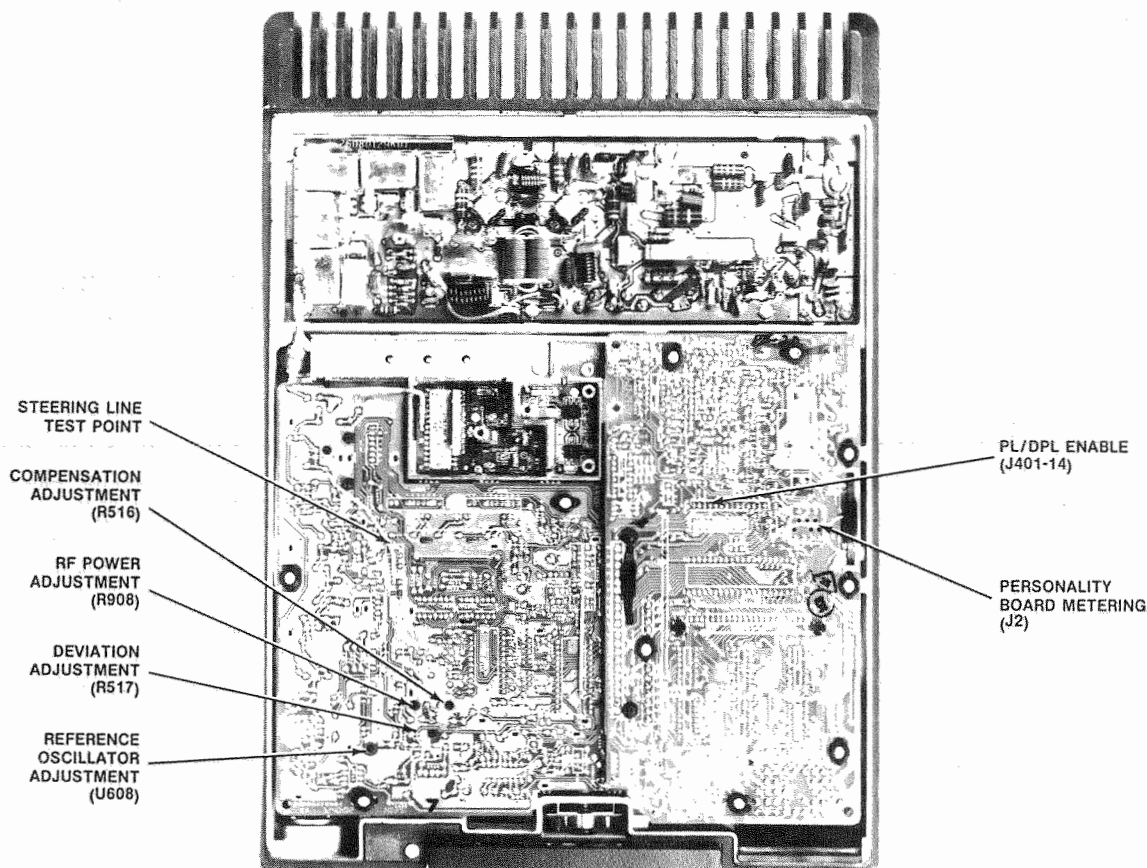


**MOTOROLA INC.**Communications  
Group

# Maintenance and Troubleshooting

## 1. Recommended Test Equipment for Servicing *SYNTOR X* Radios

General Type	Application	Recommended Model	Minimum Specifications
AC-DC VOM	DC voltage measurements, general	Motorola T1009A	Measurement range: 0–15 V dc Sensitivity: 20,000 ohms/volt
DC Multimeter	DC voltage readings requiring a high-input-resistance meter	Motorola S1063B	Measurement range: 0–15 V dc Input resistance: 11 megohms
AC Voltmeter	Audio voltage measurements	Motorola S1053C	Measurement range: 0–1 mV ac Input resistance: 1 megohm
RF Voltmeter	RF voltage measurements	Motorola S1339	Measurement range: 100 $\mu$ V–3 V from 1 MHz to 512 MHz Inputs: 50-ohm and high-impedance
Oscilloscope, Dual-Trace	Waveform observation	Motorola R1004A	Vertical sensitivity: 5 mV–10 V/division Horizontal time base: 0.2 $\mu$ sec–0.5 sec/division
RF Wattmeter	Transmitter output power measurement	Motorola S1350 with appropriate element and T1013 RF dummy load	Measurement range: 0–250 watts
Frequency Meter	Transmitter frequency measurement	Model R1200 Service Monitor with high-stability oscillator (X suffix) option. Frequency calibration recommended every 6 months or less.	Measurement range: 403–512 MHz Frequency resolution: 10 Hz
Deviation Meter	Transmitter modulation deviation measurement	Motorola R1200 Service Monitor with SLN6350 Deviation Meter and SLN6381 Audio Frequency Synthesizer ( <i>audio synthesizer required only for DPL radios</i> )	Measurement range: 0–10 kHz deviation Frequency range: 403–512 MHz
RF Signal Generator	Receiver alignment and troubleshooting	Motorola R1200 Service Monitor with attenuator	Frequency range: 403–512 MHz Output Level: 0.1 $\mu$ V–100,000 $\mu$ V Must be capable of at least $\pm 3$ kHz deviation when modulated by 1-kHz tone.
Audio Signal Generator	Audio circuit troubleshooting	Motorola S1067B	Frequency range: 20 Hz–20 kHz Output level: 50 mV–1 V
■ Logic Probe	Checking of various digital devices	Motorola RTL-4014	
PL Tone Generator*	Tone-coded <i>Private-Line</i> decoder troubleshooting	Motorola S1333B	Frequency range: 10 Hz–9999 Hz Output level: 0–3 V rms
■ DPL Test Set**	<i>Digital Private-Line</i> encoder-decoder troubleshooting	Motorola SLN6413A	
Radio Test Set	Meter readings at circuit metering points for alignment and troubleshooting	Motorola S1056 Portable Test Set with a TEK-37 or TEK-37A Test Set Adapter or a Motorola TEK-5 Meter Panel with a TEK-40 Cable	



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Figure 1. Radio Adjustments (Top View)

## 1. Recommended Test Equipment for SYNTOR X Radio Servicing (continued)

General Type	Application	Recommended Model	Minimum Specifications
■ Tuning Tool Kit	Receiver and transmitter alignment	Motorola HLN4262A	
■ DC Power Supply	DC power for shop service	Motorola R1011AA	1-20 V dc 0-40 A

\*Required for tone-coded *Private-Line* models only

\*\*Required for *Digital Private-Line* models only

### Note

The Motorola R2001 System Analyzer replaces all the test equipment listed above except that marked with ■.

### Caution

In positive-ground systems, the case of the TEK-5 Meter Panel and Portions of the S1056B Portable Test Set are hot with respect to the vehicle chassis. Take precautions to prevent the test equipment from touching the vehicle chassis.

## 2. Radio Alignment and Adjustments

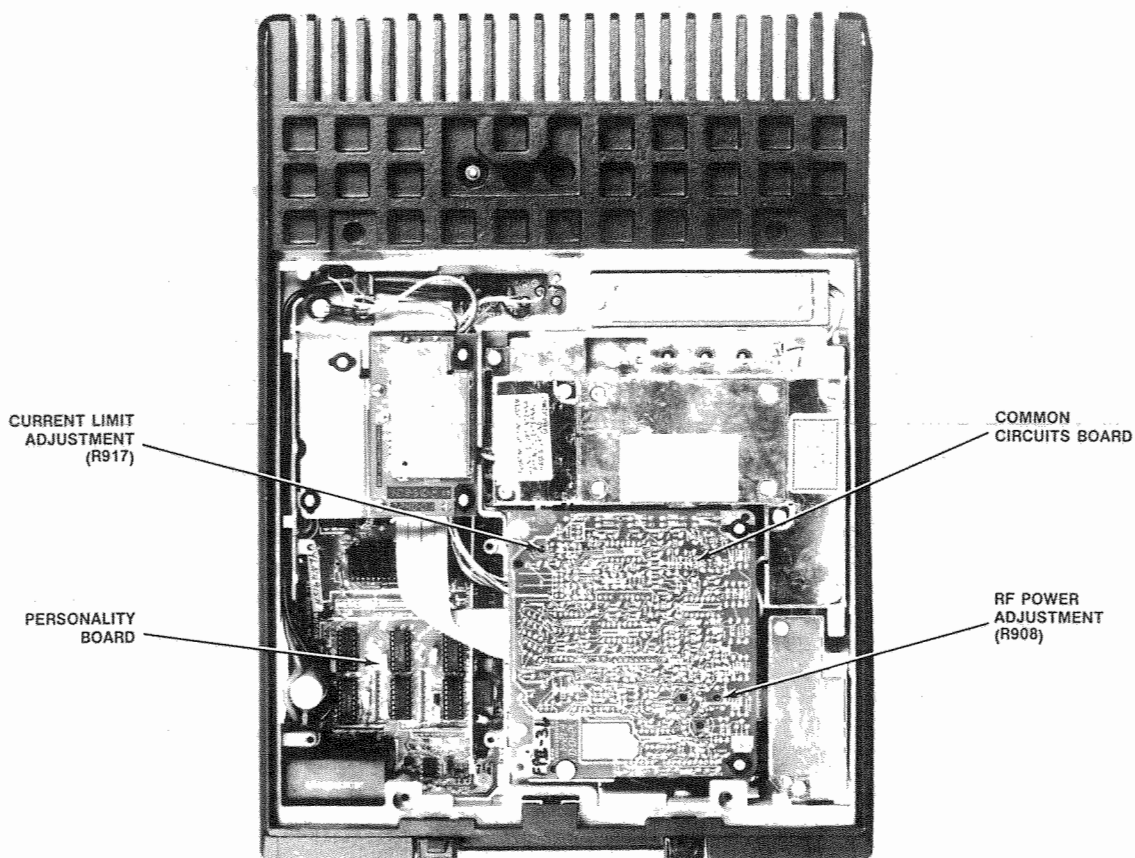
### 2.1 INTRODUCTION

2.1.1 You can adjust the following items on the low-band SYNTOR X radio:

- oscillator frequency
- deviation

- compensation
- transmitter output
- transmitter power amplifier current limit
- extender receive frequency

2.1.2 You can adjust the oscillator frequency, deviation, modulation compensation, and transmitter power through holes in the RF board, as shown in Figure 1.



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Figure 2. Radio Adjustments (Bottom View)

2.1.3 You can adjust the current limit for the transmitter power amplifier through a hole in the common circuits board, once you have removed the bottom cover. (See Figure 2.)

#### Important

Readjustment of the *SYNTOR X* receiver is NOT recommended, since the receiver is preadjusted at the factory to have a wide passband for all frequencies between 33 and 50 MHz.

#### Note

See the list of recommended test equipment in this section of the manual.

## 2.2 OSCILLATOR FREQUENCY

#### Note

Adjust the oscillator frequency before checking or setting the deviation.

- (1) Set the mode selector switch to Mode 1.
- (2) Using the portable test set, key the transmitter without modulation. On *Private-Line* and *Digital Private-Line* radios, disable the encoder output by shorting the PL/DPL ENABLE line (J401-4) to ground. J401-4 is on the personality board.
- (3) Adjust the reference oscillator (U608) warp control (Figure 1) until the proper indication shows on the frequency meter.
- (4) Set the mode selector switch (for multiple-mode units only) to each of the remaining positions and check the transmitter frequency. (No further oscillator frequency adjustments are required.)

## 2.3 DEVIATION

### Note

While setting deviation, be sure to check deviation on all transmit channels. This ensures that the radio will not over-deviate.

(1A) (For PL or DPL radios only) Using deviation adjustment potentiometer R517, set the deviation on the highest PL or DPL customer transmit frequency, to  $\pm 4.7$  kHz.

(1B) (For radios without PL or DPL) Using deviation potentiometer R517, set the deviation on the highest customer transmit frequency, to  $\pm 4.7$  kHz.

(2) Check the deviation on each mode and reset it to  $\pm 4.7$  kHz on the frequency with the highest deviation.

(3) Check the deviation on each transmit frequency to be sure that it does not exceed 5 kHz.

## 2.4 COMPENSATION

### Note

The compensation adjustment potentiometer (R516) is set at the factory and does not normally require readjustment. Nevertheless, you should use this compensation adjustment procedure whenever any of the following conditions occur: (a) if DPL transmit (encode) performance is poor, (b) if the VCO reference oscillator or common circuits board is replaced, (c) if the compensation potentiometer is replaced or inadvertently adjusted, (d) if the phase modulator is replaced. This procedure balances the transmit audio signal fed to the VCO and reference oscillator, thus insuring good DPL waveform fidelity and flat modulation response.

(1A) (For PL or DPL radios only) Turn the deviation potentiometer (Figure 1) one-half turn clockwise.

(1B) (For radios without PL or DPL) Set the compensation potentiometer to the middle of its range. Go to Step 5B.

(2) (For PL or DPL radios only) Set the mode selector to the highest PL/DPL customer transmit frequency (closest to 50 MHz).

(3) (For PL or DPL radios only) Connect the center lead of the shielded cable of an ac voltmeter to the modulation compensation test point (Figure 1) and connect the shield to the radio ground (A -). Set the voltmeter to the 1-mV range.

(4) (For PL or DPL radios only) Modulate the PL or DPL and adjust the compensation potentiometer until you see a null indication on the voltmeter. Cover the hole with tape to prevent accidental adjustment of this control.

(5A) (For PL or DPL radios only) Carry out Step 1A of Section 2.3, above.

(5B) (For radios without PL or DPL) Carry out Step 1B of Section 2.3, above.

## 2.5 TRANSMITTER POWER

### Note

Do not use coaxial cable adapters to connect different-sized cables. If you do, it may increase the output VSWR and cause protection circuitry to reduce output power. Use only cables that connect directly to the test equipment. See the Transmitter Section of this manual for information about the operation of the VSWR protection circuitry.

### Note

There is a list of recommended test equipment earlier in this section of the manual. Use only the recommended equipment for making these adjustments to get the best results.

### Note

You can make all the transmitter adjustments described here through holes in the common circuits board. (See Figures 1 and 2.)

(1) Turn R917 clockwise to the stop.

(2) Select a mode with a middle customer frequency.

(3) Adjust R908 to get a power level of 105 watts.

(4) Verify that the power level on all customer frequencies is  $105 \pm 5$  watts.

## 2.6 RECEIVER TUNING

No field tuning of the receiver is required.

## 3. Radio Disassembly

### 3.1 GENERAL

3.1.1 You can reach the solder side of the RF board, personality board, and the power amplifier deck from the top of the radio after removing the top cover. Remove the top cover by turning the key to release the front handle and then pushing the button under the

handle. This allows the top cover to pop up, giving you access to the boards. For access to the PA deck, remove the five screws securing the PA shield and lift the shield out by its handle.

3.1.2 To remove the radio from the vehicle, first release the handle, as described above. Now slide the radio forward (about an inch) and lift it out. Disconnect the cables to remove the radio from the trunk.

3.1.3 You can reach the rest of the radio by removing the four screws that secure the skid plate to the bottom of the radio. This gives you access to the metering socket of the common circuits board (J952). The common circuits board is hinged so that you can open it out to gain access to its component side and to the component side of the RF board. (See Figures 1 and 2 in the Description Section of this manual.) To turn the common circuits board on its hinge, remove two screws on the board as well as one additional screw on the regulator heat sink.

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#### **Warning**

When operating the radio with the regulator heat sink screw removed, avoid the exposed hot flange.

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#### **Note**

All serviceable mounting screws have posidrive heads that can be serviced with standard Phillips screwdrivers. To improve driver engagement, use posidrive tools (available through National Parts, Motorola part numbers 66-80344A57 and 66-80344A58).

#### **Note**

Black plastic captivators identify the mounting screws for the common circuits board, personality board, and RF board.

### **3.2 COMMON CIRCUITS BOARD**

To turn the common circuits board on its hinges, remove three screws. To remove the board from the radio, remove the two hinge screws also and unplug the ribbon cable between the common circuits board and the personality board, and the wires between the common circuits board and the PA deck. When putting the common circuits board back into the radio, pass the cable and the wires between the two board hinges.

### **3.3 PERSONALITY BOARD**

To remove the personality board from the radio: (a) remove the seven screws that secure the board to the radio, (b) disconnect the cable from the front

plug, (c) disconnect the ribbon cable from the common circuits board, (d) remove any connectors to the interface board, and (e) pull the board away from the radio to disconnect the connectors to the RF board. When putting the board back into the radio, insure that the front plug gasket is properly seated. (Silicone compound, Motorola part number 1100834678, helps in this procedure.)

### **3.4 RF BOARD**

To remove the RF board: (a) remove the personality board, as explained above, (b) remove the six retention screws, (c) disconnect a coaxial cable between the RF board and the internal casting, and (d) disconnect the wires near the antenna switch. To reach some segments of the solder side of the RF board, you must remove shields screwed to the board. Remove the two large cans on the component side of the board by simply pulling them off the board; other cans must be unsoldered to be removed.

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#### **Important**

To reinstall the RF board, align the board guide posts and the internal casting carefully. Match the spring connectors on the board precisely with those in the internal casting.

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### **3.5 INTERNAL CASTING**

#### **3.5.1 General**

To remove the internal casting from the radio:

- (1) Remove the radio covers.
- (2) Remove three screws to allow the common circuits board to hinge.
- (3) Remove the four casting mounting screws (bottom side of radio).
- (4) Remove the input coax from the high-pass filter board.
- (5) Unsolder the output coax from the RF board.
- (6) Remove the TX buffer and disconnect the TX mixer output coax.
- (7) Disconnect the remaining coax from the RF board.
- (8) Disconnect P200 and P201 from the RF board.
- (9) Remove three screws from the RF board (top side of radio).

#### **Note**

During reassembly, be sure that J650 is aligned correctly with the VCO assembly.

### 3.5.2 First Mixer

To remove the first mixer from the radio:

- (1) Remove the cover and three gasket mounting screws.
- (2) Unsolder the RF input wire coming from the extender front end board.
- (3) Unsolder the coax from the first injection filter board.
- (4) Unsolder the output wire going to the high IF board.
- (5) Remove the three mounting standoffs.

---

#### **Caution**

Do not use excessive heat. If you do, the tap leads will come off the filter.

---

### 3.5.3 First Injection Filter

To remove the first injection filter from the radio:

- (1) Remove the cover mounting screw and cover.
- (2) Unsolder the input wire from J125.
- (3) Unsolder the output coax going to the RX first mixer board.

### 3.5.4 VCO

To remove the VCO from the radio:

- (1) Remove the four screws from the VCO cover.
- (2) Remove the cover.
- (3) Remove the screw from the center of the VCO hybrid circuit module.
- (4) Remove the coaxial cable from the VCO hybrid. Use a low-wattage iron.
- (5) Pull J650 upward, removing it, the VCO, from the radio.

To install the VCO, reverse the procedure given above.

#### **Note**

If you replace the VCO assembly with a new one, readjust the compensation level, following the procedure given in the Maintenance and Troubleshooting Section of this manual.

### 3.5.5 Extender Front End Board

To remove the extender front end board from the radio:

- (1) Remove the two cover mounting screws and the cover.
- (2) Unsolder the input wire from J300 (phono plug).
- (3) Unsolder the output wire going to the first mixer board.
- (4) Unsolder the dc feed wire from the high IF board.
- (5) Unsolder the board from the three mounting tips.
- (6) Unsolder the output coax leading to the extender back end board.

### 3.5.6 Extender Back End Board

To remove the extender back end board from the radio:

- (1) Remove the cover mounting screws and the cover.
- (2) Unsolder the board from the three feedthroughs.
- (3) Unplug connector J200 from the RF board.
- (4) Unsolder the input coax from the extender front end board.
- (5) Remove the board mounting screws.

### 3.5.7 High IF Board

To remove the high IF board from the radio:

- (1) Remove the cover and gasket mounting screw.
- (2) Unsolder the output coax from the RF board.
- (3) Unsolder the input wire from the first mixer.
- (4) Unsolder the wire leading from the front end extender board.
- (5) Unsolder the board from the six mounting tips.
- (6) Remove the board mounting screw (standoff).

*Table 1. General System Troubleshooting Guide*

Symptom	Possible Source of Trouble	Chart or Diagram to be Referred to
No Receive Audio	Red or green lead fuse	None (Check the fuses.)
	Audio PA	Voltages and waveforms on audio schematic
	Audio enable switch	Squelch troubleshooting chart
	Squelch	Squelch troubleshooting chart
	Regulator	Regulator troubleshooting guide
	Synthesizer (not locking)	Synthesizer troubleshooting chart
	Microcomputer	Microcomputer troubleshooting chart
	Quad detector	Receiver section schematic
Distorted Receiver Audio	Audio PA	Audio schematic for voltages and waveforms
	Quad detector	Receiver section schematic
	IF	Receiver section schematic
Low Audio Power	Audio PA	Audio schematic
	Red lead fuse	None (Check fuse.)
	Quad detector	Receiver section schematic
	IF	Receiver section schematic
Failure to Squelch	Squelch	Squelch troubleshooting chart
	Microcomputer	Microcomputer troubleshooting chart
	Audio enable switch	Squelch troubleshooting chart
Failure to Unsquelch	Refer to <i>No Receive Audio</i> Symptom Above	
Improper Squelch Sensitivity	IF	Receiver section schematic
	Quad detector (low recovery)	Receiver section schematic
	Squelch	Squelch troubleshooting chart
Absence of PL/DPL Encode	I/O board	I/O board schematic
	Microcomputer	Microcomputer troubleshooting chart
	IDC	IDC portion of synthesizer troubleshooting chart
Absence of PL/DPL Decode	I/O board	I/O board schematic
Absence of Regulated 9.6 V or 5.0 V	Short on printed circuit board	—
	Regulator	Regulator troubleshooting guide
Absence of RF Power Output	PA enable switch	Microcomputer schematic
	Keyed 9.4 switch	Microcomputer schematic
	Synthesizer (out of lock)	Synthesizer troubleshooting chart
	Red or orange lead fuse	None (Check fuses.)
	Power control	Microcomputer schematic (PTT isolation circuit)
	PA	PA troubleshooting chart
Absence of Power Control	Power control	Power control troubleshooting chart
Low RF Power Output	Power Control	Power control troubleshooting chart
	PA	PA troubleshooting chart
	Antenna switch	Antenna switch test procedure
Absence of Transmitter Modulation	IDC	IDC portion of synthesizer troubleshooting chart
	Power control	IDC portion of synthesizer troubleshooting chart
Distorted Transmitter Modulation	Misadjusted compensation	Compensation adjustment procedure (in radio alignment and adjustment)
	IDC (PL/DPL distortion only)	IDC portion of synthesizer troubleshooting chart
	I/O board	I/O board schematic
	Reference oscillator	IDC portion of synthesizer troubleshooting chart
	VCO	IDC portion of synthesizer troubleshooting chart
Improper Microphone Sensitivity	IDC	IDC portion of synthesizer troubleshooting chart
	VCO	
	Reference oscillator	
Transmitter Frequency Shift with High-Level Modulation	IDC	IDC portion of synthesizer troubleshooting chart
Failure of Synthesizer to Lock	Synthesizer	Synthesizer troubleshooting chart
	Microcomputer	Microcomputer troubleshooting chart
	Memory module	Programing section of synthesizer troubleshooting chart

Table 1. General System Troubleshooting Guide (continued)

Symptom	Possible Source of Trouble	Chart or Diagram to be Referred to
Reference Frequency (6.25 kHz) in Speaker or on Transmitted Audio	Adaptive filter	Synthesizer troubleshooting procedure
Synthesizer Locking on Wrong Frequency	Synthesizer	Synthesizer troubleshooting chart
	Microcomputer	
	Memory module	
	Adjustment of reference oscillator	
Long Synthesizer Lock Time	Synthesizer	Synthesizer troubleshooting chart
	VCO	
Poor Receive Sensitivity	High IF	Receiver troubleshooting chart and receiver section schematic
	Low IF	
	Quad detector	
	Preamplifier	
	First mixer	
	Second mixer	
	Antenna switch	Antenna switch test procedure
Alternator Whine	Short, chassis to A –	None (Disconnect control cable and check for a short between chassis and A – .)
	Excessive whine in vehicle	Manual 68P81116A74

### 3.5.8 TX Mixer

To remove the TX mixer from the radio:

- (1) Remove three screws to allow the common circuits board to hinge.
- (2) Remove the TX buffer and unfasten the TX mixer output coax from the TX buffer board.
- (3) Remove the remaining two coax cables from the RF board.
- (4) Unsolder the two dc voltage supply wires from the TX mixer hybrid.
- (5) Remove the two TX mixer hybrid plate mounting screws.
- (6) Remove the input coax from the VCO.

## 3.6 REPLACEMENT OF TRANSISTOR DEVICES

### 3.6.1 Driver Device (Q802)

To remove the driver device (Q802) from the PA board:

- (1) Remove the hex nut from the stud of Q802. The hex nut is in a depression on the bottom of the radio.
- (2) Unsolder the flanges of the device from the board. Use a four-pronged soldering iron if one is available. If not, heat up each flange with a soldering iron and use a sharp object such as a pick to pry up the flange from the board. When all the flanges are clear of the board, lift the device out of it.

To replace the driver device in the PA board:

- (1) If you are reinstalling the old Q802, clean old thermal compound off the bottom of the device with a tissue or a rag. Also clean that part of the chassis exposed through the hole cut in the board for Q802 as well as possible. If you are installing a new Q802, just clean the chassis.
- (2) Put a new, thin, even layer of thermal compound (Wakefield 120-8 or equivalent) on the bottom of Q802.
- (3) Drop Q802 through the hole in the board, with the angled flange pointing towards L807. Screw the hex nut finger tight on the stud. (Be careful not to strip the threads on the stud.)
- (4) Solder the flanges of Q802 to the board. Q802 will not operate properly unless these flanges are well soldered.
- (5) Tighten the hex nut to 6–8 inch-pounds.

### 3.6.2 Final Devices (Q803, Q804)

To remove Q803 and Q804:

- (1) Remove the flange screws (two per device) from Q803 and Q804.
- (2) Lift up one end of R808 to make it easier to remove Q804.
- (3) Unsolder the flanges, using the procedure given in Step 2 of Section 3.6.1, above.



To replace the final devices:

- (1) If you are replacing old devices, clean off the old layer of thermal compound with a tissue or a rag. Also clean the chassis exposed through the hole in the board as well as possible.
- (2) Apply a new, thin, even layer of thermal compound (Wakefield 120-8 or equivalent) to the bottoms of the devices and drop them into their holes, making sure that the angled flange of each is pointing towards T802.
- (3) Install the flange screws. (Be sure to replace the thermistor bracket, Part No. 07-80078A01, on Q803.) Tighten the screws to 6–8 inch-pounds.

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#### Caution

Tighten the flange screws before soldering the transistor tabs to the circuit board. *Do not use more than six to seven inch-pounds of torque*, or you may damage the transistor.

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### 3.7 RF POWER AMPLIFIER CIRCUIT BOARD

To remove the PA circuit board:

- (1) Unsolder the coaxial cable from the output connector (MP801) on the PA board.
- (2) Disconnect the input cable (from the synthesizer) from input connector J801 on the PA board.
- (3) Remove the hex nut from the stud of Q802 on the bottom of the radio.
- (4) Remove the four flange screws from the final devices (Q803 and Q804).
- (5) Remove the screw from the collar heatsink of Q801.
- (6) Take the hex nut off the standoff on the PA board (next to T801).
- (7) Remove the six remaining board screws.
- (8) Unsolder all nine feedthroughs, removing the solder with a solder sucker.
- (9) Lift the board out.

To reinstall the PA board:

- (1) Clean all old thermal compound off the bottoms of Q802, Q803, and Q804. Also clean the chassis, removing any thermal compound, dirt, grit, or other contamination.

(2) Apply a thin, even layer of thermal compound to Q802, Q803, and Q804.

(3) Resolder the coaxial cable to the output connector (MP801) while the board is still loose.

(4) Put the board back in the chassis, making sure it is in properly.

(5) Install the flange screws in Q803 and Q804, making sure that the thermistor bracket (Part No. 07-80078A01) is on Q803. Tighten to 6–8 inch-pounds.

(6) Install the screw for the collar heatsink of Q801, making sure that the square plastic insulator (Part No. 14-80103B01) is under the heatsink. Also make sure that the plastic shoulder washer (Part No. 04-82345A01) is under the screw. Tighten the screw to 8–10 inch-pounds.

(7) Reinstall the hex nut on the standoff near T801. Tighten it to 6–8 inch-pounds.

(8) Install the remaining six board screws and tighten them to 8–10 inch-pounds.

(9) Resolder *all* feedthroughs. Do not flow excessive solder.

(10) Reconnect the input cable (from the synthesizer) to input connector J801 on the PA board.

### 3.8 FRONT LATCH

To remove the front latch key mechanism, insert the key into the lock, turn the key about 45 degrees clockwise, and insert the special removal tool (Part No. 66-84909B01) with the point directed away from the lock. Twist the tool 180 degrees clockwise. This releases the key mechanism, which you can then remove. To remove the black plastic part, remove the single screw securing it.

### 3.9 DIRECTIONAL COUPLER

#### 3.9.1 Directional Coupler Circuit Board

To remove the directional coupler circuit board:

- (1) Remove the cover of the coupler casting and its gasket.
- (2) Unsolder the three feedthrough capacitor leads.
- (3) Unsolder the input and output coax leads.
- (4) Remove the board.

To replace the directional coupler board, reverse the removal procedure.

### 3.9.2 Directional Coupler Casting

#### Note

You should be able to solve most board-related electrical problems without removing the directional coupler casting from the radio chassis.

To remove the directional coupler casting:

- (1) Unsolder the output coax from the PA board output.
- (2) Remove plug P953 from J953 on the common circuits board.
- (3) Remove the retaining nut from the antenna connector.
- (4) Remove the two screws securing the coupler casting to the chassis.
- (5) Pull the coupler and antenna connector assembly out of the chassis.

To reinstall the directional coupler casting, reverse the removal procedure.

### 3.10 PREAMP CIRCUIT BOARD

To remove the high-pass filter circuit board:

- (1) Remove the two screws holding the circuit board cover to the radio housing.
- (2) Unsolder the input coax from the PA board and slide it through the HUB1077A radio housing.
- (3) Disconnect the output coax from the internal casting.
- (4) Remove the two remaining screws.

## 4. Troubleshooting the General System

Table 1 is a guide to troubleshooting the general system. It lists the symptoms of various malfunctions, possible sources of the trouble, and the chart or diagram that is most likely to be of service in clearing the fault.

## 5. Antenna Switch Test Procedure

### 5.1 INTRODUCTION

When the radio is in the receive mode, the antenna switch connects the antenna to the receiver via the

receiver reed, coaxial cable, and phono plug; in the transmit mode, it connects the antenna to the transmitter via the transmitter reed, coaxial cable, directional coupler, and harmonic filter. (See Figure 3.)

### 5.2 TEST EQUIPMENT

Use a regular analog VOM for checking continuity paths or short circuits. The list at the beginning of Section 1 recommends the Motorola T1009A ac-dc VOM.

### 5.3 PROCEDURE

This procedure consists of a receive signal path test and a transmit signal path test. Before conducting either, *disconnect the coaxial cable from the LLA deck input*. This allows the antenna switch to change from one condition to the other (from receive to transmit or vice versa) without causing the PA to generate power output.

#### 5.3.1 Receive Signal Path Test

(1) Disconnect the receive cable plug from the internal casting socket. Use an ohmmeter to verify continuity between the center pin of the plug and the center pin of the antenna connector. Verify no continuity between the center pin of the plug and the plug shield (or radio chassis).

(2) Key up the radio and verify that 9.4 VDC is present at the antenna switch coil. Under this condition, the receive reed opens. Verify no continuity between the center pin of the antenna switch and that of the receive cable plug.

#### 5.3.2 Transmit Signal Path Test

(1) Verify that the coaxial cable is still disconnected from the PA deck input.

(2) Key up the transmitter and verify continuity between the center conductor of the coaxial cable and the center pin of the antenna switch. If there is continuity, check other points along the transmit path to locate any possible open circuits (Figure 3). If there is no continuity, replace the antenna switch.

(3) Verify that the resistance of the transmitter path to the radio chassis is 50 kilohms or more.

#### Important

Field servicing of the antenna switch assembly is NOT recommended. Replace the entire unit if it is defective.

## 6. Extender Tuneup Procedure

(1) If the tuneup frequency is higher than 40 MHz, remove chip resistors (zero-ohm) R300, R301, and R302 from the extender front-end board. Replace them with wire jumpers if necessary.

(2) Preset L300, L301, and L302. (See Figure 4.)

(3) Set the frequency generator to the tuneup frequency and connect it to the radio. Set the generator  $\frac{1}{4}$  MHz below the tuneup frequency if you intend to use the metal-tipped tuning tool on C321.

(4) Set the trim capacitor on the back-end board (C321) for peak voltage at the extender-tune test point. Use a hard plastic tuning tool, if possible. Do not use a screwdriver. During the tuneup process, adjust (and readjust as required) the generator RF level to maintain the voltage at the extender-tune test point in its active region.

(5) After removing the tuning tool from the trim capacitor, adjust the generator frequency for peak output at the extender-tune test point. (Little or no adjustment should be required.)

(6) Adjust L300 and L302 for peak voltage at the extender-tune test point.

(7) Adjust L301 for peak voltage at the extender-tune test point.

(8) Repeak L300 and L302.

(9) Repeak L301.

NOTE: SLUG FLUSH WITH TOP OF FORM  
EQUALS ZERO TURNS

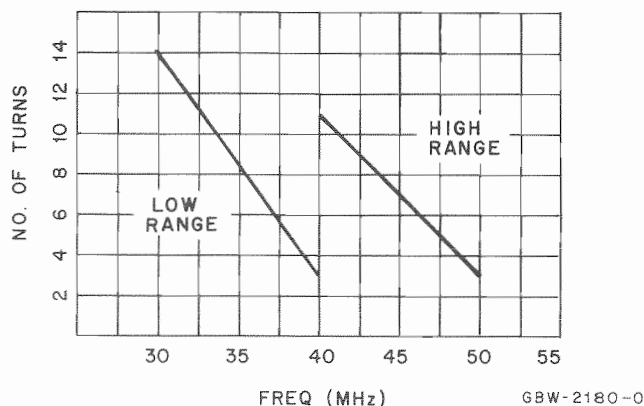


Figure 4. Preset Chart for L300-L303.

After completing the above procedure, you may be able to get 2 or 3 dB additional sensitivity by doing the following:

- (1) Hook up a pulse generator to the radio connector.
- (2) Monitor the pulse output at J200-1 with an oscilloscope with a 2- $\mu$ s-per-division sweep. Have it externally triggered by the pulse generator, if possible.
- (3) Decrease the pulse generator amplitude until the J200-1 waveform starts to disappear.
- (4) Tune L301, L302, L303, and C321 until the waveform is triggered solidly.
- (5) Repeat Steps 3 and 4 until the procedure gives no further improvement.

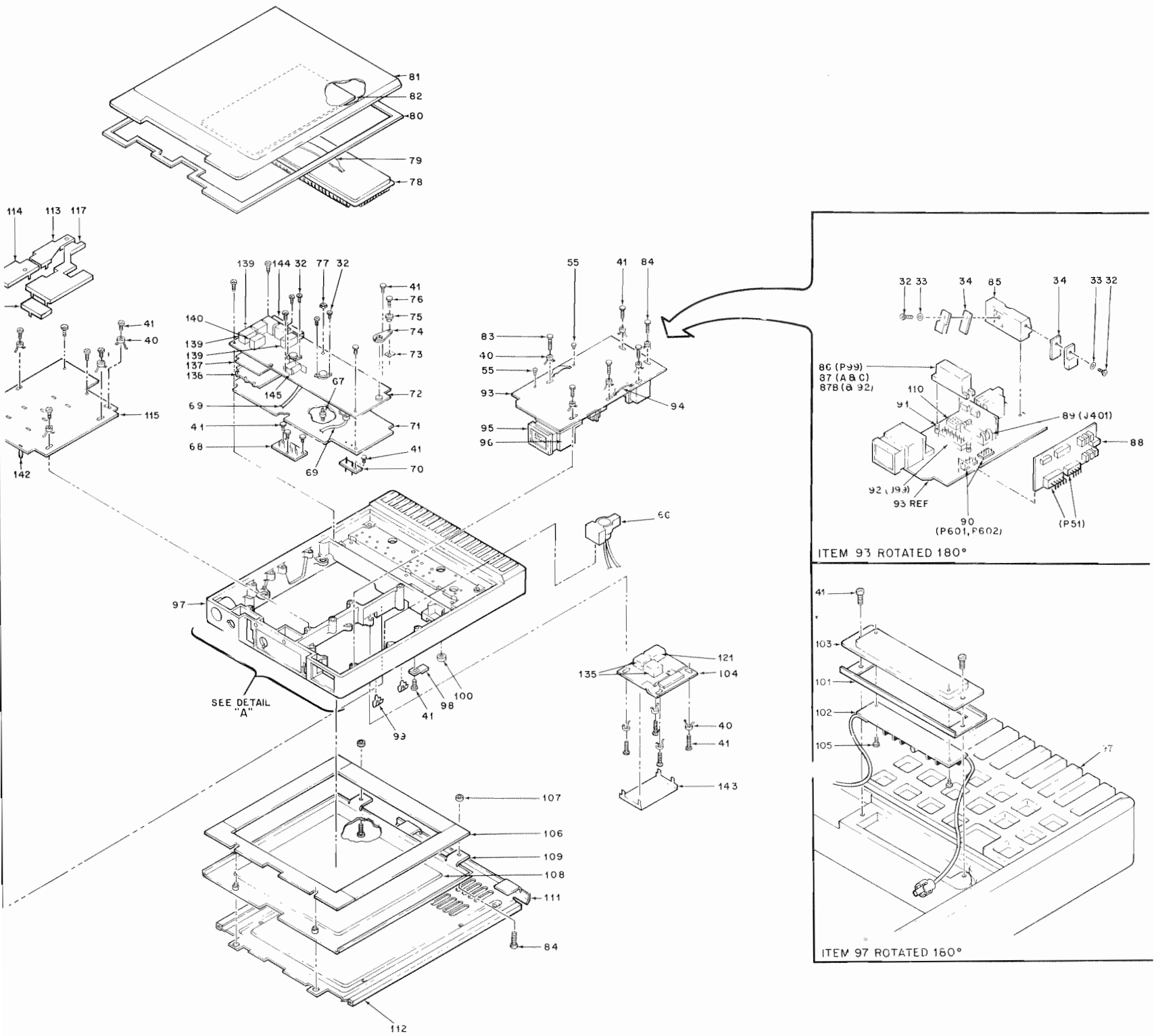
parts list

Low-Band SYNTOR X Exploded View MXW-2154-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	15-84776M11	internal casting housing
2	14-80212B01	expansion nut, 4 used
3	03-80157J01	tapping screw (4.55 x 1.59 x 19 mm), 4 used
4	32-82796H01	wire mesh gasket
5	HLB4086A	VCO substrate
6	03-10943M10	tapping screw (3 x .5 x 8 mm)
7	15-84817M01	VCO cover
8	03-80132J02	tapping screw (3.5 x .6 x 23 mm), 4 used
9	03-10943M14	tapping screw (3.5 x .6 x 6 mm), 19 used
10	15-84851M01	buffer cover
11	HLB1021A	transmit buffer, substrate and carrier
12	HFB4001A	injection filter board
13	42-80194H01	grounding clip
14	32-80207H01	injection filter gasket
15	15-80203H01	injection filter cover
16	43-80190A03	standoff (3.5 x .6 x 7 mm), 4 used
17	HLB4085A	receiver mixer board
18	32-80132K01	receiver mixer gasket
19	15-80126K01	receiver mixer cover
20	15-80204H01	RF extender cover
21	03-10943M16	tapping screw (3.5 x .6 x 10 mm), 4 used
22	32-80208H01	extender front end gasket
23	43-80294H01	board mounting spacer, 2 used
24	HLB4090A	extender front end board
25	HLB4091A	extender back end (pre-amp) board
26	32-80043D01	pre-amp gasket
27	15-84853M01	pre-amp cover
28	15-80107H01	directional coupler housing
29	HLB4092A	directional coupler board
30	32-80284H01	directional coupler gasket
31	15-80108H01	directional coupler cover
32	03-10911A11	machine screw (3 x .5 x 8 mm), 9 used
33	04-84180C01	shoulder washer, 5 used
34	14-83820M02	transistor insulator, 5 used
35	26-84835M01	regulator heatsink
36	55-83493M01	hinge, 2 used
37	HLN4817A	common circuits board
38	30-83602M01	cable (includes P401)
39	28-80052D01	10-contact right-angle connector
40	42-83503M01	screw retainer, 19 used
41	03-10943M15	tapping screw (3.5 x .6 x 8 mm), 33 used
42	HLN4251A	VCO feedthrough plate
43	15-80125K01	high IF cover
44	32-80131K01	high IF gasket
45	HLB4098A	high IF board
46	07-80152B01	handle pivot bracket, 2 used
47	22-83491M01	spring pin, 2 used
48	55-80242D01	handle
49	01-80739T21	interconnect cable assembly
50	01-80739T01	antenna connector and cable
51	32-80080A01	antenna connector gasket
52	02-80006A01	spanner nut
53	04-00114522	5/16" internal lock washer
54	55-84101B01	lock with key
55	75-80194G01	rubber bumper, 3 used
56	38-80154B01	cover release button
57	41-80160B01	lock spring, 2 used
58	55-80161B01	lock catch
59	15-80159B02	lock housing
60	42-81056B01	retainer ring
61	55-80157B01	cover release catch
62	41-80155B01	cover release spring
63	41-80206F01	cover lift spring
64	03-10908A46	machine screw (M5 x .8 x 16 mm), 2 used
65	04-00007652	5/16" lock washer, 2 used
66	HLN4461A	PA wiring bus
67	43-80013B01	PA board standoff
68	HLN4913A	power amplifier feedthrough board
69	29-83897M01	wire receptacle terminal, 2 used
70	HLN 4914A	IPA feedthrough board
71	14-80297H01	PA insulator
72	HLN4094A	power amplifier circuit board
73	14-80103B01	IPA heatsink insulator
74	26-80016B01	IPA heatsink
75	04-84152B01	shoulder washer
76	03-10943M17	tapping screw (3.5 x .6 x 13 mm)
77	02-10971A63	machine nut (M3.5 x .6 mm)
78	01-80244H01	PA shield
79	55-84300B04	PA shield handle
80	32-80226D01	top cover gasket
81	15-84075N01	top cover
82	14-84691M01	top cover insulator
83	03-80132J01	tapping screw (3.5 x .6 x 28 mm), 2 used
84	03-10943M18	tapping screw (3.5 x .6 x 16 mm), 6 used
85	26-83498M01	audio PA heatsink
86A	TRN8864A	8 and 16-mode PROM
86B	TRN8865A	32-mode PROM
86C	TRN8866A	64-mode PROM
87A	15-80155D01	right half PROM housing
87B	15-83494M01	left half PROM housing
87C	54-84392M02	direction label
88	TRN8876A	input/output board
89	28-83603M01	20-contact male connector
90	28-82647K02	10-contact male connector, 2 used
91	46-83821M01	memory module alignment pin, 2 used
92	28-82622L03	22-contact connector, male

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
93	HLN4915A	personality board
94	55-84300B03	short handle, 2 used
95	32-80219B01	front connector gasket
96	01-80739T06	37-contact male front connector assembly
97	15-84763M01	radio housing
98	42-80201B01	bus wire clip
99	42-84367M01	wire hold-down clip, 2 used
100	02-00007003	nut (8-32 x 5/16 x 1/8)
101	HLB4000A	high-pass filter preamp board
102	32-80283H01	high-pass filter preamp gasket
103	15-80192H01	high-pass filter preamp cover
104	HLB4083A	transmitter buffer board
105	03-10943M09	tapping screw (3.5 x .5 x 6 mm), 2 used
106	32-80225D01	bottom cover gasket
107	04-80149A01	captive washer, 4 used
108	14-84691M02	bottom cover insulator
109	15-80174B01	bottom cover
110	08-84207B01	7-contact metering socket
111	07-80208G02	mounting tray
112	07-80173B01	guide rail, 2 used
113	26-80199K01	second mixer shield, solder side
114	26-80198K01	low IF shield, solder side
115	HLB4087A	RF board
116	26-80289H01	RF board detector shield
117	26-80137K01	synthesizer divider shield
118	26-83596M01	RF board shield, component side, 5 used
119	26-84898M01	RF board shield, component side, 7 used
120	26-80288H01	fence shield, component side
121	26-83595M01	quad detector shield, component side, 2 used
122	09-83445L09	10-contact female connector, 2 used
123	26-80127K01	RF synthesizer shield
124	26-80292H01	RF adaptive filter shield
125	26-80296H01	transmit doubler hybrid shield
126	26-80293H01	receive injection double hybrid shield
127	26-80299H01	AGC extender fence shield
128	46-83948M01	guide post, 2 used
129	42-82160N01	speed clip, 7 used
130	09-80001F01	female phono connector, 2 used
131	09-83730M01	7-contact socket
132	28-84324M03	5-contact connector
133	28-84324M01	2-contact connector
134	26-80238K01	RF board high IF coil shield
135	26-80121A01	transmitter buffer board shield, 2 used
136	HKN4202A	2-contact interconnect cable assembly
137	14-80165K01	harmonic filter shield insulator
138	26-80287H01	harmonic filter shield
139	26-80298H01	harmonic filter coil shield, 5 used
140	26-80149J01	PA board capacitor shield
141	26-80237K01	synthesizer divider hybrid shield
142	29-80146B01	amp mod terminal, 23 used
143	26-80189M01	transmit buffer shield
144	26-80129K01	harmonic filter shield
145	25-80229J02	power transformer
146	55-80244C02	handle latch
147	03-10943R21	tapping screw (4 x .7 x 8 mm)

MXW-2154-O (2)

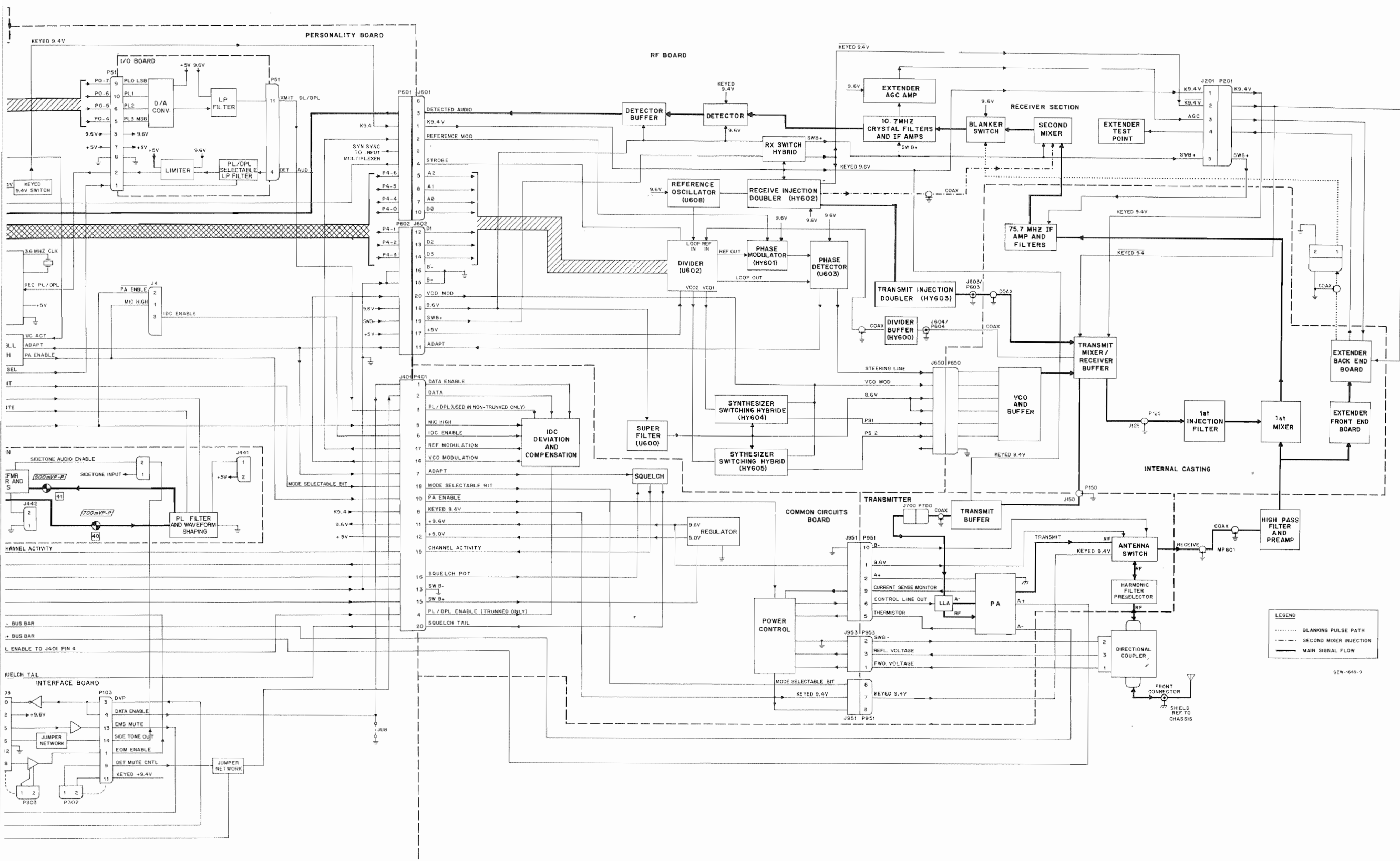


Exploded View, Mechanical Parts List, and Functional Block Diagram for SYNTOR X Low-Band Radio PDW-1645-O (Sheet 1 of 2) 8/28/85









## 1. Ceramic Microstrip Substrates

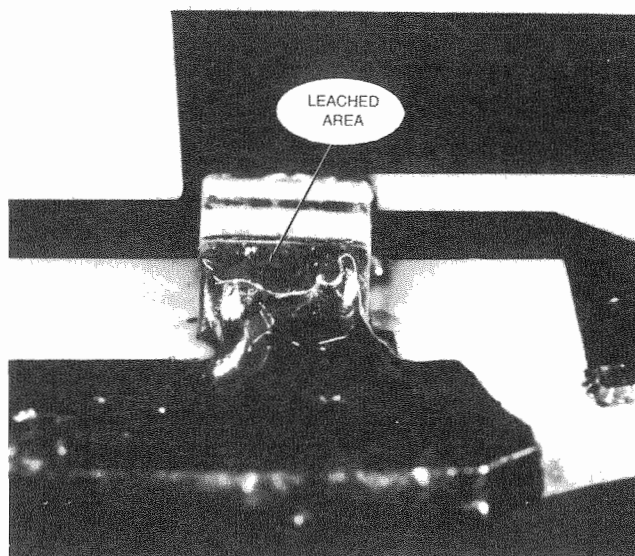
1.1 You should not attempt to repair the ceramic microstrip substrates of the radio. If a module has a faulty component, replace the whole module. Not only are repairs to the substrates and replacements of substrate components difficult to make without damaging the module, but also the factory uses special fixtures in building and testing the radio to make certain that each module operates properly. Field repairs to the microstrip substrates negate that initial factory adjustment.

1.2 The ceramic materials of the radio have properties similar to those of glass, and sharp blows and heat affect them the same way they affect glass. Therefore, if you must solder anything to ceramic microstrip modules, use as little heat and pressure as possible. You must also use solder with a high percentage of silver to avoid leaching the capacitors and non-copper runners.

## 2. Chip Capacitors

2.1 The radio uses many chip capacitors as circuit elements. They are extremely sensitive to heat and must not be re-used. Be very careful when making repairs to circuits near these components. Heat from a soldering iron being applied to a nearby component may "leach" the end metalization (terminals) of a chip capacitor. Figure 1 shows what a leached capacitor looks like.

2.2 To remove a chip capacitor, apply heat to both connecting terminals simultaneously, either with two soldering irons or a single iron with a special tip (Motorola Part No. ST-1160). When the connecting solder melts, lift the chip. Figures 2 and 3 illustrate this removal technique.



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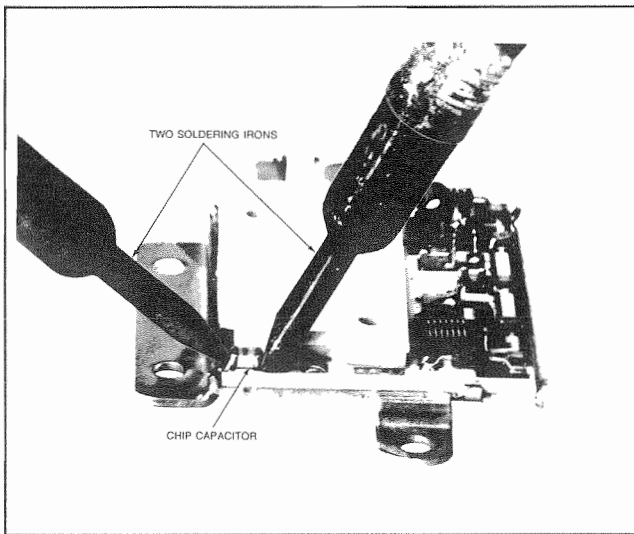
Figure 1.  
Example of "Leached" Chip Capacitor

## 3. Replacing Transistors in the Power Amplifier

3.1 To remove the power transistors, remove two transistor mounting screws or one stud nut (accessible from the chassis bottom). Unsolder and remove the clamped mica capacitors, then unsolder and remove the transistors. (Special soldering iron tips ST1160 and ST1161, available from Motorola parts offices, make it easier to remove capacitors and transistors.)

3.2 When replacing RF power transistors, you *must* take the following steps. First, use a soft cloth or paper towel to remove all thermal compound and residue from *both the chassis and the transistor*. Then apply a thin film of Wakefield thermal compound to the bottom of the transistor mounting flange. Replace the transistor in the center of the printed circuit board

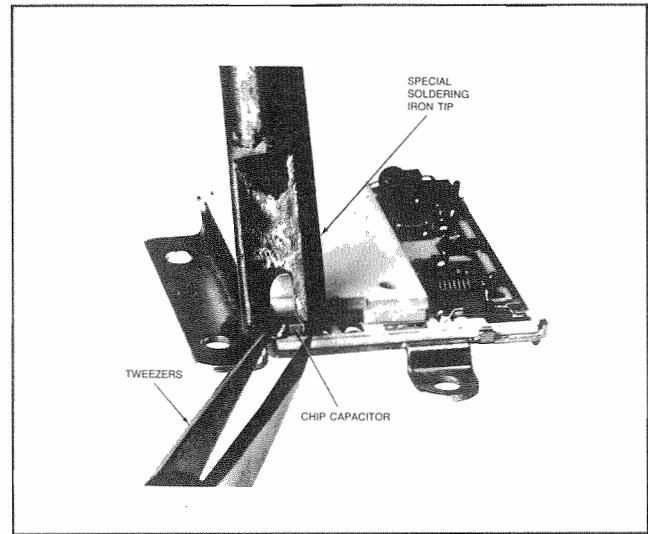




FAEPS-30533-O

*Figure 2. Removal of Chip Capacitors  
with Two Soldering Irons*

cutout, tightening the mounting hardware to a *maximum* of seven inch-pounds. With a low-power soldering iron (40–60 W) solder the leads, using enough solder to completely cover the lead and solder pad. *Make sure* that the solder is flowing freely both *over* and *under* the lead before removing the heat. If a lead tends to spring away



FAEPS-30534-O

*Figure 3. Removal of Chip Capacitor  
with Special Soldering Iron Tip*

from the printed circuit board, use the tips of a pair of pliers to hold the far end of the lead down against the board until the solder hardens. After replacing the transistors, replace the clamped mica capacitors, *being sure* to position them *exactly* as they were with respect to the transistor body.