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**User manual MOTOROLA MT-2000**  
**User guide MOTOROLA MT-2000**  
**Operating instructions MOTOROLA MT-2000**  
**Instructions for use MOTOROLA MT-2000**  
**Instruction manual MOTOROLA MT-2000**

**HT 1000™, JT 1000®,  
MT 2000™, MTS 2000™,  
and MTX Series**  
Handie-Talkie® Portable Radios  
  
Service Manual



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**Manual abstract:**

Sunrise Boulevard Fort Lauderdale, Florida 33322 Printed in U.S.A. 7/03. @@@@For details on the operation of the radio or level 1 or 2 maintenance procedures, refer to the applicable manuals, which are available separately. A list of related publications is provided in the section, "Related Publications Available Separately" on page vii. Product Safety and RF Exposure Compliance Before using this product, read the operating instructions for safe usage contained in the Product Safety and RF Exposure booklet enclosed with your radio. ATTENTION! This radio is restricted to occupational use only to satisfy FCC RF energy exposure requirements. Before using this product, read the RF energy awareness information and operating instructions in the Product Safety and RF Exposure booklet enclosed with your radio (Motorola Publication part number 6881095C98) to ensure compliance with RF energy exposure limits. For a list of Motorola-approved antennas, batteries, and other accessories, visit the following web site which lists approved accessories: <<http://www.motorola.com/cgiss/index.shtml>> ! Caution Manual Revisions Changes which occur after this manual is printed are described in FMRs (Florida Manual Revisions). These FMRs provide complete replacement pages for all added, changed, and deleted items, including pertinent parts list data, schematics, and component layout diagrams. To obtain FMRs, contact the Radio Parts Services Division (refer to "Replacement Parts Ordering" on page 115).

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68P81200C20 Service Manual (early version radios; first issue- 4/93) . . . . .



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... 68P81072C10 · MTX Series Model B4 Privacy Plus Portable Radios . .  
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..... 68P81073C60 · MTX Series Model B5 and B7 Privacy Plus Portable Radios .

..... 68P81072C40 · MTX-LS Trunked Portable Radios.

..... 68P81083C35 Mobile Vehicular Adapter (MTVA) Operating Instructions.

..... 68P81075C85 Mobile Vehicular Adapter (MTVA) Installation Instructions . . . . .

..... 68P81075C90 Mobile Vehicular Adapter (MTVA) Service Manual.

. 68P81075C95 Option-Mate, HT 1000 Analog Voice Security; Installation/ Programming/Troubleshooting Manual . . . . .

. 68P81084C35 Option-Mate, HT 1000 Analog Voice Security Operating Instructions . . . . .

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H = Hand-Held Portable Positions 2 & 3 - Model Series 0 2 1 3 K 4 D 5 D 6 9 7 P 8 W 9 1 10 B 11 N 12 S 13 P 14 0 15 1 16 Positions 13 - 16 "SP" Model  
Suffix Position 12 Unique Model Variations C = Cenelec N = Standard Package 336 to 410MHz 403 to 437MHz 438 to 482MHz 470 to 520MHz Product  
Specific 806 to 870MHz 825 to 870MHz 896 to 941MHz 1.0 to 1.

6GHz 1.5 to 2.0GHz Position 11 - Version Version Letter (Alpha) - Major Change Position 10 - Feature Level 1 = Basic 6 = Standard Plus 2 = Limited  
Package 7 = Expanded Package 3 = Limited Plus 8 = Expanded Plus 4 = Intermediate 9 = Full Feature/ 5 = Standard Package Programmable Position 9 -  
Primary System Type A = Conventional B = Privacy Plus® C = Clear SMARTNETTM D = Advanced Conventional Stat-AlertTM E = Enhanced Privacy  
Plus® F = Nauganet 888 Series G = Japan Specialized Mobile Radio (JSMR) H = Multi-Channel Access (MCA) J = CoveragePLUSTM K = MPT1327\* -  
Public L = MPT1327\* - Private M = Radiocom N = Tone Signalling P = Binary Signalling Q = Phonenet® W = Programmable X = Secure Conventional Y  
= Secure SMARTNETTM Position 4 - Frequency Band A = Less than 29.7MHz P = B = 29.7 to 35.99MHz Q = C = 36 to 41.99MHz R = D = 42 to 50MHz S =  
F = 66 to 80MHz T = G = 74 to 90MHz U = H = Product Specific V = J = 136 to 162MHz W = K = 146 to 178MHz Y = L = 174 to 210MHz Z = M = 190 to  
235MHz Values given represent range only; they are not absolute.



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One item is supplied per radio. The radio model number is required when placing an order for the controller board. The model number can be found on the FCC Label on the back of the radio. Refer to Replacement Parts Ordering, Section 10 of this manual for instructions on how to place an order.

ix MODEL CHART Private Systems Radios (MTS 2000 Models) MODEL NUMBER H01KDD9PW1BN H01KDF9PW1BN H01KDH9PW1BN H01RDD9PW1BN H01RDF9PW1BN H01RDH9PW1BN H01SDD9PW1BN H01SDF9PW1BN H01SDH9PW1BN H01UCD6PW1BN H01UCF6PW1BN H01UCH6PW1BN H01WCD4PW1CN H01WCF4PW1CN H01WCH4PW1CN DESCRIPTION VHF, 16-Mode, Top Display, 5- to 1-Watt VHF, 160-Mode, Front Display, Limited Keypad, 5- to 1-Watt VHF, 160-Mode, Front Display, Full Keypad, 5- to 1-Watt UHF B1, 16-Mode, Top Display, 4- to 1-Watt UHF B1, 160-Mode, Front Display, Limited Keypad, 4- to 1-Watt UHF B1, 160-Mode, Front Display, Full Keypad, 4- to 1-Watt UHF B2, 16-Mode, Top Display, 4- to 1-Watt UHF B2, 160-Mode, Front Display, Limited Keypad, 4- to 1-Watt UHF B2, 160-Mode, Front Display, Full Keypad, 4- to 1-Watt 800MHz, 16-Mode, Top Display, 3-Watt 800MHz, 160-Mode, Front Display, Limited Keypad, 3-Watt 800MHz, 160-Mode, Front Display, Full Keypad, 3-Watt 900MHz, 16-Mode, Top Display, 2.4W (Typ), 2.9W (Max) 900MHz, 160-Mode, Front Display, Limited Keypad 900MHz, 160-Mode, Front Display, Full Keypad ITEM NO. DESCRIPTION AAA AAA AAA AAA AAA AAA A A A A BBBB BBBB BBBB B B X X X X Note: A B X \* = = = A A A A A A A A AAA AAA B B B B X B B B B B B B X BBBB BBBB BBBB B BBB X X X X X X X X NUD7070E / NUD7070F / NUD7095A / Transceiver Board NUD7095B / NUD7092B / PMUD7095B NUE7231C / NUE7272A / NUE7272B / Transceiver Board NUE7272C / NUE7272D / PMUE7272B NUE7232C / NUE7273A / NUE7273B / Transceiver Board NUE7273C / PMUE7273B NUF6410B / NUF6500A / NUF6500B / Transceiver Board NUF6410C / NUF6410D NUF6500C / NUF6500D / NUF6533A / PMUF6500D NUF6395C / NUF6499A / NUF6499B / Transceiver Board NUF6499C / NUF6499D / PMUF6499D NTN7620E / NCN6150A / NCN6150B / Controller Board \* PMCN6150B NCN6176A NCN6106C / NCN6153A / NCN6153B / Controller Board \* PMCN6153B NTN7152A / NTN7152B NTN7153A / NTN7153B NTN7154A / NTN7154B Front Cover Front Cover Front Cover This model chart lists the model numbers and their respective major components of all private systems radios covered in this publication. Alternate transceiver board supplied, see "Model Charts General Description" (this section).

Alternate controller board supplied, see "Model Charts General Description" (this section). One item is supplied per radio. The radio model number and flash code are required when placing an order for the controller board. The model number can be found on the FCC Label on the back of the radio. The Flashcode can be obtained several ways: Check the FCC Label on the back of the radio.

Hook the radio (or sister radio) up to the Smart RIB. x MODEL CHART Shared Systems Radios (MTX 838, MTX 8000, MTX-LS, and MTX 9000 Models) MODEL NUMBER MTX 838 H01KDC9DB3AN H01KDD9DB4AN H01KDF9DB5AN H01KDH9DB7AN H01RDC9DB3AN H01RDD9DB4AN H01RDF9DB5AN H01RDH9DB7AN H01SDC9DB3AN H01SDD9DB4AN H01SDH9DB7AN H01UCC6DF3AN H01UCC6DB3AN H01UCF6DB5AN H01UCH6DB7AN H01UCC6DU3AN H01WCC4DB3AN H01WCF4DB5AN VHF, 16-Mode, 5- to 1-Watt VHF, 99-Mode, Top Display, 5- to 1-Watt VHF, 160-Mode, Front Display, Limited Keypad, 5- to 1-Watt VHF, 160-Mode, Front Display, Full Keypad, 5- to 1-Watt UHF B1, 16-Mode, 4- to 1-Watt UHF B1, 99-Mode, Top Display, 4- to 1-Watt UHF B1, 160-Mode, Front Display, Limited Keypad, 4- to 1-Watt UHF B1, 160-Mode, Front Display, Full Keypad, 4- to 1-Watt UHF B2, 16-Mode, 4- to 1-Watt UHF B2, 99-Mode, Top Display, 4- to 1-Watt UHF B2, 160-Mode, Front Display, Full Keypad, 4- to 1-Watt 800MHz, 16-Mode, Type II MTX 8000 800MHz, 16-Mode, Type I 800MHz, 160-Mode, Front Display, Limited Keypad, 3-Watt 800MHz, 160-Mode, Front Display, Full Keypad, 3-Watt MTX-LS 800MHz, 16F MTX 9000 900MHz, 16-Mode, 2.4W (Typ), 2.9W (Max) 900MHz, 160-Mode, Front Display, Limited Keypad H01WCH4DB7AN 900MHz, 160-Mode, Front Display, Full Keypad ITEM NO. DESCRIPTION AAAAA AA AA A AAAAA AA A AA AAA AAA AAA AAA X BB BB BB BBB B BB BB BB BBB BB B BBB B NUD7085E / NUD7085F / NUD7096A / Transceiver Board NUD7096B / NUD7095A / NUD7095B / PMUD7095B NUE7240D / NUE7240E / NUE7274A / Transceiver Board NUE7274B / NUE7272A / NUE7272B / PMUE7272B NUE7241C / NUE7241D / NUE7241E / NUE7275A / NUE7275B NUF6423B / NUF6501A / NUF6501B / NUF6501C / NUF6500D / PMUF6500D NUF6424B / NUF6502A / NUF6502B / NUF6502C / PMUF6499D NUF6460A / NUF6460B NTN7512D / NTN7512E / NCN6147A / NCN6147B / NCN6147B NTN7513D / NTN7513E / NCN6153A / NCN6153B / PMCN6153B NTN7857D / NTN7857E / NCN6147A / NCN6147B / PMCN6147B NTN7858D / NTN7858E / NCN6153A / PMCN6153A NCN6153B / PMCN6153B NTN7151B / NTN7151C NTN7152A / NTN7152B NTN7153A / NTN7153B NTN7154A / NTN7154B Transceiver Board Transceiver Board Transceiver Board Uniboard \* Controller Board \* Controller Board \* Controller Board \* Controller Board \* B B BBB B B BBB X X X X X X X X Note: A B X \* = = = X X X X X X X X X X X X X X X X X X X Front Cover Front Cover Front Cover Front Cover Front Cover This model chart lists the model numbers and their respective major components of all shared systems radios covered in this publication. Alternate transceiver board supplied, see "Model Charts General Description" (this section). Alternate controller board supplied, see "Model Charts General Description" (this section). One item is supplied per radio. The radio model number is required when placing an order for the uniboard. The model number can be found on the FCC Label on the back of the radio.

Refer to Replacement Parts Ordering, Section 10 of this manual for instructions on how to place an order. xi List of Antennas ANTENNA KIT NOS. NAD6566\* NAD6567\* NAD6568\* NAD6563\* NAE6546\* NAE6547\* NAE6548\* NAE6549\* NAF5037\* NAF5038\* NAF5039\* NAF5040\* NAF5042\* DESCRIPTION Helical (136 - 151MHz) Helical (151 - 162MHz) Helical (162 - 174MHz) Helical Wideband (136 - 174MHz) Helical (403 - 435MHz) Helical (435 - 470MHz) Helical (470 - 512MHz) Whip (403 - 512MHz) Whip (800MHz) Whip (900MHz) Dipole (800MHz) Dipole (900MHz) Quarter Wave, Stubby (800MHz, 900MHz) List of Batteries BATTERY KIT NOS. NTN7143 NTN7144 NTN7146\* NTN7147\* NTN7341\* NTN7372\* DESCRIPTION High-Capacity Nickel-Cadmium (groups A, B, C, D) Ultra-High-Capacity Nickel-Cadmium (groups A, B, C, D) High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups D, F, G) Ultra-High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups D, F, G) Ultra-High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups C, D, E, F, G) Ultra-High-Capacity Nickel-Cadmium FMRC Intrinsically Safe (groups C, D, E, F, G) ! WARNING Substitution of components may impair the intrinsic safety of the radio. \* These accessories are approved as being intrinsically safe by Factory Mutual Research Corporation (FMRC).



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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.  
xii Maintenance Specifications for VHF Radios (All Specifications Are Per Electronic Industries Association (EIA) 316B Unless Otherwise Noted.) GENERAL  
FCC Designation: Power Supply: Battery Voltage: Nominal: Range: Battery Drain, Typical: Standby: Receive: Transmit: Temperature Range: Operating:  
Storage: Duty Cycle (5-5-90): High Cap. Battery: Ultra-High Cap.

Battery: Dimensions (H x W x D) Less Battery: AZ489FT3768 Nickel-Cadmium Battery Bandwidth: 7.5 Volts 6 to 9 Volts 56mA 180mA 2100mA 30°C to  
+60°C 40°C to +85°C 1 Watt/5 Watts 11.2 Hrs./8 Hrs. 12.  
9 Hrs./9 Hrs. Quieting Sensitivity (20dBQ): Usable Sensitivity (12dB SINAD): Intermodulation: Selectivity (30kHz Adjacent Channel): (12.5kHz Adjacent  
Channel): Spurious Rejection: Freq. Stability (30 to +60°C; 25°C reference): Rated Audio: Distortion (At Rated Audio): Channel Spacing: ± 0.  
0005% 500mW 3% Typical 30kHz 12.5kHz High Capacity: Ultra-High Capacity: Modulation Limiting: : Recommended Battery: NTN7143 NTN7144 ±5kHz  
(30kHz syst) ± 2.5kHz(12.5kHz syst) 70dB 70dB 70dB Distortion: 3% Typical FM Hum and Noise (Companion Receiver): 45dB Typical 0.35µV Max. 70dB  
Freq. Stability 30 to +60°C; 25°C ref.: ± .0005%(30kHz syst) 42MHz 0.5µV Max.

RECEIVER Frequency Range: TRANSMITTER \*136178MHz RF Power: 136-174MHz 174-178MHz 1-5 Watts 1-4 Watts Frequency Range: \*136178MHz : ±  
.0003%(12.5kHz syst) Emission (Conducted and Radiated): 66dBw 6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm) With High Cap. Battery: 6.  
30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.  
8cm) With Ultra-High Cap. Battery: 6.30" x 2.34" x 1.54" (16.  
0cm x 5.9cm x 3.9cm) 12.1oz. (343gm) 20.2oz. (573gm) 21.3oz. (604gm) Weight: (w/Helical Antenna) Less Battery: With High Cap. Battery: With Ultra-High  
Cap.

Battery: 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 FCC Designation: Power  
Supply: Battery Voltage: Nominal: Range: Battery Drain, Typical: Standby: Receive: Transmit: Temperature Range: Operating: Storage: Duty Cycle  
(5-5-90): High Cap. Battery: Ultra-High Cap. Battery: Dimensions (H x W x D) Less Battery: AZ489FT4781 (403-470MHz) AZ489FT4780 (450-520MHz)  
Nickel-Cadmium Battery Quieting Sensitivity (20dBQ): 7.5 Volts 6 to 9 Volts 60mA 180mA 1800mA 30°C to +60°C 40°C to +85°C 1 Watt/4 Watts 11  
Hrs./8.4 Hrs. 12.

7 Hrs./9.7 Hrs. Usable Sensitivity (12dB SINAD): Intermodulation: Selectivity (25kHz Adjacent Channel): (12.5kHz Adjacent Channel): Spurious Rejection:  
450-512MHz 512-520MHz Freq.  
Stability (30 to +60°C; 25°C reference): Rated Audio: Distortion (At Rated Audio): 12.1oz. (343gm) 20.2oz. (573gm) 21.  
3oz. (604gm) Channel Spacing: 0.5µV Max. RECEIVER Frequency Range: Bandwidth: TRANSMITTER \*450-520MHz 70MHz 403-470MHz RF Power:  
403-470MHz 450-512MHz 512-520MHz Frequency Range: 0.35µV Max. 70dB Freq. Stability (30 to +60°C; 25°C ref.): ± .0005% (25kHz syst) : ±  
.0003%(12.

5kHz syst) 70dB 60dB Emission (Conducted and Radiated): FM Hum and Noise 70dB 65dB (Companion Receiver): Hear Clear: Distortion: ± 0.0005%  
Modulation Limiting: 500mW 3% Typical : Recommended Battery: NTN7143 NTN7144 ±5kHz (25kHz syst) ±2.5kHz (12.5kHz syst) 45dB Typical 48dB  
Typical 3% Typical 66dBw 1-4 Watts 1-4 Watts 1-3 Watts 403-470MHz \*450-520MHz 6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm) With High Cap.  
Battery: 6.30" x 2.34" x 1.49" (16.0cm x 5.  
9cm x 3.8cm) With Ultra-High Cap. Battery: 6.30" x 2.34" x 1.

54" (16.0cm x 5.9cm x 3.9cm) Weight: (w/Helical Antenna) Less Battery: With High Cap. Battery: With Ultra-High Cap. Battery: High Capacity: 25kHz  
Ultra-High Capacity: 12.5kHz Specifications Subject to Change Without Notice. \* Frequencies in the 512-520MHz range are not permitted in the USA. xiii  
Maintenance Specifications for 800MHz Radios (All Specifications Are Per Electronic Industries Association (EIA) 316B Unless Otherwise Noted.)  
GENERAL FCC Designation: Power Supply: Battery Voltage: Nominal: Range: Battery Drain, Typical: Standby: Receive: Transmit: Temperature Range:  
Operating: Storage: Duty Cycle (5-5-90): High Cap.

Battery: Ultra-High Cap. Battery: Dimensions (H x W x D) Less Battery: AZ489FT5747 Nickel-Cadmium Battery Bandwidth: 7.5 Volts 6 to 9 Volts 65mA  
190mA 1900mA 30°C to +60°C 40°C to +85°C 8 Hours 9 Hours Quieting Sensitivity (20dBQ): Usable Sensitivity (12dB SINAD): Intermodulation:  
Selectivity (25kHz Adjacent Channel): Spurious Rejection: Freq. Stability (30+60°C; 25°C reference): (821-824MHz Capable): Rated Audio: Distortion (At  
Rated Audio): Channel Spacing: ± .00025% ±.00015% 500mW 3% Typical 25kHz Modulation Limiting: (821-824MHz): ±5kHz ±4kHz 70dB 70dB  
Distortion: 3% Typical 0.35µV Max. 70dB 19MHz 0.5µV Max. Frequency Range: 806824MHz 851869MHz Freq.  
Stability (30 to +60°C; 25°C ref.): (821-824MHz Capable): ± .00025% ± .00015% RECEIVER Frequency Range: 851870MHz TRANSMITTER RF Power: 3  
Watts Emission (Conducted and Radiated): 46dBw FM Hum and Noise (Companion Receiver): 40dB Typical 6.30" x 2.  
34" x 1.49" (16.0cm x 5.9cm x 3.8cm) With High Cap.  
Battery: 6.30" x 2.34" x 1.49" (16.0cm x 5.9cm x 3.8cm) With Ultra-High Cap. Battery: 6.30" x 2.34" x 1.

54" (16.0cm x 5.9cm x 3.9cm) 12.1oz. (343gm) 20.2oz. (573gm) 21.3oz. (604gm) Recommended Battery: High Capacity: Ultra-High Capacity: NTN7143  
NTN7144 Weight: (w/Helical Antenna) Less Battery: With High Cap.  
Battery: With Ultra-High Cap. Battery: Specifications Subject to Change Without Notice. Maintenance Specifications for 900MHz Radios (All Specifications  
Are Per Electronic Industries Association (EIA) 316B Unless Otherwise Noted.) GENERAL FCC Designation: Power Supply: Battery Voltage: Nominal:  
Range: Battery Drain, Typical: Standby: Receive: Transmit: Temperature Range: Operating: Storage: Duty Cycle (5-5-90): High Cap. Battery: Ultra-High  
Cap.

Battery: Dimensions (H x W x D) Less Battery: AZ489FT5748 Nickel-Cadmium Battery Bandwidth: 7.5 Volts 6 to 9 Volts 65mA 185mA 1910mA 30°C to  
+60°C 40°C to +85°C 8 Hours 9 Hours Quieting Sensitivity (20dBQ): Usable Sensitivity (12dB SINAD): Intermodulation: Selectivity (12.5kHz Adjacent  
Channel): Spurious Rejection: Freq. Stability (30+60°C; 25°C reference): Rated Audio: Distortion (At Rated Audio): Channel Spacing: ± .



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00015% 500mW Recommended Battery: 3% Typical 12.

5kHz High Capacity: Ultra-High Capacity: NTN7143 NTN7144 Modulation Limiting:  $\pm 2.5\text{kHz}$  60dB 60dB Distortion: 3% Typical  $0.35\mu\text{V}$  Max. 60dB 6MHz Frequency Range:  $0.5\mu\text{V}$  Max. Freq. Stability (30 to  $+60^\circ\text{C}$ ;  $25^\circ\text{C}$  ref.):  $\pm .00015\%$  896902MHz 935941MHz RECEIVER Frequency Range: 935941MHz TRANSMITTER RF Power: 2.4 Watts (Typ).

) 2.9 Watts (Max.) Emission (Conducted and Radiated): 46dBm FM Hum and Noise (Companion Receiver / HEAR CLEAR): 45dB Typical  $6.30'' \times 2.34'' \times 1.49''$  ( $16.0\text{cm} \times 5.9\text{cm} \times 3.8\text{cm}$ ) With High Cap. Battery: 6.30'' x 2.34'' x 1.49'' ( $16.0\text{cm} \times 5.9\text{cm} \times 3.8\text{cm}$ ) With Ultra-High Cap. Battery: 6.30'' x 2.34'' x 1.54'' ( $16.0\text{cm} \times 5.9\text{cm} \times 3.9\text{cm}$ ) 12.1oz. (343gm) 20.2oz. (573gm) 21.3oz. (604gm) Weight: (w/Helical Antenna) Less Battery: With High Cap. Battery: With Ultra-High Cap.

Cap.

Battery: Specifications Subject to Change Without Notice. xiv Glossary A/D ALC Analog to Digital converter; converts an instantaneous dc voltage level to a corresponding digital value. Automatic Level Control; a circuit in the transmit RF path that controls RF power amplifier output, provides leveling over frequency and voltage, and protects against high VSWR. Complementary metal-oxide semiconductor. Defines conventional transmit and receive frequencies and muting conditions. A controller configuration that utilizes a microcontroller with no external memory (non-FLASHport operation). (Customer Board Initialization) When the controller board is received, it will need a serial from the defect unit. The serial is manually entered via the RSS prior to proceeding any further with the replacement process. Digital to Analog converter; converts a digital value to a corresponding dc voltage value. Dual Tone Multi-Frequency.

Digital Private-Line. Software or a software/hardware combination of computer programs and data, with a fixed logic configuration stored in a read-only memory; information can not be altered or reprogrammed. Frequency Generation Unit. A Motorola term (model option definition code) that determines what FLASHport options are in a radio. A Motorola term that describes the ability of a radio to change memory.

Every FLASHport radio contains a FLASHport EEPROM memory chip that can be software written and rewritten to, again and again. Integrated Circuit.

Inbound Signalling Word; data transmitted on the control channel from the subscriber unit to the central controller. Logic Trunked Radio; a registered trademark of E.F.

Johnson Company. MicroControl Unit. Motorola Digital Code. Over-Molded Pad-Array Carrier; a Motorola custom IC package, distinguished by the presence of solder balls on the bottom pads. A controller configuration that utilizes a microprocessor with extended ROM, RAM, and EEPROM, (FLASHport capable). Outbound Signalling Word; data transmitted on the control channel from the central controller to the subscriber unit. Printed Circuit board.

Private-Line® tone squelch; a continuous sub-audible tone that is transmitted along with the carrier. CMOS Channel Closed Architecture CBI D/A DTMF DPL Firmware FGU Flashcode FLASHport IC ISW LTR MCU MDC OMPAC Open Architecture OSW PC Board PL xv PLL PTT Registers RESET RF PA RSS RSSI RX DATA SLIC SmartRib Softpot Software Squelch SRAM Standby Mode TOT TPL TSOP  $\mu\text{C}$  VCO VSWR Phase-Locked Loop; a circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider. Push-To-Talk; the switch located on the left side of the radio which, when pressed, causes the radio to transmit.

Short-term data-storage circuits within the microcontrol unit or programmable logic IC. Reset line; an input to the microcontroller that restarts execution.

Radio Frequency Power Amplifier. Radio Service Software. Received signal strength indicator; a dc voltage proportional to the received rf signal strength.

Recovered digital data line. Support-Logic IC; a custom gate array used to provide I/O and memory expansion for the microcontroller. Use in conjunction with the RSS to read the Flashcode and Model Number, and to flash upgrade radios. Software potentiometer; a computer-adjustable electronic attenuator.

Computer programs, procedures, rules, documentation, and data pertaining to the operation of a system.

Muting of audio circuits when received signal levels fall below a pre-determined value. Static-RAM chip used for volatile, program/data memory. An operating mode whereby the radio is muted but still continues to monitor data. Time-Out Timer; a timer that limits the length of a transmission. Tone Private-Line; Continuous Tone Coded Squelch System (CTCSS), industry standard.

Thin Small-Outline Package. Microcontrol unit (see MCU). Voltage-Controlled Oscillator; an oscillator whereby the frequency of oscillation can be varied by changing a control voltage. Voltage Standing Wave Ratio. xvi Introduction 1 This manual includes safety information, model charts, specifications, fundamental disassembly/reassembly procedures; schematic diagrams, printed circuit board details, flex circuit diagrams, and several parts lists to completely cover the HT 1000, JT 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 manuals 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 NOTE: This is an operational procedure, practice, or condition, etc., which may result in damage to the equipment if not carefully observed.

This is an operational procedure, practice, or condition, etc., which is essential to emphasize. 1 Notes 2 Test Equipment, Service Aids, and Tools

Recommended Test Equipment 2 The list of equipment contained in Table 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. Table 1 Recommended Test Equipment MOTOROLA MODEL NUMBER R2600 Series R2670 (for trunking) \*R1097A DESCRIPTION System Analyzer CHARACTERISTICS This monitor will substitute for items with an asterisk (\*) 4,000 counts True RMS Metering 0.



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3% basic accuracy APPLICATION Frequency/deviation meter and signal generator for wide-range troubleshooting and alignment Digital voltmeter recommended for ac/dc voltage and current measurements Injection of audio and digital signalling codes Portable Radio Monitor Digital Multimeter \*R1150E \*R1527A R1368A Code Synthesizer Portable Test Receiver Counter; CTCSS, DCS, and DTMF decoder Dual-Trace Oscilloscope 20MHz bandwidth (some Waveform measurements system analyzers, R2000 series, are 15MHz bandwidth) 5mV to 5V/division 50-ohm, ±5% accuracy 10 Watts, maximum 0-1000MHz, 300W 10-watt Broadband 100µV to 3V rf 10kHz to 1.2GHz RMS Audio Voltmeter 0-20Vdc, 0-5 Amps current limited Transmitter power output measurements For use with Wattmeter RF level measurements Receiver sensitivity measurements Bench supply for 7.5Vdc \*S1350C \*ST1213B (VHF) \*ST1223B (UHF) R1065 S1339A \*R1013B or \*R1370A Watt Meter Plug-in Element RF Dummy Load Load Resistor RF Millivolt Meter SINAD Meter SINAD Meter V/RMS S1347D or DC Power Supply S1348D (programmable) 3 Service Aids and Recommended Tools Refer to the "Service Aids" in Table 2 and "Recommended Service Tools" list in Table 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 United States and Canada Radio Products Services Division listed in the "Replacement Parts Ordering" section at the back of this manual.

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. 4 The following table lists service aids recommended for working on this family of radios. These items are available from Radio Products Services Division.

Table 2 Service Aids MOTOROLA PART NO. Servicers Video Tape RKN-4035D RLN-1014A RLN-1018A RTX-4005B or both RTX-4005A / RPX-4665A RLN-4460A RLN-4008B RLN-1015C 0180302E27 3080390B48 0180357A57 0180358A56 3080369B71 3080369B72 RKN-4036D DESCRIPTION Video Tape RIB/Radio/test set cable Battery Eliminator Test Fixture Portable Test Set Field Modification Kit Portable/Mobile Test Set Radio Interface Box (RIB) Smart RIB Power Supply Computer Interface Cable Wall-mounted Power Supply Wall-mounted Power Supply Computer Interface Cable APPLICATION Includes Radio Introduction. Connects radio to RTX-4005B Test Box and RIB. Interconnects radio to power supply. Provides for troubleshooting of the radio when the housing is removed.

Allows switching for radio testing. Provides more convenient testing of mobiles and portables. Enables communications between the radio and the computer's serial communications adapter. Used to read Flashcode. Used to supply power to the Smart RIB. Connects computer serial adapter to Smart RIB. Used to supply power to the RIB (120 VAC). Used to supply power to the RIB (220 VAC). Use B72 for the IBM PC AT (7-pin). All other IBM models use B71.

Connects the computer's serial communications adapter to the RIB (25-pin). 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). Software on 3-1/2 in. and 5-1/4 in. floppy disks. Software on 3-1/2 in. and 5-1/4 in. floppy disks. Cloning Cable RVN-4097L RVN-4098G Radio Service Software Radio Service Software (HT/JT 1000/VISAR Models Only) Radio Service Software MTX-LS Model SMA to BNC Adaptor Battery Tester Battery Tester Adapter RVN-4138B 5880348B33 RLN-4201B RLN-4048A Software on 3-1/2 in. and 5-1/4 in.

floppy disks. Adapts radio's antenna port to BNC cabling of test equipment. Tests battery charge. Adapts HT 1000, JT 1000, MT 2000, MTS 2000, and MTX Series radio batteries to the RLN-4201 Battery Tester. 50-ohm, high-frequency probe.

Needle-fine test probes for high-density circuitry. RTL-4208A RT-5144/48/0 RT-5144/48/2 RF Probe Test Probe (black) Test Probe (red) 5 Service Tools The following table lists the tools recommended for working on this family of radios; these tools are also available from Motorola. The R-1319A solder/desolder workstation requires the use of some reflow nozzles which are included with the workstation. Table 3 Recommended Service Tools MOTOROLA PART NO.

R1319A DESCRIPTION Chip Master Surface Mount Device (SMD) Rework Station APPLICATION Temperature-controlled, self-contained soldering/desoldering repair station for installation and removal of surface-mounted devices. Removes RF PA's. For soldering and desoldering thru-hole components. 0180356B79 0180372E51 0180386A82 6680384A98 1010041A86 0180303E45 6680334E07 6680334E08 Solder/Desolder Station Illuminated Magnifying System Anti-static Grounding Kit Brush Solder (RMA type), 63/37, 0.020" diameter, 1 lb. spool SMD Tool Kit Chassis/Front Cover Separation Tool Flex Connector Opening Tool Used during all radio assembly and disassembly procedures. Kit includes chemicals and hand tools required to do many SMD rework procedures. Used to pry the chassis away from the front cover during disassembly. Used to raise the sliding portion of the flex connectors. 6 Transceiver Performance Testing 3 General The HT 1000, JT 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. 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 4. Table 4 Equipment Initial Control Settings SERVICE MONITOR 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 TEST SET Spkr set: A Spkr/load: Speaker PTT: OFF (center) POWER SUPPLY Voltage: 7.5Vdc DC on/standby: Standby Volt Range: 10 Current: 2.5 Setup \* When testing TX deviation, where the modulation is greater than 1kHz, set the Service Monitor low pass filter (LPF) to 15kHz. \*\* The Test Set MT/PL switch controls internal/external audio switching. Test Mode RF Test Mode, HT 1000/JT 1000 Radios NOTE: This note applies to software version R02.



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09 and earlier. If the radio is placed in TEST MODE 7 with Option-Mate interface plug enabled through the HT 1000 RSS, TX and RX audio will be muted. Do not test Analog Voice Security (AVS) installed radios in the TEST MODE. When the HT 1000/JT 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: 1. Turn the radio on.

2. 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. (HT 1000 radios), a tone is emitted to indicate that the rf test mode has been entered. b. (JT 1000 radios), the display will show the firmware version of the microprocessor for two seconds, emit a tone, then display TEST MODE). 3. Each additional press of SB3 will advance to the next test channel. (refer to Table 6), and a corresponding set of tones will indicate the channel. 4.

Pressing SB2 will scroll through and access test environments as shown in Table 5. NOTE: Transmit into a load when keying a radio under test. To exit test mode, turn the radio off then back on. Table 5 Test Environments, HT 1000/JT 1000 Radios NO. OF BEEPS 1 3 DESCRIPTION Carrier Squelch Tone Private-Line FUNCTION RX: if carrier detected TX: mic audio RX: unsquelch if carrier and tone (192.8Hz) detected TX: mic audio + tone (192.8Hz) RX: unsquelch if carrier and digital code (131) detected TX: mic audio + digital code (131) detected 4 Digital Private-Line 8 Table 6 Test Frequencies, HT 1000 / JT 1000 NO. OF BEEPS TEST CHANNEL TX #1 1 RX #1 TX #2 2 RX #2 TX #3 3 RX #3 TX #4 4 RX #4 TX #5 5 RX #5 TX #6 6 RX #6 VHF 136.025 136.075 142.

125 142.175 154.225 154.275 160.125 160.

175 168.075 168.125 173.975 173.925 UHF BAND 1 403.

100 403.150 424.850 424.900 438.050 438.100 444.050 444.100 456.350 456.400 463.

700 463.650 UHF BAND 2 450.025 450.075 465.225 465.275 475.225 475.275 484.975 485.025 500.

275 500.325 511.975 511.925 800 806.0125 851.

0625 815.0125 860.0625 824.9875 869.9375 851.

0125 851.0625 860.0125 860.0625 869.9875 869.9375 Control Head Test Mode, HT 1000/JT 1000 Radios To check the buttons and the switches, perform the following tests: 1. Turn radio on. 2. 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.

3. 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. 4. 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. NOTE: Pressing and releasing a button-actuated switch are both considered switch-position changes.

No tone when a switch position is changed indicates a test failure. Test the on/off volume potentiometer/switch by rotating the potentiometer clockwise and counter NOTE: 9 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.

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: 1. Turn the radio on. 2. After the self test is complete, press the monitor button (side button 3, SB3) five times in succession, within 10 seconds. 3. 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. 4. Each additional press of SB3 will advance to the next test channel. (Refer to Table 8.

) 5. Pressing SB2 will scroll through and access test environments as shown in Table 7. NOTE: Transmit into a load when keying a radio under test. Radios without display indicate testenvironment function by emitting a corresponding number of beeps. See Table 7. NOTE: 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: 1. Turn radio on. 2. After the self test is complete, press the monitor button (side button 3, SB3) five times in succession, within 10 seconds. 3.

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. 4. 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. 10 5. Release the orange button; "3/0" appears, which indicates that switch 3 is in the closed condition. 7. Rotate the mode selector knob; "4/0" thru "4/15"

6. Press the orange button again; "3/1" appears, which indicates that switch 3 is in the closed condition. 7. Rotate the mode selector knob; "4/0" thru "4/15" appears, which indicates that knob 4 is in mode position 1 thru 15. 8.

Rotate the concentric switch; "65/0" and "65/1" appears. 9. Rotate the volume control; "2/0" thru "2/255" appears. 10. Press SB1, view "96/1"; release, view "96/0" 11. Press SB2, view "97/1"; release, view "97/0" 12. Press SB3, view "98/1"; release, view "98/0" 13. Press PTT, view "1/1"; release, view "1/0" 14. Toggle Switch in 'A' position "64/0", 'B' position "64/1", 'C' position "64/2" 15.



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