MOTOROLA

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Scope of Manual

This manual is intended for use by experienced technicians familiar with similar types of equipment. It contains all service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by instruction manual revision. These revisions are added to the manuals as the engineering changes are incorporated into the equipment.

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Other Documentation

Table 1 lists other documentation for the GP300 Portable Radios.

Table 1. Other Documentations

Information	Location
Basic Use of GP300	GP300 Owner's Manual (6880901Z83)
Programming	GP300 RSS Manual (6880901Z81)

Technical Support

To obtain technical support, you may call Motorola's Radius Product Services. When you call, we ask that you have ready the model and serial numbers of the respective radio or its parts.

Service Policy

If malfunctions occur within 30 days that cannot be resolved over the phone with Radius Product Services, a defective major component should be returned. You must obtain authorization from Radius Product Services before returning the component.

Ordering Replacement Parts

You can order additional components and some piece parts directly through your Radius price pages. When ordering replacement parts, include the complete identification number for all chassis, kits, and components. If you do not know a part number, include with your order the number of the chassis or kit which contains the part, and a detailed description of the desired component. If a Motorola part number is identified on a parts list, you should be able to order the part through Motorola Parts. If only a generaic part is listed, the part is not normally available through Motorola. If no parts list is shown, generally, no user serviceable parts are available for the kit.

Technical Support
Radius Product Services
Hwy. 34 West
Mt. Pleasant, IA 52641 USA
1-800-356-1520
319-385-5395 (International)

Radius 30-Day Warranty
Radius Repair Depot
Attention: Warranty Return
1000 W. Washington Street
Mt. Pleasant, IA 52641 USA
1-800-356-1520
319-385-5395 (International)

Radius Major Component Repair
Radius Repair Depot
1000 W. Washington Street
Mt. Pleasant, IA 52641 USA

Motorola Parts
Worldwide System and
Aftermarket Products Division
Attention: Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Worldwide System and
Aftermarket Products Division
Attention: International Order Processing
1313 E. Algonquin Road
Schaumburg, IL 60196

Customer Service
1-800-422-4210
1-708-538-8198 (FAX)

Parts Identification
1-708-538-0021
1-708-538-8194

Model Charts

GP300
VHF
136 - 162 MHz
146 - 174 MHz

X = Indicates one of each required

Model	P93YPC20C1A_	P93YPC20D1A_	P93YPC20A1A_	P93YPC00C1A_	P93YPC00D1A_	P93YPC00A1A_	P93YPC20C2A_	P93YPC20D2A_	P93YPC20A2A_	P93YPC00C2A_	P93YPC00D2A_	P93YPC00A2A_	Item	Description
Description	16-Chan., 20/25 kHz (136-162 MHz)	8-Chan., 20/25 kHz (136-162 MHz)	2-Chan., 20/25 kHz (136-162 MHz)	16-Chan., 12.5 kHz (136-162 MHz)	8-Chan., 12.5 kHz (136-162 MHz)	2-Chan., 12.5 kHz (136-162 MHz)	16-Chan., 2-/25 kHz (146-174 MHz)	8-Chan., 20/25 kHz (146-174 MHz)	2-Chan., 20/25 kHz (146-174 MHz)	16-Chan., 12.5 kHz (146-174 MHz)	8-Chan., 12.5 kHz (146-174 MHz)	2-Chan., 12.5 kHz (146-174 MHz)		
				X	X								HLD8095_	RF Board, 12.5 kHz, (136-162 MHz)
	X	X											HLD8094_	RF Board, 20/25 KHz, (136-162 MHz)
			X										HLD8338_	RF Board, 2-Chan., 20/25 kHz, (136-162 MHz)
						X							HLD8339_	RF Board., 2-Chan., 12.5 kHz, (136-162 MHz)
										X	X		HLD9675_	RF Board, 12.5 kHz, (146-174 MHz)
							X	X					HLD9677_	RF Board, 20/25 kHz, (146-174 MHz)
									X				HLD8335_	RF Board, 2-Chan., 20/25 kHz, (146-174 MHz)
												X	HLD8332_	RF Board, 2-Chan., 12.5 kHz, (146-174 MHz)
			X			X			X			X	HLN9668_	2-Channel Control Kit
		X			X			X			X		HLN9849_	8-Channel Control Kit
	X			X			X			X			HLN9680_	16-Channel Control Kit
	X	X	X	X	X	X	X	X	X	X	X	X	HLN9667_	Chassis Hardware Assembly
	X	X	X	X	X	X	X	X	X	X	X	X	HHN9684_	Housing
	X	X	X	X	X	X							HAD9338_	Antenna (136-162 MHz)
							X	X	X	X	X	X	NAD6502_	Antenna (146-174 MHz)
	X	X	X	X	X	X	X	X	X	X	X	X	6880901Z83	Operator's Manual/Operator Card

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Parts Identification
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1-708-538-8194

Model Charts

Model	Description
P93YPC20C1A_	16-Chan., 20/25 kHz (136-162 MHz)
P93YPC20D1A_	8-Chan., 20/25 kHz (136-162 MHz)
P93YPC20A1A_	2-Chan., 20/25 kHz (136-162 MHz)
P93YPC00C1A_	16-Chan., 12.5 kHz (136-162 MHz)
P93YPC00D1A_	8-Chan., 12.5 kHz (136-162 MHz)
P93YPC00A1A_	2-Chan., 12.5 kHz (136-162 MHz)
P93YPC20C2A_	16-Chan., 2-/25 kHz (146-174 MHz)
P93YPC20D2A_	8-Chan., 20/25 kHz (146-174 MHz)
P93YPC20A2A_	2-Chan., 20/25 kHz (146-174 MHz)
P93YPC00C2A_	16-Chan., 12.5 kHz (146-174 MHz)
P93YPC00D2A_	8-Chan., 12.5 kHz (146-174 MHz)
P93YPC00A2A_	2-Chan., 12.5 kHz (146-174 MHz)

GP300
VHF
136 - 162 MHz
146 - 174 MHz

X = Indicates one of each required

Item	Description
HLD8095_	RF Board, 12.5 kHz, (136-162 MHz)
HLD8094_	RF Board, 20/25 KHz, (136-162 MHz)
HLD8338_	RF Board, 2-Chan., 20/25 kHz, (136-162 MHz)
HLD8339_	RF Board., 2-Chan., 12.5 kHz, (136-162 MHz)
HLD9675_	RF Board, 12.5 kHz, (146-174 MHz)
HLD9677_	RF Board, 20/25 kHz, (146-174 MHz)
HLD8335_	RF Board, 2-Chan., 20/25 kHz, (146-174 MHz)
HLD8332_	RF Board, 2-Chan., 12.5 kHz, (146-174 MHz)
HLN9668_	2-Channel Control Kit
HLN9849_	8-Channel Control Kit
HLN9680_	16-Channel Control Kit
HLN9667_	Chassis Hardware Assembly
HHN9684_	Housing
HAD9338_	Antenna (136-162 MHz)
NAD6502_	Antenna (146-174 MHz)
6880901Z83	Operator's Manual/Operator Card

GP300
UHF
403 - 433 MHz
438 - 470 MHz

X = Indicates one of each required

Model	P94YPC20C1A_	P94YPC20D1A_	P94YPC20A1A_	P94YPC00C1A_	P94YPC00D1A_	P94YPC00A1A_	P94YPC20C2A_	P94YPC20D2A_	P94YPC20A2A_	P94YPC00C2A_	P94YPC00D2A_	P94YPC00A2A_	Item	Description
Description	16-Chan., 20/25 kHz (403-433 MHz)	8-Chan., 20/25 kHz (403-433 MHz)	2-Chan., 20/25 kHz (403-433 MHz)	16-Chan., 12.5 kHz (403-433 MHz)	8-Chan., 12.5 kHz (403-433 MHz)	2-Chan., 12.5 kHz (403-433 MHz)	16-Chan., 20/25 kHz (438-470 MHz)	8-Chan., 20/25 kHz (438-470 MHz)	2-Chan., 20/25 kHz (438-470 MHz)	16-Chan., 12.5 kHz (438-470 MHz)	8-Chan., 12.5 kHz (438-470 MHz)	2-Chan., 12.5 kHz (438-470 MHz)		
				X	X								HLE9673_	RF Board, 12.5 kHz, (403-433 MHz)
	X	X											HLE9670_	RF Board, 20/25 kHz, (403-470 MHz)
			X										HLE8336_	RF Board, 2-Chan., 20/25 kHz, (403-433 MHz)
						X							HLE8333_	RF Board, 2-Chan., 12.5 kHz, (403-433 MHz)
										X	X		HLE9674_	RF Board, 12.5 kHz, 12.5 kHz (438-470 MHz)
							X	X					HLE9676_	RF Board, 20/25KHz, (438-470 MHz)
									X				HLE8337_	RF Board, 2-Chan., 20/25 kHz (438-470 MHz)
												X	HLE8334_	RF Board, 2-Chan., 12.5 kHz (438-470 MHz)
			X			X			X			X	HLN9668_	2-Channel Control Kit
		X			X			X			X		HLN9849_	8-Channel Control Kit
	X			X			X			X			HLN9680_	16-Channel Control Kit
	X	X	X	X	X	X	X	X	X	X	X	X	HLN9667_	Chassis Hardware Assembly
	X	X	X	X	X	X	X	X	X	X	X	X	HHN9684_	Housing
	X	X	X	X	X	X	X	X	X	X	X	X	NAE6483_	Antenna
	X	X	X	X	X	X	X	X	X	X	X	X	6880901Z83	Operator's Manual/Operator Card

GP300
UHF
465 - 495 MHz
490 - 520 MHz

X = Indicates one of each required

Model	P94YPC20C3A_	P94YPC20D3A_	P94YPC20A3A_	P94YPC00C3A_	P94YPC00D3A_	P94YPC00A3A_	P94YPC20C4A_	P94YPC20D4A_	P94YPC20A4A_	P94YPC00C4A_	P94YPC00D4A_	P94YPC00A4A_	Item	Description
Description	16-Chan., 20/25 kHz (465-495 MHz)	8-Chan., 20/25 kHz (465-495 MHz)	2-Chan., 20/25 kHz (465-495 MHz)	16-Chan., 12.5 kHz (465-495 MHz)	8-Chan., 12.5 kHz (465-495 MHz)	2-Chan., 12.5 kHz (465-495 MHz)	16-Chan., 20/25 kHz (490-520 MHz)	8-Chan., 20/25 kHz (490-520 MHz)	2-Chan., 20/25 kHz (490-520 MHz)	16-Chan., 12.5 kHz (490-520 MHz)	8-Chan., 12.5 kHz (490-520 MHz)	2-Chan., 12.5 kHz (490-520 MHz)		
				X	X								HLE8056_	RF Board, 12.5 kHz, (465-495 MHz)
	X	X											HLE8054_	RF Board, 20/25 kHz, (465-495 MHz)
			X										HLE8340_	RF Board, 2-Chan., 20/25 kHz, (465-495 MHz)
						X							HLE8341_	RF Board, 2-Chan., 12.5 kHz, (465-495 MHz)
										X	X		HLE8057_	RF Board, 12.5 kHz, (490-520 MHz)
							X	X					HLE8055_	RF Board, 20/25 kHz, (490-520 MHz)
									X				HLE8342_	RF Board, 2-Chan., 20/25 kHz, (490-520 MHz)
												X	HLE8343_	RF Board, 2-Chan., 12.5 kHz, (490-520 MHz)
			X			X			X			X	HLN9668_	2-Channel Control Kit
		X			X			X			X		HLN9849_	8-Channel Control Kit
	X			X			X			X			HLN9680_	16-Channel Control Kit
	X	X	X	X	X	X	X	X	X	X	X	X	HLN9667_	Chassis Hardware Assembly
	X	X	X	X	X	X	X	X	X	X	X	X	HHN9684_	Housing
	X	X	X	X	X	X	X	X	X	X	X	X	NAE6483_	Antenna
	X	X	X	X	X	X	X	X	X	X	X	X	6880901z83	Operator's Manual/Operator Card

Accessories

Antennas:

NAD6502 — Black	146-174 MHz VHF Antenna (Standard w/Unit)
HAD9338 — Yellow	136-162 MHz VHF Antenna (Standard w/Unit)
HAD9742 — Black	146-162 MHz VHF Stubby Antenna
HAD9743 — Blue	162-174 MHz VHF Stubby Antenna
HAD9934 — Pink	174-195 MHz VHF Antenna
HAD9935 — Purple	195-208 MHz VHF Antenna
NAE6483 — None	403-520 MHz UHF Antenna (Standard w/Unit)
NAE6521 — Red	400-440 MHz UHF Stubby Antenna
NAE6522 — Green	438-470 MHz UHF Stubby Antenna
NAE6523 — Black	470-520 MHz UHF Stubby Antenna
HAD9728 — None	Tunable Antenna Kit (136-174 MHz)

Note: Each of the color coded antennas listed is designed to cover only the frequency split indicated. Therefore, it is important to order the correct antenna (frequency split) to match a specific customer frequency.

Carrying Accessories:

HLN9149	Swivel Belt Loop Adapter (for use with HLN9720, HLN9721, HLN9750, HLN9970, and HLN9008)
HLN9720	Standard Leather Carry Case w/Belt Loop
HLN9873	Standard Leather Carry Case w/Swivel
HLN9721	Slim Leather Carry Case w/Belt Loop
HLN9076	Standard Molded Carry Holder w/Belt Clip
HLN9750	Standard Nylon Carry Case
HLN9970	DTMF Standard Leather Carry Case w/Belt Loop
HLN8411	DTMF Standard Leather Carry Case w/Swivel
HLN8412	DTMF LCD Standard Leather Carry Case w/Swivel
HLN9008	Leather Carry Case w/Belt Loop for fully approved FM 1200 mAH Battery
HLN9009	Leather Carry Case w/Swivel for fully approved FM 1200 mAH Battery
HLN9011	DTMF Carry Case w/Swivel for fully approved FM 1200 mAH Battery
HLN9017	Nylon Carry Case for fully approved FM 1200 mAH Battery
HLN9724	Replacement 2-1/2" Belt Clip
HLN8255	Spring Action 3" Belt Clip
HLN8052	Wrist Strap
NTN5243	Shoulder Strap (for all carry cases)
HLN8414	Chest Pack Carry Holder
NTN5629	Replacement 3" Swivel Belt Loop (for use with same carry accessories as 2-1/2" Belt Loop but with wider belts)
HLN9035	Replacement 2-1/2" Swivel Belt Loop (for use with HLN9873, HLN9411, HLN8412, HLN9009, and HLN9011)
HLN9084	Replacement Strap for Molded Carry Holder
HLN9973	Replacement Strap for Leather Carry Case
HLN9974	Replacement Strap for Nylon Carry Case
HLN9975	Replacement Strap for DTMF Carry Case
HLN9018	Replacement Strap for fully approved FM 1200 mAH Battery Leather Carry Case
HLN9019	Replacement Strap for fully approved FM 1200 mAH Battery Nylon Carry Case
HLN9985	Waterproof Bag

Nickel-Cadmium Battery Chargers:

HTN9630	110 Volt - 1 Hour Rapid Rate Chargert
HTN9702	110 Volt - 10 Hour Standard Rate Charger
HTN9748	110 Volt - 6 Unit - 1 Hour Rapid Rate Charger
HTN9886	100 Volt - 1 Hour Rapid Rate Charger
HTN9938	100 Volt - 6 Unit - 1 Hour Rapid Rate Charger
HTN9802	220 Volt - 1 Hour Rapid Rate Charger (European Plug)
HTN9804	220 Volt - 10 Hour Standard Rate Charger (European Plug)
HTN9811	220 Volt - 2 Unit - 1 Hour Rapid Rate Charger (European Plug)
HTN9803	240 Volt - 1 Hour Rapid Rate Charger (U.K. Plug)
HTN9805	240 Volt - 10 Hour Standard Rate Charger (U.K. Plug)
HTN9812	240 Volt - 6 Unit - 1 Hour Rapid Rate Charger (U.K. Plug)
HLN9719	1 Hour Vehicular Charger Adapter/Bracket (12 volt for use with HTN9630, HTN9802, or HTN9803 Rapid Rate Chargers)
HLN9944	Wall Mounting Bracket For Multi Unit Charger
HKN8036	Battery Eliminator

Batteries:

HNN9628	1200 mAH High Capacity Battery
HNN8133	1200 mAH Limited FM Battery
HNN8308	600 mAH Slimline Battery
HNN9808	600 mAH (Fully Approved FM Slim Battery)
HNN9701	1200 mAH (Fully Approved FM Battery)

Audio/RF Accessories:

HMN9725	Remote Speaker Microphone
HMN9727	Earpiece Without Volume Control (plastic earloop)
HMN9752	Earpiece With Volume Control (plastic earloop)
50-80386B90	Rubber Ear Inserts for Earpieces (with older metal earloop - pkg q. 25)
50-80371E73	Rubber Ear Inserts for Earpieces (with plastic earloop - pkg q. 25)
HMN9754	2 Piece Surveillance Microphone (plastic earloop)
HMN9787	Headset w/Swivel Boom Microphone
BDN6647	Medium Weight Headset w/Swivel Boom Microphone
BDN6648	Heavy Weight Headset w/Noise Cancelling Boom Microphone
BDN6646	Ear Microphone
BDN6706	Ear Microphone w/VOX Interface (External VOX Included)
HLN8096	Audio Accessory Clamp
HLN9756	BNC - RF Adapter (for use with GP300 models only)

Prices And Availability Subject To Change Without Notice

Performance Specifications

GENERAL

	VHF		UHF			
Model Series:	P93YPC		P94YPC			
Frequency:	136-162	146-174	403-433	438-470	465 - 495	490 - 520
Channel Capacity:	2, 8, 8+2, or 16 Channels					
Power Supply:	One (1) rechargeable Nickel-Cadmium battery (7.5V)					
Dimensions†:	5.5" X 2.34" X 1.65" (140 X 59 X 42mm)†					
Weight †:	17.8 oz. (509 g)†					
Average Battery Life (5-5-90 Duty Cycle): High Capacity: Low Capacity:	Low Power 10.5 Hours 5.2 Hours	High Power 8 Hours 4 hours	Low Power 10.5 Hours 5.2 Hours		High Power 8 Hours 4 hours	
Environmental:	Meets MIL-STD-810-C, D, and E & EIA RS-316B environmental specifications for vibration, shock, rain, dust, and humidity					

†Standard High Capacity Battery Model

TRANSMITTER

	VHF		UHF	
RF Output @ 7.5V:	High 5W	Low 1W	High 4W†	Low 1W
Freq. Separation:	26, 28 MHz		30, 32 MHz	
Freq. Stability (-30°C to +60°):	0.0005%			
Modulation:	5 kHz max. (25/30 kHz channel spacing) 2.5 kHz max. (12.5 kHz channel spacing)			
Spurs/Harmonics:	0.25 µW < 2GHz			
Audio Response: (from 6 dB/oct. Pre-Emphasis, 300 to 3000Hz	+1, -3 dB			
Audio Distortion: @ 1000 Hz, 60% Rated Max. Dev.	<3%			
FCC Designation:	ABZ99FT301 ABZ99FT3011		ABZ99FT4010 ABZ99FT4011 ABZ99FT4012	
FM Noise:	-40 dB‡			

†Max.RF output is 3W for frequencies greater than 512 MHz
‡Typical level

RECEIVER

	VHF		UHF	
Channel Spacing:	25 kHz	12.5 kHz	25 kHz	12.5 kHz
Freq Separation:	26, 28 MHz		30, 32 MHz	
Sensitivity - 20 dB Quieting†: 12 dB EIA SINAD†: 20 dB SINAD†:	0.32 µV 0.22 µV 0.30 µV	0.38 µV N/A 0.35 µV	0.32 µV 0.22 µV‡ 0.30 µV	0.38 µV N/A 0.35 µV
Squelch Sensitivity:	10 dB SINAD			
Selectivity:	70dB	60dB	70dB	60dB
Intermodulation	70dB	60 dB	70 dB	60 dB
Freq. Stability (-30°C to +60°C): (-10°C to +50°C):	0.0005% 0.0003%			
Spur Rejection EIA: CEPT:	75 dB 70 dB			
Image Rejection EIA: CEPT:	75 dB 70 dB		70 dB 70 dB	
Audio Output at<10% Distortion (1 kHz)	500mW			

†Typical specification is 0.28mV on frequencies greater than 512 MHz

*All specifications subject to change without notice.

Service Aids

The following table lists service aids recommended for working on the GP300.

Motorola Part No.	Description	Application
HLN9214	Radio Interface Box	Enables communication between the radio and the computer's serial communications adapter.
HSN9412	RIB Power supply	Used to supply power to the RIB.
HKN9216	Computer Interface cable	Connects the computer's serial communications adapter to the RIB.
HLN9390	AT to XT Computer adapter	Allows HKN9216 to plug into a XT style communications port.
HKN9857	Programming / test cable	Connects radio to RIB. And can be used as a Battery Eliminator.
HVN9852	Radio Service Software	Software on 3-1/2 in. and 5-1/4 in. floppy disc.
HKN9755	Cloning Cable	Allows the radio to be duplicated from a master radio by transferring programmed data from one radio to another.
RTX4005	Portable Test Set	Enables connection to the audio / accessory jack. Allows switching for radio testing.
RKN4034	Test Set cable	Connects radio to RTX4005B Test Box.

Test Equipment

The following table lists test equipment required to service the GP300 and other two-way radios.

Motorola Model No.	Description	Characteristics	Application
R2200, R2400, or R2001D with trunking option	Service Monitor	This monitor will substitute for items with an asterisk *	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049A	Digital Multimeter		Two meters recommended for ac/dc voltage and current measurements
*S1100A	Audio Oscillator	67 to 161.4Hz tones	Used with service monitor for injection of PL tones
*S1053D, *SKN6009A, *SKN6001A	AC Voltmeter, Power Cable for meter, Test leads for meter	1mV to 300V, 10-Megohm input impedance	Audio voltage measurements
R1053	Dual-trace Oscilloscope	20 Mhz bandwidth, 5mV/cm - 20V/cm	Waveform measurements
*S1350C, *ST1215B (VHF) *ST1223B (UHF) *T1013A	Wattmeter, Plug-in Elements (Vhf & Uhf), RF Dummy Load	50-ohm, ± 5% accuracy 10 Watts, maximum 0-1000 Mhz, 300W	Transmitter power output measurements
S1339A	RF Millivolt Meter	100uV to 3V rf, 10 khz to 1.2 Ghz	RF level measurements
*R1013A	SINAD Meter		Receiver sensitivity
S1347D or S1348D (prog)	DC Power Supply	0-20 Vdc, 0-5 Amps	Bench supply for 10Vdc

Test Set Service Cable

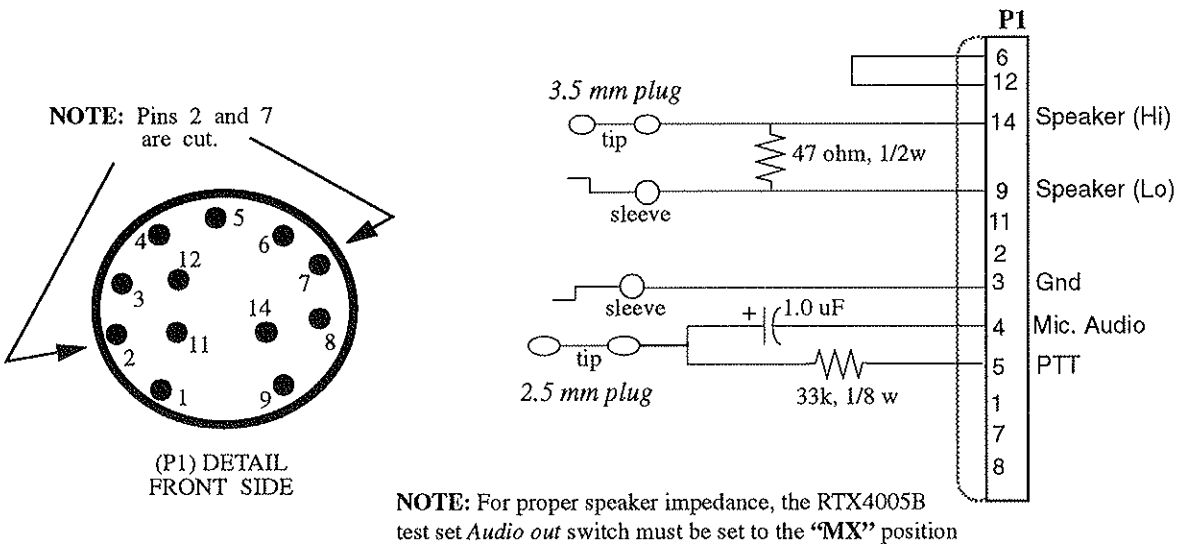


Figure 1. Service Cable (RKN4034A) for the Test Set (RTX4005B)

Radio Model Information

The model number, serial number, and Motorola FCC designation number are all on a label attached to the back of your radio. From this model number, you can determine the RF output power, frequency band, type of squelch, and number of channels. The table below outlines one portable radio model number and its specific characteristics.

All GP300 radio models are synthesized, two or four channel units that come standard with tone Private-Line (TPL) or Digital Private-Line (DPL) coded squelch, which may be enabled / disabled on a per channel basis. Programming changes can be made by your local Radius dealer.

Radio Model Number (Example: P94YPC20D2AA)

Type of Unit	Tx Power	Freq.	Model Series	Channel Spacing	Channel Capability	Frequency Sub-band	Version	Unique Model Variation
P	9 1-5 W VHF 1-4 W UHF	3 VHF	YPC Universal	00 12.5 kHz	A 2 Channels	1 Low Split	A	
		4 UHF		20 20/25 kHz	D 8 Channels	2 High Split		A
					C 16 Channels			

P = Portable

A = Package Model with Battery, Antenna, etc.

Radio Service Software Information

To run the Radio Service Software, you will need the following equipment:

Required Equipment:

1. *IBM XT, AT, Convertible, or System/2 Model 30/50*™ with 512K RAM, Dual Floppy Disk Drives or on Floppy Disk and one Hard Disk.
2. *PCDOS*™ or *MSDOS*™ 3.0 or later.
3. Radio Interface Box (RIB) **HLN9214.**
4. RIB to *IBM AT* cable **HKN9216.**
5. *IBM AT* cable to *IBM XT* computer adapter (optional) **HLN9390.**
6. Programming/Test cable.
7. RIB power supply **HSN9412** (110 VAC) or 0180358A56 (220 VAC).
8. Power Supply R1011A or equivalent.

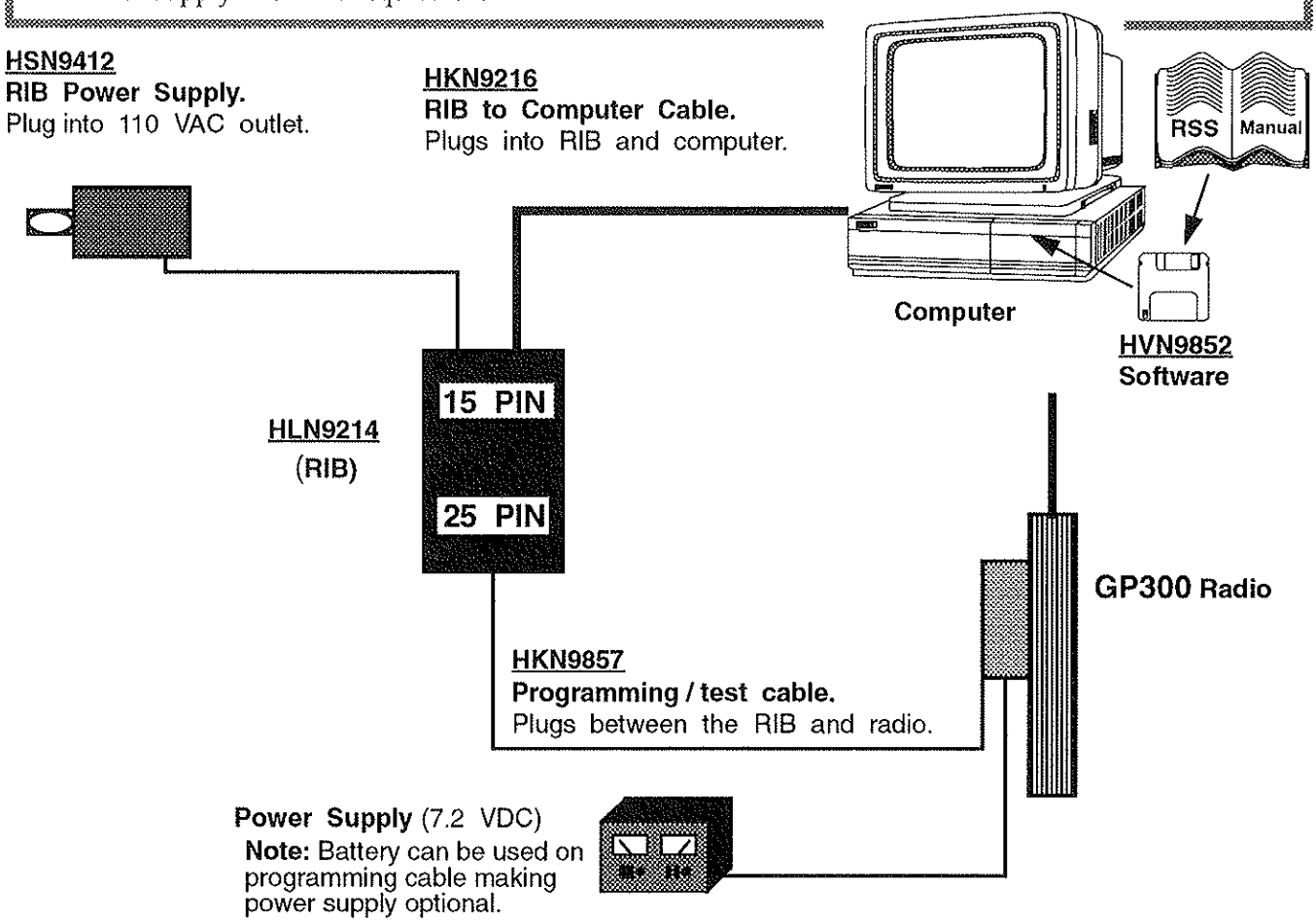


Figure 2. Equipment Setup

Configuring the RIB and Radio

1. Connect the RIB to the computer (Figure 2).
2. If your computer has an XT style communications port (25 pin connector), plug the HLN9390 adapter into the computer and plug the HKN9216 cable into the adapter. If you are unsure of which connection is on the back of your computer or the COM port, then please consult the computer manuals.
3. Plug the large 25 pin end of the HKN programming cable into the RIB. The other end of this cable has a "battery eliminator."
4. Slide the battery eliminator in place of the radio's battery.
5. Plug the HSN9412 power supply into a wall outlet, and connect the other end to the RIB.
6. Connect the radio to a power supply and turn the volume control clockwise to turn it on.

Section 1
Radio Disassembly/Assembly

Overview

This section explains, step by step, how to disassemble and reassemble the GP300 radio.

Disassemble Radio

Remove Battery

1. The battery latches are located at the bottom of the radio on each side (Figure 1-1). Press and hold both battery latches toward the front of the radio.

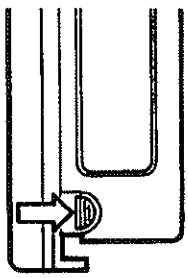


Figure 1-1. Press Battery Latches

2. Press the battery housing against the radio, while sliding it down until it is free of the chassis rails (Figure 1-2).
3. To remove the battery, pull it straight out and away from the radio.

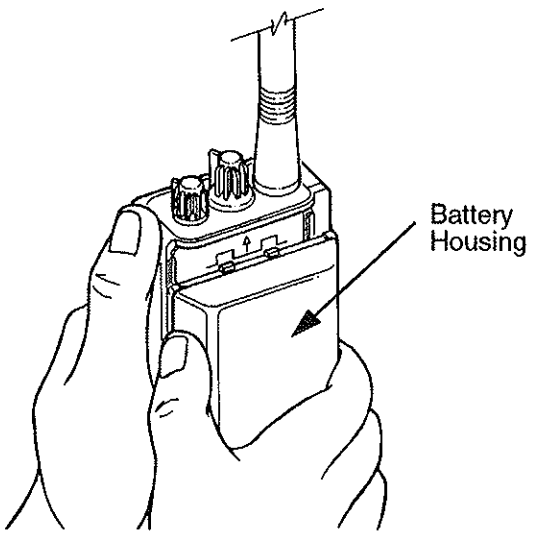


Figure 1-2. Slide Battery Housing

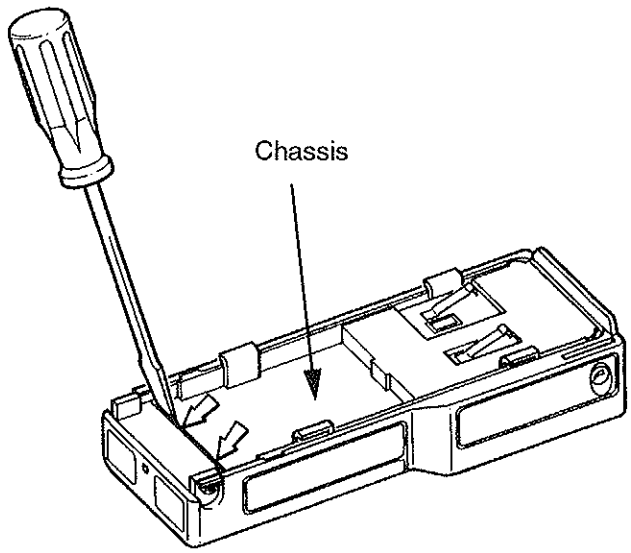


Figure 1-3. Remove Chassis

Remove Chassis

1. Pull the control knobs straight off.
2. Unscrew the antenna counter-clockwise until it is detached from the radio.
3. Carefully pry the chassis up on both sides, near the bottom, with a flat-blade screwdriver (Figure 1-3).
4. Lift the chassis approximately halfway out.

IMPORTANT
You must disconnect the ribbon cable before completely removing the chassis.

5. Remove the ribbon cable connector from the main board using pliers or a flat blade screwdriver (Figure 1-4).
6. Pull the chassis out and away from the housing as shown by the arrow (Figure 1-4).

Remove Main Board

The front shield holds the main board into the chassis. To remove the front shield:

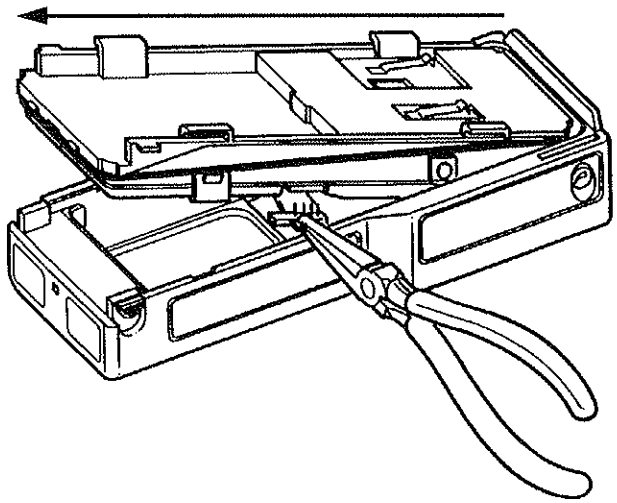


Figure 1-4. Remove Ribbon Cable Connector

1. Lay radio, shield side down, on a flat surface.
2. Apply downward pressure to chassis directly above one of the clips opposite PTT switch.
3. With a flat blade screwdriver, carefully move clip away from tab on chassis to release.

> **NOTE**
> Remove both clips opposite the PTT switch first, to ease remaining clip removal.

4. Repeat steps 2 and 3 for the remaining three clips.
5. Separate the main board from the chassis (Figure 1-5).

Reassemble Radio

1. Place chassis on a flat surface with the battery rails downward.
2. Insert main board into chassis using alignment pins as a guide (Figure 1-6).
3. Place front shield on main board using tabs as a guide (Figure 1-6).
4. Press down on front shield until chassis, main board, and front shield are seated tightly together.
5. Hook locking clips first to the chassis tab, then push clip over on shield with thumb until clip locks into front shield holes (Figure 1-7).
6. Replace chassis gasket (Figure 1-8).

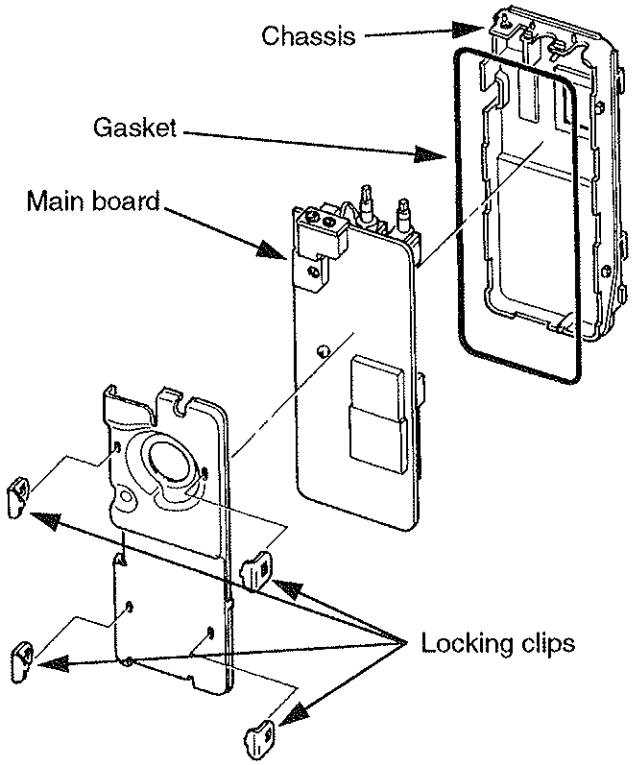


Figure 1-5. Separate Main Board From Chassis

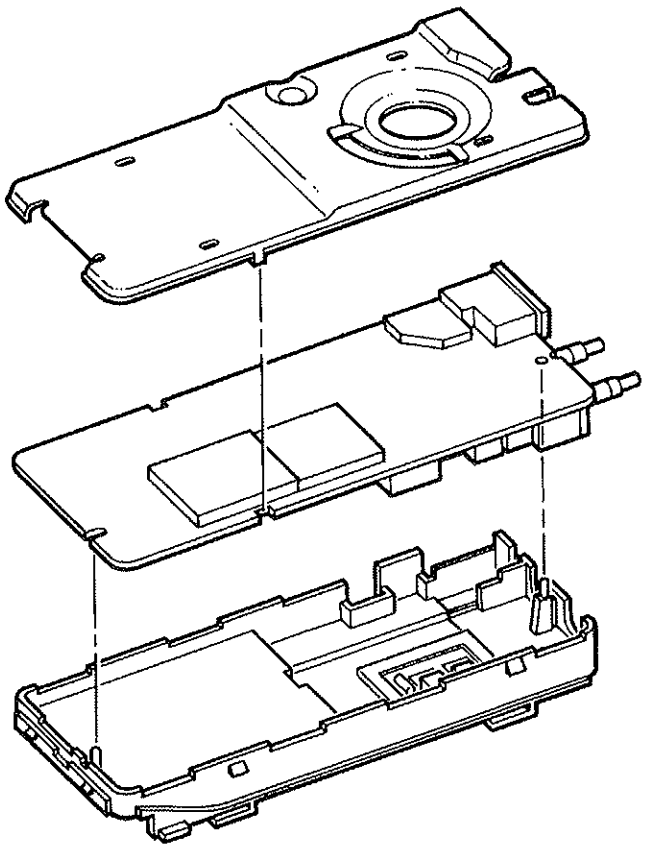


Figure 1-6. Align Pins

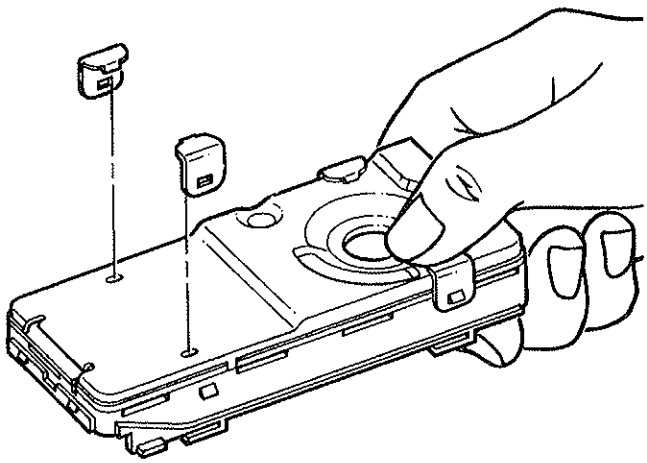


Figure 1-7. Reinsert Locking Clips

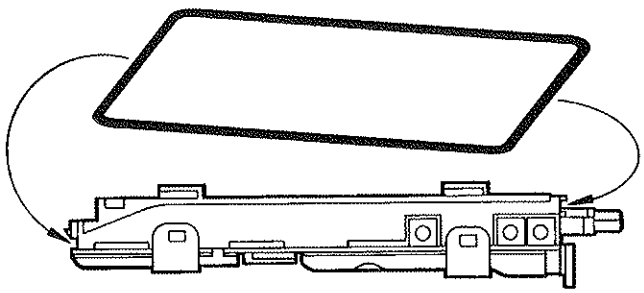


Figure 1-8. Replace Gasket

NOTE

The gasket helps keep the radio free of unwanted dirt, dust, and water. We recommend using a **new** lubricated gasket when reassembling the radio. Using an old gasket could impair the overall seal quality of the radio.

7. Insert assembled chassis, main board, and front shield into radio housing at approximately a 45-degree angle (Figure 1-9a.), using caution while inserting the volume and frequency controls through the housing top.

IMPORTANT

The main board must be inserted into chassis (Step 2) before you can secure chassis into radio housing.

8. Connect microphone/speaker ribbon cable (Figure 1-9b.).
9. While pressing chassis toward the housing top, press the bottom end down into the housing until the bottom housing wall snaps over the chassis retaining studs.

NOTE

The chassis should snap firmly into place.

10. Replace the battery, knobs, and antenna.

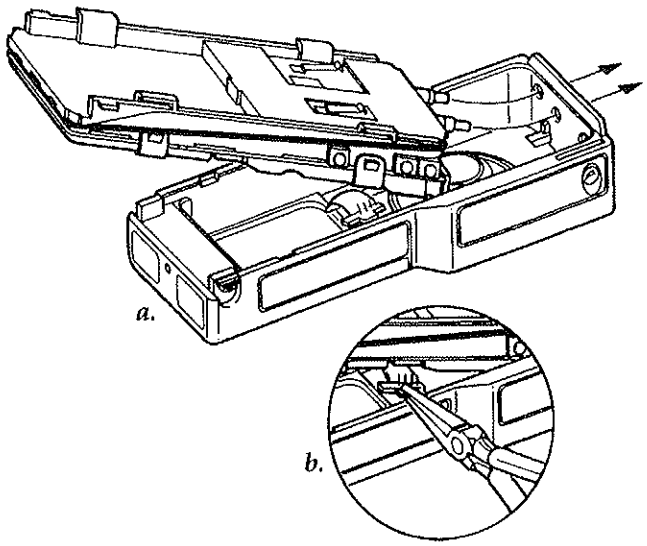


Figure 1-9. a. Insert Chassis into Housing
b. Reinsert Ribbon Cable

Section 2
Theory of Operation

Overview

This section provides a detailed theory of operation for the GP300 and its components: the microcomputer, the receiver, the transmitter, and the frequency generation circuitry.

Microcomputer

The GP300 VHF and UHF radios use the Motorola 68HC11A8 microcomputer, U401, which utilizes:

- 7.9488 MHz clock rate
- Multiplexed 8-bit address/data lines
- 16-bit addressing
- Internal watchdog circuitry
- Analog to digital conversion input ports

The microcomputer's operating program is permanently written or "masked" within the microcomputer. Included in U401 is an EEPROM memory which stores channel, signalling, and scan list information.

Microcomputer Power-Up and Reset Routine

On power-up U401's reset line (pin 19) is held low by the AFIC (U402) until the synthesizer (U201) provides a stable 2.1 MHz output. When U402 releases its control, U401's hardware holds the reset line low until it verifies that clock Y401 is operational. When the reset line goes high, U401's hardware delays briefly to allow Y401 to stabilize, then the software begins executing port assignments, RAM checking, and initialization. A fixed delay of 100 ms is added to allow the audio circuitry to settle. Next, an alert beep is generated and the steady state software begins to execute (buttons are read, radio circuits are controlled).

U401's reset line can be controlled directly by the 5V regulator (U411), the AFIC, and the microcomputer, and indirectly by the synthesizer. U411 drives the reset line low (via pin 3) if it loses regulation. This prevents possible latch-up or overwriting of registers in the microcomputer because the reset line is higher in voltage than pin 32 of U401 (VDD).

U401 can drive the reset line low if it detects a fault condition such as an expired watchdog timer, software stuck in an infinite loop, unplanned hardware inputs, static zaps, etc.

The AFIC and synthesizer can control the reset line during power-up, as outlined above.

Receiver

The receiver of the GP300 UHF and VHF radios consists of 4 major blocks each: the front-end module, the double balanced mixer, the 45.1 MHz IF and the back-end IF IC.

The UHF and VHF front-end modules consist of three blocks of circuitry each: **A pre-selector, RF amplifier and a post-selector filter.** These three items are located on a receiver module pc-board that stands perpendicular to the main radio pc-board. This module is enclosed in a shield to prevent radiation into and out of the module. All filters on the UHF and VHF modules are fixed tuned designs to eliminate the need for factory tuning and to provide wide-band operation.

The shunt and series coupled resonator topology. This topology yields a more symmetrical frequency response to guard against strong out of band signals that could produce IM products.

The worst case image frequency for this band is 90.2 MHz above the filter passband. The 3 db bandwidth is approximately 35 MHz, centered at 160 MHz. The center of the band insertion loss is approximately 1.9 db. The 4-pole filter is designed to operate with a 50 ohm input termination, while the output termination is the input impedance of the RF amplifier that follows it.

The UHF pre-selector filter is a 3-pole, .01 db Chebyshev bandpass design implemented in a shunt coupled resonator topology. This topology maximizes the attenuation at the worst case image frequency for this receiver, which is 90.2 MHz below the filter passband. The 3 db bandwidth is approximately 45 MHz, centered at 454 MHz. The center of the band insertion loss is approximately 2.2 db. The 3-pole filter is designed to operate with a 50 ohm input termination, while the output termination is the input impedance of the RF amplifier that follows it.

The RF amplifier, Q1, is a Motorola MMBR571 NPN device biased in a common emitter configuration. The amp is stabilized by the shunt feedback resistor R3, and has approximately 16.5 db of gain with a noise figure of about 3.0 db (VHF) and 2.2 db (UHF). The amplifier draws 4 ma of current and is supplied by the receiver

5 volt supply (indicated as "5R" on the schematics and block diagrams).

Terminating the RF amp is the post-selector filter. This filter is a 3-pole for VHF and a 4-pole for UHF, .01 db Chebyshev design which is also implemented in a series coupled resonator topology for maximum image attenuation. The 3 db bandwidth is approximately 38 MHz centered at 160 MHz for VHF and 42.5 MHz centered at 454 MHz for UHF.

The insertion loss of this filter is approximately 1.9 db for VHF and 3.5 db for UHF. The filter is designed to be terminated with the amplifier output impedance on one side, and 50 ohm on the other.

The net gain from the receiver module is about (12.2 db VHF) (10.8 db UHF) in the center of the band and about (10.7 db VHF) (9.5 db UHF) at the band edges. The net center of the band noise figure is approximately (5.5 db VHF) (5.2 db UHF). This is sufficient to achieve a typical center of the band sensitivity of 12 dbs.

The double balanced mixer is composed of the two baluns, T1 and T2, and the ring diode IC, CR2. The mixer operates with an LO level of +6 dbm and the conversion loss is approximately 7.5 db. The double balanced type mixer provides excellent isolation between any two ports. And since a DBM can operate over a large bandwidth, the same mixer can be used for UHF and VHF radios. The DBM also provides excellent protection against receiver spurs due to non-linearizes, such as IM and Half-IF. The received signal mixes down to the frequency of the first IF, 45.1 MHz, and enters the IF circuitry.

Intermediate Frequency (IF)

The Intermediate Frequency (IF) section of the portable radio consists of several sections including, the high IF, the second LO, the second IF, and the IF IC chip. The first LO signal and the RF signal mix to the IF frequency of 45.1 Mhz, and then enters the IF portion of the radio.

The signal first enters the high IF, passes through a crystal filter, is then amplified by the IF amp, and then passed through another crystal filter. The first crystal filter provides selectivity, second image protection, and intermodulation protection. The amplifier provides approximately 16 dB of gain to the signal. The signal then passes through the second crystal filter which provides further selectivity and second image protection. The high IF has an approximate 3 dB bandwidth of 7 KHz for 20/25/30 KHz models and 4 KHz for 12.5 KHz models.

The filtered and amplified IF signal then mixes with the second local oscillator at 44.645 MHz. The second LO uses an amplifier internal to the IF IC, an external crystal and some external chip parts. The oscillator presents an approximate level of -15 dBm to the second IF mixer, internal to the IF IC.

The output of the mixing of the IF signal and the second LO produces a signal at 455 KHz (second IF). This signal is then filtered by external ceramic filters and amplified. It is then passed back to the IF IC, sent to a phase-lock detector, and demodulated. The resulting detected audio output is then sent to the AFIC to recover the audio.

The IF IC also controls the squelch characteristics of the radio. With a few external parts the squelch tail, hysteresis, attack and delay were optimized for the radio. The AFIC allows the radio's squelch opening to be electronically adjusted.

Transmitter

The GP300 VHF and UHF transmitters contain five basic circuits: a power amplifier, an antenna switch, a harmonic filter, an antenna matching network, and a power control Refer to the block diagram and the schematic for more information.

The power amplifier consists of a module purchased from Motorola SPS. For VHF, the module (MHW607) contains three stages of amplification, while for UHF, the module (MHW707) contains four stages. Both modules require an input signal of 1 mW, a supply voltage of 7.5 Volts, and are capable of supplying, at least, 7 Watts of output. The power out of both modules can be varied by changing the voltage on their second stage

The antenna switch circuit consists of two PIN diodes (CR101 and CR102), a pi network (C119, L112, and part of C112), and at least, one current limiting resistor (R102 for UHF; and R102, R103, and R108 for VHF). In the transmit mode, TX B+ is applied to the circuit to bias the diodes "on". The shunt diode (CR102) shorts out the receiver port, and the pi network, which operates as a quarter wave transmission line, transforms the low impedance of the shunt diode to a high impedance at the input of the harmonic filter. In the receive mode, the diodes are both off, and hence, there exists a low attenuation path between the antenna and receiver ports.

The harmonic filter consists of part of C112, and L107, C113, L108, C114, L109, and C115. The design of the harmonic filter for both VHF and UHF is that of a Zolotarev design. This particular design is similar to that of a Chebyshev filter except for a large amplitude first ripple (near dc). This type of filter has the advantage that it can give greater attenuation in the stop-band for a given ripple level.

Another feature of this type of filter is that the coils tend to be smaller than with a Chebyshev design. The design of the VHF filter was modified from the Zolotarev design by slightly changing its capacitor values

to yield a filter having an input impedance which optimized the efficiency of the power module.

To optimize the performance of the transmitter and receiver into an antenna, a network is used to match the antenna's impedance to the harmonic filter. For VHF the network consists of C117, L111, and C122. For UHF the network is made up of C117 and L111. Note that, in order to measure the power out of the transmitter, one must remove the antenna and screw in its place a special BNC-to-Phono adapter.

The power control circuit consists of the networks associated with U151, Q156, Q151, Q152, Q155, and U152. The Op Amp U151A and Q156, along with resistor R101, make up a current-to-voltage amplifier whose gain is mainly dependent upon the ratio of R179 to R153. The current to the final stage of the power module is supplied through R101 (0.1 Ohms), which provides a voltage proportional to the current drain. This voltage is amplified and applied to the input of U151B. The resistors at the input of U151A (R151, R152, R154, and R155) keep the voltages at the inputs of U151A below its maximum allowable. These resistors are 1% tolerance parts to minimize the error produced at the emitter of Q156 resulting from the voltage offset at the input of U151A.

The voltage at the other input of the summing amp, U151B, is supplied from two DACs contained within U152. These DACs are controlled by the microprocessor, and provide the reference voltage for the control loop. One of the DACs, that connected to Pin 9 of U152, provides a coarse tune voltage, while the other provides a fine tune voltage. Since the output of the DACs is not zero when they are set to their lowest level, resistor R169 is provided to bias up the minus input of the summing amp to compensate for the bias resulting from the DACs.

The error voltage at the input of U151B produces a voltage at its output, which is in turn applied to the series pass transistor, Q152, through its driver, Q151. The voltage at the collector of Q152 is applied to the controlled stage of the power module, which for both VHF and UHF is the module's second stage. The feedback from the collector of Q152 to the emitter of Q151 through R166 is provided to keep the two stages stable. Likewise, the feedback from the collector of Q152 to the minus input of the summing amp is to keep the whole control loop stable.

The purpose of Q155 and its associated circuitry is to keep the control voltage on the module below 7.0 Volts, which is the maximum allowed for the UHF module.

The purpose of R173 was originally that of providing compensation to the control loop for changes in the supply voltage, TX B+. However, experimentation has shown that this compensation is not really required. Also, thermistor, R170, was provided to enable the shut back of the PA in the event that it would get too hot. This has also been shown to not be required

Frequency Generation Circuitry

The frequency generation circuitry is composed of two main IC's, the Fractional-N synthesizer (U201) and the VCO/Buffer IC (U251). Designed in conjunction to maximize compatibility, the two IC's provide many of the functions which normally would require additional circuitry. The block diagram illustrates the interconnect and support circuitry used in the design. Refer to the schematic for reference designator.

The supply for the synthesizer is from Regulated 5 Volts which also serves the rest of the radio. The synthesizer in turn generates a superfiltered 5 Volts (*actually 4.65 Volts) which powers U251.

In addition to the VCO, the synthesizer must interface with the logic and AFIC circuitry. Programming for the synthesizer is accomplished through the data, clock, and chip enable lines (pins 2, 3, and 4) from the microprocessor, U401. A serial stream of 98 bits is sent whenever the synthesizer is programmed. A 5 volt dc signal from pin 35 indicates to the microprocessor that the synthesizer is locked while unlock is indicated by a low voltage on this pin. Transmit modulation from the AFIC is applied to pin 5 of U201. Internally the audio is digitized by the Fractional-N and applied to the loop divider to provide the low-port modulation. The audio is also run through an internal attenuator for modulation balancing purposes before being outputted at pin 27 to the VCO. A 2.1 MHz clock for the AFIC is generated by the Fractional-N and is routed to pin 9 where it is filtered and attenuated from 2.5 Volts to approximately 2 Volts.

Synthesizer

The Fractional-N synthesizer uses a 16.8 MHz crystal (Y201) to provide the reference frequency for the system. The other reference oscillator components external to the IC are C205, C206, R207, and CR203. The 16.8 MHz signal is divided down signal from the VCO. The loop filter, comprised of R201, R202, R205, C201, C214, C215, and C216, provides the necessary dc steering voltage for the VCO as well as filtering of spurious signals from the phase detector. For achieving fast locking of the synthesizer, an internal adapt charge pump provides higher current capability at pin 29 than when in the normal steady-state mode. Both the normal and adapt charge pumps receive their supply from the voltage multiplier which is made up of C202, C203, C204, C231, CR201, and CR202. By combining two 5 Volt square waves which are 180 out-of-phase along with Regulated 5 Volts, a supply of approximately 12.6 Volts is available at pin 31 for the charge pumps. The current for the normal mode charge pumps is set by R203. The pre-scaler for the loop is internal to U201 with the value determined by the frequency band of operation.

VCO

The VCO (U251) in conjunction with the Fractional-N synthesizer (U201) generates rf in both the receive and the transmit modes of operation. The TRB line (U251 pin 5) determines which oscillator and buffer will be enabled. A sample of the rf signal from the enabled oscillator is routed from U251 pin 23, through a low pass filter, to the pre-scaler input (U201 pin 18). After frequency comparison in the synthesizer, a resultant CONTROL VOLTAGE is received at the VCO. This voltage is a DC voltage between 3 and 10 volts when the PLL is locked on frequency.

In the receive mode, U251 pin 5 is grounded. This activates the receive VCO by enabling the receive oscillator and the receive buffer of U251. The rf signal at U251 pin 2 is run through a low pass filter. The rf signal after the low pass filter is the LO RF INJECTION and it is applied to the first mixer at T2.

During the transmit condition, PTT depressed, five volts is applied to U251 pin 5. This activates the transmit VCO by enabling the transmit oscillator and the transmit buffer of U251. The rf signal at U251 pin 4 is run through a low pass filter and an attenuator to give the correct drive level to the input of the PA module (U101 pin 1). This rf signal is the TX RF INJECTION. Also in transmit mode, the audio signal to be frequency modulated onto the carrier is received by the transmit VCO modulation circuitry at AUDIO IN.

When a high impedance is applied to U251 pin 5, the VCO is operating in BATTERY SAVER mode. In this case, both the receive and transmit oscillators as well as the receive, transmit, and pre-scaler buffer are turned off. In the Fractional-N, the battery saver mode places the A/D and the modulation attenuator in the off state. This mode is used to reduce current drain on the radio.

GP300 receive (RX) and transmit (TX) circuits are common to both the VHF and UHF models. Most of the radio processing for RX and TX is accomplished in U402, the Audio Filter IC. The Audio Filter IC performs the following functions:

- Tone/Digital PL encoding and decoding
- PL rejection filter (RX audio)
- TX pre-emphasis amplifier
- Limiter
- Post-limiter filter
- TX deviation digital attenuators
- MIC gain attenuator
- Noise squelch digital attenuator
- Microcontroller port expanders (output only)
- 2.5 Vdc reference source

U402 parameters are programmed from U401 microcontroller ROM and EEPROM data via the serial CLOCK and DATA lines. Unless otherwise indicated, all signal levels refer to standard carrier modulation, 1kHz tone at +/-3kHz deviation.

TX Audio Path

Internal MIC Bias Switch and External PTT Sense Circuits

PNP switch transistor Q407, resistors R453, R454, and capacitor C463 control the operating bias for internal MIC MK401. Q407 is controlled by microcontroller U401 via U402-40, the Audio Filter IC expanded output port. On connecting an external MIC through connector J3, external PIT sense transistor Q408 switches "ON" when the external PTT switch is closed. Q408 collector voltage is monitored by U401-54. When collector voltage is logic "HI" state, the microcontroller configures the radio for transmit mode. In PTT equipped accessories, the PTT switch is series connected with the external MIC element.

MIC Amplifier

MIC audio from internal MIC MK401 is coupled through C429, L404, J3, and L403 to the MIC amp circuit U407B. External MIC plug insertion mechanically disconnects the internal MIC. External MIC audio is coupled through L403 to the MIC amp input. Capacitors C425, C426 and C427, and resistors R447, R448 and R450 provide a low audio frequency roll off with a high-pass corner frequency of 1kHz to improve transmit audio clarity. Crossover gain is 12 dB (at 1kHz). Reference deviation is obtained with 11.0 mV rms input to the external MIC connector J3.

TX Audio Mute Gate

PNP transistor Q409, and resistors R462 and R463 comprise the TX audio mute gate. U402-40, Audio Filter IC expanded output port, controls Q409 as well as Q407, the internal MIC bias switch. When U402-40 is logic LO state, a small dc current flows from U407B-7 MIC amp output into Q409 emitter, through Q409, and out of the collector through R462. A fraction of the emitter current flows out of the base through R463 to ground (Vss of Audio Filter IC). MIC audio at U407B-7 passes through the TX audio mute gate. When U402-40 is logic "HI", Q409 base voltage is 4Vdc (typical) and emitter voltage is 2.4 Vdc, biasing the device well into cut-off. No current flows through emitter to base/collector, and not MIC audio passes. The mute function is enabled (Q409 is "OFF") when modulating DTMF or 5/6 tone (European) Signalling.

Pre-emphasis Amp (standard models)

U402, the Audio Filter IC, contains a TX audio pre-emphasis amp, with external gain setting resistor R504,

and pre-emphasis elements R506 and C462. Connections are made at each end of resistor R506 to provide interconnection of "front cover" option board TX audio through connector P1 (below). Pre-emphasis is 6 dB/octave with a corner frequency of 6600Hz. Crossover gain is 0 dB at 1kHz, with passband gain (head-room) of 17.5 dB.

Option Interface Connector P1 (Keypad/Display models)

P1 provides interconnection of "front cover" option PC boards to the GP300 radio main board. MIC audio output is available from P1-5 at a level of 45 mVrms and 10k ohm output impedance. Option TX Audio input to the GP300 radio is available at P1-4 with sensitivity of 40 mV rms, pre-emphasized at 6 dB/octave, and less than 200 ohm output impedance (from option board). If "flat" audio response is required, the audio output from the option board must be de-emphasized at a -6 dB/octave rate, 300Hz to 3kHz, with 0 dB gain at 1kHz. The low option board output impedance is required to achieve better than 40 dB isolation between main board input (P1-4) and output (P1-5) audio.

Limiter (Audio Filter IC)

The audio filter IC U402 contains the limiter circuit, which prevents over-deviation of the RF carrier by symmetrically clipping the peaks of the modulating voltage. Audio from the pre-emphasis amplifier circuit is coupled to the limiter. Gain of the limiter stage is adjustable in four 3 dB steps, from -3 dB to +6 dB. Therefore, TX audio path gain, or MIC gain, can be adjusted to compensate for different sound environments through the Radio Service Software.

Post-Limiter Filter (Audio Filter IC)

Clipped modulating voltage from the limiter output is coupled to the post-limiter filter. Filtering attenuates the spurious products generaged by the limiter. The post-limiter filter is programmable to operate in the following modes:

- CEPT/EIA mode
- Japan mode
- FTZ (Germany) mode

PL Encoder

Private Line (CTCSS) is generated by the PL encoder circuit in U402, the Audio Filter IC. Tone PL or Digital PL data is programmed for each mode from the Radio Service Software. On entering transmit mode, TPL or DPL data is programmed to U402 via the serial DATA and CLOCK lines. U401-35 microcontroller output strobes &402-32 PL clock input at a constant rate during DPL encoding, or at a rate determined by the PL encoder algorithm in the microcontroller for TPL encoding corresponding to tone frequency. The encoded PL is summed with MIC audio at the post-limiter filter input. Digital attenuators are employed to adjust the balance of MIC radio and PL to prevent over-deviation of the carrier. PL deviation is adjustable in three "coarse" steps of 500 Hz, 750 Hz, and 1 kHz, for 25 KHz models and steps of 250 Hz, 375 Hz, and 500 Hz for 12.5KHz models with compensation of MIC audio level.

DTMF Encoder

Resistors R424, R425, R426, R428 and R484, and summer U405A form the DTMF encoder. U405A-1 is coupled to U402-13 Audio Filter IC auxiliary TX modulation input.

DTMF encoded signals pass from this input to the post-limiter filter input. U405A-1 is also coupled to U402-12 and coupled through RX audio path to the audio PA for sidetone audio.

Deviation Attenuators (Audio Filter IC)

Carrier deviation is set by programming the digital deviation attenuators of the Audio Filter IC. Deviation data for each mode is entered through the Radio Service Software, and then programmed into U402 from microcontroller U401 on entering transmit mode. U402-19 and U402-20 deviation attenuator outputs are combined through resistors R478 and R479 and dc-coupled to U201-5, the synthesizer modulation input. Capacitor C218 provides a high frequency roll-off corner at 20 kHz to further attenuate spurious signals from U402. The dc voltage at the combined attenuator outputs sets the center frequency for the modulated carrier. Any transient (R x C) voltages in the TX audio path must settle within 1 millisecond of PTT activation to prevent center frequency offset.

RX Audio Path

PL Rejection Filter (Audio Filter IC)

The recovered RX audio from the IF detector IC U51 is coupled through capacitor C435 to U402-7 and U402-8 on the Audio Filter IC. RX audio at U402-7 is processed first by the PL rejection filter, which is characterized by a two pole, 300 Hz corner frequency high-pass response. Audio then passes through the digital volume attenuator and buffer amplifier output to U402-23. Unattenuated RX audio is coupled to U402-22 and fed to the center-slicer circuit for detection of 5/6 tone (European) signals. For standard test modulation, the audio level at U402-7 is 255 mVrms, and output audio level at U402-23 is 765 mVrms with the digital volume attenuator set to minimum attenuation.

PL Decoder

Recovered RX audio at U402-8, the PL decoder input, first passes through the Tone PL filter, or the Digital PL filter, depending on the PL option selected for the current operating mode. Filtered PL is then coupled to the PL detector circuit, with detected PL output at U402-27. The detected PL signal is coupled from U402-27 to microcontroller U401-41 where algorithms perform the final PL decoding. Data for the Tone PL frequency or Digital PL code for each mode is programmed through the Radio Service Software.

Center-Slicer

The center-slicer circuit U406A detects Quick-Call and 5/6 tone signals. Unattenuated RX audio from U402-22 is dc coupled to the two inputs of U406A. The non-inverting input U406A-3 is fed through resistor R433. Capacitor C415 sets a low-pass corner frequency of 3.3 kHz. The inverting input U406A-2 is fed through resistor R434. Capacitor C416 sets a low-pass corner frequency of 16 Hz. During operation, R434 / C416 establish an averaged dc offset level at U406A-2 dependent on the average dc level of the undetected signal to set the "trigger" threshold of U406A. R433 / C415 provide high audio frequency roll-off to improve falsing immunity. The detected output from the center slicer circuit is coupled to microcontroller U401-43 where algorithms perform the final data decoding.

Option Interface Connector P1 (Keypad/Display Models)

P1 provides interconnection of "front cover" option pc boards to the GP300 radio main board. Filtered "flat" RX audio output is available at P1-7, at a level of 765 mVrms at 15k-ohm impedance. P1-7 is always unmuted, not affected by the receiver with squelch circuit. Option RX audio input to the GP300 radio is available at P1-6, with a sensitivity of 100 mVrms at less than 200 ohm output impedance from option board.

RX Audio Mute Gate

PNP transistor Q406, the RX audio mute gate, with resistors R458 and R459, and capacitors C432 and C433, provide receiver audio muting. The RX audio mute gate circuit functions in a similar manner to Q409, the TX audio mute gate circuit. Muting is controlled by microcontroller U401 via U402-39, an Audio Filter IC expanded output port. Q406 is saturated and RX audio unmuted by programming U402-39 to a logic "LO" state. Q406 is placed well into cut-off and RX audio muted by programming U402-39 to a logic "HI" state.

Audio Power Amplifer

Variable resistor R460 and resistor R461 provide RX audio volume adjustment. R461 sets the minimum volume level. Resistor R466 sets the input impedance to U409-2 of the audio power amp. Fixed level Alert Tone audio is generated by microcontroller U401-34 and coupled through capacitor C437 and resistor R465 to U409-2. The audio PA circuit is a bridged-tied-load (BTL) configuration with fixed gain of 40 dB, developing 500 mW (rated audio power) output at less than 5% harmonic distortion into the 16 ohm internal speaker LS401 with nominal 7.5 Vdc battery supply. Maximum audio power output is greater than 1.2 watts.

Audio PA Muting and Output Protection

PNP transistor Q410, the audio PA power switch, driven by NPN darlington transistor Q411, the PA mute amp, controls Vcc supply to Audio PA U409-1. U402-3, and Audio Filter IC expanded output port, is connected to Q411 base, controlling audio PA Vcc supply. Resistors R489 and R490, PNP transistor Q412, and the current sense circuit monitor current supplied to audio PA U409-1. Worst case audio PA current (at 9 Vdc battery voltage, maximum volume and full system deviation) does not exceed 450 mA at the nominal 16-ohm load. Resistor R488 and capacitor C461 provide an RC time delay for U405B, a monostable multivibrator circuit. A 2.5Vdc reference voltage is fed to U405B-6. On radio power-up, and in normal operation U405B-7 monostable multivibrator output is logic "LO" pulling Q411 emitter to Vee with the audio PA controlled by U402-3. Should U409-5 and/or U409-8 become shorted to each other or to ground (Vee), current consumption exceeds 500mA (approximately) and Q412 is forward biased. Switched battery supply voltage appears at Q412 collector. When U405B-5 voltage rises higher than the U405B-6 reference voltage (rise time is less than 50 usec), U405B is triggered and U405B-7 dc output voltage switches to 4 Vdc, effectively biasing Q411 into cut-off and turning off the audio PA power switch Q410. U405B-7 remains in this state for 15 msec, then resets to logic "LO" state. Average power dissipation in the audio PA circuit components is held to a low level by the low duty cycle (less than 0.3%) of the audio PA protection circuit. the cycle repeats until the audio PA output short is removed.

Noise Squelch Attenuator

The Audio Filter IC U402 contains a 16 step programmable digital squelch attenuator between U402-16 and U402-18. Noise squelch is set using the Radio Service Software, with open squelch at step 0, and tight squelch at step 15.

Section 3
Accessory

Overview

The remote speaker microphone is an accessory available with the GP300 portable radio. This section provides a general description of the remote speaker microphone and describes the operation, handling precautions, and maintenance of this accessory.

Description

The Model HMN9725B Remote Speaker Microphone includes a speaker, a microphone, a push-to-talk (PTT) switch and associated circuitry. A cable, terminated with a special plug, is provided for attaching to the accessory connector on the portable radio.

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

IMPORTANT
Observe safety information in the radio operating instructions.

Operation

1. Attach the microphone's accessory connector to the accessory connector on top of the radio.
2. While listening to the accessory speaker, turn the radio on.
3. Operate radio according to operating instructions supplied with the radio.

NOTE
The microphone will perform best if it is worn as shown in Figure 3-1.

Handling Precautions

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

- Prior to and while servicing a remote speaker microphone, particularly after moving within the service area, momentarily place both hands on a bare metal, earth-grounded surface. This will discharge any static charge which may have accumulated on the person doing the service.
- Whenever possible, avoid touching any electrically conductive part of the unit with your hands.

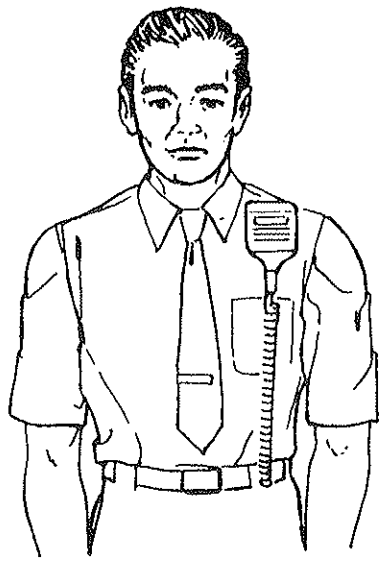


Figure 3-1. Ideal Microphone Position

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

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

- When servicing a unit, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.
- All electrically powered test equipment should be grounded. Apply the ground lead from the

test equipment to the unit before connecting the test probe. Similarly, disconnect the test probe prior to removing the ground lead.

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

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

- When soldering, be sure the soldering iron is grounded
- Prior to replacing circuit components or touching the microphone cartridge, be sure to discharge any static buildup. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch the microphone cartridge and associated wiring.
- Replacement microphone cartridges should be kept in conductive packaging until they are placed in unit.

Maintenance

Refer to the schematic diagram (shown in Figure 3-2), the exploded view (shown in Figure 3-3, on page 3-3), and the parts lists. Every part in the microphone is identified and illustrated for assistance in removal and replacement.

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

Parts List

HMN9725B Electrical Parts List PL-931023-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF +/-10%; 100 V: unless otherwise stated
C1	2113740A53	Chip, 82 pF, +/- 5%, 50V
C2	2113740A67	Chip, 330 pF, +/- 5%, 50 V
C3	2113741A53	Chip, .022 uF, +/- 5%, 50V
C4	2113741B69	Chip, .1 uF, +/- 5%, 50V
L1	2462575A02	Chip Inductor, 680nH, +/- 10%
		coil, rf:
L2	2462575A02	Chip, 680nH, +/- 10%
L3	2462575A02	Chip, 680nH, +/- 10%
L4	2462575A02	Chip, 680nH, +/- 10%
		switch:
S1	3905834K06	Dome, PTT
		miscellaneous:
MK1	0180703Y69	Microphone assembly
LS1	5005910P05	Speaker

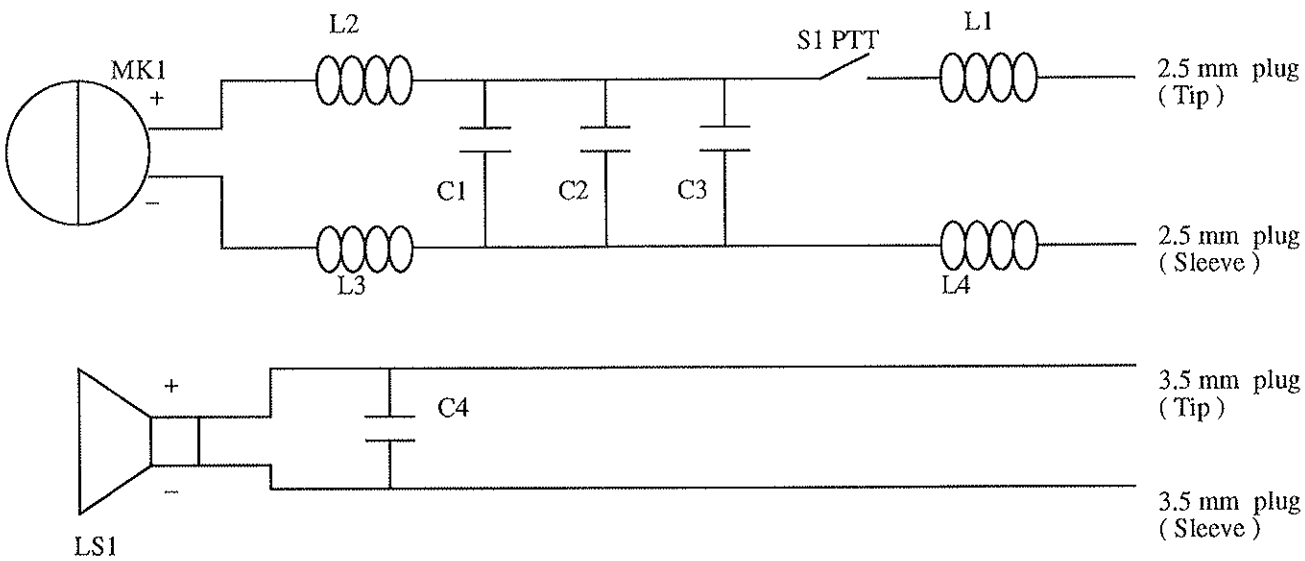


Figure 3-2. Schematic Diagram

Parts List

HMN9725B Remote Speaker Microphone PL-931024-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1	0105953N42	Front housing, items 1 thru 5
2	3305259Q01	Nameplate, Motorola
3	4505182Q01	Lever, PTT
4	3505152J01	Grille, cloth
5	1105461R01	Adhesive
6	0180703Y70	Coil cord & connector
7	0180703Y67	PCB: includes electrical parts
8	3905834K06	Switch: dome. PTT (S1)
9	3205231Q01	Seal, dome
10	1405219Q01	Boot, microphone
11	0180703Y69	Microphone assembly
12	5005910P05	Speaker (LS1)
13	7505283Q02	Pad, speaker
14	3205690R01	Gasket
15	6405689R01	Plate, housing mounting
16	0300139982	Screw, Phillips; 2-56 x 5/32"
17	1505172Q01	Housing, back
18	0484345A06	Washer, 3 used
19	0305137Q02	Screw, Phillips, 3 used
20	0105959N54	Belt clip assembly
21	0300139982	Screw, Phillips, 4 used

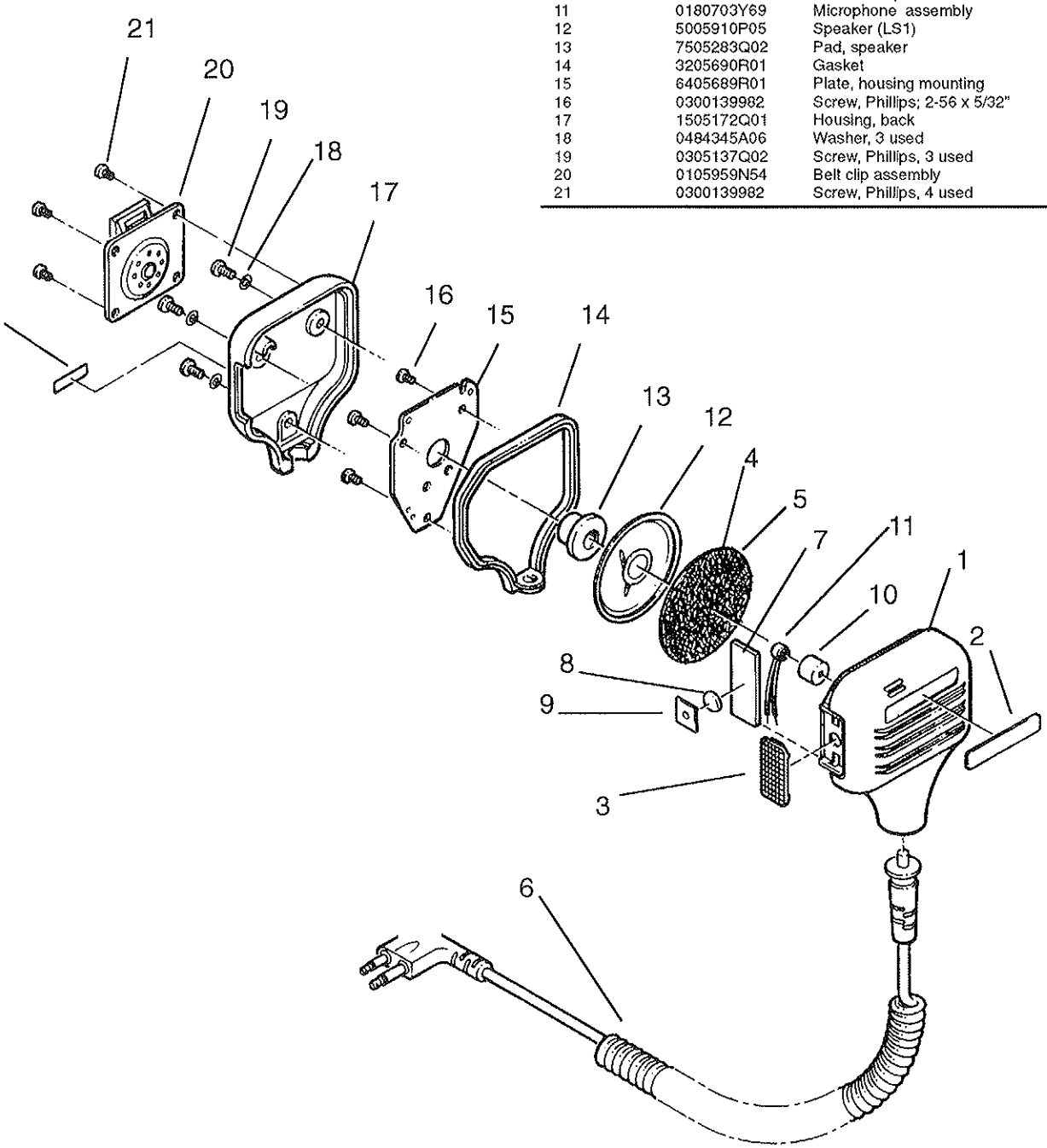


Figure 3-3. Exploded View

Section 4
Troubleshooting

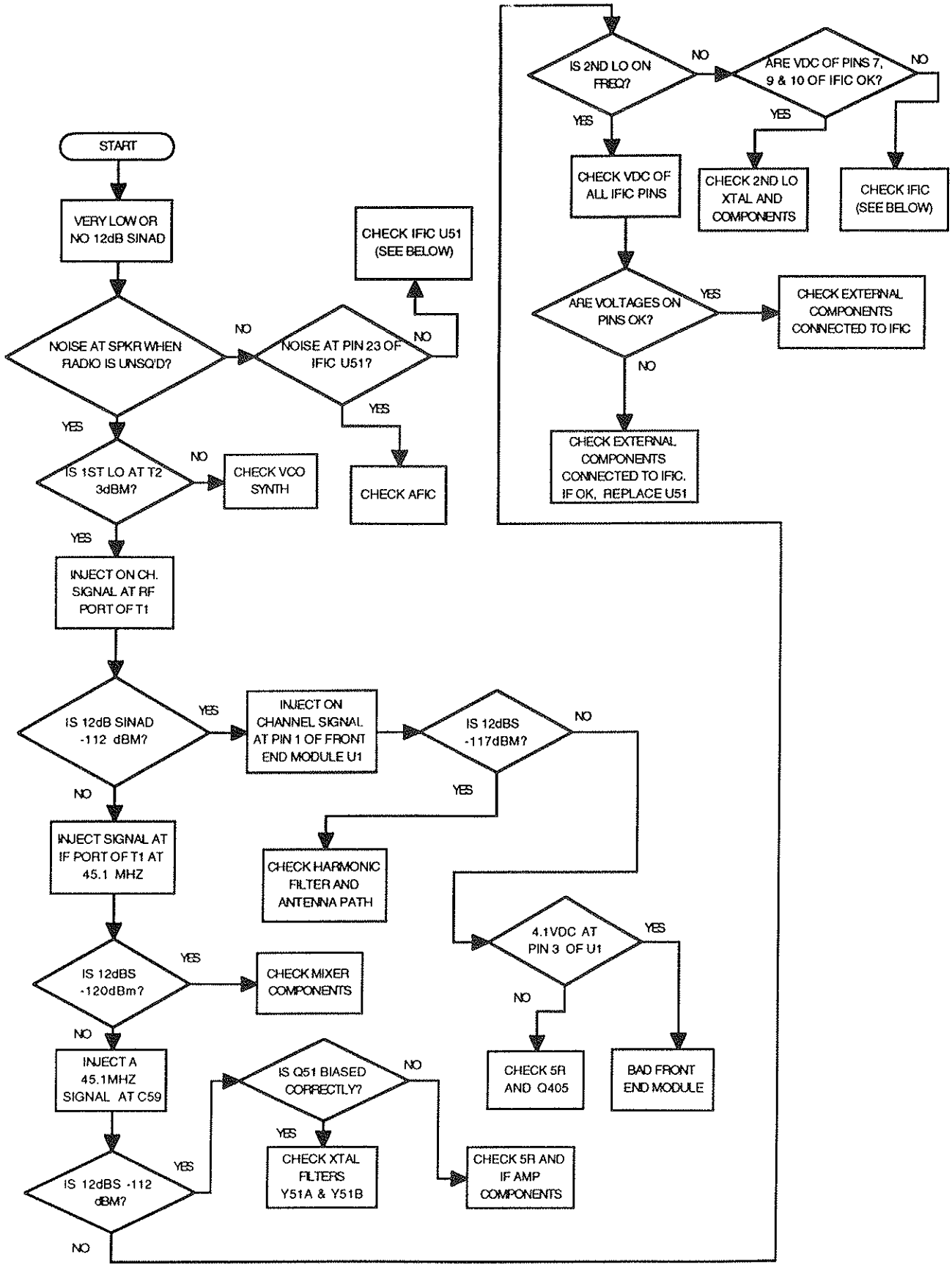
Overview

This section contains three troubleshooting tables for the following GP300 components:

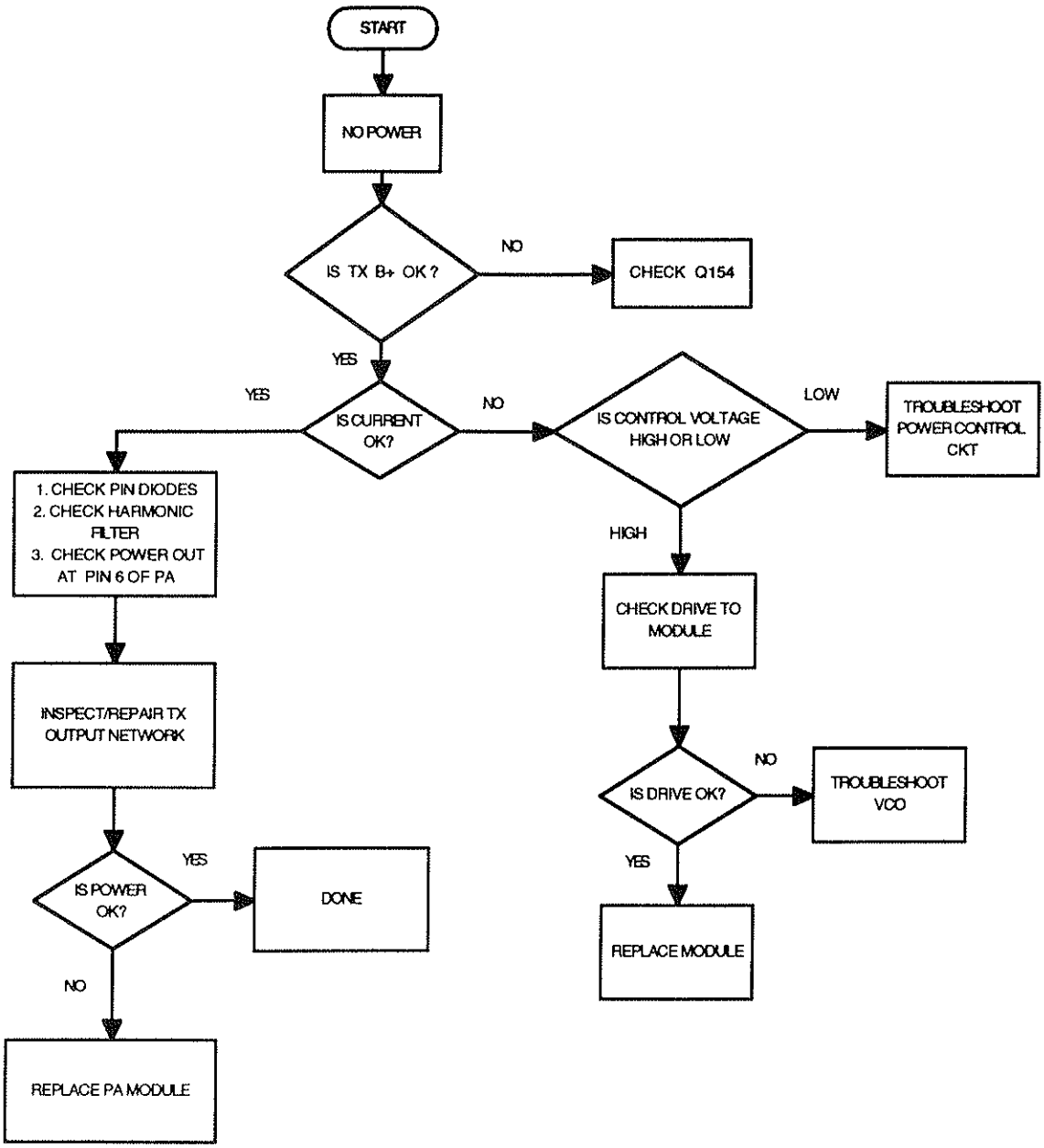
- Receiver
- Transmitter
- Synthesizer
- Microprocessor
- Voltage Controlled Oscillator (VCO)

Troubleshooting Charts

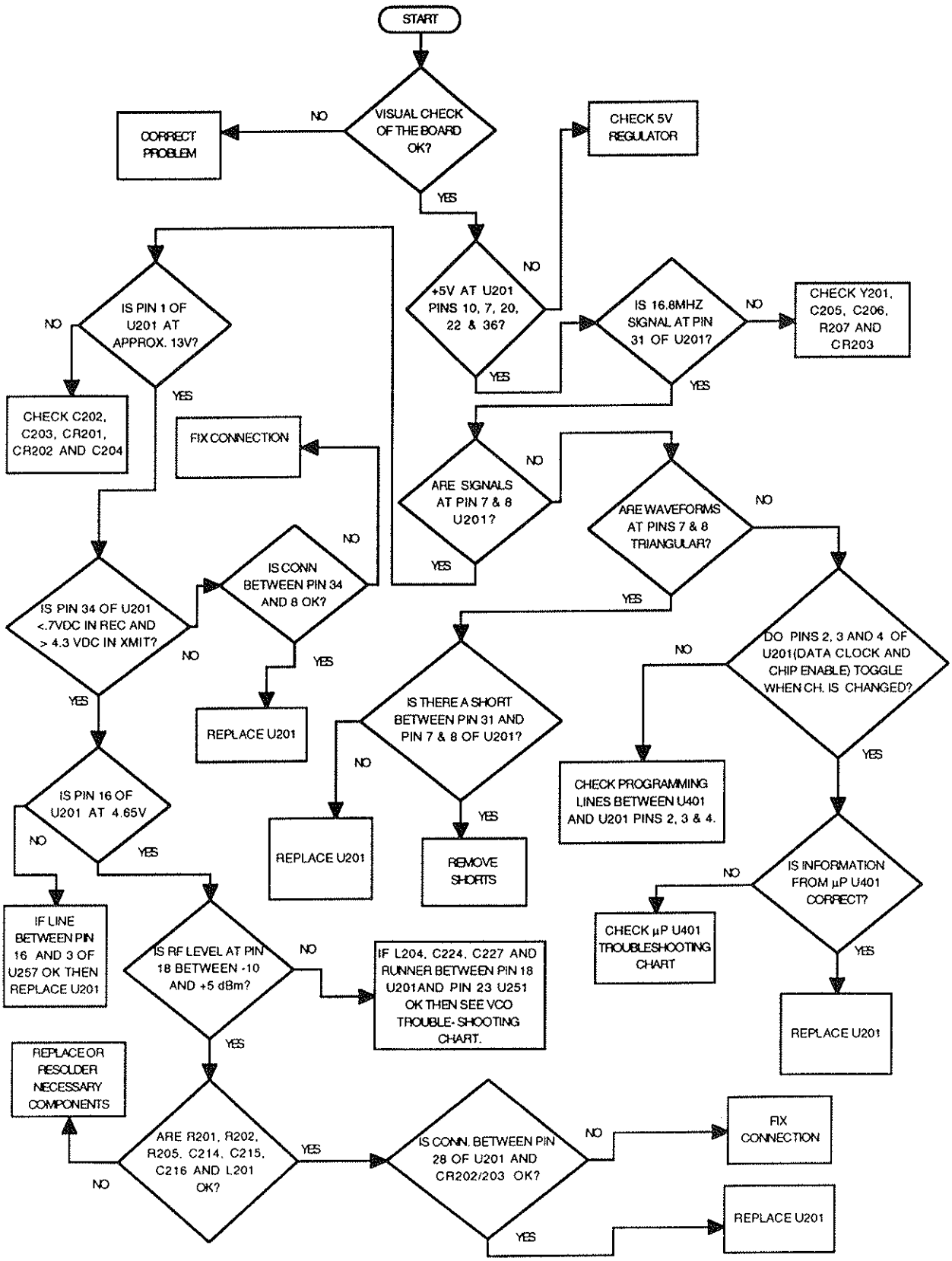
Refer to following pages.



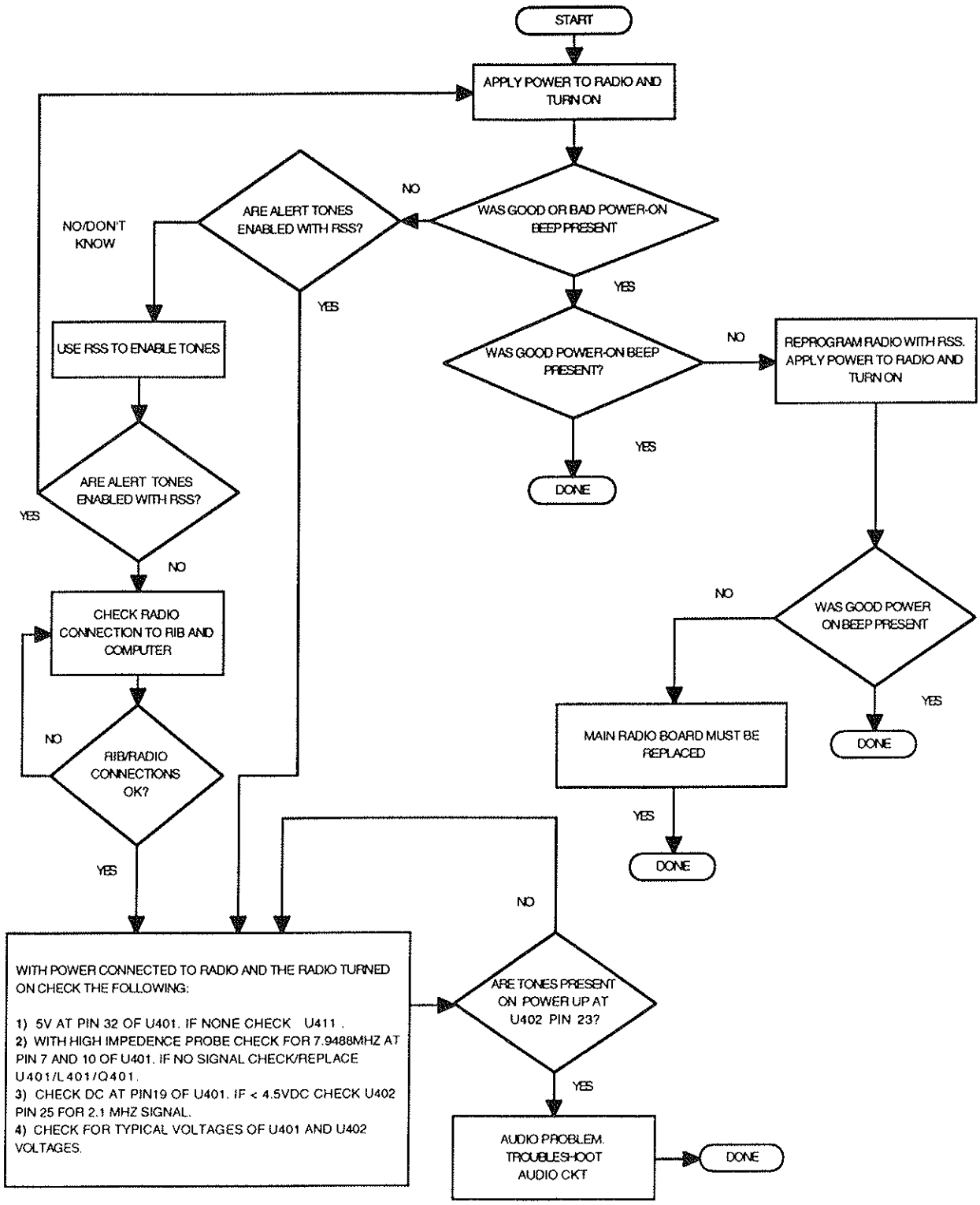
Troubleshooting Flow Chart for Receiver



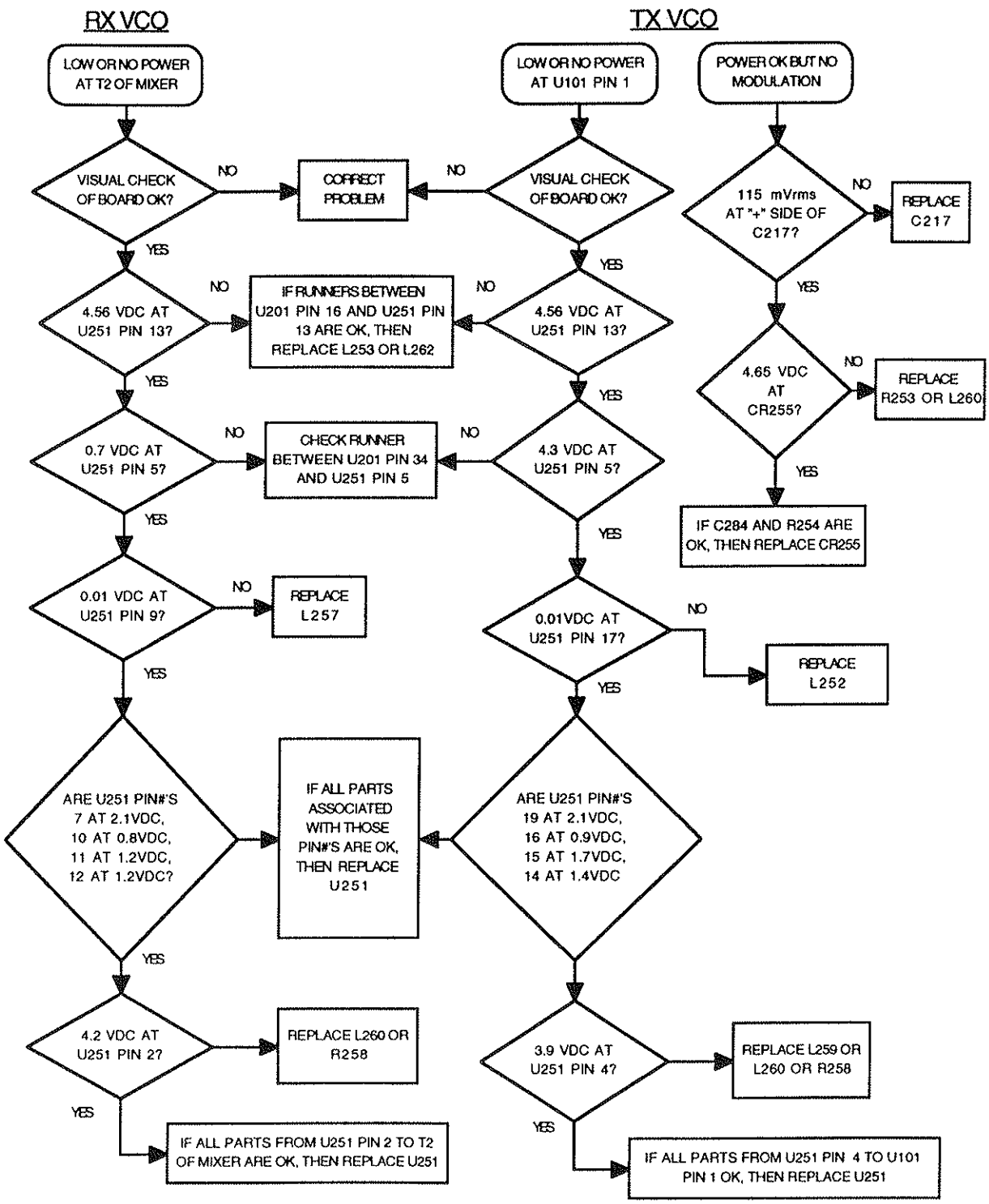
Troubleshooting Flow Chart for Transmitter



Troubleshooting Flow Chart for Synthesizer



Troubleshooting Flow Chart for Microprocessor



Troubleshooting Flow Chart for VCO