitor soldering	ST-1160
Soldering iron, 50 W	ST-646
Soldering iron tip, 50 W	ST-1174
Modeling knife	ST-1172
Model knife blades	ST-173
Tweezers	ST-492
Wakefield thermal compound	1183166A01

After the malfunctioning stage has been identified, perform a thorough physical inspection before beginning repairs. Check the ceramic substrate for hairline cracks. Hairline cracks can often be found by running a sharp instrument along the ceramic beside the microstrip conductors. Check in both directions. A crack will usually "catch" the instrument, even when the crack is too small to be seen. Broken microstrip conductors can also be found through ohmmeter continuity checks.

To remove a power transistor, unsolder all component connections at or near the points where the rf power transistor leads are soldered to the microstrip. Mica capacitors are connected between rf power transistor leads. Remove all the mica capacitors, using two soldering irons or the special ST-1160 Soldering Iron Tip.

CAUTION

Chip capacitors must not be re-used. Excessive heat applied during capacitor removal can cause leaching of the metallic contact area.

Remove excess solder from the transistor lead area with a vacuum-bulb solder remover. Then carefully lift each of the emitter leads. Use long-nosed pliers or a modeling knife to lift each lead while applying heat. Be sure the solder has melted before you try to lift the lead, but avoid prolonged or excessive heating. Also, remove any transistor mounting screws and/or grounding straps.

To replace an rf power transistor, use the following procedure:

- Lightly tin the underside of each transistor lead.

CAUTION

When pre-tinning the transistor leads, do not allow thick build-ups of solder to occur. Such a build-up could cause the transistor to separate from its mounting base when the mounting screws are tightened. Avoid getting solder or flux on the transistor mounting base.

- Thoroughly clean the transistor mounting surface, using alcohol or another solvent that leaves no residue. Apply a light coat of thermal compound to the mounting surface (bottom side of the transistor). Thick coatings of thermal compound or foreign material on the transistor mounting surface will cause poor thermal contact and may result in early failure.
- Mount the transistor, making sure that the collector lead faces the proper direction.
- Carefully tighten the transistor mounting screws. To avoid damage to the transistor or the microstrip, the transistor mounting screws must be tightened before the transistor leads are soldered to the microstrip conductors.
- Solder each transistor lead, one at a time, to the microstrip. The use of a generous amount of the solder will ensure a good contact over the entire area of the transistor tab and microstrip interface, and will assist in the

reflow soldering of the chip capacitors. Use care that the solder does not bridge the leads or short either the base or collector leads to the microstrip ground.

- Install the mica capacitors as required. Use a low-wattage soldering iron (50 W or less) with a chisel tip, or a 60-watt iron with a ST-1160 tip. A re-flow type technique must be used and the soldering iron tip must not be allowed to touch the chip capacitor end termination. Make sure that the chip capacitor is placed as close to the transistor cap as possible. Proper soldering technique and chip capacitor placement are essential to acceptable transmitter operation. Use extreme care when replacing chip capacitors.

- Check the chip solder connections. The solder should cover both capacitor sides. The solder must not run up the open back of the capacitor, or the exposed plates will be shorted to ground. The capacitor must be replaced if the transmitter is to function properly.

To remove the uhf microstrips, use the following procedure:

- Remove both transistor assemblies, as described in the preceding instructions.

- Remove all external component connections to the microstrip, including interface connections with other stages.

- Remove all remaining ground straps (if any).

- Lift the microstrip substrate out of the plastic holder.

To replace the microstrip, use the following procedure:

- Place the new microstrip substrate into the plastic holder.

- Carefully clean all solder build-up off the transistor leads. Only a very thin layer of solder should remain. Check for solder-bridge shorts between transistor leads.

- Install the transistors and their associated chip capacitors, as described for power transistors in the preceding paragraph. Be sure to tighten the transistor mounting screws before soldering the transistor leads to the microstrip conductors.

- Reconnect all external components to their proper locations on the microstrip.

To remove the vhf power amplifier board, use the following procedure:

- Remove both transistors, as described above. Note that this requires removing two screws for one transistor, and a nut (from underneath) for the other transistor.

- Remove all external connections.

- Remove seven screws holding board down.

- Lift board off.

To replace the vhf power amplifier, use the following procedure:

- Mount the board onto the heat sink with seven screws and seven fiber-insulated spacers.

- Clean and re-tin the solder areas for transistor and capacitor leads.

- Install the transistors and chip capacitors, as described previously.

- Tighten the mounting nut and screws before soldering the transistor leads to the board.

- Reconnect the external connections.

SECTION 5

SCHEMATIC AND COMPONENT LAYOUT DIAGRAMS AND PARTS LISTS

FIGURE

Vhf Receiver Parts List PLF-1761-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		MODULE, Preselector: Contains U2 & U3
A1	NLD6571A	136-150.8 MHz
	or NLD6572A	150.8-162 MHz
	or NLD6573A	162-174 MHz
		CAPACITOR, Fixed: pF ±10%; 20 V unless otherwise stated
C1		Not Used
C2	2382397D07	1 uF +40–20%
C3	2184008H01	.01 uF; 50 V ±10%
C4, 5		Not Used
C6	2182358G76	18.5 ±2%; 25 V
C7		Not Used
C8	2182358G76	18.5 ±2%; 25 V
C9	2184008H01	.01 uF; 50 V
C10		Not Used
C11	2382397D51	22 uF ±20%; 6 V
C12, 13	2382397D03	10 uF ±20%; 6 V
C14		Not Used
C15, 16	2184008H01	.01 uF; 50 V
C17		Not Used
C18	2184511B13	33; 50 V; N150 (136-150.8 MHz)
	or 2182358G50	20 ±3%; 100 V (150.8-174 MHz)
C19		Not Used
C20	2382397D15	10 uF ±20%
C25	2182213E21	.002 uF +100–20%
		CHANNEL ELEMENT:
CE1 thru 8	KXN1040B	Receiver
		DIODE: See Note
CR1, 2	4805824C01	Silicon (1 & 2 channel units only)
CR3 thru CR6	4805824C01	Silicon
CR7		Not Used
CR8	4882363E03	Silicon
		FILTER:
FL1/FL2	4805535C16	Matched Pair, FL1 coded BLK; FL2 coded ORG
FL3/FL4	4805535C17	Matched Pair, FL3 coded BLU; FL4 coded VIO
FL5	4805530C01	Discriminator, crystal; coded GRN
		RELAY:
K101	8005037E01	8-pin, DPDT
		COIL, RF: unless otherwise stated
L1, 2		Not Used
L3	2482723H07	Choke, 10 uH
L4	2405435C01	4-1/2 turns closewound, includes: 7605385C01 CORE; tuning
L5	2482723H05	Choke, 0.41 uH
		RESISTOR, Fixed: Ω ±10%; 1/8 W unless otherwise stated
R1	0600185B67	100
R2		Not Used
R3	0600185B67	100
R4	0600185B73	330
		HYBRID, Encapsulated:
U1	NFD6011A	Rf Filter, 0.5 uV sensitivity (136-150.8 MHz)
	or NFD6012A	Rf Filter, 0.5 uV sensitivity (150.8-174 MHz)
U2, 3		Part of A1
U4	NLN8917A	First I-f Amplifier
U5	NLN8773A	Second I-f Amplifier
U6	NLN5925A	Discriminator
U8	NLN8775B	Audio Power Amplifier
U121	NFN6010A	Tone PL Filter
U122	NLN4052B	PL Processor
U123	NFN6009A	Low-Pass Filter
U109	NLD6921A	Buffer Amplifier
		NONREFERENCED ITEMS
	2605434C02	Shield, Coil; for L4
	1405601C01	Insulator, for K101
	1405736C01	Insulator, for FL5
	7505295B01	Pad, for FL1–FL4
	0705196A01	Boot, for FL1–FL4
	0905604C06	Socket, for guide pin
	0905287C05	Socket, module
	1484277D14	Housing
	0984279D01	Contact
	2284835F01	Pin, Polarizing

NOTE: For optimum performance, order replacement diodes by Motorola part number only.

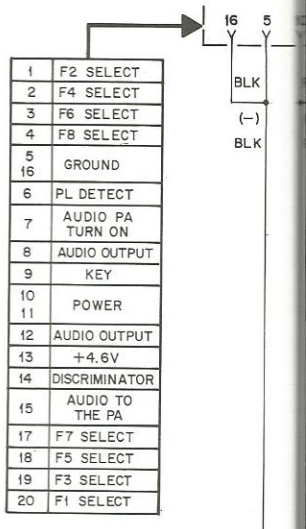
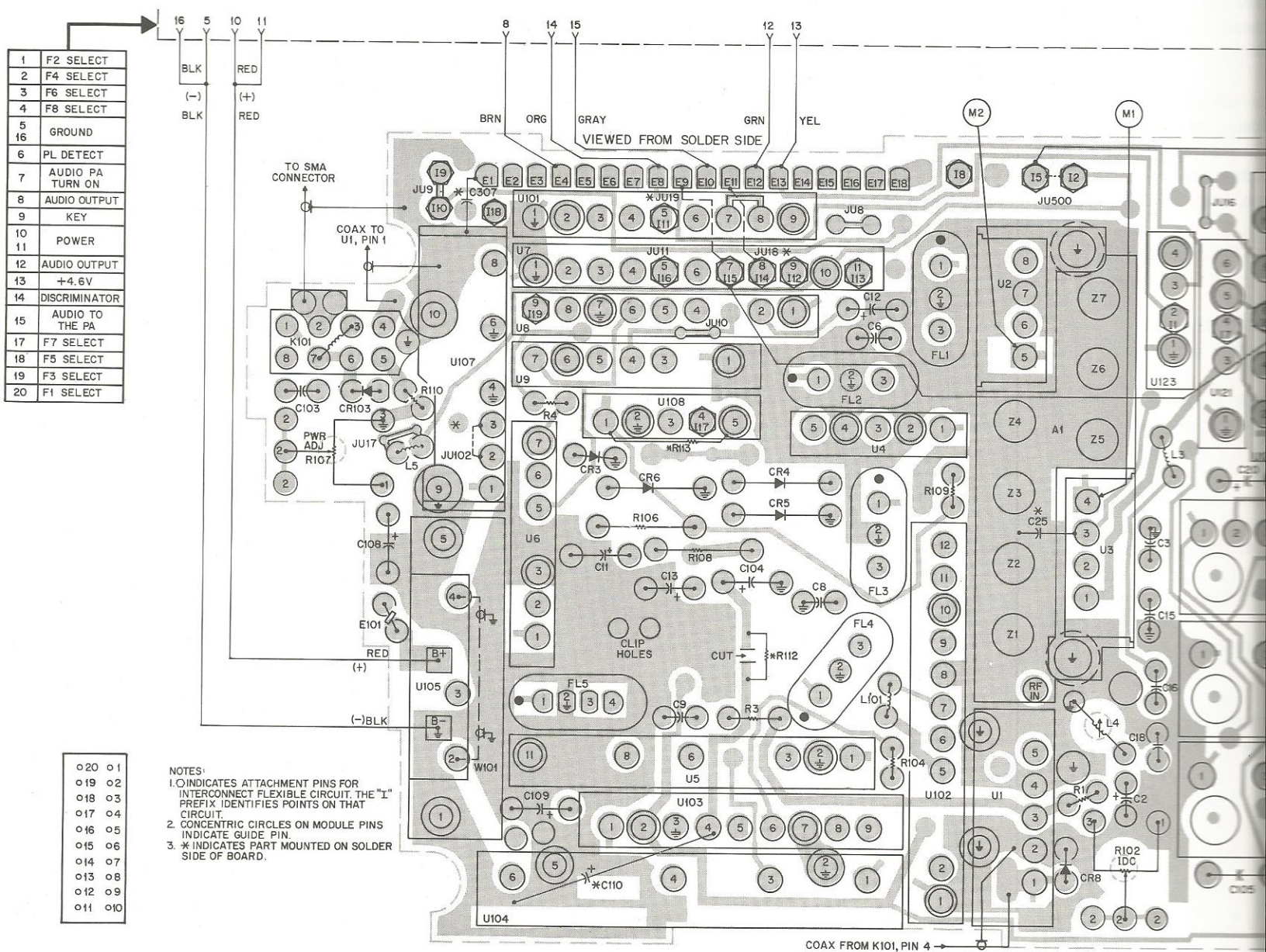


Figure 5-1. Vhf Receiver Circuit Board Component Layout and Wiring Diagram and Parts List

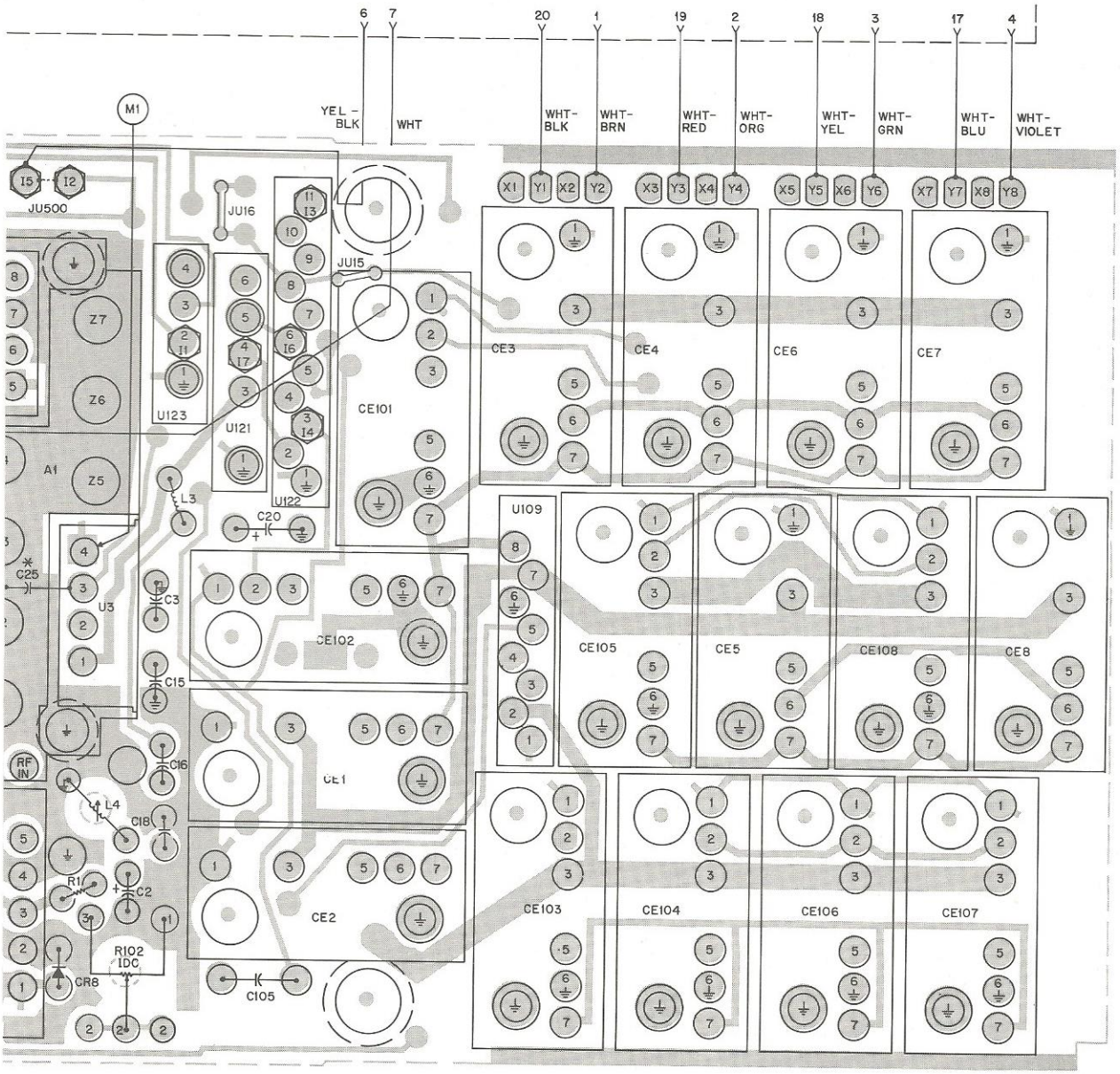
Motorola part

1	F2 SELECT
2	F4 SELECT
3	F6 SELECT
4	F8 SELECT
5 16	GROUND
6	PL DETECT
7	AUDIO PA TURN ON
8	AUDIO OUTPUT
9	KEY
10 11	POWER
12	AUDIO OUTPUT
13	+4.6V
14	DISCRIMINATOR
15	AUDIO TO THE PA
17	F7 SELECT
18	F5 SELECT
19	F3 SELECT
20	F1 SELECT

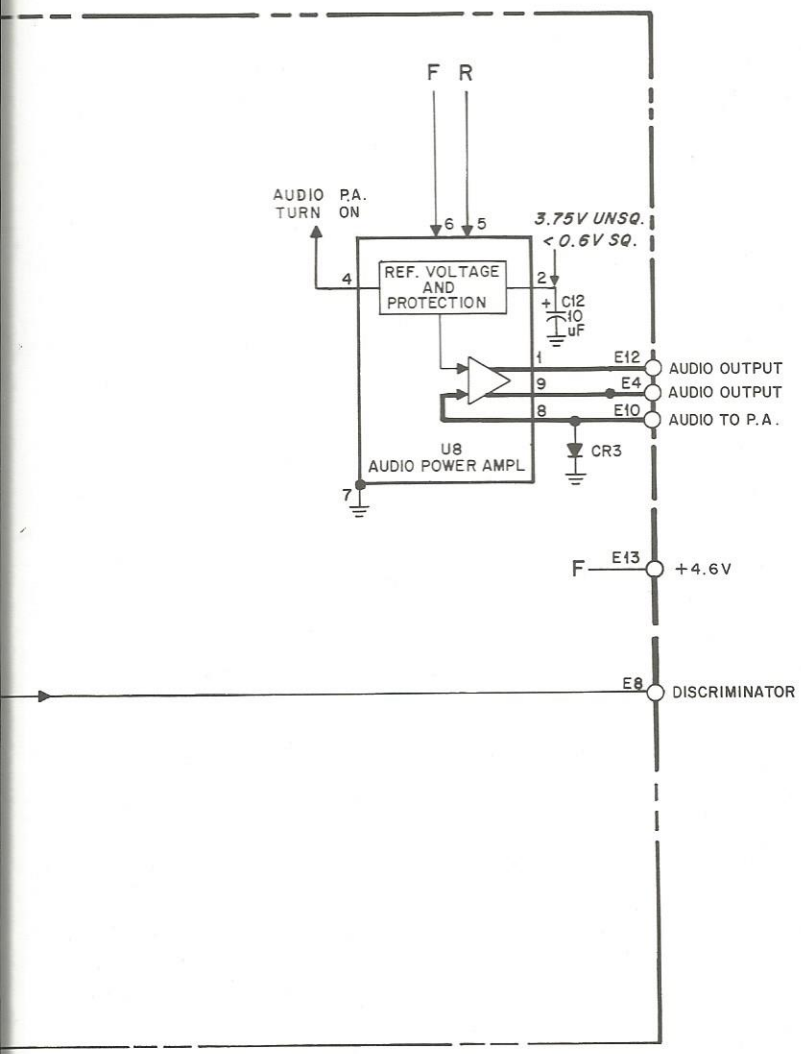


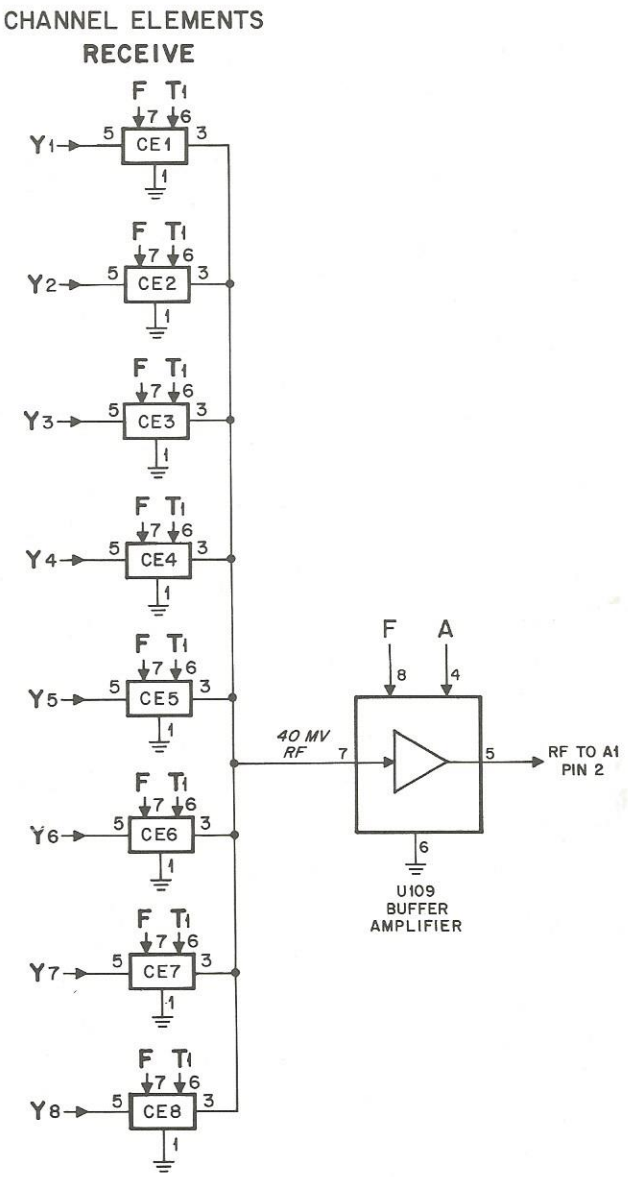
O20	O1
O19	O2
O18	O3
O17	O4
O16	O5
O15	O6
O14	O7
O13	O8
O12	O9
O11	O10

NOTES:
1. ○ INDICATES ATTACHMENT PINS FOR INTERCONNECT FLEXIBLE CIRCUIT. THE "I" PREFIX IDENTIFIES POINTS ON THAT CIRCUIT.
2. CONCENTRIC CIRCLES ON MODULE PINS INDICATE GUIDE PIN.
3. * INDICATES PART MOUNTED ON SOLDER SIDE OF BOARD.



© SS – EEPF – 10312 – C
OL – EEPF – 10254 – A





63E81021C58-B

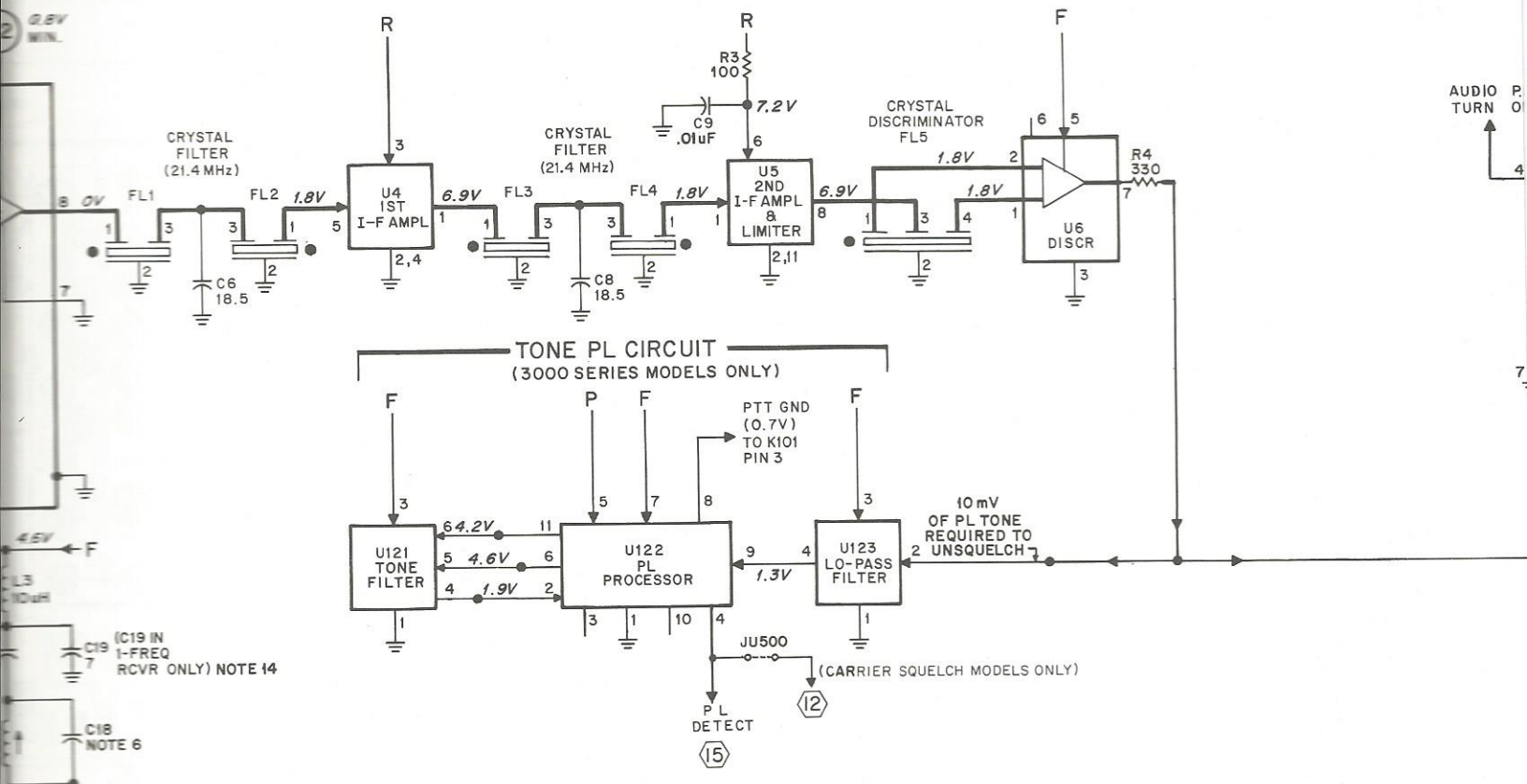
ss INDICATED OTHERWISE.

VOLTAGES:

= 7.5VDC PRESENT IN ALL MODES.
= 7.5 VDC PRESENT IN RECEIVE MODE.
= 7.5 VDC PRESENT IN TRANSMIT MODE.
= 7.5 VDC PRESENT IN "PL" OFF MODE.
= 4.6 VDC PRESENT IN ALL MODES. (FROM U7)

ITEM NUMBER	SUFFIX	FREQUENCY RANGE
PRD6011A	-	136-150.8MHz
PRD6012A	-	150.8-162MHz
PRD6013A	-	162-174 MHz

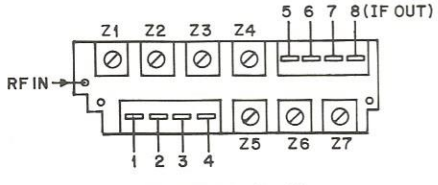
Figure 5-2.
Vhf Receiver Schematic Diagram 5-3



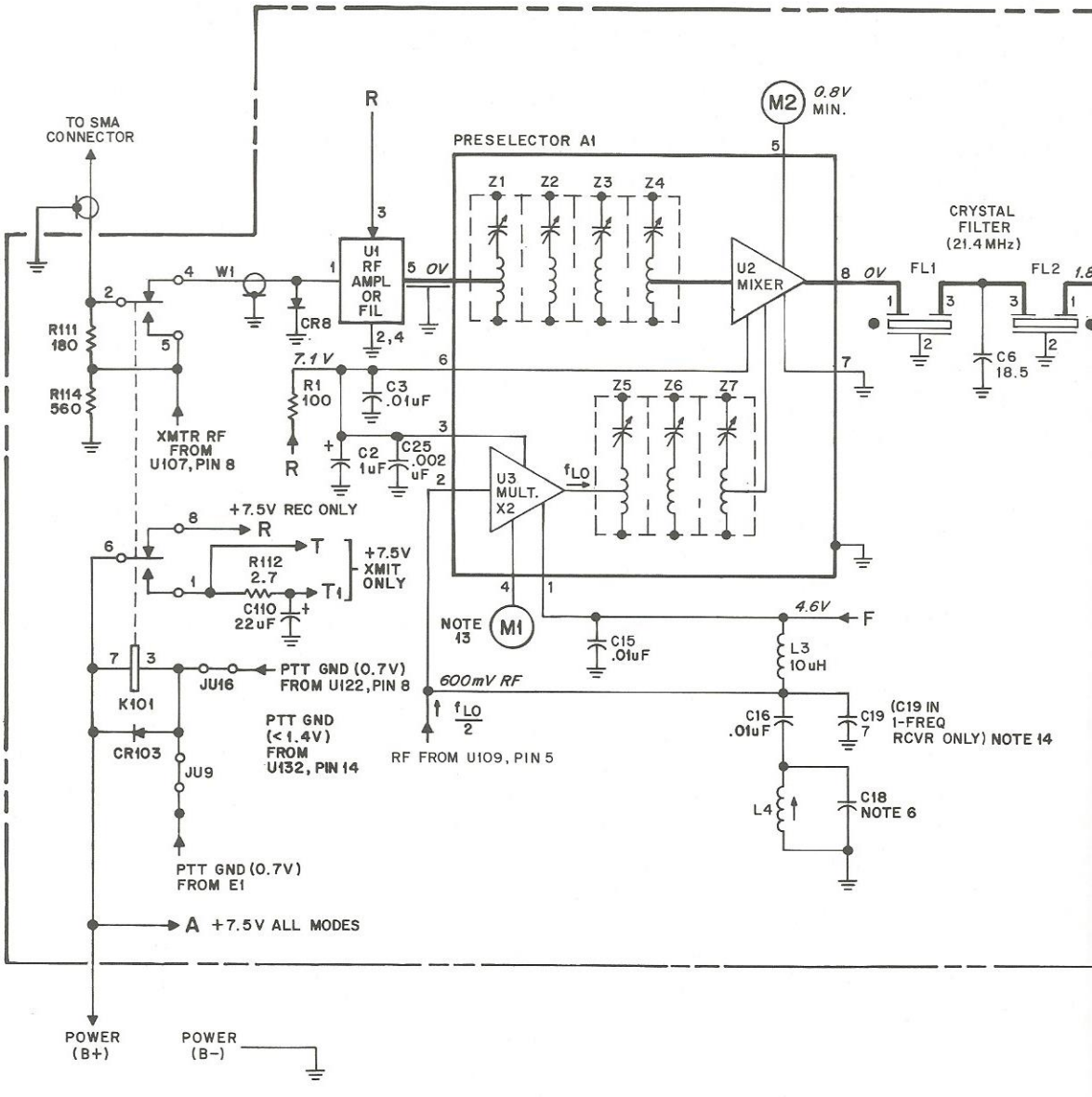
ALL VOLTAGES ARE DC UNLESS INDICATED OTHERWISE.

DC VOLTAGES:

A =	7.5VDC PRESENT IN ALL MODES.
R =	7.5VDC PRESENT IN RECEIVE MODE.
T =	7.5 VDC PRESENT IN TRANSMIT MODE
P =	7.5 VDC PRESENT IN "PL" OFF MODE
F =	4.6 VDC PRESENT IN ALL MODES. (FROM U7)



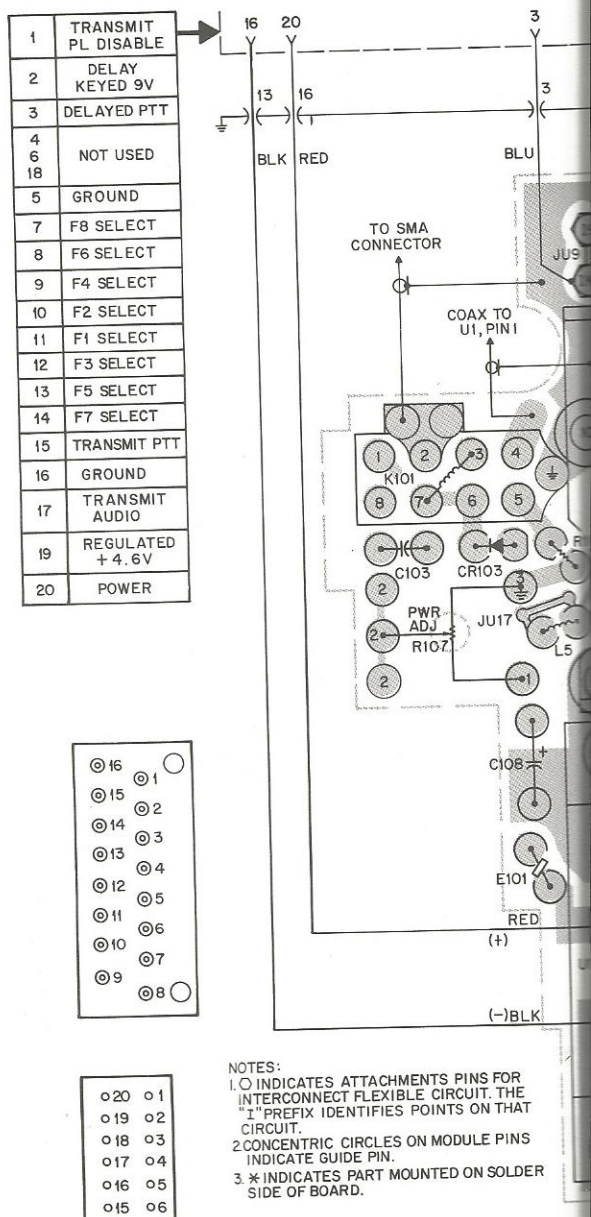
PRESELECTOR A1


TO SMA CONNECTOR
R
M2 0.8V MIN.
PRESELECTOR A1
Z1 Z2 Z3 Z4
CRYSTAL FILTER (21.4 MHz)
U1 RF AMPL OR FIL
U2 MIXER
FL1
FL2
C6 18.5
W1
CR8
R111 180
R114 560
XMTR RF FROM U107, PIN 8
7.1V
R1 100
C3 .01uF
C2 1uF
C25 .002 uF
U3 MULT. X2
Z5 Z6 Z7
+7.5V REC ONLY
R112 2.7
C110 22uF
+7.5V XMIT ONLY
NOTE 13
M1
C15 .01uF
4.6V
L3 10uH
600mV RF
PTT GND (0.7V) FROM U122, PIN 8
K101
JU16
CR103
JU9
PTT GND (< 1.4V) FROM U132, PIN 14
RF FROM U109, PIN 5
C16 .01uF
C19 7
(C19 IN 1-FREQ RCVR ONLY) NOTE 14
L4
C18 NOTE 6
PTT GND (0.7V) FROM E1
A +7.5V ALL MODES
POWER (B+)
POWER (B-)

Vhf Transmitter Parts List PLF-1762-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±10%; 20 V unless otherwise stated
C101, 102		Not Used
C103	2184008H01	.01 uF; 50 V
C104	2382397D16	22 uF ±20%
C105, 106, 107		Not Used
C108	2382397D04	15 uF ±20%; 15 V
C109	2382397D15	10 uF ±20%
C110	2382397D16	22 uF ±20%; 15 V
C111 thru C131		Not Used
C132	2184008H13	.05 uF ±20%; 25 V
		CHANNEL ELEMENT:
CE101 thru CE108	KXN1041A	Transmitter
		DIODE: See Note
CR101, 102	4805824C01	Silicon (1 & 2 channels only)
CR103	4805824C01	Silicon
CR104		Not Used
CR131, 132	4883654H01	Silicon
		RESISTOR, Fixed: Ω ±10% unless otherwise stated
R101		Not Used
R102	1805310C01	Pot. 10 k
R103		Not Used
R104	0600185B55	10
R105		Not Used
R106	0600185B87	4.7 k (136-150.8 MHz)
	or 0600185B85	3.3 k (150.8-174 MHz)
R107	1805310C02	Pot. 2 k
R108	----------	Jumper (136-150.8 MHz)
	or 0600185B83	2.2 k (150.8-174 MHz)
R109	0600185B90	8.2 k
R110, 111		Not Used
R112	0600185C35	2.7
R113	0600185B90	8.2 k (136-150.8 MHz only)
R114	0600124C43	560; 1/2 W
R115 thru R130		Not Used
R131	0600185A83	27 k ±5%
R132	0600185B80	1.2 k
		HYBRID, Encapsulated:
U102	NLD6592A	PLL Processor
U103	NLD6601A	VCO (136-150.8 MHz)
	or NLD6602B	VCO (150.8-162 MHz)
	or NLD6603A	VCO (162-174 MHz)
U104	NLD6610A	Power Amplifier (136-150.8 MHz)
	or NLD6611A	Power Amplifier (150.8-162 MHz)
	or NLD6612B	Power Amplifier (162-174 MHz)
U105	NLD6631A	Power Amplifier (136-150.8 MHz)
	or NLD6632B	Power Amplifier (150.8-162 MHz)
	or NLD6633B	Power Amplifier (162-174 MHz)
U106		Not Used
U107	NFD6061A	Filter/Detector (136-150.8 MHz)
	or NFD6062A	Filter/Detector (150.8-174 MHz)
U108	NLN8779A	ALC
U109	NLD6921A	Buffer Amplifier
U110 thru U120		Not Used
U121	NFN6010A	PL Tone Filter
U122	NLN4052B	PL Processor
	NONREFERENCED ITEMS	
	1405601C01	Insulator, for K101
	0905604C06	Socket, for guide pin
	0905287C05	Socket, for module
	2205794E01	Pin
	0705778D01	Boot, for U108
	7605445C01	Slug, for channel elements
	0300139B35	Screw, for U107
	0405683D01	Lockwasher, for U107
	1484277D14	Housing
	0984279D01	Contact
	2284835F01	Pin, Polarizing

NOTE: For optimum performance, order replacement diodes by Motorola part number only.



NOTES:
1. ○ INDICATES ATTACHMENTS PINS FOR INTERCONNECT FLEXIBLE CIRCUIT. THE "1" PREFIX IDENTIFIES POINTS ON THAT CIRCUIT.
2. CONCENTRIC CIRCLES ON MODULE PINS INDICATE GUIDE PIN.
3. * INDICATES PART MOUNTED ON SOLDER SIDE OF BOARD.

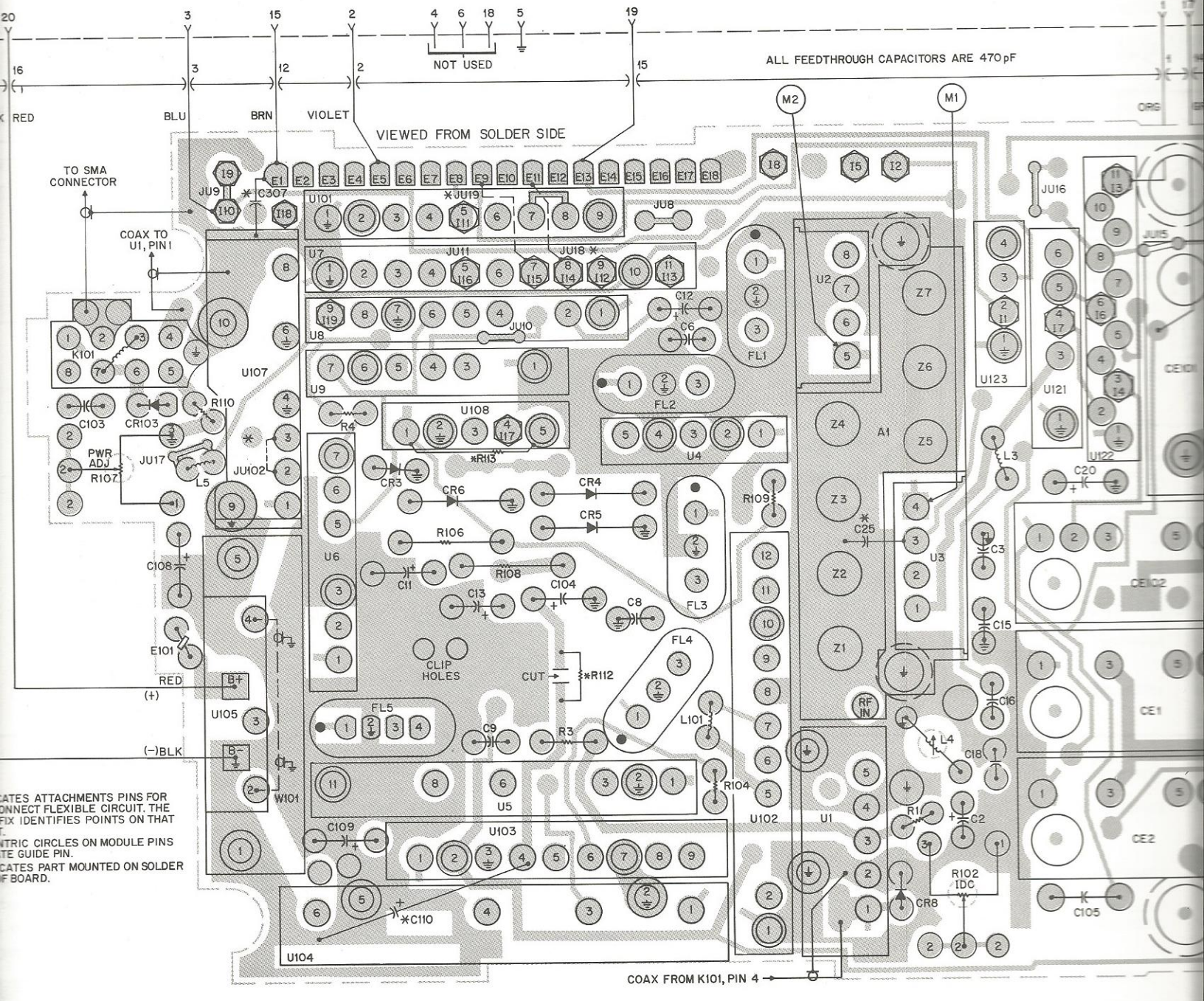


Figure 5-3.
Vhf Transmitter Circ
Wiring Diagram and

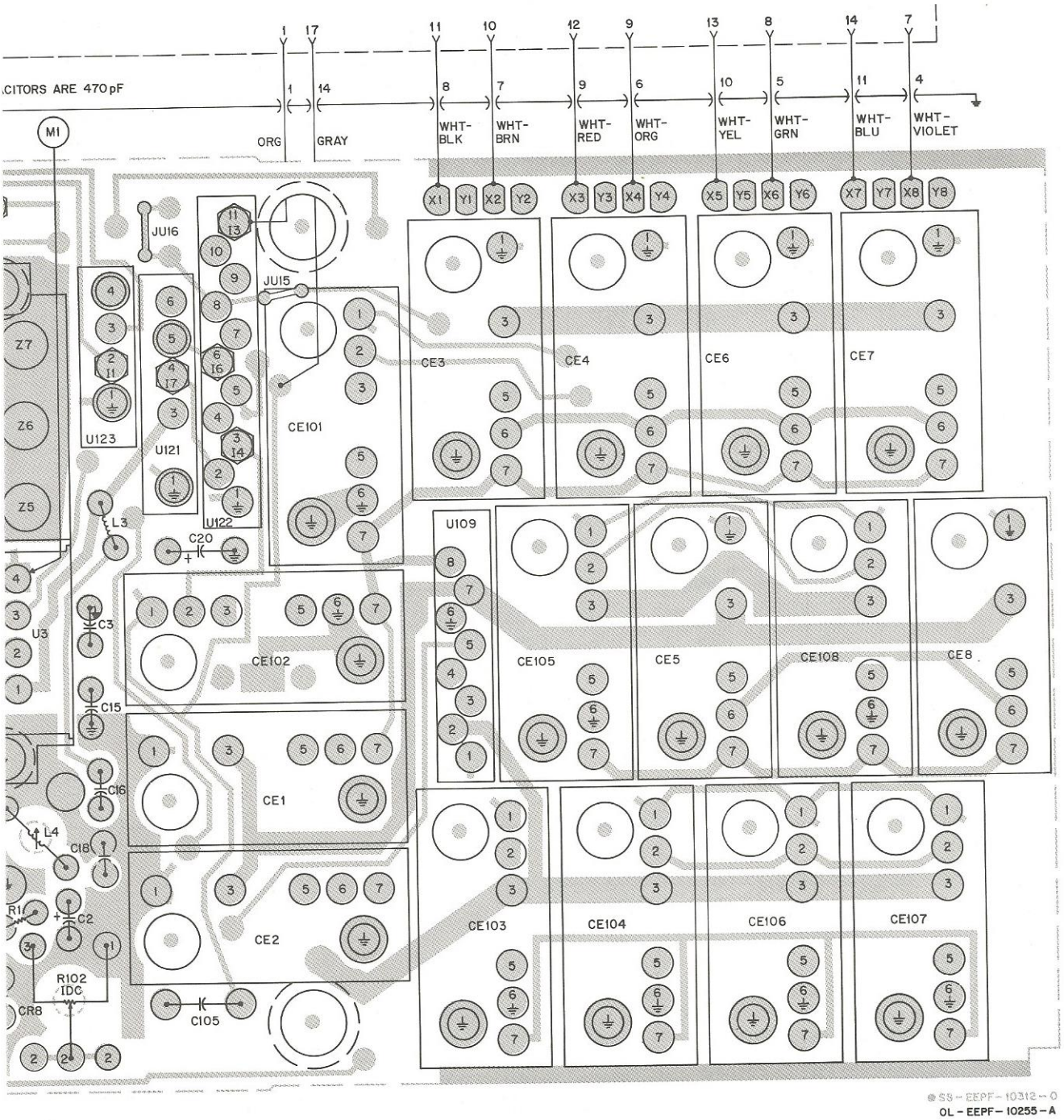
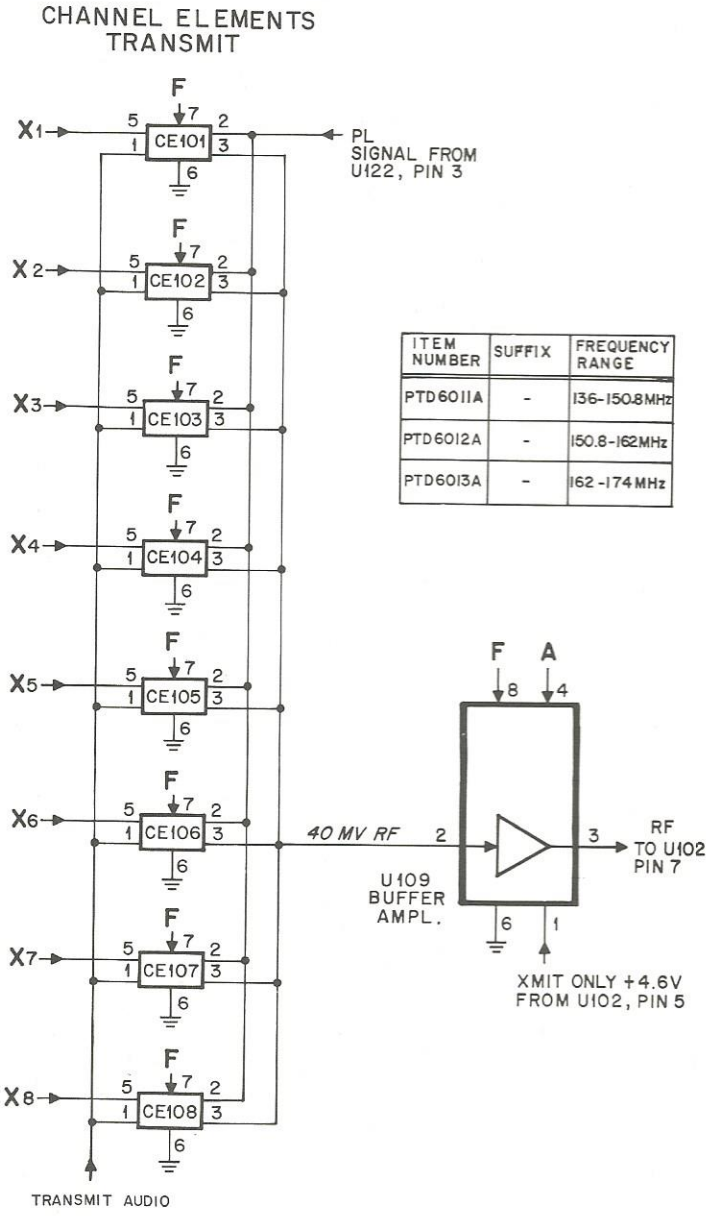


Figure 5-3.
Vhf Transmitter Circuit Board Component Layout and Wiring Diagram and Parts List

DELAYED KEYED 9V

REGULATED +4.6V

TRANSMIT PTT

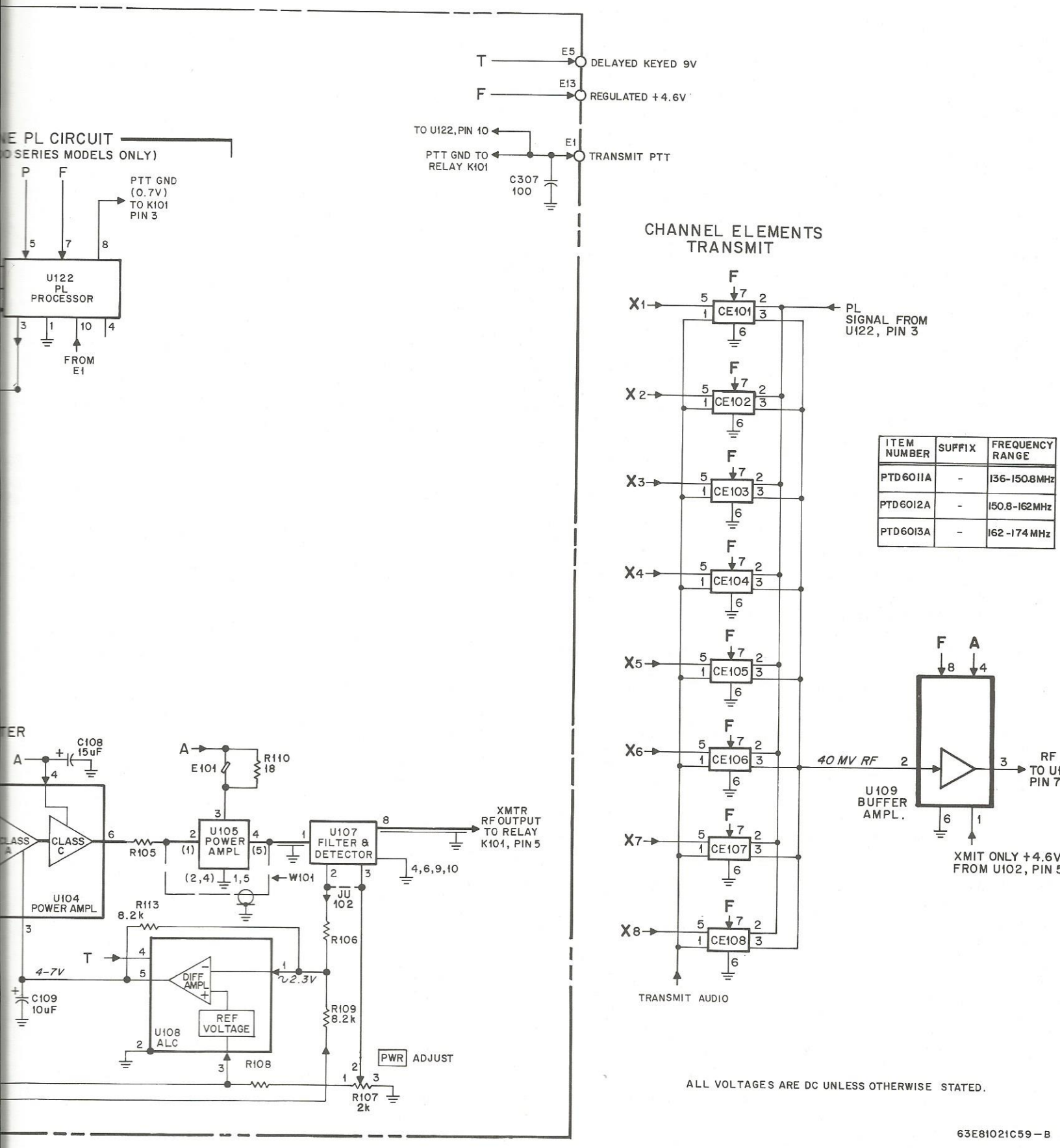


ITEM NUMBER	SUFFIX	FREQUENCY RANGE
PTD6011A	-	136-150.8MHz
PTD6012A	-	150.8-162MHz
PTD6013A	-	162-174MHz

ALL VOLTAGES ARE DC UNLESS OTHERWISE STATED.

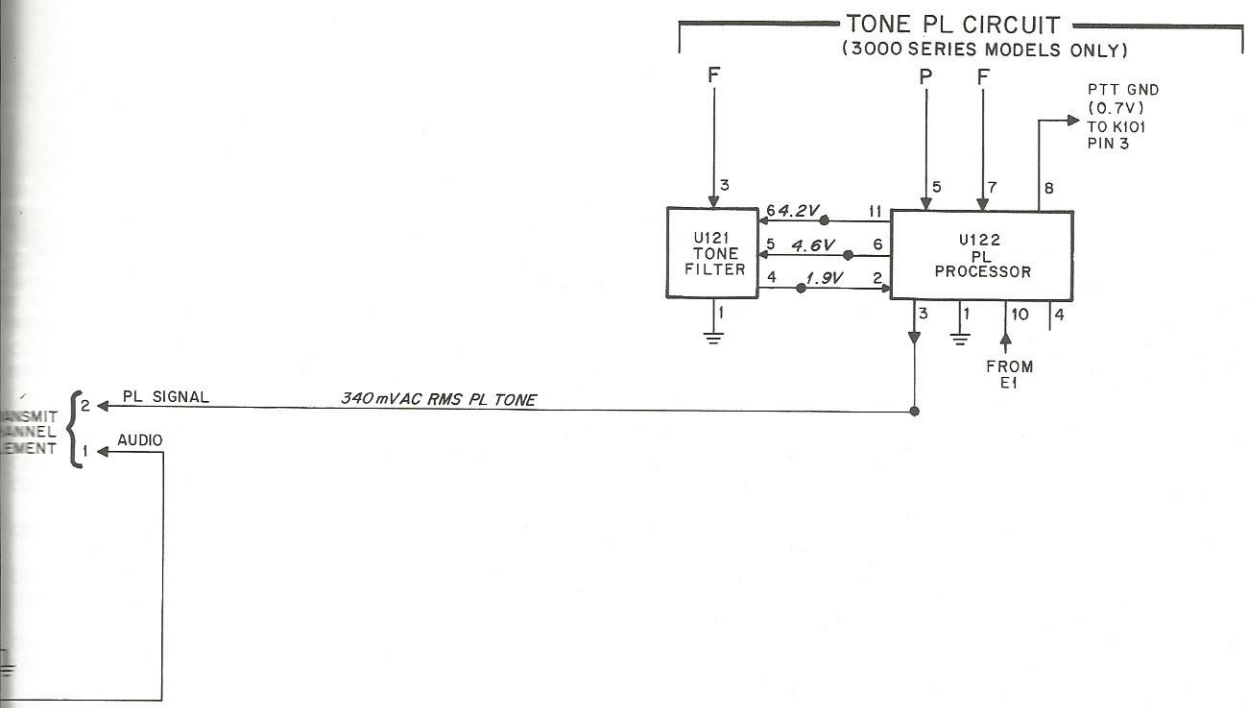
63E81021C59-B

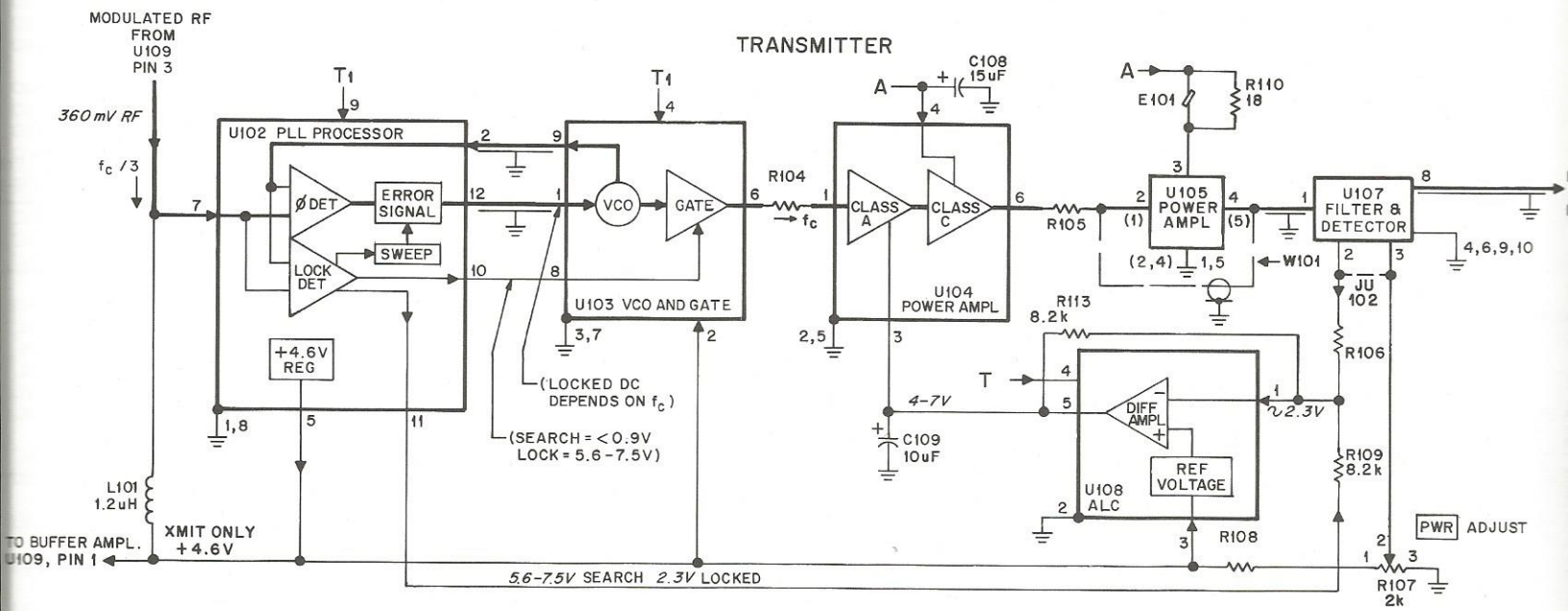
Figure 5-4.
Vhf Transmitter Schematic Diagram

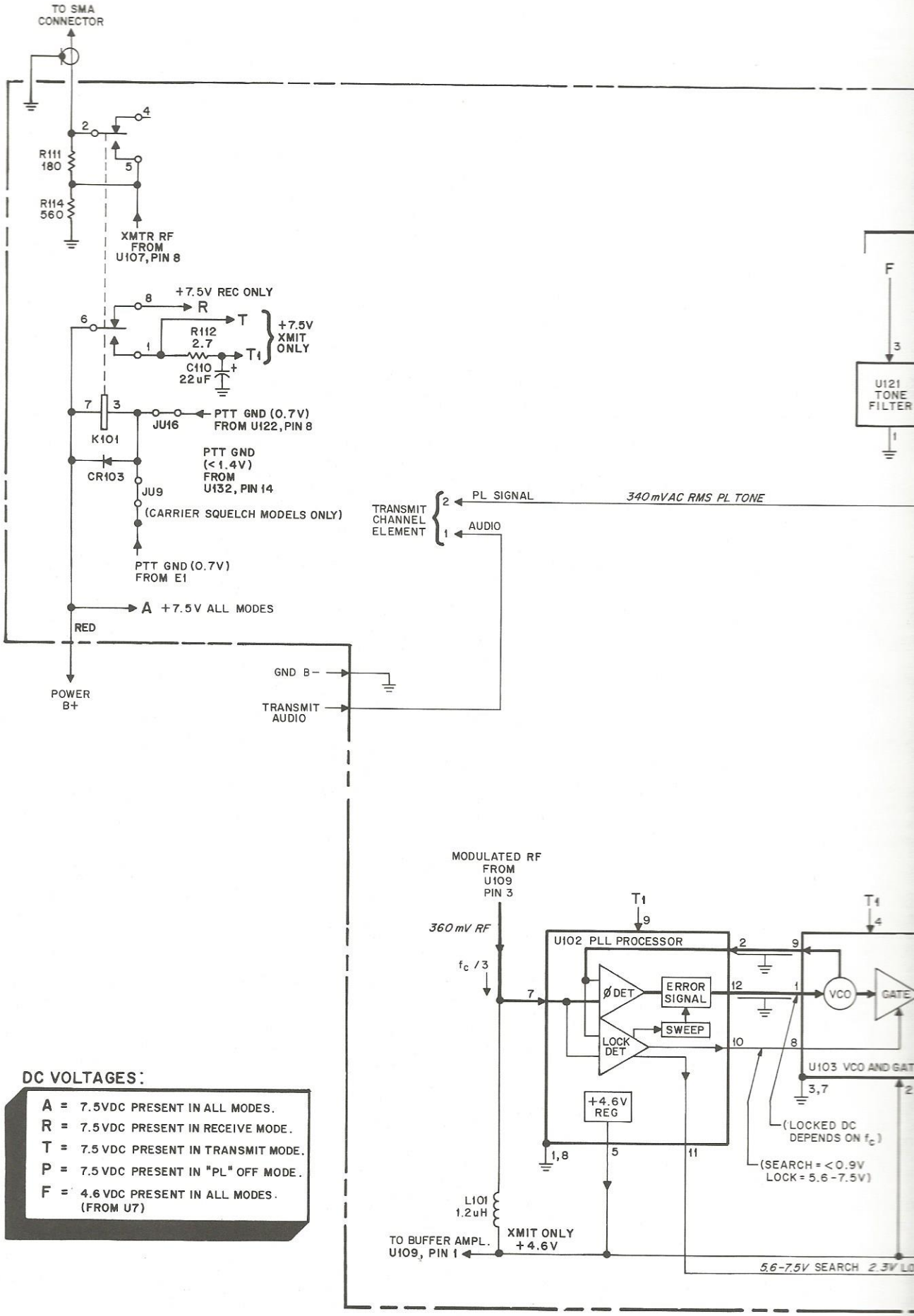


ALL VOLTAGES ARE DC UNLESS OTHERWISE STATED.

63E81021C59-B


TONE PL CIRCUIT
(3000 SERIES MODELS ONLY)
F
P
F
PTT GND
(0.7V)
TO K101
PIN 3
U121
TONE
FILTER
U122
PL
PROCESSOR
4.2V
4.6V
1.9V
FROM
E1
PL SIGNAL
340mVAC RMS PL TONE
AUDIO


TRANSMITTER
MODULATED RF
FROM
U109
PIN 3
360 mV RF
fc /3
U102 PLL PROCESSOR
ØDET
ERROR
SIGNAL
SWEEP
LOCK
DET
+4.6V
REG
VCO
GATE
U103 VCO AND GATE
(LOCKED DC
DEPENDS ON fc)
(SEARCH = <0.9V
LOCK = 5.6-7.5V)
R104
CLASS
A
CLASS
C
U104
POWER AMPL
C108
15uF
C109
10uF
R105
E101
R110
18
U105
POWER
AMPL
(1)
(5)
(2,4)
1,5
W101
U107
FILTER &
DETECTOR
4,6,9,10
JU
102
R106
R113
8.2k
DIFF
AMPL
REF
VOLTAGE
U108
ALC
R108
R109
8.2k
R107
2k
PWR ADJUST
4-7V
2.3V
L101
1.2uH
XMIT ONLY
+4.6V
TO BUFFER AMPL.
U109, PIN 1
5.6-7.5V SEARCH 2.3V LOCKED



DC VOLTAGES:

A =	7.5VDC PRESENT IN ALL MODES.
R =	7.5VDC PRESENT IN RECEIVE MODE.
T =	7.5 VDC PRESENT IN TRANSMIT MODE.
P =	7.5 VDC PRESENT IN "PL" OFF MODE.
F =	4.6 VDC PRESENT IN ALL MODES. (FROM U7)

HLD4011B Power Amplifier
(136-150.8 MHz = L)
HLD4012A Power Amplifier
(150.8-174 MHz = H)

PLF-1763-O

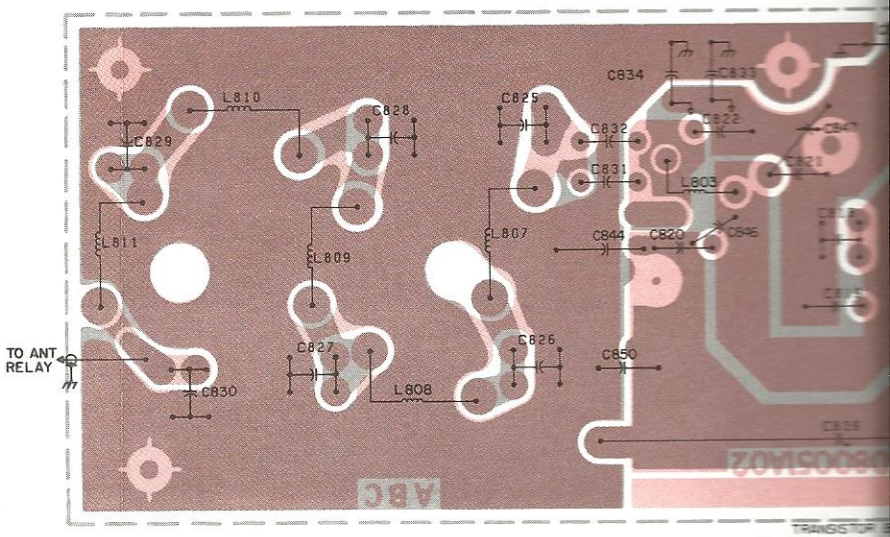
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: uF ±5% unless otherwise stated
C801	2183596E36	.01 +60–40%; 200 V
C802	2184493B27	51 pF; 200 V (L)
	or 2183406D92	36 pF; 500 V (H)
C803	2180169A55	57 pF; 200 V; N150 (L)
	or 2183406D92	36 pF; 500 V (H)
C804	2180169A55	57 pF; 200 V
C805		Not Used
C806		See PLD6230A
C807	0883813H23	.068; 50 V
C808	2183406D56	24 pF; 500 V (L)
	or 2180171A45	3 pF; 500 V (H)
C809		Not Used
C810	2182204B54	150 pF; (L)
	or 2182187B49	150 pF ±10%; 500 V
C811		Not Used
C812	2184493B30	62 pF (L only)
C813	2184493B30	62 pF (L)
	or 2180169A55	57 pF; 200 V (H)
C814, 815		See PLD6230A
C816		Not Used
C817	2183406D92	36 pF; 500 V (H only)
C818	2184395B26	160 pF ±2%; (L)
	or 2184395B07	60 pF; 250 V (H)
C819	2183406D87	43 pF; 500 V (H only)
C820	2183406D92	36 pF; 500 V (H only)
C821	2183406D97	15 pF; (L)
	or 2183406D92	36 pF; 500 V (H)
C822	2183406D89	10 pF ±0.5 pF (L)
	or 2183406D56	24 pF; 500 V (H)
C823, 824		Not Used
C825	2184395B42	16.5 pF (L)
	or 2184395B16	15 pF; 250 V (H)
C826	2184395B43	38 pF; (L)
C827, 828	2184395B44	46 pF; (L)
	or 2184395B18	44 pF; 850 V (H)
C829	2184395B43	38 pF (L)
	or 2184395B17	36 pF; 850 V (H)
C830	2184395B42	16.5 pF (L)
	or 2184395B16	15 pF; 850 V (H)
C831, 832	2182187B49	150 pF ±10%; 500 V
C833	2182187B49	150 pF ±10%; 500 V (H only)
C834	2182187B49	150 pF ±10%; 500 V (H only)
C835	2382783B27	10 ±10%; 25 V
C836, 837, 838	2183596E36	.01 +60–40%; 200 V
C839	2383210A22	660 +150–10%; 25 V
C840	2182204B54	150 pF (L)
	or 2183596E13	.001; 1000 V (H)
C841, 842, 843		See PLD6230A
C844	2182204B54	150 pF (L only)
C845	2183406D71	33 pF (L only)
C846	2183406D97	15 pF (L only)
C847	2084579B11	Variable; 7-57 pF (L only)
C849		Not Used
C850	2182204B54	150 pF (L only)
C851 thru C890		Not Used
C891	2182187B49	150 pF ±10%; 500 V (L)
	or 2183596E10	.00022 ±20%; 500 V (H)
CR801	4882466H13	Diode, Silicon
L801	2480036A02	Ferrite, 1/2 turn
L802	2483977B02	Ferrite, 2-1/2 turns (H only)
L803	2484614A05	1-1/2 turns
L804	2483884G06	4-1/2 turns, molded
L805	2483884G08	5-1/2 turns, molded (L)
	or 2484411B02	14-1/2 turns, molded (H)
L806	2483547G10	2-1/2 turns
L807, 808	2480066A03	6-1/2 turns (L)
	or 2480066A01	5-1/2 turns (H)
L809	2480066A04	5-1/2 turns (L)
	or 2480066A02	5-1/2 turns (H)
L810, 811	2480066A03	6-1/2 turns (L)
	or 2480066A01	6-1/2 turns (H)
L812	2482723H28	290 nH
L813	2480036A02	Ferrite, 1/2 turn (L only)
L814	2482723H28	290 nH
R801		**RESISTOR, Fixed: ±5%; 1/4 W** unless otherwise stated Not Used
R802	0611009C49	1 k
R803		Not Used
R804	0611009C49	1 k
R805		Not Used
R806	0611009C33	220 ±10%
R807 thru R810		Not Used
R811	0600125A01	10; 1/2 W (L)
	0600125B64	6.2; 1/2 W (H)
R812	0600125A24	91; 1/2 W (L)
	or 0600125A32	200; 1/2 W (L)
R813	0600125A01	10; 1/2 W (L)
	or 0600125B64	6.2; 1/2 W (H)
R814	0611009C01	10
R815, 816	0600125A11	27; 1/2 W (L)
	or 0611009C25	100 (H)
R817		Not Used
R818	0600125C10	10 ±10%; 1/2 W (L)
	or 0600125A11	27; 1/2 W (H)
RT801	0683600K05	Thermistor; 100 k at 25°C
		NONREFERENCED ITEMS
	1480077A01	Insulator, P.A. Compartment
	2080006A01	Nut, Spanner for antenna switch
	2980014A01	Clip, Coax
	3010904A02	Screw, for feed-thru plate
	3280080A01	Gasket, for antenna switch
	4083755H01	Washer, solder
	4210217A26	Strap, for C839
	6480005B09	Plate, feed-thru
	7080007A01	Bracket, thermistor mount
	7080291A01	Bracket, ground; harmonic filter

PLD6230A Vhf P.A. Hardware Kit

PLF-1854-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR: Fixed pF ±5%; 250 V unless otherwise stated
C801 thru C805		See HLD4011B or HLD4012A
C806	2184366F12	200 (H only)
C807 thru C813		See HLD4011B or HLD4012A
C814, 815	2184366F12	200
C816	2184366F22	50 (L)
	or 2184366F12	200 (H)
C817 thru C841		See HLD4011B or HLD4012A
C842	2184366F22	50 (H only)
C843	2184366F08	40
C844 thru C891		See HLD4011B or HLD4012A
C892	2182133G03	100; N750
C893 thru C896	2184211B01	Feed-thru
CR802	4800869806	Transistor, NPN; type M9806
Q803	4882525G13	Diode, Silicon
		NONREFERENCED ITEMS
	0200007003	Nut, 8-32 x 5/16 x 1/8; Hex
	0200115968	Nut, 1/4-28 x 3/8 x 1/8; Hex
	0300122804	Screw, 6-32 x 1/4; Phillips Binder Head
	0300122924	Screw, 4-40 x 5/16; Phillips Round Head
	0300136774	Screw, 4-40 x 1/4; Phillips Binder Head
	0300138035	Screw, 6-32 x 3/8; Phillips Pan Head
	0300139012	Screw, 4-40 x 1/4; Phillips Hex Head
	0400007670	Washer, Lock; 1/4 Int
	0400483513	Washer, Ins 7/16 x .265 x 3/32
	0484180C01	Washer, Shoulder
	0705306J01	Bracket, P.A. Shield
	0705307J01	Bracket, Hi/Low Relay No.1
	0705308J01	Bracket, Hi/Low Relay No.2
	0780291A01	Bracket, Ground
	1110022A55	Compound, Thermal
	1484268A01	Insulator, Transistor
	1505310J01	Cover, P.A.
	2605305J01	Heatsink
	4305340J01	Standoff
	6405309J01	Plate, Hi/Low; Relay; Mounting

		RESISTOR, Fixed: ±5%; 1/4 W unless otherwise stated
R801		Not Used
R802	0611009C49	1 k
R803		Not Used
R804	0611009C49	1 k
R805		Not Used
R806	0611009C33	220 ±10%
R807 thru R810		Not Used
R811	0600125A01	10; 1/2 W (L)
	0600125B64	6.2; 1/2 W (H)
R812	0600125A24	91; 1/2 W (L)
	or 0600125A32	200; 1/2 W (L)
R813	0600125A01	10; 1/2 W (L)
	or 0600125B64	6.2; 1/2 W (H)
R814	0611009C01	10
R815, 816	0600125A11	27; 1/2 W (L)
	or 0611009C25	100 (H)
R817		Not Used
R818	0600125C10	10 ±10%; 1/2 W (L)
	or 0600125A11	27; 1/2 W (H)
RT801	0683600K05	Thermistor; 100 k at 25°C
	NONREFERENCED ITEMS	
	1480077A01	Insulator, P.A. Compartment
	2080006A01	Nut, Spanner for antenna switch
	2980014A01	Clip, Coax
	3010904A02	Screw, for feed-thru plate
	3280080A01	Gasket, for antenna switch
	4083755H01	Washer, solder
	4210217A26	Strap, for C839
	6480005B09	Plate, feed-thru
	7080007A01	Bracket, thermistor mount
	7080291A01	Bracket, ground; harmonic filter



PLD6230A Vhf P.A. Hardware Kit PLF-1854-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR: Fixed pF ±5%; 250 V unless otherwise stated
C801 thru C805		See HLD4011B or HLD4012A
C806	2184366F12	200 (H only)
C807 thru C813		See HLD4011B or HLD4012A
C814, 815	2184366F12	200
C816	2184366F22	50 (L)
	or 2184366F12	200 (H)
C817 thru C841		See HLD4011B or HLD4012A
C842	2184366F22	50 (H only)
C843	2184366F08	40
C844 thru C891		See HLD4011B or HLD4012A
C892	2182133G03	100; N750
C893 thru C896	2184211B01	Feed-thru
CR802	4800869806	Transistor, NPN; type M9806
Q803	4882525G13	Diode, Silicon
	NONREFERENCED ITEMS	
	0200007003	Nut, 8-32 x 5/16 x 1/8; Hex
	0200115968	Nut, 1/4-28 x 3/8 x 1/8; Hex
	0300122804	Screw, 6-32 x 1/4; Phillips Binder Head
	0300122924	Screw, 4-40 x 5/16; Phillips Round Head
	0300136774	Screw, 4-40 x 1/4; Phillips Binder Head
	0300138035	Screw, 6-32 x 3/8; Phillips Pan Head
	0300139012	Screw, 4-40 x 1/4; Phillips Hex Head
	0400007670	Washer, Lock; 1/4 Int
	0400483513	Washer, Ins 7/16 x .265 x 3/32
	0484180C01	Washer, Shoulder
	0705306J01	Bracket, P.A. Shield
	0705307J01	Bracket, Hi/Low Relay No.1
	0705308J01	Bracket, Hi/Low Relay No.2
	0780291A01	Bracket, Ground
	1110022A55	Compound, Thermal
	1484268A01	Insulator, Transistor
	1505310J01	Cover, P.A.
	2605305J01	Heatsink
	4305340J01	Standoff
	6405309J01	Plate, Hi/Low; Relay; Mounting

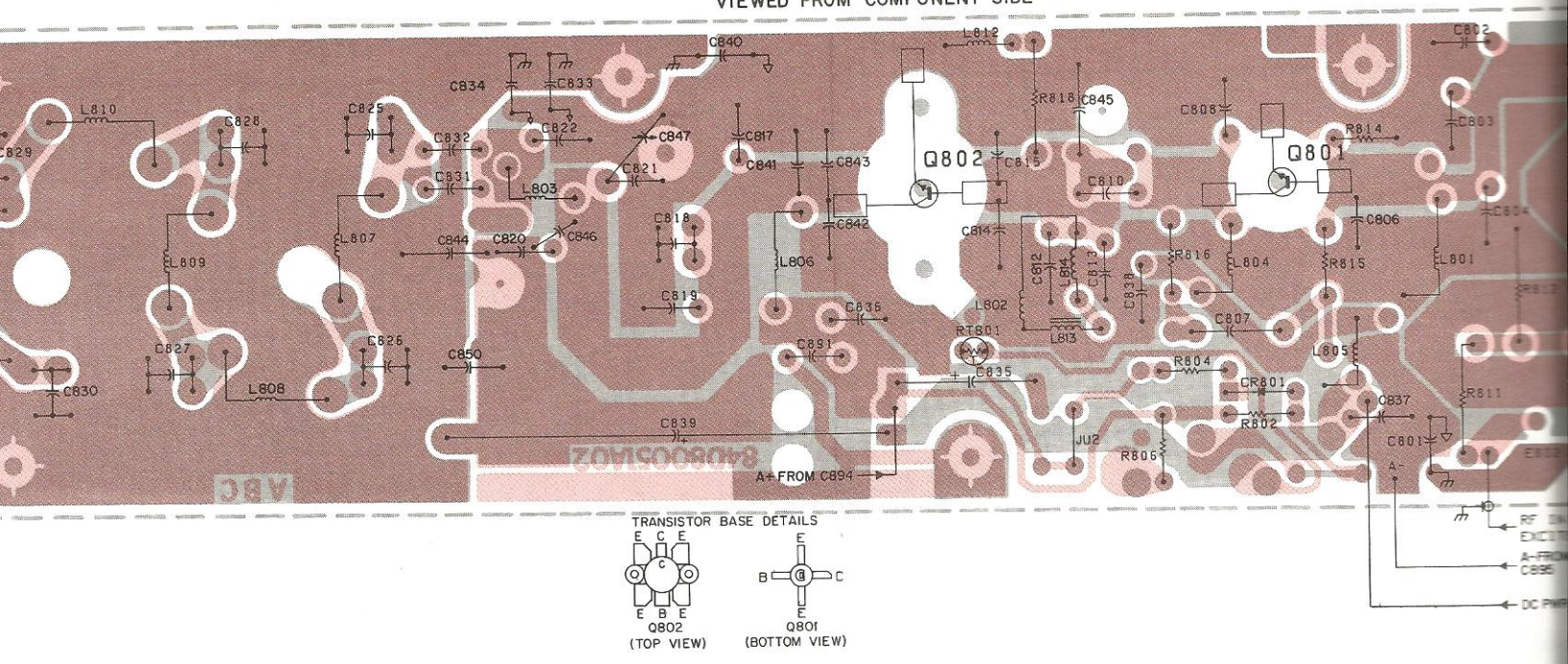
PLD6130A Directional Coupler PLF-1796-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±10% unless otherwise stated
C1	2182204B22	5 ±0.5 pF; npo
C2	2182187B08	220; 500 V
C3	2182204B22	5 ±0.5 pF; npo
C4	2182187B08	220; 500 V
CR1, CR2	4884616A01	DIODE, Hot Carrier
		RESISTOR, Fixed: Ω ±5%; 1/4 W
R1	0600124A20	62
R2	0600124A13	33
R3	0600124A57	2200
R4	0600124A20	62
R5	0600124A13	33
R6	0600124A57	2200
	NONREFERENCED ITEMS	
	4284501B01	Clip, Mounting
	5884685B01	Coupler, Rf

PTD1001A Vhf Power Amplifier Overall Unit (150.8-174 MHz) PLF-1856-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	HLD4012A	P.A. Board (150.8-174 MHz)
	HLD4061A	Power Transistor
	PKD6001A	Rf Cabling
	PKD6002A	Dc Cabling
	PLD6130A	Rf Directional Coupler
	PLD6230A	Vhf P.A. Hardware
	TLN4640A	Relay
	TLN5240A	Power Control Board

VIEWED FROM COMPONENT SIDE



TRANSISTOR BASE DETAILS

TLN5240A Rf Power Control Board PLF-1767-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:
C1 thru C10	2184493B46	100 pF ±10%; 200 V
C11	2384538G13	22 uF ±20%; 15 V
		DIODE: See Note
CR1, 2	4883654H01	Silicon
		TRANSISTOR: See Note
Q1, 2	4800869570	NPN; type M9570
Q3	4800869571	PNP; type M9571
Q4	4800869570	NPN; type M9570
Q5	4800869440	NPN; type M9440
		RESISTOR, Fixed: ±10%; 1/4 W unless otherwise stated
R1	0600124C25	100
R2	0600124C53	1.5 k
R3	0600124C51	1.2 k
R4	1883067F02	Variable, 10 k
R5	0600125C35	270; 1/2 W
R6	0600124C59	2.7 k
R7	0600124C47	820
R8	0600124C25	100
R9	0600124C51	1.2 k
R10	0600124C69	6.8 k
R11	0600124C83	27 k
R12	0600124C25	100
R13	0600124C49	1 k
R14	0600124C53	1.5 k
R15	0600124C51	1.2 k
R16	0600124C49	1 k
R17	0600124C01	10
R18	0600124C05	15
R19 thru R100		Not Used
R101	0600124C65	4.7 k
		THERMISTOR:
RT100	0684499B01	4.7 k
		VOLTAGE REGULATOR:
VR1	4882256C38	Zener type

NOTE: For optimum performance, order replacement diodes and transistors by Motorola part number only.

A Directional Coupler PLF-1796-O

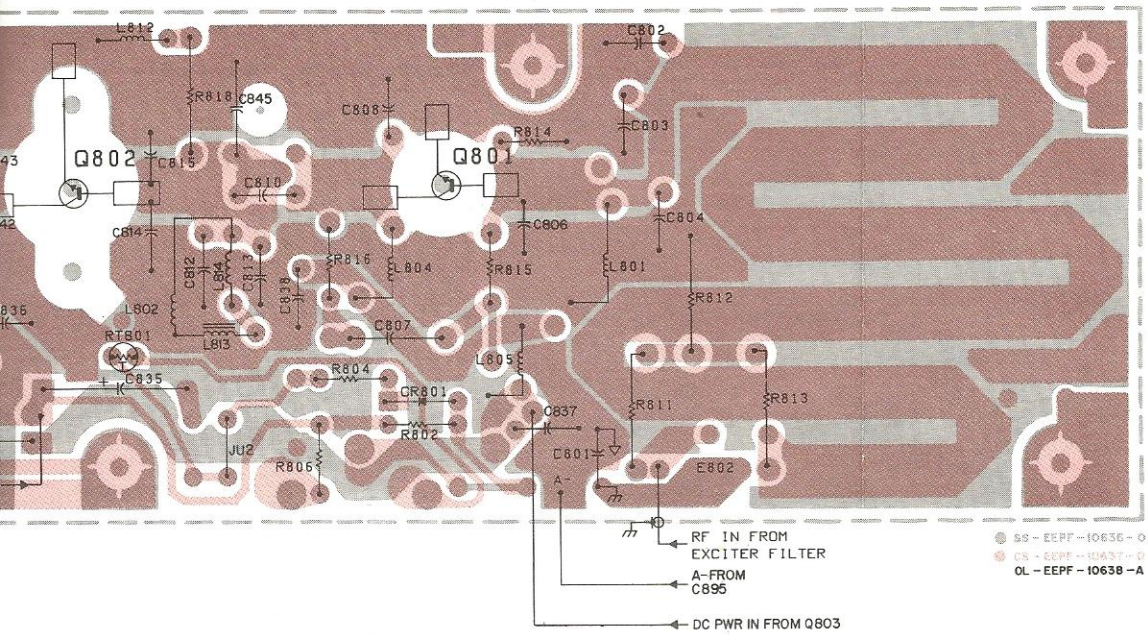
NCE OL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±10% unless otherwise stated
	2182204B22	5 ±0.5 pF; npo
	2182187B08	220; 500 V
	2182204B22	5 ±0.5 pF; npo
	2182187B08	220; 500 V
	4884616A01	DIODE, Hot Carrier
		RESISTOR, Fixed: Ω ±5%; 1/4 W
	0600124A20	62
	0600124A13	33
	0600124A57	2200
	0600124A20	62
	0600124A13	33
	0600124A57	2200
	NONREFERENCED ITEMS	
	4284501B01	Clip, Mounting
	5884685B01	Coupler, Rf

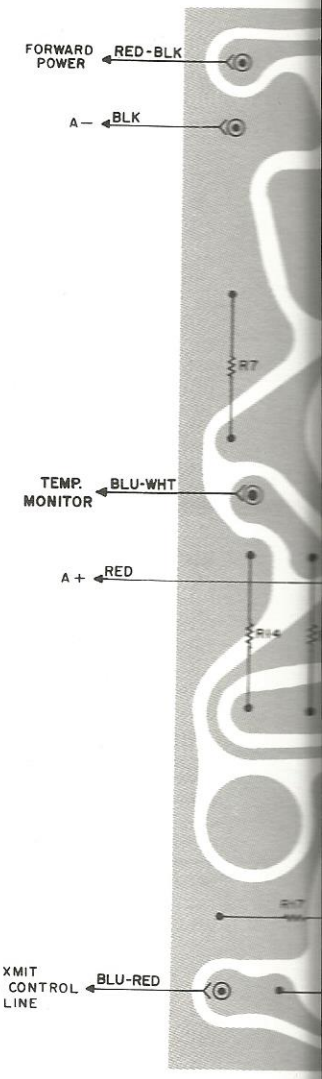
A Vhf Power Amplifier nit (150.8-174 MHz) PLF-1856-O

NCE OL	MOTOROLA PART NO.	DESCRIPTION
	HLD4012A	P.A. Board (150.8-174 MHz)
	HLD4061A	Power Transistor
	PKD6001A	Rf Cabling
	PKD6002A	Dc Cabling
	PLD6130A	Rf Directional Coupler
	PLD6230A	Vhf P.A. Hardware
	TLN4640A	Relay
	TLN5240A	Power Control Board

PTD1031A Vhf P Overall Unit (136

REFERENCE SYMBOL





Control Board PLF-1767-O

OTOROLA PART NO.	DESCRIPTION
	CAPACITOR, Fixed:
184493B46	100 pF ±10%; 200 V
384538G13	22 uF ±20%; 15 V
	DIODE: See Note
383654H01	Silicon
	TRANSISTOR: See Note
300869570	NPN; type M9570
300869571	PNP; type M9571
300869570	NPN; type M9570
300869440	NPN; type M9440
	RESISTOR, Fixed: ±10%; 1/4 W unless otherwise stated
600124C25	100
600124C53	1.5 k
600124C51	1.2 k
383067F02	Variable, 10 k
600125C35	270; 1/2 W
600124C59	2.7 k
600124C47	820
600124C25	100
600124C51	1.2 k
600124C69	6.8 k
600124C83	27 k
600124C25	100
600124C49	1 k
600124C53	1.5 k
600124C51	1.2 k
600124C49	1 k
600124C01	10
600124C05	15
	Not Used
600124C65	4.7 k
	THERMISTOR:
384499B01	4.7 k
	VOLTAGE REGULATOR:
382256C38	Zener type

ormance, order replacement diodes and transistors only.

PTD1031A Vhf Power Amplifier Overall Unit (136-150.8 MHz) PLF-1855-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	HLD4011B	P.A. Board (136-150.8 MHz)
	HLD4063A	Power Transistor
	PKD6001A	Rf Cabling
	PKD6002A	Dc Cabling
	PLD6130A	Rf Directional Coupler
	PLD6230A	Vhf P.A. Hardware
	TLN4640A	Relay
	TLN5240A	Power Control Board

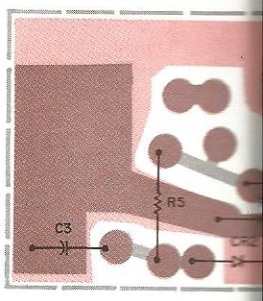
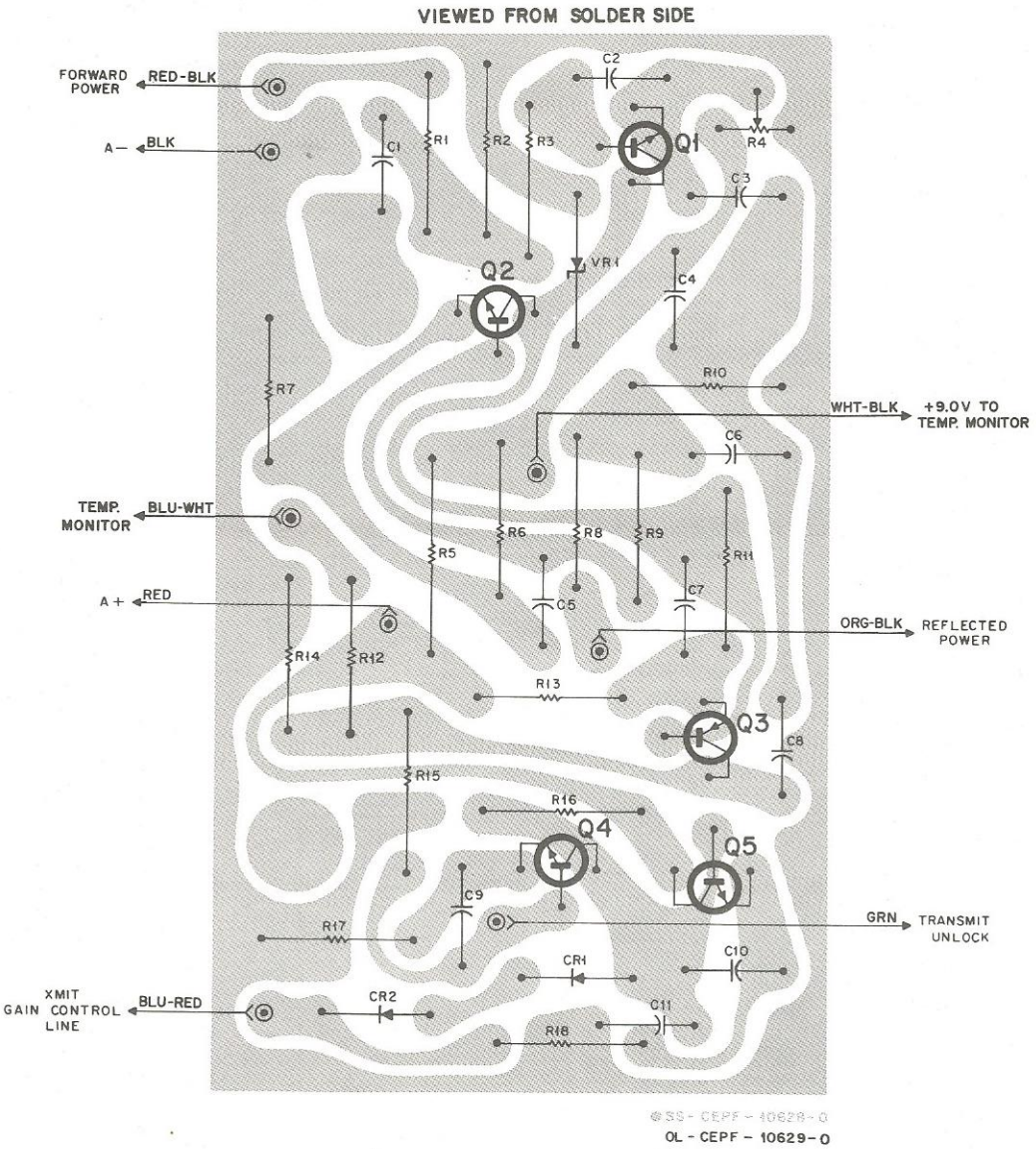


Figure 5-5.
Vhf Power Amplifier Circuit Board
Component Layout Diagram and Parts Lists

VIEWED FROM SOLDER SIDE

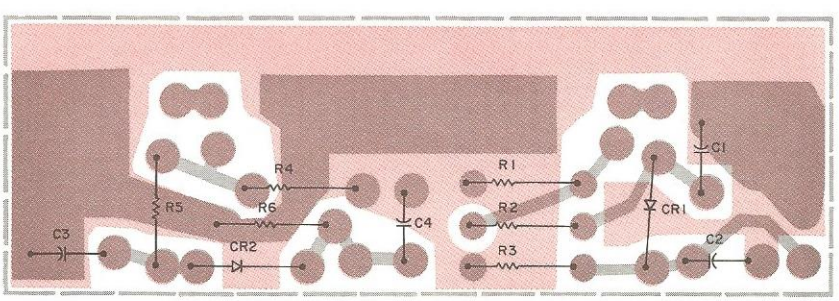


SS - CEPF - 10628 - O
OL - CEPF – 10629-O

VIEWED FROM COMPONENT SIDE

PLF-1855-O

DESCRIPTION
(136-150.8 MHz)
Power Transistor
Directional Coupler
Hardware
Power Control Board



SS BEPF - 10626 - O
CS BEPF - 10627 - O
OL BEPF – 10659 -O

Figure 5-5.
Vhf Power Amplifier Circuit Board Component Layout Diagram and Parts Lists

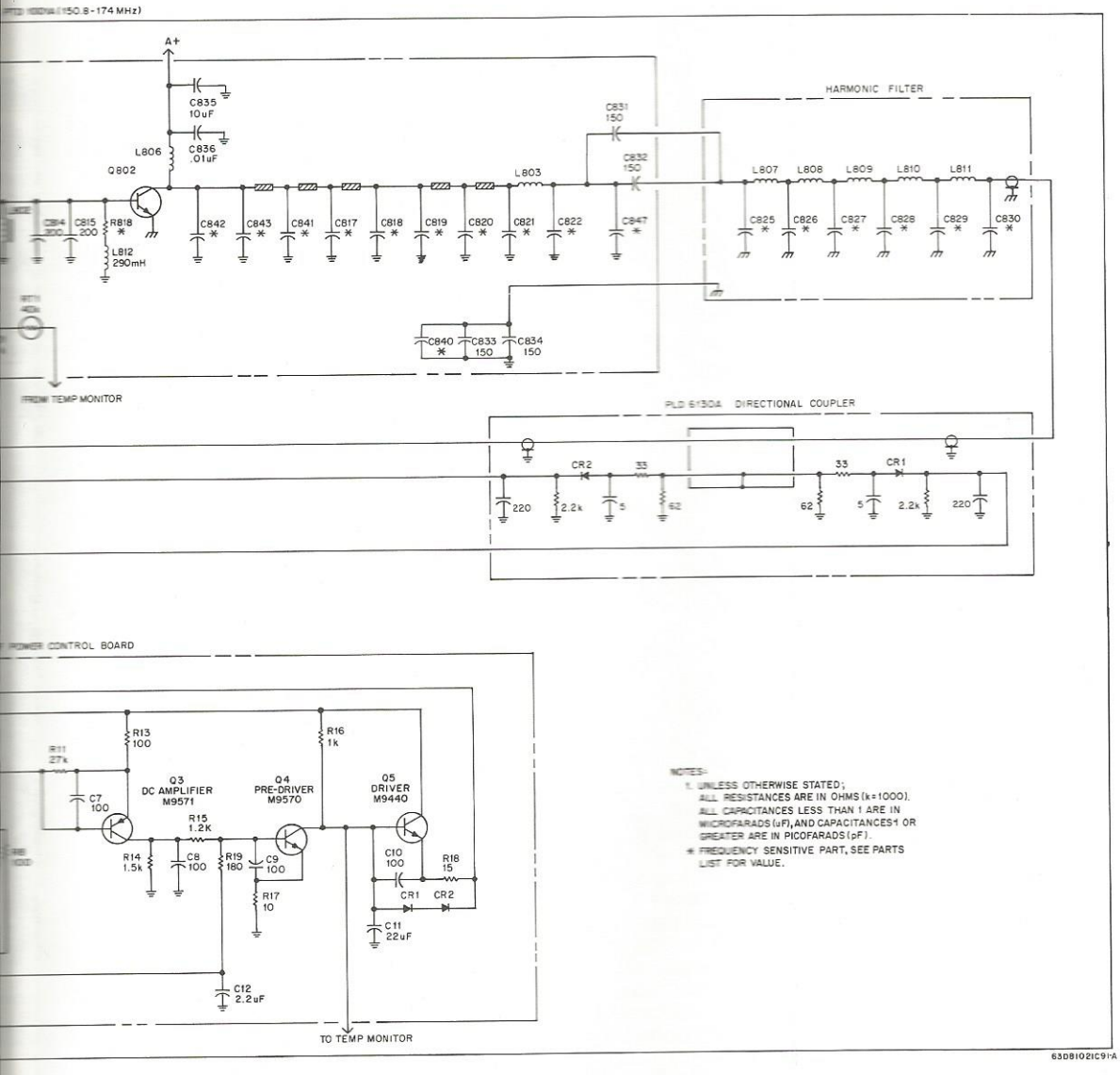
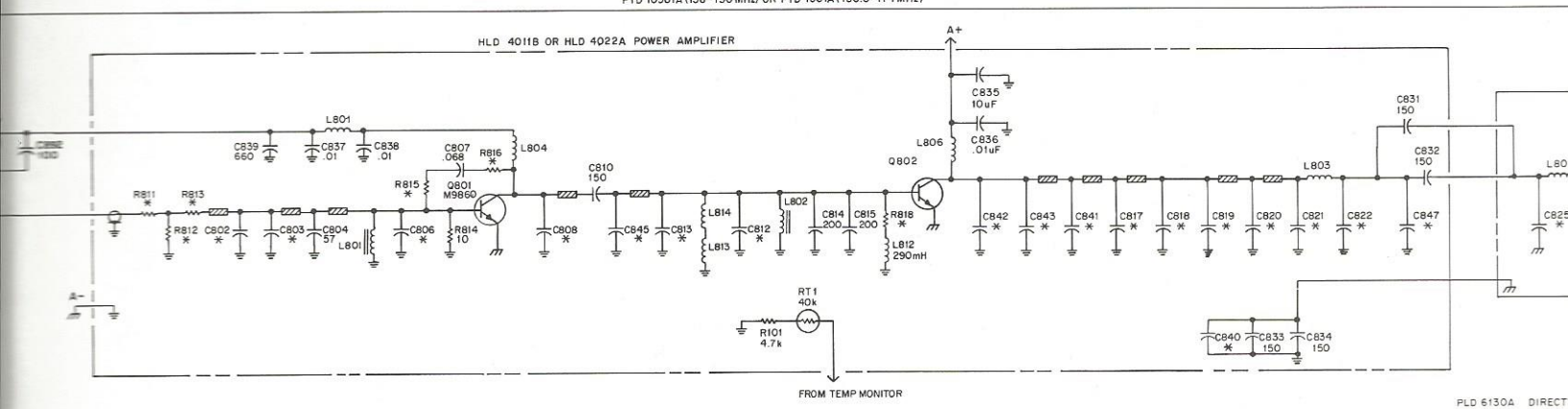
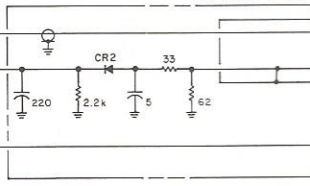


Figure 5-6.
Vhf Power Amplifier Schematic Diagram 5-7

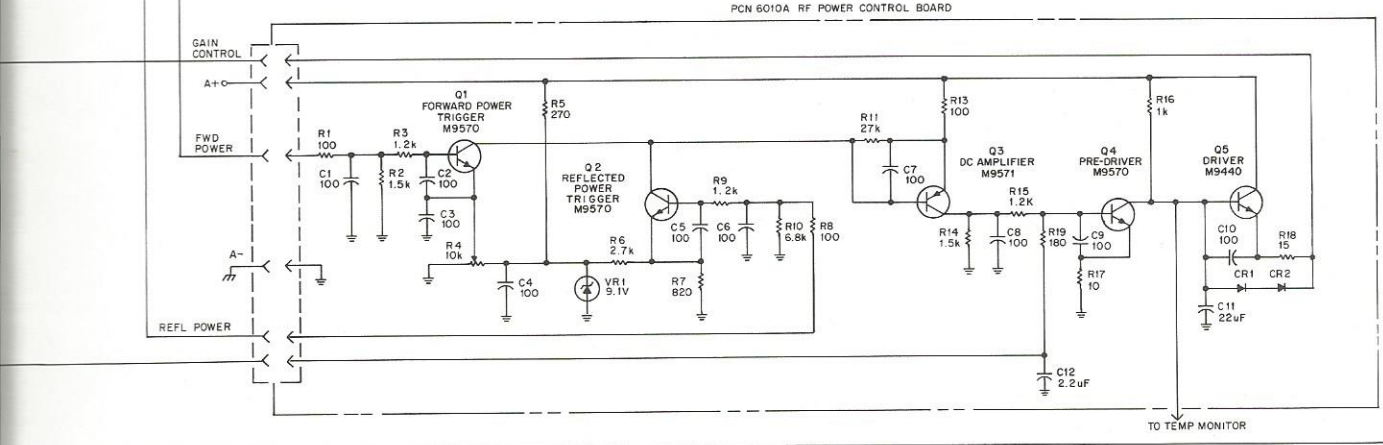
PTD 10301A (136–150 MHz) OR PTD 1001A (150.8–174 MHz)



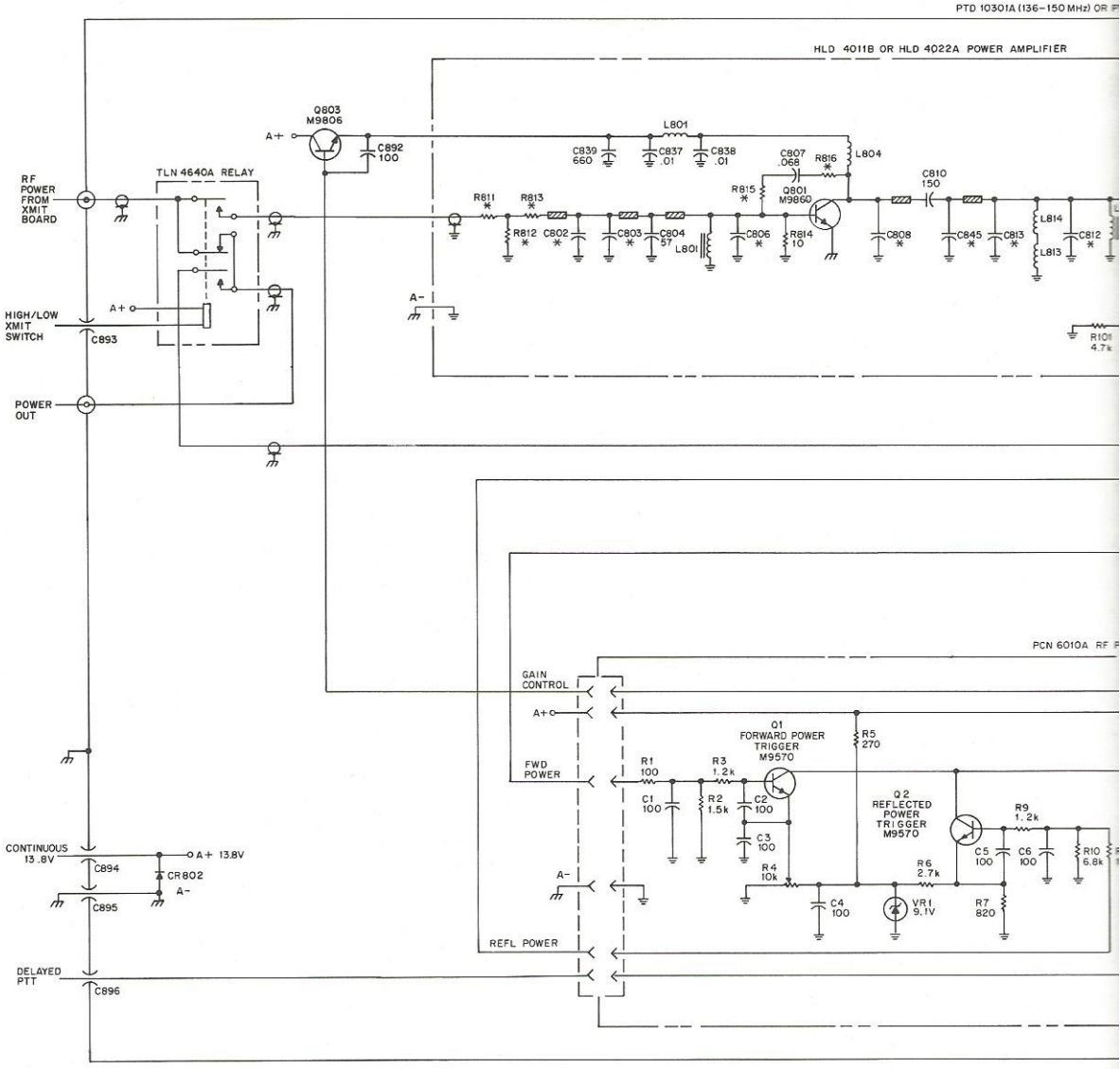
PLD 6130A DIRECT



PCN 6010A RF POWER CONTROL BOARD



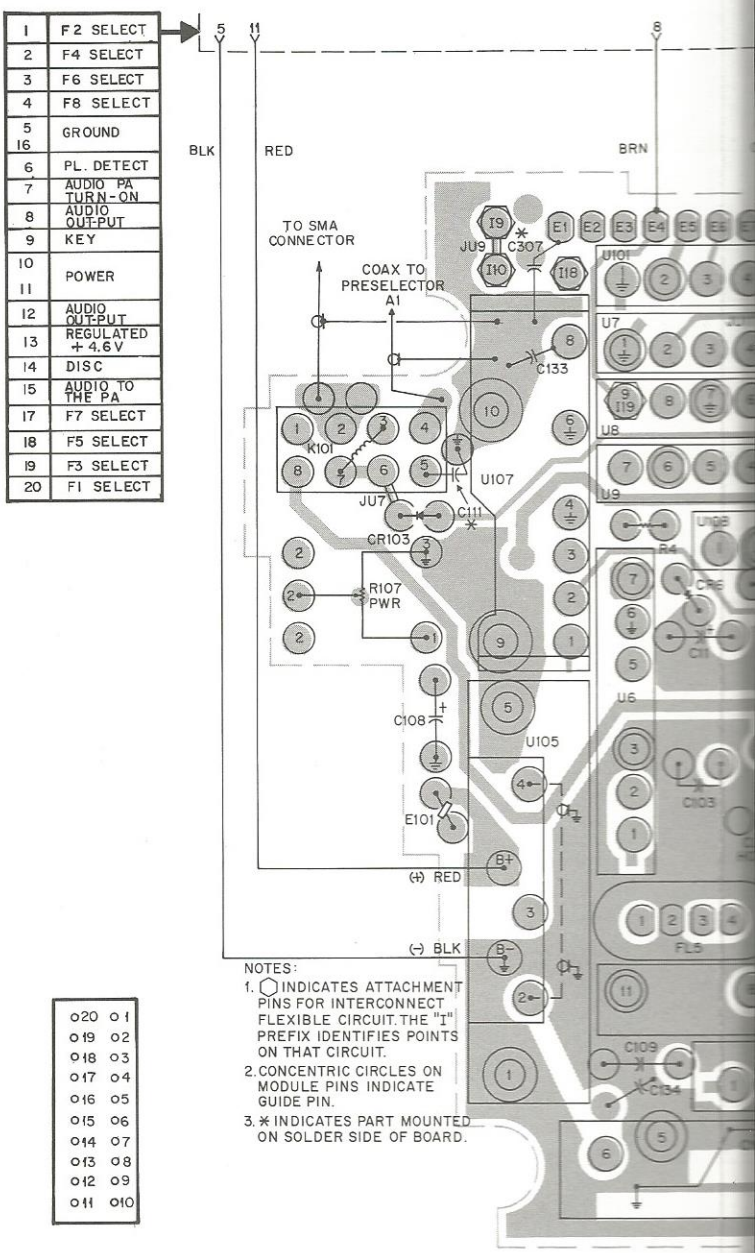
NOTES:
1. UNLESS OTHER
ALL RESISTAN
ALL CAPACITAN
MICROFARADS
GREATER ARE
* FREQUENCY SE
LIST FOR VALU


PTD 10301A (136–150 MHz) OR P
HLD 4011B OR HLD 4022A POWER AMPLIFIER
Q803
M9806
A+
C892
100
L801
C839
660
C837
.01
C838
.01
C807
.068
R816
*
L804
C810
150
RF
POWER
FROM
XMIT
BOARD
TLN 4640A RELAY
R811
*
R813
*
R815
*
Q801
M9860
R812
*
C802
*
C803
*
C804
57
L801
C806
*
R814
10
C808
*
C845
*
C813
*
L814
L813
C812
*
R101
4.7k
HIGH/LOW
XMIT
SWITCH
A+
C893
A-
POWER
OUT
PCN 6010A RF P
GAIN
CONTROL
A+
Q1
FORWARD POWER
TRIGGER
M9570
R5
270
FWD
POWER
R1
100
R3
1.2k
C1
100
R2
1.5k
C2
100
C3
100
Q2
REFLECTED
POWER
TRIGGER
M9570
R9
1.2k
C5
100
C6
100
R10
6.8k
R6
2.7k
A-
R4
10k
C4
100
VR1
9.1V
R7
820
REFL POWER
CONTINUOUS
13.8V
C894
A+ 13.8V
CR802
A-
C895
DELAYED
PTT
C896

Uhf Receiver Parts List PLF-1764-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		PRESELECTOR:
A1	NLE6931A	403–430 MHz
	or NLE6932A	440–470 MHz
	or NLE6933A	470–512 MHz
		CAPACITOR, Fixed: pF ±10%; 20 V unless otherwise stated
C1	2182358G96	30; 75 V; N150
C2	2382397D16	22 uF ±20%; 15 V
C3	2182358G95	30; 75 V; N750
C4		Not Used
C5	2182213E06	4700 ±20%; 100 V
C6	2182358G76	18.5 ±2%; 25 V
C7		Not Used
C8	2182358G76	18.5 ±2%; 25 V
C9	2184008H01	.01 uF; 50 V
C10		Not Used
C11, 12, 13	2382397D03	10 uF ±20%; 6 V
C14	2182358G51	20 ±2% (403–430 MHz, 4, 6, & 8 channels)
	or 2182877B11	10.5 ±5%; 75 V (440–470 MHz)
	or 2182358G21	7 ±0.25 pF; 25 V (470–512 MHz)
C15	2184008H14	4700; 100 V
C16	2182213E21	2000 +100%–20%; 25 V
		CHANNEL ELEMENT:
CE1 thru CE8	KXN1067B	Receiver
		DIODE: See Note
CR1, 2	4805824C01	Silicon (1 & 2 channels only)
CR3 thru CR6	4805824C01	Silicon
CR7	4805893D01	Silicon
		FILTER:
FL1/FL2	4805535C16	Matched pair, FL1 coded BLK, FL2 coded ORG
FL3/FL4	4805535C17	Matched pair, FL3 coded BLU, FL4 coded VIO
FL5	4805530C01	Discriminator, crystal; coded GRN
		RELAY:
K101	8005037E01	8–pin, DPDT
		COIL, Rf:
L1, 2	2482723H04	Choke, 0.29 uH
		RESISTOR, Fixed: Ω ±10%; 1/8 W unless otherwise stated
R1	0600185B34	4.7
R2	0600185B63	47
R3	0600185B67	100
R4	0600185B73	330
R5	0600185B70	180
		HYBRID, Encapsulated:
U1, 2, 3		Part of A1
U4	NLN8917A	First I-f Amplifier
U5	NLN8773A	Second I-f Amplifier
U6	NLN5925A	Discriminator
U8	NLN8775B	Audio Power Amplifier
U121	NFN6010A	PL Tone Filter
U122	NLN4052B	PL Processor
U123	NFN6009A	Low–Pass Filter
		NONREFERENCED ITEMS
	0305628C01	Slug and Mounting Stud for A1
	1405601C01	Insulator, for K101
	1405736C01	Insulator, for FL5
	7505295B01	Pad, for FL1–FL4
	7605445C01	Slug, for channel elements
	0705196A01	Boot, for FL1–FL5
	0905604C06	Socket, Guide pin
	0905287C05	Socket, Module
	0205863A01	Nut, for A1
	0400115361	Lockwasher, for A1
	0400474215	Washer, for A1
	1484277D14	Housing
	0984279D01	Contact
	2284835F01	Pin, Polarizing

NOTE:
For optimum performance, order replacement diodes by Motorola part number only.



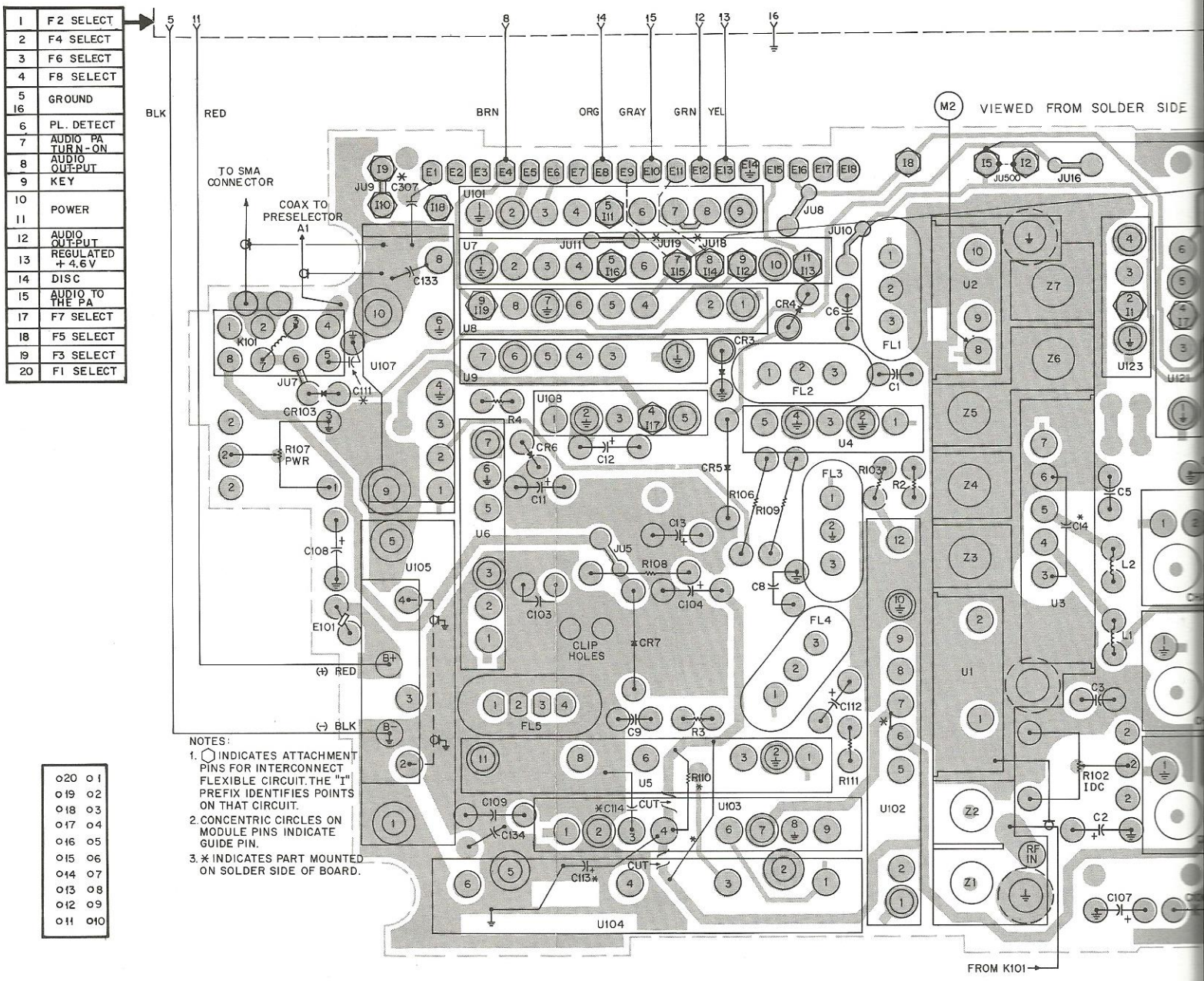


Figure 5-7.
Uhf Receiver Circuit Board Component Layout and Wiring Diagram and Parts List

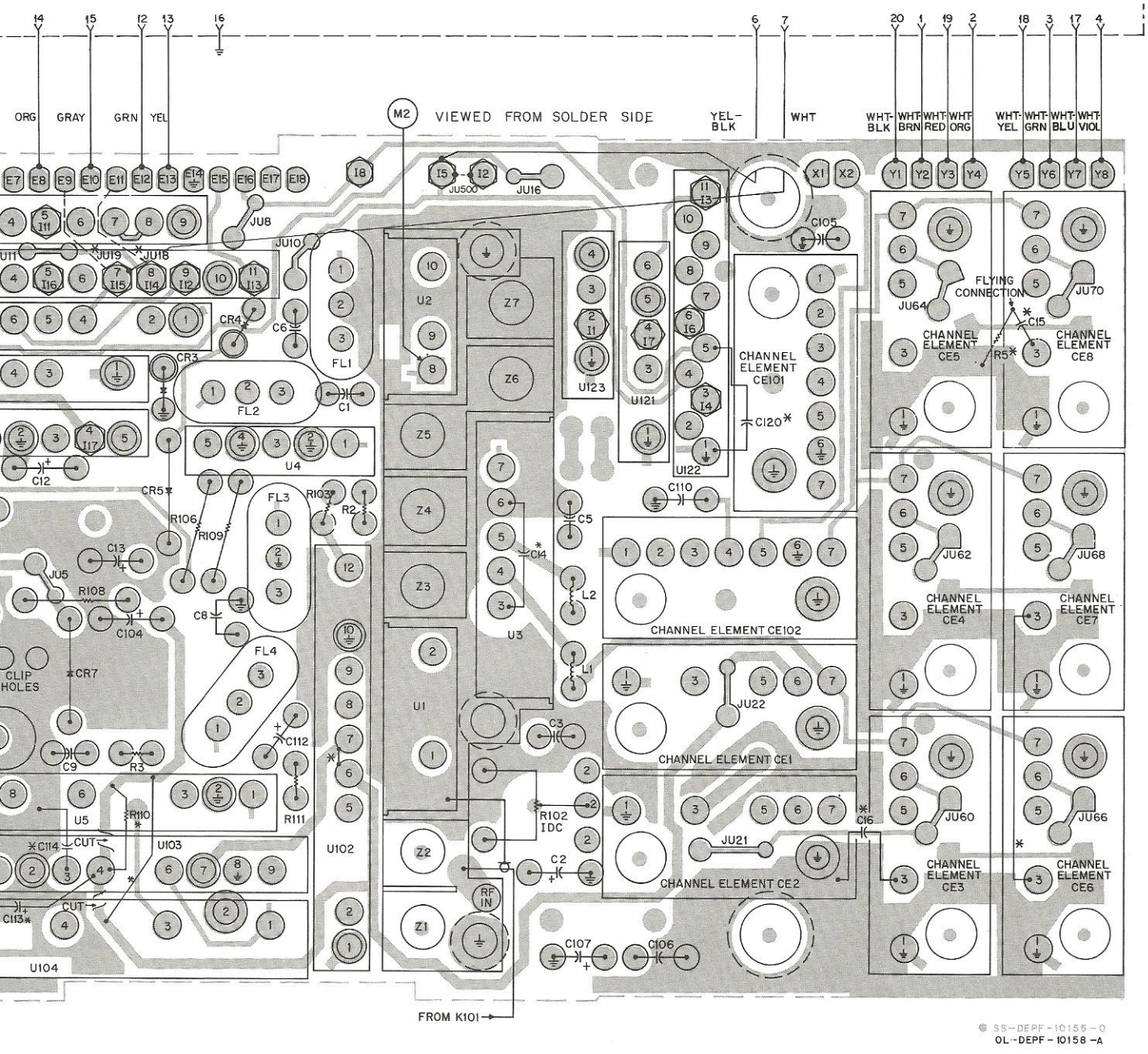
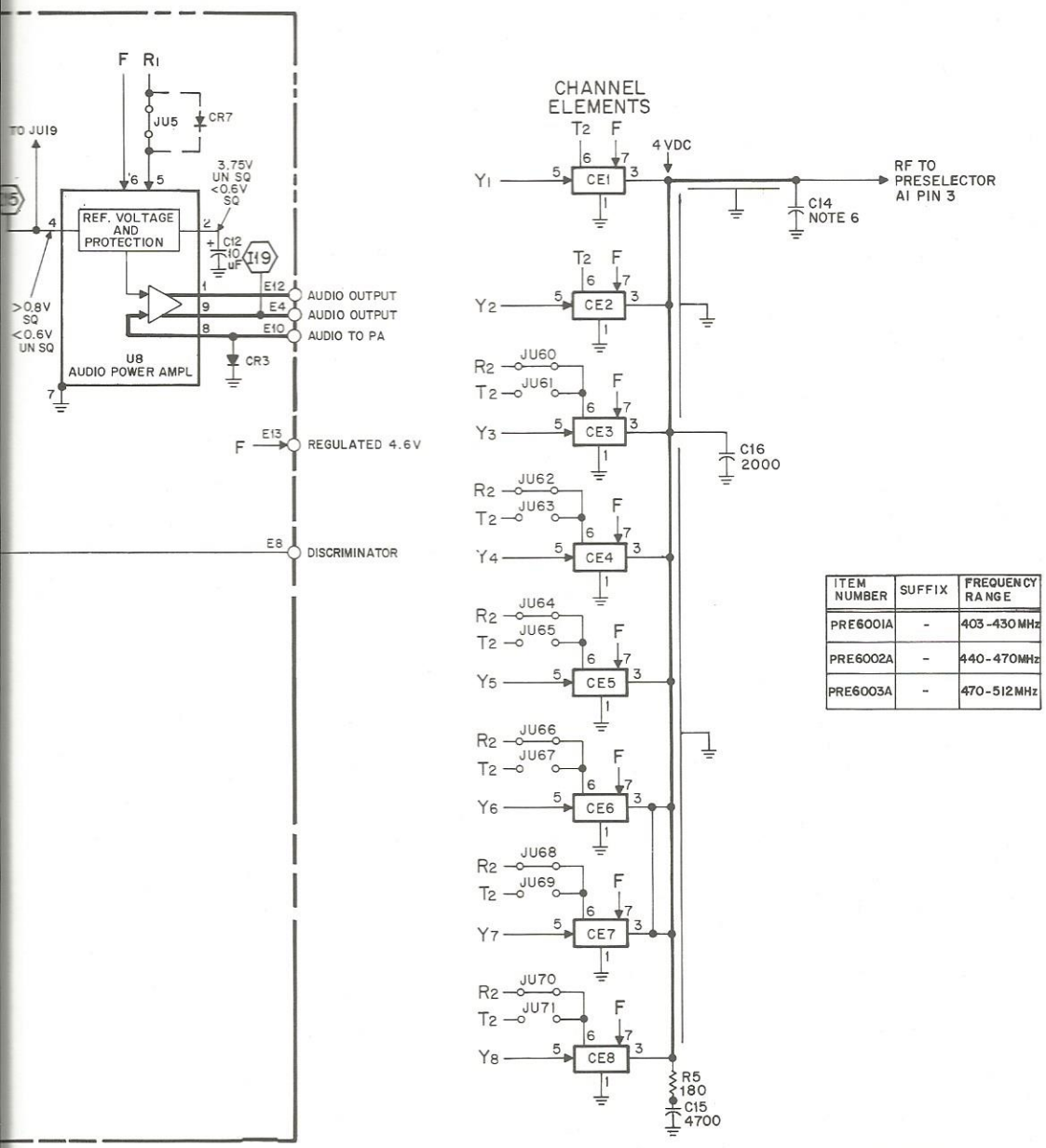


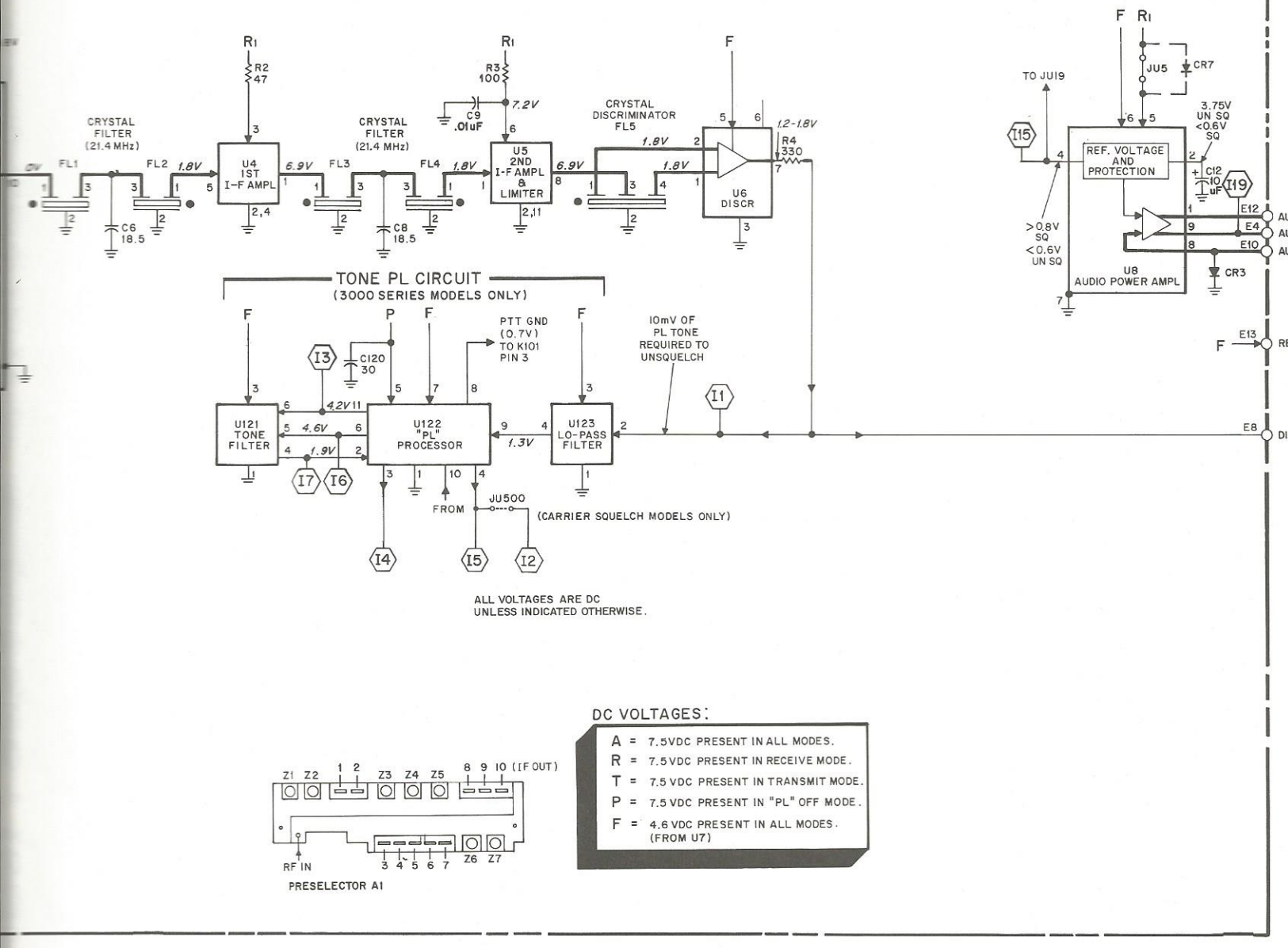
Figure 5-7.
Uhf Receiver Circuit Board Component Layout and Wiring Diagram and Parts List



ITEM NUMBER	SUFFIX	FREQUENCY RANGE
PRE6001A	-	403-430 MHz
PRE6002A	-	440-470MHz
PRE6003A	-	470-512MHz

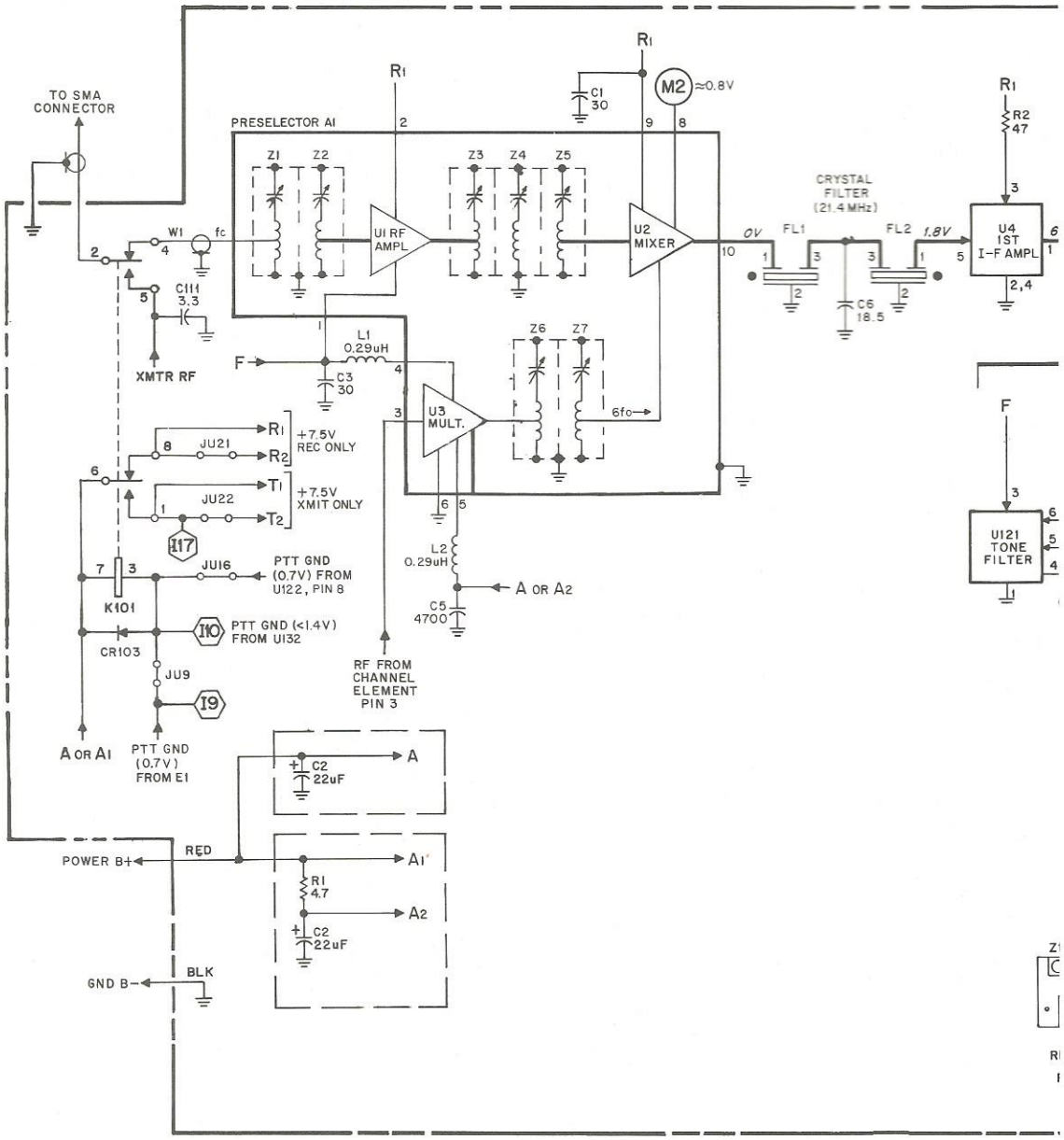
63E81021C92-B

Figure 5-8.
Uhf Receiver Schematic Diagram 5-9



DC VOLTAGES:

A =	7.5VDC PRESENT IN ALL MODES.
R =	7.5VDC PRESENT IN RECEIVE MODE.
T =	7.5 VDC PRESENT IN TRANSMIT MODE.
P =	7.5 VDC PRESENT IN "PL" OFF MODE.
F =	4.6 VDC PRESENT IN ALL MODES. (FROM U7)


TO SMA CONNECTOR
PRESELECTOR A1
R1
C1 30
M2 ≈0.8V
Z1
Z2
Z3
Z4
Z5
U1 RF AMPL
U2 MIXER
CRYSTAL FILTER (21.4 MHz)
FL1
FL2
0V
1.8V
R2 47
U4 1ST I-F AMPL
W1
fc
C111 3.3
XMTR RF
L1 0.29uH
C3 30
F
Z6
Z7
U3 MULT.
6fo
+7.5V REC ONLY
+7.5V XMIT ONLY
JU21
JU22
J17
JU16
PTT GND (0.7V) FROM U122, PIN 8
K101
CR103
PTT GND (<1.4V) FROM U132
J10
JU9
J9
A OR A1
PTT GND (0.7V) FROM E1
L2 0.29uH
C5 4700
A OR A2
RF FROM CHANNEL ELEMENT PIN 3
U121 TONE FILTER
C2 22uF
A
A1
A2
R1 4.7
POWER B+
RED
GND B−
BLK

Uhf Transmitter Parts List PLF-1765-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		PRESELECTOR:
A1	NLE6931A	403–430 MHz
	or NLE6932A	440–470 MHz
	or NLE6933A	470–512 MHz
		CAPACITOR, Fixed: pF ±10%; 20 V unless otherwise stated
C101, 102	2382397D04	15 uF ±20%; 15 V
C103	2184400H01	.01 uF; 50 V
C104	2382397D04	15 uF ±20%; 15 V
C105, 106	2182358G95	30; 75 V; N750
C107	2382397D03	10 uF ±20%; 6 V
C108	2382397D04	15 uF ±20%; 15 V
C109	2382397D15	10 uF ±20%
C110	2184008H01	.01 uF; 50 V
C111		Not Used
C112	2382397D09	6.8 uF ±20%; 10 V
C113	2382397D16	22 uF ±20%; 15 V
C114	2182358G95	30; 75 V; N750
C115 thru C119		Not Used
C120	2182358G96	30; 75V; N150
C121 thru C131		Not Used
C132	2184008H13	.05 uF ±20%; 25 V
		CHANNEL ELEMENT:
CE1 thru CE8	KXN1067A	Receiver
CE102	NLE6973A	Transmitter, 24.4 MHz (3 MHz offset)
		DIODE: See Note
CR101, 102, 103	4805824C01	Silicon
CR104 thru CR130		Not Used
CR131, 132	4883654H01	Silicon
		RELAY:
K101	8005037E01	8–pin, DPDT
		RESISTOR, Fixed: Ω ±10%; 1/8 W unless otherwise stated
R101		Not Used
R102	1805310C01	Pot. 10 k
R103	0600185B79	1 k
R104, 105		Not Used
R106	0600185B83	2.2 k
R107	1805310C02	Pot. 2 k
R108	0600185B83	2.2 k
R109	0600185B87	4.7 k
R110	0600185C34	4.7
R111	0600185C85	3.3 k
R112 thru R130		Not Used
R131	0600185A83	27 k ±5%
R132	0600185B80	1.2 k
		HYBRID, Encapsulated:
U102	NLE8342A	PLL Processor
U103	NLE8801A	VCO (403–430 MHz)
	or NLE8802A	VCO (440–470 MHz)
	or NLE8803A	VCO (470–512 MHz)
U104	NLE8181A	Power Amplifier (403–430 MHz)
	or NLE8182A	Power Amplifier (430–470 MHz)
	or NLE8183A	Power Amplifier (470–512 MHz)
U105	NLE8001A	Power Amplifier (403–430 MHz)
	or NLE8002A	Power Amplifier (430–470 MHz)
	or NLE8003A	Power Amplifier (470–512 MHz)
U106		Not Used
U107	NFE6041A	Filter & Detector (403–430 MHz)
	or NFE6042A	Filter & Detector (430–512 MHz)
U108	NLN8779A	ALC
U109 thru U120		Not Used
U121	NFN6010A	PL Tone Filter
U122	NLN4052B	PL Processor
	NONREFERENCED ITEMS	
	0305628C01	Slug, for A1
	1405601C01	Insulator, for K101
	7605445C01	Slug, for channel elements
	0705778D01	Boot, for U108
	0905604C06	Socket, guide pin
	0905287C05	Socket, module
	4205360E01	Clip, grounding; for U102
	0205863A01	Nut, for A1
	0400115361	Lockwasher, for A1
	0400474215	Washer, for A1
	0300139835	Screw, for U107
	0405683D01	Lockwasher, for U107
	1484277D14	Housing
	0984279D01	Contact
	2284835F01	Pin, polarizing

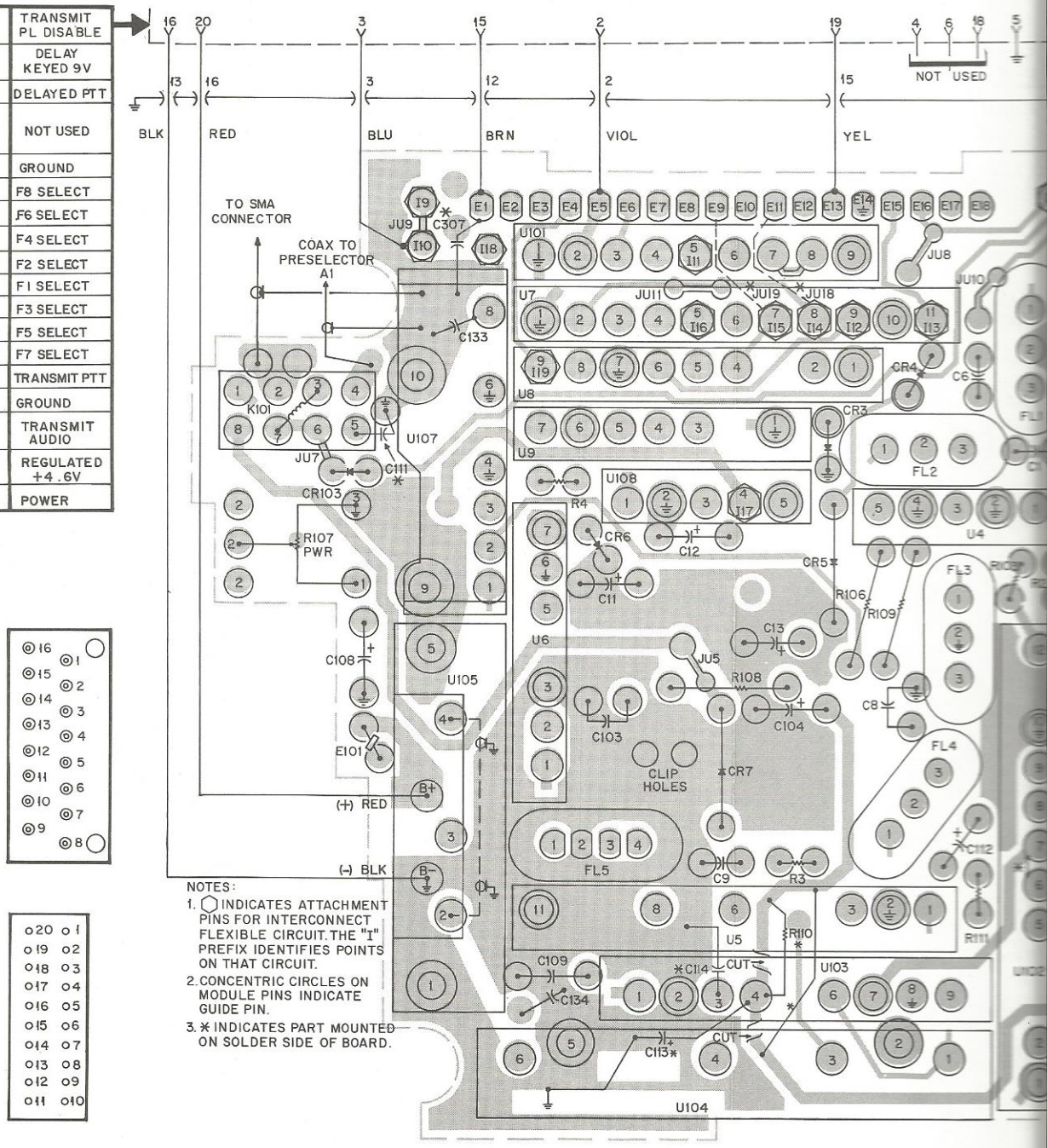
NOTE: For optimum performance, order replacement diodes by Motorola part number only.

ding; for U102

er, for A1
r A1
U107
er, for U107

ing

1	TRANSMIT PL DISABLE
2	DELAY KEYED 9V
3	DELAYED PTT
4 6 18	NOT USED
5	GROUND
7	F8 SELECT
8	F6 SELECT
9	F4 SELECT
10	F2 SELECT
11	F1 SELECT
12	F3 SELECT
13	F5 SELECT
14	F7 SELECT
15	TRANSMIT PTT
16	GROUND
17	TRANSMIT AUDIO
19	REGULATED +4.6V
20	POWER



NOTES:
1. ⬡ INDICATES ATTACHMENT PINS FOR INTERCONNECT FLEXIBLE CIRCUIT. THE "I" PREFIX IDENTIFIES POINTS ON THAT CIRCUIT.
2. CONCENTRIC CIRCLES ON MODULE PINS INDICATE GUIDE PIN.
3. * INDICATES PART MOUNTED ON SOLDER SIDE OF BOARD.

Figure 5-9. Uhf Transmitter Wiring Diagram

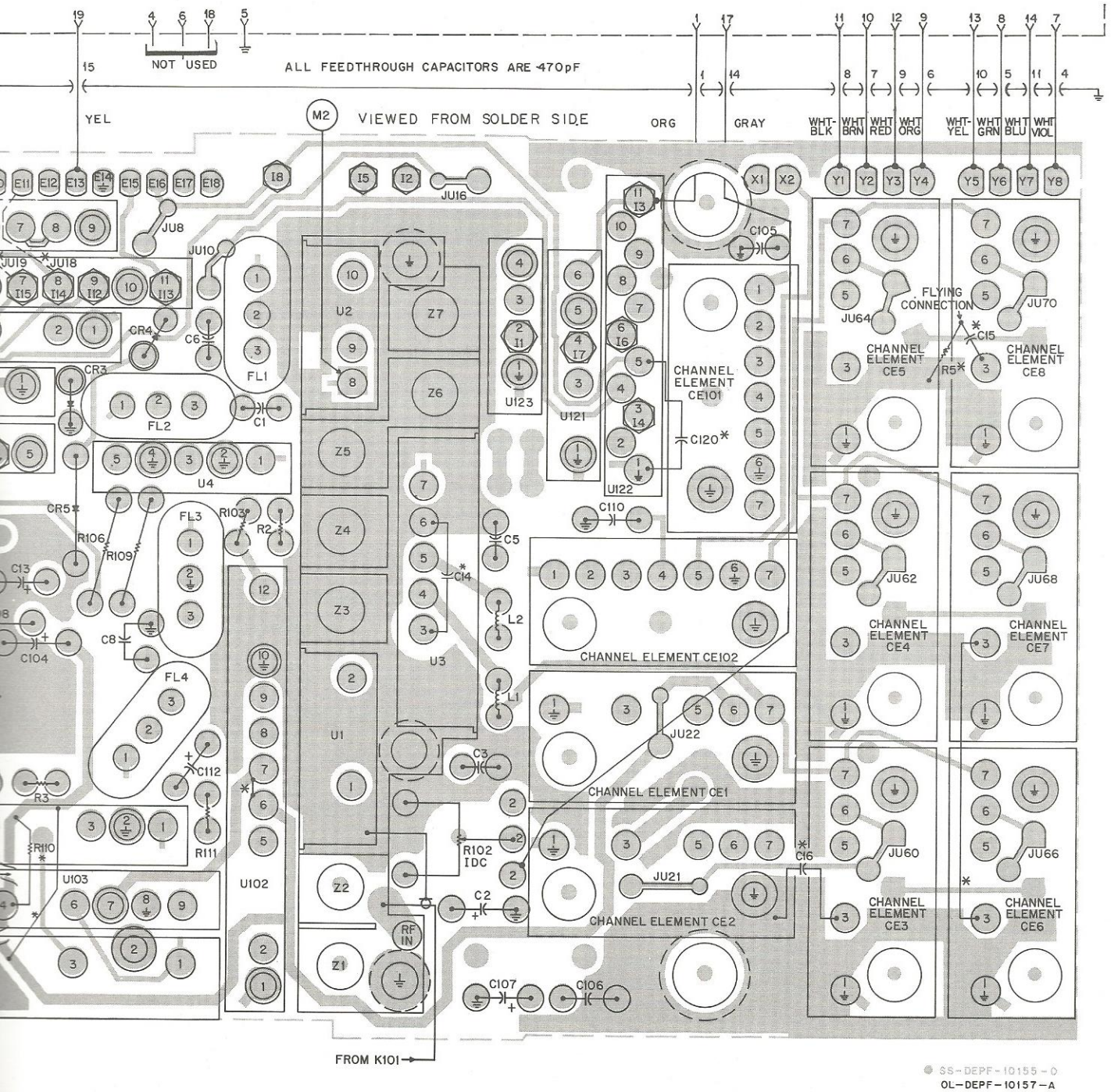
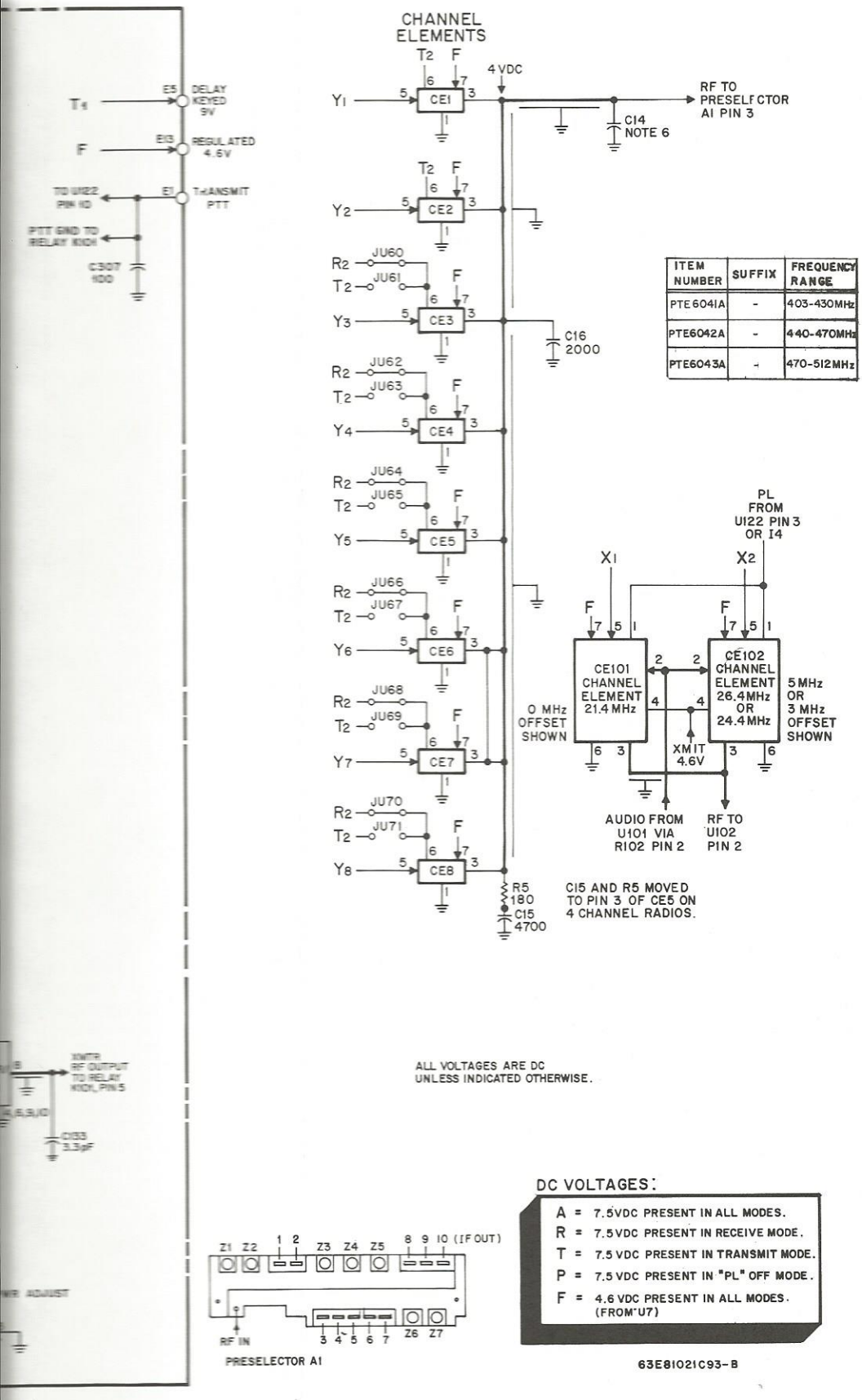


Figure 5-9.
Uhf Transmitter Circuit Board Component Layout and Wiring Diagram and Parts List



ITEM NUMBER	SUFFIX	FREQUENCY RANGE
PTE6041A	-	403-430MHz
PTE6042A	-	440-470MHz
PTE6043A	-	470-512MHz

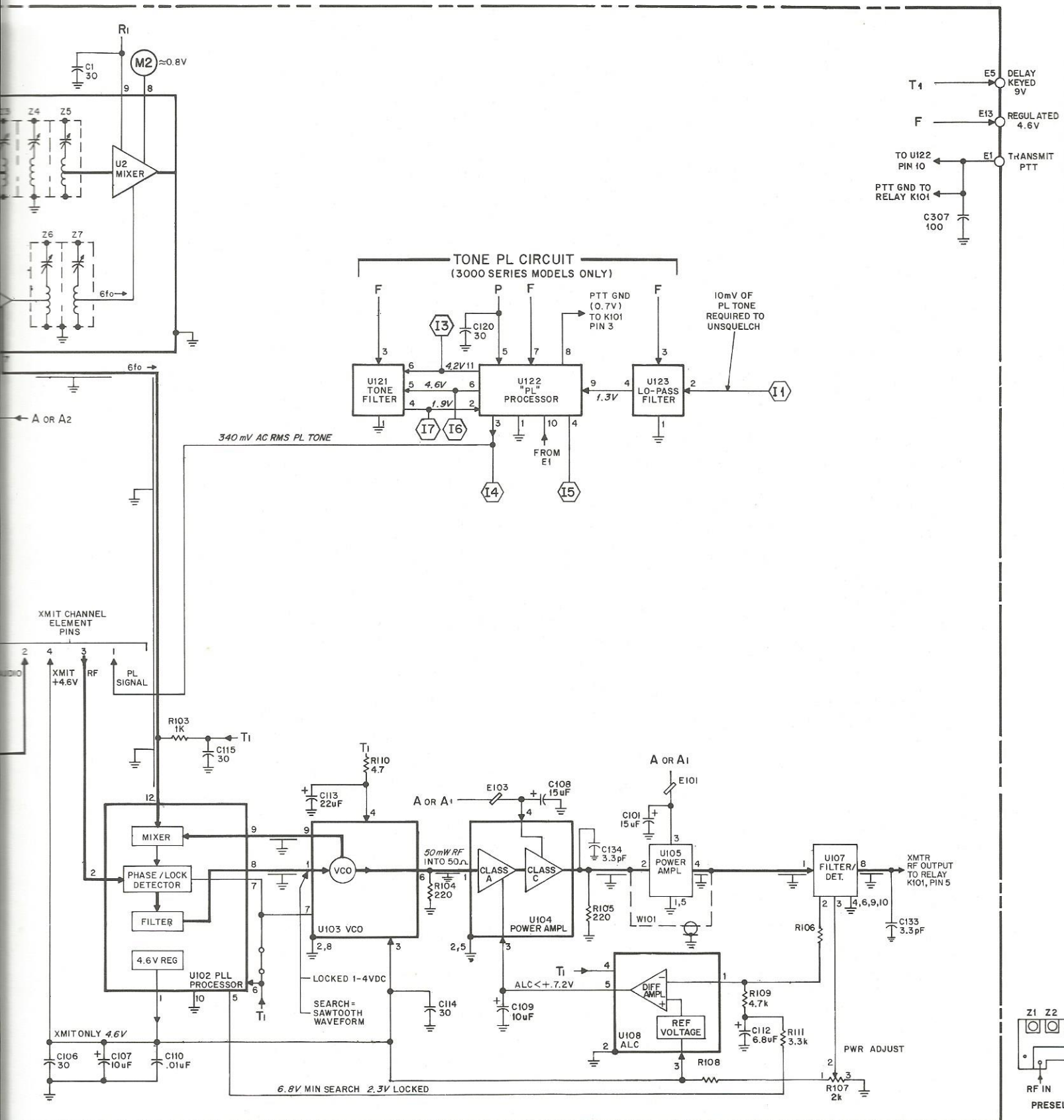
ALL VOLTAGES ARE DC UNLESS INDICATED OTHERWISE.

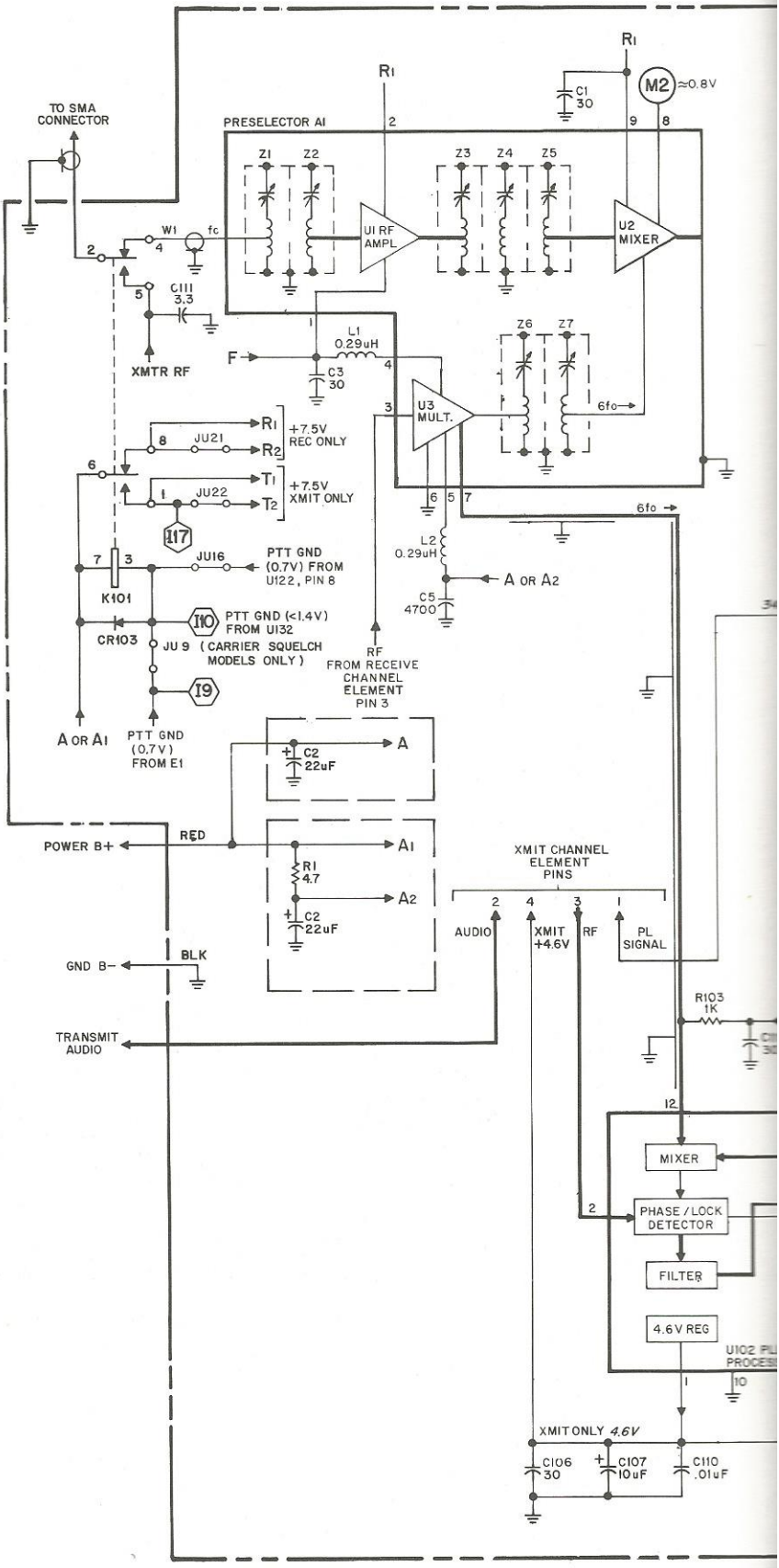
DC VOLTAGES:

- A = 7.5VDC PRESENT IN ALL MODES.
- R = 7.5VDC PRESENT IN RECEIVE MODE.
- T = 7.5 VDC PRESENT IN TRANSMIT MODE.
- P = 7.5 VDC PRESENT IN "PL" OFF MODE.
- F = 4.6 VDC PRESENT IN ALL MODES. (FROM U7)

63E81021C93-B

Figure 5-10.
Uhf Transmitter Schematic Diagram 5-11


R1
C1 30
M2 ≈0.8V
U2 MIXER
Z4 Z5 Z6 Z7
6fo
A OR A2
T1
E5 DELAY KEYED 9V
F
E13 REGULATED 4.6V
TO U122 PIN 10
E1 TRANSMIT PTT
PTT GND TO RELAY K101
C307 100
TONE PL CIRCUIT
(3000 SERIES MODELS ONLY)
PTT GND (0.7V) TO K101 PIN 3
10mV OF PL TONE REQUIRED TO UNSQUELCH
C120 30
U121 TONE FILTER
4.2V
4.6V
1.9V
U122 "PL" PROCESSOR
1.3V
U123 LO-PASS FILTER
I1 I3 I4 I5 I6 I7
340 mV AC RMS PL TONE
FROM E1
XMIT CHANNEL ELEMENT PINS
XMIT +4.6V
RF
PL SIGNAL
R103 1K
C115 30
R110 4.7
C113 22uF
E103
C108 15uF
A OR A1
E101
C101 15uF
MIXER
PHASE / LOCK DETECTOR
FILTER
4.6V REG
U102 PLL PROCESSOR
VCO
U103 VCO
50mW RF INTO 50Ω
R104 220
CLASS A
CLASS C
U104 POWER AMPL
C134 3.3pF
R105 220
U105 POWER AMPL
W101
U107 FILTER/ DET.
XMTR RF OUTPUT TO RELAY K101, PIN 5
C133 3.3pF
R106
LOCKED 1-4VDC
SEARCH = SAWTOOTH WAVEFORM
C114 30
C109 10uF
ALC <+7.2V
DIFF AMPL
REF VOLTAGE
U108 ALC
R109 4.7k
C112 6.8uF
R111 3.3k
R108
PWR ADJUST
R107 2k
XMIT ONLY 4.6V
C106 30
C107 10uF
C110 .01uF
6.8V MIN SEARCH 2.3V LOCKED
Z1 Z2
RF IN
PRESELECT


TO SMA CONNECTOR
PRESELECTOR A1
R1
C1 30
M2 ≈0.8V
Z1
Z2
Z3
Z4
Z5
U1 RF AMPL
U2 MIXER
W1
fc
C111 3.3
XMTR RF
F
L1 0.29uH
C3 30
Z6
Z7
U3 MULT.
6fo
R1
R2
+7.5V REC ONLY
JU21
T1
T2
+7.5V XMIT ONLY
JU22
I17
JU16
PTT GND (0.7V) FROM U122, PIN 8
K101
I10
PTT GND (<1.4V) FROM U132
CR103
JU 9 (CARRIER SQUELCH MODELS ONLY)
I9
A OR A1
PTT GND (0.7V) FROM E1
L2 0.29uH
A OR A2
C5 4700
RF FROM RECEIVE CHANNEL ELEMENT PIN 3
C2 22uF
A
POWER B+
RED
A1
R1 4.7
A2
C2 22uF
BLK
GND B-
TRANSMIT AUDIO
XMIT CHANNEL ELEMENT PINS
AUDIO
XMIT +4.6V
RF
PL SIGNAL
R103 1K
MIXER
PHASE / LOCK DETECTOR
FILTER
4.6V REG
XMIT ONLY 4.6V
C106 30
C107 10uF
C110 .01uF

PTE1031A Uhf Power Amplifier Overall Unit (403-420 MHz)

PLF-1857-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	HLE4074A	Substrate, Driver
	HLE4078A	Substrate, Predriver
	PKE6001A	Cable Kit
	PKE6002A	Cabling
	PLE6500A	Hardware
	PTE6004A	Transistor, Driver
	TFE6252A	Harmonic Filter
	TLE8751A	Isolator Network
	TLN4640A	Rf Switch
	TLN5240A	Power Control Board

PTE1001A Uhf Power Amplifier Overall Unit (440-512 MHz)

PLF-1766-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	HLE4074A	Substrate, Driver
	HLE4079A	Substrate, Predriver
	PKE6001A	Cable Kit
	PKE6002A	Cabling
	PLE6500A	Hardware
	PTE6004A	Transistor, Driver
	TFE6252A	Harmonic Filter
	TLE8751A	Isolator Network
	TLN4640A	Rf Switch
	TLN5240A	Power Control Board

TLN5240A Rf Power Control Board

PLF-1767-O

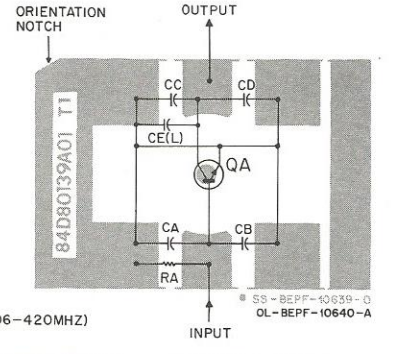
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:
C1 thru C10	2184493B46	100 pF ±10%; 200 V
C11	2384538G13	22 uF ±20%; 15 V
		DIODE: See Note
CR1, 2	4883654H01	Silicon
		TRANSISTOR: See Note
Q1, 2	4800869570	NPN; type M9570
Q3	4800869571	PNP; type M9571
Q4	4800869570	NPN; type M9570
Q5	4800869440	NPN; type M9440
		RESISTOR, Fixed: ±10%; 1/4 W unless otherwise stated
R1	0600124C25	100
R2	0600124C53	1.5 k
R3	0600124C51	1.2 k
R4	1883067F02	Variable, 10 k
R5	0600125C35	270; 1/2 W
R6	0600124C59	2.7 k
R7	0600124C47	820
R8	0600124C25	100
R9	0600124C51	1.2 k
R10	0600124C69	6.8 k
R11	0600124C83	27 k
R12	0600124C25	100
R13	0600124C49	1 k
R14	0600124C53	1.5 k
R15	0600124C51	1.2 k
R16	0600124C49	1 k
R17	0600124C01	10
R18	0600124C05	15
R19 thru R100		Not Used
R101	0600124C65	4.7 k
		THERMISTOR:
RT100	0684499B01	4.7 k
		VOLTAGE REGULATOR:
VR1	4882256C38	Zener type

NOTE: For optimum performance, order replacement diodes and transistors by Motorola part number only.

PLE6500A Uhf P.A. Hardware

PLF-1861-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±5% unless otherwise stated
C1 thru C850		Not Used
C851	2184511B25	120 ±10%; N150
C852 thru C855	2184211B01	Feed-thru
C856	2182133G03	100; N750
CR101	4882525G13	DIODE, Silicon
E809	7684069B01	Bead; Ferrite
L1 thru L815		Not Used
L816	2484346A01	Choke, Rf; 0.090 uH
L817	2483977B02	Choke
Q101	4800869806	TRANSISTOR, NPN, type M9806
		RESISTOR, Fixed: Ω ±5%; 1/4 W unless otherwise stated
R1 thru R100		Not Used
R101	0600124A65	4700
R102 thru R800		Not Used
R801	0600124A23	82
R802	0600124A01	10
RT1 thru RT99		Not Used
RT100	0684499B01	Thermistor
U1 thru U800		Not Used
U801	0180740B06	Parasitic Suppressor
		NONREFERENCED ITEMS
	0200009627	Nut, No.4
	0200115968	Nut, 1/4-28 x 3/8 x 1/8; Hex
	0300007178	Screw, 6-32 x 5/16; Binder Head
	0300007363	Screw, 6-32 x 1; Slotted Binder Head
	0300122804	Screw, 6-32 x 1/4; Phillips Binder Head
	0300122924	Screw, 4-40 x 5/16; Phillips Round Head
	0300136774	Screw, 4-40 x 1/4; Phillips Binder Head
	0300139012	Screw, 4-40 x 1/4; Phillips Hex Head
	0400002627	Washer, No.6 Lock
	0400007670	Washer, 1/4" Lock
	0400008442	Washer, No.4 Lock
	0484180C01	Washer, Shoulder
	0705306J01	Bracket, P.A. Shield
	0705307J01	Bracket, Hi/Low Relay No.1
	0705308J01	Bracket, Hi/Low Relay No.2
	0705317J01	Bracket, Uhf Filter
	1484268A01	Insulator, Transistor
	1505310J01	Cover, P.A.
	2605305J01	Heatsink
	2900005369	Lug, Solder
	310012155	Terminal strip (3), No.1 ground
	4205318J01	Holder, Substrate
	4305340J02	Standoff
	6405309J01	Plate, Hi/Low Relay Mounting



QA	CA	CB	CC	CD	RA	CE (L)
Q803	C810	C811	N.U.	C812	R801	NOT USED
Q804	C819	C820	C821	C822	NOT USED	C861

PLF-1861-O

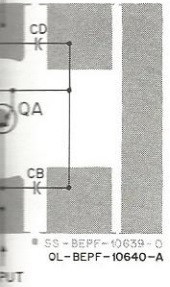
DESCRIPTION
ACITOR, Fixed: pF ±5%
ss otherwise stated
Used
±10%; N150
d-thru
N750
DE, Silicon
d; Ferrite
Used
ke, Rf; 0.090 uH
ke
NSISTOR, NPN, type M9806
ISTOR, Fixed: Ω ±5%; 1/4 W
ss otherwise stated
Used
Used
Used
mistor
Used
sitic Suppressor
D ITEMS
No.4
1/4-28 x 3/8 x 1/8; Hex
w, 6-32 x 5/16; Binder Head
w, 6-32 x 1; Slotted Binder Head
w, 6-32 x 1/4; Phillips Binder Head
w, 4-40 x 5/16; Phillips Round
d
w, 4-40 x 1/4; Phillips Binder Head
w, 4-40 x 1/4; Phillips Hex Head
her, No.6 Lock
her, 1/4" Lock
her, No.4 Lock
her, Shoulder
ket, P.A. Shield
ket, Hi/Low Relay No.1
ket, Hi/Low Relay No.2
ket, Uhf Filter
ator, Transistor
er, P.A.
sink
Solder
inal strip (3), No.1 ground
er, Substrate
doff
e, Hi/Low Relay Mounting

HLE4078A Predriver Substrate (406-420 MHz = L)
HLE4079A Predriver Substrate (440-512 MHz = H) PLF-1860-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50 V unless otherwise stated
C1 thru C816		Not Used
C817	2184736E15	12 (L)
	or 2184736E19	4.7 ±0.25 pF (H)
C818 thru C822		Not Used
C823	2105157A61	100 (L)
C824	2184547A13	100 k ±10%
C825	2184736E29	7.5 (L)
	or 2184736E21	100 (H)
C826	2105632D43	1.8 pF ±0.25 pF
CR1 thru CR804		Not Used
CR805	4884616A01	Diode (See Note) Hot Carrier
		FERRITE BEAD:
E1 thru E804		Not Used
E805	7683960B01	.138" OD x .118" long
E806, 807		Not Used
E808	7683960B01	.138" OD x .118" long
		COIL:
L1 thru L804		Not Used
L805	2480071B01	Choke, 6 turns
L806, 807		Not Used
L808	2480071B01	Choke, 6 turns
L809 thru L814		Not Used
L815	2482723H04	290 nH
		NONREFERENCED ITEMS
	5580065B01	Strap, Driver
	6480382A02	Plate, Substrate P.A. Deck

HLE4074A Driver Substrate PLF-1862-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50 V unless otherwise stated
C816	2184547A05	.01 uF
C818	2105157A07	100 ±20%
C850	2382783B07	33 uF; 25 V
E1 thru E805		Not Used
E806, 807	7683960B01	Ferrite Bead; .138" OD x .118"long
L1 thru L805		Not Used
L806, 807	2480071B01	Choke, 6 turns
R1 thru R819		Not Used
R820	0600124A18	Resistor, Fixed: 51 ±5%; 1/4 W
		NONREFERENCED ITEMS
	6480144A02	Plate, P.A. Deck



RA	CE (L)
R801 NOT USED	NOT USED C861

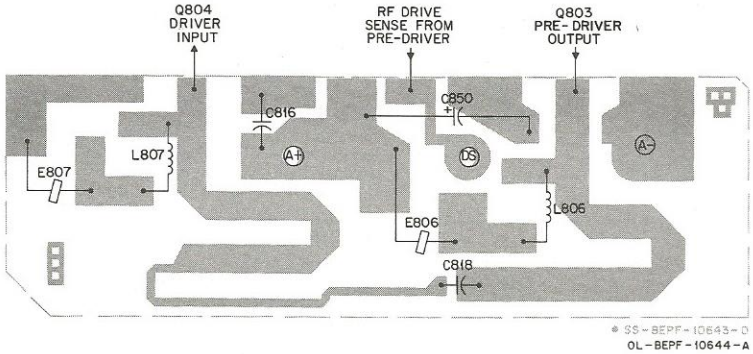
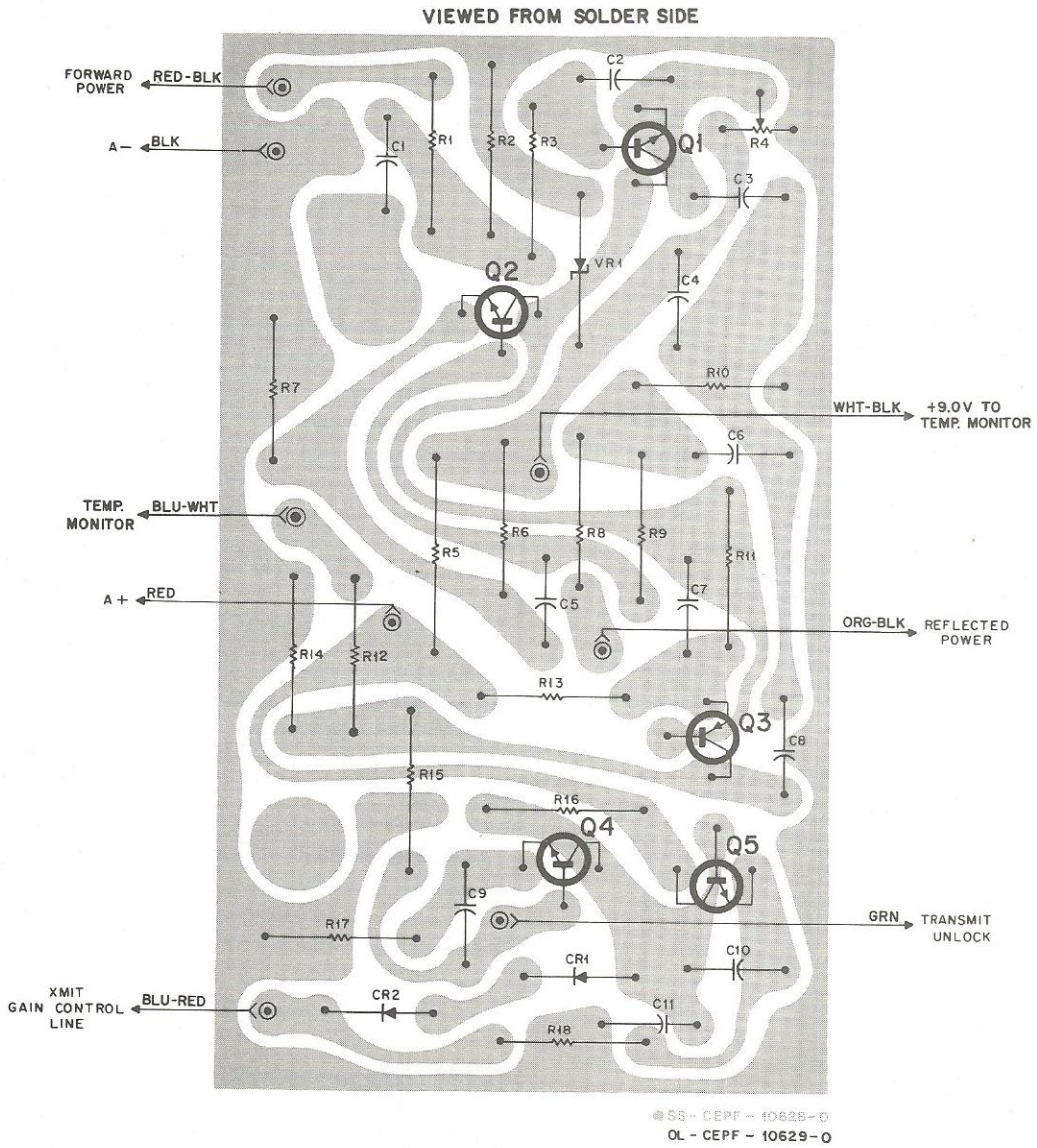


Figure 5-11. Uhf Power Ampli Component Layo



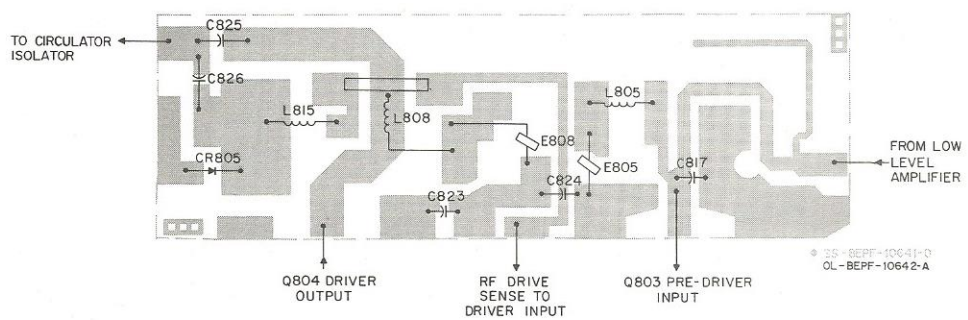
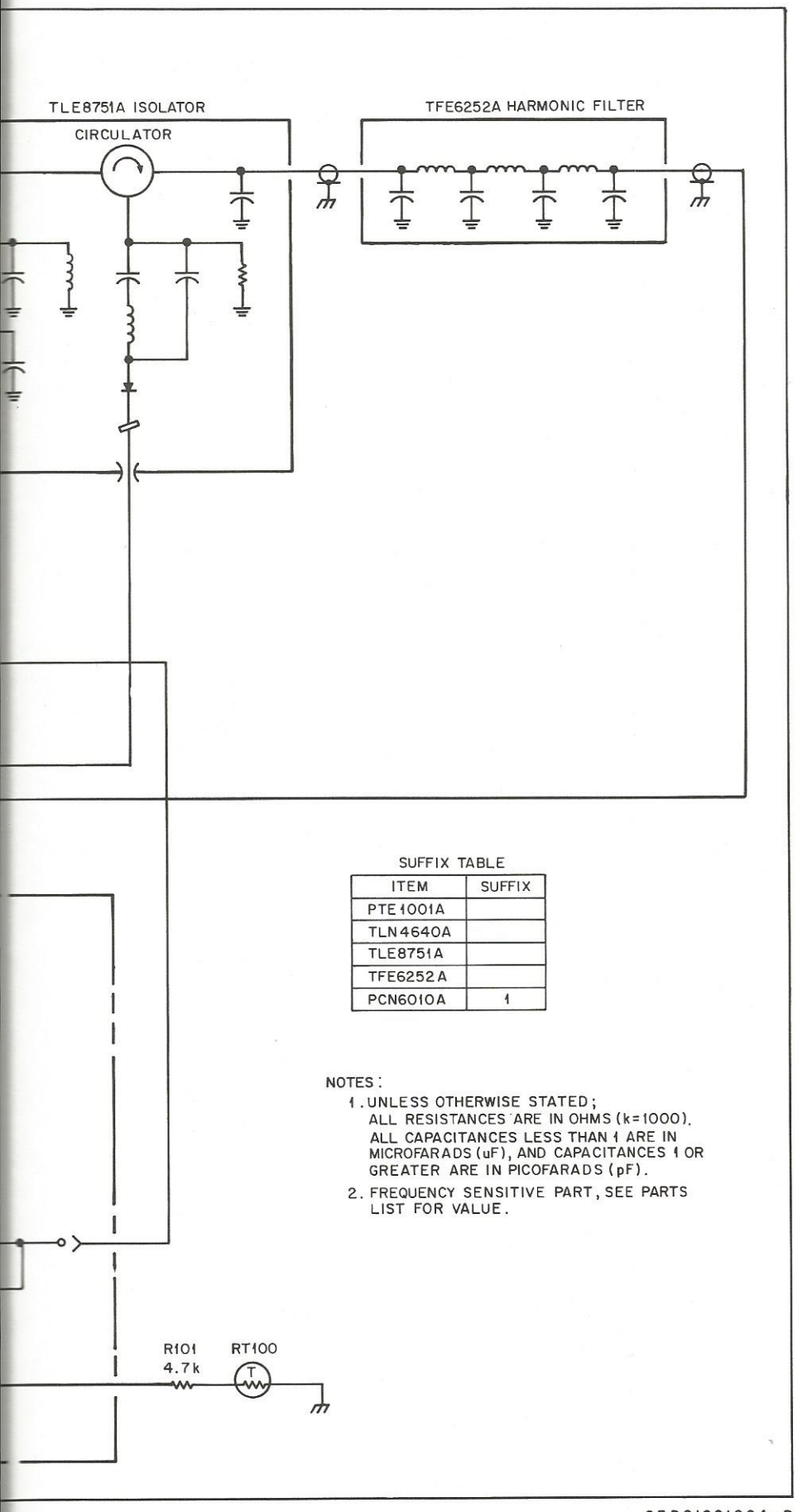


Figure 5-11.
Uhf Power Amplifier Circuit Board
Component Layout Diagram and Parts Lists



SUFFIX TABLE

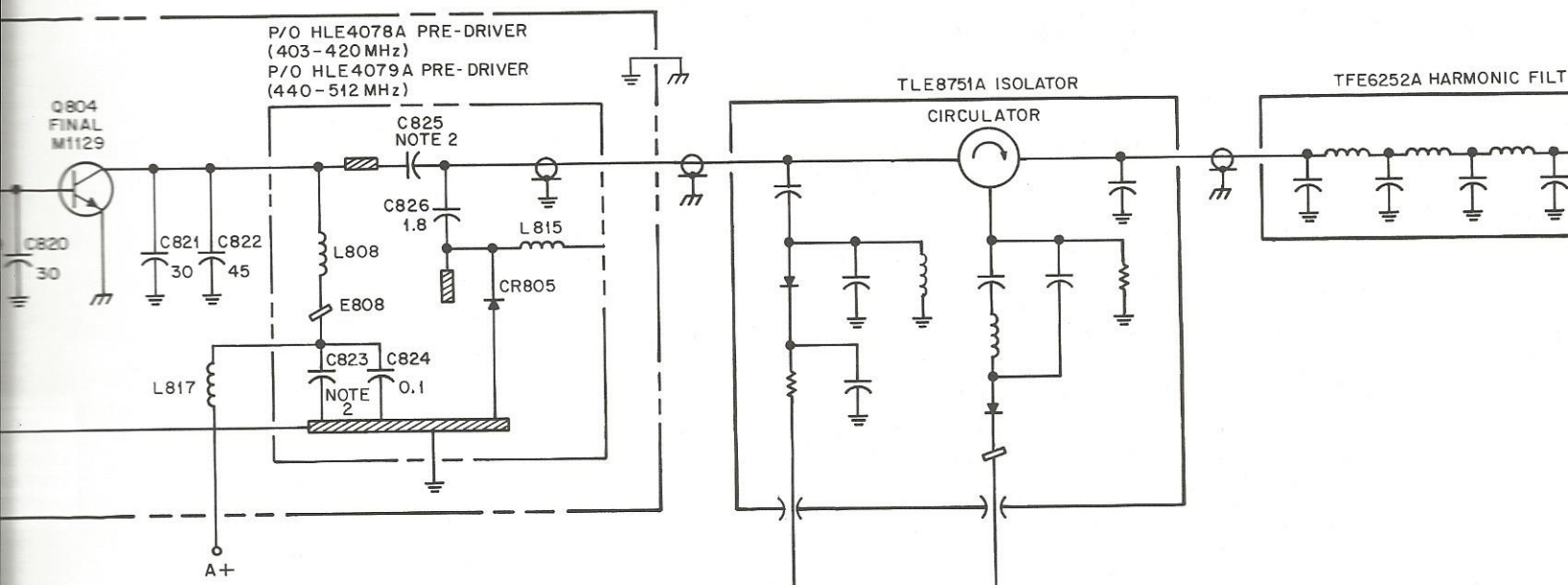
ITEM	SUFFIX
PTE1001A	
TLN4640A	
TLE8751A	
TFE6252A	
PCN6010A	1

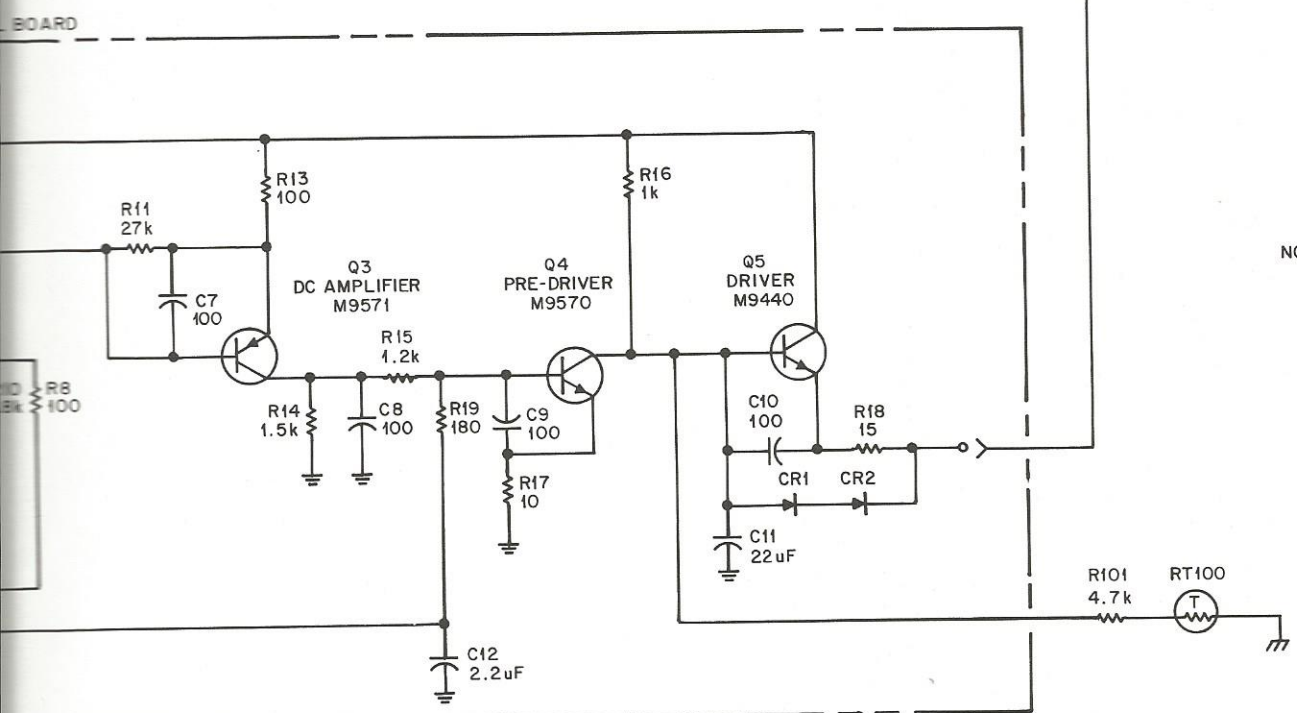
NOTES:

1. UNLESS OTHERWISE STATED; ALL RESISTANCES ARE IN OHMS (k=1000). ALL CAPACITANCES LESS THAN 1 ARE IN MICROFARADS (uF), AND CAPACITANCES 1 OR GREATER ARE IN PICOFARADS (pF).
2. FREQUENCY SENSITIVE PART, SEE PARTS LIST FOR VALUE.

63D81021C94-B

Figure 5-12.
Uhf Power Amplifier Schematic Diagram





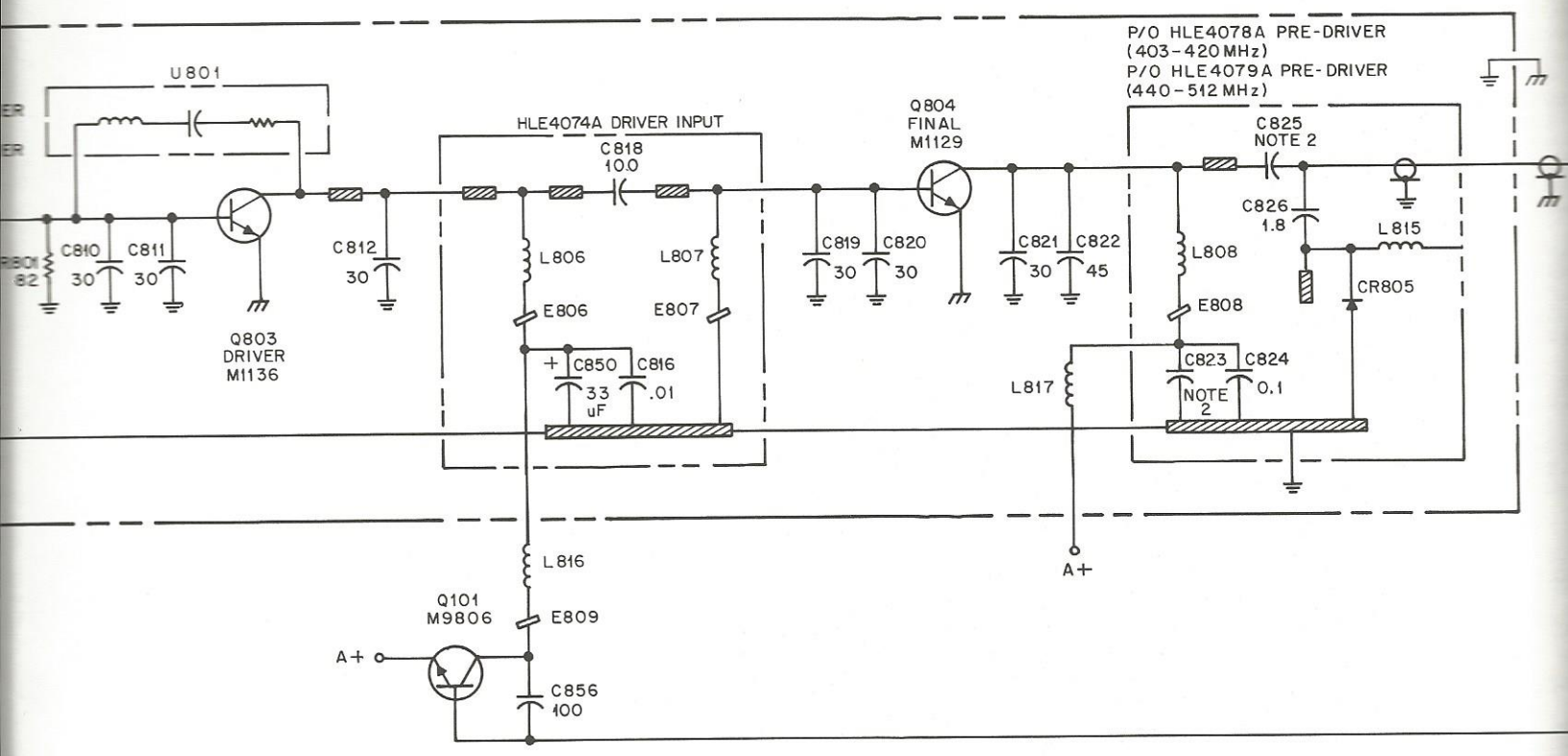
SUFFIX TABLE

ITEM	SUFFIX
PTE1001A	
TLN4640A	
TLE8751A	
TFE6252A	
PCN6010A	1

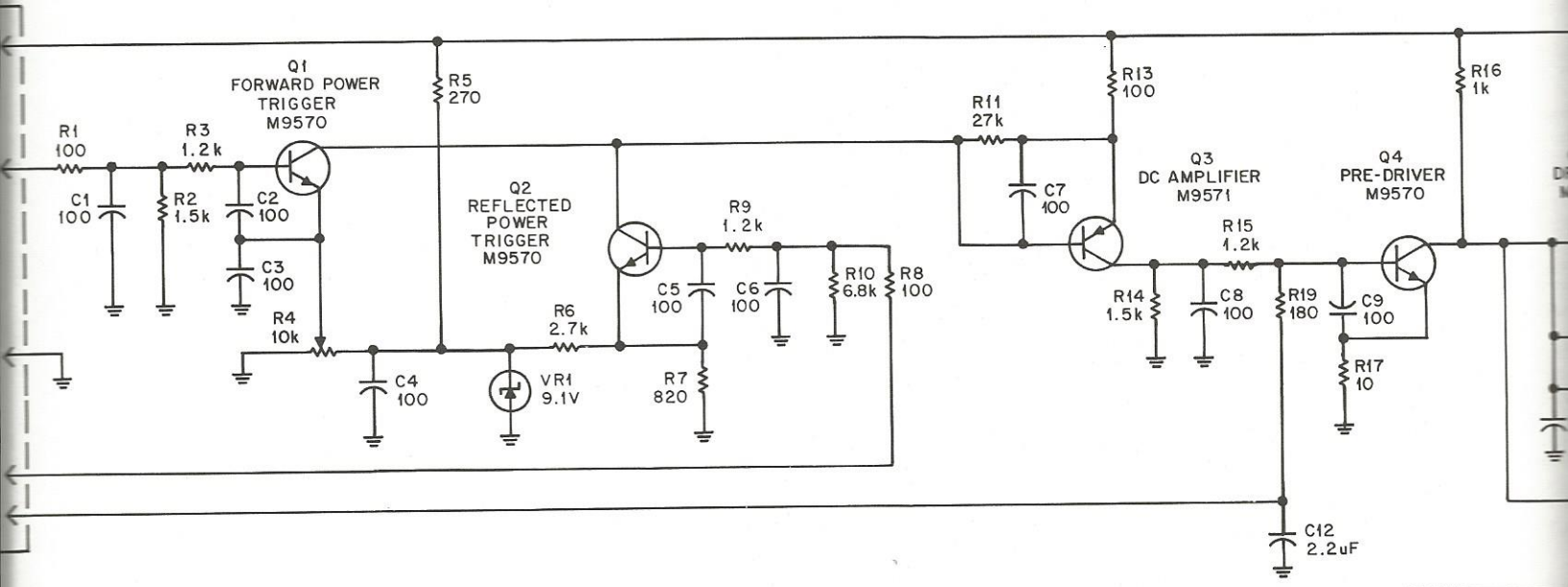
NOTES:

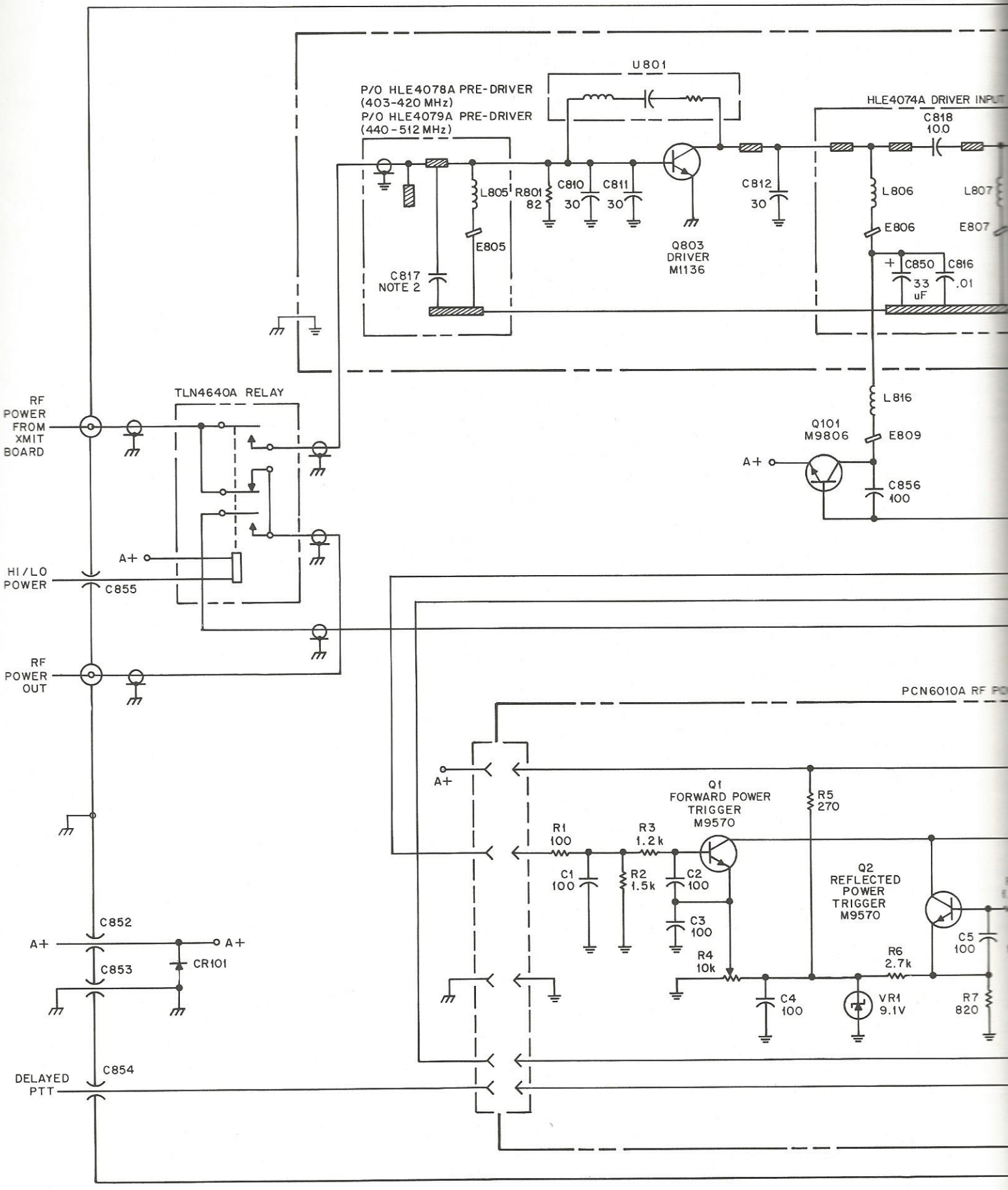
1. UNLESS OTHERWISE STATED; ALL RESISTANCES ARE IN OHMS ALL CAPACITANCES LESS THAN MICROFARADS (uF), AND CAPACIT GREATER ARE IN PICOFARADS (
2. FREQUENCY SENSITIVE PART, S LIST FOR VALUE.

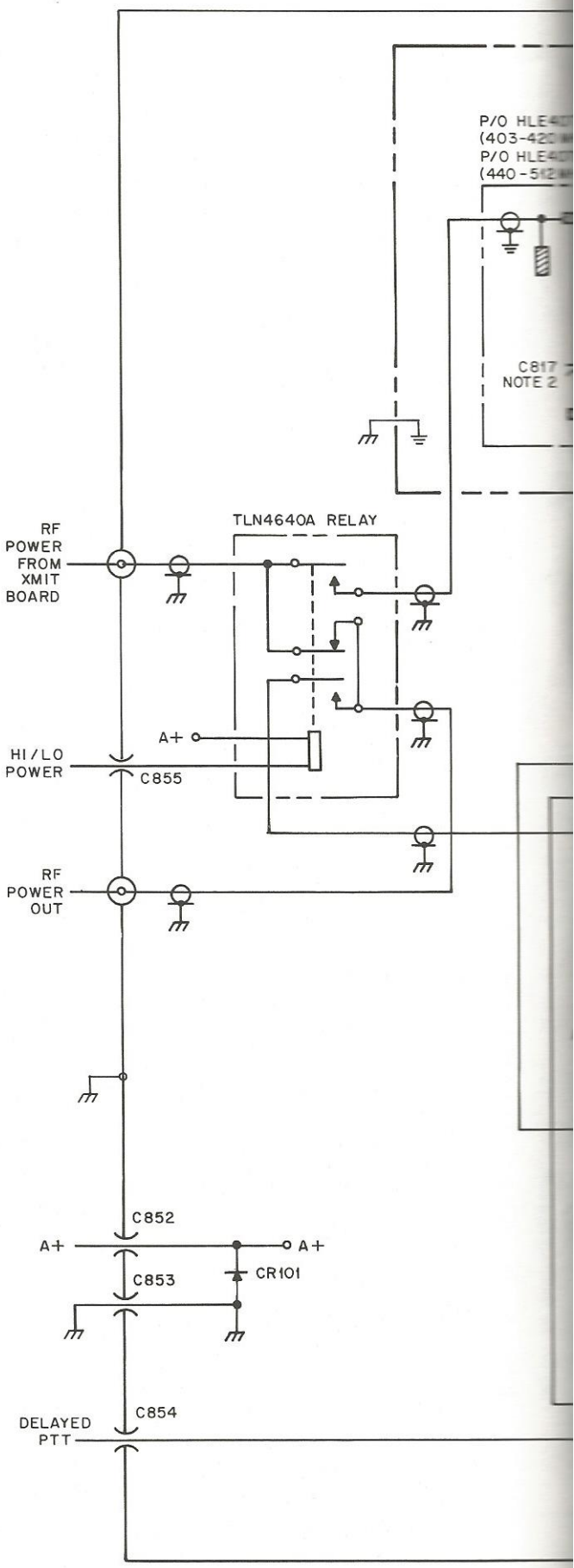
PTE1031A (403-420 MHz) OR PTE1001A (440-512 MHz)



PCN6010A RF POWER CONTROL BOARD




U801
P/O HLE4078A PRE-DRIVER
(403-420 MHz)
P/O HLE4079A PRE-DRIVER
(440-512 MHz)
HLE4074A DRIVER INPUT
C818
10.0
L805
R801
82
C810
30
C811
30
C812
30
L806
L807
E805
E806
E807
C817
NOTE 2
Q803
DRIVER
M1136
C850
33
uF
C816
.01
L816
Q101
M9806
E809
A+
C856
100
TLN4640A RELAY
RF
POWER
FROM
XMIT
BOARD
HI/LO
POWER
C855
RF
POWER
OUT
PCN6010A RF PO
A+
Q1
FORWARD POWER
TRIGGER
M9570
R5
270
R1
100
R3
1.2k
C1
100
R2
1.5k
C2
100
C3
100
R4
10k
Q2
REFLECTED
POWER
TRIGGER
M9570
C5
100
R6
2.7k
C4
100
VR1
9.1V
R7
820
C852
A+
A+
C853
CR101
DELAYED
PTT
C854


P/O HLE4
(403-42
P/O HLE4
(440-51
C817
NOTE 2
TLN4640A RELAY
RF
POWER
FROM
XMIT
BOARD
A+
HI/LO
POWER
C855
RF
POWER
OUT
C852
A+
A+
C853
CR101
C854
DELAYED
PTT

PLN6175A Main Control Board (Coded) PLF-1768-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
BT1	6005347J01	BATTERY, 3.6 V
		CAPACITOR, Fixed: uF ±20%; 20 V unless otherwise stated
C1	2182187B29	.001 ±10%; 100 V
C2	2383210A19	500
C3	2382397D15	10
C4	2183596E21	.01 +80–20%; 200 V
C5	2382397D23	6.8
C6	2382397D36	1
C7	2382397D23	6.8
C8, 9	2182187B29	.001 ±10%; 100 V
C10	2382397D52	1
C11, 12	2182187B29	.001 ±10%; 100 V
C13	2382397D15	10
C14	2182187B29	.001 ±10%; 100 V
C15	2382397D36	1
C16	2182187B07	470 pF; ±10%; 500 V
C17	2182133G43	15 pF ±5%; N330
C18	2183596E21	.01 +80–20%; 200 V
C19	2182187B30	330 pF; 500 V
C20	2183406D81	20 pF ±5%; NPC
C21	2182187B30	330 pF; 500 V; X5F
C22	2382397D03	10; 6 V
C23	2382397D16	22; 15 V
C24	2382397D36	1
C25	2382397D15	10
C26	2182187B29	.001 ±10%; 100 V
C27, 28	2382397D16	22; 15 V
C29	2182187B07	470 pF; 500 V
C30, 31	2382397D36	1
C32, 33	2182397D15	10
C34	2382397D36	1
C35, 36		Not Used
C37	2182187B08	220 pF
C38	2382397D15	10
C39	2182187B07	470 pF; 500 V
C40	2382397D52	1
C41	0882905G03	.047 ±10%; 50 V
C42	2382397D36	1
C43	2184008H01	.01; 50 V
C44	0882905G26	4700 pF; 100 V
C45	2100865452	680 pF
C46	2382397D05	4.7 +40–20%; 40 V
C47	2382397D15	10
		DIODE: See Note
CR1, 2	4883329G04	Silicon
CR3	4883654H01	Silicon
CR4, 5, 6	4882466H13	Silicon
CR7 thru CR23	4883654H01	Silicon
CR24, 25	4882525G13	Silicon
CR26 thru CR49	4883654H01	Silicon
CR50	4882525G13	Silicon
CR51	4883634H01	Silicon
CR52	4888245C05	LED, Red
CR53	4888245C06	LED, Green
CR54, 55, 56	4883654H01	Silicon
CR57	4888245C09	LED, Yellow
CR58	4888245C05	LED, Red
CR59, 60, 61	4883654H01	Silicon
F1	650042092	FUSE, 2A; 250 V
		CONNECTOR:
J1	0982672G01	Receptacle, Microphone
J2	1583061L02	Receptacle, Code Insert
P1	2884528K01	Plug, 20–pin
P2	2884528K06	Plug, 10–pin
P3	2884528K05	Plug, 8–pin
P4	2884528K01	Plug, 20–pin
P5, 6	2884528K06	Plug, 10–pin
		TRANSISTOR: See Note
Q1, 2, 3	4800869642	NPN; Type M9642
Q4, 5	4800869706	NPN; Type M9706
Q6, 7, 8	4800869642	NPN; Type M9642
Q9, 10	4800869643	PNP; Type M9643
Q11	4800869642	NPN; Type M9642
Q12, 13	4800869706	NPN; Type M9706
Q14, 15	4800869642	NPN; Type M9642
Q16	4800869568	NPN; Type M9568
Q17	4800869643	PNP; Type M9643
Q18 thru Q22	4800869642	NPN; Type M9642
		RESISTOR, Fixed: Ω ±10% unless otherwise stated
R1	0600124A27	120 ±5%; 1/4 W
R2	0684444A39	3160 ±1%; 1/4 W
R3	0600124A65	4700
R4	0600124A01	10 ±5%; 1/4 W
R5	0600124A49	1 k
R6	0600124A97	100 k
R7	0600124A49	1 k
R8	0600124A81	22 k
R9	0600124A49	1 k
R10	1884944C03	Variable, 10 k
R11	0600124A73	10 k
R12 thru R15	0600124A97	100 k
R16, 17	0600124A81	22 k
R18	0600124A73	10 k
R19	0600124A81	22 k
R20, 21	0600124A97	100 k
R22	0600124A81	22 k
R23	0600124A73	10 k
R24	0600124A81	22 k
R25	1884944C03	Variable, 10 k
R26	0600124A79	18 k
R27	0600124A81	22 k
R28, 29	0600124A73	10 k
R30	0600124A81	22 k
R31	0684444A39	3160 ±1%
R32	0600124A73	10 k
R33	0600124A81	22 k
R34	0610621C45	3320 ±1%; 1/8 W
R35	0600124A85	33 k
R36	1782177B01	3; 5 W
R37	0600124A97	100 k
R38	0600124A81	22 k
R39	0600124A73	10 k
R40	0600124A97	100 k
R41	0600124A41	470
R42	0600124A39	390
R43	0600124A97	100 k
R44	1884944C02	Variable, 25 k
R45	1884584A02	Variable, 25 k
R46	0600124A33	220
R47	0600124A37	330
R48, 49	0684444A39	3160 ±1%
R50, 51	0600124A85	33 k
R52, 53	0600124A97	100 k
R54	0600124A25	100
R55	0600124A65	4.7 k
R56	0600124A51	1.2 k
R57	0600124B02	150 k
R58	0600124A17	47
R59	0600124A83	27 k
R60	0600124A97	100 k
R61	0600124A85	33 k
R62	0600124A49	1 k
R63	0600124A89	47 k
R64	0600124A47	820
R65	0600124A97	100 k
R66	0600124A77	15 k
R67	0600124A53	1.5 k
R68	0600124A73	10 k
R69	0600124A39	390
R70	0600124A09	22
R71	0600124A97	100 k
R72, 73	0600124A73	10 k
R74	0600124A09	22
R75	0600124A73	10 k
R76	0600124A97	100 k
R77, 78	0600124A73	10 k
R79	0600125A97	100 k
R80, 81	0600124A73	10 k
R82, 83, 84	0600124A97	100 k
R85	0600124B08	270 k
R86	0600124A97	100 k
R87	0600124A73	10 k
R88		
R89		
R90		
R91		
R92		
R93		
R94		
R95		
R96		
R97		
R98		
R99 thru R102		
R103		
R104		
R105		
R106		
R107, 108		
R109		
R110		
R111		
R112, 113		
R114		
R115		
R116		
S1		
S2, 3		
S4, 5		
S6		
U1		
U2		
U3		
U4, 5		
U6		
U7		
U8		
U9		
U10		
U11		
U12		
U13, 14		
U15		
U16		
U17		
U18, 19		
U20		
U21		
U22		
U23		
U24		
U25, 26		
U27		
U28		
U29		
U30		
U31		
U32, 33		
U34		
U35		
U36		
U37, 38		
U39		
U40, 41		
U42, 43		
U44		
U45		
U46		
U47		
U48		
U49		
VR1		
X1		
X2		
X3		
Y1		

NOTE: For optimum performance, order replacement diodes, transistors, and integrated circuits by Motorola part number only.

	4800869642	NPN; Type M9642
	4800869706	NPN; Type M9706
	4800869642	NPN; Type M9642
	4800869568	NPN; Type M9568
	4800869643	PNP; Type M9643
22	4800869642	NPN; Type M9642
		RESISTOR, Fixed: Ω ±10% unless otherwise stated
	0600124A27	120 ±5%; 1/4 W
	0684444A39	3160 ±1%; 1/4 W
	0600124A65	4700
	0600124A01	10 ±5%; 1/4 W
	0600124A49	1 k
	0600124A97	100 k
	0600124A49	1 k
	0600124A81	22 k
	0600124A49	1 k
	1884944C03	Variable, 10 k
	0600124A73	10 k
15	0600124A97	100 k
	0600124A81	22 k
	0600124A73	10 k
	0600124A81	22 k
	0600124A97	100 k
	0600124A81	22 k
	0600124A73	10 k
	0600124A81	22 k
	1884944C03	Variable, 10 k
	0600124A79	18 k
	0600124A81	22 k
	0600124A73	10 k
	0600124A81	22 k
	0684444A39	3160 ±1%
	0600124A73	10 k
	0600124A81	22 k
	0610621C45	3320 ±1%; 1/8 W
	0600124A85	33 k
	1782177B01	3; 5 W
	0600124A97	100 k
	0600124A81	22 k
	0600124A73	10 k
	0600124A97	100 k
	0600124A41	470
	0600124A39	390
	0600124A97	100 k
	1884944C02	Variable, 25 k
	1884584A02	Variable, 25 k
	0600124A33	220
	0600124A37	330
	0684444A39	3160 ±1%
	0600124A85	33 k
	0600124A97	100 k
	0600124A25	100
	0600124A65	4.7 k
	0600124A51	1.2 k
	0600124B02	150 k
	0600124A17	47
	0600124A83	27 k
	0600124A97	100 k
	0600124A85	33 k
	0600124A49	1 k
	0600124A89	47 k
	0600124A47	820
	0600124A97	100 k
	0600124A77	15 k
	0600124A53	1.5 k
	0600124A73	10 k
	0600124A39	390
	0600124A09	22
	0600124A97	100 k
	0600124A73	10 k
	0600124A09	22
	0600124A73	10 k
	0600124A97	100 k
	0600124A73	10 k
	0600125A97	100 k
	0600124A73	10 k
	0600124A97	100 k
	0600124B08	270 k
	0600124A97	100 k
	0600124A73	10 k

R88	0600124A49	1 k
R89	0600124A73	10 k
R90	0600124A65	4700
R91	0600124A73	10 k
R92	1884584A02	Variable, 25 k
R93	0600124A73	10 k
R94	0600124A97	100 k
R95	0600124A73	10 k
R96	0600124A87	39 k
R97	0600124A97	100 k
R98	0600124A83	27 k
R99 thru R102		Not Used
R103	0600124A77	15 k
R104	0600124B06	220 k
R105	0600124A75	12 k
R106	1884944C02	Variable, 25 k
R107, 108	0600124A61	3.3 k
R109	0600124A75	12 k
R110	0600124A77	15 k
R111	0600124A73	10 k; ±5%
R112, 113	0600124A81	22 k
R114	0600124A39	390
R115	0600124A97	100 k
R116	0600124A49	1 k
		SWITCH:
S1	4005352J01	8–position
S2, 3	4005350J02	Toggle
S4, 5		Not Used
S6	4005350J02	Toggle
		INTEGRATED CIRCUIT: See Note
U1	5184621K27	IC, 5 V Regulator
U2		Not Used
U3	5184887K60	IC, Type MC14053B
U4, 5	5184887K09	IC, Type MC14001B
U6	5184887K08	IC, Type MC14011B
U7		Not Used
U8	5184887K09	IC, Type MC14001B
U9	5184887K60	IC, Type MC14053B
U10	5184887K08	IC; Type MC14011B
U11	5184887K54	IC; Type MC14070B
U12	5184887K06	IC; Type MC14520B
U13, 14	5184887K12	IC; Type MC14020B
U15	5184320A13	IC; Op Amp; Type 1741CPI
U16	5184887K09	IC; Type MC14001B
U17	5184887K08	IC; Type MC14011B
U18, 19	5184887K09	IC; Type MC14001B
U20	5184887K13	IC; Type MC14013B
U21	5184887K41	IC; Type MC14516B
U22	5184887K12	IC; Type MC14020B
U23	5184887K09	IC; Type MC14001B
U24	5184887K78	IC; Type MC14569B
U25, 26	5184621K26	IC; Type CA3130
U27		Not Used
U28	5184887K60	IC; Type MC14053B
U29	5184887K13	IC; Type MC14013B
U30	5184887K54	IC; Type MC14070B
U31	5184887K41	IC; Type MC14516B
U32, 33	5184887K08	IC; Type MC14011B
U34	5184887K09	IC; Type MC14001B
U35	5184887K08	IC; Type MC14011B
U36	5184887K30	IC; Type MC14175B
U37, 38	5184887K77	IC; Type MC14006B
U39	5184887K06	IC; Type MC14520B
U40, 41		Not Used
U42, 43	5184887K60	IC; Type MC14053B
U44	5184887K09	IC; Type MC14001B
U45	5184887K78	IC; Type MC14569B
U46		Not Used
U47	5184621K21	IC; Type MC3403P
U48	5184887K14	IC; Type MC14015B
U49	5184887K06	IC; Type MC14520B
VR1	4882256C15	DIODE, Zener; 5.1 V
		SOCKET:
X1	0905287C07	Circuit Board
X2	0905604C06	Guide Pin
X3	0984728L01	Connector
Y1	4805470G01	CRYSTAL, 768 kHz

	NONREF
	4284731H
	7505295B
	0705332J
	0705333J
	0200482
	3083361G
	2884528K

PLN1015A Main Control Boar

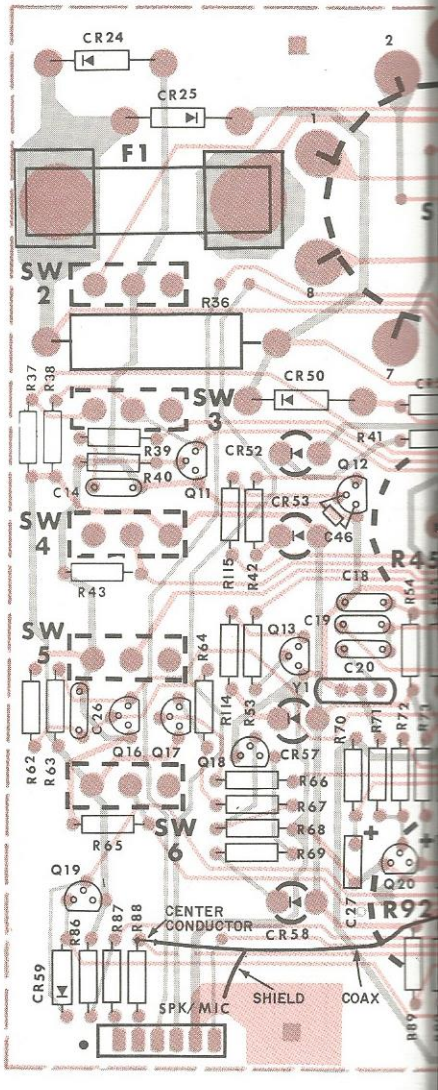
REFERENCE SYMBOL	MOTOROL PART NO.
	NFN6013A
	NLN4679A
	NLN6776A
	NLN6777B
	NLN6778A
	TRN6777A
	PLN6175A

4A49	1 k
4A73	10 k
4A65	4700
4A73	10 k
4A02	Variable, 25 k
4A73	10 k
4A97	100 k
4A73	10 k
4A87	39 k
4A97	100 k
4A83	27 k
	Not Used
4A77	15 k
4B06	220 k
4A75	12 k
4C02	Variable, 25 k
4A61	3.3 k
4A75	12 k
4A77	15 k
4A73	10 k; ±5%
4A81	22 k
4A39	390
4A97	100 k
4A49	1 k
	SWITCH:
2J01	8–position
0J02	Toggle
	Not Used
0J02	Toggle
	INTEGRATED CIRCUIT: See Note
1K27	IC, 5 V Regulator
	Not Used
7K60	IC, Type MC14053B
7K09	IC, Type MC14001B
7K08	IC, Type MC14011B
	Not Used
7K09	IC, Type MC14001B
7K60	IC, Type MC14053B
7K08	IC; Type MC14011B
7K54	IC; Type MC14070B
7K06	IC; Type MC14520B
7K12	IC; Type MC14020B
0A13	IC; Op Amp; Type 1741CPI
7K09	IC; Type MC14001B
7K08	IC; Type MC14011B
7K09	IC; Type MC14001B
7K13	IC; Type MC14013B
7K41	IC; Type MC14516B
7K12	IC; Type MC14020B
7K09	IC; Type MC14001B
7K78	IC; Type MC14569B
K26	IC; Type CA3130
	Not Used
7K60	IC; Type MC14053B
7K13	IC; Type MC14013B
7K54	IC; Type MC14070B
7K41	IC; Type MC14516B
7K08	IC; Type MC14011B
7K09	IC; Type MC14001B
7K08	IC; Type MC14011B
7K30	IC; Type MC14175B
7K77	IC; Type MC14006B
7K06	IC; Type MC14520B
	Not Used
7K60	IC; Type MC14053B
7K09	IC; Type MC14001B
7K78	IC; Type MC14569B
	Not Used
K21	IC; Type MC3403P
7K14	IC; Type MC14015B
7K06	IC; Type MC14520B
C15	DIODE, Zener; 5.1 V
	SOCKET:
7C07	Circuit Board
C06	Guide Pin
L01	Connector
G01	CRYSTAL, 768 kHz

	NONREFERENCED ITEMS	
	4284731H01	Clip, Fuse
	7505295B01	Pad, Crystal Base
	0705332J01	Bracket, Control Switch/LED
	0705333J01	Bracket, Toggle Switch
	0200482070	Nut, Microphone Jack
	3083361G01	Coaxial Cable, RG178B/U
	2884528K19	Connector

PLN1015A Main Control Board Assembly (Coded) PLF-1858-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	NFN6013A	Splatter Filter
	NLN4679A	CVSD
	NLN8776A	Squelch
	NLN8777B	Audio Preamp
	NLN8778A	Transmit Audio
	TRN6777A	Encode/Decode
	PLN6175A	DVP Board



* = FLYING CONNECTION

EMS

- ...al Base
- ...ntrol Switch/LED
- ...ggle Switch
- ...phone Jack
- ...ble, RG178B/U

...Coded) PLF-1858-O

DESCRIPTION
...ilter
...amp
...Audio
...Decode

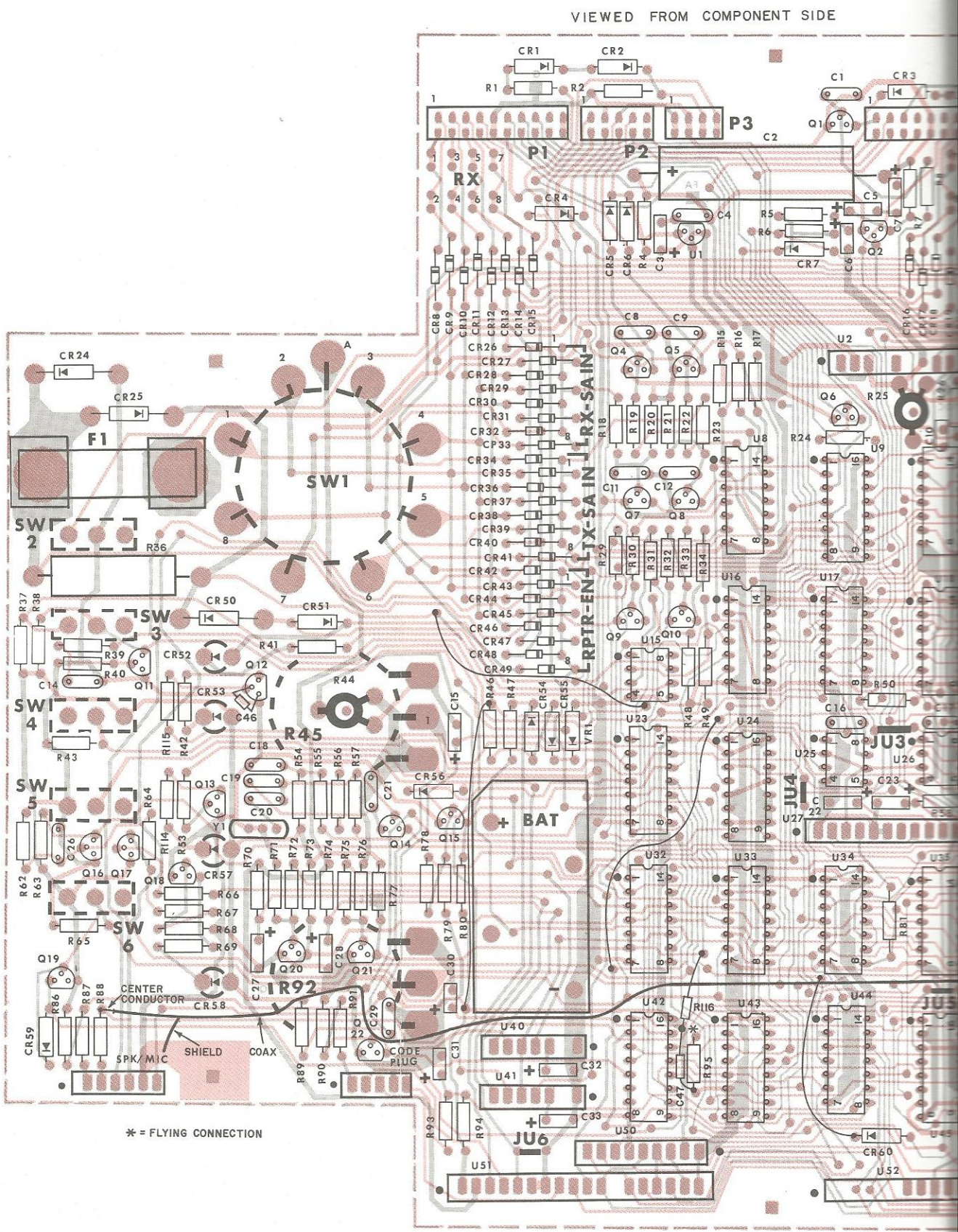


Figure 5-13.
Main Control Board (Coded)
Component Layout Diagram and Parts Lists

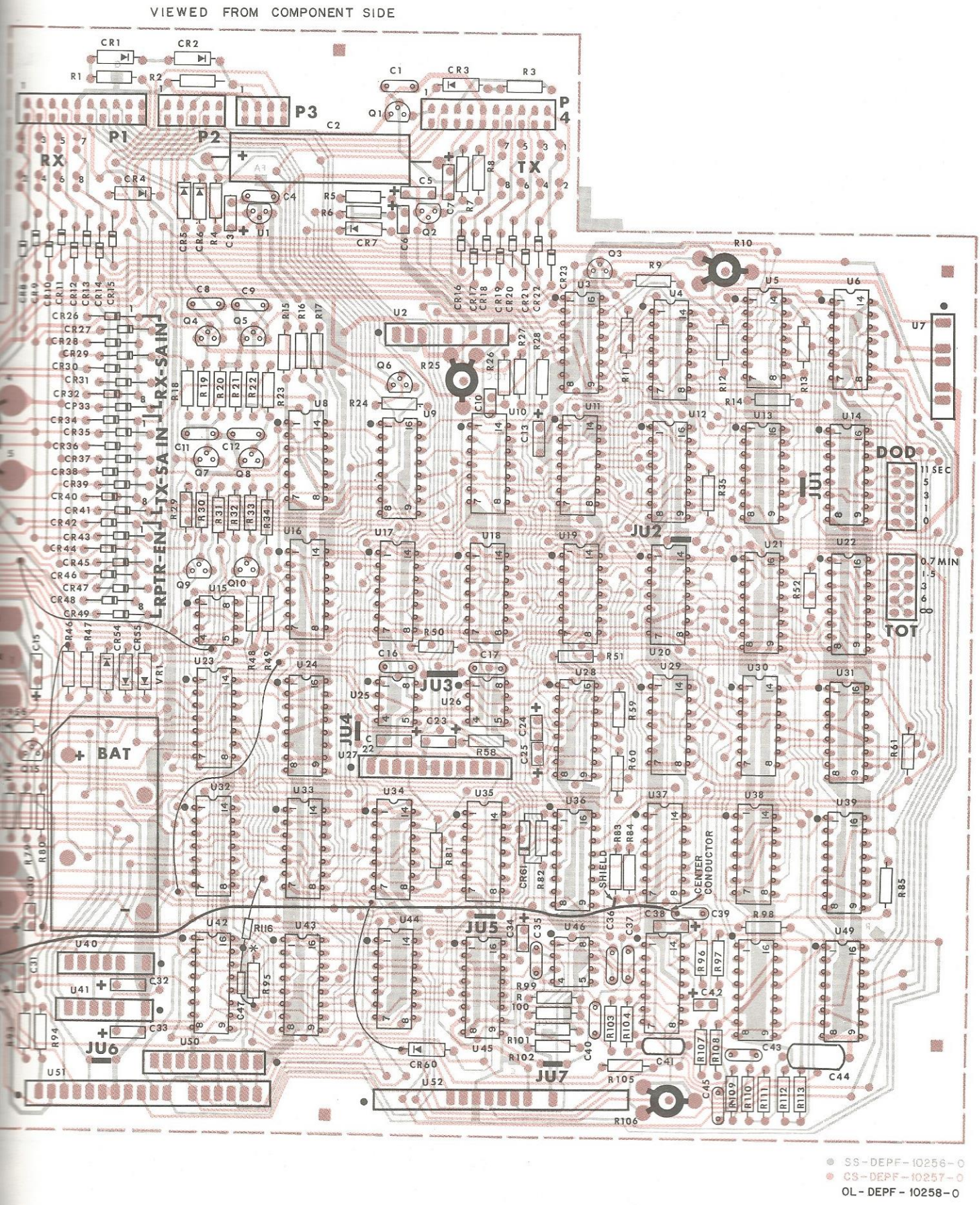


Figure 5-13.
Main Control Board (Coded)
Component Layout Diagram and Parts Lists

TRANSMITTER CONNECTIONS

DIODE PROGRAMMING

DIODE	CHANNEL	DESCRIPTION
CR26–CR33	F1–F8	DIODE IS IN TO SWITCH AROUND THE DUPLEXER IN RECEIVE MODE (BASE). DIODE IS CUT OUT FOR REPEATER OPERATION ON CORRESPONDING CHANNEL POSITION.
CR34–CR41	F1–F8	DIODE IS IN TO SWITCH AROUND THE DUPLEXER IN TRANSMIT MODE (BASE). DIODE IS CUT OUT FOR REPEATER OPERATION ON CORRESPONDING CHANNEL POSITION.
CR42–CR49	F1–F8	DIODE IS IN FOR REPEATER OPERATION ON CORRESPONDING CHANNEL SELECTOR POSITION. DIODE IS OUT TO DISABLE REPEAT FUNCTION ON CORRESPONDING CHANNEL SELECTOR POSITION BASE-ONLY OPERATION ON THAT CHANNEL.

NOTE: PROGRAMMING OF DIODES CR26 THROUGH CR41 REFERS ONLY TO UNITS WITH THE SWITCH-AROUND RELAYS OPTION (H950).

CHANNEL STRAPPING

CHANNELS MAY BE STRAPPED FOR TRANSMIT AND RECEIVE FREQUENCIES INDEPENDENTLY BY JUMPERING RECEIVER OR TRANSMITTER SELECT LINES ON THE BOARD.

EPF-10315-O

JUMPER TABLES

REPEATER MODEL	JU2	JU7	R5
DVP	OUT	OUT	IN
DVP (PL)	IN	OUT	OUT
CLEAR	IN	IN	OUT
CLEAR (PL)	IN	IN	OUT

TYPE OF OPERATION DESIRED	JU1	JU3	JU4	JU5	JU6
NO PROPER CODE	IN	IN	--	--	--
PROPER CODE, SPKR ONLY	OUT	IN	--	--	--
PROPER RPTR ONLY	IN	OUT	--	--	--
PROPER CODE, SPKR & RPTR	OUT	OUT	--	--	--
[1]CARRIER SQUELCH (CLEAR)	--	--	IN	IN	--
[2]AND SQUELCH (CLEAR)	--	--	OUT	IN	--
[3]PL-ONLY SQUELCH (CLEAR)	--	--	IN	OUT	--
CODE 1 / CODE 2	--	--	--	--	OUT
NO CODE 2	--	--	--	--	IN

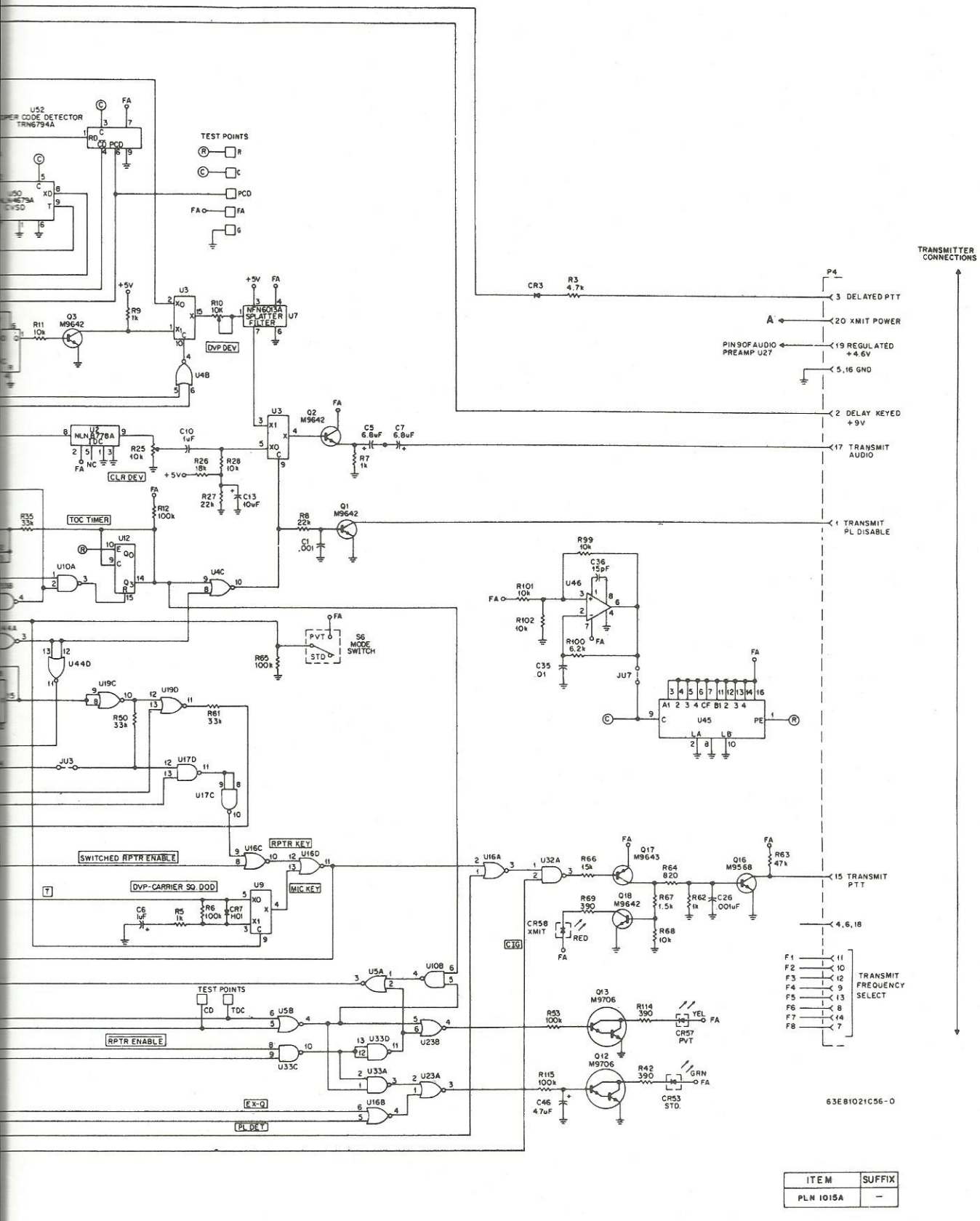
[1]CARRIER SQUELCH: SAME AS AND SQUELCH EXCEPT PL IS UNNECESSARY.

[2]AND SQUELCH: THIS IS PREFERRED FOR REPEATER OPERATION. THE RADIO UNSQUELCHES WHEN PL IS DETECTED AND BOTH INTERNAL AND EXTERNAL SQUELCH LEVELS ARE SURPASSED. IT REMAINS UNSQUELCHED AS LONG AS PL IS DETECTED AND THE EXTERNALLY ADJUSTABLE SQUELCH IS UNSQUELCHED.

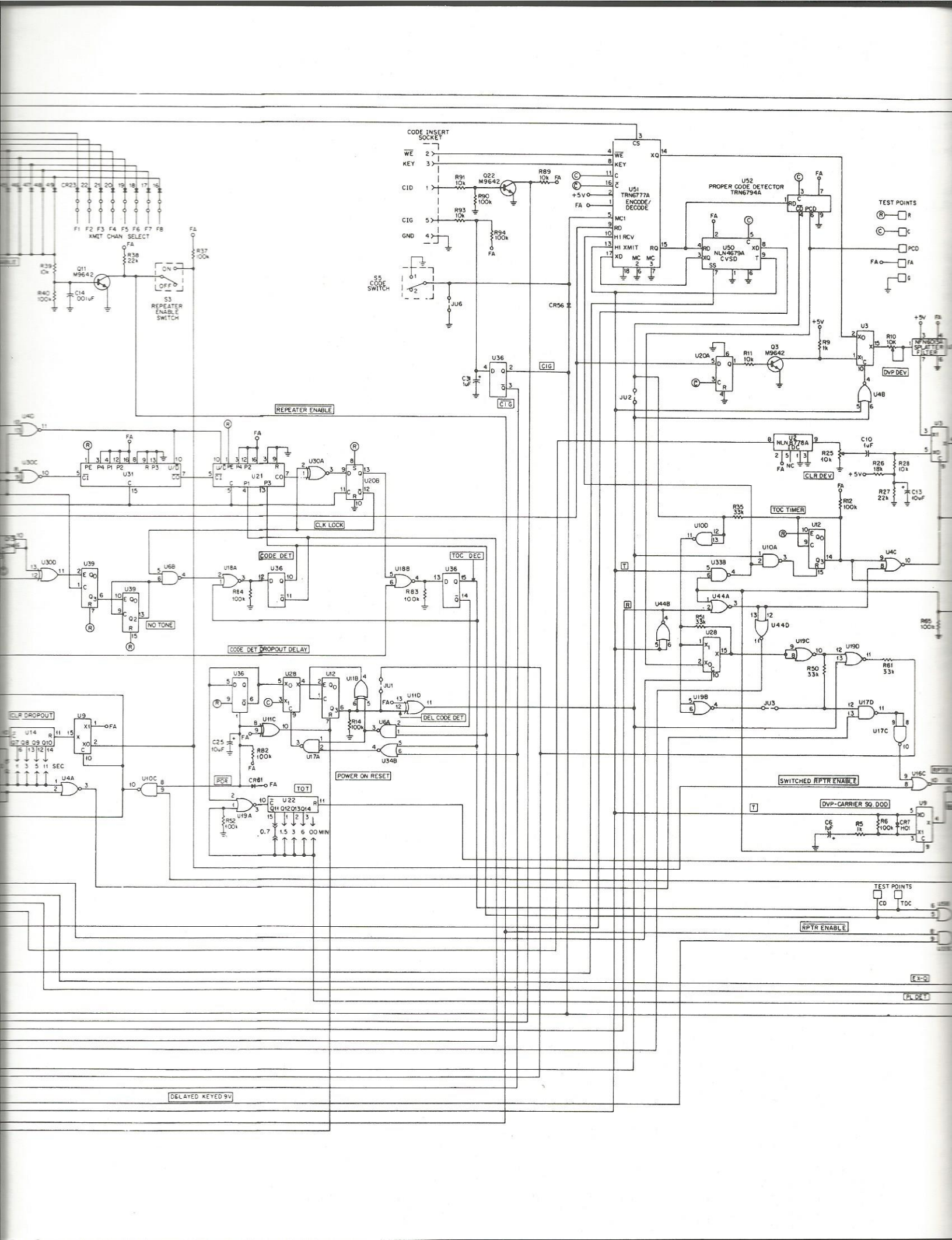
[3]PL-ONLY SQUELCH: THE RADIO UNSQUELCHES WHEN PL IS DETECTED AND THE INTERNAL QUIETING LEVEL IS PASSED. IT REMAINS UNSQUELCHED AS LONG AS PL IS DETECTED.

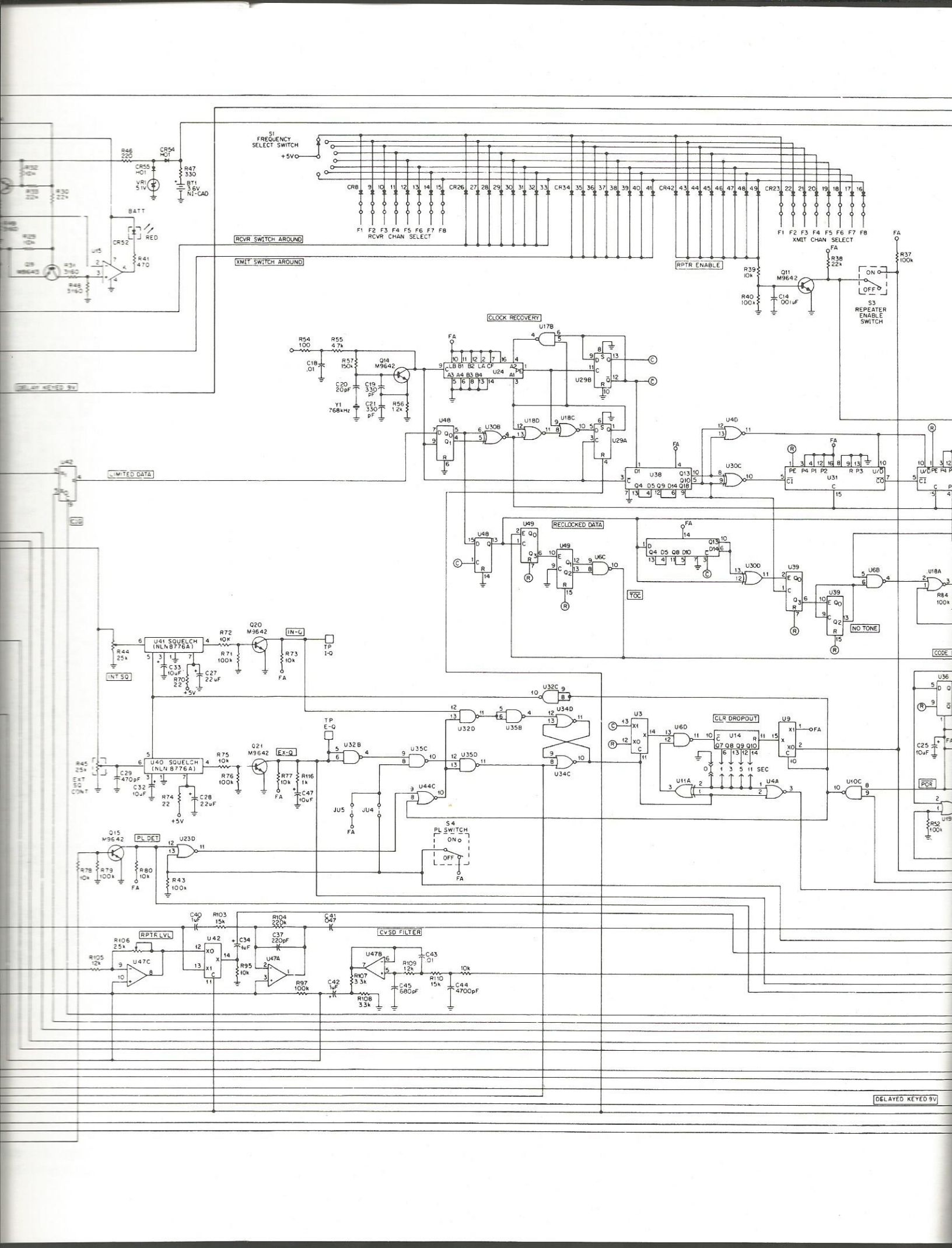
EPF-10314-O

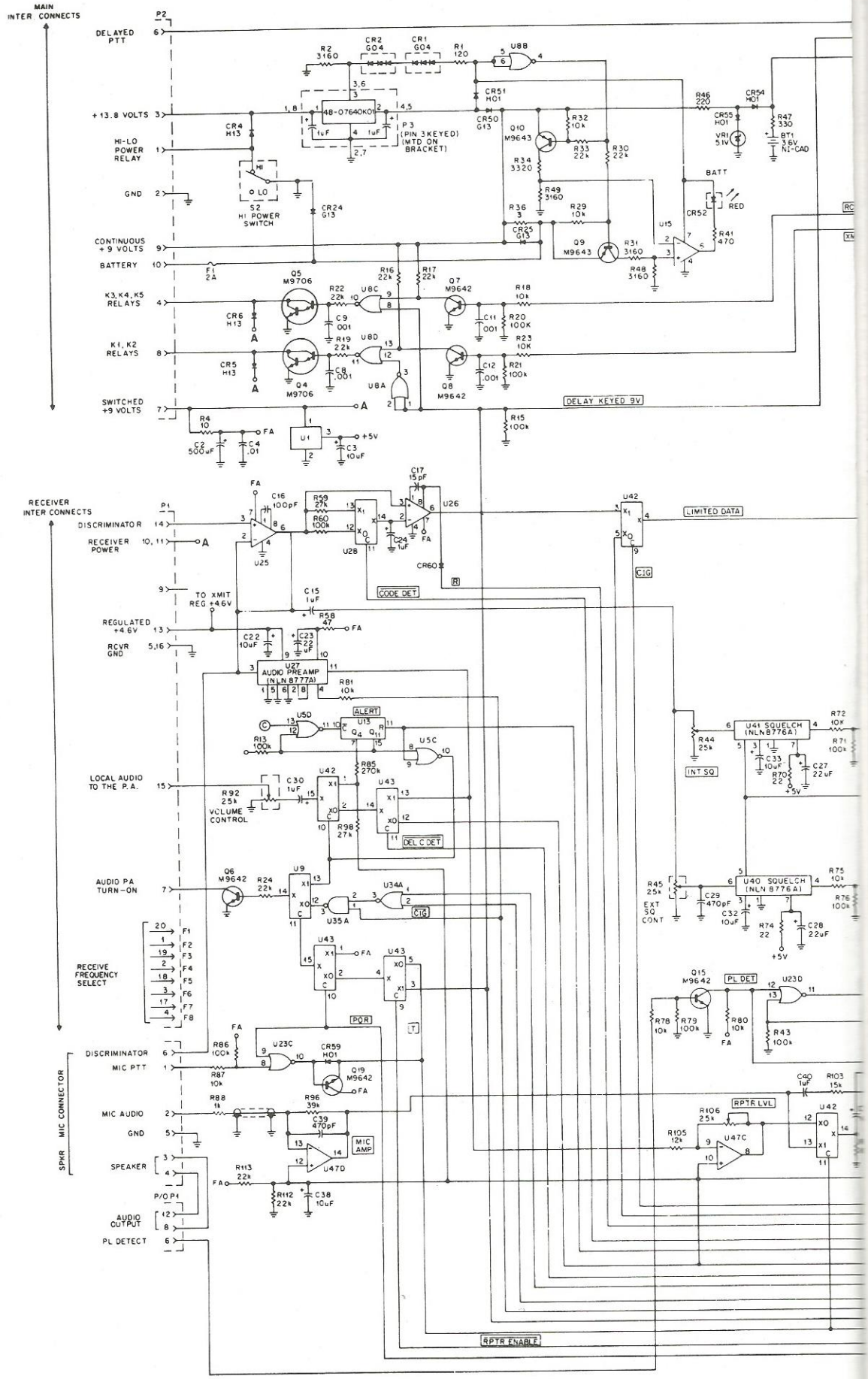
Figure 5-14.
Main Control Board (Coded) Schematic Diagram



ITEM	SUFFIX
PLN 1015A	–


CODE INSERT SOCKET
U51 TRN6777A ENCODE/ DECODE
U52 PROPER CODE DETECTOR TRN6794A
U50 NLN6679A CVSD
TEST POINTS
F1 F2 F3 F4 F5 F6 F7 F8 XMIT CHAN SELECT
S3 REPEATER ENABLE SWITCH
S5 CODE SWITCH
REPEATER ENABLE
CLK LOCK
CODE DET
TOC DEC
NO TONE
CODE DET DROPOUT DELAY
CLR DROPOUT
POWER ON RESET
DEL CODE DET
CLR DEV
TOC TIMER
DVP DEV
SWITCHED RPTR ENABLE
DVP-CARRIER SQ. DOD
RPTR ENABLE
DELAYED KEYED 9V
PL DET


S1 FREQUENCY SELECT SWITCH
+5V
F1 F2 F3 F4 F5 F6 F7 F8
RCVR CHAN SELECT
XMIT CHAN SELECT
RCVR SWITCH AROUND
XMIT SWITCH AROUND
RPTR ENABLE
S3 REPEATER ENABLE SWITCH
CLOCK RECOVERY
LIMITED DATA
RECLOCKED DATA
TOC
NO TONE
INT SQ
EXT SQ CONT
IN-Q
EX-Q
TP I-Q
TP E-Q
CLR DROPOUT
PL DET
S4 PL SWITCH
CVSD FILTER
RPTR LVL
POR
CODE
DELAYED KEYED 9V
BATT
RED
U41 SQUELCH (NLN8776A)
U40 SQUELCH (NLN8776A)


MAIN INTER CONNECTS
P2
DELAYED PTT
+13.8 VOLTS
HI-LO POWER RELAY
GND
CONTINUOUS +9 VOLTS
BATTERY
K3,K4,K5 RELAYS
K1, K2 RELAYS
SWITCHED +9 VOLTS
HI
LO
S2 HI POWER SWITCH
48-07640K01
P3 (PIN 3 KEYED) (MTD ON BRACKET)
BATT
RED
DELAY KEYED 9V
RECEIVER INTER CONNECTS
DISCRIMINATOR
RECEIVER POWER
TO XMIT REG +4.6V
REGULATED +4.6V
RCVR GND
U27 AUDIO PREAMP (NLN 8777A)
LIMITED DATA
CODE DET
CIG
ALERT
U41 SQUELCH (NLN 8776A)
INT SQ
U40 SQUELCH (NLN 8776A)
EXT SQ CONT
LOCAL AUDIO TO THE P.A.
VOLUME CONTROL
DEL C DET
AUDIO PA TURN-ON
RECEIVE FREQUENCY SELECT
F1
F2
F3
F4
F5
F6
F7
F8
PL DET
POR
J1
DISCRIMINATOR
MIC PTT
MIC AUDIO
GND
SPEAKER
P/O P1
AUDIO OUTPUT
PL DETECT
SPKR MIC CONNECTOR
MIC AMP
RPTR LVL
RPTR ENABLE

PLN6263A Main Control Board (Clear) PLF-1769-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: uF ±20%; 20 V unless otherwise stated
C1		Not Used
C2	2383210A19	500
C3	2382397D15	10
C4	2183596E21	.01 +80–20%; 200 V
C5	2382397D23	6.8
C6		Not Used
C7	2382397D23	6.8
C8, 9	2182187B29	.001 ±10%; 10 V
C10	2382397D52	1
C11, 12	2182187B29	.001 ±10%; 100 V
C13	2382397D15	10
C14	2182187B29	.001 ±10%; 100 V
C15	2382397D36	1
C16	2182187B07	470 pF; ±10%; 500 V
C17 thru C21		Not Used
C22	2382397D03	10; 6 V
C23	2382397D16	22; 15 V
C24		Not Used
C25	2382397D15	10
C26	2182187B29	.001 ±10%; 100 V
C27, 28	2382397D16	22; 15 V
C29	2182187B07	470 pF; 500 V
C30	2382397D36	1
C31		Not Used
C32, 33	2182397D15	10
C34	2382397D36	1
C35	2184008H01	.01; 50 V
C36	2182133G43	15 pF ±5%; N330
C37		Not Used
C38	2382397D15	10
C39	2182187B07	470 pF; 500 V
C40 thru C45		Not Used
C46	2382397D05	4.7 +40–20%; 4 V
C47	2382397D15	10
		DIODE: See Note
CR1, 2	4883329G04	Silicon
CR3	4843654H01	Silicon
CR4, 5	4882466H13	Silicon
CR8 thru CR23	4883659H01	Silicon
CR24, 25	4882525G13	Silicon
CR26 thru CR49	4883654H01	Silicon
CR50	4882525G13	Silicon
CR51	4883654H01	Silicon
CR52	4888245C05	LED, Red
CR53	4888245C06	LED, Green
CR54 thru CR57		Not Used
CR58	4888245C05	LED, Red
CR59	4883654H01	Silicon
CR60		Not Used
CR61	4883654H01	Silicon
F1	650042092	FUSE, 2 A; 250 V
		CONNECTOR:
J1	0982672G01	Receptacle, Microphone
P1	2884528K01	Plug, 20–pin
P2	2884528K06	Plug, 10–pin
P3	2884528K05	Plug, 8–pin
P4	2884528K01	Plug, 20–pin
P5, 6	2884528K06	Plug, 10–pin
		TRANSISTOR: See Note
Q1		Not Used
Q2	4800869642	NPN; Type M9642
Q3		Not Used
Q4, 5	4800869706	NPN; Type M9706
Q6, 7, 8	4800869642	NPN; Type M9642
Q9, 10	4800869643	PNP; Type M9643
Q11	4800869642	NPN; Type M9642
Q12	4800869706	NPN; Type M9706
Q13, 14		Not Used
Q15	4800869642	NPN; Type M9642
Q16	4800869568	NPN; Type M9568
Q17	4800869643.	PNP; Type M9643
Q18 thru Q21	4800869642	NPN; Type M9642

NOTE: For optimum performance, order replacement diodes, transistors, and integrated circuits by Motorola part number only.

DESCRIPTION
CAPACITOR, Fixed: uF ±20%; 20 V
nless otherwise stated
Not Used
500
0
01 +80–20%; 200 V
6.8
Not Used
6.8
001 ±10%; 10 V
001 ±10%; 100 V
0
001 ±10%; 100 V
470 pF; ±10%; 500 V
Not Used
0; 6 V
22; 15 V
Not Used
0
001 ±10%; 100 V
22; 15 V
470 pF; 500 V
Not Used
0
01; 50 V
5 pF ±5%; N330
Not Used
0
470 pF; 500 V
Not Used
4.7 +40–20%; 4 V
0
DIODE: See Note
Silicon
Silicon
Silicon
Silicon
Silicon
Silicon
Silicon
Silicon
LED, Red
LED, Green
Not Used
LED, Red
Silicon
Not Used
Silicon
FUSE, 2 A; 250 V
CONNECTOR:
Receptacle, Microphone
Plug, 20–pin
Plug, 10–pin
Plug, 8–pin
Plug, 20–pin
Plug, 10–pin
TRANSISTOR: See Note
Not Used
NPN; Type M9642
Not Used
NPN; Type M9706
NPN; Type M9642
PNP; Type M9643
NPN; Type M9642
NPN; Type M9706
Not Used
NPN; Type M9642
NPN; Type M9568
PNP; Type M9643
NPN; Type M9642

placement diodes, transistors, and
only.

		RESISTOR, Fixed: Ω ±10% unless otherwise stated
R1	0600124A27	120 ±5%; 1/4 W
R2	0684444A39	3160 ±1%; 1/4 W
R3	0600124A65	4700
R4	0600124A01	10 ±5%; 1/4 W
R5		Not Used
R6	0600124A97	100 k
R7	0600124A49	1 k
R8 thru R11		Not Used
R12 thru R15	0600124A97	100 k
R16, 17	0600124A81	22 k
R18	0600124A73	10 k
R19	0600124A81	22 k
R20, 21	0600124A97	100 k
R22	0600124A81	22 k
R23	0600124A73	10 k
R24	0600124A81	22 k
R25	1884944C03	Variable, 10 k
R26	0600124A79	18 k
R27	0600124A81	22 k
R28, 29	0600124A73	10 k
R30	0600124A81	22 k
R31	0684444A39	3160 ±1%
R32	0600124A73	10 k
R33	0600124A81	22 k
R34	0610621C45	3320 ±1%; 1/8 W
R35	0600124A85	33 k
R36	1782177B01	3 ±1%; 1/8 W
R37	0600124A97	100 k
R38	0600124A81	22 k
R39	0600124A73	10 k
R40	0600124A97	100 k
R41	0600124A41	470
R42	0600124A39	390
R43	0600124A97	100 k
R44	1884944C02	Variable, 25 k
R45	1884584A02	Variable, 25 k
R46, 47		Not Used
R48, 49	0684444A39	3160 ±1%
R50, 51	0600124A85	33 k
R52	0600124A97	100 k
R53 thru R57		Not Used
R58	0600124A17	47
R59, 60		Not Used
R61	0600124A85	33 k
R62	0600124A49	1 k
R63	0600124A89	47 k
R64	0600124A47	820
R65	0600124A97	100 k
R66	0600124A77	15 k
R67	0600124A53	1.5 k
R68	0600124A73	10 k
R69	0600124A39	390
R70	0600124A09	22
R71	0600124A97	100 k
R72, 73	0600124A73	10 k
R74	0600124A09	22
R75	0600124A73	10 k
R76	0600124A97	100 k
R77, 78	0600124A73	10 k
R79	0600124A97	100 k
R80, 81	0600124A73	10 k
R82, 83, 84	0600124A97	100 k
R85		Not Used
R86	0600124A97	100 k
R87	0600124A73	10 k
R88	0600124A49	1 k
R89, 90, 91		Not Used
R92	1884584A02	Variable, 25 k
R93		Not Used
R94	0600124A97	100 k
R95	0600124A73	10 k
R96	0600124A87	39 k
R97	0600124A97	100 k
R98	0600124A83	27 k
R99	0600124A73	10 k
R100	0600124A68	6.2 k
R101, 102	0600124A73	10 k
R103		Not Used
R104	0600124B06	220 k
R105	0600124A75	12 k

R106	1884944C02	Variable, 2
R107 thru R111		Not Used
R112, 113	0600124A81	22 k
R114		Not Used
R115	0600124A97	100 k
R116	0600124A49	1 k
		SWITCH:
S1	4005352J01	8–position
S2, 3	4005350J02	Toggle
		INTEGRA
U1	5184621K27	IC; 5 V Re
U2		Not Used
U3	5184887K60	IC; Type M
U4, 5	5184887K09	IC; Type M
U6	5184887K08	IC; Type M
U7		Not Used
U8	5184887K09	IC; Type M
U9	5184887K60	IC; Type M
U10	5184887K08	IC; Type M
U11	5184887K54	IC; Type M
U12, 13		Not Used
U14	5184887K12	IC; Type M
U15	5184320A13	IC; Op Am
U16	5184887K09	IC; Type M
U17	5184887K08	IC; Type M
U18		Not Used
U19	5184887K09	IC; Type M
U20,21		Not Used
U22	5184887K12	IC; Type M
U23	5184887K09	IC; Type M
U24		Not Used
U25	5184621K26	IC; Type C
U26 thru U31		Not Used
U32, 33	5184887K08	IC; Type M
U34	5184887K09	IC; Type M
U35	5184887K08	IC; Type M
U36	5184887K30	IC; Type M
U37 thru U41		Not Used
U42, 43	5184887K60	IC; Type M
U44	5184887K09	IC; Type M
U45	5184887K78	IC; Type M
U46	5184887K26	IC; Type C
U47	5184621K21	IC; Type M
		NONREFERENCED ITE
	4284731H01	Clip, Fuse
	0705332J01	Bracket, C
	0705333J01	Bracket, T
	3083361G01	Coaxial Ca
	2884528K19	Connector

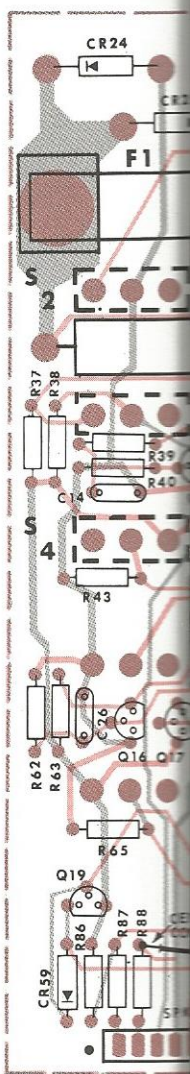
PLN1036A Main Control Board Assembly (C

REFERENCE SYMBOL	MOTOROLA PART NO.	
	NLN8776A	Squelch
	NLN8777B	Audio Pres
	NLN8778A	Transmit A
	PLN6263A	Clear Boar

R106	1884944C02	Variable, 25 k
R107 thru R111		Not Used
R112, 113	0600124A81	22 k
R114		Not Used
R115	0600124A97	100 k
R116	0600124A49	1 k
		SWITCH:
S1	4005352J01	8–position
S2, 3	4005350J02	Toggle
		INTEGRATED CIRCUIT: See Note
U1	5184621K27	IC; 5 V Regulator
U2		Not Used
U3	5184887K60	IC; Type MC14053B
U4, 5	5184887K09	IC; Type MC14001B
U6	5184887K08	IC; Type MC14011B
U7		Not Used
U8	5184887K09	IC; Type MC14001B
U9	5184887K60	IC; Type MC14053B
U10	5184887K08	IC; Type MC14011B
U11	5184887K54	IC; Type MC14070B
U12, 13		Not Used
U14	5184887K12	IC; Type MC14020B
U15	5184320A13	IC; Op Amp Type MC1741CPI
U16	5184887K09	IC; Type MC14001B
U17	5184887K08	IC; Type MC14011B
U18		Not Used
U19	5184887K09	IC; Type MC14001B
U20, 21		Not Used
U22	5184887K12	IC; Type MC14020B
U23	5184887K09	IC; Type MC14001B
U24		Not Used
U25	5184621K26	IC; Type CA3130
U26 thru U31		Not Used
U32, 33	5184887K08	IC; Type MC14011B
U34	5184887K09	IC; Type MC14001B
U35	5184887K08	IC; Type MC14011B
U36	5184887K30	IC; Type MC14175B
U37 thru U41		Not Used
U42, 43	5184887K60	IC; Type MC14053B
U44	5184887K09	IC; Type MC14001B
U45	5184887K78	IC; Type MC14569B
U46	5184887K26	IC; Type CA3130
U47	5184621K21	IC; Type MC3403P
		NONREFERENCED ITEMS
	4284731H01	Clip, Fuse
	0705332J01	Bracket, Control Switch and LED
	0705333J01	Bracket, Toggle Switch
	3083361G01	Coaxial Cable, RG–178B/U
	2884528K19	Connector

PLN1036A Main Control Board Assembly (Clear) PLF-1859-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	NLN8776A	Squelch
	NLN8777B	Audio Preamp
	NLN8778A	Transmit Audio
	PLN6263A	Clear Board



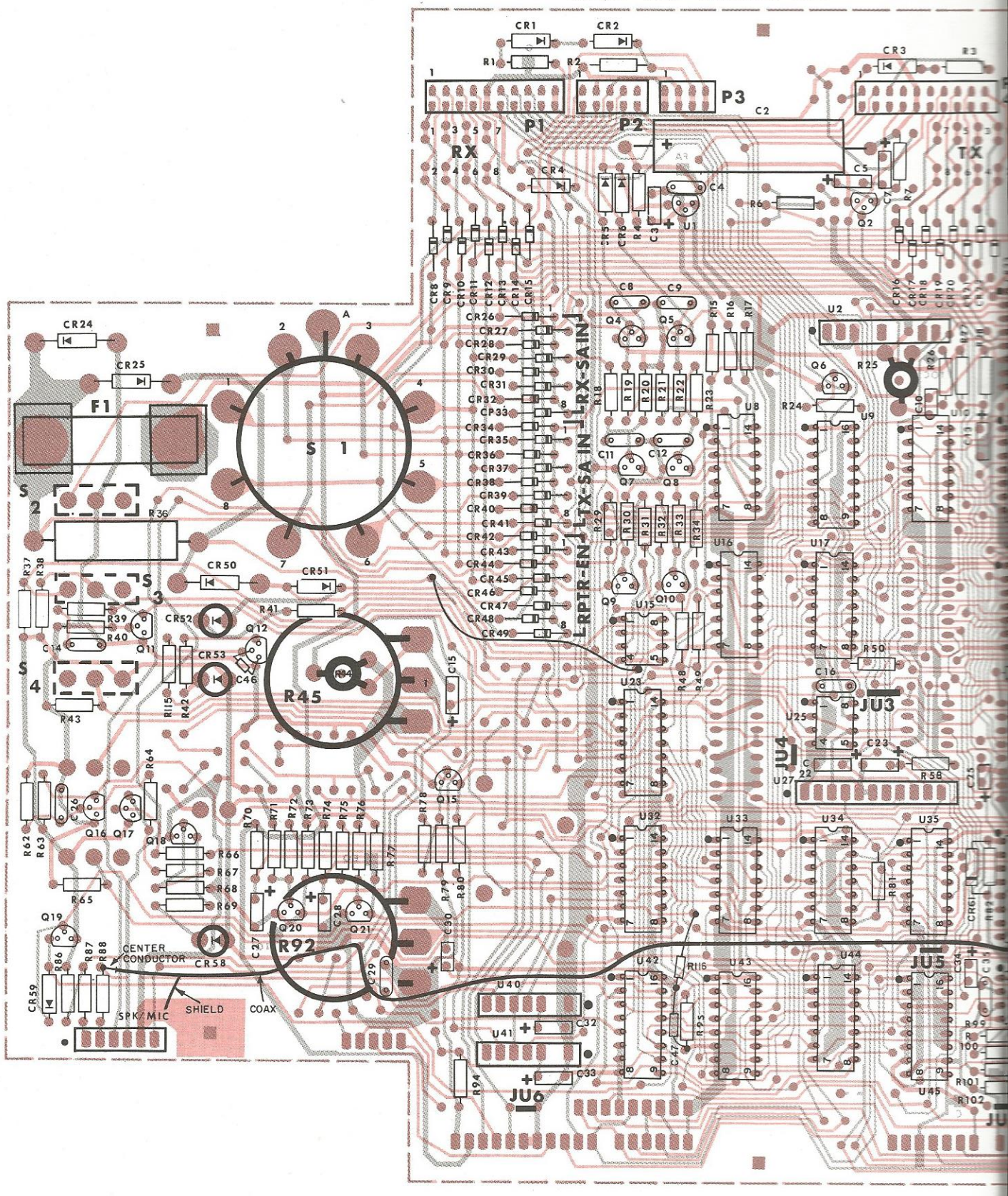
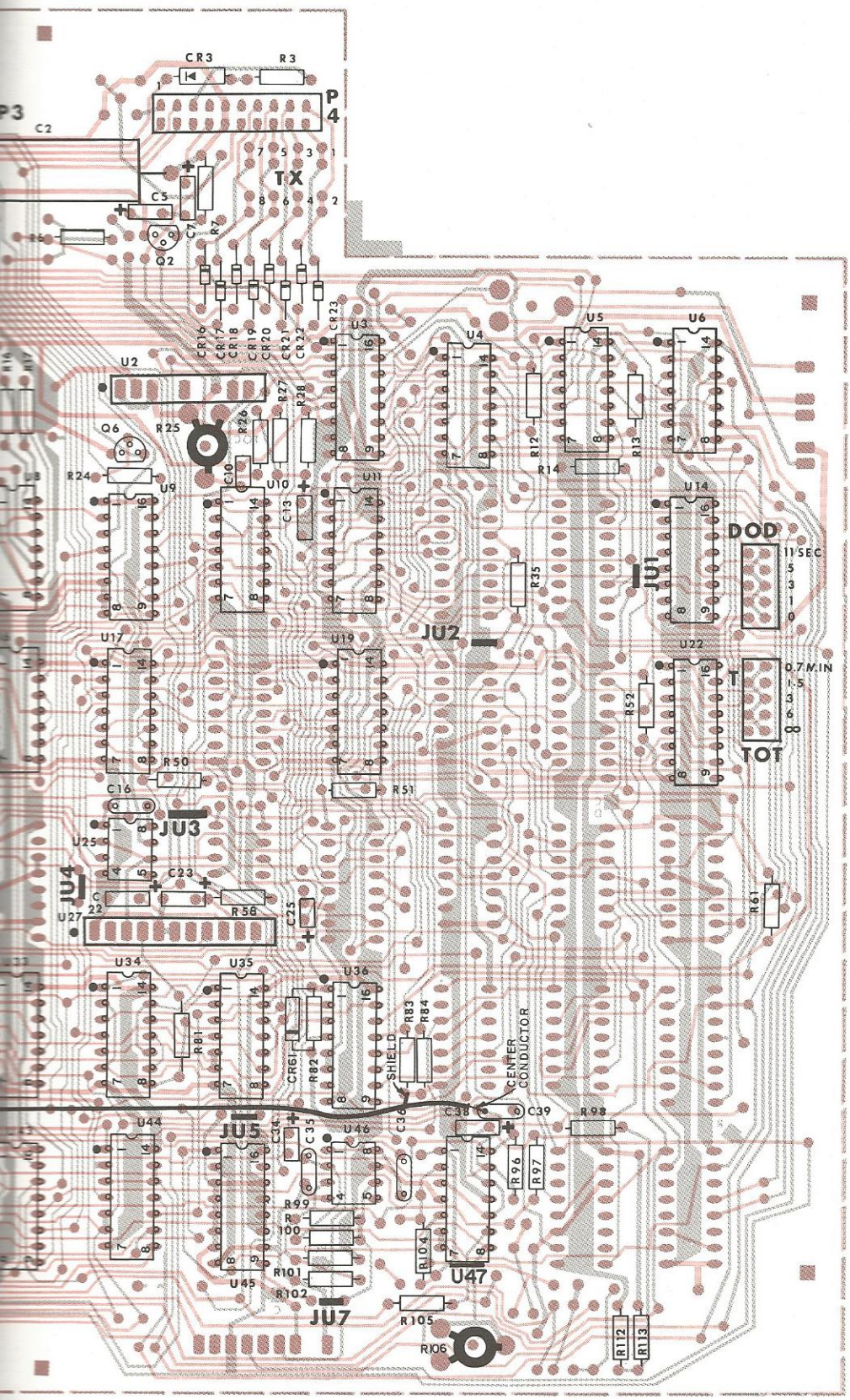


Figure 5-15.
Main Control Board (C
and Parts Lists



SS-DEPF-10256-0
CS-DEPF-10257-0
OL-DEPF-10259-0

Figure 5-15.
Main Control Board (Clear) Component Layout Diagram and Parts Lists

DIODE PROGRAMMING

DIODE	CHANNEL	DESCRIPTION
CR26–CR33	F1–F8	DIODE IS IN TO SWITCH AROUND THE DUPLEXER IN RECEIVE MODE (BASE). DIODE IS CUT OUT FOR REPEATER OPERATION ON CORRESPONDING CHANNEL POSITION.
CR34–CR41	F1–F8	DIODE IS IN TO SWITCH AROUND THE DUPLEXER IN TRANSMIT MODE (BASE). DIODE IS CUT OUT FOR REPEATER OPERATION ON CORRESPONDING CHANNEL POSITION.
CR42–CR49	F1–F8	DIODE IS IN FOR REPEATER OPERATION ON CORRESPONDING CHANNEL SELECTOR POSITION. DIODE IS OUT TO DISABLE REPEAT FUNCTION ON CORRESPONDING CHANNEL SELECTOR POSITION BASE-ONLY OPERATION ON THAT CHANNEL.

NOTE: PROGRAMMING OF DIODES CR26 THROUGH CR41 REFERS ONLY TO UNITS WITH THE SWITCH-AROUND RELAYS OPTION (H950).

CHANNEL STRAPPING

CHANNELS MAY BE STRAPPED FOR TRANSMIT AND RECEIVE FREQUENCIES INDEPENDENTLY BY JUMPERING RECEIVER OR TRANSMITTER SELECT LINES ON THE BOARD.

EPF-10315-O

TRANSMITTER CONNECTIONS

JUMPER TABLES

REPEATER MODEL	JU2	JU7	R5
DVP	OUT	OUT	IN
DVP (PL)	IN	OUT	OUT
CLEAR	IN	IN	OUT
CLEAR (PL)	IN	IN	OUT

TYPE OF OPERATION DESIRED	JU1	JU3	JU4	JU5	JU6
NO PROPER CODE	IN	IN	--	--	--
PROPER CODE, SPKR ONLY	OUT	IN	--	--	--
PROPER RPTR ONLY	IN	OUT	--	--	--
PROPER CODE, SPKR & RPTR	OUT	OUT	--	--	--
[1]CARRIER SQUELCH (CLEAR)	--	--	IN	IN	--
[2]AND SQUELCH (CLEAR)	--	--	OUT	IN	--
[3]PL-ONLY SQUELCH (CLEAR)	--	--	IN	OUT	--
CODE 1 / CODE 2	--	--	--	--	OUT
NO CODE 2	--	--	--	--	IN

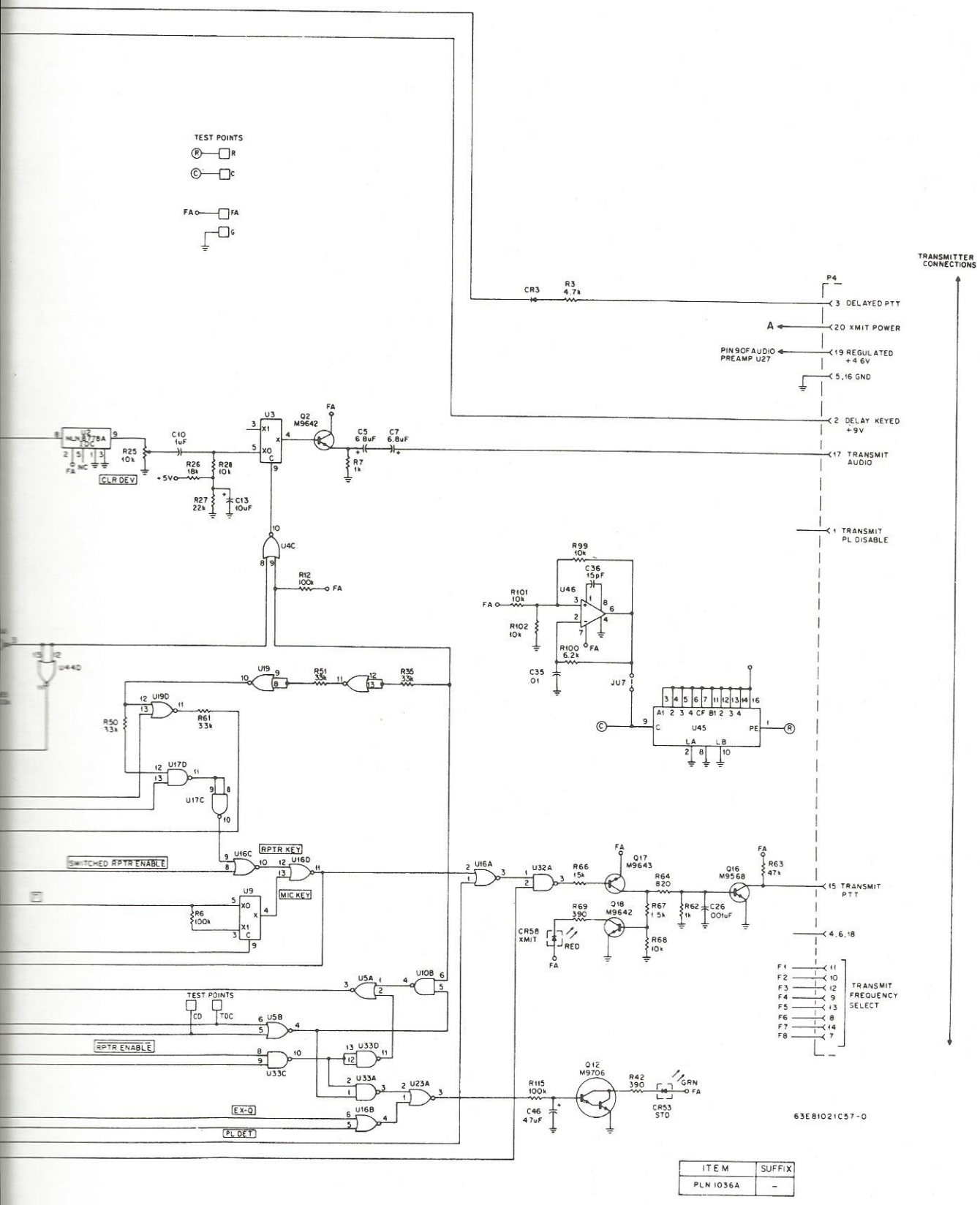
[1]CARRIER SQUELCH: SAME AS AND SQUELCH EXCEPT PL IS UNNECESSARY.

[2]AND SQUELCH: THIS IS PREFERRED FOR REPEATER OPERATION. THE RADIO UNSQUELCHES WHEN PL IS DETECTED AND BOTH INTERNAL AND EXTERNAL SQUELCH LEVELS ARE SURPASSED. IT REMAINS UNSQUELCHED AS LONG AS PL IS DETECTED AND THE EXTERNALLY ADJUSTABLE SQUELCH IS UNSQUELCHED.

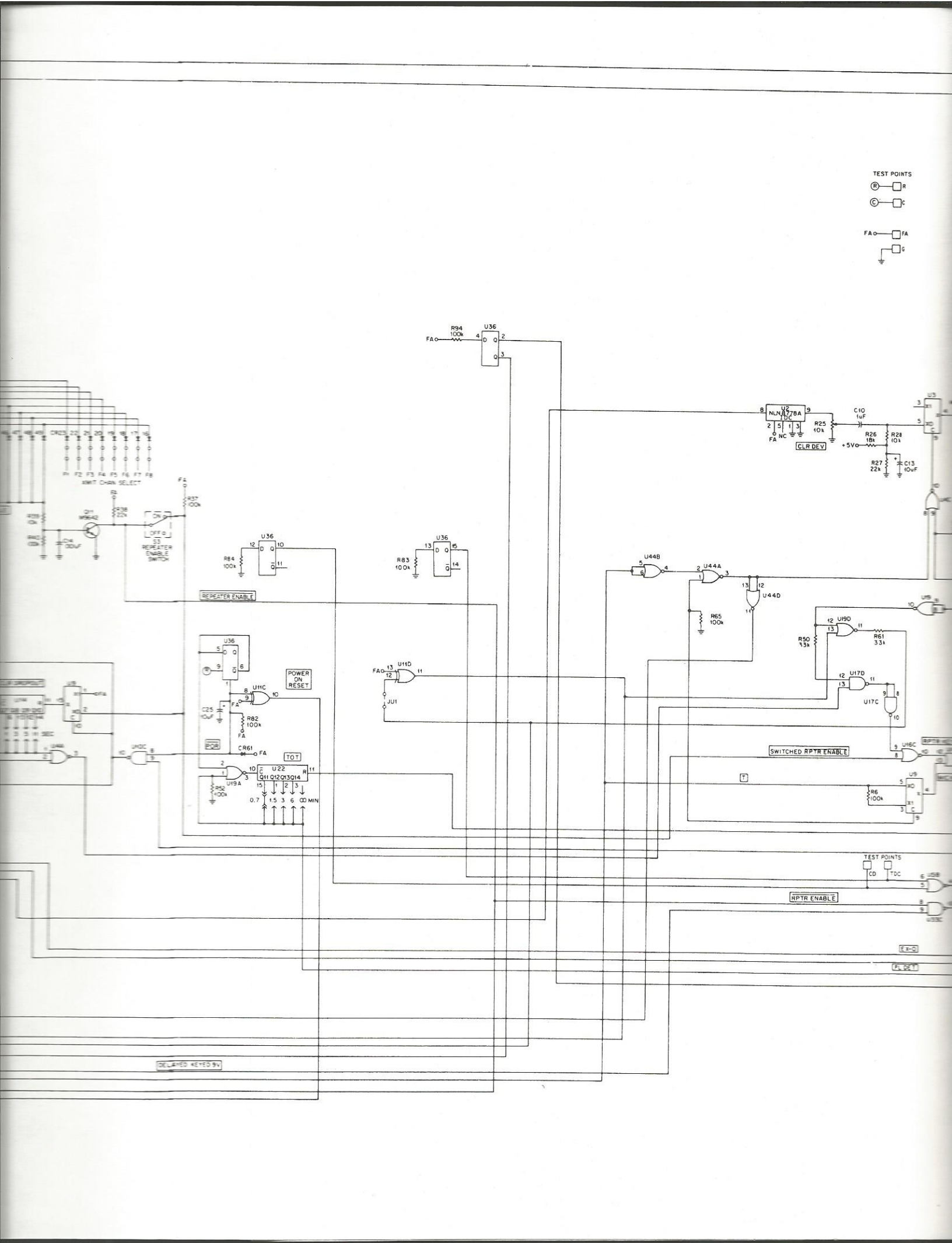
[3]PL-ONLY SQUELCH: THE RADIO UNSQUELCHES WHEN PL IS DETECTED AND THE INTERNAL QUIETING LEVEL IS PASSED. IT REMAINS UNSQUELCHED AS LONG AS PL IS DETECTED.

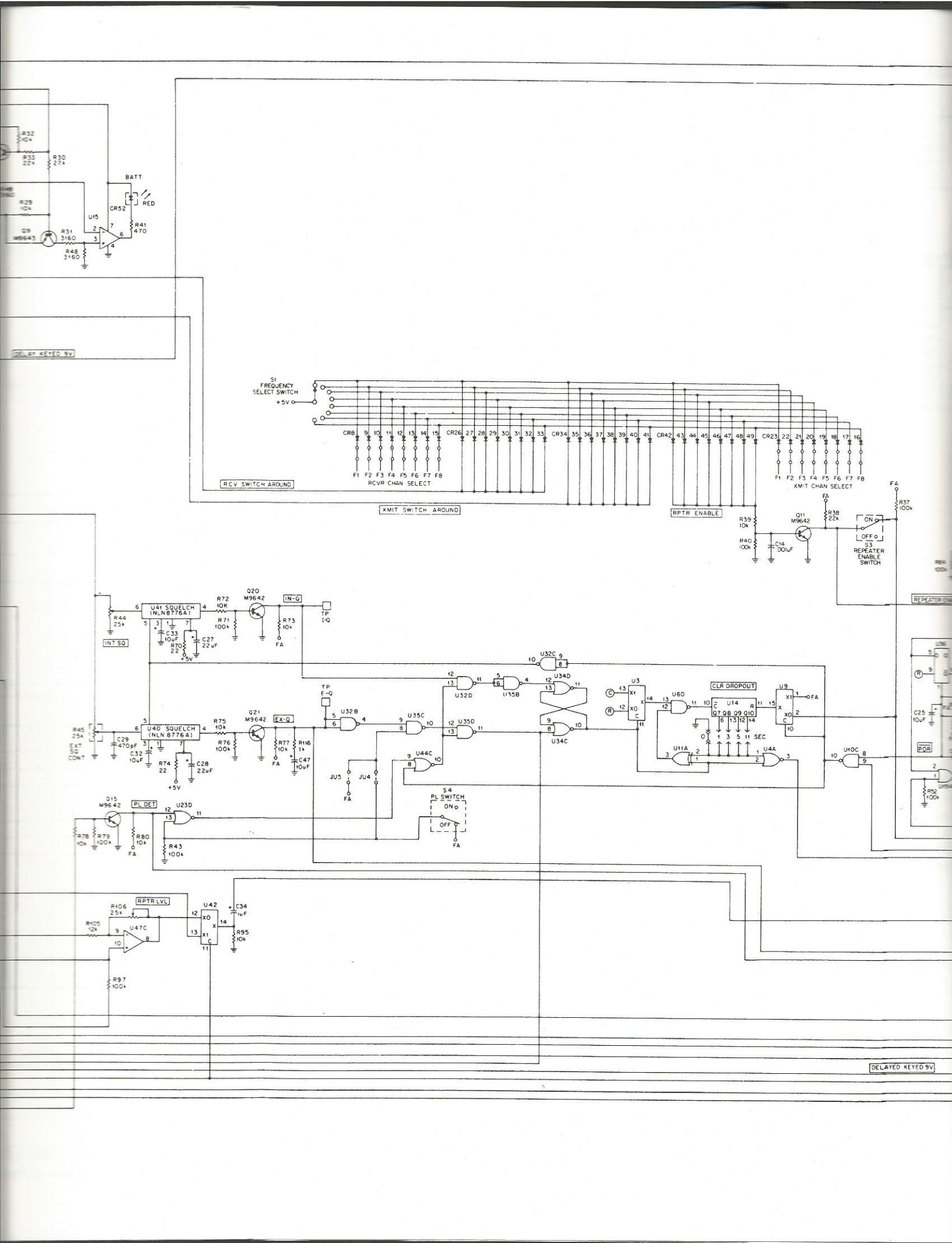
EPF-10314-O

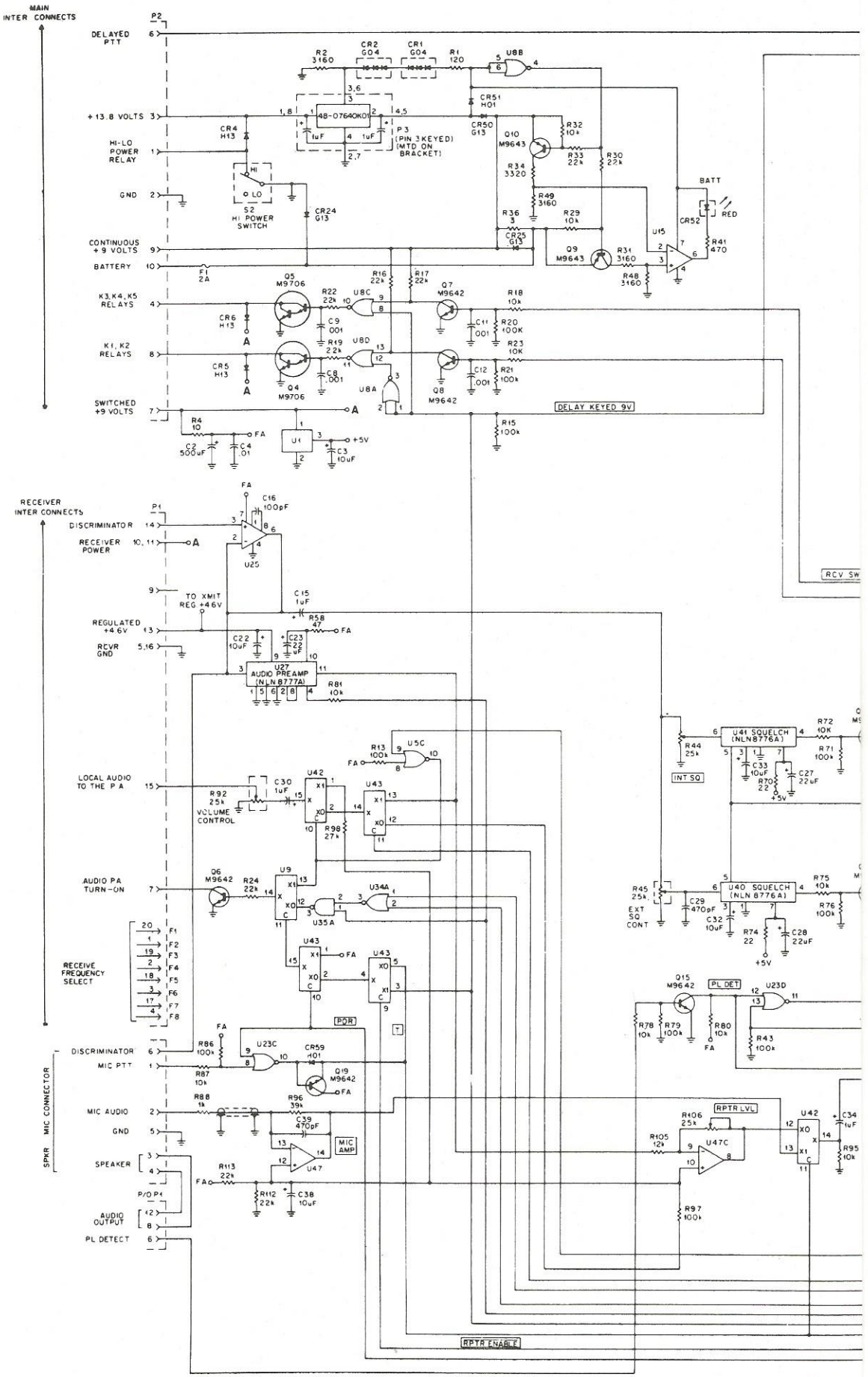
Figure 5-16.
Main Control Board (Clear) Schematic Diagram



ITEM	SUFFIX
PLN 1036A	–


TEST POINTS
R
C
FA
G
R94 100k
U36
FA
R84 100k
R83 100k
U2 NLN8778A TDC
C10 1uF
R25 10k
R26 18k
R28 10k
R27 22k
C13 10uF
+5V
NC
CLR DEV
U13
U44B
U44A
U44D
R65 100k
U19D
R50 13k
R61 33k
U17D
U17C
U11D
U11C
C25 10uF
R82 100k
POR
POWER ON RESET
CR61
TOT
U19A
R52 100k
U22 Q11 Q12 Q13 Q14
0.7 1.5 3 6 ∞ MIN
JU1
SWITCHED RPTR ENABLE
T
U16C
U9
R6 100k
R37 100k
R38 22k
Q1 MPS43
C14 330uF
S3 REPEATER ENABLE SWITCH
ON
OFF
REPEATER ENABLE
XMIT CHAIN SELECT
F1 F2 F3 F4 F5 F6 F7 F8
TEST POINTS
CD
TDC
RPTR ENABLE
E.S.-Q
PL DET
DELAYED KEYED 9V


DELAY KEYED 9V
R32 10k
R33 22k
R30 27k
BATT
CR52
RED
R29 10k
Q9 M9643
R31 3160
U15
R41 470
R48 3160
S1 FREQUENCY SELECT SWITCH
+5V
CR8 9 10 11 12 13 14 15
CR26 27 28 29 30 31 32 33
CR34 35 36 37 38 39 40 41
CR42 43 44 45 46 47 48 49
CR23 22 21 20 19 18 17 16
F1 F2 F3 F4 F5 F6 F7 F8
RCVR CHAN SELECT
XMIT CHAN SELECT
RCV SWITCH AROUND
XMIT SWITCH AROUND
RPTR ENABLE
FA
R37 100k
R38 22k
Q11 M9642
ON
OFF
S3 REPEATER ENABLE SWITCH
R39 10k
R40 100k
C14 001uF
REPEATER
U41 SQUELCH (NLN8776A)
R44 25k
INT SQ
R72 10K
Q20 M9642
IN-Q
TP I-Q
R71 100k
R73 10k
C33 10uF
R70 22
C27 22uF
+5V
U32C
U32D
U135B
U34D
U34C
TP E-Q
U32B
U35C
U35D
U44C
JU5
JU4
U3
U6D
CLR DROPOUT
U14
Q7 Q8 Q9 Q10
0 1 3 5 11 SEC
U9
U11A
U4A
U10C
C25 10uF
PQR
R52 100k
R45 25k
EXT SQ CONT
U40 SQUELCH (NLN8776A)
C29 470pF
C32 10uF
R74 22
C28 22uF
R75 10k
Q21 M9642
EX-Q
R76 100k
R77 10k
R116 1k
C47 10uF
Q15 M9642
PL DET
U23D
R78 10k
R79 100k
R80 10k
R43 100k
S4 PL SWITCH
ON
OFF
RPTR LVL
R106 25k
R105 12k
U47C
U42
C34 1uF
R95 10k
R97 100k
DELAYED KEYED 9V


MAIN INTER CONNECTS
P2
DELAYED PTT
+13.8 VOLTS
HI-LO POWER RELAY
GND
CONTINUOUS +9 VOLTS
BATTERY
K3,K4,K5 RELAYS
K1,K2 RELAYS
SWITCHED +9 VOLTS
S2 HI POWER SWITCH
P3 (PIN 3 KEYED) (MTD ON BRACKET)
48-07640K01
DELAY KEYED 9V
RECEIVER INTER CONNECTS
P1
DISCRIMINATOR
RECEIVER POWER
TO XMIT REG +4.6V
REGULATED +4.6V
RCVR GND
U27 AUDIO PREAMP (NLN8777A)
LOCAL AUDIO TO THE P A
VOLUME CONTROL
AUDIO PA TURN-ON
RECEIVE FREQUENCY SELECT
F1
F2
F3
F4
F5
F6
F7
F8
POR
DISCRIMINATOR
MIC PTT
MIC AUDIO
GND
SPEAKER
AUDIO OUTPUT
PL DETECT
SPKR MIC CONNECTOR
MIC AMP
U41 SQUELCH (NLN8776A)
U40 SQUELCH (NLN 8776A)
INT SQ
EXT SQ CONT
PL DET
RPTR LVL
RPTR ENABLE
RCV SW

NMN6071B-SP5 Speaker-Microphone Kit PLF-1770-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	NMN6071B	Speaker-Microphone, with Coiled Cord
	2800881072	Plug, Cable; 6-pin
	3084123H04	Cord, Coiled

PHN6004A Case PLF-1771-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1505331J01	Case, Keylock (6.5 inches)
	1505362J01	Envelope, Accessory
	6405361J01	Plate, Magnetic Antenna Mounting

PKE6000A Rf Cabling (Repeater Only, Vhf) PLF-1772-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0500129621	Eyelet
	0982442E01	Receptacle, Chassis
	1500483599	Hood, Receptacle
	2884476G01	Plug, Cable
	2887317C03	Connector, Cable
	3083794C01	Cable, Coaxial

PKE6001A Rf Cabling (Uhf P.A.) PLF-1773-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0500136977	Eyelet
	0984885E02	Connector, Female
	0987318C07	Receptacle
	2884282D01	Connector, Phone; Male
	2882365D02	Plug, Insulator
	3082921H01	Cable, Coaxial
	3083794C01	Cable, Coaxial

PKN6015A Ac Power Cord PLF-1774-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2805353J01	Plug, Power
	3084406H01	Cord

PKN6016A Dc Power Cord PLF-1775-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	2805353J01	Plug, Power
	2882620C01	Plug
	3083155H01	Cable, 2-Conductor

PKN6017A Interconnect Cable PLF-1776-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0905354J01	Receptacle, Power
	1484277D18	Housing, Connector
	1505335J01	Housing, External Connector
	2100821474	Capacitor, 470 pF (Feed-thru)
	2284835F01	Pin, Nylon
	2900824456	Lug, Ring; Small
	2900845081	Lug, Ring; Large
	2900859118	Lug
	2905784F01	Terminal
	2984078B01	Lug, Flanged
	4210217A02	Strap, Tie
	6405323J01	Plate (Feed-thru)

PKN6018A Receiver Cable PLF-1777-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0987318C07	Receptacle, Bulkhead
	1484277D14	Housing, Connector
	2284835F01	Pin, Nylon; Polarized
	2905784F01	Terminal
	3000859004	Cable, Coaxial; RG188/U

PKN6019A Transmitter Cable PLF-1778-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0987318C07	Receptacle, Bulkhead
	1484277D14	Housing, Connector
	2100821474	Capacitor, 470 pF (Feed-thru)
	2284835F01	Pin, Nylon; Polarized
	2905784F01	Terminal
	3000859004	Cable, Coaxial; RG188/U
	6405324J01	Plate, Transmit (Feed-thru)

PLN6167A Power Supply (230 V) PLF-1780-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0300127604	Screw, 8-32 x 1/4; Phillips Binder Head Steel Cadmium
	0400002628	Washer, Lock; 8 Steel Nickel
	2505348J01	Transformer; 220 V to 110 V

PNN6001A Battery Kit PLF-1792-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0282360B29	Nut, Speed
	0300122804	Screw, 6-32 x 1/4; Phillips Binder; Steel Cadmium
	0300127604	Screw, 8-32 x 1/4
	0400002627	Washer, Lock; 6 Steel Nickel
	0400002628	Washer, Lock; 8 Split
	0705314J01	Bracket, Battery Mounting
	6005346J01	Battery, 8 V Gel Cell
	6405315J01	Plate, Battery Holddown
	7505316J01	Pad, Battery Holddown

PLF-1776-O

	DESCRIPTION
	Receptacle, Power
	Housing, Connector
	Housing, External Connector
	Capacitor, 470 pF (Feed-thru)
	Pin, Nylon
	Lug, Ring; Small
	Lug, Ring; Large
	Lug
	Terminal
	Lug, Flanged
	Strap, Tie
	Plate (Feed-thru)

PLF-1777-O

	DESCRIPTION
	Receptacle, Bulkhead
	Housing, Connector
	Pin, Nylon; Polarized
	Terminal
	Cable, Coaxial; RG188/U

PLF-1778-O

	DESCRIPTION
	Receptacle, Bulkhead
	Housing, Connector
	Capacitor, 470 pF (Feed-thru)
	Pin, Nylon; Polarized
	Terminal
	Cable, Coaxial; RG188/U
	Plate, Transmit (Feed-thru)

V)

PLF-1780-O

	DESCRIPTION
	Screw, 8-32 x 1/4; Phillips Binder Head Steel Cadmium
	Washer, Lock; 8 Steel Nickel
	Transformer; 220 V to 110 V

PLF-1792-O

	DESCRIPTION
	Nut, Speed
	Screw, 6-32 x 1/4; Phillips Binder; Steel Cadmium
	Screw, 8-32 x 1/4
	Washer, Lock; 6 Steel Nickel
	Washer, Lock; 8 Split
	Bracket, Battery Mounting
	Battery, 8 V Gel Cell
	Plate, Battery Holddown
	Pad, Battery Holddown

PLN6296A Top Panel PLF-1790-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0300136934	Screw, 6-32 x 3/8; Phillips Hex; Locking
	0300139012	Screw, 4-40 x 1/4; Phillips Hex; Locking Steel
	0300140099	Screw, 10-24 x 1/2; Phillips Flat Head; Steel Cadmium
	0300140100	Screw, 10-24 x 1/2; Phillips Round Head; Steel Cadmium
	0400135817	Washer, Lock; 10 Steel Cadmium
	0410058B35	Washer, Felt; Black
	0600124A41	Resistor, 470 ±5%; 1/4 W
	0705325J01	Support
	0705328J01	Bracket, Power Switch
	0982083C01	Receptacle, Fuse
	1484277D17	Housing, Connector
	2284835F01	Pin, Nylon; Polarized
	2383281G04	Capacitor, 1.0 uF ±20%; 35 V
	2905784F01	Terminal
	4005350J01	Switch, Power
	4084241G03	Switch, Slide; Circuit Board Mounting
	4805776C01	LED
	5505329J01	Handle, Control Panel
	6405319J01	Panel, Control
	6500020404	Fuse, 3 Amp; 250 V
	6500804906	Fusetron, 15 Amp; 32 V
	7505365J01	Pad, Control Board Hybrid
	7505364J01	Pad, Channel Element (Uhf, Xmit)
	7505364J02	Pad, Channel Element (Uhf, Rcv)
	7505364J03	Pad, Channel Element (Vhf, Xmit)
	7505364J04	Pad, Channel Element (Vhf, Rcv)
	4805359J01	Regulator, Variable Voltage

PLN6297A Exterior Hardware Kit PLF-1791-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0282360B33	Nut, Speed
	0300006935	Screw, 4-40 x 1/4; Slotted Binder Head; Steel; Black
	0300122804	Screw, 6-32 x 1/4; Phillips Binder Head; Steel Cadmium
	0300127604	Screw, 8-32 x 1/4; Phillips Binder Head; Steel Cadmium
	0300131269	Screw, 10-32 x 1/2; Phillips Round Head; Steel; Black
	0300132033	Screw, 6-32 x 1/4; Phillips Flat Head; Steel Cadmium
	0300134175	Screw, 10-32 x 3/8; Phillips Round Head; Steel; Black
	0300136890	Screw, 4-40 x 9/32; Phillips Locking; Steel
	0300139012	Screw, 4-40 x 1/4; Phillips Hex; Locking; Steel
	0384416F03	Screw, 10-16 x 1/2; Phillips Nickel; Black
	0400002628	Washer, Lock; 8 Steel Nickel
	0410058B34	Washer, Nylon; Black
	0484345A10	Washer, Insulator
	1405363J01	Insulator, Control Board
	2605321J01	Heatsink
	4205338J01	Fastener, 1/4 turn
	4205322J01	Strap, Heatsink
	6405336J01	Plate, Connector Cover
	7505339J01	Bumper, Case
	1505303J01	Panel, Shield; Top
	0300127604	Screw, 8-32 x 1/4; Phillips Binder Head; Steel Cadmium
	0300136010	Screw, 8-32 x 5/16; Phillips Flat Heat; Steel Cadmium
	0400002628	Washer, Lock; 8 Steel Nickel
	1405302J01	Insulator, MX Radio Bd.
	3205304J01	Gasket, Top Panel

PPN6001A Power Supply (120 V)

REFERENCE SYMBOL	MOTOROLA PART NO.
	0105360J01 0300136010 0605357J01 4210217A02

PLN6169A Escutcheon & Knob K

REFERENCE SYMBOL	MOTOROLA PART NO.
	1305327J03 3605320J01 6105326J01 6105326J02

PLN6170A Nameplate

REFERENCE SYMBOL	MOTOROLA PART NO.
	0105473G50

PAN6000A Antenna

REFERENCE SYMBOL	MOTOROLA PART NO.
	8505330J01

PLN6266A Escutcheon & Knob K

REFERENCE SYMBOL	MOTOROLA PART NO.
	1305327J05 3605320J01 6105326J01 6105326J02

PLN6173A Escutcheon & Knob K

REFERENCE SYMBOL	MOTOROLA PART NO.
	1305327J02 3605320J01 6105326J01 6105326J02

PPN6001A Power Supply (120 V) PLF-1793-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0105360J01	Power Supply, 12 V
	0300136010	Screw, 8-32 x 5/16; Phillips Flat Head; Steel Cadmium
	0605357J01	Varistor
	4210217A02	Strap, Tie; .091 x 3.62; Nylon; White

PLN6169A Escutcheon & Knob Kit (DVP) PLF-1794-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1305327J03	Escutcheon
	3605320J01	Knob
	6105326J01	Lens, Control; LED
	6105326J02	Lens, Power; LED

PLN6170A Nameplate PLF-1795-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0105473G50	Label

PAN6000A Antenna PLF-1853-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	8505330J01	Antenna, 1/4 Wave; Magnet Mount

PLN6266A Escutcheon & Knob Kit (Clear PL) PLF-1863-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1305327J05	Escutcheon, Clear; PL
	3605320J01	Knob
	6105326J01	Lens, Control LED
	6105326J02	Lens, Power LED

PLN6173A Escutcheon & Knob Kit (DVP, PL) PLF-1864-O

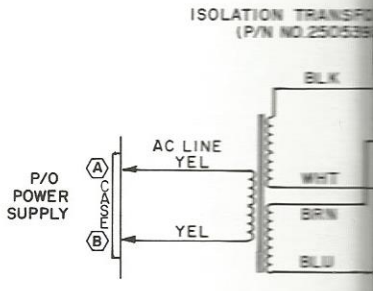
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1305327J02	Escutcheon, DVP, PL
	3605320J01	Knob
	6105326J01	Lens, Control LED
	6105326J02	Lens, Power LED

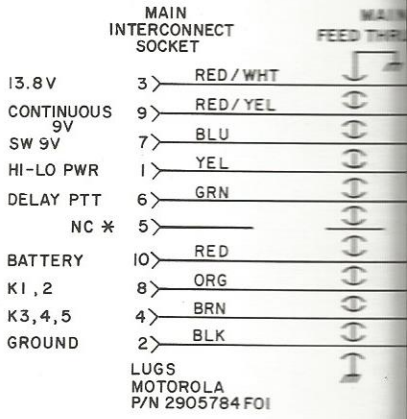
PLN6265A Escutcheon & Knob Kit (Clear) PLF-1865-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	1305327J06	Escutcheon, Clear
	3605320J01	Knob
	6105326J01	Lens, Control LED
	6105326J02	Lens, Power LED

PLN6294A Bottom Bracket Hardware PLF-1867-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0300127604	Screw, 8-32 x 1/4; Phillips Binder Head; Steel Cadmium
	0300136010	Screw, 8-32 x 5/16; Phillips Flat Head; Steel Cadmium
	0400002628	Washer, Lock; 8 Steel Nickel
	0705300J01	Bottom Bracket





* POLARIZING PIN
22-84835F01
USED HERE

(Clear) PLF-1865-O

DESCRIPTION
Escutcheon, Clear
Knob
Lens, Control LED
Lens, Power LED

PLN6174A PL Switch PLF-1866-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	0410058B35	Black Felt Washer
	4005350J02	PL Switch

ware PLF-1867-O

DESCRIPTION
Screw, 8-32 x 1/4; Phillips Binder Head; Steel Cadmium
Screw, 8-32 x 5/16; Phillips Flat Head; Steel Cadmium
Washer, Lock; 8 Steel Nickel
Bottom Bracket

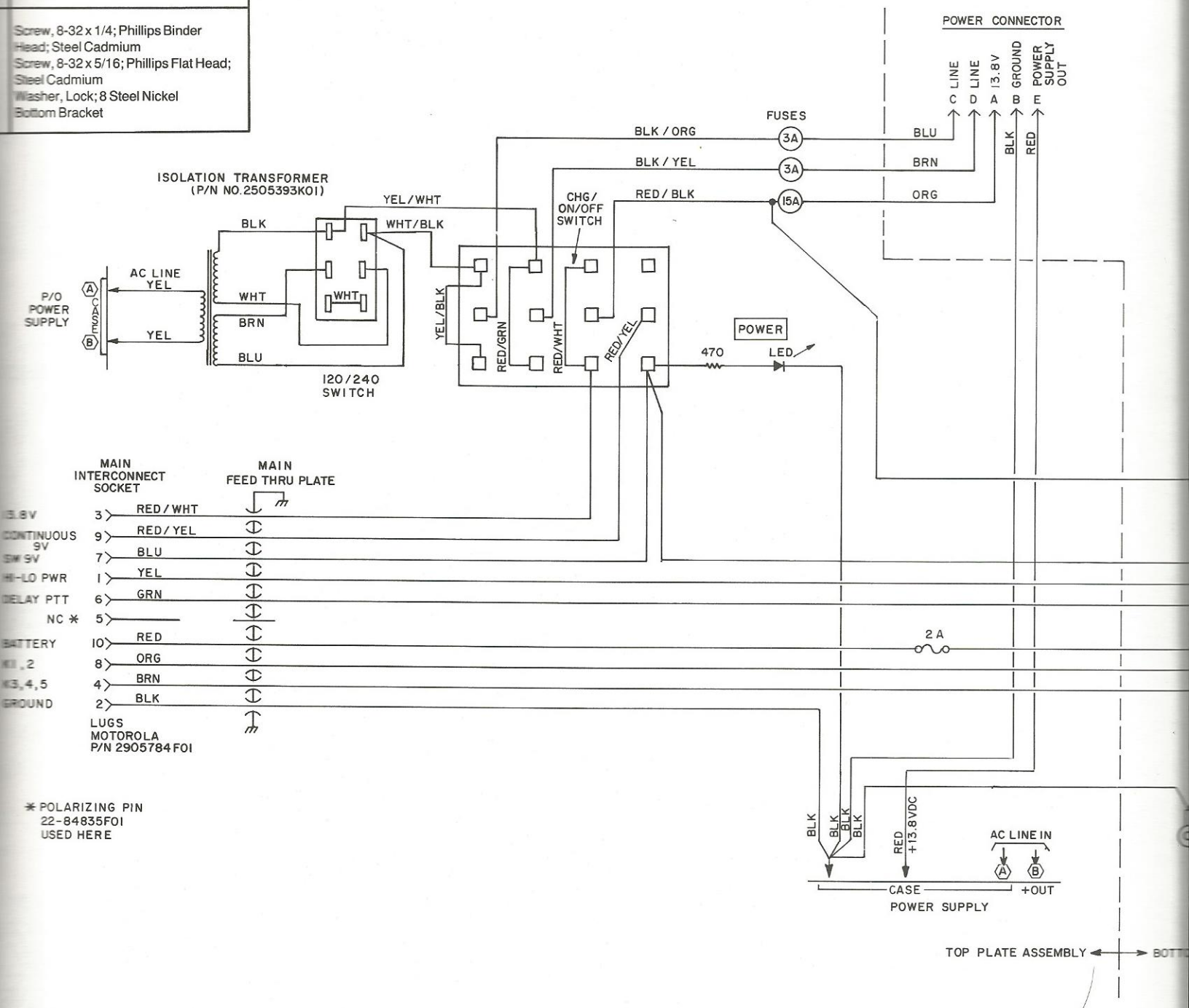


Figure 5-17. Interconnect Cabling D and Miscellaneous Parts

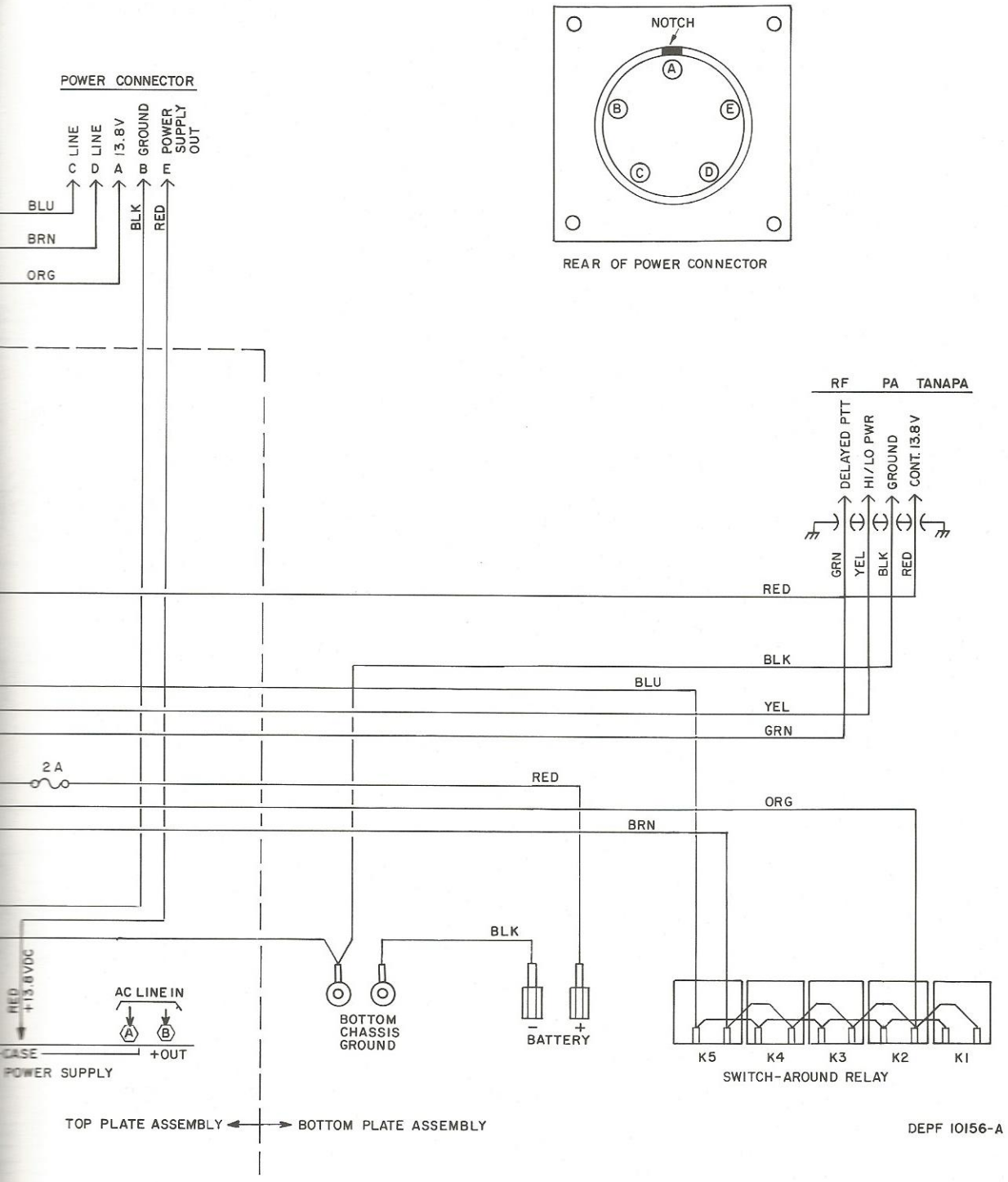


Figure 5-17.
Interconnect Cabling Diagram

MOTOROLA

MANUAL USER QUESTIONNAIRE

We believe that reports from users provide valuable information for producing good service manuals. Your answers and comments on the following questionnaire will aid us in writing manuals that contain information of maximum benefit to you.

In reference to Manual No. 68P_____

DIAGRAMS (indicate diagram number/description) _____

_____

☐ Are adequate

☐ Are too small ☐ too big

☐ Should contain the following additional information: _____

_____

☐ Contain the following errors: _____

_____

PARTS LISTS

☐ Are adequate

☐ The following information is incorrect or should be added: _____

_____

☐ I prefer exploded views for parts identification

THEORY/TROUBLESHOOTING INFORMATION

Fold down to this line

☐ I use troubleshooting charts frequently.

☐ I do not use troubleshooting charts.

☐ I prefer tabular symptom/remedy charts.

☐ The following information should be added (or corrected): _____

_____

MODEL CHARTS

☐ I use charts to determine if manual is applicable to my radio model.

☐ I use the charts to determine content of model or identify what chassis/kits are in the model; or: _____

_____

☐ I do not use these charts.

EPF-10120-O

PRINTED CIRCUIT BOARD DETAILS

EPF-10123-O

- ☐ I use printed circuit details for component location only.
- ☐ In addition to component location, I use printed circuit details for: _____
  _____
- ☐ I prefer photographs/drawings with call-outs for component location purposes.
- ☐ Different shades of gray are adequate for double-sided boards.
- ☐ I prefer use of different colors for double-sided boards.

OTHER COMMENTS

_____

_____

My name is _____

Company _____

Address _____

City _____ State _____ Zip _____

Phone no. (include area code) _____

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When ordering replacement parts, the complete number identification of the item must be used whether it be a component, kit, or complete chassis. This will fix proper identification and assure delivery of the desired item. Complete number identification should also be used when requesting equipment information.

Crystal and channel element orders should specify the crystal or channel element type number, crystal frequency, carrier frequency, and the chassis model number in which the part is used.

Orders for "Vibrasender" and "Vibrasponder" resonant reeds and "Permacode" active filters should specify the type number and frequency, and should identify the owner/operator of the communications system in which these items are to be used.

Orders for programmed "Permacode" code plugs should specify the desired code.

FACTORY ADDRESSES FOR ORDERING CRYSTALS, CHANNEL ELEMENTS, RESONANT REEDS, AND "PERMACODE" ACTIVE FILTERS

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Motorola, Inc.
Component Service Department
P.O. Box 66191
O'Hare International Airport
Chicago, IL 60666

REGULAR MAIL ORDERS AND CORRESPONDENCE

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Component Service Department
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Tel: 312-451-1297, TWX: 910-227-0799

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Pacific Southwestern Area Parts Dept.
P.O. Box 85036, San Diego, CA 92138
Tel: 714-292-8224, TWX: 910-335-1634

Southwestern Parts Dept.
3320 Belt Line Road, Dallas, TX 75234
Tel: 214-241-2151, TWX: 910-860-5505

Midwest Parts Dept.
10 W. North Avenue, Lombard, IL 60148
Tel: 312-620-3000, TWX: 910-693-1592

Communications Group Parts Dept.
1313 East Algonquin Road, Schaumburg, IL 60172
Attn: Communications Group - Parts Department
Tel: 312-397-3500, TWX: 910-693-1592
Alternate TWX: 910-693-1599

East Central Parts Dept.
12955 Snow Road, Parma, OH 44130
Tel: 216-267-2210, TWX: 810-421-8845

Mid-Atlantic Area Parts Dept.
7230 Parkway Drive, Hanover, MD 21076
Tel: 301-796-8600, TWX: 710-862-1941

Eastern Parts Dept.
85 Harristown Road, Glen Rock, NJ 07452
Tel: 201-447-4000, TWX: 710-988-5602

Southeastern Parts Dept.
P.O. Box 368, Decatur, GA 30031
Tel: 404-981-9800, TWX: 810-766-0876

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Federal Government, Railroads, Airlines, and Telephone
1313 East Algonquin Road, Schaumburg, IL 60196
Tel: 312-397-3500, TWX: 910-693-1592

Motorola National Data Services
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Tel: 602-994-6472