



HT 1000,<sup>TM</sup> MT 2000,<sup>TM</sup> MTS 2000,<sup>TM</sup>  
and MTX Series  
Handie-Talkie<sup>®</sup> Portable Radios  
Service Section



HT 1000,<sup>TM</sup> MT 2000,<sup>TM</sup> MTS 2000,<sup>TM</sup>  
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## CONTENTS

TITLE	PAGE
LIST OF TABLES.....	iii
LIST OF ILLUSTRATIONS.....	iii
RELATED PUBLICATIONS AVAILABLE SEPARATELY.....	iii
MODEL NUMBERING SYSTEM.....	iv
LIST OF MODELS.....	v
LIST OF ANTENNAS AND BATTERIES.....	vi
MAINTENANCE SPECIFICATIONS FOR VHF RADIOS.....	vii
MAINTENANCE SPECIFICATIONS FOR UHF RADIOS.....	vii
MAINTENANCE SPECIFICATIONS FOR 800MHz RADIOS.....	viii
MAINTENANCE SPECIFICATIONS FOR 900MHz RADIOS.....	viii
SECTION I. INTRODUCTION.....	1
SECTION II. RECOMMENDED AND REQUIRED TEST EQUIPMENT, SERVICE AIDS, AND TOOLS LISTS.....	2
A. Recommended Test Equipment.....	2
B. Service Aids and Recommended Tools.....	2
C. Field Programming.....	2
SECTION III. TRANSCEIVER PERFORMANCE TESTING.....	5
A. General.....	5
B. Setup.....	5
C. Test Mode.....	5
SECTION IV. ERROR CODE DISPLAYS.....	10
A. Power-up Display Codes.....	10
B. Operational Display Codes.....	10
SECTION V. RADIO ALIGNMENT PROCEDURE.....	11
A. General.....	11
B. Reference Oscillator Alignment.....	13
C. Front-End Pre-Selector (VHF/UHF only).....	13
D. Rated Audio.....	13
E. Squelch.....	13
F. Transmitter Power.....	14
G. Transmit Deviation Balance (Compensation).....	14
H. Transmit Deviation Limit.....	14
I. Transmit Deviation Limit Reference.....	15
J. VCO Crossover Frequency.....	15
K. Signalling Deviation.....	15
SECTION VI. DISASSEMBLY AND REASSEMBLY.....	17
A. General.....	17
B. Disassembly to Board Level.....	17
C. Disassembly of Control Top.....	19
D. Disassembly of Front Cover Assembly.....	20
E. Reassembly.....	21
SECTION VII. MAINTENANCE.....	23
A. Introduction.....	23
B. Preventive Maintenance.....	23
C. Safe Handling of CMOS Devices.....	23
D. Repair Procedures and Techniques.....	23

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# CONTENTS (cont.)

TITLE	PAGE
NUD7070A, NUD7070B, NUD7085A, AND NUD7085B VHF TRANSCEIVER BOARDS' COMPONENT LOCATION DIAGRAMS AND SCHEMATIC DIAGRAM .....	29
NUD7070A, NUD7070B, NUD7085A, AND NUD7085B VHF TRANSCEIVER BOARDS' PARTS LIST, AND NUE7213A, NUE7213B, NUE7231B, NUE7240A, AND NUE7240A UHF (403-470MHz) TRANSCEIVER BOARDS' COMPONENT LOCATION DIAGRAMS .....	30
NUE7213A, NUE7213B, NUE7231A, NUE7231B, NUE7240A, AND NUE7240B UHF (403-470MHz) TRANSCEIVER BOARDS' SCHEMATIC DIAGRAM .....	31
NUE7213A, NUE7213B, NUE7231A, NUE7231B, NUE7240A, AND NUE7240B UHF (403-470MHz) TRANSCEIVER BOARDS' PARTS LIST, AND NUE7214A, NUE7214B, NUE7232A, NUE7232B, NUE7241A, AND NUE7241B UHF (450-520MHz) TRANSCEIVER BOARD COMPONENT LOCATION DIAGRAMS .....	32
NUE7214A, NUE7214B, NUE7232A, NUE7232B, NUE7241A, AND NUE7241B UHF (450-520MHz) TRANSCEIVER BOARDS' SCHEMATIC DIAGRAM .....	33
NUE7214A, NUE7214B, NUE7232A, NUE7232B, NUE7241A, AND NUE7241B UHF (450-520MHz) TRANSCEIVER BOARDS' PARTS LIST, AND NUF6394A, NUF6394B, NUF6410B, NUF6423A, AND NUF6423B, 800MHz TRANSCEIVER BOARDS' COMPONENT LOCATION DIAGRAMS .....	34
NUF6394A, NUF6394B, NUF6410A, NUF6410B, NUF6423A, AND NUF6423B 800MHz TRANSCEIVER BOARDS' SCHEMATIC DIAGRAM .....	35
NUF6394A, NUF6394B, NUF6410A, NUF6410B, NUF6423A, AND NUF6423B 800MHz TRANSCEIVER BOARDS' PARTS LIST, AND NUF6395B, NUF6395C, NUF6424A, AND NUF6424B 900MHz TRANSCEIVER BOARDS' COMPONENT LOCATION DIAGRAMS .....	36
NUF6395B, NUF6395C, NUF6424A, AND NUF6424B 900MHz TRANSCEIVER BOARDS' SCHEMATIC DIAGRAM .....	37
NUF6395B, NUF6395C, NUF6424A, AND NUF6424B 900MHz TRANSCEIVER BOARDS' PARTS LIST, AND NTN7089A/NTN7092A CONTROLLER BOARDS' (JT 1000/HT 1000 MODELS ONLY) COMPONENT LOCATION DIAGRAMS .....	38
NTN7089A/NTN7092A CONTROLLER BOARDS' (JT 1000/HT 1000 MODELS ONLY) SCHEMATIC DIAGRAM .....	39
NTN7089A/NTN7092A CONTROLLER BOARDS' (JT 1000/HT 1000 MODELS ONLY) PARTS LIST, MISCELLANEOUS PARTS LIST, FRONT COVER/DISPLAY FLEX, CONTROLS FLEX, JUMPER FLEX, AND NTN7091A/NTN7093A CONTROLLER BOARDS' COMPONENT LOCATION DIAGRAMS .....	40
NTN7091A/NTN7093A CONTROLLER BOARDS' SCHEMATIC DIAGRAM .....	41
NTN7091A/NTN7093A CONTROLLER BOARDS' PARTS LIST, SHIELDS LOCATION DETAIL AND PARTS LIST, UNIVERSAL (ACCESSORY) CONNECTOR PIN NUMBERS AND SIGNAL ASSIGNMENTS, AND NTN7620B CONTROLLER BOARD COMPONENT LOCATION DIAGRAMS .....	42
NTN7620B CONTROLLER BOARD SCHEMATIC DIAGRAM .....	43
NTN7620B CONTROLLER BOARD PARTS LIST, AND NTN7512A, NTN7513A, NTN7857A, AND NTN7858A CONTROLLER BOARDS' COMPONENT LOCATION DIAGRAMS .....	44
NTN7512A, NTN7513A, NTN7857A, AND NTN7858A CONTROLLER BOARDS' SCHEMATIC DIAGRAM .....	45
NTN7512A, NTN7513A, NTN7857A, AND NTN7858A CONTROLLER BOARDS' PARTS LIST, BASIC RADIO EXPLODED VIEW DIAGRAM, TOP-DISPLAY EXPLODED VIEW DIAGRAM, AND PARTS LIST .....	46
KEYPAD RADIO EXPLODED VIEW DIAGRAM AND PARTS LIST .....	47
INTEGRATED CIRCUITS WITH PIN-OUT NAMES .....	48
APPENDIX .....	51
REPLACEMENT PARTS ORDERING .....	<i>inside back cover</i>

## LIST OF TABLES

TABLE	TITLE	PAGE
40-1	Recommended Test Equipment .....	2
40-2	Service Aids .....	3
40-3	Recommended Service Tools .....	4
40-4	Initial Equipment Control Settings .....	5
40-5	Test Environments, HT 1000 Radios .....	5
40-6	Test Frequencies, HT 1000 Radios .....	6
40-7	Test Environments, MT 2000, MTS 2000, and MTX Series Radios .....	7
40-8	Test Frequencies, MT 2000, MTS 2000, and MTX Series Radios .....	7
40-9	Receiver Performance Checks .....	8
40-10	Transmitter Performance Checks .....	9
40-11	Power-up Display Codes .....	10
40-12	Operational Display Codes .....	10
40-13	Reference Oscillator Alignment .....	13
40-14	Standard Test Modulation (1kHz Tone) .....	13
40-15	Transmit Power Setting.....	14
40-16	Transmit Deviation Limit .....	15
40-17	Transmit Deviation Limit Reference .....	15
40-18	Signalling Deviation .....	16

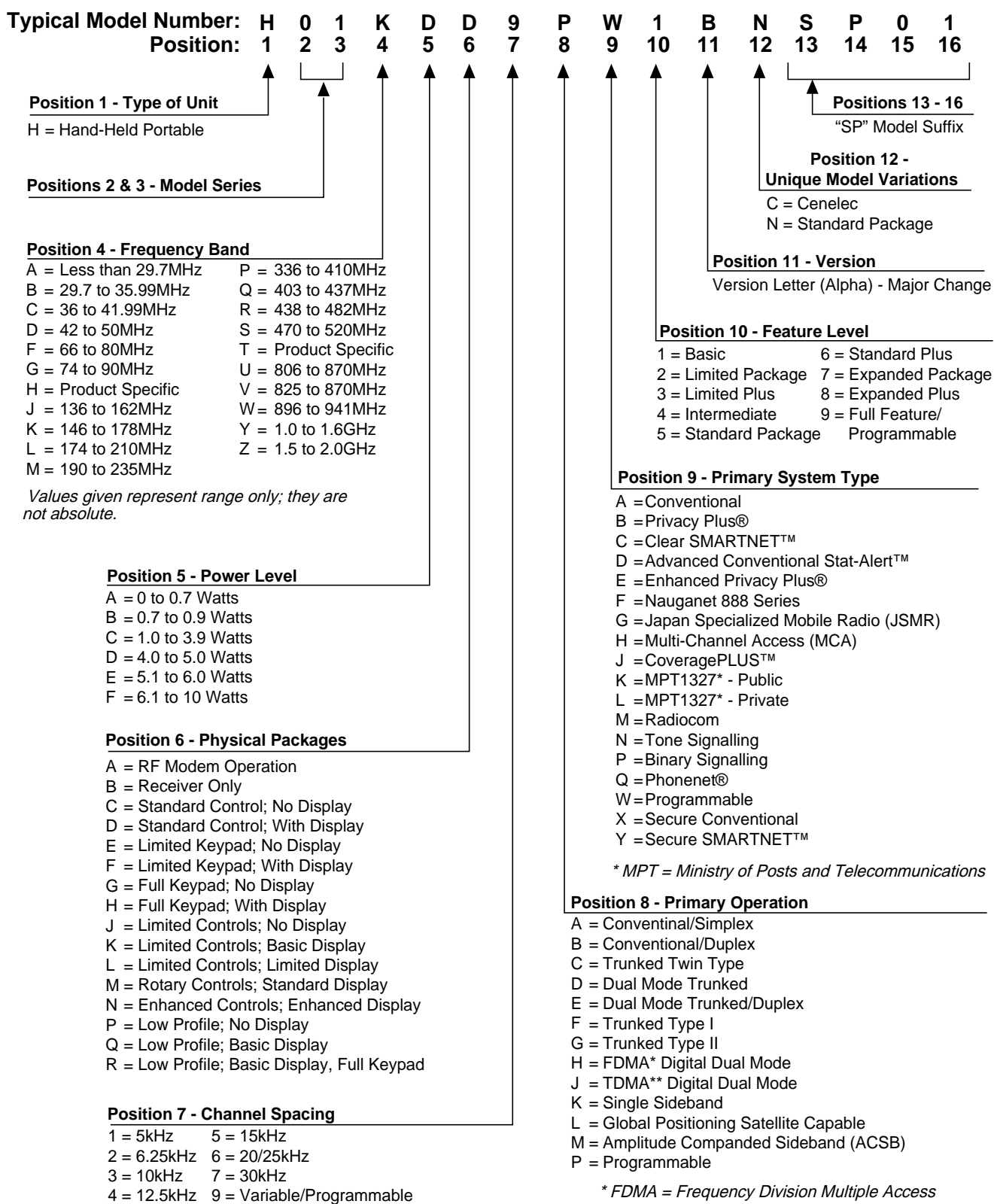
## LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
40-1	Radio Alignment Test Set-Up .....	11
40-2	RSS Service Menu Layout.....	12
40-3	Softpot Concept .....	12
40-4 thru 40-17	Disassembly And Reassembly .....	17-27

## RELATED PUBLICATIONS AVAILABLE SEPARATELY

Service Manual (early version radios; first issue- 4/92) .....	68P81200C20
Service Manual (later version radios; first issue- 4/93).....	68P81200C25
Service Manual (this publication; present version radios; first issue- 7/94) .....	68P81200C40
includes:	
• all servicing information	
• assembly / disassembly	
• maintenance	
Theory Manual.....	68P81200C15
includes:	
• theory of operation	
• troubleshooting information and troubleshooting charts	
Secure Modules Instruction Manual .....	68P81200C35
Operating Instructions	
• HT 1000 A Model Portable Radios.....	68P81071C70
• HT 1000 B Model Portable Radios.....	68P81079C50
• MT 2000 Portable Radios.....	68P81076C65
• MTS 2000 I Portable Radios .....	68P81072C15
• MTS 2000 II and III Portable Radios .....	68P81072C45
• MTX Series Model B3 Privacy Plus Portable Radios .....	68P81072C10
• MTX Series Model B4 Privacy Plus Portable Radios .....	68P81073C60
• MTX Series Model B5 and B7 Privacy Plus Portable Radios.....	68P81072C40
Mobile Vehicular Adapter (MTVA) Operating Instructions .....	68P81075C85
Mobile Vehicular Adapter (MTVA) Installation Instructions.....	68P81075C90
Mobile Vehicular Adapter (MTVA) Service Manual .....	68P81075C95
Remote Speaker Microphones NMN6191A / N MN6193A Operating Instructions.....	68P81073C40
Remote Speaker Microphones NMN6191A / N MN6193A Service Manual .....	68P81200C30
Public Safety Speaker Microphone NMN6228A Operating Instructions.....	68P81079C15
Public Safety Speaker Microphone NMN6228A Service Manual .....	68P81009C41

# MODEL NUMBERING SYSTEM



# LIST OF MODELS

## CONVENTIONAL SYSTEMS RADIOS

### HT 1000 Model Family

H01KDC9AA1BN 2-Freq., 5- to 1-Watt, 136 - 178 MHz  
 H01KDC9AA3BN 16-Freq., 5- to 1-Watt, 136 - 178 MHz

H01RDC9AA1BN 2-Freq., 4- to 1-Watt, 403 - 470 MHz  
 H01RDC9AA3BN 16-Freq., 4- to 1-Watt, 403 - 470 MHz

H01SDC9AA1BN 2-Freq., 4- to 1-Watt, 450 - 520 MHz  
 H01SDC9AA3BN 16-Freq., 4- to 1-Watt, 450 - 520 MHz

H01UCC6AA1BN 2-Freq., 3-Watt, 806 - 870 MHz  
 H01UCC6AA3BN 16-Freq., 3-Watt, 806 - 870 MHz

### MT 2000 Model Family

H01KDD9AA4AN 16-Freq., 6-Character Top Display, 5- to 1-Watt, 136 - 178 MHz  
 H01KDH9AA7AN 10-Zone, 16-Channel, 14-Character Front Display, Full Keypad, 5- to 1-Watt, 136 - 178 MHz

H01RDD9AA4AN 16-Freq., 6-Character Top Display, 4- to 1-Watt, 403 - 470 MHz  
 H01RDH9AA7AN 10-Zone, 16-Channel, 14-Character Front Display, Full Keypad, 4- to 1-Watt, 403 - 470 MHz

H01SDD9AA4AN 16-Freq., 6-Character Top Display, 4- to 1-Watt, 450 - 520 MHz  
 H01SDH9AA7AN 10-Zone, 16-Channel, 14-Character Front Display, Full Keypad, 4- to 1-Watt, 450 - 520 MHz

H01UCD6AA4AN 16-Freq., 6-Character Top Display, 3-Watt, 806 - 870 MHz  
 H01UCH6AA7AN 10-Zone, 16-Channel, 14-Character Front Display, Full Keypad, 3 -Watt, 806 - 870 MHz

H01WCD4AA4AN 16-Freq., 6-Character Top Display, 2.9 Watt, 896 - 941 MHz  
 H01WCH4AA7AN 10-Zone, 16-Channel, 14-Character Front Display, Full Keypad, 2.9 Watt, 896 - 941 MHz

## PRIVATE SYSTEMS RADIOS

### MTS 2000 Model Family

H01KDD9PW1BN 16-Mode, 6-Character Top Display, 5- to 1-Watt, 136 - 178 MHz  
 H01KDF9PW1BN 16-Mode, 14-Character Front Display, Limited Keypad, 5- to 1-Watt, 136 - 178 MHz  
 H01KDH9PW1BN 16-Mode, 14-Character Front Display, Full Keypad, 5- to 1-Watt, 136 - 178 MHz

H01RDD9PW1BN 16-Mode, 6-Character Top Display, 4- to 1-Watt, 403 - 470 MHz  
 H01RDF9PW1BN 16-Mode, 14-Character Front Display, Limited Keypad, 4- to 1-Watt, 403 - 470 MHz  
 H01RDH9PW1BN 16-Mode, 14-Character Front Display, Full Keypad, 4- to 1-Watt, 403 - 470 MHz

H01SDD9PW1BN 16-Mode, 6-Character Top Display, 4- to 1-Watt, 450 - 520 MHz  
 H01SDF9PW1BN 16-Mode, 14-Character Front Display, Limited Keypad, 4- to 1-Watt, 450 - 520 MHz  
 H01SDH9PW1BN 16-Mode, 14-Character Front Display, Full Keypad, 4- to 1-Watt, 450 - 520 MHz

H01UCD6PW1BN 16-Mode, 6-Character Top Display, 3-Watt, 806 - 870 MHz  
 H01UCF6PW1BN 16-Mode, 14-Character Front Display, Limited Keypad, 3-Watt, 806 - 870 MHz  
 H01UCH6PW1BN 16-Mode, 14-Character Front Display, Full Keypad, 3-Watt, 806 - 870 MHz

H01WCD4PW1BN 16-Mode, 6-Character Top Display, 2.9 Watt, 896 - 941 MHz  
 H01WCF4PW1BN 16-Mode, 14-Character Front Display, Limited Keypad, 2.9 Watt, 896 - 941 MHz  
 H01WCH4PW1BN 16-Mode, 14-Character Front Display, Full Keypad, 2.9 Watt, 896 - 941 MHz

## LIST OF MODELS (cont.)

### SHARED SYSTEMS RADIOS

#### MTX 838 Model Family

H01KDC9DB3AN	16-Mode, 5- to 1-Watt, 136 - 178 MHz
H01KDD9DB4AN	99-Mode, 6-Character Top Display, 5- to 1-Watt, 136 - 178 MHz
H01KDF9DB5AN	160-Mode, 14-Character Front Display, Limited Keypad, 5- to 1-Watt, 136 - 178 MHz
H01KDH9DB7AN	160-Mode, 4-Character Front Display, Full Keypad, 5- to 1-Watt, 136 - 178 MHz

H01RDC9DB3AN	16-Mode, 4- to 1-Watt, 403 - 470 MHz
H01RDD9DB4AN	99-Mode, 6-Character Top Display, 4- to 1-Watt, 403 - 470 MHz
H01RDF9DB5AN	160-Mode, 14-Character Front Display, Limited Keypad, 4- to 1-Watt, 403 - 470 MHz
H01RDH9DB7AN	160-Mode, 14-Character Front Display, Full Keypad, 4- to 1-Watt, 403 - 470 MHz

H01SDC9DB3AN	16-Mode, 4- to 1-Watt, 450 - 520 MHz
H01SDD9DB4AN	99-Mode, 6-Character Top Display, 4- to 1-Watt, 450 - 520 MHz
H01SDF9DB5AN	160-Mode, 14-Character Front Display, Limited Keypad, 5- to 1-Watt, 450 - 520 MHz
H01SDH9DB7AN	160-Mode, 14-Character Front Display, Full Keypad, 5- to 1-Watt, 450 - 520 MHz

#### MTX 8000/MTX 838 Model Family

H01UCC6DB3AN	16-Mode, 3-Watt, 806 - 870 MHz, Type I
H01UCD6DB4AN	99-Mode, 3-Watt, 6-Character Top Display, 806 - 870 MHz
H01UCF6DB5AN	160-Mode, 14-Character Front Display, Limited Keypad, 3-Watt, 806 - 870 MHz
H01UCH6DB7AN	160-Mode, 14-Character Front Display, Full Keypad, 3-Watt, 806 - 870 MHz
H01UCC6DF3AN	16-Mode, 3-Watt, 806-870MHz, Type II

#### MTX 9000 Model Family

H01WCC4DB3AN	16-Mode, 2.9 Watt, 896 - 941 MHz
H01WCD4DB4AN	99-Mode, 2.9 Watt, 6-Character Top Display, 896 - 941 MHz
H01WCF4DB5AN	160-Mode, 14-Character Front Display, Limited Keypad, 2.9 Watt, 896 - 941 MHz
H01WCH4DB7AN	160-Mode, 14-Character Front Display, Full Keypad, 2.9 Watt, 896 - 941 MHz

## LIST OF ANTENNAS AND BATTERIES

### ANTENNA KIT NOS.

### DESCRIPTION

NAD6566*	Helical (136 - 151MHz)
NAD6567*	Helical (151 - 162MHz)
NAD6568*	Helical (162 - 174MHz)
NAD6563*	Helical Wideband (136 - 174MHz)
NAE6546*	Helical (403 - 435MHz)
NAE6547*	Helical (435 - 470MHz)
NAE6548*	Helical (470 - 512MHz)
NAE6549*	Whip (403 - 512MHz)
NAF5037*	Whip (800MHz)
NAF5038*	Whip (900MHz)
NAF5039*	Dipole (800MHz)
NAF5040*	Dipole (900MHz)
NAF5042*	Quarter Wave, Stubby (800MHz, 900MHz)

### BATTERY KIT NOS.

### DESCRIPTION

NTN7143	High-Capacity Nickel-Cadmium (groups A, B, C, D)
NTN7144	Ultra-High-Capacity Nickel-Cadmium (groups A, B, C, D)
NTN7146*	High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups D, F, G)
NTN7147*	Ultra-High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups D, F, G)
NTN7341*	Ultra-High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups C, D, E, F, G)
NTN7372*	High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups C, D, E, F, G)

\* These accessories are approved as being intrinsically safe by Factory Mutual Research Corporation (FMRC). Refer to the radio label for intrinsic safety ratings and required batteries. Only the accessories and antennas noted (by \*) may be used on approved radios.



#### WARNING

**Substitution of components may impair the intrinsic safety of the radio.**

# MAINTENANCE SPECIFICATIONS FOR VHF RADIOS

(All Specifications Are Per Electronic Industries Association (EIA) 316B Unless Otherwise Noted.)

GENERAL		RECEIVER		TRANSMITTER	
<b>FCC Designation:</b>	AZ489FT3768	<b>Frequency Range:</b>	*136-178MHz	<b>RF Power:</b>	
<b>Power Supply:</b>	Nickel-Cadmium Battery	<b>Bandwidth:</b>	42MHz	<b>136-174MHz</b>	1-5 Watts
<b>Battery Voltage:</b>		<b>Quieting Sensitivity (20dBQ):</b>	0.5µV Max.	<b>174-178MHz</b>	1-4 Watts
<b>Nominal:</b>	7.5 Volts	<b>Usable Sensitivity (12dB SINAD):</b>	0.35µV Max.	<b>Frequency Range:</b>	*136-178MHz
<b>Range:</b>	6 to 9 Volts	<b>Intermodulation:</b>	-70dB	<b>Freq. Stability (-30 to +60°C; 25°C ref.):</b>	± .0005%
<b>Battery Drain, Typical:</b>		<b>Selectivity (30kHz Adjacent Channel):</b>	-70dB	<b>Emission (Conducted and Radiated):</b>	-66dBw
<b>Standby:</b>	56mA	<b>Spurious Rejection:</b>	-70dB	<b>FM Hum and Noise (Companion Receiver):</b>	-45dB Typical
<b>Receive:</b>	180mA	<b>Freq. Stability (-30 to +60°C; 25°C reference):</b>	± 0.0005%	<b>Distortion:</b>	3% Typical
<b>Transmit:</b>	2100mA	<b>Rated Audio:</b>	500mW	<b>Modulation Limiting:</b>	±5kHz
<b>Temperature Range:</b>		<b>Distortion (At Rated Audio):</b>	3% Typical	<b>Recommended Battery:</b>	
<b>Operating:</b>	-30°C to +60°C	<b>Channel Spacing:</b>	30kHz	<b>High Capacity:</b>	NTN7143
<b>Storage:</b>	-40°C to +85°C			<b>Ultra-High Capacity:</b>	NTN7144
<b>Duty Cycle (5-5-90):</b>	1 Watt/5 Watts				
<b>High Cap. Battery:</b>	11.2 Hrs./8 Hrs.				
<b>Ultra-High Cap. Battery:</b>	12.9 Hrs./9 Hrs.				
<b>Dimensions (H x W x D)</b>					
<b>Less Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With High Cap. Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With Ultra-High Cap. Battery:</b>	6.30" x 2.34" x 1.54" (16.0cm x 5.9cm x 3.9cm)				
<b>Weight: (w/Helical Antenna)</b>					
<b>Less Battery:</b>	12.1oz. (343gm)				
<b>With High Cap. Battery:</b>	20.2oz. (573gm)				
<b>With Ultra-High Cap. Battery:</b>	21.3oz. (604gm)				

Specifications Subject to Change Without Notice.

\* Frequencies in the 174-178MHz range are not permitted in the USA.

# MAINTENANCE SPECIFICATIONS FOR UHF RADIOS

(All Specifications Are Per Electronic Industries Association (EIA) 316B Unless Otherwise Noted.)

GENERAL		RECEIVER		TRANSMITTER	
<b>FCC Designation:</b>	AZ489FT4781 (403-470MHz) AZ489FT4780 (450-520MHz)	<b>Frequency Range:</b>	403-470MHz *450-520MHz	<b>RF Power:</b>	
<b>Power Supply:</b>	Nickel-Cadmium Battery	<b>Bandwidth:</b>	70MHz	<b>403-470MHz</b>	1-4 Watts
<b>Battery Voltage:</b>		<b>Quieting Sensitivity (20dBQ):</b>	0.5µV Max.	<b>450-512MHz</b>	1-4 Watts
<b>Nominal:</b>	7.5 Volts	<b>Usable Sensitivity (12dB SINAD):</b>	0.35µV Max.	<b>512-520MHz</b>	1-3 Watts
<b>Range:</b>	6 to 9 Volts	<b>Intermodulation:</b>	-70dB	<b>Frequency Range:</b>	403-470MHz *450-520MHz
<b>Battery Drain, Typical:</b>		<b>Selectivity (25kHz Adjacent Channel):</b>	-70dB	<b>Freq. Stability (-30 to +60°C; 25°C ref.):</b>	± .0005%
<b>Standby:</b>	60mA	<b>Spurious Rejection:</b>		<b>Emission (Conducted and Radiated):</b>	-66dBw
<b>Receive:</b>	180mA	<b>450-512MHz</b>	-70dB	<b>FM Hum and Noise (Companion Receiver):</b>	-45dB Typical
<b>Transmit:</b>	1800mA	<b>512-520MHz</b>	-65dB	<b>Distortion:</b>	3% Typical
<b>Temperature Range:</b>		<b>Freq. Stability (-30 to +60°C; 25°C reference):</b>	± 0.0005%	<b>Modulation Limiting:</b>	±5kHz
<b>Operating:</b>	-30°C to +60°C	<b>Rated Audio:</b>	500mW	<b>Recommended Battery:</b>	
<b>Storage:</b>	-40°C to +85°C	<b>Distortion (At Rated Audio):</b>	3% Typical	<b>High Capacity:</b>	NTN7143
<b>Duty Cycle (5-5-90):</b>	1 Watt/4 Watts	<b>Channel Spacing:</b>	25kHz	<b>Ultra-High Capacity:</b>	NTN7144
<b>High Cap. Battery:</b>	11 Hrs./8.4 Hrs.				
<b>Ultra-High Cap. Battery:</b>	12.7 Hrs./9.7 Hrs.				
<b>Dimensions (H x W x D)</b>					
<b>Less Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With High Cap. Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With Ultra-High Cap. Battery:</b>	6.30" x 2.34" x 1.54" (16.0cm x 5.9cm x 3.9cm)				
<b>Weight: (w/Helical Antenna)</b>					
<b>Less Battery:</b>	12.1oz. (343gm)				
<b>With High Cap. Battery:</b>	20.2oz. (573gm)				
<b>With Ultra-High Cap. Battery:</b>	21.3oz. (604gm)				

Specifications Subject to Change Without Notice.

\* Frequencies in the 512-520MHz range are not permitted in the USA.



# MAINTENANCE SPECIFICATIONS FOR 800MHz RADIOS

(All Specifications Are Per Electronic Industries Association (EIA) 316B Unless Otherwise Noted.)

GENERAL		RECEIVER		TRANSMITTER	
<b>FCC Designation:</b>	AZ489FT5747	<b>Frequency Range:</b>	851–870MHz	<b>RF Power:</b>	3 Watts
<b>Power Supply:</b>	Nickel-Cadmium Battery	<b>Bandwidth:</b>	19MHz	<b>Frequency Range:</b>	806–824MHz 851–869MHz
<b>Battery Voltage:</b>		<b>Quieting Sensitivity (20dBQ):</b>	0.5µV Max.	<b>Freq. Stability</b>	
<b>Nominal:</b>	7.5 Volts	<b>Usable Sensitivity</b>		<b>(–30 to +60°C; 25°C ref.):</b>	± .00025%
<b>Range:</b>	6 to 9 Volts	<b>(12dB SINAD):</b>	0.35µV Max.	<b>(821-824MHz Capable):</b>	± .00015%
<b>Battery Drain, Typical:</b>		<b>Intermodulation:</b>	–70dB	<b>Emission (Conducted and Radiated):</b>	–46dBw
<b>Standby:</b>	65mA	<b>Selectivity</b>		<b>FM Hum and Noise</b>	
<b>Receive:</b>	190mA	<b>(25kHz Adjacent Channel):</b>	–70dB	<b>(Companion Receiver):</b>	–40dB Typical
<b>Transmit:</b>	1900mA	<b>Spurious Rejection:</b>	–70dB	<b>Distortion:</b>	3% Typical
<b>Temperature Range:</b>		<b>Freq. Stability</b>		<b>Modulation Limiting:</b>	±5kHz
<b>Operating:</b>	–30°C to +60°C	<b>(–30+60°C; 25°C reference):</b>	± .00025%	<b>(821-824MHz):</b>	±4kHz
<b>Storage:</b>	–40°C to +85°C	<b>(821-824MHz Capable):</b>	±.00015%	<b>Recommended Battery:</b>	
<b>Duty Cycle (5-5-90):</b>		<b>Rated Audio:</b>	500mW	<b>High Capacity:</b>	NTN7143
<b>High Cap. Battery:</b>	8 Hours	<b>Distortion (At Rated Audio):</b>	3% Typical	<b>Ultra-High Capacity:</b>	NTN7144
<b>Ultra-High Cap. Battery:</b>	9 Hours	<b>Channel Spacing:</b>	25kHz		
<b>Dimensions (H x W x D)</b>					
<b>Less Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With High Cap. Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With Ultra-High Cap. Battery:</b>	6.30" x 2.34" x 1.54" (16.0cm x 5.9cm x 3.9cm)				
<b>Weight: (w/Helical Antenna)</b>					
<b>Less Battery:</b>	12.1oz. (343gm)				
<b>With High Cap. Battery:</b>	20.2oz. (573gm)				
<b>With Ultra-High Cap. Battery:</b>	21.3oz. (604gm)				

Specifications Subject to Change Without Notice.

# MAINTENANCE SPECIFICATIONS FOR 900MHz RADIOS

(All Specifications Are Per Electronic Industries Association (EIA) 316B Unless Otherwise Noted.)

GENERAL		RECEIVER		TRANSMITTER	
<b>FCC Designation:</b>	AZ489FT5748	<b>Frequency Range:</b>	935–941MHz	<b>RF Power:</b>	2.9 Watts
<b>Power Supply:</b>	Nickel-Cadmium Battery	<b>Bandwidth:</b>	6MHz	<b>Frequency Range:</b>	896–902MHz 935–941MHz
<b>Battery Voltage:</b>		<b>Quieting Sensitivity (20dBQ):</b>	0.5µV Max.	<b>Freq. Stability</b>	
<b>Nominal:</b>	7.5 Volts	<b>Usable Sensitivity</b>		<b>(–30 to +60°C; 25°C ref.):</b>	± .00015%
<b>Range:</b>	6 to 9 Volts	<b>(12dB SINAD):</b>	0.35µV Max.	<b>Emission (Conducted and Radiated):</b>	–46dBw
<b>Battery Drain, Typical:</b>		<b>Intermodulation:</b>	–60dB	<b>FM Hum and Noise</b>	
<b>Standby:</b>	65mA	<b>Selectivity</b>		<b>(Companion Receiver /</b>	
<b>Receive:</b>	185mA	<b>(12.5kHz Adjacent Channel):</b>	–60dB	<b>HEAR CLEAR):</b>	–45dB Typical
<b>Transmit:</b>	1910mA	<b>Spurious Rejection:</b>	–60dB	<b>Distortion:</b>	3% Typical
<b>Temperature Range:</b>		<b>Freq. Stability</b>		<b>Modulation Limiting:</b>	±2.5kHz
<b>Operating:</b>	–30°C to +60°C	<b>(–30+60°C; 25°C reference):</b>	± .00015%	<b>Recommended Battery:</b>	
<b>Storage:</b>	–40°C to +85°C	<b>Rated Audio:</b>	500mW	<b>High Capacity:</b>	NTN7143
<b>Duty Cycle (5-5-90):</b>		<b>Distortion (At Rated Audio):</b>	3% Typical	<b>Ultra-High Capacity:</b>	NTN7144
<b>High Cap. Battery:</b>	8 Hours	<b>Channel Spacing:</b>	12.5kHz		
<b>Ultra-High Cap. Battery:</b>	9 Hours				
<b>Dimensions (H x W x D)</b>					
<b>Less Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With High Cap. Battery:</b>	6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm)				
<b>With Ultra-High Cap. Battery:</b>	6.30" x 2.34" x 1.54" (16.0cm x 5.9cm x 3.9cm)				
<b>Weight: (w/Helical Antenna)</b>					
<b>Less Battery:</b>	12.1oz. (343gm)				
<b>With High Cap. Battery:</b>	20.2oz. (573gm)				
<b>With Ultra-High Cap. Battery:</b>	21.3oz. (604gm)				

Specifications Subject to Change Without Notice.

# SECTION I. INTRODUCTION

This manual includes a model chart, specifications, fundamental disassembly/reassembly procedures; and all schematic diagrams, printed circuit board details, flex circuit diagrams, and several parts lists to completely cover the HT 1000, MT 2000, MTS 2000, and MTX series radios. Hereafter, the text will refer collectively to these radios as “this family of radios.” For maintenance/troubleshooting, theory, accessories, and operation of the radio, refer to the applicable manual available separately. To help you with your selection, a list is provided in this manual, titled “RELATED PUBLICATIONS AVAILABLE SEPARATELY.”

Special notices are incorporated into the text, alerting you to safety hazards and suggesting procedures. These notices are divided and labeled according to the information they contain so that you can become immediately aware of the type of information being presented. The three classifications are: **WARNINGS**, **CAUTIONS**, and **NOTES**.



## WARNING

**This is an operational procedure, practice, or condition, etc., which may result in injury or death if not carefully observed.**



## CAUTION

This is an operational procedure, practice, or condition, etc., which may result in damage to the equipment if not carefully observed.

## NOTE

This is an operational procedure, practice, or condition, etc., which is essential to emphasize.

## SECTION II. RECOMMENDED AND REQUIRED TEST EQUIPMENT, SERVICE AIDS, AND TOOLS LISTS

**Table 40-1. Recommended Test Equipment**

MOTOROLA MODEL NUMBER	DESCRIPTION	CHARACTERISTICS	APPLICATION
R2000 Series	System Analyzer	This monitor will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
R2600 Series	System Analyzer	This monitor will substitute for items with an asterisk (*)	Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment
*R1049A	Digital Multimeter		Digital voltmeter recommended for ac/dc voltage and current measurements
*R1150C	Code Synthesizer		Injection of audio and digital signalling codes
*S1053D *SKN6008A *SKN6001A	AC Voltmeter Power Cable for Meter Test Leads for Meter	1mV to 300V, 10-Megohm input impedance	Audio voltage measurements
R1094A	Dual-Trace Oscilloscope	20MHz bandwidth 5mV to 5V/division	Waveform measurements
*S1350C *ST1213B (VHF) *ST1223B (UHF)	Watt Meter Plug-in Element RF Dummy Load	50-ohm, ±5% accuracy 10 Watts, maximum 0-1000MHz, 300W	Transmitter power output measurements
R1065	Load Resistor	10-watt Broadband	For use with Wattmeter
S1339A	RF Millivolt Meter	100µV to 3V rf 10kHz to 1.2GHz	RF level measurements
*R1013A	SINAD Meter		Receiver sensitivity measurements
S1347D or S1348D (programmable)	DC Power Supply	0-20Vdc, 0-5 Amps current limited	Bench supply for 7.5Vdc

\*Any of the R2000/R2600 series system analyzers will substitute for items with an asterisk (\*).

### A. Recommended Test Equipment

The list of equipment contained in Table 40-1 includes all of the standard test equipment required for servicing two-way portable radios, as well as several unique items designed specifically for servicing this family of radios. Battery-operated test equipment is recommended when available. The "CHARACTERISTICS" column is included so that equivalent equipment may be substituted; however, when no information is provided in this column, the specific Motorola model listed is either a unique item or no substitution is recommended.

### B. Service Aids and Recommended Tools

Refer to the "SERVICE AIDS" in Table 40-2 and "RECOMMENDED TOOLS LIST" in Table 40-3 for a listing and description of the service aids and tools designed specifically for servicing this family of radios, as well as the more common tools required to disassemble and properly maintain the radio. These kits and/or parts are available from the Motorola Communications Parts office listed in the "Replacement Parts Ordering" section of this manual.

*MAV-PACK 3 (VID-952)/F.A.S.T. 60*

The VID-952 Motorola Video Visual Package (MAV-PACK) is a video tape training program on leadless component repair techniques. This VHS format video

cassette and supplemental literature describe the removal and replacement of leadless components using the R-1070A surface-mounted IC removal station:

- 0180386A62 Heated Tweezers
- 0180356B79 Desoldering Station
- 0180371B30 Soldering Station

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

National Service Training's Field Assist Service Training (F.A.S.T.) Video Tape #60 introduces this family of radios. Included on this tape are basic theory of operation, disassembly, and basic troubleshooting techniques.

The MAV-PACK 3 (VID-952), as well as others, and the F.A.S.T. 60 are available from:

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

### C. Field Programming

This family of radios can be aligned and programmed in the field. This requires specific equipment and special instructions. Refer to the applicable "Radio Service Software User's Manual" for complete field programming information.

The following table lists service aids recommended for working on this family of radios. These items are available from the Motorola Parts Department.

**Table 40-2. Service Aids**

<b>MOTOROLA PART NO.</b>	<b>DESCRIPTION</b>	<b>APPLICATION</b>
RKN-4035A	RIB/Radio/test set cable	Connects radio to RTX-4005B Test Box and RIB.
RLN-1014A	Battery Eliminator	Interconnects radio to power supply.
RLN-1018A	Test Fixture	Provides for troubleshooting of the radio when the housing is removed.
RTX-4005B or both RTX-4005A and RPX-4665A Field Modification Kit	Portable Test Set	Enables connection to the universal connector. Allows switching for radio testing.
RLN-4008B	Radio Interface Box	Enables communications between the radio and the computer's serial communications adapter.
0180357A57 0180358A56	Wall-mounted Power Supply Wall-mounted Power Supply	Used to supply power to the RIB (120 VAC). Used to supply power to the RIB (220 VAC).
3080369B71 or 3080369B72	Computer Interface Cable	Use B72 for the IBM PC AT. All other IBM models use B71. Connects the computer's serial communications adapter to the RIB.
RKN-4036A	Cloning Cable	Allows a radio to be duplicated from a master radio by transferring programmed data from one radio to another (HT 1000/MT 2000 Models Only).
RVN-4097A	Radio Service Software	Software on 3-1/2 in. and 5-1/4 in. floppy disks.
RVN-4098A	Radio Service Software (HT 1000 Models Only)	Software on 3-1/2 in. and 5-1/4 in. floppy disks.
5880348B33	SMA to BNC Adaptor	Adapts radio's antenna port to BNC cabling of test equipment.
F.A.S.T. 60	Video Tape, Radio Introduction	Includes operation, disassembly, and basic troubleshooting.
RLN-4201	Battery Tester	Tests battery charge.
RLN-4048	Battery Tester Adapter	Adapts HT 1000, MT 2000, MTS 2000, and MTX Series radio batteries to the RLN-4201 Battery Tester.
RTL-4208	RF Probe	50-ohm, high-frequency probe.
RT-5144/48/0	Test Probe (black)	Needle-fine test probes for high-density circuitry.
RT-5144/48/2	Test Probe (red)	

The following table lists the tools recommended for working on this family of radios; these tools are also available from Motorola. Note that the R-1319A solder/desolder workstation requires the use of some reflow nozzles. The nozzles' part numbers and general descriptions are listed in the table with the R-1319A.

Also note that the R-1070A workstation requires the use of a specific "heat focus head" for each of the components on which this item is used. **Each of these heat focus heads must be ordered separately.** The individual heat focus heads (and the components on which they are used) are listed at the end of the table.

**Table 40-3. Recommended Service Tools**

MOTOROLA PART NO.		DESCRIPTION	APPLICATION
0180381B45 or 0180300E06 8180369E97	110VAC 220VAC	MBT250 Surface-mount/ thru-hole repair station	Temperature-controlled, self-contained soldering/desoldering repair station for installation and removal of surface-mounted devices.
1105139W02		Flux holder/applicator	Allows for the proper amount of flux to be applied to pad grid arrays for repair.
0180386A81		30cc plastic syringe and flux paste	For use with flux holder/applicator 8180369E97.
0180386A78		Miniature digital readout soldering station (incl. 1/64" micropoint tip)	
0180386A82		Illuminated magnifying glass with lens attachment	
6684253C72		Anti-static grounding kit	Used during all radio assembly and disassembly procedures.
6680384A98		Straight prober	
1010041A86		Brush	
		Solder (RMA type), 63/37, 0.020" diameter- 1 lb. spool	
R-1319A (Supersedes R-1070A)		Surface-Mounted Device Rework Station	Removal of surface-mounted integrated circuits.
6680332E82		R-1319A Reflow Nozzle	For IC removal (approximate size 0.8 in. x 0.8 in.)
6680332E83		R-1319A Reflow Nozzle	For IC removal (approximate size 0.6 in. x 0.6 in.)
6680332E84		R-1319A Reflow Nozzle	For IC removal (approximate size 0.5 in. x 0.5 in.)
6680333E28		R-1319A Reflow Nozzle	For removal of RF PA
R-1070A (Superseded by R-1319A)		Shields and surface-mounted component - IC removal/rework station (order all heat focus heads separately)	Removal of surface-mounted integrated circuits.
HEAT-FOCUS HEADS	INSIDE DIMENSIONS OF HEADS	USED ON	MAXIMUM PRESCRIBED HEAT SETTING
6680334B49	0.410" x 0.410"	U601, U702	Temperature settings using the R-1319A and the R-1070A are the same. Refer to Maintenance Sec- tion of Manual for prescribed heat setting.
6680334B50	0.430" x 0.430"	U4, U5, U713	
6680334B51	0.492" x 0.492"	U3	
6680334B52	0.572" x 0.572"	U701, U705	
6680334B53	0.670" x 0.790"	* metal shields B, C, E, and F	
6680370B51	0.475" x 0.475"	U204	
6680370B54	0.710" x 0.710"	U710	
6680370B57	0.245" x 0.245"	U2, U201	
6680370B58	0.340" x 0.340"	U101, U102	
6680371B15	0.460" x 0.560"	* metal shields A, D, G, H, and I	
6680371B74	0.470" x 0.570"	U203	
6680332E45	0.591" x 0.315"	U714	
6680332E46	0.862 x 0.350"	U715	

\* Refer to the SHIELDS LOCATION DETAIL and Shields Parts List in the rear of this manual to match the shield with the proper heat focus head.

## SECTION III. TRANSCEIVER PERFORMANCE TESTING

### A. General

The HT 1000, MT 2000, MTS 2000, and MTX series radios have been prepared to meet published specifications through their manufacturing process, with the use of laboratory-quality test equipment of highest accuracy. The recommended field service equipment approaches the accuracy of the manufacturing equipment with a few exceptions. Accuracy of the equipment must be maintained in compliance with the manufacturer's recommended calibration schedule.

### B. Setup

Supply voltage can be connected from the battery eliminator. The equipment required for alignment procedures is connected as shown in the Radio Alignment Test Setup diagram.

Initial equipment control settings should be as indicated in the following table, and should hold for all alignment procedures except as noted in Table 40-4.

**Table 40-4. Initial Equipment Control Settings**

SERVICE MONITOR	TEST SET	POWER SUPPLY
Monitor Mode: Pwr Mon RF Attn: -70 AM, CW, FM: FM  O'scope Source: Mod O'scope Horiz: 10mSec/Div O'scope Vert: 2.5kHz/Div O'scope Trig: Auto Monitor Image: Hi Monitor BW: Nar Monitor Squelch: mid CW Monitor Vol: 1/4 CW	Spkr set: A  Spkr/load: Speaker PTT: OFF (center)	Voltage: 7.5Vdc  DC on/standby: Standby Volt Range: 10  Current: 2.5

### C. Test Mode

#### 1. RF Test Mode, HT 1000 Radios

When the HT 1000 radio is operating in its normal environment, the radio's microcontroller controls the RF channel selection, transmitter key-up, and receiver muting. However, when the unit is on the bench for testing, alignment, or repair, it is removed from its normal environment. It cannot receive commands from its system and, therefore, the internal microcontroller will not key the transmitter nor unmute the receiver. This prevents the use of normal tune-up procedures. To solve this problem a special routine, called TEST MODE or "air test," has been incorporated in the radio.

To enter test mode:

- (a) Turn the radio on.
- (b) Within ten seconds after the self test is complete, press the monitor button (side button 3, SB3) five times in succession. After the fifth press, a tone is emitted to indicate that the rf test mode has been entered.

- (c) Each additional press of SB3 will advance to the next test channel. (refer to Table 40-6), and a corresponding set of tones will indicate the channel.
- (d) Pressing SB2 will scroll through and access test environments as shown in Table 40-5.

#### NOTE

Transmit into a load when keying a radio under test.

To exit test mode, turn the radio off then back on.

**Table 40-5. Test Environments, HT 1000 Radios**

NO. OF BEEPS	DESCRIPTION	FUNCTION
1	Carrier Squelch	RX: if carrier detected TX: mic audio
3	Tone Private-Line	RX: unsquelch if carrier and tone (192.8Hz) detected TX: mic audio + tone (192.8Hz)
4	Digital Private-Line	RX: unsquelch if carrier and digital code (131) detected TX: mic audio + digital code (131) detected

#### 2. Control Head Test Mode, HT 1000 Radios

To check the buttons and the switches, perform the following tests:

- (a) Turn radio on
- (b) After the self test is complete, press the monitor button (side button 3, SB3) five times in succession, within 10 seconds. After the fifth press, a tone is emitted to indicate that the RF test mode has been entered.
- (c) Exit the RF test mode and enter the control head test mode by pressing and holding SB3 for more than three seconds. Upon entering the control head test mode, a tone is emitted and the green LED begins flashing. The green LED continues to flash until the control head test mode is exited.

#### NOTE

Return to the RF test mode by pressing and holding SB3 for more than three seconds. Then re-enter the control head test mode by pressing and holding SB3 for more than three seconds.

- (d) Test each switch (toggle, rotary, or button-actuated) by changing the position of the switch. A tone is emitted to indicate a "good test" each time a switch position is changed.

#### NOTES

1. Pressing and releasing a button-actuated switch are both considered switch-position changes.
2. No tone when a switch position is changed indicates a test failure.

**Table 40-6. Test Frequencies, HT 1000 Radios**

NO. OF BEEPS	TEST CHANNEL	VHF	UHF BAND 1	UHF BAND 2	800
1	TX #1	136.025	403.100	450.025	806.0125
	RX #1	136.075	403.150	450.075	851.0625
2	TX #2	142.125	424.850	465.225	815.0125
	RX #2	142.075	424.900	465.275	860.0625
3	TX #3	154.225	438.050	475.225	824.9875
	RX #3	154.275	438.100	475.275	869.9375
4	TX #4	160.125	444.050	484.975	851.0125
	RX #4	160.175	444.100	485.025	851.0625
5	TX #5	168.075	456.350	500.275	860.0125
	RX #5	168.125	456.400	500.225	860.0625
6	TX #6	173.975	463.700	511.975	869.9875
	RX #6	173.925	463.750	511.925	869.9375

- (e) Test the on/off volume potentiometer/switch by rotating the potentiometer clockwise and counter clockwise. The loudness of tone beeps will increase and decrease accordingly.

**NOTE**

During test mode, the volume level is not regulated to the same limits as during normal radio operation.

To exit test mode, turn the radio off then back on.

- 3. RF Test Mode, MT 2000, MTS 2000, and MTX Series Radios

When the MT 2000, MTS 2000, or MTX series radio is operating in its normal environment, the radio's microcomputer controls the RF channel selection, transmitter key-up, and receiver muting. However, when the unit is on the bench for testing, alignment, or repair, it is removed from its normal environment. It cannot receive commands from its system and, therefore, the internal microcomputer will not key the transmitter nor unmute the receiver. This prevents the use of normal tune-up procedures. To solve this problem a special routine, called TEST MODE or "air test," has been incorporated in the radio.

To enter test mode:

- (a) Turn the radio on.
- (b) After the self test is complete, press the monitor button (side button 3, SB3) five times in succession, within 10 seconds.
- (c) After "RF TEST" appears (on 14-character displays) or "RF TST" appears (on 6-character displays), press the orange button on top of the radio once. "1 CSQ" appears, indicating: test frequency 1, carrier squelch mode.
- (d) Each additional press of SB3 will advance to the next test channel. (Refer to Table 40-8.)
- (e) Pressing SB2 will scroll through and access test environments as shown in Table 40-7.

**NOTES**

- 1. Transmit into a load when keying a radio under test.
- 2. Radios without display indicate test-environment function by emitting a corresponding number of beeps. See Table 40-7.
- 4. Control Head Test Mode, MT 2000, MTS 2000, and MTX Series Radios  
To check the display, the buttons, and the switches, perform the following tests:
  - (a) Turn radio on
  - (b) After the self test is complete, press the monitor button (side button 3, SB3) five times in succession, within 10 seconds.
  - (c) After "RF TEST" appears on the display, press side button 1 (SB1), "CH TEST" (14-character radio) or "CH TST" (6-character radio) appears on the display.
  - (d) Next, press and hold the orange button on top of the radio; all segments on the display will light, and the LED on the control top will illuminate a yellowish color.
  - (e) Release the orange button; "3/0" appears, which indicates that switch 3 is in the open condition.
  - (f) Press the orange button again; "3/1" appears, which indicates that switch 3 is in the closed condition.
  - (g) Rotate the mode selector knob; "4/0" thru "4/15" appears, which indicates that knob 4 is in mode position 1 thru 15.
  - (h) Rotate the concentric switch; "65/0" and "65/1" appears.
  - (i) Rotate the volume control; "2/0" thru "2/255" appears.
  - (j) Press SB1, view "96/1"; release, view "96/0"
  - (k) Press SB2, view "97/1"; release, view "97/0"

(l) Press SB3, view "98/1"; release, view "98/0"

(m) Keypad:

- Press **0**, view "48/1"; release, view "48/0"
- Press **1**, view "49/1"; release, view "49/0"
- Press **2**, view "50/1"; release, view "50/0"
- Press **3**, view "51/1"; release, view "51/0"
- Press **4**, view "52/1"; release, view "52/0"
- Press **5**, view "53/1"; release, view "53/0"
- Press **6**, view "54/1"; release, view "54/0"
- Press **7**, view "55/1"; release, view "55/0"

- Press **8**, view "56/1"; release, view "56/0"
- Press **9**, view "57/1"; release, view "57/0"
- Press **\***, view "58/1"; release, view "58/0"
- Press **#**, view "59/1"; release, view "59/0"
- Press **<**, view "128/1"; release, view "128/0"
- Press **HOME**, view "129/1"; release, view "129/0"
- Press **>**, view "130/1"; release, view "130/0"

To exit test mode, turn the radio off then back on.

**Table 40-7. Test Environments, MT 2000, MTS 2000, and MTX Series Radios**

NO. OF BEEPS	DISPLAY	DESCRIPTION	FUNCTION
1*	CSQ	Carrier Squelch	RX: unsquelch if carrier detected TX: mic audio
2	HC	Hear Clear**	RX: unsquelch if carrier detected TX: compressed mic audio
3	TPL	Tone Private-Line	RX: unsquelch if carrier and tone (192.8 Hz) detected TX: mic audio + tone (192.8 Hz)
4	DPL	Digital Private-Line	RX: unsquelch if carrier and digital code (131) detected TX: mic audio + digital code (131) detected
5	TLS	Trunking Low Speed	RX: unsquelch if carrier detected TX: mic audio + connect tone (105.8 Hz) @ correct deviation
6	THS	Trunking	RX: unsquelch if valid outbound signalling word (OSW) detected High Speed TX: 1500 Hz tone
7	DTM multiple freq.	dual-tone	RX: unsquelch if carrier detected TX: selected DTMF tone pair
8	M12	MDC1200	RX: unsquelch if carrier detected without DOS (1800 Hz); squelch if carrier detected with DOS (1800 Hz) TX: 1500 Hz tone
9	SEC	Secure***	RX: auto-coded clear TX: with key present - encrypted audio with key absent - constant unsquelch
12	USQ	Unsquelch****	RX: constant unsquelch TX: mic audio

\* radios without display indicate function by emitting a number of beeps  
\*\* on 900 MHz radios only

\*\*\* on radios equipped with secure option  
\*\*\*\* not available on all radios

**Table 40-8. Test Frequencies, MT 2000, MTS 2000, and MTX Series Radios**

TEST CHANNEL	VHF	UHF BAND 1	UHF BAND 2	800	900	R-BAND
TX #1	136.025	403.100	450.025	806.0125	896.0125	885.0125
RX #1	136.075	403.150	450.075	851.0625	935.0625	830.0125
TX #2	142.125	424.850	465.225	815.0125	899.0125	885.0125
RX #2	142.075	424.900	465.275	860.0625	938.0625	859.9875
TX #3	154.225	438.050	475.225	824.9875	901.9875	885.0125
RX #3	154.275	438.100	475.275	869.9375	940.9375	859.9875
TX #4	160.125	444.050	484.975	851.0125	935.0125	895.0125
RX #4	160.175	444.100	485.025	851.0625	935.0625	859.9875
TX #5	168.075	456.350	500.275	860.0125	938.0125	905.0125
RX #5	168.125	456.400	500.225	860.0625	938.0625	859.9875
TX #6	173.975	463.700	511.975	869.9875	940.9875	914.9875
RX #6	173.925	463.750	511.925	869.9375	940.9375	859.9875
TX #7	177.975	469.650	519.975	None	None	None
RX #7	177.925	469.700	519.925	None	None	None



**Table 40-9. Receiver Performance Checks**

TEST NAME	COMMUNICATIONS ANALYZER	RADIO	TEST SET	COMMENTS
Reference Frequency	Mode: PWR MON 4th channel test frequency <sup>◇</sup> Monitor: Frequency error Input at RF In/Out	TEST MODE, 4 CSQ output at antenna	PTT to continuous (during the performance check)	Frequency error to be $\pm 150\text{Hz}$
Rated Audio	Mode: GEN Output level: 1.0mV RF 4th channel test frequency <sup>◇</sup> Mod: 1kHz tone at 3kHz deviation Monitor: DVM: AC Volts	TEST MODE, 4 CSQ	PTT to OFF (center), meter selector to Audio PA	Set volume control to 3.74Vrms
Distortion	As above, except to distortion	As above	As above	Distortion < 3.0%
Sensitivity (SINAD)	As above, except SINAD, lower the RF level for 12dB SINAD.	As above	PTT to OFF (center)	RF input to be < 0.35 $\mu\text{V}$
Noise Squelch Threshold (only radios with conventional system need to be tested)	RF level set to 1mV RF	As above	PTT to OFF (center), meter selection to Audio PA, spkr/load to speaker	Set volume control to 3.74Vrms
	As above, except change frequency to a conventional system. Raise RF level from zero until radio unsquelches.	out of TEST MODE; select a conventional system	As above	Unsquelch to occur at < 0.25 $\mu\text{V}$ . Preferred SINAD = 8-10dB

<sup>◇</sup> See Table 40-6 or Table 40-8 as applicable.

**Table 40-10. Transmitter Performance Checks**

<b>TEST NAME</b>	<b>COMMUNICATIONS ANALYZER</b>	<b>RADIO</b>	<b>TEST SET</b>	<b>COMMENTS</b>
Reference Frequency	Mode: PWR MON 4th channel test frequency <sup>◇</sup> Monitor: Frequency error Input at rf In/Out.	TEST MODE, 4 CSQ	PTT to continuous (during the performance check).	Frequency error to be < 150Hz.
Power RF	As above.	As above, 4 CSQ	As above.	Refer to Maintenance Specifications page in front of manual.
Voice Modulation	Mode: PWR MON 4th channel test frequency <sup>◇</sup> atten to -70, input to RF In/Out, Monitor: DVM, AC Volts Set 1kHz Mod Out level for 0.025Vrms at test set, 80mVrms at AC/DC test set jack	As above, 4 CSQ	As above, meter selector to mic.	Deviation: VHF, UHF, and 800MHz: ≥ 3.6kHz but ≤ 5.0kHz.  900MHz: ≤ 2.5kHz.
Low-Speed Data Modulation 800/900 UHF	As above.	TEST MODE 4TLS output at antenna	PTT to continuous (during the performance check).	Deviation: UHF, 800MHz: ≥ 500Hz but ≤ 1000Hz.
Voice Modulation (internal)	Mode: PWR MON 4th channel test frequency <sup>◇</sup> atten to -70, input to RF In/Out.	TEST MODE, 4 CSQ, output at antenna.	Remove modulation input.	Press PTT switch on radio. Say "four" loudly into the radio mic. Measure deviation: VHF, UHF, and 800MHz: ≥ 3.8kHz but ≤ 5.0kHz. 900MHz: ≤ 2.5kHz.
High-Speed Data Modulation***	As above.	TEST MODE, 4 THS, output at antenna.	PTT to continuous (during the performance check).	Deviation: UHF and 800MHz: ≥ 2.4kHz but ≤ 3.6kHz. 900MHz: ≥ 1.52kHz but ≤ 1.95kHz.
DTMF Modulation	As above, 4th channel test frequency <sup>◇</sup>	TEST MODE, 4 DTMF, output at antenna.	As above.	Deviation: VHF, UHF, and 800MHz: ≥ 3.8kHz but ≤ 5.0kHz. 900MHz: ≥ 1.5kHz but ≤ 1.9kHz.
PL/DPL Modulation (radios with conventional, clear mode, coded squelch operation only)	Change frequency to a conventional transmit frequency, BW to narrow.	Conventional coded squelch personality (clear mode operation). 4 TPL 4 DPL	As above.	Deviation: VHF, UHF, and 800MHz: ≥ 500Hz but ≤ 1000Hz.  900MHz: ≥ 250Hz but ≤ 500Hz.
Talk-around Modulation (radios with conventional, clear mode, talk-around operation only)	Change frequency to conventional talk-around frequency. Mode: PWR MON deviation, attenuation to -70, input to RF In/Out Monitor: DVM, AC volts Set 1kHz Mod Out level for 25mVrms at test set.	Conventional talk-around personality (clear mode operation). 1 CSQ	As above.	Deviation: UHF and 800MHz: ≥ 3.8kHz but ≤ 5.0kHz.  900MHz: ≥ 1.95kHz but ≤ 2.45kHz.
Talk-around Modulation (radios with conventional, secure mode, talk-around operation only) (**)	Change frequency to conventional talk-around frequency. Mode: PWR MON deviation, attenuation to -70, input to RF In/Out Monitor: DVM, AC volts Mod: 1kHz out level for 25mVrms at test set.	Conventional talk-around personality (secure mode operation) Load key into radio. 1 Sec.	As above.	Deviation: UHF and 800MHz: ≥ 3.6kHz but ≤ 4.4kHz.

\* 800 MHz radios only

\*\* The secure mode, talk-around modulation test is only required for trac mode radios which do not have clearmode talk-around capability.

\*\*\* Trunked Only

◇ See Table 40-6 or Table 40-8 as applicable.

## IV. ERROR CODE DISPLAYS

### A. Power-up Display Codes

At power-up, the radio performs cursory tests to determine if its basic electronics and software are in working order. Problems detected during these tests are presented as error codes on the radio display. The presence of an error code should prompt the user that a problem exists and that a service technician should be contacted.

Self-test errors are classified as either fatal or non-fatal. Fatal errors will inhibit user operation, while non-fatal errors will not. Use Table 40-11 to aid in understanding particular power-up error code displays.

### B. Operational Display Codes

During operation, the radio performs dynamic tests to determine if it is working properly. Problems detected during these tests are presented as error codes on the radio display. The presence of an error code should prompt a user that a problem exists and that a service technician should be contacted. Use Table 40-12 to aid in understanding particular operational error code displays.

**Table 40-11. Power-up Display Codes**

FAILURE DISPLAY		TYPE OF FAILURE	DESCRIPTION	POSSIBLE SOURCE
14-Character Display	6-Character Display			
FAIL 01/81	F01/81	FATAL	External ROM/Flash checksum error	Bad ROM data, Defective ROM
FAIL 01/82	F01/82	FATAL	External EEPROM checksum error	Bad external codeplug data, Defective external EEPROM
ERROR 01/02	E01/02	NON-FATAL	External EEPROM checksum error	Bad external codeplug data
FAIL 01/84	F01/84	FATAL	External EEPROM checksum blank	Unprogrammed external codeplug data
FAIL 01/88	F01/88	FATAL	External RAM error	Defective RAM
FAIL 01/90	F01/90	FATAL	Hardware failure	Defective IC
FAIL 01/92	F01/92	FATAL	Internal EEPROM checksum error	Bad internal codeplug data, Defective microcontroller
ERROR 01/12	E01/12	NON-FATAL	Internal EEPROM checksum error	Bad internal codeplug data
FAIL 01/94	F01/94	FATAL	Internal EEPROM checksum blank	Unprogrammed internal codeplug data
FAIL 01/98	F01/98	FATAL	Internal RAM error	Defective microcontroller

#### NOTE

Due to the nature of fatal ROM & RAM errors, it may not be possible to present an error code on the display. In these cases the radio will attempt to display the appropriate error code, generate an illegal mode tone for one second and then reset its microcontroller.

**Table 40-12. Operational Display Codes**

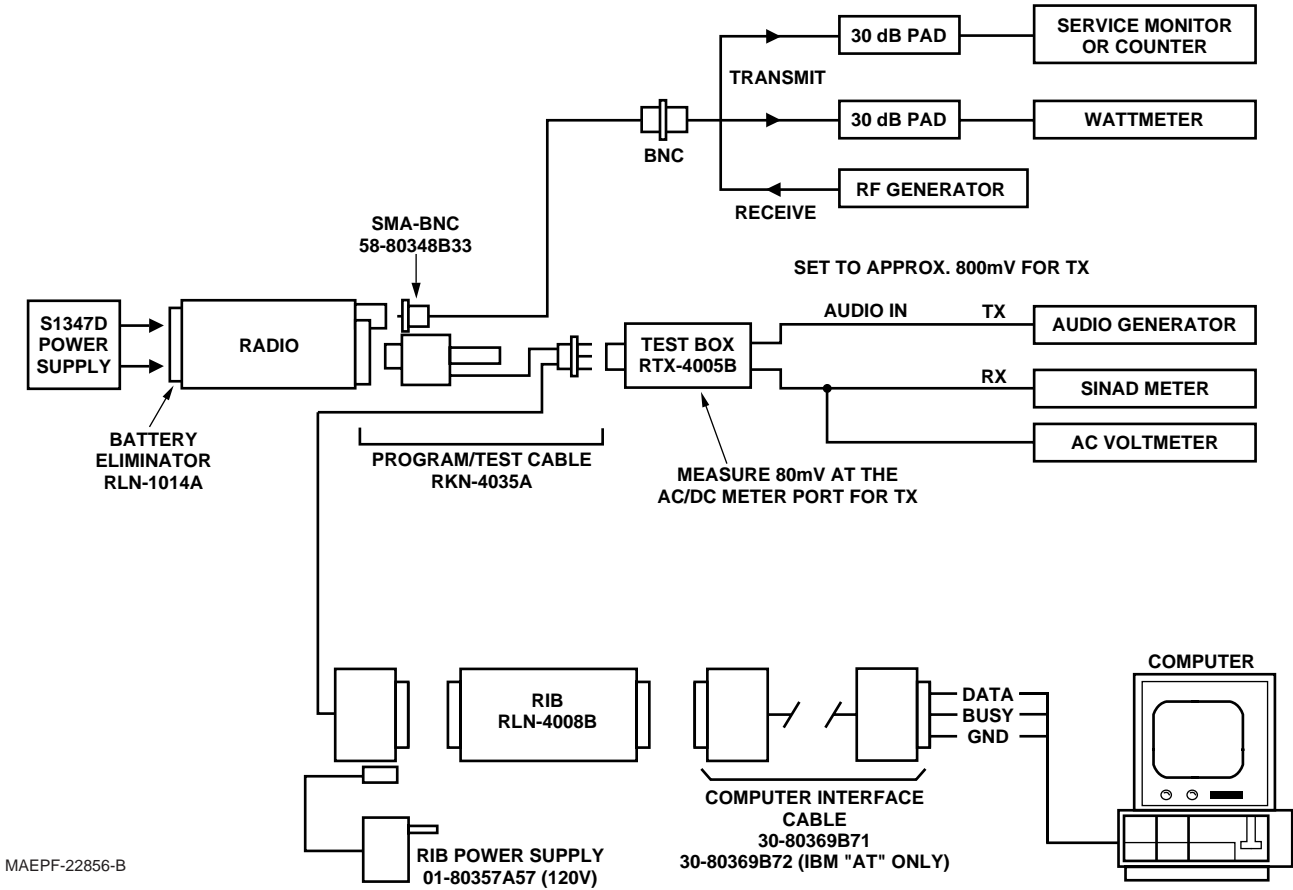
FAILURE CODE		DESCRIPTION	POSSIBLE SOURCE
14-Character Display	6-Character Display		
FAIL 001	F001	Synthesizer out of lock	Bad frequency data in codeplug; defective synthesizer
FAIL 002	F002	Selected Mode (Zone/Channel) codeplug checksum error	Bad codeplug data
FAIL 100	F100	Incompatible trunking software and hardware	Trunking hardware decoder disabled in codeplug; old SLIC IC version
FAIL 101	F101	Incompatible MDC1200 software and hardware	MDC 1200 hardware decoder disabled in codeplug; old SLIC IC version

# SECTION V. RADIO ALIGNMENT PROCEDURE

## A. General

An IBM PC (personal computer) and RSS (Radio Service Software) are required to align the radio. Refer to the applicable RSS manual for installation and setup

procedures for the software. To perform the alignment procedures, the radio must be connected to the PC, RIB (radio interface box), and Universal Test Set as shown in Figure 40-1.



MAEPF-22856-B

Figure 40-1. Radio Alignment Test Setup

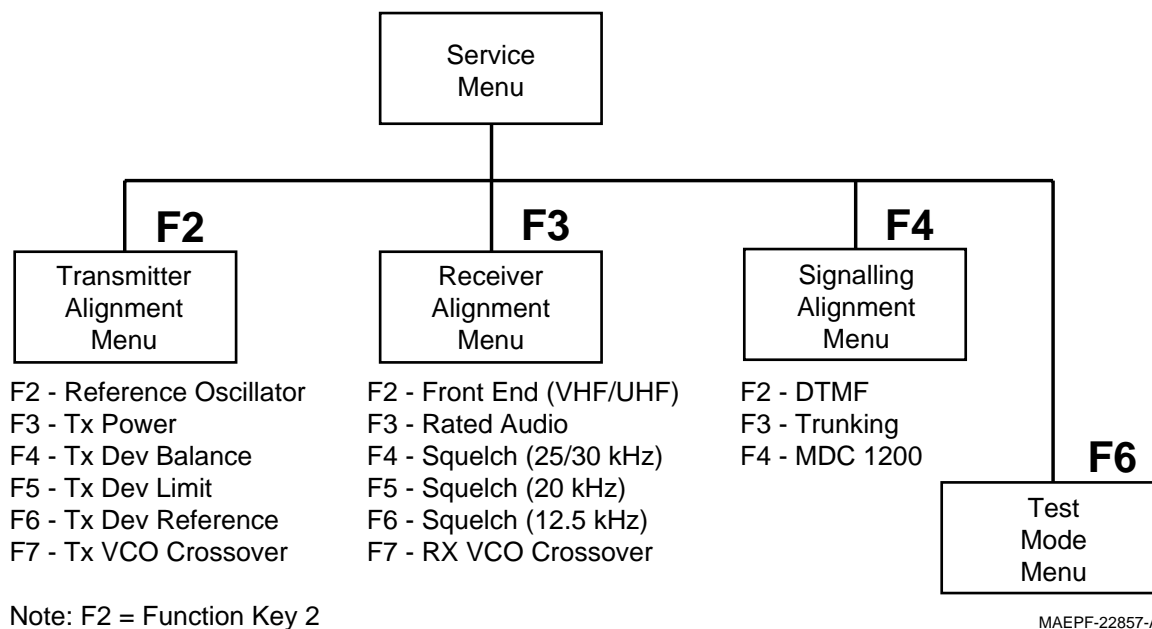


Figure 40-2. RSS Service Menu Layout

All service and tuning procedures are performed from the SERVICE menu, which is selected by pressing F2 from the MAIN MENU. Figure 40-2 illustrates how the RSS SERVICE screens are organized.

All SERVICE screens read and program the radio codeplug directly; you do NOT have to use the RSS GET/SAVE functions to use the SERVICE menus. You will be prompted at each screen to save changed values before exiting the screen. RSS references in this manual are to HT 1000 RSS. Some slight differences may be noted if you are using the MTS/MTX RSS.

The SERVICE screens introduce the concept of the “softpot”, an analog SOFTWARE controlled POTentiometer used for adjusting all transceiver alignment controls.

Each SERVICE screen provides the capability to increase or decrease the ‘softpot’ value with the keyboard UP/DOWN arrow keys respectively. A graphical scale is displayed indicating the minimum, maximum, and proposed value of the softpot, as shown in figure 40-3.

**CAUTION**

Do NOT switch radios in the middle of any SERVICE procedure. Always use the EXIT key to return to the MAIN menu screen before disconnecting the radio. Improper exits from the SERVICE screens may leave the radio in an improperly configured state and result in seriously degraded radio or system performance.

The radio contains internal test modes that can be accessed from the RSS. The test modes permit the service technician to easily select various frequency, modulation, and transmit power combinations to verify proper operation of the radio. The test modes can be used to check both transmit and receive operation. From the Service Menu press F6 to navigate to the TEST MODE screen.

MAEPF-22858-O

Figure 40-3. Softpot Concept

Adjusting the softpot value sends information to the radio to increase (or decrease) a DC voltage in the corresponding circuit. For example, pressing the UP arrow key at the Reference Oscillator screen instructs the radio microprocessor to increase the voltage across a varactor in the reference oscillator to increase the frequency.

In ALL cases, the softpot value is just a relative number corresponding to a D/A (Digital-to-Analog) generated voltage in the radio. All standard measurement procedures and test equipment are similar to previous radios.

Perform the following procedures in the sequence indicated.

**B. Reference Oscillator Alignment**

Adjustment of the reference oscillator is critical for proper radio operation. Improper adjustment will not only result in poor operation, but also a misaligned radio that will interfere with other users operating on adjacent channels. For this reason, the reference oscillator should be checked every time the radio is serviced. The frequency counter used for this procedure must have a stability of 0.1 ppm (or better).

1. From the SERVICE menu, press F2 to select TRANSMITTER alignment.
2. Press F2 again to select the REFERENCE OSCILLATOR softpot.
3. Press F6 to key the radio. The screen will indicate that the radio is transmitting.
4. Measure the transmit frequency on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the reference oscillator per the targets shown in Table 40-13.

**Table 40-13. Reference Oscillator Alignment**

BAND	TARGET
VHF	± 150 Hz
UHF	± 150 Hz
800 /900 MHz	± 150 Hz

**C. Front-End Pre-Selector (VHF/UHF only)**

**NOTE**

This procedure is only required for tuning the front-end filter varactors in the VHF and UHF models. The 800 and 900 MHz models utilize a stripline pre-selector.

1. Set the Test Box (RTX4005B) meter selection switch to the "VOL" position, and connect a dc voltmeter capable of 1mV resolution on a 2V scale to the Test Box AC/DC meter port to monitor the Received Signal Strength Indicator (RSSI).
2. From the SERVICE menu, press F3 to select RECEIVER alignment.
3. Press F2 to select the FRONT END FILTER softpot. The screen will indicate the receive frequencies at which the filter is to be tuned.
4. Set the RF test generator to the first receive frequency +150 Hz. Set the RF level at the radio standard antenna port to 4.0 µVolts with no modulation.
5. Adjust the UP/DOWN arrow keys to obtain a peak voltage on the dc voltmeter.
6. Press F8 to program the softpot value.
7. Repeat steps 4-6 for the remaining test frequencies.

8. Press F10 and F2 to return to the RECEIVER menu.

**D. Rated Audio**

1. Set test box (RTX-4005B) meter selection switch to the "AUDIO PA" position and connect an ac voltmeter to the test box ac/dc meter port.
2. Press F3 to select the RATED AUDIO softpot. The screen will indicate the receive test frequency to be used.
3. Set the RF test generator to the receive test frequency, and set the RF level at the radio standard antenna port to 1mV modulated with standard test modulation (see Table 40-14).

**Table 40-14. Standard Test Modulation (1 kHz Tone)**

CHANNEL SPACING	DEVIATION
25/30 kHz	3.0 kHz
20 kHz	2.4 kHz
12.5 kHz	1.5 kHz

4. Adjust the UP/DOWN arrow keys to obtain rated audio (as close as possible to 3.74 Vrms) into a speaker (28 ohms) or equivalent resistive load.
5. Press F8 to program the softpot value.
6. For 900 MHz radios, go to step 7; otherwise press F10 to return to the RECEIVER menu.
7. Now set the RF test generator to the receive test frequency, and set the RF level at the radio standard antenna port to 1mV modulated with a 1 kHz tone, 1.2 kHz deviation.
8. Select the Hear Clear RATED AUDIO softpot, and adjust the UP/DOWN arrow keys to obtain rated audio (3.74 Vrms) into a speaker (28 ohms) or equivalent resistive load.
9. Press F8 to program the softpot value
10. Press F10 to return to the RECEIVER menu.

**E. Squelch**

1. Channel spacing determines the next key press. Press F4, F5, or F6 (as applicable) to select the SQUELCH softpot.
2. With no signal applied, decrease the softpot value until squelch opens. Set the RF test generator to the test frequency plus the following offset:  
vhf: +200Hz    uhf: +200Hz    800MHz: +500Hz  
Adjust the generator for 8 to 10dB SINAD.
3. Increase the softpot until the squelch closes.
4. Monitor for squelch chatter. If chatter is present, increase the softpot until no chatter is detected. Press F8 to program the softpot value. Press ENTER to select the next softpot adjustment.
5. Repeat steps 2 thru 4 for all test frequencies shown on the screen.

- Press F10, F2, then F10 again to return to the service menu.

#### F. Transmitter Power

VHF and UHF radios require two power-level adjustments, a high-power or rated-power adjustment, and a low-power adjustment. The low power adjustment is required since the radio may be used in a reduced power mode, or with a vehicular adapter.

##### NOTE

All power measurements are to be made at the antenna port.

- From the SERVICE menu, press F2 to select TRANSMITTER alignment.
- Press F3 to select the TRANSMIT POWER softpot. The screen will indicate the transmit test frequencies to be used.
- Begin with the highest test frequency shown.
- Press F6 to key the radio, and use the UP/DOWN arrow keys to adjust the transmit power per the value shown in Table 40-15.
- Press F6 to dekey the radio, and then press F8 to program the value.
- Repeat steps 4-5 for the remaining test frequencies.
- Press F10, then F2 to return to the TRANSMIT menu.

#### G. Transmit Deviation Balance (Compensation)

Compensation alignment balances the modulation sensitivity of the VCO and reference modulation (synthesizer low frequency port) lines. The compensation algorithm is critical to the operation of signalling schemes that have very low frequency components (e.g. DPL) and could result in distorted waveforms if improperly adjusted.

##### NOTE (Secure-Equipped Only)

If a secure module is currently installed in the radio being aligned, refer to the appendix at the rear of this manual. Read section III, "Secure Alignment Procedure", before performing the transmit deviation balance (compensation) procedure.

- Press F4 to select the TRANSMIT DEVIATION BALANCE softpot. The screen will indicate the transmit test frequencies to be used.
- Begin with the lowest test frequency shown on the screen.
- Set the Test Box (RTX4005B) meter selector switch to the "MX DISC" position, and inject an 80 Hz tone at 100 mVrms into the AC/DC MTR port. Keep the ac voltmeter in parallel to ensure the proper input signal level.
- Press F6 to key the radio, and measure deviation. Record this measurement.
- Change the input tone to 3 kHz, 100 mVrms and use the UP/DOWN arrow keys to adjust the deviation to within  $\pm 2\%$  of the value recorded in step 4.
- Change the input tone back to 80Hz and measure the deviation.
- Repeat steps 5 and 6 until the 3 kHz tone deviation is within  $\pm 2\%$  of the 80Hz tone deviation.
- Press F6 to dekey the radio, and press F8 to program the softpot value. Press ENTER to move to next softpot value.
- Repeat steps 3-8 for the remaining test frequencies.
- Press F10 to return to the TRANSMIT menu.

##### NOTE

- The step size change for step 5 is approximately 2.5% per softpot value.
- This adjustment should only be made to the 3kHz deviation. Do not adjust the 80Hz deviation.

#### H. Transmit Deviation Limit

- Press F5 to select the TRANSMIT DEVIATION LIMIT softpot. The screen will indicate the transmit test frequencies to be used.
- Begin with the lowest test frequency shown on the screen.

Table 40-15. Transmit Power Setting

VHF			UHF		
Power Level	Test Frequencies		Power Level	Test Frequencies	
	136-174MHz	177.975MHz		450-512MHz	512-520MHz
<b>5 W</b>	5.2 - 5.4	4.2 - 4.4	<b>4 W</b>	4.2 - 4.4	3.2 - 3.4
<b>1 W</b>	1.2 - 1.4	1.2 - 1.4	<b>1 W</b>	1.2 - 1.4	1.2 - 1.4
<b>800 MHz</b>			<b>900 MHz</b>		
Power Level	All Test Frequencies		Power Level	All Test Frequencies	
<b>3 W</b>	3.20-3.40		<b>2.9 W</b>	2.80 - 3.00	

3. With the meter selector switch (RTX4005B) set to MIC, inject a 1 kHz tone on the AUDIO IN terminal on the test set, 80mVrms as measured on the AC/DC MTR port.
4. Press F6 to key the radio, and use the UP/DOWN arrow keys to adjust the deviation per the values shown in Table 40-16.

**Table 40-16. Transmit Deviation Limit**

BAND	DEVIATION (KHZ)
VHF/UHF/800 MHz	4.30 - 4.60
900 MHz	2.20 - 2.30

5. Press F6 to dekey the radio, and press F8 to program the softpot value. Press ENTER to move to the next softpot value.
6. Repeat steps 3-5 for the remaining frequencies shown on the screen.
7. Press F10 to return to the TRANSMIT menu.

**I. Transmit Deviation Limit Reference**

**NOTE**

1. This procedure is not required for 900 MHz models.
2. This procedure is required for VHF, UHF, and 800 MHz models with 20 kHz channel spacing and VHF and UHF models with 12.5 kHz channel spacing.

1. Press F6 to select the TRANSMIT DEVIATION LIMIT REFERENCE softpot.
2. With the meter selector switch (RTX4005B) set to MIC, inject a 1 kHz tone on the AUDIO IN terminal on the test set, 80mVrms as measured on the AC/DC MTR port.
3. Press F6 to key the radio, and use the UP/DOWN arrow keys to adjust the deviation per Table 40-17.

**Table 40-17. Transmit Deviation Limit Reference**

CHANNEL SPACING	DEVIATION (KHZ)
20 KHz	3.40 - 3.60
12.5 KHz	2.20 - 2.30

4. Press F6 to dekey the radio, and press F8 to program the softpot value.
5. Press F10 to return to the TRANSMIT menu.

**J. VCO Crossover Frequency**

**NOTE**

This procedure is only required after the field repair of a VHF or UHF VCO.

In order for a phase-locked-loop to tune very wide bandwidths, both negative and positive control voltages (Vcntl) are required. This procedure sets the crossover frequency at which the negative Vcntl (or -Vee) switches from zero to negative.

**TX VCO Crossover**

1. From the SERVICE menu, press F2 to select TRANSMITTER alignment.
2. Press F7 to select the TRANSMIT VCO CROSSOVER softpot. The screen will indicate the transmit test frequency to be used.
3. Connect a dc voltmeter capable of 1mV resolution to test point 5 (TP5), which is accessible through a hole in the bottom side VCO circuitry shield.
4. Beginning with the default softpot frequency of line 2, press F6 to key the transmitter, and adjust the UP/DOWN arrow keys until the voltage reading at TP5 is 3.0 ±0.1 volts. The frequency will increment in steps of 50kHz.
5. Press F6 again to dekey the transmitter, and press F8 to program the softpot value.

6. Press F10 twice to return to the SERVICE menu.

**RX VCO Crossover**

1. From the SERVICE menu, press F3 to select RECEIVER alignment.
2. Press F5 to select the RECEIVE VCO CROSSOVER softpot. The screen will indicate the receive test frequency to be used.
3. Connect a dc voltmeter capable of 1mVolt resolution to test point 5 (TP5), which is accessible through a hole in the bottom side VCO circuitry shield.
4. Beginning with the default softpot frequency of line 2, adjust the UP/DOWN arrow keys until the voltage reading at TP5 is 3.0 ±0.1 volts.
5. Press F8 to program the softpot value.
6. Press F10 twice to return to the SERVICE menu.

**K. Signalling Deviation**

Transmit deviation balance compensation and transmit deviation limit adjustments should be completed before signalling deviation is adjusted.

**DTMF Tuning**

1. From the SERVICE menu, press F4 to select SIGNALLING alignment.
2. Press F4 again to select the DTMF softpot.
3. Press F6 to key the radio on the test frequency. The screen will indicate that the radio is transmitting.
4. Measure the DTMF deviation on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the DTMF deviation per table 40-16.
6. Press F6 again to dekey the radio.
7. Press F8 to program the softpot value; press F10 to return to the SIGNALLING menu.



### Trunking High Speed Signalling

1. From the SERVICE menu, press F4 to select SIGNALLING alignment.
2. Press F3 to select the TRUNKING HIGH SPEED softpot.
3. Press F6 to key the radio on the test frequency. The screen will indicate that the radio is transmitting.
4. Measure the TRUNKING HIGH SPEED deviation on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the TRUNKING HIGH SPEED deviation per Table 40-18.
6. Press F6 again to dekey the radio.
7. Press F8 to program the softpot value; press F10 to return to the SIGNALLING menu.

### MDC 1200

1. From the SERVICE menu, press F4 to select SIGNALLING alignment.
2. Press F4 to select the MDC softpot.
3. Press F6 to key the radio on the test frequency. The screen will indicate that the radio is transmitting.
4. Measure the MDC deviation on your service monitor.
5. Use the UP/DOWN arrow keys to adjust the MDC deviation per table 40-16.
6. Press F6 again to dekey the radio.
7. Press F8 to program the softpot value; press F10 twice to return to the SERVICE menu.

The radio alignment procedure is now complete; the radio may be disconnected and returned to service.

**Table 40-18. Signalling Deviation**

CHANNEL SPACING (KHZ)	DTMF	TRUNKING	MDC
25 / 30	3.05-3.45	2.5-3.5	3.40-3.75
20 (VHF/UHF)	2.44-2.76	2.0-2.8	2.6-3.0
20 (821-824, 866-869)	2.44-2.76	2.0-2.8	2.6-3.0
12.5	1.55-1.85	1.40-1.75	1.640-1.875

## SECTION VI. DISASSEMBLY AND REASSEMBLY



### CAUTION

THIS RADIO CONTAINS STATIC-SENSITIVE DEVICES. DO NOT OPEN THE RADIO UNLESS PROPERLY GROUNDED. TAKE THE FOLLOWING PRECAUTIONS WHEN WORKING ON THIS UNIT.

1. Store and transport all complementary metal-oxide semiconductor (CMOS) devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
2. Ground the working surface of the service bench to protect the CMOS device. We recommend using the Motorola Static Protection Assembly (part number 0180386A82), which includes a wrist strap, two ground cords, a table mat, and a floor mat.
3. Wear a conductive wrist strap in series with a 100k resistor to ground. Replacement wrist straps that connect to the bench top covering are Motorola part number RSX-4015.
4. Do not wear nylon clothing while handling CMOS devices.
5. Neither insert nor remove CMOS devices with power applied. Check all power supplies that are to be used for testing CMOS devices to be certain that there are no voltage transients present.
6. When straightening CMOS pins, provide ground straps for apparatus used.
7. When soldering, use a grounded soldering iron.
8. If at all possible, handle CMOS devices by the package and not by the leads. Prior to touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

### A. General

Since this product disassembles and reassembles without the use of any screws, it is important for the technician to pay particular attention to the snaps and tabs, and how parts align with each other.

#### NOTE

In the disassembly/reassembly procedure, the numbers in parentheses refer to call-out numbers in the referenced figures.

### B. Disassembly to Board Level

1. Turn off the radio.
2. Remove the battery (see Figure 40-4).
  - a. Hold the radio such that the battery is tilted down.
  - b. Press down on the two battery-release levers.
  - c. With the release levers pulled down, the top of the battery will fall away from the radio.
  - d. Remove the battery completely from the radio.

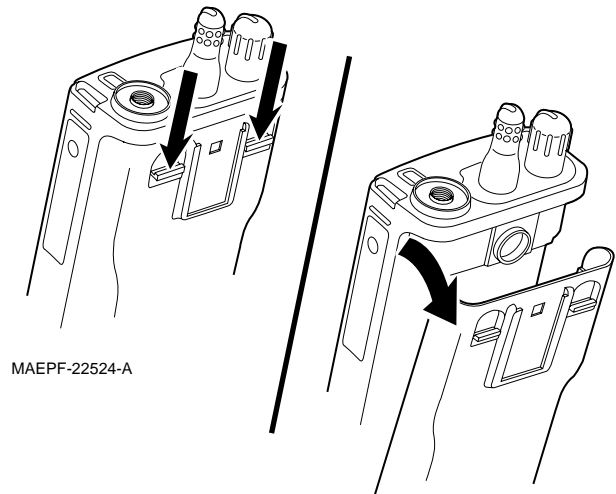


Figure 40-4.

3. Loosen the antenna by turning it in a counterclockwise direction, and remove it from the radio.
4. Remove the volume on/off knob and the channel selector switch knob by pulling them off their respective switch shafts.

#### NOTE

Both knobs **slide** on and off but fit very snug on their respective switch shafts. A small flat blade screwdriver may be necessary to help pry the knobs loose. Take care not to mar the surrounding radio surface.

5. Separate the front cover assembly from the internal electronics (chassis) (see Figure 40-5).

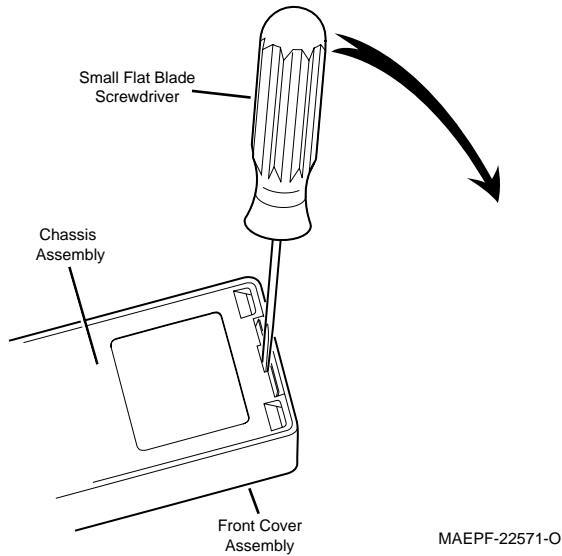


Figure 40-5.

- a. Insert a small, flat-blade screwdriver or like instrument in the slotted area at the bottom center of the radio. Take care not to mar the O-ring sealing area on the housing.
- b. Pry the bottom of the chassis free from the cover by pushing the screwdriver down and rotating the handle of the screwdriver over and behind the base of the radio. This prying action forces the thin inner plastic wall toward the base of the radio, which releases the two chassis base tabs.

**NOTE**

A flexible ribbon cable (front cover/display flex), which connects to the front cover assembly and the chassis, keeps you from completely separating the two units.

- c. Lay the chassis down, and rotate the front cover back and partially away from the chassis (see Figure 40-6).

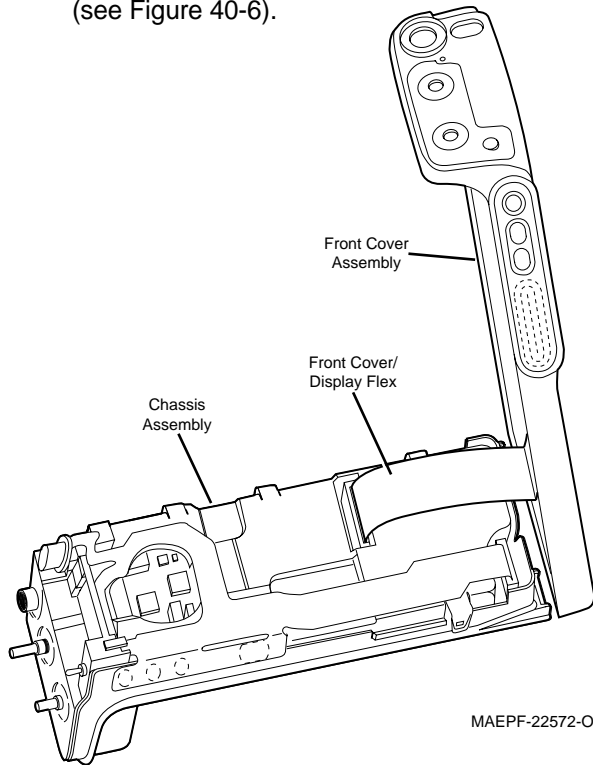


Figure 40-6.

6. Disconnect the front cover display flex from the connector on the chassis.

**NOTE**

A special locking connector secures the flex to the chassis (see Figure 40-7).

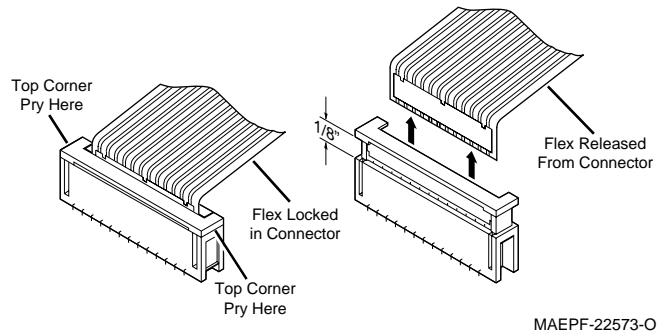


Figure 40-7.

- a. Use a small, thin, flat-blade screwdriver (or like instrument) to help raise the sliding portion of the connector approximately 1/8 of an inch from its seated position. A slight prying action, alternating back and forth on the top corners of the connector, achieves the best results for unlocking the connector.
  - b. Remove the flex from the chassis connector.
7. Remove the contoured O-ring/antenna bushing seal from the chassis.
  8. Disconnect the controls flex from the connector on the controller board by following the procedure in step 6a and 6b.

**NOTE**

A large portion of the controls flex is attached to the large metal shield (front shield) with adhesive. Do not remove the controls flex from the front shield unless it is absolutely necessary.

9. As a unit, separate the control top, the front shield, and the controls flex from the chassis and circuit boards (see Figure 40-8).

**NOTE**

Four large tabs secure the front shield to the chassis and hold the RF board and the controller board in the chassis.

MOTOROLA			
DESCRIPTION Fig. 20-6			
Jedi Disassembly P			
ILLUSTRATOR	DATE	ENG	
EH	2/21/92	C	
EDITOR	DATE	CHK	
JWB	3/4/92		
LETTERING S			

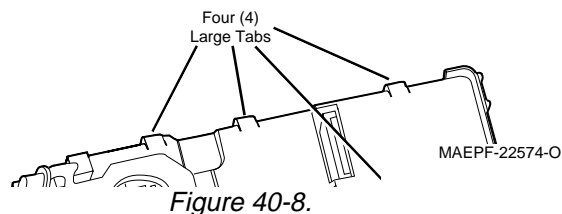


Figure 40-8.

- a. Loosen the front shield by prying each of the four tabs away from the chassis. Be careful not to pry the tabs any more than is necessary to free them from their respective retaining slots. To completely loosen the shield from the chassis, a slight lifting and clockwise twisting action may be required.
- b. Insert a small, flat-blade screwdriver in the recessed area of the control top and pry the control top slightly away from the chassis.
- c. Completely remove the control top/front shield/controls flex unit from the chassis.

10. Carefully remove the RF board and the controller board from the chassis.

**NOTE**

The RF board and the controller board are connected together with a jumper flex. The connection is made more rigid using a hard plastic cover that snaps across the top of the jumper flex (see Figure 40-9).

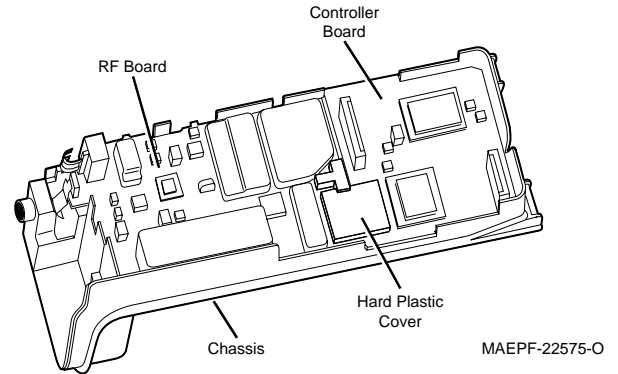


Figure 40-9.

**C. Disassembly of Control Top**

1. Remove the rubber controls seal from the control top.
2. Turn the control top such that the black switch housing cover is facing up.
  - a. Five retaining clips hold the switch housing cover to the switch housing. Clips 1, 2, and 3 are important during disassembly (see Figure 40-10).

**NOTE**

To perform step 2b, two tools will be required; your thumbnail or small, flat-blade screwdriver, and a pen, pencil, or another small, flat-blade screwdriver.

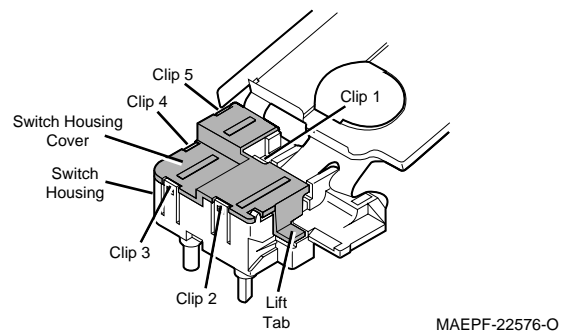


Figure 40-10.

- b. Using your thumbnail or small, flat-blade screwdriver, lift the tab that covers the base of the LED approximately 1/16 of an inch from its seated position. While applying constant lifting pressure there, (in order) release clips 1, 2, and 3 with the other tool.

- c. The cover will pop loose from the switch housing.
- 3. Push the three switches and the LED out of the switch housing.
- 4. The remainder of the controls flex is attached to the switch housing with adhesive. Do not remove the flex from the switch housing unless it is absolutely necessary.

**D. Disassembly of Front Cover Assembly**

- 1. On top display model radios only, release the display board by using a “press and pull” action on the top two corners of the display board. Press down on the two top corners of the display board and pull the top of the board away from the two corner retaining tabs. The display board will free itself from the retaining tabs and two retaining slots in the front cover housing.
- 2. Remove the edge connector (part of the front cover flex, located behind the universal connector), by sliding it out of the plastic rails that hold it in place. A slight prying action, alternating back and forth on the bottom corners of the connector, achieves the best results.
- 3. Remove the speaker retainer bracket, speaker, microphone, and front cover flex from the front cover housing (see Figure 40-11).

**NOTE**

The speaker and front cover flex are held in position with a three-leg retainer bracket. The legs of the bracket are secured by slots in the front cover. When removing the retainer bracket, use caution not to damage the speaker.

- a. Disengage the retainer bracket leg that points toward the bottom of the front cover from its retaining tab.

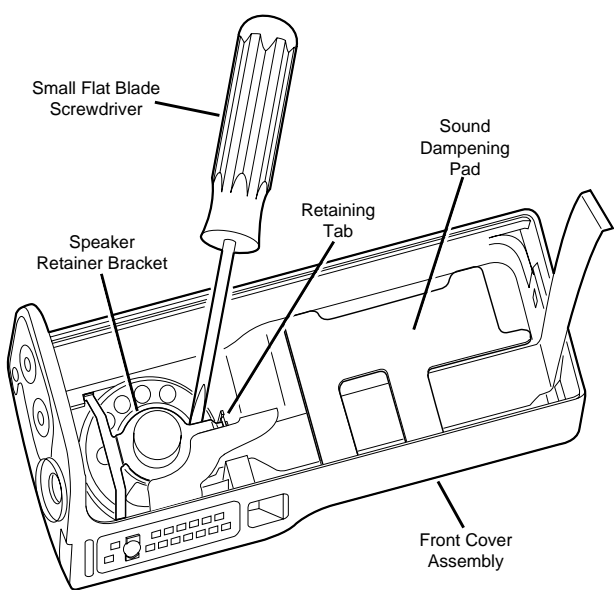


Figure 40-11.

- (1) Insert a small, flat-blade screwdriver under the base of the bracket leg near the ring.
- (2) Lift the bracket leg until it pops loose from under its retaining tab.

- b. Lift the freed leg of the retainer bracket and use it to pull the remaining two legs of the bracket out and away from their respective slots in the front cover housing.
- c. Pull the rubber microphone boot, containing the microphone, from its seated position. Unless you are replacing the microphone, leave the microphone in the boot.
- 4. Remove, if necessary, and replace the sound dampening pad.
- 5. As necessary, replace the speaker and/or microphone while out of the front cover housing.

**NOTE**

If the microphone is replaced, ensure that the microphone is reinstalled back into the rubber boot with the microphone port facing the round hole at the bottom of the boot.

- 6. On front display model radios only, notice that the keypad/display board is secured to the front cover housing using six tabs, three small tabs on one side and three larger tabs on the universal connector side. Remove the keypad/display board by inserting a small flat-blade screwdriver in the circuit board slot provided (slot nearest the top retaining tab on the universal connector side of the radio, see Figure 40-12). A slight prying action will release the keypad/display board. If applicable, remove the rubber keypad.

**NOTE**

Be careful not to mar the front cover housing O-ring sealing area. Doing so will compromise the sealing integrity of the radio.

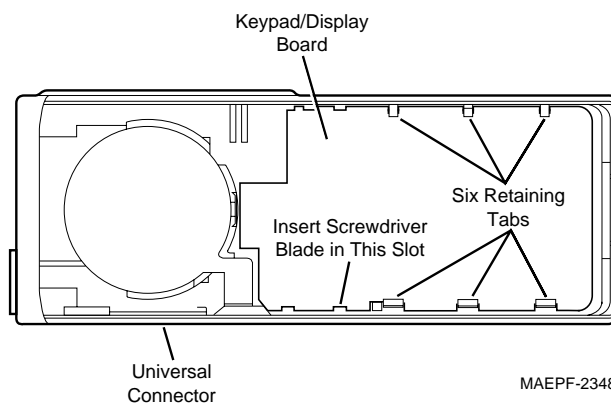


Figure 40-12.

## E. Reassembly

Reassembly is the reverse of disassembly. Some suggestions and illustrations are provided to help you more easily reassemble the radio.

1. Keypad/Display Board  
(front display model radios only)
  - a. If applicable, replace the rubber keypad.
  - b. Place the keypad/display board into the front cover housing at an angle such that the three small slots on the edge of the board slide under the three mating retaining tabs. Ensure that the board slides **under** the tabs.
  - c. Near the three larger slots on the other side of the board, use finger pressure to push and press that side of the board down until it snaps into place under the three large retaining tabs.
2. Front Cover Assembly
  - a. Place the speaker and microphone into their respective positions in the front cover. Make sure that the speaker is seated properly in the recessed area provided.
  - b. Press the rubber microphone boot into its respective recessed area in the front cover housing. The little rubber flap in the back of the rubber boot should fold up to cover the microphone insertion opening.
  - c. Reinstall the speaker retainer bracket (see Figure 40-13).

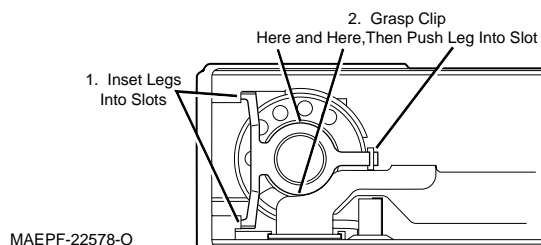


Figure 40-13.

- (1) Position the spring bracket over the speaker, and toward the top of the front cover housing; insert the appropriate two legs of the bracket into their respective slots
  - (2) Grasp the center portion of the spring bracket (ring area) with thumb and forefinger.
  - (3) While holding the ring area of the spring bracket at approximately the same height as the speaker's base, push the remaining leg down and into its respective slot.
- d. Orient the edge connector so that its gold contacts face the gold contacts of the housing. Align the edge connector with the respective

slots in the housing, and slide the connector down into place. Ensure that the edge connector is fully seated into position.

- e. On top display model radios only, seat the display board by inserting the two display board tabs into their mating slots in the front cover housing. Push the top of the display board toward the top of the radio until the front cover housing retaining tabs engage the display board and secure it into position.
3. Chassis  
Inside of the chassis where the RF board fits is a protruding block that functions as the PA heatsink. To help provide maximum heat transfer, ensure that the PA heatsink block (top surface) is coated with a thin film of thermal compound (Motorola part number 1110022A55).  
Place the RF board and controller board into the chassis. Ensure that the plastic cover that more rigidly holds the two boards together is snapped into place.
  4. Control Top
    - a. Reinstall the switches and LED into the switch housing.
    - b. Reinstall the switch housing cover onto the switch housing by sliding tabs 4 and 5 of the cover into their respective clips on the housing. Then press down on the cover to engage tabs 1, 2, and 3.
  5. Control Top/Front Shield/Controls Flex as a Unit to Chassis
    - a. Slide the control top into the appropriate position in the chassis, and place the front shield into position over the chassis and circuit boards.
    - b. Check to see that the four large tabs of the front shield are aligned with the respective slots on the sides of the chassis, then snap the front shield in place. Ensure that the shield is fully seated, especially in the PTT switch area.
    - c. Slide the connector end of the controls flex into the special locking connector mounted on the control board. Ensure that the flex is fully seated into the board connector and secure the connection.

### NOTE

View the flex connection at a slight angle from the **bottom** of the radio (see Figure 40-14). If the flex is fully seated, the orange circuit plating will be parallel with the connector top surface and three reliefs in the plating will make the flex plating appear to be separated. If the orange plating of the flex is not parallel with the connector's top surface, or the three reliefs are raised enough to see plating under them, then the flex is not fully seated.

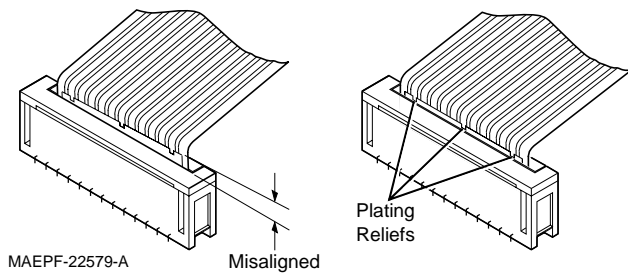


Figure 40-14.

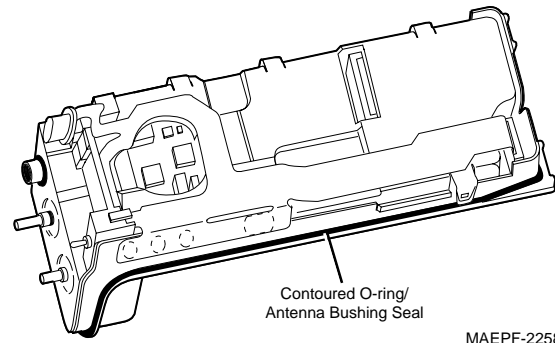


Figure 40-15.

- d. Reinstall the rubber controls top seal on the control top.

**NOTE**

Two tabs are provided in the emergency button area to help hold the seal in place.

6. Front Cover Assembly to Chassis

- a. Install the contoured O-ring/antenna bushing seal around the antenna and in the groove provided (see Figure 40-15).
- b. Orient the front cover assembly with the chassis, and insert the front cover/display flex connector into the locking connector of the controller board (refer back to Figure 40-6). Secure the connection. View the flex connection at a slight angle from the **top** of the radio and ensure that the flex connector is fully seated into the locking connector as described in step 4c.
- c. Check to make sure that the O-ring is in place, and slide the chassis (switch end first) into the

front cover assembly. Check to ensure that the orange emergency button seal slides into position freely.

**NOTE**

When performing the next part of this step, pay particular attention to the O-ring near the bottom of the radio to ensure that it does not raise up and get pinched between the front cover clip and the chassis. With the top of the chassis fully seated, lower the bottom of the chassis and press it into the front cover assembly until it snaps into place.

- d. Check the emergency button again. If it is cocked to one side, repositioning it may be necessary.
- 6. Reinstall the switch knobs and antenna; the shorter knob with the volume on/off switch, the taller knob with the channel selector switch.
- 7. Reinstall the battery.

## SECTION VII. MAINTENANCE

### A. Introduction

This section of the manual describes preventive maintenance, safe handling of CMOS devices, and repair procedures and techniques. Each of these topics provides information vital to the successful operation and maintenance of your radio.

### B. Preventive Maintenance

The HT 1000, MT 2000, MTS 2000, and MTX series radios do not require a scheduled preventive maintenance program; however, periodic visual inspection and cleaning is recommended.

#### 1. Inspection

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

#### 2. Cleaning

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

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



#### CAUTION

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

#### a. Cleaning External Plastic Surfaces

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

#### b. Cleaning Circuit Boards and Components

Isopropyl alcohol may be applied with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-

to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of the radio.

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

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

#### NOTE

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

### C. Safe Handling of CMOS Devices

Complementary metal-oxide semiconductor (CMOS) devices are used in this family of radios. While the benefits of CMOS are many, their characteristics make them susceptible to damage by electrostatic or high voltage charges. Damage can be latent, resulting in failures occurring weeks or months later. Therefore, you must take special precautions to prevent device damage during disassembly, troubleshooting, and repair. Handling precautions are mandatory for CMOS circuits, and are especially important in low humidity conditions. DO NOT attempt to disassemble the radio without first referring to the CMOS CAUTION paragraph in the Disassembly and Reassembly section of the manual.

### D. Repair Procedures and Techniques

Refer to the Disassembly and Reassembly section of the manual for pertinent information prior to replacing and substituting parts.

#### 1. General

##### a. Parts Replacement and Substitution

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

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



b. Rigid Circuit Boards

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

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

c. Flexible Circuits

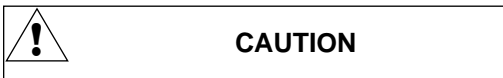
The flexible circuits are made from a different material than the rigid boards, and different techniques must be used when soldering. Excessive prolonged heat on the flexible circuit can damage the material. Avoid excessive heat and excessive bending. For parts replacement, use the ST-1087 Temperature-Controlled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

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

2. Specific

During all repair procedures, heating neighboring components can be minimized by:

- using upper heat only.
- using the correct size heat-focus head, approximately the same size as the carrier being replaced.
- keeping the heat focus head approximately 1/8" above the printed circuit board when removing or replacing the device.



If neighboring OMPAC components are heated above 365 degrees F. (185 degrees C.), they will suffer die-bond delamination and possible "popcorn" failure.

a. Strip Connector (P301/P704)

On the latest version HT 1000, MT 2000, MTS 2000, and MTX series radios, a strip connector, two female connectors and a strain relief electrically connect the RF board with the controller board. On earlier versions of these radios, the RF board and controller board were connected using a jumper flex that soldered directly to the circuit board solder pads.

An interconnect kit, REX4035A, is available to retrofit earlier version jumper-flex radios with the later version strip connector parts. The REX4035A kit includes the following items:

- CONNECTOR, Female (J301) 0905461X01
- CONNECTOR, Female (J704) 0905461X01
- CONNECTOR, Male (P301/P704) 0905461X01
- STRAIN RELIEF 4205507X01
- INSTRUCTIONS 6880309F14

b. Jumper Flex (on radios shipped prior to 7/94)

Jumper flexes are not available. They are replaced with connectors as described in paragraph "a" of this section. If the jumper flex needs to be replaced, order Interconnect Kit REX4035A. The retrofit kit includes all of the parts required and detailed instructions on the removal of the old jumper flex, and the installation of the new connector arrangement.

c. RF Switch (S101):

Refer to the applicable exploded view and to your radio's RF board (antenna contact area) to locate the RF switch components.

**NOTE**

The RF switch spring and the RF switch piston must be ordered separately.

**To remove the RF switch:**

- (1) On VHF and UHF radios, unsolder the two tabs of the RF switch bracket that secure the RF switch to the RF board. On 800MHz and 900MHz radios, use a #2 slotted screwdriver to straighten the two tabs of the RF switch bracket that wrap around the RF board. Use your forefinger to hold the RF switch bracket to the RF board while straightening the tabs to avoid lifting the solder tabs on the opposite end of the RF switch bracket.

- (2) Refer to Figure 40-16 and use a small heat-focus head to distribute heat over the area occupied by the three solder tabs until the solder softens.

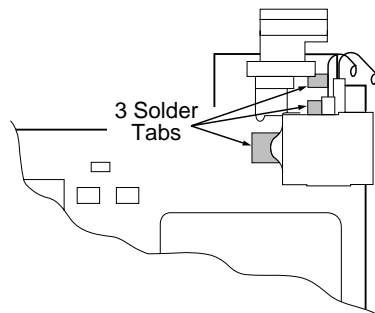


Figure 40-16.

- (3) Carefully lift the RF switch assembly away from the rf board. Notice that the RF switch circuit board remains attached (soldered) to the RF board.
- (4) Using the same heat-focus head as in step (3), unsolder the RF switch circuit board and remove it from the RF board using forceps.
- (5) In the RF switch circuit board area, reflow all the solder pad areas on the main RF board such that similarly shaped pads have uniform solder heights. Add or remove solder as required. Clean the RF board thoroughly. Then swab on a minimum amount of flux to each of the solder pads.

#### To replace the RF switch:

- (1) Place the RF switch assembly on the RF main board and gently heat. Visually inspect to make sure no flux migrated onto the gold plated areas of the RF switch board. The guide pins should provide self alignment between the two circuit boards. Visually inspect the plastic switch housing to ensure that it has not warped due to overheating.
- (2) While holding the RF switch bracket firmly against the RF board:
  - VHF and UHF radios - solder the two leads of the housing to the solder pads on the RF board.
  - 800MHZ and 900MHz radios - bend the two tabs around the side of the RF board as close to the board edge as possible to hold the bracket down tightly.


- (3) Insert the new RF switch spring and RF switch piston into the RF switch assembly. The contacts of the piston should be facing the gold-plated pads of the RF switch board. Once the spring and piston are inserted into the RF switch, they will be retained by the switch.


#### d. Chip Components

Use either the RLN-4062 Hot-Air Repair Station or the Motorola 0180381B45 Repair Station for chip component replacement. When using the 0180381B45 Repair Station, select the TJ-65 mini-thermojet hand piece. On either unit, adjust the temperature control to 700 degrees F. (370 degrees C), and adjust the airflow to a minimum setting. Airflow can vary due to component density.

- (1) **To remove a chip component**, select a hot- air hand piece and position the nozzle of the hand piece approximately 1/8" (0.3cm) above the component to be removed. Begin applying the hot air. Once the solder reflows, remove the component using a pair of tweezers. Using solder wick and a soldering iron or a power desoldering station, remove the excess solder from the pads.
- (2) **To replace a chip component using a soldering iron**, select the appropriate micro-tipped soldering iron and apply fresh solder to one of the solder pads. Using a pair of tweezers, position the new chip component in place while heating the fresh solder. Once solder wicks onto the new component, remove the heat from the solder. Heat the remaining pad with the soldering iron and apply solder until it wicks to the component. If necessary, touch up the first side. All solder joints should be smooth and shiny.
- (3) **To replace a chip component using hot air**, select the hot-air hand piece and reflow the solder on the solder pads to smooth it. Apply a drop of solder paste flux to each pad. Using a pair of tweezers, position the new component in place. Position the hot-air hand piece approximately 1/8" (0.3cm) above the component and begin applying heat. Once the solder wicks to the component, remove the heat and inspect the repair. All joints should be smooth and shiny.

e. Over-Molded Pad-Array Carrier (OMPAC)


	<b>CAUTION</b>
<p>All pad-array carriers in these radios, except for the IF IC (U3), are OMPAC. Prior to use, all OMPACs must be kept in the sealed bag (with moisture-indicator card) as supplied by the Motorola Parts Department. Once the sealed bag is opened and/or the OMPAC subjected to ambient humidity (for an unknown amount of time or for more than 96 hours) then that OMPAC must be baked in an oven for at least eight hours at 260 degrees F. (125 degrees C.)</p>	

	<b>CAUTION</b>
<p>If neighboring OMPAC components are heated above 365 degrees F. (185 degrees C.), they will suffer die-bond delamination and possible "popcorn" failure.</p>	

During all repair procedures, heating neighboring components can be minimized by:

- using upper heat only.
- using the correct size heat-focus head, approximately the same size as the carrier being replaced.
- keeping the heat focus head approximately 1/8"-1/4" (0.3cm-0.6cm) above the printed circuit board when removing or replacing the device.

- (1) **To remove an OMPAC**, select the R-1319 Rework Station and the appropriate heat-focus head (approximately the same size as the OMPAC. Attach the heat-focus head to the chimney heater. Adjust the temperature control to approximately 415 degrees F (215 degrees C); 445 degrees F (230 degrees C) maximum. Apply the solder paste flux around the edge of the OMPAC. Place the circuit board in the circuit board holder, and position the OMPAC under the heat-focus head. Lower the vacuum tip and attach it to the OMPAC by turning on the vacuum pump. Lower the heat-focus head until it is approximately 1/8"-1/4" (0.3cm-0.6cm) above the carrier. Turn on the heater and wait until the OMPAC lifts off the circuit board. Once the part is off, grab it with a pair of tweezers and turn off the vacuum pump. Remove the circuit board from the R-1070's circuit board holder.

	<b>CAUTION</b>
<p>The application of heat to the OMPAC device, beginning at ambient air temperature and ending with the OMPAC lifting from the circuit board, should take longer than 60 seconds. If the OMPAC lifts from the circuit board earlier than 60 seconds:</p> <ul style="list-style-type: none"><li>• check the temperature control setting on the rework station, and if OK</li><li>• lift the heat-focus head an additional 1/8" from nominal setting, and</li><li>• check the circuit board plating for possible damage.</li></ul>	

- (2) **To replace an OMPAC**, the solder pads on the board must first be cleaned of all solder to ensure alignment of the new chip carrier. Prepare the site by using solder wick and a soldering iron to remove all solder from the solder pads on the circuit board. If a power desoldering tool is available, it can be used instead of the solder wick. Clean the solder pads with alcohol and a small brush. Dry and inspect. Ensure that all solder is removed.

Once the preparation is complete, place the circuit board back in the circuit board holder. Add solder paste flux in the trench of the flux block and spread it using a one-inch putty knife. Flux the OMPAC by placing it in the trench of the flux block. Once the flux is applied, place the OMPAC on the circuit board, making certain that it is oriented correctly on the board. Position the heat-focus head over the OMPAC and lower it to approximately 1/8"-1/4" (0.3cm-0.6cm) over the carrier. Using the same heat setting used to remove the OMPAC, turn on the heater and wait for the carrier to reflow (heating and reflow should take longer than 60 seconds). Watch the OMPAC reflow and note that when a proper reflow has taken place, the OMPAC will drop (usually one side, then the other). The end result is that both sides have reflowed, and the OMPAC is sitting parallel to the circuit board.

Once the carrier reflows, raise the heat-focus head and wait approximately one minute for the part to cool. Remove the circuit board and inspect the repair. No cleaning should be necessary.

f. Thin Small Outline Package (TSOP)  
Components

**Removing and replacing a TSOP component** will be done with the R-1319, using the same procedure used to remove and replace an OMPAC.

Place the circuit board in the circuit board holder. Select the proper heat focus head and attach it to the heater chimney. Position the TSOP component under the heat-focus head. Lower the vacuum tip and attach it to the component by turning on the vacuum pump. Lower the focus head until it is approximately 1/8"-1/4" (0.3cm-0.6cm) above the component. Turn on the heater and wait until the TSOP lifts off the circuit board.

Once the part is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump. Prepare the circuit board for the new component by applying solder paste flux to the solder pads. Position the circuit board under the heat-focus head, lower the head to approximately 1/8"-1/4" (0.3cm-0.6cm) above the board, and turn on the heat. When the solder left behind on the pads reflows, turn off the heat and raise the heat-focus head. Remove the circuit board from the holder and inspect the pads to ensure that the solder has flattened out and that there are no solder shorts. Clean the area with alcohol and a small brush.

Once the preparation is complete, place the circuit board back in the circuit board holder. Add solder paste flux to the solder pads and place the new component on the circuit board. Position the heat-focus head over the component and lower it to approximately 1/8"-1/4" (0.3cm-0.6cm) above the carrier. Turn on the heater and wait for the component to reflow.

Once the component reflows, raise the heat-focus head and wait approximately one minute for the part to cool. Remove the circuit board and inspect the repair. No cleaning should be necessary.

g. Shields

**Removing and replacing the shields** will be done with the R-1319, using the same procedure used to remove and replace TSOP and OMPAC components.

Place the circuit board in the circuit board holder. Select the proper heat focus head and attach it to the heater chimney. Add solder paste flux around the base of the shield. Position the shield under the heat-focus head. Lower the vacuum tip and attach it to the shield by turning on the vacuum pump. Lower the

focus head until it is approximately 1/8"-1/4" (0.3cm-0.6cm) above the shield. Turn on the heater and wait until the shield lifts off the circuit board. Once the shield is off, turn off the heat, grab the part with a pair of tweezers, and turn off the vacuum pump. Remove the circuit board from the circuit board holder.

**To replace the shield**, add solder to the shield if necessary, using a micro-tipped soldering iron. Next, rub the soldering iron tip along the edge of the shield to smooth out any excess solder. Use solder wick and a soldering iron to remove excess solder from the solder pads on the circuit board. Place the circuit board back in the circuit board holder. Place the shield on the circuit board using a pair of tweezers. Position the heat-focus head over the shield and lower it to approximately 1/8"-1/4" (0.3cm-0.6cm) above the shield. Turn on the heater and wait for the solder to reflow.

Once complete, turn off the heat, raise the heat-focus head, and wait approximately one minute for the part to cool. Remove the circuit board and inspect the repair. No cleaning should be necessary.

h. RF PA (U105)

The procedure for removing and replacing the RF PA is very similar to the procedure for removing and replacing an OMPAC or a TSOP component. But because the device is large, extra heating time is required to flow the pads. And as a result, neighboring components (especially those on the opposite side of the circuit board) will heat, reflow, and may inadvertently move. Be careful when performing the following procedure.

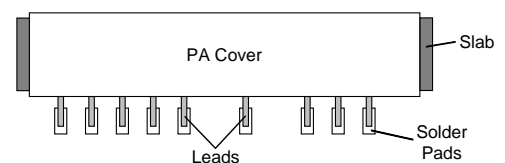


Figure 40-17.

- (1) Refer to Figure 40-17 for RF PA nomenclature.

**To remove the RF PA**, add flux to the leads of the device, and use a soldering iron and pair of tweezers to heat and lift each lead free and clear of its respective solder pad on the circuit board. Use the R-1319 Rework Station and the heat-focus head designed especially for removal of the RF PA. Attach the heat-focus head to the chimney heater. Adjust the temperature control to approximately 415 degrees F

(215 degrees C) 445 degrees F (230 degrees C) maximum. Apply solder paste to the exposed solder pads under the PA. Place the circuit board in the circuit board holder, and position the RF PA under the heat-focus head. Lower the heat-focus head until it is approximately 1/8"-1/4" (0.3cm-0.6cm) above the PA cover. Turn on the heater and begin the reflow cycle. Heating time should not be less than two minutes.

Once the part has reflowed, before trying to remove the PA, **carefully** lower the circuit board holder as follows:

- Loosen the thumbscrew on the shaft of the circuit board holder,
- push the spring-loaded holder down and away from the heat-focus head, and
- retighten the thumbscrew with the holder in the bottomed position.

Grab the PA with a large pair of tweezers and remove it from the circuit board. Let the circuit board cool for approximately two minutes. Then remove the circuit board from the circuit board holder.

- (2) **To replace the RF PA;** if necessary, add solder to the PA ground plane on the printed circuit board. Then clean each PA lead

solder pad on the circuit board to ensure alignment of the new RF PA. Prepare the sight by using solder wick and a soldering iron to remove all solder from the solder pads. Clean the solder pads with alcohol and a small brush. Dry and inspect. Ensure that all solder is removed.

Once the preparation is complete, place the circuit board back in the circuit board holder. Add solder paste flux to the ground plane and to the leads' solder pads. Once the flux is applied, place the new RF PA on the circuit board, making certain that the PA heatsink sits flush on the board. Position the heat-focus head over the RF PA and lower it to approximately 1/8"-1/4" (0.3cm-0.6cm) above the PA cover. Turn on the heater and begin the reflow cycle. Heating time should not be less than two minutes.

Once the RF PA reflows, raise the heat-focus head and wait approximately two minutes for the part to cool. Remove the circuit board and inspect the solder joint between the slab and the ground plane. No cleaning should be necessary. Use the soldering iron and add solder to each of the RF PA leads and associated pads. Inspect the lead/pad bond for opens and solder shorts.

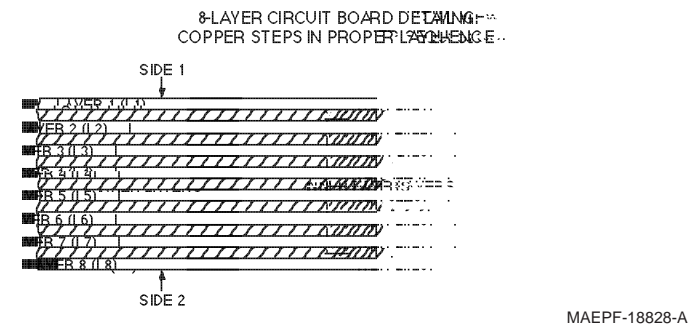
**SCHEMATIC AND CIRCUIT BOARD NOTES**

- \* COMPONENT IS FREQUENCY SENSITIVE. REFER TO THE ELECTRICAL PARTS LIST FOR VALUE AND USAGE.
- UNLESS OTHERWISE STATED, RESISTANCES ARE IN OHMS (k = 1000), AND CAPACITANCES ARE IN PICO FARADS (pF) OR MICROFARADS (uF).
  - DC VOLTAGES ARE MEASURED FROM POINT INDICATED TO CHASSIS GROUND USING A MOTOROLA DC MULTIMETER OR EQUIVALENT. TRANSMITTER MEASUREMENTS SHOULD BE MADE WITH A 1.2 uF CHOKE IN SERIES WITH THE VOLTAGE PROBE TO PREVENT CIRCUIT LOADING.
  - REFERENCE DESIGNATORS ARE ASSIGNED IN THE FOLLOWING MANNER:  
 UNITS SERIES = RECEIVER  
 100 SERIES = TRANSMITTER  
 200 SERIES = FREQUENCY GENERATION  
 300 SERIES = MISCELLANEOUS  
 400 SERIES = HOUSING/ESCUTCHEON  
 500 SERIES = DISPLAY  
 600 SERIES = HEAR CLEAR OPTION  
 700 SERIES = CONTROLLER
  - INTERCONNECT TIE POINT LEGEND:  
 5V REG = REGULATED FIVE VOLTS  
 B+ = BATTERY VOLTAGE (7.5V)  
 R5 = RECEIVER FIVE VOLTS  
 T5 = TRANSMITTER FIVE VOLTS  
 CLK = CLOCK  
 D = DATA  
 DAC = DIGITAL TO ANALOG CONVERTER  
 DAC RST = DAC RESET  
 LCK = LOCK  
 NC = NO CONNECTION  
 SYN = SYNTHESIZER  
 VR = VOLTAGE REGULATOR

INSERT DIAGRAMS  
 (L1) BEPF-24631-O (20% BLK, 133 LINE)  
 (OL) BEPF-24632-O (100% BLK.)  
 R.T. 50%

INSERT SCHEMATIC DIAGRAM  
 63D81200C31-O (100% BLK.)  
 (OL) DEPF-24635-O (100% RED)  
 R.T.

INSERT DIAGRAMS  
 (L8) BEPF-24633-O (20% BLK., 133 LINE)  
 (OL) BEPF-24634-O (100% BLK.)  
 R.T. 50%



**Electrical Parts List, VHF Transceiver Boards; VHF  
 NUD7070A, NUD7070B  
 NUD7085A, NUD7085B**

TPLF- 4072-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		<b>CAPACITOR, Fixed: pF ±5%; 50V unless stated</b>
C4	2113741F13	330
C6	2113740F22	6.2 ± 0.25pF
C7	2113740F13	2.7 ± 0.25pF
C8	2113740F32	16
C9	-----	Not Placed
C11	2113741F49	.01µF
C12	-----	Not Placed
C13	2113741F49	.01µF
C14	2311049A66	22µF; 4V
C15	2113741F49	.01µF
C16	2113740F20	5.1 ± 0.25pF
C31	2113741F49	.01µF
C33	2113740F26	9.1
C34	2113740F43	47
C35	2113740F40	36
C36	2113740F19	0.47µF; ±0.25pF
C38	2113740F17	3.9µF; ±0.25pF
C40	0662057B47	0
C41	2113740F51	100
C42 thru 46	2113743A19	0.1µF
C47	2109720D14	0.22µF
C48	2113741F16	430
C49	2113743A19	0.1µF
C50	2113743K15	0.1µF
C52	2113741A51	0.18µF
C53	2113749B17	15µF
C54	2113741F13	330
C55	2113740F37	27
C56, 57	2113740F42	43
C58	2113740F11	2.2
C60	2113743K15	0.1µF
C61	2109720D14	0.1µF
C62	2113741F49	.01µF
C63	2113743K15	0.1µF
C65	2113741F49	.01µF
C70	2113741F49	.01µF
C71 thru 72	2113741F13	330
C77	2113743K15	0.1µF
C80	2113740F39	33
C82 thru 84	2113741F49	.01µF
C85	2311049A60	10µF; 4V
C86	2113740F22	6.2 ± 0.25pF
C87	2113740F32	16
C88	2113740F25	8.2 ± 0.25pF
C90	2113740F18	4.3 ± 0.25pF
C95	2113740F33	18
C96	2113741F49	.01µF
C97	2113740A32	13
C98	2113741F13	330
C99	2113740F39	33
C101	2113743K15	0.1µF
C102	2113741F13	330
C103	2311049J26	10µF; 16V
C104	2311049A54	3.3µF; 16V
C105	2113741F13	330
C106	2311049J26	10µF; 16V
C107, 108	2113741F13	330
C110	2311049A07	1µF; 16V
C111	2113741F13	330
C112	-----	Not Placed
C113	2113741F13	330
C115	2113743K03	.033µF
C116	2113740F03	1.0±0.1pF
C118	2113743K15	0.1µF
C119	2113741F13	330
C123	2113743K15	0.1µF
C125, 126	2311049A54	3.3µF; 16V
C128	2311049A07	1µF; 16V
C129	2113740F03	1
C130	2113740F28	11
C132	2113740F38	30
C133, 135	2113741F13	330
C139	-----	Not Placed
C140, 141, 146	2113741F13	330
C147	2113743E07	.022µF
C148	2113740F20	5.1 ± 0.25pF
C149, 150	2113740F34	20
C151	2113740F27	10

C152	2113741F13	330
C153	2113741F13	330
C154	2113741F13	330
C161	2113743K15	0.1µF
C162	2113741F13	330
C163	2113740F44	51
C164	2113740F51	100
C165	2311049A86	1.0µF; 10V
C202	2113740F27	10
C203	2113740F20	5.1 ± 0.25pF
C204	2113741F13	330
C205	2113740F14	3.0 ± 0.25pF
C206	2113741F20	620
C207	2113740F03	1.0 ± 0.1pF
C208	2113740F22	6.2 ± 0.25pF
C209	2113743K15	0.1µF
C210	2113743E07	.022µF
C211	2113741F13	330
C212	-----	Not Placed
C213	2113740F21	5.6 ± 0.25pF
C214	-----	Not Placed
C219	2113740F27	10
C220	2113740F31	15
C221	2113741F13	330
C222	2113740F24	7.5 ± 0.25pF
C223	2113906C02	ATC, 4pF
C225	2113740F08	1.6 ± 0.1pF
C226	2113740F46	62
C227, 228	2113741F13	330
C230	2113740F19	4.7 ± 0.25pF
C231	2311049A60	10µF; 4V
C233	2113741F13	330
C235	2113740F31	15
C236	2113740F27	10
C237	2113740F30	13
C238	2113741F25	.001µF
C240	2113906C02	ATC, 4pF
C241, 243	2113740F38	30
C244	2109720D09	.022µF
C245	2113741F25	.001µF
C246	2109720D09	.022µF
C247	2311049A07	1µF; 16V
C248	2113743K15	0.1µF
C250	2113741F25	.001µF
C251, 252	2113741F13	330
C253	2311049J23	10µF; 6V
C254	2311049A56	4.7µF; 10V
C255	2113741F25	.001µF
C256, 257	2113741F49	.01µF
C258	2311049J11	4.7µF; 16V
C259	2113743A23	0.22µF
C260	2113743K05	.039µF
C266, 267	2113741F49	.01µF
C270	2113741F25	.001µF
C271	2311049A56	4.7µF; 10V
C274	2113741F49	.01µF
C277	2113741F13	330
C280	2113740F51	100
C285, 286	2113741F13	330
C287	2113740F14	3.0 ± 0.25pF
C288	2113741F13	330
C291, 292	2113743E07	.022µF
C293	-----	Not Placed
C294	2113741F13	330
C303	2113743E07	.022µF
C304	2113741F13	330
C305 thru 308	2113740F51	100
C309	2113741F37	.0033µF
C310	2113741F13	330
C311	2113741F37	.0033µF
C313, 314	-----	Not Placed
C315	2113741F13	330
		<b>DIODE:</b>
CR1 thru 9	4862824C01	Varactor
CR11	4805129M96	PIN
CR12	4805218N57	Dual
CR102, 103	4805129M67	Dual
CR108, 109	4802482J02	PIN
CR201	4805649Q10	Varactor
CR202, 203	4805649Q08	Varactor
CR204, 205	4802233J09	Triple
CR206	4805129M06	Dual
		<b>CORE:</b>
E101	2484657R01	Bead, Ferrite
F1	6505757V01	FUSE: 1-Amp.

FL1	4802655J05	<b>FILTER:</b> Crystal, 44.85 MHz
J301	-----	<b>JACK:</b> Circuit plating on NUD7070A and NUD7085A; 20 contacts; to P301 on Jumper Flex Connector on NUD7070B and NUD7085B; 20 contacts; to P301 Strip Connector Contact, Antenna Ground
	or 0905461X01	
J401	3905264W01 and 3905643V01	
		<b>COIL, RF:</b>
L3	2462587T42	.047µH
L4	2462587T41	.039µH
L5	2462587T42	.047µH
L6	2462587T13	.068µH
L7	2462587T16	0.12µH
L8	2462587T17	0.15µH
L9	2462587T15	0.1µH
L10	2462587T12	.056µH
L11	2460591M12	4 turns, airwound
L12	2462587T23	0.47µH
L13, 14	2460591N36	5 turns, airwound
L16	2460591M12	4 turns, airwound
L19	2462587T20	0.27µH
L20	2462587N69	1.2µH
L22	2462587T30	1µH
L23	2462587Q50	1.8µH
L24	2462587T23	0.47µH
L25	2462587Q20	2.2µH
L30	2462575A21	.047µH
L32, 33	2462587Q20	2.2µH
L101	2462587T30	1µH
L105	2462587T30	1µH
L121, 122	2462587T30	1µH
L126	2460591K40	12 turns, airwound
L127	2460591G24	9 turns, airwound
L128	2460591K40	12 turns, airwound
L130, 131	2462587T30	1µH
L201	2462587T40	.033µH
L204	2462587T30	1µH
L205	2462587S28	.033µH
L208, 209	2462587T30	1µH
L210	2462587T39	.027µH
L211	2462587T12	.056µH
L212	2462587T15	0.1µH
L213, 215	2462587T30	1µH
L216	2462587T41	.039µH
L217, 218	2462587T30	1µH
L219	2462587T38	.022µH
L220	2462587T17	0.15µH
L221, 222	2462587Q42	0.39µH
L223	2462587T18	0.18µH
L225	2462587Q20	2.2µH
L301, 302	2462587Q47	1µH
		<b>PLUG:</b>
P402	-----	Contact, External Antenna; part of RF switch S101
P404	3905861X02	Connector, Battery; 2-pin
		<b>TRANSISTOR:</b>
Q1, 4	4805218N63	NPN
Q101	4805128M16	PNP
Q104, 105, 107	4805921T02	PNP NPN
Q108	4802245J10	NPN Dual
Q109	4813822A10	PNP
Q201	4802245J15	JFET
Q202	4805218N55	NPN
		<b>RESISTOR, Fixed: Ω ± 5% .0625W unless stated</b>
R1	0662057A01	10
R2	0662057A91	58k
R4, 5	0662057A73	10k
R7	0662057A25	100
R8	0662057A41	470
R16	0662057A59	2.7k
R17	0662057A80	20k
R32, 33	0662057A59	2.7k
R34, 35	0662057A89	47k
R40	0662057A35	270
R41	0662057A09	22
R42	0662057A35	270
R43	0662057A42	510
R44	0662057A77	15k
R45	0660257B47	0

R46	0662057A89	47k
R47	0662057A09	22
R49	0662057A53	1.5k
R50	0662057A63	3.9k
R51	0662057B05	200k
R70	0662057A53	1.5k
R72	0662057A25	100
R73	0662057A73	10k
R101	0662057C01	0
R102	0662057A65	4.7k
R106	0662057A61	3.3k
R110	0662057A57	2.2k
R111	0662057A67	5.6k
R112	0662057B22	1.1M
R113	0662057A73	10k
R114	0662057A77	15k
R115	0660078L28	180k ± 1%
R116	0662057G19	130k ± 1%; 0.1W
R117	0662057A89	47k
R126	0662057A18	51
R127	0662057A15	39
R130	0662057A65	4.7k
R131, 132	0662057A97	100k
R199	0660257B47	0; used in place of S101 in NUD7085A and NUD7085B Not Used, replaced with S101 in NUD7070A and NUD7070B
	or -----	
R203	0662057A09	22
R204	0662057A80	20k
R205	0662057A84	30k
R206, 207	0662057A80	20k
R208	0662057A62	3.6k
R209, 210	0662057A42	510
R211	0662057A20	62
R212	0662057A44	620
R213	0662057A41	470
R214	0662057A88	43k
R215	0662057A84	30k
R217	0662057A84	30k
R218	0662057A97	100k
R219	0662057A09	22
R220, 221	0662057A56	2k
R222	0662057A51	1.2k
R223	0662057A89	47k
RT101	0605621	

INSERT SCHEMATIC  
63D81200C32-O (100% BLK.)  
(OL) DEPF-24640-O (100% RED)  
SHOOT AT 100%



Electrical Parts List, Transceiver Boards;  
**UHF (403-470MHz)**  
**NUE7213A, NUE7213B**  
**NUE7231A, NUE7231B (MTS 2000 Radios)**  
**NUE7240A, NUE7240B**

TPLF-4112-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C1	2113740F19	<b>CAPACITOR, Fixed: pF ±5%;</b> <b>50V unless stated</b> 4.7 ± 0.25pF
C2, 3	-----	Not Placed
C4	2113740F31	15
C5	2113740F23	6.8 ± 0.25pF
C6	2113740F20	5.1 ± 0.25pF
C7	2113740F27	10
C9	2113740F12	2.4 ± 0.25pF
C10	2113740F27	10
C11	2113741F49	.01µF
C12	-----	Not Placed
C13	2311049A66	22µF, 4V
C15	2113740F51	100
C16	2113740F38	30
C17	2113743K15	.01µF
C18	2113740F19	4.7 ± 0.25pF
C19	2113740F15	3.3 ± 0.25pF
C31	2113741F49	.01µF
C35	2113740F15	3.3 ± 0.25pF
C36	2113740F19	4.7 ± 0.25pF
C38	2113740F31	15
C39	-----	Not Placed
C40	2113740F51	100
C41	2113743A19	0.1µF
C42 thru 46	2113743A23	0.22µF
C47	2109720D14	0.1µF
C48	2113741F16	430
C49	2113743A19	0.1µF
C50	2113741F49	.01µF
C51	2113743K15	0.1µF
C52	2113741A51	.018µF
C53	2113743B17	0.15µF
C54	2113740F41	39
C55	2113740F39	33
C56, 57	2113740F42	43
C58	2113740F11	2.2 ± 0.25pF
C59	2113741F49	.01µF
C60	2113743K15	0.1µF
C61	2109720D14	0.1µF
C63, 64	2113743K15	0.1µF
C65	2113741F41	.0047µF
C72	2113740F51	100
C82	2113741F49	.01µF
C83	2113740F51	100
C84	2113741F49	.01µF
C85	2311049J23	10µF, 6V
C86, 87	2113740F51	100
C88	2113740F45	56
C89	2113740A23	6.2 ± 0.25pF
C90	2113740F31	15
C91	2113740F28	11
C92	2113740F18	4.3 ± 0.25pF
C93	2113740F20	5.1 ± 0.25pF
C94	2113740F29	12
C95	2113740F25	8.2 ± 0.25pF
C96	2113741F49	.01µF
C98	2113740F51	100
C99	2113740F28	11
C101	2113743E07	.022µF
C102	-----	Not Placed
C103	2311049J26	10µF, 16V
C104	2113740F51	100
C105	-----	Not Placed
C106	2311049A56	4.7µF, 10V
C107	2113740F51	100
C108	-----	Not Placed
C109	2311049A07	1µF, 16V
C110	-----	Not Placed
C111	2113740F51	100
C112	-----	Not Placed
C113	2113740F51	100
C115	2113743K03	.033µF
C116	-----	Not Placed
C117	2113740F51	100
C118	2113743K15	0.1µF
C119, 121	2113740F51	100
C123	2113743K15	0.1µF

C125, 126	2311049A54	3.3µF; 16V
C127	-----	Not Placed
C132	2113740F25	8.2 ± 0.25pF
C133	2113740F09	1.8 ± 0.25pF
C135, 137, 138	2113740F51	100
C139	-----	Not Placed
C140	2113741F41	.0047µF
C141, 145, 147	2113740F51	100
C148	2113740F07	1.5 ± 0.25pF
C149, 150	2113740F31	15
C151	2113740F20	5.1 ± 0.25pF
C153, 154, 155	2113740F51	100
C156	2311049A86	1.0µF; 10V
C201	2113740F03	1.0 ± 0.1pF
C202	-----	Not Placed
C203	2113740F07	1.5 ± 0.1pF
C204	2113740F51	100
C205	-----	Not Placed
C206	2113741F33	.0022µF
C208	2113740F51	100
C209	2113741F49	.01µF
C210	2113743E07	.022µF
C211	2113740F51	100
C214	-----	Not Placed
C216	2113741F37	.0033µF
C217	2113740F51	100
C219	2113740F17	3.9 ± 0.25pF
C220	2113740F20	5.1 ± 0.25pF
C221	2113741F49	.01µF
C222	2113740F17	3.9 ± 0.25pF
C223	2113906C02	ATC, 4.0pF
C225	2113740F03	1.0 ± 0.1pF
C226	2113740F26	9.1 ± 0.25pF
C227, 228	2113740F51	100
C230	-----	Not Placed
C231	2311049A60	10µF; 4V
C233	2113740F51	100
C235	2113740F18	4.3 ± 0.25pF
C236	2113740F20	5.1 ± 0.25pF
C237	2113740F15	3.3 ± 0.25pF
C238	2113740F51	100
C239	2113740F27	10
C240	2113906C02	ATC, 4.0pF
C243	2113740F27	10
C244	2109720D09	.022µF
C245	2113741F25	.001µF
C246	2109720D09	.022µF
C247	2311049A05	0.47µF; 16V
C250	2113741F25	.001µF
C253	2311049J23	10µF; 6V
C254	2311049A56	4.7µF; 10V
C255	2113743K15	0.1µF
C256, 257	2113741F49	.01µF
C258	2311049J11	4.7µF; 16V
C260	2113743K07	.047µF
C266, 267	2113741F49	.01µF
C270	2113741F25	.022µF
C271	2311049A56	4.7µF; 10V
C274	2113741F49	.01µF
C275	2113743K15	0.1µF
C279	2113740F51	100
C280, 282	2113743K15	0.1µF
C284	2311049A33	0.22µF
C289, 290	2113740F51	100
C292	2113740F03	1.0 ± 0.1pF
C294	2113740F51	100
C303	2113743E07	.022µF
C304 thru 308	2113740F51	100
C309	2113741F37	.0033µF
C310	2113740F51	100
C311	2113741F37	.0033µF
C313, 314	-----	Not Placed
C315	2113740F51	100
CR5 thru 9	4862824C01	<b>DIODE:</b> Varactor
CR11	4805129M96	PIN
CR12	4805218N57	Dual
CR101, 103	4805129M67	Dual
CR108, 109	4802482J02	PIN
CR201	4805649Q10	Varactor
CR202	4862824C01	Varactor
CR203	4805649Q08	Varactor
CR204, 205	4802233J09	Triple
CR206	4805129M06	Dual
CR207	4805649Q10	Varactor
E101, 104	2484657R01	<b>CORE:</b> Bead, Ferrite

F1	6505757V01	<b>FUSE:</b> 1-Amp.
FL1	4802655J03	<b>FILTER:</b> Crystal, 73.35 MHz
J301	-----	<b>JACK:</b> Circuit plating on NUE7213A, NUE7231A, and NUE7240A; 20 contacts; to P301 on Jumper Flex
	or 0905461X01	Connector on NUE7213B, NUE7231B, and NUE7240B; 20 contacts; to P301 Strip Connector
J401	3905264W01 and 3905643V01	Contact, Antenna Contact, Antenna Ground
L6	2462587T38	<b>COIL, RF:</b> .022µH
L7	2462587T39	.027µH
L8	2462587T42	47nH
L9	2462587T41	39nH
L10	2462587T05	15nH
L11	2460591B04	4 turns, airwound
L12	2460591M32	4 turns, airwound
L13	2460591B80	4 turns, airwound
L14, 15	2460591B04	4 turns, airwound
L16	2462587Q20	2.2µH
L20	2462587N62	0.56µH
L22	2462587T21	0.47µH
L23	2462587Q44	0.56µH
L24	2462587S37	0.18µH
L25	2462587Q20	2.2µH
L30, 31	2460591B22	4 turns, airwound
L32	2460591B04	4 turns, airwound
L34, 35	2460591B22	4 turns, airwound
L36	2462587S36	0.15µH
L37	2460591B04	4 turns, airwound
L101	2462587T20	0.27µH
L102	-----	Not Placed
L103	2462587T20	0.27µH
L105	2462587T20	0.27µH
L107, 108	2462587T17	0.15µH
L121, 122	2462587T20	0.27µH
L123	2462587S38	0.22µH
L126 thru 128	2460591B04	4 turns, airwound
L201	2462587T38	.022µH
L202	2462587Q20	2.2µH
L204	2462587Q42	0.39µH
L205	2462587S27	.027µH
L207	2462587S38	0.22µH
L208, 209	2462587T22	0.39µH
L210	2405619V01	.0181µH, molded coil
L211	2405619V05	.012µH, molded coil
L212	2462587V26	.022µH
L213	2462587T15	0.1µH
L215	2462587T22	0.39µH
L216	2462587T05	.015µH
L218	2462587T22	0.39µH
L219	2462587T37	.018µH
L220	2462587T39	.027µH
L221	2462587T22	0.39µH
L223	2462587Q42	0.39µH
L224	2462587T40	.033µH
L301, 302	2462587Q42	0.39µH
P402	-----	<b>PLUG:</b> Contact, External Antenna; part of RF switch S101
P404	3905861X02	Connector, Battery; 2-pin
Q1, 4	4805218N63	<b>TRANSISTOR:</b> NPN
Q101	4805128M16	PNP
Q104, 105, 107	4805921T02	PNP NPN
Q108	4802245J12	NPN Dual
Q110	4802245J12	PNP
Q201	4802245J15	JFET
Q202	4805218N55	NPN
R7	0662057A25	<b>RESISTOR, Fixed: Ω ± 5%</b> <b>.0625W unless stated</b>
R16	0662057A59	100
R17	0662057A80	2.7k
R18	0662057B05	20k
R22, 23	0662057A73	200k
R26	-----	10k
R27	0662057A01	Not Placed
R32, 33	0662057A59	10
		2.7k

R34, 35	0662057A89	47k
R36	-----	Not Placed
R40	0662057A41	470
R41	0662057A09	22
R42	0662057A41	470
R43	0662057A42	510
R44	0662057A45	680
R45	0662057B47	0
R46	0662057A89	47k
R47	0662057A09	22
R48	-----	Not Placed
R49	0662057A77	15k
R50	0662057A53	1.5k
R51	0662057A51	1.2k
R52	0662057A25	100
R53	0662057A73	10k
R102	0662057A65	4.7k
R106	0662057A61	3.3k
R107	0662057A58	2.4k
R110	0662057A57	2.2k
R111	0662057A67	5.6k
R113, 114	0662057A73	10k
R115	0660078L28	180k ± 1%
R116	0662057G19	130k ± 1%; 0.1W
R119	0662057B22	1M
R126	0662057A18	51
R127	0662057A12	30
R128	0662057A89	47k
R129	0662057A65	4.7k
R130	0662057B47	0
R138	0662057B29	2M
R139	0662057A97	100k
R199	0660357B47	0; used in place of S101 in NUE7240A and NUE7240B Not Used, replaced with S101 in NUE7213A, NUE7213B, NUE7231A, and NUE7231B
R203	0662057A09	22
R204	0662057A73	10k
R205	0662057A77	15k
R206	0662057A73	10k
R207	0662057A93	68k
R208	0662057A56	2k
R209	0662057A41	470
R210	0662057A37	330
R211	0662057A27	120
R212, 213	0662057A46	750
R214	0662057A89	47k
R215	0662057A88	43k

Electrical Parts List, Transceiver Board  
UHF (450-520MHz)  
NUE7214A, NUE7214B  
NUE7232A, NUE7232B MTS 2000 Radios  
NUE7241A, NUE7241B  
TPLF-4073-C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		<b>CAPACITOR, Fixed: pF ±5%; 50V unless stated</b>
C1	2113740F15	3.3 ± 0.25pF
C2, 3	2113740F12	2.4 ± 0.25pF
C4	2113740F51	100
C5, 6	2113740F20	5.1 ± 0.25pF
C7	2113740F28	11
C9	2113740F09	1.8 ± 0.1pF
C10	2113740F22	6.2 ± 0.25pF
C11	2113741F49	.01µF
C12	-----	Not Placed
C13	2311049A66	22µF; 4V
C15	2113740F51	100
C16	2113740F38	30
C17	2113743K15	0.1µF
C18, 19	2113740F20	5.1 ± 0.25pF
C31	2113741F49	.01µF
C35	2113740F15	3.3 ± 0.25pF
C36	2113740F19	4.7 ± 0.25pF
C38	2113740F31	15
C39	-----	Not Placed
C40	2113740F51	100
C41	2113743A19	0.1µF
C42 thru 46	2113743A23	0.22µF
C47	2109720D14	0.1µF
C48	2113741F16	430
C49	2113743A19	0.1µF
C50	2113741F49	.01µF
C51	2113743K15	0.1µF
C52	2113741A51	.018µF
C53	2113743B17	0.15µF
C54	2113740F41	39
C55	2113740F39	33
C56, 57	2113740F42	43
C58	2113740F11	2.2 ± 0.25pF
C59	2113741F49	.01µF
C60	2113743K15	0.1µF
C61	2109720D14	0.1µF
C63, 64	2113743K15	0.1µF
C65	2113741F41	.0047µF
C72	2113740F51	100
C82	2113741F49	.01µF
C83	2113740F51	100
C84	2113741F49	.01µF
C85	2311049J23	10µF; 6V
C86, 87	2113740F51	100
C88	2113740F45	56
C89	2113740A18	4.3 ± 0.25pF
C90	2113740F25	8.2 ± 0.25pF
C91	2113740F30	13
C92	2113740F09	1.8 ± 0.1pF
C93	2113740F18	4.3 ± 0.25pF
C94	2113740F29	12
C95	2113740F25	8.2 ± 0.25pF
C96	2113741F49	.01µF
C98	2113740F51	100
C99	2113740F21	5.6 ± 0.25pF
C101	2113743E07	.022µF
C102	-----	Not Placed
C103	2311049J26	10µF; 16V
C104	2113740F51	100
C105	-----	Not Placed
C106	2311049A56	4.7µF; 10V
C107	2113740F51	100
C108	-----	Not Placed
C109	2311049A07	1µF; 16V
C110	-----	Not Placed
C111	2113740F51	100
C112	-----	Not Placed
C113	2113740F51	100
C115	2113743K07	.047µF
C116	-----	Not Placed
C117	2113740F51	100
C118	2113743K15	0.1µF
C119, 121	2113740F51	100
C123	2113743K15	0.1µF
C125, 126	2311049A54	3.3µF; 16V
C127	-----	Not Placed
C128	2311049A07	1µF; 16V

C132	2113740F25	8.2 ± 0.25pF
C133	2113740F09	1.8 ± 0.1pF
C135, 137, 138	2113740F51	100
C139	-----	Not Placed
C140	2113741F41	.0047µF
C141, 145, 147	2113740F51	100
C148	2113740F03	1.0 ± 0.1pF
C149	2113740F30	13
C150	2113740F29	12
C151	2113740F18	4.3 ± 0.25pF
C153, 154, 155	2113740F51	100
C156	2311049A86	1µF; 10V
C201	2113740F03	1.0 ± 0.1pF
C202	-----	Not Placed
C203	2113740F07	1.5 ± 0.1pF
C204	2113740F51	100
C205	-----	Not Placed
C206	2113741F29	.0015µF
C208	2113740F51	100
C209	2113741F49	.01µF
C210	2113743E07	.022µF
C211	2113740F51	100
C214	2113740F14	3.0 ± 0.1pF
C216	2113741F37	.0033µF
C217	2113740F51	100
C219	2113740F15	3.3 ± 0.25pF
C220	2113740F22	6.2 ± 0.25pF
C221	2113741F49	.01µF
C222	2113740F18	4.3 ± 0.25pF
C223	2113906C02	ATC, 4pF
C225	2113740F03	1.0 ± 0.1pF
C226	2113740F26	9.1 ± 0.25pF
C227, 228	2113740F51	100
C230	-----	Not Placed
C231	2311049A60	10µF; 4V
C233	2113740F51	100
C235	2113740F20	5.1 ± 0.25pF
C236	2113740F18	4.3 ± 0.25pF
C237	2113740F15	3.3 ± 0.25pF
C238	2113740F51	100
C239	2113740F24	7.5 ± 0.25pF
C240	2113906C02	ATC, 4pF
C243	2113740F24	7.5 ± 0.25pF
C244	2109720D09	.022µF
C245	2113741F25	.001µF
C246	2109720D09	.022µF
C247	2311049A05	0.47µF; 25V
C250	2113741F25	.001µF
C253	2311049J23	10µF; 6V
C254	2311049A56	4.7µF; 10V
C255	2113743K15	0.1µF
C256, 257	2113741F49	.01µF
C258	2311049J11	4.7µF; 16V
C260	2113743K07	.047µF
C266, 267	2113741F49	.01µF
C270	2113741F25	.001µF
C271	2311049A56	4.7µF; 10V
C274	2113741F49	.01µF
C275	2113743K15	0.1µF
C279	2113740F51	100
C280	2113743K15	0.1µF
C282	2113743K15	0.1µF
C284	2311049A33	0.22µF
C289, 290	2113740F51	100
C292	2113740F03	1.0 ± 0.1pF
C294	2113740F51	100
C303	2113743E07	.022µF
C304 thru 308	2113740F51	100
C309	2113741F37	.0033µF
C310	2113740F51	100
C311	2113741F37	.0033µF
C313, 314	-----	Not Placed
C315	2113740F51	100

F1	650575V01	<b>FUSE:</b> 1-Amp.
FL1	4802655J03	<b>FILTER,</b> Crystal; 73.35 MHz
J301	-----	<b>JACK:</b> Circuit plating on NUE7214A, NUE7232A, and NUE7241A; 20 contacts; to P301 on Jumper Flex
	or 0905461X01	Connector on NUE7214B, NUE7232B, and NUE7241B; 20 contacts; to P301 Strip Connector
J401	3905264W01 and 3905643V01	Contact, Antenna Contact, Antenna Ground
L6	2462587T38	<b>COIL, RF:</b> .022µH
L7	2462587T39	.027µH
L8	2462587T15	0.1µH
L9	2462587T11	.047µH
L10	2462587T39	.027µH
L11	2460591B04	4 turns, airwound
L12	2460591M32	4 turns, airwound
L13	2460591B80	4 turns, airwound
L14, 15	2460591B04	4 turns, airwound
L16	2462587Q20	2.2µH
L20	2462587N62	0.56 µH
L22	2462587T23	0.47 µH
L23	2462587Q44	0.56µH
L24	2462587V37	0.18µH
L25	2462587Q20	2.2µH
L30, 31	2460591A01	3 turns, airwound
L32	2460591B04	4 turns, airwound
L34, 35	2460591A01	3 turns, airwound
L36	2462587V36	0.15µH
L37	2460591B04	4 turns, airwound
L101 thru 103	2462587T20	0.27µH
L105	2462587T20	0.27µH
L107, 108	2462587T17	0.15µH
L121, 122	2462587T20	0.27µH
L123	2462587V38	0.22µH
L126 thru 128	2460591A56	3 turns, airwound
L201	2462587T37	.018µH
L202	2462587Q20	2.2µH
L204	2462587Q42	0.39µH
L205	2462587V23	.012µH
L207	2462587V36	0.15µH
L208, 209	2462587T22	0.39µH
L210	2405619V03	.0151µH, molded coil
L211	2405619V07	.009µH, molded coil
L212	2462587V25	.018µH
L213, 215	2462587T22	0.39µH
L216	2462587T05	.015µH
L218	2462587T22	0.39µH
L219	2462587T37	.018µH
L220	2462587T39	.027µH
L221	2462587T22	0.39µH
L223	2462587Q42	0.39µH
L224	2462587T40	.033µH
L301, 302	2462587Q42	0.39µH
P402	-----	<b>PLUG:</b> Contact, External Antenna; part of RF switch S101
P404	3905861X02	Connector, Battery; 2-pin
Q1, 4	4805218N63	<b>TRANSISTOR:</b> NPN
Q101	4805128M16	PNP
Q104, 105, 107	4805921T02	PNP NPN
Q108	4802245J10	NPN Dual
Q110	4802245J12	PNP
Q201	4802245J15	JFET
Q202	4805218N55	NPN
R7	0662057A25	<b>RESISTOR, Fixed: Ω ± 5%; .0625W unless stated</b> 100
R16	0662057A59	2.7k
R17	0662057A80	20k
R18	0662057B05	200k
R22, 23	0662057A73	10k
R26	-----	Not Placed
R27	0662057A01	10
R32, 33	0662057A59	2.7k
R34, 35	0662057A89	47k
R36	-----	Not Placed
R40	0662057A41	470

R41	0662057A09	22
R42	0662057A41	470
R43	-----	Not Placed
R44	0662057A45	680
R45	0662057B47	0
R46	0662057A89	47k
R47	0662057A09	22
R48	-----	Not Placed
R49	0662057A77	15k
R50	0662057A53	1.5k
R51	0662057A51	1.2k
R52	0662057A25	100
R53	0660257A73	10k
R102	0662057A65	4.7k
R106	0662057A61	3.3k
R107	0662057A58	2.4k
R110	0662057A65	4.7k
R111	0662057A49	1k
R113	0662057A73	10k
R114	0662057A77	15k
R115	0662057G27	182k ± 1%; 0.1W
R116	0662057G19	130k ± 1%; 0.1W
R119	0662057B22	1M
R126	0662057A18	51
R127	0662057A12	30
R128	0662057A89	47k
R129	0662057A65	4.7k
R130	0662057A43	560
R138	0662057B29	2.0M
R139	0662057A97	100k
R199	0660357B47	0, used in place of S101 in NUE7241A and NUE7241B Not Used, replaced with S101 in NUE7214A, NUE7214B, NUE7232A, and NUE7232B
R203	0662057A01	10
R204	0662057A73	10k
R205	0662057A77	15k
R206	0662057A73	10k
R207	0662057A93	68k
R208	0662057A58	2.4k
R209	0662057A41	470
R210	0662057A37	330
R211	0662057A27	120
R212, 213	0662057A46	750
R214	0662057A89	47k
R215	0662057A88	43k
R217	0662057A77	15k
R218	0662057A97	100k
R219	0662057B47	0
R220	0662057A56	2k
R221	0662057A51	1.2k
R222	0662057A56	2k
R223	0662057A89	47k
RT101	0605621T02	<b>THERMISTOR:</b> Thermistor, 50k
S101	4005831W01	<b>SWITCH:</b> RF, used on NUE7214A, NUE7214B, NUE7232A, and NUE7232B Not Used, replaced with R199 on NUE7241A and NUE7241B
T1	2505515V08	<b>TRANSFORMER:</b> Balun; 4:1
T2	2505515V11	Balun; 16:1
U1	5	

INSERT SCHEMATIC DIAGRAM  
63D81200C33-O (100% BLK.)  
(OL) DEPF-24645-O (100% RED)  
R.T. 94%

INSERT SCHEMATIC  
63D81200C34-O (100% BLK.)  
(OL) DEPF-24650-O (100% RED)  
SHOOT AT 86%

INSERT SCHEMATIC  
63D81200C38-O (100% BLK.)  
(OL) DEPF-24655-O (100% RED)  
R.T. 81%

Electrical Parts List, Transceiver Board; 800MHz  
 NUF6394A, NUF6394B  
 NUF6410A, NUF6410B  
 NUF6423A, NUF6423B

TPLF-4080-C

REFERENCE SYMBOL	DESCRIPTION	MOTOROLA PART NO.
		<b>CAPACITOR, Fixed: pF ±5%; 50V unless stated</b>
C1	2311049J23	10µF
C2	2113743K15	0.1µF
C3	2113741F37	3.3nF
C4	2113740F13	330
C5	2113741F37	3.3nF
C6	2113740F34	20
C7	2113740F22	6.2
C8	2113740F39	33
C9	2113743K15	0.1µF
C10	2113740F01	1
C11	2113740F51	100
C12	2113740F15	3.3
C13	2311049J23	10µF
C14	2113740F27	10
C15	2113743E07	.022µF
C19	2113740F41	39pF
C31	2113743E07	.022µF
C34	2113743K15	0.1µF
C35	2113740A43	39
C36	2113740F06	1.3
C38	2113740F20	5.1
C40	2113740F51	100
C41	2113743A19	0.1µF
C42 thru 45	2113743A23	0.22µF
C46	2113743K15	0.1µF
C47	2109720D14	0.1µF
C48	2113740A70	430
C49	2311049A07	1µF
C52	2113741A51	.018µF
C53	2311049A02	0.15µF
C54, 55	2113740F41	39
C56, 57	2113740F42	43
C58	2113740F11	2.2
C60	2113743K15	0.1µF
C61	2113740F51	100
C62	2113743K15	0.1µF
C65	2113743K15	0.1µF
C72	2113740F41	39
C82	2113743E07	.022µF
C83	2113740F41	39
C84	2113743E07	.022µF
C85	2311049J23	10µF
C87	2113743K15	0.1µF
C88	2113740F51	100
C89	2113743E07	.022µF
C90	2113740F41	39
C91	2311049J23	10µF
C92	2113743E07	.022µF
C95	2113740F25	8.2
C96	2113743K15	0.1µF
C98	2113741F13	330
C101, 102	2113740F39	33
C103	2311049A07	1µF
C104, 105	2113743E07	.022µF
C106	2311049J12	4.7µf
C107, 108	2113740F39	33
C109	-----	Not Placed
C110, 111, 113	2113740F39	33
C114	2113743K15	0.1µF
C115	2113743E07	.022µF
C116	2113743K15	0.1µF
C117, 118	2113740F39	33
C119	2113743E07	.022µF
C120	2113743K15	0.1µF
C121	2113740F34	20
C122, 123	2113740F39	33
C125	2113743K15	0.1µF
C126	2113743E07	.022µF
C132	2113743E07	.022µF
C133	2311049J23	10µF
C135	2113740F39	33
C137	2113740F39	33
C138	2113740F34	20
C140	2113743E07	.022µF
C141	2113740F13	330
C149	2113740F12	2.4
C150	2113740F09	1.8
C151	2113740F29	12

C152	2113740F39	33
C153	2113740F13	2.7
C201	2113740F19	4.7
C202	2113740F34	20
C204	2113740F39	33
C205	2113740F14	3
C209	2113743E07	.022µF
C211	2113740F14	3
C214	2113743E07	.022µF
C219	2113743E07	.022µF
C225	2113740F39	33
C227, 228	2113740F39	33
C230, 231	2113740F39	33
C233	2113743E07	.022µF
C236	2113743E07	.022µF
C237 thru 241	2109720D14	0.1µF
C244	2113741F18	510
C245, 246	2113743E07	.022µF
C247	2105248W02	1200
C250	2113743K15	0.1µF
C253, 254	2311049J23	10µF
C255	2113743E07	.022µF
C256, 257, 258	2113743K15	0.1µF
C260	2113743K07	.047µF
C266, 267	2113741F37	3.3nF
C270	2311049J12	4.7µF
C271	2311049J23	10µF
C274	2113743E07	.022µF
C275	2113743A13	.047µF
C279	2113743K15	0.1µF
C280	2113743E07	.022µF
C284	2113743E07	.022µF
C289	2113740F42	43
C294	2113740F39	33
C301	2113743E07	.022µF
C302	2113740F39	33
C303	2113741F37	3.3nF
C304 thru 308	2113740F39	33
C309	2113741F37	3.3nF
C310	2113740F39	33
C311	2113741F37	3.3nF
C312, 313, 314	2113740F39	33
CR4	4805218N57	<b>DIODE:</b>
CR5	4862824C01	Dual
CR101, 103	4805218N57	Varactor
CR107, 108, 109	4805129M96	PIN
CR204	4802233J09	Triple
F1	6505757V01	<b>FUSE:</b> 1.0A
FL1	5102463J03	<b>FILTER:</b> 73.35MHz
J301	-----	<b>JACK:</b> Circuit plating on NUF6394A, NUF6410A, and NUF6423A; 20 contacts; to P301 on Jumper Flex
J401	or 0905461X01	Connector on NUF6394B, NUF6410B, and NUF6423B; 20 contacts; to P301 Strip Connector
	3905264W01	Contact, Antenna
	and 3905643V01	Contact, Antenna Ground
L8	2462587V28	<b>COIL, RF:</b>
L9	2462587V37	33nH
L10	2462587V24	180nH
L20	2405452C64	15nH
L22	2462587T31	1500nH
L23	-----	1200nH
L24	2462587V37	Not Placed
L30	2460591A11	180nH
L32, 34	2460591C40	7.7nH
L36	2462587V38	17nH
L105	2462587V37	220nH
L107	2462587V24	180nH
L108	2462587V37	15nH
L126	2462587V37	180nH
L127	2460591A11	180nH
L204	2462587V24	7.7nH
L209	2462587Q59	15nH
		10µH
P402	-----	<b>PLUG:</b> Contact, External Antenna; part of RF switch S101
P404	3905861X02	Connector, Battery; 2-pin

Q1	4805218N63	<b>TRANSISTOR:</b>
Q4	4805218N63	NPN
Q101	4805128M27	NPN
Q108	4805921T06	PNP
Q110	4805218N45	Dual PNP
		PNP
		<b>RESISTOR, Fixed: Ω ± 5% .0625W unless stated</b>
R1	0662057A50	1.1k
R2	-----	Not Placed
R3	0662057A25	100
R7	0662057A25	100
R16	0662057A59	2.7k
R17	0662057A80	20k
R21	0662057A73	10k
R22	0662057A85	33k
R23	0662057A53	1.5k
R25	0662057B05	200k
R26	0662057A66	5.1k
R27	0662057A01	10
R32, 33	0662057A59	2.7k
R34, 35	0662057A89	47k
R37	0662057B47	0 ohms
R36	0662057A42	510
R101	0662057A61	3.3k
R102	0662057A67	5.6k
R103	0662057A49	1k
R104	0662057B47	0 ohms
R105	-----	Not Placed
R110, 111, 113	0662057A73	10k
R114	0662057A81	22k
R120	0662057A56	2k
R128	0662057A90	51k
R129	0662057C75	1k
R139	0605021K01	0
R149	0605021K01	0
R199	0660357B47	0, used in place of S101 in NUF6423A and NUF6423B
	or -----	Not Used, replaced with S101 in NUF6394A, NUF6394B, NUF6410A, and NUF6410B
R201	0662057B47	0 ohms
R211	0662057A18	51
R212	0662057A49	1k
R213	0662057A56	2k
R214	0662057A87	39k
R215	0662057A90	51k
R216	-----	Not Placed
R220	0662057A77	15k
R221, 222	0662057A49	1k
RT101	0605621T02	<b>THERMISTOR:</b> 50k
S101	4005831W01	<b>SWITCH:</b> RF, used on NUF6394A, NUF6394B, NUF6410A, and NUF6410B
	or -----	Not Used, replaced with R199 on NUF6423A and NUF6423B
T1	2505515V04	<b>TRANSFORMER:</b>
T2	2505515V07	Balun; 4:1 Balun; 2:1
U1	5105329V21	<b>MODULES:</b>
U2	5105329V26	RF Amp
U3	5105457W11	Mixer
U4, 5	5105279V15	IF
U101	5105662U72	3-Pole Filte
U102	5105662U70	TX ALC
U104	5105279V26	D/A
U105	5105279V24	Couple
U201	5105662U76	RF PA
U202	5105469E65	VCO
U203	5105279V38	5V Regulator
	or 5105279V31	Ref. Oscillator, 16.8MHz
U204	5105625U31	Ref. Oscillator, 16.8MHz;
U205	5105238U94	NUF6410A, NUF6410B only
		Synthesizer
		VCO
VR101	4813830A33	<b>DIODE, Zener:</b> 20V

Note: "Not Placed" means that the components are for future use, and are not placed on the circuit board at this time.

INSERT DIAGRAMS  
 (L1) BEPF-24651-O (20% BLK, 133 LINE)  
 (OL) BEPF-24652-O (100% BLK.)  
 R.T. 50%

INSERT DIAGRAMS  
 (L6) BEPF-24653-O (20% BLK., 133 LINE)  
 (OL) BEPF-24654-O (100% BLK.)  
 R.T. 50%

NUF6394A, NUF6394B, NUF6410A, NUF6410B, NUF6423A, AND NUF6423B  
 800MHz TRANSCIVER BOARDS' PARTS LIST, AND  
 NUF6395B, NUF6395C, NUF6424A, AND NUF6424B  
 900MHz TRANSCIVER BOARDS' COMPONENT LOCATION DIAGRAMS

**Electrical Parts List, Transceiver Board; 900MHz**  
**NUF6395B, NUF6395C**  
**NUF6424A, NUF6424B**

TPLF-4081-D

REFERENCE SYMBOL	DESCRIPTION	MOTOROLA PART NO.
		<b>CAPACITOR, Fixed: pF ±5%; 50V unless stated</b>
C1	2311049J23	10µF
C2	2113743K15	0.1µF
C3	2113741F37	3.3nF
C4	2113740F24	7.5
C5	2113741F37	3.3nF
C6, 7	2113740F34	20
C8	2113740F39	33
C9	2113743K15	0.1µF
C10	-----	Not Placed
C11	2113740F51	100
C12	2113740F18	4.3
C13	2311049J23	10µF
C14	2113740F18	4.3
C15	2113743E07	.022µF
C19	2113740F39	33pF
C31	2113743E07	.022µF
C34	2113743K15	0.1µF
C35	2113740A43	39
C36	2113740F06	1.3
C38	2113740F20	5.1
C40	2113740F51	100
C41	2113743A19	0.1µF
C42 thru 45	2113743A23	0.22µF
C46	2113743K15	0.1µF
C47	2109720D14	0.1µF
C48	2113740A70	430
C49	2110920D14	0.1µF
C52	2113741A51	.018µF
C53	2311049A02	0.15µF
C54, 55	2113740F41	39
C56, 57	2113740F42	43
C58	2113740F11	2.2
C60	2113743K15	0.1µF
C61	2113740F61	100
C62	2113743K15	0.1µF
C65	2113743K15	0.1µF
C72	2113740F39	33
C82	2113743E07	.022µF
C83	2113740F39	33
C84	2113743E07	.022µF
C85	2311049J23	10µF
C87	2113743K15	0.1µF
C88	2113740F39	33
C89	2113743E07	.022µF
C90	2113740F39	33
C91	2311049J23	10µF
C92	2113743E07	.022µF
C95	2113740F25	8.2
C96	2113743K15	0.1µF
C98	2113741F20	5.1
C101, 102	2113740F39	33
C103	2311049A07	1µF
C104, 105	2113743E07	.022µF
C106	2311049J12	4.7µF
C107, 108	2113740F39	33
C109	-----	Not Placed
C110, 111, 113	2113740F39	33
C114	2113743K15	0.1µF
C115	2113743E07	.022µF
C116	2113743K15	0.1µF
C117, 118	2113740F39	33
C119	2113743E07	.022µF
C120	2113743K15	0.1µF
C121	2113740F34	20
C122, 123	2113740F39	33
C125	2113743K15	0.1µF
C126	2113743E07	.022µF
C132	2113743E07	.022µF
C133	2311049J23	10µF
C135	2113740F39	33
C137	2113740F39	33
C138	2113740F34	20
C140	2113743E07	.022µF
C141	2113740F29	12
C149, 150	2113740F12	2.4
C151	2113740F29	12
C152	2113740F39	33
C153	2113740F11	2.2
C201	2113740F16	3.6

C202	2113740F24	7.5
C204	2113740F14	3
C205	-----	Not Placed
C209	2113743E07	.022µF
C211	2113740F14	3
C214	2113743E07	.022µF
C219	2113743E07	.022µF
C225	2113740F39	33
C227, 228	2113740F39	33
C230, 231	2113740F39	33
C233	2113743E07	.022µF
C236	2113743E07	.022µF
C237 thru 241	2109720D14	0.1µF
C244	2113741F18	510
C245, 246	2113743E07	.022µF
C247	2105248W01	1000
C250	2113743K15	0.1µF
C251	2113740F39	33
C253, 254	2311049J23	10µF
C255	2113743E07	.022µF
C256, 257, 258	2113743K15	0.1µF
C260	2113743K07	.047µF
C266, 267	2113741F37	3.3nF
C270	2311049J12	4.7µF
C271	2311049J23	10µF
C274	2113743E07	.022µF
C275	2113743A13	.047µF
C279	2113743K15	0.1µF
C280	2113743E07	.022µF
C283	2113743A23	0.22µF
C284	2113743E07	.022µF
C289	2113740F42	43
C294	2113740F39	33
C301	2113743E07	.022µF
C302	2113740F39	33
C303	2113741F37	3.3nF
C304 thru 308	2113740F39	33
C309	2113741F37	3.3nF
C310	2113740F39	33
C311	2113741F37	3.3nF
C312, 313, 314	2113740F39	33
CR4	4805218N57	<b>DIODE:</b>
CR5	4862824C01	Dual
CR101, 103	4805218N57	Varactor
CR107, 108, 109	4805129M96	Dual
CR204	4802233J09	PIN
		Triple
F1	6505757V01	<b>FUSE:</b> 1.0A
FL1	5102463J03	<b>FILTER:</b> 73.35MHz
J301	-----	<b>JACK:</b>
		Circuit plating on NUF6395B
		and NUF6424A; 20 contacts;
		to P301 on Jumper Flex
		Connector on NUF6395C
		and NUF6424B; 20 contacts;
		to P301 Strip Connector
		Contact, Antenna
		Contact, Antenna Ground
J401	3905264W01	<b>COIL, RF:</b>
	and 3905643V01	180nH
		15nH
		1500nH
		1200nH
		Not Placed
		180nH
		7.7nH
		17nH
		220nH
		180nH
		15nH
		180nH
		180nH
		7.7nH
		15nH
		10µH
L8, 9	2462587V37	<b>PLUG:</b>
L10	2462587V24	Contact, External Antenna;
L20	2405452C64	part of RF switch S101
L22	2462587T31	Connector, Battery; 2-pin
L23	-----	
L24	2462587V37	
L30	2460591A11	
L32, 34	2460591C40	
L36	2462587V38	
L105	2462587V37	
L107	2462587V24	
L108	2462587V37	
L126	2462587V37	
L127	2460591A11	
L204	2462587V24	
L209	2462587Q59	

Q1	4805218N63	<b>TRANSISTOR:</b>
Q4	4805218N63	NPN
Q101	4805128M27	NPN
Q108	4805921T06	PNP
Q110	4805218N45	Dual PNP
		PNP
		<b>RESISTOR, Fixed: Ω ± 5% .0625W unless stated</b>
		1.1k
R1	0662057A50	Not Placed
R2	-----	Not Placed
R3	0662057A25	100
R7	0662057A25	100
R16	0662057A59	2.7k
R17	0662057A80	20k
R21	0662057A73	10k
R22	0662057A85	33k
R23	0662057A53	1.5k
R25	0662057B05	200k
R26	0662057A66	5.1k
R27	0662057A01	10
R32, 33	0662057A59	2.7k
R34, 35	0662057A89	47k
R36	0662057A42	510
R37	0662057B47	0
R101	0662057A61	3.3k
R102	0662057A67	5.6k
R103	0662057A49	1k
R104	0662057B47	0
R105	-----	Not Placed
R110, 111, 113	0662057A73	10k
R114	0662057A81	22k
R120	0662057A56	2k
R128	0662057A90	51k
R129	0662057C75	1k
R139	0605021K01	0
R149	0605021K01	0
R199	0660357B47	0 <sup>1</sup> used in place of S101 in NUF6424A and NUF6424B
		Not Used, replaced with S101 in NUF6395B and NUF6395C
		33
		or -----
R201	0662057A13	33
R211	0662057A18	51
R212	0662057A49	1k
R213	0662057A56	2k
R214	0662057A81	22k
R215	0662057A87	39k
R216	-----	Not Placed
R220	0662057A77	15k
R221, 222	0662057A49	1k
RT101	0605621T02	<b>THERMISTOR:</b> 50k
S101	4005831W01	<b>SWITCH:</b>
		RF, used on NUF6395B,
		and NUF6395C
		Not Used, replaced with R199
		on NUF6424A and NUF6424B
		or -----
T1	2505515V03	<b>TRANSFORMER:</b>
T2	2505515V07	Balun; 4:1
		Balun; 2:1
U1	5105329V21	<b>MODULES:</b>
U2	5105329V26	RF Amp
U3	5105457W11	Mixer
U4, 5	5105279V06	IF
U101	5105662U72	3-Pole Filte
U102	5105662U70	TX ALC
U104	5105279V26	D/A
U105	5105279V25	Couple
U201	5105662U76	RF PA
U202	5105469E65	VCO
U203	5105279V31	5V Regulator
U204	5105625U31	Ref. Oscillator
U205	5105279V01	Synthesizer
		VCO
VR101	4813830A33	<b>DIODE, Zener;</b> 20V

**Note:** "Not Placed" means that components are for future use, and are not placed on the circuit board at this time.

INSERT DIAGRAMS  
(L1) BEPF-24491-O  
(20% BLK, 133 LINE)  
(OL) BEPF-24492-O  
(100% BLK.)  
R.T.

INSERT DIAGRAMS  
(L6) BEPF-24493-O  
(20% BLK, 133 LINE)  
(OL) BEPF-24494-O  
(100% BLK.)  
R.T.

**NUF6395B, NUF6395C, NUF6424A, AND NUF6424B**  
**900MHz TRANSCEIVER BOARDS' PARTS LIST, AND**  
**NTN7089A/NTN7092A CONTROLLER BOARDS' (JT 1000/HT 1000 MODELS ONLY)**  
**COMPONENT LOCATION DIAGRAMS**

INSERT SCHEMATIC  
63D81200C42-A (100% BLK.)  
(OL) DEPF-24495-A (100% RED)  
SHOOT AT 100%





INSERT SCHEMATIC  
63D81200C43-O (100% BLK.)  
SHOOT AT 87%

**Electrical Parts List**  
NTN7091A/NTN7093A

TPLF-4212-A

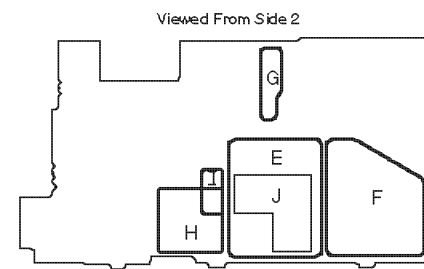
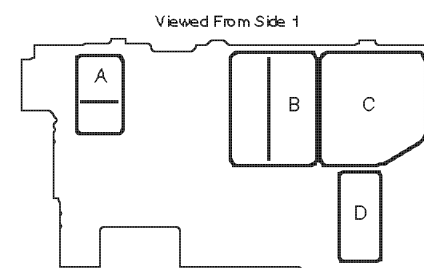
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		<b>CAPACITOR, Fixed: pF ±5%; 50V unless stated</b>
C601	2113743A19	0.1µF
C602, 603, 604	2113741A33	3.3nF
C605, 606	2113743K15	0.1µF
C607	2113743A23	0.22µF
C608	2113743A19	0.1µF
C609, 610	2311049A04	0.33µF
C611, 612	2311049A42	3.3µF
C613	2113741F17	470
C614	2113741F49	10nF
C615	2113741F17	470
C616	2113743K15	0.1µF
C617	2113741M53	.022µF
C618	2113743A19	0.1µF
C619	2113741F49	10nF
C620	2113741M53	.022µF
C700 thru 708	2113741F17	470
C709	2113743A23	0.22µF
C710	2311049A09	2.2µF
C711	2311049J11	4.7µF
C712, 713	2113743A19	0.1µF
C714, 715	2113743K15	0.1µF
C716, 717	2113743A45	.01µF
C718	2113743K15	0.1µF
C719	2311049A01	0.1µF
C720	2113741F49	10nF
C721	2113743K15	0.1µF
C722	2311049A09	2.2µF
C723	2113743A23	0.22µF
C724	2113740F36	24
C725	2311049A07	1µF
C726	2113743F12	0.33µF
C727	2311049A07	1µF
C728	2113743F12	0.33µF
C729	2311049A07	1µF
C730	2113741F41	4.7nF
C731	2113743K15	0.1µF
C732	2311049A57	10µF
C733	2113743K15	0.1µF
C734	2311049J23	10µF
C735 thru 738	2113741F17	470
C739	2113740F39	33
C740, 741, 742	2113741F17	470
C743	2113741A49	15nF
C744	2113741F49	10nF
C745	2113740F39	33
C746 thru 757	2113741F17	470
C758	2113743K15	0.1µF
C759, 760, 761	2113741F17	470
C762	2113743K15	0.1µF
C763, 764	2113740F36	24
C765	2113743K15	0.1µF
C766	2311049A42	3.3µF
C767	2113743K15	0.1µF
C768	2113741F49	10nF
C769	2113741F17	470
C770	2311049J23	10µF
C771	2113743K15	0.1µF
C772	2311049A42	3.3µF
C773	2113743A19	0.1µF (NTN7093A only)
C774, 775	2113741F17	470
C776	2113743K15	0.1µF
C777	2311049A07	1µF
C778	2113743K15	0.1µF
C779	2113740F39	33
C780 thru 786	2113741F17	470
C787	2113740F39	33
C788 thru 791	2113741F17	470
C792	2113741F13	330
C793	2113743A19	0.1µF
C795	2113740F39	33
C796	2311049A07	1µF
C797	2113740F51	100
C798	2113741F49	10nF
C804	2113741F41	4700
C808	2113741F17	470

CR701	4880236E05	<b>DIODE:</b> Schottky
CR702, 703, 704	4805218N57	Dual
CR705	4813833C02	Dual
CR706	4805218N57	Dual
J701	0905257V04	<b>JACK:</b> Connector, 26-pin; to P701 on Front Cover Display Flex
J702	0913915A11	Connector, 25-pin
J703	0905257V03	Connector, 18-pin; to P703 on Controls Flex
J704	-----	Circuit plating on early version radios, 20-contacts; to P704 on Jumper Flex
	or 0905461X01	Connector on later version radios, 20-contacts; to P704 Strip Connector
L702 thru 706	2462587Q40	<b>COIL, RF:</b> 270 nH
Q701	4805128M40	<b>TRANSISTOR:</b> PNP
Q703	4880048M01	NPN
		<b>RESISTOR, Fixed: Ω ±5%; .0625W unless stated</b>
R601	0662057G13	100k
R602	0662057A53	1.5k
R603	0662057R60	10k
R604	0662057R30	1k
R605	0662057A97	100k
R606	0662057R92	47.5k
R607	0662057G13	100k
R608	0662057A81	22k
R700	0662057A65	4.7k
R701	0662057A56	2k
R702	0662057A81	22k
R703	0662057A56	2k
R704	0662057A41	470
R705	0662057R92	47.5k
R706	0662057A56	2k
R707	0662057A41	470
R708	0662057A56	2k
R710	0662057A89	47k
R711	0662057A97	100k
R712	0662057A56	2k
R713	0662057A81	22k
R714	0683962T45	68
R715	0662057A97	100k
R716, 717	0662057A81	22k
R718	0662057A97	100k
R719	0662057B02	150k
R720, 721, 722	0662057A89	47k
R723	0662057A49	1k
R724	0662057A89	47k
R725	0662057G07	75k
R726	0662057G08	82.5k
R727	0662057A81	22k
R728, 729	0662057A89	47k
R730, 731	0662057C55	150
R732	0662057A73	10k
R736	0662057A81	22k
R738	0662057A81	22k
R739	0662057A73	10k
R740, 741	0662057A81	22k
R743	0662057A73	10k
R746	0662057A97	100k
R747	0662057B02	150k
R749	0662057A73	10k
R750	0662057A97	100k
R754	0662057B47	0
R757	0662057A81	22k
R758	0662057A97	100k
R759	0662057A81	22k
R761	0662057A73	10k
R762	0660257B47	0
R801	0660076E56	2k
R802, 803	0662057A56	2k
U601	5105662U60	<b>MODULE:</b> Hear Clear
U701	5105835U14	Audio Signalling Filter
U702	5105662U62	Audio PA
U703	4805921T09	Dual Transistor
U704	4805921T07	Transistor, NPN
U705	5105662U52	Microcomputer

U708	5105469E65	5V Regulator
U709	5105750U28	Mux
U710	5105457W06	SLIC IV
U711	5113806A20	Multiplexer
U712	4805718V01	Transistor Package
U713	5105662U58	EEPROM
U714	5105662U54	SCRAM
U715	5105329V30	256 x 8 FLASH
VR701, 702	4813830A23	10V
VR703	4813830A15	5.6V
VR704 thru 711	4880140L09	6.2V
VR712	4813830A33	20V
VR713	4813830A23	10V
VR714	4813830A18	6.8V
VR715	4813830A14	5.1V
VR716	4880140L09	6.2V, See Note
VR717	4813830A27	14V
VR718	4813830A15	5.6V

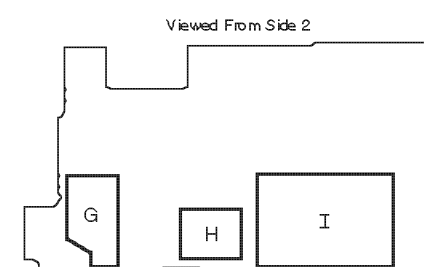
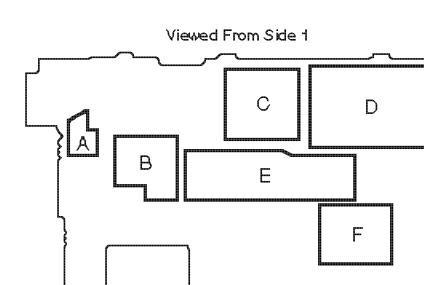
Note: 600 Series HearClear components are part of NTN7093A.

**SHIELDS LOCATION DETAIL VHF AND UHF RADIOS**



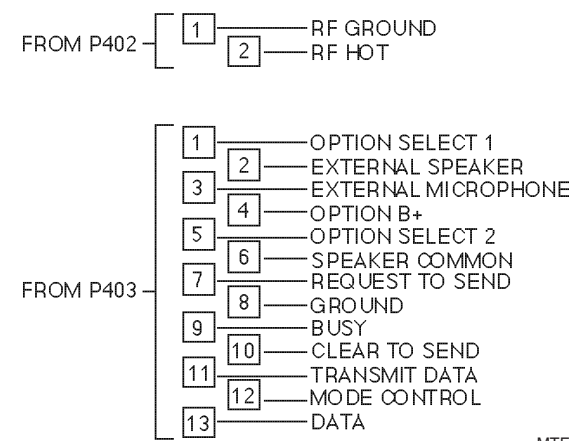
MAEPP-22605-A

**SHIELDS LOCATION DETAIL 800 AND 900MHz RADIOS**



MAEPP-22855-O

**UNIVERSAL (ACCESSORY) CONNECTOR PIN NUMBERS AND SIGNAL ASSIGNMENTS**



MTEPF-22606-O

**UNIVERSAL CONNECTOR OPTION SELECT (OPT SEL) DEFINITION**

MODE#	MODE	OPT SEL 1	OPT SEL 2	COMMENT
00	External PTT	0	0	
01	External Audio	0	1	External Speaker
10	Mandown	1	0	
11	Normal Operation	1	1	
A	MTVA	◀		Fixed Audio Output Level
B	"Smart" SB9600 Accessory	▶		Identifies SB9600 Accy.
C	External RF Modem/FAX	—		Enables AUX TX and Discriminator Audio Output

**Shields Parts List VHF and UHF Radios**

TPLF-4079-A

ITEM	MOTOROLA PART NO.	DESCRIPTION
A	2602661J01 or 2602660J01	SHIELD, Varactor Filter (VHF)
B	2602657J01	SHIELD, VCO Front
C	2602658J01	SHIELD, Ref. Oscillator
D	2602659J01	SHIELD, IF
E	2602674J01	SHIELD, VCO Back
F	2602675J01	SHIELD Synthesizer
G	2602680J01	SHIELD, AGC
H	2602815X01	SHIELD, Fixed Tuned Filter (VHF)
I	2602886J01	SHIELD, Coil (UHF)
J	2602819X02	FOIL, Aluminum; with adhesive and paper backing

**Shields Parts List 800 and 900MHz Radios**

TPLF-4110-A

ITEM	MOTOROLA PART NO.	DESCRIPTION
A	2605634V01	SHIELD, Antenna
B	2605263V02	SHIELD, 3-Pole Filter
C	2605540W01	SHIELD, Loop Filter
D	2605890U01	SHIELD, VCO
E	2605541W01	SHIELD, Crystal/Transformer
F	2605261V01	SHIELD ZIF
G	2605260V01	SHIELD, RF Switch
H	2605259V0101	SHIELD, Diode
I	2605258V0101	SHIELD, Synthesizer

INSERT DIAGRAMS  
(L1) BEPF-23475-A (20% BLK., 133 LINE)  
(OL) BEPF-23476-O (100% BLK.)  
R.T. 50%

INSERT DIAGRAMS  
(L8) BEPF-23477-O (20% BLK., 133 LINE)  
(OL) BEPF-23478-A (100% BLK.)  
R.T. 50%

INSERT SCHEMATIC  
63D81200C44-O (100% BLK.)  
SHOOT AT 100%

**Electrical Parts List**  
**NTN7620B Controller** TPLF-4213-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		<b>CAPACITOR, Fixed: pF ±5%; 50V unless stated</b>
C700 thru 708	2113741F17	470
C709	2113743A23	0.22µF
C710	2311049A09	2.2µF
C711	2311049J11	4.7µF
C712, 713	2113743A19	0.1µF
C714, 715	2113743K15	0.1µF
C716, 717	2113741A45	.01µF
C718	2113743K15	0.1µF
C719	2311049A01	0.1µF
C720	2113741F49	10nF
C721	2113743K15	0.1µF
C722	2311049A09	2.2µF
C723	2113743A23	0.22µF
C724	2113740F36	24
C725	2311049A07	1µF
C726	2113743F12	0.33µF
C727	2311049A07	1µF
C728	2113743F12	0.33µF
C729	2311049A07	1µF
C730	2113741F41	4.7nF
C731	2113743K15	0.1µF
C732	2311049J11	4.7µF
C733	2113743K15	0.1µF
C734	2311049J23	10µF
C735 thru 738	2113741F17	470
C739	2113740F39	33
C740, 741, 742	2113741F17	470
C743	2113741A49	15nF
C744	2113741F49	10nF
C745	2113740F39	33
C746 thru 757	2113741F17	470
C758	2113743K15	0.1µF
C759, 760, 761	2113741F17	470
C762	2113743K15	0.1µF
C763, 764	2113740F36	24
C765	2113743K15	0.1µF
C766	2311049A42	3.3µF
C767	2113743K15	0.1µF
C768	2113741F49	10nF
C769	2113741F17	470
C770	2311049J23	10µF
C771	2113743K15	0.1µF
C772	2311049A42	3.3µF
C774, 775	2113741F17	470
C776	2113743K15	0.1µF
C777	2311049A07	1µF
C778	2113743K15	0.1µF
C779	-----	Not Placed
C780 thru 786	2113741F17	470
C787	2113740F39	33
C788 thru 791	2113741F17	470
C792	2113741F13	330
C793	2113743A19	0.1µF
C794	2113743K15	0.1µF
C795	2311049A56	4.7µF
C804	2113741F41	4700
C805	2113743A23	0.22µF
C808	2113741F17	470
		<b>DIODE:</b>
CR701	4880236E05	Schottky
CR702, 703, 704	4805218N57	Dual
CR705	4813833C02	Dual
CR706	4805218N57	Dual
		<b>JACK:</b>
J701	0905257V04	Connector, 26-pin; to P701 on Front Cover Display Flex
J702	0913915A11	Connector, 25-pin
J703	0905257V03	Connector, 18-pin; to P703 on Controls Flex

J704	-----	Circuit Plating on early version radios, 20 contacts, to P704 on Jumper Flex
	or 0905461X01	Connector on later version radios, 20 contacts; to P704 Strip Connector
L703 thru 706	2462587Q40	<b>COIL, RF:</b> 270 nH
		<b>TRANSISTOR:</b>
Q701	4805128M40	PNP
Q703	4880048M01	NPN
		<b>RESISTOR, Fixed: Ω ±5%; .0625W unless stated</b>
R700	0662057A65	4.7k
R701	0662057A56	2k
R702	0662057A81	22k
R703	0662057A56	2k
R704	0662057A41	470
R705	0662057R92	47.5k
R706	0662057A56	2k
R707	0662057A41	470
R708	0662057B47	0
R710	0662057A89	47k
R711	0662057A97	100k
R712	0662057B47	0
R713	0662057A81	22k
R714	0683962T45	68
R715	0662057A97	100k
R716, 717	0662057A81	22k
R718	0662057A97	100k
R719	0662057B02	150k
R720, 721, 722	0662057A89	47k
R723	0662057A49	1k
R724	0662057A89	47k
R725	0662057G07	75k
R726	0662057G08	82.5k
R727	0662057A81	22k
R728, 729	0662057A89	47k
R730, 731	0662057C55	150
R732	0662057A73	10k
R736	0662057A81	22k
R737	-----	Not Placed
R738	0662057A81	22k
R739	0662057A73	10k
R740, 741	0662057A81	22k
R743	0662057A73	10k
R746	0662057A97	100k
R747	0662057B02	150k
R749	0662057A73	10k
R750	0662057A97	100k
R754	0662057B47	0
R755	-----	Not Placed
R757	0662057A81	22k
R758	0662057A97	100k
R759	0662057A81	22k
R760	0662057B47	0
R761	0662057A73	10k
R762	0662057B47	0
R763 thru 768	-----	Not Placed
R769	0662057A81	22k
R770	2113741F49	Capacitor, 10nF
R771	0662057B47	0
R772	-----	Not Placed
R773	0662057A41	470
R801	0660076E56	2k
R802, 803	0662057A56	2k
R804	0662057A65	4.7k
R805	0662057A41	470
		<b>MODULE:</b>
U701	5105835U14	Audio Signalling Filter
U702	5105662U62	Audio PA
U703	4805921T09	Dual Transistor
U704	4805921T07	Transistor, NPN
U705	5105662U52	Microcomputer
U708	5105469E65	5V Regulator
U709	5105750U28	Mux
U710	5105457W06	SLIC IV
U711	5113806A20	Multiplexer

U712	4805718V01	Transistor Package
U713	5105662U58	EEPROM
U714	5105662U54	SCRAM
U715, 716	5105329V30	256 x 8 FLASH
U717	-----	Not Placed
		<b>DIODE, Zener:</b>
VR701, 702	4813830A23	10V
VR703	4813830A18	6.8V
VR704 thru 711	4813830A15	5.6V
VR712	4813830A33	20V
VR713	4813830A23	10V
VR714	4813830A18	6.8V
VR715	4813830A14	5.1V
VR716	4813830A15	5.6V
VR717	4813830A27	14V
VR718	4813830A15	5.6V

**Note:** "Not Placed" means that the components are for future use, and are not placed on the circuit board at this time.

INSERT DIAGRAMS  
(L1) BEPF-24431-O (20% BLK., 133 LINE)  
(OL) BEPF-24432-O (100% BLK.)  
R.T. 50%

INSERT DIAGRAMS  
(L8) BEPF-24433-O (20% BLK., 133 LINE)  
(OL) BEPF-24434-A (100% BLK.)  
R.T. 50%

INSERT SCHEMATIC  
63D81200C41-A (100% BLK.)  
SHOOT AT 100%

**Electrical Parts List, Controller** TPLF-4206-A  
**NTN7512A Front Display VHF, UHF, and 800MHz Radios**  
**NTN7513A Front Display 900MHz Hear Clear Radios**  
**NTN7857A Top/No Display VHF, UHF, and 800MHz Radios**  
**NTN7858A Top/No Display 900MHz Hear Clear Radios**

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		<b>CAPACITOR, Fixed: pF ±5%; 50V unless stated</b>
C601	2113743A19	0.1µF
C602, 603, 604	2113741A33	3.3nF
C605, 606	2113743K15	0.1µF
C607	2113743A23	0.22µF
C608	2113743A19	0.1µF
C609, 610	2311049A04	0.33µF
C611, 612	2311049A42	3.3µF
C613	2113741F17	470
C614	2113741F49	10nF
C615	2113741F17	470
C616	2113743K15	0.1µF
C617	2113741M53	.022µF
C618	2113743A19	0.1µF
C619	2113741F49	10nF
C620	2113741M53	.022µF
C700 thru 708	2113741F17	470
C709	2113743A23	0.22µF
C710	2311049J11	4.7µF
C711	2311049A07	1.0µF
C712, 713	2113743A19	0.1µF
C714, 715	2113743K15	0.1µF
C716, 717	2113743A23	0.22µF
C718	2113743K15	0.1µF
C719	2311049A01	0.1µF
C720	2113741F49	10nF
C721	2113743K15	0.1µF
C722	2311049A09	2.2µF
C723	2113743A23	0.22µF
C724	2113740F36	24
C725	2311049A07	1µF
C726	2113743F12	0.33µF
C727	2311049A07	1µF
C728	2113743F12	0.33µF
C729	2311049A07	1µF
C730	2113741F41	4.7nF
C731	2113743K15	0.1µF
C732	2311049J11	4.7µF
C733	2113743K15	0.1µF
C734	2311049J23	10µF
C735 thru 738	2113741F17	470
C739	2113740F39	33
C740, 741, 742	2113741F17	470
C743	2113741A49	15nF
C744	2113741F49	15nF
C745	2113740F39	33
C746 thru 757	2113741F17	470
C758	2113743K15	0.1µF
C759, 760, 761	2113741F17	470
C762	2113743K15	0.1µF
C763, 764	2113740F36	24
C765	2113743K15	0.1µF
C766	2311049A42	3.3µF
C767	2113743K15	0.1µF
C768	2113741F49	10nF
C769	2113741F17	470
C770	2311049J23	10µF
C771	2113743K15	0.1µF
C772	2311049A42	3.3µF
C773	2113743A19	0.1µF
C774, 775	2113741F17	470
C776	2113743K15	0.1µF
C777	2311049A07	1µF
C778	2113743K15	0.1µF
C779	Not Placed	
C780 thru 786	2113741F17	470
C787	2113740F39	33
C788 thru 791	2113741F17	470
C792	2113741F13	330
C793	2113743A19	0.1µF
C795	2113740F39	33
C796	2311049A07	1.0µF
C797	2113740F51	100
C798	2113741F49	10nF
C804	2113741F41	4700
C808	2113741F41	4700

CR701	4880236E05	<b>DIODE:</b> Schottky
CR702, 703, 704	4805218N57	Dual
CR705	4813833C02	Dual
CR706	4805218N57	Dual
J701	0905257V04	<b>JACK:</b> Connector, 26-pin; to P701 on Front Cover Display Flex
J702	0913915A11	Connector, 25-pin
J703	0905257V03	Connector, 18-pin; to P703 on Controls Flex
J704	-----	Circuit Plating on early ver-
sion		radios, 20 contacts; to P704
on	or 0905461X01	Jumper Flex
		Connector on later version
		radios, 20 contacts; to P704
		Strip Connector
L702 thru 706	2462587Q40	<b>COIL, RF:</b> 270 nH
Q701	4805128M40	<b>TRANSISTOR:</b> PNP
Q703	4880048M01	NPN
R601	0662057G13	<b>RESISTOR, Fixed: Ω ±5%; .0625W unless stated</b>
R602	0662057A53	100k
R603	0662057R60	1.5k
R604	0662057R30	10k
R605	0662057A97	1k
R606	0662057R92	100k
R607	0662057G13	47.5k
R608	0662057A81	22k
R700	0662057A65	100k
R701	0662057A56	4.7k
R702	0662057A81	2k
R703	0662057A56	22k
R704	0662057A41	2k
R705	0662057R92	47.5k
R706	0662057A56	2k
R707	0662057A41	470
R708	0662057A56	2k
R710	0662057A89	47k
R711	0662057A97	100k
R712	0662057A56	2k
R713	0662057A81	22k
R714	0683962745	68
R715	0662057A97	100k
R716, 717	0662057A81	22k
R718	0662057A97	100k
R719	0662057B02	150k
R720, 721, 722	0662057A89	47k
R723	0662057A49	1k
R724	0662057A89	47k
R725	0662057G07	75k
R726	0662057G06	62.5k
R727	0662057A81	22k
R728, 729	0662057A89	47k
R730, 731	0662057C55	150
R732	0662057A73	10k
R736	0662057A81	22k
R738	0662057A81	22k
R739	0662057A73	10k
R740, 741	0662057A81	22k
R743	0662057A73	10k
R746	0662057A97	100k
R747	0662057B02	150k
R749	0662057A73	10k
R750	0662057A97	10k
R754	0662057B47	0
R757	0662057A81	22k
R758	0662057A97	100k
R759	0662057A81	22k
R761	0662057A73	10k
R801	0660076E56	2k
R802, 803	0660257A56	2k
U601	5105662U60	<b>MODULE:</b> Hear Clear
U701	5105663U42	Audio Signalling Filter
U702	5105662U62	Audio PA
U703	4805921T09	Dual Transistor
U704	4805921T07	Transistor, NPN
U705	5105662U52	Microcomputer
U708	5105469E65	SV Regulator
U709	5105750U28	Mux
U710	5105750U31	SLIC IV

U711	5184704M60	Multiplexer
U712	4805718V01	Transistor Package
U713	5105662U58	EEPROM
U714	5105662U54	SCRAM
U715	5105318X01	256 x 8 Masked ROM (for all keypad radios)
	or 5105318X02	256 x 8 Masked ROM (for no display and top display radios)
VR701, 702	4813830A23	<b>DIODE, Zener:</b> 10V
VR703	4813830A18	6.8V
VR704 thru 711	4880140L09	6.2V
VR712	4805718V01	20V
VR713	4813830A23	10V
VR714	4813830A18	6.8V
VR715	4813830A14	5.1V
VR717	4813830A27	14V
VR718	4880140L09	6.2V

- Notes:**
- 600 Series HearClear components are part of NTN7513A and NTN7858A.
  - "Not Placed" means that components are for future use, and are not placed on the circuit board at this time.

**INSERT EXPLODED VIEW  
CEPF-22595-D**

**Basic Radio Exploded View Parts List** TPLF-4075-D

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	4505896U01	LEVER, PTT
2	3205902U01	SEAL, PTT, and ACTUATOR for S404, S405, S406, and S408
3A	1505627V01	COVER, Front
3B	or 1505637V03	COVER, Front; DTMF
4	-----	LABEL, Agency Approval; not field replaceable
5	3305183R55	LABEL, Motorola
6	3305183R56	LABEL, HT1000
7	3505535X02	FELT, Speaker
8	See Note 1	SPEAKER (LS401)
9	0705470V01	BRACKET, Speaker Retainer
10	See Note 1	MICROPHONE (MK401)
11	1405330W01	BOOT, Microphone
12	8405310W01	FLEX, Front Cover/Display
13	8405151Y01	FLEX, Controls
14	3905517V01	POPPLER, PTT (p/o S406)
15	3605253V01	KNOB, On/Off/Volume
16	3605254V02	KNOB, Frequency
or	3605254V01	2-Frequency Radios
17	1305872V02	16-Frequency Radios
or	1305872V01	ESCUTCHEON, Control Top
18	3205160W01	2-Frequency Radios
19	2205159W01	SEAL, Actuator; for S101
20	3205514W01	PIN, Actuator; for S101
21	3205292W01	SEAL, Accessory Connector
		SEAL, Control Top

- Notes:**
- Refer to electrical parts list (miscellaneous) for part number and complete description.
  - Refer to electrical parts list (transceiver board) for part number and complete description.

22	3205293W01	SEAL, Emergency Button
23	2705877U01	HOUSING, Switch
24	See Note 1	SWITCH, Toggle (S402)
25	See Note 1	POTENTIOMETER/SWITCH, On/Off/Volume Control (R401/S403)
26	3905329W01	POPPLER, Emergency Button
27	See Note 1	LED (CR702A/CR702B)
28	See Note 1	SWITCH, Frequency (S401)
29	1505632V01	COVER, Switch Housing
30	-----	SPRING, PA; not field replaceable, order front shield (item 37)
31	4205507X01	STRAIN RELIEF
32	See Note 1	CONNECTOR, Strip (P301/P704)
or	8405247V02	LABEL, Motorola
33	See Note 2	FLEX, Jumper (early version radios)
34	3205820V02	PLUG, Connector (P404)
35	-----	SEAL, Connector Plug
36	3205126W01	LABEL, Rear; Information; not field replaceable
37	2605891U01	O-RING, Contoured/SEAL, Antenna SHIELD, Front
38	See Note 1	SWITCH, RF (S101)
39	-----	LABEL, Barcode; not field replaceable
40	4105266V01	SPRING, RF Switch
41	4405524V01	PISTON, RF Switch
42	1405307X01	INSULATOR
43	5105892U01	CHASSIS (Rear Cover)
44	3905838V01	CONTACT, Antenna Shield Ground (800MHz and 900MHz radios only)
45	2605898U01	SHIELD, PA (800MHz and 900MHz radios only)
46	7505334W01	PAD, Sound Dampening
47	7505437W01	KEYPAD, DTMF
48	5102463J08	CIRCUIT BOARD, DTMF
49	7505393N33	PAD, Shock

**Top-Display Exploded View Parts List** TPLF-4154-A

ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	4505896U01	LEVER, PTT
2	3205902U01	SEAL, PTT, and ACTUATOR for S404, S405, S406, and S408
3	1505627V02	COVER, Front
4	-----	LABEL, Agency Approval; not field replaceable
5	3305183R55	LABEL, Motorola
6	3305183R70	LABEL, MT2000
or	3305183R71	LABEL, MTS2000
or	3305183R94	LABEL, MTX
7	3505535X02	SEAL, Connector Plug
8	See Note 1	LABEL, Rear; Information; not field replaceable
9	0705470V01	SPEAKER (LS401)
10	See Note 1	BRACKET, Speaker Retainer
11	1405330W02	MICROPHONE (MK401)
12	8405641V01	BOOT, Microphone
13	8405151Y01	FLEX, Front Cover/Display
14	3905517V01	FLEX, Controls
15	3605253V01	POPPLER, PTT (p/o S406)
16	3605253V01	KNOB, On/Off/Volume
17	3605636V01	KNOB, Frequency
18	1305698V01	16-Frequency Radios
19	3205160W01	ESCUTCHEON, Control Top
20	2205159W01	SEAL, Actuator; for S101
21	3205514W01	PIN, Actuator; for S101
22	3205292W01	SEAL, Accessory Connector
23	2705877U01	HOUSING, Switch
24	See Note 1	SWITCH, Toggle (S402)

- Notes:**
- Refer to electrical parts list (miscellaneous) for part number and complete description.
  - Refer to electrical parts list (transceiver board) for part number and complete description.

25	See Note 1	POTENTIOMETER/SWITCH, On/Off/Volume Control (R401/S403)
26	3905329W01	POPPLER, Emergency Button
27	See Note 1	LED (CR702A/CR702B)
28	See Note 1	SWITCH, Frequency (S401)
29	1505632V01	COVER, Switch Housing
30	-----	SPRING, PA; not field replaceable, order front shield (item 37)
31	4205507X01	STRAIN RELIEF
32	See Note 1	CONNECTOR, Strip (P301/P704)
or	8405247V01	LABEL, Motorola
33	See Note 2	FLEX, Jumper (early version radios)
34	3205820V02	PLUG, Connector (P404)
35	-----	SEAL, Connector Plug
36	3205126W01	LABEL, Rear; Information; not field replaceable
37	2605891U02	O-RING, Contoured/SEAL, Antenna SHIELD, Front
38		

## INSERT EXPLODED VIEW CEPF-22751-C

**Keypad Radio Exploded View Parts List**      TPLF-4085-D

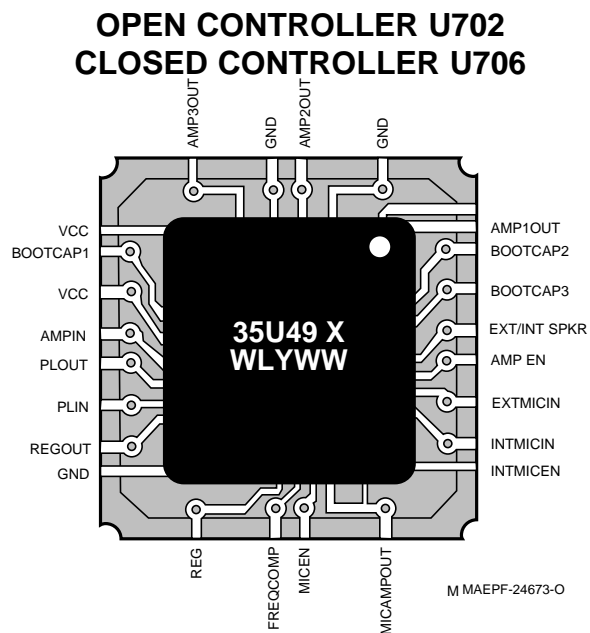
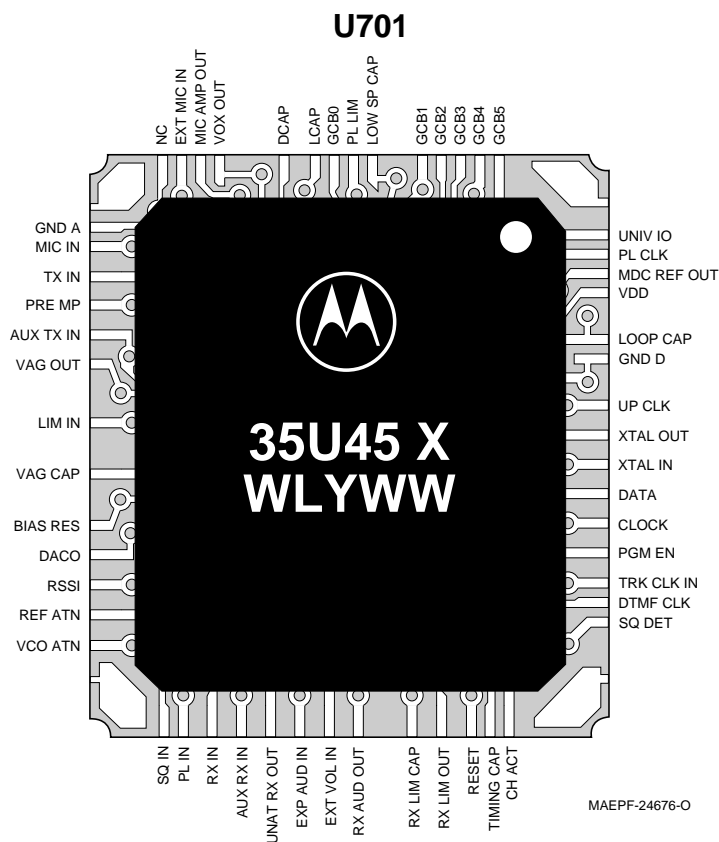
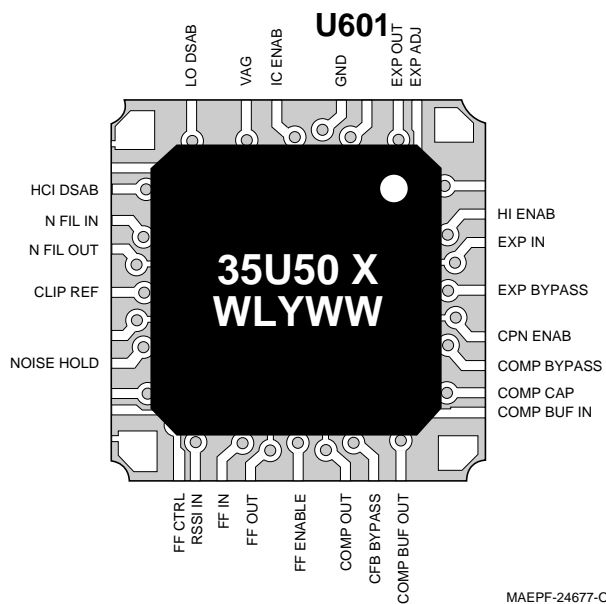
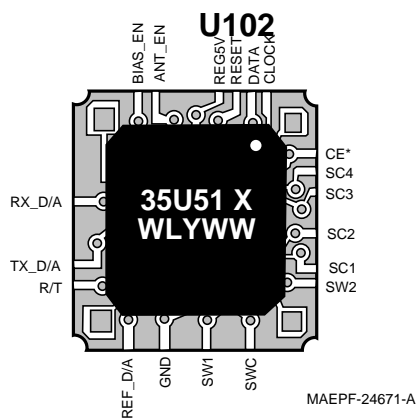
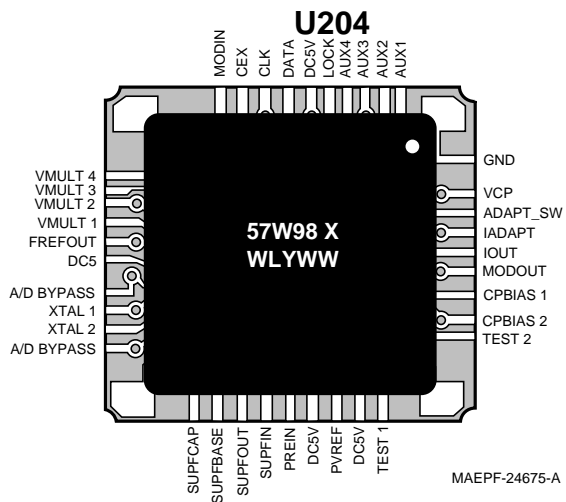
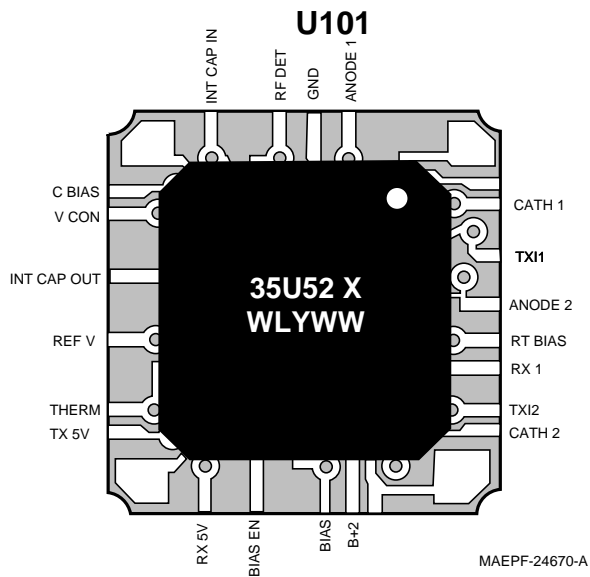
ITEM NO.	MOTOROLA PART NO.	DESCRIPTION
1	4505896U01	LEVER, PTT
2	3205902U01	SEAL, PTT, and ACTUATOR for S404, S405, S406, and S408
3A	1505637V01	COVER, Front; Full Keypad
3B	1505637V02	COVER, Front; Limited Keypad
4	-----	LABEL, Agency Approval; not field replaceable
5A	7505870U01	KEYPAD, 15-key
5B	7505870U02	KEYPAD, 6-key
6	5105238U83	MODULE, Display
7	3305183R55	LABEL, Motorola
8	3305183R70	LABEL, MTS2000
	or 3305183R71	LABEL, MTS2000
	or 3305183R94	LABEL, MTX
9	3505535X02	FELT, Speaker
10	See Note 1	SPEAKER (LS401)
11	0705470V01	BRACKET, Speaker Retainer
12	See Note 1	MICROPHONE (MK401)
13	1405330W02	BOOT, Microphone
14	8405310W01	FLEX, Front Cover/Display
15	8405151Y01	FLEX, Controls
16	3905517V01	POPPLE, PTT (p/o S406)
17	3605253V01	KNOB, On/Off/Volume
18	3605636V01	KNOB, Frequency
19	1305633V01	RING, Concentric; Escutcheon
20	3605635V01	KNOB, Concentric Ring
21	1305698V01	ESCUTCHEON, Control Top
22	3205160W01	SEAL, Actuator; for S101

23	2205159W01	PIN, Actuator; for S101
24	3205514W01	SEAL, Accessory Connector
25	3205292W01	SEAL, Control Top
26	3205293W01	SEAL, Emergency Button
27	2705877U01	HOUSING, Switch
28	See Note 1	SWITCH, Toggle (S402)
29	See Note 1	POTENTIOMETER/SWITCH, On/Off/Volume Control (R401/S403)
30	3905329W01	POPPLE, Emergency Button
31	See Note 1	LED (CR702A/CR702B)
32	See Note 1	SWITCH, Frequency (S401)
33	1505632V01	COVER, Switch Housing
34	-----	SPRING, PA; not field replaceable, order front shield (item 41)
35	4205507X01	STRAIN RELIEF
36	See Note 1	CONNECTOR, Strip (P301/P704)
	or 8405247V01	FLEX, Jumper (early version radios)
37	See Note 2	PLUG, Connector (P404)
38	3205820V02	SEAL, Connector Plug
39	-----	LABEL, Rear; Information; not field replaceable
40	3205126W01	O-RING, Contoured/SEAL, Antenna
41	2605891U02	SHIELD, Front
42	See Note 1	SWITCH, RF (S101)
43	-----	LABEL, Barcode; not field replaceable
44	4105266V01	SPRING, RF Switch
45	4405524V01	PISTON, RF Switch
46	1405307X01	INSULATOR
47	1505892U01	CHASSIS (Rear Cover)
48	3905838V01	CONTACT, Antenna Shield Ground (800MHz and 900MHz radios only)
49	2605898U01	SHIELD, PA (800MHz and 900MHz radios only)
50	7505393N33	PAD, Shock

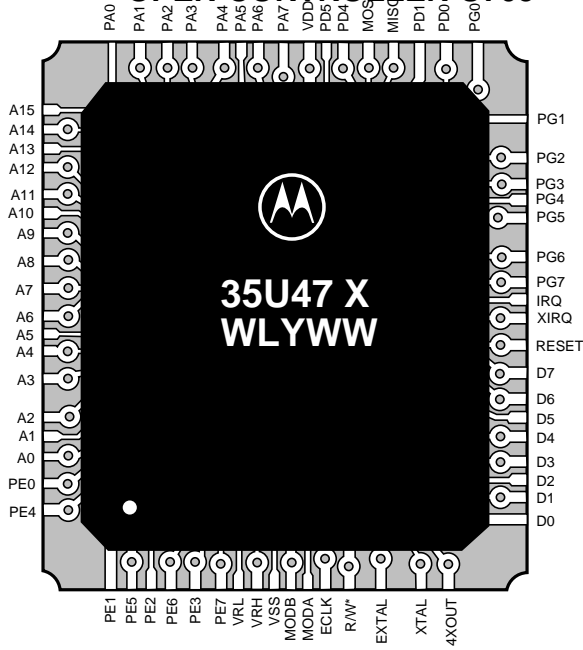
**Notes:**

1. Refer to electrical parts list (miscellaneous) for part number and complete description.
2. Refer to electrical parts list (transceiver board) for part number and complete description.



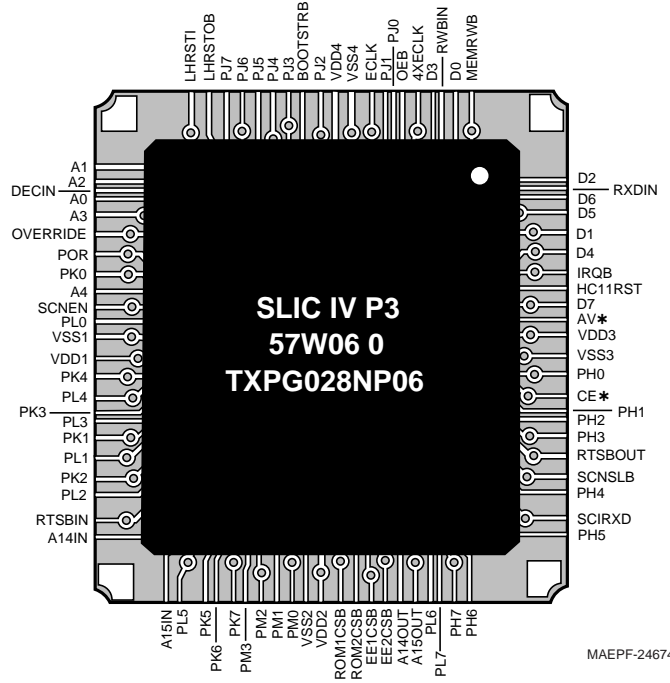


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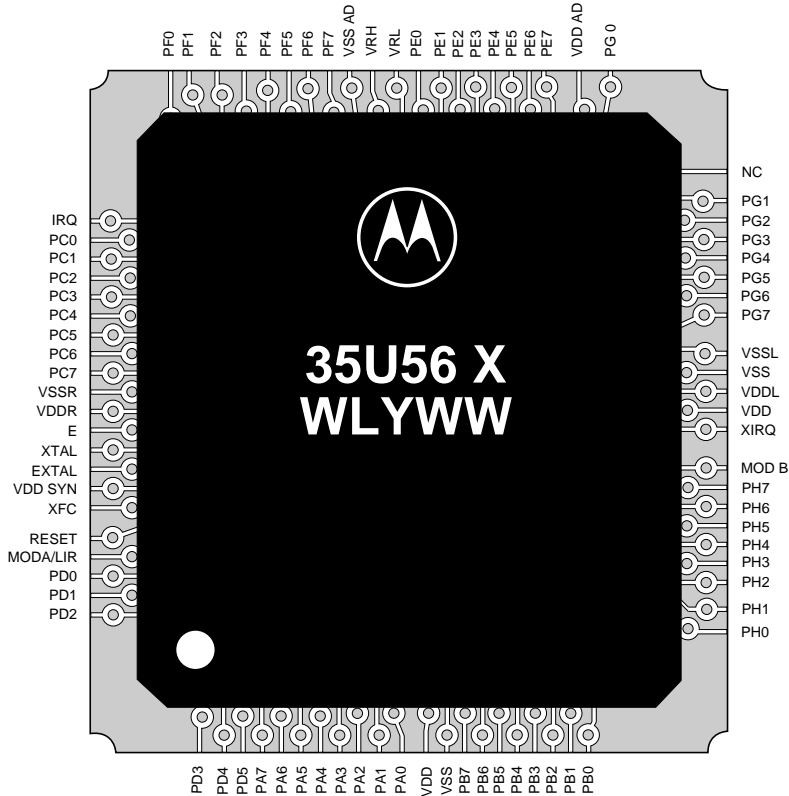
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### OPEN CONTROLLER U710



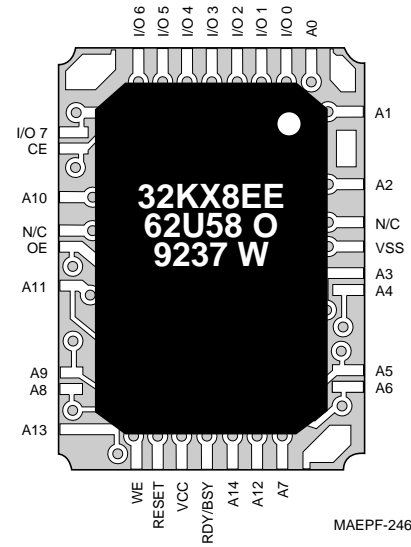
MAEPF-24674-O

### CLOSED CONTROLLER U705



MAEPF-24678-A

### U713



MAEPF-24688-O



# APPENDIX

## Secure Modules: NTN7279A, NTN7280A, NTN7281A, NTN7282A, and NTN7283A for MTS 2000 Radios

### NOTE

The Secure Module is NOT serviceable. The information contained in this appendix is only meant to help determine whether a problem is due to the Secure Module or the radio itself.

### I. INTRODUCTION

The Secure Module is designed to digitally encrypt and decrypt voice data in Motorola's MTS 2000 Series Handie-Talkie™ Portable Radios. The Secure Module uses a custom encryption integrated circuit (IC) and an encryption key variable to perform its encode/decode function. The encryption key variable is loaded into the Secure Module via the radio's universal (side) connector from a hand held key variable loader. The encryption IC corresponds to the particular encryption algorithm purchased. The encryption algorithms and their corresponding kit numbers are:

- Data Encryption Standard (DES)      NTN7279A
- DES-XL                                      NTN7280A
- Digital Voice Protection (DVP)        NTN7281A
- DVP-XL                                      NTN7282A
- DVI-XL                                      NTN7283A

### II. CIRCUIT DESCRIPTION

The Secure Module, shown in Figure 1, operates from two power supplies. The first 5 volt supply (Vdd)

is received from the controller board through connector plug P1 pin 2. This Vdd supply is turned on and off with the radio on/off switch. The second supply (UNSW B+) is received from the controller board through connector Plug P1 pin 1. UNSW B+ provides power to the Secure Module as long as the radio battery is in place.

Key variables are loaded into the Secure Module through connector P1 pins 13, 15, and 16. One key variable can be stored in the module at a time. The key variable is stored in volatile electronic memory, so it can only remain in memory as long as the radio is connected to a charged battery. If the battery is removed or if the battery fails, then a capacitor will allow the module to retain the key variable for at least 30 seconds while the battery is being replaced.

The radio's host processor communicates with the Secure Module on the Serial Peripheral Interface (SPI) bus. The host processor is the master on this bus, while the Secure Module is a slave on the bus. The SPI bus consists of five signal lines. Refer to Table 1 for the signal information. A communications failure between the host processor and the Secure Module will be indicated as an "ERROR 09/10" message on the radio display.

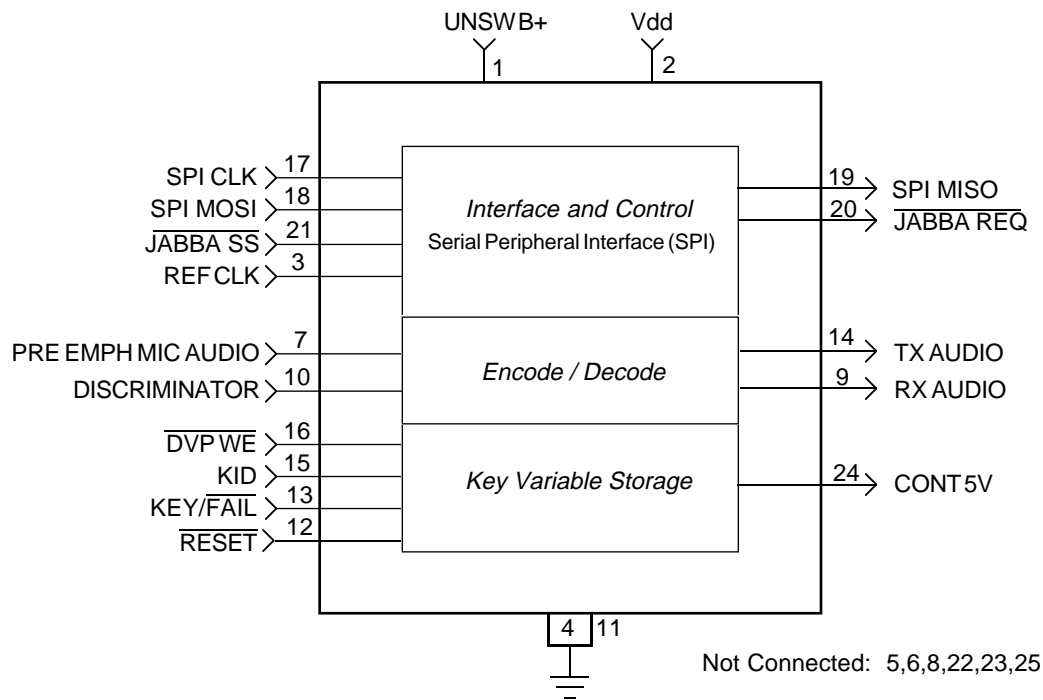


Figure 1. MTS 2000 Single Key Secure Module Block Diagram

**Table 1. MTS 2000 Single Key Secure Module I/O Definition**

<b>SIGNAL NAME</b>	<b>CONNECTOR PLUG P1 PIN NUMBER</b>	<b>FUNCTION</b>
UNSW B+	1	Unswitched battery voltage
Vdd	2	Switched 5 volt supply
REF CLK	3	2.1/2.4 MHz clock signal
GROUND	4	Ground
PRE EMPHMIC AUDIO	7	Transmit Clear Audio
RX AUDIO	9	Receive Clear Audio
DISCRIMINATOR	10	Receive Encrypted Audio
GROUND	11	Ground
RESET	12	Radio Reset - Does NOT reset module
KEY/FAIL	13	Keyloading Signal
TX AUDIO	14	Transmit Encrypted Audio
KID	15	Keyloading Signal
DVP WE	16	Keyloading Signal
SPI CLK	17	SPI Data Clock
SPI MOSI	18	SPI Data from Host
SPI MISO	19	SPI Data to Host
JABBA REQ	20	SPI Secure Interrupt Request
JABBA SEL	21	SPI Secure Slave Select
CONT 5V	24	Continuous 5 Volt Regulator Output
	5,6,8,22,23,25	Not Used

### III. Troubleshooting Secure Operations

Refer elsewhere in this radio service manual for disassembly and reassembly information, and refer to the radio theory/troubleshooting manual for a general overview of troubleshooting information and procedures. A key variable loader and oscilloscope are needed to troubleshoot the Secure Module.

#### NOTE

The Secure Module itself is NOT serviceable. If the Secure Module is found to be defective then it must be replaced.

#### A. ERROR 09/10

The MTS 2000 Series Handie-Talkie™ Portable Radio automatically performs a self test on every power-up. Should the radio fail the self tests, the display will show "ERROR XX/XX" (where XX/XX is alphanumeric) accompanied by a short beep. If the display shows "ERROR 09/10" or "E09/10", then the radio failed the secure power-up self tests and the host microcontroller is unable to communicate with the Secure Module via the SPI bus. Turn off the radio, check the battery connection, and turn the radio back on. If the radio still does not pass the self tests, then a problem exists with the secure operations of the radio.

Since the module is removable, a good first step in troubleshooting secure operation is simply to replace the suspect Secure Module with a known

working module. If this does not fix the problem, then the original module is probably not the cause of the problem. If the new module does fix the problem, then the original module must be replaced.

A complete procedure for troubleshooting this error is listed below:

1. Turn the radio off, check the battery connection, and turn the radio back on.
2. If the error condition still exists, check that a Secure Module is installed and make sure that it is properly connected to the controller board. To do this, refer to the disassembly and reassembly sections of this manual.
3. Turn the radio back on.
4. If the error condition still exists and a working secure module with the same kit number is available, replace the suspect module with the working module.
5. If the problem persists, disassemble the radio and check the encryption connector SPI pins (listed in Table 1) for data transitions when the radio is turned on and off. If activity is not seen on all five lines, check both sides of the connector for broken connections.
6. Troubleshoot the Controller Board.

## B. Keyloading Problems

Use the following procedure to troubleshoot keyloading problems:

1. Verify that the correct Key Variable Loader (KVL) is being used for the particular encryption algorithm present in the radio. Refer to the following chart:

Secure Module Kit	KVL Kit	Description
NTN7279A	T3011_X	DES
NTN7280A	T3011_X	DES-XL
NTN7281A	T3010_X	DVP
NTN7282A	T3014_X	DVP-XL
NTN7283A	T3012_X	DVI-XL

2. Connect the KVL to the radio via the TDN9390A keyloader cable. When the cable is connected to the radio, the radio should enter the keyloading mode of operation, and the radio should display "KEYLOADING" or "KEYLDG" and make a beep tone.
3. If the radio displays "ERROR 09/10" or "E09/10" then go to the ERROR 09/10 troubleshooting section.
4. If the radio does not go into keyloading mode, detach and reattach the keyloader cable.
5. If there is still a problem, refer to the universal connector illustration found in the schematic and circuit board section of this manual, and short pins 8, 10, and 12 on the universal connector together. If this causes the radio to go into keyloading mode, then replace the keyloader cable.
6. If the radio still does not go into keyloading mode, check the continuity of the the Front Cover/Display Flex and make sure that the Flex is properly connected to the Universal Connector and to the Controller Board.
7. If the radio does go into keyloading mode, but after starting the keyloading process the KVL display indicates "X FAIL", then check to see if there are transitions on pins 13, 15, and 16 of connector P1 on the Secure Module during a keyload.
8. If there are no transitions on any one of these lines during a keyload, check the integrity and continuity of the Expansion Board Connector. If it is OK, try replacing the Controller Board.
9. If there are transitions on these lines, try replacing the Secure Module.
10. If the KVL display indicates "X PASS" but you cannot hear a keyload verification tone, then check the volume of the radio. If the volume is OK, troubleshoot the receive routing paths in the radio.

## IV. SERVICE AID

A cable, Motorola kit number TDN9390A, connects the MTS 2000 radio universal connector to the keyloader.

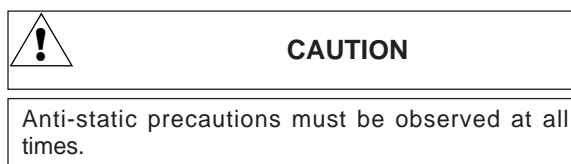
## V. RETROFIT INSTRUCTIONS

### A. General

This section gives instructions on retrofitting a secure module into a secure-capable MTS 2000 radio. The following paragraphs give directions on how to physically install the secure module, how to enable the secure options by updating the codeplug, and how to tune the radio for optimum secure performance.

### B. Physical Retrofit of Secure Module

The radio must be partially disassembled to install the secure module.



Follow the disassembly procedures in section VI, located toward the front of this manual. Proceed through paragraph B (Disassembly to Board Level) step 8, where the front cover has been removed and the controls flex has been disconnected from the controller board.

Continue through step 9a, to loosen the front shield. **Do not completely remove the front shield.** Simply raise the lower portion of the shield while the opposite end is still connected to the top of the radio. With the front shield raised, observe the controller board which takes up the bottom third of the radio. On the lower right corner of the controller board is an empty female connector, which will be used to mate the controller board to the secure module. Place the secure module (component side toward controller board) over the controller board with the secure module's male connector placed above and aligned to the female connector on the controller board. Interlock the connectors by pressing down on the back of the the secure module. The secure module has now been installed. Reassemble the radio according to the reassembly instructions in section VI, located toward the front of this manual. Begin with paragraph E, step 5b.

### C. Update Codeplug Through RSS

#### 1. General

Once the secure module is installed, the radio's codeplug must be reprogrammed so that the new hardware can be used. There will also be some secure options that the user may or may not want to activate. Table 3, at the end of this appendix, gives a quick reference to several properties and a

brief description for each parameter. Refer to the RSS manual for general instructions in the use of RSS.

2. Set Secure-Equipped Field

The radio must be reprogrammed to utilize the secure module. At the RSS main menu, press **F4** for the CHANGE/CREATE/VIEW menu. Press **F3** for the Radio Wide Buttons, Switches, Display, Scan, Phone screen. Press **F2** for Radio Wide Options screen. Here, press tab to reach the Secure Equipped field. Press up/down arrow keys to select YES.

3. Set XL IC Present Field

If the secure module has an XL IC (the Range Extension or -XL option), the radio must be reprogrammed to show that this IC is present. While still in the Radio Wide Options screen, press **F6** to see Secure Options. Press Tab until the XL IC Present field is highlighted. Press up/down arrow keys to select YES. If the secure module does not have an XL IC, set the XL IC Present field to NO.

4. Enable Secure On Desired Channels

To actually use the secure option, Secure must be enabled on the channels for which it is desired. A channel can be strapped to secure-only, or clear-only, or secure/clear-selectable.

For conventional channels, proceed as follows: Press **F4** at the Main Menu to see the CHANGE/CREATE/VIEW menu. Press **F6** to see Conventional Systems, Personalities, MDC, Options. Press **F3** to see Conventional Personalities, Options. Press **F6** to see the SECURE OPTIONS screen. Press Tab to select the Secure/Clear Strapping field.

For trunking channels, proceed as follows: Press **F4** at the Main Menu to see the CHANGE/CREATE/VIEW menu. Press **F4** to see Trunking Systems, Personalities, Call Lists, Options screen. Press **F4** to see Trunking Personalities: Talk Groups, Emergency Options, etc. Press Tab to select the Strapping field. An Announcement Group must be specified for the Strapping parameter to appear. This selects the Announcement Group Strapping. Press **F7** to select Talk Groups. Press Tab to select the strapping of each Talk Group.

5. Other Secure Options

There are other secure options that can be changed on a per-channel basis, such as: Proper Code Detection, Transmit XL, or CFB. For conventional channels, these options are found on the same screen as Secure/Clear Strapping (**F4/F6/F3/F6**). These options are XL Transmit, Scan Holdoff Strapping, RX Modulation, and Proper Code Detect. For trunking channels, the only

selectable option is Proper Code Detect. This can be found by going to the MORE OPTIONS screen (**F9**) from the screen that was used to select secure/clear Strapping for trunking channels.

#### D. Secure Retrofit Tuning

After installing a secure-retrofit board into a radio, the secure TX deviation and the secure RX discriminator level must be tuned. Follow the procedure outlined in section III of this publication for the tuning of these two secure-related alignments.

The TX deviation balance (compensation) does not need to be performed as part of the secure retrofit procedure. Use the transmit deviation balance (compensation) procedure as outlined in this appendix, section III paragraph B, only when a complete radio alignment is being performed with a secure board installed.

### VI. SECURE ALIGNMENT PROCEDURE

#### A. General

For optimum radio performance, the secure transmit deviation and the receive discriminator level must be set. Refer to SECTION V, RADIO ALIGNMENT PROCEDURE, for a description of the radio alignment test setup, an RSS service menu overview, and for general radio tuning procedures. All normal radio tuning should be performed in the proper sequence before proceeding with secure tuning.

Note that the transmit deviation balance (compensation) tuning must be performed differently if a secure board is installed in the radio. Follow the procedure changes outlined below when tuning transmit deviation balance, and complete the normal tuning. Then proceed with the additional tuning for secure TX deviation and secure RX discriminator level tuning.

#### B. Transmit Deviation Balance (Compensation)

When tuning with a secure board installed, the coupling capacitor inside the RKN4035A Test Cable will cause rolloff of the low port modulation. To fix this, the cable should be dc coupled ("VOL" position) and an external coupling capacitor (1.3 $\mu$ F or larger) must be placed in series with the signal source input to the AC/DC MTR.

Follow the Transmit Deviation Balance (Compensation) procedure outlined in section V paragraph G, except change step 3 as follows:

3. Set the RTX4005B Test Box meter selector switch to the "VOL" position, and connect the signal source to the AC/DC MTR port thru a 1.3 $\mu$ F capacitor. Inject an 80 Hz tone at 100mVrms thru this capacitor. Keep the ac voltmeter in parallel to the AC/DC MTR input to ensure the proper input signal level.

**C. Secure TX Deviation**

Transmit deviation balance compensation and transmit deviation limit adjustments should be completed before secure deviation is adjusted. Remember to use the new transmit deviation balance procedure outlined in paragraph B before performing the following steps.

1. From the SERVICE menu, press **F2** to select TRANSMITTER alignment.
2. Press **F8** to select the SECURE TX DEV softpot.
3. Press **F6** to key the radio on the test frequency. The screen will indicate that the radio is transmitting.
4. Measure the secure deviation on your service monitor.
5. Use the up/down arrow keys to adjust the secure deviation per Table 2.

**Table 2. Secure Deviation**

Channel Spacing (KHz)	Secure Deviation (KHz)
25 / 30	2.91 - 3.06
20 (VHF/UHF)	1.69 - 1.84
20 (821-824, 866-869)	1.69 - 1.84
12.5	N/A

6. Press **F6** to dekey the radio. Press **F8** to program the softpot value.
7. Press **F10** to return to the TRANSMITTER menu.

**D. Secure RX Discriminator Level**

1. Set the RTX4005B Test Box meter selector switch to the "MX DISC" position, and connect an ac voltmeter (capable of 1mV resolution on a 2V scale) to the test box AC/DC meter port.
2. From the SERVICE menu, press F3 to select RECEIVER alignment.
3. Press **F8** to select the SECURE DISCRIMINATOR LEVEL softpot. The screen will indicate the receive test frequency to be used.
4. Set the RF test generator to the receive test frequency. Set the RF level at the radio standard antenna port to 1mV (-47dBm) modulated with 3.0 kHz FM deviation of a 1 kHz tone.
5. Use the UP/DOWN arrow keys to obtain a discriminator level between 206 - 218mVrms (target value of 212 mVrms) observed on the ac volt-meter.
6. Press **F8** to program the softpot value.
7. Press **F10** to return to the RECEIVER menu.



**Table 3. RSS Secure Parameters**

<b>Parameter</b>	<b>Default</b>	<b>Possible Settings</b>	<b>Radio Wide/ Per Channel</b>	<b>Used in Conv/Trunk</b>	<b>Description</b>
Secure Equipped	No	Yes/No	Radio Wide	Both	Notifies radio that Secure Module is present
XL IC Present	No	Yes/No	Radio Wide	Both	Notifies radio that Secure Module contains XL IC
Secure/Clear Strapping	Select	Select/ Clear/ Secure	Per Channel	Conv	Sets channel to Clear-Only or Secure-Only or user Selectable
Strapping	Clear	Select/ Clear/ Secure	Per Channel	Trunk	Sets channel to Clear-Only or Secure-Only or user Selectable
XL Transmit	Enable	Enable/ Disable	Per Channel	Conv	Enables TX XL operation or disables for CFB
Scan Select	Non-XL&XL	Non-XL/ Non-XL&XL	Per Channel	Conv	Selects between Non-XL and XL Scan Unsilence Duration
Scan Holdoff Strapping	Both	Both/ Clear Only/ Secure Only	Per Channel	Conv	Scan for Clear or Secure or Both on a particular channel
RX Modulation	2-Level Rx	Auto Rx/ 2-Level Rx	Per Channel	Conv	Tells radio to look for 2&4-level signals or 2-level signals only
Proper Code Detect (Conv)	Enabled	Enabled/ Disabled	Per Channel	Conv	Enables RX proper code detection
Proper Code Detect (Trunk)	Disabled	Enabled/ Disabled	Per Channel	Trunk	Enables RX proper code detection
TX Clear Alert Tones	Enabled	Enabled/ Disabled	Radio Wide	Both	Enables alert tone when PTT is pressed while in the Clear mode
Periodic Keyfail Alert Tone	Enabled	Enabled/ Disabled	Radio Wide	Both	Enables a Keyfail Alert Tone to sound periodically in a key-fail condition
Non-XL Scan Unsilence Duration	275mS	0-6375ms	Radio Wide	Both	The time after an activity detect that radio will wait on channel without an unsilence in Non-XL mode
XL Scan Unsilence Duration	875mS	0-6375ms	Radio Wide	Both	The time after an activity detect that radio will wait on channel without an unsilence in XL mode



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