MOTOROLA INC.

MT1000®
Handie-Talkie® Portable Radios

Instruction Manual

68P81067C40-A

THIS MANUAL HAS BEEN
DISCONTINUED

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68P81067C40-A

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SPECIAL TERMS AND ABBREVIATIONS

The construction technology and circuits in the MT1000 radio require the use of the following special terms and abbreviations.

TERM:	DESCRIPTION:
Alert Tones	Audible annunciators of radio status
Code Plug	That portion of the software that is coded for the individual user
DPL	"Digital Private Line" (digitally coded squelch)
DTMF	Dual-Tone, Multi-Frequency (phone interconnect signalling)
FGU	Frequency Generation Unit (Lowband Models Only)
Logic 1	A voltage level of approximately 5Vdc
Logic 0	A voltage level of approximately 0Vdc
PA	Power Amplifier
PL	"Private-Line" (tone coded squelch)
PLL	Phase-Locked Loop
Quik-Call II™	Paging Option
RIB	Radio Interface Box - Converts RS-232 voltage level signals to 0 and 5 volts
RX	Receive
TX	Transmit
Transceiver Board	The printed circuit board containing the functional components of the receiver and transmitter
VCO	Voltage Controlled Oscillator

FCC REGULATIONS

State that:

1. 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.

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

FCC DESIGNATIONS

H41 Series Models: AZ489FT1622
H33 Series Models: AZ489FT3716
H43 Series Models: AZ489FT3717
H34 Series Models: AZ489FT4717
H44 Series Models: AZ489FT4718

COMPUTER SOFTWARE COPYRIGHTS

RELATED PUBLICATIONS AVAILABLE SEPARATELY

Operating Instructions.....68P81061C35
HELP Card.....68P81066C15

MODEL CHART

MODEL NUMBER	DESCRIPTION
H41GCU7160AN	MT1000 HANDIE-TALKIE PORTABLE RADIO, LOWBAND, ROTARY RADIO
H41GCJ7130AN	MT1000 HANDIE-TALKIE PORTABLE RADIO, LOWBAND, DISPLAY RADIO
H33GCU7100CN	MT1000 HANDIE-TALKIE PORTABLE RADIO, VHF, 2-WATT ROTARY RADIO
H43GCU7100CN	MT1000 HANDIE-TALKIE PORTABLE RADIO, VHF, 5-WATT ROTARY RADIO
H33GCJ7190CN	MT1000 HANDIE-TALKIE PORTABLE RADIO, VHF, 2-WATT DISPLAY RADIO
H43GCJ7190CN	MT1000 HANDIE-TALKIE PORTABLE RADIO, VHF, 5-WATT DISPLAY RADIO
H34GCU7100BN	MT1000 HANDIE-TALKIE PORTABLE RADIO, UHF, 2-WATT ROTARY RADIO
H44GCU7100BN	MT1000 HANDIE-TALKIE PORTABLE RADIO, UHF, 4-WATT ROTARY RADIO
H34GCJ7190BN	MT1000 HANDIE-TALKIE PORTABLE RADIO, UHF, 2-WATT DISPLAY RADIO
H44GCJ7190BN	MT1000 HANDIE-TALKIE PORTABLE RADIO, UHF, 4-WATT DISPLAY RADIO

1	2	3	4	5	6	7	8	9	10	ITEM NO.	DESCRIPTION
X	X									NAB6042A	ANTENNA, HELIFLEX, CODED (30-36MHz); FACTORY CUT, NOT FOR REORDERING
X	X									NAB6043A	ANTENNA, HELIFLEX, CODED (36-42MHz); FACTORY CUT, NOT FOR REORDERING
X	X									NAB6044A	ANTENNA, HELIFLEX, CODED (42-50MHz); FACTORY CUT, NOT FOR REORDERING
R	R									NAB6051A	ANTENNA, HELIFLEX, CODED (30-36MHz); NPD
R	R									NAB6052A	ANTENNA, HELIFLEX, CODED (36-42MHz); NPD
R	R									NAB6053A	ANTENNA, HELIFLEX, CODED (42-50MHz); NPD
		A	A	A	A					NAD6282A	ANTENNA, HELIFLEX, CODED YELLOW (136-150.8MHz)
		A	A	A	A					NAD6562A	ANTENNA, HELIFLEX, CODED BLUE (146-174MHz)
						X	X	X	X	NAE6350A	ANTENNA, WHIP (403-512MHz)
		X	X	X	X	X	X	X	X	NHN6419A	HOUSING, SHADOW BRONZE
X	X									NHN6463A	HOUSING, SHADOW BRONZE
X	X	X	X	X	X	X	X	X	X	NTN4623A	HARDWARE, MISCELLANEOUS
X	X	X	X	X	X	X	X	X	X	NTN5781A	BELT CLIP - PUBLIC SAFETY SIZE
		X		X		X		X		NTN4822A	BATTERY, DUAL CHARGE, MEDIUM CAPACITY
X	X		X		X		X		X	NTN5447B	BATTERY, DUAL CHARGE, HIGH CAPACITY
X	X	X	X	X	X	X	X	X	X	NTN4767A	LABEL, FCC
		X	X			X	X			NTN4892C	CONTROLLER, ROTARY RADIO
				X	X			X	X	NTN4893C	CONTROLLER, DISPLAY RADIO
X										NTN5716A	CONTROLLER, ROTARY RADIO
	X									NTN5717A	CONTROLLER, DISPLAY RADIO
X	X	X	X	X	X	X	X	X	X	NTN4904A	FASTENER KIT
				X	X			X	X	NTN4908A	FRAME, CONTROL TOP, ROTARY RADIO
				X	X			X	X	NTN4910A	FRAME, CONTROL TOP, DISPLAY RADIO
X										NTN5718A	FRAME, CONTROL TOP, ROTARY RADIO
	X									NTN5901A	FRAME, CONTROL TOP, DISPLAY RADIO
X	X	X	X	X	X	X	X	X	X	NTN4956A	FRONT COVER
X	X	X	X	X	X	X	X	X	X	NTN5098A	NAMEPLATE
				X	X			X	X	NTN5671A	RETAINER KIT
X		X	X			X	X			NTN5871A	RETAINER KIT
	X			X	X			X	X	NTN5872A	RETAINER KIT
						X	X	X	X	NTN5767A	SHIELD KIT
						X	X	X	X	NTN5379A	SHIELD, UHF
		A	A	A	A					NTN4581A	SHIELD, VHF (136-150.8MHz)
		A	A	A	A					NTN5708A	SHIELD, VHF (146-174MHz)
X	X									NTN5782A	SHIELD KIT
A	A									NUB6091A	TRANSCEIVER CIRCUIT, 6-WATT (30-36MHz)
A	A									NUB7001A	TRANSCEIVER CIRCUIT, 6-WATT (30-36MHz)
A	A									NUB6092A	TRANSCEIVER CIRCUIT, 6-WATT (36-42MHz)
A	A									NUB6093A	TRANSCEIVER CIRCUIT, 6-WATT (42-50MHz)
			A		A					NUD6771B	TRANSCEIVER CIRCUIT, 5-WATT (136-150.8MHz)
		A		A						NUD6781B	TRANSCEIVER CIRCUIT, 2-WATT (136-150.8MHz)
			A		A					NUD7030A	TRANSCEIVER CIRCUIT, 5-WATT (146-174MHz)
		A		A						NUD7040A	TRANSCEIVER CIRCUIT, 2-WATT (146-174MHz)
							A		A	NUE6901B	TRANSCEIVER CIRCUIT, 4-WATT (403-433MHz)
							A		A	NUE6902D	TRANSCEIVER CIRCUIT, 4-WATT (438-470MHz)
							A		A	NUE6903A	TRANSCEIVER CIRCUIT, 4-WATT (470-500MHz)
							A		A	NUE6904A	TRANSCEIVER CIRCUIT, 4-WATT (488-520MHz)
						A		A		NUE6911B	TRANSCEIVER CIRCUIT, 2-WATT (403-433MHz)
						A		A		NUE6912E	TRANSCEIVER CIRCUIT, 2-WATT (438-470MHz)

KEY: **X** = ITEM INCLUDED
A = ALTERNATE ITEM INCLUDED, CHOICE DEPENDS ON CARRIER FREQUENCY AND TRANSMIT POWER
R = REPLACEMENT ANTENNA, SUPPLIED UNCUT INSTRUCTIONS FOR SPECIFIC FREQUENCIES

OPTION CHART

MODEL NUMBER	DESCRIPTION
H41GCU7160AN	MT1000 HANDIE-TALKIE PORTABLE RADIO, LOWBAND, ROTARY RADIO
H41GCJ7130AN	MT1000 HANDIE-TALKIE PORTABLE RADIO, LOWBAND, DISPLAY RADIO
H33GCU7100CN	MT1000 HANDIE-TALKIE PORTABLE RADIO, VHF, 2-WATT ROTARY RADIO
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H41GCU7160AN	H41GCJ7130AN	H33GCU7100CN	H43GCU7100CN	H33GCJ7190CN	H43GCJ7190CN	H34GCU7100BN	H44GCU7100BN	H34GCJ7190BN	H44GCJ7190BN	OPTION NO.	OMIT	ADD	DESCRIPTON
X	X									H112	NAB6041A	NAB6051A	UNCUT ANTENNA (30-36MHz)
X	X										NAB6043A	NAB6052A	UNCUT ANTENNA (36-42MHz)
X	X										NAB6044A	NAB6053A	UNCUT ANTENNA (42-50MHz)
				X	X	X	X				NAD6282A	-----	OMIT ANTENNA
				X	X	X	X				NAD6562A	-----	
								X	X		NAE6350A	-----	
						X	X	X	X	H124	NAE6350A	NAE6231A	HELIFLEX ANTENNA 403-438 MHz
						X	X	X	X			NAE6232A	HELIFLEX ANTENNA 438-470 MHz
						X	X	X	X			NAE6233A	HELIFLEX ANTENNA 470-512 MHz
						X	X	X	X	H153	-----	*	OMIT ALL ALERT TONES
		X		X		X		X		H224	NTN5447B	NTN4822A	DUAL CHARGE MEDIUM CAPACITY BATTERY
			X		X		X		X	H226		NTN5447A	DUAL CHARGE HIGH CAPACITY BATTERY
		X		X		X		X		H228	-----	*	BATTERY SAVER
		X		X		X		X		H236	NTN4822A	NTN4825A	DUAL CHARGE HIGH CAPACITY BATTERY (FACTORY MUTUAL)
X	X		X		X		X		X		NTN5447B		
			X		X		X		X	H251	-----	*	TIME-OUT TIMER (60 SECONDS)
X	X	X	X	X	X	X	X	X	X	H273	-----	*	PRIORITY CHANNEL SCAN, USER PROGRAMMABLE
X	X	X	X	X	X	X	X	X	X	H297	NTN4956A	NTN5040A	DTMF INTERCONNECT
X	X	X	X	X	X	X	X	X	X	H300	NTN5781A	NTN4814A	CARRY HOLDER
X	X	X	X	X	X	X	X	X	X	H312	NTN5781A	NTN4758A	CARRY CASE
X	X	X	X	X	X	X	X	X	X	H314	NTN5781A	NTN5883A	LEATHER SWIVEL CASE AND T-STRAP W/3" BELT LOOP
X	X	X	X	X	X	X	X	X	X	H319	NTN5781A	NTN4655A	LEATHER SWIVEL CASE AND T-STRAP W/2" BELT LOOP
X	X	X	X	X	X	X	X	X	X	H326	NTN5781A	-----	OMIT BELT CLIP
X	X	X	X	X	X	X	X	X	X	H358	-----	*	LED DISABLE
X	X	X	X	X	X	X	X	X	X	H365	-----	*	TRANSMIT INHIBIT ON BUSY CHANNEL
X	X	X	X	X	X	X	X	X	X	H376	-----	*	SCAN FOR PL (NON-PRIORITY CHANNEL)
X	X	X	X	X	X	X	X	X	X	H384	-----	*	DISABLE POWER-UP ALERT TONE
X	X	X	X	X	X	X	X	X	X	H448	-----	*	DISABLE TALK-BACK SCAN
		X	X	X	X	X	X	X	X	H473	-----	-----	SPECIFIED FREQUENCY BAND
X	X	X	X	X	X	X	X	X	X	H552	-----	*	FIXED PRIORITY/HOME CHANNEL
X	X	X	X	X	X	X	X	X	X	H619	-----	*	OMIT MDC SIDETONES
X	X	X	X	X	X	X	X	X	X	H701	-----	*	INDIVIDUAL CALL (QUIK-CALL II™)
X	X	X	X	X	X	X	X	X	X	H703	-----	*	INDIVIDUAL AND GROUP CALL (QUIK-CALL II)
X	X	X	X	X	X	X	X	X	X	H713	NTN4956A	NTN5596A	CONTINUOUS TONE DTMF
X	X	X	X	X	X	X	X	X	X	H743	NTN4956A	NTN5395A	DTMF WITH ANI
		X		X		X		X		H753	NTN4822A	NTN4823A	MEDIUM CAPACITY DUAL CHARGE FACTORY MUTUAL
X	X		X		X		X				NTN5447B		
X	X	X	X	X	X	X	X	X	X	H757	-----	-----	FM NON-INCENDIVE RATING
X	X	X	X	X	X	X	X	X	X	H770	-----	*	PRETIME DELAY (300ms)
X	X	X	X	X	X	X	X	X	X	H771	-----	*	PRETIME DELAY (700ms)
X	X	X	X	X	X	X	X	X	X	H779	-----	*	PRETIME DELAY (NONSTANDARD)
X	X	X	X	X	X	X	X	X	X	H804	-----	*	PAC•RT OPERATION
X	X	X	X	X	X	X	X	X	X	H901	-----	*	TIME-OUT TIMER (NON-STANDARD)
X	X	X	X	X	X	X	X	X	X	H923	NTN4956A	NTN5457B	UNIT ID AND EMERGENCY REVERT (MDC 600™)
X	X	X	X	X	X	X	X	X	X	H944	-----	*	NON-PRIORITY CHANNEL SCAN, USER PROGRAMMABLE
X	X	X	X	X	X	X	X	X	X	H946	NTN4956A	NTN5457B	UNIT ID AND EMERGENCY REVERT (MDC 1200™)
X	X	X	X	X	X	X	X	X	X	H958	NTN4956A	NTN5456A	UNIT ID (MDC 600)
X	X	X	X	X	X	X	X	X	X	H959	NTN4956A	NTN5456A	UNIT ID (MDC 1200)
X	X	X	X	X	X	X	X	X	X	H961	NTN4956A	NTN5457B	UNIT ID AND EMERGENCY (MDC 600)
X	X	X	X	X	X	X	X	X	X	H962	NTN4956A	NTN5457B	UNIT ID AND EMERGENCY (MDC 1200)

KEY: **X** Specifies radio model for which option is available

* Programming modifications only

GENERAL DESCRIPTION

1. INTRODUCTION

The frequency-synthesized MT1000 Handie-Talkie Radio is an advanced design, microcomputer-based transceiver that incorporates the latest technology available in two-way radio communications. All channel frequencies and squelch codes are stored in an electrically erasable programmable read only memory (EEPROM), with all transmit and receive operations controlled by a microcomputer.

The functions provided by the radio are identified by the model and option numbers as illustrated by the model/option charts at the front of this manual. Model and option numbers will be shown on the radio information sheet, which is shipped with each new radio.

a. Physical Description

All operating controls, except the push-to-talk (PTT) switch, the monitor button, the LCD backlight/scan program button, and the keypad (models with DTMF option), are located on top of the radio (see Figure 2). The PTT switch, monitor button, and LCD backlight/scan program button are located on the left side of the radio (viewed from the front, see Figure 1), and the keypad (if so equipped) is an integral part of the front cover (see Figure 1).

The MT1000 radio is small in size and weight, and constructed of a highly durable, impact resistant, molded polycarbonate housing. O-rings and seals are utilized throughout the radio. All controls, including the PTT switch, the monitor buttons, and the keypad are weather resistant, and the microphone and speaker are covered with a special diaphram to provide extra resistance against dirt, dust, and water intrusion. This proven rugged construction offers excellent protection against adverse environmental conditions.

The height of the radio varies with the size of the battery. All other dimensions are standard, except for those radios with a keypad option.

b. Electrical Description

Electrically, the radio can be divided into two basic sections; a transceiver board and a controller flexible circuit. The transceiver performs the transmit and receive functions, and the controller controls those functions.

The transceiver board includes an antenna switching circuit, a dual-conversion receiver, and a transmitter. The transmitter carrier and receiver first injection signals are generated by a common phase-locked loop (PLL) consisting of a voltage controlled oscillator (VCO) and a frequency synthesizer. In lowband radios, the VCO and synthesizer are combined to form a frequency generation unit (FGU).

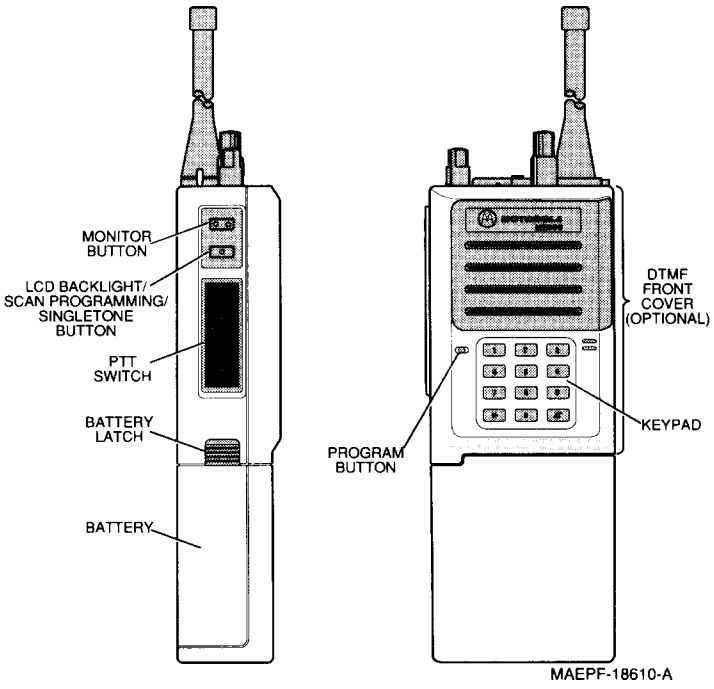


Figure 1. Typical MT1000 Series Radio

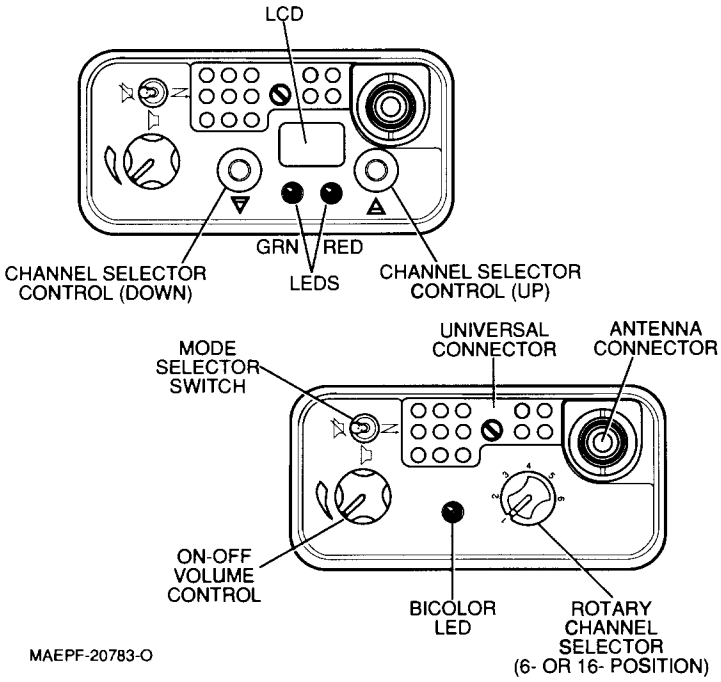


Figure 2. Top Panel Controls and Indicators

The controller flex assembly contains a microcomputer, an EEPROM which stores the channel frequencies and squelch codes, and an audio power amplifier integrated circuit (IC) that includes transmitter and receiver audio amplifiers. The controller flex also includes an audio filter IC which encodes and decodes (in conjuction with a microcomputer) squelch codes, adjusts and limits the audio level for correct transmitter deviation, and pre-emphasizes and de-emphasizes audio signals. Another circuit which is contained on the controller flex is a dc switch, which controls the radio's transmit and receive voltages.

2. STANDARD FEATURES

The MT1000 radio has an internal microphone and speaker, but can be operated with an optional external microphone and/or speaker. An external antenna connector and a top-mounted "universal connector" provide easy access for testing, and for attaching a wide variety of audio accessories. Radio models are available with up to 99 (32 for lowband) channels of carrier, tone Private-Line® (PL), and or Quik-Call II™,and/or Digital Private-Line™ (DPL) squelch operation. Type of squelch is enabled on a per channel basis with up to 16 code pairs available per radio. Two power output levels are offered, medium power (2 watts) or high power (5 watts on VHF models or 4 watts on UHF models). Lowband models are available in high power (6 watts) only.

The battery pack slides on to the bottom of the radio and is held in place by a spring loaded catch. Batteries are available in two different sizes which correspond to the battery capacity (medium and high). The medium and high capacity batteries are available in standard and rapid charge rates. The different size batteries affect the operating time between charges as well as the overall height and weight of the radio.

A bicolor LED (for rotary radios) or two LEDs (for display radios) on the top of the radio serve as user feedback. The LED indicates when the radio is in transmit (continuous red), a low battery condition (flashing red), or channel busy (flashing green - coded squelch application only).

3. SPECIAL STANDARD FEATURES

a. Radio Cloning

Each MT1000 radio has a unique data-stored "personality" with frequencies, squelch code pairs, and other operating characteristics. Using a simple cloning cable, one radio's characteristics can be duplicated into another MT1000 radio of the same bandsplit.

b. Field Programming

The MT1000 radio utilizes a reprogrammable EEPROM codeplug, which permits operating characteristics to be changed without opening the radio. Programming is accomplished via a programming cable interface to an IBM PC, Laptop PC, or Personal System/2 computers.

c. Multiple Digital Private-Line , Tone Private-Line Coded Squelch, And Single Combination of Quik-Call II Codes

Coded squelch allows only those calls with a radio's particular code to be heard, and can be enabled on a per channel basis. So an MT1000 radio can have carrier squelch on some channels, Digital PL squelch on others, Tone PL squelch on others, and Quik-Call II on even others. You can choose from 80 Digital Private-Line codes and 28 Tone Private-Line codes.

4. PRINTED CIRCUIT BOARDS AND FLEXIBLE CIRCUITS

a. General

Functional circuits in the MT1000 radio are contained on: (1) the Transceiver Board and (2) the Controller Flex. Five flexible printed circuits eliminate all discrete wiring, except the switched B+ wire to the transceiver board. Radios with keypad options have functional circuits contained on a board in the front cover.

b. Tranceiver Board

The transceiver board is a two-layer or four-layer printed circuit board containing the rf and i-f portions of the radio. Almost all components are mounted on the top side of this board.

c. Controller Flex

The controller flex is packaged inside a protective flex carrier. It is a two-layer flexible printed circuit with the components surface-mounted on one side. When packaged in the flex carrier it is folded in half with all components on the outside.

d. Interconnect Flexes

The interconnect flexes are two-layer flexible printed circuits. These include:

- PTT/B+ Flex
- Volume Pot Flex
- Frequency Switch Flex
- I-F interconnect Flex
- Front Cover Flex

e. Keypad Board (Optional)

The keypad option board is a four-layer printed circuit board mounted in the radio's front cover. All components are surface mounted on one side of the board.

5. BATTERIES

The rechargeable nickel-cadmium batteries availabe for the MT1000 radio are listed in Table 1. Battery choice is governed by duty cycle, operating time, and maximum height and weight desired.

Table 1. Batteries for the MT1000 Radio

KIT NUMBER	BATTERY CAPACITY	CHARGE TIME (IN RAPID CHARGER)	*TYPICAL HOURS OF OPERATION		
			2-WATT RADIOS	4- & 5-WATT RADIOS	6-WATT RADIOS
NTN4822A	MEDIUM	1 HR	8 HRS	5 HRS	
NTN4823A	MEDIUM	1 HR	8 HRS	5 HRS	
NTN5447B	HIGH	1 HR	**13 HRS	8 HRS	7 HRS
NTN4825A	HIGH	1 HR	**13 HRS	8 HRS	

* BASED ON A DUTY CYCLE OF 5% TRANSMIT, 5% RECEIVE, AND 90% STANDBY TIME.
** 14 HOURS ON VHF RADIOS

BATTERY CHARGING

1. CHARGERS AVAILABLE

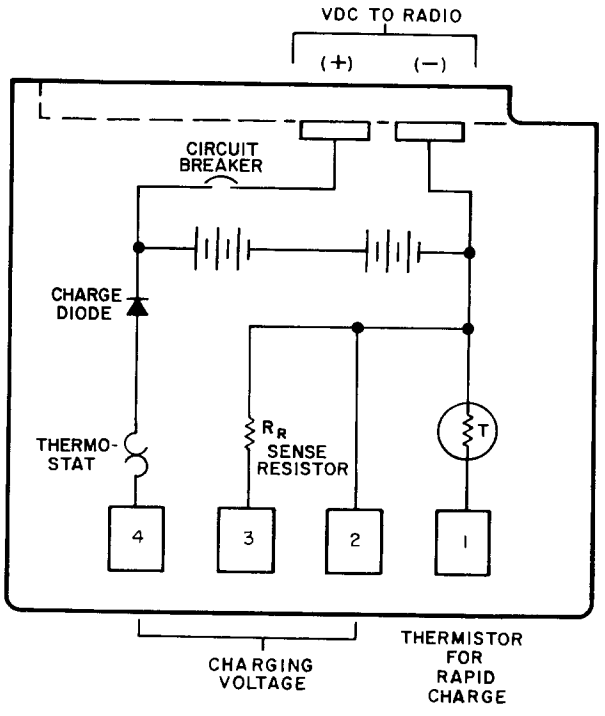
Available chargers include compact chargers, single-unit desk top chargers, and multiple-unit chargers that may be mounted on a wall or bench. The multiple-unit chargers will charge up to six nickel-cadmium batteries at one time.

The chargers are available in slow charge and rapid charge models. The slow charge models will charge the batteries, with or without the radio attached, in 16 hours (RADIO MUST BE TURNED OFF). The rapid charge models will charge the dual-charge batteries in approximately one hour.

Refer to the ACCESSORIES page in the Operating Instructions manual for a list of the available battery chargers and their applications. For further information, contact your Motorola sales representative.

2. BATTERY CONSTRUCTION *(See Figure 3)*

The MT1000 dual-charge battery has four charger contacts, two of which receive the charging current. A third contact connects an internal resistor (R_R) to the charger, automatically setting the charging current output to match the capacity of the battery. The fourth contact connects an internal thermistor to the charger. The thermistor senses battery temperature and automatically controls the charger output to permit maximum charger output without overheating the battery.



AEPF-18611-O

Figure 3. Typical Dual-Charge Battery Construction, Rear View

All dual-charge batteries contain an internal current-limiting device (breaker) for protection. A diode in the battery prevents damage from an accidental short between the charging contacts.

CAUTION

Sustained shorts across the radio contacts (+,-) will cause excessive current, producing excessive heat which will destroy the internal thermal fuse, which is not replaceable.

3. BATTERY CHARACTERISTICS

Each nickel-cadmium battery consists of eight cells connected in series to provide a nominal 10Vdc output, which remains approximately constant under load until the battery approaches a discharged condition. At this time, a marked decrease in voltage occurs and the discharge condition (1.0 volt per cell) is reached abruptly.

A general characteristic of all rechargeable batteries in storage is self-discharge. If the battery is to be used after an unknown period of storage, it is recommended that it be charged at the full charging rate using an approved battery charger.

4. MAINTENANCE

The battery cells will never require additional electrolyte. The only maintenance required is recharging the battery and keeping the contacts clean. Use only a Motorola approved charger. The use of other chargers, unless approved, will void the battery warranty and may result in permanent damage to the battery.

5. STORAGE

The battery may be stored at room temperature in any state of charge without damage. As previously stated, however, the battery is subject to self-discharge and should be recharged after extended storage.

6. DETERMINING BATTERY CAPACITY

Battery capacity is determined by measuring the time that a fully-charged battery requires to discharge to eight volts through a specified load, as described in the following procedure.

NOTE

This procedure requires using a 20-ohm, 1%, 10-Watt load resistor to discharge medium capacity batteries, and an 11-ohm, 1%, 15-Watt load resistor to discharge high capacity batteries.

a. Obtain a Radio Housing Adapter (Motorola part number 1580368B62) from your nearest Area Parts Office.

b. Connect the appropriate 20-ohm or 11-ohm load resistor (See Note above) between the gold (+) terminal and a solder lug (-) screw and nut of the housing adapter.

c. Connect a voltmeter across the load resistor and slide a fully charged battery onto the housing adapter.

d. Monitor the voltmeter as the battery discharges through the load resistor, until the voltage is eight volts.

e. Disconnect battery from the housing adapter (resistor load) when the cell pack reaches 8.0 volts.

CAUTION

Discharging the battery down to 4.0 volts can cause permanent cell pack damage.

f. Recharge the battery to a complete charge. This will require a 1-hour rapid charge followed by a 16-hour standard charge.

g. Re-attach the battery to the housing adapter (resistor load) and measure the elapsed time until the cell pack reaches 8.0 volts. Disconnect the battery.

h. A good battery will require 48 minutes or longer to discharge, indicating greater than 80% of rated capacity. A weak battery will drop below 8.0 volts in less than 48 minutes.

THEORY OF OPERATION

1. INTRODUCTION

This section of the manual provides a functional description of the MT1000 radio. First, overall basic functions are discussed in general terms, with each circuit and its relationship to other parts of the radio described. Then, detailed circuit descriptions are given for each board, circuit, and module used in the radio.

2. BASIC FUNCTIONAL DESCRIPTION

a. DC Voltage Distribution *(See Figure 4)*

Operating power for the radio is derived from a 10-volt battery. This 10 volts (BATT B+), via the PTT/B+Flex, the Frequency Switch Flex, and the Volume Pot Flex, is applied to the ON/OFF switch. When the radio is turned on, the voltage sources required to operate the various stages of the radio are distributed as shown in Figure 4. In the transmit mode (PTT actuated) a logic low on the R/T line enables the DC switch to provide the required 5 Vdc and 10 Vdc to the transmitter circuits.

b. Frequency Generation and Distribution Circuits *(See Figures 5A and 5B)*

The frequency generation and distribution circuits in the MT1000 radio are common to both transmitter and receiver. They consist of two phase-locked loops (PLLs). One PLL provides the carrier frequency for the transmitter and the injection signal for the receiver first mixer stage. The other PLL generates the second local oscillator (LO) signal. Audio is modulated on the carrier in two different places (two-spot modulation); the VCO's frequency response allows it to modulate audio above 60 Hz, the reference modulator modulates audio below 60 Hz.

The frequency generation circuits include a reference oscillator (U106), a synthesizer (U202), and a VCO (U201). In lowband radios, the synthesizer and VCO/Buffer are both part of a frequency generation unit (FGU), U201. The reference oscillator/alternate reference oscillator generates a 16.8 MHz/2.1 MHz reference signal for the synthesizer. An external adjustment is provided to set the frequency at the output of the reference oscillator.

The following is a functional description of the transmitter first injection PLL. Initially, the VCO becomes active and generates a signal, part of which is coupled back to the synthesizer as a feedback signal. The synthesizer divides this signal and compares it to a reference frequency. If the frequencies differ, the synthesizer generates a control (error) voltage which causes the VCO to change frequency. When the VCO reaches the correct frequency, the synthesizer generates a constant control voltage signal, locking the VCO on frequency. In the transmit mode, voice audio is applied to a varactor on the VCO. The capacitance of the varactor changes in proportion to the instantaneous audio voltage, which results in a shift in carrier frequency at an audio rate. Audio below 60 Hz is modulated onto the synthesizer reference signal, which in turn causes a similar shift in the carrier frequency.

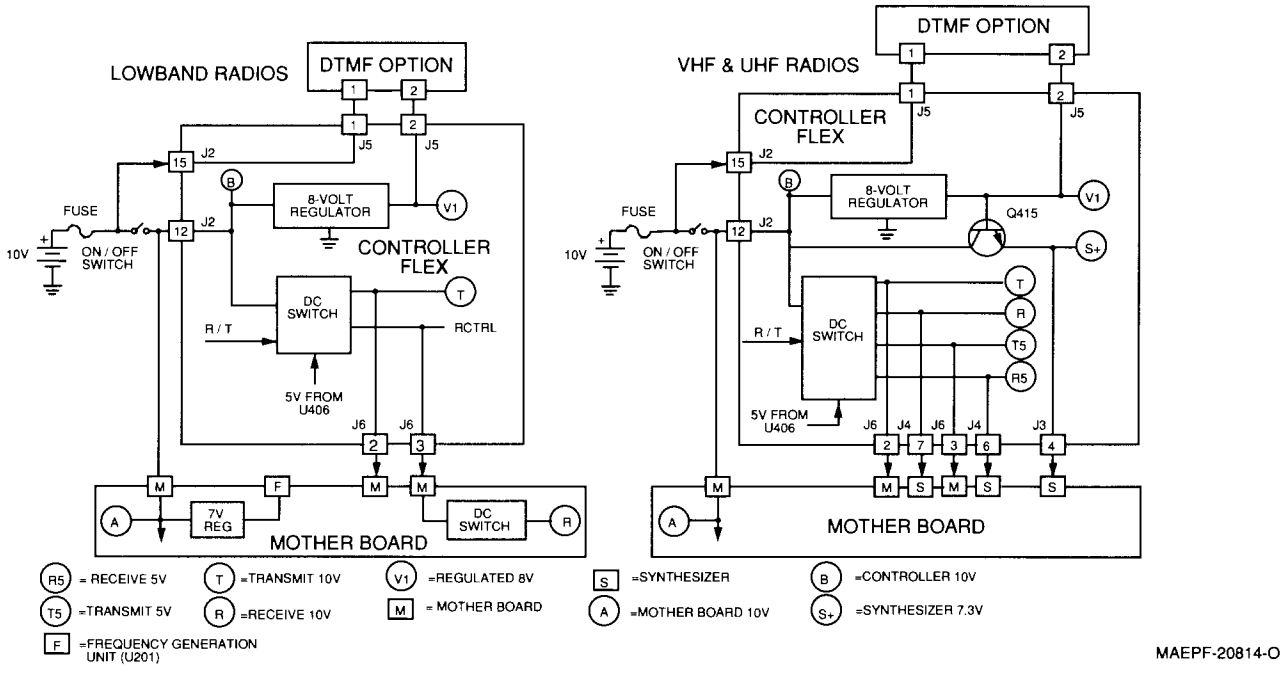


Figure 4. DC Voltage Distribution Block Diagram

c. Basic Controller Functions

Module U401 is a single-chip microcomputer and is the heart of the MT1000 controller. It works in conjunction with the code plug (U402) which stores radio information. The controller's functions are as follows:

- Read the PTT and channel selector switches, and program the synthesizer for the desired operating frequency using the information stored in the code plug.
- Set the audio output levels for the VCO and synthesizer.
- Control the DC switch.
- Unsquelch the receiver's audio PA when a carrier is present, a correct PL/DPL/Quik-Call tone(s) is (are) decoded, or when an alert tone is generated or the monitor button is pressed.
- Monitor the internal and external PTT.
- Control the Receive/Transmit LED.
- Monitor battery voltage.
- Perform a self test during power-up.

d. Antenna Switch

The antenna switch consists of module U103 on lowband models, modules U103 and U104 on VHF models, and module U105 on UHF models. Through the use of pin diodes, the antenna switch directs incoming rf from either the standard or remote antenna to the receiver circuitry and outgoing rf from the transmitter to the remote or standard antenna.

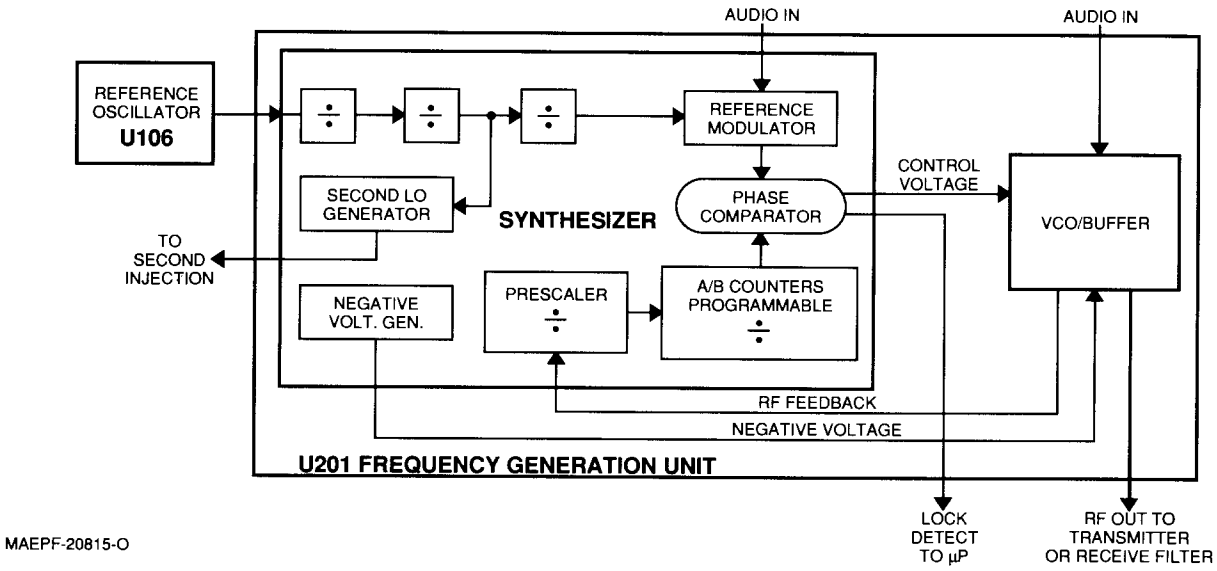


Figure 5A. Frequency Generation Circuits (Lowband Radios)

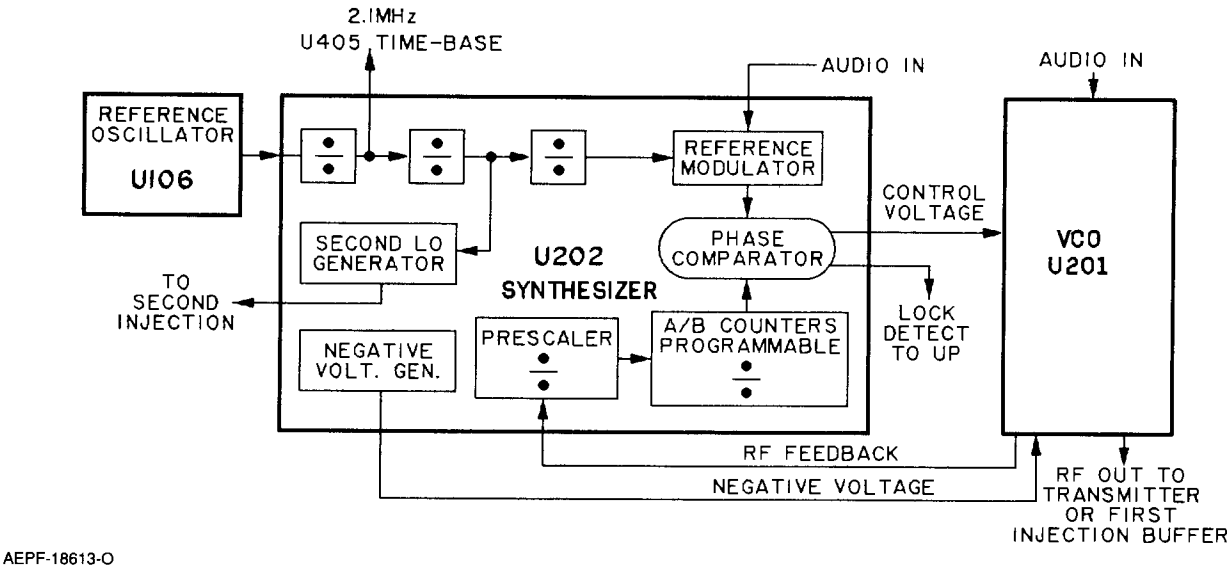


Figure 5B. Frequency Generation Circuits (VHF & UHF Radios)

e. Basic Receiver Operation *(See Figure 6)*

The MT1000 uses double-conversion superheterodyne receiver circuits to provide greater image-signal suppression and improved adjacent channel selectivity. The receiver consists of three main sections:

- radio frequency (rf) circuits
- intermediate frequency (i-f) circuits
- audio frequency (af) circuits

(1) RF Signal Path

The rf signal is received by the antenna and coupled to a two-pole bandpass filter through the antenna switch. The output of the two-pole filter is amplified by an rf amplifier (Q1). The output of the amplifier is then coupled through a three-pole bandpass filter, and applied to the rf input of the first mixer stage (Q2/CR5 for lowband, or CR2/T2 for wideband). An injection signal (FIRST LO) is applied to the second input of the mixer, resulting in an output difference frequency of 53.55 MHz (19.95/16.65 MHz for lowband), which is the first i-f frequency. In wideband radios (146-174 MHz), the signal is applied to post mixer amplifier Q2.

(2) I-F Signal Path

The first i-f signal is passed through highly selective crystal filters (FL1 and FL2) to circuit module U1, where it is mixed with a second oscillator injection signal (SECOND LO) to produce the second i-f frequency of 450 kHz. The low conversion signal is then filtered via highly selective ceramic filters (FL3 and FL4), amplified, and demodulated. The resultant signal (RECOVERED AUDIO) is sent to the audio filter (U405) on the controller flex. Module U1 also contains a squelch detect circuit.

(3) Audio Signal Path

Recovered audio from U1 is received by the audio filter IC (U405). The audio filter performs basically two functions in the receive mode. It filters, de-emphasizes, and attenuates the voice audio, and routes the signal to the volume control. Secondly, if the radio is receiving a coded signal, U405 low-pass filters the audio and seperates the subaudible PL/DPL tones. The tones are filtered, sampled and then sent to the microcomputer for decoding.

After passing through the volume control, the audio is sent to audio PA IC (U406), which amplifies the audio and drives the speaker. The audio amplifier consists of three separate amplifiers; an internal speaker amplifier, an external speaker amplifier, and a common amplifier. If the internal speaker is selected, it is differentially driven by the internal and common amplifiers. If the external speaker is selected, it is driven by the external and common amplifiers.

Squelch circuitry resides in the i-f module (U1). Discriminator noise from U1 is sent to U405, where the noise is passed through a programmable attenuator (squelch control) and sent back to U1. The squelch circuits in U1 detect demodulator signal-to-noise ratio and produce a dc logic output (5 volts when carrier is present). This output is read by the microcomputer, which in turn programs the audio filter (U405) to enable the audio power amplifiers on U406.

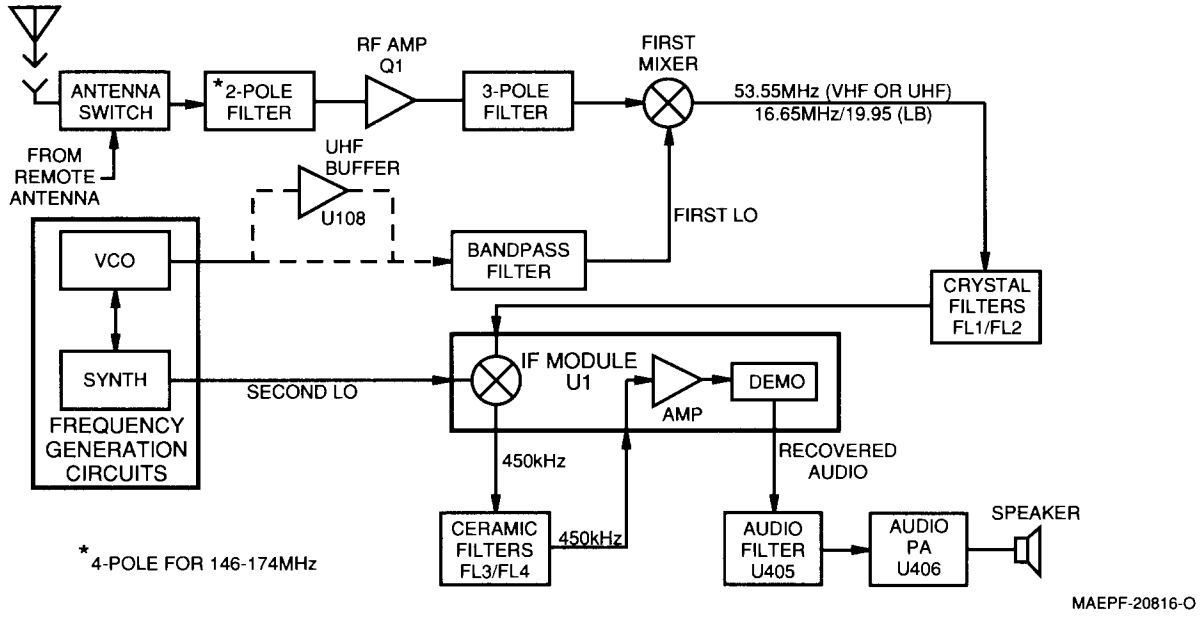


Figure 6. Receiver Block Diagram

f. Basic Transmitter Operation *(See Figure 7)*

The transmitter (excluding the frequency generation and distribution circuits described in earlier paragraphs) comprises two main circuits:

- Audio circuitry
- RF power amplifiers

(1) Audio Signal Path

When the PTT switch is pressed, audio from the microphone is fed to the input of the mic amplifier in U406. The amplified audio is then sent to an audio filter IC (U405), which pre-emphasizes, limits, and low-pass filters the audio. IC U405 also generates squelch codes, which are summed with the voice audio. The audio is then passed through programmable attenuators and sent to the reference modulator and VCO to be modulated.

(2) UHF Low Power Modulated RF Signal Path

The modulated rf carrier from the VCO/synthesizer is applied through a transmit buffer stage to three consecutive stages of amplification: pre-driver, driver, and rf power amplifier. Low power UHF radios output 2 Watts of rf power.

(3) UHF High Power Modulated RF Signal Path

High power UHF radios output 4 Watts of rf power, by means of four consecutive stages of amplification: pre-driver, driver, intermediate power amplifier (IPA), and final rf power amplifier.

(4) VHF Modulated RF Signal Path

VHF radios are available in low (2 Watt) and high (5 Watt) power models. In both models, the modulated rf carrier is applied directly from the VCO/synthesizer to three consecutive stages of amplification: pre-driver, driver, and final rf power amplifier. The difference in power output between low and high power radios is achieved using different final rf power transistors.

Wideband radios include an additional circuit, automatic level control (ALC), which operates as a feedback network, monitoring the PA current and controlling the collector voltage to the driver stage. As the power amplifier draws more current, the ALC circuit reduces the drive to the PA, limits the current, and controls the power output. This stage contributes to increasing the radio's battery life.

(5) Lowband Modulated RF Signal Path

The modulated rf carrier is applied directly from the FGU to three consecutive stages of amplification: pre-driver, driver, and final rf power amplifier.

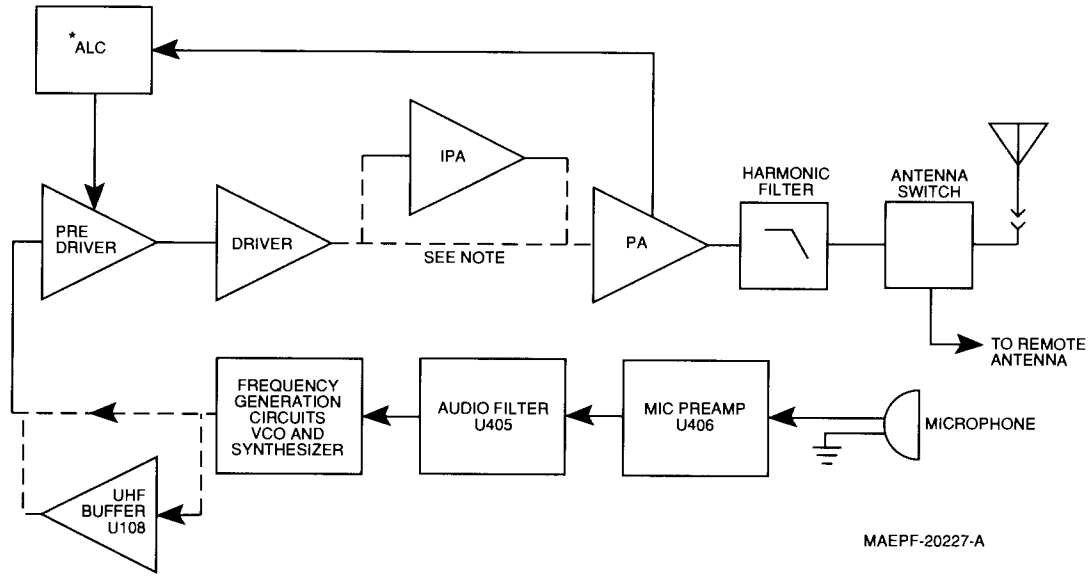
3. DETAILED CIRCUIT DESCRIPTION

The circuit descriptions contained in the following paragraphs are supplemented with simplified schematic diagrams to help the service technician understand the signal processing in various parts of the radio. They are not intended for troubleshooting or servicing. Refer to the complete schematic diagram in this manual when repairing a radio. **When signal tracing on the schematic diagram, pay particular attention to the circles and squares around the module's pin numbers. Circles denote connections to the controller flex; squares denote connections to the main circuit board.**

a. DC Switch

(1) VHF and UHF Radios

The dc switch controls voltages being applied to the receiver and transmitter circuits. These voltages are R (10V) and R5 (5V) for receive, and T (10V) and T5 (5V) for transmit. The DC switch consists of module



NOTE: IPA STAGE ONLY ON UHF HIGH-POWER MODELS
*FOR 146-174 MHz ONLY

Figure 7. Transmitter Block Diagram

U403, transistors Q403 thru Q407, Q412, Q413, Q416, resistors R421 thru R424, R427, R428, and diodes CR403 through CR407. Transistors Q403 and Q405 drive the T voltage line while transistors Q404 and Q406 drive the R voltage line. R5 and T5 voltages are provided via transistors Q407 and Q412 respectively. The DC switch receives its supplies from fused 10V, B, and the five-volt regulator (Q400 collector). Module U403 responds to the R/T line from U405 pin 40, which is controlled by the microcomputer. In transmit the R/T line is low (0 volts) and in receive the R/T line is high (5 volts).

The microcomputer monitors the LOCK DETECT line from the synthesizer (U202 pin 7). When the LOCK DETECT line is low, indicating a frequency lock condition, the microcomputer signals U405, via the microprocessor interface, to switch the output at U405 pin 39 low. This low is applied to diode CR405, which supplies a ground path for the emitters of transistors Q405 and Q406. These emitters must have this ground path so that the R/T line can forward bias Q405 or Q406, activating the T or the R line, respectively.

In transmit (synthesizer locked), the R/T line is at 0 volts. The R/T low is fed to the input of an inverter on U403. The output of the inverter turns on transistors Q416, Q405, and Q403 to activate the T voltage line (Q403 collector). The R/T low is also fed to the base of transistor Q412, which turns on Q412 and activates the T5 voltage line (Q412 collector).

In receive (synthesizer locked, Battery Saver - off, U202 pin 3 high), the R/T line is at 5 volts. The R/T high is fed to the input of U403 where it is NANDed with the high on the BATTERY SAVER line (U403 pins 8 and 7 respectively). The resulting low at the NAND gate output forward biases transistor Q407, which activates the R5 voltage line (Q407 collector). Also, the low output from the NAND gate is inverted and the high output at U403 pin 14 turns on Q406 and Q404 to activate the R voltage line (Q404 collector). When the R voltage line is activated, Q413 is forward biased, which supplies drive voltage for the green LED (CR501A).

If the battery saver option is programmed into the radio, the microcomputer programs the synthesizer to strobe the R and R5 lines via the BATTERY SAVER line. The battery saver signal is a square wave which is NANDed with the 5 volts on the R/T line. The strobing of the receive voltages reduces current drain when the radio is in the stand-by condition.

Another part of the dc switch circuit is an 8-volt regulator. The 8-volt reguator consists of module U407, transistor Q410, and resistors R447, R448, and R446. Module U407 is a five-volt regulator which is offset to 8 volts by R447 and R448. Transistor Q410 is a pass transistor which increases the regulators current sourcing ability. The 8 volts is applied to the audio PA (U406 pin 9) and also applied to the base of Q415, which supplies approximately 6.6V S+ to the synthesizer at U202 pin 4.

(2) Lowband Radios

Lowband radios utilize two dc switches; one on the transceiver board and the other on the controller flex.

The **transceiver dc switch** consists of module U3, diodes CR3 and CR4, and resistors R6 and R7. During receive, the RCTRL line is high, turning on module U3 to supply the receive voltage, R (10 V), to transistors Q1 and Q2. Diode CR4 is a protective device which guards against short circuiting. If the R voltage line should short, U3 pin 5 is pulled low (approximately 0.7V), disabling B+ from the R line.

Another part of the transceiver dc switch is the seven-volt regulator, which consists of module U102, capacitor C137, and resistors R112 and R113. Module U102 is a five-volt regulator which is offset to 8 volts through resistors R112 and R113. Capacitor C137 is used to bypass low frequency noise. The 7-volt regulator supplies power to the frequency generation unit, U201.

The **controller flex dc switch** consists of module U403, transistors Q403, Q405, and Q416, and associated circuitry. Transistors Q403 and Q405 drive the T voltage line. The dc switch receives its supply from fused 10V, B, and the five-volt regulator (Q400 collector). Module U403 responds to the R/T line from U405 pin 40, which is controlled by the microcomputer. The R/T line is low (0V) in transmit and high (5V) in receive.

The microcomputer monitors the LOCK DETECT line from the FGU (U201 pin 7). When the LOCK DETECT line is low, indicating a frequency lock condition, the microcomputer signals U405, via the microprocessor interface, to switch the output at U405 pin 39 low.

In transmit (synthesizer locked), the R/T line is at 0 volts. The R/T low is fed to the input of a NOR gate on U403. The R/T low and the lock low (U405 pin 39) are NORed to give a logic output 1 This turns on transistors Q416, Q403, and Q405 to activate the T voltage line.

In receive (synthesizer locked, Battery Saver - off), the R/T line is at 5 volts. The R/T high is fed to the input of module U403, where it is NANDed with the high on the BATTERY SAVER line. The output is fed to the input of the inverter U403 pin 5, and inverted to activate the RCTRL line.

If the battery saver option is programmed into the radio, the microcomputer programs the synthesizer to strobe the RCTRL line via the BATTERY SAVER line. The battery saver signal is a square wave which is NANDed with the 5 volts on the R/T line. The strobing of the receive voltages reduces current drain when the radio is in the stand-by condition.

b. Frequency Generation and Distribution

(See Figures 8, 9, and 10)

(1) The VCO (VHF Radios - Figure 8)

The VCO (U201), in conjunction with the synthesizer (U202) and the reference oscillator (U106), generates rf in both modes of operation (receive and transmit). The VCO RF OUT signal is produced at U201 pin 7. A sample of the rf signal is routed from U201 pin 3 as a buffered feedback to a prescaler circuit in the synthesizer (U202). After frequency comparison in the synthesizer, a resultant control voltage from U202 pin 14 is received at U201 pin 12. This voltage is between 0 and 5 volts when the PLL is locked on frequency. At the same time, a negative voltage from the synthesizer is applied to U201 pin 11. This negative voltage is either -2, -4, -6, or -8 volts. The negative voltage and control voltage are applied at opposing ends of a varactor diode, which tunes the VCO to the correct frequency. The frequencies for respective - VEEs are shown in Table 2.

Five volts at U201 pin 8 places the VCO in the receive mode. During the receive condition, the VCO produces the first LO injection signal at U201 pin 7. The signal is routed to the first mixer (Q2), via a transistor buffer stage (Q3).

During the transmit condition, PTT depressed, the five volts at U201 pin 8 is removed and five volts is applied to U201 pin 2. This places the VCO in the transmit mode. During the transmit condition, the VCO generates the carrier signal, and routes it from U201 pin 7 to the pre-driver (Q102), via a transistor buffer stage (Q101). Also in the transmit mode, the audio signal to be modulated onto the carrier is received by a varactor in the VCO module at U201 pin 5.

Table 2.
Negative Voltage Vs. User Rx and Tx Frequencies

BANDSPLIT	-VEE	Rx (MHz)	Tx (MHz)
(LOWBAND)			
30.0-36.0(MHz)	-2	30.00000-33.64900	30.00000-32.29900
	-4	33.65000-36.00000	32.30000-34.49900
	-6		34.50000-36.00000
36.0-42.0(MHz)	-2	36.00000-39.64900	36.00000-38.29900
	-4	39.65000-42.00000	38.30000-40.59900
	-6		40.60000-42.00000
42.0-50.0(MHz)	-2	42.00000-46.64900	42.00000-44.69900
	-4	46.65000-50.00000	44.70000-47.69900
	-6		47.70000-50.00000
(VHF)			
136.0-151.0(MHz)	-2	136.00000-139.45000	136.00000-139.00000
	-4	139.45001-144.45000	139.00001-145.00000
	-6	144.45001-148.45000	145.00001-149.00000
	-8	148.45001-151.00000	149.00001-151.00000
146.0-162.0(MHz)	-2	146.00000-150.95000	146.00000-150.20000
	-4	150.95001-155.35000	150.20001-155.20000
	-6	155.35001-159.85000	155.20001-160.70000
	-8	159.85001-162.00000	160.70001-162.00000
157.0-174.0(MHz)	-2	157.00000-161.15000	157.00000-158.70000
	-4	161.15001-165.95000	158.70001-165.20000
	-6	165.95001-171.45000	165.20001-171.70000
	-8	171.45001-174.00000	171.70001-174.00000
(UHF)			
403.0-433.0(MHz)	-2	402.55000-410.75000	403.00000-409.60000
	-4	410.75001-418.75000	409.60001-417.20000
	-6	418.75001-427.35000	417.20001-426.00000
	-8	427.35001-433.55000	426.00001-433.00000
438.0-470.0(MHz)	-2	437.55000-444.55000	438.00000-446.00000
	-4	444.55001-454.55000	446.00000-456.00000
	-6	454.55001-462.55000	456.00001-465.00000
	-8	462.55001-470.55000	465.00001-470.00000
470.0-500.0(MHz)	-2	469.55000-477.55000	470.00000-477.00000
	-4	477.55001-486.05000	477.00001-485.20000
	-6	486.05001-494.05000	485.20001-494.50000
	-8	494.05001-500.55000	494.50001-500.00000
488.0-520.0(MHz)	-2	487.55000-495.55000	488.00000-496.50000
	-4	495.55001-504.25000	496.50001-504.80000
	-6	504.25001-513.25000	504.80001-514.40000
	-8	513.25001-520.55000	514.40001-520.00000

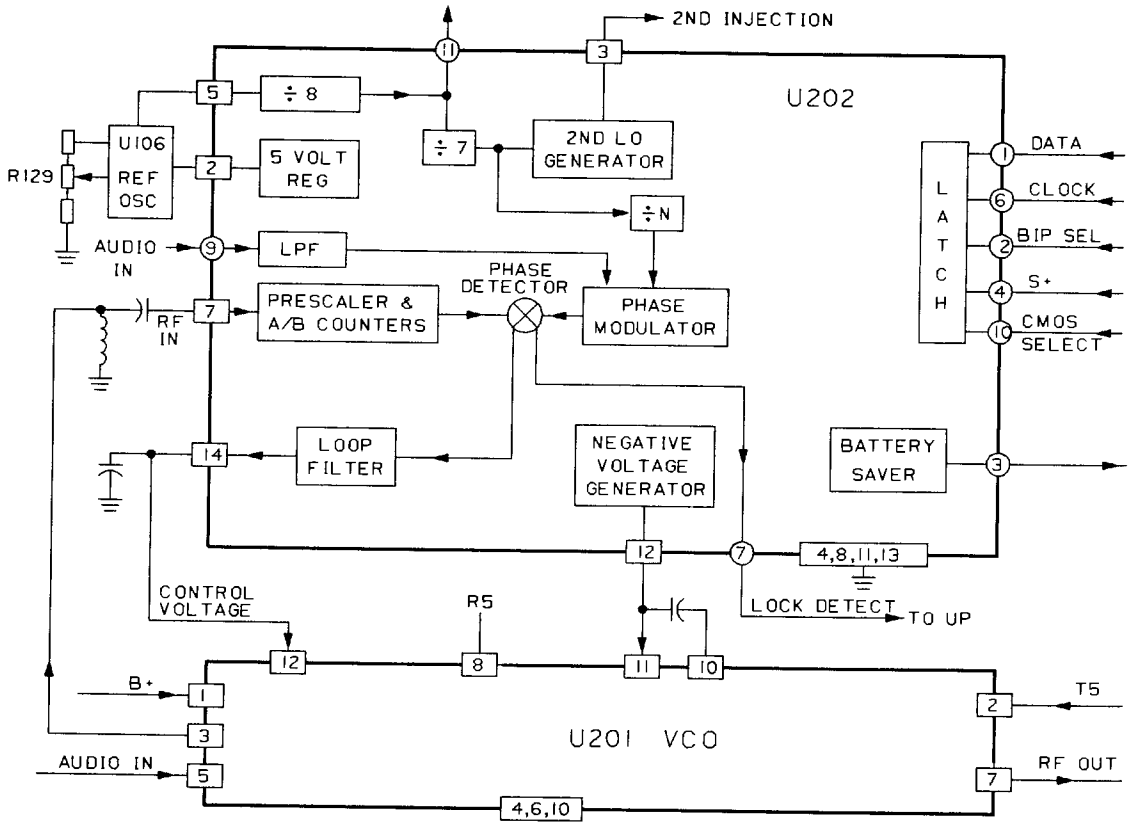


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Figure 8. VCO/Synthesizer Block Diagram, VHF

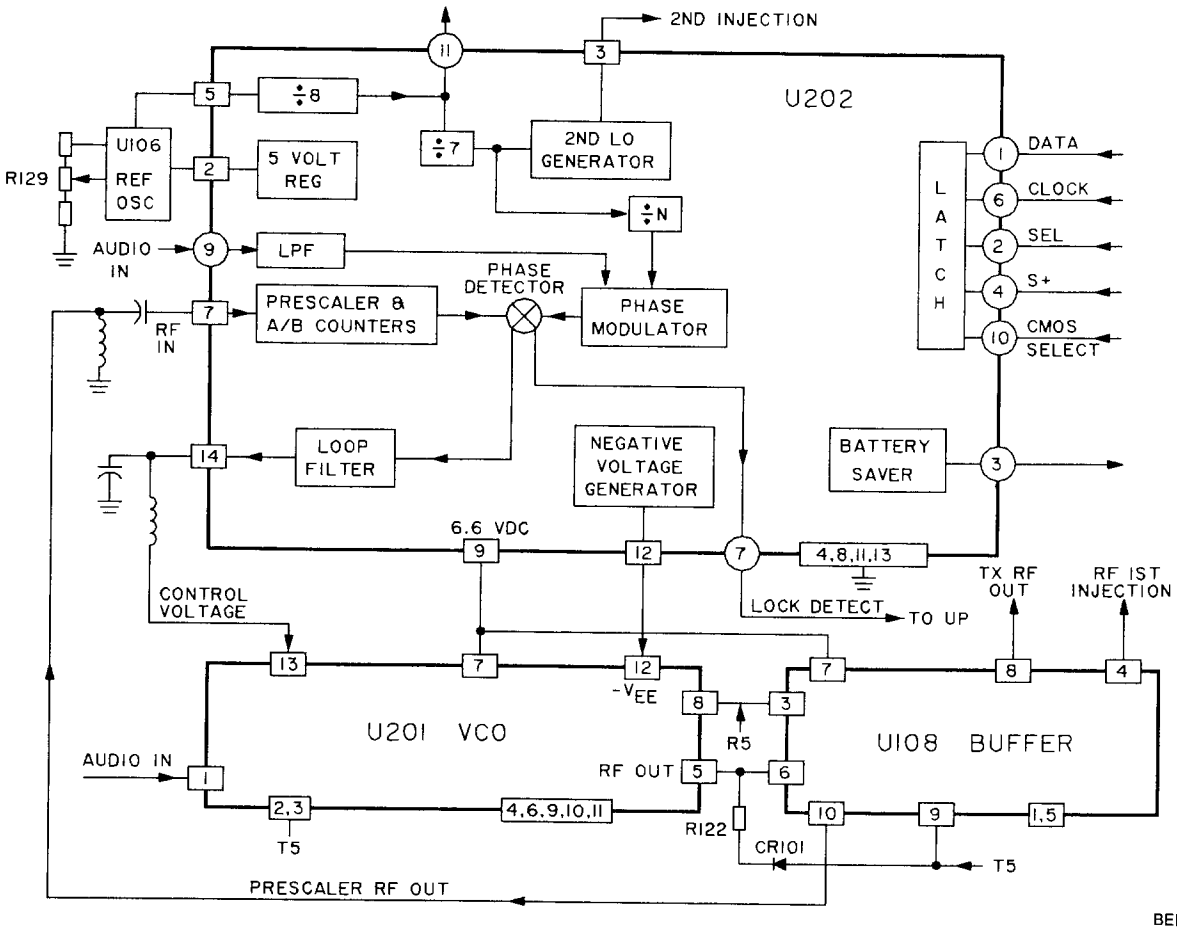

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Figure 9. VCO/Synthesizer Block Diagram, UHF

(2) The VCO (UHF Radios - Figure 9)

The VCO (U201), in conjunction with the synthesizer (U202) and the reference oscillator (U106), generates rf in both modes of operation (receive and transmit). The VCO rf output, produced at U201 pin 5, is routed to the VCO buffer (U108). A sample of the rf signal is routed from U108 pin 10 (PRE-SCALER RF OUT) as a buffered feedback to a prescaler circuit in the synthesizer (U202). After frequency comparison in the synthesizer, a resultant control voltage from U202 pin 14 is received at U201 pin 13. This voltage is between 0 and 5 volts when the PLL is locked on frequency. At the same time, a negative voltage from the synthesizer is applied to U201 pin 12. This negative voltage is either -2, -4, -6, or -8 volts. The negative voltage and control voltage are applied at opposing ends of a varactor diode, which tunes the VCO to the correct frequency. The frequencies for respective negative voltages are shown in Table 2.

In the receive mode, five volts (R5) is applied to U201 pin 8 and U108 pin 3, which places the VCO in the receive mode and enables a receive injection buffer in U108. The rf signal (first LO injection) at U201 pin 5 is received at U108 pin 6 (VCO IN). The buffer stage in U108 routes this signal (RF INJECTION OUT), via U108 pin 4, to the first mixer (Q2).

During the transmit condition (PTT depressed), the five volts at U201 pin 8 and U108 pin 3 is removed. Five volts is applied to U201 pin 3 and U108 pin 9, which places the VCO in the transmit mode and enables a transmit buffer in U108. During the transmit condition, the VCO generates the carrier signal, and routes it from U201 pin 5 to U108 pin 6 (VCO IN). The buffer stage in U108 routes this signal (Tx RF OUT), via U108 pin 8, coil L101, capacitor C105, and coil L116, to the pre-driver Q102. Also in the transmit mode, the audio signal to be modulated onto the carrier is received by a varactor in the VCO module at U201 pin 1.

(3) The Synthesizer (VHF and UHF Radios)

The microcomputer (U401) reads the code plug (U402) and sends set-up signals, which are received by the synthesizer (U202) latch circuit. These set-up signals determine the correct negative voltage and the A/B counter divide ratios needed to generate the proper rf frequencies. The reference frequency for the synthesizer/VCO phase-locked loop is provided by a 16.8MHz crystal oscillator (U106), which is fine-tuned by resistor R129. The 16.8MHz crystal oscillator frequency is divided, first to 2.1MHz and then to 300kHz. The 300kHz signal is used for two different applications in the synthesizer.

First, the 300kHz reference frequency is applied to an internal phase-locked loop circuit (within the synthesizer), which generates the receiver's second LO injection signal. The second LO injection frequency of 53.1MHz (for low-side injection) or 54.0MHz (for high-side injection) is routed from U202 pin 3 to the second mixer stage in I-F module U1.

Secondly, the 300kHz frequency is further divided to produce a VCO/synthesizer PLL reference frequency of 5.0kHz (or 6.25kHz), which is applied to a phase modulator. In the transmit mode, the phase modulator modulates audio below 60Hz (PL/DPL tones, U202 pin 9) onto this reference signal. The reference signal is then fed, as one of two inputs, to a phase detector. The second input signal to the phase detector comes from the VCO (U201 pin 3, VHF radios) or from the VCO buffer (U108 pin 10 UHF radios). This second signal (RF IN) is received by the synthesizer at U202 pin 7, divided by a prescaler circuit, divided again by an A/B counter circuit, and then applied to the phase detector. The phase detector circuit compares the two input signals. If the frequencies are not the same, a CONTROL VOLTAGE (error voltage) is generated and sent to the VCO, ultimately pulling the PLL on frequency. When the two frequencies are the same, the phase detector outputs a low on the lock detect line. This lock detect low is routed to the microcomputer, which in turn sets up radio transmit and receive voltages. Refer to the "DC SWITCH" section for a more detailed explanation.

(4) The Frequency Generation Unit, FGU (Lowband Radios, Figure 10)

In lowband radios, the VCO, buffer, and synthesizer functions are performed by a single module, the frequency generation unit, FGU (U201). The FGU module, in conjunction with the reference oscillator (U106), generates rf in both modes of operation (receive and transmit). In the FGU, two sections (a synthesizer section and a VCO/Buffer section) interact with each other to produce the necessary voltages and signals for rf generation. The FGU receives its power (VSS) from a 7.0 volt regulator at U102 pin 3, via interconnect point J8-4.

Within the VCO/buffer stage, an rf output is routed from the VCO to the buffer. A sample of this signal, PRESCALER OUT, is passed from the VCO/buffer to a prescaler circuit in the synthesizer section. After a frequency comparison in the synthesizer, a resultant control voltage is routed, via a loop filter in the synthesizer, back to the VCO/buffer. The voltage is between 0 and 5 volts when the PLL is locked on frequency. At the same time, a negative voltage from the synthesizer is applied to the VCO. The negative voltage and control voltage are applied at opposing ends of a varactor diode, which tunes the VCO to the correct frequency. These signals and voltages are not accessable on the main circuit board.

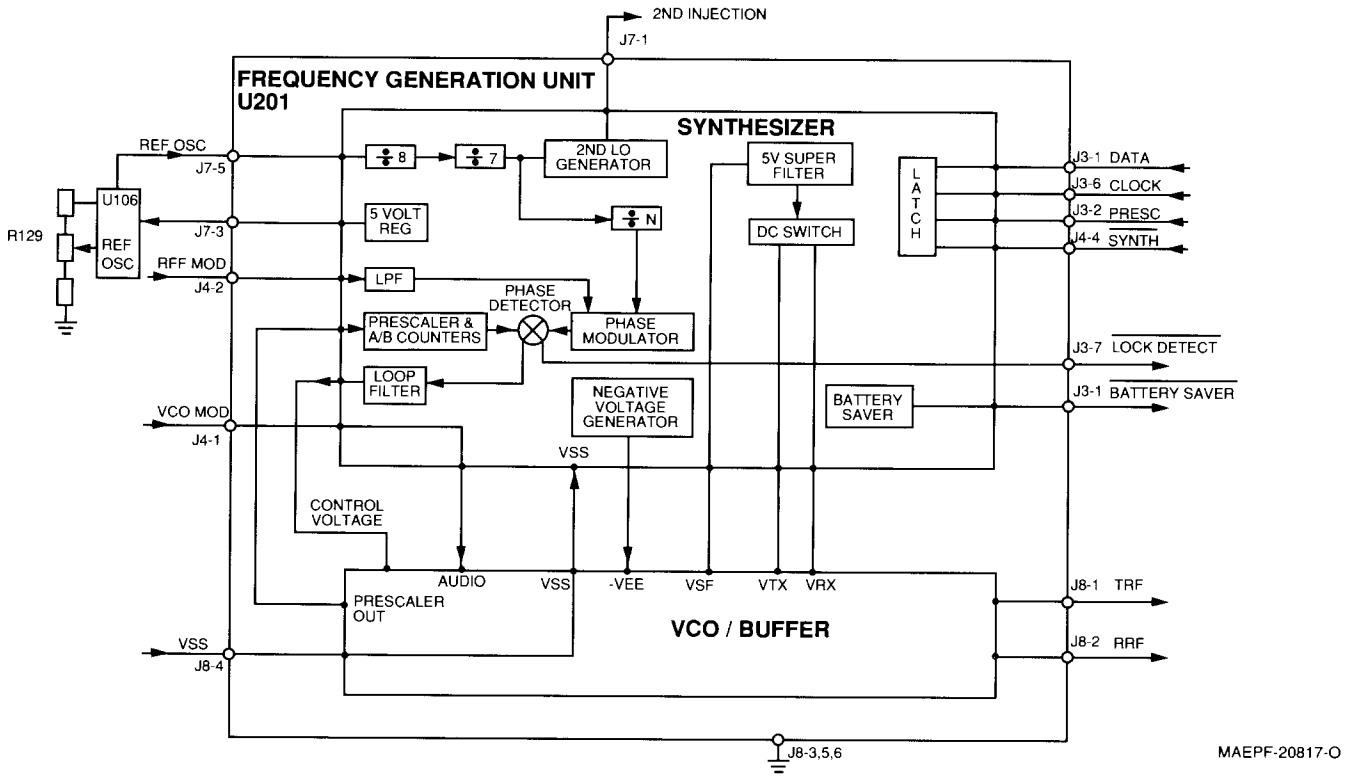

Figure 10. Frequency Generation Unit (Lowband Radios)

In the receive mode, five volts (VRX) from a dc switch in the synthesizer is applied to and enables the VCO buffer. The weak signal from the VCO is amplified by the buffer, and the resulting signal (RFF) is applied to the first injection filter via interconnect point J8-2.

During the transmit condition (PTT depressed), five volts (VTX) from a dc switch in the synthesizer is applied to and enables the transmit buffer. The resulting signal (TRF) is routed to the transmitter via interconnect point J8-1. Also in the transmit mode, the audio signal to be modulated onto the carrier (VCO MOD) is received in the synthesizer at interconnect point J4-1, and routed to a varactor in the VCO.

Synthesizer- The microcomputer (U401) reads the codeplug (U402) and sends set-up signals, which are received by the synthesizer latch circuit. These set-up signals determine the correct negative voltage and the A/B counter divide ratios needed to generate the proper rf frequencies. The reference frequency for the synthesizer/VCO phase-locked loop is provided by a 16.8MHz crystal oscillator (U106), which is fine-tuned by resistor R120. The 16.8MHz crystal oscillator frequency is divided first to 2.1MHz (÷8) and then to 300kHz. The 300kHz signal is used for two different applications in the synthesizer. Lowsplit (30-36MHz) radios may use a 2.1MHz reference oscillator which is fine tuned with an external fixture.

First, the 300kHz reference frequency is applied to an internal PLL circuit (within the synthesizer), which generates the receiver's second LO injection signal. The second LO is 19.5MHz (for low-side injection) or 20.4MHz (for high-side injection) for low-split radios, and 16.2MHz (LSI) or 17.1 (HSI) for mid- and high-split radios. This signal is routed to the i-f module U1 via interconnect point J7-1.

Secondly, the 300kHz frequency is further divided to produce a VCO/synthesizer PLL reference frequency of 5.0kHz (or 6.25kHz), which is applied to a phase modulator. In the transmit mode, the phase modulator modulates audio below 60Hz (PL/DPL tones) onto this reference signal. The reference signal is then fed, as one of the two inputs, to a phase detector. The second input to the phase detector comes from the VCO. This second signal is received by the synthesizer, divided by a prescaler circuit, divided again by an A/B counter circuit, and then applied to the phase detector. The phase detector circuit compares the two input signals. If the frequencies are not the same, a control voltage (error voltage) is generated and sent to the VCO, ultimately pulling the PLL on frequency. When the two frequencies are the same, the phase detector outputs a low on the LOCK DETECT line. This LOCK DETECT low is routed to the microcomputer, which in turn sets the radio transmit and receive voltages. Refer to the "DC SWITCH" section for a more detailed explanation.

c. Controller *(See Figure 11)*

Module U401 is a single chip, 8-bit microcomputer which performs control and processing functions. It works in conjunction with the code plug which store the radio personality in its non-volatile memory. The microcomputer controls three data buses; the code plug bus, the synthesizer module/audio filter IC bus, and the radio programming bus.

The code plug data bus is bi-directional, meaning that data can be sent to or received from the code plug. When the microcomputer wants to access the code plug it will pull CODE PLUG POWER (U401, pin 37) low, turning on the supply to the code plug(s) through Q402. The microcomputer will then transmit the address of the data to the code plug on the data bus by toggling CODE PLUG CLOCK (U401, pin 34). The data will be available on CODE PLUG DATA (U401, pin 35). During a read instruction, data is input to the microcomputer from the code plug. During a write instruction, data is output from the microcomputer to the code plug(s).

The synthesizer module/audio filter IC programming bus is uni-directional, meaning that data is sent from the microcomputer to the synthesizer module (U202)/audio filter IC (U405). The bus is synchronous and the flow of data is controlled by SPI CLOCK (U401, pin 14). The data appears on SPI DATA (U401, pins 10 and 11).

- In vhf and uhf radios, the synthesizer module has two separate programming latch circuits which are controlled by BIPOLAR SEL (U401 pin 8) and CMOS SEL (U401 pin 7). When programming the synthesizer module, the microcomputer first pulls BIPOLAR SEL low and sends data using SIP CLOCK and SIP DATA. BIPOLAR SEL is then pulled high and CMOS SEL is pulled low. The microcomputer again sends data using SIP CLOCK and SIP DATA. When data transfer is complete, CMOS SEL is pulled high. The synthesizer module is now programmed for the new operating frequency. To program the audio filter IC, AF SELECT (U401 pin 9) is pulled low. The data is transfered using SIP CLOCK and SIP DATA. When the data transfer is complete, AF SELECT goes high.
- In lowband radios, the synthesizer module has two separate programming latch circuits which are controlled by PRESC (U401 pin 17) and SYNTH (U401 pin 16). When programming the synthesizer module, the microcomputer first pulls PRESC low and sends data using SIP CLOCK and SIP DATA. PRESC is then pulled high and SYNTH is pulled low. The microcomputer again sends data using SIP CLOCK and SIP DATA. When data transfer is complete, SYNTH is pulled high. The synthesizer module is now programmed for the new operating frequency. To program the audio filter IC, AF SELECT (U401 pin 18) is pulled low. The data is transferred using SIP CLOCK and SIP DATA. When the data transfer is complete, AF SELECT goes high.

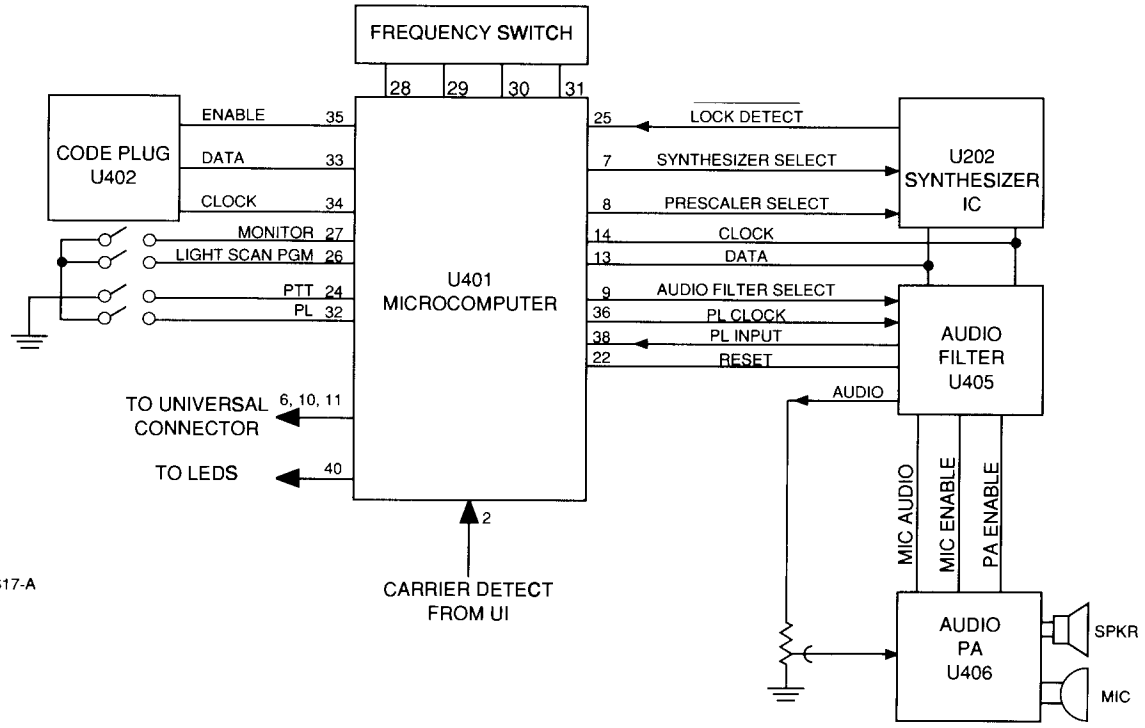

Figure 11. Microcomputer Interface (VHF and UHF Radios)

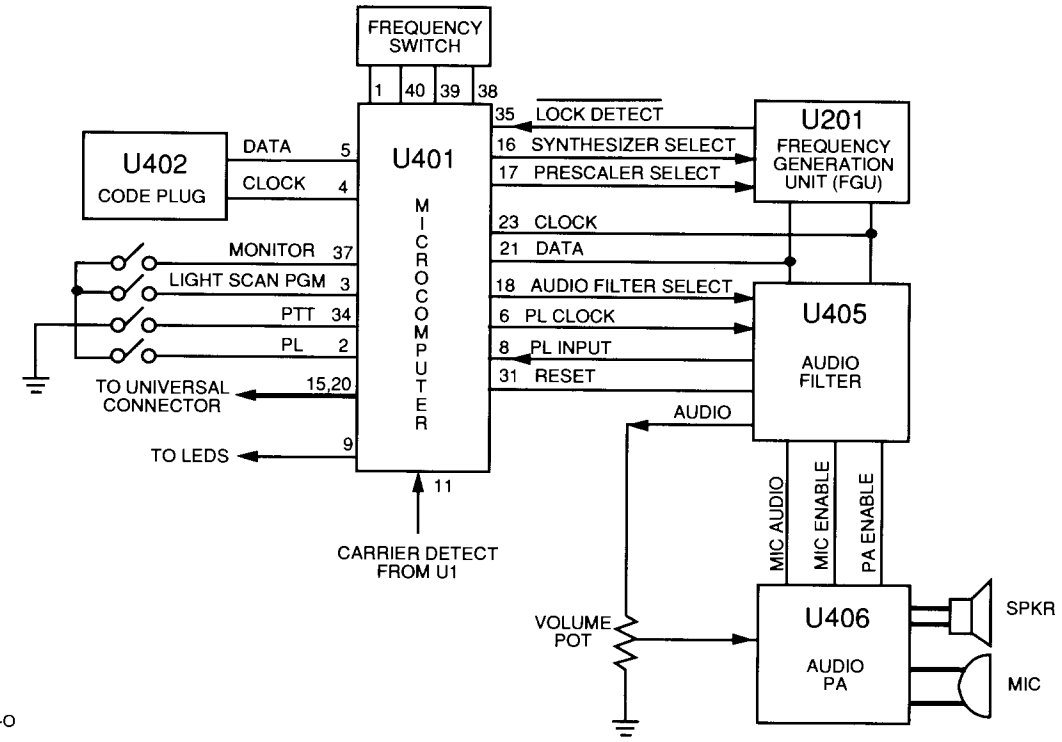

Figure 12. Microcomputer Interface (Lowband Radios)

The radio programming bus is bi-directional, meaning that data can be sent to or received from the microcomputer. The bus is asynchronous and data is sent or received on SCI DATA (U401, pins 10 and 11 for vhf and uhf radios, or pins 20 and 15 for lowband radios). The flow of data is controlled by $\overline{\text{BUSY}}$ (U401, pin 6). A low on the $\overline{\text{BUSY}}$ line indicates that a message exists on the DATA line.

(1) Microcomputer (U401) functions

- Read the PTT and channel selector status, and program the synthesizer module (U202) for the desired operating frequency using the data stored in the code plug.
- Program the audio filter IC (U405) to set the audio output levels to the speaker, VCO module (U201), and synthesizer module (U202) in vhf and uhf radios, or FGU module (U201) in lowband radios.
- Control the dc switch circuits which supply B+ and other voltages to the receiver and transmitter at various times. It does this by signalling the audio filter IC (U405) to set the R/T line (U405, pin 40) and the dc switch enable line at U405, pin 39.
- Program the audio filter IC (U405) to unsquelch the radio when a carrier is detected, when a squelch code is detected, when an alert tone is to be generated, or when the monitor button is pressed.
- Control the flashing of the LED by turning transistor Q401 on and off.

(2) Microcomputer (U401) input/output pin functions

NOTE

The pin number listed first is for vhf and uhf radios; the pin number listed second is for lowband radios.

- **Vss** (pin 1) (pin 10) - Ground for the microcomputer.
- **CARRIER DETECT** (pin 2) (pin 11) - This input to the microcomputer goes high when a carrier is present. It is used in conjunction with CHANNEL ACTIVITY to determine if the radio should be unsquelched.
- **$\overline{\text{CVC IN}}$** (pin3) (pin12) - This input to the microcomputer is normally high. When the radio is put into a CVC, this line will be pulled low and the microcomputer will reprogram the volume attenuator in the audio filter IC (U405) to a preset value. A low on this pin causes pin 11 of U404 to go high and pin 2 of U404 to go low, resulting in audio being routed around the volume control.
- **CHANNEL ACTIVITY** (pin 4) (pin 13) - This input to the microcomputer is used to determine if carrier is present. A high on this line indicates the presence of carrier. This line is sampled several times before sampling the CARRIER DETECT line to determine if the radio should be unsquelched.
- **SELECTIVE CALL DECODE** (pin 5) (pin 14) - This input to the microcomputer is a filtered and limited signal from the demodulator used by the microcomputer to decode a selective call.
- **$\overline{\text{BUSY}}$** (pin 6) (pin 15) - This line is bi-directional and is used to indicate the presence of data on the programming bus.

- **CMOS SEL** (pin 7) or **SYNTH** (pin 16) - This output from the microcomputer is used when programming the synthesizer module (U202) for uhf and vhf, or FGU module (U201) for lowband.
- **BIPOLAR SEL** (pin 8) or **PRESC** (pin 17) - This output from the microcomputer is used when programming the synthesizer module (U202) for uhf and vhf, or FGU module (U201) for lowband radios.
- **AF SELECT** (pin 9) (pin 18) - This output from the microcomputer is used when programming the audio filter IC (U405). It is also used to reset a watchdog timer in the audio filter IC (U405), ensuring that the microcomputer is operating properly. When the microcomputer is operating properly this line will be pulsed at a periodic rate.
- **SCI DATA** (pins 10,11) (pins 19, 20) - These lines are the asynchronous, bi-directional lines used for communicating with the microcomputer.
- **SPI DATA** (pins 12,13)(pins 21, 22) - These lines are the synchronous uni-directional lines used for communicating with the synthesizer module (U202) and the audio filter IC (U405).
- **SPI CLOCK** (pin 14)(pin 23) - This output from the microcomputer is the clock line used when programming the synthesizer module (U202) or audio filter IC (U405).
- **SLAVE SELECT** (pin 15) (pin 24) - This input to the microcomputer enables the SPI CLOCK and SPI DATA lines.
- **ADAPT** (pin16) (pin 25) - This output from the microcomputer will go high whenever the channel changes and when going from transmit to receive mode. It will cause the squelch circuitry to go into a fast mode of operation.
- **LOW BATTERY** (pin 17) (pin 26) - This input to the microcomputer goes low when the radio battery voltage drops below approximately 8.5 volts. The microcomputer responds by flashing the red LED when in the transmit mode.
- **OSC1, OSC2** (pins 19,20) (pins 28, 29) - These two lines are connected to the 3.6864 MHz crystal that provides the reference clock frequency for the microcomputer.
- **Vcc** (pin 21) (pin 30) - 5-volt dc power for the microcomputer.
- **RESET** (pin 22) (pin 31) - A low on this line will reset the microcomputer. The microcomputer is reset by the watch dog timer on the audio filter IC (U404).
- **IRQ** (pin 23) (pin 32) - This pin is not used and is pulled to 5 volts through a resistor.
- **PTT** (pin 24) (pin 34) - This input to the microcomputer goes low when the PTT switch is pressed, and signals the microcomputer to enable the transmitter circuitry.
- **LOCK DETECT** (pin 25) (pin 35) - This input to the microcomputer goes low when the synthesizer is locked on frequency.
- **LIGHT/SCAN PROGRAMMING** (pin 26) (pin 36) - This input to the microcomputer goes low when the light/scan programming button is pressed. It is used to put the radio into scan programming mode.
- **MONITOR** (pin 27) (pin 37) - This input to the microcomputer goes low when the monitor button is pressed. The microcomputer will respond by turning on the audio.
- **CHANNEL SELECT** (pins 28,29,30,31) (pins 1, 38, 39, 40) - On rotary radios, channel selection is made via the freq sw (S3). Channel 1 corresponds to all pins being low, while channel 16 corresponds to all pins being high.

  On display radios; pin 28 (pin 38) is used as the clock input to the LCD driver; pin 29 (pin 39) is used as the data input to the LCD driver; pin 30 (pin 40) is the down button used for channel selection; pin 31 (pin 1) is the up button used for channel selection.
- **PL SWITCH** (pin 32) (pin 2) - This input to the microcomputer goes low when the mode select switch is in the PL mode. The microcomputer will respond by turning on the PL CLOCK (pin 36) (pin 6 for lowband) when carrier is detected.
- **SCAN SWITCH** (pin 33) (pin 3) - This input to the microcomputer goes low when the mode select switch is in the scan mode.
- **CODE PLUG CLOCK** (pin 34) (pin 4) - This output from the microcomputer is used to clock data in and out of the code plug(s).
- **CODE PLUG DATA** (pin 35) (pin 5) - This input/output from the microcomputer receives data from or sends data to the code plug(s).
- **PL CLOCK** (pin 36) (pin 6) - This output from the microcomputer is the reference clock used when encoding/decoding PL.
- **CODE PLUG POWER** (pin 37) (pin 7) - This output from the microcomputer is used to power-up the code plug(s).
- **PL DECODE** (pin 38) (pin 8) - This input to the microcomputer receives filtered and limited squelch code signal from the audio filter IC (U405).
- **LED CONTROL** (pin 40) (pin 9) - This output from the microcomputer turns on the LEDs through Q401.

d. Antenna Switch and Filters

(1) VHF Radios

The antenna switching circuitry consists of two modules, U103 and U104. Module U103 is the receiver/transmitter signal select switch. Module U104 is the remote/standard antenna select switch. Applying 10V through L116 to U103 pin 1 puts U103 in transmit mode, and creates a low impedance path between pin 1 and pin 2. Removing 10 volts from L116 causes U103 to revert to receive mode and a low impedance path exists between pin 2 and pin 4.

Grounding pin 3 of U104 selects the remote antenna while an open circuit at pin 3 selects the standard antenna. Ten volts is present at the anode of CR101 during the transmit mode to increase the bias and reduce insertion loss. Coils L115, L119, L120 and capacitors C123, C145, C148, C149, C151, and C152 provide additional filtering and matching to the antennas.

(2) UHF Radios

In transmit, 10 volts T is supplied to the antenna switch (U105 pin 4), via L114. When T is removed the antenna switch reverts to receive mode. Grounding the REMOTE ANTENNA SELECT line (pin 7) selects the remote antenna while an open circuit will select the standard antenna. In transmit, with the remote antenna selected, a low impedance path exists between pin 4 and pin 5. When the standard antenna is selected a low impedance path exists between pin 4 and pin 6. In receive, with the remote antenna selected, a low impedance path exists between pin 5 and pin 1. When the standard antenna is selected a low impedance path exists between pin 6 and pin 1. Coils L115 and L122 and capacitors C143 and C154 match the output of U108 to the standard antenna. Capacitors C151 and C185 match the remote port of U108 to the universal connector. When the remote antenna is selected, current flows via R128 and L119 to turn on the remote port. Also, when transmitting with a remote antenna, additional current is provided to the antenna switch via CR103 and R123.

(3) Lowband Radios

In transmit, 10 volts (T) is supplied to diodes CR101/CR102 via resistor R116 and coils L121 and L117. This puts a high impedance in the receiver path, which allows transmitter power to be delivered to the standard or remote port. When T is removed, the antenna switch reverts to the receive mode. Grounding the REMOTE ANTENNA SELECT line (pin 1) selects the remote antenna, while an open circuit will select the standard antenna. With the remote antenna selected, a low impedance path exists between pin 4 and pin 5. When the standard antenna is selected, a low impedance path exists between pin 4 and pin 2. Coil L120 and capacitors C126, C127, and C128 match the output of U103 to the standard antenna. Inductor L118 and capacitors C123, C124, and C125 match the remote port of U103 to the universal connector. When the remote antenna is selected, current flows via resistor R115 to turn on the remote port.

e. Receiver Selectivity and RF Amplifier

The received signal at the antenna is routed through the antenna switch and antenna matching networks, and applied to the receiver rf front end for filtering and amplification.

(1) VHF Radios (136-150.8 MHz)

There are 5 poles of filtering for rf front end selectivity. Coils L1, L2, and capacitors C1 thru C5 form a two-pole tuned butterworth filter with a bandwidth of greater than 16 MHz. Capacitor C8 thru C14 together with coils L3, L4, and L5 form a 3-pole Chebychev filter with a bandwidth of 16 MHz. The rf amplifier (Q1) is a low noise rf transistor, configured in the common-base mode for good intermodulation performance. Transistor Q1 is biased when the R5 voltage is applied to the resistor divider of R1 and R2. Capacitor C21 provides a good rf ground to the base of Q1. The weak rf signal from the two-pole filter is fed to the emitter of Q1, and the amplified signal is available at the collector.

(2) VHF Radios (146 - 174 MHz)

There are 7 poles of filtering for rf front end selectivity. Coils L1 thru L4 and capacitors C1 thru C12 form a 4-pole fixed tuned Chebychev filter with a bandwidth of greater than 28 MHz. The rf amplifier (Q1) is a low noise rf transistor, configured in the common emitter mode. Transistor Q1 is biased when the R voltage is applied to the resistor divider of R1, R2, and R4. The weak rf signal from the four-pole filter is fed to the base of Q1, and the amplified signal is available at the collector. Coils L5 thru L7 and capacitors C13 thru C19 form a 3-pole fixed tuned mesh Chebychev filter with a bandwidth of greater than 28 MHz.

(3) UHF Radios

Tunable preselectors L1 and L2 form a two-pole tunable butterworth filter with a bandwidth of greater than 8 MHz. Capacitors C1, C2, C3, resistor R1, and coil L3 match the output of the preselector's to the input of the rf amp (Q1). Capacitors C41 and C49 improve the preselector's performance. Transistor Q1 is configured in the common-emitter mode. The amplified rf signal is available at the collector and is matched to the 3-pole fixed tuned preselector (L5, L6, and L7) by L4, C6, and C7. Capacitors C35, C36, and C37 improve preselector performance. In some bandsplits C7, C35, C36, C37, and C41 are replaced by 0-ohm resistors. The 3-pole filter has a bandwidth of greater than 30 MHz. Capacitor C8 and coils L8 and L16 match the output of the 3-pole filter to the input of the mixer (Q2).

(4) Lowband Radios

There are 5 poles of filtering for rf front end selectivity. Coils L1, L2, L3, and capacitors C1 thru C4 form a 2-pole tuned Butterworth filter with a bandwidth greater than 6 MHz (for low and mid split radios), or greater than 8 MHz (for high split radios). Coils L4, L5, and L6, together with their associated components, form a 3-pole Chebyshev filter. Different coupling techniques are used on the three band splits. On low slpit radios, the filters are capacitively coupled using capacitors C33 and C34; on mid split radios, mixed coupling is used with capacitor C33 and inductor L15; on high split radios, inductive coupling is used with coils L14 and L15. The three different coupling approaches are used to obtain the best image rejection.

The rf amplifier (Q1) is a low noise rf transistor, configured in the common-emitter mode for high gain. Collector voltage shunt feedback through resistor R15 and capacitor C35 is used to improve the linearity of the rf amp for better intermodulation. Resistors R1, R2, and R3 provide the dc biasing for transistor Q1. The incoming rf signal from the 2-pole filter is fed to the base of transistor Q1, and the resultant amplified signal at the collector of Q1 is coupled to the 3-pole filter using capacitive, inductive, or mixed coupling, which is dependent on the band split of the radio.

f. Receiver First Mixer, Crystal Filter, and Injection Buffer

(1) VHF Radios (136-150.8 MHz)

Transistor Q2, a dual-gate MOSFET, is used as the first mixer stage. The rf signal from the three-pole filter is fed to the source of Q2. The first injection signal from the VCO, via buffer transistor Q3, is introduced at gate 1. The output of Q2 is taken from the drain. The difference signal of 53.55 MHz is the desired i-f output.

The first or high i-f is fed to filter FL1 / FL2 , which is a four-pole quartz crystal filter resonant at 53.55 MHz. The filter provides about 28 dB of adjacent channel protection. Components C20, C19, L12, C37, C24, L7, L8 C25, C26, and C27 provide matching for the crystal filters. The i-f signal is then passed to the i-f module (U1) for further signal processing.

Transistor Q3 is in cascade with an open-collector transistor located within the VCO module (U201). Biasing of Q3 (common base) occurs when the R5 voltage is applied to the voltage divider of R13 and R14. Capacitor C36 insures a good rf ground at the base. Transistor Q3, together with coils L9, L10 and capacitors C30, C32, and C35, provide buffering and rejection of unwanted harmonics on the injection string.

(2) VHF Radios (146 - 174 MHz)

The ring mixer (CR2) is used to down convert the rf signal from the 3-pole filter to the first i-f frequency of 53.55 MHz. The mixer is followed by a diplexer consisting of L31, L32, C31, R31, and R32. The diplexer is followed by the i-f amplifier (Q2) which provides 9dB of gain.

The first i-f frequency is fed to filters FL1/FL2, which are 4-pole, quartz crystal filters resonant at 53.55 MHz. The filters provide about 28dB of adjacent channel protection. Capacitors C38 and C42 and coils L34, L35, and L36 provide impedance matching for the crystal filters. The signal is then passed to the i-f module (U1) for further signal processing.

The VCO module (U201) provides the injection signal for the ring mixer (CR2). This signal is amplified and buffered by transistor Q3 which is in cascode with the output buffer on the VCO. Biasing of Q3 occurs when the R5 voltage is applied to the voltage divider of R62 and R61. Coil L60 and capacitor C63 provide impedance matching to the input of the ring mixer (CR2).

(3) UHF Radios

Transistor Q2, a dual-gate MOSFET, is used as the first mixer stage. The rf signal from the three-pole filter is fed to gate 1 of Q2. The first injection signal is developed by the VCO (U201) and sent to an injection buffer contained on the VCO buffer module, U108. The buffered signal is routed through a bandpass filter network consisting of C21, C22, L12, L13, C25, C31 and C30, and applied to gate 2 of the mixer. The output of Q2 is taken from the drain. The difference signal of 53.55 MHz is the desired i-f output.

The first or high i-f is fed to filter FL1 / FL2 , which is a four-pole quartz crystal filter resonant at 53.55 MHz. The filter provides about 28 dB of adjacent channel protection. Components L9, L10, L11, L14, C14, C15, C43, C29, C16, and C18 match the output of the mixer to the input of the i-f module, U1.

(4) Lowband Radios

A double-balanced mixer (CR5) is used to down convert the carrier to the intermediate frequency. The carrier and LO are coupled to the mixer via balanced transformers T1 and T2. The output of CR5 is routed to a diplexer consisting of components L9, C25, R9, R10, and C26. This diplexer is designed to terminate the mixer to 50 ohms at off-channel frequencies. The i-f signal is then amplified by an i-f amplifier (Q2), which is configured in the common-base mode. Transistor Q2 is biased via resistors R12 and R13 and inductor L12.

The output signal from the first i-f is fed to filters FL1/FL2, which are 4-pole quartz crystal filters resonant at the i-f frequency. Lowband radios use two different i-f frequencies, 19.95 MHz for the low split frequency range or 16.65 MHz for the mid and high split frequency ranges. The FL1/FL2 filter provides approximately 35dB adjacent channel protection. Components C15, C16, L12, C31, L13, and C19 impedance matching between the output of the crystal filter and the input to the i-f module, U1 pin 7. The i-f signal is passed to the i-f module (U1) for further signal processing.

A receive buffer module in the frequency generatin unit (U201)outputs the injection signal (RRF) to the ring

mixer, CR5. The RRF signal output at interconnect point J6-2 is applied to the ring mixer via a 2-pole capacitively coupled filter, which is comprised of components R5, C12, L7, C22, L8, C13, and C14. The filter circuit provides buffering to the injection frequency, and rejection to the unwanted harmonics of the injection string.

g. Receiver Second I-F and Signal Processing *(See Figure 13)*

Module U1 contains the second mixer, i-f amplifier, PLL demodulator, noise amplifier and filters, and squelch circuitry. The first i-f signal (53.55MHz for vhf and uhf radios, or 19.95MHz/16.65MHz for lowband radios) is received at U1 pin7. The second LO injection signal from the synthesizer (U202 pin 3 in vhf and uhf radios) or FGU module (U201 pin 1) is received by the mixer at U1 pin 9. The desired output frequency from the mixer is 450kHz. Therefore, the oscillator injection frequency must be 450kHz above or below the first i-f frequency. For vhf and uhf radios, the second oscillator frequency is 54MHz (high-side injection) or 53.1MHz (low-side injection). For lowband radios, the second oscillator frequency is 19.5MHz (low-side injection) or 20.4MHz (high-side injection) for the low split, or 16.2MHz (low-side injection) or 17.1MHz (high-side injection) for the mid and high splits.

The resulting 450kHz second i-f signal is filtered by the ceramic filter FL3 and FL4 to reject unwanted mixing products. The second i-f signal is then amplified and can be monitored at M1 (U1 pin 4 or 12). The signal is then demodulated and the resultant audio can be monitored at U1 pin 1. The audio is then passed to the audio filter IC (U405).

The squelch controller circuit contained in module U1 is a noise detection circuit. The noise output from the squelch controller at U1 pin 5 is routed to U405 to be attenuated by a programmable squelch attenuator. It is then fed back through U1 pin 7 to the carrier detect circuitry. When the noise level exceeds the threshold level set by the squelch pot on U405, U1 pin 9 (CARRIER DETECT line) goes low, indicating the absence of a carrier signal. The microcomputer reads this CARRIER DETECT low and programs the audio filter (U405) to turn off the power amplifiers on U406 by pulling the PA EN line (U405 pin 3) low. If the noise is less than the threshold level set by the attenuator on U405, U1 pin 9 (CARRIER DETECT line) goes high, indicating the presence of a carrier signal. The microcomputer reads this CARRIER DETECT high and programs the audio filter (U405) to turn on the power amplifiers (U406) by outputting a high PA EN signal (U405 pin 3).

h. Receiver Audio Circuitry *(See Figure 14)*

The recovered audio from U1 is routed to the audio filter IC (U405 pins 7 and 8). The audio is low-pass filtered to separate squelch codes and high pass filtered to separate voice. Squelch codes are filtered, sampled, and sent to the microcomputer (U401 pin 38). If the radio is in the PL/DPL squelch mode, the microcomputer turns on its decoding circuitry. When the squelch codes are decoded, the microcomputer sends program signals to a microprocessor interface circuit in the audio filter module (U405). The audio filter IC, via the PA EN line, turns on the audio PA IC (U406).

After high-pass filtering, voice audio is de-emphasized, filtered, sent through a programmable attenuator (volume control), and then passed from the audio filter

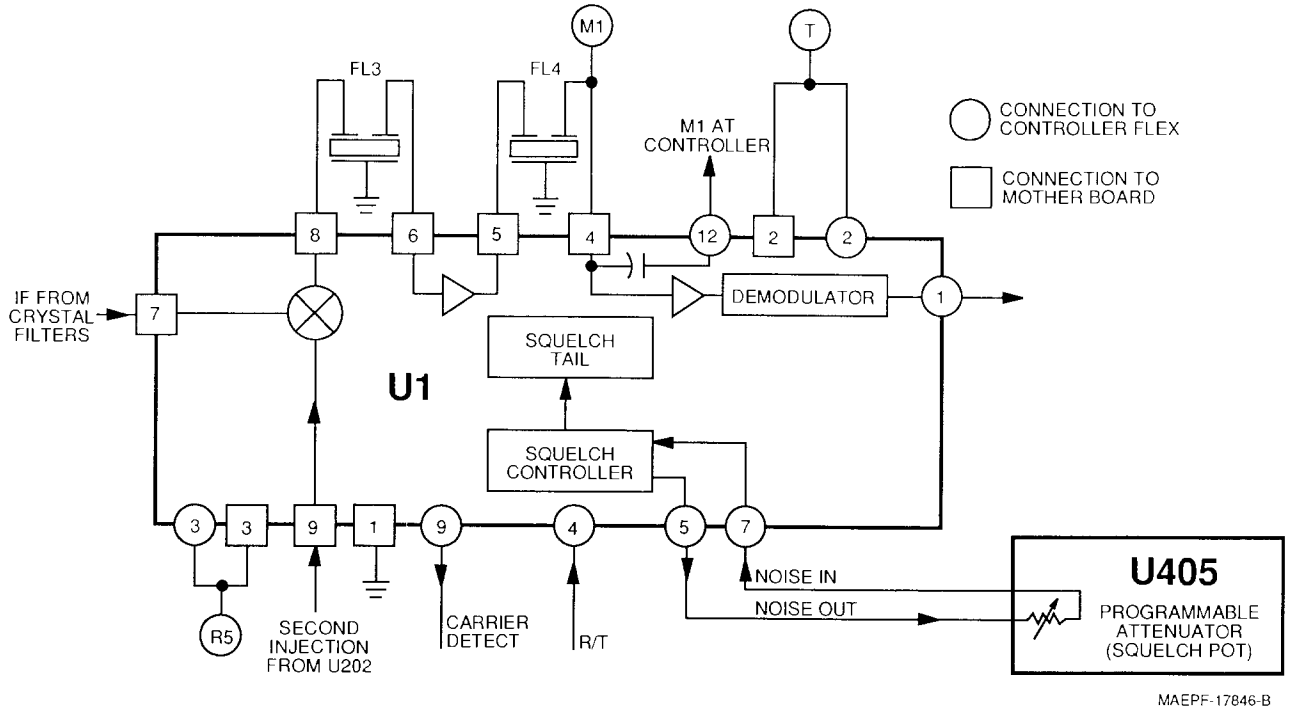

Figure 13. U1, I-F Module

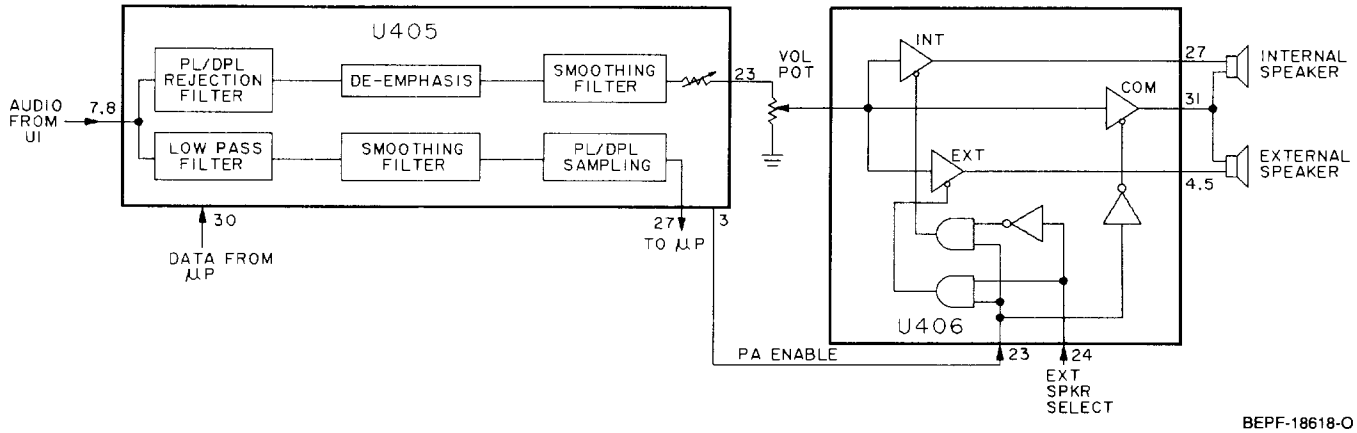

Figure 14. Receiver Audio Circuitry

to the volume pot (U405 pin 23 to R140), or through the analog switch (U404) if CVC sense is actuated. Audio is routed from the volume pot to the audio PA IC (U406 pin 10) and applied to three audio power amplifiers: internal PA, external PA and common PA. The common PA is active for both internal and external speaker applications. Without an external speaker connected, a high input at on the EXTERNAL SPEAKER SELECT line (U406 pin 24) biases the internal PA, and audio from the internal and common power amplifiers is 180 degrees out of phase, which drives the internal speaker (LS1) differentially. Audio from the common power amplifier and external power amplifier is in phase.

If an external speaker is attached to the radio's universal connector, the EXTERNAL SPEAKER SELECT line (U406 pin 24) is pulled low. This low biases the external PA and shifts the audio output of the common amplifier 180 degrees. This phase shift does two things. First, it puts the audio output from the common amplifier 180 degrees out of phase with the audio output from the external amplifier, and the external speaker is driven differentially. Secondly, audio from the common power amplifier and internal power amplifier is in phase, which results in no audio drive for the internal speaker.

i. Transmitter Audio Circuitry *(See Figure 15)*

Audio from the microphone is routed to the audio power amplifier (U406), which contains two microphone amplifiers (internal and external). Pressing the PTT switch (internal or external) pulls U401 (pin 24 for vhf and uhf radios, or pin 34 for lowband radios) low. The microcomputer reacts by programming the microprocessor interface on U405 to output a low on the R/T line (U405 pin 39). This low is inverted by U403 and applied to U406 pin 18, which enables the microphone circuits. If the internal PTT switch is pressed, a high is present at U406 pin 20, enabling the internal amplifier. If the external PTT switch is pressed, U406 pin 20 is pulled low, and the external microphone amplifier is enabled. Module U406 amplifies and high pass filters the audio. The audio signal is then routed from U406 pin 19 to the audio filter (U405 pin 10), where it is pre-emphasized, limited, and sent through a splatter filter. In PL/DPL applications, the audio is summed with the squelch codes, which are generated

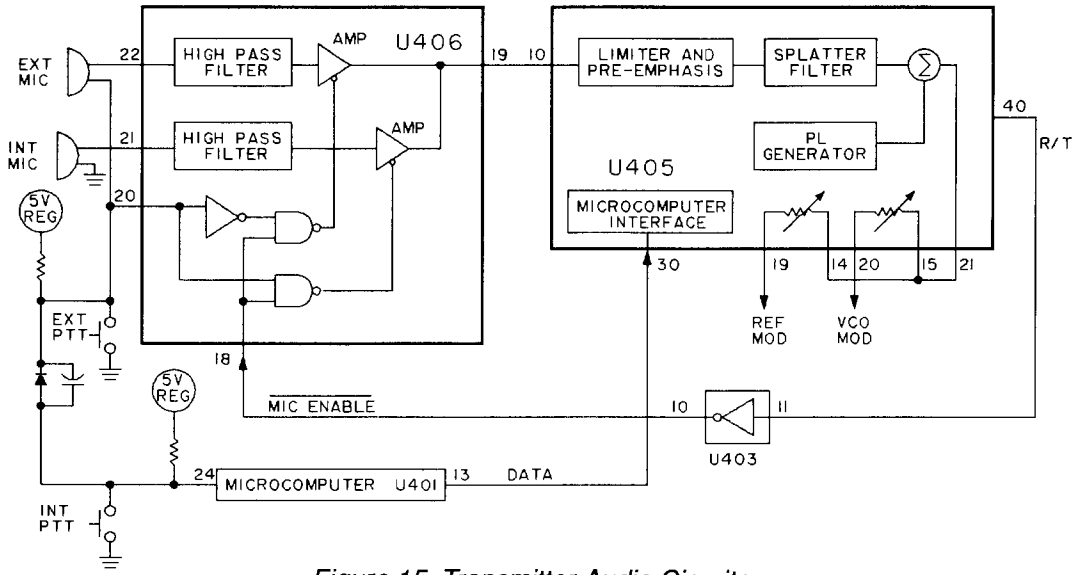

Figure 15. Transmitter Audio Circuitry

in U405. The audio is then attenuated by two programmable attenuators and the resultant audio signal is routed from U405 pin 20 to the VCO modulation port (U201 pin 5), and from U405 pin 19 to the reference modulator input at U202 pin 9.

j. Transmitter

(1) VHF Radios (136-150.8 MHz)

Transmit rf is originated in the VCO/synthesizer modules as discussed in earlier paragraphs of this manual. The rf output of the VCO (U201 pin 7) is applied to the buffer stage (Q101 and associated circuitry). Transistor Q101 is base biased by the T5 voltage via R100, and collector biased by the A voltage line via R102. The rf signal is coupled to the predriver stage (Q102) through C100 and the matching network of C101, L102, and C102. The predriver (Q102), operated class AB, is biased from the T voltage line. Base bias for Q102 is supplied through resistors R105, R104, and R103. Collector bias for Q102 is provided through coil L103. The predriver (Q102) is matched to the driver (Q103) by coils L104, L105, and capacitors C140, C107, C108 and C109. Transistor Q103 operates class C and is supplied from the A voltage line. Collector bias for Q103 is provided through L107. Coil L106 and resistor R108 establish a dc ground return for the base. RF from the collector of Q103 is coupled through C111 and matched to the final PA (Q104) by capacitors C142, C112 and coil L108. Resistor R112 provides stage stability. Transistor Q104 operates class C and is supplied from the A voltage line. Collector bias for Q104 is provided through coil L110. Resistor R109 and coil L109 provide a dc ground return for the base. The PA (Q104) is matched to the antenna switch (U103) by capacitors C143, C117, C118 , C120, and coils L111 and L112. A five-element low-pass filter is used to reject unwanted harmonics of the carrier signal. This network consists of C119, C121, C122, L113, and L114. The trimmer cap (C120) is used for adjusting output power. The VHF transmitter is available in 2-watt and 5-watt versions. The main difference is the device used for the final PA (Q104).

(2) VHF Radios (146 - 174 MHz)

The transmitter line-up follows the standard line-up with the addition of an ALC module (U105) to overcome gain variations of individual stages over a 28 MHz bandwidth. The ALC module monitors the DC voltage difference across a sensing resistor (R303) which is proportional to the sum of the current drawn by the driver (Q301) and PA (Q401). The differential voltage is sensed by the ALC module which provides an error voltage to control the bias to the pre-driver (Q102). By adjusting R300, the transmitter power output can be adjusted.

(3) UHF Low-Power Radios

Transmit rf is originated in the VCO/synthesizer / VCO buffer stages as discussed in earlier paragraphs of this manual. RF output of the VCO buffer (U108 pin 8) is applied to the predriver stage (Q102). Impedance matching between the VCO buffer (U108) and the predriver (Q102) is accomplished by L101, C105, C102 and L116. Transistor Q102 operates in the class AB mode. Transistor Q106 and associated circuitry is use to supply operating voltage to the predriver. The T voltage line forward biases Q106 and supplies drive to the base of Q102 through resistors R107, R103, and R102. The collector of Q102 is biased via L104. Both the buffer and predriver have a 30 MHz bandwidth. The output of the predriver (Q102) is matched to the input of the driver (Q103) by L105, C110, C158 and L106. Capacitor C152 and resistor R121 provide stage stability. Both the driver and final PA (U102) operate in class C mode. The driver (Q103) is collector biased from the A voltage line through coil L108. A dc ground return for the base is provided by L107 and R113. Resistor R127 and capacitor C155 provide stage stability. RF output from the driver (Q103) is matched to the input of the PA module (U102) by C116, L112, and C117. The trimmer cap on U102 adjusts the power output. The nominal power output for the UHF low power radio is 2 watts.

(4) UHF High-Power Radios

The transmitter in high power radios is very similar to the transmitter in low power radios. The differences are:

- In the high power model Q106 is eliminated and the predriver is powered directly from the T voltage line.
- The high power model has an additional stage of amplification (the IPA stage). Impedance matching the output of the driver (Q103) to the input of the IPA (Q104) is accomplished by L118, C167, C111, L109, and C112. Transistor Q104 operates in the class C mode and is supplied by the A voltage line. Collector bias is provided through L111, and a dc ground return for the base is provided through L110 and R115. The nominal output power of the UHF transmitter is 4 watts.

(5) Lowband Radios

Transmit rf (TRF), originated in the FGU, is routed from interconnect point J8-1 to the base of the predriver stage, transistor Q101. Impedance matching between the FGU buffer and the predriver is accomplished by components L101, L102, C102, C103, C104, and C105. Transistor Q101 operates in the class AB mode and is turned on via the T voltage line. The collector of Q101 is biased through inductor L103. The output on the collector of Q101 is matched to the input on the base of Q102 by coils L104 and L105, and capacitors C106, C107, C108, and C109. Transistor Q102 is powered via the B+ line and operates in the class C mode. Capacitor C138 and resistors R107, R122, and R124 provide stage stability. A dc ground return for the base is provided by inductor L106 and resistor R106. The output on the collector of Q102 is

matched to the input on the base of driver Q103 by coils L108 and L109, and capacitors C111 and C112. Components R109, R111, R121, C114, and C160 provide PA stage stability. Transistor Q103 is powered via the B+ line and operates in the class C mode. A dc ground return for the base of Q103 is provided by inductor L123 and resistor R108. Power adjust is accomplished at Q102 and Q103 by trimmer capacitors C159 and C115 respectively. Nominal output power is 6.0 watts. A 5-pole elliptical filter, consisting of inductors L115 and L116, and capacitors C117, C118, C119, C120, and C121 is used to reject unwanted harmonics. The output on the collector of transistor Q103 is matched to the input of the elliptical filter by inductors L115 and L116 and capacitor C116. The output of the filter is matched to the input of the antenna switch (U103) through coil L124 and capacitor C129.

k. Dual-Tone Multiple Frequency (DTMF) Circuits (Optional)

(1) Timed Tone Option

The DTMF circuit receives its power from unswitched battery B+ and an 8-volt regulator (U407) on the controller flex, via connector plug P701. When the radio is turned on, the regulated 8 volts supplied to the DTMF board is routed through a low-pass filter network (R729 and C725). The 8 volts is applied to audio amplifier U702 pin 6, and to the 5-volt regulator (U706). The regulated 5 volts is used throughout the circuit. Module U701, the heart of the DTMF circuit, receives its supply voltage (5V) through steering diode CR702. When the radio is turned off, the 5 volts is removed and U701 is supplied with memory retention voltage from the radio's unswitched B+ through resistor R701 and steering diode CR701. Resistor R706 and capacitor C701 act as a low-pass filter to keep noise off the IC's supply line. Capacitor C701 is also a memory retention cap. When the radio's battery is removed C701 will hold memory retention voltage for 2 minutes. **If the battery is not replaced within two minutes, memory will be lost.** All of the 47 pf caps are used for rf bypassing.

Transistor Q701, and resistors R722, R716 lock and unlock the keypad. When the radio is on, Q701 is saturated, U701 pin 22 is pulled low, and the keypad is unlocked. When the radio is turned off, Q701 is off, U701 pin 22 is pulled high through resistor R716, and the keypad is locked-up.

Integrated circuit U701 is a CMOS tone generator. Components Y701, R726, C722, and C723 form the oscillator circuit for the tone generator. When a key is pressed, U701 goes into the encode mode and outputs the appropriate tone on pin 21. Module U701 also sends a low (MUTE output) from pin 23 to NOR gate U703D pin 3. The tone (DTMF OUT) is routed through the deviation adjusting network of R720 and potentiometer R709, and applied to pin 6 of isolation switch U704B. If the control "C" input at U704B pin 4 is high, the switch closure is made and the DTMF tone output at U704B at pin 7 is applied to the radio's INT MIC IN line via connector plug P701 pin 3.

The purpose of the isolation gate (NOR gate U703D) is to prevent the transmission of beep tones. Therefore, the switch (U704B) will only close when a DTMF tone is to be transmitted, which is determined by a high output of NOR gate U703D at pin 4. This high output is achieved when both inputs are low. One input (pin 3) goes low everytime a DTMF tone is generated. The other input (pin 2) goes low whenever the radio is in transmit, via the saturation of transistor Q703.

The function of FET transistor Q702 is to mute the microphone during tone transmission. If the microphone was not muted, noise could get mixed with the DTMF tones and prevent successful decoding. Transistor Q702 is controlled by the MUTE output (U701 pin 23). When no tone is present, the mute line is pulled high by resistor R728, transistor Q702 is on, and the microphone has a low impedance path to ground. When a DTMF tone is generated the mute line goes low, Q702 is turned off, and the microphone is no longer grounded. Therefore, the microphone is muted. It is also necessary to mute the microphone when beep

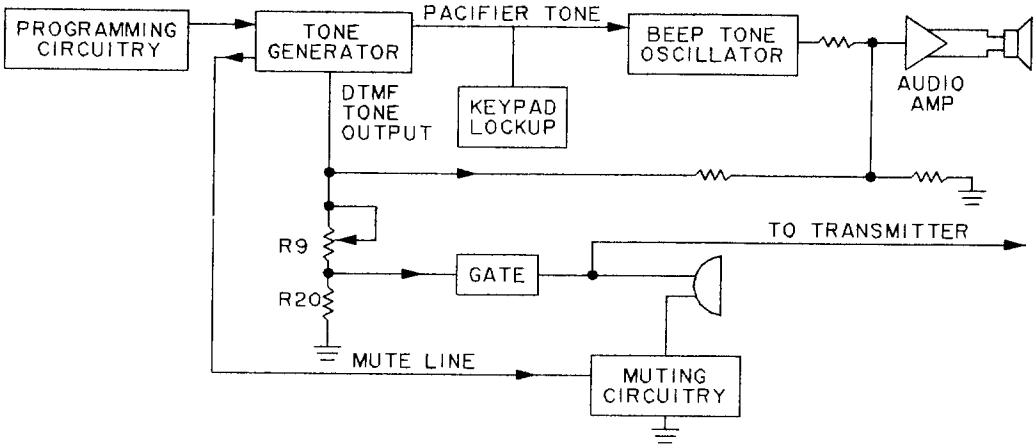

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Figure 16. DTMF Option Diagram

tones are generated. When a beep tone is present, switch U704C closes and transistor Q702 turns off. The time that Q702 stays off is controlled by the RC network of C724 and R719.

The combination of U703B, U703C, U704A, R707, R708, C705,C703, and R723 is the beep-tone oscillator circuit. When a "*" or a "#" command key is pressed, or when any key is pressed during the program mode, module U701 generates a pacifier tone. This tone, which lasts for approximately 30 milliseconds, is applied to beep tone gate U704A, which responds with a low output at pin 9. The low at U704A pin 9 is applied to the beep-tone oscillator (U703B pin 10), which responds by generating a 2000 Hz beep tone. The beep tone continues until U703B pin 10 goes high, which is determined by the RC network of C703 and R723 (approximately 57 milliseconds).

DTMF and beep tones are routed to the sidetone / beep-tone amplifier U702. This IC amplifies the tones and sends them to the speaker. Amplifier U702 is enabled when pin 1 is pulled low through CR704A or CR704B, which occurs when module U701 is in the program mode or when the radio is in transmit. Resistor R702 and capacitor C702 control the duration of the DTMF tones and the rate the tones are generated during automatic dialing. Tone duration is set at 150 ms.

Program switching is done by U704D, U703A, U705, R703, R704, R705, and CR703. Pressing the program button puts the DTMF circuit in the program mode by grounding the control line of U704D, which in turn causes pin 39 of U701 to be pulled high through resistor R705. With module U701 in the program mode (U701 pin 39 high), numbers can be stored in the memory registers. When the program button is not pressed, the control line of U704D is pulled high through R727, the switch (U704D) is closed, pin 39 of U701 is grounded, and U701 is in tone mode.

R731 is removed in radios with the ANI version DTMF circuit to prevent programming DTMF functions. In order to put module U701 into the program mode (a high at U701 pin 39), both inputs (pins 6 and 8) of U703A must be low. This can be accomplished only by using the ANI programming fixture to push the program button.

(2) Continuous Tone Option

Integrated circuit U801 is a DTMF tone generator, which accepts inputs from the keypad. The option is supplied from the radio's 8-volt line. During tone generation, the IC outputs a high on its MUTE line 1. (pin 8). This output mutes the microphone by saturating Q804 which turns off Q802, resulting in a high impedance path to ground for the microphone. The MUTE line also turns on Q801, which supplies a path to ground for the resistor divider network of R804 and R805.

The tone generator outputs a tone on pin 16 of U801. This tone level is reduced by R804 and R805, and is applied to the radio's MIC line to be transmitted. The tones are also divided by R806 and R807, and routed to the side-tone amplifier (U802). The amplified tones are then sent to the radio's speaker for user feedback.

The amplifier is enabled by the radio's MIC line. In the transmit mode, the MIC line is at 5 volts. This turns on Q803 and pulls pin 1 of U802 low, enabling the amplifier.

MAINTENANCE

1. INTRODUCTION

This section of the manual describes the disassembly and reassembly procedures, recommended repair procedures, special precautions regarding maintenance, and recommended test equipment. Each of these topics provides information vital to the successful operation and maintenance of the MT1000 radio.

2. PREVENTIVE MAINTENANCE

The MT1000 radio does not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

a. Inspection

Check that the external surfaces of the radio are clean, and that all external controls and switches are functional. A detailed inspection of the interior electronic circuitry is not needed or desired.

b. Cleaning

The following procedures describe the recommended cleaning agents and the methods to be used when cleaning the external and internal surfaces of the radio. External surfaces include the front cover, housing assembly, and battery case. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime. Internal surfaces should be cleaned only when the radio is disassembled for servicing or repair.

The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dishwashing detergent, such as JOY®, in water. The only factory recommended liquid for cleaning the printed circuit boards and their components is ISOPROPYL alcohol (70% by volume).

CAUTION

The effects of certain chemicals and their vapors can have harmful results on certain plastics. Aerosal sprays, tuner cleaners and other chemicals should be avoided.

(1) Cleaning External Surfaces

(a) Polycarbonate Surfaces

The detergent-water solution should be applied sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from the radio. A soft, absorbent, lintless cloth or tissue should be used to remove the solution and dry the radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

(b) Silverized Surfaces

A non-metallic, soft-bristled brush should be used to apply the detergent-water solution to silverized surfaces, and a second non-metallic soft-bristled brush (free of detergent or rinsed in clean water) should be used to remove the detergent-water solution.

Upon completion of the cleaning process, a soft, absorbent, lintless cloth or tissue should be used (with a blotting action) to dry the frame and covers. The blotting action will prevent damage to the silverized conductive coating.

(2) Cleaning Internal Circuit Boards and Components

Isopropyl alcohol may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio.

Alcohol is a high-wetting liquid and can carry contamination into unwanted places if an excessive quantity is used. Make sure that controls or tunable components are not soaked with the liquid. Do not use high-pressure air to hasten the drying process, since this could cause the liquid to puddle and collect in unwanted places.

Upon completion of the cleaning process, use a soft, absorbent, lintless cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

NOTE

Always use a fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

3. DISASSEMBLY *(Refer to the exploded view in back of this manual)*

Disassembly of the radio involves removal of the major components listed below, one at a time, in the sequence described in the following paragraphs.

NOTE

1. Several special tools are required to completely disassemble the radio. Refer to the "Test Equipment and Service Aids" paragraphs in this section of the manual. Also refer to the "Torque and Tool Specifications Chart."
2. Before proceeding, make sure that the radio is turned off.

JOY® is a registered trademark of Proctor and Gamble. The use of other dishwashing solutions could cause damage to the plastic parts.

a. Battery Removal

To remove the battery from the radio, proceed as follows:

Step 1. Hold the radio with the front of the radio facing up.

Step 2. Disengage the battery latch from the battery by pushing and holding the latch towards the top of the radio.

Step 3. With the battery latch disengaged, slide the battery from left to right to remove it from the baseplate on the bottom of the radio housing.

b. Gaining Access to Internal Components

CAUTION

The MT1000 radio contains complementary metal-oxide semiconductor (CMOS) devices, which are highly susceptible to damage in handling due to static discharge. The entire printed circuit board should be treated as static sensitive. Damage can be latent, resulting in failures occurring weeks or months later.

DO NOT attenpt to disassemble the radio without first referring to the "Safe Handling of CMOS Devices" paragraph in this section of the manual.

Step 1. Remove the battery as described in paragraph **a**.

Step 2. Remove the two screws from the back of the radio.

Step 3. Remove the two screws on the bottom of the radio (baseplate corners).

Step 4. Lift the front cover from the radio housing, being careful not to pull against the speaker/-microphone flex.

Step 5. Disconnect the speaker/microphone connector from the controller flex by grasping the speaker flex strain relief (near the plug) and pulling the plug straight out and away from the circuit board.

Step 6. Loosen the two captive screws on the bottom of the radio. Do not completely remove the captive screws from the baseplate.

Step 7. With a thumb and forefinger, grasp the antenna at its base and pull lightly to remove the frame assembly from the radio housing. Do not press the PTT switch during removal.

Step 8. Remove the antenna by unscrewing it counterclockwise.

Step 9. Remove the screw that secures the front shield to the controller carrier. (Does not apply to lowband.)

Step 10. Remove the front shield by pulling it straight out and away from the radio. (Does not apply to lowband.)

Step 11. Remove the four screws that secure the main back shield to the frame.

Step 12. Remove the main back shield by pulling it straight out and away from the radio.

c. Removing the Controller Assembly

Step 1. Perform steps 1 through 10 of paragraph **b**.

Step 2. Remove the plastic retainer clip that holds the two connectors in place at the top of the controller.

Step 3. Remove the four screws (two on each side) that secure the controller carrier to the frame.

NOTE

Be careful to pull each connector straight out and away from the mating socket so as not to bend or break the connector pins.

Step 4. Disconnect the two bottom flex connectors by carefully sliding them away from the synthesizer.

Step 5. Lift the controller circuit (nearest the bottom of the radio) away from the radio just enough to gain access to the connector under the controller.

Step 6. Disconnect the connector under the controller.

Step 7. Disconnect the two connectors at the top of the controller.

Step 8. Lift the controller assembly totally away from the radio.

d. Gaining Access to the Controller Flexible Circuit

Step 1. Perform steps 1 through 8 of paragraph **c**.

Step 2. Remove the screws that secure the bottom shield to the top flex carrier.

Step 3. Along the top edge of the controller assembly (edge nearest speaker clearance indentation), gently pry the bottom shield away from the top flex carrier.

Step 4. Pull the bottom shield completely away from the top flex carrier and remove the controller flexible circuit.

e. Removing the Transceiver Board from the Frame

Step 1. Perform steps 1 through 8 of paragraph **c**.

Step 2. Remove the four screws that secure the main back shield, and remove the shield.

Step 3. Unsolder four contacts (two pins and one frame ground connection) located next to the screw (back, top-center of transceiver board), and the antenna ferrule located on the back, top-left corner of the transceiver board.

Step 4. Remove one screw (back, top-center of transceiver board) that secures the transceiver board to the frame.

Step 5. Unsolder and remove the red B+ wire (controller side of radio) from the On-Off / volume switch pot.

CAUTION

Always place the On-Off/Volume switch pot in the 'On' position before soldering to this switch, and return to the 'Off' position when finished soldering.

Step 6. Gently pull the transceiver circuit board straight out and away from the frame.

f. Removing the Control-Top Panel Components

Step 1. Perform steps 1 through 6 of paragraph **e**.

NOTE

All control-top panel components, except the antenna jack, are connected on two flexible circuits, which are connected together and should be removed as one unit.

Step 2. Remove the control knob(s) by pulling straight out and away from the control-top panel.

Step 3. Remove the teflon washer(s).

Step 4. The escutcheon is stuck to the top surface of the control-top panel with adhesive. Gently pry one corner of the escutcheon away from the control-top panel and then peel the escutcheon completely away. Notice that washer(s) are stuck on the back side of the escutcheon.

Step 5a. Remove the hex nut and washer from the volume potentiometer.

Step 5b. On rotary radios, remove the hex nut and washer from the frequency switch.

Step 6. Using a spanner wrench, remove the spanner nut and washer from the PL switch.

Step 7. Unsolder and remove the black wire from the volume pot flex.

Step 8. Unsolder the nine solder joints between the flex and the universal connector pins, then remove the flex.

Step 9. Unsolder the three legs of the LED and pull the flex away from the LED's legs.

Step 10. Unsolder the nine solder joints between the PC board and the universal connector pins, then remove the PC board

NOTE

Be careful not to apply too much heat to the pins.

Step 11. The frequency switch flex connects to the PTT/B+ flex with five solder tabs located along the side of the frame near the monitor popple switch.

NOTE

A capacitor is placed across the last two tabs.

Unsolder the five contact tabs, and with "solder-wick", remove the solder and separate the two flexes.

Step 12. Push the switch shaft(s) until clear of the mounting holes, and remove the flex circuits and control-top panel components away from the frame.

g. Removing the Control-Top Panel and LED

Step 1. Perform steps 1 through 10 of paragraph **f**.

Step 2. On rotary radios, unsolder the ground pin of the universal connector contacting the frame (near the antenna bushing).

Step 2a. Remove the screw and washer located near the antenna receptacle.

Step 2b. Gently pull the control-top panel away from the frame.

Step 2c. Push the LED and rubber boot out of the control-top panel, and pull the LED out of the rubber boot.

Step 3. On display radios, remove the screw by the antenna ferrule to release the control top from the frame.

h. Removing the Battery Latch

Step 1. Perform steps 1 through 7 of paragraph **b**.

Step 2. Remove the ground contact screw that holds the negative battery contact. Be careful not to lose the lockwasher, contact, and rubber pad (under the contact).

Step 3. While holding the latch slide, carefully pull the baseplate assembly away from the housing.

Step 4. Carefully slide the latch out of the housing.

Step 5. Remove the exposed latch springs.

i. Removing the PTT / B+ Flex

Step 1. Perform steps 1 through 7 of paragraph **b**.

Step 2. Two corners of the PTT / B+ flex are soldered to the frame. Remove the solder, using "solder-wick".

Step 3. The PTT / B+ flex connects to the frequency switch flex with five solder tabs located along the top side of the frame near the PL switch. Unsolder the five contact tabs, and with "solder-wick", remove the solder and separate the two flexes.

NOTE

A capacitor is placed across the last two tabs.

Step 4. The PTT / B+ flex is stuck to the frame with adhesive. Carefully peel the PTT / B+ flex away from the frame.

4. REASSEMBLY *(Refer to the exploded view in the back of this manual.)*

1. DO NOT attempt to reassemble the radio without first referring to the "Safe Handling of CMOS Devices" paragraph in this section of the manual.
2. DO NOT attempt to reassemble the radio without first referring to the approriate VHF or UHF service manual "TORQUE AND TOOL SPECIFICATIONS CHART".
3. Inspect all O-rings and replace if obvious damage exists.

a. Reinstalling the Battery Latch and Base Plate

Step 1. Insert the two springs into their proper holes, and replace the slide latch.

Step 2. Position the base plate and hold it firmly to compress the springs.

Step 3. Holding the base plate in place, install the negative battery contact, being sure that the rubber pad is in place in the cup of the contact.

Step 4. Reinstall the screw and lockwasher in the negative battery contact. Tighten the screw per the "TORQUE AND TOOL SPECIFICATIONS CHART".

b. Reinstalling the PTT / B+ Flex

Step 1. Position the PTT / B+ flex to the frame such that the five contact tabs line up with the corresponding tabs on the frequency switch flex. Note that a little oval hole in the corner of the flex (near the solder tabs) mates with a round dot on the frame.

Step 2. Press the flex to the frame. Note that two more places, holes in the flex correspond with dots on the frame.

Step 3. Resolder the five solder tabs connecting the PTT / B+ flex to the frequency switch flex.

NOTE

A capacitor is placed across the last two tabs.

Step 4. Resolder the two corners of the flex to the frame.

c. Reinstalling the LED and Control-Top Panel (Rotary Radios)

Step 1. Insert the LED into the rubber boot such that the flat edge of the LED's base mates with the flat edge inside the boot.

Step 2. Insert the LED and boot into the control-top panel.

Step 3. Place the control-top panel on the frame.

Step 4. Reinstall the screw and washer located near the antenna receptacle, and tighten the screw per the "TORQUE AND TOOL SPECIFICATIONS CHART".

Step 5. Resolder the ground pin of the universal connector to the frame.

d. Reinstalling the LCD and Control-Top Panel (Display Radios)

Step 1. Insert the LCD into the molded control-to panel.

Step 2. Place the control-top and LCD board on the frame.

Step 3. Reinstall the screw located near the antenna receptacle, and tighten the screw per the "TORQUE AND TOOL SPECIFICATIONS CHART".

e. Reinstalling the Control-Top Panel Components

Step 1. Insert the switch shafts into the proper holes.

Step 2. Slide the universal connector PC board over the interconnect pins and solder the board to the nine pins.

Step 3. Resolder the three LED legs to the frequency switch flex.

Step 4. Solder the volume pot flex to the nine universal connector pins.

Step 5. Resolder the black ground wire wire to the volume pot flex.

Step 6. Resolder the five solder tabs of the frequency switch flex to the corresponding tabs of the PTT/B+ flex.

Step 7. Reinstall the PL switch washer and spanner nut, and tighten per the "TORQUE AND TOOL SPECIFICATIONS CHART".

Step 8. Reinstall the frequency switch (rotary radios only) and volume pot washers and hex nuts, and tighten each screw per the "TORQUE AND TOOL SPECIFICATIONS CHART".

Step 9. Reinstall the escutcheon.

Step 10. Reinstall the teflon washer(s) on the frequency switch (rotary radios only) and volume pot shafts.

Step 11. Reinstall the switch knob(s).

f. Reinstalling the Transceiver Board

Step 1. With the frame's backside laying down, and viewing the transceiver board from the solder side with the assembly upright, slightly spread the sides of the frame and slide the transceiver into the frame.

Step 2. Turn the unit over and resolder the loose end of the red B+ wire to the On-Off/Volume switch pot.

CAUTION

Always place the On-Off/Volume switch pot in the 'On' position before soldering to this switch, and return to the 'Off' position when finished soldering.

Step 3. Reinstall one screw (back, top-center of transceiver board) that secures the transceiver board to the frame, and tighten securely.

Step 4. Resolder four contacts (two pins and one frame ground connection) located next to the screw (back, top-center of transceiver board), and the antenna ferrule contact (back top-left corner of board).

Step 5. Press the main back shield (edges over the frame) flush to the transceiver board.

Step 6. Reinstall the four screws that secure the main back shield to the frame, and tighten each screw per the "TORQUE AND TOOL SPECIFICATIONS CHART".

g. Reassembling the Controller Assembly

CAUTION

Make sure that the flex insulator is installed around the controller flex before placing the controller flex into the carrier.

Step 1. With the outside surface of the carrier laying down, and the controller flex folded over (shield-to-shield), align the holes in the flex with corresponding holes in the carrier, and place the flex into the carrier. Make sure that the P1 and P2 jack's grooves slide into the tabs of the carrier. Also, make sure that the J5 jack is seated properly in the carrier.

Step 2. Align the controller bottom shield to the controller flex and carrier. In the J5 jack area, slide the tab of the shield under the slot in the carrier, and press the bottom shield into place (sides of the bottom shield fit inside the sides of the carrier).

Step 3. Reinstall the screws that secure the bottom shield to the controller carrier, and tighten each screw per the "TORQUE AND TOOL SPECIFICATIONS CHART".

h. Reinstalling the Controller Assembly

NOTE

Be careful to push each connector straight into the mating socket so as not to bend or break the connector pins.

Step 1. Reconnect the two top flex connectors, firmly seating both plug/jack connections.

Step 2. Reconnect the connector under the controller, firmly seating the plug/jack connection.

Step 3. Press the controller into place (inside of frame sides).

Step 4. Reconnect the two bottom flex connectors, firmly seating both plug / jack connections.

Step 5. Reinstall the four screws (two on each side) that secure the controller carrier to the frame, and tighten each screw per the "TORQUE AND TOOL SPECIFICATIONS CHART".

Step 6. Insert the plastic retainer that holds the top two connectors in place.

Step 7. Reinstall front shield (shield edges fit inside the frame). (Does not apply to lowband.)

Step 8. Reinstall the screw that secures the front shield to the controller carrier, and tighten the screw per the "TORQUE AND TOOL SPECIFICATIONS CHART". (Does not apply to lowband.)

i. Final Reassembly

Step 1. Insert the internal radio unit into its housing, and tighten the two screws on the baseplate per the "TORQUE AND TOOL SPECIFICATIONS CHART".

Step 2. Reconnect the speaker / microphone connector, being careful to push the connector straight into the mating socket so as not to bend or break the connector pins.

Step 3. Reinstall the front cover.

Step 4. Reinstall the two screws on the bottom of the radio (baseplate corners), and tighten the screws per the "TORQUE AND TOOL SPECIFICATIONS CHART".

Step 5. Reinstall the two screws that secure the front cover to the housing, and tighten each screws per the "TORQUE AND TOOL SPECIFICATIONS CHART".

Step 6. Reinstall the antenna.

Step 7. Reinstall the battery.

5. SAFE HANDLING OF CMOS DEVICES

Complementary metal-oxide semiconductor (CMOS) devices are used in the MT1000 radio. While the attributes of CMOS are many, their characteristics make them susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair. The following handling precautions are mandatory for CMOS circuits, and are especially important in low humidity conditions.

a. All CMOS devices must be stored or transported in conductive material so that all exposed leads are shorted together. CMOS devices must not be inserted into conventional plastic "snow" or plastic trays of the type that are used for storage or transportation of other semiconductor devices.

b. All CMOS devices must be placed on a grounded bench surface and the technicians must ground themselves prior to handling the devices. This is done most effectively by having the technician wear a conductive wrist strap in series with a 100k-ohm resistor to ground.

c. Do not wear nylon clothing while handling CMOS circuits.

d. Do not insert or remove CMOS devices with power applied. Check all power supplies to be used for testing CMOS devices, and be certain that there are no voltage transients present.

e. When straightening CMOS device leads, provide ground straps for the apparatus used.

f. When soldering, use a grounded soldering iron.

g. All power must be turned off in a system before printed circuit boards containing CMOS devices are inserted, removed, or soldered.

6. REPAIR PROCEDURES AND TECHNIQUES

CAUTION

Leadless component technology requires the use of specialized equipment and procedures for repair and servicing of the MT1000 radio. If you are not totally familiar with leadless component repair techniques, it is strongly recommended that you either defer maintenance to qualified service personnel and service shops or take the recommended video taped leadless component repair training program, MAV-PACK 3 (VID-952) (see paragraph 7b, Service Aids and Recommended Tools, in this section). This is of paramount importance as irreparable damage to the radio can result from service by unauthorized persons. Unauthorized attempts to remove or repair parts may void any existing warranties or extended performance agreements with the manufacturer.

a. Parts Replacement and Substitution

Special care should be taken to be as certain as possible that a suspected component is actually the one at fault. This special care will eliminate unnecessary unsoldering and removal of parts, which could damage or weaken other components or the printed circuit board itself.

When damaged parts are replaced, identical parts should be used. If the identical replacement component is not locally available, check the parts list for the proper Motorola part number and order the component from the nearest Motorola Communications Parts office listed in the "Replacement Parts Ordering" section of this manual.

b. Rigid Circuit Boards

The MT1000 radio uses bonded multi-layer printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The printed through holes may interconnect multiple layers of the printed circuit. Therefore, care should be exercised to avoid pulling the plated circuit out of the hole.

When soldering near the module socket pins, use care to avoid accidentally getting solder in the socket. Also, be careful not to form solder bridges between the module socket pins. Closely examine your work for shorts due to solder bridges. When removing modules with metal enclosures, be sure to desolder the enclosure ground tabs as well as the module pins.

c. Flexible Circuits

The flexible circuits are made from a different material than the rigid boards, and different techniques must be used when soldering. Excessive prolonged heat on the flexible circuit can damage the material. Avoid excessive heat and excessive bending. For parts replacement, use the ST-1087 Temperature-Controlled Solder Station with a 600 or 700 degree tip, and use small diameter solder such as ST-633. The smaller size solder will melt faster and require less heat being applied to the circuit.

To replace a component on a flexible circuit, grasp the edge of the flexible circuit with seizers (hemostats) near the part to be removed, and pull gently. Apply the tip of the soldering iron to the component connections while pulling with the seizers. Do not attempt to puddle out components. Prolonged application of heat may damage the flexible circuit.

7. TEST EQUIPMENT AND SERVICE AIDS

The following paragraphs describe the test equipment and service aids required for maintaining the MT1000 radio. Your Motorola sales representative will assist in analyzing your specific requirements and help you select the latest available equipment to suit your individual needs. In addition, your sales representative can advise you of the availability of new test equipment and service aids that become available after the printing of this manual.

Refer to Figure 17 for an illustration of troubleshooting, test equipment, and programming set-up.

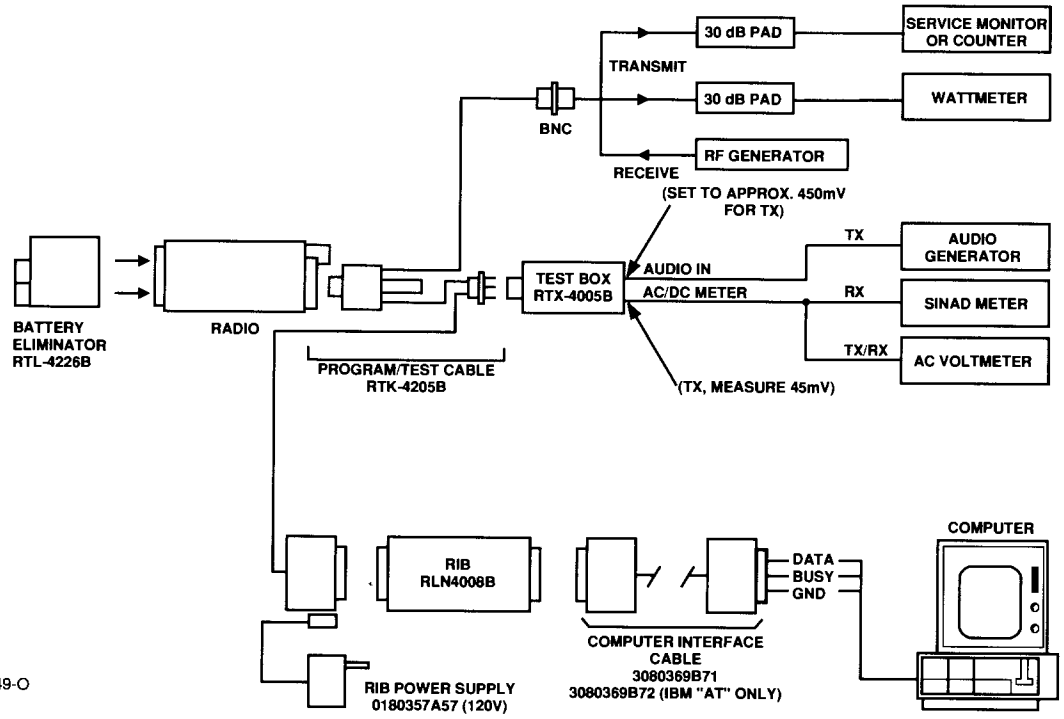


Figure 17. Troubleshooting, Test Equipment, and Programming Set-Up Detail

a. Recommended Test Equipment

The list of equipment contained in Table 3 includes all of the standard test equipment required for servicing two-way portable radios, as well as several unique items designed specifically for servicing the MT1000 radio. Battery operated test equipment is recommended when available. The "Characteristics" column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

b. Service Aids and Recommended Tools

Refer to the "SERVICE AIDS" and "RECOMMENDED TOOL LIST" for a listing and description of the service aids and tools designed specifically for servicing the MT1000 radio, as well as the more common tools required to disassemble and properly maintain the radio. These kits and/or parts are available from the Motorola Communications Parts office listed in the "Replacement Parts Ordering" section of this manual.

MAV-PACK 3 (VID-952)

The VID-952 Motorola Video Visual Package (MAV-PACK) is a video tape training program on leadless component repair techniques. This VHS format video cassette and supplemental literature describe the removal and replacement of leadless components using the following specialized equipment:

- RRX-4033 Laurier Hot Gas Bonder
- RPX-4234A Regulator and Hardware Kit
- 0180386A62 Heated Tweezers
- RSX-1002 Desoldering Station
- RSX-1008 Weller Soldering Station

This MAV-PACK is strongly recommended for technicians who intend to service this and other Motorola radios using leadless components. This VHS videotape is in standard half-inch format. This MAV-PACK, as well as others, is available from:

Motorola C&E, Inc.
National Service Training Center
1300 N. Plum Grove Road
Schaumburg, Illinois 60195

8. FIELD PROGRAMMING

The MT1000 radio can be field programmed. Field programming requires specific equipment and accompanying instructions. Refer to the MT1000 "Radio Service Software User's Manual" for complete field programming information.

Table 3. Test Equipment

MOTOROLA MODEL NUMBER	DESCRIPTION	CHARACTERISTICS	APPLICATION
R2200, R2400, or R2001D with trunking option	Service Monitor	This monitor will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049A	Digital Multimeter		Two meters recommended for ac/dc voltage and current measurements
*S1100A	Audio Oscillator	67 to 161.4Hz tones	Used with service monitor for injection of PL tones
*S1053D *SKN6009A *SKN6001A	AC Voltmeter Power Cable for Meter Test Leads for Meter	1mV to 300V, 10-Megohm input impedance	Audio voltage measurements
R1053	Dual-Trace Oscilloscope	20MHz bandwidth 5mV/cm - 20V/cm	Waveform measurements
*S1350C *ST1215B (VHF) *ST1223B (UHF) *T1013A	Watt Meter Plug-in Element RF Dummy Load	50-ohm, ±5% accuracy 10 Watts, maximum 0-1000MHz, 300W	Transmitter power output measurements
S1339A	RF Millivolt Meter	100µV to 3V rf 10kHz to 1.2GHz	RF level measurements
*R1013A	SINAD Meter		Receiver sensitivity measurements
S1347D or S1348D (programmable)	DC Power Supply	0-20Vdc, 0-5 Amps current limited	Bench supply for 7.5Vdc

* R2200, R2400, or R2001D will substitute for items with an asterisk (*)

TROUBLESHOOTING

1. INTRODUCTION

Servicing the MT1000 Series radio requires the localization of the malfunctioning circuit before the defective component can be isolated and replaced. Since localizing and isolating a defective component constitutes the most time consuming part of troubleshooting, a thorough understanding of the circuits involved will aid the technician in performing efficient servicing. The technician must know how one function affects another; he must be familiar with the overall operation of the radio and the procedures necessary to place it back in operation in the shortest possible time.

The radio functional block diagrams, schematic diagrams, and troubleshooting charts provide valuable information for troubleshooting purposes. The functional diagrams provide signal flow information in a simplified format, while the schematic diagrams provide the detailed circuitry and the biasing voltages required for isolating malfunctioning components. By using the diagrams, troubleshooting charts, and deductive processes, the suspected circuit may be readily found.

To determine if analyzation of the radio is required, perform checks such as 20dB quieting, 12dB SINAD, noise and PL squelch sensitivity, for the receiver; and current drain for the transmitter. These should give the technician a general indication of where the problem is located.

NOTE

See Figure 17 - Troubleshooting, Test Equipment, and Programming Set-Up Detail.

After the general problem area of the radio has been identified, careful use of a dc voltmeter, rf millivoltmeter, and an oscilloscope should isolate the problem to an individual component.

2. TROUBLESHOOTING PROCEDURE

Each time that the radio is turned on, a microcomputer self-test occurs. A 1600Hz alert tone is generated for approximately 500 milliseconds to indicate that the microcomputer is functioning properly. If the alert tone is not heard (and the alert tones have not been disabled via the Radio Service Software), there is a problem with the radio.

Following the microcomputer self-test, a synthesizer self-test occurs. A continuous 1600Hz alert tone is generated if the synthesizer test is **not** successful. If this condition occurs (continuous alert tone) refer to the VCO/synthesizer troubleshooting chart.

When a radio performs unsatisfactorily, the following procedures should help localize the fault.

a. Check Batteries

The first step in localizing a problem is to check the battery voltage under load. With the transmitter turned on (keyed), check the battery voltage. A convenient way to do this is to remove the front cover and monitor the B+ line with a voltmeter (with respect to ground). The measured load voltage should not be less than eight volts. Even though the transmitter may operate at a lower voltage, operation would be marginal and for only a short period of time. Low-voltage transmit operation is indicated by the flashing LED on top of the radio. If the measured voltage is zero volts, check the battery and fuse. The recommended procedure is to replace, or recharge, the battery if the voltage is below eight volts under load.

b. Alignment

Strict adherence to the published procedures is a prerequisite to accurate alignment and proper evaluation of the performance of the radio. The selection of test equipment is critical. The use of equipment other than that recommended should be cleared through your Motorola Area Representative to ensure that it is of equivalent quality.

The service technician must observe good servicing techniques. The use of interconnecting cables that are too long, poorly positioned (dressed), or improperly terminated will result in erratic meter readings. As a result, it will not be possible to tune the radio to the desired specifications.

Use the recommended test equipment setup and proper connections for alignment and adjustments. Refer to the detailed procedures supplied in the applicable service manual.

c. Check Overall Transmitter Operation

If the battery voltage is sufficient, check the overall performance of the transmitter. A good overall check of the transmitter is the rf power output measurement. This check indicates the proper operation of the transmitter amplifier stages. A properly tuned and operating transmitter will produce the rated rf output into a 50-ohm load with a dc input of 10 volts (refer to "Transmitter Alignment Procedure," located in the service section of this manual, for specific rf output). If the power is less than rated rf output, refer to the applicable transmitter troubleshooting chart.

d. Check Overall Receiver Operation

(1) 20dB Quieting Sensitivity Test

A good overall check of receiver operation is the 20dB quieting sensitivity measurement. This check will indicate that the receiver has sufficient gain and that all

of the included circuitry is working properly. The quieting signal is that rf signal input necessary to reduce the audio output at the speaker by 20dB. This measurement should be made with no modulation. It will be necessary to hold the monitor button during this test, or the radio's squelch circuitry will remove the noise from the speaker.

Make the actual measurement (using an ac voltmeter) by setting the noise voltage across the test box speaker load (with no rf signal received at the antenna) to one-fourth (1/4) of the rated audio power output (2.24Vrms). Sufficient carrier signal from a generator is then introduced via the universal connector (remote antenna port) to reduce the noise output voltage to one-tenth (1/10) of the previous reading. If all of the circuitry is operating correctly, this reading should be 0.35μV or less on lowband and vhf models and 0.5μV on uhf models. If the radio does not meet this specification, try to retune the receiver using the procedure indicated in the service manual. If this does not solve the problem, refer to the receiver troubleshooting chart.

(2) 12dB SINAD

This procedure is a standard method for evaluating the performance of an FM receiver, since it provides a check of the rf, i-f, and audio stages. The method consists of finding the lowest modulated signal necessary to produce 50% of the radio's rated audio output with a 12dB or better ratio of signal + noise + distortion / noise + distortion. This is termed "usable sensitivity."

To perform this measurement, connect the leads from a SINAD meter to the audio output of the test box. Set the Motorola service monitor or rf signal generator to output a 1-millivolt signal. Modulate the rf signal with a 1kHz tone at 3kHz deviation. Introduce the signal to the radio at the exact channel frequency through the universal connector. Set the volume control for rated audio output (4.47Vrms). Decrease the rf signal level until the SINAD meter reads 12dB. The signal generator output (12dB SINAD measurement) should be less than 0.25μV on lowband and vhf receivers or less than 0.35μV on uhf receivers. If the radio does not meet this specification, try to retune the receiver using the procedure indicated in the service manual. If this does not solve the problem, refer to the receiver troubleshooting chart.

3. VOLTAGE MEASUREMENT AND SIGNAL TRACING

To aid in troubleshooting, ac and dc voltage readings are provided (in red) on the transceiver schematic diagram in the service manual. When making these voltage checks, pay particular attention to any notes that may accompany the voltage reading of a particular stage.

If receiver sensitivity is high or if the rf power output is lower than normal for a fully tuned transceiver, the dc voltages on the printed circuit board should be checked. These voltages should be referenced to ground.

CAUTION

When checking a transistor or module, either in or out of the circuit, do not use an ohmmeter having more than 1.5 volts dc appearing across the test leads or an ohms scale of less than x 100.

It is recommended not to replace a transistor or module before a thorough check is made. Read the voltages around the suspected stage. If these voltages are not reasonably close to those specified, the associated components should be checked.

A low impedance meter should not be used for measurement. If all dc voltages are correct, the signal should be traced through the circuit to show any possibility of breaks in the signal path.

CAUTION

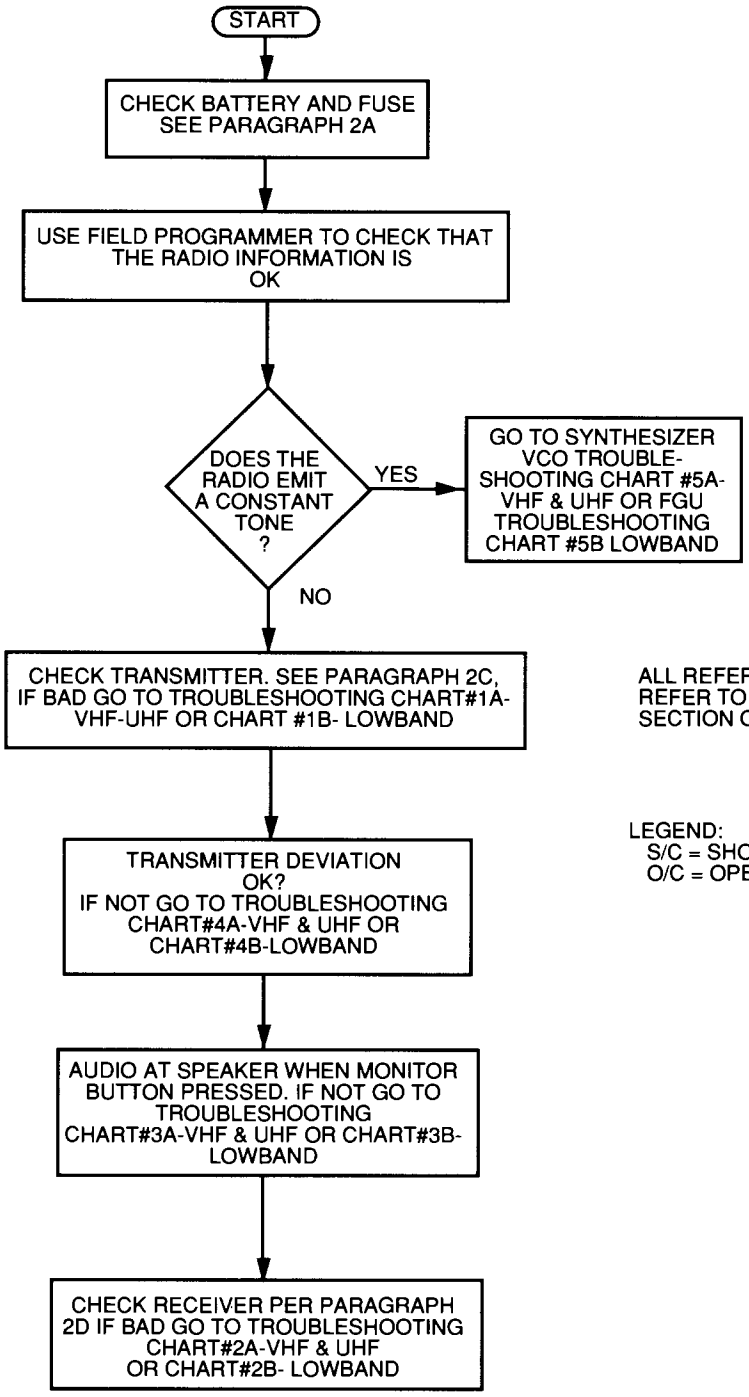
The microcomputer is a static sensitive device contained on the controller flex assembly. DO NOT attempt to troubleshoot or disassemble the microcomputer/controller flex assembly without first referring to the "Safe Handling of CMOS Devices" paragraph in the **MAINTENANCE** section of the manual.

When troubleshooting the microcomputer controller flex circuits, it will be necessary to disconnect the flex from the radio main circuit board and reconnect it via a flex extender fixture. Also, many of the measurements referred to in the microcomputer troubleshooting charts that follow are short in duration. So, it will be necessary to use an oscilloscope set for 1V / division and 5ms / division.

4. TROUBLESHOOTING CHARTS

The troubleshooting charts on the following pages will help isolate troubles in the different sections of the radio. Start at the top of the appropriate chart and make the checks as indicated. Most usual malfunctions will respond to the systematic approach to troubleshooting. Also, a flowchart is provided to aid in choosing the proper troubleshooting chart.

TROUBLESHOOTING FLOW CHART



ALL REFERENCES TO PARAGRAPHS (I.E. 2A) REFER TO THE TROUBLESHOOTING SECTION OF THIS MANUAL.

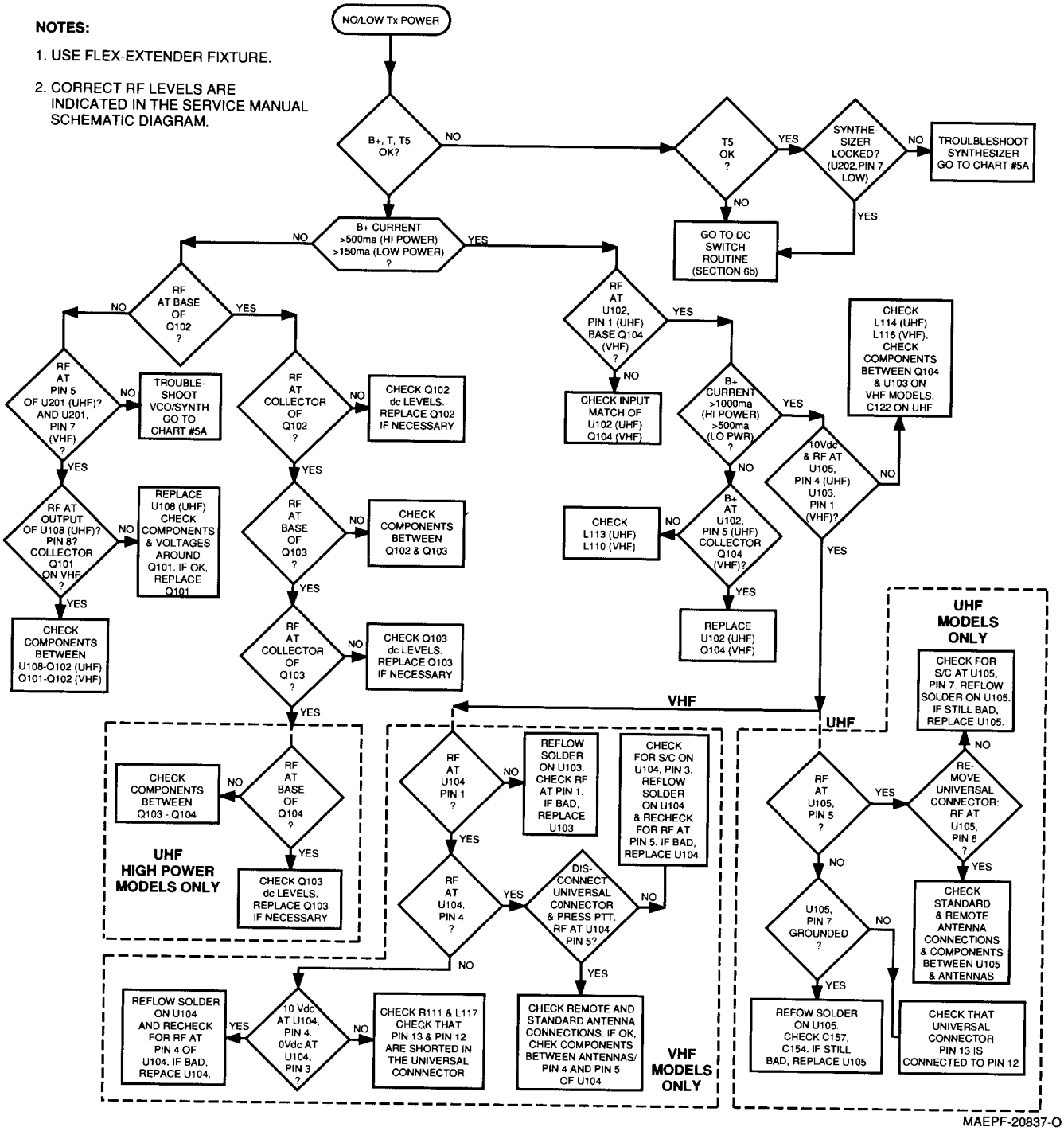
LEGEND:
S/C = SHORT CIRCUIT
O/C = OPEN CIRCUIT

MAEPF-20836-O

CHART #1A
VHF and UHF TRANSMITTER (RF)

NOTES:

1. USE FLEX-EXTENDER FIXTURE.
2. CORRECT RF LEVELS ARE INDICATED IN THE SERVICE MANUAL SCHEMATIC DIAGRAM.

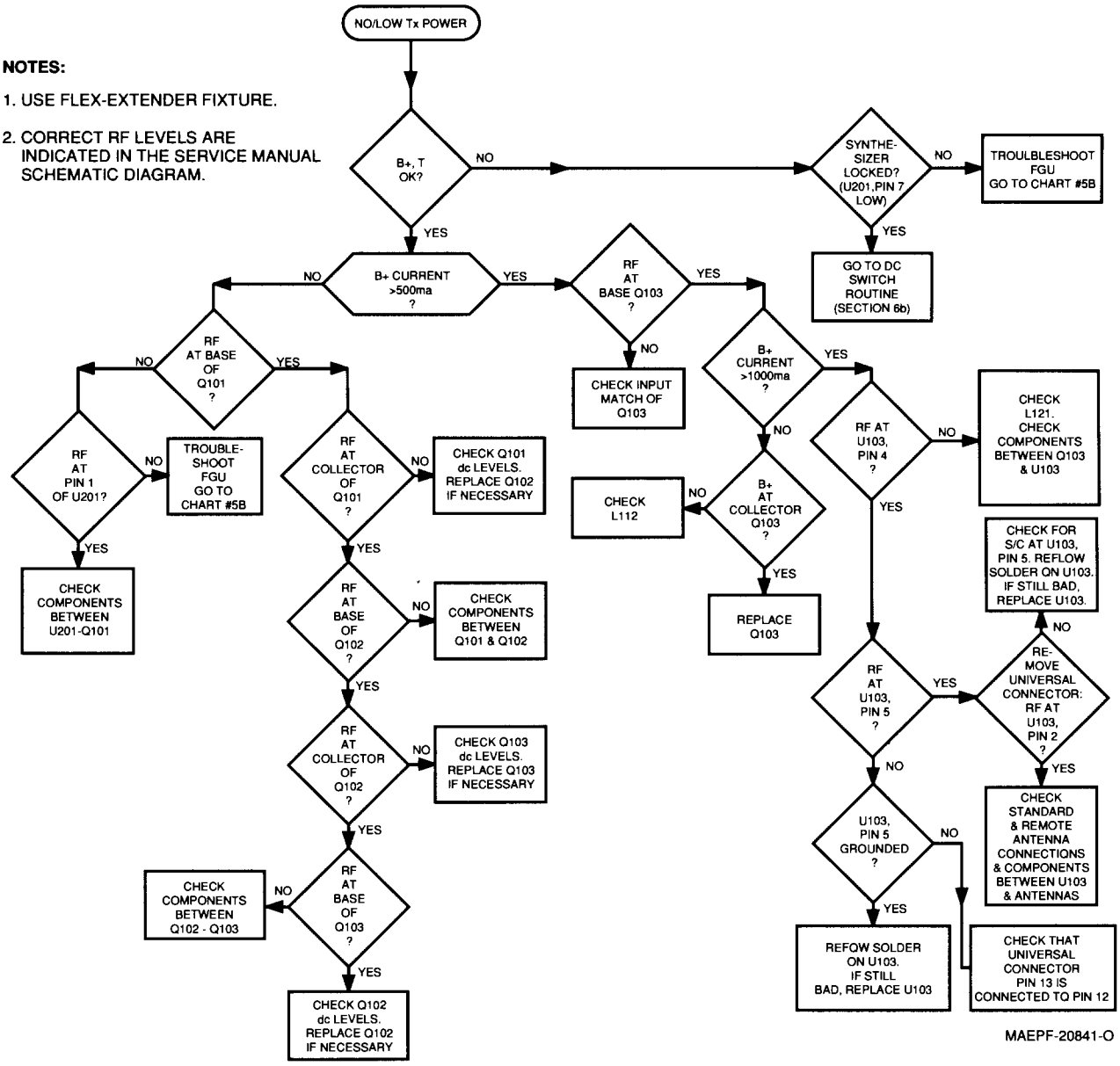


MAEPF-20837-O

CHART #1B
LOWBAND TRANSMITTER (RF)

NOTES:

1. USE FLEX-EXTENDER FIXTURE.
2. CORRECT RF LEVELS ARE INDICATED IN THE SERVICE MANUAL SCHEMATIC DIAGRAM.



MAEPF-20841-O

CHART #2A
VHF and UHF RECEIVER (RF)

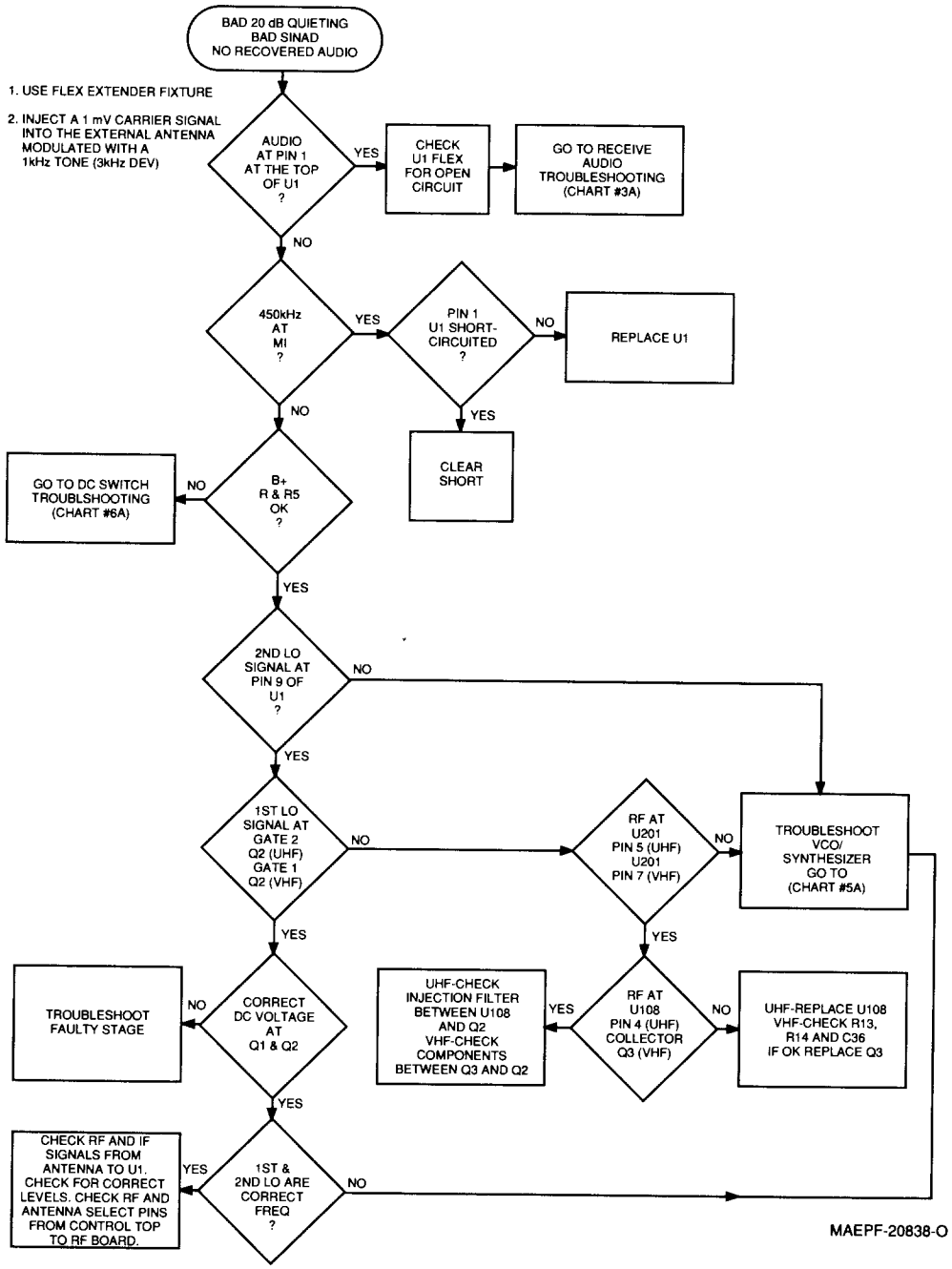


CHART #2B
LOWBAND RECEIVER (RF)

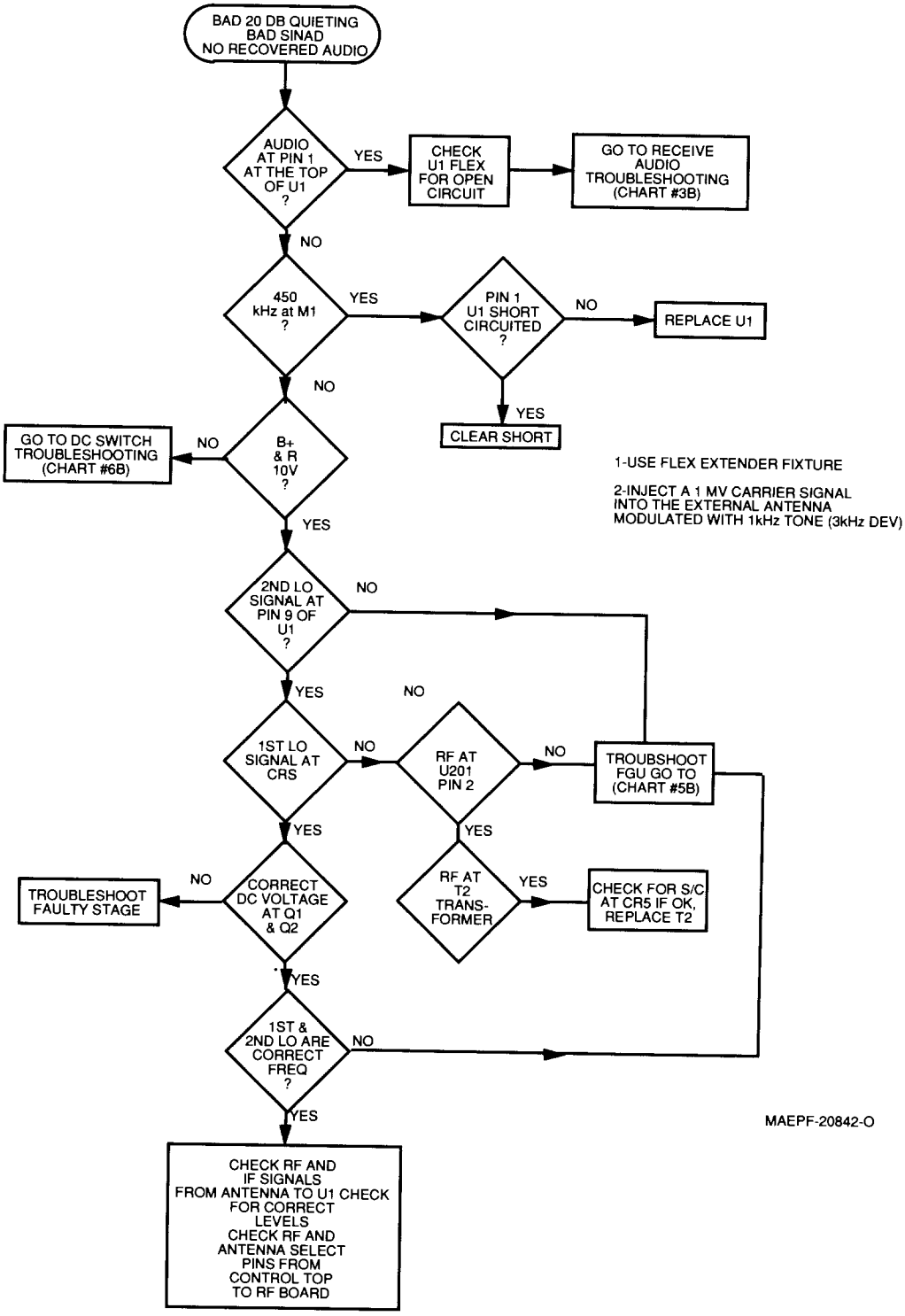
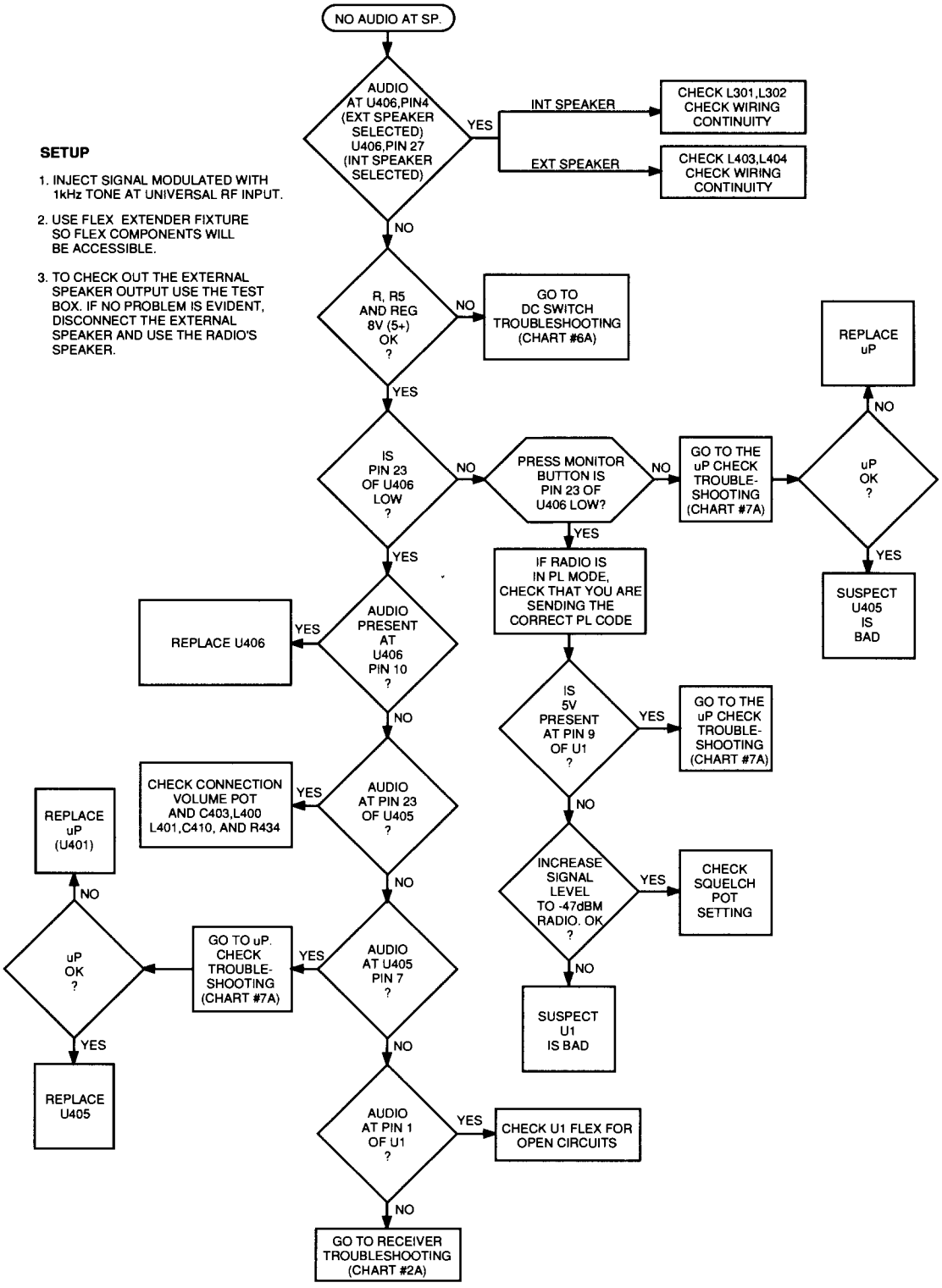


CHART #3A
VHF and UHF RECEIVER (AUDIO)

SETUP

1. INJECT SIGNAL MODULATED WITH 1kHz TONE AT UNIVERSAL RF INPUT.
2. USE FLEX EXTENDER FIXTURE SO FLEX COMPONENTS WILL BE ACCESSIBLE.
3. TO CHECK OUT THE EXTERNAL SPEAKER OUTPUT USE THE TEST BOX. IF NO PROBLEM IS EVIDENT, DISCONNECT THE EXTERNAL SPEAKER AND USE THE RADIO'S SPEAKER.

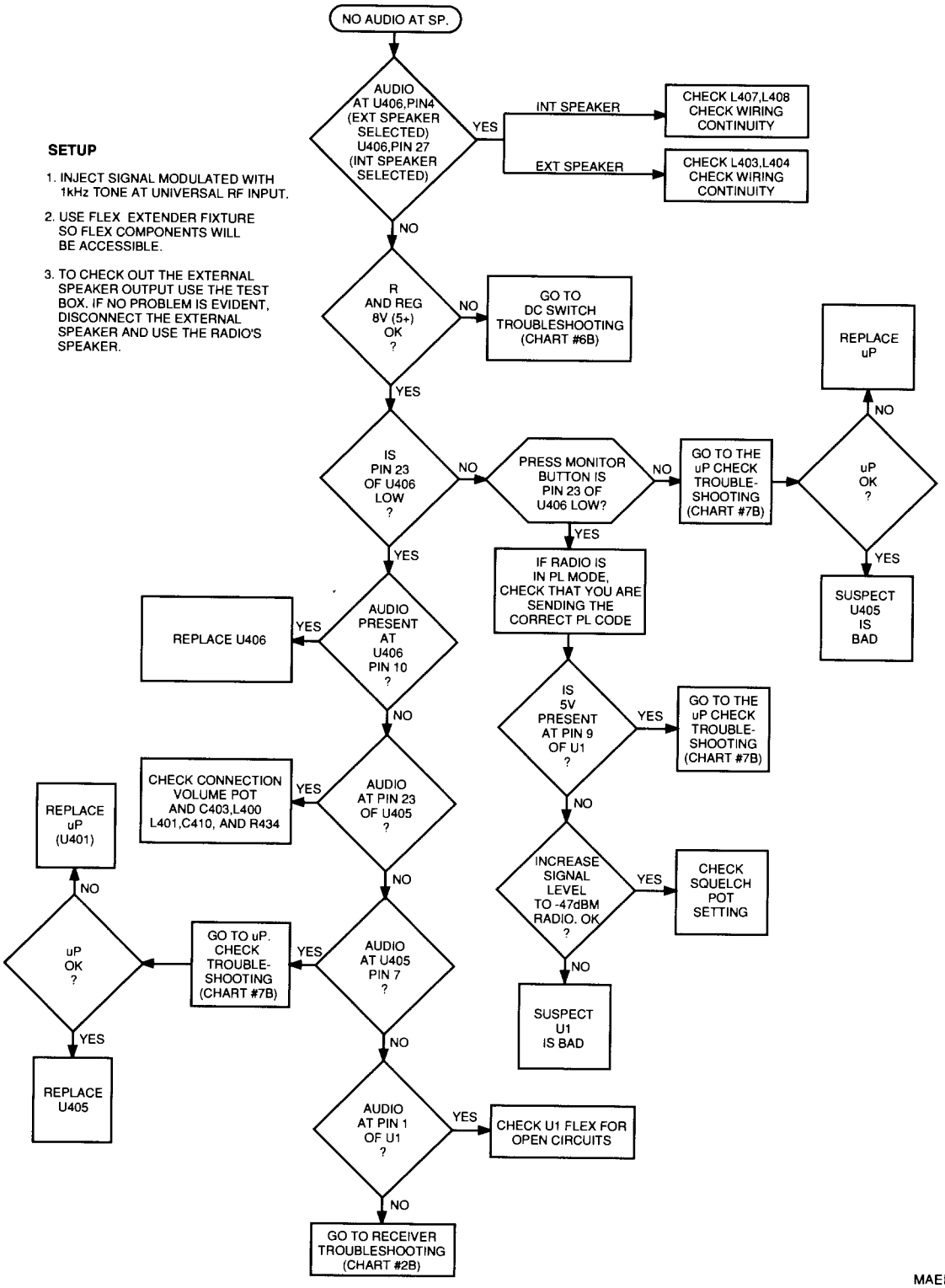


MAEPF-18622-A

CHART #3B
LOWBAND RECEIVER (AUDIO)

SETUP

1. INJECT SIGNAL MODULATED WITH 1kHz TONE AT UNIVERSAL RF INPUT.
2. USE FLEX EXTENDER FIXTURE SO FLEX COMPONENTS WILL BE ACCESSIBLE.
3. TO CHECK OUT THE EXTERNAL SPEAKER OUTPUT USE THE TEST BOX. IF NO PROBLEM IS EVIDENT, DISCONNECT THE EXTERNAL SPEAKER AND USE THE RADIO'S SPEAKER.



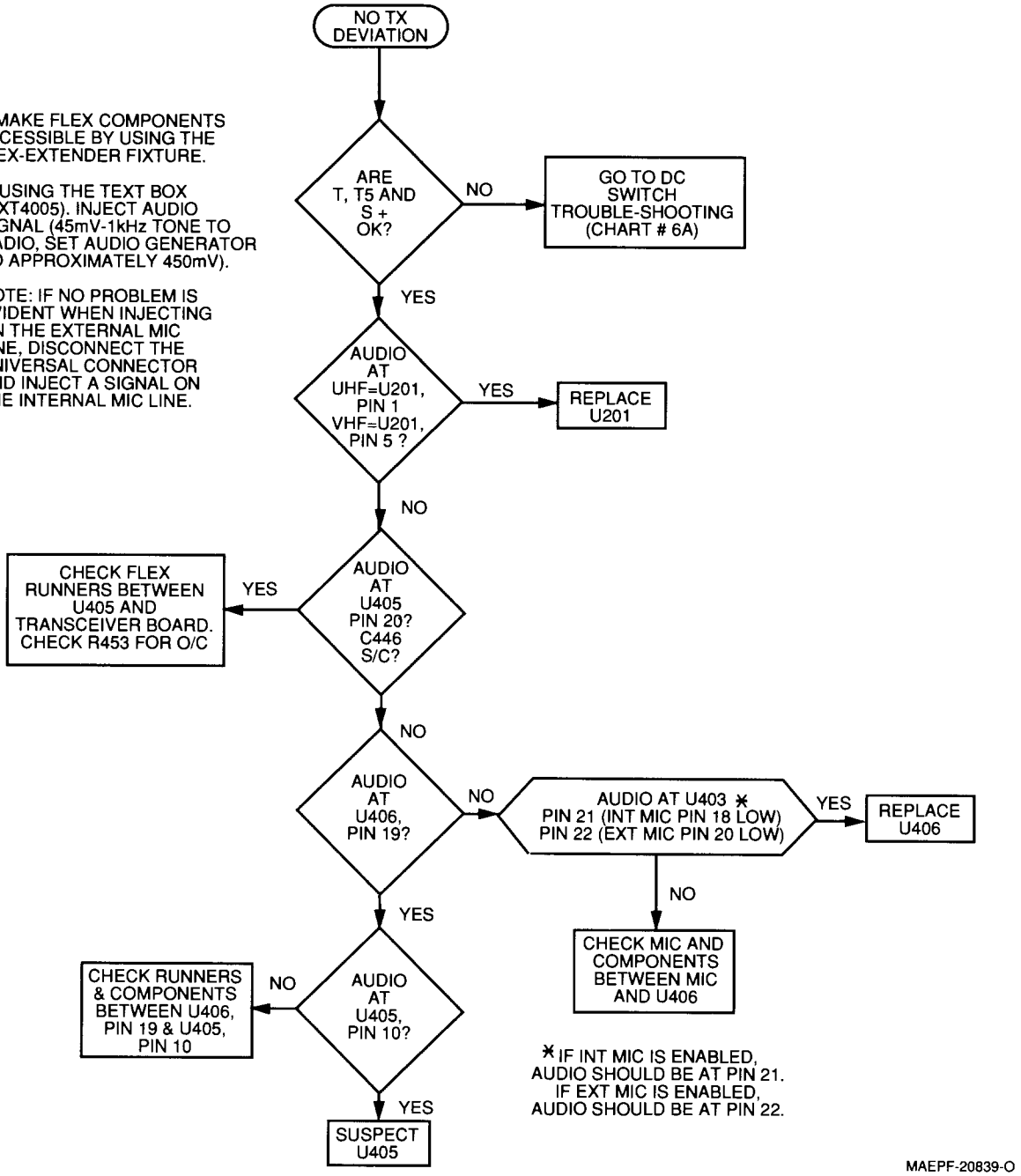
MAEPF-20843-O

CHART #4A
VHF and UHF TRANSMITTER (AUDIO)

1. MAKE FLEX COMPONENTS ACCESSIBLE BY USING THE FLEX-EXTENDER FIXTURE.

2. USING THE TEXT BOX (RXT4005). INJECT AUDIO SIGNAL (45mV-1kHz TONE TO RADIO, SET AUDIO GENERATOR TO APPROXIMATELY 450mV).

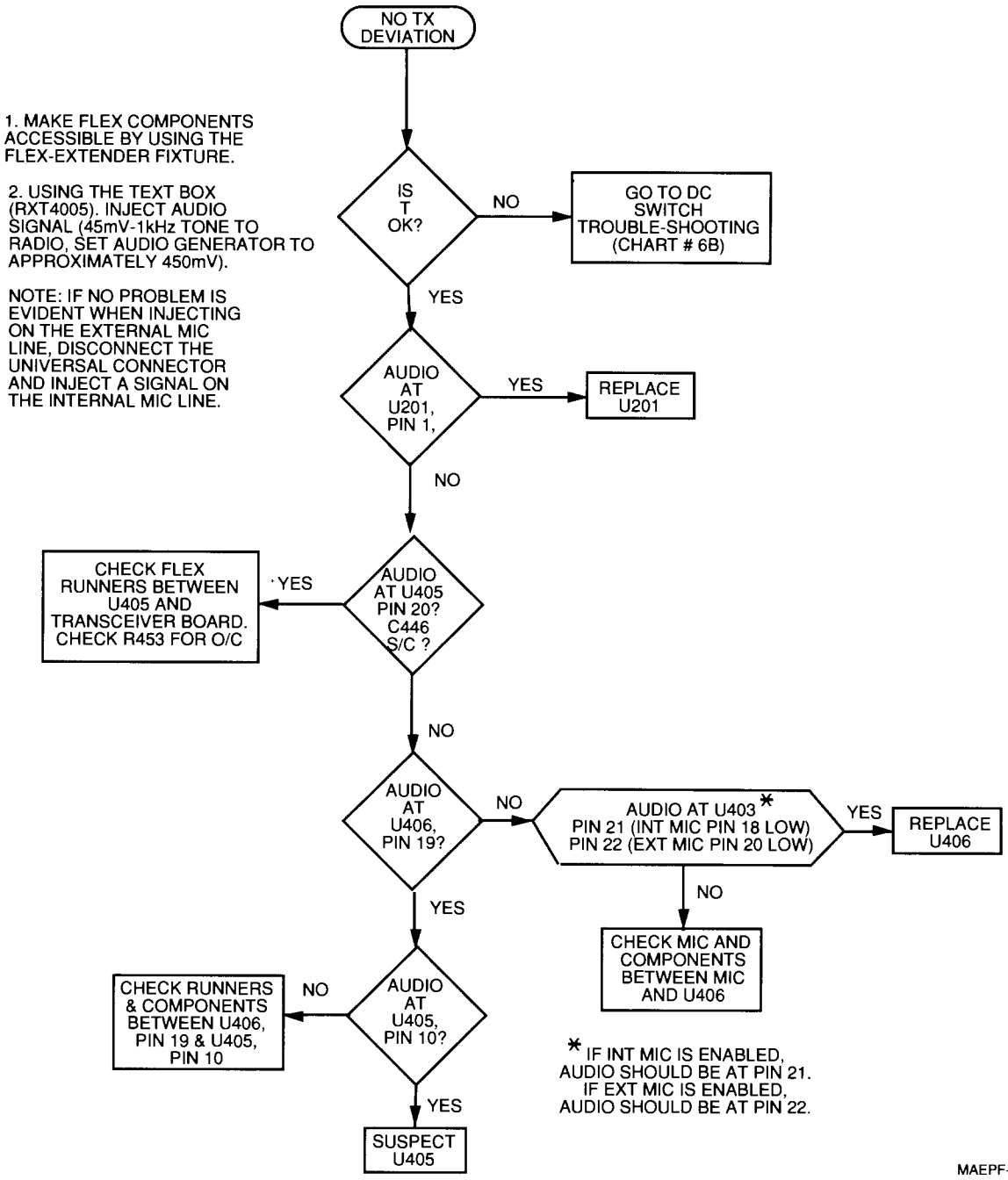
NOTE: IF NO PROBLEM IS EVIDENT WHEN INJECTING ON THE EXTERNAL MIC LINE, DISCONNECT THE UNIVERSAL CONNECTOR AND INJECT A SIGNAL ON THE INTERNAL MIC LINE.



*IF INT MIC IS ENABLED, AUDIO SHOULD BE AT PIN 21. IF EXT MIC IS ENABLED, AUDIO SHOULD BE AT PIN 22.

MAEPF-20839-O

CHART #4B
LOWBAND TRANSMITTER (AUDIO)



MAEPF-20844-O

CHART #5A
VHF and UHF VCO/SYNTHESIZER

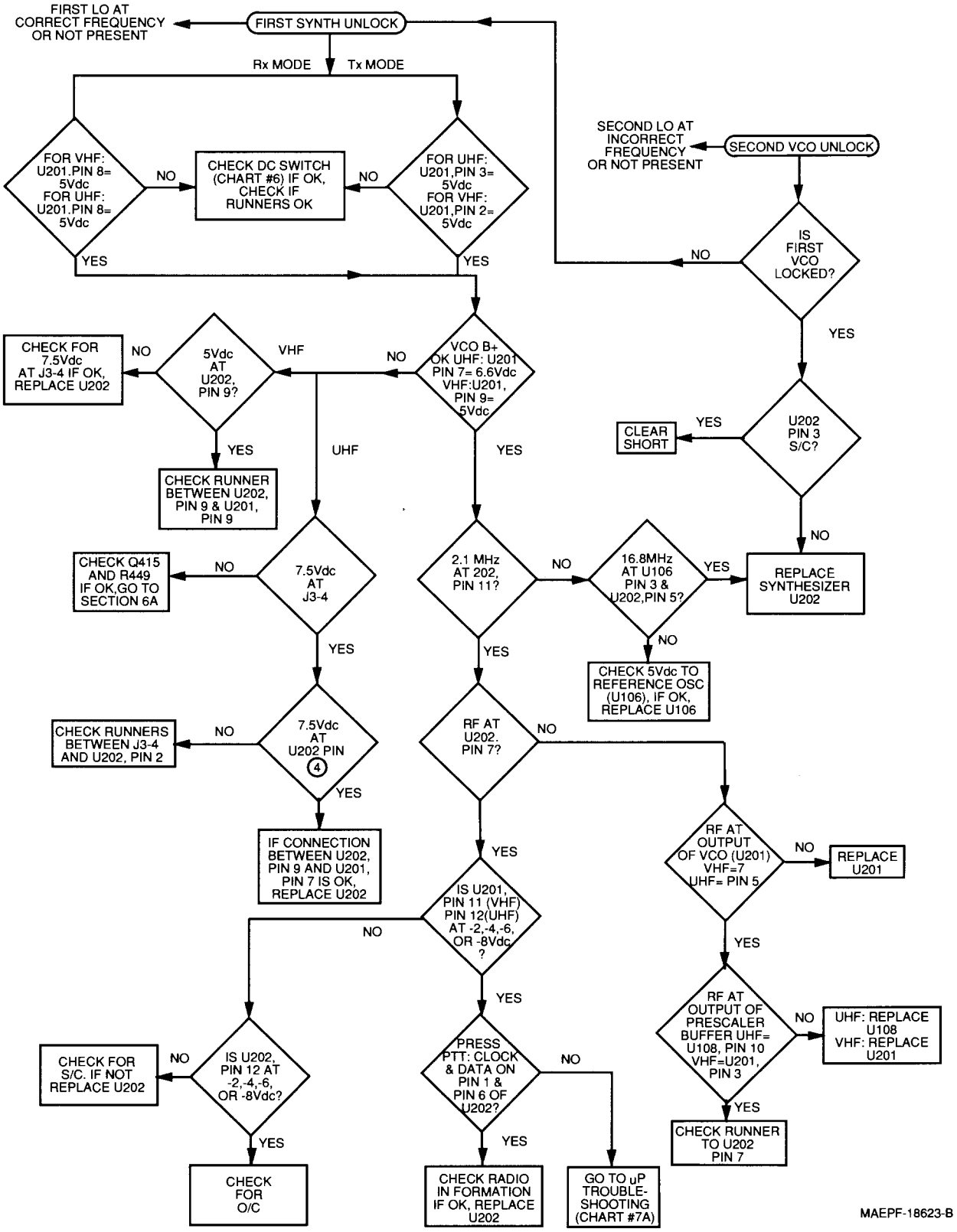


CHART #5B
LOWBAND FREQUENCY GENERATION UNIT

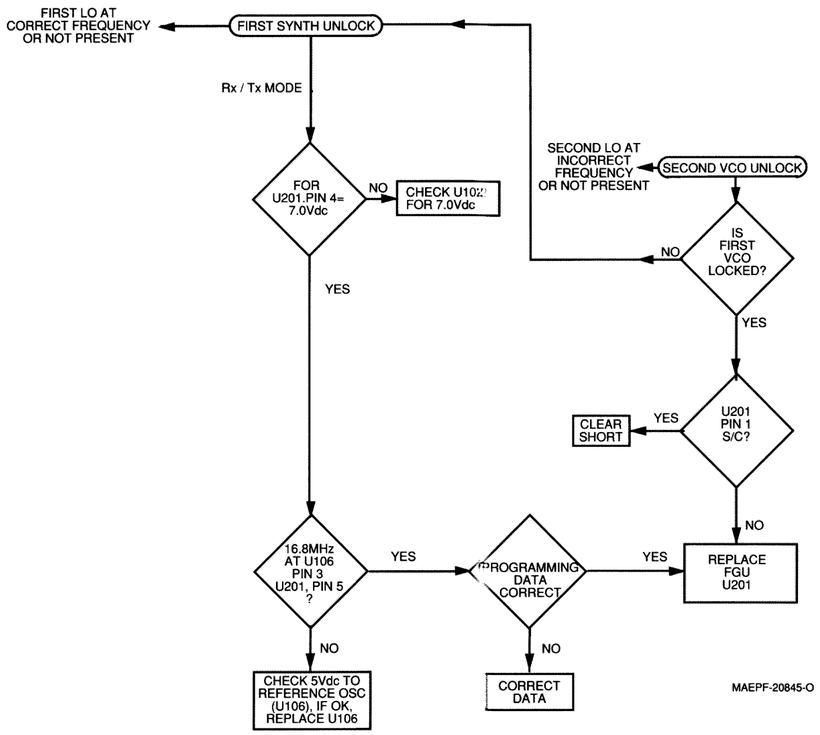


CHART #6A
VHF and UHF DC SWITCH

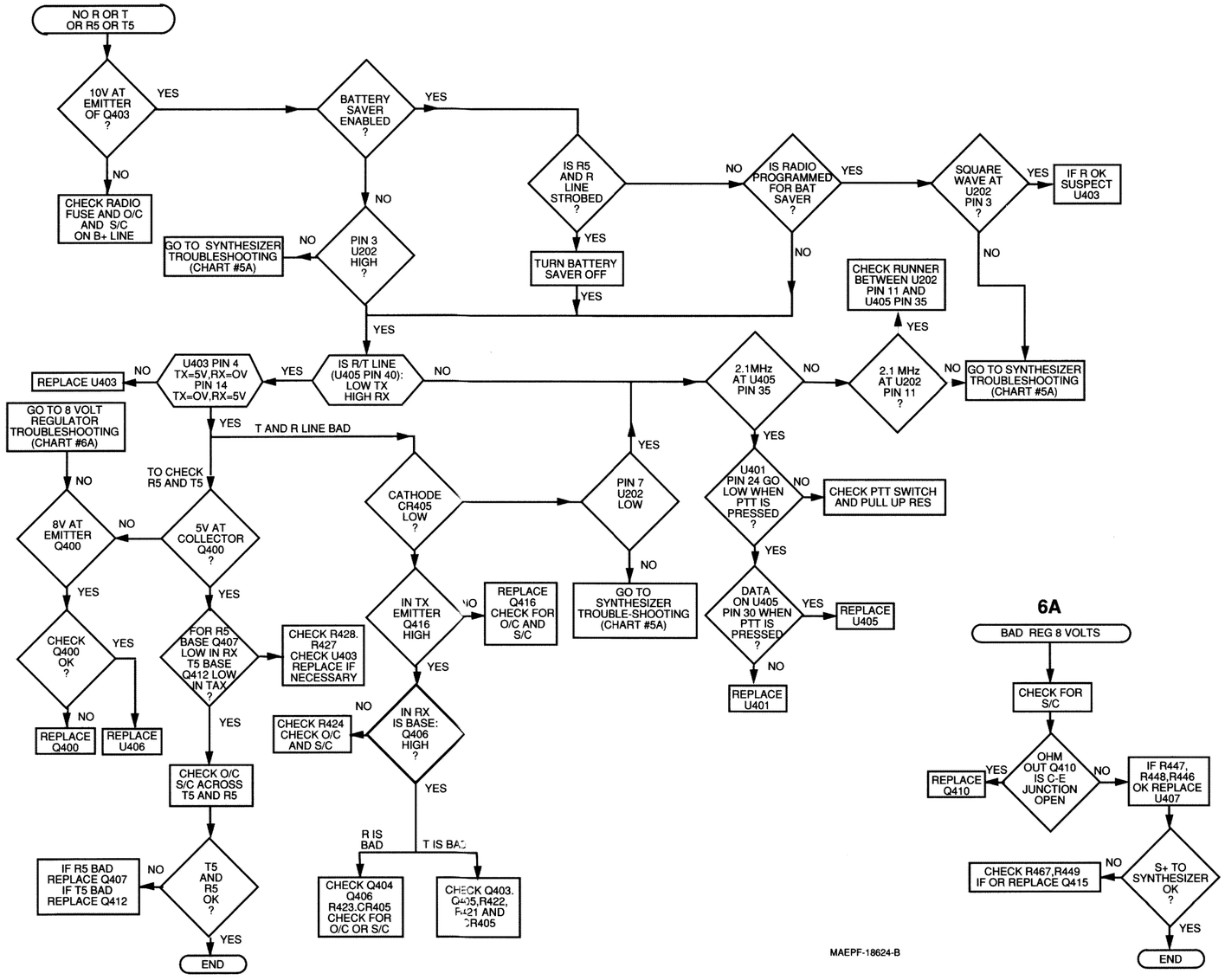
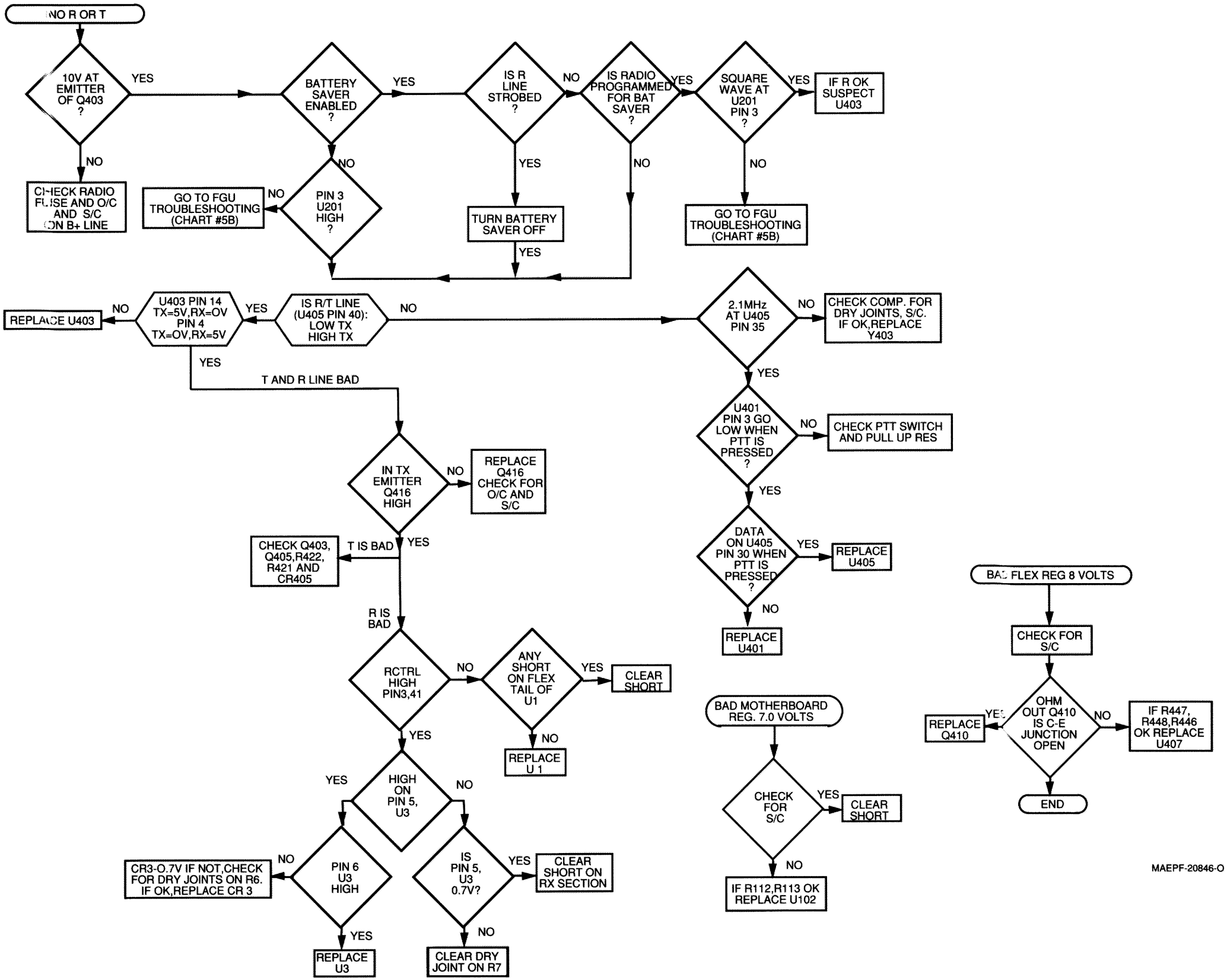
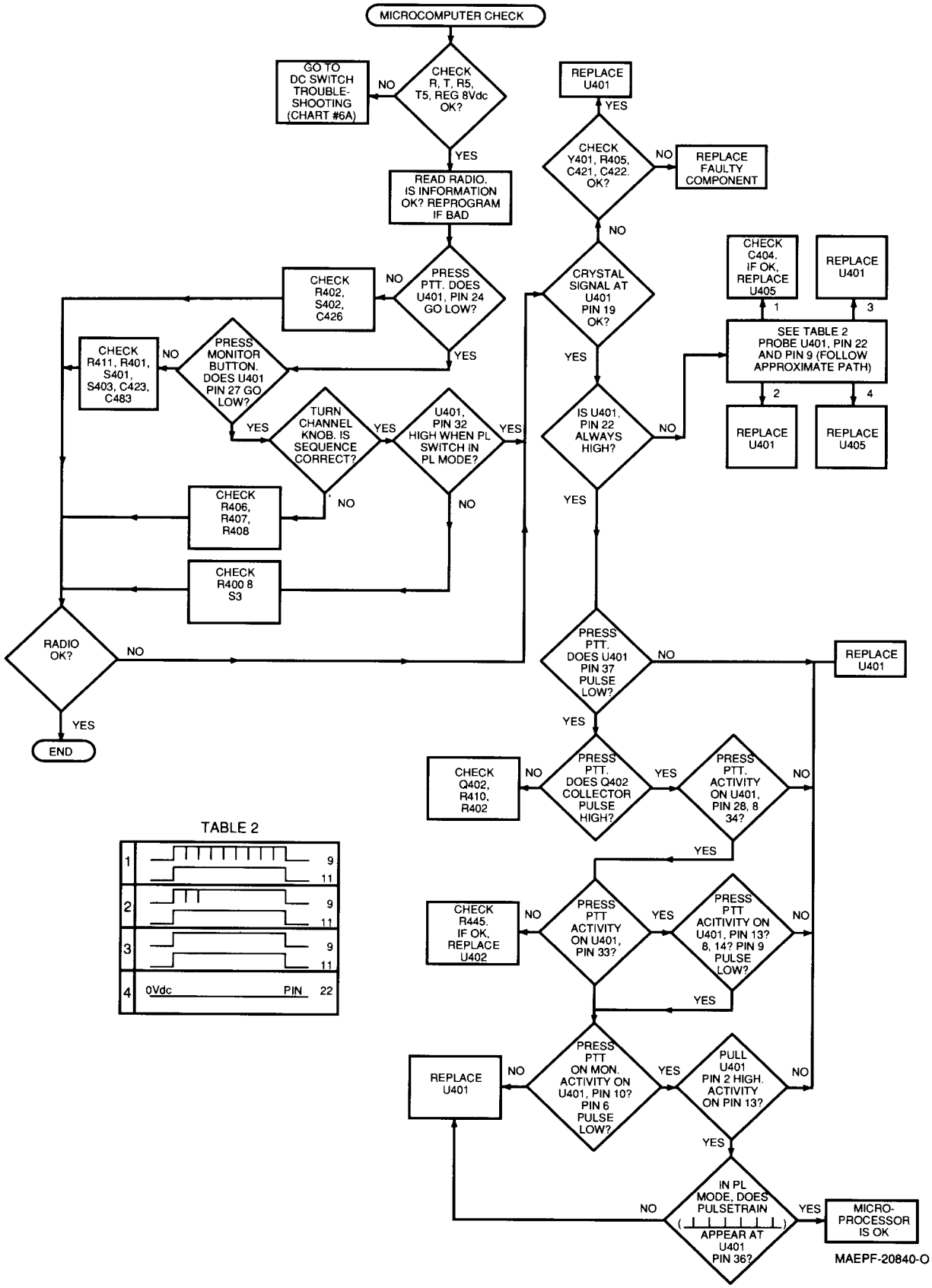


CHART #6B
LOWBAND DC SWITCH



MAEPF-20846-O

CHART #7A
VHF and UHF MICROCOMPUTER



MAEPF-20840-O

CHART #7B
LOWBAND MICROCOMPUTER

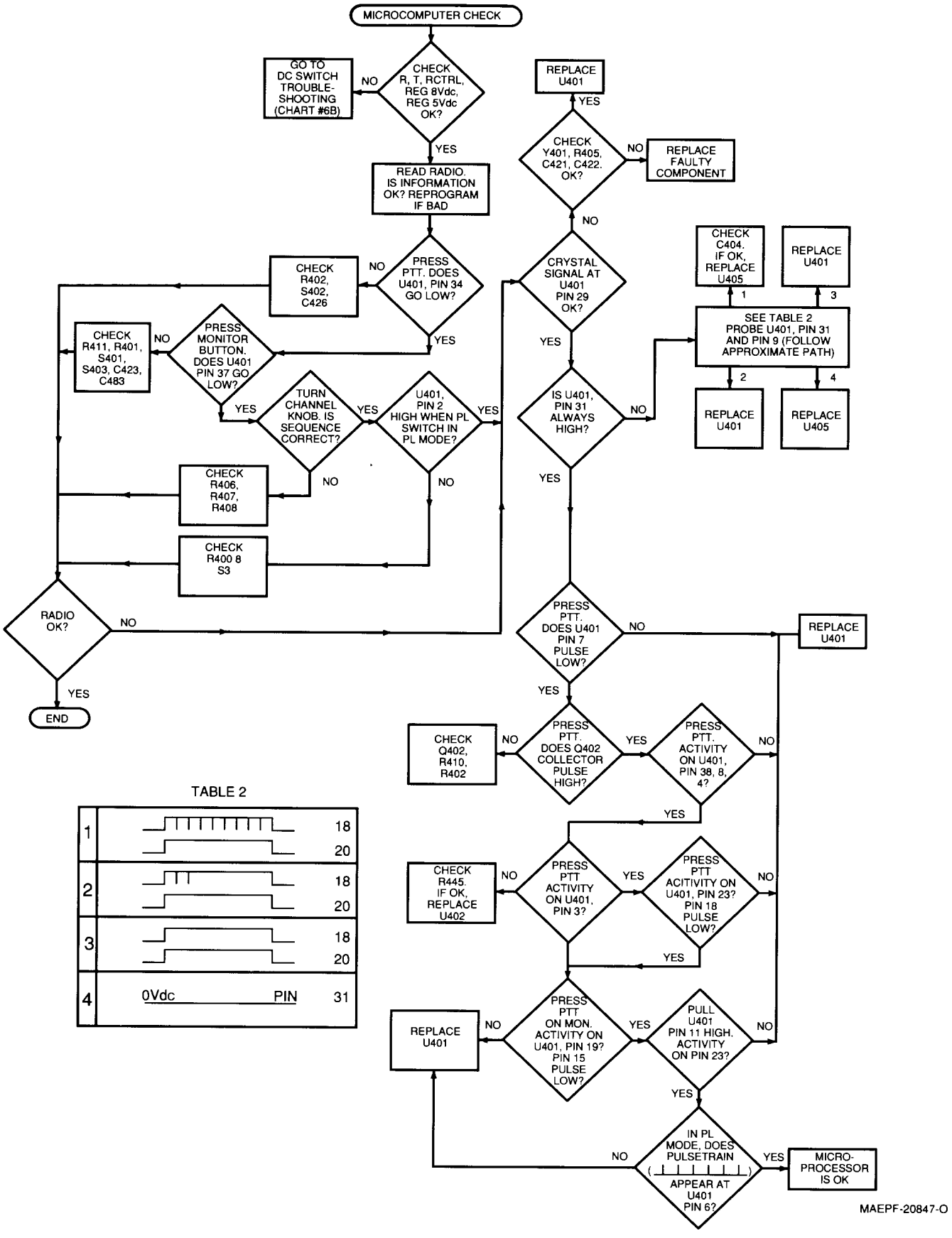


TABLE 2

MAEPF-20847-O

LOWBAND SPECIFICATIONS

GENERAL

FREQUENCY RANGE: 30-50 MHz

BANDSPLITS: 30-36 MHz
36-42 MHz
42-50 MHz

POWER SUPPLY: Nickel-cadmium battery

BATTERY DRAIN- at 10Vdc

Standby:	*42mA
Standby in Scan	*50mA
Receive:	*163mA
Transmit:	**2000mA

* Add 15mA with Remote Antenna
** Add 30mA with Remote Antenna

DIMENSIONS:

WIDTH:	2.63"	(66.8mm)
DEPTH:	1.39"	(35.3mm)

HEIGHT:

Radio Only:	3.90"	(99.0mm)
Radio with Battery		
Medium Capacity:	6.35"	(161.3mm)
High Capacity:	7.26"	(184.4mm)

WEIGHT:

Radio Only:	13.5 oz.	(383 g)
Radio with Battery (Nickel-Cadmium)		
Medium Capacity:	21.6 oz.	(612 g)
High Capacity:	24.1 oz.	(684 g)

TRANSMITTER

RF OUTPUT-
Nickel-cadmium battery: 6.0W at 10Vdc

MODULATION: Type 16K 0F 3E, ±5kHz for 100% modulation at 1000Hz (±4.0kHz min.) including PL modulation for PL models

PL MODULATION:
±1kHz max. ±500Hz min.

AUDIO DISTORTION: Less than 3% at 1000Hz, 3kHz deviation

MAX. PERMISSIBLE CHANNEL SEPARATION: 1MHz (no degradation)

FREQUENCY STABILITY:
±.0005% from -30°C to +60°C (+25°C ref.)

SPURIOUS & HARMONIC FREQUENCIES:
More than 53dB below carrier

FM NOISE (COMPANION RECEIVER):
At least 45dB below ±3.0kHz deviation at 1000 Hz

AUDIO RESPONSE:
+1, -3dB from 6dB/octave pre-emphasis characteristic from 300-3000Hz

RECEIVER

AUDIO OUTPUT: 500mW at less than 5% distortion

SECOND I-F FREQUENCY: 450kHz±1.5kHz measured at M1

SENSITIVITY:

12dB SINAD	0.25µV max.
20dB Quieting	0.35µV max.

NOISE SQUELCH SENSITIVITY: Noise compensated type, Programmable

MAX. PERMISSIBLE CHANNEL SEPARATION: 1MHz (no degradation)

FREQUENCY STABILITY:
±.0005% from -30°C to +60°C (+25°C ref.)

USEABLE BANDWIDTH: ±7kHz

SPURIOUS FREQUENCY REJECTION:
More than 70dB below carrier

IMAGE REJECTION:
More than 70dB below carrier

SELECTIVITY:
More than 70dB at ±20kHz (12dB SINAD)

INTERMODULATION:
More than 70dB at adjacent channel

CHANNEL SPACING: 20kHz

Specifications Subject to Change Without Notice

NOTES:

- ALL BATTERIES MUST BE CHARGED PRIOR TO USE.
- USE OF CHEMICALS (DETERGENTS, ALCOHOLS, AEROSOL SPRAYS, PETROLEUM PRODUCTS) MAY BE HARMFUL AND MAY DAMAGE THE RADIO HOUSING. WE RECOMMEND A MILD DISHWASHING SOAP FOR CLEANING THE EXTERIOR OF THE PRODUCT.
- O-RING SEALS MUST BE PROPERLY ASSEMBLED TO ENSURE CONFORMANCE TO MIL-810D SPECIFICATIONS FOR WATER INTRUSION.

VHF SPECIFICATIONS

GENERAL

FREQUENCY RANGE: 136-174 MHz

BANDSPLITS: 136-150.8MHz
146-174MHz

POWER SUPPLY: Nickel-cadmium battery

BATTERY DRAIN-

at 10Vdc	H33	H43
Standby:	*43mA	*43mA
Standby in Scan	*50mA	*50mA
Receive:	*163mA	*163mA
Transmit:	***775mA	**1600mA

* Add 8mA with Remote Antenna; Add 4mA for 146-174MHz Bandsplit
** Add 25mA with Remote Antenna
*** Add 25mA with Remote Antenna; and 100mA for 146-174MHz Bandsplit

DIMENSIONS:

WIDTH:	2.63"	(66.8mm)
DEPTH:	1.39"	(35.3mm)

HEIGHT:

Radio Only:	3.90"	(99.0mm)
Radio with Battery		
Medium Capacity:	6.35"	(161.3mm)
High Capacity:	7.26"	(184.4mm)

WEIGHT:

Radio Only:	13.5 oz.	(383 g)
Radio with Battery (Nickel-Cadmium)		
Medium Capacity:	21.6 oz.	(612 g)
High Capacity:	24.1 oz.	(684 g)

TRANSMITTER

RF OUTPUT-	H33	H43
Nickel-cadmium battery:	2.0W at 10Vdc	5.0W at 10Vdc

MODULATION: Type 20K0F3E, ±5kHz for 100% modulation at 1000Hz (±4.0kHz min.) including PL modulation for PL models

PL MODULATION:
±1kHz max. ±500Hz min.

AUDIO DISTORTION: Less than 3% at 1000Hz, 3kHz deviation

MAX. PERMISSIBLE CHANNEL SEPARATION: Full Bandsplit (no degradation)

FREQUENCY STABILITY:
±.0005% from -30°C to +60°C (+25°C ref.)

SPURIOUS & HARMONIC FREQUENCIES:
More than 60dB below carrier

FM NOISE (COMPANION RECEIVER):
At least 45dB below ±3.0kHz deviation at 1000 Hz

AUDIO RESPONSE:
+1, -3dB from 6dB/octave pre-emphasis characteristic from 300-3000Hz

RECEIVER

AUDIO OUTPUT: 500mW at less than 5% distortion

SECOND I-F FREQUENCY: 450kHz±1.5kHz measured at M1

SENSITIVITY:

12dB SINAD	0.25µV max.
20dB Quieting	0.35µV max.

NOISE SQUELCH SENSITIVITY: Noise compensated type, Programmable

MAX. PERMISSIBLE CHANNEL SEPARATION: Full Bandsplit (no degradation)

FREQUENCY STABILITY:
±.0005% from -30°C to +60°C (+25°C ref.)

USEABLE BANDWIDTH: ±5kHz

SPURIOUS FREQUENCY REJECTION:
More than 70dB below carrier

IMAGE REJECTION:
More than 70dB below carrier

SELECTIVITY:
More than 70dB at ±30kHz (12dB SINAD)

INTERMODULATION:
More than 70dB at adjacent channel

CHANNEL SPACING: 30kHz

Specifications Subject to Change Without Notice

NOTES:

- ALL BATTERIES MUST BE CHARGED PRIOR TO USE.
- USE OF CHEMICALS (DETERGENTS, ALCOHOLS, AEROSOL SPRAYS, PETROLEUM PRODUCTS) MAY BE HARMFUL AND MAY DAMAGE THE RADIO HOUSING. WE RECOMMEND A MILD DISHWASHING SOAP FOR CLEANING THE EXTERIOR OF THE PRODUCT.
- O-RING SEALS MUST BE PROPERLY ASSEMBLED TO ENSURE CONFORMANCE TO MIL-810D SPECIFICATIONS FOR WATER INTRUSION.

UHF SPECIFICATIONS

GENERAL

BAND SPLITS: 403-433 MHz
438-470 MHz
470-500 MHz
488-520 MHz

POWER SUPPLY: Nickel-cadmium battery

BATTERY DRAIN-

at 10Vdc	H34	H44
Standby:	*48mA	*48mA
Standby in Scan	*56mA	*56mA
Receive:	*166mA	*166mA
Transmit:	**875mA	**1600mA

*Add 8mA with Remote Antenna
**Add 15mA with Remote Antenna

DIMENSIONS:

WIDTH:	2.63"	(66.8mm)
DEPTH:	1.39"	(35.3mm)
HEIGHT:		
Radio Only	3.90"	(99.0mm)
Radio with Battery		
Medium Capacity	6.35"	(161.3mm)
High Capacity	7.26"	(184.4mm)

WEIGHT:

Radio Only	13.5 oz.	(383 g)
Radio with Battery (Nickel-Cadmium)		
Medium Capacity	21.6 oz.	(612 g)
High Capacity	24.1 oz.	(684 g)

TRANSMITTER

RF OUTPUT-	H34	H44
Nickel-cadmium battery:	2.0W at 10Vdc	4.0W at 10Vdc

MODULATION: Type 20K0F3E, ±5kHz for 100% modulation at 1000Hz (±4.0kHz min.) including PL modulation for PL models

PL MODULATION:
±1kHz max. ±500Hz min.

AUDIO DISTORTION: Less than 5% at 1000Hz, 3kHz deviation

MAX. PERMISSIBLE CHANNEL SEPARATION: 15MHz (no degradation)

FREQUENCY STABILITY:
±.0005% from -30°C to +60°C (+25°C ref.)

SPURIOUS & HARMONIC FREQUENCIES:
More than 53dB below carrier

FM NOISE (COMPANION RECEIVER):
At least 45dB below ±3.0kHz deviation at 1000 Hz

AUDIO RESPONSE:
+1, -3dB from 6dB/octave pre-emphasis characteristic from 300-3000Hz

RECEIVER

AUDIO OUTPUT: 500mW at less than 5% distortion

SECOND I-F FREQUENCY: 450kHz±1.5kHz measured at M1

SENSITIVITY: 0.35uV max. (12dB SINAD), 0.50uV max. (20dB quieting)

NOISE SQUELCH SENSITIVITY: Noise compensated type, Programmable

MAX. PERMISSIBLE CHANNEL SEPARATION: 8MHz (no degradation)

FREQUENCY STABILITY:
±.0005% from -30°C to +60°C (+25°C ref.)

USEABLE BANDWIDTH: ±5kHz

SPURIOUS FREQUENCY REJECTION:
More than 70dB below carrier

IMAGE REJECTION:
More than 70dB below carrier

SELECTIVITY:
More than 70dB at ±25kHz (12dB SINAD)

INTERMODULATION:
More than 70dB at adjacent channel

CHANNEL SPACING: 25kHz

Specifications Subject to Change Without Notice

NOTE:

- ALL BATTERIES MUST BE CHARGED PRIOR TO USE.
- USE OF CHEMICALS (DETERGENTS, ALCOHOL, AEROSOL SPRAY, PETROLEUM PRODUCTS) MAY BE HARMFUL AND MAY DAMAGE THE RADIO HOUSING. WE RECOMMEND A MILD DISHWASHING SOAP FOR CLEANING THE EXTERIOR OF THE PRODUCT.
- O-RING SEALS MUST BE PROPERLY ASSEMBLED TO ENSURE CONFORMANCE TO MIL-810D SPECIFICATIONS FOR WATER INTRUSION.

SERVICE AIDS

The following table lists tools and service aids recommended for working on the MT1000 portable radio. While all of these items are available from Motorola, most are standard shop equipment items, and any equivalent item capable of the same performance may be substituted for the item listed.

MOTOROLA PART NO.	DESCRIPTION	APPLICATION
RTK-4205B	RIB/Radio/test set cable	Connects radio to RTX-4005B Test Box and RIB.
RTL-4226B	Battery Eliminator	Interconnects radio to power supply.
1580368B62	Battery Adapter	Connects radio to battery eliminator without main housing.
REN-4000A	Controller Flex Extender Fixture	Eases in troubleshooting of controller flex and RF board.
0180371B37	Controller Flex Hold Down Fixture	Provides secure mount for controller flex during servicing.
RTX-4005B or both RTX-4005A and RPX-4665A field modification kit.	Portable Test Set	Enables connection to the universal connector. Allows switching for radio testing.
RLN-4008B	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter. Requires 9-Volt snap type battery, Motorola part number 6082728J01. (Also accepts power supply part number 0180357A57.)
0180357A57	Wall-mounted Power Supply	Used to supply power to the RIB (117 VAC).
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT. All other IBM models use B71. Connects the computer's serial communications adapter to the RIB.
NKN6376A	Cloning Cable	Allows an MT1000 radio to be duplicated from a master radio by transferring programmed data from one radio to another.
RVN-4017E	Radio Service Software	Software on 5 1/4 in. floppy disc.
RVN-4018E	Radio Service Software	Software on 3 1/2 in. floppy disc.
F.A.S.T. 47	"Using the RLN-4062A Hot Air Repair Station"	How to use the RLN-4062A to successfully remove and replace chip components.
0180358A59	ANI Programming Tool	Used on DTMF ANI Options to program ANI codes.
6082728J01	Battery	9-Volt snap type battery for RIB.
TT907	National Service Technical Guide	Repairing leadless component assemblies.
R-1070A or R-1080A	Hot Air Repair Station (Described in TT907)	
RPX-4726	Reference Oscillator Tuner Box	Tuning the alternate oscillator for lowband.

RECOMMENDED TOOL LIST

The following table lists the tools recommended for working on the MT1000 portable radio; these also are available from Motorola. Note that the R-1070A workstation requres the use of a specific "heat focus head" for each of the components on which this item is used. **Each of these heat focus heads must be ordered separately.** The individual heat focus heads (and the components on which they are used) are listed at the end of the table.

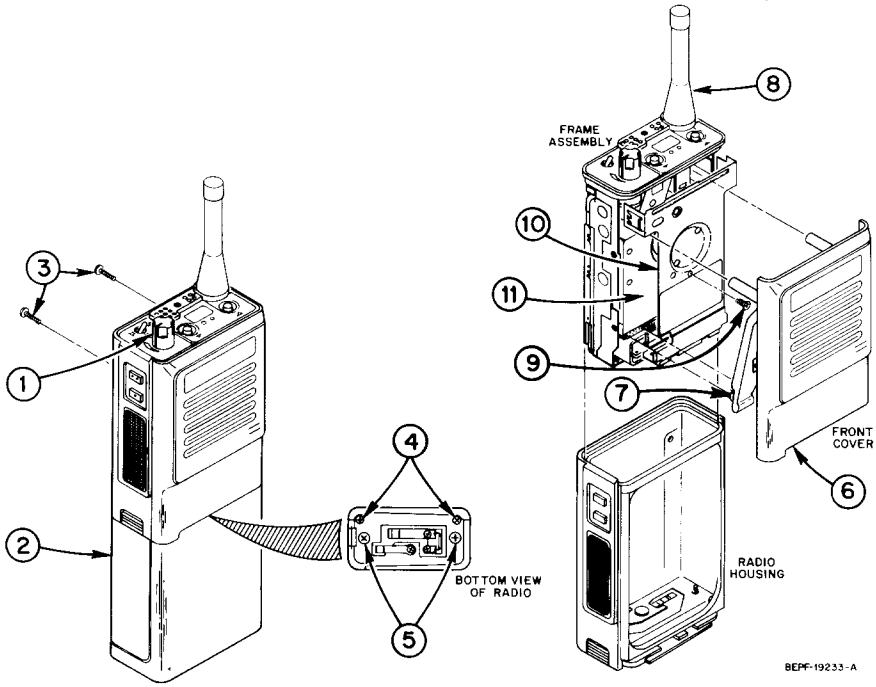
MOTOROLA PART NO.	DESCRIPTION	APPLICATION
RSX-4043A	Torque screwdriver	Handle for bits listed below
6680321B86	Phillips bit (0)	Radio screws
6680321B79	Phillips bit (1)	Radio screws
6680371B03	Hex socket bit	Volume and rotary switch nuts
6680371B34	Spanner bit	Antenna bushing spanner nut
6680370B95	Spanner bit	Toggle switch spanner nut
6605106N01	Tuning tool	Tunable coils and potentiometers
6680387A59	Extractor, 2 contact	Removal of discrete surface-mounted devices
6680387A64	Heat controller with safety stand, or	
6680387A65	Safety stand only	
0180382A31	Portable desoldering unit	
6680375A74	0.025 replacement tip,5/pk	For 0180382A31 portable desoldering unit
0180386A81	Miniature digital readout soldering station (incl. 1/64" micropoint tip)	
0180386A78	Illuminated magnifying glass with lens attachment	
0180386A82	Anti-static grounding kit	Used during all radio assembly and disassembly procedures
6684253C72 6680384A98	Straight prober Brush	
1010041A86	Solder (RMA type), 63/37, 0.020" diameter-1 lb. spool	
1080370B43	RMA liquid flux	
R-1070A	Surface mounted component IC removal/rework station (order all heat focus heads separately)	Removal of surface-mounted integrated circuits
MOTOROLA PART NO.	**DESCRIPTION**	**APPLICATION**
HEAT FOCUS HEADS	**INSIDE DIMENSIONS OF HEADS**	
6680334B48	0.318" x 0.318" for U402, U408, and U409	
6680334B49	0.140" x 0.410" for U406	
6680334B51	0.492" x 0.492" for U401 and U405	
6680370B57	0.245" x 0.245" for U403 and U801	
6680370B66	0.180" x 0.180" for U404	

TORQUE AND TOOL SPECIFICATIONS CHART

PART DESCRIPTION	SIZE	NUMBER	QTY.	RETIGHTEN WITH RSX-4043A TORQUE SCREWDRIVER AND	TORQUE (IN./LB.)	EXP. VIEW NUMBER
Control Top Antenna Bushing Spanner		0205765L02	1	6680370B90	12	22
Volume Pot. Nut	0.75x8X1.6	0205629L01	1	6680371B03	5	17
Freq. Switch Nut Rotary Radios Only	0.75x8X1.6	0205629L01	1	6680371B03	5	17
Toggle Switch Spanner		0205163Q01	1	6680370B95	4	19
Control Top Screw Rotary Radios Display Radios	 4-40x3/16" 2-56x5/16"	 0300136785 0305573R01	 1 1	 6680321B79 6680321686	 5 3	 6 26
Housing Battery Contact Screws	2-56 x 5/32"	0300139982	2	6680321B86	3	45
Bottom Front Cover Screws	2-56 x 1/4"	0300140041	2	6680321B86	3	87
Baseplate to Frame Screws	4-40 (captive)	0305941K01	2	6680321B79	5	49
Front Cover Post Screws	4-40x1/2"	0305137Q01	2	6680321B79	5	52
Controller Front Shield Screw	2-56x1/8"	0300140369	1	6680321686	3	35
Controller Bottom Screws	2-56x5/16"	0300138620	2	6680321686	3	67
Controller to Frame Screws	2-56x1/8"	0300140369	4	6680321686	2	35
RF Board Back Shield Screws	2-56x5/16"	0300136772	5	6680321686	3	65
PA Heatsink to PCB (VHF-LP)	2-56x3/16"	0300136771	2	6680321686	3	15
PA Heatsink to PCB	2-56x3/16"	0300136771	1	6680321686	3	15
PA to Heatsink (VHF-LP)	2-56x5/32"	0300139675	1	6680321686	3	101
PA to Heatsink Nut (VHF-HP)	1/4	0200007007	1		5	97
Synthesizer Casting Screw	2-56x3/16"	0300136771	2	6680321686	4	15
Front Cover Speaker/Mic Tab Screws	2-56x5/32"	0300139982	4	6680321686	3	45

TUNING AND ALIGNMENT DISASSEMBLY PROCEDURE

Disassembly Typical (VHF Radio Shown)



1. Turn off the radio.
2. Remove the battery:

   While pushing the spring-loaded battery latch toward the top of the radio, slide the battery away from the latch, removing it from the baseplate on the bottom of the radio.
3. Remove the two screws from the back of the radio.
4. Remove the two screws from the bottom of the radio (baseplate corners).
5. Loosen the two captive screws on the bottom of the radio (middle of each baseplate). Do not completely remove the captive screws from the base plate.
6. Lift the front cover from the radio housing, being careful not to pull against the speaker/microphone flex.
7. Disconnect the speaker/microphone connector from the controller flex by grasping the flex (near the plug) and pulling the plug straight out and away from the circuit board.
8. With a thumb and forefinger, grasp the antenna at its base and pull lightly to remove the frame assembly from the radio housing. Do not press the PTT switch during removal.

CAUTION

REFER TO "CMOS" PRECAUTIONS, PART OF "SAFETY INFORMATION" SECTION.

9. Remove the screw that secures the front shield. (Does not apply to lowband.)
10. Remove the front shield by pulling it straight out and away from the radio. (Does not apply to lowband.)
11. Remove the controller circuit as follows:

    (A) Remove the 4 screws (2 on each side) that secure the controller to the frame.

    (B) Remove the retainer clip that secures the top two connectors.

    NOTE

    Be careful to pull each connector straight out and away from the mating socket so as not to bend or break the connector pins.

    (C) Disconnect the 2 bottom flex connectors by carefully sliding them away from the bottom of the radio.

    (D) Lift the controller circuit (nearest the bottom of the radio) away from the radio just enough to gain access to the connector under the controller.

    (E) Disconnect the connector under the controller.

    (F) Disconnect the 2 connectors at the top of the controller.

    (G) Lift the controller totally away from the radio.

    NOTE

    Refer to the Exploded View Diagram if further disassembly if necessary.
12. Assemble the radio in the reverse order of disassembly, making certain:

- to avoid damage to the flex circuits, connectors, and connector pins when reinserting the controller.
- not to depress the PTT switch when sliding the circuit board back into the housing.

CAUTION

Inspect the frame O-ring and control head O-ring. Replace if obvious damage exists.

GENERAL

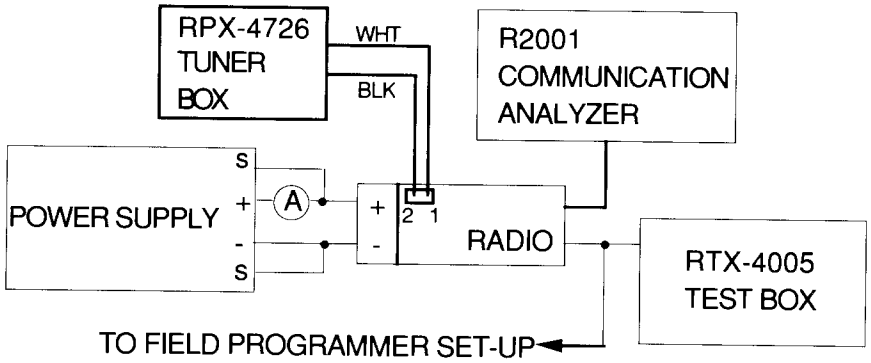
THIS RADIO HAS BEEN FACTORY ALIGNED AND DOES NOT REQUIRE ANY ADJUSTMENTS. Realignment may be required if components are replaced or have aged,or if any transmitter/receiver frequencies are changed. If it is necessary to realign the radio, perform the following procedures:

1. When using the RTX-4005 test box, place the **MT PL** switch in the **OFF** position.
2. Remove the battery and front cover as described in the "DISASSEMBLY PROCEDURE".
3. Refer to the Test Set-Up Detail and connect the test equipment and Computer/RIB to the radio as illustrated.
4. Connect a dc power supply to the battery eliminator and attach the battery eliminator to the radio.
5. Adjust the power supply for 10.0Vdc. Set current limit to 2.0A.
6. Turn the radio off then on to reinitialize the radio.
7. **Frequency Adjust (Synthesizer)** Lowband radios, refer to alternate procedure - Terminate the program/test cable (RTK-4205A), RF Lines (pins 10 and 12), through a 30dB pad to a frequency counter or service monitor. Set the radio to any channel. Key the radio using the external PTT switch. Compare the frequency reading on the counter (or service monitor) to the customer frequency assigned to that channel. The frequency difference should be less than ±300Hz (lowband), ±750Hz (vhf), or 1250Hz (uhf). Adjust R129 (vhf) or R120 (Lowband and uhf) if the frequency difference is more than ±300Hz (lowband), ±750Hz (vhf), or 1250Hz (uhf).
8. Perform either the "RECEIVER ALIGNMENT" procedure or "TRANSMITTER ALIGNMENT" procedure or both procedures as required.

ALTERNATE LOWBAND REFERENCE OSCILLATOR FREQUENCY ADJUST

If your lowband radio has reference oscillator adjustment potentiometer R120, return to and perform step 7 of the GENERAL procedure. If your lowband radio has a 2-pin connector in place of R120, perform the following alternate procedure.

ALTERNATE TEST SET-UP



PRESET:

Communications Analyzer to:
- MODE- Monitor
- MONITOR- Frequency Error

Portable Test Box to:
MT PL- Off
PTT switch- Continuous

RESULT: Read frequency error on Service Monitor. Desired result is nominal frequency ±300Hz.

PROCEDURE: With the Alternate Test Set-up above, use the UP/DOWN and COARSE/FINE switches on the Tuner Box to bring the measurement within tolerance (300 Hz). Adjust by holding the POWER button depressed and simultaneously pressing and releasing the TUNE button. Adjust to nominal frequency + 50 Hz to allow for drift.

TRANSMITTER ALIGNMENT

Review "GENERAL" information section before performing TRANSMITTER ALIGNMENT

Preliminary Adjustments:

1. Terminate the program/test cable, RF lines (pins 10 and 12), to a power meter through a 30dB pad.
2. Make all measurements at the Universal Interface Connector (pins 10 and 12), with radio keyed through the external PTT switch.
3. Program new customer frequencies (if necessary).

Power Output Adjustment (lowband)

STEP	ADJUST	FOR	USING	NOTE
1	Check power output on all channels. **NOTE:** You must dekey before changing channels for the synthesizer to change frequencies. Set the frequency switch to the channel with the lowest output power.			
2	C159 Trimmer Capacitor	Maximum power output with least current drain	RF Wattmeter and Ampmeter	Use wide end of tuning tool.
3	*C115 Trimmer Capacitor	Maximum power output with least current drain	RF Wattmeter and Ampmeter	Use narrow end of tuning tool. If the power exceeds 7.8W, tune C115 to 7.8W.
4	*C159 Trimmer Capacitor	Power output of 6.8 to 7.0W.	RF Wattmeter and Ampmeter	If power does not make the 6.8 to 7.0W window, peak C159.
5	C115 Trimmer Capacitor	Power output of 6.2 to 6.4W	RF Wattmeter and Ampmeter	Two possible peaks, choose peak with least current drain. Adjust from component side.
6	Check both ends of the customer frequency to ensure a minimum power output of 6.2W.		RF Wattmeter and Ampmeter	Maximum frequency separation is 1MHz.

* When tuning capacitor C115, be careful not to touch the leg of C115 and the heatsink with a metal tuning tool. Refer to the Alignment and Metering Point Locations.

Power Output Adjustments (vhf and uhf)

STEP	ADJUST	FOR	USING	NOTE
1	Check power output on all channels. **NOTE:** You must dekey before changing channels for the synthesizer to change frequencies. Set the frequency switch to the channel with the lowest output power.			
2A VHF 136-150.8 MHz	C120 Trimmer Capacitor	Maximum power output with least current drain	RF Wattmeter and Ampmeter	Reading should be greater than rated rf power output and less than rated current drain.
2B VHF 146-174 MHz	R300 Trimmer Capacitor	Maximum power output with least current drain	RF Wattmeter and Ampmeter	**NOTE:** Two possible peaks; steps 2A or 2C. Choose peak with least current drain. Adjust from component side.
2C UHF	PA Trimmer Capacitor (on U102)	Maximum power output with least current drain	RF Wattmeter and Ampmeter	
3	Check remaining channels	Same power and current readings obtained in STEP 2	RF Wattmeter and Ampmeter	
4	Repeat steps 1 through 3 if necessary.			

Deviation Check:

1. Terminate the program/test cable (RTK-4205A) through a 30 dB pad to a service monitor (or deviation meter).
2. Place the **METER SELECTOR** switch on the test box (RTK-4005) to the MIC position. Insert a 1 kHz tone at the **AUDIO IN** port of the test box. Use an ac voltmeter to monitor the voltage at the **AC/DC METER** port of the test box. Using the PTT switch on the test box to key the radio, adjust the level of the 1 kHz tone until 45mV is present at the **AC/DC METER** port. Dekey the radio.
3. If the radio requires a change in frequency or options, make the appropriate changes to the workspace and program the radio.

NOTE

The RTK-4005 test box has a resistive divider between the **AUDIO IN** port and the **AC/DC METER** port. To accurately set deviation, 45mV must be present at the **AC/DC METER** port. This means that approximately 450mVRMS must be applied to the **AUDIO IN** port.

4. With the 1 kHz tone applied, check the total transmit deviation. It should be greater than 4 kHz but less than 5 kHz. If any of the deviations are not in the proper range perform the **Radio Wide Deviation Alignment.**
5. For channels with Transmit PL, remove the 1 kHz tone from the **AUDIO IN** port of the test box. Check the deviation of the PL signal. It should be greater than 500Hz but less than 1000Hz. If any of the deviations are not in the proper range perform the **Radio Wide Deviation Alignment.**
6. For channels with Digital Signalling, key the radio to check the deviation of the signalling packet. The packet only lasts for a very short time, so it may be necessary to key the radio several times to check the deviation. The deviation should be greater than 3.5kHz but less than 4.5kHz. If the deviations are not in the proper range, perform the Signalling Option Deviation Alignment.
7. For Digital Signalling radios with DTMF, key the radio and press any button and check the deviation. The deviation should be greater than 3.5kHz but less than 4.5kHz. If the deviation is not in the proper range, perform the **Signalling Option Deviation Alignment.**

Radio Wide Deviation Alignment:

DO NOT PEFORM RADIO WIDE DEVIATION ALIGNMENT UNTIL THE DEVIATION CHECK HAS BEEN PERFORMED.

NOTE

To tune the MT1000 portable radio it is necessary to align the deviation at several predefined alignment frequencies. The Radio Service Software automatically places the alignment frequency in the radio's RAM. After the alignment procedure is complete, the Radio Service Software will automatically calculate the deviation for each frequency in the work space. The radio and work space must match. If any frequencies were modified, the radio must be programmed before proceeding.

1. Press the **F5** key in the MAIN/SERVICE menu to enter the RADIO WIDE DEVIATION Alignment menu. The cursor will be at TRANSMIT DEV Alignment Point 1.
2. Set the service monitor (or deviation meter) to the alignment frequency displayed in the upper right hand corner of the screen. Press the PTT switch on the test box to continuously key the radio.
3. With the 1 kHz tone applied, use the up/down arrow keys to adjust the peak deviation to the limits displayed on the screen. Release the PTT switch on the test box to dekey the radio. Press the **ENTER** key to proceed to the next alignment point.
4. Repeat steps 2 and 3 until all TRANSMIT DEV Alignment Points have been completed.

NOTE

Failure to complete all TRANSMIT DEV Alignment Points, may cause the transmit deviations to be incorrect.

5. After the last TRANSMIT DEV alignment point has been aligned, the cursor will automatically proceed to REFERENCE DEV Alignment Point 1.
6. Disconnect the 1 kHz tone from the **AUDIO IN** port of the test box.
7. Set the service monitor (or deviation meter) to the alignment frequency displayed in the upper right hand corner of the screen. Press and hold down the PTT switch on the test box to continuously key the radio.
8. Use the up/down arrow keys to adjust the peak deviation to the limits displayed on the screen. Release the PTT switch on the test box to dekey the radio. Press the **ENTER** key to proceed to the next alignment point.

9. Repeat steps 7 and 8 until all REFERENCE DEV alignment points have been completed.

NOTE

Failure to complete all REFERENCE DEV alignment points, may cause the reference deviations to be incorrect.

10. Press **F8** to program the deviation values into the radio.
11. Press **F10** to exit the menu.
12. With the 1 kHz tone applied, check the peak deviation for each channel. It should be greater than 4 kHz butless that 5 kHz. If any of the deviations are not in the proper range perform the **CHANNEL DEVIATION ALIGNMENT.**
13. For channels with Transmit PL, remove the 1 kHz tone from the **AUDIO IN** port of the test box. Check the deviation of the PL signal. It should be greater than 500 Hz but less than 1000 Hz. If any of the deviations are not in the proper range perform the **CHANNEL DEVIATION ALIGNMENT.**

Channel Deviation Alignment:

ONLY PERFORM CHANNEL DEVIATION ALIGNMENT ON THOSE CHANNELS THAT FAILED THE RADIO WIDE DEVIATION ALIGNMENT.

1. Press the **F7** key in the MAIN/SERVICE menu to enter the CHANNEL DEVIATION Alignment menu to realign an individual channel. The cursor will be at TRANSMIT DEV position.
2. Set the radio on the channel to be aligned.
3. Set the service monitor (or deviation meter) to the transmit frequency (displayed in the upper right hand corner of the screen) of the channel to be aligned. Press and hold down the PTT switch on the test box to continuously key the radio.
4. With the 1 kHz tone applied, use the up/down arrow keys to adjust the peak deviation to the limits displayed on the screen. Release the PTT switch on the test box to dekey the radio. Press the **ENTER** key to move the cursor to the REFERENCE DEV position.
5. Disconnect the 1 kHz tone from the **AUDIO IN** port of the test box.
6. Press and hold down the PTT switch on the test box to continuously key the radio.
7. Use the up/down arrow keys to adjust the peak deviation to the limits displayed on the screen. Release the PTT switch on the test box to dekey the radio.
8. Press **F8** to program the deviation values for this channel into the radio.
9. Press F10 to exit the menu.
10. With the 1 kHz tone applied, check the peak deviation for this channel. It should be greater than 4 kHz but less that 5 kHz.
11. For channels with Transmit PL, remove the 1 kHz tone from the **AUDIO IN** port of the test box. Check the deviation of the PL signal. It should be greater than 500 Hz but less than 1000 Hz.
12. Repeat steps 1 through 11 for all channels that failed the deviation check in the "Radio Wide Deviation Alignment" procedure.

Deviation Adjustment for non-MDC Signalling DTMF Radios:

1. Follow the deviation procedure detailed above.
2. Press the number **1** key on the DTMF pad and continuously key the radio's PTT switch. Adjust R709 for 3.0 to 3.2 kHz deviation.

NOTE

DTMF memory is volatile. If the battery is left off for more than 2 minutes the memory will be erased.

Signalling Option (MDC/Singletone) Deviation Alignment:

DO NOT PERFORM SIGNALLING OPTION DEVIATION ALIGNMENT UNTIL THE DEVIATION CHECK HAS BEEN PERFORMED.

NOTE

To tune the MT1000 MDC/Singletone Signalling Option, it is necessary to perform the radio deviation tuning first. Failure to tune the radio transmit deviation settings, may cause the Signalling Option deviation settings to be incorrect.

1. Press the **F9** key in the MAIN/SERVICE menu to enter the SIGNALLING DEVIATION Alignment menu. The cursor will be at the SIG DEV ADJUST position.
2. Set the service monitor (or deviation meter) to the transmit frequency displayed at the bottom in the middle of the screen. Press the **F3** key to put the radio into transmit. It is not necessary to press the PTT on the test box. The radio is keyed automatically by the Radio Service Software.
3. The Signalling tone is internally generated by the signalling option. It is not necessary to inject a signal. Use the up/down arrow keys to adjust the peak deviation to the limits shown on the screen. Press the **F3** key to dekey the radio.
4. If the radio has DTMF along with MDC Signalling, press the **ENTER** key to move the cursor to the DTMF DEV ADJUST position. If the radio does not have DTMF, go to step 7.

5. Set the service monitor (or deviation meter) to the transmit frequency displayed in the upper right hand corner of the screen. Press the **F3** key to put the radio into transmit. It is not necessary to press the PTT on the test box. The radio is keyed automatically by the Radio Service Software.
6. The DTMF tone is internally generated by the signalling option. It is not necessary to inject a signal. Use the up/down arrow keys to adjust the peak deviation to the limits shown on the screen. Press the **F3** key to dekey the radio.
7. Press the **F8** key to program the deviation adjustment values into the signalling option.
8. Press **F10** to exit the menu.
9. For channels with Digital Signalling, key the radio to check the deviation of the signalling packet. The packet. The packet only lasts for a very short time, so it may be necessary to key the radio several times to check the deviation. The deviation should be greater than 3.5kHz but less than 4.5kHz.

   NOTE

   If singletone is enabled instead of digital signalling, the deviation should be between 3.0 and 4.0kHz.
10. For radios with DTMF, key the radio and press any button and check the deviation. The deviation should be greater than 3.5kHz but less than 4.5kHz.

RECEIVER ALIGNMENT (Lowband and VHF Radios)

Review "GENERAL" information section before performing RECEIVER ALIGNMENT.

Preliminary Adjustments:

1. The receiver is factory-tuned to operate over the entire bandsplit and should not need retuning. Perform the "Receiver Check" to determine if "RECEIVER ALIGNMENT" (tuning any portion of the receiver) is necessary.
2. Connect the program/test cable (RTK-4205A) to the Radio Interface Box (RIB). Use the radio service software to read the radio.
3. When using the RTX-4005 test box, place the **AUDIO OUT** switch in the **B** position to set for proper speaker loading. Place the meter selector in the **AUDIO PA** position for receiver tests.
4. Connect the rf cable of the test cable to an rf generator or service monitor.

NOTE

Some interference conditions can be eliminated by changing the second injection. The second injection can be changed using the radio service software. Refer to the RSS manual for more details.

Receiver Check:

1. Use the radio service software to program for new customer frequencies, if necessary.
2. Set the rf generator (or service monitor) for the appropriate frequency at a 1mV level with a 1kHz tone modulated at 3kHz deviation.
3. Connect the **AC/DC METER** port of the RTX-4005 to an ac voltmeter. Adjust the volume potentiometer (R140) for an ac voltmeter reading of 4.47Vrms.
4. Connect a SINAD meter to the **AC/DC METER** port of the RTX-4005.
5. Reduce the rf level until 12dB of SINAD is obtained; record the rf level reading. Depress the monitor button while taking this measurement to ensure that the radio is not squelched. Also temporarily disconnect the test cable from the RIB to ensure that computer noise does not affect the measurement.
6. Perform SINAD measurements on all channels.
7. If the rf level required to produce 12dB SINAD is 0.25uV or less, *DO NOT REALIGN THE RECEIVER;* instead, proceed directly to "Squelch Sensitivity Check Adjustment". If the rf level required to produce 12dB SINAD is greater than 0.25uV, perform the "Receiver Alignment".

Receiver Alignment (Back End):

DO NOT PERFORM RECEIVER ALIGNMENT UNTIL THE "RECEIVER CHECK" HAS BEEN PERFORMED.

NOTE

The receiver back end coils (L12 and L13 for lowband radios, or L6, L7, and L8 for vhf radios) and the receiver front end coil(s) (L2 for lowband radios, or L1, L3, L4, and L5 for vhf radios) are factory tuned to cover the entire bandsplit and should not need retuning. Should the rf amp, mixer, crystal filters, i-f module, or accompanying parts need replacing, it may be necessary to perform the following tuning procedure:

Receiver Alignment (Back End):

1. Remove the radio from its housing as described in the "DISASSEMBLY PROCEDURE", then remove the backplane shield.
2. Attach the battery adapter to the radio frame, then attach the battery eliminator to the battery adapter.
3. Selecting any one of the customer frequencies, adjust the rf generator or service monitor for the appropriate frequency. Then place the radio front side down so that the solder side (side 2) of the PC board is facing up.
4. Tune coils (L12 and L13 for lowband radios, or L6, L7, and L8 for vhf radios) flush with the solder side of the PC board.
5. With an ac voltmeter, monitor M1 on the solder side of the PC board. Set the ac voltmeter to the -40dB scale, and adjust the rf level so that the voltage can be monitored at M1. During the following procedure, adjust the rf level to keep the ac voltage at M1 with the -40dB scale.
6. Peak coils (L12 and L13 for lowband radios, or L6, L7, and L8 for vhf radios) (in that order) for maximum ac voltage at M1.
7. Perform the "Receiver Check" procedure, then repeat steps 4-6 of the "back end" procedure, if necessary.

Receiver Alignment (Front End):

NOTE

Perform the following procedure only if the radio fails the "Receiver Check" and the "Receiver Back End Alignment" tests. The radio should already be removed from the housing. "Receiver Front End Alignment" is not required on radios operating in the 146-174MHz bandsplit.

8. Tune coil(s) (L2 for lowband radios, or L1 and L3 through L8 for vhf radios) flush with the solder side (side 2) of the PC board.

NOTE

Steps 9A,10A, and 11A apply to lowband radios. Steps 9B through 14B apply to vhf radios.

9A. Program the radio to a frequency centered between the highest and lowest customer frequency. Then adjust coil L2 for the maximum ac voltage level at M1. Select the peak where the slug of the coil is closest to the solder side of the PC board.

10A. Program the radio back to the original customer frequency.

11A. Perform the "Receiver Alignment (Back End)" procedure and then the "Receiver Check".

9B. Program the radio for the following frequencies:

CHANNEL	LOW SPLIT (136-151MHz)	MID SPLIT (146-162MHz)	HIGH SPLIT (152.9-174MHz)
1	147.125MHz	158.125 MHz	170.125 MHz
2	150.800MHz	161.975 MHz	173.975 MHz
3	136.125MHz	146.125 MHz	157.125 MHz

If interface is present, program the radio for a receive frequency as close as possible to the desired frequency, but within ±0.1MHz.

10B. Set the radio to Channel 1. Adjust L3 then L5 for the maximum ac voltage level at M1. Select the peak where the slugs of the coils are closest to the solder side of the PC board.

11B. Set the radio to Channel 2. Adjust L4 for the maximum ac voltage level at M1. Select the peak where the slug of the coil is closest to the solder side of the PC board.

12B. Set the radio to Channel 3. Adjust L1 for the maximum ac voltage level at M1. Select the peak where the slug of the coil is closest to the solder side of the PC board.

13B. Program the radio back to the original customer frequencies.

14B. Perform the "Receiver Alignment (Back End)" procedure and then the "Receiver Check".

Squelch Sensitivity Check/Adjustment:

1. Set the radio to the channel determined to have the poorest sensitivity on the "Receiver Check". Place the PL/SCAN switch in the carrier squelch position (▷).
2. Connect an ac voltmeter to the **AC/DC METER** port of the test box (RTX-4005).
3. Set the rf generator or service monitor for the appropriate frequency and no modulation. Reduce the rf level to a minimum.
4. Depress the monitor button on the side of the radio and adjust the noise level for 2.2Vrms. Make a note of the level on the dB scale. This will be the reference level for quieting measurements.
5. Press the **F3** key in the MAIN/SERVICE menu to enter the SQUELCH and VOLUME Alignment menu. The cursor will be at the CARRIER SQUELCH position. Increase the rf level until squelch break occurs. Note the quieting level at squelch break. If squelch break occurs between 8 and 18dB of quieting, proceed directly to the TONE SQUELCH check, step 8. If the quieting level is not within the range, continue on with step 6.
6. Press the up/down arrow keys to adjust the CARRIER SQUELCH setting to 0. Adjust the rf level for 8 dB quieting.
7. Holding the rf level constant, press the up arrow key to increment the CARRIER SQUELCH setting one step at a time until radio squelches. This will be the CARRIER SQUELCH setting.
8. Reduce the rf level to a minimum. The radio should be squelched.
9. Press the **ENTER** key to proceed to the TONE SQUELCH position on the menu.
10. The TONE SQUELCH setting should be the same as the CARRIER SQUELCH setting. If not, use the up/down arrows to set the TONE SQUELCH setting to the same value as the CARRIER SQUELCH setting.
11. Press the **ENTER** key to proceed to the SCAN SQUELCH position on the menu.
12. The SCAN SQUELCH setting should be the same as the CARRIER SQUELCH setting. If not, use the up/down arrows to set the SCAN SQUELCH the same as the CARRIER SQUELCH setting.
13. If the squelch settings require modification, program the radio.

Cloning Procedure:

(The content of radio A is to be duplicated into radio B)

1. Turn off radio A and turn on radio B.
2. Connect the cloning cable (NKN6376A) to the Universal Connector of both radio A and radio B.
3. Simultaneously depress the PTT and monitor button on radio A and hold.
4. Turn on radio A. The green LED on radio B will flash, indicating cloning is in progress.
5. Cloning is complete once the green LED turns off. Release both the PTT and monitor button on radio A. Turn radio A off and on to reset.

NOTE

Cloning procedure does not duplicate the deviation and squelch settings.

6. Disconnect the cloning cable and turn on both radios to resume normal operation.

NOTE

- All VHF wideband radios (146-174MHz) are "C" model radios. A "C" model radio can be cloned only to/form another "C" model radio. An attempt to clone a "C" model radio to an "A" or "B" model radio will result in an unsuccerssful cloning attempt.
- Any unsuccessful cloning attempt (depending on operating condition of the radio) will result in one of the following alerts:
  1. in receive (rotary radio) - 1600Hz continuous alert tone
  2. in receive (display radios) - 88 displayed on LCD
  3. in transmit - 1600Hz beeping alert tone

RECEIVER ALIGNMENT (UHF Radios)

Review "GENERAL" information section before performing RECEIVER ALIGNMENT

Preliminary Adjustments:

1. Coils L9 through L13 are tuned at the factory for a 30MHz bandwidth and should never need retuning. Coils L1 and L2 adjust an 8MHz window. Perform the "Receiver Check" to determine if "RECEIVER ALIGNMENT" (tuning any portion of the receiver) is necessary.
2. Connect the program/test cable (RTK-4205A) to the Radio Interface Box (RIB). Use the Radio Service Software to read the radio.
3. When using the RTX-4005 test box, place the **AUDIO OUT** switch in the **B** position to set for proper speaker loading. Place the meter selector in the **AUDIO PA** position for receiver tests.
4. Connect the rf cable of the test cable to an rf generator or service monitor.

NOTE

Some Interference conditions can be eliminated by changing the second injection. The second injection can be changed using the radio service software. Refer to the RSS manual for more details.

Receiver Check:

1. Use the Radio Service Software to program for new customer frequencies, if necessary.
2. Set the rf generator (or service monitor) for the appropriate frequency at a 1mV level with a 1 kHz tone modulated at 3kHz deviation.
3. Connect the **AC/DC METER** port of the RTX-4005 to an ac voltmeter. Adjust the volume potentiometer (R140) for an ac voltmeter reading of 4.47Vrms.
4. Connect a SINAD meter to the **AC/DC METER** port of the RTX-4005.
5. Reduce the rf level until 12dB of SINAD is obtained; record the rf level reading. Depress the monitor button while taking this measurement to ensure that the radio is not squelched. Also, temporarily disconnect the test cable from the RIB to ensure that computer noise does not affect the measurement.
6. Perform SINAD measurements on all channels.
7. If the rf level required to produce 12dB SINAD is 0.35uV or less, *DO NOT REALIGN THE RECEIVER*; instead, proceed directly to "Squelch Sensitivity Check Adjustment". If the rf level required to produce 12dB SINAD is greater than 0.35uV, perform the "Receiver Alignment".

Receiver Alignment (Front End):

NOTE

The receiver front end tuning procedure can be accomplished with the radio in its housing. Coils L1 and L2 are tuned through the flex carrier while M1 is monitored on the controller flex.

Narrow Bandwidth (less than 4MHz)

1. Select the customer frequency that is at the center of the specified customer frequencies. On the customer's radio, select the channel that represents that center frequency.
2. Tune coils L1 and L2 to the top of the coil form. This will be the position where the coils are nearest to the flex carrier.
3. With an ac voltmeter, monitor M1 on the controller flex. Set the ac voltmeter to the -40dB scale. Set the service monitor to the appropriate frequency and adjust the rf level so that the ac voltage can be read at M1. During the following procedure, adjust the rf level to keep the ac voltage at M1 within the -40dB scale.
4. Peak coil L1 for maximum ac voltage at M1. Select the peak where the coil's slug is closest to the flex carrier assembly.
5. Peak coil L2 for maximum ac voltage at M1. Select the peak where the coil's slug is closest to the flex carrier assembly.
6. Perform steps 2-7 of the "Receiver Check" procedure, then repeat the "Narrow Bandwidth" procedure, if necessary.

Wide Bandwidth (greater than 4MHz)

7. For wide bandwidth tuning, coils L1 and L2 must be peaked at a frequency that is centered between the highest and the lowest customer frequency. If no such frequency is specified, it will be necessary to program a temporary tune frequency. Program the radio for this frequency (if necessary).
8. Tune coils L1 and L2 to the top of the coil form. This will be the position where the coils are nearest to the flex carrier.
9. With an ac voltmeter, monitor M1 on the controller flex. Set the ac voltmeter to the -40dB scale. Set the service monitor to the appropriate frequency and adjust the rf level so that the ac voltage can be read at M1. During the following procedure, adjust the rf level to keep the ac voltage at M1 within the -40dB scale.
10. Peak coil L1 for maximum ac voltage at M1. Select the peak where the coil's slug is closest to the flex carrier assembly.
11. Peak coil L2 for maximum ac voltage at M1. Select the peak where the coil's slug is closest to the flex carrier assembly.
12. Program the radio back to the specified customer frequency.
13. Peak coil L1 for maximum ac voltage at M1 with radio set at highest customer frequency.

14. Peak coil L2 for maximum ac voltage at M1 with radio set at lowest customer frequency.
15. Perform steps 2 through 7 of the "Receiver Check" procedure, then repeat the "Wide Bandwidth" procedure if necessary.

Receiver Alignment (Back End/Injection Filter):

NOTE

The receiver back end coils L9, L10, and L11, and the injection filter coils L12 and L13 are factory tuned for 30 MHz and should not need retuning. Should the mixer, crystal filters, i-f modules, or accompanying back end parts need replacing, it will be necessary to perform the back end procedures:

Back End:

16. Remove the radio from its housing as described in the "DISASSEMBLY PROCEDURE", then remove the backplane shield.
17. Attach the battery adapter to the radio frame, then attach the battery eliminator to the battery adapter.
18. Selecting any one of the customer frequencies, adjust the rf generator or service monitor for the appropriate frequency. Then place the radio front side down so that the solder side (side 2) of the PC board is facing up.
19. Tune coils L9, L10, and L11 flush with the solder side of the PC board.
20. With an ac voltmeter, monitor M1 on the solder side of the PC board. Set the ac voltmeter to the -40dB scale, and adjust the rf level so that the voltage can be monitored at M1. During the following procedure, adjust the rf level to keep the ac voltage at M1 within the -40dB scale.
21. Peak coils L9, L10, and L11 (in that order) for maximum ac voltage at M1.
22. Perform the "Receiver Check" procedure, then repeat steps 17-19 of the "Back End" procedure, if necessary.

Injection Filter:

NOTE

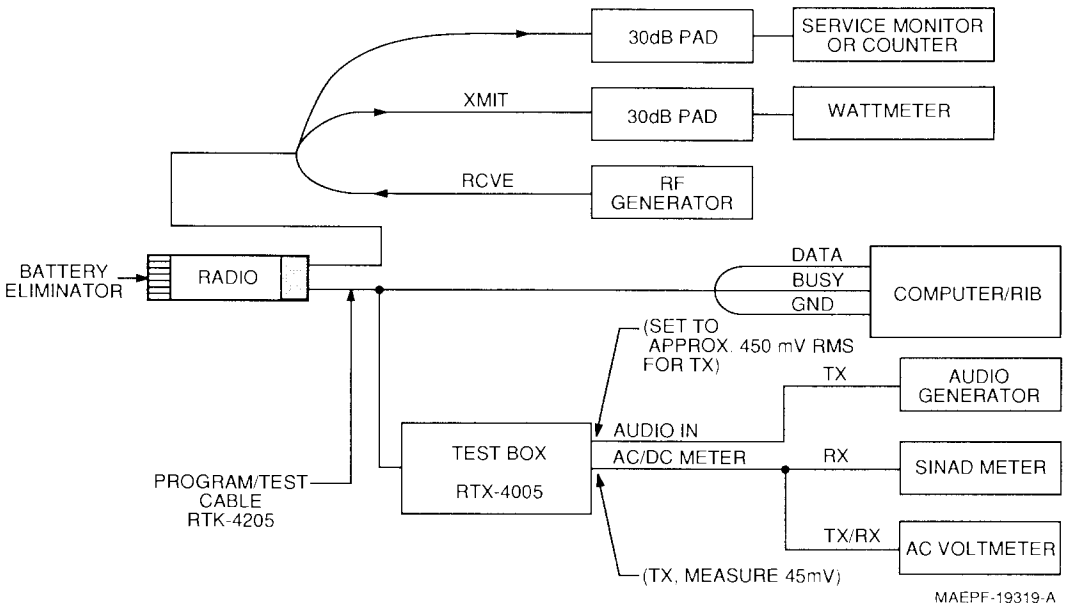
"Receiver Back End Alignment" has been performed. The radio should already be removed from the housing.

23. Tune coils L12 and L13 to be flush with the solder side (side 2) of the PC board.
24. Monitor M2 with a dc voltmeter.
25. Peak L12, then L13 for maximum dc voltage at M2.
26. Perform the "Receiver Check" procedure, then repeat steps 21-23 of the "Back End" procedure, if necessary. If quieting level is not within the range, continue on with step 16.

Squelch Sensitivity Check/Adjustment:

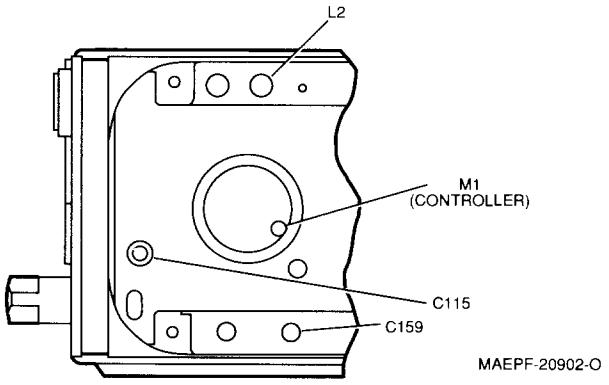
1. Set the radio to the channel determined to have the poorest sensitivity on the "Receiver Check". Place the PL/SCAN switch in the carrier squelch position ( ).
2. Connect an ac voltmeter to the AC/DC METER port of the test box (RTX-4005).
3. Set the rf generator or service monitor for the appropriate frequency and no modulation. Reduce the rf level to a minimum.
4. Depress the monitor button on the side of the radio and adjust the noise level for 2.2Vrms. Make a note of the level on the dB scale. This will be the reference level for quieting measurements.
5. Press the **F3** key in the MAIN/SERVICE menu to enter the SQUELCH and VOLUME Alignment menu. The cursor will be at the CARRIER SQUELCH position. Increase the rf level until squelch break occurs. Note the quieting level at squelch break. If squelch break occurs between 8 and 18dB of quieting, proceed directly to the TONE SQUELCH check, step 8. If the quieting level is not within the range, continue on with step 6.
6. Press the up/down arrow keys to adjust the CARRIER SQUELCH setting to 0. Adjust the rf level for 8 dB quieting.
7. Holding the rf level constant, press the up arrow key to increment the CARRIER SQUELCH setting one step at a time until radio squelches. This will be the CARRIER SQUELCH setting.
8. Reduce the rf level to a minimum. The radio should be squelched.
9. Press the **ENTER** key to proceed to the TONE SQUELCH position on the menu.
10. The TONE SQUELCH setting should be the same as the CARRIER SQUELCH setting. If not, use the UP/DOWN arrows to set the TONE SQUELCH setting to the same value as the CARRIER SQUELCH setting.
11. Press the **ENTER** key to proceed to the SCAN SQUELCH position of the menu.
12. The SCAN SQUELCH setting should be the same as the CARRIER SQUELCH setting. If not, use the UP/DOWN arrows to set the SCAN SQUELCH the same as the CARRIER SQUELCH setting.
13. If the squelch settings require modification, program the radio.

TEST SET-UP DETAIL

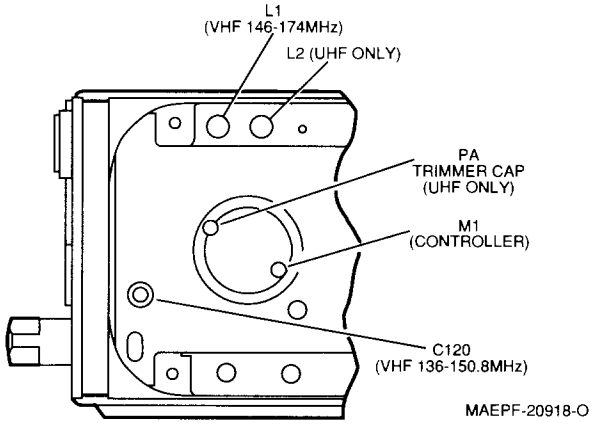


ALIGNMENT AND METERING POINT LOCATION (CONTROLLER)

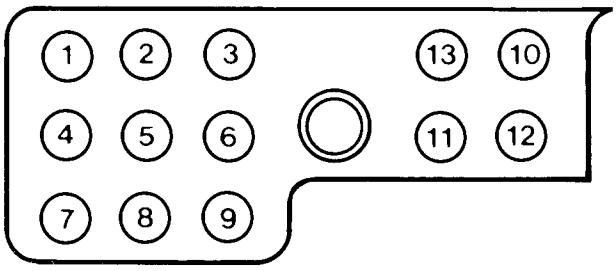
LOWBAND RADIOS



VHF AND UHF RADIOS



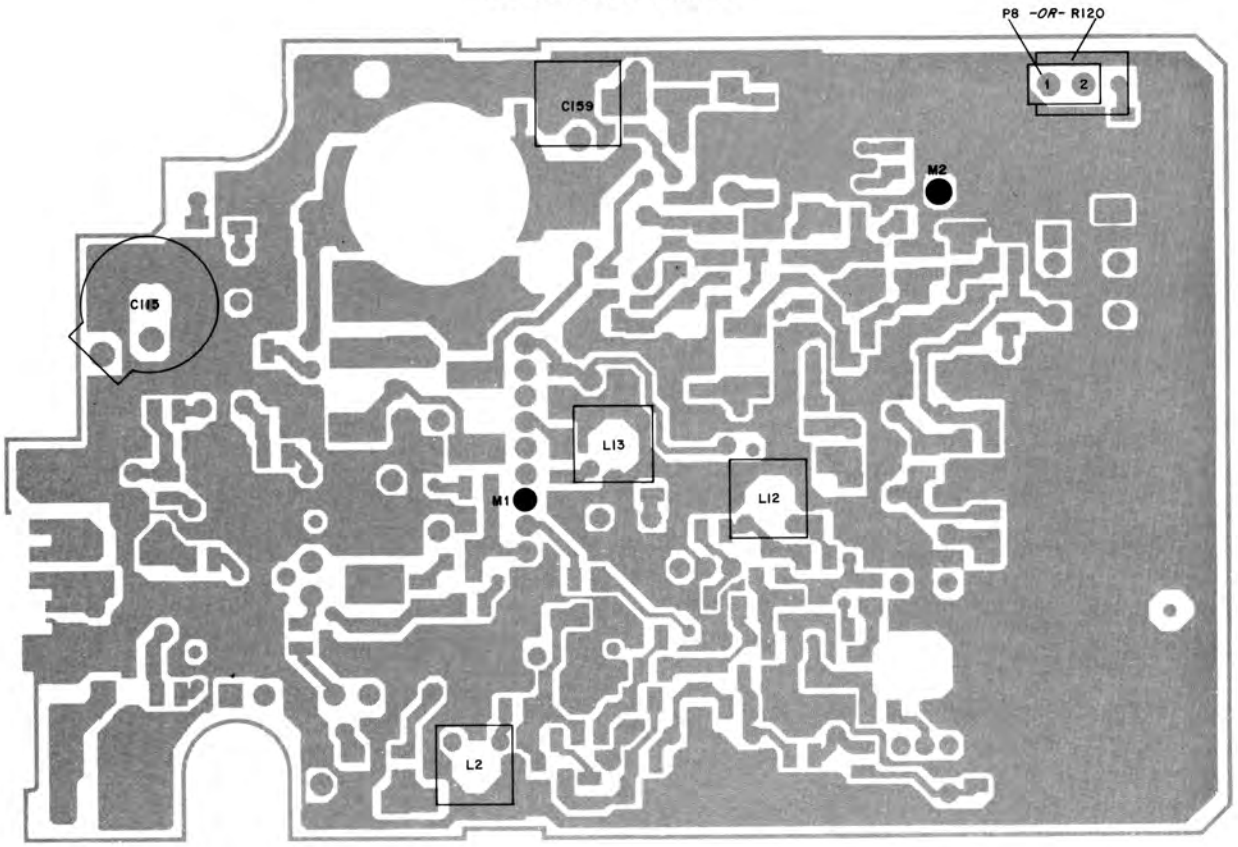
UNIVERSAL CONNECTOR DETAIL AND PIN NUMBER ASSIGNMENT



1) EXTERNAL MICROPHONE
2) EXTERNAL SPEAKER
3) OPTION B+
4) EXTERNAL PTT
5) GROUND (to controller board)
6) DATA
7) EXTERNAL SPEAKER SELECT
8) SPEAKER COMMON
9) BUSY
10) REMOTE ANTENNA
11) CVC SENSE
12) RF GROUND (to mother board)
13) SENSE

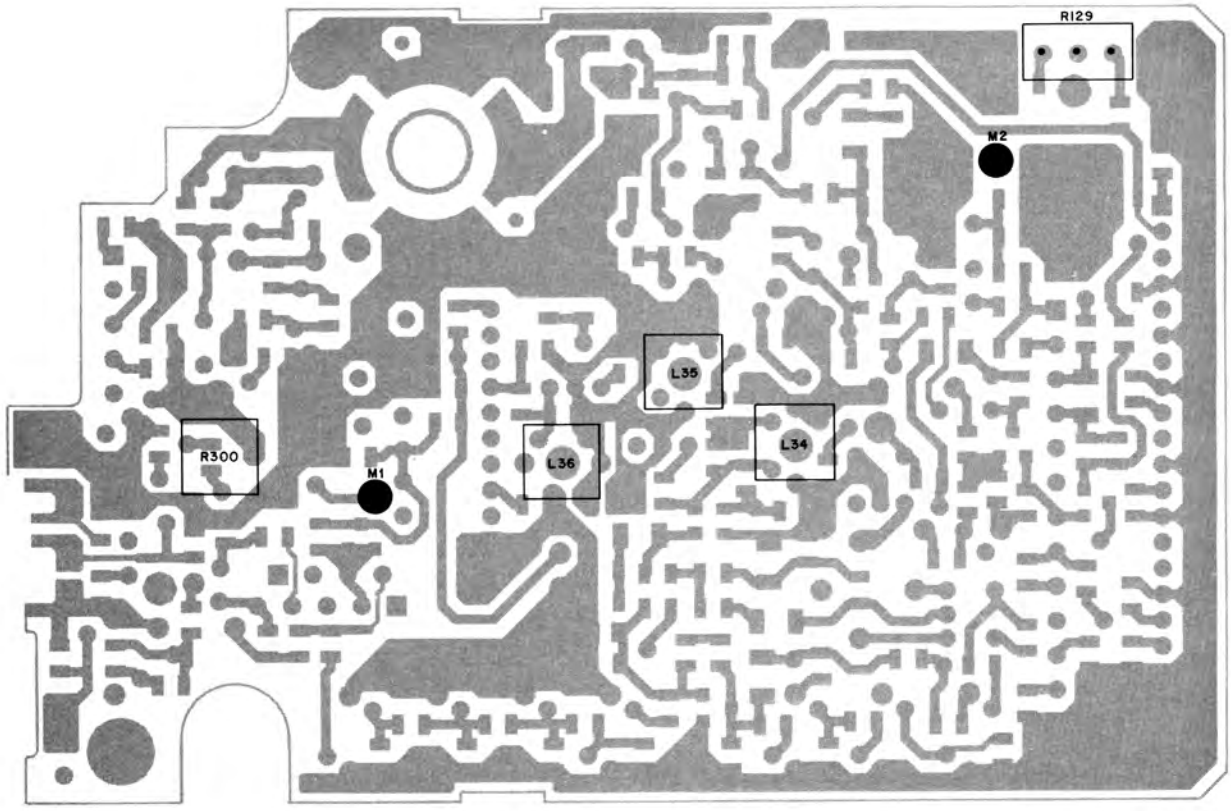
AEPF-19321-O

LOWBAND RADIOS



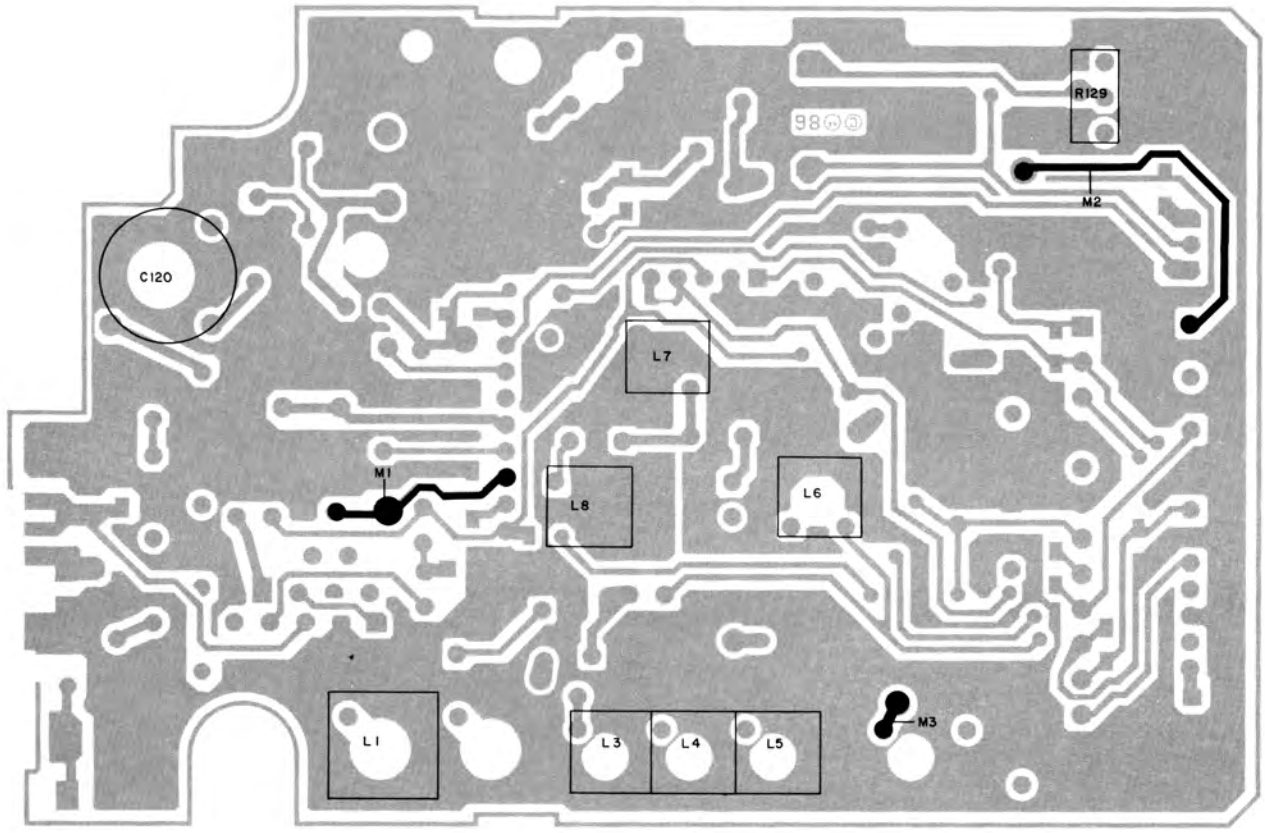
L4-CEPF-20760-A
OL-CEPF-20903-0

VHF RADIOS (146-174MHz)



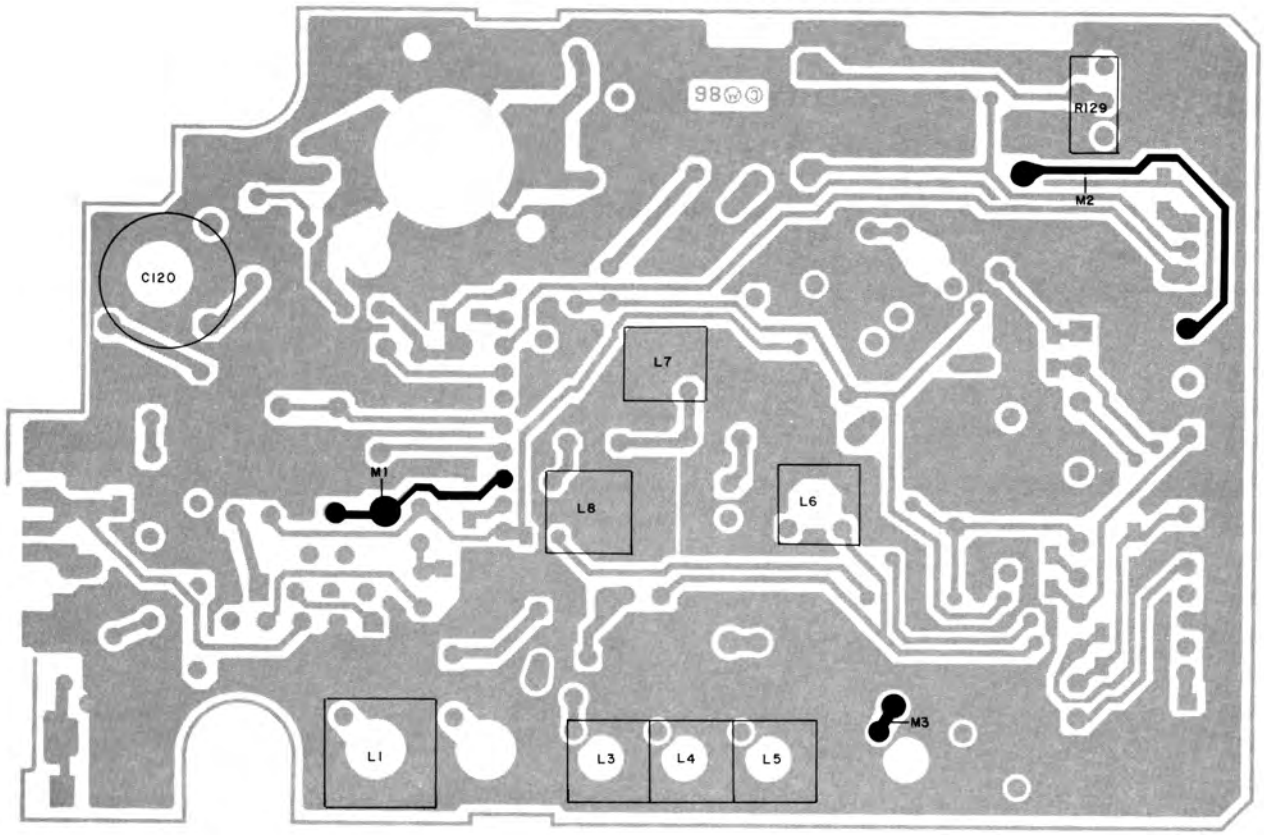
L4-CEPF-20709-A
OL-CEPF-20904-0

2-WATT VHF RADIOS (136-150.8MHz)



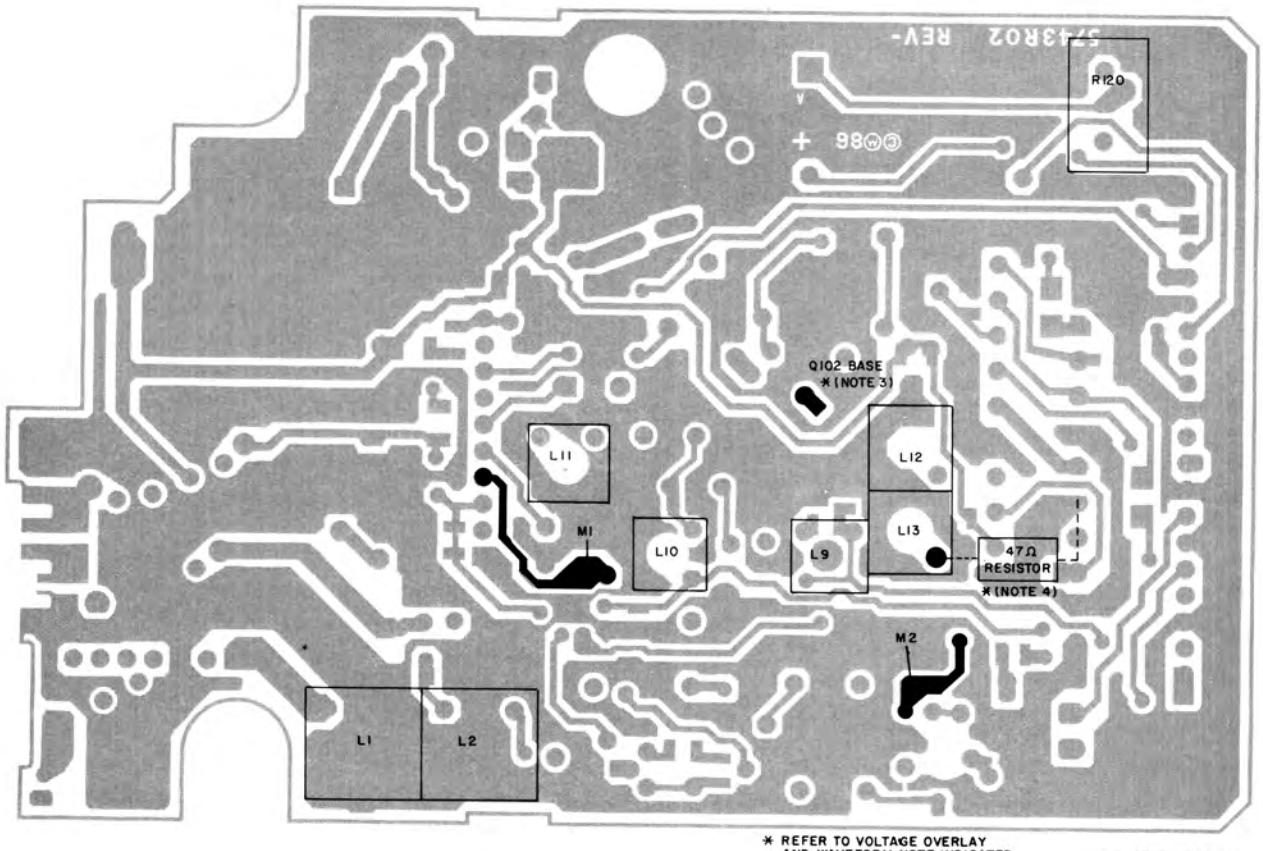
L2-CEPF-19239-0
OL-CEPF-19240-0

5-WATT VHF RADIOS (136-150.8MHz)



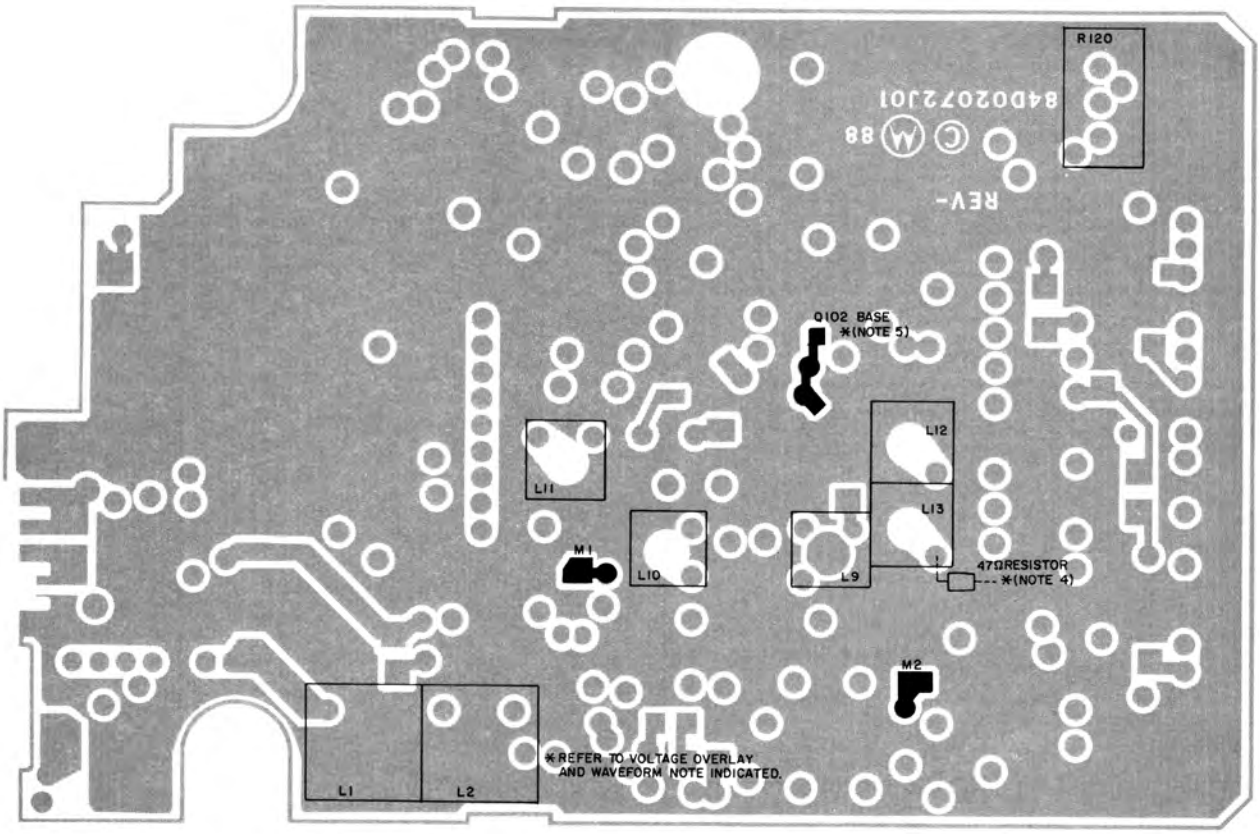
L2-CEPF-19288-0
OL-CEPF-19322-0

ALIGNMENT ADJUSTMENT LOCATIONS (UHF 2-WATT RADIOS)



OL CEPF-19388-0

UHF 4-WATT RADIOS

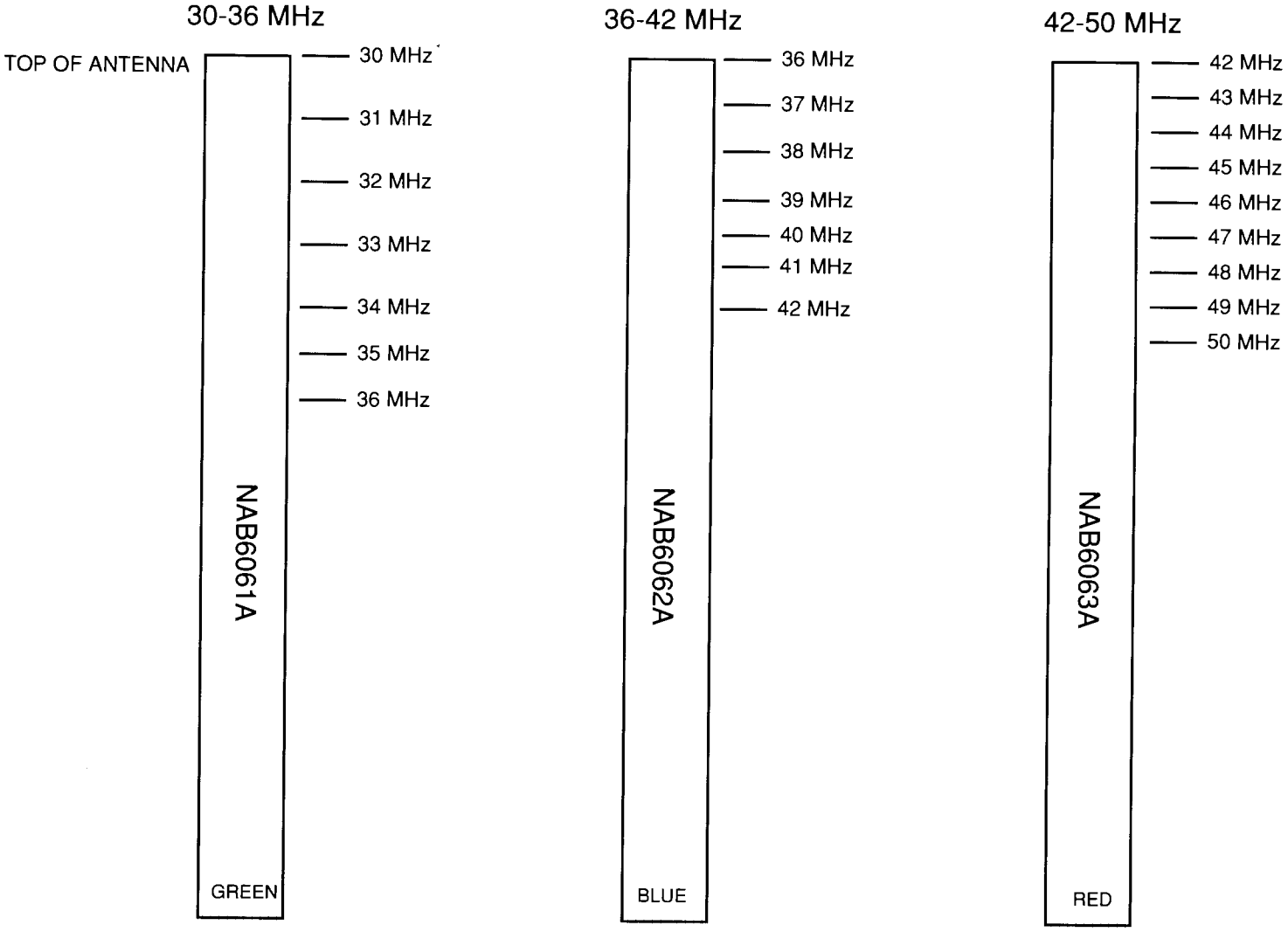


OL-CEPF-19402-0

MT1000 LOWBAND ANTENNA CUT CHART

IMPORTANT - FOR OPTIMUM PERFORMANCE, ANTENNA MUST BE CUT TO PROPER LENGTH BEFORE RADIO IS USED.

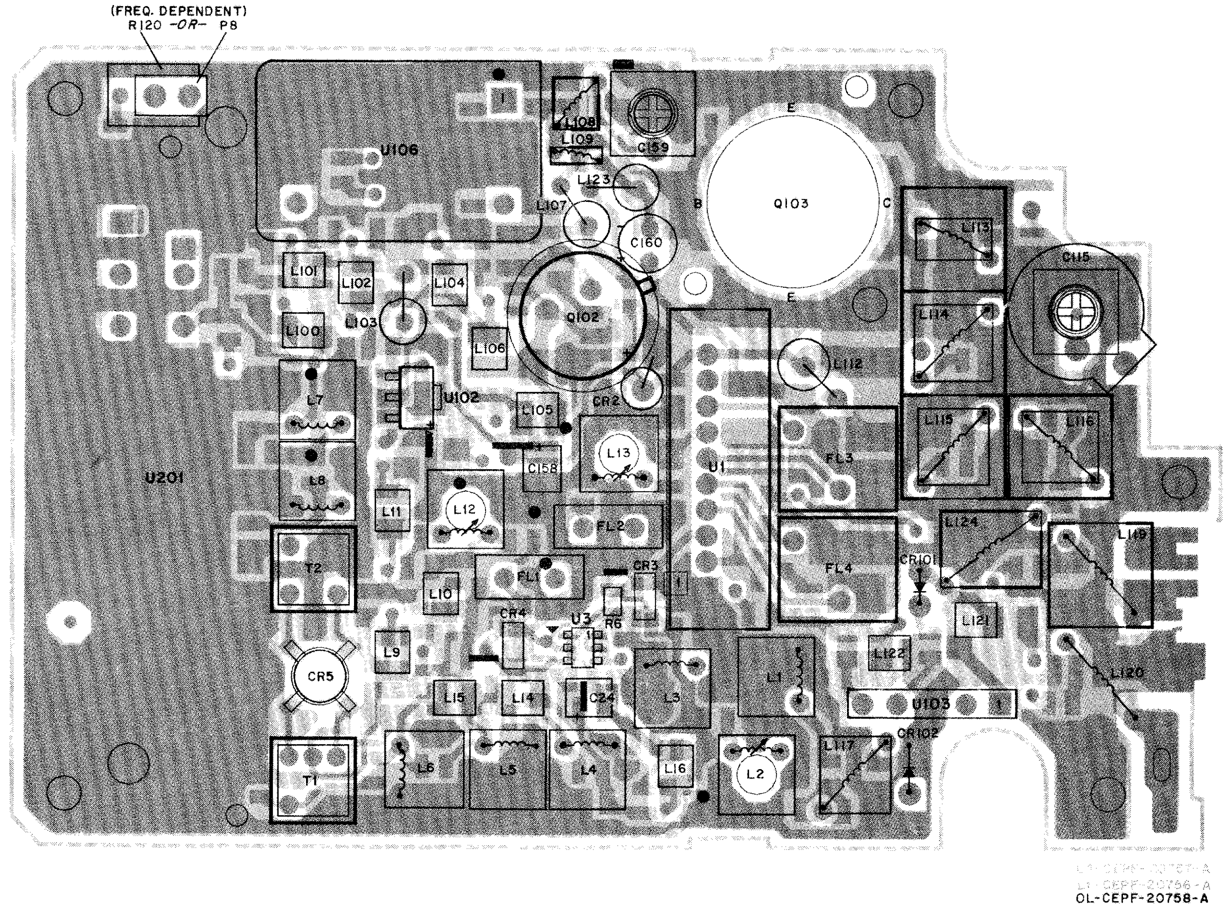
1. Remove antenna cap and align **top** of uncut antenna with **top** of corresponding cut diagram.
2. Mark antenna for the cutting length corresponding to the desired frequency indicated by the frequency scale on the chart.
3. Cut antenna.
4. If using adhesive strip, remove strip from white backing, wrap adhesive around top of antenna, remove second backing from adhesive, and replace antenna cap. If not using adhesive strip, apply glue (P/N 1100842335) to top of antenna and replace cap.



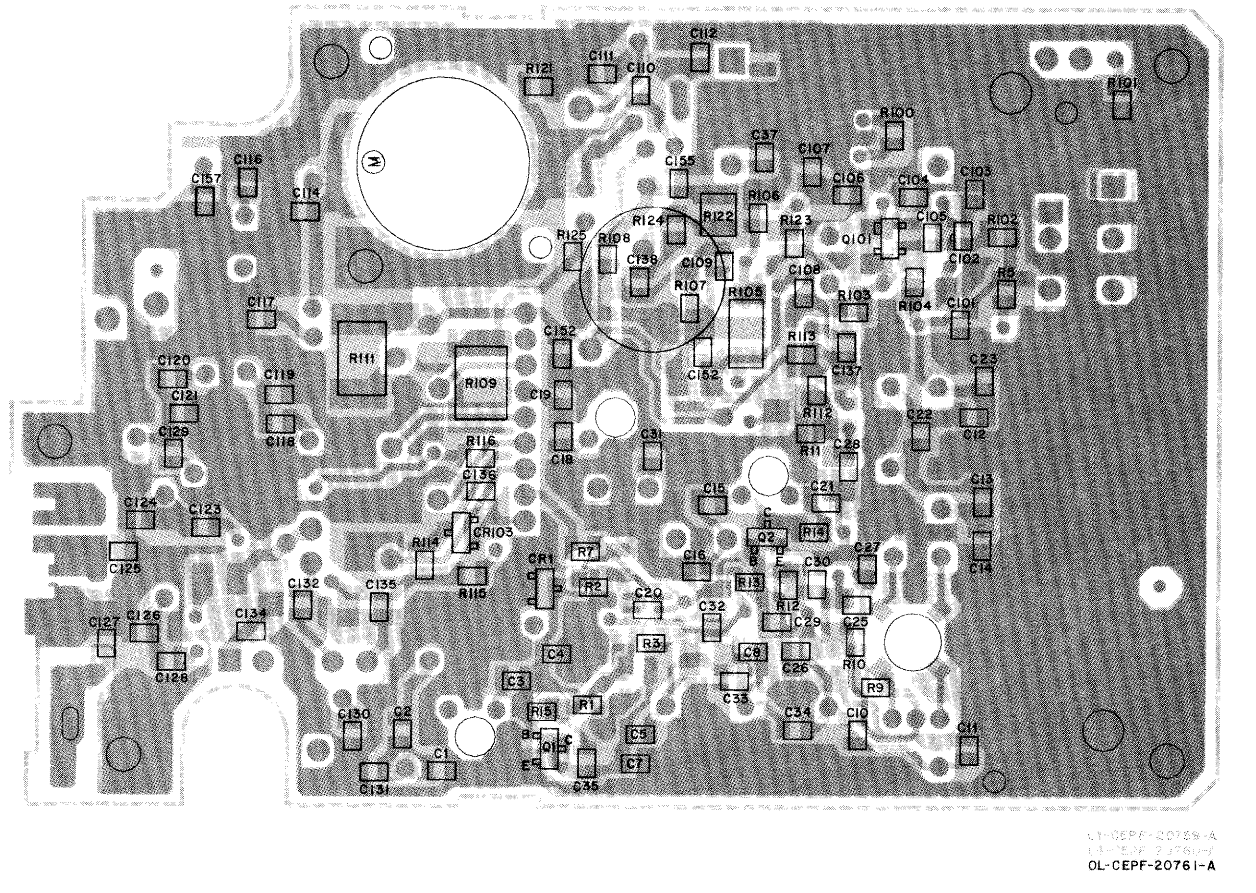
MAEPF-21110-O

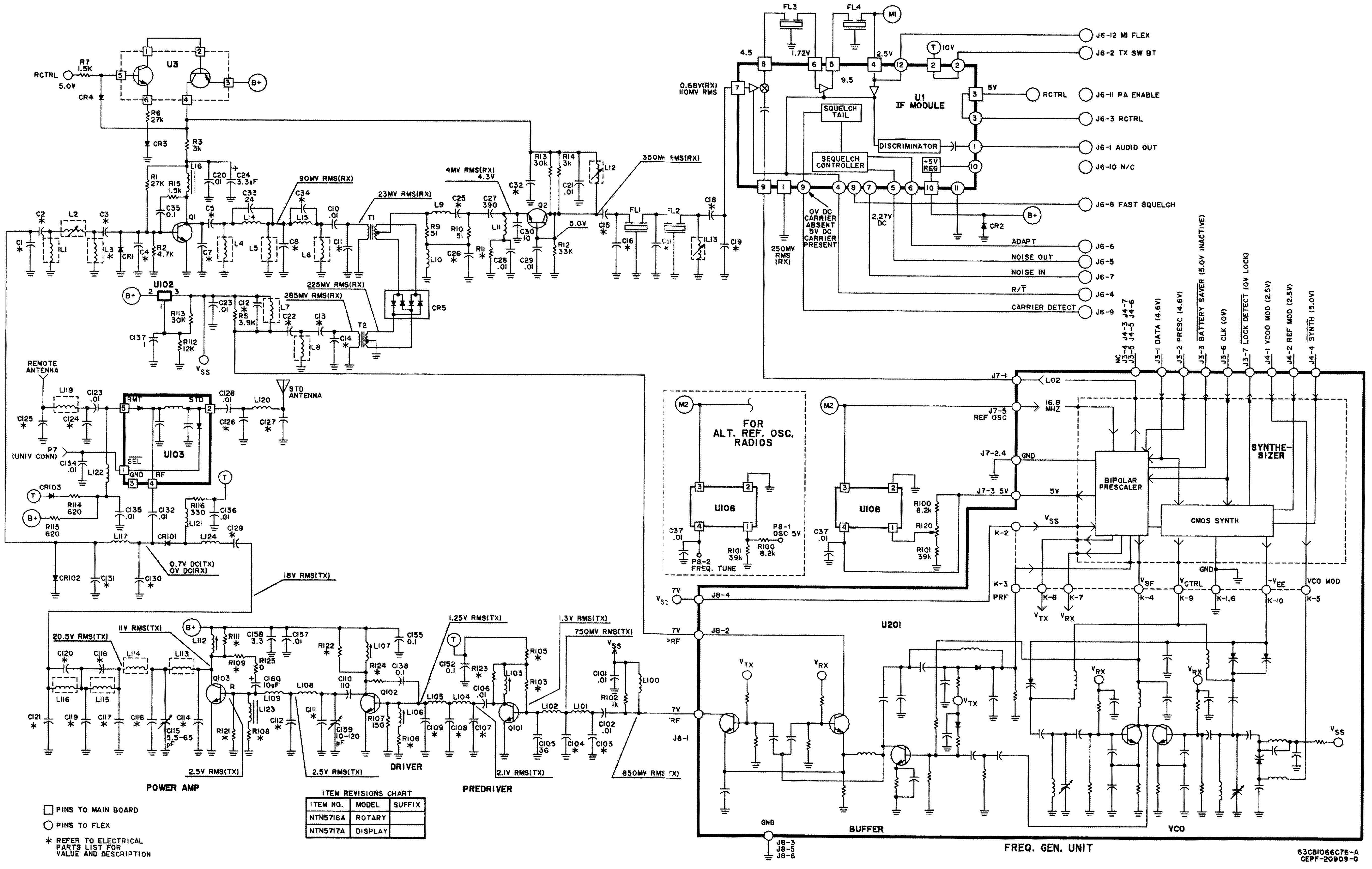
NOTE: Uncut antennas are color coded at the top, under the cap.

VIEWED FROM SIDE 1 (COMPONENT SIDE)



VIEWED FROM SIDE 2 (SOLDER SIDE)





ITEM REVISIONS CHART

ITEM NO.	MODEL	SUFFIX
NTN5716A	ROTARY	
NTN5717A	DISPLAY	

□ PINS TO MAIN BOARD
○ PINS TO FLEX
* REFER TO ELECTRICAL PARTS LIST FOR VALUE AND DESCRIPTION

LOWBAND Electrical Parts List, Transceiver Board

L = 30-36MHz
M = 36-42MHz
H = 42-50MHz

TPLF-3876-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%;50V 1/10W unless stated
C1	2113740A65	270 (L)
	or 2113740A62	200 (M)
	or 2113740A59	150 (H)
C2	2113740A67	330 (L)
	or 2113740A62	200 (M)
	or 2113740A58	130 (H)
C3	2113741A25	1500 (L)
	or 2113740A72	510 (M)
	or 2113740A66	300 (H)
C4	2113740A59	150(L)
	or 2113740A57	120 (M)
	or 2113740A54	91 (H)
C5	2113741A25	1500 (L)
	or 2113740A77	820 (M)
	or 2113740A70	430 (H)
C7	2113740A55	100 (L)
	or 2113740A56	110 (M)
	or 2113740A53	82 (H)
C8	2113740A52	75 (L)
	or 2113740A54	91 (M,H
C10	2113740A62	200 (L)
	or 2113740A56	110 (M,H)
C11	2113740A66	300 (L)
	or 2113740A59	150 (M)
	or 2113740A64	240 (H)
C12	2113740A20	5.1 (L,M)
	or 2113740A19	4.7 (H)
C13	2113740A50	62 (L)
	or 2113740A33	15 (M)
	or 2113740A43	39 (H)
C14	2113740A57	120 (L,H)
	or 2113740A46	47 (M)
C15	2113740A69	390 (L)
	or 2113740A62	200 (M)
	or 2113741A31	2700 (H)
C16	2113740A50	60 (L)
	or 2113740A61	180 (M)
	or 2113740A54	91(H)
C18	2113740A59	150 (L)
	or 2113740A62	200 (M)
	or 2113740A63	220 (H)
C19	2113740A54	91 (L)
	or 2113740A59	150 (M)
	or 2113740A60	160 (H)
C20,21	2113741A45	.01uF
C22	2113740A23	6.2 (L)
	or 2113740A13	2.7 (M)
	or 2113740A20	5.1 (H)
C23	2113741A45	.01uF
C24	2311049J08	3.3uF; Tant.
C25	2113740A52	75 (L)
	or 2113740A56	110 (M,H)
C26	2113740A66	300 (L)
	or 2113740A69	390 (M,H)
C27	2113740A69	390
C28	2113741A45	.01uF
C29	2113741A45	.01uF
C30	2113740A29	10
C31	2113740A25	7.5 (L)
	or 2113740A21	5.6 (M)
	or 2113740A20	5.1 (H)
C32	2113741A45	.01uF (L)
	or 2113741A53	22000 (M)
	or 2113741A47	12000 (H)
C33	2113740A38	24 (L)
C34	2113740A38	24 (L)
	or 2113740A36	20 (M)
C35	2160521G37	0.1+80-20%,25V
C37	2113741A45	.01uF
C101	2113741A45	.01uF
C102	2113741A45	.01uF
C103	2113740A33	15 (L)
	or 2113740A36	20 (M)
	or 2113740A23	6.2 (H)
C104	2113740A32	13 (L,M)
	or 2113740A36	20 (H)
C105	2113740A42	36 (L)
C106	2113741A45	.01uF
C107	2113740A59	150 (L)
	or 2113740A60	160 (M)
	or 2113740A39	27 (H)
C108	2113740A73	560 (L)
	or 2113740A71	470 (M)
	or 2113740A57	120 (H)
C109	2113740A64	240 (L)
	or 2113740A58	130 (M)
	or 2113740A53	82 (H)
C110	2113740A56	110
C111	2113740A49	56 (L)
	or 2113740A52	75 (M)
C112	2113740A72	510 (L,M)
	or 2113740A68	360 (H)
C114	2113740A59	150 (L)
	or 2113740A61	180 (M)
	or 2113740A59	150 (H)
C115	2005568P01	Trimmer,5.5-65pF
C116	2113740A61	180 (L,M)
	or 2113740A60	160 (H)
C117	2113740A51	68 (L)
	or 2113740A54	91 (M,H)
C118	2113740A42	36 (L,M)
	or 2113740A38	24 (H)
C119	2113740A57	120 (L)
	or 2113740A53	82 (M)
	or 2113740A56	110 (H)
C120	2113740A42	36 (L,M)
	or 2113740A38	24 (H)
C121	2113740A49	56 (L)
	or 2113740A46	47 (M)
	or 2113740A50	62 (H)
C123	2113741A45	.01uF
C124	2113740A53	82 (L,M)
	or 2113740A51	68 (H)
C125	2113740A53	82 (L,M)
	or 2113740A51	68 (H)
C126	2113740A51	68 (L)
	or 2113740A53	82 (M)
	or 2113740A38	24 (H)
C127	2113740A51	68 (L,M)
	or 2113740A44	43 (H)
C128	2113741A45	.01uF
C129	2113740A52	75 (L)
	or 2113740A51	68 (M)
	or 2113740A46	47 (H)
C130	2113740A55	100 (L)
	or 2113740A53	82 (M)
	or 2113740A50	62 (H)
C131	2113740A55	100 (L)
	or 2113740A53	82 (M)
	or 2113740A50	62 (H)
C132	2113741A45	.01uF
C134	2360562B01	.01uF;Tant.
C135,136	2113741A45	.01uF
C137	2311049A37	1uF
C138,152,155	2160521G37	0.1uF
C157	2113741A45	.01uF
C158	2311049J08	3.3uF; 16V
C159	2002407J01	Trimmer; 10-120pF
C160	2305499G20	10uF±20%; 20V Tant.
		DIODE: See Note
CR1	4805119G34	Silicon
CR2	4805490G02	Silicon
CR3,4	4805494Q04	Silicon
CR5	4880236E16	Quad Ring Array
CR101,102	0102712J05	Unitrode,9401and Heat Shrink
CR103	4805119G34	Silicon
CR104	4805119G34	Silicon (M, H Only)
CR301A, 301B	4805729G24	LED, Bicolor (Rotary Radios Only)
		FILTER:
FL1, 2	4805245J26	Crystal,19.95MHz (L)
	or 4805245J27	Crystal,16.65MHz (M,H)
FL3	9105725Q02	Ceramic, 450kHz
FL4	9105726Q01	Ceramic, 450kHz
		COIL, RF: unless stated
L1	2402406J05	6- turns, spacewound
L2	2402406J11	11- turns, spacewound
L3 thru 6	2402406J05	6- turns, spacewound
L7	2402406J10	Tunable, Choke (L,M)
	or 2402406J09	Tunable, Choke (H)
L8	2402406J05	6- turns, spacewound (L,H)
	or 2402406J10	Tunable, Choke (M)
L9	2411087B25	0.82uH Choke
L10	2411087B18	0.220uH Choke
L11	2411087B25	0.82uH Choke
L12,13	2405063H13	1.2uH Choke
L14	2411087B25	0.82uH Choke
L15	2411087B25	0.85uH Choke (M, H Only)
L16	2411087B37	8.2uH Choke
L100	2411087B36	6.8uH Choke
L101	2411087B27	1.2uH Choke (L,M)
	or 2411087B26	1uH Choke (H)
L102	2411087B27	1.2uH Choke (L)
	or 2411087B28	1.5uH Choke (M,H)
L103	0102710J48	1.2uH Choke and Heat Shrink(L)
	or 0102710J46	6.2uH Choke and Heat Shrink (M,H)
L104	2411087B16	0.15uH Choke (L)
	or 2411087B15	0.12uH Choke (M)
	or 2411087B21	0.39uH Choke (H)
L105	2411087B13	0.82uH Choke (L)
	or 2411087B12	.068uH Choke (M)
	or 2411087B16	0.15uH Choke (H)
L106	2411087B37	8.2uH Choke (L,H)
	or 2411087B36	6.8uH Choke (M)
L107	0102710J48	Assy., 1.2µH Choke and Heat Shrink (L)
	or 0102710J46	Assy., 6.2µH Choke and Heat Shrink (M,H)
L108	0102710J83	Assy.,6-1/2 turns, airwound (L,M)
	or 0102710J82	Assy.,5-1/2 turns, airwound (H)
L109	0102710J79	Assy.,2-1/2 turns, airwound
L112	2482723H48	.085uH Choke (L,H)
	or 0102712J04	Assy..085uH Choke and Heat Shrink (M)
L113	0102710J69	4-1/2 turns, airwound (L)
	or 0102710J68	3-1/2 turns, airwound (M,H)
L114	0102710J74	9-1/2 turns, airwound (L)
	or 0102710J72	7-1/2 turns, airwound (M,H)
L115	0102710J73	8-1/2 turns, airwound (L)
	or 0102710J71	6-1/2 turns, airwound (M,H)
L116	0102710J73	8-1/2 turns, airwound (L)
	or 0102710J71	6-1/2 turns, airwound (M,H)
L117	0102710J73	8-1/2 turns, airwound (L)
	or 0102710J72	7-1/2 turns, airwound (M)
	or 0102710J71	6-1/2 turns, airwound (H)
L119	0102710J75	10-1/2 turns, airwound (L)
	or 0102710J74	9-1/2 turns, airwound (M)
	or 0102710J72	7-1/2 turns, airwound (H)
L120	0102710J75	10-1/2 turns, airwound (L,M)
	or 0102710J74	9-1/2 turns, airwound (H)
L121,122	2411087B36	6.8uH Choke
L123	0102710J48	1.2uH Choke and Heat Shrink (M, H Only)
L124	0102710J76	11-1/2 turns, airwound (L)
	or 0102710J75	10-1/2 turns, airwound (M)
	or 0102710J74	9-1/2 turns, airwound (H)
LS1	5005155Q03	**TRANSDUCER**
MK1	0105956P37	**MICROPHONE ASSEMBLY**
		PLUG:
P1, 2	2805466R01	Connector, Flex Top; 15-pin
P3, 4	2805144Q01	Connector, FCIU; 7-pin
P5	2805433R02	Connector, Front Cover
P6	2805247Q01	Connector, I-F
P7	----------	Not field replaceable, order Top Control Panel Assembly
	0102700J59	(Rotary Radios) or
	0105958N64	(Display Radios)
P8*	2805507R01	Connector, 2-pin (replaces R120 in radios with alternate reference oscillator)
		TRANSISTOR: See Note
Q1,2	4802245J02	NPN,Type MMBR941L
Q101	4802233J11	NPN,Type MRF0211
Q102	4800869B59	Driver
Q103	4802245J03	NPN,Type MRF0233
		RESISTOR, Fixed: Ω ± **5%; 1/10W** unless stated
R1	0660076A83	27k
R2	0660076A65	4.7k
R3	0660076A60	3k
R5	0660076A63	3.9k
R6	0660076A83	27k
R7	0660076A53	1.5k
R9,10	0660076A18	51
R11	0660076A57	2.2k (L,M)
	or 0660076A60	3k (H)
R12	0660076A85	33k
R13	0660076A84	30k
R14	0660076A60	3k
R15	0660076A53	1.5k
R100	0660076A71	8.2k
R101	0660076A87	39k
R102	0660076A49	1k
R103	0660076A73	10k (L,M)
	or 0660076A76	13k (H)
R105	0602432J27	120;1/2W (L,M)
	or 0602432J29	150;1/2W (H)
R106	0660076A01	10 (L,M)
	or 0660076A15	39 (H)
R107	0660076A29	150
R108	0660076A01	10 (L)
	or 0660076A10	24 (M, H)
R109	0602433J29	150;1W (L)
	or 0602433J28	130;1W (M,H)
R111	0602433J28	130;1W (L)
	or 0602433J29	150;1W (M)
	or 0602433J25	100;1W (H)
R112	0660076E75	12k±1%
R113	0660076E84	30k±1%
R114,115	0660076A44	620
R116	0660076A37	330
R120	1805559S02	Pot., 50k
R121	0660076A10	24 (M,H)
	or 0660076A01	10 (L)
R122	0611072A33	220; 1/4W (L)
	or 0611072A32	200 (M)
	or 0611072A34	240 (H)
R123	0660076A49	1k (L)
	or 0660076A41	470 (M,H)
R124	0660076A41	470 (L,M)
	or 0660076A34	240 (H)
R125	0660076M01	0
R140	1805100Q04	Pot., 25k
S1	----------	**SWITCH:** On/Off, Part of R140
S2	4005265Q02	16-position, Hexadecimal (Rotary Radios Only)
S3	4005101Q02	Toggle, PL Disable/Scan
S301	3905834K06	Snap Dome, Monitor
S302	3905834K06	Snap Dome, PTT
S303	3905834K06	Snap Dome, Light/Scan
T1,2	2580163M02	**TRANSFORMER:**
		CIRCUIT MODULE: See Note
U1	5102001J12	I-F
U3	4802245J01	Dual Transistor
U102	5160880B01	Regulator (5V)
U103	5102001J36	Antenna Switch (L)
	or 5102001J37	Antenna Switch (M)
	or 5102001J38	Antenna Switch (H)
U106*	5105729E52	Ref. Oscillator, 16.8MHz
	or 5102463J01	Ref. Oscillator (alternate), 2.1MHz
U201*	5102001J47	Freq. Generator (L)
	or 5102001J64	Freq. Generator (L); alternate
	or 5102001J48	Freq. Generator (M)
	or 5102001J49	Freq. Generator (H)

NONREFERENCED ITEMS

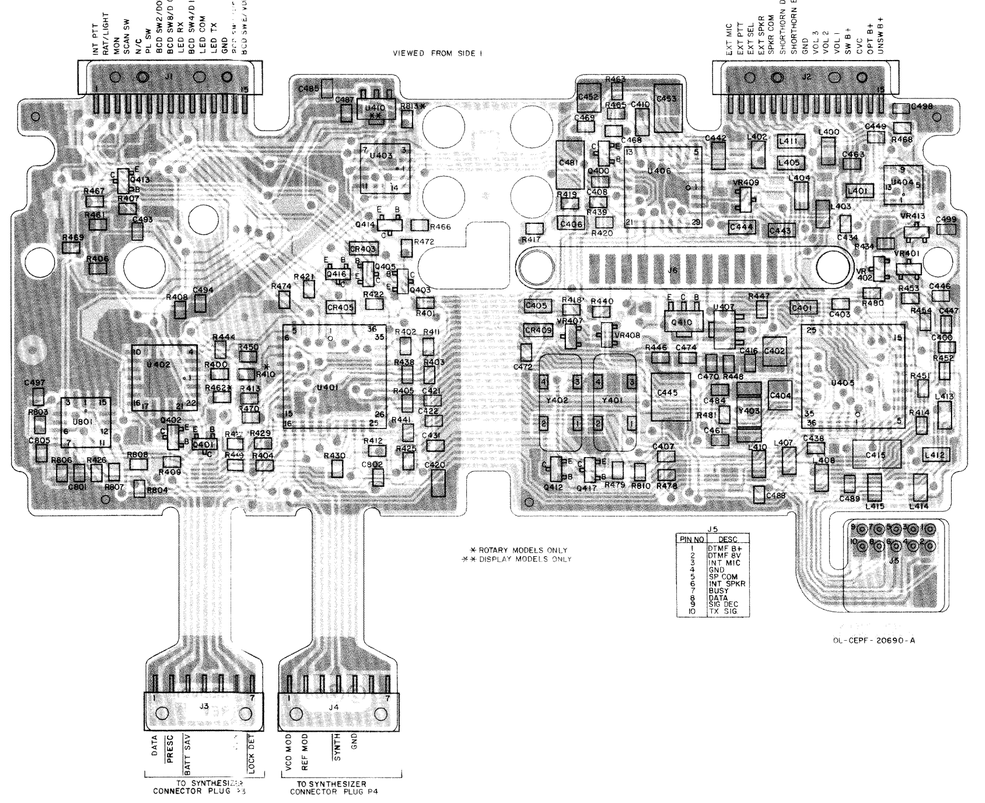
	1402428J01	INSULATOR
	1405511R02	SHIELD
	2602240J01	HEATSINK (PA)
	2605296Q01	HEATSINK (Driver)
	2682671D21	CAN, for L113 thru 116 and L119
	2805507R01*	CONNECTOR, 2-Pin (used with alternate low split reference oscillator only)
	7505295B07	PAD, for FL1, FL2
	8402214J01	BOARD, Printed Circuit

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

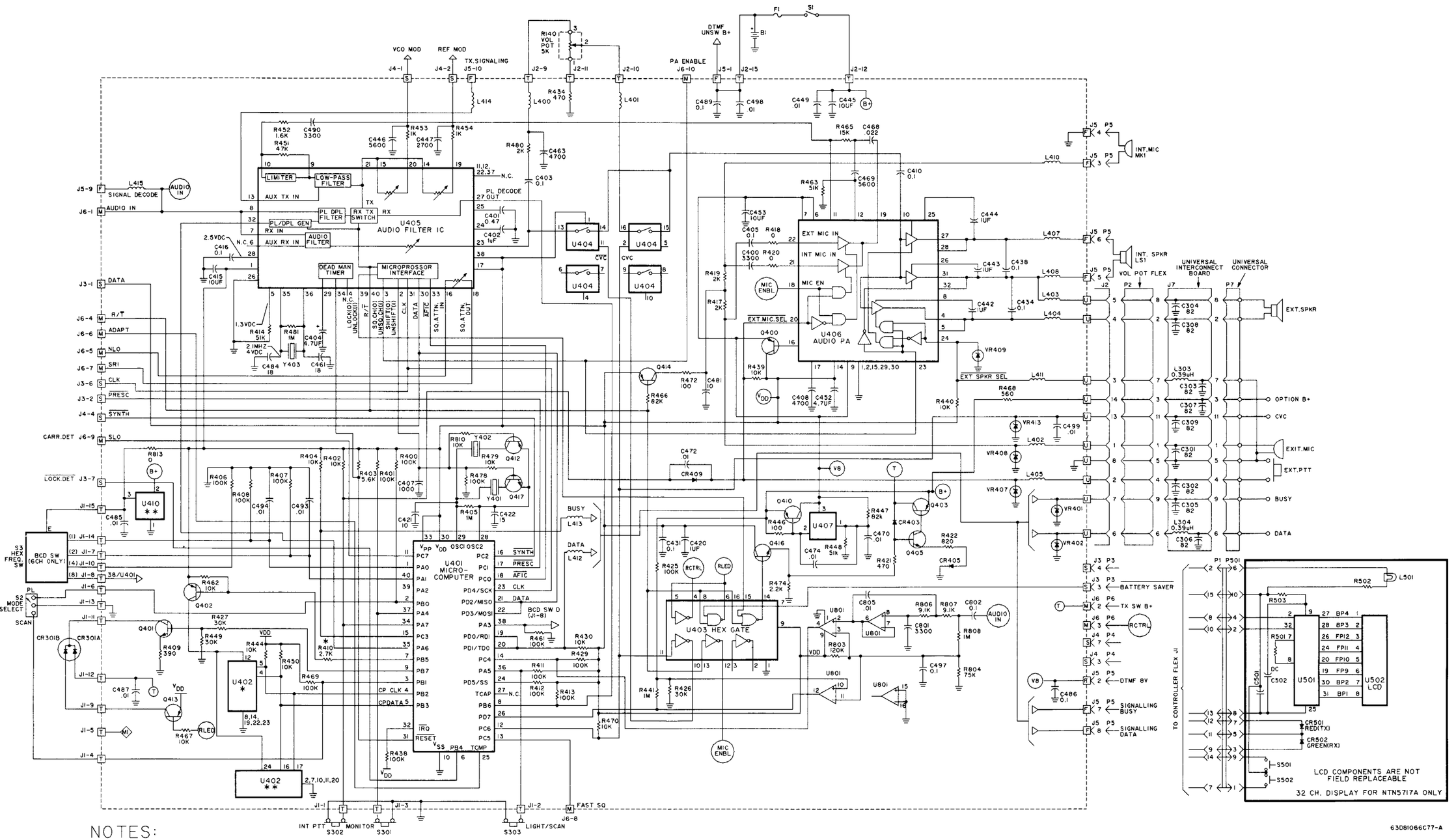
* In the (L) frequency split, radios operating on 33.6 MHz will be equipped with three alternate parts:

- U106
- U201
- P8 a 2-pin connector that replaces resistor R120

If the radio is not equipped with the alternate parts, it will not perform properly on 33.6 MHz.



LOWBAND TRANSCEIVER PARTS LIST AND LOWBAND CONTROLLER COMPONENT LOCATION DIAGRAM



NOTES:

1. * FOR NTN5716A ONLY (ROTARY RADIOS)
   ** FOR NTN5717A ONLY (DISPLAY RADIOS)
2. R813 & R423 ARE 0 OHM JUMPER.
3. U402 ORIENTATION FOR NTN5717A IS ROTATED 180°

63D81066C77-A

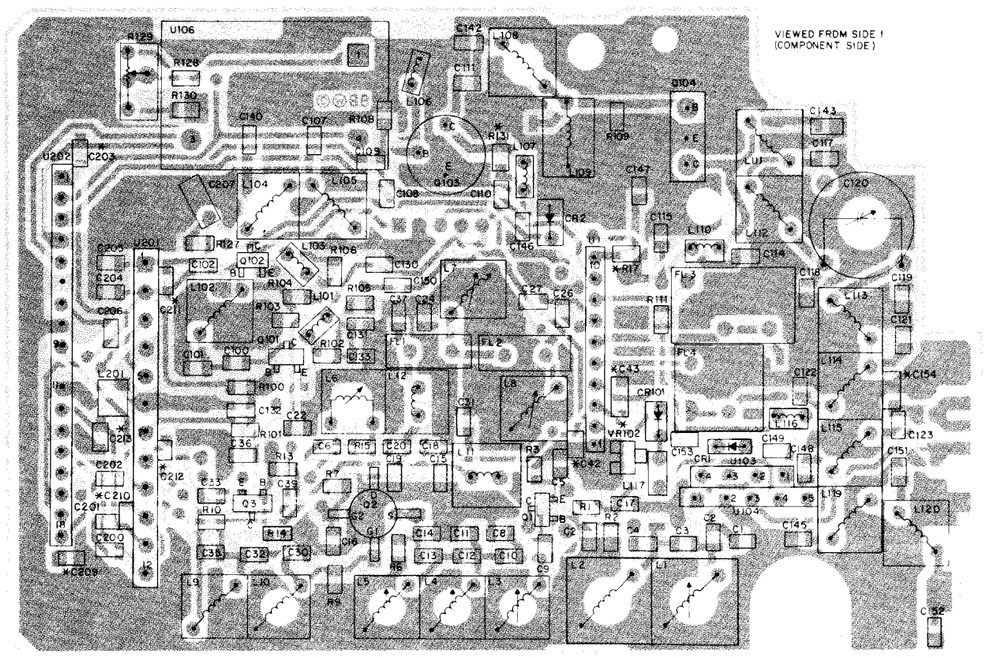
Electrical Parts List
Lowband Controller Flex
NTN5716A Rotary Radios
NTN5717A Display Radios

TPLF-3875-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: µF ±5%; 50V, unless stated
C400	2113741A33	3300pF±10%
C401	2311049A35	0.47±20%; 25V
C402	2311049A37	1.0; 16V
C403	2160521G37	0.1+80-20%; 25V
C404	2311049J12	4.7; 10V
C405, 406	2111032B13	0.1 +80 -20%
C407	2113741A21	1000pF
C408	2113741A37	.0047±10%
C410	2111032B13	0.1 +80 -20%
C415	2311049J26	10; 16V
C416	2160521G37	0.1+80-20%; 25V
C420	2311049A37	1; 16V
C421	2113740A29	10pF
C422	2113740A33	15pF
C431, 434, 438	2160521G37	0.1+80-20%; 25V
C442, 443, 444	2311049A37	1; 16V
C445	2369562A35	10; 25V
C446	2113741A39	5600pF
C447	2113741A31	2700pF
C449	2113741A45	.01
C452	2311049J12	4.7; 10V
C453	2311049J26	10; 16V
C461	2113740A35	18pF
C463	2113741A37	4700pF
C468	2113741A53	22000pF
C469	2113741A39	5600pF
C470	2113741A45	.01
C472, 474	2113741A45	.01
C481	2360562A43	10; 16V Tant.
C484	2113740A35	18pF
C485	2113741A45	.01
C487	2113741A45	.01
C488, 489	2160521G37	0.1+80-20%; 25V
C493, 494	2113741A45	.01
C497	2160521G37	0.1+80-20%; 25V
C498	2113741J26	10; 16V Tant.
C499	2113741A45	.01
C801	2113741A33	3300pF
C802	2160521G37	0.1+80-20%; 25V
C805	2113741A45	0.01
		DIODE: See Note I
CR403, 405	4805494Q04	Silicon
CR409,	4805494Q04	Silicon
		JACK:
J1,2	0905467R01	Socket, 15-position
J3	0905577P01	Connector, Synthesizer; 7-pin
J4	0905577P01	Connector, Synthesizer; 7-pin
J5	0905504R01	Connector, 10-pin
J6	0105959M27	Receptacle,10-pin
		COIL, RF:
L400,401	0611024B23	0Ω
L402 thru 405	2462575A07	10uH
L407,410	0611024B23	0Ω
L408, 411	2462575A07	10uH
L412,413	0611024A01	10Ω
L414,415	0611024B23	0Ω
		TRANSISTOR: See Note I
Q400	4802245J04	PNP
Q401	4805128M12	NPN
Q402	4805128M94	PNP
Q403	4880141L03	PNP
Q405	4805128M12	NPN
Q410	4805128M10	PNP
Q412 thru 414	4805128M94	PNP
Q416,417	4805128M12	NPN
		RESISTOR, Fixed: Ω±**5%; 1/8W** unless stated
R400,401	0660076B01	100k
R402	0660076A73	10k
R403	0660076A67	5.6k
R404	0660076A73	10k
R405	0660076H49	10 Meg
R406 thru 408	0660076B01	100k
R409	0660076E39	390±1%
R410	0660076A59	2.7k(Rotary Radios)
R411 thru 413	0660076B01	100k
R414	0660076A90	51k
R417	0660076A56	2k
R418	0660076M01	0
R419	0660076A56	2k
R420	0660076M01	0
R421	0660076A41	470;1/10W
R422	0611076A47	820
R425	0660076F01	100k±1%
R426,427	0660076E84	30k±1%;1/10W
R429	0660076B01	100k
R430	0660076A73	10k
R434	0660076A41	470
R438	0660076B01	100k
R439,440	0660076A73	10k;1/10W
R441	0660076B25	1 Meg; 1/10W
R444	0660076A73	10k
R446	0660076A25	100;1/10W
R447	0660076E95	82k
R448	0660076E90	51k
R449	0660076E84	30k;1/10W
R450	0660076A73	10k;1/10W
R451	0660076A89	47k;1/10W
R452	0660076A54	1.6k
R453,454	0660076A49	1k;1/10W
R461	0660076B01	100k
R462	0660076A73	10k; 1/10W (Rotary Radios)
R463	0660076A90	51k
R465	0660076A77	15k
R466	0660076A95	82k;1/10W
R467	0660076A73	10k;1/10W
R468	0660076A43	560;1/10W
R469	0660076B01	100k;1/10W
R470	0660076A73	10k; 1/10W
R472	0660076A25	100; 1/10W
R474	0660076A57	2.2k
R478	0660076B01	100k
R479	0660076A73	10k; 1/10W
R480	0660076A56	2k
R481	0660076B25	1Meg;1/10W
R803	0660076F03	120k±1%
R804	0660076E94	75k±1%
R806,807	0660076A72	9.1k;1/10W
R808	0660076B25	1Meg;1/10W
R810	0660076A73	10k;1/10W
R813	0660076M01	0 (Rotary Radios)
		CIRCUIT MODULE: See Note I
U401	0102712J01	Microcomputer
U402	0105950R56	EEPROM (Display Radios)
	or 0105958N07	EEPROM (Rotary Radios)
U403	0105957N87	Hex Gate
U404	0105954P13	Analog Gate
U405	0105954R66	Audio Filter
U406	0105958P03	Audio PA
U407	5160880B01	5V Regulator, CMOS
U410	5160880B01	5V Regulator, CMOS (Display Radios Only)
U801	0105957N83	Quad Op Amp
		DIODE: See Note I
VR401, 402	4880140L09	Zener, 6.2V
VR407,408, 409	4880140L09	Zener, 6.2V
VR413	4880140L09	Zener, 6.2V
		CRYSTAL: See Note II
Y401	4802297J01	3.6864MHz
Y402	4802297J02	3.6914MHz
Y403	4805719G05	2.1MHz Murata
		NONREFERENCED ITEMS
	0300138620	SCREW, Flat Head
	1405264Q01	INSULATOR, Flex
	1405585S01	INSULATOR, Flex Tail
	1505765R02	CARRIER, FlexTop
	2602229J01	ASSEMBLY, Bottom Shield
	2605185S01	SHIELD
	1405582S01	INSULATOR

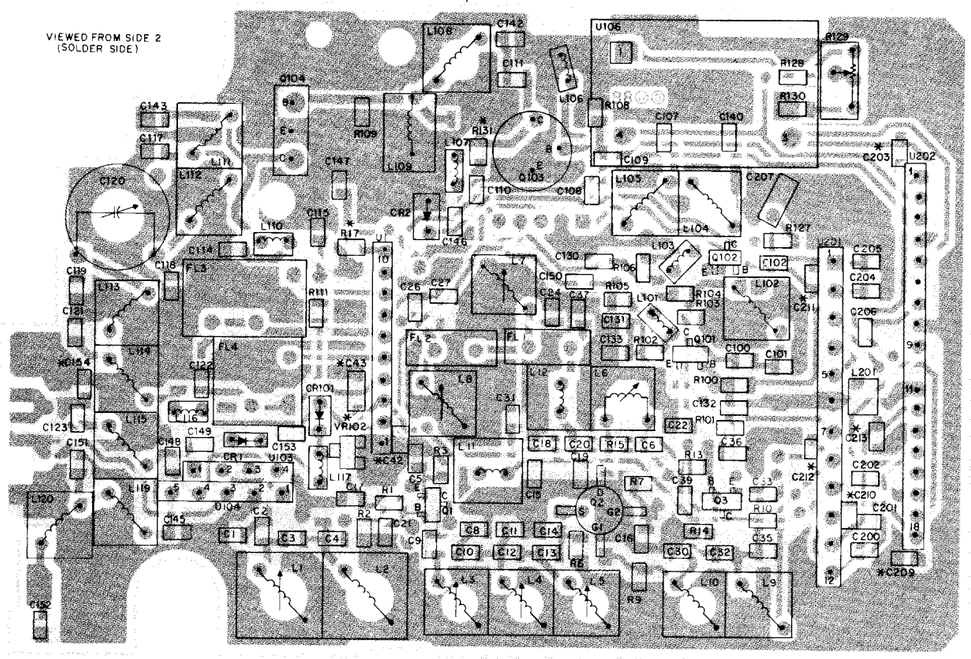
NOTES:
1. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.
2. When ordering crystal units, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.

VHF 2-WATT RADIOS (136-150.8MHz)



* MOUNTED ON SOLDER SIDE

OL-CEPF-19236-A

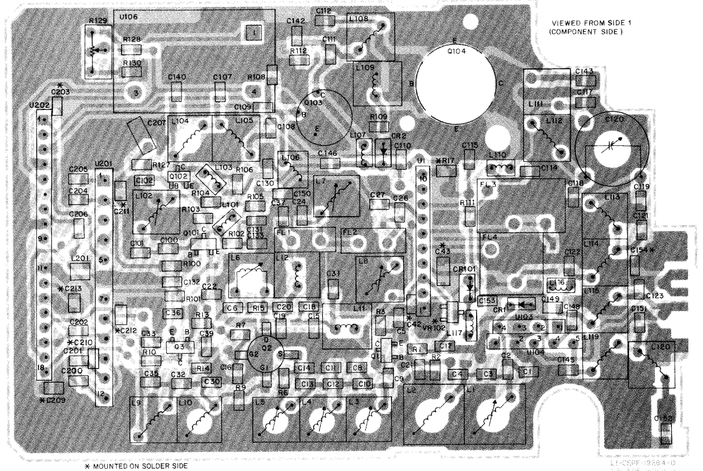


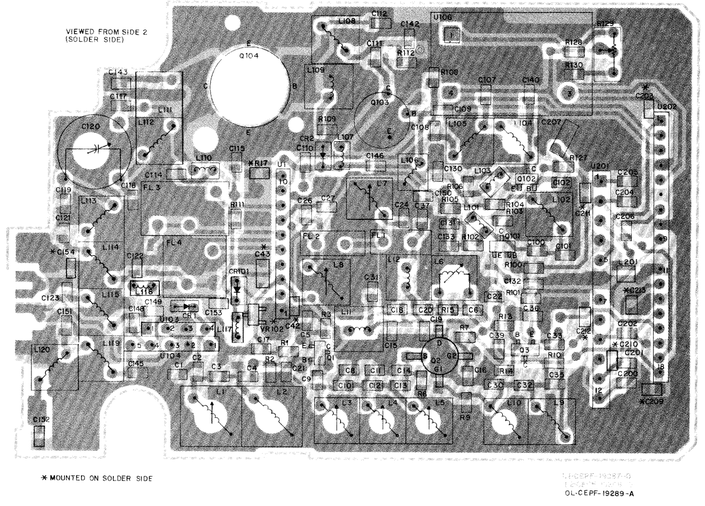
* MOUNTED ON SOLDER SIDE

OL-CEPF-19239-A

LOWBAND CONTROLLER FLEX PARTS LIST AND
VHF TRANSCEIVER COMPONENT LOCATION DIAGRAMS (2W, 136-150.8MHz)

VHF 5-WATT RADIOS (136-150.8MHz)





SCHEMATIC AND CIRCUIT BOARD NOTES

1. UNLESS OTHERWISE STATED, RESISTANCES ARE IN OHMS (k=1000), CAPACITANCES LESS THAN 1 ARE IN MICROFARADS, AND CAPACITANCES 1 OR GREATER ARE IN PICOFARADS.
2. DC VOLTAGES ARE MEASURED FROM POINT INDICATED TO CHASSIS GROUND USING MOTOROLA DC MULTIMETER OR EQUIVALENT. TRANSMITTER MEASUREMENTS SHOULD BE MADE WITH A 1.2uH RF CHOKE IN SERIES WITH VOLTAGE PROBE TO PREVENT CIRCUIT LOADING.
3. REFERENCE DESIGNATIONS ARE ASSIGNED IN THE FOLLOWING MANNER:

UNIT SERIES	=	RECEIVER
100 SERIES	=	TRANSMITTER
200 SERIES	=	VCO & SYNTHESIZER
300 SERIES	=	MISCELLANEOUS
400 SERIES	=	CONTROLLER FLEX
500 SERIES	=	DISPLAY BOARD
800 SERIES	=	SIGNALLING (CONTROLLER FLEX)

4. INTERCONNECT TIE POINT LEGEND:

- (A) B+ TO MOTHER BOARD
- (B) CONTROLLER FLEX B+
- (5V REG) REGULATED 5V
- (M) TO MOTHER BOARD
- (M1) METERING POINT M1, M2, M3
- (R) RECEIVER 10V
- (R5) RECEIVER 5V
- (S) TO SYNTHESIZER BOARD
- (T) TRANSMIT 10V
- (T5) TRANSMIT 5V
- (T) TO CONTROL TOP FLEX
- (U) TO UNIVERSAL CONNECTOR
- (*) TO FRONT COVER
- (V1) REGULATED 8V

TEPF-18821-A

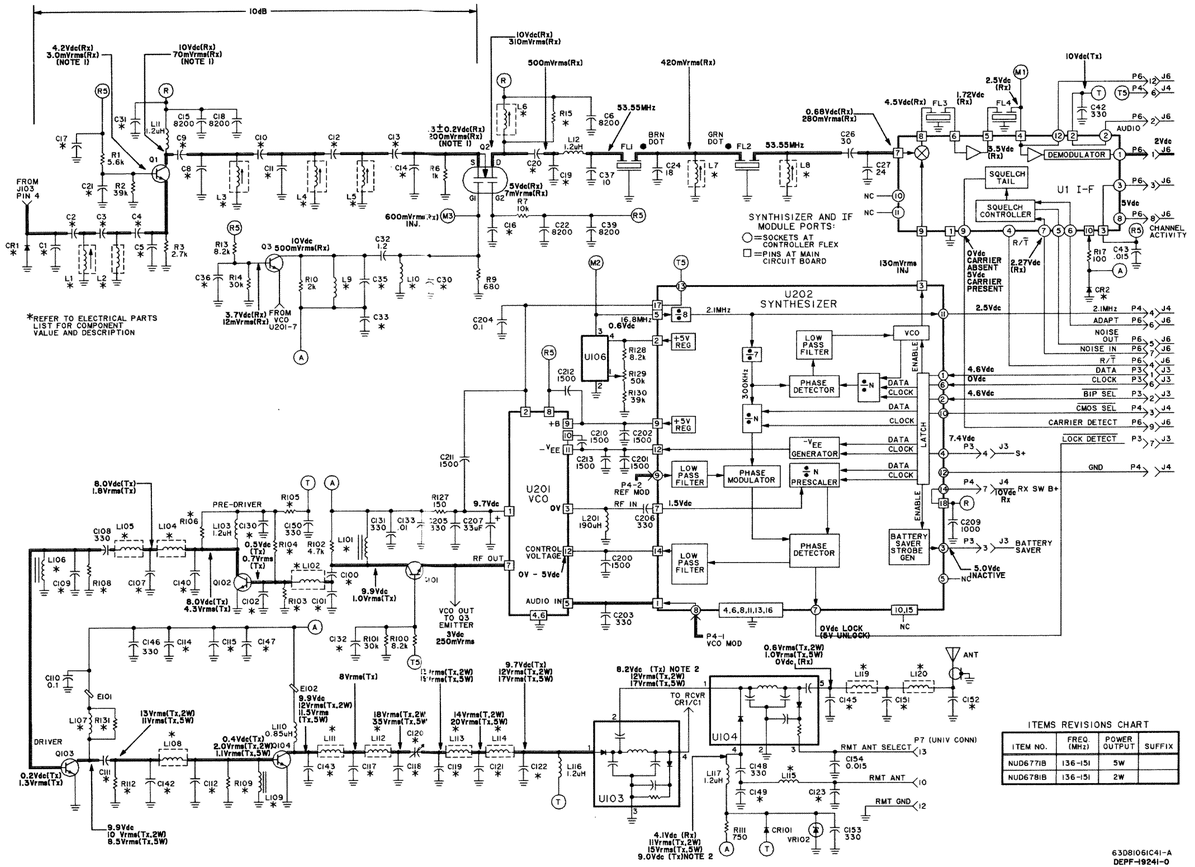
VOLTAGE OVERLAY AND WAVEFORM NOTES

1. 7mV SIGNAL GENERATOR LEVEL. PLACE A 47 Ω RESISTOR ACROSS L10 TO REDUCE 1ST L.O. INJECTION FEED THROUGH.
2. BASE OF Q102 SHORTED TO GROUND.
3. INJECT (AT SELECTED ANTENNA) AN ON CHANNEL SIGNAL AT 1mV, 1kHz MODULATION AT 3kHz DEVIATION.
4. VERIFY USING PROGRAMMER.
5. EXTERNAL SIGNAL FROM AUDIO SIGNAL GENERATOR AT MIC INPUT.

TEPF-18822-A

2-LAYER CIRCUIT BOARD COPPER DETAIL VIEWING COPPER STEPS AT EDGE OF BOARD IN PROPER LAYER SEQUENCE.

MAEPF-16805-O



Electrical Parts List
VHF 136-150.8MHz

TPLF-3920-O

REFERENCE SYMBOL	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 50V unless stated
C1	2160520S09	22 ±0.25pF
C2	2113740A32	13
C3	2113740A15	3.3 ±0.25pF
C4	2113740A34	16
C5	2113740A36	20
C6	2113741A43	8200
C8	2113740A23	6.2 ±0.25pF
C9	2113740A75	680
C10	2113740A04	1.1 ±0.25pF
C11	2113740A25	7.5 ±0.25pF
C12	2113740A04	1.1 ±0.25pF
C13	2113740A32	13
C14	2113740A32	13
C15	2113741A43	8200
C16, 17	2113740A75	680
C18	2113741A43	8200
C19	2113740A43	39
C20	2113740A19	4.7 ±0.25pF
C21	2113740A75	680
C22	2113741A43	8200
C24	2113740A35	18
C25	- - - - - - - -	Not Used
C26	2113740A40	30
C27	2113740A38	24
C30	2113740A18	4.3 ±0.25pF
C31	2113740A75	680
C32	2113740A05	1.2 ±0.25pF
C33	2113740A75	680
C35	2113740A21	5.6 ±0.25pF
C36	2113740A75	680
C37	2160520S01	10 ±0.25pF
C39	2113741A43	8200
C42	2113740A67	330
C43	2113741B49	.015µF; 25V
C100	2113740A12	2.4 ±0.25pF (2W)
	or 2113740A11	2.2 ±0.25pF (5W)
C101	2113740A36	20
C102	2113740A41	33 (2W)
	or 2113740A38	24 (5W)
C107	2113740A49	56 (2W)
	or 2113740A52	75 (5W)
C108	2113740A67	330
C109	2113740A43	39 (2W)
	or 2113740A40	30 (5W)
C110	2160521G37	0.1µF +80 –20%
C111	2113740A46	47 (2W)
	or 2113740A48	51 (5W)
C112	2113740A57	120 (5W models only)
C114	2113740A67	330
C115	2160521G37	0.1µF +80 –20%
C117	2113740A51	68 (2W)
	or 2113740A55	100 (5W)
C118	2113740A37	22 (2W)
	or 2113740A35	18 (5W)
C119	2113740A38	24 (2W)
	or 2113740A31	12 (5W)
C120	2005568P01	Trimmer, 5.5-65pF
C121	2113740A43	39
C122	2113740A36	20
C123	2113740A36	20 (2W)
	or 2113740A35	18 (5W)
C130	2113740A67	330 (2W)
	or 2113741A33	3300 (5W)
C131	2113740A67	330
C132	2113740A67	330 (2W)
	or 2113740A75	680 (5W)
C133	2113741A45	0.01µF
C140	2113740A18	4.3 ±0.25pF (2W)
	or 2113740A17	3.9 ±0.25pF (5W)
C142	2113740A42	36 (2W)
	or 2113740A49	56 (5W)
C143	2113740A33	15 (2W)
	or 2113740A37	22 (5W)
C145	2113740A36	20
C146	2113740A67	330
C147	2113740A67	330 (2W models only)
C148	2113740A67	330
C149	2113740A35	18 (2W)
	or 2113740A37	22 (5W)
C150	2113740A67	330
C151	2113740A50	62
C152	2113740A39	27 (2W)
	or 2113740A37	22 (5W)
C153	2113740A67	330
C154	2113741B49	.015µF; 25V
C200 thru 202	2113741A25	1500pF
C203	2113740A67	330
C204	2160521G37	0.1µF +80 –20%
C205, 206	2113740A67	330
C207	2305458G12	33µF; 16V
C209	2113741A21	1000
C210 thru 213	2113741A25	1500
C301 thru 310	2113740A53	82
		DIODE: See Note
CR1	4883654H08	Silicon
CR2	4805490G02	Silicon
CR101	4883654H01	Silicon
CR301A,301B	4805729G24	LED, Bicolor (Rotary Radios only)
		CORE:
E101	7683960B04	Ferrite Bead
E102	7683960B01	Ferrite Bead
		FUSE:
F1	6505214E02	Axial, 5-Amp.
		FILTER:
FL1, 2	4805245J20	Crystal, 53.55MHz
FL3	9105725Q02	Ceramic, 450kHz
FL4	9105726Q01	Ceramic, 450kHz
		COIL, RF: unless stated
L1	2405669G13	5-1/2 turns, spacewound
L2	2405669G31	5-1/2 turns, spacewound
L3, 4, 5	2405523P29	9-1/2 turns, closewound; with core
L6	2405063H13	Tunable, 1.2µH Choke
L7, 8	2405063H05	Tunable, 0.4µH Choke
L9	2405523P28	6-1/2 turns, spacewound
L10	2405523P10	5-1/2 turns, spacewound
L11	2482723H38	1.2µH Choke
L12	2505129Q02	1.2µH Choke, precision
L101	2482723H28	0.29µH Choke (2W)
	or 0105951P49	Assy., 0.29µH Choke and bead (5W)
L102	2405523P28	6-1/2 turns, spacewound
L103	2482723H38	1.2µH Choke
L104	2405523P32	9-1/2 turns, closewound
L105	2405523P07	2-1/2 turns, spacewound
L106	2405913C01	3-turn ferrite bead
L107	0105951P49	Assy., 0.29µH Choke and bead (2W)
	or 0105951P48	Assy., .085µH Choke and bead (5W)
L108	2405523P07	2-1/2 turns, spacewound (2W)
	or 2405559P09	1-1/2 turns, airwound (5W)
L109	2405913C01	3-turn ferrite bead
L110	0105951P48	Assy., 0.85µH Choke and bead
L111	2405559P07	2-1/2 turns, airwound (2W)
	or 2405559P08	1-1/2 turns, airwound (5W)
L112	2405559P11	4-1/2 turns, airwound
L113,114,115	2405559P01	6-1/2 turns, airwound
L116, 117	2482723H38	1.2µH Choke
L119, 120	2405559P01	6-1/2 turns, airwound
L201	2405452C70	190µH Choke
L303, 304	2462575A01	0.39µH Choke
LS1	5005155Q03	**TRANSDUCER**
MK1	0105956P37	**MICROPHONE ASSEMBLY**
		PLUG:
P1, 2	2805466R01	Connector, Flex Top; 15-pin
P3, 4	2805144Q01	Connector, Synthesizer; 7-pin
P5	2805433R02	Connector, Front cover
P6	2805247Q01	Connector, I-F
P7	- - - - - - - - - -	Not field replaceable, order Top Control Panel Assembly 0102700J59 (rotary radios) or 0105958N64 (display radios)
		TRANSISTOR: See Note
Q1	4805218N08	NPN
Q2	4805452G08	Dual Gate MOSFET; Type M52G08
Q3	4805218N09	NPN
Q101, 102	4805218N09	NPN
Q103	4805474G37	NPN; Type M74G37
Q104	4805452G06	NPN; Type M52G06 (2W)
	or 4805474G33	NPN; Type M74G33 (5W)
		RESISTOR, Fixed: Ω ±5%; 1/10W unless stated
R1	0660076A67	5.6k
R2	0660076A87	39k
R3	0660076A59	2.7k
R6	0660076A49	1k
R7	0660076A73	10k
R9	0660076A45	680
R10	0660076A56	2k
R13	0660076A71	8.2k
R14	0660076A84	30k
R15	0660076A71	8.2k
R17	0660076A25	100
R100	0660076A71	8.2k
R101	0660076A84	30k
R102	0660076A65	4.7k
R103	0660076A69	6.8k
R104	0660076A80	20k (2W)
	or 0660076A82	24k (5W)
R105	0660076A25	100
R106	0660076A75	12k
R108	0660076A17	47 (2W)
	or 0660076A25	100 (5W)
R109	0660076A17	47 (2W)
	or 0660076A07	18 (5W)
R111	0660076A46	750
R112	0660076A29	150 (5W only)
R127	0660076A29	150
R128	0660076A71	8.2k
R129	1805559S02	Pot., 50k
R130	0660076A87	39k
R131	0660076A36	300 (2W only)
R140	1805100Q03	Pot., 25k
		SWITCH:
S1	- - - - - - - - - -	On/Off, Part of R140
S2	4005265Q02	16-position, Hexadecimal (rotary models only)
S3	4005101Q02	Toggle, PL Disable/Scan
S301	3905834K06	Snap Dome, Monitor
S302	3905834K06	Snap Dome, PTT
S303	3905834K06	Snap Dome, Monitor
		CIRCUIT MODULE: See Note
U1	5102001J12	I-F
U103	5105822P51	Antenna Switch
U104	5105822P64	Antenna Selector (2W)
	or 5105729E93	Antenna Selector (5W)
U106	5105729E52	Ref. Oscillator
U201	5105822P61	VCO
U202	5102001J03	Synthesizer
		DIODE: See Note
VR102	4805129M61	Zener, 18V

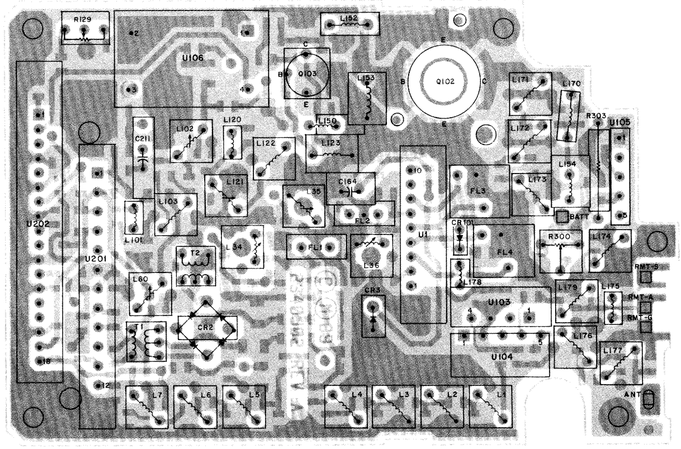
NONREFERENCED ITEMS

	0200007007	NUT, Hex; 8-32 X 1/4" X 3/32" (for Q104, 5W models)
	0300136771	SCREW, Phillips; 2-56 x 3/16" (for Q104 heatsink)
	0705196A04	BOOT, for FL1, FL2
	0705766R01	SUPPORT, Rubber
	1400861196	INSULATOR, for Q103
	1405238Q01	INSULATOR, for U106
	1405496B01	INSULATOR (I-F)
	2605524P01	CAN, for L11, L12
	2605524P03	CAN, for L111 thru L115, L119, L120, and L108 (5W models)
	2605532P01	HEATSINK, for Q104 (5W models)
	2605578P01	HEATSINK, for Q104 (2W models)
	2605820D07	CAN, For L1, L2
	2683379H01	HEATSINK, for Q103
	3905130N01	CONTACT STRIP
	3905509R02	CONTACT
	7505295B07	PAD, for FL1, FL2
	7505695R01	CUSHION, for U106

For optimum performance, order replacement diodes, transistors , and circuit modules by Motorola part number only.

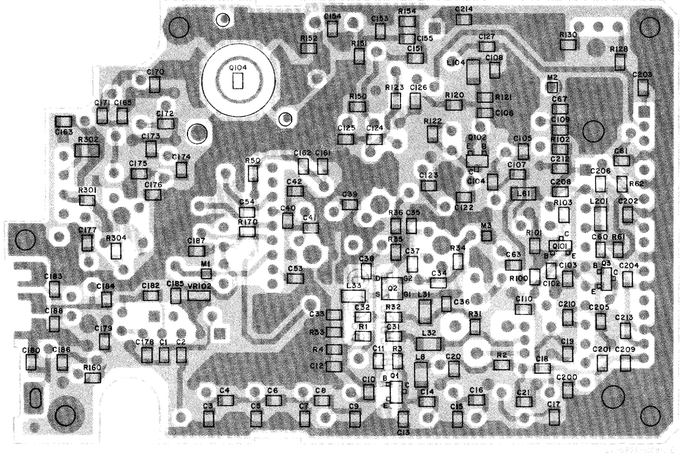
VHF (146-174MHZ)
TRANSCEIVER COMPONENT LOCATION DIAGRAMS

VIEWED FROM SIDE 1 (COMPONENT SIDE)



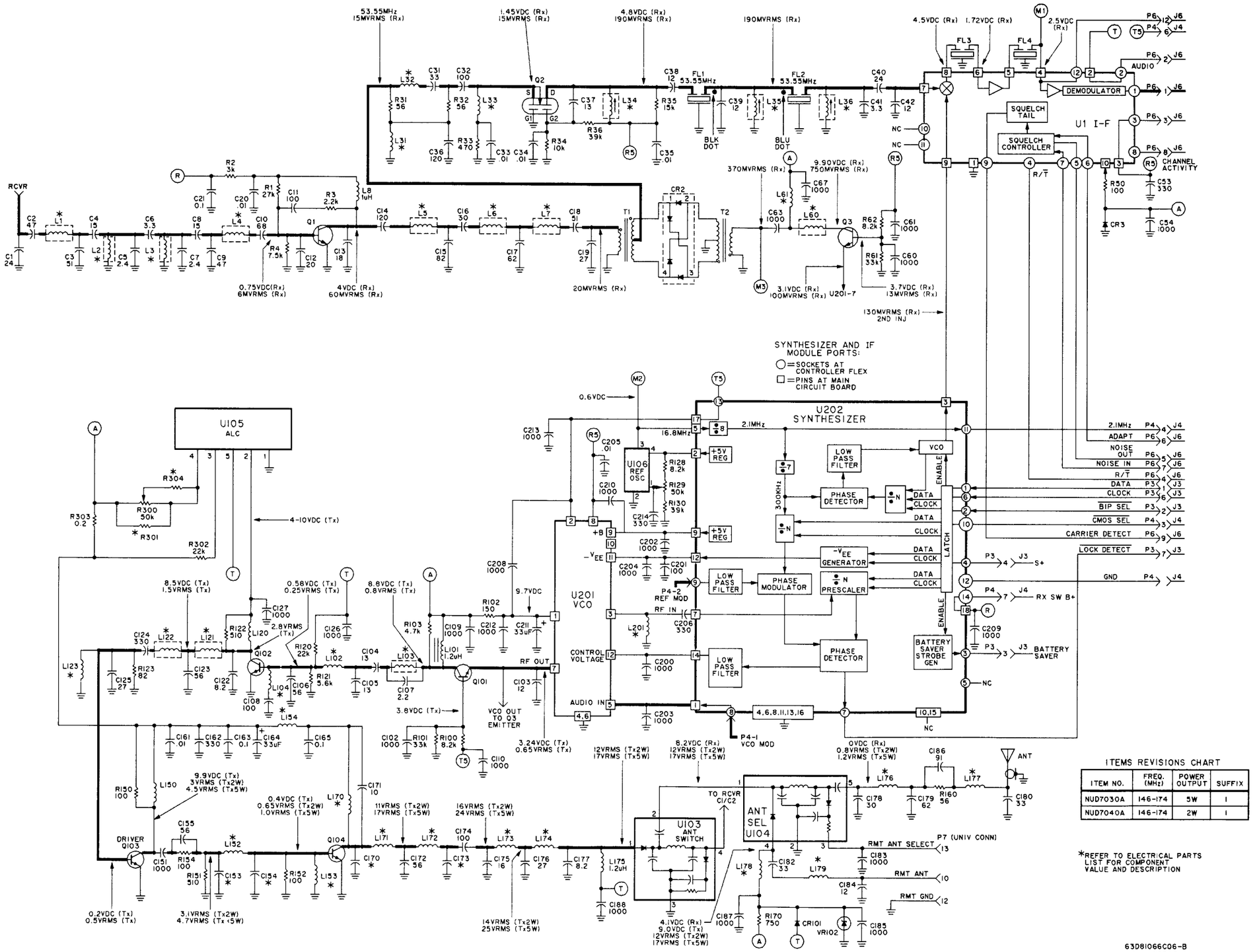
OL-CEPF-20708-A

VIEWED FROM SIDE 2 (SOLDER SIDE)



OL-CEPF-20710-A

VHF (136-150.8MHz) ELECTRICAL PARTS LIST AND VHF (146-174MHz) COMPONENT LOCATION DIAGRAMS



ITEMS REVISIONS CHART

ITEM NO.	FREQ. (MHz)	POWER OUTPUT	SUFFIX
NUD7030A	146-174	5W	1
NUD7040A	146-174	2W	1

*REFER TO ELECTRICAL PARTS LIST FOR COMPONENT VALUE AND DESCRIPTION

63D81066C06-B
DEPF-20307-0

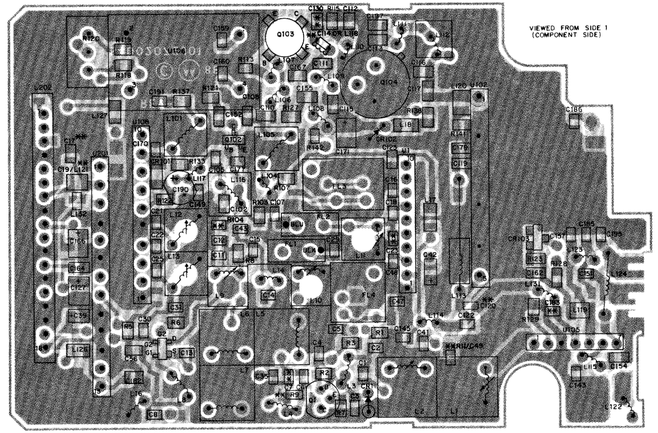
Electrical Parts List (146-174MHz Bandsplit)

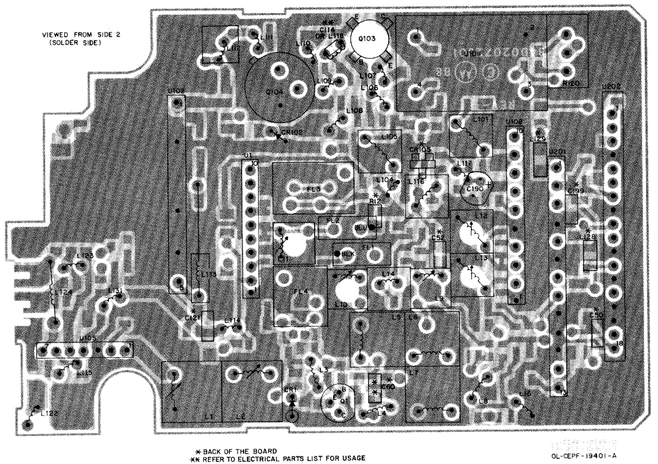
TPLF-3843-B

REFERENCE SYMBOL	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed: pF±5%; 50 V unless stated
C1	2113740A38	24
C2	2113740A46	47
C3	2113740A48	51
C4	2113740A33	15
C5	2113740A12	2.4 ± 0.25 pF
C6	2113740A15	3.3 ± 0.25 pF
C7	2113740A12	2.4 ± 0.25 pF
C8	2113740A33	15
C9	2113740A46	47
C10	2113740A51	68
C11	2113740A55	100
C12	2113740A36	20
C13	2113740A35	18
C14	2113740A57	120
C15	2113740A53	82
C16	2113740A40	30
C17	2113740A50	62
C18	2113740A48	51
C19	2113740A39	27
C20	2113741A45	.01µF
C21	2160521G37	0.1µF
C31	2113740A41	33
C32	2113740A55	100
C33	2113741A45	.01µF
C34	2113741A45	.01µF
C35	2113741A45	.01µF
C36	2113740A57	120
C37	2113740A32	13
C38	2113740A31	12
C39	2113740A31	12
C40	2113740A38	24
C41	2113740A15	3.3 ± 0.25 pF
C42	2113740A31	12 (2W only)
C53	2113740A67	330
C54	2113741A21	.001µF
C60	2113741A21	.001µF
C61	2113741A21	.001µF
C63	2113741A21	.001µF
C67	2113741A21	.001µF
C102	2113741A21	.001µF
C103	2113740A31	12
C104	2113740A32	13
C105	2113740A32	13
C106	2113740A49	56
C107	2113740A11	2.2 ± 0.25 pF
C108	2113740A55	100
C109	2113741A21	.001µF
C110	2113741A21	.001µF
C122	2113740A27	8.2 ± 0.25 pF
C123	2113740A49	56
C124	2113740A67	330 pF
C125	2113740A39	27
C126	2113741A21	.001µF
C127	2113741A21	.001µF
C151	2113741A21	.001µF
C153	2113740A51	68 (2W)
	or 2113740A49	56 (5W)
C154	2113740A61	180 (5W)
	or 2113740A53	82 (2W)
C155	2113740A49	56 (2W)
C161	2113741A45	.01 µF
C162	2113740A67	330
C163	2160521G37	0.1 µF
C164	2305458G12	33 µF, 16 V
C165	2160521G37	0.1 µF
C170	2113740A37	22 (2W)
	or 2113740A38	24 (5W)
C171	2113740A29	10 ±0.25 pF
C172	2113740A49	56
C173	2113740A36	20 (5W)
	or 2113740A41	33 (2W)
C174	2113740A55	100
C175	2113740A34	16
C176	2113740A39	27
C177	2113740A27	8.2
C178	2113740A40	30
C179	2113740A50	62
C180	2113740A41	33
C182	2113470A41	33
C183	2113741A21	.001µF
C184	2113740A31	12
C185	2113741A21	.001µF
C186	2113740A54	91
C187	2113741A21	.001µF
C188	2113741A21	.001 µF
C200	2113741A21	.001µF
C201	2113740A55	100
C202	2113741A21	.001µF
C203	2113741A21	.001µF
C204	2113741A21	.001µF
C205	2113741A45	.01 µF
C206	2113740A67	330
C208	2113741A21	.001µF
C209	2113741A21	.001µF
C210	2113741A21	.001µF
C211	2305458G12	33 µF, 16 V
C212	2113741A21	.001µF
C213	2113741A21	.001µF
C214	2113740A67	330
		DIODE: See Note 1
CR2	4880236E16	Schottky
CR3	4805490G02	Silicon
CR101	4883654H01	Silicon
CR301A,301B	4805729G24	LED, Bicolor (Rotary Radios Only)
		FUSE:
F1	6505214E02	Axial, 5 Amp
		FILTER:
FL1, FL2	4805245J20	Crystal (set), 53.55 MHz
FL3	9105725Q02	Ceramic, 450 kHz
FL4	9105726Q01	Ceramic, 450 kHz
		COIL, RF: unless stated
L1	2405055P13	5 1/2 turns spacewound
L2	2405055P13	5 1/2 turns spacewound
L3	2405055P13	5 1/2 turns spacewound
L4	2405055P13	5 1/2 turns spacewound
L5	2405055P13	5 1/2 turns spacewound
L6	2405055P13	5 1/2 turns spacewound
L7	2405055P13	5 1/2 turns spacewound
L8	2462575A04	1 µH Choke
L31	2462575A22	68 nH Choke
L32	2462575A14	270 nH Choke
L33	2462575A14	270 nH Choke
L34	2405063H05	0.4 µH tunable
L35	2405063H05	0.4 µH tunable
L36	2405063H05	0.4 µH tunable
L60	2405055P20	9 1/2 turns closewound
L61	2462575A04	1 µH Choke
L101	0102703J47	ASSEMBLY, 1.2 µH Choke and bead
L102	2405055P03	6 1/2 turns spacewound
L103	2405055P06	11 1/2 turns closewound
L104	2462575A14	270 nH Choke
L120	0102703J47	ASSEMBLY, 1.2 µH Choke and bead
L121	2405055P17	8 1/2 turns closewound
L122	2405055P11	2 1/2 turns spacewound
L123	2405913C01	3 turns ferrite bead
L150	0105951P48	ASSEMBLY, 85 nH Choke and bead
L152	2411030E04	1/2 turn airwound
L153	2405913C01	3 turns ferrite bead
L154	0105951P48	ASSEMBLY, 85 nH Choke and bead
L170	0102710J45	ASSEMBLY, Choke and bead
L171	2405055P07	1 1/2 turns spacewound
L172	2405055P11	2 1/2 turns spacewound
L173	2405559P01	6 1/2 turns airwound
L174	2405559P01	6 1/2 turns airwound
L175	2482723H38	1.2 µH Choke
L176	2405559P05	3 1/2 turns airwound
L177	2405559P02	5 1/2 turns airwound
L178	2482723H38	1.2 µH Choke
L179	2405559P01	6 1/2 turns airwound
L201	2462575A26	180 nH Choke
L303,304	2462575A01	0.39 µH Choke
LS1	5005155Q03	**TRANSDUCER**
MK1	0105956P37	**MICROPHONE ASSEMBLY**
		PLUG:
P1,2	2805466R01	Connector, Flex Top; 15-pin
P3, 4	2805144Q01	Connector, Synthesizer; 7-pin
P5	2805433R02	Connector, Front Cover
P6	2805247Q01	Connector, I-F
P7	----------	Not field replaceable, order Top Control Panel Assembly 0105951N41 (rotary radios) or 0105958N64 (display radios)
		TRANSISTOR: See note 1
Q1	4880182D44	NPN
Q2	4805585Q01	GAAS FET
Q3	4805218N09	NPN
Q101	4805218N09	NPN
Q102	4880182D44	NPN
Q103	4805474G37	NPN; Type M74G37
Q104	4805474G33	NPN; Type M74G33
		RESISTOR, Fixed:Ω ±5%;1/10W unless stated
R1	0660076A83	27 k
R2	0660076A60	3 k
R3	0660076A57	2.2 k
R4	0660076A70	7.5 k
R31	0660076A19	56
R32	0660076A19	56
R33	0660076A41	470
R34	0660076A73	10 k
R35	0660076A77	15 k
R36	0660076A87	39 k
R50	0660076A25	100
R61	0660076A85	33 k
R62	0660076A71	8.2 k
R100	0660076A71	8.2 k
R101	0660076A85	33 k
R102	0660076A29	150 k
R103	0660076A65	4.7 k
R120	0660076A81	22 k
R121	0660076A67	5.6 k
R122	0660076A42	510
R123	0660076A23	82
R128	0660076A71	8.2 k
R129	1805559S02	Pot., 50 k
R130	0660076A87	39 k
R140	1805100Q04	Pot, 25 k
R150	0660076A25	100
R151	0660076A42	510
R152	0660076A25	100
R154	0660076A25	100
R160	0660076A19	56
R170	0660076A46	750
R300	1805098H01	Pot., 50 k
R301	0660076A93	68 k (2W)
	or 0660076A95	82k (5W)
R302	0611077B07	22 k
R303	1705530E26	0.2 wirewound (2W)
R304	0660076A93	68 k (2W)
	or 0660076A25	100 (5W)
		SWITCH:
S1	----------	On/Off, Part of R140
S2	4005265Q02	16-position, Hexidecimal (rotary models only)
S3	4005101Q02	Toggle, PL Disable/Scan
S301	3905834K06	Snap Dome, Monitor
S302	3905834K06	Snap Dome, PTT
S303	3905834K06	Snap Dome, Light/Scan
		TRANSFORMER:
T1	2580163M02	RF
T2	2580163M02	RF
		CIRCUIT MODULE: See note 1
U1	5102001J12	IF
U103	5105822P51	Antenna Switch
U104	5105729E93	Antenna Selector
U105	5102199J04	ALC
U106	5105729E52	Ref. Oscillator
U201	5102199J03	VCO
U202	5102001J03	Synthesizer
		DIODE:
VR102	4805129M61	Zener, 18 V

NON-REFERENCED ITEMS		
	0105957N35	SHIELD, I-F Module
	0705196A04	BOOT for FL1, FL2
	0705766R01	SUPPORT, Rubber
	1105668K28	PAD for R129
	1400861196	INSULATOR for Q103
	2605532P01	HEAT SINK for Q104
	2683379H01	HEAT SINK for Q103
	3905509R02	CONTACT
	7505295B07	PAD for FL1, FL2
	7505695R01	PAD for U106

4-WATT RADIOS





SCHEMATIC AND CIRCUIT BOARD NOTES

1. UNLESS OTHERWISE STATED, RESISTANCES ARE IN OHMS (K=1000), CAPACITANCES LESS THAN 1 ARE IN MICROFARADS, AND CAPACITANCES 1 OR GREATER ARE IN PICOFARADS.
2. DC VOLTAGES ARE MEASURED FROM POINT INDICATED TO CHASSIS GROUND USING MOTOROLA DC MULTIMETER OR EQUIVALENT. TRANSMITTER MEASUREMENTS SHOULD BE MADE WITH A 0.29uH RF CHOKE IN SERIES WITH VOLTAGE PROBE TO PREVENT CIRCUIT LOADING.
3. REFERENCE DESIGNATIONS ARE ASSIGNED IN THE FOLLOWING MANNER:

UNIT SERIES	=	RECEIVER
100 SERIES	=	TRANSMITTER
200 SERIES	=	VCO & SYNTHESIZER
300 SERIES	=	MISCELLANEOUS
400 SERIES	=	CONTROLLER FLEX
500 SERIES	=	DISPLAY BOARD
800 SERIES	=	SIGNALLING (CONTROLLER FLEX)

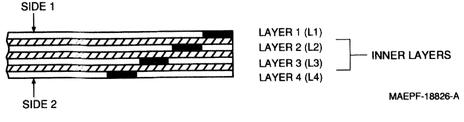
4. INTERCONNECT TIE POINT LEGEND:

- (A) B+ TO MOTHER BOARD
- (B) CONTROLLER FLEX B+
- (5V REG) REGULATED 5V
- (M1) METERING POINTS M1, M2, M3
- (M) TO MOTHER BOARD
- (R) RECEIVER 10V
- (R5) RECEIVER 5V
- (S) TO SYNTHESIZER BOARD
- (T) TRANSMIT 10V
- (T5) TRANSMIT 5V
- (T) TO CONTROL TOP FLEX
- (U) TO UNIVERSAL CONNECTOR
- (*) TO FRONT COVER
- (V1) REGULATED 8V

VOLTAGE OVERLAY AND WAVEFORM NOTES

1. AC VOLTAGE READINGS IN dBm ARE MADE VIA A 1pF CAPACITOR INTO THE 50 OHM ADAPTER OF AN RF mV METER. RX READINGS ARE MADE WITH -20dBm CARRIER SIGNAL INTO REMOTE RF PORT. TX READINGS MADE WITH REMOTE RF PORT INTO 50 OHMS.
2. AC VOLTAGE READINGS IN mV ARE MADE VIA A HIGH IMPEDANCE RF mV METER.
3. THIS READING IS OBTAINED BY SHORTING BASE OF Q102 TO GROUND. (Q102-B ON ALIGNMENT/ADJUSTMENT LOCATIONS DIAGRAM).
4. THIS READING IS OBTAINED BY SOLDERING A 47-OHM RESISTOR ACROSS L13 TO REDUCE 1ST L.O. INJECTION FEED THROUGH. (REFER TO ALIGNMENT/ADJUSTMENT LOCATIONS DIAGRAM)

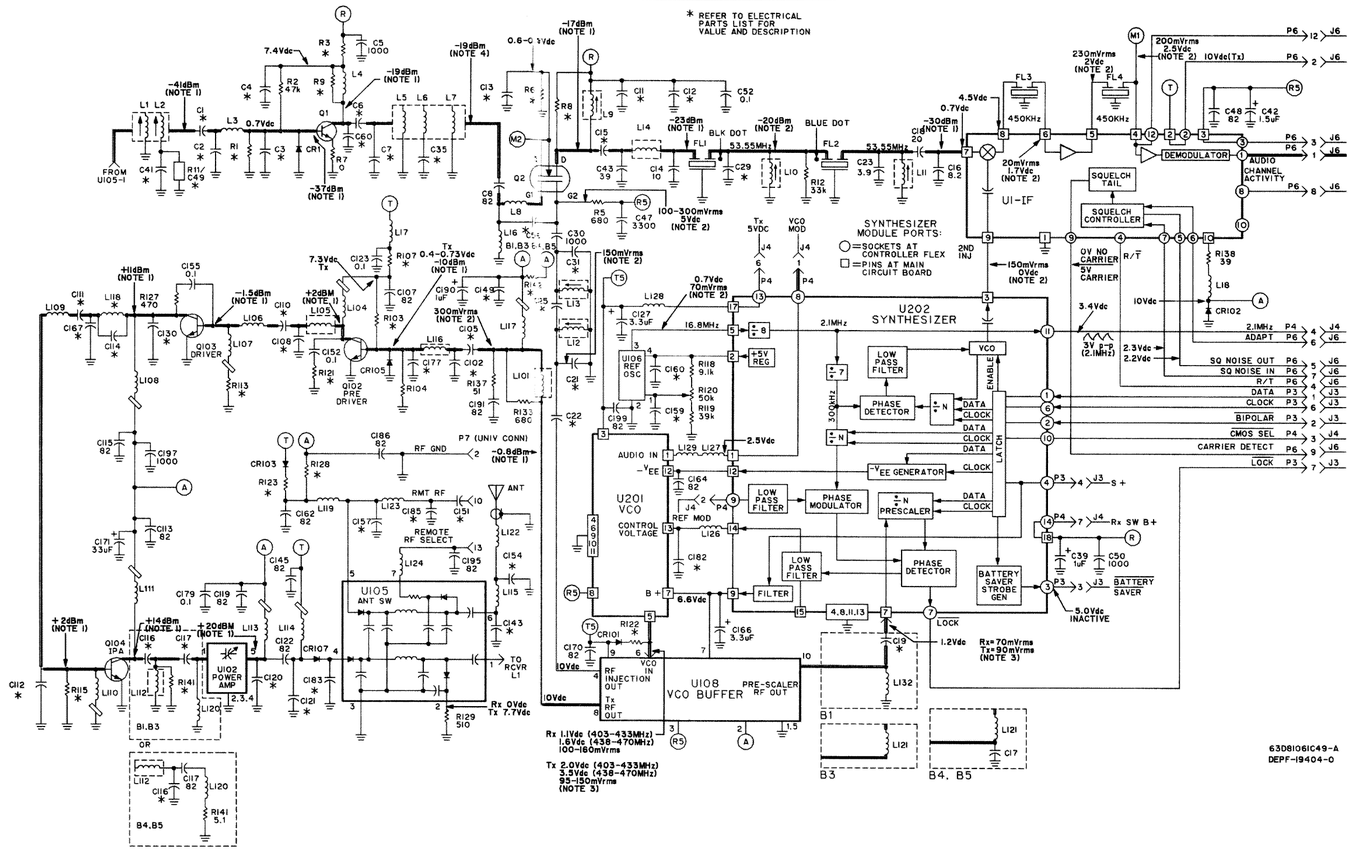
4-LAYER CIRCUIT BOARD DETAIL VIEWING
COPPER STEPS IN PROPER LAYER SEQUENCE.



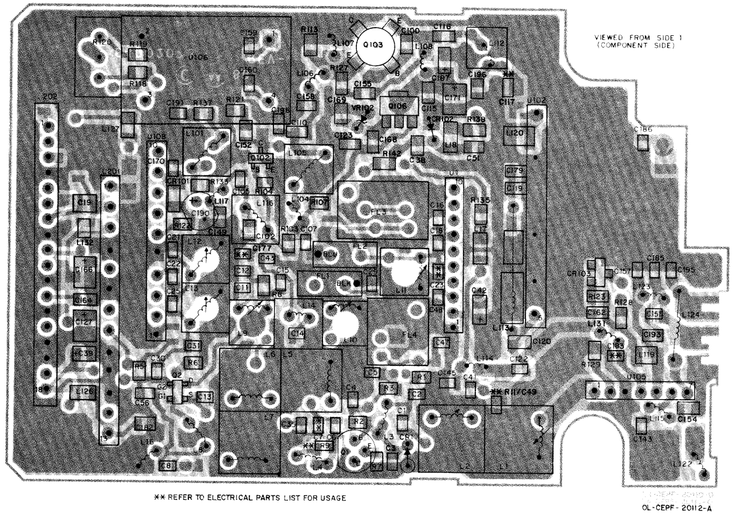
ITEM REVISIONS CHART

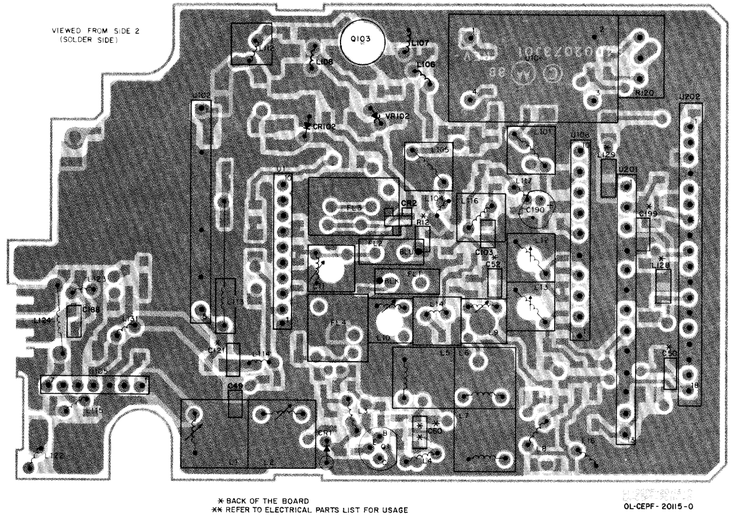
ITEM NO.	FREQ. (MHz)	POWER OUTPUT	SUFFIX
NUE6901B	403-433	4W	
NUE6902D	438-470	4W	
NUE6903A	470-500	4W	
NUE6904A	488-520	4W	

* REFER TO ELECTRICAL PARTS LIST FOR VALUE AND DESCRIPTION



2-WATT RADIOS





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- METERING POINTS M1, M2, M3
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- RECEIVER 10V
- RECEIVER 5V
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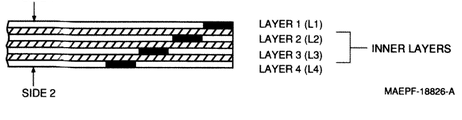
4. THIS READING IS OBTAINED BY SOLDERING A 47-OHM RESISTOR ACROSS L13 TO REDUCE 1ST L.O. INJECTION FEED THROUGH. (REFER TO ALIGNMENT/ADJUSTMENT LOCATIONS DIAGRAM)

4-LAYER CIRCUIT BOARD DETAIL VIEWING
COPPER STEPS IN PROPER LAYER SEQUENCE.



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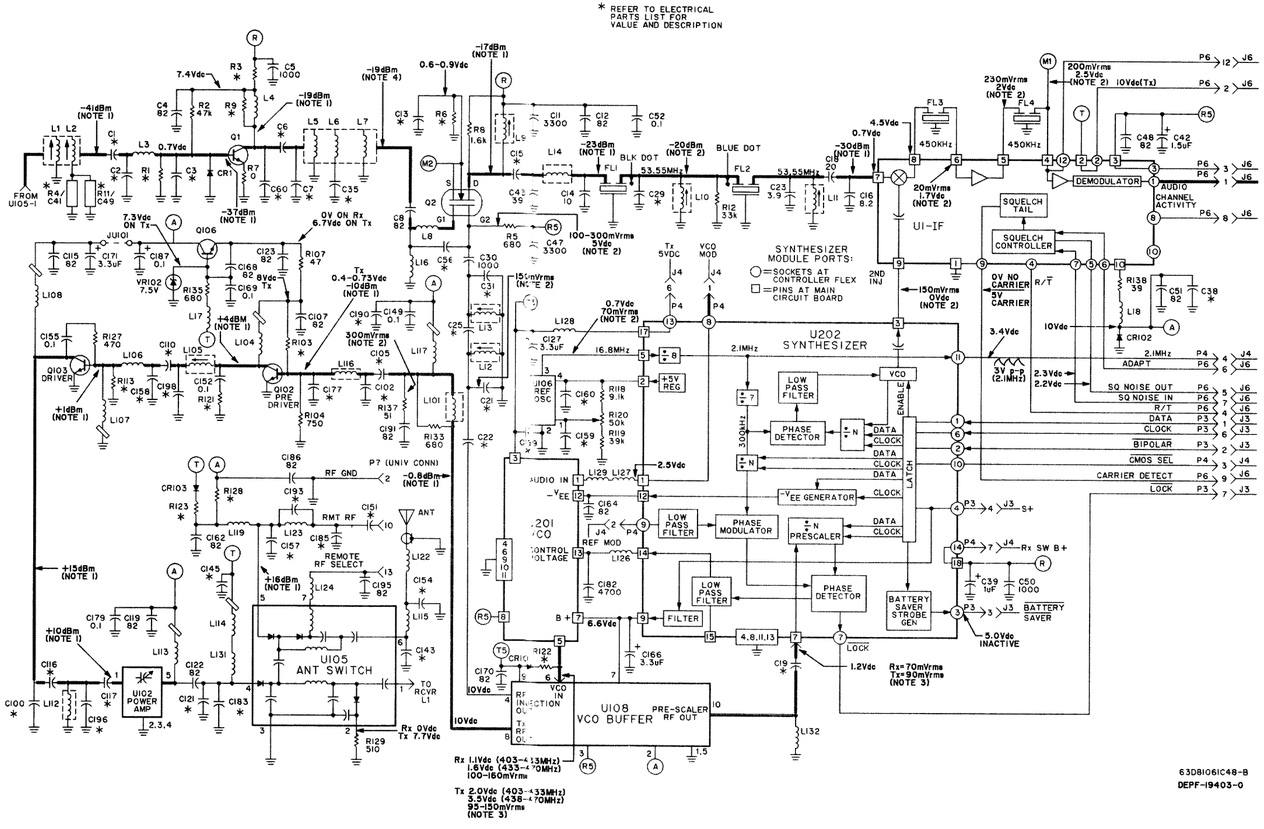


UHF 2-W, 4-LAYER TRANSCEIVER COMPONENT LOCATION DIAGRAMS AND SCHEMATIC DIAGRAM

Electrical Parts List, Transceiver Board

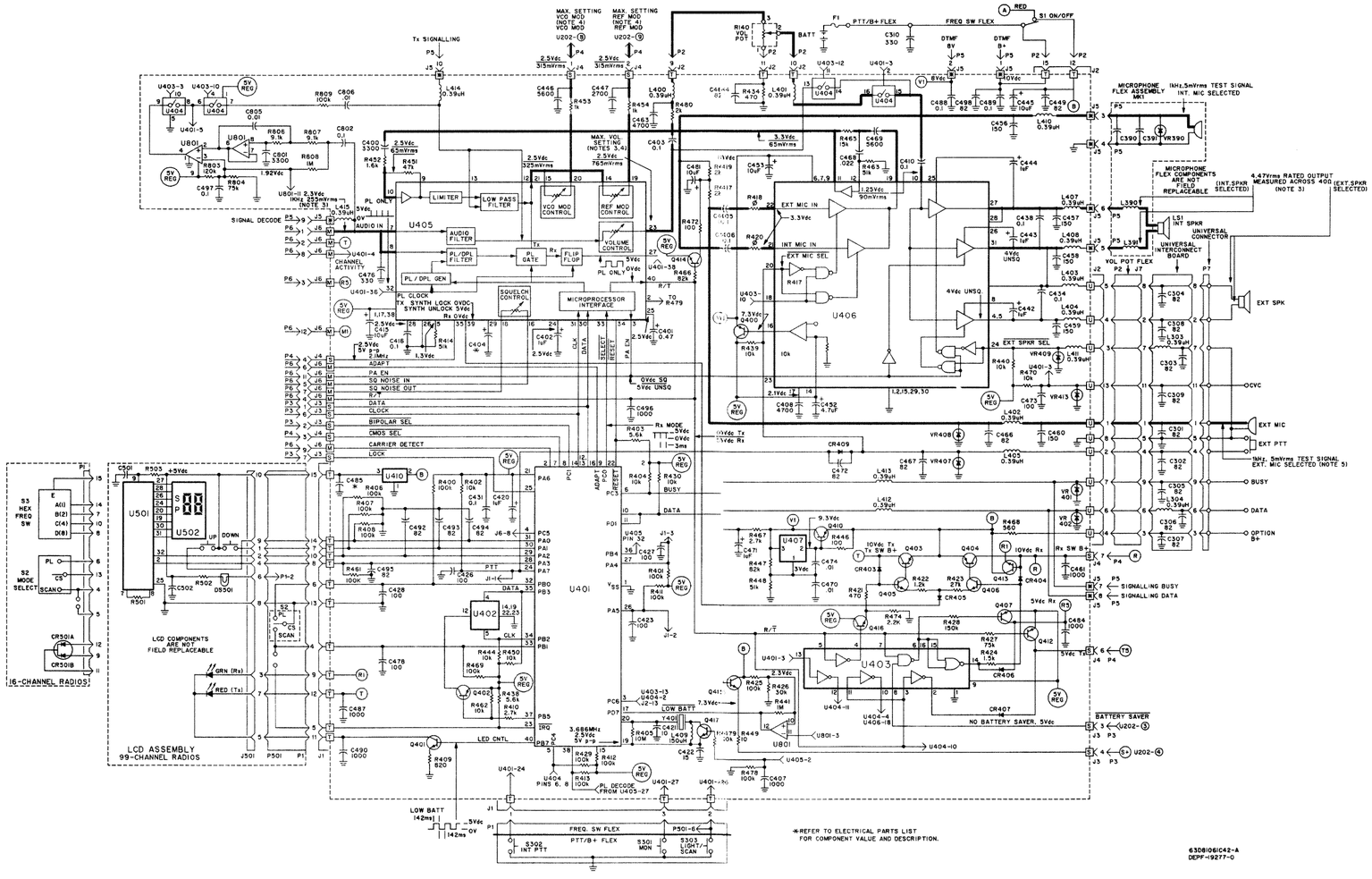
B1 = 403-433 MHz 2 - and 4 - Watt Radios
B3 = 438-470 MHz 2 - and 4 - Watt Radios
B4 = 470-500 MHz 4 - Watt Radios Only
B5 = 488-512 MHz 4 - Watt Radios Only **TPLF-3745-B**

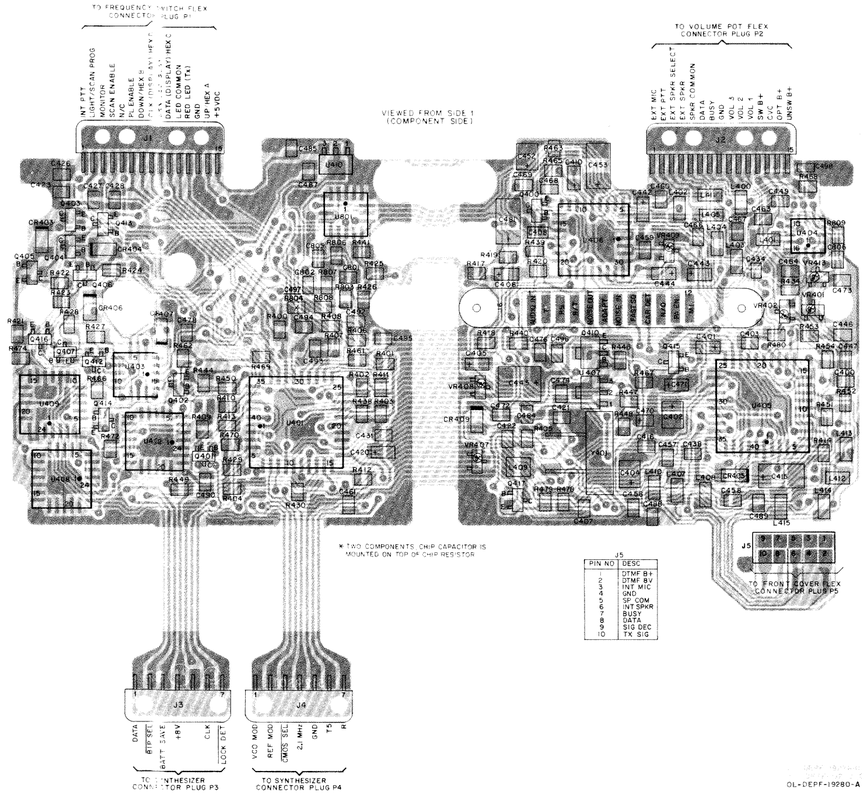
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF±5%; 50V unless stated
C1	2113740A33	15 (B1)
	or 2113740A23	6.2 ±0.25pF (B3)
	or 2113740A39	27.(B4)
	or 2113740A40	30 (B5)
C2	2113740A19	4.7 ±0.25pF (B1)
	or 2113740A13	2.7 ±0.25pF (B3)
	or 2113740A27	8.2 ±0.25 (B4)
	or 2113740A21	5.6 ±0.25 (B5)
C3	2113740A21	5.6 ±0.25pF (B1)
	or 2113740A29	10 ±0.25pF (B3 2W)
	or 2113740A28	9.1 ±0.25pF (B3 4W)
	or Not Used	(B4 and B5)
C4	2113740A53	82 (B1, B3, B4)
	or 2113740A43	39 (B5)
C5	2113741A21	1000
C6	2113740A17	3.9 ±0.25pF (B1, B3 4W)
	or 2113740A13	2.7 ±0.25 (B3 2W)
	or 2113740A10	2.0 ±0.25 (B4)
	or 2113740A14	3.0 ±0.25 (B5)
C7	2113740A07	1.5 ±0.25 (B1)
	or 2113740A19	4.7 ±0.25pF (B3 2W)
	or 2113740A23	6.2 ±0.25pF (B3 4W)
	or 2113740A03	1.0 ±0.25 (B4)
	or Not Used	(B5)
C8	2113740A53	82
C11	2113741A33	3300; 25V (B1, B3, B4)
	or 2113741A25	1500 (B5)
C12	2113740A53	82 (B1, B3, B4)
	or 2113741A25	1500 (B5)
C13	2113741A45	.01uF; 25V (B1)
	or 2113741A21	1000 (B3)
	or 2113741A43	8200 (B4)
	or 2160521G37	0.1uF (B5)
C14	2113740A29	10
C15	or 2113740A28	9.1 ±0.25 (B1, B3, B4)
	or 2113740A29	10 (B5)
C16	2113740A27	8.2 ±0.25pF
C17	2113740A32	13 (B5 only)
C18	2113740A36	20
C19	2113740A43	39 (B1 only)
C21	2113740A19	4.7 ±0.25pF (B1)
	or 2113740A29	10 (B3 2W)
	or 2113740A28	9.1 (B3 4W)
	or 2113740A27	8.2 ±0.25 (B4)
	or 2113740A30	11 (B5)
C22	2113740A10	2.0 ±0.25pF (B1)
	or 2113740A14	3.0 ±0.25pF (B3)
	or 2113740A05	1.2 ±0.25 (B4)
	or 2113740A16	3.6 ±0.25 (B5)
C23	2113740A17	3.9 ±0.25pF
C25	2113740A21	5.6 ±0.25pF (B1)
	or 2113740A10	2.0 ±0.25pF (B3)
	or 2113740A09	1.8 ±0.25pF (B4, B5)
C29	2113740A18	4.3 ±0.25pF (B1, B3)
	or 2113740A16	3.6 ±0.25pF (B4, B5)
C30	2113741A21	1000
C31	2113740A16	3.6 ±0.25pF (B1)
	or 2113740A13	2.7 ±0.25 (B3 2W)
	or 2113740A17	3.9 ±0.25pF (B3 4W)
	or 2113740A15	3.3 ±0.25 (B4)
	or 2113740A19	4.7 ±0.25 (B5)
C35	2113740A31	12 (B1)
	or 2113740A40	30 (B3)
	or 2113740A28	9.1 ±0.25 (B4)
	or 2113740A33	15 (B5)
C38	2113741A53	82 (B1 2W Only)
	or 2113741A21	1000 (B3 2W Only)
C39	2311049A37	1.0uF; 16V
C41	2113740A53	82 (B4, B5)
C42	2360562A16	1.5uF;10V
C43	2113740A43	39
C47	2113741A33	3300; 25V
C48	2113740A53	82
C49	Not Used	(B1)
	or 2113740B37	33 (B3 2W)
	or 2113740A34	24 (B3 4W, B4, B5)
C50	2113741B73	1000
C51	2113741A53	82 (B1 2W Only, B3 2W Only)
C52	2113741B69	0.1uF(B1 2W, B3 2W)
	or 2111032B13	0.1uF (B1 4W, B3 4W, B4, B5)
C56	2113740A03	1.0 ±0.25pF (B1, B3 2W, B5)
	or 2113740A10	2.0 ±0.25pF (B3 4W)
	or 2113740A07	1.5 ±0.25 (B4)
C60	2113740A01	1.0 ±0.25 (B1, B3)
	or 2113740B07	1.8 ±0.25pF (B4)
	or Not Used	(B5)
C100	2113740A09	1.8 ±0.25pF (B3 2W Only)
C102	2113740A33	15 (B1 2W)
	or 2113740A32	13 (B1 4W)
	or 2113740A19	4.7 (B4)
	or 2113740A27	8.2 ±0.25 (B5)
C105	2113740A53	82 (B1 2W, B4, B5)
	or 2113740A38	24 (B1 4W)
	or 2113740A27	8.2 (B3 2W)
	or 2113740A35	18 (B3 4W)
C107	2113740A53	82
C108	2113740A24	6.8 ±0.25pF (B1 4W Only)
	or 2113740A36	20 (B3 4W Only)
	or 2113740A33	15 (B4)
	or 2113740A28	9.1 (B5)
C110	2113740A18	4.3 (B1 2W)
	or 2113740A53	82 (B1 4W)
	or 2113740A33	15 (B3 2W)
	or 2113740A37	22 (B3 4W)
	or 2113740A39	27 (B4)
	or 2113740A48	51 (B5)
C111	2113740A42	36 (B1 4W Only)
	or 2113740A29	10 (B3 4W Only)
	or 2113740A24	6.8 ±0.25 (B4)
	or 2113740A53	82 (B5)
C112	2113740A36	20 (B1 4W, B3 4W,B4)
	or 2113740A31	12 (B5)
C113	2113740A53	82 (4W Only)
C114	2105454G02	11(B5 Only)
C115	2113740A53	82
C116	2113740A32	13 (B1)
	or 2113740A43	39 (B3 2W)
	or 2113740A28	9.1 (B3 4W)
	or 2113740A30	11(B4)
	or 2113740A17	3.9 ±0.25 pF (B5)
C117	2105454B47	82 (B1 2W, B3 2W)
	or 2113740A53	82 (B1 4W, B3 4W, B4, B5)
C119	2113740A53	82
C120	2113740A16	3.6 ±0.25pF (B3, 4W Only)
	or 2113740A15	3.3 ±0.25 (B4 Only)
C121	2111031A62	4.7 ±0.25pF (B4 Only)
	or 2113740A21	5.6 ±0.25pF (B5 Only)
C122	2113740A53	82
C123	2113740A53	82 (2W)
	or 2160521G37	0.1 (4W)
C127	2360562A24	3.3uF; 16V
C130	2113740A12	2.4 ±0.25pF (B1, 4W Only)
	or 2113740A16	3.6 ±0.25pF (B3 4W Only, B4 Only)
C143	2113740A23	6.2 ±0.25pF (B1 2W)
	or 2113740A16	3.6 ±0.25pF (B1 4W)
	or 2113740A20	5.1pF ±0.25pF (B3)
	or 2113740A24	6.8 ±0.25pF (B4)
	or 2113740A15	3.3 ±0.25pF (B5)
C145	Not Used	(B1 2W, B3 2W)
	or 2113740A53	82 (B1 4W, B3B4,B5)
C149	2160521G37	0.1uF+80-20% (B1 2W, B3 2W, B4)
	or 2113740A53	82 (B1 4W, B3 4W, B5)
C151	2113740A53	82 (B1, B3, B4)
	or 2113740A42	36 (B5)
C152	2160521G37	0.1uF+80-20%
C154	2113740A19	4.7 ±0.25pF (B1 4W)
	or 2113740A03	1.0 ±0.25pF (B1 2W, B3)
	or Not used	(B4, B5)
C155	2160521G37	0.1uF+80-20%
C157	2113740A27	8.2 ±0.25pF (B1 2W)
	or 2113740A17	3.9 ±0.25pF (B1 4W)
	or 2113740A12	2.4 ±0.25pF (B3 4W)
	or 2113740A03	1.0 ±0.25 (B4 B5)
C158	2113740A21	5.6 ±0.25pF (B1 2W Only)
	or 2113740A31	12 (B3 2W Only)
C159,160	2113740A53	82 (B1 2W, B3 2W,B4,B5)
	or Not Used	(B1 4W, B3 4W)
C162	2113740A53	82
C164	2113740A53	82
C166	2360562A24	3.3uF ±20%; 16V
C167	2113740A32	13 ±0.25pF (B1 4W Only)
	or 2113740A29	10 ±0.25pF (B3 4W Only, B4)
	or 2113740A12	2.4 ±0.25pF (B5)
C168	2113740A53	82 (B1 2W Only, B3 2W Only)
C169	2160521G37	0.1uF+80-20%(B1 2W Only
	2113740A53	82 (B3 2W Only)
C170	2113740A53	82
C171	2360562A24	3.3uF
C177	2113740A29	10 ±0.25pF (B3 2W)
	or 2113740A03	1.0 ±0.25pF (B3 4W, B4)
	or 2113740A12	2.4 ±0.25pF (B5)
C179	2160521G37	0.1uF+80-20%
C182	2113741A37	4700 ±10%;25V (B1, B3 2W, B4)
	or Not Used	(B3 4W)
C183	or 2113741A21	1000 (B5)
	2113740A24	6.8 ±0.25pF (B1 2W)
	or 2113740A28	9.1 ±0.25pF (B1 4W)
	or 2113740A16	3.6 ±0.25pF (B3 2W)
	or 2113740A11	2.2 ±0.25pF (B3 4W)
	or 2113740A04	1.1 ±0.25pF (B4)
	or Not used	(B5)
C185	2113740A17	3.9 ±0.25pF (B1 2W)
	or 2113740A20	5.1 ±0.25pF (B1 4W)
	or 2113740A15	3.3 ±0.25pF (B3)
	or 2113740A03	1.0 ±0.25 (B4)
	or 2113740A07	1.5 ±0.25 (B5)
C186	2113740A53	82
C187	2160521G37	0.1uF ±20%;35V (B1 2W Only, B3 2W Only)
C190	2305499G13	1uF±20%; 25V
C191	2113740A53	82
C193	2113740A03	1.0 ±0.25pF (B3 2W Only)
C195	2113740A53	82
C196	2113740A27	8.2 ±0.25pF (B1 2W Only)
	or 2113740A16	3.6 ±0.25pF (B3 2W Only)
C197	2113741A21	1000 (B1 4WOnly, B3 4W Only, B4, B5)
C198	2113740A03	1.0 (B1 2W Only)
	or 2113740A21	5.6 (B3 2W Only)
C199	2113740B47	82 (B1, B3 4W, B4, B5)
	or 2113740B44	62pF (B3 2W)
C300 thru 304	2113740A53	82
C305,306	2113740A49	56
C307,308	2113740A53	82
C309	2105454G38	33
C310	2113741A45	.01uF
		DIODE: See Note
CR1	4883654H08	Silicon
CR101	4805494Q04	Silicon
CR102	4805490G02	Silicon
CR103	4805129M24	Silicon
CR105	4805119G14	Silicon (4W Only)
CR301A/B	4805729G24	Led, Bicolor
		FUSE:
F1	6505214E02	5-Amp.
		FILTER:
FL1, FL2	4805245J20	Crystal, 53.55 MHz
FL3	9105725Q02	Ceramic, 450 KHz
FL4	9105726Q01	Ceramic, 450 KHz
		COILS:
L1, 2	0105951P30	ASSEMBLY, Preselector; 2-pole (B1)
	or 0105957M23	ASSEMBLY, Preselector; 2-pole (B3)
	or 0102702J62	ASSEMBLY, Preselector, 2-Pole (B4)
	or 0102702J63	ASSEMBLY, Preselector, 2-Pole (B5)
L3	2405559P18	3-1/2 turns, airwound (B1)
	or 2484238H02	1-1/2 turns (B3)
	or 2405027E38	3-1/2 turns, airwound (B4, B5)
L4	2405559P03	1-1/2 turns, airwound (B1, B3)
	or 2405027E38	3-1/2 turns, airwound (B4, B5)
L5	2405732J22	11 -3/4 turns, Preselector (B1)
	or 2405732J21	10 -3/4 turns, Preselector (B3)
	or 2405732J08	10 turns, Preselector (B4, B5)
L6	2405732J10	12 turns, Preselector (B1)
	or 2405732J01	11 turns, Preselector (B3)
	or 2405732J06	10-1/2 turns, Preselector (B4)
	or 2405732J23	10-1/4 turns, Preselector (B5)
L7	2405732J22	11-3/4 turns, Preselector (B1)
	or 2405732J01	11 turns, Preselector (B3)
	or 2405732J23	10-1/4 turns, Preselector (B4)
	or 2405732J08	10 turns, Preselector (B5)
L8	2405559P22	4 - 1/2 turns, airwound (B1)
	or 2405559P12	4 - 1/2 turns, airwound (B3 2W)
	or 2405027E19	5 - 1/2 turns, airwound (B3 4W, B4, B5)
L9	2405063H24	13 turns, space wound
L10	2405063H13	1.2 uH , tunable
L11	2405063H05	0.4 uH , tunable
L12,13	2405523P39	2 -1/2 turns, spacewound; with core (B1)
	or 2405523P48	1-1/2 turns, spacewound; with core (B3, B4, B5)
L14	2505129Q02	1.2 uH Choke
L16	2405027E19	Coil, RF (B1)
	or 2405559P19	4-1/2 turns, airwound (B3)
	or 2405559P18	3-1/2 turns, airwound (B4)
	or 2405027E38	3-1/2 turns, airwound (B5)
L17,18	2462575A01	0.39uH Choke
L101	2405559P07	2 -1/2 turns, airwound (B1)
	or 2405559P14	3 -1/2 turns, spacewound (B3 2W)
	or 2484238H02	1-1/2 turns, fixed (B3 4W)
	or 2405523P06	1-1/2 turns, spacewound (B4, B5)
L104	0105951N35	Assembly, 0.085 uH Choke, with bead (B1, B3 4W, B4, B5)
	or 0105950L78	Assembly, 1.2 uH Choke, with bead (B3 2W)
L105	2405523P08	3 -1/2 turns, spacewound (B1 2W)
	or 2484238H02	2-1/2 turns, spacewound (B1 4W, B3 4W)
	or 2405559P07	2-1/2 turns, spacewound (B3 2W)
	or 2405523P07	1-1/2 turns, fixed (B4, B5)
L106	2405559P18	3 -1/2 turns, airwound (B1 2W)
	or 2405027E38	3 -1/2 turns (B1 4W, B3 4W, B4)
	or 2405027E21	2 -1/2 turns (B3 2W, B5)
L107	0105950L78	Assembly,1.2uH Choke with bead (B1, B4, B5)
	or 0105951N35	Assembly, .085 uH Choke, with bead (B3)
L108	0105951N35	Assembly, .085uH Choke, with bead
L109	2405027E21	2 -1/2 turns airwound (B1 4W Only, B5)
	or 2405027E38	3 -1/2 turns airwound (B3 4W Only, B4)
L110	0105951N34	Assembly,0.29 uH Choke, with bead (B1 4W Only, B5)
	or 0105950L78	Assembly, 1.2uh, with bead (B3 4W Only, B4)
L111	0105951N35	Assembly, .085 uH Choke, with bead (B1 4W Only, B3 4W Only, B4, B5)
L112	2405027E19	Coil, RF (B1 2W)
	or 2405027E38	3 -1/2 turns (B1 4W)
	or 2405059P19	4 -1/2 turns airwound (B3, 2W)
	or 2405027E21	2-1/2 turns airwound (B3 4W, B4, B5)
L113	0105955N19	Assembly, 0.2 uH Choke, with bead (B1 2W, B3 2W)
	or 0105952N08	Assembly, 0.15uH Choke, with bead (B1 4W, B3 4W)
	or 0102702J40	Assembly, 0.085uH, with Bead (B5)
L114	0105951N34	Assembly, 0.29uH Choke, with bead (B1, B3 4W, B4, B5)
	or 0105951N35	Assembly, .085uH Choke, with Bead (B3 2W)
L115	2405559P18	3-1/2 turns, air wound (B1 2W)
	or 2405207E38	3-1/2 turns, fixed (B1 4W)
	or 2405559P19	4-1/2 turns, airwound (B3, B4, B5)
L116	2484238H02	1 -1/2 turns (B1 2W, B3)
	or 2405559P03	1-1/2 turns, airwound (B1 4W)
	or 2405559P09	1-1/2 turns, airwound (B4)
	or 2405027E38	3-1/2 turns, airwound (B5)
L117	0105951N34	Assembly, 0.29 uH, with bead (B1, B3 4W, B4, B5)
	or 0105951N35	Assembly, .085 uH, with bead (B3 2W
L118	2405027E38	3 -1/2 turns airwound (4W Only)
L119	2405452C08	275 nH choke
L120	2405452C08	275 nH chip (B1, 4W Only, B4, B5)
L121	2405452C09	50nH choke (B3 Only)
	or 2405452C06	21 nH choke (B4 Only, B5 Only)
L122	2405559P19	4 -1/2 turns, airwound (B1 2W)
	or 2405559P18	3 - 1/2 turns airwound (B1 4W, B3 2W)
	or 2405027E21	2-1/2 turns airwound (B3 4W, B4)
	or 2405559P14	3-1/2 turns, airwound (b5)
L123	2405559P18	3-1/2 turns (B1 2W, B5)
	or 2405027E38	3 -1/2 turns (B1 4W, B3 2WB4)
	or 2405559P14	3 -1/2 turns airwound (B3 4W)
L124	2482723H28	0.29 uH Choke
L126,127	2462575A01	0.39 uH Choke
L128	2462575A01	0.39 uH (B1 2W, B3 2W, B4, B5)
	or 2462575A03	0.82 uH Choke (B1 4W)
	or 2462575A04	1 uH Choke (B3 4W)
L129	2462575A03	0.82 uH Choke (B1)
	or 2462575A01	0.39 uH Choke (B3 2W, B4, B5)
	or 2462575A04	Choke (B3, 4W)
L131	2405027E38	3 -1/2 turns airwound (B1 2W B3 2W, B4) or
	or 2405027E21	2-1/2 turns airwound (B1 4W, B3 4W, B5)
L132	2405452C06	21 nH Choke (B1 Only)
L303, 304	2462575A01	0.39 uH Choke
LS1	5005155Q03	**TRANSDUCER:**
MK1	0105956M62	**MICROPHONE ASSEMBLY:**
		PLUG:
P1, P2	2805466R01	Connector, Flex Top; 15-pin
P3, 4	2805144Q01	Connector, Synthesizer; 7-pin
P5	2805250Q02	Connector, Front Cover
P6	2805247Q01	Connector, I-F
P7	------	Not field repairable, order Top Control Panel Assembly 0105958N64
		TRANSISTOR: See Note
Q1	4880182D39	NPN
Q2	4805452G13	Dual Gate MOSFET
Q102	4805128M84	NPN
Q103	4805474G48	NPN (2W)
	or 4805474G38	NPN (4W)
Q104	4808869887	NPN (B1 4W Only, B3 4W Only)
	or 4880225C09	NPN (B4, B5)
Q106	4805128M09	NPN (2W Only)
		RESISTOR, Fixed: Ω±5%;1/10W unless specified
R1	0660076A71	8.2k (B1, B4, B5)
	or 0660076A69	6.8k (B3)
R2	0660076A89	47k
R3	0660076A59	2.7k (B1, B4, B5)
	or 0660076A57	2.2k (B3)
R4	0660076M01	0 (B1 Only, B3 Only)
R5	0660076A45	680
R6	0660076A35	270 (B1)
	or 0660076A39	390 (B3, B4)
	or 0660076A34	240 (B5)
R7	0660076M01	0
R8	0660076A54	1.6k (B1, B3)
	or 0660076A71	8.2k (B4)
	or 0660076A56	2k (B5)
R9	0660076A56	2k (B1)
	or 0660076A57	2.2k (B3)
	or 0660076A49	1k (B4 Only)
R11	0660076M01	o (B3 4W Only)
R12	0660076A85	33k
R103	0660076A65	4.7k (B1 2W)
	or 0660076A64	4.3k (B3, B1 4W)
	or 0660076A73	10k (B4)
	or 0660076A59	2.7k (B5)
R104	0660076A46	750 (B1 4W, B3 4W)
R107	0660076A17	47 (B1 2W, B3 2W)
	or 0660076A29	150 (B1 4W, B3 4W, B4)
	or 0660076A31	180 (B5)
R113	0660076A22	75 (B1 2W)
	or 0660076A25	100 (B3 2W)
	or 0660076M01	0 (B1 4W, B3 4W, B4)
	or 0660076A18	51 (B5)
R115	0660076A22	68 (B1, 4W Only, B5)
	or 0660076A25	100 (B3, 4W Only)
	or 0660076A21	75 (B4)
R118	0660076A72	9.1k
R119	0660076A87	39k
R120	1805559S02	Pot., 50k
R121	0660076A49	1k (B1 2W,B3 2W)
	or 0660076A39	390 (B1 4W, B3 4W)
	or 0660076A41	470 (B4, B5)
R122	0660076A79	18k (B1)
	or 0660076A67	5.6k (B3 2W)
	or 0660076A63	3.9k (B3 4W)
	or 0660076A64	4.3k (B4, B5)
R123	0660076A48	910 (B1, B4, B5)
	or 0660076A49	1k (B3)
R127	0660076A41	470
R128	0660076A52	1.3k (B1, B4, B5)
	or 0660076A51	1.2k (B3)
R129	0660076A42	510
R133	0660076A45	680
R135	0660076A45	680 (2W Only)
R137	0660076A18	51
R138	0660076A15	39
R140	1805100Q04	Pot., 25k
R141	0660076M01	0 (B1 4W Only)
	or 0660076L18	5.1 (B4, B5)
R142	0660076A18	51 (B4, B5)
S1	------	**SWITCH:** On/Off, Part of R140
S2	4005265Q02	16-position, BCD
S3	4005101Q02	Toggle, PL Disable / Scan
S301	3905834K06	Snap Dome, Monitor
S302	3905834K06	Snap Dome, PTT
S303	3905834K06	Snap Dome, Light / Scan
		CIRCUIT MODULE: See Note
U1	5102001J08	I-F
U102	5105729E79	2-Watt PA (B1 2W)
	or 5105729E81	4-Watt PA (B1 4W)
	or 5105729E80	2-Watt PA (B3 2W)
	or 5105729E82	4-Watt PA (B3 4W)
	or 5105822P68	4-Watt PA (B4)
	or 5105822P69	4-Watt PA (B5)
U105	5105822P85	Antenna Switch (B1 2W)
	or 5105729E75	Antenna Switch (B1 4W)
	or 5105822P63	Antenna Switch (B3 2W)
	or 5102001J19	Antenna Switch (B3 4W)
	or 5105729E77	Antenna Switch (B4)
	or 5105729E78	Antenna Switch (B5)
U106	5105729E52	Ref. Oscillator, 5-PPM
U108	5102001J05	Buffer (B1)
	or 5102001J02	Buffer (B3)
	or 5105822P90	Buffer (B4)
	or 5105822P91	Buffer (B5)
U201	5105822P54	VCO (B1)
	or 5102001J45	VCO (B3)
	or 5105822P57	VCO (B4)
	or 5105822P58	VCO (B5)
U202	5105822P84	Synthesizer (B1)
	or 5105822P75	Synthesizer (B3, B4, B5)
		DIODE: See Note
VR102	4805189E05	Zener, 7.5V (2W Only)

NONREFERENCED ITEMS

		ASSEMBLY, Preselector Can; for L5, L6, L7
	0102706J48	(B1)
	or 0102702J47	(B3)
	or 0102702J38	(B4)
	or 0102702J39	(B5)
	0705196A04	BOOT, for FL1, FL2
	0705766R01	SUPPORT, Rubber
	2605524P01	CAN, for L14, L112, L116
	2605567S01	HEAT SINK, for Q104
	3905509R02	CONTACT
	7505695R01	PAD, for U106
	7505295 B07	PAD, for FL1, FL2

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





VHF AND UHF CONTROLLER FLEX SCHEMATIC DIAGRAM, COMPONENT LOCATION DIAGRAM, AND LCD ASSEMBLY

Electrical Parts List
VHF and UHF Controller Flex
NTN4892C Rotary Radios
NTN4893C Display Radios

TPLF-3746-A

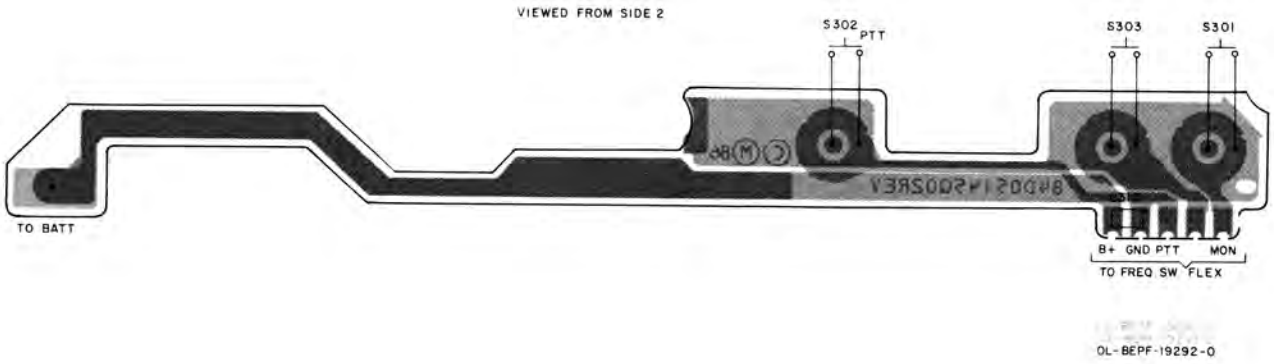
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Capacitor, Fixed: pF±5%; 50V unless stated
C400	2113741A33	3300
C401	2311049A35	0.47uF; 25V
C402	2311049A37	1uF; 16V
C403	2160521G37	0.1uF +80-20%
C404	2311049J12	4.7uF; 10V (NTN4892C)
	or 2362998C70	6.8uF; 7V (NTN4893C)
C405,406	2111032B13	0.1uF +80–20%
C407	2113741A21	1000
C408	2113741A37	4700
C410	2111032B13	0.1uF +80–20%
C415	2311049J26	10uF; 16V
C416	2160521G37	0.1uF +80-20%
C420	2311049A37	1uF; 16V
C421	2113740A29	10
C422	2113740A33	15
C423	2113740A55	100
C424	----------	Not Used
C426, 427, 428	2113740A55	100
C431	2160521G37	0.1uF +80-20%
C434	2160521G37	0.1uF +80-20%
C438	2160521G37	0.1uF +80-20%
C442, 443, 444	2311049A37	1 uF; 16V
C445	2360562A35	10uF; 25V
C446	2113741A39	5600
C447	2113741A31	2700
C448	----------	Not Used
C449	2113740A53	82
C452	2311049J12	4.7uF; 10V
C453	2311049J26	10uF; 16V
C456 thru 460	2113740A59	150
C461	2113741A21	1000
C463	2113741A37	4700
C464	2113740A53	82
C466, 467	2113740A53	82
C468	2113741A53	.022uF
C469	2113741A39	5600
C470	2113741A45	.01uF
C471	2311049A37	1 uF; 16V
C472	2113740A53	82
C473	2113740A55	100
C474	2113741A45	.01uF
C476	2113740A67	330
C478	2113740A55	100
C481	2311049J26	10uF; 16V
C484	2113741A21	1000
C485	2113740A67	330; NTN4893C
C487	2113741A21	1000
C488, 489	2160521G37	0.1uF +80-20%
C490	2113741A21	1000
C492 thru 495	2113740A53	82
C496	2113741A21	1000
C497	2160521G37	0.1uF +80-20%
C498	2113740A53	82
C801	2113741A33	3300 ±10%
C802	2160521G37	0.1uF +80-20%
C805, 806	2113741A45	.01uF
		DIODE: See Note
CR403 thru 407	4805494Q04	Silicon
CR409	4805494Q04	Silicon
		JACK:
J1, 2	0905467R01	Connector, 15-pin
J3, 4	0905577P01	Connector, 7-pin
J5	0905504R01	Connector, 10-pin
J6	0105959M27	Header Assembly, 12-pin
		COIL, RF: unless stated
L400 thru 405	2462575A01	0.39uH Choke
L407, 408	2462575A01	0.39uH Choke
L409	2460590A02	150uH Choke
L410 thru 415	2462575A01	0.39uH Choke
		TRANSISTOR: See Note II
Q400	4802245J04	PNP
Q401	4805128M12	NPN
Q402 thru 404	4805128M94	PNP
Q405, 406	4805128M12	NPN
Q407	4805128M94	PNP
Q410	4805128M10	PNP
Q412	4805128M94	PNP
Q413	4805128M12	NPN
Q414	4805128M94	PNP
Q415, 416, 417	4805128M12	NPN
		RESISTOR, Fixed: Ω±5%;1/8W unless stated
R400, 401	0660076B01	100k
R402	0660076A73	10k
R403	0660076A67	5.6k
R404	0660076A73	10k
R405	0660076H49	10 Meg
R406, 407, 408	0660076B01	100k
R409	0660076A47	820
R410	0660076A59	2.7k
R411, 412, 413	0660076B01	100k
R414	0660076A90	51k
R417	0660076A56	2k
R418	0660076M01	0
R419	0660076A56	2k
R420	0660076M01	0
R421	0660076A41	470
R422	0660076A51	1.2k
R423	0660076A83	27k
R424	0660076A53	1.5k
R425	0660076F01	100k ±1%
R426	0660076E84	30k ±1%
R427	0660076A94	75k
R428	0660076B05	150k
R429	0660076B01	100k
R430	0660076A73	10k
R434	0660076A41	470
R438	0660076A67	5.6k
R439, 440	0660076A73	10k
R441	0660076B25	1 Meg
R444	0660076A73	10k
R446	0660076A25	100
R447	0660076E95	82k ±1%
R448	0660076E90	51k ±1%
R449	0660076A01	10
R450	0660076A73	10k
R451	0660076A89	47k
R452	0660076A54	1.6k
R453, 454	0660076A49	1k
R461	0660076B01	100k
R462	0660076A73	10k
R463	0660076A90	51k
R465	0660076A77	15k
R466	0660076A95	82k
R467	0660076A59	2.7k
R468	0660076A43	560
R469	0660076B01	100k
R470	0660076A73	10k
R472	0660076A25	100
R474	0660076A57	2.2k
R478	0660076B01	100k
R479	0660076A73	10k
R480	0660076A56	2k
R803	0660076F03	120k ±1%
R804	0660076E94	75k ±1%
R806, 807	0660076A72	9.1k
R808	0660076B25	1 Meg
R809	0660076B01	100k
		CIRCUIT MODULE: See Note I
U401	5105805P38	Microcomputer
U402	0105956M99	4K EEPROM; NTN4892C
	or 5102226J02	16K EEPROM; NTN4893C
U404	0105953F23	Analog Gate
U403	0105956M87	Hex Gate
U405	0102227J01	Audio Filter
U406	5105165R65	Audio PA
U407	5160880B01	5V Regulator, CMOS
U408, 409	----------	Not Used
U410	5160880B01	5V Regulator, CMOS
U801	0105950N67	Quad Op-Amp
		DIODE: See Note I
VR401, 402	4880140L09	Zener, 6.2V
VR407, 408, 409	4880140L09	Zener, 6.2V
VR413	4880140L09	Zener, 6.2V
		CRYSTAL: See Note II
Y401	4805664G33	3.6864 MHz

NOTES

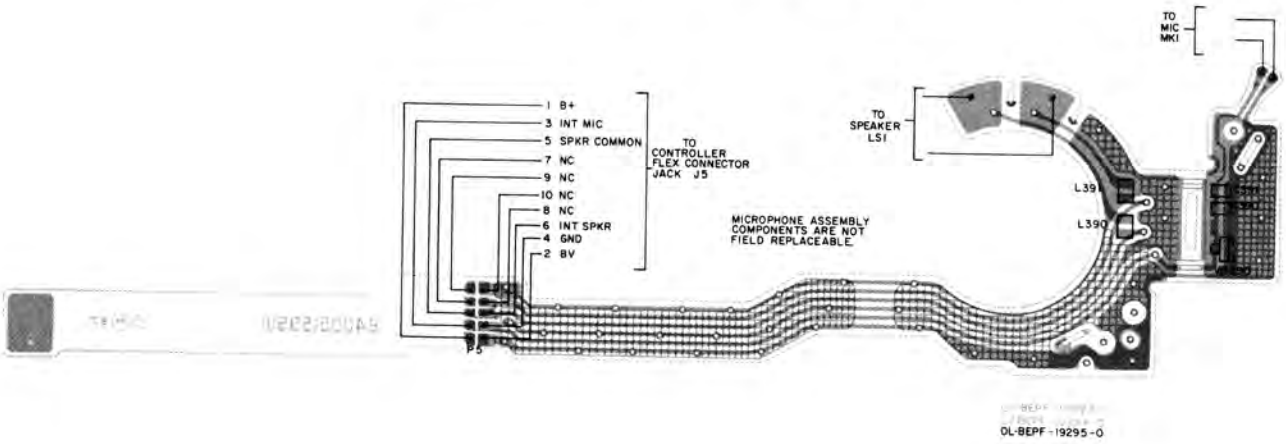
I. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.

II. When ordering crystal units, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.

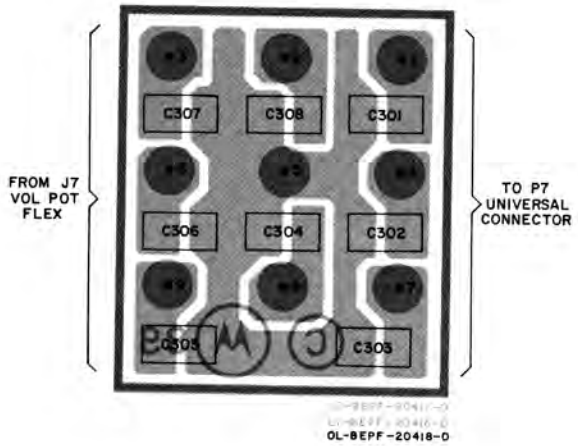
PTT/B+ FLEX



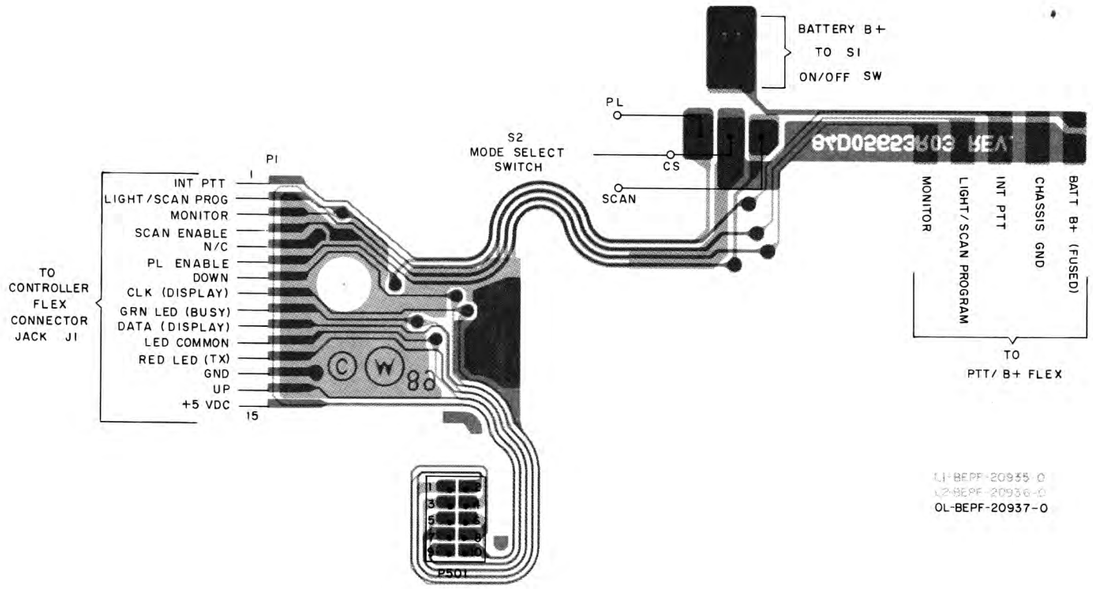
MICROPHONE FLEX ASSEMBLY MK1



UNIVERSAL INTERCONNECT BOARD

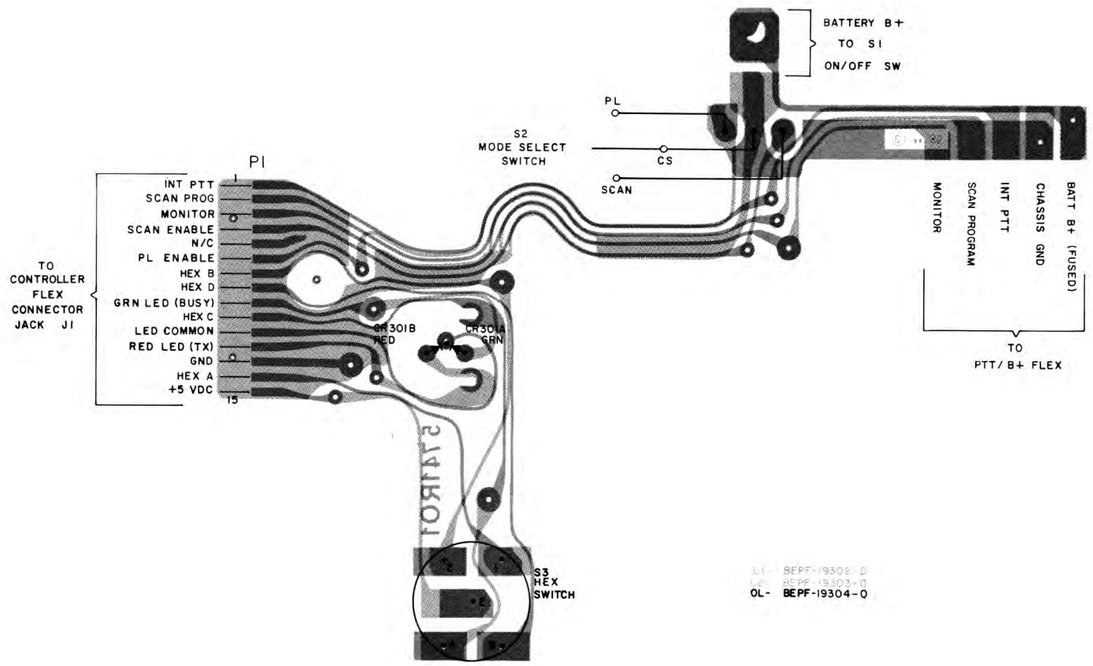


FREQUENCY SWITCH FLEX
DISPLAY RADIOS



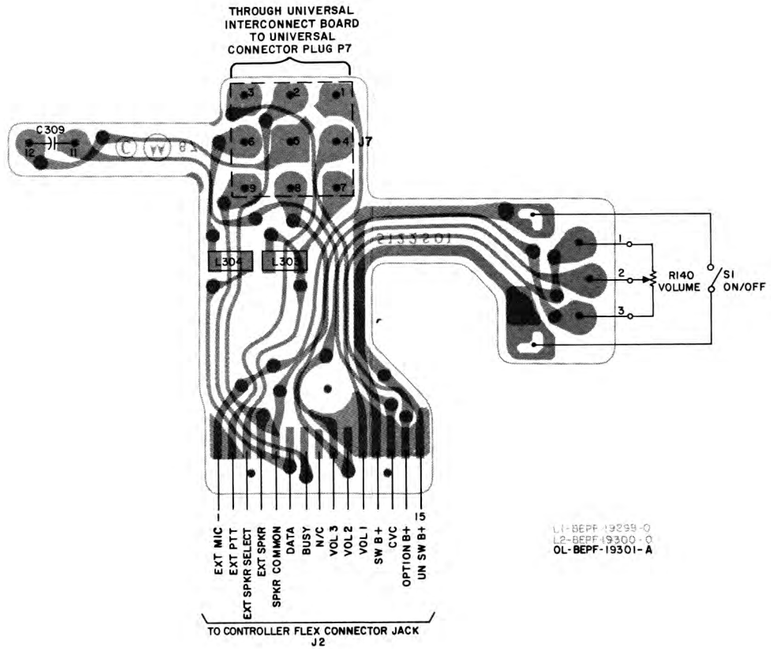
L1-BEPF-20935-0
L2-BEPF-20936-0
OL-BEPF-20937-0

FREQUENCY SWITCH FLEX
ROTARY RADIOS



L1- BEPF-19302-0
L2- BEPF-19303-0
OL- BEPF-19304-0

VOLUME POT FLEX

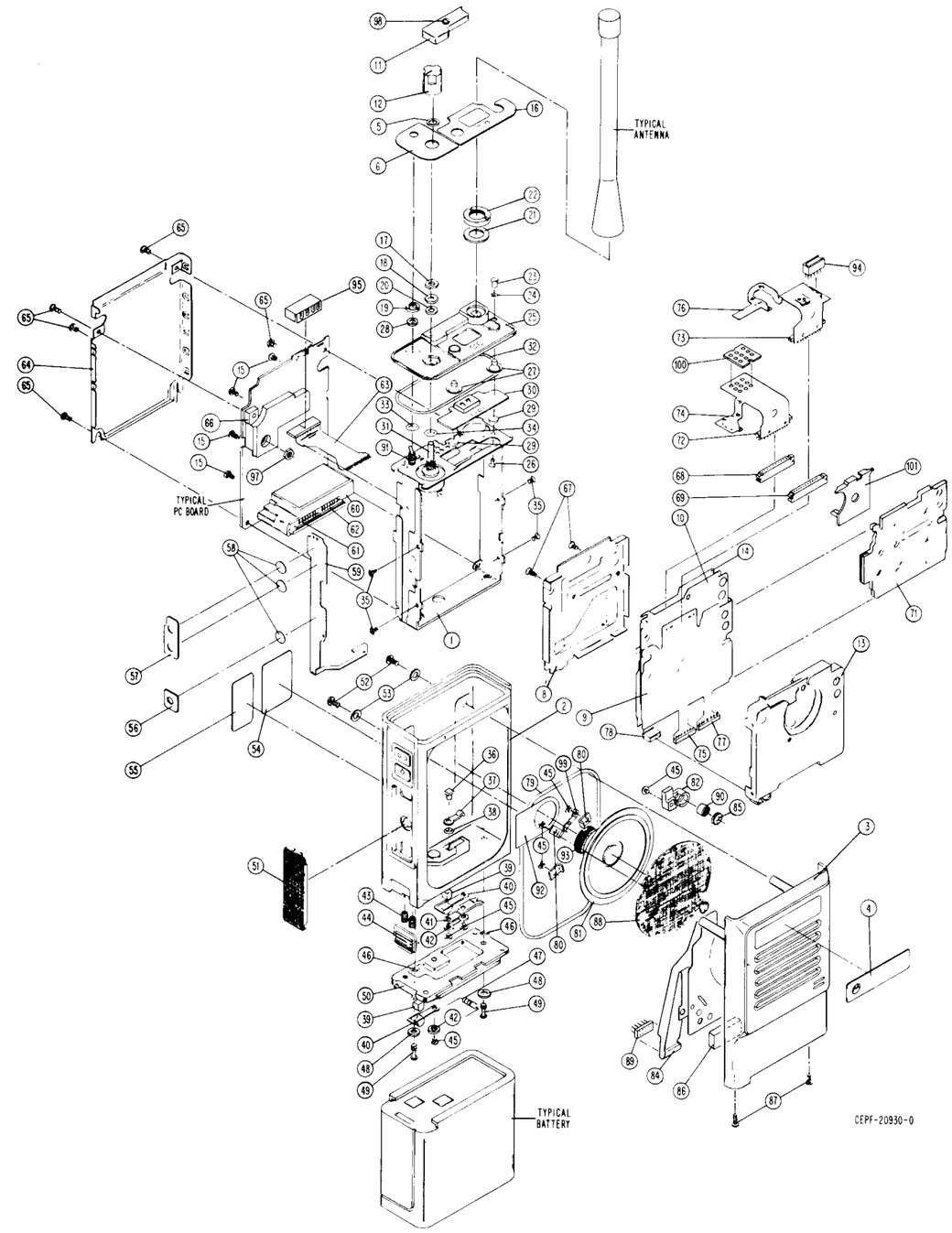


L1-BEPF-19299-0
L2-BEPF-19300-0
OL-BEPF-19301-A

Exploded View Parts List TPLF-3921-O
Lowband Display Radio

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0105958N57	ASSEMBLY, Frame
2	NHN6463A	KIT, Housing; includes items 36 thru 51
3	NTN4956A	KIT, Front Cover
4	NTN5098A	NAMEPLATE, Front
5	0405749R01	WASHER, Flat
6	1305564R01	ESCUTCHEON, ON/OFF Volume
7	NTN5717A	KIT, Controller Flex; includes items 8, 9, 10, 13, 14, 67, 68, 69, 75, 77, 78
8	0102708J43	ASSEMBLY, Shield Bottom
9	- - - - -	ASSEMBLY, Controller Flex; part of item 7
10	- - - - -	SHIELD, Center; Top Carrier Side; part of item 7
11	1505102S01	COVER, Dust
12	0102704J83	ASSEMBLY, Knob; VOLUME
13	1505765R02	CARRIER, Top; Controller Flex
14	- - - - -	SHIELD, Center; Bottom Carrier Side; part of item 7
15	0300136771	SCREW, Phillips; 2-56 x 3/16" (4 req'd)
16	1305563R01	ESCUTCHEON, Display
17	0405534R01	WASHER, Flat; Octagonal (Volume Pot)
18	0205629L01	NUT, Hex; Volume Pot
19	0205163Q01	NUT, Spanner; Mode Select Switch
20	0405162Q02	WASHER,Flat; Volume Pot
21	0405216L04	WASHER, Flat, Antenna
22	0205765L02	NUT, Spanner
23	0205562R01	NUT, Plate
24	3205556R02	SEAL, Nut Plate
25	See Note	ASSEMBLY, Control Top (P7)
26	0305573R01	SCREW,Phillips Hd.; 2-56 x 5/16"
27	3805558R02	ELASTOMER, Switch (2 req'd)
28	0405162Q01	WASHER, Flat
29	7505561R01	PAD, LCD (2 req'd)
30	0102700J15	ASSEMBLY, LCD
31	See Note	SWITCH / POT, On-Off / Volume (S1 / R140)
32	3205141Q02	GASKET, O-Ring; Control Top
33	3205141Q03	GASKET, O-Ring; Mode Select Switch
34	3205082E01	GASKET, O-Ring; Volume Pot
35	0300140369	SCREW, Flat Hd.; 2-56 x 1/8" (4 req'd)
36	4605945K05	CONTACT STUD, Battery
37	3905127Q01	CONTACT, B+
38	3205082E24	GASKET, O-Ring
39	0705830C02	SUPPORT, Contact (2 req'd)
40	3905421C07	CONTACT, Battery (2 req'd)
41	2905124Q01	LUG (2 req'd)
42	0400002625	LOCKWASHER, Split #2 (3 req'd)
43	4105944K01	SPRING, Battery Latch (2 req'd)
44	5505536P03	LATCH
45	0300139982	SCREW, Phillips; 2-56 x 5/32" (7 req'd)
46	3205082E03	GASKET, O-Ring (2 req'd)
47	See Note	FUSE (F1)
48	0400009761	LOCKWASHER, Split #4 (2 req'd)
49	0305941K01	SCREW, Captive 4-40 (2 req'd)
50	6405531P02	PLATE, Base
51	4505535P01	LEVER, PTT
52	0305137Q01	SCREW, Phillips 4-40 x 1/2" (2 req'd)
53	0484345A06	WASHER, Seal (2 req'd)
54	- - - - -	LABEL, FCC
55	- - - - -	LABEL, FM
56	3205231Q01	SEAL, Dome (PTT)
57	3205196Q01	SEAL, Dome (MON)
58	See Note	CONTACT, Snap Dome; (S301, S302, S303)
59	0105951N40	ASSEMBLY, B+ / PTT Flex; includes items 56, 57, 58
60	See Note	(FGU, U201)
61	See Note	PLUG (P3)
62	See Note	PLUG (P4)
63	See Note	FLEX, Connector (P/O of U1)
64	0102712J02	ASSEMBLY, Main Back Shield
65	0300136772	SCREW, Phillips Hd.; 2-56 x 5/16" (5 req'd)
66	2602240J01	HEATSINK
67	0300138620	SCREW, Phillips; 2-56 x 5/16" (2 req'd)
68	See Note	JACK (J2)
69	See Note	JACK (J1)
70	- - - - -	Not Used
71	1405264Q01	INSULATOR, Flex
72	See Note	PLUG (P2)
73	See Note	PLUG (P1)
74	0105958N56	ASSEMBLY, Volume Pot Flex
75	See Note	JACK (J3)
76	0105958N55	ASSEMBLY, Frequency Flex
77	See Note	JACK (J4)
78	See Note	JACK (J5)
79	3205141Q01	GASKET, O-Ring
80	4205140Q01	CLAMP, Speaker (3 req'd)
81	See Note	SPEAKER (LS1)
82	4202036J01	RETAINER, Microphone
83	- - - - -	Not Used
84	See Note	ASSEMBLY, Microphone Flex (MK1); includes item 90
85	7505564S01	PAD, Microphone Boot
86	7505501R03	PAD, Front Cover
87	0300140041	SCREW, Phillips; 2-56 x1/4" (2 req'd)
88	0105958N94	ASSEMBLY, Speaker Felt
89	See Note	PLUG (P5)
90	- - - - -	CARTRIDGE, Microphone; part of item 84
91	See Note	SWITCH (S3)
92	1405299Q01	INSULATOR, Speaker
93	7505501R02	PAD, Speaker
94	See Note	PLUG (P501)
95	0102712J38	ASSEMBLY, I-F Shield
96	- - - - -	Not Used
97	0200007007	NUT, Hex (for Q103)
98	0305103S01	SCREW, Captive
99	3905178S01	CONTACT, Grounding
100	0105958N56	ASSEMBLY, Universal Board
101	4205154S01	RETAINER, Flex Connector

NOTE: Refer to Electrical Parts List for part number and description.

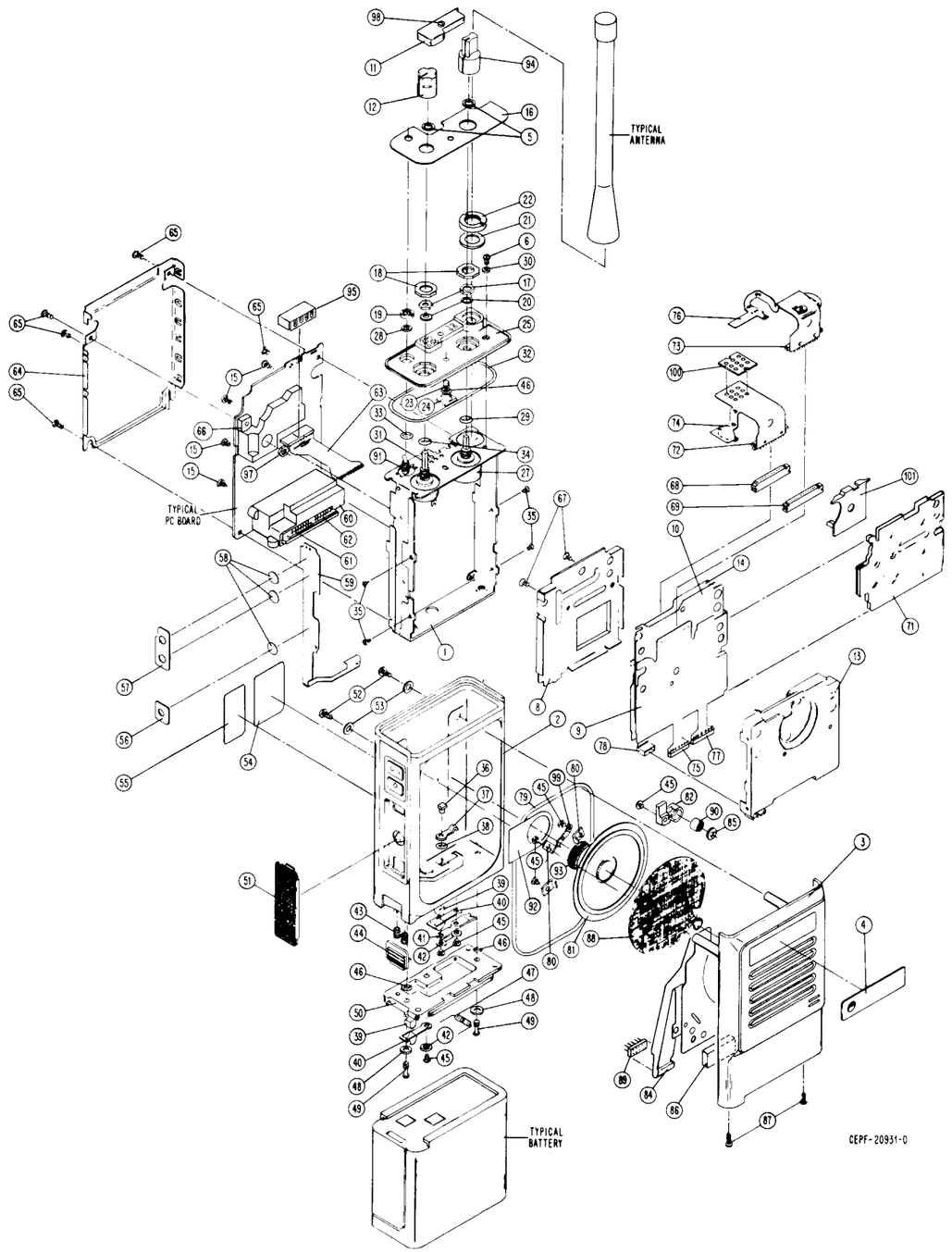


Exploded View Parts List
Lowband Rotary Radio

TPLF-3922-O

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0102708J27	ASSEMBLY, Frame
2	NHN6463A	KIT, Housing; includes items 36 thru 51
3	NTN4956A	KIT, Front Cover
4	NTN5098A	NAMEPLATE, Front
5	0405749R01	WASHER, Flat (2 req'd)
6	0300136785	SCREW, Phillips; 4-40 x 3/16"
7	NTN5716A	KIT, Controller Flex; includes items 8, 9, 10, 13, 14, 67, 68, 69, 75, 77, 78
8	0102708J43	SHIELD, Bottom
9	-----	ASSEMBLY, Controller Flex; part of item 7
10	-----	SHIELD, Center; Top Carrier Side; part of item 7
11	1505102S01	COVER, Dust
12	0102704J83	ASSEMBLY, Knob; VOLUME
13	1505765R02	CARRIER, Top; Controller Flex
14	-----	SHIELD, Center; Bottom Carrier Side; part of item 7
15	0300136771	SCREW, Phillips; 2-56 x 3/16" (4 req'd)
16	1305765R18	ESCUTCHEON
17	0205629L01	NUT, Hex (2 req'd)
18	0405534R01	WASHER, Flat; Octagonal (2 req'd)
19	0205163Q01	NUT, Spanner
20	0405162Q02	WASHER,Flat; Volume Pot & Freq. Switch (2 req'd)
21	0405216L04	WASHER, Flat
22	0205765L02	NUT, Spanner
23	See Note	LED, Bicolor (CR301A, 301B)
24	3205131S01	SEAL, LED
25	See Note	ASSEMBLY, Control Top (P7)
26	-----	Not Used
27	See Note	SWITCH, Frequency (S2)
28	0405162Q01	WASHER, Flat
29	3205082E01	GASKET, O-Ring; Freq. Switch
30	0484345A06	WASHER, Seal
31	See Note	SWITCH / POT, On-Off / Volume (S1 / R140)
32	3205141Q02	GASKET, O-Ring
33	3205141Q03	GASKET, O-Ring; Mode Select Switch
34	3205082E01	GASKET, O-Ring; Volume Pot
35	0300140369	SCREW, Flat Hd.; 2-56 x 1/8" (4 req'd)
36	4605945K05	CONTACT STUD, Battery
37	3905127Q01	CONTACT, B+
38	3205082E24	GASKET, O-Ring
39	0705830C02	SUPPORT, Contact (2 req'd)
40	3905421C07	CONTACT, Battery (2 req'd)
41	2905124Q01	LUG (2 req'd)
42	0400002625	LOCKWASHER, Split #2 (3 req'd)
43	4105944K01	SPRING, Battery Latch (2 req'd)
44	5505536P03	LATCH
45	0300139982	SCREW, Phillips Hd.; 2-56 x 5/32" (7 req'd)
46	3205082E03	GASKET, O-Ring (3 req'd)
47	See Note	FUSE (F1)
48	0400009761	LOCKWASHER, Split #4 (2 req'd)
49	0305941K01	SCREW, Captive; 4-40 (2 req'd)
50	6405531P02	PLATE, Base
51	4505535P01	LEVER, PTT
52	0305137Q01	SCREW, Phillips; 4-40 x 1/2" (2 req'd)
53	0484345A06	WASHER, Seal (2 req'd)
54	-----	LABEL, FCC
55	-----	LABEL, FM
56	3205231Q01	SEAL, Dome (PTT)
57	3205196Q01	SEAL, Dome (MON)
58	See Note	CONTACT, Snap Dome; (S301, S302, S303)
59	0105951N40	ASSEMBLY, B+ / PTT Flex; includes items 56, 57, 58
60	See Note	(FGU, U201)
61	See Note	PLUG (P3)
62	See Note	PLUG (P4)
63	See Note	FLEX, Connector (P/O of U1)
64	0102712J02	ASSEMBLY, Main Back Shield
65	0300136772	SCREW, Phillips Hd.; 2-56 x 5/16" (5 req'd)
66	2602240J01	HEATSINK
67	0300138620	SCREW, Phillips; 2-56 x 5/16" (2 req'd)
68	See Note	JACK (J2)
69	See Note	JACK (J1)
70	-----	Not Used
71	1405264Q01	INSULATOR, Flex
72	See Note	PLUG (P2)
73	See Note	PLUG (P1)
74	0102708J86	ASSEMBLY, Volume Pot Flex
75	See Note	JACK (J3)
76	0102708J28	ASSEMBLY, Frequency Flex
77	See Note	JACK (J4)
78	See Note	JACK (J5)
79	3205141Q01	GASKET, O-Ring
80	4205140Q01	CLAMP, Speaker (3 req'd)
81	See Note	SPEAKER (LS1)
82	4202036J01	RETAINER, Microphone
83	-----	Not Used
84	See Note	ASSEMBLY, Microphone Flex (MK1); includes item 90
85	7505564S01	PAD, Microphone Boot
86	7505501R03	PAD, Front Cover
87	0300140041	SCREW, Phillips; 2-56 x1/4" (2 req'd)
88	0105958N94	ASSEMBLY, Speaker Felt
89	See Note	PLUG (P5)
90	-----	CARTRIDGE, Microphone; part of item 84
91	See Note	SWITCH (S3)
92	1405299Q01	INSULATOR, Speaker
93	7505501R02	PAD, Speaker
94	0102704J67	ASSEMBLY, Knob
95	0102712J38	ASSEMBLY, I-F Shield
96	-----	Not Used
97	0200007007	NUT,Hex (for Q103)
98	0305103S01	SCREW, Captive
99	3905178S01	CONTACT
100	0102708J85	ASSEMBLY, Universal Board
101	4205153S02	RETAINER, Flex Connector

NOTE: Refer to Electrical Parts List for part number and description.

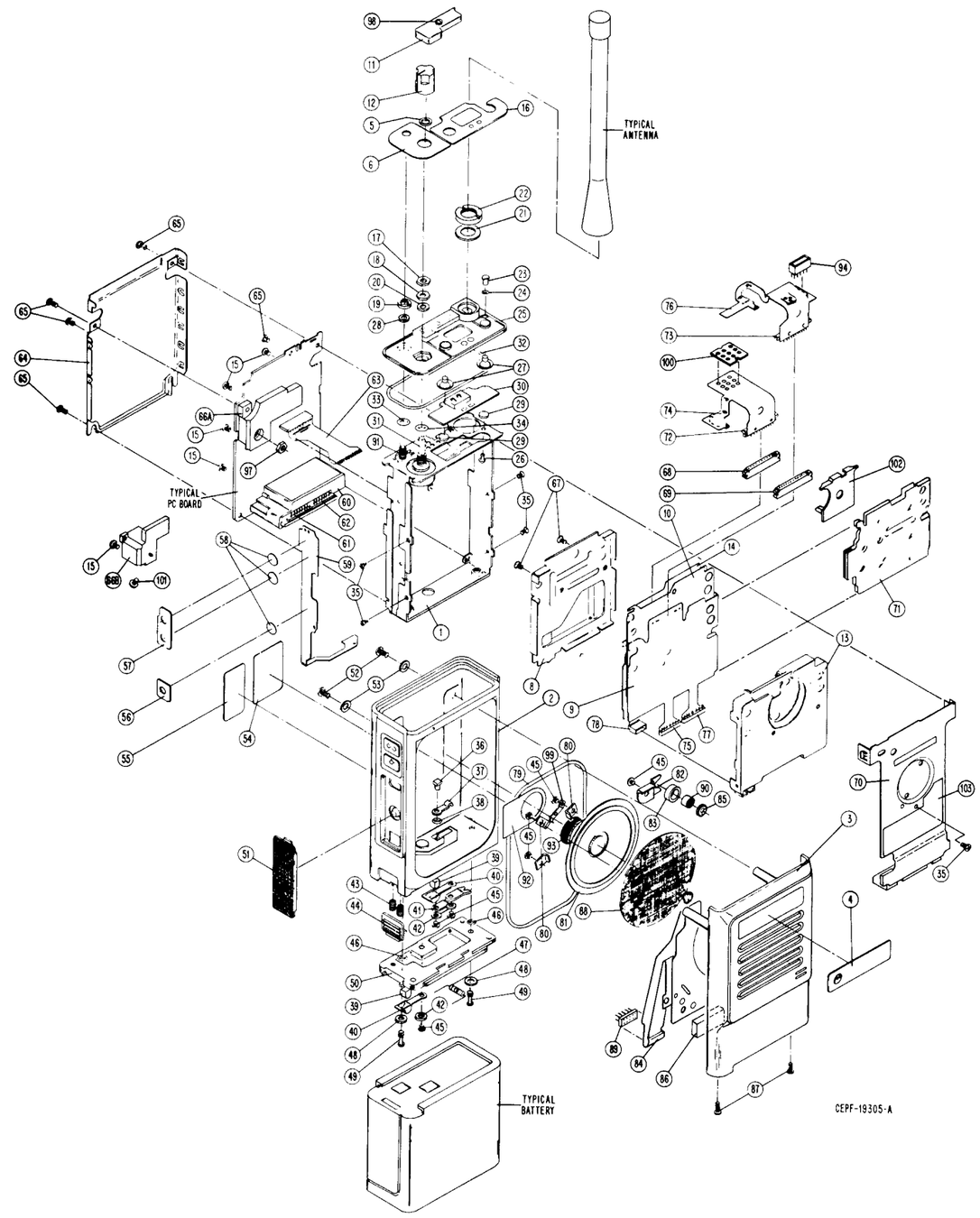


Exploded View Parts List
VHF Display Radio

TPLF-3726-A

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0105958N59	ASSEMBLY, Frame
2	NHN6419A	KIT, Housing; includes items 36 thru 51
3	NTN4956A	KIT, Front Cover
4	NTN5098A	NAMEPLATE, Front
5	0405749R01	WASHER, Flat
6	1305564R01	ESCUTCHEON, ON/OFF Volume
7	NTN4893C	KIT, Controller Flex; includes items 8, 9, 10, 13, 14, 67, 68, 69, 75, 77, 78
8	0102700J04	SHIELD, Bottom
9	-----	ASSEMBLY, Controller Flex; part of item 7
10	-----	SHIELD, Center; Top Carrier Side; part of item 7
11	0102706J99	ASSEMBLY, Dust Cover
12	0102704J83	ASSEMBLY, Knob; VOLUME
13	1505765R01	CARRIER, Top; Controller Flex
14	-----	SHIELD, Center; Bottom Carrier Side; part of item 7
15	0300136771	SCREW, Phillips; 2-56 x 3/16" (4 req'd)
16	1305563R01	ESCUTCHEON, Display
17	0405534R01	WASHER, Flat; Octagonal (Volume Pot)
18	0205629L01	NUT, Hex; Volume Pot
19	0205163Q01	NUT, Spanner; Mode Select Switch
20	0405162Q02	WASHER,Flat; Volume Pot
21	0405216L04	WASHER, Flat, Antenna
22	0205765L02	NUT, Spanner
23	0205562R02	NUT, Plate
24	3205556R02	SEAL, Nut Plate
25	See Note	ASSEMBLY, Control Top (P7)
26	0305573R01	SCREW,Phillips Hd.; 2-56 x 5/16"
27	3805558R02	ELASTOMER, Switch (2 req'd)
28	0405162Q01	WASHER, Flat
29	7505561R01	PAD, LCD (2 req'd)
30	0102700J15	ASSEMBLY, LCD
31	See Note	SWITCH / POT, On-Off / Volume (S1 / R140)
32	3205141Q02	GASKET, O-Ring; Control Top
33	3205141Q03	GASKET, O-Ring; Mode Select Switch
34	3205082E01	GASKET, O-Ring; Volume Pot
35	0300140369	SCREW, Flat Hd.; 2-56 x 1/8" (5 req'd)
36	4605945K05	CONTACT STUD, Battery
37	3905127Q01	CONTACT, B+
38	3205082E24	GASKET, O-Ring
39	0705830C02	SUPPORT, Contact (2 req'd)
40	3905421C07	CONTACT, Battery (2 req'd)
41	2905124Q01	LUG (2 req'd)
42	0400002625	LOCKWASHER, Split #2 (3 req'd)
43	4105944K01	SPRING, Battery Latch (2 req'd)
44	5505536P01	LATCH
45	0300139982	SCREW, Phillips; 2-56 x 5/32" (7 req'd)
46	3205082E03	GASKET, O-Ring (2 req'd)
47	See Note	FUSE (F1)
48	0400009761	LOCKWASHER, Split #4 (2 req'd)
49	0305137Q04	SCREW, Captive 4-40 (2 req'd)
50	6405531P02	PLATE, Base
51	4505535P01	LEVER, PTT
52	0305137Q01	SCREW, Phillips 4-40 x 1/2" (2 req'd)
53	0484345A06	WASHER, Seal (2 req'd)
54	-----	LABEL, FCC
55	-----	LABEL, FM
56	3205231Q01	SEAL, Dome (PTT)
57	3205196Q01	SEAL, Dome (MON)
58	See Note	CONTACT, Snap Dome; (S301, S302, S303)
59	0105951N40	ASSEMBLY, B+ / PTT Flex; includes items 56, 57, 58
60	See Note	(P/O U201)
61	See Note	PLUG (P3)
62	See Note	PLUG (P4)
63	See Note	FLEX, Connector (P/O of U1)
64	0102704J75	ASSEMBLY, Main Back Shield
65	0300136772	SCREW, Phillips Hd.; 2-56 x 5/16" (5 req'd)
66A	2605532P01	HEATSINK (5W radios)
66B	2605578P01	HEATSINK (2W radios)
67	0300138620	SCREW, Phillips; 2-56 x 5/16" (2 req'd)
68	See Note	JACK (J2)
69	See Note	JACK (J1)
70	0105951P28	ASSEMBLY, Front Shield
71	1405264Q01	INSULATOR, Flex
72	See Note	PLUG (P2)
73	See Note	PLUG (P1)
74	0105958N56	ASSEMBLY, Volume Pot Flex
75	See Note	JACK (J3)
76	0105958N55	ASSEMBLY, Frequency Flex
77	See Note	JACK (J4)
78	See Note	JACK (J5)
79	3205141Q01	GASKET, O-Ring
80	4205140Q01	CLAMP, Speaker (3 req'd)
81	See Note	SPEAKER (LS1)
82	4205136S01	RETAINER, Microphone
83	1405299L01	BOOT, Microphone
84	See Note	ASSEMBLY, Microphone Flex (MK1); includes item 90
85	7505564S01	PAD, Microphone Boot
86	7505501R03	PAD, Front Cover
87	0300140041	SCREW, Phillips; 2-56 x1/4" (2 req'd)
88	0105958N94	ASSEMBLY, Speaker Felt
89	See Note	PLUG (P5)
90	-----	CARTRIDGE, Microphone; part of item 84
91	See Note	SWITCH (S3)
92	1405299Q01	INSULATOR, Speaker
93	7505501R02	PAD, Speaker
94	See Note	PLUG (P501)
95	-----	Not Used
96	-----	Not Used
97	0200007007	NUT, Hex (for Q104 5W radios only)
98	0305103S01	SCREW, Captive
99	3905178S01	CONTACT, Grounding
100	0105958N56	ASSEMBLY, Universal Board
101	0300139675	SCREW, Phillips; 2-56 x 5/32"
102	4205154S01	RETAINER, Connector
103	5402446J01	LABEL, Warning

NOTE: Refer to Electrical Parts List for part number and description.

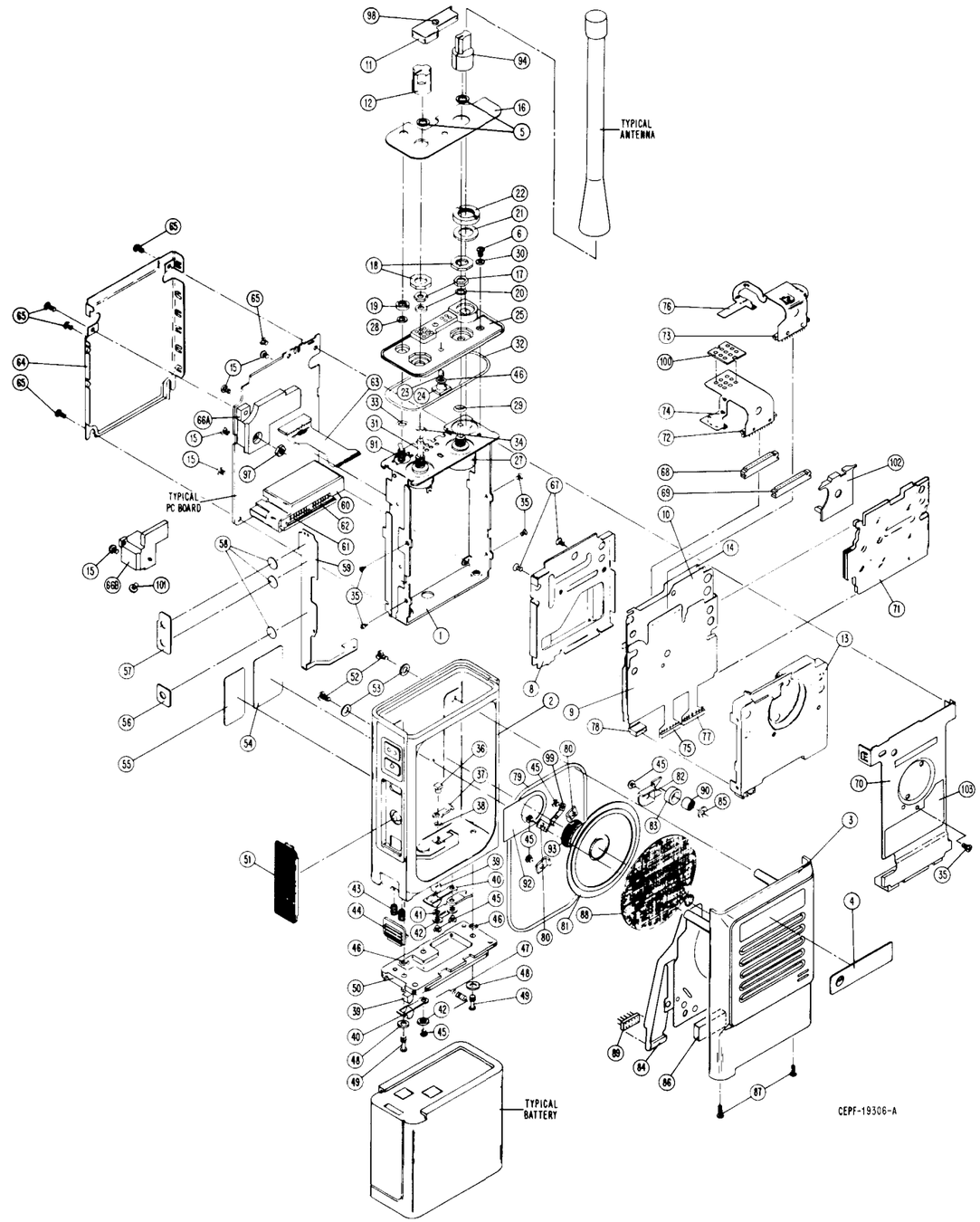


Exploded View Parts List
VHF Rotary Radio

TPLF-3727-A

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0105950P59	ASSEMBLY, Frame
2	NHN6419A	KIT, Housing; includes items 36 thru 51
3	NTN4956A	KIT, Front Cover; includes items 45, 79 thru 86
4	NTN5098A	NAMEPLATE, Front
5	0405749R01	WASHER, Flat (2 req'd)
6	0300136785	SCREW, Phillips; 4-40 x 3/16"
7	NTN4892C	KIT, Controller Flex; includes items 8, 9, 10, 13, 14, 67, 68, 69, 75, 77, 78
8	0102700J04	SHIELD, Bottom
9	-----	ASSEMBLY, Controller Flex; part of item 7
10	-----	SHIELD, Center; Top Carrier Side; part of item 7
11	0102706J99	ASSEMBLY, Dust Cover
12	0102704J83	ASSEMBLY, Knob; VOLUME
13	1505765R01	CARRIER, Top; Controller Flex
14	-----	SHIELD, Center; Bottom Carrier Side; part of item 7
15	0300136771	SCREW, Phillips; 2-56 x 3/16" (5 req'd)
16	1305676R07	ESCUTCHEON
17	0205629L01	NUT, Hex (2 req'd)
18	0405534R01	WASHER, Flat; Octagonal (2 req'd)
19	0205163Q01	NUT, Spanner
20	0405162Q02	WASHER,Flat; Volume Pot & Freq. Switch
21	0405216L04	WASHER, Flat
22	0205765L02	NUT, Spanner
23	See Note	LED, Bicolor (CR301A, 301B)
24	3205131S01	SEAL, LED
25	See Note	ASSEMBLY, Control Top (P7)
26	-----	Not Used
27	See Note	SWITCH, Frequency (S2)
28	0405162Q01	WASHER, Flat
29	3205082E01	GASKET, O-Ring; Freq. Switch
30	0484345A06	WASHER, Seal
31	See Note	SWITCH / POT, On-Off / Volume (S1 / R140)
32	3205141Q02	GASKET, O-Ring
33	3205141Q03	GASKET, O-Ring; Mode Select Switch
34	3205082E01	GASKET, O-Ring; Volume Pot
35	0300140369	SCREW, Flat Hd.; 2-56 x 1/8" (5 req'd)
36	4605945K05	CONTACT STUD, Battery
37	3905127Q01	CONTACT, B+
38	3205082E24	GASKET, O-Ring
39	0705830C02	SUPPORT, Contact (2 req'd)
40	3905421C07	CONTACT, Battery (2 req'd)
41	2905124Q01	LUG (2 req'd)
42	0400002625	LOCKWASHER, Split #2 (3 req'd)
43	4105944K01	SPRING, Battery Latch (2 req'd)
44	5505536P01	LATCH
45	0300139982	SCREW, Phillips Hd.; 2-56 x 5/32" (7 req'd)
46	3205082E03	GASKET, O-Ring (3 req'd)
47	See Note	FUSE (F1)
48	0400009761	LOCKWASHER, Split #4 (2 req'd)
49	0305317Q04	SCREW, Captive; 4-40 (2 req'd)
50	6405531P02	PLATE, Base
51	4505535P01	LEVER, PTT
52	0305137Q01	SCREW, Phillips; 4-40 x 1/2" (2 req'd)
53	0484345A06	WASHER, Seal (2 req'd)
54	-----	LABEL, FCC
55	-----	LABEL, FM
56	3205231Q01	SEAL, Dome (PTT)
57	3205196Q01	SEAL, Dome (MON)
58	See Note	CONTACT, Snap Dome; (S301, S302, S303)
59	0105951N40	ASSEMBLY, B+ / PTT Flex; includes items 56, 57, 58
60	See Note	(P/O U201)
61	See Note	PLUG (P3)
62	See Note	PLUG (P4)
63	See Note	FLEX, Connector (P/O of U1)
64	0102712J02	ASSEMBLY, Main Back Shield
65	0300136772	SCREW, Phillips Hd.; 2-56 x 5/16" (5 req'd)
66A	2605532P01	HEATSINK (5W radios)
66B	2605578P01	HEATSINK (2W radios)
67	0300138620	SCREW, Phillips; 2-56 x 5/16" (2 req'd)
68	See Note	JACK (J2)
69	See Note	JACK (J1)
70	0105951P28	ASSEMBLY, Front Shield
71	1405264Q01	INSULATOR, Flex
72	See Note	PLUG (P2)
73	See Note	PLUG (P1)
74	0102708J86	ASSEMBLY, Volume Pot Flex
75	See Note	JACK (J3)
76	0102708J28	ASSEMBLY, Frequency Flex
77	See Note	JACK (J4)
78	See Note	JACK (J5)
79	3205141Q01	GASKET, O-Ring
80	4205140Q01	CLAMP, Speaker (3 req'd)
81	See Note	SPEAKER (LS1)
82	4205136S01	RETAINER, Microphone
83	1405299L01	BOOT, Microphone
84	See Note	ASSEMBLY, Microphone Flex (MK1); includes item 90
85	7505564S01	PAD, Microphone Boot
86	7505501R03	PAD, Front Cover
87	0300140041	SCREW, Phillips; 2-56 x1/4" (2 req'd)
88	0105958N94	ASSEMBLY, Speaker Felt
89	See Note	PLUG (P5)
90	-----	CARTRIDGE, Microphone; part of item 84
91	See Note	SWITCH (S3)
92	1405299Q01	INSULATOR, Speaker
93	7505501R02	PAD, Speaker
94	0102704J67	ASSEMBLY, Knob
95	-----	Not Used
96	-----	Not Used
97	0200007007	NUT, Hex (for Q104 5W radios only)
98	0305103S01	SCREW, Captive
99	3905178S01	CONTACT
100	0102708J85	ASSEMBLY, Universal Board
101	0300139675	SCREW, Phillips; 2-56 x 5/32"
102	4205153S02	RETAINER, Flex Connector
103	5402446J01	LABEL, Warning

NOTE: Refer to Electrical Parts List for part number and description.

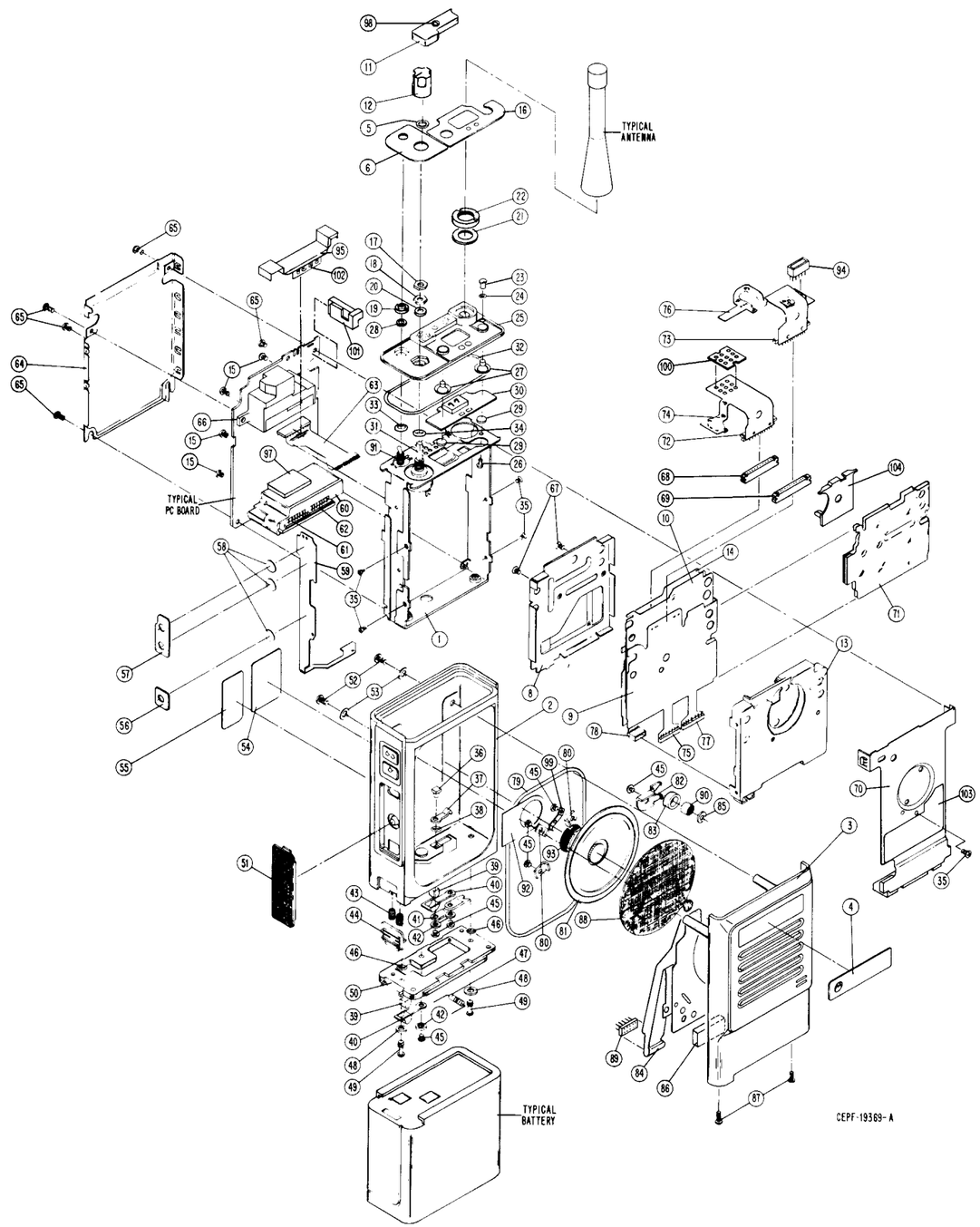


Exploded View Parts List
UHF Display Radio

TPLF-3753-A

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0105958N59	ASSEMBLY, Frame
2	NHN6419A	KIT, Housing; includes items 36 thru 51
3	NTN4956A	KIT, Front Cover
4	NTN5098A	NAMEPLATE, Front
5	0405749R01	WASHER, Flat
6	1305564R01	ESCUTCHEON, ON/OFF Volume
7	NTN4893C	KIT, Controller Flex; includes items 8, 9, 10, 13, 14, 67, 68, 69, 75, 77, 78
8	0102700J04	ASSEMBLY, Bottom Shield
9	- - - - -	ASSEMBLY, Controller Flex; part of item 7
10	- - - - -	SHIELD, Center; Top Carrier Side; part of item 7
11	0102706J99	ASSEMBLY, Dust Cover
12	0102704J83	ASSEMBLY, Knob; VOLUME
13	1505765R01	CARRIER, Top; Controller Flex
14	- - - - -	SHIELD, Center; Bottom Carrier Side; part of item 7
15	0300136771	SCREW, Phillips; 2-56 x 3/16" (4 req'd)
16	1305563R01	ESCUTCHEON, Display
17	0405534R01	WASHER, Flat; Octagonal (Volume Pot)
18	0205629L01	NUT, Hex; Volume Pot
19	0205163Q01	NUT, Spanner; Mode Select Switch
20	0405162Q02	WASHER,Flat; Volume Pot
21	0405216L04	WASHER, Flat, Antenna
22	0205765L02	NUT, Spanner
23	0205562R02	NUT, Plate
24	3205556R02	SEAL, Nut Plate
25	0105958N64	ASSEMBLY, Control Top
26	0305573R01	SCREW,Phillips Hd.; 2-56 x 5/16"
27	3805558R01	ELASTOMER, Switch (2 req'd)
28	0405162Q01	WASHER, Flat
29	7505561R01	PAD, LCD (2 req'd)
30	0102700J15	ASSEMBLY, LCD
31	See Note	SWITCH / POT, On-Off / Volume (S1 / R140)
32	3205141Q02	GASKET, O-Ring; Control Top
33	3205141Q03	GASKET, O-Ring; Mode Select Switch
34	3205082E01	GASKET, O-Ring; Volume Pot
35	0300140369	SCREW, Flat Hd.; 2-56 x 1/8" (5 req'd)
36	4605945K05	CONTACT STUD, Battery
37	3905127Q01	CONTACT, B+
38	3205082E24	GASKET, O-Ring
39	0705830C02	SUPPORT, Contact (2 req'd)
40	3905421C07	CONTACT, Battery (2 req'd)
41	2905124Q01	LUG (2 req'd)
42	0400002625	LOCKWASHER, Split #2 (3 req'd)
43	4105944K01	SPRING, Battery Latch (2 req'd)
44	5505536P01	LATCH
45	0300139982	SCREW, Phillips; 2-56 x 5/32" (7 req'd)
46	3205082E03	GASKET, O-Ring (2 req'd)
47	See Note	FUSE (F1)
48	0400009761	LOCKWASHER, Split #4 (2 req'd)
49	0305137Q04	SCREW, Captive 4-40 (2 req'd)
50	6405531P02	PLATE, Base
51	4505535P01	LEVER, PTT
52	0305137Q01	SCREW, Phillips Hd.; 4-40 x 1/2" (2 req'd)
53	0484345A06	WASHER, Seal (2 req'd)
54	- - - - -	LABEL, FCC
55	- - - - -	LABEL, FM
56	3205231Q01	SEAL, Dome (PTT); part of item 59
57	3205196Q01	SEAL, Dome (Mon); part of item 59
58	3905834K06	CONTACT, Snap Dome; part of item 59
59	0105951N40	ASSEMBLY, B+ / PTT Flex; includes items 56, 57, 58
60	See Note	(P/O U201)
61	See Note	PLUG (P3)
62	See Note	PLUG (P4)
63	See Note	FLEX, Connector (P/O of U1)
64	0102704J740	ASSEMBLY, Main Back Shield
65	0300136772	SCREW, Phillips Hd.; 2-56 x 5/16" (5 req'd)
66	See Note	RF PA (U102)
67	0300138620	SCREW, Phillips; 2-56 x 5/16" (2 req'd)
68	See Note	JACK (J2)
69	See Note	JACK (J1)
70	0102700J17	ASSEMBLY, Front Shield
71	1405264Q01	INSULATOR, Flex
72	See Note	PLUG (P2)
73	See Note	PLUG (P1)
74	0105958N56	ASSEMBLY, Volume Pot Flex
75	See Note	JACK (J3)
76	0105958N55	ASSEMBLY, Frequency Flex
77	See Note	JACK (J4)
78	See Note	JACK (J5)
79	3205141Q01	GASKET, O-Ring
80	4205140Q01	CLAMP, Speaker (3 req'd)
81	See Note	SPEAKER (LS1)
82	4205136S01	RETAINER, Microphone
83	1405299L01	BOOT, Microphone; part of item 84
84	See Note	ASSEMBLY, Microphone Flex (MK1); includes items 81, 83, 89, and 90
85	7505564S01	PAD, Microphone Boot
86	7505501R03	PAD, Front Cover
87	0300140041	SCREW, Phillips; 2-56 x1/4" (2 req'd)
88	0105958N94	ASSEMBLY, Speaker Felt
89	See Note	PLUG (P5)
90	- - - - -	CARTRIDGE, Microphone; part of item 84
91	See Note	SWITCH (S3)
92	1405299Q01	INSULATOR, Speaker
93	7505501R02	PAD, Speaker
94	- - - - -	(P501) part of item 76
95	2605120S01	SHIELD, I-F/PA
96	- - - - -	Not Used
97	2605119S01	SHIELD, Buffer
98	0305103S01	SCREW, Captive
99	3905178S01	CONTACT, Grounding
100	0105958N56	ASSEMBLY, Universal Board
101	See Note	ASSEMBLY, Antenna Switch (U105)
102	2605494R02	SHIELD, I-F
103	5402446J01	LABEL, \Warning
104	4205154S01	RETAINER, Connector

NOTE: Refer to Electrical Parts List for part number and description.

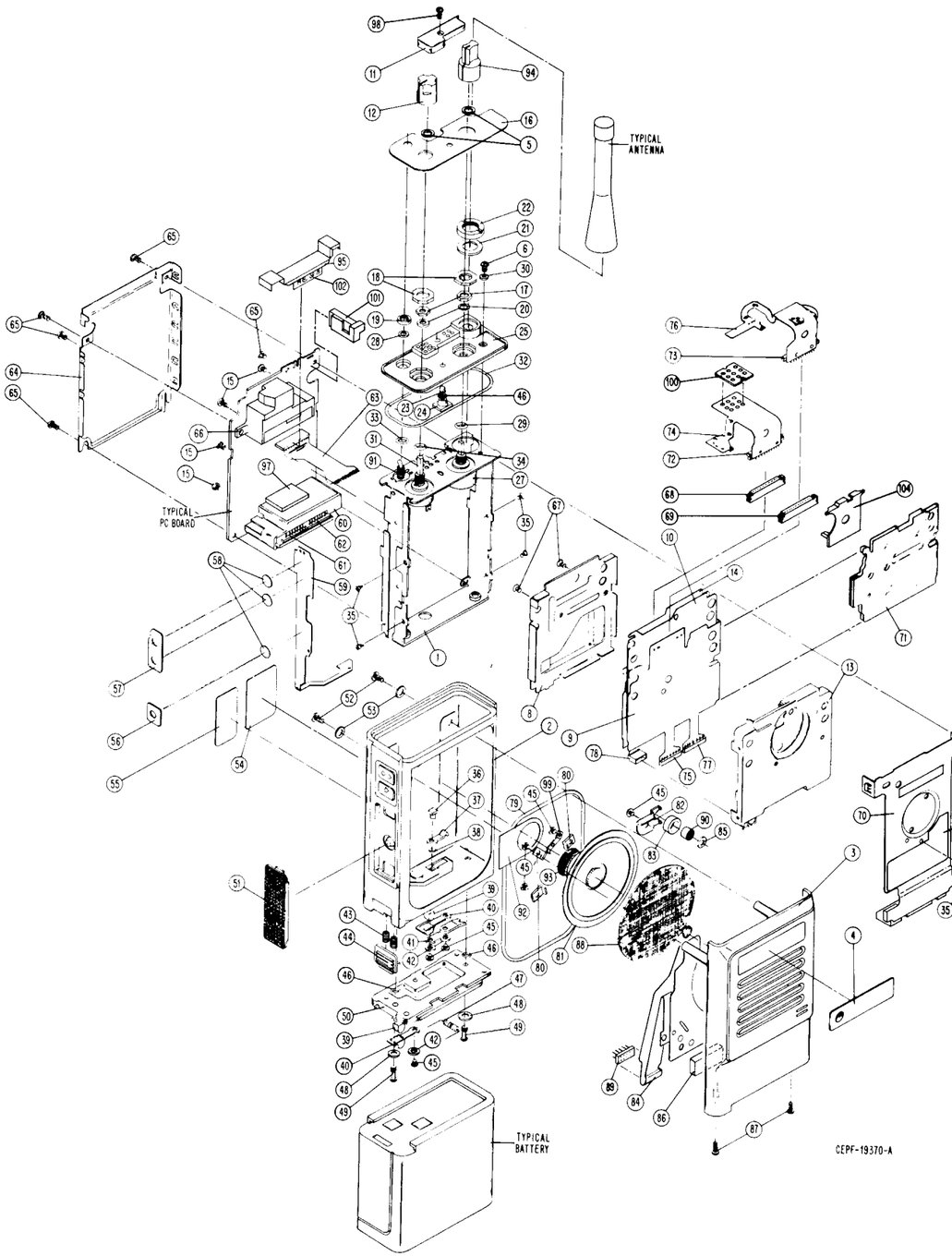


Exploded View Parts List
UHF Rotary Radio

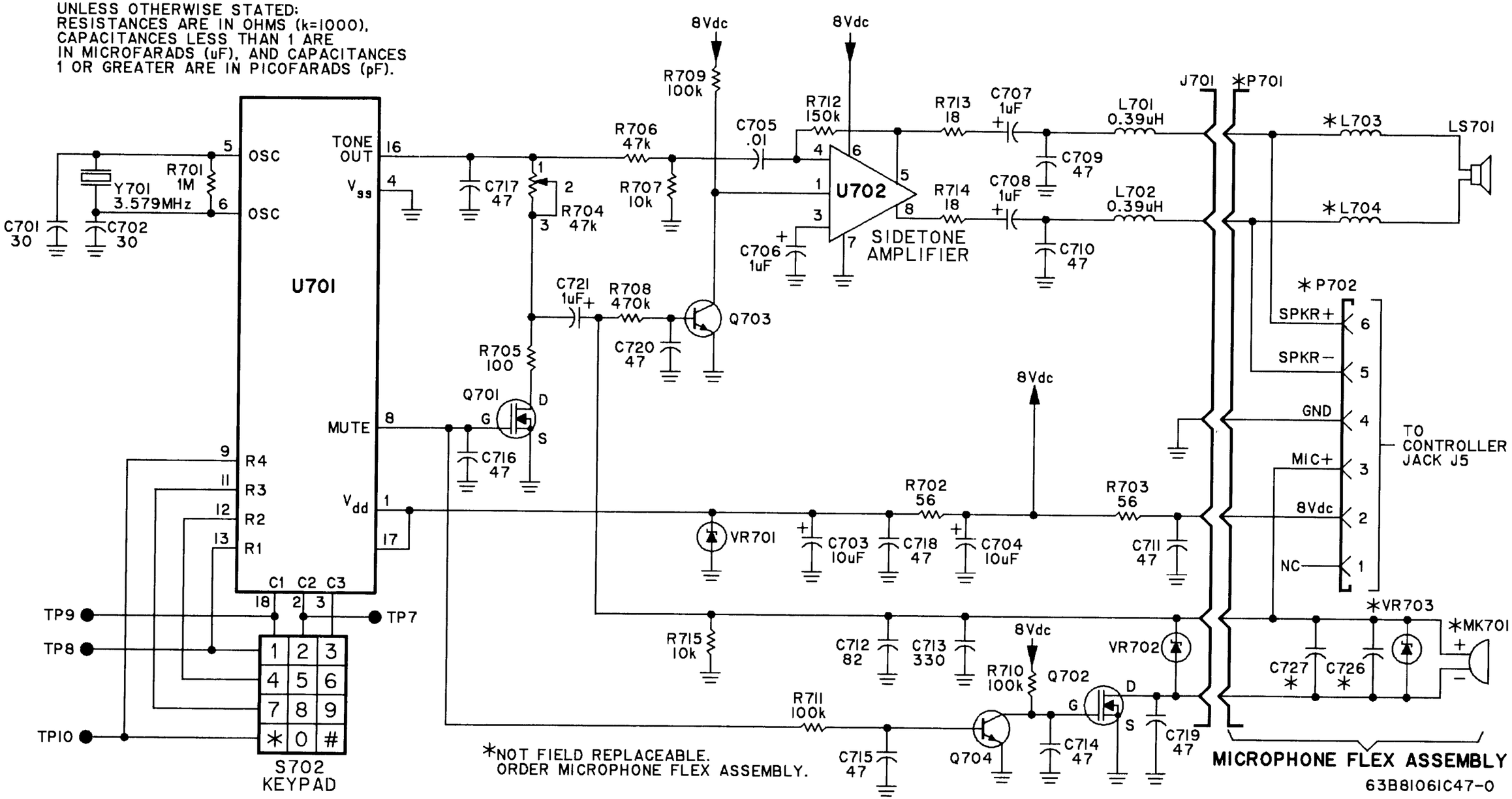
TPLF-3754-A

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0105950P95	ASSEMBLY, Frame
2	NHN6419A	KIT, Housing; includes items 36 thru 51
3	NTN4956A	KIT, Front Cover
4	NTN5098A	NAMEPLATE, Front
5	0405749R01	WASHER, Flat (2 req'd)
6	0300136785	SCREW, Phillips; 4-40 x 3/16"
7	NTN4892C	KIT, Controller Flex; includes items 8, 9, 10, 13, 14, 67, 68, 69, 75, 77, 78
8	0102700J04	ASSEMBLY, Bottom Shield
9	- - - - -	ASSEMBLY, Controller Flex; part of item 7
10	- - - - -	SHIELD, Center; Top Carrier Side; part of item 7
11	0102706J99	ASSEMBLY, Dust Cover
12	0102704J83	ASSEMBLY, Knob; VOLUME
13	1505765R01	CARRIER, Top; Controller Flex
14	- - - - -	SHIELD, Center; Bottom Carrier Side; part of item 7
15	0300136771	SCREW, Phillips; 2-56 x 3/16" (4 req'd)
16	1305676R07	ESCUTCHEON
17	0205629L01	NUT, Hex (2 req'd)
18	0405534R01	WASHER, Flat; Octagonal (2 req'd)
19	0205163Q01	NUT, Spanner
20	0405162Q02	WASHER,Flat; Volume Pot and Freq. Switch
21	0405216L04	WASHER, Flat
22	0205765L02	NUT, Spanner
23	See Note	LED, Bicolor (CR301A, 301B)
24	3205131S01	SEAL, LED
25	0102700J59	ASSEMBLY, Control Top
26	- - - - -	Not Used
27	See Note	SWITCH, Frequency (S2)
28	0405162Q01	WASHER, Flat
29	3205082E01	GASKET, O-Ring; Freq. Switch
30	0484345A06	WASHER, Seal
31	See Note	SWITCH / POT, On-Off / Volume (S1 / R140)
32	3205141Q02	GASKET, O-Ring
33	3205141Q03	GASKET, O-Ring; Mode Select Switch
34	3205082E01	GASKET, O-Ring; Volume Pot
35	0300140369	SCREW, Flat Hd.; 2-56 x 1/8" (5 req'd)
36	4605945K05	CONTACT STUD, Battery
37	3905127Q01	CONTACT, B+
38	3205082E24	GASKET, O-Ring
39	0705830C02	SUPPORT, Contact (2 req'd)
40	3905421C07	CONTACT, Battery (2 req'd)
41	2905124Q01	LUG (2 req'd)
42	0400002625	LOCKWASHER, Split #2 (3 req'd)
43	4105944K01	SPRING, Battery Latch (2 req'd)
44	5505536P01	LATCH
45	0300139982	SCREW, Phillips Hd.; 2-56 x 5/32" (7 req'd)
46	3205082E03	GASKET, O-Ring (3 req'd)
47	See Note	FUSE (F1)
48	0400009761	LOCKWASHER, Split #4 (2 req'd)
49	0305137Q04	SCREW, Captive; 4-40 (2 req'd)
50	6405531P02	PLATE, Base
51	4505535P01	LEVER, PTT
52	0305137Q01	SCREW, Phillips Hd.; 4-40 x 1/2" (2 req'd)
53	0484345A06	WASHER, Seal (2 req'd)
54	- - - - -	LABEL, FCC
55	- - - - -	LABEL, FM
56	3205231Q01	SEAL, Dome (PTT); part of item 59
57	3205196Q01	SEAL, Dome (Mon); part of item 59
58	See Note	CONTACT, Snap Dome; (S301, S302, S303)
59	0105951N40	ASSEMBLY, B+ / PTT Flex; includes items 56, 57, 58
60	See Note	(P/O U201)
61	See Note	PLUG (P3)
62	See Note	PLUG (P4)
63	See Note	FLEX, Connector (P/O of U1)
64	0102704J74	ASSEMBLY, Main Back Shield
65	0300136772	SCREW, Phillips Hd.; 2-56 x 5/16" (5 req'd)
66	See Note	RF PA (U102)
67	0300138620	SCREW, Phillips; 2-56 x 5/16" (2 req'd)
68	See Note	JACK (J2)
69	See Note	JACK (J1)
70	0102700J17	ASSEMBLY, Front Shield
71	1405264Q01	INSULATOR, Flex
72	See Note	PLUG (P2)
73	See Note	PLUG (P1)
74	0102708J86	ASSEMBLY, Volume Pot Flex
75	See Note	JACK (J3)
76	0102708J28	ASSEMBLY, Frequency Flex
77	See Note	JACK (J4)
78	See Note	JACK (J5)
79	3205141Q01	GASKET, O-Ring
80	4205140Q01	CLAMP, Speaker (3 req'd)
81	See Note	SPEAKER (LS1)
82	4205136S01	RETAINER, Microphone
83	1405299L01	BOOT, Microphone; part of item 84
84	See Note	ASSEMBLY, Microphone Flex (MK1); includes items 81, 83, 89, and 90
85	7505564S01	PAD, Microphone Boot
86	7505501R03	PAD, Front Cover
87	0300140041	SCREW, Phillips; 2-56 x1/4" (2 req'd)
88	0105958N94	ASSEMBLY, Speaker Felt
89	See Note	PLUG (P5)
90	- - - - -	CARTRIDGE, Microphone; part of item 84
91	See Note	SWITCH (S3)
92	1405299Q01	INSULATOR, Speaker
93	7505501R02	PAD, Speaker
94	0102704J67	ASSEMBLY, Knob
95	2605120S01	SHIELD, I-F/PA
96	- - - - -	Not Used
97	2605119S01	ASSEMBLY, Buffer Shield
98	0305103S01	SCREW, Captive
99	3905178S01	CONTACT
100	0102708J85	ASSEMBLY, Universal Board`
101	See Note	ASSEMBLY, Antenna Switch (U105)
102	2605494R02	SHIELD, I-F
103	5402446J01	LABEL, Warning
104	4205153S02	RETAINER, Connector

NOTE: Refer to Electrical Parts List for part number and description.

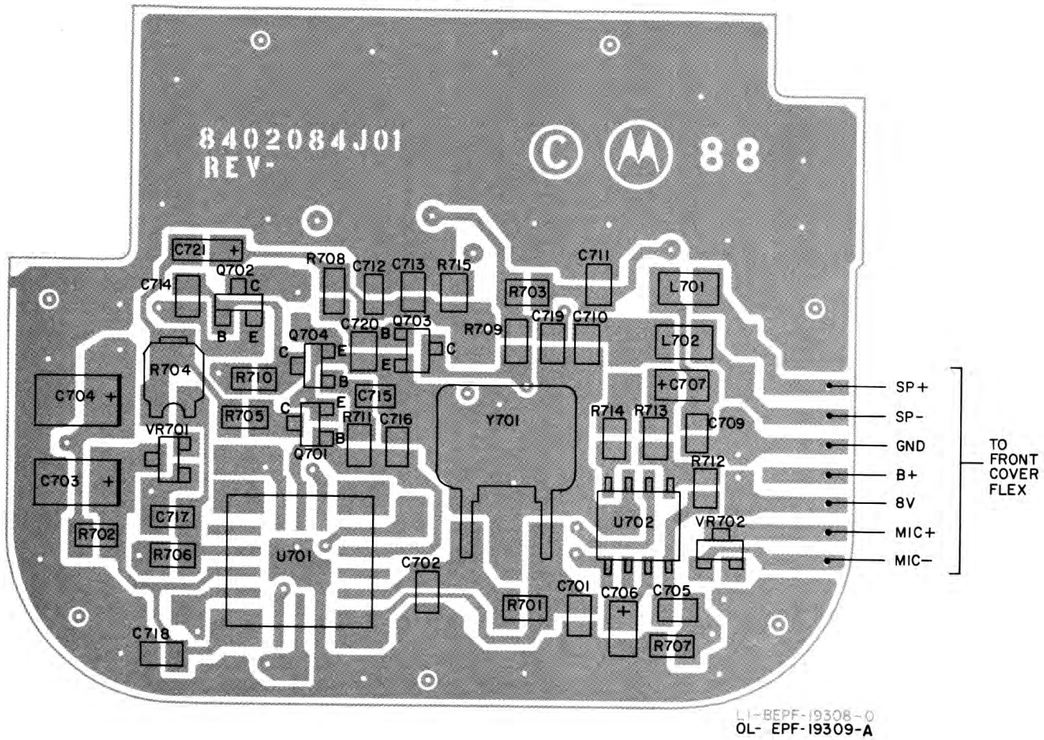


UNLESS OTHERWISE STATED:
RESISTANCES ARE IN OHMS (k=1000),
CAPACITANCES LESS THAN 1 ARE
IN MICROFARADS (uF), AND CAPACITANCES
1 OR GREATER ARE IN PICOFARADS (pF).



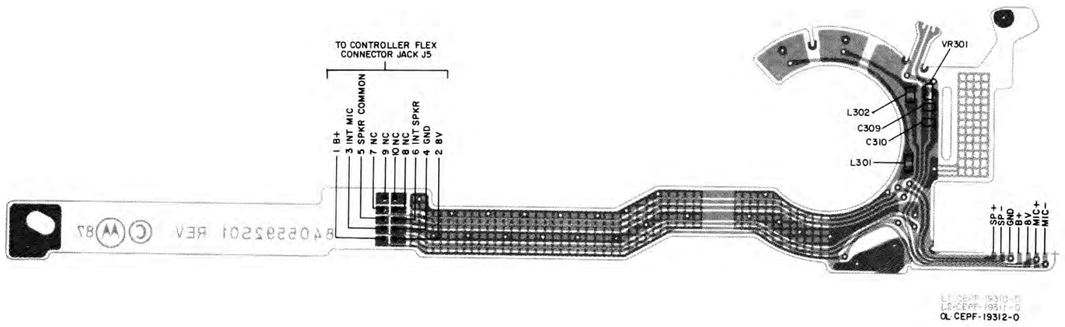
NTN5596A CIRCUIT BOARD COMPONENT LOCATION DETAIL

VIEWED FROM SIDE I



LI-BEPF-19308-O
OL- EPF-19309-A

MICROPHONE FLEX ASSEMBLY



OL CEPF-19312-O

NTN5596A DTMF Front Cover (Continuous Tone) Electrical Parts List

TPLF-3728-O

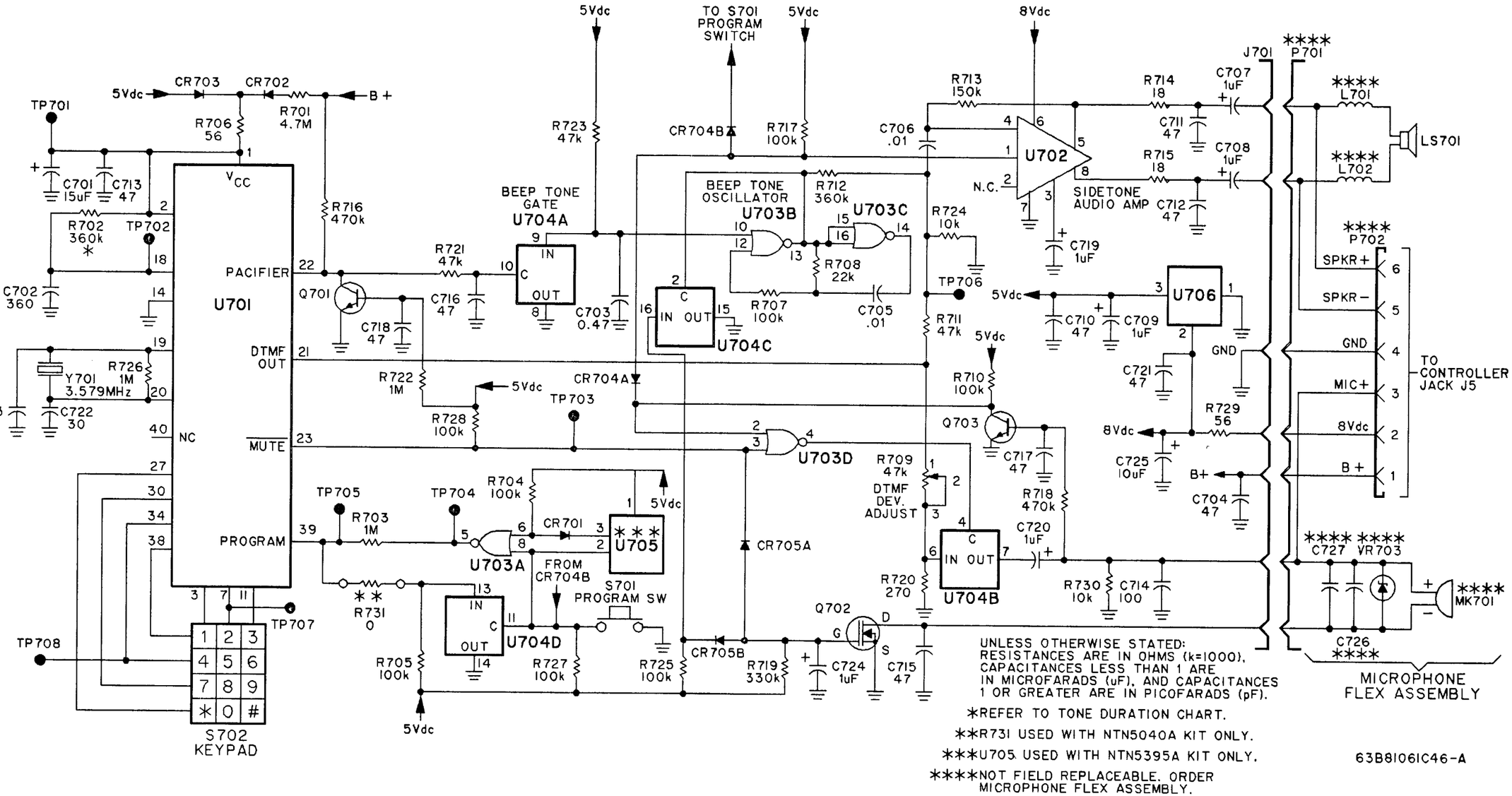
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:pF±5%; 50V unless stated
C701, 702	2113740A40	30
C703, 704	2362998B73	10µF±20%; 16V
C705	2113741A45	.01µF
C706, 707, 708	2362998C09	1µF±10%; 16V
C709, 710, 711	2113740A46	47
C712	2113740A53	82
C713	2113740A67	330
C714 thru 720	2113740A46	47
C721	2362998C09	1µF±10%; 16V
C726**	-----	
C727**	-----	
		COIL, RF:
L701, 702	2462575A01	0.39µH
L703, 704**	-----	0.39µH
LS701	5005155Q03	**TRANSDUCER**
MK701**	-----	**MICROPHONE**
		PLUG
P701**	-----	Contacts, flex circuit plating
P702**	-----	Socket, 10-Pin
		TRANSISTOR: See Note I
Q701, 702	4805218N11	D-MOS FET
Q703, 704	4805128M11	NPN
		RESISTOR, Fixed: Ω±5%; 1/10W unless stated
R701	0660076B25	1M
R702, 703	0660076A19	56
R704	1860502A17	47k Pot.
R705	0660076A25	100
R706	0660076A89	47k
R707	0660076A73	10k
R708	0660076B17	470k
R709, 710, 711	0660076B01	100k
R712	0660076B05	150k
R713, 714	0660076A07	18
R715	0660076A73	10k
		SWITCH:
S701	-----	Program, Non-Functional (Not replaceable, order DTMF Front Cover Kit)
S702	-----	Keypad (Not replaceable, order DTMF Front Cover Kit)
		CIRCUIT MODULE: See Note I
U701	0105951Q08	Tone Generator
U702	5105469E51	Audio Amplifier
		DIODE: See Note I
VR701	4805129M49	Zener
VR702	4805129M42	Zener, 5.6V
VR703**	-----	Zener, 5.6V
		CRYSTAL: See Note II
Y701	4805719G04	Resonator; 3.579 MHz

NOTES:

I. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.

II. When ordering crystal units, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.

** Not field replaceable, order microphone flex assembly 0102700J18.



UNLESS OTHERWISE STATED:
RESISTANCES ARE IN OHMS (k=1000),
CAPACITANCES LESS THAN 1 ARE
IN MICROFARADS (uF), AND CAPACITANCES
1 OR GREATER ARE IN PICOFARADS (pF).

*REFER TO TONE DURATION CHART.

**R731 USED WITH NTN5040A KIT ONLY.

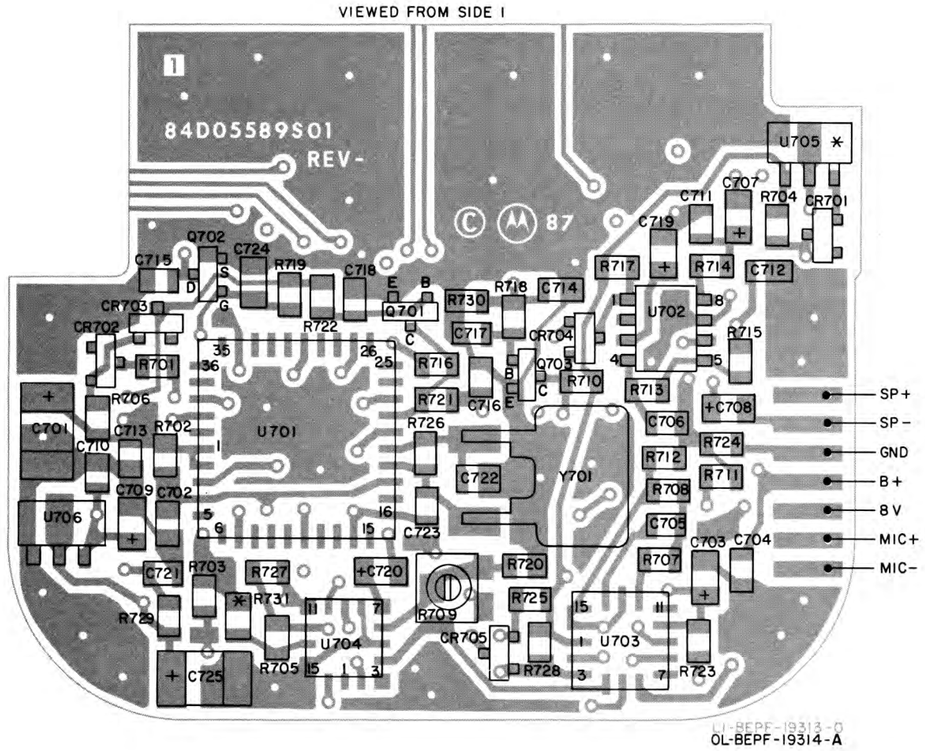
***U705 USED WITH NTN5395A KIT ONLY.

****NOT FIELD REPLACEABLE. ORDER MICROPHONE FLEX ASSEMBLY.

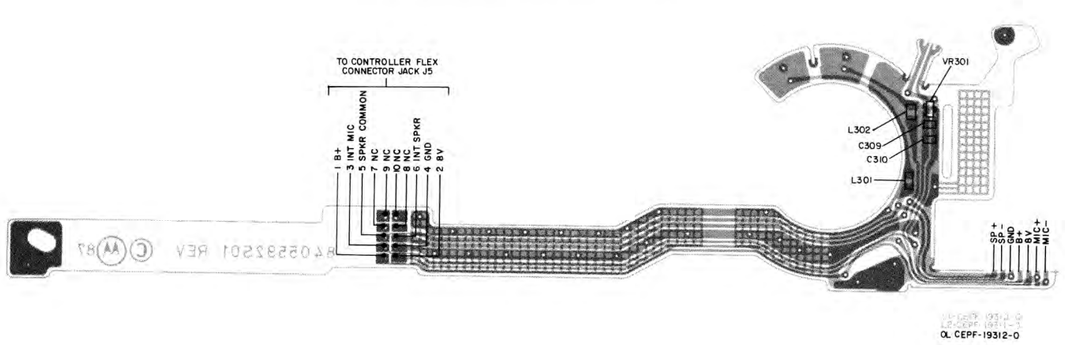
63B8106IC46-A

NTN5040A AND NTN5395A STANDARD AND ANI DTMF FRONT COVER SCHEMATIC DIAGRAM

NTN5040A AND NTN5395A CIRCUIT BOARDS COMPONENT LOCATION DETAIL



MICROPHONE FLEX ASSEMBLY



NTN5040A DTMF Front Cover TPLF-3729-O
NTN5395A DTMF with ANI Front Cover
Electrical Parts List

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: **uF±10%; 16V** unless stated
C701	2362998C24	15;10V; Tant.
C702	2113740A68	360pF±2%;25V
C703	2362998C05	0.47;35V
C704	2113740A46	47pF±5%;50V
C705, 706	2113741A45	.01;25V
C707 thru 709	2362998C09	1
C710 thru 713	2113740A46	47pF±5%;50V
C714	2113740A55	100pF±5%
C715 thru 718	2113740A46	47pF±5%;50V
C719, 720	2362998C09	1
C721	2113740A46	47pF±5%;50V
C722, 723	2113740A40	30pF±5%;50V
C724	2362998C09	1
C725	2362998B73	10±20%
C726 **	-----	
C727 **	-----	
		DIODE: See Note I
CR701 thru 705	4805129M24	Switching
L701, 702 **	-----	**COIL:** 0.39uH Choke
LS701	5005155Q03	**TRANSDUCER**
MK701 **	-----	**MICROPHONE**
		PLUG:
P701 **	-----	Contacts, flex circuit plating
P702 **	-----	Socket, 10-Pin
		TRANSISTOR: See Note I
Q701	4805128M11	SOT
Q702	4805218N11	D-MOS
Q703	4805128M11	SOT
		RESISTOR, Fixed: Ω **±5%;1/10W** unless stated
R701	0660076H41	4.7Meg
R702	0660076B14	360k: See Note III
R703	0660076B25	1Meg
R704, 705	0660076B01	100k
R706	0660076A19	56;1/8W
R707	0660076B01	100k
R708	0660076A81	22k
R709	1860502A17	Pot., 47k
R710	0660076B01	100k
R711	0660076A89	47k
R712	0660076B14	360k
R713	0660076B05	150k
R714, 715	0660076A07	18
R716	0660076B17	470k
R717	0660076B01	100k
R718	0660076B17	470k
R719	0660076B13	330k
R720	0660076A35	270
R721	0660076A89	47k
R722	0660076B25	1Meg
R723	0660076A89	47k
R724	0660076A73	10k
R725	0660076B01	100k
R726	0660076B25	1Meg
R727, 728	0660076B01	100k
R729	0660076A19	56
R730	0660076A73	10k
R731	0660076M01	0 (NTN5040A only)
		SWITCH:
S701	-----	Program, Single-Pole (Not replaceable, order DTMF Front Cover Kit)
S702	-----	Keypad (Not replaceable, order DTMF Front Cover Kit)
		CIRCUIT MODULE: See Note I
U701	0105953P31	Tone Generator
U702	5105469E51	Audio Amplifier
U703	0105953P32	Quad NOR Gate
U704	0105954P13	Analog Switch
U705	5105469E52	Hall Effect Digital Switch (NTN5395A only)
U706	5160880B01	5-Volt Regulator
		DIODE: See Note I
VR703 **	-----	Zener, 5.6V
		CRYSTAL: See Note II
Y701	4805719G04	3.579 MHz Resonator

NOTES:

I. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.

II. When ordering crystal units, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.

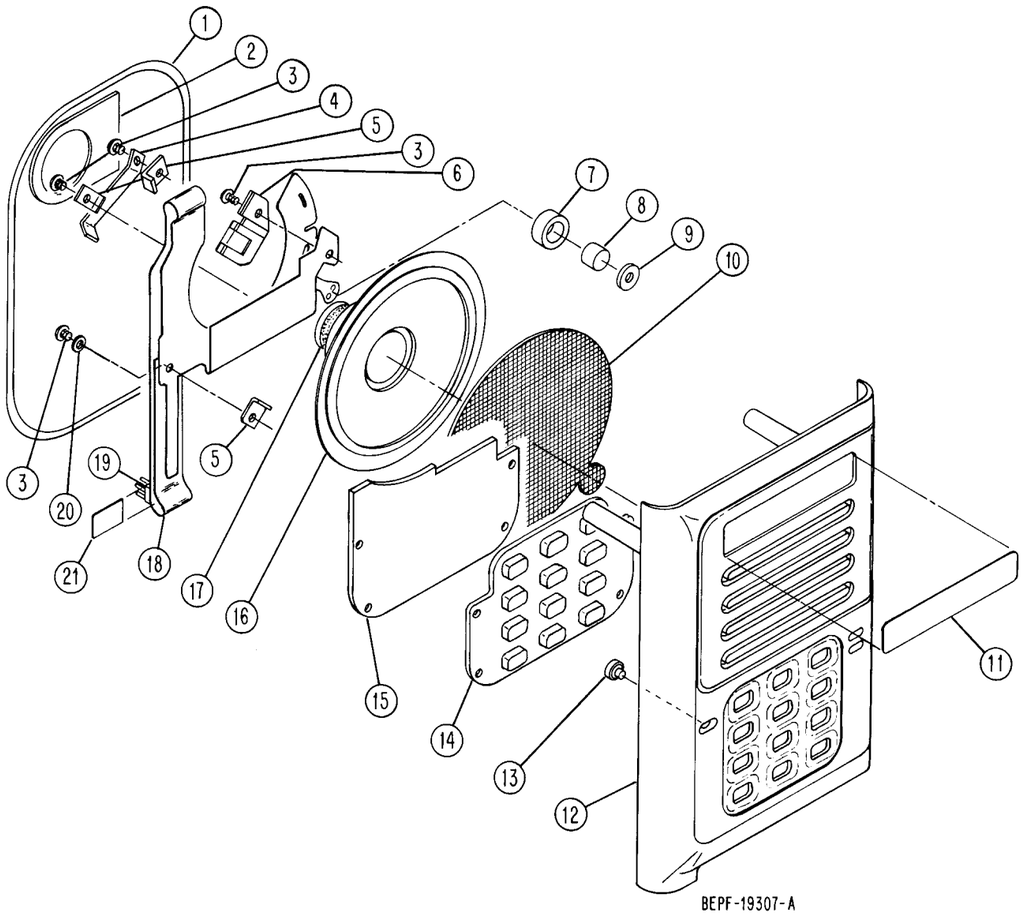
III. DTMF radios transmit timed DTMF tones. These tones are preset at the factory for 150ms. duration. To accommodate equipment with timing requirements other than 150ms., the tone duration can be changed by changing resistor R702, which is located between pins 2 and 18 of U701. Refer to the TONE DURATION CHART for specific values.

** Not field replaceable, order microphone flex assembly 0102700J18

TONE DURATION CHART

R702 USER-SELECTABLE VALUES			
MOTOROLA PART NUMBER	VALUE OHMS ±5%	TONE DURATION RANGE (ms)	TONE DURATION NOMINAL Tn (ms)
0660076B10	240k	94 - 108	101
0660076B12	300k	117 - 135	126
0660076B14	360k	141 - 162	150
0660076B16	430k	168 - 193	180
0660076B17	470k	184 - 211	197
0660076B18	510k	199 - 229	214
0660076B19	560k	219 - 252	235
0660076B20	620k	242 - 279	260
0660076B21	680k	266 - 306	285
0660076B22	750k	293 - 337	315
0660076B23	820k	320 - 368	344
0660076B24	910k	355 - 409	382

TEPF-18743-O



BEPF-19307-A

Exploded View Parts List TPLF-3743-O

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	3205141Q01	O-RING, Front Cover
2	1405299Q01	INSULATOR, Speake
3	0300139444	SCREW, #2-56x5/32"
4	3905178S01	CONTACT, Front Cover
5	4205166S01	CLAMP, Speaker
6	4205167S01	RETAINER, Microphone
7	1405299L01	BOOT, Microphone
8	-----	MICROPHONE, part of item 18
9	7505564S01	PAD, Microphone
10	3505152J01	FELT, Speaker
	1105776R01	ADHESIVE, Speaker Felt, part of item 10
11	NTN5098A	NAMEPLATE
12	-----	* FRONT COVER
13	-----	* SWITCH, Actuator
14	-----	* SWITCH, Keypad
15	-----	* CIRCUIT BOARD
16	See Note	SPEAKER
17	7505501R02	PAD, Speaker
18	See Note	FLEX, Microphone (MK701) includes items 7, 8, 16 & 19
19	2805433R02	PLUG, PCB
20	0484345A06	WASHER, Seal

NOTE: See Electrical Parts List for number and description.

* Not field replaceable. Order applicable DTMF Front Cover Kit.

MOTOROLA INC.

NTN5697A
DTMF Encode/Decode Option for MT1000™ Handie-Talkie® Portable Radios

1. DESCRIPTION

The NTN5697A Dual-Tone Multi Frequency (DTMF) Encode/ Decode Option is compatible with the MT1000 "B" model radio and is capable of encoding and decoding standard DTMF tones. Encode is a continuous tone with no memory.

The DTMF section is capable of decoding one to three number sequences of one to seven digits in length. The number sequences are classified as follows:

Sequence 1: Unit ID
Sequence 2: Group Call I
Sequence 3: Group Call II

The decode sequences are programmable via the front cover keypad. A user lockout function incorporating a "Hall Effect Device" is available to those users who do not want others to modify the memory content. This option is enabled by removing R920; a programming tool must now be used to program the option (part no. 01R80358A59).

The decoder responds to a correct Unit ID by emitting five sequential alert tones (1640Hz) of 150 ms in length. The option then automatically keys up the radio and sends out an acknowledge alert. The decoder responds to a correct Group Call I sequence by emitting two sequential alert tones (1640Hz); there is no auto acknowledge. A correct Group Call II sequence results in a single alert tone of 1.5 sec. in length; again, there is no auto acknowledge.

The DTMF decoder is enabled on a per channel basis by the field programmer by enabling the Unit ID feature in the per channel options menu. Pressing and releasing the monitor button will mute the radio's receive audio path until a correct sequence is decoded or the PTT switch is pressed. The decoder will still be active even if the monitor button is not pressed; this allows users to monitor channel activity as desired.

2. OPERATION

The programming button must be pressed at all times during programming. Pressing the programming button followed by pressing the "# " key one time causes all memory locations to be erased once the programming button is released. The programming tool must be used if memory lockout is enabled.

To program decode sequences, press the programming button and enter the numbers on the keypad; each sequence can be from one to seven numbers in length. If you want to enter a " # " in your decode sequence, the "# " key has to be pressed twice. A Unit ID is stored in location 1 ; to store your number in location 1, enter the number followed by "# 1". Group Call I sequences are loaded into location 2 ; to store your sequence in location 2, use the command "#2 ". Group Call II sequences are stored in location 3 in the same manner(#3). Memory location 4 is used to enable and disable the auto acknowledge alert ; a 0 in location 4 disables and a 1 enables. To encode DTMF, press the PTT switch and enter the numbers on the keypad. To squelch the receiver, press and release the monitor button.

3. THEORY OF OPERATION

This option receives its power from the radio's 8V regulator, which is supplied to the input of the 5V regulator consisting of U905, Q903 and associated circuitry. Regulated 5V supplies power to the remainder of the circuitry on the board.

Circuit U902 is a DTMF transceiver which encodes and decodes standard DTMF tones.Circuit U902 receives its operating voltage from the 5V regulator via Q904. Transistor Q904 is turned on by microcomputer (uC) U901 when pin 34 is pulled low. In the standby mode, Q904 is turned off to minimize current drain. Circuit U902 receives its frequency reference from the color burst crystal Y902.

When the radio is in the receive mode, audio from the output of the demodulator is supplied to the input

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68P81064C55-O

of U902 pin 2. Resistors R912 and R913 set the gain of a preamplifier internal to the integrated circuit. If a valid tone pair is read, the IRQ line (U902 pin 18) is pulled low and the number corresponding to the tone is fed to data lines D0 through D3. The uC senses that the IRQ line was pulled low and clocks in the output of the decoder. The number is placed into a buffer and is compared against the numbers programmed into the code plug in the program mode. The uC will continue to clock in numbers received by the decoder; if a correct sequence of numbers is received, it will signal the radio via the shorthorn data bus U901 pins 20 and 11 to turn on the alert tone path.Microcomputer U901 will control the alert tone path and issue the appropriate alert tone. If an acknowledge signal is to be sent, U901 will signal the radio (via the data bus) to key up and enable the transmit audio path. Circuit U902 will generate the acknowledge tone and will be via pin 12.

If the program button is pressed (programming tool must be used if user memory lockout option has been enabled), the uC will read the keypad. Any entries on the keypad will be placed in a buffer. The command #1, #2, or #3 will place the number sequences entered into their dedicated buffers (Unit ID, Group Call I, and Group Call II buffers). Releasing the program buttons will result in the dedicated buffers being downloaded into the code plug U903. The number sequences are now in non-volatile memory. Whenever the radio is turned on, the contents of the code plug will be read and placed into the dedicated buffers.

The code plug receives its power from regulated 5V via Q901. Transistor Q901 is turned on when U901 pin 14 is pulled low. The uC will only turn on the code plug when data is to be written or read; this reduces the option's standby current drain. Data is written and read from U903 serially; data is received by the code plug on pin 2 and is clocked in by pin 5. Data is fed to the uC on pins 3 and 6.

If the radio PTT switch is pressed, the uC reads the keypad to see if it is being pressed. If a key is being pressed, the uC interprets the number and sends the data to a buffer. The uC then configures U902 to the encode mode and sends this data to pins D0 through D3. The tone generator then outputs the corresponding tone pair on pin 12. The uC will then configure the radio's transmit auxiliary and alert tone path (via shorthorn data bus), and the DTMF tone will be transmitted. Meanwhile, the uC continues to read the keypad and when it senses that the key has been released, the tone is turned off and the alert and transmit aux paths are turned off.

The uC receives its reference frequency from crystal Y901. Components L901, Q902 and associated circuitry are used to shift the crystal frequency slightly if the radio is programmed for a self quieting channel.

Electrical Parts List TPLF-3833-O

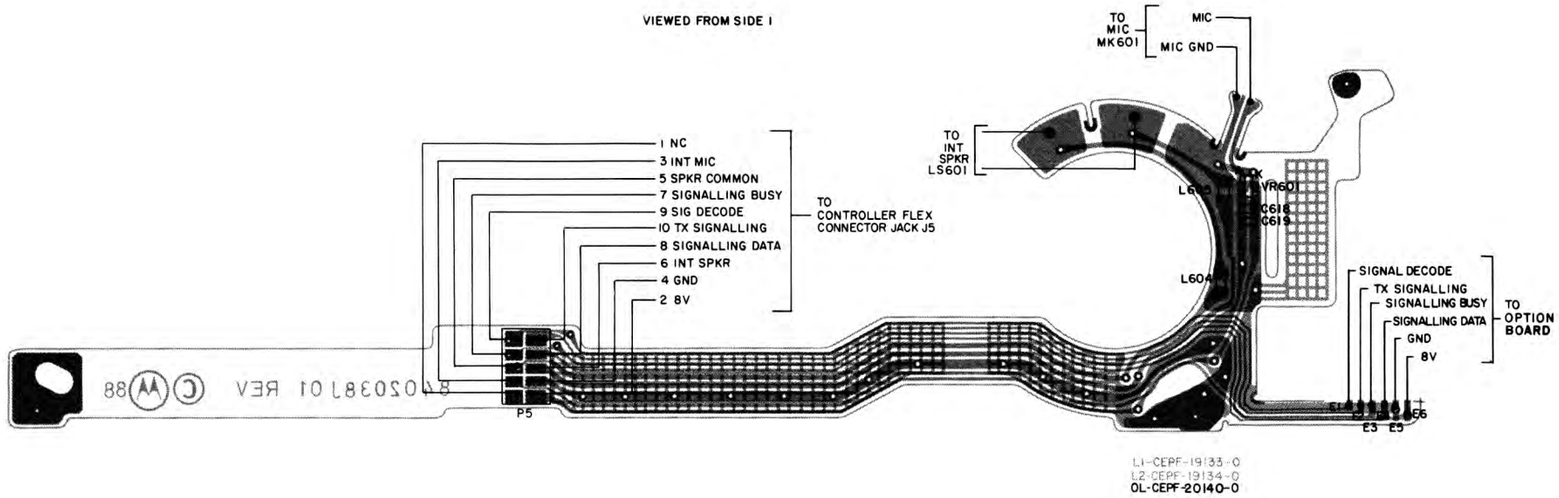
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF ±5%; 1/8W unless stated
C901	2160521G37	100nF+80-20%
C902	2113740A38	24
C903	2113740A53	82
C904,C905	2113740A40	30
C906	2113741A21	1000
C907 thru C909	2160521G37	100nF+80-20%
C910	2113740A67	330
C911 thru C913	2113740A53	82
C914	2160521G37	100nF+80-20%
C915	2113740A38	24
C916	2160521G37	100nF+80-20
		COIL:
L901	2460590A02	Inductor
L902	.....	Not Used
L903,L904	2462575A03	Choke, 0.820uH
		TRANSISTOR: See Note I
Q901 thru Q904	4805128M94	PNP
		RESISTOR, Fixed:Ω±5%; 1/8W unless stated
R901 thru R907	0660076B01	100k
R908 thru R910	0660076A73	10k
R911	0660076A59	2.7k; 1/10W
R912 ,R913	0660076B01	100k
R914	0660076B11	270k
R915	1860502A17	Pot,47k
R916	0660076H49	10Meg
R917	0660076A25	100;1/10W
R918	0660076A73	10k;1/10W
R919	0660076B01	100k
R920	0660076M01	0
R921	0660076A73	10k;1/10W
R922	0660076M01	0
R923	0660076A59	2.7k;1/10W
R924	0660076A61	3.3k;0.1W
R925	0660076B25	1Meg;1/10W
		SWITCH:
S901	-----	Keypad
S902	-----	Program
		CIRCUIT MODULE: See Note I
U901	0105956Q34	Microcomputer, Programmed UVC8 05D02
U902	5105469E89	Transceiver, DTMF
U903	0105957N84	Code Plug, CC 26P64
U904	5105469E52	Device, Hall Effect
U905	5160880B01	Regulator, CMOS SOT-89
		DIODE: See Note I
VR901	4880140L09	Zener, 6.2V
		CRYSTAL: See Note II
Y901	4805664G33	3.6864MHz
Y902	4805719G04	3.579MHz Resonator

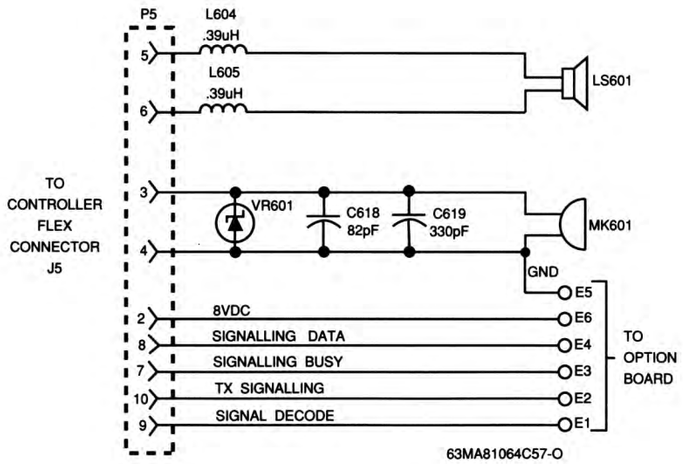
NOTES:

I. For optimum performance, order replacement diodes transistors, and circuit modules by Motorola part number only.

II. When ordering crystal units, specify carrier frequency, crystal frequency, and crystal type number, and Motorola part number.

MICROPHONE FLEX ASSEMBLY





0102700J93
Microphone Flex Assembly

TPLF-3737-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed:pF±5%; 50V, unless stated
C618	2113740A53	82
C619	2113740A67	330
		COIL, RF: unless stated
L604,L605	2462575A01	390nH
LS601	5005155Q03	**SPEAKER**
MK601	- - - -	**ASSEMBLY, Microphone** (Not field replaceable, order assembly 0102700J93).
		DIODE: See Note
VR601	4880140L09	6.2V Zener

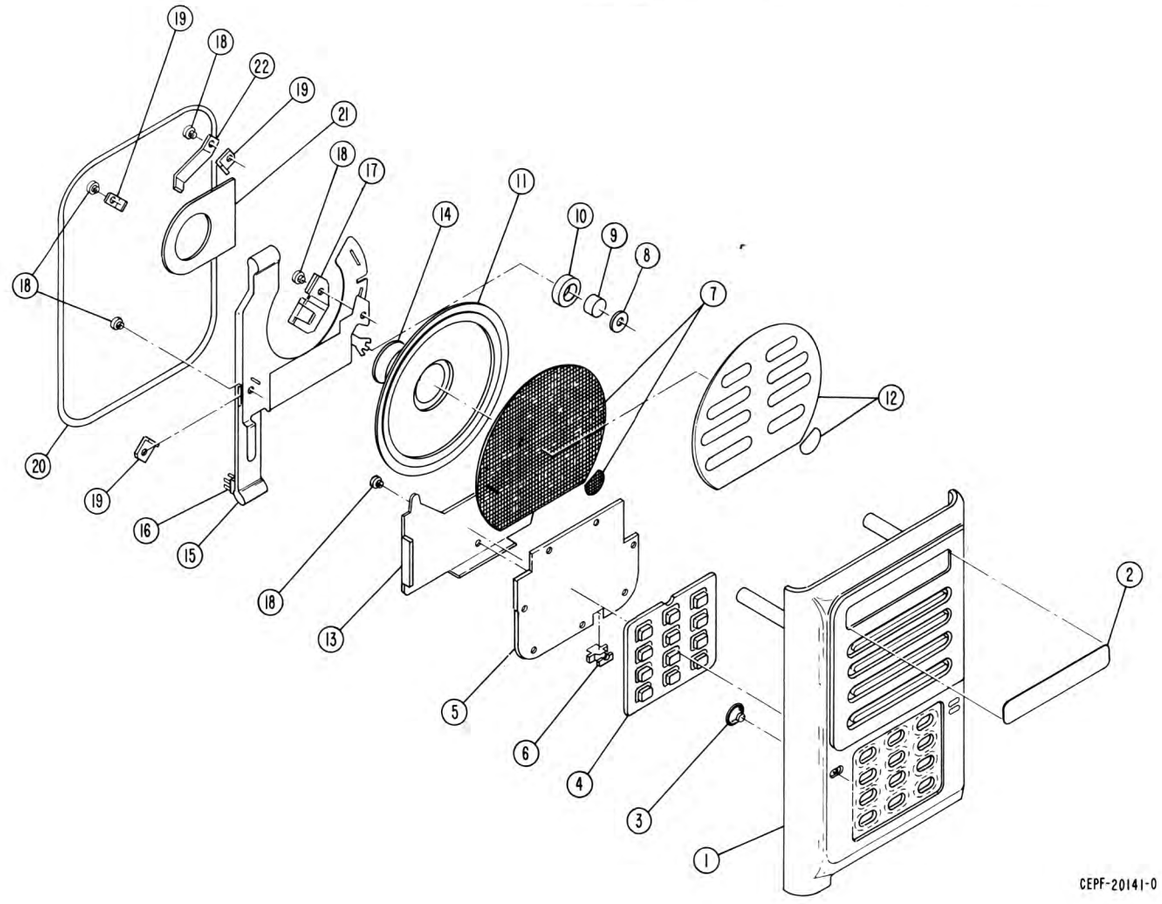
NOTE: For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.

Exploded View Parts List

TPLF-3811-O

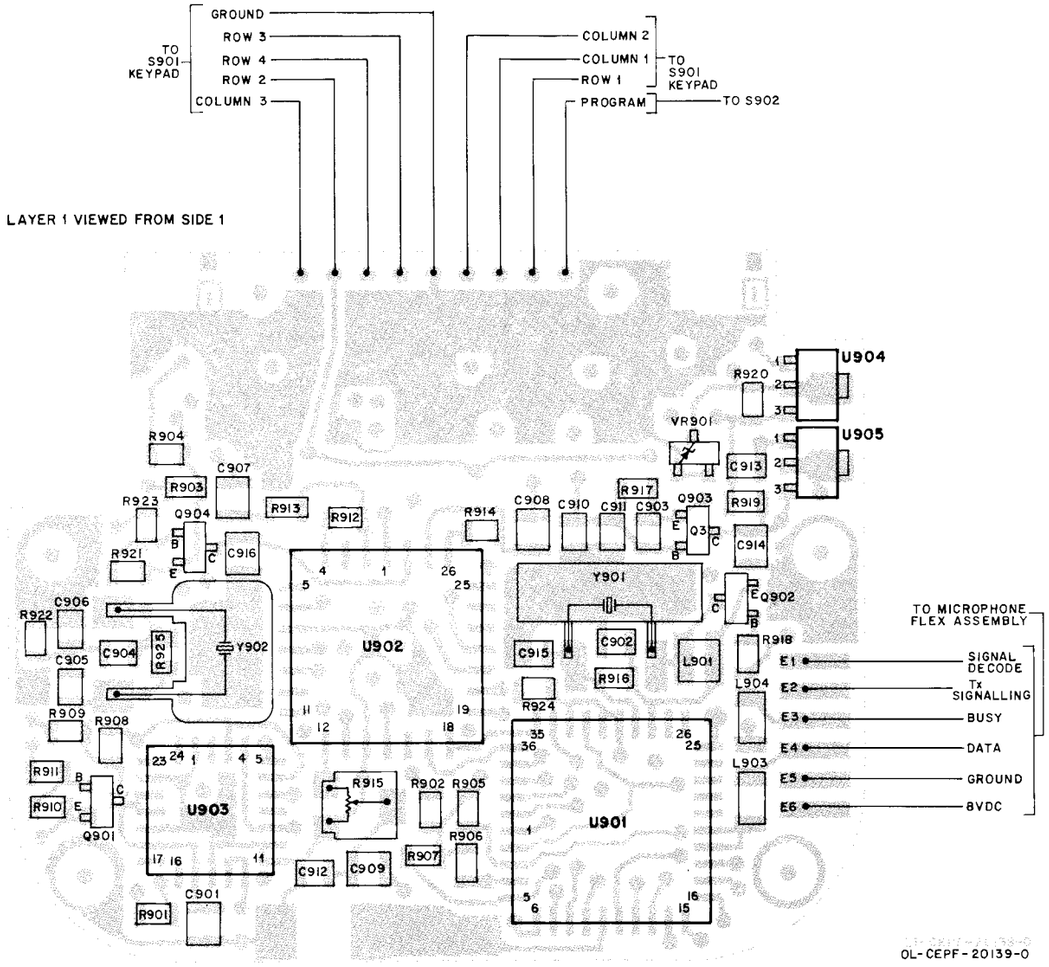
ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	1505155S01	COVER, Front
2	3305260Q01	NAMEPLATE
3	- - - - -	KEYPAD, Single
4	- - - - -	KEYPAD, 3"X4"
5	- - - - -	BOARD, DTMF Encode/Decode
6	- - - - -	INSERT, Shield
7	- - - - -	FELT, Speaker
8	7505564S01	PAD, Microphone
9	See Note	MICROPHONE
10	1405299L01	BOOT, Microphone
11	See Note	SPEAKER (LS601)
12	- - - - -	ADHESIVE
13	2602042J02	SHIELD, PC Board
14	7505501R02	PAD, Speaker
15	See Note	ASSEMBLY, Microphone Fle (MK601) includes items 9 thru 11, 15, and 16
16	2805433R02	PLUG, 10-Position
17	4205167S01	RETAINER, Mic/Spkr.
18	0300139444	SCREW, 2-56" x 5/32"
19	4205166S01	CLAMP, Speaker
20	3205141Q01	O- Ring, Front Cover
21	1405299Q01	INSULATOR, Speaker
22	3905178S01	CONTACT, Front Cover

NOTE: Refer to Microphone Flex Assembly Parts list for part number and description.

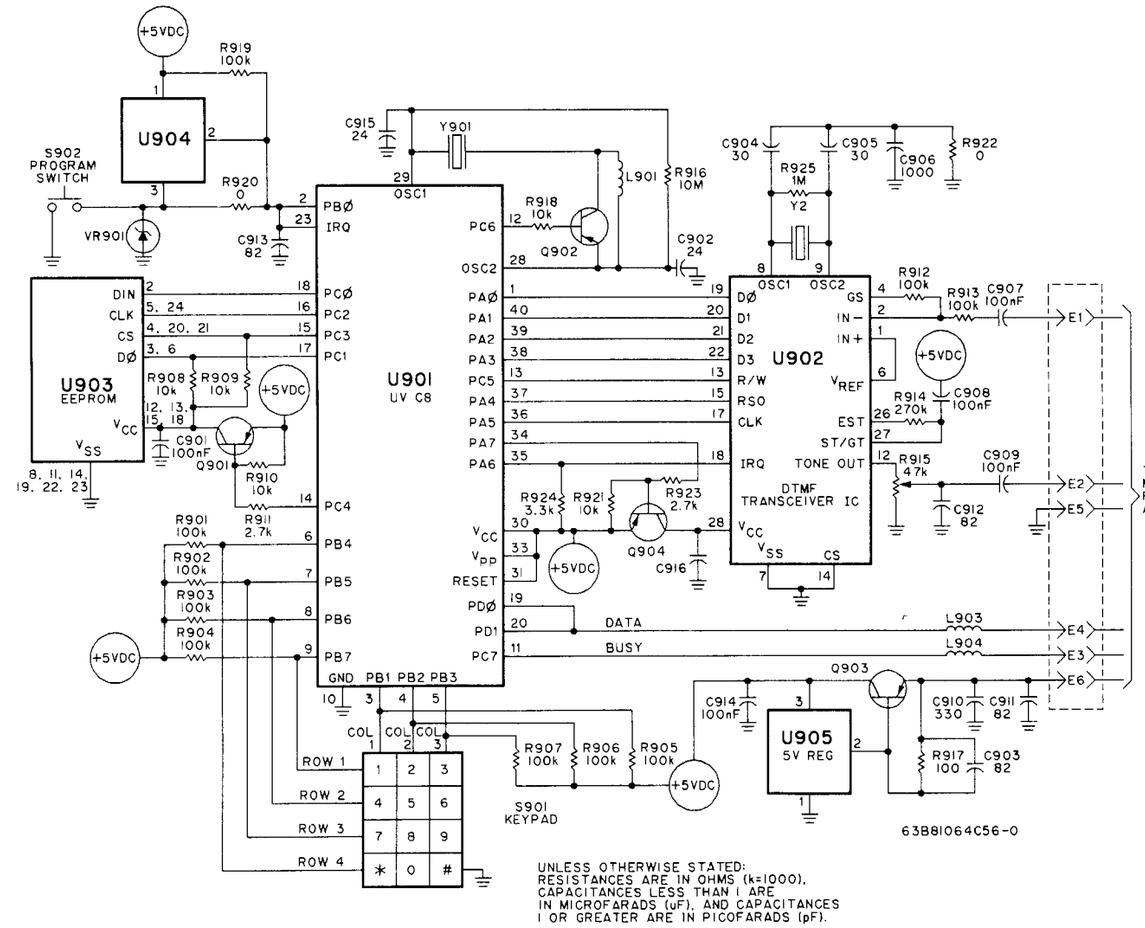


MICROPHONE FLEX ASSEMBLY SCHEMATIC DIAGRAM, COMPONENT LOCATION DETAIL & PARTS LIST, AND EXPLODED VIEW & PARTS LIST

CIRCUIT BOARD COMPONENT LOCATION DETAIL



SCHEMATIC DIAGRAM



UNLESS OTHERWISE STATED:
RESISTANCES ARE IN OHMS (k=1000).
CAPACITANCES LESS THAN 1 ARE IN MICROFARADS (uF), AND CAPACITANCES 1 OR GREATER ARE IN PICOFARADS (pF).

MOTOROLA INC.

REMOTE SPEAKER MICROPHONES

MODELS NMN6145A NMN6155A NMN6156A

1. DESCRIPTION

Remote Speaker Microphones NMN6145A, NMN6155A, and NMN6156A, all include a speaker, a microphone, a push-to-talk (PTT) switch, and associated circuitry. Each of the speaker microphones also includes a cable and connector assembly, terminated with a special plug, for attaching to the universal connector on the portable radio. The NMN6145A and NMN6156A Speaker microphones use a belt clip for attaching the unit to a user. The NMN6155A Speaker Microphone uses a Velcro® patch for attaching the unit to a user, and requires a corresponding Velcro Patch kit NLN8410A, which is available separately.

Also, the NMN6145A Speaker Microphone includes a 2.5mm earphone jack, which is attached to and located on the special plug.

When the remote speaker microphone is attached to the radio, the speaker in the radio is disabled, and receiver audio is connected to the accessory speaker. Similarly, the accessory microphone is connected to the transmitter, and the accessory PTT switch can now control the PTT function in the radio. The radio microphone and PTT switch are still operational, but you can listen to the radio only through the accessory speaker.

When a secondary receiver audio accessory is plugged into the earphone jack (NMN6145A), audio to the remote speaker microphone is disconnected and rerouted to the secondary audio accessory.

NOTE

Observe safety information in the radio operating instructions.

2. OPERATION

a. Attach the microphone's accessory connector to the universal connector on top of the radio.

b. Firmly tighten the captive screw of the accessory connector into the threaded hole (middle of universal connector). The maximum recommended torque is 4 in. lbs.

Figure 1.

c. While listening to the accessory speaker, turn the radio on and operate it as explained in the operating instructions supplied with the radio.

d. The microphone will perform best if it is worn as shown in Figure 1.

3. HANDLING PRECAUTIONS

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

a. Prior to and while servicing a remote speaker microphone, particularly after moving within the service area, momentarily place both hands on a bare metal, earth-grounded surface. This will discharge any static charge which may have accumulated on the person doing the service.

CAUTION

Wearing a conductive wrist strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

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WARNING

When wearing a conductive wrist strap, be careful near high voltage sources. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentally touching high voltage sources.

b. Whenever possible, avoid touching any electrically conductive part of the unit with your hands.

c. When servicing a unit, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

d. All electrically powered test equipment should be grounded. Apply the ground lead from the test equipment to the unit before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

e. If the microphone cartridge is removed from the unit, place it on a conductive surface, such as a sheet of aluminum foil which is connected to ground through 100k ohms of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

f. When soldering, be sure the soldering iron is grounded.

g. Prior to replacing circuit components or touching the microphone cartridge, be sure to discharge any static buildup. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch the microphone cartridge and associated wiring.

h. Replacement microphone cartridges should be kept in conductive packaging until they are placed in the unit.

4. MAINTENANCE

Refer to the schematic diagram, the exploded view, and the parts lists. Every part in the microphone is identified and illustrated for assistance in removal and replacement.

If necessary, the external surfaces of the remote speaker microphone may be cleaned with a 0.5% solution of mild dishwashing detergent in water (one teaspoon of detergent in a gallon of water).

5. OPTION

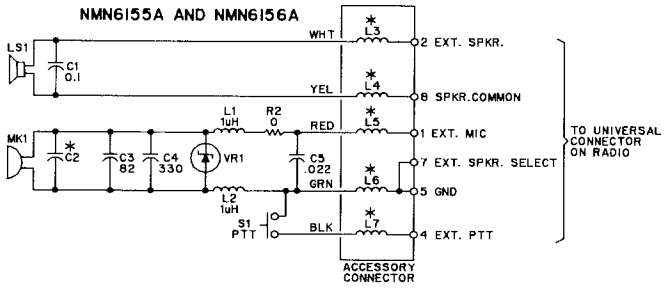
An optional thumbscrew is available that replaces the captive screw, exploded view item 7. The Motorola part number for the replacement thumbscrew is:

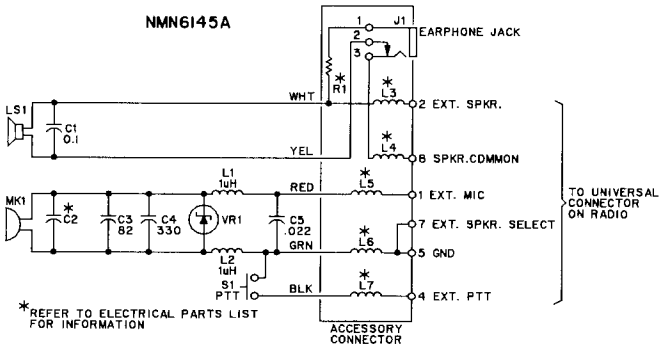
- 0305202T02 (NMN6145A)
- 0305202T03 (NMN6155A and NMN6156A)

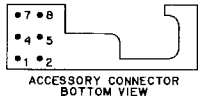
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR: Fixed: pF±5% unless otherwise stated
C1	2160521D37	0.1µF
C2	-----	Not field repairable, order Microphone Assembly (MK1)
C3	2160520B23	82
C4	2160520C13	330
C5	2160521A29	.022µF
J1	0902126J02	**JACK, Earphone;** 2.5mm mono (NMN6145A only)
		COIL, RF: unless otherwise stated
L1, 2	2462575A04	Choke, 1µH
L3 thru 7	-----	Not field repairable, order Cable and Connector Assembly (Exp. View Item 6)
LS1	5005910P03	**SPEAKER:** 1 3/4"; 28Ω
MK1	0105953N48	**ASSEMBLY, MICROPHONE:** Electret, includes capacitor C2
		RESISTOR, Fixed:
R1	-----	Not field repairable (NMN6145A only), order Cable and Connector Assembly, Exp. View item no. 6.
R2	0660076M01	DΩ (NMN6155A and NMN6155A and NMN6156A only)
S1	3905834K04	**SWITCH:** Dome, PTT
VR1	4880140L14	**DIODE, Zener:** 9.1V

NOTE:

1. For optimum performance, order replacement diodes and circuit modules by Motorola part number only.







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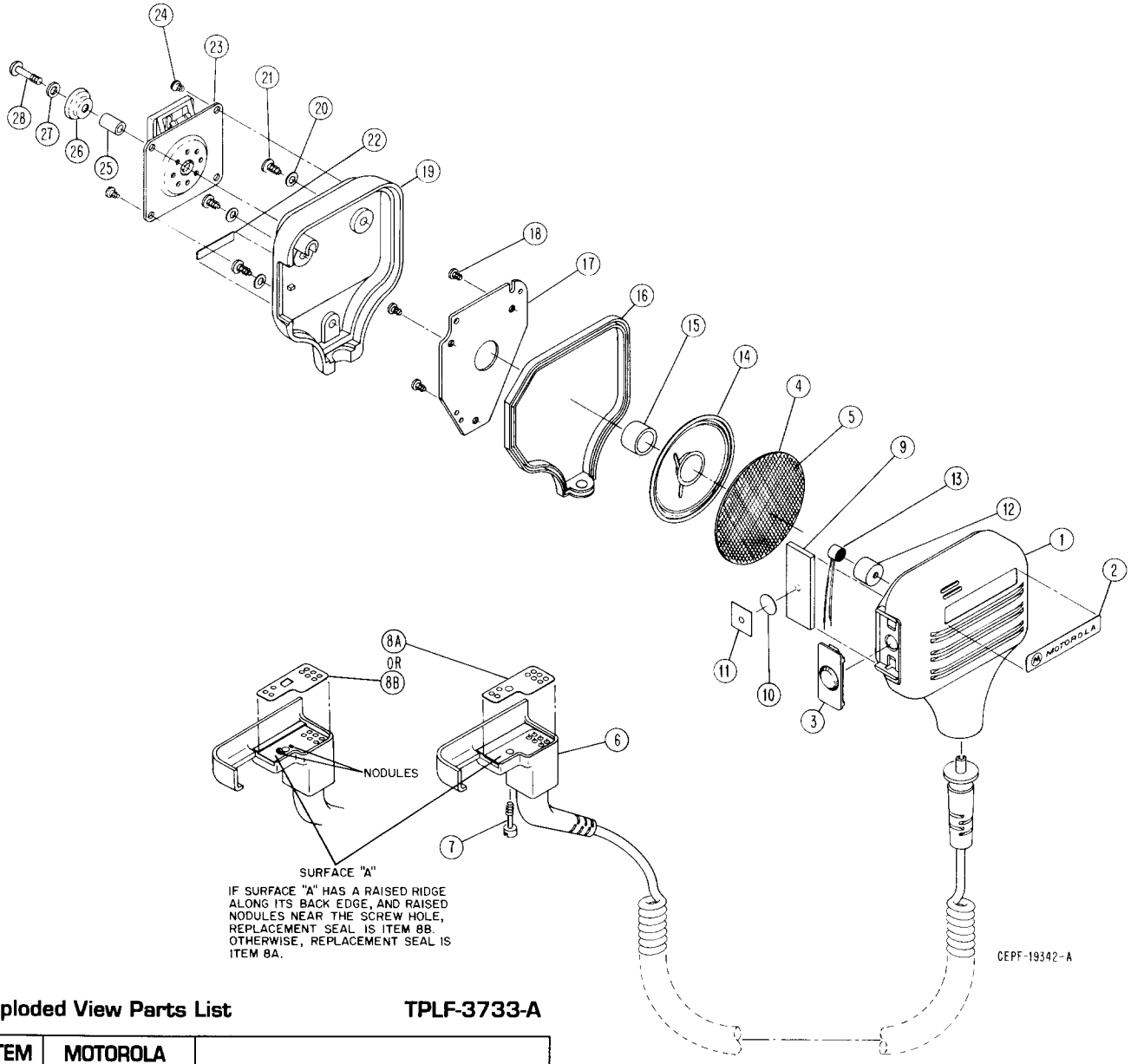


Exploded View Parts List — TPLF-3733-A

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0102701J97	ASSEMBLY, Front Housing; includes items 1 thru 5
2	3305259Q01	NAMEPLATE, Motorola
3	0102701J96	LEVER, PTT
4	3505152J01	GRILLE CLOTH
5	1105461R01	ADHESIVE
6		ASSEMBLY, Cable and Connector; includes items 6, 7, and 8
	0102701J87	(NMN6145A)
	or 0102701J45	(NMN6155A and NMN6156A)
7		SCREW, Captive (See text, paragraph 5)
	0305425R02	(NMN6145A)
	or 0305425R03	(NMN6155A and NMN6156A)
8A	3205378T01	SEAL
8B	or 3205884T01	SEAL
9	0105953N46	ASSEMBLY, PC Board; includes electrical components
10	See Note	SWITCH, Snap Dome Contact (S1)
11	3205231Q01	SEAL, Dome
12	1405219Q01	BOOT, Microphone
13	See Note	ASSEMBLY, Microphone (MK1); includes items 11 and 12
14	See Note	SPEAKER (LS1)
15	7505283Q02	PAD, Speaker
16	3205690R01	GASKET
17	6405689R01	PLATE, Housing Mounting
18	0300139982	SCREW, Phillips Hd.; 2-56 x 5/32" (3 req'd)
19	1505172Q01	HOUSING, Back
20	0484345A06	WASHER, Seal (3 req'd)
21	0305137Q02	SCREW, Phillips Hd. (3 req'd)
22		LABEL, Kit Number
	5405258Q09	(NMN6145A)
	or 5405258Q10	(NMN6156A)
	or 5405258Q11	(NMN6155A)
23		ASSEMBLY, Attachment
	0105959N54	BELT CLIP (NMN6145A and NMN6156A); shown on Exp. View
	or 7505385P01	VELCRO (NMN6155A)
24		SCREW, Phillips Hd.; 4 req'd
	0300139982	2-56 x 5/32" (NMN6145A and NMN6156A)
	or 0300139939	2-56 x 3/16" (NMN6155A)
25	4382377B71	SPACER
26	0905518D02	SNAP SOCKET
27	0482650D06	WASHER
28	0382210E01	SCREW

NOTE: Refer to Electrical Parts List for part number and description.

MOTOROLA INC.

ADAPTERS

NTN4812A
NTN5075B
NTN5368A
NTN5598A

DESCRIPTION

The following adapters provide a convenient method of connecting remote accessories to many Motorola series Handie-Talkie® portable radios. Each adapter has a connector or connector jack for connecting to the remote accessory, and spring loaded pins, which make positive contact with corresponding mating pins of the universal connector on the radio.

Attaching any of the three adapters to the radio does not disable or alter the radio's operation in any way. But, when the adapter is attached to the radio and terminated at the other end with a remote accessory, the radio's corresponding function of that remote accessory is disabled. For example, if the NTN5368A RF Adapter is attached to the radio and connected to a remote antenna, the radio's antenna becomes nonfunctional.

- The NTN4812A Adapter provides an earphone jack that connects the radio to audio accessories using a 3.5mm phone plug. A 3.5mm to 2.5mm jack (part number 5880378B84) can be used with this adapter to connect the radio to audio accessories using a 2.5mm phone plug.

- The NTN5368A Adapter provides an rf port that connects the radio to a remote antenna. This adapter requires an NKN6408A Cable Kit.

WARNING

DO NOT plug an audio accessory into the NTN5368A RF Adapter and transmit.

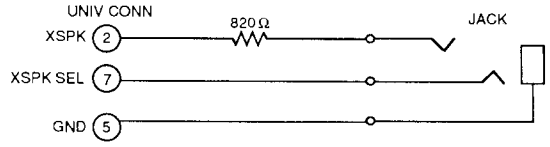
The NTN4812A Earphone Adapter and the NTN5368A RF Adapter look alike. The NTN5368A RF Adapter is marked with an antenna symbol on the top surface of the housing near the antenna jack. Be careful not to mistake one adapter for the other.

- The NTN5075B Adapter provides a six-pin jack to connect the radio to two-piece and three-piece audio accessories.

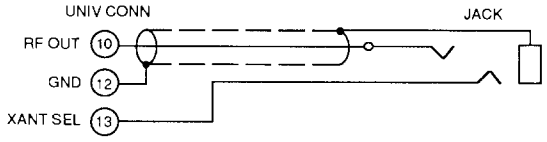
- The NTN5598A Adapter provides a six-pin jack (like the NTN5075B) to connect the radio to two-piece and three-piece audio accessories. This adapter applies to radios with B+ at the universal connector pin 3. When connected to the radio, the adapter routes battery voltage (B+) to the six-pin jack at pin 2.

The NTN5075B and NTN5598A Adapters are similar and look alike. Both units have a six-pin jack, but differ at the universal connector end. The NTN5075B Adapter has five pins and the NTN5598A Adapter has six pins.

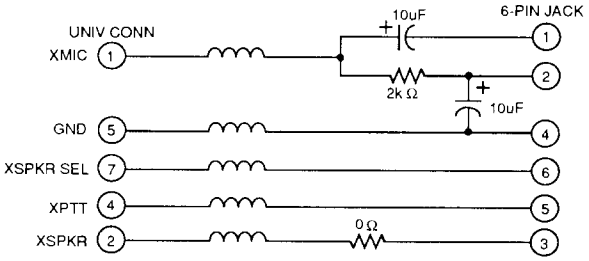
NTN4812A EARPHONE JACK ADAPTER



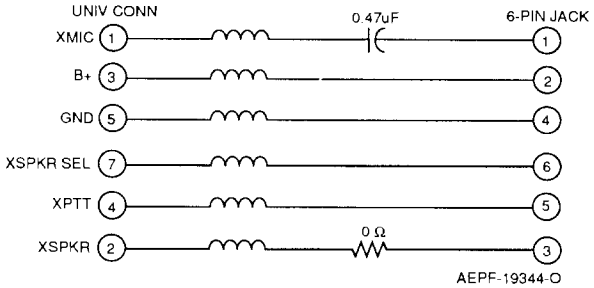
NTN5368A RF ADAPTER



NTN5075B UNIVERSAL CONNECTOR ADAPTER



NTN5598A UNIVERSAL ADAPTER WITH B+



AEPF-19344-O

Instruction Manual

68P81107C30-A

MOTOROLA INC.

PUBLIC SAFETY MICROPHONES
MODELS NTN5050A, NTN5493A, NTN5881A, & ZLN6416A (for UHF Models Only)

1. DESCRIPTION

Public Safety Microphones (PSM's) NTN5050A, NTN5493A, NTN5881A, and ZLN6416A include a microphone, a push-to-talk (PTT) switch, a high/low volume switch, and associated circuitry. Each of the public safety microphones also includes a cable and connector assembly, terminated with a special plug, for attaching to the universal connector on the portable radio. The NTN5050A PSM uses a Velcro® patch for attaching the unit to a user, and requires a corresponding Velcro® Patch Kit NLN8410A, which is available separately. The NTN5493A PSM uses a belt clip for attaching the unit to a user. The NTN5881A and ZLN6416A PMSs have a lower profile accessory connector, which allows for easier access to the volume and frequency knobs. The NTN5881A and ZLN6416A PSMs also include an earphone jack in the accessory connector. In order for the PSM to operate properly, a removable antenna, designed for the desired frequency band, must be ordered separately and installed on the PSM.

When the PSM's accessory connector is connected to the radio's universal connector, the speaker and antenna in the radio are disabled, and the speaker and antenna in the PSM are enabled. The radio's PTT switch and internal microphone still operate normally. If the PSM's PTT switch is used to activate the radio's transmitter, the PSM's microphone must also be used; if the radio's PTT switch is used, the radio's microphone must be used as well. In either case, the radio can be listened to only through the remote speaker.

A high/low volume switch, S2, allows the user to monitor the audio at a low volume level, then to immediately switch to a high volume level without resetting the volume control on the radio. This feature is especially useful when the radio is worn on the belt and the speaker microphone is on the lapel or shoulder, as shown in Figure 1.

NOTE

Observe safety information in the radio operating instructions.

2. OPERATION

a. Attach the microphone's accessory connector to the universal connector on top of the radio.

b. Firmly tighten the captive screw of the accessory connector into the threaded hole (middle of universal connector). The maximum recommended torque is 4 in. lbs. (A knurled thrumbscrew is provided as an alternate replacement to the standard slotted screw.)

Figure 1.

c. Turn the radio on and operate it as explained in the operating instructions supplied with the radio. Listen to the radio through the PSM's speaker.

d. Set the "high-low" switch on the speaker microphone to the "low" position to monitor audio at a low volume; for a high volume level, set the switch to the "high" position.

e. The microphone will perform best if it is worn with the antenna above the shoulder as shown in Figure 1.

f. A radio antenna bushing boot (Motorola part number 3205782P01) is provided to cover the radio antenna bushing.

3. HANDLING PRECAUTIONS

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions:

a. Prior to and while servicing a public safety speaker microphone, particularly after moving within the service area, momentarily place both hands on a bare metal, earth-grounded surface. This will discharge any static charge which your body may have accumulated.

CAUTION

Wearing a conductive wrist strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

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WARNING

When wearing a conductive wrist strap, be careful near high-voltage sources. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentally touching high-voltage sources.

b. Whenever possible, avoid touching any electrically conductive part of the unit with your hands.

c. Because they contribute to static buildup, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) when servicing a unit.

d. All electrically-powered test equipment should be grounded. Connect the ground lead from the test equipment to the unit before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

e. If the microphone cartridge is removed from the unit, place it on a conductive surface, such as a sheet of aluminum foil, which is connected to ground through 100k ohms of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil and other electrical circuits at the same time.

f. When soldering, be sure the soldering iron is grounded.

g. Prior to replacing circuit components or touching the microphone cartridge, be sure to discharge any static buildup. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch the microphone cartridge and associated wiring.

h. Replacement microphone cartridges should be kept in conductive packaging until they are placed in the unit.

4. MAINTENANCE

Refer to the schematic diagram, the exploded view, and the parts lists. Every part in the speaker microphone is identified and illustrated for assistance in removal and replacement.

If disassembly of the public safety microphone is required, do not reassemble it without doing the following (numbers in parentheses refer to item numbers in the exploded view):

- Remove the O-ring (22) from the cover assembly (16).
- Inspect the seal areas around the housing (1) and the cover (16) for foreign material which might prevent the O-ring from sealing properly.
- Inspect O-ring (22) and both cover screw O-rings (18). If any of these are split, cracked, or damaged in any way, discard and replace them.
- If the main printed circuit board (14) is removed, remove the speaker spacer (27) and inspect the membrane of the seal pad (28) for tears or holes. If the membrane is damaged, remove it, being careful to remove all old adhesive, and replace it with a new seal pad.

NOTE

When replacing the seal pad (28), it is critical that the small seal pad opening be aligned with the microphone port in the housing.

- Tighten all hardware loosened or removed during disassembly per the values listed in the Torque Specifications table. Use the recommended torque driver (Sturtevant PM-5 Rototorq Tool or equivalent).

TORQUE SPECIFICATIONS

APPLICATION	TORQUE (IN.LBS.)	TORQUE (N-m)	TORQUE BIT NO.
Cover Screws	6	.68	6680321B78
PC Board Screws	4	.45	6680321B78
Velcro Pad Screws	4	.45	6680321B78
Toggle Switch Boot	3	.34	6680370B99
RF Connector Nut	20	2.27	6680371B01
Accessory Connector Captive Screw	4	.45	-----

If necessary, the external surfaces of the speaker microphone may be cleaned with a 0.5% solution of mild dishwashing detergent in water (one teaspoon of detergent in a gallon of water.

ELECTRICAL PARTS LIST

TPLF-3552-B

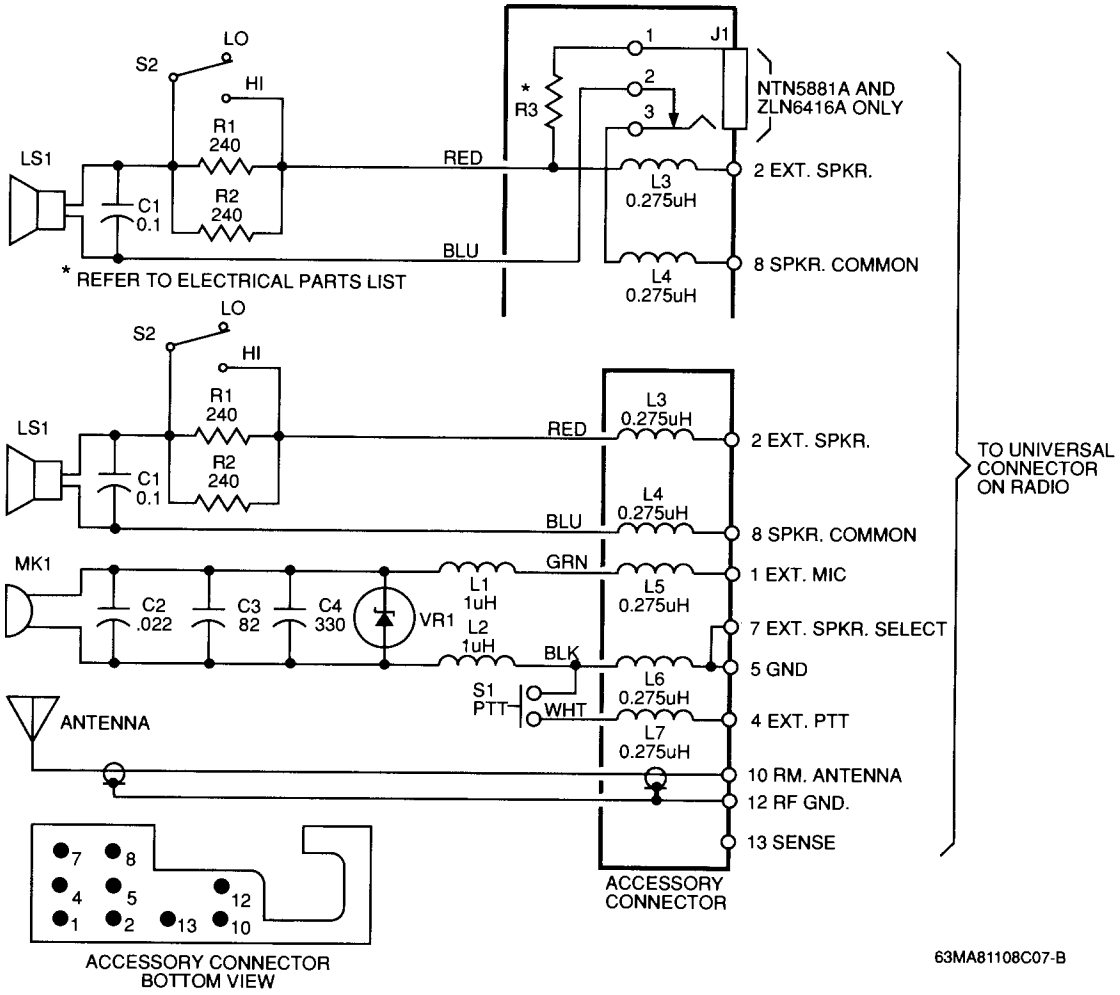
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR: Fixed: pF ±5%; unless otherwise stated
C1	2160521D37	0.1µF
C2	2184008H08	.022µF
C3	2160520B23	82
C4	2160520C13	330
J1	0905101S02	**JACK,** Earphone (NTN5881A and ZLN6416A)
		COIL, RF: unless otherwise stated
L1, 2	2462575A04	Choke, 1µH
L3 thru 7	2405452C08	Choke, 0.275µH
		SPEAKER:
LS1	5005910P03	1-3/4"
		MICROPHONE:
MK1	5005227J02	Electret
		RESISTOR, Fixed:
R1, 2	0611024A34	240Ω±5%; 1/4W
R3	- - - - - - - - -	Not Field Replaceable, order NTN5881A or ZLN6416A as applicable
		SWITCH:
S1	3905834K05	Dome, PTT
S2	4005680K04	Toggle
VR1	4880140L14	**DIODE, Zener:** 9.1V

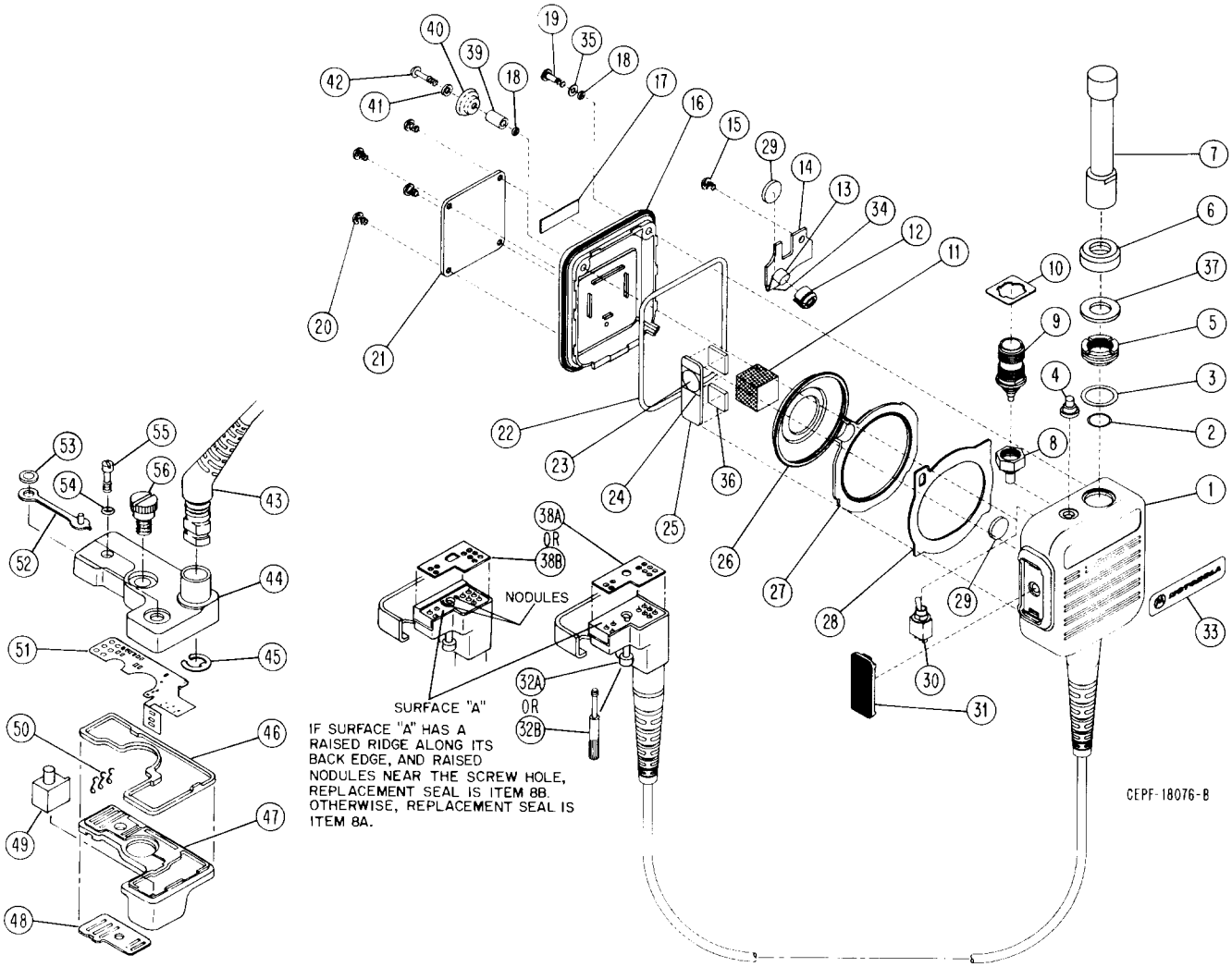
NONREFERENCED ITEMS		
	NAE6131A	ANTENNA, Helical (400-440MHz) (See Note II)
	or NAE6132A	ANTENNA, Helical (440-470MHz) (See Note II)
	or NAE6133A	ANTENNA, Helical (470-512MHz) (See Note II)
	0905261B01	CONNECTOR, RF

NOTES:

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

II. The antenna is not part of the Public Safety Microphone Kit; it must be ordered separately.





Exploded View Parts List

TPLF-3553-D

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	0105954P63	ASSEMBLY, Housing, Cable, and Accessory Connector. Includes items 28, 29, 31, and 32.
2	3205082E69	GASKET, O-Ring
3	0405465C02	WASHER, Plastic
4	0205791P01	NUT, Toggle Seal
5	0205326S01	NUT, Antenna
6	3205325S01	SEAL, Washer
7	See Note	ANTENNA (must be ordered separately)
8	0205541C01	NUT, Special
9	See Note	CONNECTOR, RF
10	0405327S01	WASHER, Bearing
11	7582154D33	PAD, Speaker
12	1405490Q01	BOOT, Microphone
13	See Note	MICROPHONE (MK1)
14	See Note	PRINTED CIRCUIT BOARD, Main
15	0300139047	SCREW, Cutting
16	0105955P12	ASSEMBLY, Cover
17	5405152S01	LABEL, Kit Number (NTN5050A)
	or 5405152S17	LABEL, Kit Number (NTN5881A)
	or 5405152S02	LABEL, Kit Number (ZLN6416A)
18	3205082E03	GASKET, O-Ring (2 req'd.)
19	0382210E19	SCREW, Cover-Captive; #4-40 (2 req'd.)
20	0300139939	SCREW, Pad Retainer (4 req'd.)
21	7505385P01	PAD, Hook (NTN5050A)
	or 0105957Q44	ASSEMBLY, Belt Clip (NTN5493A)
22	3205082E63	GASKET, O-Ring
23	See Note	DOME, PTT (S1)
24	3205264L06	SEAL, PTT
25	See Note	PRINTED CIRCUIT BOARD, PTT
26	See Note	SPEAKER (LS1)
27	4305407R01	SPACER, Speaker
28	3205190R01	PAD, Seal
29	7505136L03	PAD, Silicon Sponge (2 req'd.)
30	See Note	SWITCH, Toggle (S2)
31	4505211R01	LEVER, PTT
32A	0305425R02	SCREW, Captive
32B	0305202T02	THUMBSCREW
33	3305269R01	LABEL, Nameplate
34	See Note	PRINTED CIRCUIT, Flexible
35	0405465C01	WASHER, Plastic (2 req'd.)
36	1405424D04	INSULATOR (2 req'd.)
37	0405910D01	WASHER, Insulator
38A	3205378T01	SEAL
38B	3205884T01	SEAL
39	4382377B71	SPACER
40	0905518D02	SNAP SOCKET
41	0482650D06	WASHER
42	0382210E01	SCREW, Captive; # 4-40
43	- - - - - - - - -	STRAIN RELIEF; Not field replaceable, order NTN5881A
44	- - - - - - - - -	HOUSING, Top; Not field replaceable, order NTN5881A
45	- - - - - - - - -	CLIP; Not field replaceable, order NTN5881A
46	3202475J01	SEAL, Housing
47	1502469J01	HOUSING, Bottom
48	3202472J01	SEAL
49	See Note	JACK, Earphone
50	3902474J01	CONTACT
51	8402467J01	PC FLEX
52	3205557S01	SEAL, Earphone Jack
53	0205163Q01	NUT, Spanner
54	0405179S02	WASHER, Seal
55	0302473J01	SCREW, Mounting
56	4302471J01	ADAPTER, Antenna

NOTE: Refer to Electrical Parts List for part number and description.

MOTOROLA INC.

Signalling Option for MT1000® Handie-Talkie® Portable Radios

1. INTRODUCTION

The MT1000 Signalling Option provides the radio user with the capability to operate in several digital and tone signalling modes: MDC600, MDC1200, Singletone, and Dual-Tone Multi Frequency (DTMF). The system's operational features include Unit ID, Emergency, Data Operated Squelch (DOS) and DTMF telephone interconnect, or Singletone and DTMF. Four different signalling option front cover kits are available for the MT1000 radio, as follows:

- NTN5456A Unit ID Only (no emergency button or keypad)
- NTN5457B Unit ID and Emergency (emergency button, no keypad)
- NTN5458B Unit ID and DTMF, or Singletone and DTMF (no emergency button, keypad)
- NTN5459B Unit ID and Emergency and DTMF (emergency button and keypad)

Each of the four signalling option front covers has a unique configuration. Refer to the exploded view details for your particular application.

NOTE

Data Operated Squelch (DOS) is a standard per radio feature for all configurations, but may be disabled by using the Radio Service Software.

2. OPERATION

a. Unit I.D.

When on a channel enabled with this feature, the radio transmits an identification code (Unit I.D.) to the base station, indicating which portable is in operation. This code will be sent whenever the PTT switch is depressed. A sidetone will be heard as the unit I.D. code is being transmitted; when the tone ends, start your voice message in the standard manner.

NOTE

You cannot transmit a voice message while the I.D. code is being sent.

b. Unit I.D. with Emergency

This option includes both Unit I.D. and Emergency operation. The unit I.D. code is transmitted each time the PTT switch is depressed.

The emergency button is located on top of the protruding portion of the front cover (near the antenna). Depressing this button causes the radio to repeatedly transmit an alarm code which includes the Unit I.D. code. Pressing the PTT switch during the emergency sequence cancels the emergency function and the radio reverts to standard operation.

Radios with the emergency option can be programmed for *live microphone* operation. Live microphone simply means that the radio will transmit for a specific period of time with the microphone enabled. This transmission occurs after the completion of the emergency sequence.

c. Singletone

Instead of **Unit ID** and DTMF, **Singletone** and DTMF can be programmed into radios using the optional NTN5458B Front Cover Kit. The singletone mode of operation is entered by pressing and holding the singletone button (button just above the PTT). While holding the singletone button depressed, pressing one of the keys on the keypad (0 - 9) causes the radio to go into the transmit mode and send a pre-programmed tone (singletone) corresponding to the key pressed. The singletone lasts either as long as the keypad key is depressed, or for a time period which has been preset into the radio's memory.

Radios with the singletone option are shipped from the factory with a default tone programmed into each of ten locations corresponding to keypad keys 0 through 9. Other frequencies (1KHz - 2992Hz) can be field programmed into these locations for specific customer requirements.

The NTN5458B Optional Front Cover Kit cannot be programmed for Unit ID and singletone at the same time.

Instruction Manual

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3. GENERAL CIRCUIT DESCRIPTION

a. Unit I.D.

Upon keyup (optionally dekey), the signalling microcomputer U601 is notified by the controller via the serial bus that the PTT switch has been depressed. The microcomputer then takes control of the transmitter maintaining the radio in the transmit mode. The microcomputer sets up a time-out-timer (TOT) which is used to track the amount of pretime that has been selected. During the pretime, the microcomputer utilizes the serial data bus to select the auxiliary transmit audio path, and to turn off the microphone. A 1640Hz sidetone is also initiated at the beginning of pretime to notify the radio user that no voice may be transmitted at that time. The hardware filters are then switched from the decode mode to the encode mode by the microcomputer and Q604. Upon completion of pretime, the signalling data is retrieved from the codeplug and encoded in the format which is proper for the selected digital signalling scheme. The data is then baseband modulated on an audio sub-carrier for transmission over the channel.

Upon completion of the transmission of the Unit I.D. data packet, the transmitter control is relinquished to the control of the PTT switch, the 1640Hz sidetone is turned off, and the microphone path is re-enabled.

b. Emergency

The microcomputer's IRQ line (U601, pin 32), is used to monitor the emergency switch located at the top of the radio. Upon actuation of the emergency switch, the IRQ line of U601 is pulled low. The microcomputer's operation is immediately interrupted and begins the debounce procedure of the switch via PB0 (U601, pin 2). When a valid switch closure has been detected, the microcomputer disables the emergency switch by making PB0 (U601, pin 2) an active low, and begins the emergency transmission sequence.The microcomputer will automatically keyup and dekey the radio via the serial bus for a programmable number of emergency transmissions and the live mic time period. It will make the transmissions without further action by the radio user. When the emergency sequence has been completed, the microcomputer re-enables the emergency switch by returning PB0 U601 (pin 2) to a high impedance state. Emergency may be cancelled by pressing the PTT switch. Live mic cannot be cancelled.

c. Data Operated Squelch (DOS)

During the receive mode, the microcomputer monitors the output of the rf demodulator via the decode data filters/hard limiter, and PD7/TCAP, (U601, pins 26 and 27 respectively), for the presence of a baseband modulated subcarrier of the same type as the digital data scheme which is selected in the codeplug. The microcomputer monitors the channel using software implemented phase-locked loops and lock detectors. Once lock has been detected, the microcomputer squelches the radio via the serial bus for the duration of the data packet. This minimizes the irritating sound of the data heard by the radio user by reducing it to a period of approximately 35mS (strong signal conditions).

d. Singletone

The microcomputer can be programmed to generate timed or continuous singletones in the 1KHz - 3KHz frequency range. This programming is accomplished by using the radio service software to disable the digital signalling, and enable singletone. The microcomputer uses a software algorithm and the digital to analog converter (U601 pins 12 - 18, R609 - R615, and R618 - R624) to generate the tones.

e. Dual-Tone Multiple Frequency (DTMF) Circuits

When the radio PTT switch has been depressed, the microcomputer scans the keypad for entries. When a valid switch closure has been detected, the microcomputer generates samples of the corresponding DTMF waveform at a rate of one per each 97.65uS which are submitted to a digital to analog converter (D/A). The output of the D/A is submitted to the digital signalling buffer/filter. The software generates the tones at levels which compensate for the data filter to provide properly pre-emphasized tones. This signal is rf modulated through the TXAUX path of the audio filter IC (U405) and a 1640Hz TX sidetone is emitted. The signal may optionally be transmitted flat (un-preemphasized) which is a programmable option. The microcomputer uses a separate table of values to allow for a flat response when this option is selected.

4. DETAILED CIRCUIT DESCRIPTION

a. Buffer/Filter Limiter

The baseband filters, buffer and hard limiter shape the signal out of the rf demodulator such that it may be processed by the microcomputer while monitoring the channel during the receive mode for data. During the transmit mode, the buffer and filters are used to shape the outgoing waveform such that energy in the PL band is acceptably low and the distortion is kept to a minimum for the digital signals.

During the receive mode, the buffer minimizes loading effects on the rf demodulator; the filters rid the signal of PL and high frequency noise which would decrease DOS sensitivity; the limiter converts the sinusoidal audio signal into a square wave which

is processed by the microcomputer. The output of the demodulator is capacitively coupled to the buffer via C612. The buffer is configured to receive with Q604 in cutoff. The signal is amplified by U604 with the gain being set by R645 and R646 to approximately 2. The output of the buffer is submitted to the bandpass filters (825 to 2275Hz), and converted to a square wave by the limiter circuit (the hardlimiter incorporates some hysterisis for noise rejection). The output of the hardlimiter is connected to pin PD7 (U601, pin 26) where it is processed by the microcomputer.

In the transmit mode, the buffer is reconfigured during pretime and data transmission by switching on Q604. The baseband modulated output of the D/A analog converter (U601 pins 12-18) is then divided by the resistor combination of R643 and R644 and then amplified by the buffer with a gain of about 3 (non-inverted amplifier). The baseband modulated data is then filtered and submitted to the Auxilliary Transmit path through the dc blocking capacitor C606 to be rf modulated via the audio IC (U405) and VCO modulation port.

b. Oscillator System

There are two frequency modes available: a) unshifted, and b) shifted. The unshifted mode frequency is about 3.6864MHz; this is the normal oscillating frequency; however, if there is a need to change the frequency mode for spur reasons, the microcomputer may be shifted to about 3.6855MHz. The frequency is shifted via the TCMP (U601, pin25) line which drives Q601 on or off. When the TCMP (U601, pin25) line is high, Q601 is switched on. This shorts L601 out and places the oscillator in an unshifted mode. When the TCMP (U601, pin 25) is low, Q601 is off and L601 causes the oscillator to shift frequency.

c. Power Supply

The +8V regulated line from the radio controller flex circuit is used as the primary supply for the circuit. The +8V line directly supplies U604 and the CMOS+5V regulator. The +5V regulator is used with a series pass PNP transistor (Q603), and a bias resistor R608 to supply U601,U602 and U604. The series pass element is required to source the transient current required when powering up the EEPROM (U602). Capacitor C608 is used for stability and filtering noise which may be introduced on the +5V supply line. A +2.5V circuit reference source is generated using the R601/R602 voltage divider and operational amplifier as a buffer. This supplies a circuit reference for the data filters and hard limiter circuit.

d. EEPROM

The EEPROM (U602) is used to store data which configures the signalling option to operate with the proper parameters required for a given system. Data includes the deviation, digital signalling mode select, Unit ID enable, Emergency enable, and DOS enable. It also includes a variety of options and the electrical parameters for the DOS detectors.

The EEPROM is read and written to via the microcomputer. The EEPROM is powered up when pin PB3 (U601, pin 5) is pulled low, and Q602 turns on making power available to U602. Chip Select is provided by pin PB6 (U601, pin 8), and the data clock is provided by PB4 (U601,pin 6). Data is clocked in to the code plug via PB5 (U601,pin 7), and data is clocked out of the code plug via PB7(U601,pin 9).

e. Keypad

The keypad is an array of switches which are read and debounced by the microcomputer. The keypad is monitored at port "A" of U601. PA1 to PA4 (U601, pins 37 to 40) are normally in a low state which pulls the rows of the keypad low. PA5 to PA7 (U601, pins 34 to 36) are connected to the columns of the keypad and are always inputs. The columns are pulled high via resistors R605,R606, and R607. When a keypad button is pressed, the column associated with the pressed keypad switch is pulled low by contact with a low state row. The microcomputer detects a low state on one of the columns and selectively drives each row high until the low state column changes to a high state. The microcomputer then waits a specified debounce time and examines the switch to determine if it still closed. If the switch is still closed, the microcomputer acts on the closure; if the switch is open, the microcomputer returns to scanning the entire keypad.

f. Digital to Analog (D/A) Converter

The D/A converter (R609 thru R615 and R618 thru R624) is used to convert sequences of data samples which have been stored in the microcomputer. The D/A converter has 7-bit resolution and consists of an R/2R resistor ladder network. This type of network provides good performance for component tolerance variations.

When a 7-bit data word representing the voltage of the DTMF, singletone, or MDC waveform is submitted to the D/A converter by the microcomputer at port "C" (U601, pins 12 thru 18) the network of resistors sums the voltages at the I/O pins yielding a voltage which corresponds to the data word. A new data sample appears at port "C" about every 97.65uS.

NTN5456A Unit ID
Electrical Parts List

TPLF-3736-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: ±5%; 50V unless stated
C601	2113740A39	27
C602	2113740A38	24
C603	2113741A37	4700
C604	2113741A21	1000
C605	2113740A67	330
C606,C607	2160521G37	0.1uF+80-20%
C608	2362998C09	1.0uF±10%
C609 thru C611	-----	Not Used
C612	2160521A37	0.1uF+80-20%
C613 thru C615	2113740A71	470
C616	2113741A37	4700
C617	2362998C09	1.0uF±10%
C618,C619	-----	Not Used
C620	2160521G37	0.1uF±80-20%
C621,C622	2113740A53	82
		COIL: RF: unless stated
L601	2460590A03	180uH
L602,L603	2462575A03	0.82uH Ferrite Choke
		TRANSISTOR: See Note 1
Q601	4805218N09	NPN
Q602,Q603	4805128M94	PNP
Q604	4805128M12	NPN
		RESISTOR, Fixed: Ω **±5%;1/8W** unless stated
R601,R602	0660076B05	150k
R603	0660076H49	10Meg±10%
R604	0660076A73	10k
R605 thru R607	0660076B05	150k
R608	0660076A25	100
R609 thru R615	0660076B05	150k
R616	0660076A73	10k
R617	0660076A89	47k
R618	0660076B05	150k
R619 thru R624	0660076A94	75k
R625	0660076A73	10k
R626 thru R629	-----	Not Used
R630	0660076A59	2.7k
R631 thru R633	0660076A73	10k
R634	0660076B01	100k
R635 thru R641	-----	Not Used
R642	0660076A73	10k
R643	0660076B06	160k
R644	0660076A65	4.7k
R645	0660076B17	470k
R646	0660076B25	1Meg
R647	0660076B07	180k
R648	0660076B17	470k
R649,R650	0660076A90	51k
R651	0660076A73	10k
R652	0660076A65	4.7k
R653	0660076B09	220k
R654	0660076A65	4.7k

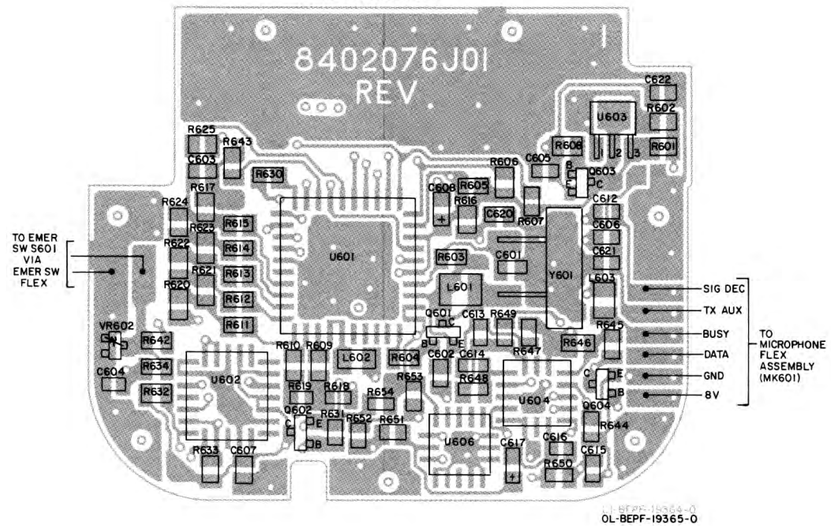
		CIRCUIT MODULE: See Note 1
U601	0105954R68	Microcomputer (MCU)
U602	0105957N84	EEPROM
U603	5160880B01	+5V Regulator
U604	0105957N83	Quad Operational Amplifier
U605	-----	Not Used
U606	0105954R04	Quad Comparator
		DIODE: See Note 1
VR601	-----	Not Used
VR602	4880140L09	6.2V Zener
		CRYSTAL: See Note 2
Y601	4805664G33	3.6864MHz

NOTES:

I. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.

II. When ordering crystal units, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.

VIEWED FROM SIDE 1



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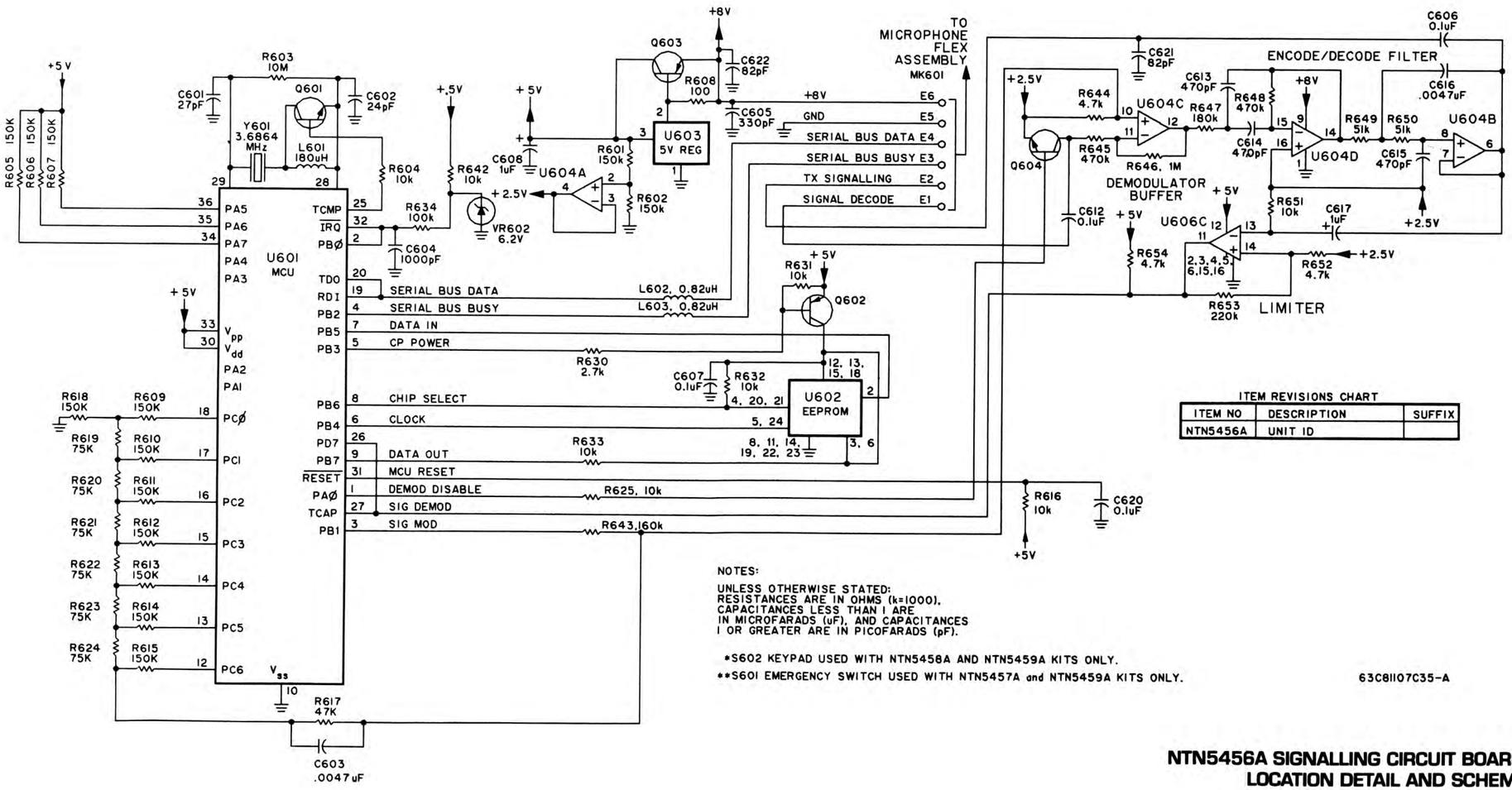


ITEM REVISIONS CHART

ITEM NO	DESCRIPTION	SUFFIX
NTN5456A	UNIT ID	

NOTES:

UNLESS OTHERWISE STATED:
RESISTANCES ARE IN OHMS (k=1000).
CAPACITANCES LESS THAN 1 ARE
IN MICROFARADS (uF), AND CAPACITANCES
1 OR GREATER ARE IN PICOFARADS (pF).

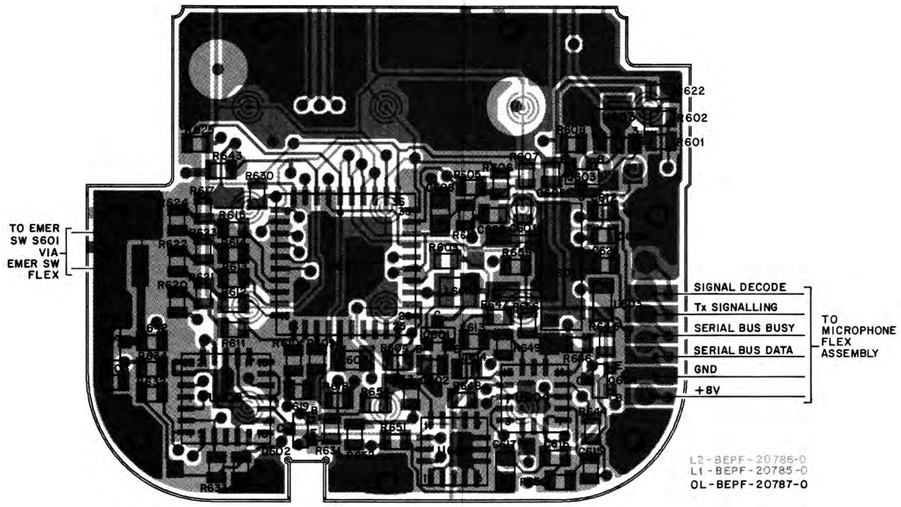
*S602 KEYPAD USED WITH NTN5458A AND NTN5459A KITS ONLY.

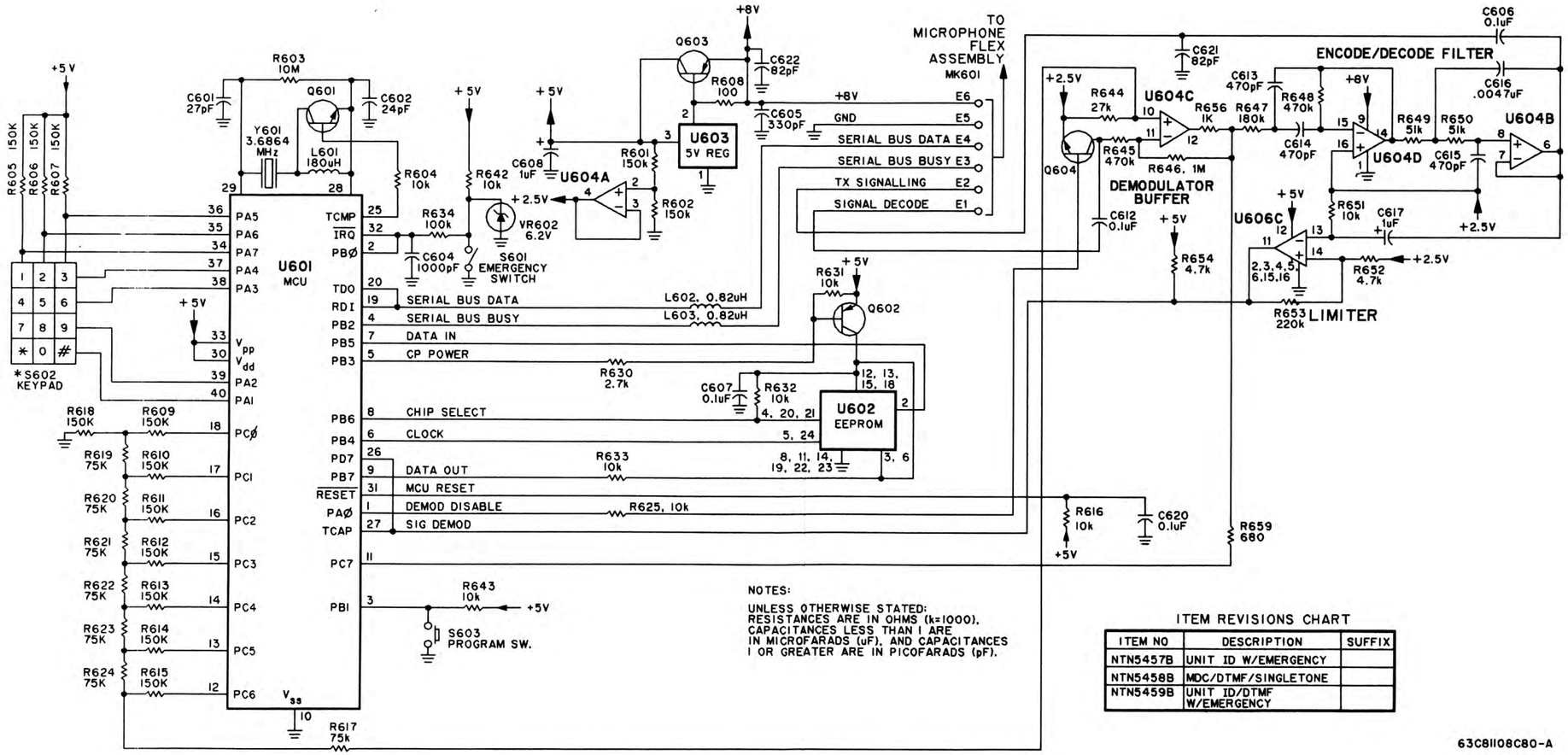
**S601 EMERGENCY SWITCH USED WITH NTN5457A and NTN5459A KITS ONLY.

63C81107C35-A

NTN5456A SIGNALLING CIRCUIT BOARD COMPONENT LOCATION DETAIL AND SCHEMATIC DIAGRAM

VIEWED FROM SIDE 1





NOTES:

UNLESS OTHERWISE STATED:
RESISTANCES ARE IN OHMS (k=1000).
CAPACITANCES LESS THAN 1 ARE IN MICROFARADS (uF), AND CAPACITANCES 1 OR GREATER ARE IN PICOFARADS (pF).

ITEM REVISIONS CHART

ITEM NO	DESCRIPTION	SUFFIX
NTN5457B	UNIT ID W/EMERGENCY	
NTN5458B	MDC/DTMF/SINGLETONE	
NTN5459B	UNIT ID/DTMF W/EMERGENCY	

63C81108C80-A

NTN5457B, NTN5458B, AND NTN5459B SIGNALLING CIRCUIT BOARD COMPONENT LOCATION DETAIL AND SCHEMATIC DIAGRAM

NTN5457B Unit ID/Emergency TPLF-3898-A
NTN5458B MDC/DTMF/Singletone
NTN5459B Unit ID/DTMF w/Emergency
Electrical Parts List

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: ±5%; 50V unless stated
C601	2113740A39	27
C602	2113740A38	24
C603	-----	Not Used
C604	2113741A21	1000
C605	2113740A67	330
C606,C607	2160521G37	0.1uF+80-20%
C608	2311049A07	1.0uF±10%
C609 thru C611	-----	Not Used
C612	2160521G37	0.1uF+80-20%
C613 thru C615	2113740A71	470
C616	2113741A37	4700
C617	2311049A07	1.0uF±10%
C618,C619	-----	Not Used
C620	2160521G37	0.1uF±80-20%
C621,C622	2113740A53	82
		COIL: RF: unless stated
L601	2460590A03	180uH
L602,L603	2462575A03	0.82uH Ferrite Choke
		TRANSISTOR: See Note 1
Q601	4805218N09	NPN
Q602,Q603	4805128M94	PNP
Q604	4805128M12	NPN
		RESISTOR, Fixed: Ω **±5%;1/8W** unless stated
R601,R602	0660076B05	150k
R603	0660076H49	10Meg±10%
R604	0660076A73	10k
R605 thru R607	0660076B05	150k
R608	0660076A25	100
R609 thru R615	0660076B05	150k
R616	0660076A73	10k
R617	0660076A94	75k
R618	0660076B05	150k
R619 thru R624	0660076A94	75k
R625	0660076A73	10k
R626 thru R629	-----	Not Used
R630	0660076A59	2.7k
R631 thru R633	0660076A73	10k
R634	0660076B01	100k
R635 thru R641	-----	Not Used
R642	0660076A73	10k
R643	0660076A73	10k
R644	0660076A83	27k
R645	0660076B17	470k
R646	0660076B25	1Meg
R647	0660076B07	180k
R648	0660076B17	470k
R649,R650	0660076A90	51k
R651	0660076A73	10k
R652	0660076A65	4.7k
R653	0660076B09	220k
R654	0660076A65	4.7k
R656	0660076A49	1k
R659	0660076A45	680
		SWITCH:
S601	------	Emergency, Not field repairable, order front cover kit
S602	------	Keypad, Not field repairable, order front cover kit
S603		Program, Not field repairable, order front cover kit
U601	0105954R68	**CIRCUIT MODULE:** See Note 1 Microcomputer (MCU)
U602	0105957N84	EEPROM
U603	5160880B01	+5V Regulator
U604	0105957N83	Quad Operational Amplifier
U605	-----	Not Used
U606	0105954R04	Quad Comparator
		DIODE: See Note 1
VR601	-----	Not Used
VR602	4880140L09	6.2V Zener
		CRYSTAL: See Note 2
Y601	4805664G33	3.6864MHz

NOTES:

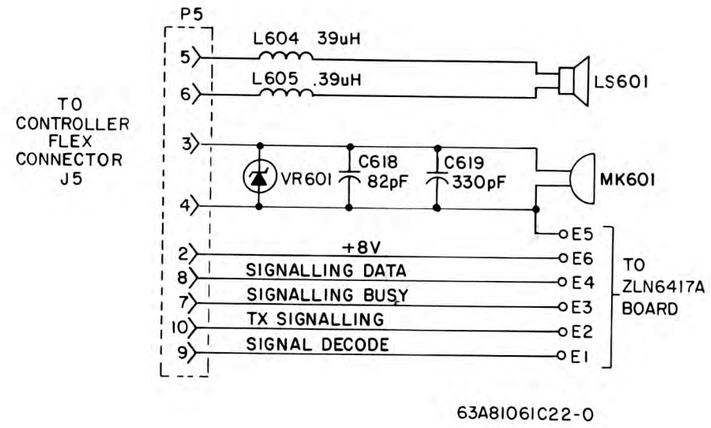
I. For optimum performance, order replacement diodes, transistors, and circuit modules by Motorola part number only.

II. When ordering crystal units, specify carrier frequency, crystal frequency, crystal type number, and Motorola part number.

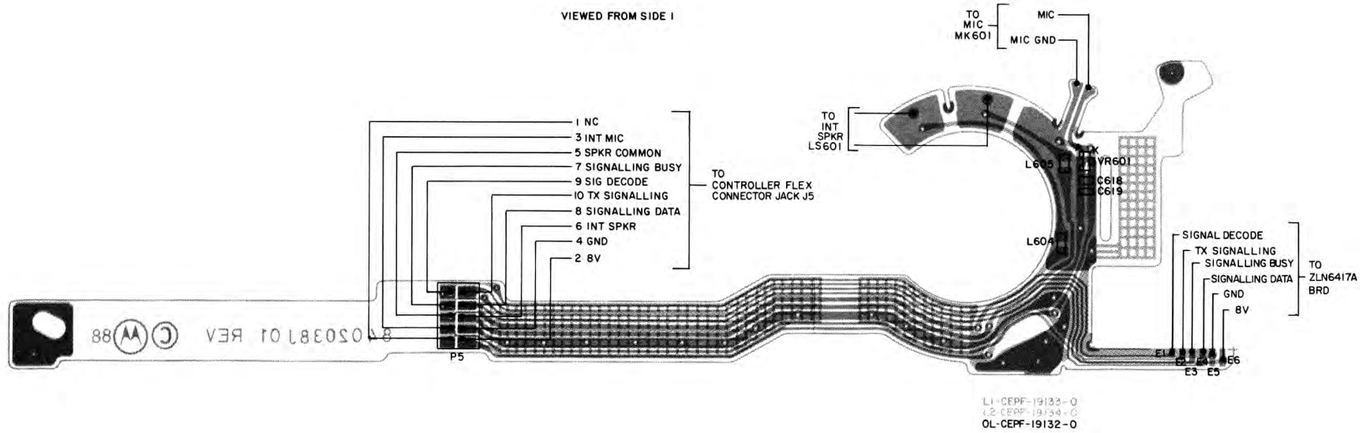
0102700J93 Microphone Flex Assembly TPLF-3737-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, Fixed: pF±5%; 50V unless stated
C618	2113740A53	82
C619	2113740A67	330
		COIL, RF: unless stated
L604, L605	2462575A01	390nH
LS601	5005155Q03	**SPEAKER**
MK601	----	**ASSEMBLY**, Microphone
		DIODE: See Note
VR601	4880140L09	6.2V Zener

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



MICROPHONE FLEX ASSEMBLY



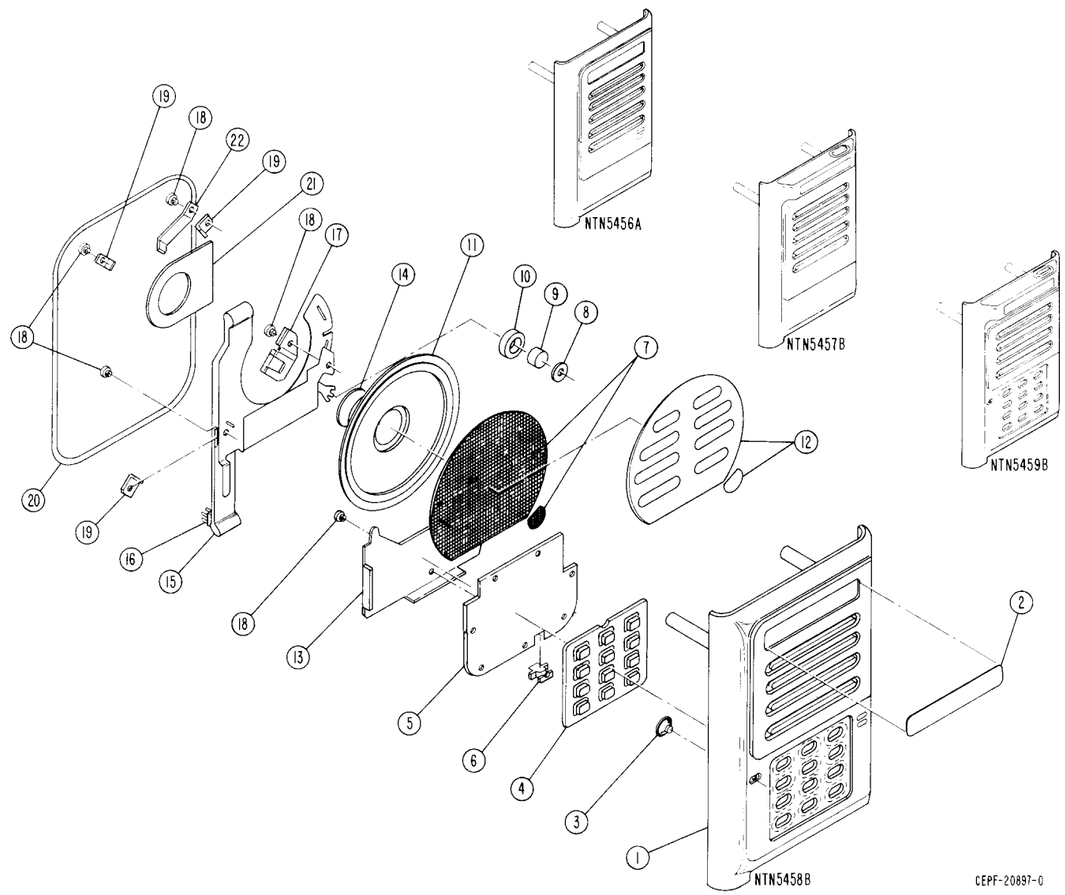
Exploded View Parts List

TPLF-3911-0

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	NTN5456A	COVER, Front
	or NTN5457B	COVER, Front
	or NTN5458B	COVER, Front
	or NTN5459B	COVER, Front
2	3305260Q01	NAMEPLATE(NTN5456A,NTN5458B)
	or 3302028J01	NAMEPLATE(NTN5457B,NTN5459B)
3	-----	* KEYPAD, Single
4	-----	* KEYPAD, 3"X4"
5	-----	* BOARD, MDC
6	-----	* INSERT, Shield
7	3505152J01	FELT, Speaker
8	7505564S01	PAD, Microphone
9	-----	MICROPHONE (part of item 15)
10	1405299L01	BOOT, Microphone
11	See Note	SPEAKER (LS601)
12	1105773R01	ADHESIVE
13	2602042J02	SHIELD, PC Board
14	7505501R02	PAD, Speaker
15	See Note	ASSEMBLY, Microphone Flex (MK601) includes items 9 thru11,15 and 16
16	2805433R02	PLUG, 10-Position
17	4205167S01	RETAINER, Mic/Spkr.
18	0300139444	SCREW, 2-56" x 5/32"
19	4205166S01	CLAMP, Speaker
20	3205141Q01	0-Ring, Front Cover
21	1405299Q01	INSULATOR, Speaker
22	3905178S01	CONTACT, Front Speaker

NOTE: Refer to Microphone Flex Assembly Parts list for part number and description.

* These parts are not field replaceable



MOTOROLA INC.

NTN5438A

12VDC CONTROL UNIT/VEHICULAR CHARGER With PAC•RT® Operation

1. DESCRIPTION

The NTN5438A 12VDC Control Unit/Vehicular Charger performs two basic functions. It automatically activates or deactivates the PAC•RT Vehicular Repeater to and from its standby condition, and it trickle charges the portable radio nickel-cadmium battery while the portable radio is in the unit. The unit may also be used as a stand alone charger in which case, all the references to PAC•RT operation will not be applicable.

Two switches control the unit: an on/off switch and an enable/disable switch. The on/off switch applies dc power to the PAC•RT repeater and to the charging circuitry when the mobile radio is on. The enable/disable switch duplicates the automatic functions of the pocket switch, which switches the repeater to and from its standby condition.

Two lamps indicate the condition of the repeater; the green lamp indicates that power is applied to the repeater and to the charging circuits of the charging unit, and the blue lamp indicates that the portable radio is properly seated in the pocket and its nickel-cadmium battery is being charged.

The control unit/vehicular charger is housed in a metal cabinet approximately 3 inches high by 7 1/4 inches wide by 5 inches deep (less mounting hardware). The operating switches and indicators are conveniently located on the front panel. Power and control connections are made through a receptacle on the rear panel to the PAC•RT vehicular charger/holder cable. In the stand-alone charger mode of operation, the power connection is made via a power cable (NKN6428A).

2. INSTALLATION

Mounting hardware supplied includes a bracket for mounting the unit below the vehicle dashboard. The bracket enables the charger to be pivoted to a position which offers the best security to the portable radio during rough traveling conditions. Install the unit as described in the following steps:

a. Use the trunnion bracket as a template and drill three 0.265-inch holes in a convenient place on the underside of the dashboard.
b. Refer to the installation detail, and mount the bracket to the dash using three 1/4-20 bolts, lockwashers, and nuts provided.
c. Mount the unit to the bracket using four 1/4-20 bolts and lockwashers, and two flat washers as shown in the figure. The flat washers **must** be placed between the lockwasher and the bracket to ensure proper locking action of the lockwasher. Do not tighten the four bolts yet.
d. Rotate the unit to a position that provides about a 45-degree mounting angle. This angle provides operational convenience for the operator and physical security for the portable radio under rough traveling conditions. Tighten the four mounting bolts holding the charger to the bracket.
e. Attach the PAC•RT cable to the unit. Refer to the PAC•RT manual for more information. If used as a stand alone charger, make the power connection per installation instructions supplied with the NKN6428A Cable Kit.

CAUTION

The NKN6428A Cable is the only power cable compatible with vehicular charger NTN5438A. Do not use cable kits NKN6149, NKN6150, or NKN6151.

3. OPERATION

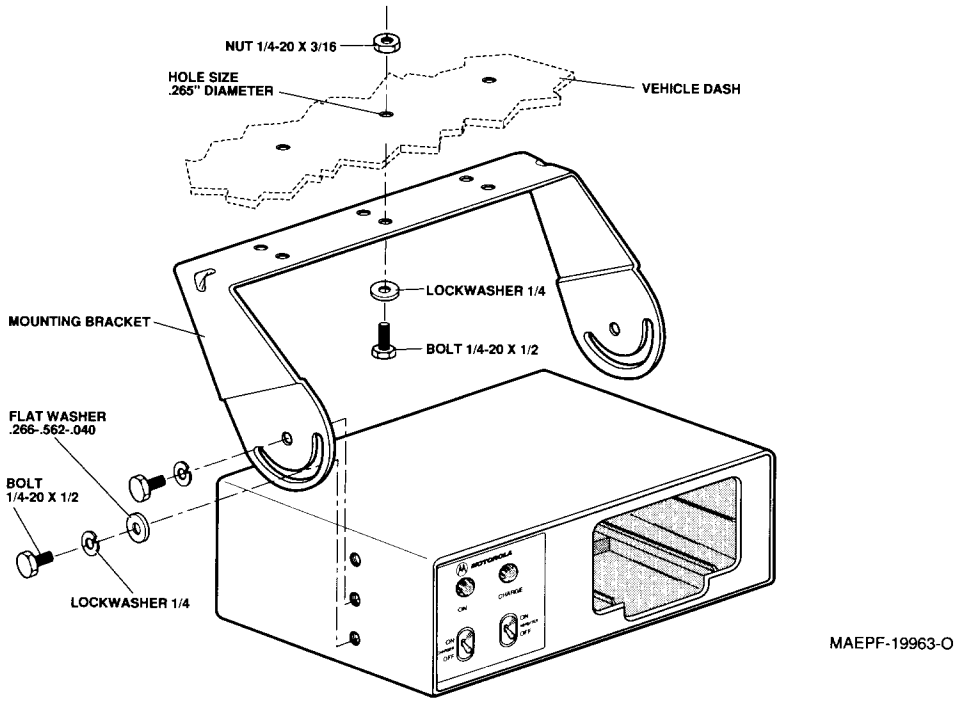
When used with a mobile/PAC•RT system, turn the mobile radio on.

Place the vehicular charger on/off switch in the ON position. The green lamp above the on/off switch should glow. This switch applies unregulated B+ to both the charging circuitry and the PAC•RT repeater (if applicable).

Place the portable radio in the pocket of the unit. The blue lamp should glow indicating that the

Instruction Manual

68P81108C50-O



Vehicular Charger or Holder Installation Detail

portable radio nickel-cadmium battery is being charged. If a battery other than a nickel-cadmium battery is used, the blue lamp will not glow.

NOTE

For best charging results, turn the portable radio off while it's in the charging unit. The approximate charge time is 16 hours.

When used with a mobile/PAC•RT system, the enable/disable switch and the pocket switch have similar functions. With the enable/disable switch in the enable position, the pocket switch enables the repeater (switches from standby to its on condition) when the portable radio is out of the pocket. When the radio is in the pocket, the pocket switch disables (switches back to standby) the repeater. The automatic function of the pocket switch is manually disabled by setting the enable/disable switch in the disable position. This disables the repeater even if the portable radio is removed from the pocket. For more details, refer to the PAC•RT instruction manual.

NOTE

All of the switching functions are operative even if the lamps are burned out.

CAUTION

If the unit is directly connected to the vehicle's battery, place the on/off switch in the OFF position when the vehicle is not running.

4. THEORY OF OPERATION

When the on/off switch is turned on, and a portable radio is in the pocket, the blue lamp (DS2) will glow and the portable radio nickel-cadmium battery will begin to charge. Source voltage is applied through fuse F1 to on/off switch S1. Components L1 and C6 form a filter for noise elimination. Integrated circuit IC1 consists of six inverters which form an oscillator stage (IC1-A and IC1-F) and amplifiers IC1-B, IC1-C, IC1-D, and IC1-E. The ac signal from the integrated circuit is fed to voltage drivers Q1 and Q2, which drive the voltage doublers Q3 and Q4. Components CR4 and C4 filter the voltage doubler output.

Current regulation is provided by transistor Q5 and its associated components. Current through the charging contacts biases current sensor Q7 into conduction and activates lamp driver Q6. Lamp driver Q6 applies a ground to lamp DS2 to causes it to glow, indicating that the battery is being charged. Diode CR5 prevents the radio battery from discharging when power is turned off with a radio in the charger pocket.

5. MAINTENANCE

A. Lamp Replacement

Unscrew the green or blue lamp jewel with your fingers. Remove the miniature flange lamp bulb from the jewel and replace it with a new bulb. Place the jewel and replacement bulb back into the unit.

B. Fuse Replacement

The fuse can be replaced by unscrewing the fuseholder at the back of the chassis.

C. Charging Current

Connect a milliamp meter (0 -100 mA range) between the charging contacts. With an input voltage of 13.8 volts dc, the charging current should be approximately 85mA.

NTN5438A
Control Unit/Vehiuclar Charger

TPLF-3809-O

REFERENCE SYMBOL	MOTOROLA PART NUMBER	DESCRIPTION
		CAPACITOR, Fixed:
C1	2183162H22	470pF±5%; 50V
C2	2184511B01	100pF±10%; N750
C3, 4	2384669A23	60uF-10+150%; 50V
C5	2382256J06	2.2uF-10+50%; 63V
C6	2383441B19	10uF±20%; 20V
CR2 thru 7	4883654H01	**DIODE:** Silicon, See Note
DS1, 2	6500868908	**LAMP:** #327
F1	6500804908	**FUSE:** 2-Amp; 32V
IC1	5182822F02	**INTEGRATED CIRCUIT**: Hex Inverter
L1	2482549D13	**CHOKE:** 68uH
		TRANSISTOR: See Note
Q1, 2	4800869570	NPN, Type M9570
Q3	4800869677	PNP, Type M9677
Q4	4800869676	NPN, Type M9676
Q5	4800869677	PNP, Type M9677
Q6	4800869570	NPN, Type M9570
Q7	4800869571	PNP, Type M9571
		RESISTOR, Fixed: Ω ± 10%; 1/4W unless stated
R1	0600124C79	18k
R2	0600124D04	180k
R3	0600124A75	12k ±5%
R4	0600124C73	10k
R5, 6	0600124C79	18k
R7	0600124C49	1k
R8	0600124C57	2.2k
R9	0600124C47	820
R10	0611009D26	8.2 ±5%
R12	0600124C59	2.7k
R13	0600124C37	330
R14	0600124C95	82k
R16	0600124C67	5.6k
R17	0600124C97	100k
		SWITCH:
S1, 2	4000482097	Toggle, SPST
S3	4183052A01	Spring part of switch
	3905590D01	Contact part of switch
		DIODE: See Note
VR1	4882256C18	Zener, 9.1V
VR2	4805746G24	Zener, 15V
NONREFERENCED ITEMS		
	0105954Q54	ASSEMBLY, Pocket
	0105954Q53	ASSEMBLY, Contact
	0105953C60	ASSEMBLY, PC Board Chassis with Terminal Strip
	0180792A30	ASSEMBLY, Mounting Hardware
	0982083C01	HOLDER, Fuse
	0982684G02	SOCKET and JEWEL, Grn (for DS1
	0982684G03	SOCKET and JEWEL, Blue (for DS2
	0984509H01	RECEPTACLE, 6-contact
	1305622T01	ESCUTCHEON

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

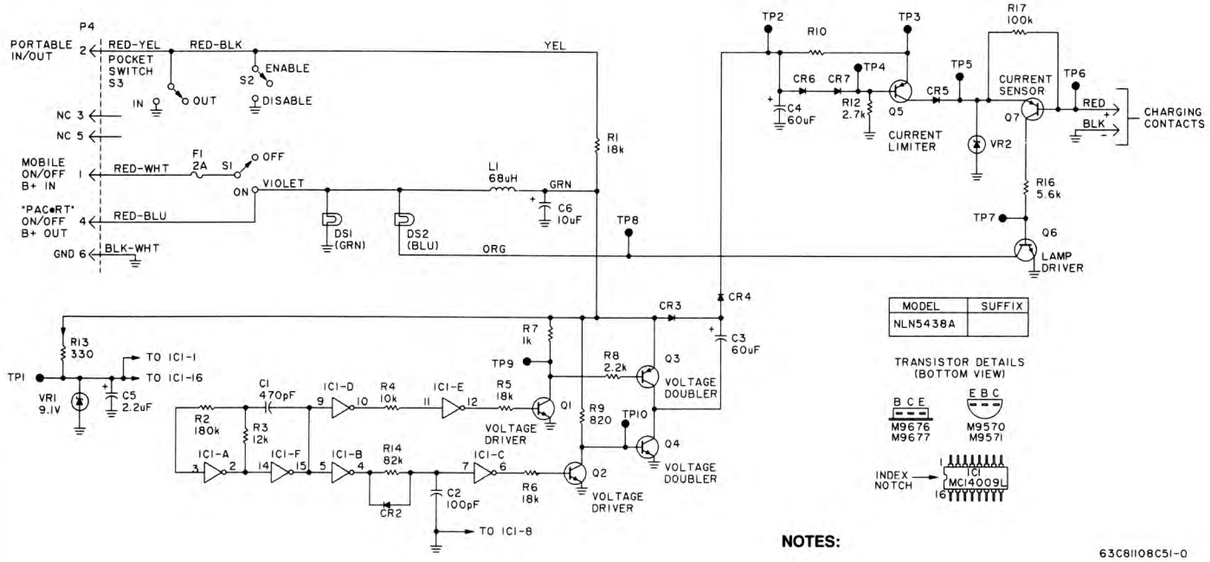
NOMINAL DC VOLTAGE MEASUREMENTS

* TEST POINT	BATTERY CHARGING CONTACTS OPEN (VDC)	BATTERY CHARGING CONTACTS SHORTED WITH 100-OHM 2-WATT RESISTOR (VDC)
1	9.1	9.1
2	22.0	22.0
3	21.3	21.3
4	20.4	20.4
5	16.0	9.7
6	15.9	8.6
7	0	0.77
8	13.8	.04
9	5.5	5.5
10	0.24	0.24

* REFERENCE VOLTAGES ARE TAKEN WITH 13.8 VDC FROM AN EXTERNAL POWER SUPPLY.

TEPF-19910-O

SCHEMATIC DIAGRAM

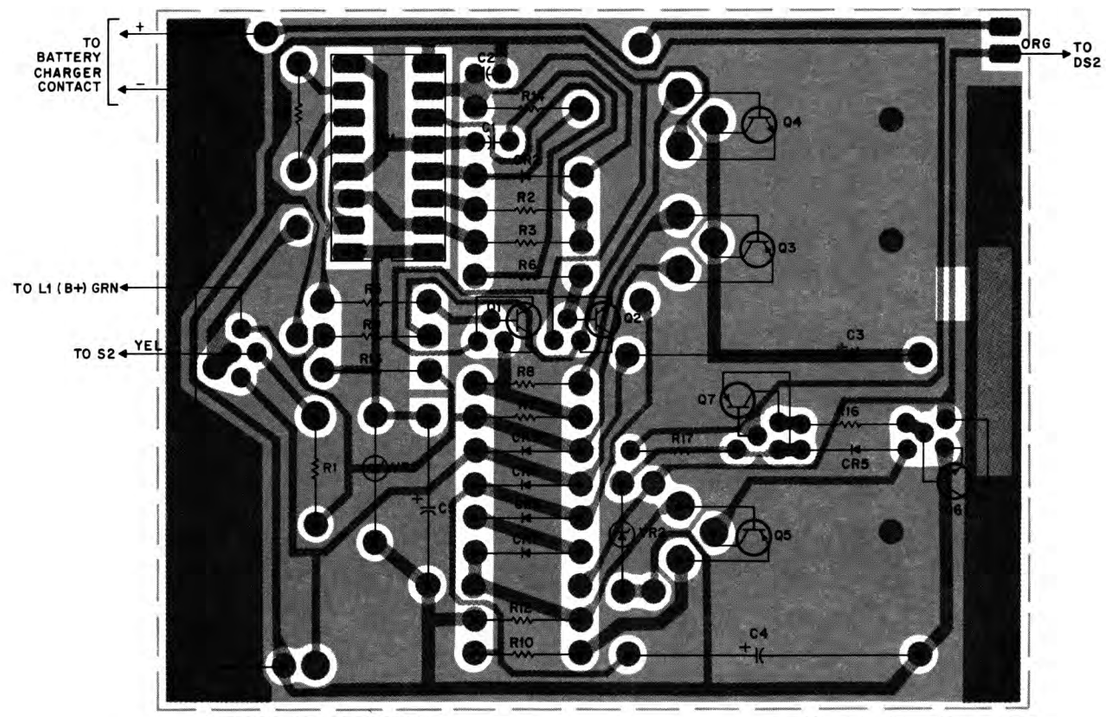


NOTES:

1. UNLESS OTHERWISE STATED: RESISTOR VALUES ARE IN OHMS, k = 1000; AND ALL CAPACITOR VALUES ARE SHOWN.
2. DC VOLTAGES ARE MEASURED FROM POINT INDICATED TO CHASSIS GROUND USING MOTOROLA DC MULTIMETER OR EQUIVALENT.

TEPF-19909-O

63C81108C51-O



CIRCUIT BOARD VIEWED FROM COMPONENT SIDE

● SOLDER SIDE CEPF-19917-O
● COMP SIDE CEPF-19918-O
OL-CEPF-19919-O