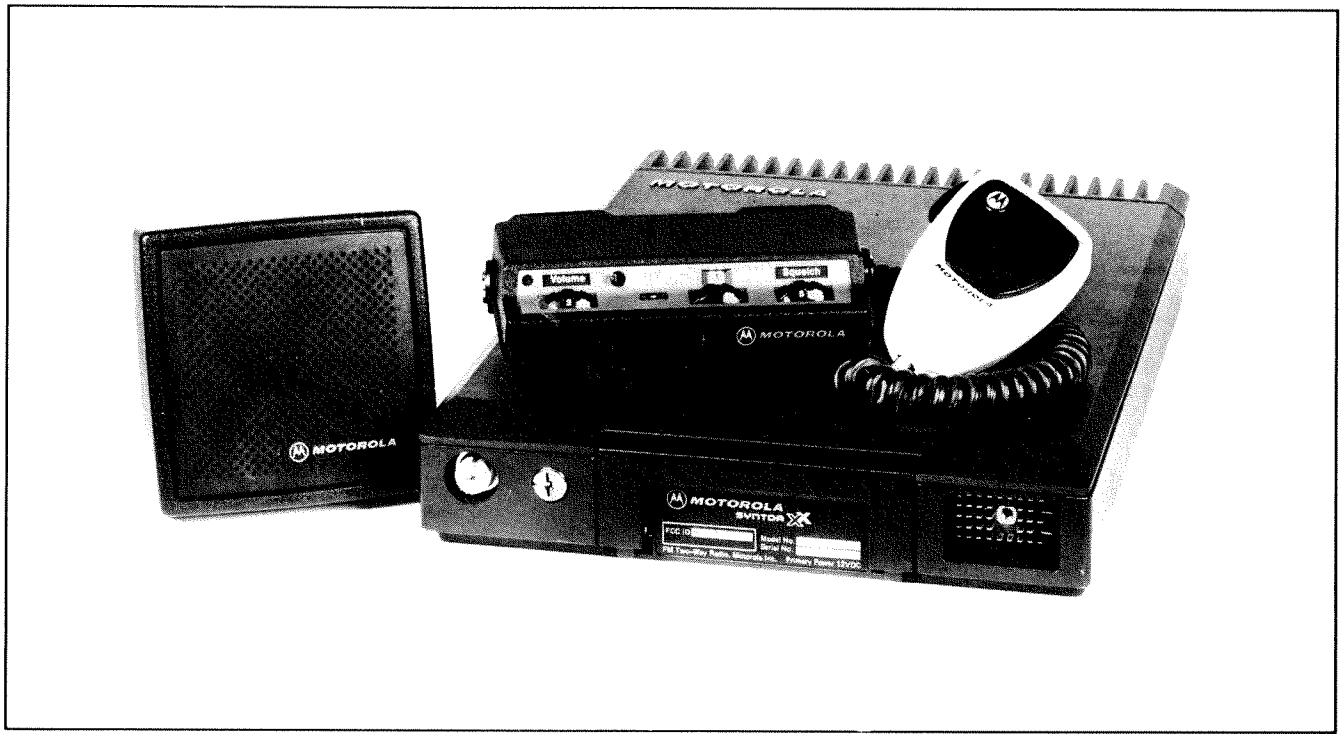
MOTOROLA

Mobile Products Division

SYNTOR X

UHF Radio

Range 1: 406–420 MHz
Range 2: 450–470 MHz
Range 3: 470–488 MHz
Range 4: 482–500 MHz
Range 5: 494–512 MHz



Instruction Manual

68P80100W45-E

MOTOROLA
Mobile Products Division

SYNTOR X UHF RADIO
Range 1: 406–420 MHz
Range 2: 450–470 MHz
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Worldwide Parts Division
1313 E. Algonquin Road
Schaumburg, Illinois 60196

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7/10/93 - PHI

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Foreword

1. Scope of Manual

This manual is intended for the use of experienced technicians familiar with this general type of equipment. In it you should be able to find all the information you will need for installing and servicing the equipment it covers. It is current as of the publication date, and incorporates changes that have occurred since then in the form of instruction manual revisions (WMR's). (WMR's that cover production or engineering changes to the circuitry usually include corrected schematics and circuit board diagrams.)

2. Model and Kit Identification

Each Motorola product has an identifying model number stamped on its nameplate. In most cases, assemblies and kits that make up the product also have identifying kit numbers stamped on then. Schematics and circuit board diagrams for such kits show this same identifying number prominently in the lower left–hand or right–hand corner.

3. Service

Motorola's national service organization maintains one of the finest nation–wide installation and maintenance programs available to users of communication equipment. The administrative staff of this organization consists of national, area, and district service managers, all of whom are Motorola employees dedicated to giving our customers the best possible service. The organization has about 900 authorized Motorola Service Stations (MSS's) throughout the United States, each manned by one or more trained, FCC–licensed technicians.

Motorola selected each one of these independently owned and operated MSS's to service its customers. They offer Motorola maintenance either by the job (priced by time and material), or on a service contract at a fixed periodic fee. To buy a service contract for your Motorola equipment, contact your Motorola Service Representative or write to:

National Service Manager
Motorola Communications and Electronics, Inc.
1301 E. Algonquin Road
Schaumburg, Illinois 60196

4. Ordering Replacement Parts

When ordering replacement parts (components, kits, or chassis) or equipment information, include the complete identification number. If the component part number is not known, include in your order the number of the chassis or kit of which it is a part, and enough component description to identify the desired part.

In orders for crystal and channel elements, specify the crystal or channel element type number, crystal and carrier frequency, and the model number of the radio in which the part is used.

In orders for active filters, *Vibrasender* and *Vibrasponder* resonant reeds, specify type number and frequency, and identify the owner/operator of the communications system in which these items are to be used; also include any serial numbers stamped on the components being replaced.

Replacement Parts Ordering

MAIL ORDERS

Send written orders to the following addresses;

Replacement Parts, Test Equipment, Crystal Service Items:

Motorola, Inc.
Communications Parts Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Federal Government Orders:

Motorola, Inc. Communications Parts Division
Attention: Order Processing
1701 McCormick Drive
Landover, MD 20785

International Orders:

Motorola, Inc.
Communications Parts Division
Attention: International Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

TELEPHONE ORDERS

Replacement Parts/Test Equipment

call: 1–800–422–4210
or Federal Government orders,
1–800–826–1913

Crystal Service Items

call: 1–800–323–1570
or Illinois residents,
1–800–445–4564

TELEX/FAX ORDERS

Replacement Parts/Test Equipment

Telex: 280127
FAX: 312–576–6285

Federal Government orders

FAX: 301–925–2473 or 301–925–2474

Crystal Service Items

Telex: 433–0067
FAX: 910–277–0799

Customer Service

Replacement Parts/Test Equipment

call: 1–800–537–7007

Crystals

call: 1–800–323–0234

Parts Identification

call: 312–576–7418

National Data Services

1711 West 17th Street, Tempe, AZ 85281

call; 602–994–6472
TWX: 910–951–1334

GENERAL SAFETY INFORMATION

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

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

DO NOT operate the transmitter of a fixed radio (base station, microwave, and rural telephone RF equipment) or marine radio when someone is within two feet (0.6 meter) of the antenna.

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

In addition,

DO NOT operate this equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly grounded according to Motorola installation instructions for safe operation.

All equipment should be serviced only by a qualified technician.

Refer to the appropriate section of the product service manual for additional pertinent safety information.

INSTALLATION SAFETY WARNING

Consider the occupants' safety when you choose a location for the radio. Do not mount the radio overhead or on a sidewall unless you take special precautions.

If someone were to remove the radio and fail to replace it properly, road shock could bump the radio loose, and the falling radio could in some circumstances cause serious injury to the driver or a passenger.

If you must mount the radio overhead or on a sidewall, give it the added protection of a retaining strap. Custom–made straps are available from Motrola National Parts. Order kit number HLN4698A (for *Mitrek* and *MaraTrac)* or HLN4697A (for *SYNTOR, SYNTOR X,* or *SYNTOR X 9000*).

WARNING

For vehicles equipped with electronic anti–skid braking systems, see "ANTI–SKID BRAKING PRECAUTIONS" Publication, Motorola Number 68P81109E34.

WARNING

To gain full access to the Common Circuits Board for servicing, the regulator heat sink screw must be removed. When operating the radio with the regulator heat sink screw removed, care should be taken to avoid the exposed hot flange.

WARNING

It is mandatory that radio installations in vehicles fueled by liquefied petroleum gas conform to the following standard.

National Fire Protection Association standard NFPA 58 applies to radio installations in vehicles fueled by liquefied petroleum (LP) gas with the LP–gas container in the trunk or other sealed–off space within the interior of the vehicles. This standard requires that:

1. Any space containing radio equipment shall be isolated by a seal from the space in which the LP–gas container and its fittings are located.

2. Remote (outside) filling connections shall be used.

3. The container space shall be vented to the outside.

Safe Handling of CMOS Integrated–Circuit Devices

Many of the integrated–circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open–circuit impedance, CMOS IC's are vulnerable to damage from static charges. Everyone involved in handling, shipping, and servicing them must be extremely careful not to expose them to such damage.

CMOS IC's do have internal protection, but it is effective only against overvoltages in the hundreds of volts, such as those that could occur during normal operations. Overvoltages from static discharge can be in the thousands of volts.

When a CMOS IC is installed in a system, the system's circuit elements distribute static charges and load the CMOS circuits. This decreases the vulnerability of the IC's to static discharge, but improper handling will probably cause static damage even when the IC's are so installed.

To avoid damaging CMOS IC's, take the following precautions when handling, shipping, and servicing them.

1. Before touching a circuit module, particularly after having moved around in the service area, touch both hands to a bare metal earth–grounded surface. This discharges any static charge you may have accumulated.

Note

Wear a conductive wrist strap (Motorola Part No. RSX–4015A) to minimize the buildup of static charges on your person while you are servicing CMOS equipment.

WARNING

When wearing a conductive wrist strap, be careful near sources of high voltage. By grounding you thoroughly, the wrist strap also increases the danger of lethal shock from accidental contact with such a source.

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2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

3. Check the INSTALLATION and MAINTENANCE sections of the service manual and the notes on the schematic to find out whether or not you can insert or remove circuit modules with power applied to the unit, and act accordingly.

4. When servicing a circuit module, avoid carpeted areas, dry environments, and the wearing of static–generating clothing.

5. Be sure that all electrically powered test equipment is grounded. Attach the ground lead from the test equipment to the circuit module before connecting the test probe. Similarly, disconnect the test probe before removing the ground lead.

6. When you remove a circuit module from the system, lay it on a sheet of aluminum foil or other conductive surface connected to ground through 100,000 ohms of resistance.

WARNING

If the aluminum foil is connected directly to ground, you may get a shock if you touch it and another electrical circuit at the same time.

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

8. Before connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary during the replacement of an integrated–circuit device), be sure to discharge any static buildup on your person (see Procedure 1, above). Because you can have a voltage difference across your body, you should use only one hand if you must touch the board wiring or any of the pins on the CMOS device.

9. When replacing a CMOS integrated–circuit device, leave the device in its metal rail container or conductive foam until you are ready to insert it into the pronged circuit module.

10. Connect any low–impedance test equipment such as a pulse generator to CMOS device inputs after you have applied power to the CMOS circuitry. Similarly, disconnect such low–impedance equipment before turning off the power.

11. Wrap CMOS modules in conductive material when transporting them from one area to another, even within the same room. Use wrapping material similar to that in which replacement modules are wrapped when they arrive from the factory. (You can also use aluminum foil.) Never use nonconductive material for packaging these modules.

Model Chart for *SYNTOR X* UHF Radio
Range 1: 406–420 MHz
Range 2: 450–470 MHz
Range 3: 470–488 MHz
Range 4: 482–500 MHz
Range 5: 494–512 MHz

CODE:

- ● = ONE ITEM SUPPLIED
- # = BREAKDOWN IN A SEPERATE CHART
- * = ONLY ONE SUPPLIED, DEPENDING ON FREQ.

MODEL	T74VBJ7204AK	T74VBJ7204BK	T74VBJ7D04AK	T74VBJ7D04BK	T74VBJ7J04AK	T74VBJ7J04BK	T64VBJ7204AK	T64VBJ7D04AK	T64VBJ7J04AK	T34VBJ7204AK	T34VBJ7D04AK	T34VBJ7J04AK	ITEM	DESCRIPTION
DESCRIPTION	8–MODE, 100–50 WATT	8–MODE, 100–50 WATT	16–MODE, 100–50 WATT	16–MODE, 100–50 WATT	32–MODE, 100–50 WATT	32–MODE, 100–50 WATT	8–MODE, 78–39 WATT	16–MODE, 78–39 WATT	32–MODE, 78–39 WATT	8–MODE, 30–15 WATT	16–MODE, 30–15 WATT	32–MODE, 30–15 WATTT		
	*		*		*								# HUE1241A	UNIFIED CHASSIS, R1, 100 WATT
		*		*		*							# HUE1241B	UNIFIED CHASSIS, R1, 100 WATT
	*		*		*								# HUE1242A	UNIFIED CHASSIS, R2, 100 WATT
		*		*		*							# HUE1242B	UNIFIED CHASSIS, R2, 100 WATT
		*		*		*							# HUE1242C	UNIFIED CHASSIS, R2, 100 WATT
							*	*	*				# HUE1235A	UNIFIED CHASSIS, R5, 78 WATT
							*	*	*				# HUE1243A	UNIFIED CHASSIS, R3, 78 WATT
							*	*	*				# HUE1244A	UNIFIED CHASSIS, R4, 78 WATT
										*	*	*	# HUE1272B	UNIFIED CHASSIS, R2, 30 WATT
										*	*	*	# HUE1273A	UNIFIED CHASSIS, R3, 30 WATT
										*	*	*	# HUE1274A	UNIFIED CHASSIS, R4, 30 WATT
										*	*	*	# HUE1275A	UNIFIED CHASSIS, R5, 30 WATT
●	●	●	●	●	●	●	●	●	●	●	●	●	HBN4002A	PACKING KIT
●	●						●			●			HCN1009A	CONTROL HEAD, 8 MODE
●	●	●	●	●	●	●	●	●	●	●	●	●	TLN4369A/B	CONTROL HEAD BOARD
●	●						●			●			HLN4108A	CONTROL HEAD HARDWARE, 8 MODE
		●	●					●			●		HCN1019A	CONTROL HEAD, 16 MODE
		●	●					●			●		HLN4266A	CONTROL HEAD HARDWARE, 16 MODE
		●	●	●	●			●	●		●	●	HLN4330A	DIODE MATRIX BOARD
					●	●			●			●	HCN1020A	CONTROL HEAD, 32 MODE
					●	●			●			●	HLN4267A	CONTROL HEAD HARDWARE, 32 MODE
●	●	●	●	●	●	●	●	●	●	●	●	●	HKN4051A	POWER CABLE & FUSE KIT
●	●	●	●	●	●	●	●	●	●	●	●	●	HKN4052A	CONTROL HEAD POWER CABLE
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN1125A	MEMORY MODULE
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4255A	COVER PROM MODE
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4580A	MEMORY MODULE BOARD
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4581A	EEPROM
●			●			●							HLN4111A	INSTALLATION KIT
	●			●			●	●	●	●	●	●	HLN4022C	INSTALLATION KIT
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4188A	MICROPHONE HANG–UP BOX
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4208A	TRUNNION & BREAKAWAY
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4243A	BOTTOM COVER
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4262A	TUNING TOOL
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4263A	TOP COVER
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4527A	NAMEPLATE
●	●	●	●	●	●	●	●	●	●	●	●	●	HLN4666A	MOUNTING TRAY
	●			●		●							HLN5035A	GOLD KEY HARDWARE
●		●			●								HMN4002A	MICROPHONE
	●		●			●	●	●	●	●	●	●	HMN1015A	MICROPHONE
	●		●			●	●	●	●	●	●	●	HLN4384B	MICROPHONE BD (EARLY VERSION)
	●		●			●	●	●	●	●	●	●	HLN5459A	MICROPHONE BD (LATER VERSION)
	●		●			●	●	●	●	●	●	●	HLN5336A	MICROPHONE HARDWARE
●	●	●	●	●	●	●	●	●	●	●	●	●	HSN4005A	SPEAKER
●	●	●	●	●	●	●							TAE6051A	ROOFTOP ANTENNA, R1
●	●	●	●	●	●	●				●	●	●	TAE6052A	ROOFTOP ANTENNA, R2
							●	●	●	●	●	●	TAE6054A	ROOFTOP ANTENNA, R3–5
●	●	●	●	●	●	●	●	●	●	●	●	●	TKN8087A	CABLE, 17'

Model Chart for *SYNTOR X* UHF Unified Chassis Range 1

CODE:

● = ONE ITEM SUPPLIED

ITEM	DESCRIPTION	HUE1241A UNIFIED CHASSIS, 100 WATT	HUE1241B UNIFIED CHASSIS, 100 WATT	HUE1902A UNIFIED CHASSIS WITH PREAMP, 100–50 WATT	HUE1902B UNIFIED CHASSIS WITH PREAMP, 100–50 WATT
HLE1081A	INTERNAL CASTING	●	●		
HLE1603A	INTERNAL CASTING, WITH PREAMP			●	●
HLE1080B	VCO BUFFER	●	●	●	●
HLE4190B	VCO BUFFER BOARD	●	●	●	●
HKN4157A	VCO BUFFER CABLE	●	●	●	●
HLE4181B	MIXER	●	●	●	●
HLE4191C	VCO	●	●	●	●
HLN4251A	VCO INTERCONNECT	●	●	●	●
HLN4467A	RECEIVER LOW–PASS FILTER BOARD	●	●		
HLN4757A	INTERNAL CASTING HARDWARE	●	●		
HLN4758A	INTERNAL CASTING HARDWARE, WITH PREAMP			●	●
HFE4015A	HARMONIC FILTER	●	●	●	●
HKN4130A	INTERCONNECT CABLE	●	●	●	●
HLE4155A	COMBINER SUBSTRATE	●	●	●	●
HLE4175A	DIRECTIONAL COUPLER	●	●	●	●
HLE4345A	POWER DISTRIBUTION BOARD	●	●	●	●
HLE4354A	LOW–LEVEL AMPLIFIER	●	●	●	●
HLE4355A	DRIVER SUBSTRATE	●		●	
HLE4454A	DRIVER SUBSTRATE		●		●
HLE4356A	PREDRIVER SUBSTRATE	●	●	●	●
HLE4357A	SPLITTER SUBSTRATE	●		●	
HLE4455A	SPLITTER SUBSTRATE		●		●
HLE4445A	PA POWER TRANSISTOR	●	●	●	●
HLE4447A	PA POWER TRANSISTOR, PREAMP	●	●	●	●
HLN4046A	FEEDTHRU PLATE	●	●	●	●
HLN4259A	FRONT HARDWARE	●	●	●	●
HLN4459A	CHASSIS HARDWARE	●	●	●	●
HLN4460B	ANTENNA SWITCH	●	●	●	●
HLN4462B	RF BOARD	●	●	●	●
HLN4759A	LOW–LEVEL AMPLIFIER INTERFACE BOARD	●	●	●	●
HLN4760B	PERSONALITY BOARD	●		●	
HLN4760C	PERSONALITY BOARD		●		●
HLN4770A	PA HARDWARE	●	●	●	●
HLN4797C	COMMON CIRCUIT BOARD	●	●	●	●
HLN4994A	TRANSFORMER BRACKET	●	●		●
HLN4869A	TRANSFORMER BRACKET			●	
TRN8857B	BUSS WIRE	●	●	●	●
HLN5008A*	INTERFACE BOARD	●	●	●	●

* USED WITH OPTIONS W452, W566, W586, W587, W681, W682, W683, W687, & W711

Model Chart for *SYNTOR X* UHF Unified Chassis Range 2

CODE:

● = ONE ITEM SUPPLIED

ITEM	DESCRIPTION	MODEL: HUE1242A	HUE1242B	HUE1242C	HUE1272A	HUE1272B	HUE1247A	HUE1247B	HUE1247C	HUE1277A	HUE1277B
		UNIFIED CHASSIS, 100–50 WATT	UNIFIED CHASSIS, 100–50 WATT	UNIFIED CHASSIS, 100–50 WATT	UNIFIED CHASSIS, 30–15 WATT	UNIFIED CHASSIS, 30–15 WATT	UNIFIED CHASSIS WITH PREAMP, 100–50 WATT	UNIFIED CHASSIS WITH PREAMP, 100–50 WATT	UNIFIED CHASSIS WITH PREAMP, 100–50 WATT	UNIFIED CHASSIS WITH PREAMP, 30–15 WATT	UNIFIED CHASSIS WITH PREAMP, 30–15 WATT
HLE1082A	INTERNAL CASTING	●	●	●	●	●					
HLE1087A	INTERNAL CASTING, WITH PREAMP						●	●	●	●	●
HLE1080B	VCO BUFFER	●	●	●	●	●	●	●	●	●	●
HLE4190B	VCO BUFFER BOARD	●	●	●	●	●	●	●	●	●	●
HKN4157A	VCO BUFFER CABLE	●	●	●	●	●	●	●	●	●	●
HLE4182A	MIXER	●	●	●	●	●	●	●	●	●	●
HLE4192B	VCO	●	●	●	●	●	●	●	●	●	●
HLN4251A	VCO INTERCONNECT	●	●	●	●	●	●	●	●	●	●
HLN4467A	RECEIVER LOW–PASS FILTER BOARD	●	●	●	●	●					
HLN4737A	INTERNAL CASTING HARDWARE	●	●	●	●	●					
HLN4468A	INTERNAL CASTING HARDWARE, PREAMP						●	●	●	●	●
HFE4013A	HARMONIC FILTER	●	●	●			●	●	●		
HFE4017A	HARMONIC FILTER				●	●				●	●
HKN4130A	INTERCONNECT CABLE	●	●	●	●	●	●	●	●	●	●
HLE4065A	COMBINER SUBSTRATE	●	●	●			●	●	●		
HLE4175A	DIRECTIONAL COUPLER	●	●	●	●	●	●	●	●	●	●
HLE4345A	POWER DISTRIBUTION BOARD	●	●	●			●	●	●		
HLE4405A	POWER DISTRIBUTION BOARD				●	●				●	●
HLE4189A	LOW–LEVEL AMPLIFIER	●	●	●			●	●	●		
HLE4395A	LOW–LEVEL AMPLIFIER				●	●				●	●
HLE4074A	DRIVER SUBSTRATE	●	●	●			●	●	●		
HLE4421A	DRIVER SUBSTRATE				●	●				●	●
HLE4079A	PREDRIVER SUBSTRATE	●	●	●			●	●	●		
HLE4409A	PREDRIVER SUBSTRATE				●	●				●	●
HLE4070A	SPLITTER SUBSTRATE	●	●	●			●	●	●		
HLE4445A	PA POWER TRANSISTOR, PREAMP			●					●		●
HLE4401A	PA POWER TRANSISTOR				●					●	
HLE4168A	PA POWER TRANSISTOR	●	●				●	●			
HLE4447A	PA POWER TRANSISTOR			●		●			●		●
HLN4046A	FEEDTHRU PLATE	●	●	●	●	●	●	●	●	●	●
HLN4259A	FRONT HARDWARE	●	●	●	●	●	●	●	●	●	●
HLN4459A	CHASSIS HARDWARE	●	●	●	●	●	●	●	●	●	●
HLN4460B	ANTENNA SWITCH	●	●	●	●	●	●	●	●	●	●
HLN4462B	RF BOARD	●	●		●		●	●		●	
HLN5215A	RF BOARD			●		●			●		●
HLN4466A	LOW–LEVEL AMPLIFIER INTERFACE BOARD	●	●	●			●	●	●		
HLN5119A	LOW–LEVEL AMPLIFIER INTERFACE BOARD				●	●				●	●
HLN4760A	PERSONALITY BOARD	●			●		●	●		●	
HLN4760B	PERSONALITY BOARD		●						●		●
HLN4760C	PERSONALITY BOARD			●		●			●		●
HLN4465A	PA HARDWARE	●					●				
HLN4465B	PA HARDWARE		●	●				●	●		
HLN5016A	PA HARDWARE				●	●				●	●
HLN4797A	COMMON CIRCUIT BOARD						●				
HLN4797B	COMMON CIRCUIT BOARD		●								
HLN4797C	COMMON CIRCUIT BOARD			●				●			
HLN5148A	COMMON CIRCUIT BOARD				●	●				●	●
HLN4969A	TRANSFORMER BRACKET	●	●		●		●	●		●	
HLN4994A	TRANSFORMER BRACKET			●		●			●		●
TRN8857B	BUSS WIRE	●	●	●	●	●	●	●	●	●	●
HLN4040A	CAP	●	●	●			●	●	●		
HLN5165A	FORMED CAPACITOR				●	●				●	●
TRN8876A	INPUT/OUTPUT BOARD	●									
HLN5008A*	INTERFACE BOARD	●	●	●	●	●	●	●	●	●	●

*USED WITH OPTIONS W452, W566, W586, W587, W681, W682, W687, & W711

Model Chart for *SYNTOR X* UHF Unified Chassis Range 3

CODE:

● = ONE ITEM SUPPLIED

MODEL DESCRIPTION	HUE1243A UNIFIED CHASSIS, 78–39 WATT	HUE1273A UNIFIED CHASSIS, 30–15 WATT	HUE1248A UNIFIED CHASSIS WITH PREAMP, 78–39 WATT	HUE1278A UNIFIED CHASSIS WITH PREAMP, 30–15 WATT	ITEM	DESCRIPTION
	●	●			HLE1083A	INTERNAL CASTING
			●	●	HLE1088A	INTERNAL CASTING, WITH PREAMP
	●	●	●	●	HLE1080B	VCO BUFFER
	●	●	●	●	HLE4190B	VCO BUFFER BOARD
	●	●	●	●	HKN4157A	VCO BUFFER CABLE
	●	●	●	●	HLE4183A	MIXER
	●	●	●	●	HLE4193A	VCO
	●	●	●	●	HLN4251A	VCO INTERCONNECT
	●	●			HLN5036A	INTERNAL CASTING HARDWARE
			●	●	HLN5037A	INTERNAL CASTING HARDWARE, PREAMP
	●		●		HFE4013A	HARMONIC FILTER
		●		●	HFE4017A	HARMONIC FILTER
	●	●	●	●	HKN4130A	INTERCONNECT CABLE
	●		●		HLE4065A	COMBINER SUBSTRATE
	●	●	●	●	HLE4175A	DIRECTIONAL COUPLER
	●		●		HLE4345A	POWER DISTRIBUTION BOARD
		●		●	HLE4405A	POWER DISTRIBUTION BOARD
	●	●	●	●	HLE4395A	LOW–LEVEL AMPLIFIER
	●		●		HLE4074A	DRIVER SUBSTRATE
		●		●	HLE4421A	DRIVER SUBSTRATE
	●		●		HLE4079A	PREDRIVER SUBSTRATE
		●		●	HLE4409A	PREDRIVER SUBSTRATE
	●		●		HLE4070A	SPLITTER SUBSTRATE
	●	●	●	●	HLE4445A	PA POWER TRANSISTOR, PREAMP
	●	●	●	●	HLE4447A	PA POWER TRANSISTOR
	●	●	●	●	HLN4046A	FEEDTHRU PLATE
	●	●	●	●	HLN4259A	FRONT HARDWARE
	●	●	●	●	HLN4459A	CHASSIS HARDWARE
	●	●	●	●	HLN4460B	ANTENNA SWITCH
	●		●		HLN4936A	LOW–LEVEL AMPLIFIER INTERFACE BOARD
		●		●	HLN5119A	LOW–LEVEL AMPLIFIER INTERFACE BOARD
	●	●	●	●	HLN4462B	RF BOARD
	●	●	●	●	HLN4760B	PERSONALITY BOARD
	●	●	●	●	HLN4760C	PERSONALITY BOARD
	●		●		HLN5014A	PA HARDWARE
		●		●	HLN5017A	PA HARDWARE
	●		●		HLN4797C	COMMON CIRCUIT BOARD
		●		●	HLN5148A	COMMON CIRCUIT BOARD
	●	●	●	●	HLN4994A	TRANSFORMER BRACKET
	●	●	●	●	TRN8857B	BUSS WIRE
	●		●		HLN5145A	STABILITY KIT
		●		●	HLN5165A	FORMED CAPACITOR
	●	●	●	●	HLN5008A*	INTERFACE BOARD

*USED WITH OPTIONS W452, W566, W586, W587, W681, W682, W683, W687, & W711

Model Chart for *SYNTOR X* UHF Unified Chassis Range 4

CODE:

● = ONE ITEM SUPPLIED

MODEL	HUE1244A	HUE1274A	HUE1249A	HUE1279A	ITEM	DESCRIPTION
DESCRIPTION	UNIFIED CHASSIS, 78–39 WATT	UNIFIED CHASSIS, 30–15 WATT	UNIFIED CHASSIS WITH PREAMP, 78–39 WATT	UNIFIED CHASSIS WITH PREAMP, 30–15 WATT		
	●	●			HLE1084A	INTERNAL CASTING
			●	●	HLE1089A	INTERNAL CASTING, WITH PREAMP
	●	●	●	●	HLE1080B	VCO BUFFER
	●	●	●	●	HLE4190B	VCO BUFFER BOARD
	●	●	●	●	HKN4157A	VCO BUFFR CABLE
	●	●	●	●	HLE4183A	MIXER
	●	●	●	●	HLE4194A	VCO
	●	●	●	●	HLN4251A	VCO INTERCONNECT
	●	●			HLN5036A	INTERNAL CASTING HARDWARE
			●	●	HLN5037A	INTERNAL CASTING HARDWARE, PREAMP
	●		●		HFE4013A	HARMONIC FILTER
		●		●	HFE4017A	HARMONIC FILTER
	●	●	●	●	HKN4130A	INTERCONNECT CABLE
	●		●		HLE4066A	COMBINER SUBSTRATE
	●	●	●	●	HLE4175A	DIRECTIONAL COUPLER
	●		●		HLE4345A	POWER DISTRIBUTON BOARD
		●		●	HLE4405A	POWER DISTRIBUTION BOARD
	●	●	●	●	HLE4395A	LOW–LEVEL AMPLIFIER
	●	●	●	●	HLE4421A	DRIVER SUBSTRATE
	●		●		HLE4422A	PREDRIVER SUBSTRATE
		●		●	HLE4409A	PREDRIVER SUBSTRATE
	●		●		HLE4070A	SPLITTER SUBSTRATE
	●	●	●	●	HLE4448A	PA POWER TRANSISTOR
	●	●	●	●	HLE4445A	PA POWER TRANSISTOR, PREAMP
	●	●	●	●	HLN4046A	FEEDTHRU PLATE
	●	●	●	●	HLN4259A	FRONT HARDWARE
	●	●	●	●	HLN4459A	CHASSIS HARDWARE
	●	●	●	●	HLN4460B	ANTENNA SWITCH
	●		●		HLN4936A	LOW–LEVEL AMPLIFIER INTERFACE BOARD
		●		●	HLN5119A	LOW–LEVEL AMPLIFIER INTERFACE BOARD
	●	●	●	●	HLN4462B	RF BOARD
	●	●	●	●	HLN4760B	PERSONALITY BOARD
	●	●	●	●	HLN4760C	PERSONALITY BOARD
	●		●		HLN5015A	PA HARDWARE
		●		●	HLN5018A	PA HARDWARE
	●		●		HLN4797C	COMMON CIRCUIT BOARD
		●		●	HLN5148A	COMMON CIRCUIT BOARD
	●	●	●	●	HLN4994A	TRANSFORMER BRACKET
	●	●	●	●	TRN8857B	BUSS WIRE
	●		●		HLN5145A	STABILITY KIT
		●		●	HLN5165A	FORMED CAPACITOR
	●	●	●	●	HLN5008A*	INTERFACE BOARD

*USED WITH OPTIONS W542, W566, W586, W587, W681, W682, W687 & W711

Model Chart for *SYNTOR X* UHF Unified Chassis Range 5

CODE:

● = ONE ITEM SUPPLIED

MODEL	DESCRIPTION
HUE1235A	UNIFIED CHASSIS, 78–39 WATT
HUE1275A	UNIFIED CHASSIS, 30–15 WATT
HUE1240A	UNIFIED CHASSIS WITH PREAMP, 78–39 WATT
HUE1280A	UNIFIED CHASSIS WITH PREAMP, 30–15 WATT

HUE1235A	HUE1275A	HUE1240A	HUE1280A	ITEM	DESCRIPTION
●	●			HLE1085A	INTERNAL CASTING
		●	●	HLE1090A	INTERNAL CASTING, WITH PREAMP
●	●	●	●	HLE1080B	VCO BUFFER
●	●	●	●	HLE4190B	VCO BUFFER BOARD
●	●	●	●	HKN4157A	VCO BUFFER CABLE
●	●	●	●	HLE4185A	MIXER
●	●	●	●	HLE4195A	VCO
●	●	●	●	HLN4251A	VCO INTERCONNECT
●	●			HLN4940A	INTERNAL CASTING HARDWARE
		●	●	HLN4941A	INTERNAL CASTING HARDWARE, PREAMP
●		●		HFE4016A	HARMONIC FILTER
	●		●	HFE4017A	HARMONIC FILTER
●	●	●	●	HKN4130A	INTERCONNECT CABLE
●		●		HLE4066A	COMBINER SUBSTRATE
●	●	●	●	HLE4175A	DIRECTIONAL COUPLER
●		●		HLE4345A	POWER DISTRIBUTION BOARD
	●		●	HLE4405A	POWER DISTRIBUTION BOARD
●	●	●	●	HLE4395A	LOW–LEVEL AMPLIFIER
●		●		HLE4074A	DRIVER SUBSTRATE
	●		●	HLE4421A	DRIVER SUBSTRATE
●		●		HLE4079A	PREDRIVER SUBSTRATE
	●		●	HLE4409A	PREDRIVER SUBSTRATE
●		●		HLE4070A	SPLITTER SUBSTRATE
●	●	●	●	HLE4448A	PA POWER TRANSISTOR
●	●	●	●	HLE4445A	PA POWER TRANSISTOR, PREAMP
●	●	●	●	HLN4046A	FEEDTHRU PLATE
●	●	●	●	HLN4359A	FRONT HARDWARE
●	●	●	●	HLN4459A	CHASSIS HARDWARE
●	●	●	●	HLN4460B	ANTENNA SWITCH
●		●		HLN4936A	LOW–LEVEL AMPLIFIER INTERFACE BOARD
	●		●	HLN5119A	LOW–LEVEL AMPLIFIER INTERFACE BOARD
●	●	●	●	HLN4462B	RF BOARD
●	●	●	●	HLN4760B	PERSONALITY BOARD
●	●	●	●	HLN4760C	PERSONALITY BOARD
●		●		HLN4939A	PA HARDWARE
	●		●	HLN5019A	PA HARDWARE
●		●		HLN4797C	COMMON CIRCUIT BOARD
	●		●	HLN5148A	COMMON CIRCUIT BOARD
●	●	●	●	HLN4994A	TRANSFORMER BRACKET
●	●	●	●	TRN8857B	BUSS WIRE
●	●	●	●	HLN5008A	INTERFACE BOARD

*USED WITH OPTIONS W452, W566, W587, W681, W682, W683, W687 & W711

SYNTOR X UHF OPTIONS CHART

W11	Time–out timer (60 seconds)
W12	RF preamplifier
W20	DTMF microphone
W54	Positive–ground cable
W70	Omit antenna
W71	Omit microphone
W87	Omit speaker
W90	Omit all accessories
W101	22–foot negative–ground cable
W109	Handset with hang–up
W123	3.5–dB–gain antenna
W124	5–dB–gain antenna
W204	Double *System 90®S* housing with trunnion extenders
W239	Noise–cancelling microphone
W269	Siren, high–low tone
W271	Siren, steady tone
W415	Multi–coded squelch 4–code operator select
W416	Multi–coded squelch 8–code operator select
W417	8–frequency operator select scan
W421	Second priority for *Channel Scan*
W425	Repeater/talkaround (selected by a switch)
W427	"AND" opening squelch
W428	Time–out timer (duration variable by mode)
W452	*MDC–600* unit ID
W470	*MDC–600* emergency footswitch
W478	Delete coded squelch
W492	Priority *Channel Scan*, 2–frequency (internally programmed by mode)
W493	*Systems 90®S* single housing
W494	Mode–select, multi–coded squelch
W495	Scan display with pushbutton mode–select
W496	10–foot negative–ground cable
W543	Headset with lip microphone
W545	Digital dial encoder, 2805 Hz
W546	Digital dial decoder, 2805 Hz
W554	*Touch–Code* encoder
W562	*Quik–Call II* decoder, individual call
W566	Five–tone, signle–tone
W577	Coaxial antenna bumper mount
W578	Coaxial antenna side mount
W580	Voice privacy adapter
W582	Digital dial encoder, 1500 Hz
W583	Digital dial decoder, 1500 Hz
W585	*Touch–Code* decoder, individual call
W586	EMS accessory group with headset and footswitch
W587	EMS accessory group with handset
W589	Public address module
W591	Auxiliary switch panel
W599	Pushbutton control head, 8–mode
W614	Pushbutton control head, 16–mode
W615	Pushbutton control head, 32–mode
W681	*MDC–600* unit ID and SEL CALL decode
W682	*MDC–600* five status
W683	*MDC–600* five status, one meassage
W687	*MDC–600* unit ID and SEL CALL encode/decode
W688	*MDC–600* emergency pushbutton
W703	Talkback Scan
W708	*MDC–600* add trailing ID
W711	*Mobile Voice Storage*
W814	*MDC–600* ID sent at end of transmission only
W828	Handheld control head with internal scan
W845	Handheld control head with operator select scan
VB7604A	Spare accessory group, 8–mode
VB7605A	Spare accessory group, 16–mode
VB7606A	Spare accessory group, 32–mode

SYNTOR X UHF Performance Specifications

General

Number of Modes	Models available in 8, 16, and 32 mode configurations.
Channel Resolution	Multiples of 5.0 kHz or 6.25 kHz.
Squelch Options	*Private–Line* and *Digital Private–Line* coded squelch are standard and available in the same radio unit. Carrier Squelch and multiple coded squelch are optional.
Primary Power	±12 VDC with a DC–isolated floating ground system. Radio supplied for operation with negative ground vehicles. Optional Cable kit permits operation with positive ground vehicles.
Radio Unit Dimensions	2.65" H x 11.5" W x 16.0" L (63.5mm x 292mm x 406mm)
Radio Unit weight	Approximately 22.5 lb (10.2 kg). Shipping weight approximately 37.5 lb (17 kg).
Metering	A single scale 0–50 microampere meter or Motorola portable test set can be used to measure all circuits essential to checking and adjustments.

			Maximum Battery Drain (inc. std. accessories)		
Model (series)	**Frequency (MHz)**	**Minimum RF Power Output**	**Standby @ 13.8V**	**Receive at Rated Audio @ 13.8V**	**Transmit @ Rated Power**
T74VBJ	450–470	100 W continuously variable to 50 W	0.9A	3.3A	31A
	406–420	100W	0.925A	3.3A	31A
T64VBJ	470–512	78 W continuously variable to 39 W	1.2A	3.5A	31A
T34VBJ	450–512	30 W continuously variable to 15 W	0.9A	3.3A	14A

Transmitter

Output Impedance	50 ohms.
Spuious and Harmonic Emissions	More than 85 dB below carrier (for EIA spec. RS152B), 100W models. More than 70 dB below carrier (for EIA spec. R5152B), 78W and 30W models.
Frequency Stablility	±.0002% of reference frequency form –30°C to +60°C ambient (+30°C reference).
Maximum Frequency Separation	Range 1: 14 MHz without degradation. Range 2: 20 MHz without degradation. Range 3–5: 18 MHz without degradation.
Modulation	15F2 and 16F3, ±5 kHz for 100% @ 1000 Hz.
Audio sensitivity	0.080V ±3 dB of 60% maximum deviation @ 1000 Hz.
FM Hum and Noise EIA Method Companion Receiver	
Response	–60 dB.
RS152B Response	–50 dB.
Audio Response	+1, –3 dB of 6 dB/octave pre–emphasis characteristic from 300 to 3000 Hz.
Audio Distortion	Less than 2% @ 1000 Hz, 60% maximum deviation.
FCC Designation	ABZ89FT4633, 100 W–Licensable under FCC rules Parts 22, 74, and 90 for 15F2, 16F3, and 16F9 emmision. ABZ89FT4666, 78 W–Licensable under FCC rules Parts 22, 74, and 90 for 15F2, 16F3, and 16F9 emmision. ABZ89FT4687, 30 W–Licensable under FCC rules Parts 22, 74, and 90 for 15F2, 16F3, and 16F9 emmision.

Control Head

Type	**Rotary (standard)**	**Pushbutton (optional)**
Dimensions (excluding mounting bracket)	6.875" W x 2" H x 3.75" D (175mm x 51mm x 95mm)	6.875" W x 2.25" H x 5.75" D (175mm x 57mm x 146mm)
Weight	1 lb (453 g)	1.5 lb (680 g)
Current Drain	150 mA	500 mA

Speaker

Dimensions (excluding mounting bracket)	5" x 5" x 2.5" (127mm x 127mm x 63mm)
Weight	1.5 lb (680 g)

SYNTOR X UHF Performance Specifications (continued)

Receiver

Input Impedence	50 ohms.			
EIA Modulation Acceptance	± 7.0 kHz minimum.			
Frequency Stability	±.0002% of reference frequency from –30°C to +60°C ambient (±30°C reference).			
Maximum Frequency Separation	Range 1: 14 MHz without degradation. Range 2: 20 MHz without degradation. Ranges 3–5: 18 MHz without degradation.			
Sensitivity		**With Pre–Amp**		**Without Pre–Amp**
20 dB quieting		0.25 uV		0.50 uV
EIA SINAD		0.20 uV		0.35 uV
Intermodulation EIA SINAD		80 dB		85 dB
Spurious and Image Rejection		90 dB		100 dB 95 dB (Ranges 3–5)
Selectivity EIA SINAD	**Adjacent Channel**	**Alternate Channel**	**4th Channel**	**±400 kHz**
25 kHz Ch.	85 dB	90 dB	95 dB	110 dB
Audio Output	15 watts @ less than 3% distortion into an 8 ohm load.			
FCC Designation	ABZ89FT4633, 100 W ABZ89FT4666, 78 W ABZ89FT4687, 30 W			

Systems 90® S OPTIONS

- *Quik–Call II* Signaling
- *Touch–Code* Signaling
- *Single Tone* Signaling
- EMS Accessory Group
- Digital Dial Signaling
- Electronic Siren and Public Address
- Mobile Public Address
- VPA (Speech Scrambler)
- Auxiliary Switch Panel
- *MDC–600*
- *MVS–20*

1. Introduction

The UHF *SYNTOR X* Radio (Figures 1 and 2) is a microcomputer-controlled transceiver with all-solid-state circuitry that uses a synthesizer to generate its frequencies.

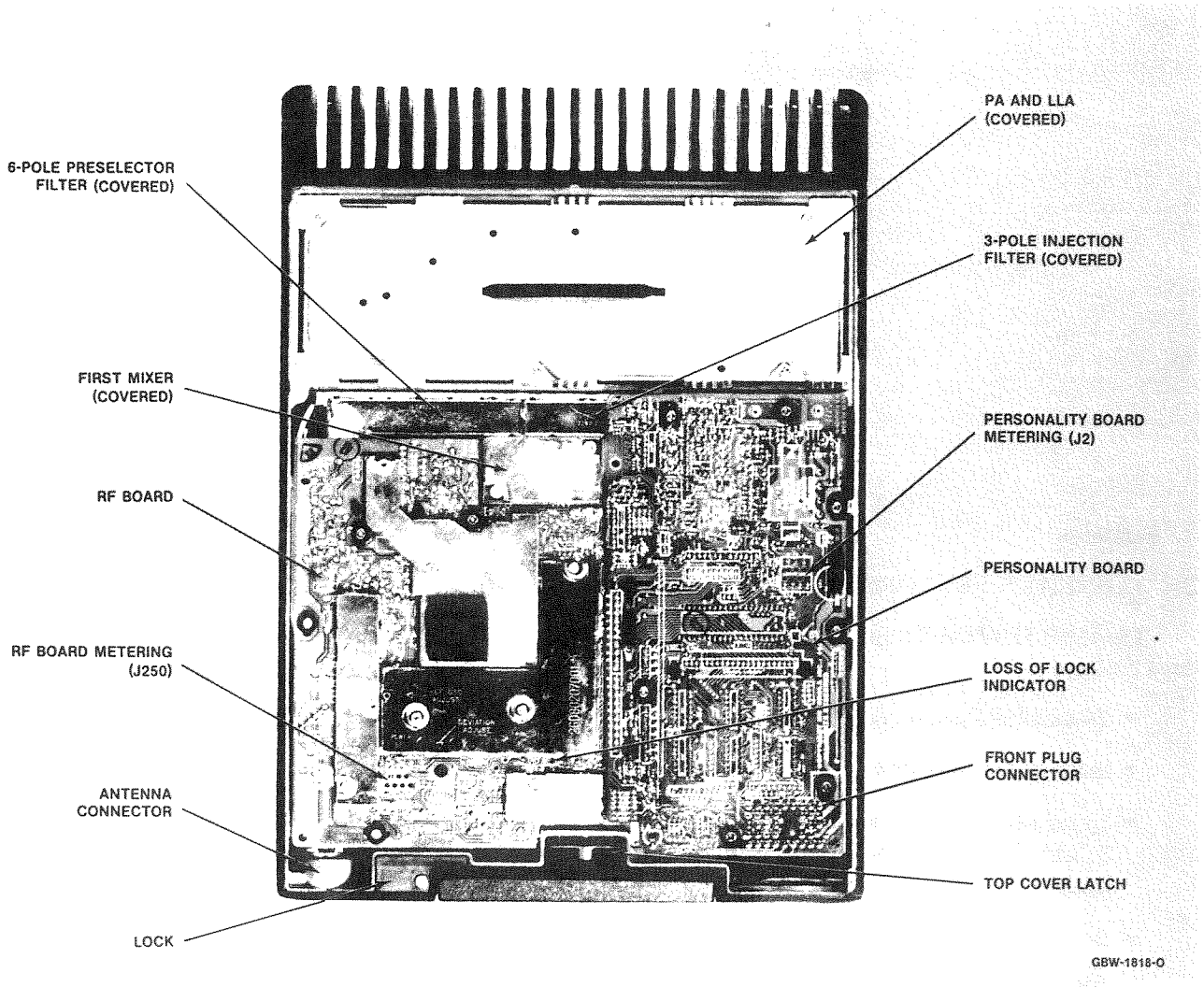


Figure 1. Top View of UHF SYNTOR X *Radio*

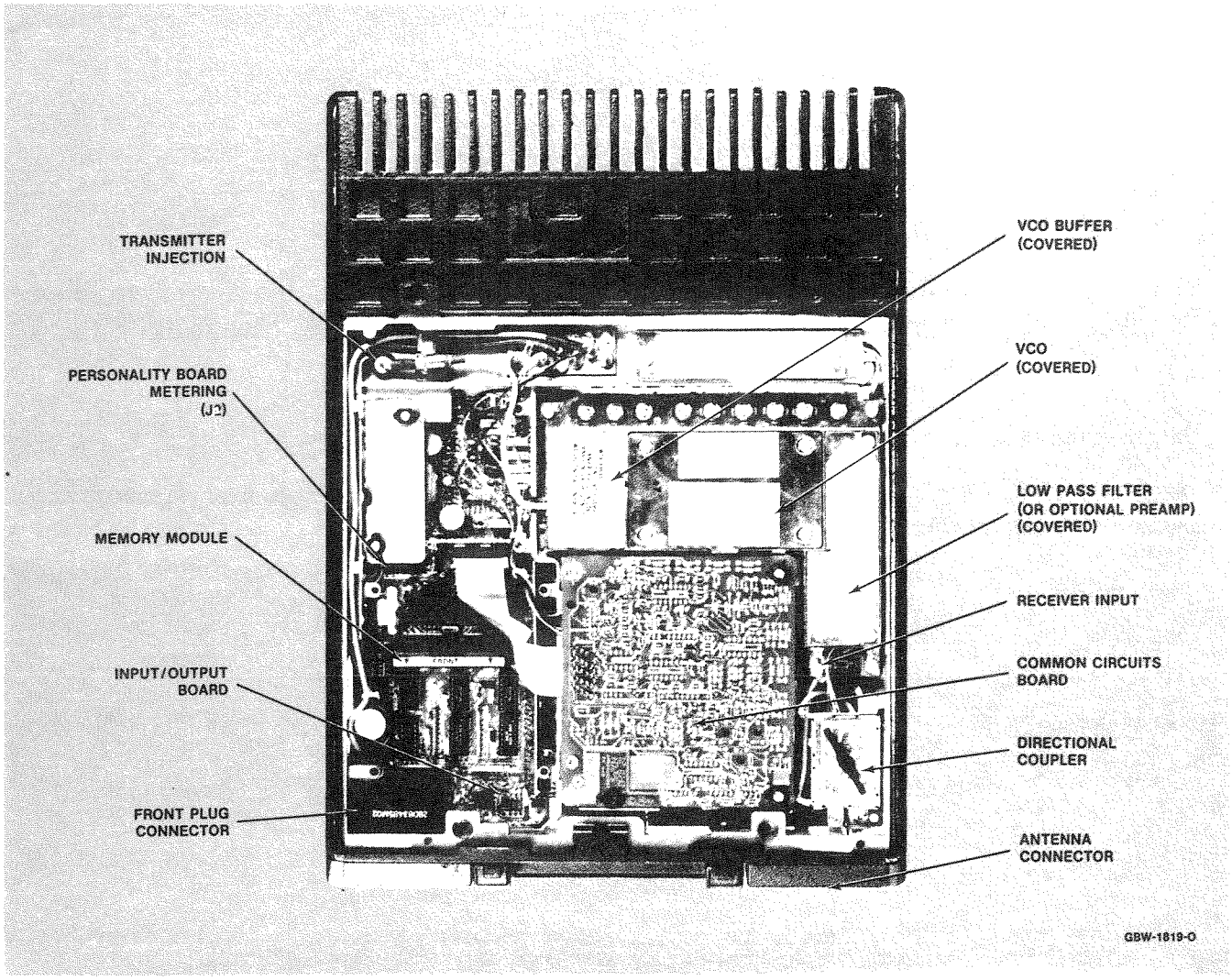


Figure 2. Bottom View of UHF SYNTOR X *Radio*

2. Features

2.1 STANDARD FEATURES

The UHF *SYNTOR X* radio has the following standard features:

- *TRAKMODE* microcomputer-controlled system
- mode-select operation
- broad-band 14-MHz Range 1, 20-MHz Range 2, and 18-MHz Ranges 3–5 transmitter and receiver
- frequency synthesizer
- *Private-Line* and *Digital Private-Line* coded squelch
- rugged construction that meets MIL-STD-810C specifications for enduring rain, dust, salty atmosphere, shock, and vibration
- all-solid-state, compact, modular design that simplifies radio maintenance and troubleshooting

Some of these standard features are discussed below

2.1.1 *TRAKMODE* Microcomputer-Controlled Operation

Major radio set operations are controlled by an eight-bit microcomputer that reads the user-specified operating parameters from a memory module. These parameters include:

- transmit and receive frequencies
- *Private-Line* or *Digital Private-Line* squelch codes
- *Channel Scan* operation
- time-out timing
- "AND" or standard squelch

Customizing is simply a matter of replacing the memory module with one that has been programed according to the user's requirements. Consequently, a *SYNTOR X* radio can easily be moved between fleets with different operating parameters.

2.1.2 Mode-Select Operation

Mode-select operation is a major feature of the *TRAKMODE* system. It gives the operator only one switch to control, thus simplifying the operation of the radio and reducing the chance of missing messages. A "mode" consists of a list of functions performed on a channel. The mode-select options put various auxiliary functions under control of the control head selector switch, thus eliminating the need for separate controls and control heads. The mode-select feature allows the operator to simultaneously select:

- the transmit and receive frequency or frequencies
- *Private-Line* operation on some channels, *Digital Private-Line* or carrier squelch (CSQ) on others; also "slaved" multiple *Private-Line* or *Digital Private-Line* squelch select (transmit or receive)
- *Private-Line* (or *Digital Private-Line)* squelch disable
- *Channel Scan* monitoring, including the ability to specify the channels to be scanned as well as the priority level associated with each scanned channel
- duration for the time-out timer

2.1.3 Alternate Memory Module

The alternate memory module (HLN1125A) is used in *SYNTOR X* radios and is designed around a five-volt programable 2k-by-eight-bit Electrically Erasable Programable Read Only memory (EEPROM). When installed in a *SYNTOR X* radio, the EEPROM is in a *read only* mode and operates exactly as the fusible link PROM memory modules (HLN1087 and 1088) do.

The EEPROM, unlike the PROM, may be reprogramed in excess of 10,000 times. The Motorola Portable Programer (or the R-1800 Reader Programer with the RTL-5815A adapter) can reprogram part or all of the EEPROM. Modes and options may be added or changed any time without purchasing a new memory module. The same module is used for 8, 16, and 32-mode radio models.

The Motorola Portable Programer operates off a 5.3 volt Ni-Cad battery pack. It is not capable of generating the high voltages necessary to program a fusible-link PROM. For this reason, the Portable Programer will read, but will not write to the fusible-link (one-time-programable) PROM.

2.1.4 Broad-Band 14-MHz Range 1, 20-MHz Range 2, and 18-MHz Ranges 3–5 Operation

The UHF *SYNTOR X* radio can transmit and receive on any combination of authorized frequencies, multiples of 5.0 kHz or 6.25 kHz, in the following ranges without degradation in performance:

- 406–420 MHz (Range 1 Radios)
- 450–470 MHz (Range 2 Radios)
- 470–488 MHz (Range 3 Radios)
- 482–500 MHz (Range 4 Radios)
- 494–512 MHz (Range 5 Radios)

The *SYNTOR X* radio has been designed without special "dual exciter" or "dual front end" circuits that operate on widely separated channels. Frequencies can be changed or added without retuning or realigning the radio.

2.1.5 Frequency Synthesis

The *SYNTOR X* has a synthesizer that generates all required frequencies electronically without using individual channel elements. The synthesizer's "fast-locking" feature handles priority *Channel Scan* monitoring options as well as data applications that require fast frequency switching.

2.1.6 Improved Transmitter and Receiver Performance

The UHF *SYNTOR X* radio receives and transmits over 14-MHz (Range 1), 20-MHz (Range 2), or 18-MHz (Ranges 3–5) bandwidths without degradation. Its frequency stability is rated at ± 2 ppm, its transmit audio distortion less than 2%. Receiver sensitivity (without a preamplifier) is rated at 0.35 microvolt (EIA SINAD) over the full 14-MHz (Range 1), 20-MHz (Range 2), or 18-MHz (Ranges 3–5) bandwidths.

2.1.7 *Private-Line* and *Digital Private-Line* Coded Squelch

Private-Line or *Digital Private-Line* coded squelch is programed into the memory module as required. This feature allows the operators to hear only those messages that use their individual system code, thus reducing listening fatigue as well as the probability of missing or misunderstanding messages.

2.1.8 Positive and Negative-Ground Systems

The UHF *SYNTOR X* radio is designed to operate in vehicles with positive or negative-ground systems. The only requirement is that a cable kit with the correct polarity be used. Separate converter kits are not required.

2.2 OPTIONAL FEATURES

The UHF *SYNTOR X* radio has the following optional features:

- repeater talkaround
- mode-selectable *Private-Line* and *Digital Private-Line*
- mode-select *Channel Scan*
- operator-select *Channel Scan*
- preamplifier
- programable time-out timer
- programable "AND" opening squelch
- multimode pushbutton control head
- *Systems 90•S* options

2.2.1 Repeater Talkaround

Repeater Talkaround permits direct communication between two mobile units or between a mobile and a portable unit. Talkaround operation is selected with the MODE-SELECT switch, a separate pushbutton, or a toggle switch.

2.2.2 Multiple *Private-Line* and *Digital Private-Line* Coded Squelch

Coded squelch for multiple *Private-Line* and *Digital Private-Line* is programed into the memory module and is activated by means of the MODE-SELECT switch. Coded squelch is used for repeater access, selective call, and other purposes. This feature allows a radio unit to operate into both *Private-Line* and *Digital Private-Line* systems. All *Private-Line* and *Digital Private-Line* squelch codes are programed into the memory module, making both types of coded squelch as well as carrier squelch available in the same *SYNTOR X* radio. Transmit codes may differ from receive codes without imposing any operational restrictions. All standard CTCSS (continuous-tone carrier-squelch systems) and *Digital Private-Line* codes are available. This feature allows a *SYNTOR X* radio to operate in systems having different squelch codes—single, multiple, or mixed. Codes can be changed with an appropriately programed memory module that plugs into the radio.

2.2.3 Mode-Select *Channel Scan* Operation

The *Channel Scan* parameters are preprogramed into the memory module and are activated by means of the MODE-SELECT switch. For two-frequency internal scan with priority channel (W492), there is no external switch to defeat the *Channel Scan* operation. It is important to note that when the radio is unsquelched, the microprocessor interprets this as channel activity and stops scanning on (a) the next channel or (b) the priority channel (for priority scan). Be sure to keep this in mind when making receiver sensitivity measurements.

In the carrier-squelch *Channel Scan* mode, when the scan detects a carrier on a channel, it stops on that channel to receive the audio. In the coded-squelch *Channel Scan* mode, the scan still stops on a channel when it detects a carrier on it, but it does not receive the audio unless the proper PL/DPL is present.

2.2.4 Operator-Select *Channel Scan*

Operator-Select *Channel Scan* allows the operator to select manually from one to eight non-priority channels. This is suited to operators who prefer manual *Channel Scan* operation.

2.2.5 Preamplifier

The optional preamplifier improves the 12-dB SINAD receiver sensitivity from 0.35 microvolt to 0.2 microvolt, with a 5-dB decrease in intermodulation protection.

2.2.6 Time-Out Timer

When the time-out timer is preprogramed into the memory module, it makes the transmitter stop transmitting either after a standard fixed period of 60 seconds, or after a duration ranging from a minimum of 15 seconds to a maximum of 7 minutes and 45 seconds, in 15-second increments, according to the information programed into the memory module. This timer option prevents repeater or channel tie-up because of prolonged keying of the transmitter.

2.2.7 "AND" Opening Squelch

When "AND" opening squelch is preprogramed into the memory module, it makes the audio unmute when both the proper signal strength (level set by the SQUELCH control) and the proper code (*Private-Line* or *Digital Private-Line)* are present. This squelch option has the advantages of *Private-Line* or *Digital Private-Line* for privacy and protection against fading signals, yet allows the operator to select the signal quality required to unmute the receiver while "on-hook." It can also be used to eliminate messages coming from distant users of the same frequency and *Private-Line* or *Digital Private-Line* code.

2.2.8 Pushbutton Control Head

The pushbutton control head is an optional substitute for the standard rotary control head. It is available in 8, 16, and 32-mode configurations. The optional *Channel Scan* monitoring display (W495) allows the radio to monitor frequencies up to the capacity of the pushbutton control head, in groups of eight.

3. Electrical Characteristics

The basic *SYNTOR X* radio consists of a single-frequency unit that operates from a negative-ground, 12-volt dc source, a rotary-mode-select control head, a speaker, a microphone with a hangup box, a quarter-wave unity-gain antenna, and a 17-foot negative-ground cable kit. The basic radio also has coded squelch for both *Private-Line* and *Digital Private-Line* coding.

3.1 CIRCUIT BLOCKS

The UHF *SYNTOR X* can be grouped into physical blocks: personality board, input/output (I/O) board, memory module, common circuits board, 100-watt power amplifier, radio frequency (RF) board, directional coupler board, and internal casting. The internal casting includes a voltage-controlled oscillator (VCO), filter board (or optional preamplifier), mixer, 6-pole filter, 3-pole filter, and VCO buffer.

3.2 FUNCTIONAL DESCRIPTION

The *SYNTOR X* radio has four functional parts: the microcomputer, the frequency synthesizer, the receiver, and the transmitter. The microcomputer circuits are on the personality board; the frequency synthesizer circuits are on the common circuits board, RF board, and internal casting; the receiver circuits are on the personality board, common circuits board, RF board, and internal casting; and the transmitter circuits are on the common circuits board, directional coupler board, and power amplifier. Each functional segment is discussed briefly below, and again in more detail in the section associated with the circuit in question.

3.2.1 Microcomputer

An eight-bit microcomputer controls the personality board. This board has a 3.6-MHz clock crystal with its own crystal oscillator circuitry. The microcomputer reads the user-specified operating parameters, such as the transmit/receive frequencies, *Private-Line* or *Digital Private-Line* codes, *Channel Scan,* time-out timing, and squelch codes, from a preprogramed memory. The operating mode of the *SYNTOR X* radio is selected by means of the MODE SELECT switch on the control head. This switch not only determines the transmit and receive frequencies, but also selects a specific set of operating parameters from those preprogramed into the memory module.

3.2.2 Frequency Synthesizer

The frequency synthesizer uses a phase-locked loop (PLL) consisting of a reference oscillator, voltage-controlled oscillator (VCO), a programable divide-by-3-or-4 prescaler, a multiplex divider, a sample-and-hold phase detector, a loop adaptive filter, and a VCO buffer. For frequency generation and control, the microcomputer reads the proper information from the memory module and then applies it to the multiplex divider via four data lines. This information is contained in six four-bit words. A multiplexing sequence passes the six words to the multiplex divider. The multiplex divider divides the reference oscillator frequency and generates four bits. Two of these bits (C0 and C1) control a "C" counter inside the divide-by-3-or-4 prescaler; the two other bits (S0 and S1) are used by the sample-and-hold phase detector to control the loop adaptive filter. Once the mode of operation and the channel are selected, the six four-bit words stay the same. However, any change in mode makes the microcomputer address different memory locations in the memory module. Consequently, the six four-bit words supply different information to the multiplex divider via the four data lines.

Microphone audio from the personality board is applied to the IDC circuitry along with the PL/DPL encode signals (if used). The IDC circuits process the audio to ensure that the proper level of audio drive is supplied to the frequency synthesizer. In *Private-Line/Digital Private-Line* radios, the low-frequency PL/DPL encode signals from the personality board are combined with the microphone audio signal and routed to the VCO and the synthesizer reference oscillator via the deviation and compensation circuits.

3.2.3 Receiver

Incoming RF signals go to the filter board (or optional preamplifier) via the antenna relay. The filter output passes through a six-pole preselector filter and then goes to the first mixer stage. The selectivity of the two filters prevents high-level, out-of-band signals from degrading receiver performance. The radio does not use receiver channel elements to generate the first mixer injection frequency. Rather, the frequency synthesizer output provides a high-side (Range 1) or a low-side (Ranges 2–5) injection frequency that is applied to the first mixer via a three-pole injection filter. The second mixer uses the 53.9-MHz signal and a 43.2-MHz signal from an injection tripler to generate a 10.7-MHz IF. The receiver uses two four-pole 10.7-MHz crystal filters to attenuate signals outside the predetermined receiver bandpass range. After filtering and amplification, the 10.7-MHz signal passes to the limiter/detector stage.

The squelch circuit gives the microcomputer two signals (CHANNEL ACTIVITY and SQUELCH TAIL). In the absence of an RF carrier, both signals are in a low state. When an RF carrier appears, both signals switch to a high state, and this tells the

Table 1. Data Contained in Mode Label A (for illustration only)

Mode	Control Head Mode	RX Freq. (kHz)	TX Freq. (kHz)	RX Code	TX Code	Dir. Freq.	TOT (Min.)	Sql.
1	1	455275	455275	1A	1A	—	1	AND
2	2	460100	460100	CSQ	1A	—	0.25	Std
3	3	469975	469975	7A	036	—	7.75	AND
4	4	450025	450025	134.8	134.8	—	Off	AND
5	5	450025	450025	174	CSQ	—	1	Std
6	6	450025	469975	CSQ	CSSQ	—	Off	Std
7	7	453000	453000	CSQ	CSQ	—	Off	Std
8	8	465125	465125	CSQ	CSQ	—	Off	Std

Note: Label A is supplied with each radio.

microcomputer to enable the audio stages. The faster CHANNEL ACTIVITY line is used as a preliminary indicator during *Channel Scan* operation, while the SQUELCH TAIL line protects the audio signals against fading.

3.2.4 Transmitter

The RF output generated by the frequency synthesizer at the required transmit frequency is applied to the controlled stage of the transmitter.

3.3 *SYNTOR X* MODES OF OPERATION

3.3.1 The mode of a *SYNTOR X* radio is preprogramed to contain the following operation data:

- receive frequency
- receive coded squelch } receive channel
- transmit frequency
- transmit coded squelch } transmit channel
- time-out timer duration
- squelch operation
- *Channel Scan* operation
- *Channel Scan* frequency list } radio control data
- S.P. operation

Each mode position on the control head has its own receive channel, transmit channel, and radio control data information, some of which may be the same on different modes.

3.3.2 Every UHF *SYNTOR X* radio has a mode label (Table 1) that gives the data for the modes that have been preprogramed into the radio for the user. This label (Label A) is on the inside of the top cover of the radio. If the radio has all the options, it has two more labels: Label B (Table 2) for *Channel Scan*, and Label C (Table 3) for any of the operator-selectable coded squelch options (W415 or W416). The labels shown in Tables 1, 2, and 3 are illustrative examples of these.

Table 2. Data Contained in Mode Label B (for illustration only)

Control Head Mode	*Channel Scan*	Internal List	P1	P2
1	On	7, 8	1	4
2	Off	—	—	—
3	Off	—	—	—
4	On	4, 5, 7, 8	1	5
5	On	4, 5	None	None
6	On	1, 4, 5	6	None
7	Off	—	—	—
8	Off	—	—	—

Note
Label B is supplied for radios equipped with one of the *Channel Scan* options.

Table 3. Data Contained in Label C (for illustration only)

Mode	TX	RX
1	1A	1A
2	7A	CSQ
3	CSQ	7A
4	036	036
5	214.0	214.0
6	306	M1
7	M6	M6
8	142.4	142.4

Note
Label C is supplied for radios equipped with the operator-selectable coded squelch option.

3.3.3 The sample Label A in Table 1 shows that the radio has eight modes and that each mode contains different data. For example, Mode 1 specifies the following:

- Receive frequency: 455275 kHz
- Transmit frequency: 455275 kHz
- Receive code: PL code 1A
- Transmit code: PL code 1A
- Direct frequency: none (this is specified only if the repeater/talkaround option is used)
- Time-out timer: one minute
- Opening squelch: AND

3.3.4 The one-minute time-out timer duration specified for Mode 1 is the standard time-out timer option. However, a radio can be preprogramed with a shorter or longer time-out timer duration. This additional option gives a range from 15 seconds to 7 minutes and 45 seconds in 15-second increments. Consequently, a specific radio mode can be programed with a time-out timer duration of 45 seconds.

3.3.5 Squelch operation is specified as standard or "AND." When standard squelch is used, the radio unmutes upon detecting the proper coded squelch, and mutes upon losing the proper coded squelch. Consequently, for standard squelch operation, the operator need not set the SQUELCH control. When "AND" squelch is used, the radio unmutes upon detecting both the proper coded squelch and channel activity, and mutes upon losing the proper coded squelch. The difference between the two types of squelch is summarized in Table 4. With "AND" squelch, the operator can use the SQUELCH control on the control head to adjust the squelch. In both cases, when the microphone is removed from the hangup box to transmit, the receiver reverts to the carrier squelch mode, thus permitting the user to verify that the channel is clear before transmitting. In this case, the SQUELCH control adjusts the squelch level even if standard squelch is specified.

Table 4. Standard and "AND" Squelch Operation

Squelch Type	Radio Unmutes	Radio Mutes
STANDARD	Detection of proper coded squelch	Loss of detection of proper coded squelch
"AND"	Detection of proper coded squelch *and* channel activity	Loss of detection of proper coded squelch

3.3.6 Mode 1 of Label B (Table 2) specifies the following additional data for radios equipped with a *Channel Scan* option:

- *Channel Scan:* ON
- Internal list: Modes 7 and 8
- Highest priority mode (P1): Mode 1
- Second highest priority mode (P2): Mode 4

3.3.7 Where Table 2 shows channel scan off, it has no further data. Where it shows channel scan on, a list of non-priority channels follows. This can be followed by a priority-one (highest priority) channel and, possibly, by a priority-two (second highest priority) channel. For example, in Mode 1 of Table 2, the channel scan is specified on and is followed by a non-priority internal list of Modes 7 and 8. The highest-priority (P1) mode is Mode 1 (the selected mode) and the second-highest-priority mode is Mode 4. If the highest-priority and the second-highest-priority modes are not specified, P1 and P2 are labeled "NONE," as shown in Mode 5. If only the highest-priority mode is specified (as shown for Mode 6), the second-highest-priority mode (P2) is labeled "NONE."

3.3.8 With Mode 1 selected, and in the absence of channel activity, the radio receiver scans all the modes designated in the internal list, P1, and P2 (Modes 7, 8, 1, and 4). When it detects activity on a non-priority mode (Modes 7 or 8), the radio stops scanning all the channels and unmutes the audio on the mode with the activity, but persists in looking for activity on the highest-priority mode (Mode 1) and the second-highest priority mode (Mode 4). This search is analogous to "cutting small holes" in the audio while the receiver is sampling the priority modes. If activity is detected on the second-highest-priority mode (Mode 4), this channel takes precendence over the non-priority mode. Once locked on the second priority channel, the receiver keeps looking for activity on the highest-priority channel (Mode 1); again, the search "cuts small holes" in the audio while the receiver is looking for activity on the highest-priority channel. When it detects activity on the highest-priority channel, the receiver locks on this channel and no further scanning occurs until after activity has ceased on the highest-priority channel.

3.3.9 Code 1 of Label C (Table 3) specifies the following additional data for radios equipped with an operator-selectable coded squelch option:

- Transmit code: PL code 1A
- Receive code: PL code 1A

3.4 OPERATOR-SELECTABLE MULTIPLE CODED SQUELCH

With the *Systems 90•S* operator-selectable multiple coded squelch option, the transmit (TX) and receive (RX) codes are the ones specified in Table 3. For Mode 1, for example, the TX and RX codes are 1A, as shown in Table 3. If this option is turned off, the TX and RX codes are specified by Label A (Table 1).

4. Primary Power Source

The *SYNTOR X* radio is designed to operate from a negative-ground, 12-volt dc source, but an optional cable kit allows it to operate from positive-ground sources. The radio has a built-in floating ground.

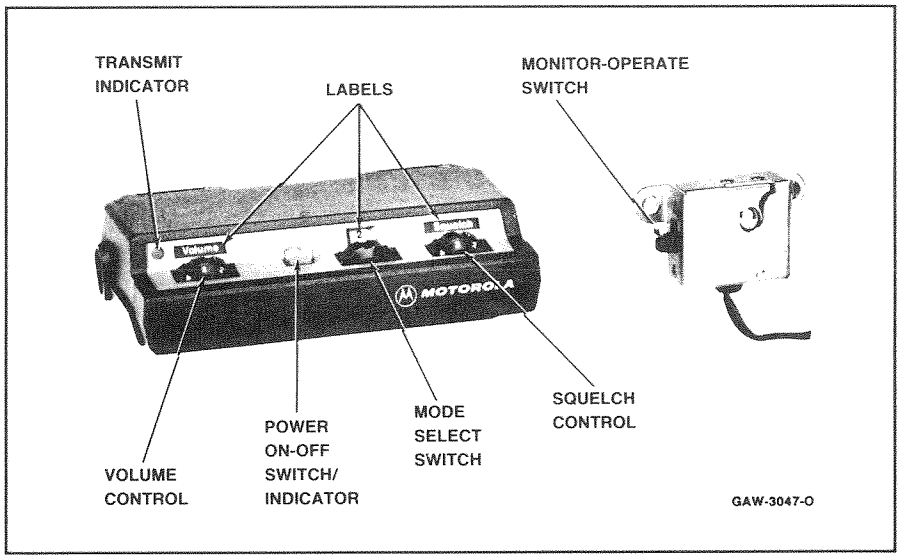
5. Physical Characteristics

5.1 The *SYNTOR X* electronic circuits are enclosed in a rugged low-profile housing. One end of the housing contains the antenna connector, lockswitch, main cable connector, and handle. The other end contains the heatsink fins, which cool the power amplifier circuits. The various radio circuits are isolated by partitions and shielding covers. The radio has an easy-

to-snap-on top cover and a bottom cover that is secured to the radio by means of four screws. It also has a mounting tray.

5.2 The electronic circuits of the radio are divided into five major subassemblies that can be removed and replaced with ease. The radio uses printed circuit boards that can be plugged together. The *TRAKMODE* microprocessor can be electronically ''isolated'' by a simple procedure. The radio uses the standard Motorola centralized metering arrangement, and requires only three field adjustments, thus further simplifying servicing and the replacement of parts.

5.3 The *SYNTOR X* radio occupies 487 cubic inches (8002 cubic centimeters) of space and weighs 22.5 lbs. (10.2 kg).



1. Introduction

1.1 The *SYNTOR X* control head has the following controls and indicators:

- rotary volume control
- two-way (up or down) power on-off switch and indicator
- rotary mode-select switch (not on single-mode control heads)
- rotary squelch control
- transmit indicator light
- labels associated with the volume, power on-off, mode-select, and squelch controls

1.2 The microphone hangup box has a single two-way (up or down) monitor-operate switch.

2. To Receive

(1) Put your finger under the control head and push the power on-off switch up until it locks in position. The indicator light will be visible only in low ambient light.

(2) On multiple-mode models, select a mode.

Note

The Description Section of the service manual contains a full description of the *SYNTOR X* mode operation.

(3) (PL/DPL models) With the microphone in its hang-up box, push the monitor-operate switch down. You can hear only the PL/DPL-encoded signals with the switch in this position. Push the monitor-operate switch up; now you can hear all signals on this frequency.

(4) Remove the microphone from its hangup box. Now you can hear all the on-frequency signals regardless of the position of the monitor-operate switch.

(5) Turn the squelch control counterclockwise to the stop.

(6) Turn the volume control clockwise.

(7) Slowly turn the squelch control clockwise until the noise is just squelched (cannot be heard).

(8) Set the volume control for a comfortable level with an incoming signal.

(9) To transmit, follow the steps in the next section. (To turn off the power, push the power on-off switch down until it locks.)

3. To Transmit

(1) If the equipment power has been turned off, turn it on by repeating Step 1 of the "To Receive" procedure.

(2) Turn on the vehicle ignition switch, if necessary. Keep the engine running while transmitting to avoid draining the battery.

(3) Perform Steps 2 through 8 of the "To Receive" procedure, if you have not already done so.

(4) Remove the microphone from its hangup box; now you hear all the on-frequency signals. After verifying that the channel is clear, push the microphone PTT switch. The transmit indicator lights up.

(5) Start transmitting by first identifying yourself and the mobile unit or station being called. (For best results, keep the microphone at least one inch from your lips.)

(6) At the end of the transmission, release the PTT switch and listen for a reply.

(7) When you are through transmitting and receiving, turn the power off by pushing down the power on-off switch. All indicators go out.

4. *SYNTOR X* Modes

4.1 The *SYNTOR X* modes are preprogramed into the radio's memory at the factory in accordance with the user's requirements. A *SYNTOR X* radio can be programed with four, eight, sixteen, or thirty-two modes (1, 2, 5, or 8 modes for 800 MHz). For example, a mode (depending on the options used) may be programed as follows:

- Mode: 1
- Receive frequency: XXXXXX
- Transmit frequency: XXXXXX
- Receive code: PL code 1A
- Transmit code: PL code 1A
- Time-out timer: one minute
- Opening squelch: AND
- *Channel Scan:* ON
- Internal list: Modes 7 and 8
- Highest-priority mode: Mode 1
- Second-highest-priority mode: Mode 4

4.2 For further information on the *SYNTOR X* modes, refer to the Description Section in this manual.

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 μV–3 V from 1 MHz–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 μsec–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 (*audio synthesizer required only for DPL radios*)	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 μV–100,000μV Must be capable of at least ±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 *Private-Line* decoder troubleshooting	Motorola S1333B	Frequency range: 10 Hz–9999 Hz Output level: 0–3 V rms
■DPL Test Set**	*Digital Private-Line* 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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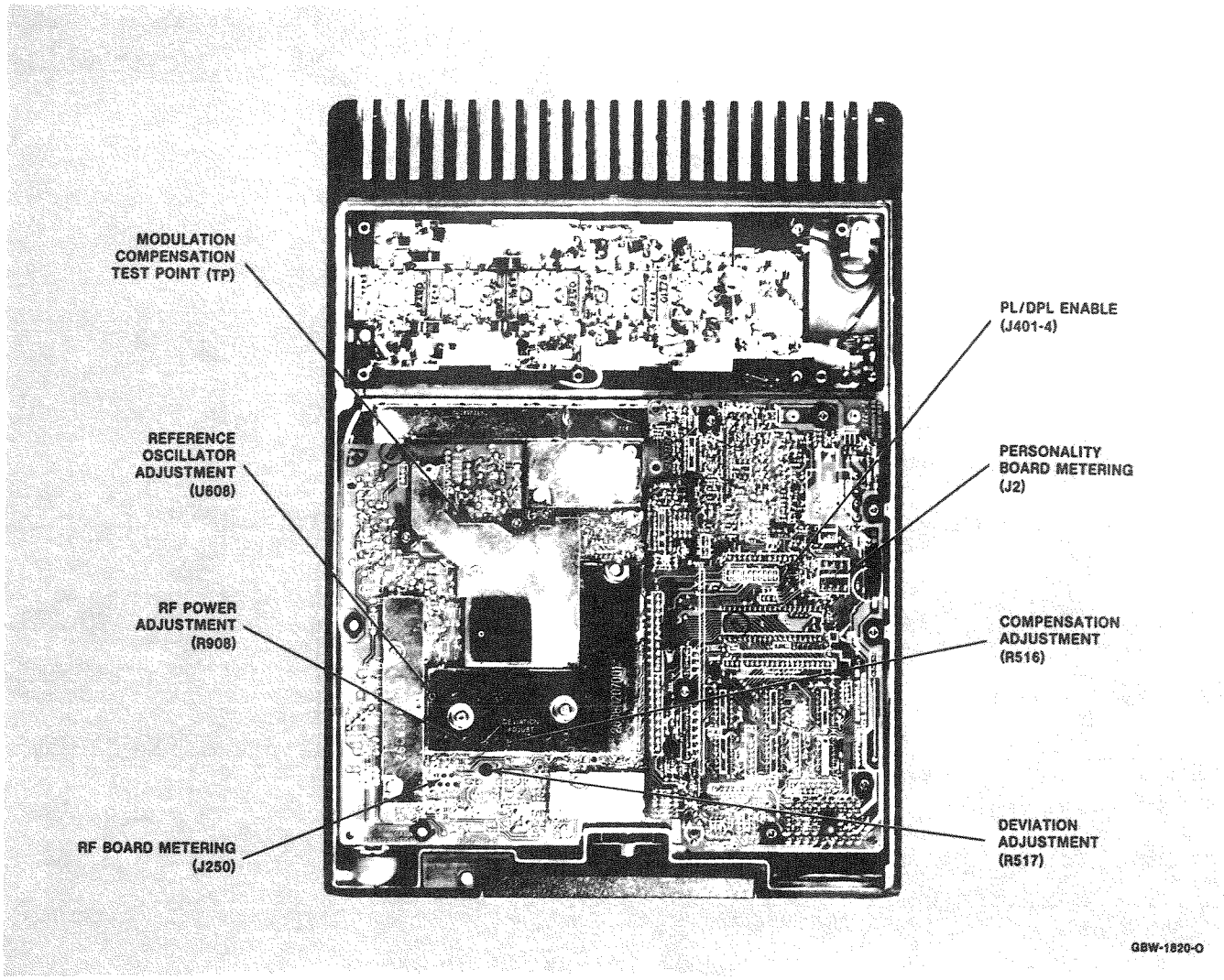


Figure 1. Radio Adjustment Locations (Top View)

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

All the test equipment listed above except that marked with ■ can be replaced with the Motorola R2001 System Analyzer.

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 necessary precautions to prevent the test equipment from touching the vehicle chassis.

2. Radio Alignment and Adjustments

2.1 INTRODUCTION

2.1.1 The following five items can be adjusted on the UHF *SYNTOR X* radio:

- oscillator frequency
- deviation
- compensation
- transmitter output
- transmitter power amplifier current limit

2.1.2 The oscillator frequency, deviation, modulation compensation, and transmitter power can be adjusted through directly accessible holes on the RF board, as shown in Figure 1.

2.1.3 The transmitter power amplifier current limit can be adjusted after the bottom cover has been removed and the holes on the common circuits board exposed. (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 the following values:

406–420 MHz (Range 1 Radios)
450–470 MHz (Range 2 Radios)
470–488 MHz (Range 3 Radios)
482–500 MHz (Range 4 Radios)
494–512 MHz (Range 5 Radios)

Note

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

2.2 OSCILLATOR FREQUENCY

Note

The oscillator frequency should be adjusted before the deviation is checked or set.

(1) Set the mode selector switch to Mode 1.

(2) Using the portable test set, key the transmitter without modulation. On tone 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.

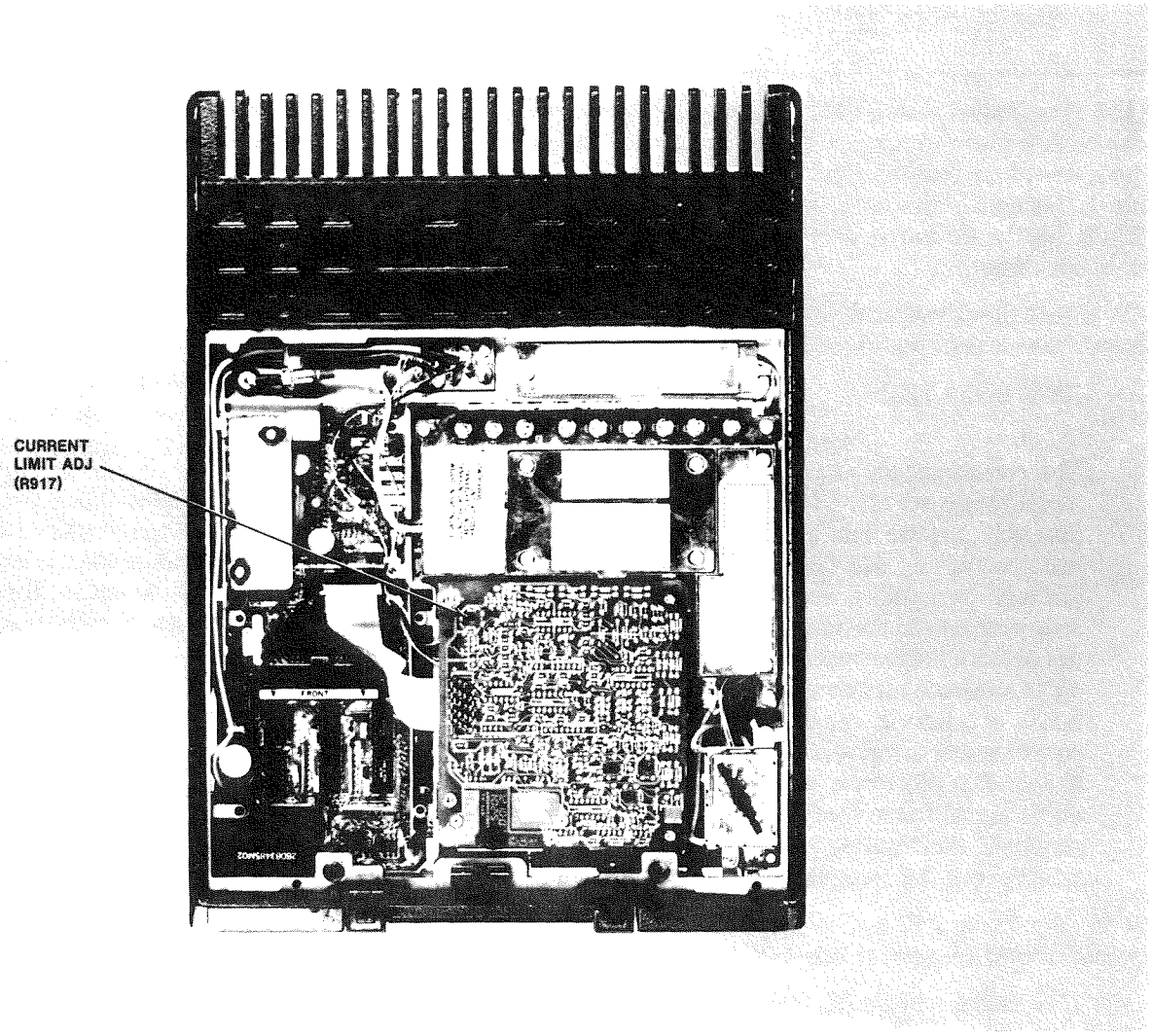


Figure 2. Radio Adjustment Locations (Bottom View)

(4) Set the mode selector switch (for multiple-mode units only) to all the remaining positions and check the transmitter frequencies. (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) Determine the PL or DPL customer transmit frequency that is closest to, and less than, *one* of the radio's target frequencies listed in Table 1. Using the deviation adjustment potentiometer R517, set the deviation to ±4.8 KHz on the chosen transmit frequency.

Table 1. Target Frequencies for Deviation Adjustments

Range	Target Frequency (MHz) First	Second
1	412.8	420
2	459.6	470
3	478.7	488
4	490.7	500
5	502.7	512

(1B) (For radios without PL or DPL) Determine the customer transmit frequency that is closest to, and less than, *one* of the radio's target frequencies listed in Table 1. Using the deviation adjustment potentiometer R517, set the deviation to ±4.8 kHz on the chosen transmit frequency.

(2) Check the deviation on all transmit frequencies to ensure that it does not exceed 5 kHz on any of them.

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. 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 its midpoint. Go to Step 5B.

(2) (For PL or DPL radios only) Set the mode selector switch to the PL/DPL customer transmit frequency that is closest to the radio's first target frequency listed in Table 1.

(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 a null indication is obtained 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

Use of coaxial cable adapters for interconnectors of different cables is not recommended. Different-sized cables may increase the output VSWR and cause protection circuitry to reduce output power. Use only cables that connect directly to the test equipment. Refer to the Transmitter Section of this manual for information about the operation of the VSWR protection circuitry.

Note

See the list of recommended test equipment in this section of the manual. Use only the recommended equipment for making these adjustments to avoid erroneous results.

Note

All the transmitter adjustments described in the following procedure can be performed from the bottom of the radio, through the holes in the common circuits board. (See Figures 1 and 2.)

Note

For variable power-set, the level must be between ½ and full-rated power. For example, set a 100W radio to any power level between 50 and 100 Watts.

(1) Terminate the radio with a wattmeter and a 50-ohm load.

(2) Adjust the dc power supply voltage to 16.1 volts for 100W and 78W models; 16.3 volts for 30W models.

(3) Rotate potentiometers R908 and R917 fully clockwise (see Figure 2). For 30W radios, preset R908 fully counterclockwise and R917 clockwise.

(4) Select the channel closest to the radio's first target frequency listed in Table 2. Key the transmitter and adjust R908 to obtain a nominal power of 110W for 100W radios, 86W for 78W radios, or 33W for 30W radios. For variable power-set, adjust R908 until the power is 10% over the desired power-set level (e.g. 55W for a 50W radios).

Table 2. Target Frequencies for Transmitter Power Adjustment

Range	Full-Rated Power (W)	Target Frequency (MHz) First	Second
1	100	420	406
2	100	460	450
	30	470	450
3	78	488	470
	30	488	470
4	78	500	482
	30	500	482
5	78	512	494
	30	512	494

(5) Select a channel close to the radio's second target frequency listed in Table 2. Key the transmitter and rotate R917 until the power drops slightly. Do not let the power drop below 105 W for 100 W radios, 82 W for 78 W radios, or 32 W for 30 W radios. For variable power-set, do not let the power drop by more than 5% when R917 is adjusted (e.g. 53W for a 50W radio).

(6) Adjust the dc power supply to 13.4 volts for 100W and 78W models; 13.6 volts for 30W models.

(7) Select the channel closest to the radio's first target frequency listed in Table 2. Key the transmitter and adjust R908 for an output power indication of 105 W for 100 W radios, 82 W for 78 W radios, or 32 W for 30 W radios. Check the power output on *all* the channels and readjust R908 until all channels indicate a power output not less than 105 W for 100 W radios, 82 W for 78 W radios, or 32 W for 30 W radios. For variable power-set, adjust R908 to 5% over the desired set level (e.g. 53W for a 50W radio). Check power on all channels and readjust R908, if necessary, to 5% over the desired set level.

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. Now the top cover pops up, allowing access to the boards. This procedure allows you to reach the metering sockets of the RF board (J250) and of the personality board (J2) without removing the radio from its mounting tray. For access to the PA deck, lift the PA 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 turning it on its hinge gives you access to its component side as well as 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.

Warning

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

Note

All serviceable mounting screws are 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

Mounting screws for the common circuits board, personality board, and RF board can be easily identified by the black plastic captivators that fasten them to the 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 both 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 (if used), 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 can be helpful in this process.)

Important

The reinstallation of the RF board requires careful alignment between the board guide posts and the internal casting. Match the board spring connectors carefully with those of the internal casting.

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.

3.5 INTERNAL CASTING

3.5.1 General

To remove the internal casting from the radio:

(1) Remove four cover mounting screws from the bottom of the radio.

(2) Remove three screws to allow the common circuits board to hinge.

(3) Remove four casting mounting screws.

(4) Remove two screws from the RF board (from the top side of the radio).

(5) Disconnect the coaxial cable between the internal casting and the PA deck.

(6) Disconnect a set of RF board wires located near the antenna switch.

(7) Disconnect the coaxial cable from the RF board.

(8) Disconnect the coaxial cable from the antenna relay.

During the reassembly operation, be careful to make the proper connections between the various connectors and to replace all the screws.

3.5.2 First Mixer

To remove the first mixer: (a) remove the two screws that secure the first mixer cover and gasket to the internal casting, (b) carefully unsolder the two tap leads from the first mixer to the filters, (c) remove the solder between the feedthrough and the circuit board, (d) unsolder the ground straps from the mixer circuit board to the internal casting wall, and (e) remove the two screws that hold the circuit board to the internal casting. Now the first mixer board can be removed.

Caution

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

3.5.3 Low-Pass Filter Board (or Optional Preamplifier)

Once you have removed the cover and gasket over the low-pass filter board (or preamplifier), you can remove the low-pass filter board (or preamplifier) as follows:

(1) Carefully, and without using too much heat, unsolder and remove the wires between the printed circuit board and the phono connector.

(2) Carefully, and without using too much heat, unsolder and remove the coaxial cable connected to the six-pole filter.

(3) If a preamplifier is used, carefully unsolder the feedthrough leads connected to the preamplifier board.

(4) Unscrew and remove the two retaining screws of the board.

(5) Remove the low-pass filter board (or preamplifier).

3.5.4 VCO Assembly

To remove the VCO assembly:

(1) Remove the four screws that secure the VCO assembly cover.

(2) Disconnect the coaxial cable and two wires from the substrate.

(3) Remove the screw from the center of the VCO carrier PC board.

(4) Remove the VCO assembly by lifting and disconnecting it from the 7-pin connector.

Note

If the VCO assembly is replaced with a new one, readjust the compensation level as explained in Section 2.4, above.

3.5.5 VCO Buffer Replacement

To remove the VCO buffer, you first remove the internal casting from the radio (see Section 3.5.1). Then unsolder the TX output cable from the internal casting, and remove the coax that goes from the VCO to the VCO buffer. Unsolder the two wires underneath the buffer plate, and remove the two mounting screws. Now remove the buffer from the casting by using the lifting handle of the carrier bracket.

After you install the new buffer, be sure to solder the TX output coax and the buffer input coax to the casting wall to insure proper operation.

3.6 REPLACEMENT OF TRANSISTOR MODULE

Note

Transistors are replaced as part of a module assembly. There are six module assemblies in each power amplifier: low-level amplifier (control stage), predriver, driver, and three finals.

3.6.1 To remove the low-level amplifier (control stage), unsolder the input coax, output strap, and bias pin. Using C805 as a handle, carefully pull up on the module until Q802 is released from its heat sink clip. Before installing a new module, apply a light coating of Wakefield compound to Q802. Be careful when installing the new module to avoid breaking the substrate. When Q802 is aligned with the heat sink clip, apply pressure to Q802 only until the module is firmly seated.

3.6.2 To remove any of the other modules, unsolder the tabs from the ceramic substrates (eight tabs on the predriver and driver modules and six on each of the final stage modules). Remove transistor mounting screws and extract the module. Before installing the new module, apply a thin coating of Wakefield compound to the mounting surface. Be sure that the module output (as indicated by the beveled corner) is facing in the proper direction.

Caution

The transistor mounting screws must be tightened before the transistor tabs are soldered to the circuit board. *Do not tighten to more than six to seven inch-pounds,* or damage to the transistor may result.

Solder the module tabs to the substrate so that the connection covers the entire surface of the tab.

3.7 REMOVAL OF RF POWER AMPLIFIER AND A+ DISTRIBUTION BOARD

3.7.1 Unless you must gain access to the A+ distribution board, there should be no need to remove the power amplifier assembly. To gain this access:

(1) Unsolder the bias pin connections (seven) from the substrates.

(2) Unsolder the input and output coaxial cables.

(3) Remove the ten transistor mounting screws.

(4) Remove the five hex-head screws holding the plastic carrier.

(5) Remove the amplifier. (Take the special precautions given in Section 3.1.1).

If it is necessary to remove the A+ distribution board, unsolder the seven feedthrough capacitor connections and remove the three mounting screws.

3.7.2 To replace the boards, reverse the removal procedure. When replacing the power amplifier assembly, give the low-level amplifier the special handling described in Section 3.1.1. Apply a thin coating of Wakefield compound to the transistor mounting surfaces. Start the transistor mounting screws to insure proper alignment, then insert and tighten the hex-head screws in the plastic carrier. Tighten the transistor mounting screws.

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 (Motorola part number 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. Removal of the black plastic part requires the removal of a single screw.

3.9 DIRECTIONAL COUPLER

To remove the directional coupler, remove the top cover and unsolder the two coaxial cables. Remove the mounting screws. Swing up the common circuits board, unplug the connector, and lift the carrier from the radio.

3.10 ANTENNA RELAY

Remove the directional coupler cover and unsolder the coaxial cable to the antenna relay. You can now remove the antenna relay by disconnecting the dc connector from the RF board and unplugging the coaxial cable from the internal casting. The antenna relay is secured by means of a nut located outside the radio chassis. Remove this nut with a spanner nut removal tool (Motorola part number RSX4028A).

4. Troubleshooting the General System

Table 3 is a guide to troubleshooting the general system. It is divided into three sections: symptoms of malfunction, possible cause of failure, and the chart or diagram to be used to clear the fault.

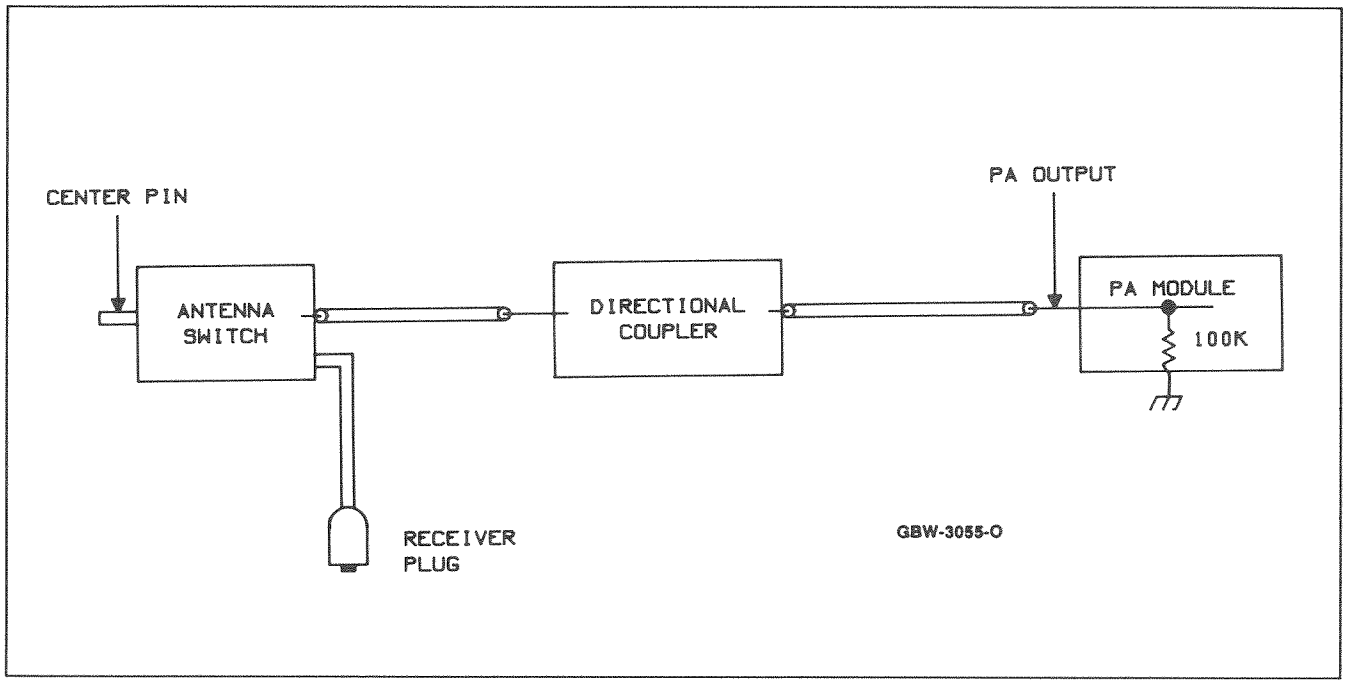


Figure 3. Transmit Signal Path

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

A regular analog VOM is required for checking continuity paths or short circuits. Refer to the list of recommended test equipment at the beginning of this section.

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 dc volts are 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.

Table 3. 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 *No Receive Audio* 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 relay	Antenna relay 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 3. 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 relay	Antenna relay 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

6. Installation Power Set Procedure

6.1 AUDIT POWER OUTPUT

After completion of the radio installation, you must audit the power output of your radio. Each radio installation may affect the transmitter's power output due to variations in antenna loading. The factory sets each radio to its specific power output using a calibrated 50-ohm load. Your antenna might not present the same load impedance to the radio transmitter causing changes to system performance.

6.2 VERIFY POWER OUTPUT

Verify your system has the correct antenna for the frequency range of your radio.

Note

SYNTOR X radios operate over a greater portion of the spectrum than most antennas are resonant. Motorola offers a wideband antenna for each band of *SYNTOR X* model radios. Contact the nearest Motorola center for assistance.

Perform the following steps to verify the power output of your radio.

(1) Connect a 50-ohm power meter in series with the coax leading to the antenna.

(2) Measure the VSWR of the radio system for each channel.

(3) Verify that the power output on the transmit frequency that has the lowest VSWR is at least the output listed in the performance specifications.

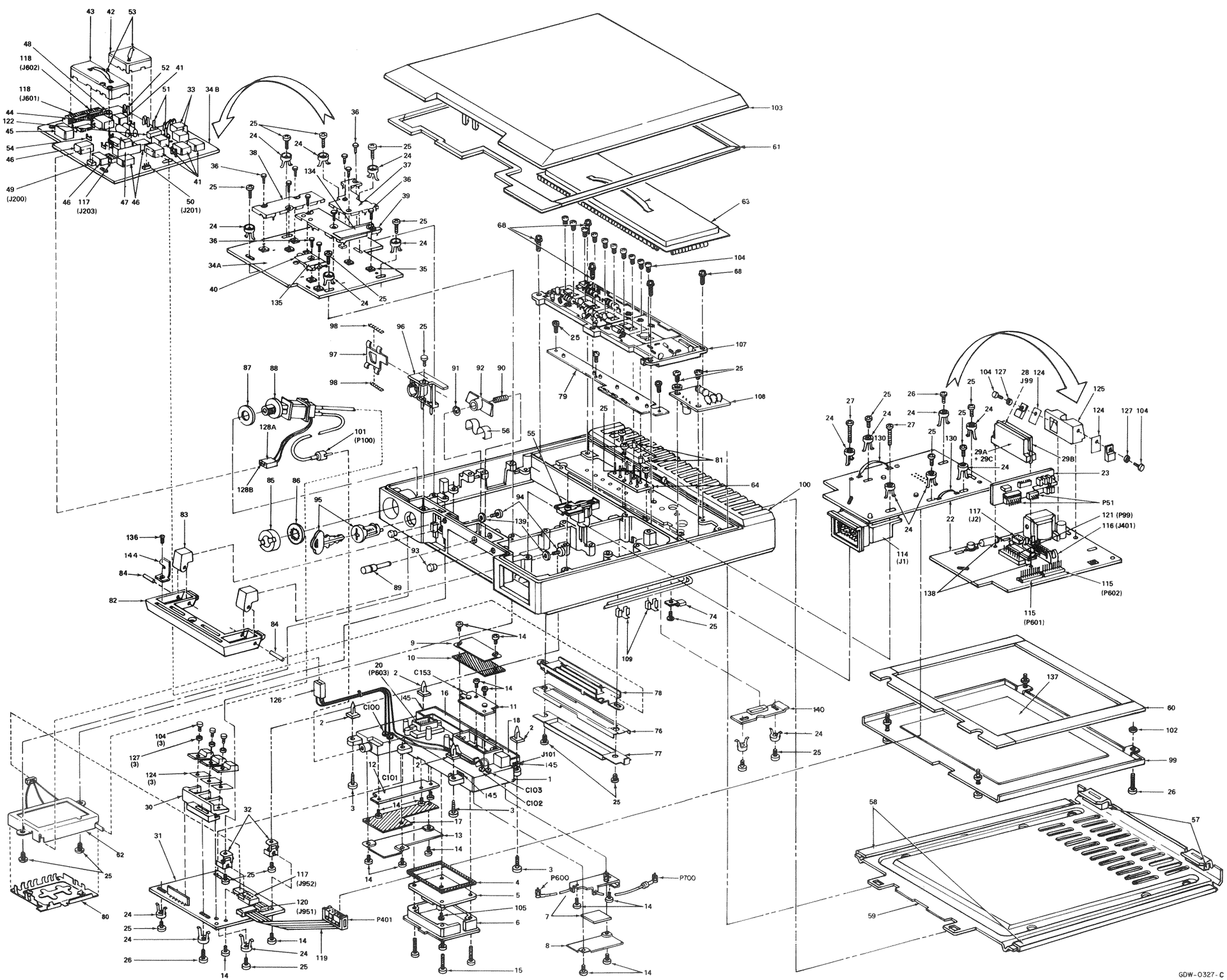
Note

Do not make adjustments to the power output if the measured VSWR is greater than 1.5:1. Check your antenna for proper installation and ensure it is designed for your operating frequency.

(4) If measured power output, using a 50-ohm load, is within 5% of the recommended power, make NO adjustments to the radio.

(5) If measured power output, using an antenna, is within 10% of the recommended power, make NO adjustments to the radio.

Should the measured power output differ from expected levels outlined above, see the Power Set Procedures in this manual. Reset the power output to the specified level for your radio model.



parts list

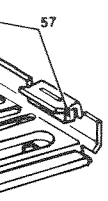
SYNTOR X UHF Mechanical Parts

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	15–84776M09	internal casting housin
2	14–80212B01	expansion nut, 4 used
3	03–80157J01	tapping screw (4.2x1.4
4	32–82796H01	wire mesh gasket
5	HLE4192B	VCO substrate
6	15–84817M01	VCO cover
7	HLE1080A	VCO buffer substrate
8	15–84851M01	buffer cover
9	15–84852M01	mixer cover
10	32–80042D01	mixer gasket
11	HLE4182A	mixer circuit board
12	HLE4187A or HLE4467A	preamplifier circuit boa receive filter circuit bo
13	15–84853M01	preamplifier/receive filt
14	03–10943M14	tapping screw (3.5x0.6
15	03–80132J02	tapping screw (3.5x0.6
16	15–80209B01	preselector cover (6–c
17	32–80043D01	preamplifier/receive filt
18	15–80210B02	injection filter cover
19	—	not used
20	HLN4251A	VCO interconnect
21	—	not used
22	HLN4760B	personality circuit boar
23	01–80749T82	input/output circuit boa
24	42–83503M01	retainer, 16 used
25	03–10943M15	tapping screw (3.5x0.6
26	03–10943M18	tapping screw (3.5x0.6
27	03–80132J01	tapping screw (3.5x0.6
28	HLN4580A	EEPROM board
29A	15–83494M01	left half PROM housing
29B	15–83819M02	right half PROM housi
29C	54–84392M01	direction label
30	26–84835M03	regulator heatsink
31	HLN4797C	common circuits circuit
32	55–83493M01	hinge, 2 used
33	26–84898M01	circuit board shield, 2
34A	HLN4462B	RF circuit board (solde
34B	HLN4462B	RF circuit board (comp
35	05–84220B01	grommet, 11 used
36	03–80136F01	tapping screw, 11 use
37	26–84862M01	adaptive filter shield (s
38	26–83586M01	lower IF shield (solder
39	26–80207D02	divider/phase–detector
40	26–83587M01	quadrature detector sh
41	26–83594M01	can shield (component
42	26–84978M01	adaptive filter shield (c
43	26–83593M01	divider/phase–tector sh (component side)
44	26–83597M01	prescaler shield (comp
45	26–83595M01	quadrature detector sh
46	26–80055K01	lower IF shield (compo
47	26–83814M01	fence shield (compone
48	09–84231B02	male phono connector
49	28–84324M01	2–contact male connec
50	28–84324M02	3–contact male connec
51	46–83948M01	guide post, 2 used
52	42–83891L01	mixer clip, 4 used
53	55–84300B02	handle, 2 used
54	42–82160N02	speed clip, 10 used
55	HLN4248B	PA wiring bus
56	41–80206F01	top cover spring
57	75–80195G01	rubber tray pad, 2 use
58	07–80173B02	guiderail, 2 used
59	07–80208G03	mounting frame
60	32–80255D01	bottom cover gasket
61	32–80256D01	top cover gasket
62	HLE4175A	directional coupler sub
63	01–80244H02	PA cover shield
64	HLN4046A	feedthru plate (PA)
65–67	—	not used
68	03–10943M16	tapping screw (3.5x0.6
69–73	—	not used
74	42–80201B01	bus wire clip
75	—	not used
76	32–80211F01	harmonic filter gasket
77	15–84827M01	harmonic filter cover
78	HFE4013A	harmonic filter
79	84–80138A01	power distribution boa
80	01–80724T82	directional coupler cov
81	29–83897M01	wire receptacle termini
82	55–80242D01	handle
83	07–80152B01	handle pivot bracket, 2
84	22–83491M01	spring pin
85	02–80006A01	spanner nut
86	04–00014522	lockwasher
87	32–80080A02	ring gasket
88	HLN4460B	antenna switch
89	38–80154B01	cover release button
90	41–80155B01	cover release spring
91	42–80156B01	retainer ring
92	55–80157B02	cover release catch
93	75–00838926	rubber bumper, 2 use
94	03–10908A46	machine screw (5.0x0
95	55–84101B01	lock with key
96	15–80159B01	lock housing
97	55–80161B01	lock catch
98	41–80160B01	lock spring
99	15–80174B01	bottom cover
100	15–84763M02	radio housing
101	28–82365D02	male phone connector
102	04–80149A01	captive washer, 4 use

parts list

SYNTOR X UHF Mechanical Parts — MXW–0328–E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	15–84776M09	internal casting housing
2	14–80212B01	expansion nut, 4 used
3	03–80157J01	tapping screw (4.2x1.41x19mm), 4 used
4	32–82796H01	wire mesh gasket
5	HLE4192B	VCO substrate
6	15–84817M01	VCO cover
7	HLE1080A	VCO buffer substrate
8	15–84851M01	buffer cover
9	15–84852M01	mixer cover
10	32–80042D01	mixer gasket
11	HLE4182A	mixer circuit board
12	HLE4187A or HLE4467A	preamplifier circuit board receive filter circuit board
13	15–84853M01	preamplifier/receive filter cover
14	03–10943M14	tapping screw (3.5x0.6x6mm), 16 used
15	03–80132J02	tapping screw (3.5x0.6x25mm), 4 used
16	15–80209B01	preselector cover (6–cell)
17	32–80043D01	preamplifier/receive filter gasket
18	15–80210B02	injection filter cover
19	—	not used
20	HLN4251A	VCO interconnect
21	—	not used
22	HLN4760B	personality circuit board
23	01–80749T82	input/output circuit board
24	42–83503M01	retainer, 16 used
25	03–10943M15	tapping screw (3.5x0.6x8mm), 24 used
26	03–10943M18	tapping screw (3.5x0.6x16mm)
27	03–80132J01	tapping screw (3.5x0.6x28mm)
28	HLN4580A	EEPROM board
29A	15–83494M01	left half PROM housing
29B	15–83819M02	right half PROM housing
29C	54–84392M01	direction label
30	26–84835M03	regulator heatsink
31	HLN4797C	common circuits circuit board
32	55–83493M01	hinge, 2 used
33	26–84898M01	circuit board shield, 2 used
34A	HLN4462B	RF circuit board (solder side)
34B	HLN4462B	RF circuit board (component side)
35	05–84220B01	grommet, 11 used
36	03–80136F01	tapping screw, 11 used
37	26–84862M01	adaptive filter shield (solder side)
38	26–83586M01	lower IF shield (solder side)
39	26–80207D02	divider/phase–detector shield (solder side)
40	26–83587M01	quadrature detector shield (solder side)
41	26–83594M01	can shield (component side), 5 used
42	26–84978M01	adaptive filter shield (component side)
43	26–83593M01	divider/phase–tector shield (component side)
44	26–83597M01	prescaler shield (component side)
45	26–83595M01	quadrature detector shield
46	26–80055K01	lower IF shield (component side)
47	26–83814M01	fence shield (component side)
48	09–84231B02	male phono connector
49	28–84324M01	2–contact male connector
50	28–84324M02	3–contact male connector
51	46–83948M01	guide post, 2 used
52	42–83891L01	mixer clip, 4 used
53	55–84300B02	handle, 2 used
54	42–82160N02	speed clip, 10 used
55	HLN4248B	PA wiring bus
56	41–80206F01	top cover spring
57	75–80195G01	rubber tray pad, 2 used
58	07–80173B02	guiderail, 2 used
59	07–80208G03	mounting frame
60	32–80255D01	bottom cover gasket
61	32–80256D01	top cover gasket
62	HLE4175A	directional coupler substrate
63	01–80244H02	PA cover shield
64	HLN4046A	feedthru plate (PA)
65–67	—	not used
68	03–10943M16	tapping screw (3.5x0.6x10mm)
69–73	—	not used
74	42–80201B01	bus wire clip
75	—	not used
76	32–80211F01	harmonic filter gasket
77	15–84827M01	harmonic filter cover
78	HFE4013A	harmonic filter
79	84–80138A01	power distribution board
80	01–80724T82	directional coupler cover
81	29–83897M01	wire receptacle terminal, 2 used
82	55–80242D01	handle
83	07–80152B01	handle pivot bracket, 2 used
84	22–83491M01	spring pin
85	02–80006A01	spanner nut
86	04–00014522	lockwasher
87	32–80080A02	ring gasket
88	HLN4460B	antenna switch
89	38–80154B01	cover release button
90	41–80155B01	cover release spring
91	42–80156B01	retainer ring
92	55–80157B02	cover release catch
93	75–00838926	rubber bumper, 2 used
94	03–10908A46	machine screw (5.0x0.8x16mm), 2 used
95	55–84101B01	lock with key
96	15–80159B01	lock housing
97	55–80161B01	lock catch
98	41–80160B01	lock spring
99	15–80174B01	bottom cover
100	15–84763M02	radio housing
101	28–82365D02	male phone connector
102	04–80149A01	captive washer, 4 used



GDW-0327-C

RADIO EXPLODED VIEW AND MECHANICAL PARTS LIST

SYNTOR X UHF Mechanical Parts — MXW–0328–E (2)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
103	15–84075N02	top cover
104	03–10911A11	machine screw (3.0x0.5x10mm), 15 used
105	03–10943M10	tapping screw (3.0x0.5x8mm)
106	—	not used
107	42–80137A02	PA mounting frame
108	HLN4466A	LLA interface board
109	42–84367M01	wire hold–down clip, 2 used
110–113	—	not used
114	01–80029L05	37–contact male front connector assembly
115	28–82647K02	10–contact male connector, 2 used
116	28–83603M01	20–contact male connector
117	08–84207B01	7–contact metering socket, 4 used
118	09–83445L09	10–contact female connector
119	30–83602M01	20–conductor cable (includes P401)
120	28–80052D01	10–contact right–angle connector
121	28–82662L03	22–contact male connector
122	09–83729M01	7–contact female socket
123	—	not used
124	24–83820M02	transistor insulator, 5 used
125	26–83498M01	audio PA heatsink
126	15–84301K01	3–position connector housing
127	04–84180C01	shoulder washer, 5 used
128A	15–84301K16	2–position connector housing
128B	39–82717M01	contact receptacle, 2 used
129	55–84300B04	long handle
130	55–84300B03	short handle
131–133	—	not used
134	14–84690M01	insulator
135	14–84692M02	insulator
136	03–10943R22	screw
137	—	not used
138	46–83821M01	memory module alignment pin
139	04–00007652	lockwasher, 2 used
140	64–80191H03	transformer bracket
141	—	not used
142	03–10908A26	machine screw (3.5x0.6x6mm), 5 used
143	03–10943R22	TT flat–head screw (4.7x17x10.0)
144	55–80244C02	latch handle
145	14–80175M02	insulator shield (3 used)

non–referenced items

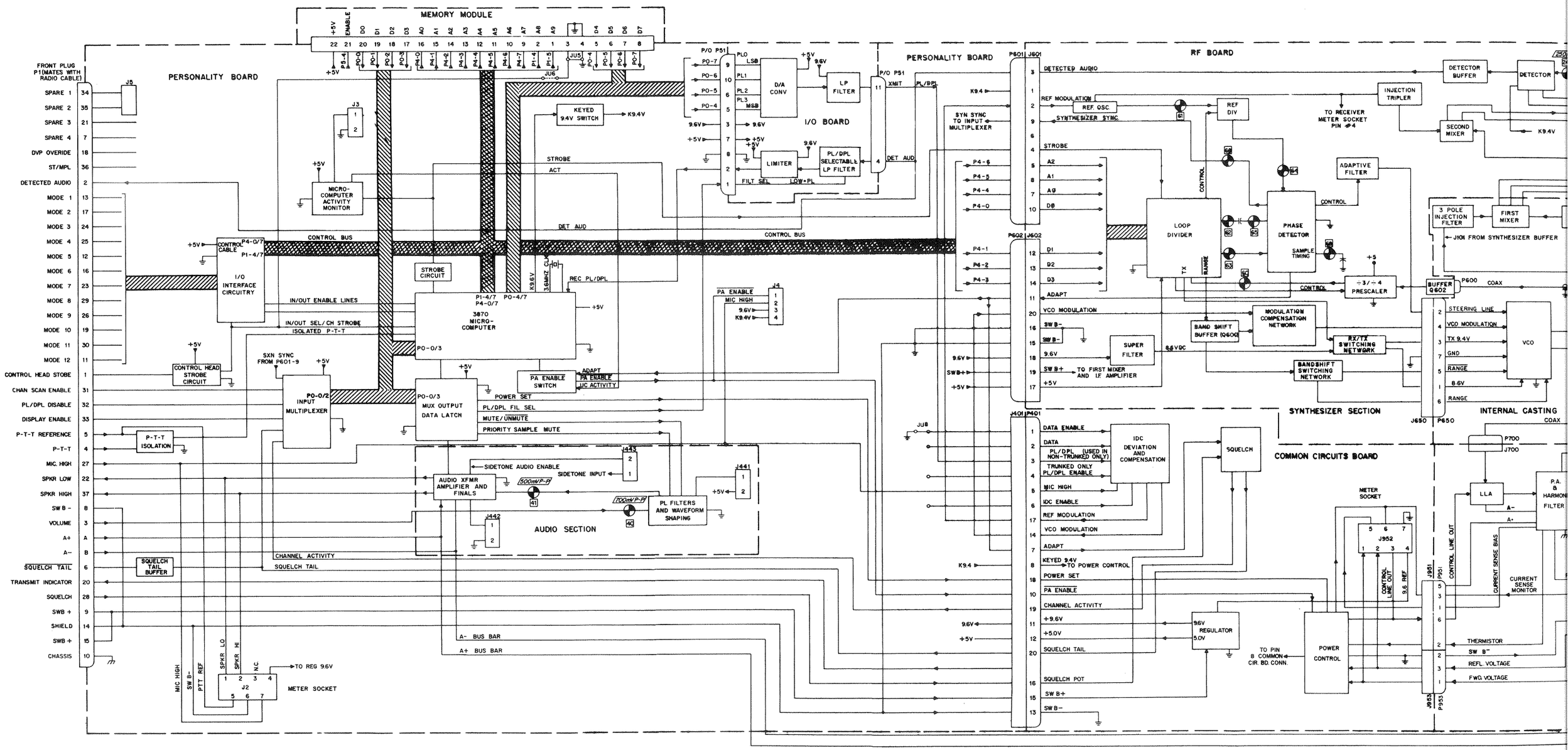
	54–84342M01	floating ground label (mixer coer, VCO cover), 2 used
	54–84126C01	Motorola Rep. Parts casting wall label
	54–84659M01	patent label (buffer cover)
	54–00850440	FCC label
	54–80067F01	caution label

9/27/88

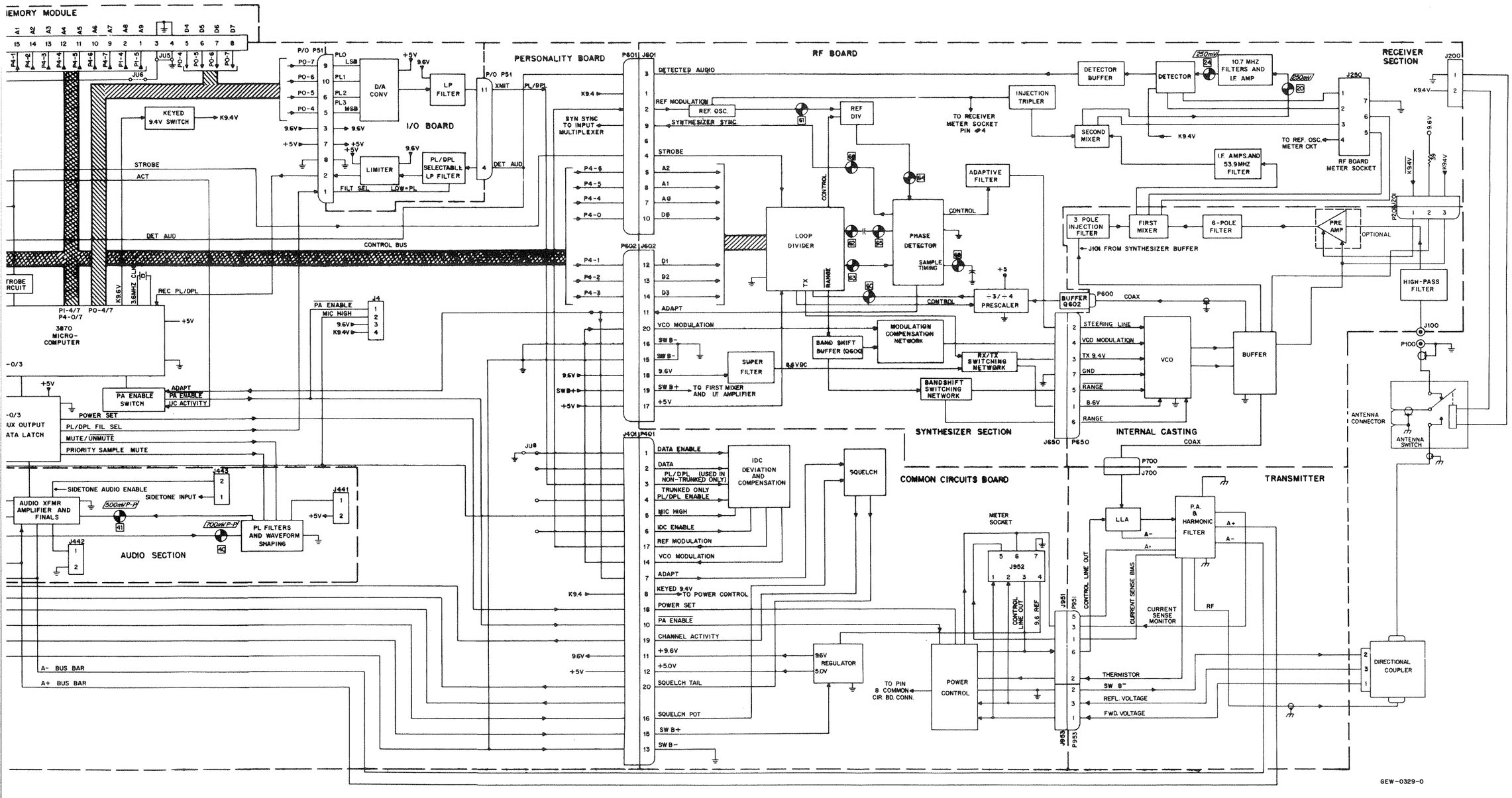
GENERAL MAINTENANCE/TROUBLESHOOTING

Exploded View, Mechanical Parts List, and Functional Block Diagram for *SYNTOR X* UHF Radio
PW–0326–D
(Sheet 1 of 2)
9/30/88

FUNCTIONAL BLOCK DIAGRAM OF RADIO



Exploded View, Mechanical Parts List, and
Functional Block Diagram for
SYNTOR X UHF Radio
PW–0326–D
(Sheet 2 of 2)
9/30/88


MEMORY MODULE
A1 A2 A3 A4 A5 A6 A7 A8 A9 D4 D5 D6 D7
15 14 13 12 11 10 9 2 1 3 4 5 6 7 8
P4-1 P4-2 P4-3 P4-4 P4-5 P4-6 P4-7 P4-4 P1-5 P0-4 P0-5 P0-6 P0-7
JU5
JU6
P/O P51
PO-7
PO-6
PO-5
PO-4
PL0 LSB
PL1
PL2
PL3 MSB
D/A CONV
+5V
9.6V
LP FILTER
P/O P51
XMIT
PL/DPL
DET AUD
I/O BOARD
PERSONALITY BOARD
RF BOARD
KEYED 9.4V SWITCH
K9.4V
STROBE
ACT
LIMITER
PL/DPL SELECTABLE LP FILTER
FILT SEL
LOW-PL
CONTROL BUS
DET AUD
P4-1/P4-0/7
PO-4/7
K9.6V
3.6MHZ CLK
REC PL/DPL
3870 MICRO-COMPUTER
PA ENABLE MIC HIGH
J4
9.6V
K9.4V
PA ENABLE SWITCH
ADAPT
PA ENABLE
UC ACTIVITY
POWER SET
PL/DPL FIL SEL
MUTE/UNMUTE
PRIORITY SAMPLE MUTE
J443
SIDETONE AUDIO ENABLE
SIDETONE INPUT
AUDIO XFMR AMPLIFIER AND FINALS
500mV P-P
41
700mV P-P
40
PL FILTERS AND WAVEFORM SHAPING
J441
J442
AUDIO SECTION
A- BUS BAR
A+ BUS BAR
SYN SYNC TO INPUT MULTIPLEXER
P601 J601
P602 J602
DETECTED AUDIO
REF MODULATION
REF. OSC.
SYNTHESIZER SYNC.
STROBE
A2
A1
A0
D0
D1
D2
D3
ADAPT
VCO MODULATION
SW B-
9.6V
SW B+
+5V
TO FIRST MIXER AND I.F. AMPLIFIER
SUPER FILTER
8.6VDC
LOOP DIVIDER
TX
RANGE
CONTROL
REF DIV
PHASE DETECTOR
SAMPLE TIMING
ADAPTIVE FILTER
÷3/÷4 PRESCALER
BAND SHIFT BUFFER Q600
MODULATION COMPENSATION NETWORK
RX/TX SWITCHING NETWORK
BANDSHIFT SWITCHING NETWORK
SYNTHESIZER SECTION
J401 P401
DATA ENABLE
DATA
PL/DPL (USED IN NON-TRUNKED ONLY)
TRUNKED ONLY PL/DPL ENABLE
MIC HIGH
IDC ENABLE
REF MODULATION
VCO MODULATION
ADAPT
KEYED 9.4V
TO POWER CONTROL
POWER SET
PA ENABLE
CHANNEL ACTIVITY
+9.6V
+5.0V
SQUELCH TAIL
SQUELCH POT
SW B+
SW B-
IDC DEVIATION AND COMPENSATION
SQUELCH
9.6V REGULATOR 5.0V
TO PIN 8 COMMON CIR. BD. CONN.
POWER CONTROL
COMMON CIRCUITS BOARD
TO RECEIVER METER SOCKET PIN #4
INJECTION TRIPLER
DETECTOR BUFFER
DETECTOR
250mV
10.7 MHZ FILTERS AND I.F. AMP
250mV
J250
SECOND MIXER
K9.4V
I.F. AMPS AND 53.9MHZ FILTER
TO REF. OSC. METER CKT
RF BOARD METER SOCKET
RECEIVER SECTION
J200
K9.4V
K9.6V
K9.4V
K9.4V
PS201/J201
1 2 3
3 POLE INJECTION FILTER
FIRST MIXER
6-POLE FILTER
PRE AMP
OPTIONAL
J101 FROM SYNTHESIZER BUFFER
HIGH-PASS FILTER
J100
P100
BUFFER Q602
P600
COAX
STEERING LINE
VCO MODULATION
TX 9.4V
GND
RANGE
8.6V
RANGE
VCO
BUFFER
J650 P650
INTERNAL CASTING
COAX
ANTENNA CONNECTOR
ANTENNA SWITCH
P700
J700
TRANSMITTER
METER SOCKET
J952
CONTROL LINE OUT
9.6 REF
J951 P951
CONTROL LINE OUT
CURRENT SENSE BIAS
LLA
P.A. & HARMONIC FILTER
A+
A-
A-
A+
CURRENT SENSE MONITOR
RF
THERMISTOR
SW B-
REFL. VOLTAGE
FWD. VOLTAGE
J953 P953
DIRECTIONAL COUPLER
GEW-0329-0

1. Ceramic Microstrip Substrates

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.

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

The radio uses many chips 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.

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 #ST–1160). When the connecting solder melts, lift the chip. Figures 2 and 3 illustrate this removal technique.

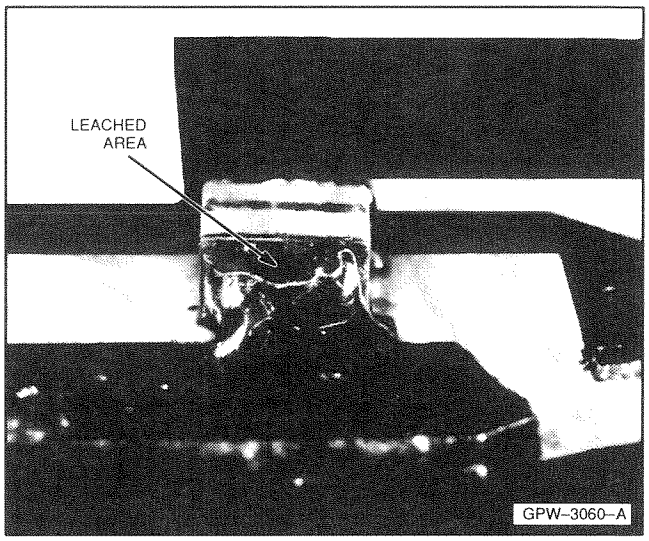


Figure 1. "Leached" Chip Capacitor

3. Replacing Transistors in the Power Amplifier

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 an remove the transistors. Special soldering iron tips ST1160 and ST1161 (available form Motorola parts offices) make it easier to remove capacitors and transistors.

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 cutout, tightening the mounting hardware to a maximum of 7 inch–pounds. With a low power soldering iron (40–60W), 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 from the 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.

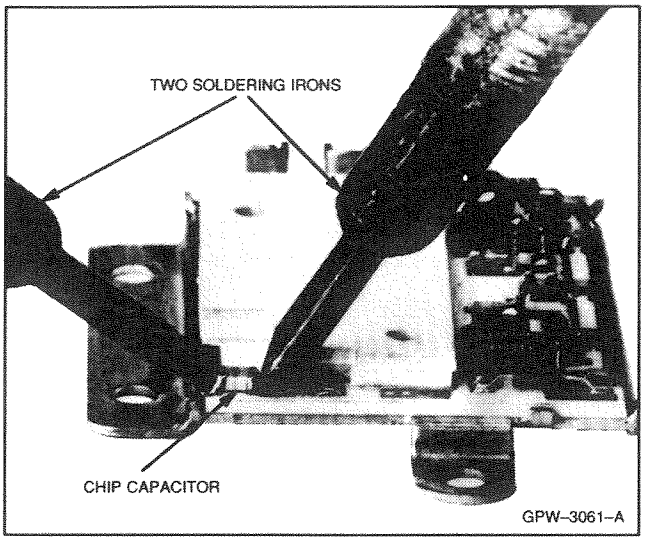


Figure 2. Capacitor Removal with Two Soldering Irons

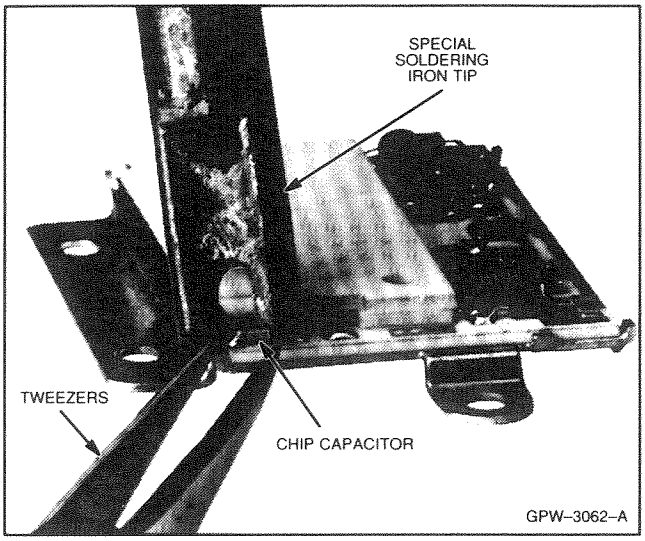


Figure 3. Capacitor Removal with Special Soldering Tip