SERVICE SECTION FOR MDX SERIES, 800 MHz, DATA ONLY RADIO

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(Cont.)

DESCRIPTION

This Service Section contains the information necessary for aligning and troubleshooting the DATA ONLY 800 MHz Mobile Radio. In addition, information is provided for disassembling the radio and replacing surface mount components.

INITIAL ADJUSTMENT

After the radio has been installed as described in the Installation Manual, the following adjustments should be made by a certified electronics technician.

TRANSMITTER ADJUSTMENT

The transmitter has been adjusted at the factory and should require no readjustment. However, the antenna length should be adjusted for optimum VSWR, and the frequency and modulation measured and recorded for future reference. For complete transmitter alignment, refer to the Alignment Procedures.

RECEIVER ADJUSTMENT

No initial adjustments to the receiver are required. Refer to the Receiver Alignment Procedure when service is required.

RE-INSTALLATION

The radio is designed to operate in 12 volt, negative ground vehicles only. If the mobile radio is moved to a different vehicle, always check the battery polarity of the new vehicle system.

PREVENTIVE MAINTENANCE

To ensure high operating efficiency and to prevent mechanical and electrical failures from interrupting system operations, routine checks should be made of all mechanical and electrical parts at regular intervals. Preventive maintenance should include the following checks.

CONNECTIONS

Ground connections to the voltage source should be periodically checked for tightness. Loose or poor connections to the power source will cause excessive voltage drops and faulty operation. When ground connections are not made directly to the battery, the connection from the battery to vehicle chassis must be checked for low resistance. A high resistance may cause excessive voltage drops and alternator noise problems.

ELECTRICAL SYSTEM

Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe operational limits. Overvoltage is indicated when the battery loses water rapidly. Usage of 1 or 2 ounces of water per cell per week is acceptable for batteries in continuous operation. A weak battery often causes excessive noise or faulty operation.

MECHANICAL INSPECTION

Since mobile units are subject to constant shock and vibration, check for loose plugs, nuts, screws and other parts to make sure that nothing is working loose.

ANTENNA

The antenna, antenna base and all contacts should be kept clean and free from dirt or corrosion. If the antenna or its base should become coated or poorly grounded, loss of radiation and a weak signal often results.

ALIGNMENT

The transmitter and receiver meter readings should be checked periodically and the alignment optimized when necessary. Refer to the Alignment Procedure.

FREQUENCY CHECK

Check transmitter frequency and deviation. Normally, these checks are made when the unit is first placed in operation, after the first six months, and once a year thereafter.

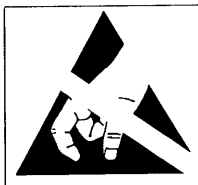
STATIC HANDLING PRECAUTIONS

This radio contains Metal Oxide Semiconductor (MOS) devices that are vulnerable to damage from Electrostatic Discharge (ESD). As a result, extra care must be taken when handling or testing the devices, modules, or the assemblies in which they are used.

To prevent damage from ESD, observe the following precautions:

- Service the radio only at a static free work station or on a grounded mat.
- Perform diagnostics to isolate a faulty assembly or component. Do not use canned coolant for fault isolation.
- Discharge static voltage from your body by wearing a grounded antistatic wrist strap where possible. Where ground straps cannot be used, touch a grounded item prior to handling an open radio.
- Avoid touching any electrically conductive parts of circuit modules with your hands. When you must handle components, pick them up by the body and avoid touching the leads.
- Do not remove static sensitive devices from their protective packaging until you are ready to install them. Ground the package, to dissipate any accumulated charge, prior to removing the component.
- Ground all electrically powered test equipment. Ground test equipment leads prior to connecting to a circuit and connect the ground lead prior to connecting the test probe. Disconnect the probe before removing the ground lead.
- When soldering, be sure the soldering iron is grounded using a three prong cord connected to an outlet with a known good earth ground.
- Use only metallized or ESD protective vacuum-type desoldering tools.

NOTE



This symbol is used to identify circuitry using Electrostatic sensitive devices. Be sure to follow Static Handling Procedures when working near these devices.

DISASSEMBLY PROCEDURES

Disassembly procedures are provided to completely disassemble the radio. In general, reassembly is in the reverse order. Included are procedures to remove the top and bottom covers, RF board, audio/logic board, system board, and front cap assembly. Refer to Assembly Diagrams located in the Combination Manual for this radio when assembling or disassembling the radio or replacing component boards.

NOTE

Remove power from the radio before servicing.

TO REMOVE BOTTOM COVER

1. Remove the four screws securing the bottom cover to the radio.
2. Gently lift the bottom cover from the radio.

TO REMOVE TOP COVER

1. Remove the bottom cover and slide the top cover up out of the casting.

NOTE

When replacing the covers check to see that the "O" ring gaskets are properly seated in the cover grooves. Also make sure the cables are pressed down in the inner wall slots so they will not be pinched during reassembly.

TO REMOVE RF BOARD A2

1. Remove the top and bottom covers from the radio.
2. Pry off the friction fit covers covering the RF board.
3. Gently pry interconnect plug P702 from the logic and RF boards using a small standard screwdriver.
4. Remove the two clips securing Q101 and U102 to the frame (on top side of board).
5. Remove the two M3.5-0.6 x 20 TORX screws (#15 drive) securing PA module U101 to the frame.
6. Remove the six M3.5-0.6 x 8 TORX screws (#15 drive) from the bottom side of the board.
7. Disconnect wires attached to J704, J705 and cables going to the PA Board.
8. Remove the six spring clips protruding through the RF board from the bottom side.
9. Gently push the RF board out of the radio casting.

TO REMOVE THE FRONT CAP ASSEMBLY

1. Remove the top and bottom covers of the radio.
2. Remove the four TORX screws (#10 drive) from top and bottom of the front cap assembly.
3. Gently pull the front cap assembly away from the radio.

NOTE

When replacing the front cap assembly on the radio casting first check that the "O" ring gasket is seated in the casting groove. Carefully press the front cap over the gasket making sure the gasket remains in the groove. Reinstall the 4 TORX screws while applying pressure to seat the front cap against the casting.

TO REMOVE AUDIO/LOGIC BOARD A1

1. Remove the top cover, bottom cover, front cap assembly and the audio board from the radio. Refer to the disassembly procedures for each.
2. Remove interconnect plug P702 from the RF and audio/logic boards on the bottom of the radio.
3. Remove the four M3.5-0.6 x 8 TORX screws (#15 drive) securing the audio/logic board to the radio frame.
4. Carefully work the audio/logic board out of the radio, being careful not to damage the plug going to the front cap assembly.

TO REMOVE SYSTEM BOARD A5

1. Remove radio bottom cover.
2. Disconnect the speaker leads from J904.
3. Disconnect the ribbon cable from J902.
4. Disconnect the option cable, if used.
5. Remove the three M3.5-0.6 x 8 TORX screws (#15 drive) securing the system board to the frame.
6. Carefully work the board out of the radio, unplugging it from feed through assembly Z903.

COMPONENT REPLACEMENT

SURFACE MOUNTED COMPONENTS

Surface mounted "Chip" components should always be replaced using a temperature controlled soldering system. The soldering tools may be either a temperature controlled soldering iron or a temperature controlled hot-air soldering station. A hot-air system is recommended for the removal of components on multi-layer boards. With either soldering system, a temperature of 700°F (371°C) should be maintained.

The following procedure outlines the removal and replacement of surface mounted components. If a hot-air soldering system is employed, see the manufacturer's operating instructions for detailed information on the use of your system.

CAUTION

Avoid applying heat to the body of any chip component when using standard soldering methods. Heat should be applied only to the metallized terminals of the components. Hot-air systems do not damage the components since the heat is quickly and evenly distributed to the external surface of the component.

CAUTION

This unit contains many static sensitive components, observe static handling precautions during any service procedure.

To Remove Surface Mounted Components

1. Grip the component with tweezers or small needle nose pliers.

2. Alternately heat the metallized terminal ends of the chip component with the soldering iron. If a hot-air system is used, direct the heat to the terminals of the component. Use extreme care with the soldering equipment to prevent damage to the printed wire board (PWB) and the surrounding components.

3. When the solder on all terminals is liquefied, gently remove the component. If all solder is not completely liquefied, the use of excessive force may cause the PWB pads to separate from the board.

4. It may be necessary to remove excess solder using a vacuum de-soldering tool or Solderwick®. Again, use great care when de-soldering or soldering on the printed wire boards. It may also be necessary to remove the epoxy adhesive that was under the chip component and any flux from the printed wire board.

To Replace Surface Mounted Components

1. "Tin" all terminal ends on the new component and on the pads of the PWB. Use as little solder as possible.

2. Place the component on the PWB pads, observing proper orientation for capacitors, diodes, transistors, etc.

3. Simultaneously touch the "tinned" terminal end and the "tinned" pad with the soldering iron. It may be necessary to slightly press the component down on the board. Repeat this procedure on all component terminals as necessary. Do not apply heat for an excessive length of time and do not use excessive solder.

   With a hot-air system, apply hot air until all "tinned" areas are melted and the component is seated in place. It may be necessary to slightly press the component down on the board. Touch-up the soldered connections with a standard soldering iron if needed. Do not use excessive solder.

4. Allow the component and the board to cool and then remove all flux from the area using alcohol or other EGE approved flux remover.

CAUTION

Some chemicals may damage the internal and external plastic and rubber parts of the radio.

To Replace Surface Mounted Integrated Circuits

Soldering and de-soldering techniques of the surface mounted IC's are similar to the procedures for the surface mounted chip components. Use extreme care and observe static precautions when removing or replacing

the defective (or suspect) IC's. This will prevent damage to the printed wire board or the surrounding circuitry.

Replacement of the surface mounted IC's is best completed using a hot-air soldering system. See the manufacturers instructions for complete details on tip selection and other operating instructions unique to your system.

If a hot-air system is not available, the service technician may wish to clip the leads near the body of the defective IC and remove it. The leads can then be removed from the PWB using a standard soldering iron and tweezers. Install the new IC following the Chip Component Replacement procedures. It may not be necessary to "tin" the IC leads before the installation process.

TROUBLESHOOTING PROCEDURES

This section should help isolate a problem to a particular board or circuit. Block diagrams for power distribution, audio signal flow, and logic flow are located in LBI-38917, DATA ONLY MDX™ radio manual. Refer to the appropriate LBI on the suspect board for additional circuit information.

The Dual Format MDX 800 MHz mobile radio is divided into 6 boards or assemblies. To aid in identifying the suspect board, major functions for each board are given below. Refer to the appropriate LBI on each for more details.

- RF Board A2:

  Synthesizer: generates all transmit and receive frequencies.

  Receiver: provides detected audio to the audio board.

  Transmitter: includes exciter and 10 watt PA Module.

  Power control circuitry for the transmitter.

  Pin diode TX/RX RF switch.

  Lowpass filter for the transmitter.

- Audio/Logic Board A4

  Analog filtering of the RX and TX audio (voice, low speed data, high speed data, and signalling tones).

  RX squelch processing.

  Conventional analog tone filtering and processing.

  Signal routing between the RF, audio amplifier, and display boards.

  EEPROM for the radio personality.

  The main radio microprocessor.

  Accepts PTT from the microphone.

  Provides DPTT to turn on the transmitter.

  Provides synthesizer channel data to the RF Board.

  Generates and detects the Channel Guard tones and data.

  Generates and detects high speed and low speed data.

  Generates and detects GE-MARC busy tones.

  Generates and detects GE-MARC signalling tones.

SYMPTOMS AND CHECKS

SYMPTOMS	CHECKS
Poor Rx	Suspect the RF board. Check Sensitivity and receiver alignment. Refer to the RF board maintenance manual.
No Tx Power	Check the DPTT command to the RF board. If present, then the problem is likely on the RF board. If the DPTT is not present, the problem is likely on the audio/logic board.
Low Tx Power	Check the transmit frequency. If its not OK, check the synthesizer on the RF board for load commands from the audio/logic board. If the commands are not present, a problem in the audio/logic board is likely. If the Tx frequency is correct, refer to the maintenance manual for the RF board and troubleshoot the transmitter.

Radio will not program when plugged into the TQ3310 or TQ3370 interface module	Verify radio is getting turned "on" by programmer.
Transmitter Off Frequency	Suspect the RF board. Refer to Frequency Set" procedure in the Transmitter Alignment section of this manual. Check the synthesizer load command. If the load command is wrong, a faulty audio/logic board is likely.
Calls Processed Incorrectly	Check personality PROM programming.

TEST PROCEDURE

TRANSMITTER VERIFICATION

Transmitter Frequency

Key the transmitter on any channel and measure the transmit frequency. The measured frequency should be within ±250 Hz of the assigned channel frequency.

Transmit Power

Select a channel and key the transmitter. Measured power should be 10 watts ±0.5 dB. Current should be less than 11 amperes.

RECEIVER VERIFICATION

High Speed Data Eye Pattern

1. Input a companion radio high speed dotting data TX output in the antenna port at 25 milliwatts. Verify an optimum receive eye pattern on the VOL/SQ HI line at J705-3. A typical Eye Pattern is shown in Figure 1.

ALIGNMENT PROCEDURE

To align the radio, test mode operation should be used as described in the Test Preparation section. Refer to the assembly diagrams for board location and to Figure 2 for adjustment and test point locations.

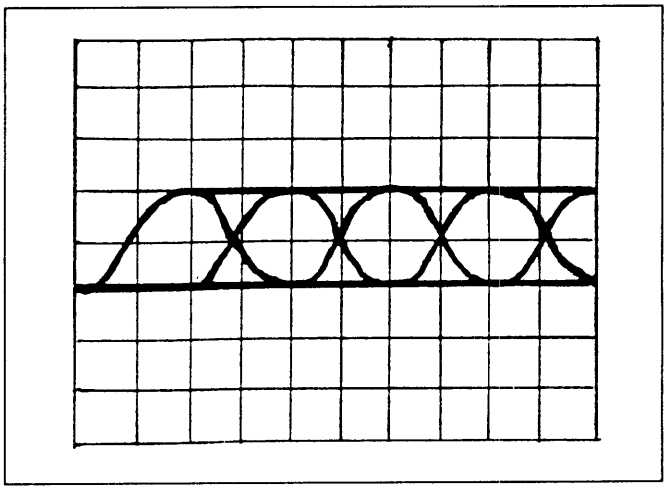


Figure 1 - High Speed Data Eye Pattern

TEST EQUIPMENT AND SERVICE AIDS

The following list of test equipment and service aids are available to facilitate servicing.

- TQ3310 — NOTE: The TQ3310 can be used for PC programming test but TQ3370 is required for flash programming.
- TQ3378 — Programming cable
- ST3712 — Pin extractor Tool (11-03-0038) - Allows removal of contacts from connector shell that mates with Option Cable CC01. The Option Cable is required with all external options.
- ST2513 — Alignment Tool - with two ceramic tips - used for squelch control and other adjustments.
- ST2617 — Crimping Tool for field attachment of TNC - series male connectors 19A115903P1 to RG-58/U (and similar) coaxial cable.

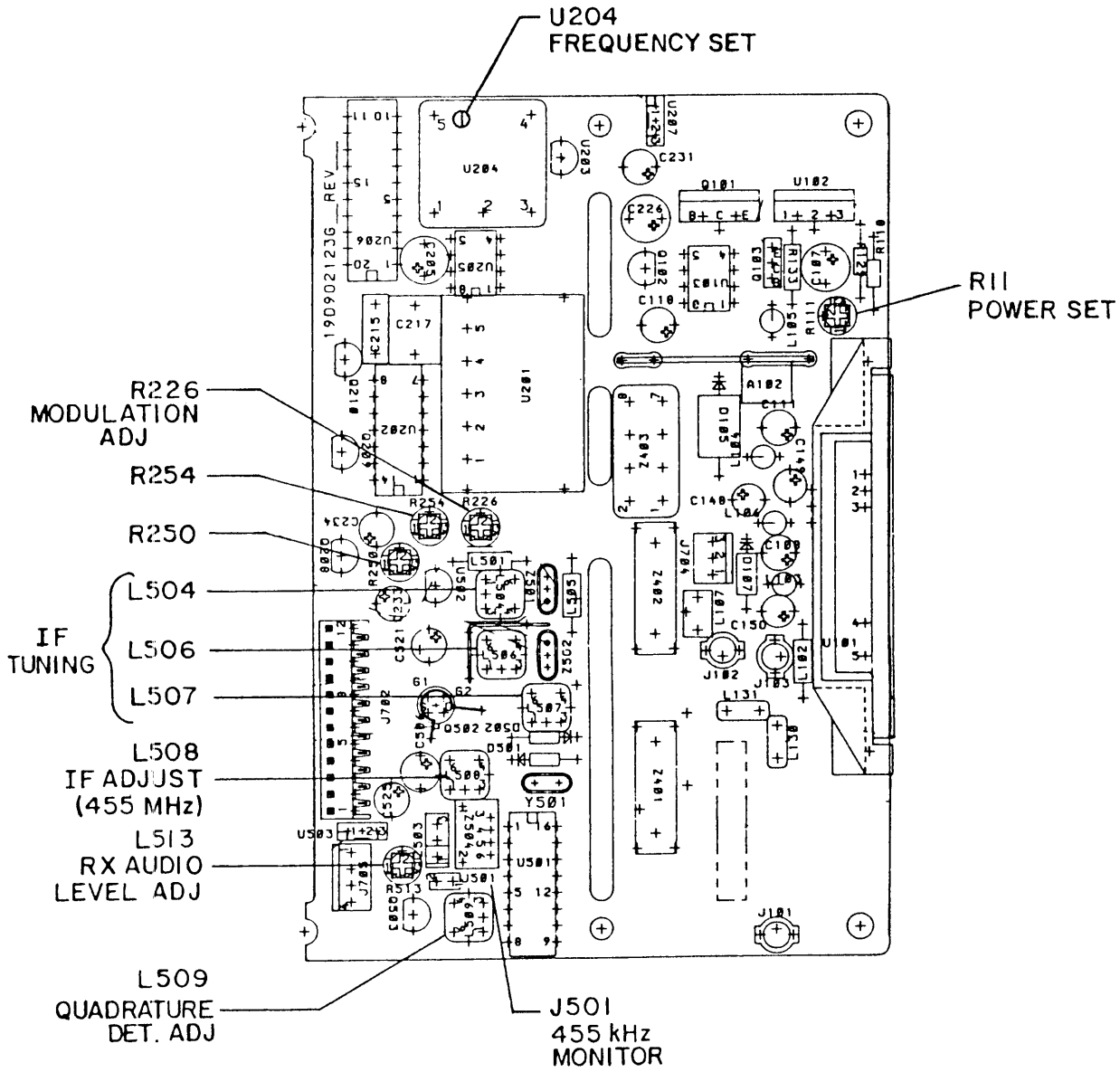


Figure 2 - Location of Controls and Adjustments, RF Board

TRANSMITTER ALIGNMENT

Frequency Set

Select any channel frequency. Key the transmitter and measure the transmit frequency. The frequency should be within ±250 Hz of the channel frequency. If not, adjust U204 to within ±100 Hz.

> **NOTE**
>
> The temperature should be 25° ±5°C. Ensure frequency counter calibration is better than ±0.1 PPM.

Transmitter Power Set

1. Key the transmitter and adjust R111 in the power control circuit for 10 watts.

RECEIVER ALIGNMENT

Frequency Set

1. Verify that the transmitter is on frequency as described in the transmitter alignment procedure.
2. Inject a strong on-channel signal (-50 dBm) at the antenna input J101.
3. Monitor J501 with a frequency counter and adjust L508 for a reading of 455 kHz ±100 Hz.

IF Tuning

1. Monitor J501 pin 1 with an AC voltmeter (pin 2 is ground). Inject an on-channel signal at the antenna jack modulated with a 1 kHz tone at 3 kHz deviation.
2. Adjust L504, L506, and L507 for a peak on the voltmeter. Adjust the level of the generator to keep the signal at J501 out of limiting (approximately -65 dBm)
3. Repeak the coils.

Quadrature Detector Adjustment

1. Inject a strong (-60 dBm) on-channel signal at the antenna jack modulated with a 1 kHz tone at 3.0 kHz deviation.
2. Monitor the VOL/SQ HI output at J705-3 with an AC voltmeter and adjust L509 for a peak indication on the meter.

POWER DISTRIBUTION

Refer to the Power Distribution Block Diagram for an understanding of the distribution of A+, SW A+, and the regulated voltages throughout the radio.

A+

A+ (+13.8 volts nominal) enters the radio on the power cable and is connected to the system board. A+ feeds MOSFET switch Q903 providing SW A+ power to the audio amplifier board through A5 J902 and A6 J901. A+ is also applied to the display board through A6 J707 and P707 on the display board.

A+ leaves the system board on J903 and feeds the PA board and RF transistor Q151 through feedthru capacitor assembly Z903. D905 on the system board provides reverse polarity protection for the radio. D904 provides overvoltage positive spike protection on the system board A+ lead. A+ leaves the board on J151 and supplies power to PA module U101 and Q101 on the RF board. Q101 supplies the power control voltage to the PA module.

SW A+

Switched A+ (13.6 volts nominal) originates from the MOSFET switch on the system board. The Ignition Sense lead and the **POWER** push-button control the MOSFET switch. Fuse F901 protects the MOSFET and the radio from high current failures. SW A+ is supplied through J902 and J903 to the front cap assembly. It provides power to the 5 volt regulator, 10 watt audio PA, and the front cap display board. J903 provides SW A+ to the PA board which, in turn, passes SW A+ through A4 J151 and A2 J705 to the RF board.

SW A+ enters the RF board on J704 and J705 and supplies power to three 8-volt regulators and the transmitter power control circuitry. SW A+ leaves the RF board on A2 J702 to supply power to 8-volt regulator U805 on the audio/logic board.

Regulated Voltages

SW A+ is the source of power for all voltage regulators. Several 5 volt regulators receive power from an 8-volt regulator reducing the power dissipated by the 5-volt regulators.

RF Board

8-volt regulator U502 provides power to the receiver. A separate 8.3-volt regulator U207 and 5-volt regulator U203 provide power to the synthesizer. 8 volt regulator U102 provides power to the transmitter. The output of U102 is switched to the exciter and the power control circuit. U503 powers the audio/logic board. U102 (TX 8-volt supply) and Q101 (power control output transistor) are mounted for heat sinking.

Audio/Logic Board

A 5-volt regulator, U801, is used to power the audio/logic board. The input voltage is derived from the 8-volt regulator on the RF board. The power-on reset circuitry for the audio/logic board microprocessor is part of regulator U801. This reset signal prevents scrambled operation due to low voltage transients during automobile starting. An 8-volt regulator is used to power the audio circuits.

LOGIC SIGNAL FLOW

Refer to the Interconnect Diagram in LBI-38917 to see the distribution of logic signals throughout the radio.

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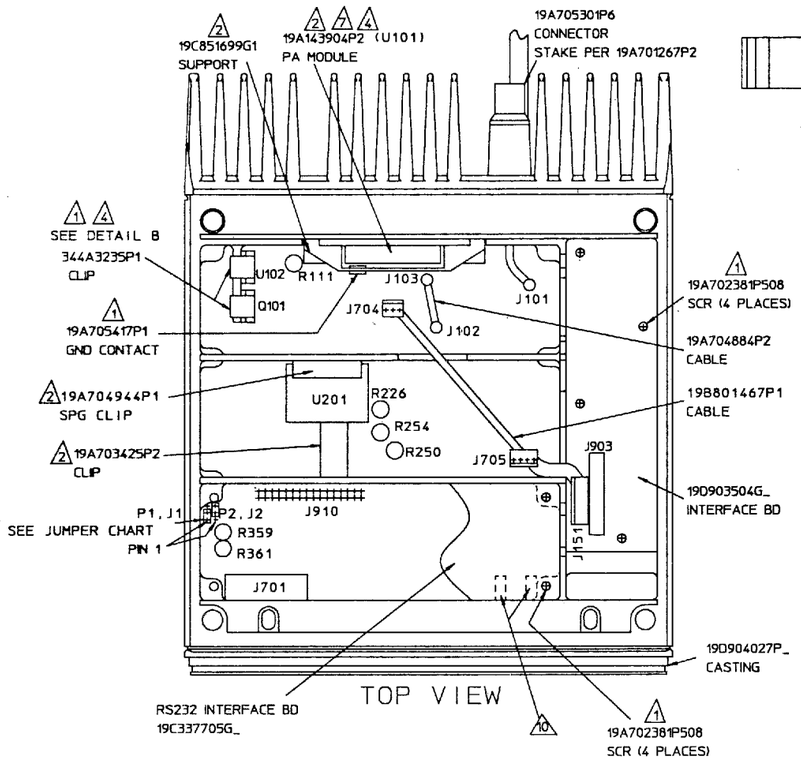
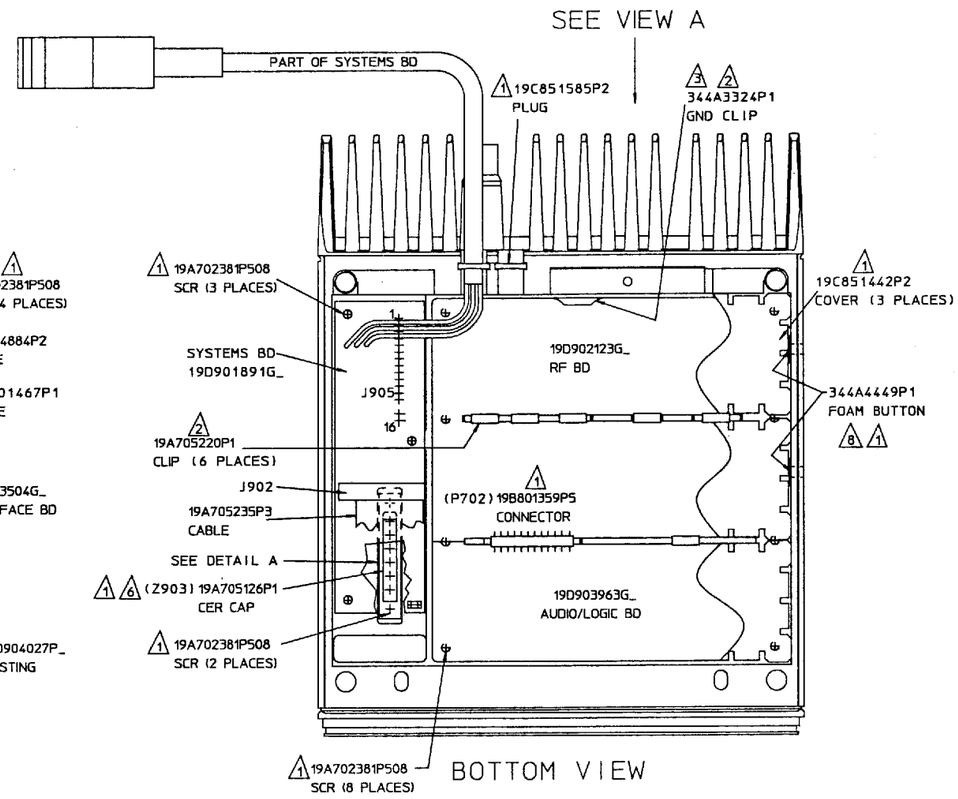
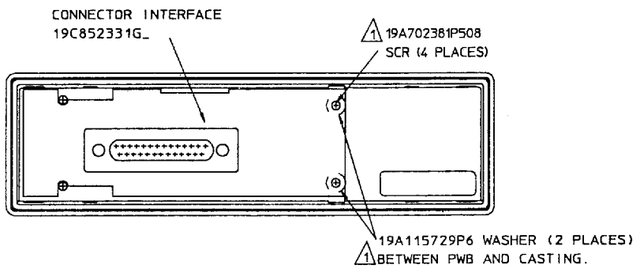
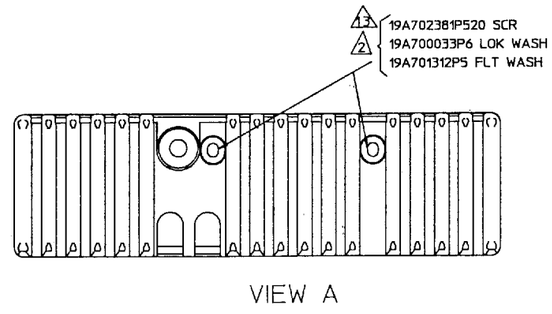
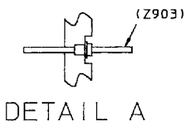
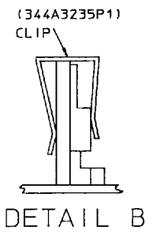










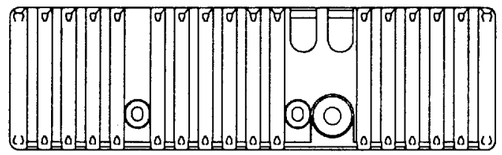


AUDIO/LOGIC BD JUMPER CHART		
JUMPER	INSTALLATION	NOTES
P1	J1-1&2	BASE BOOST DISABLED
P2	J2-2&3	TX SIDETONE NEG.POLARITY

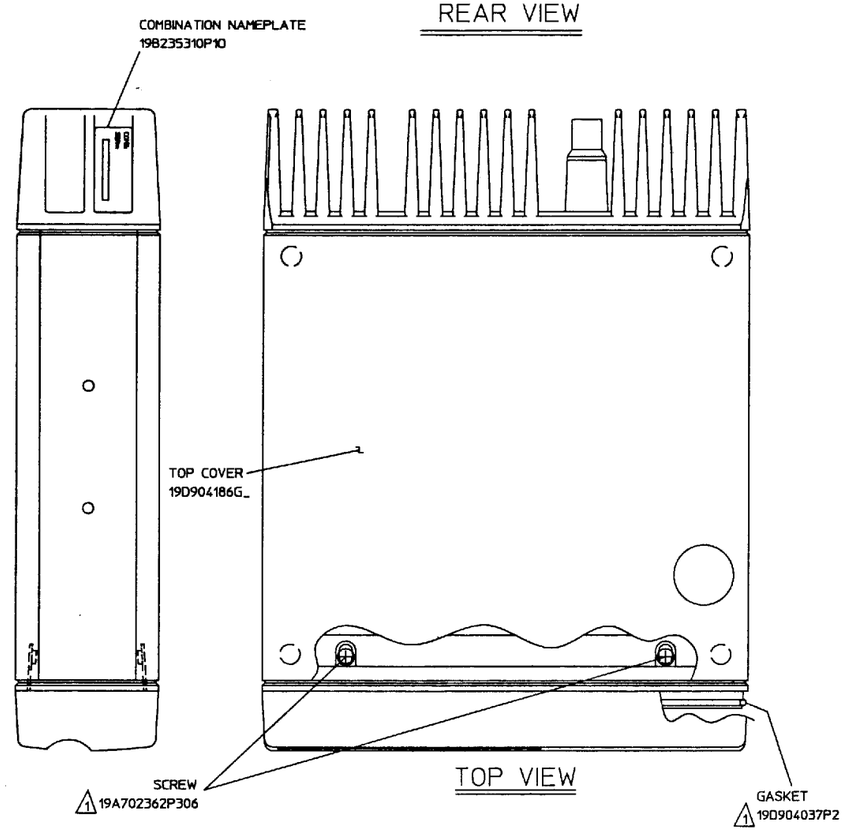
(1) MDX DATA RADIO

NOTES:

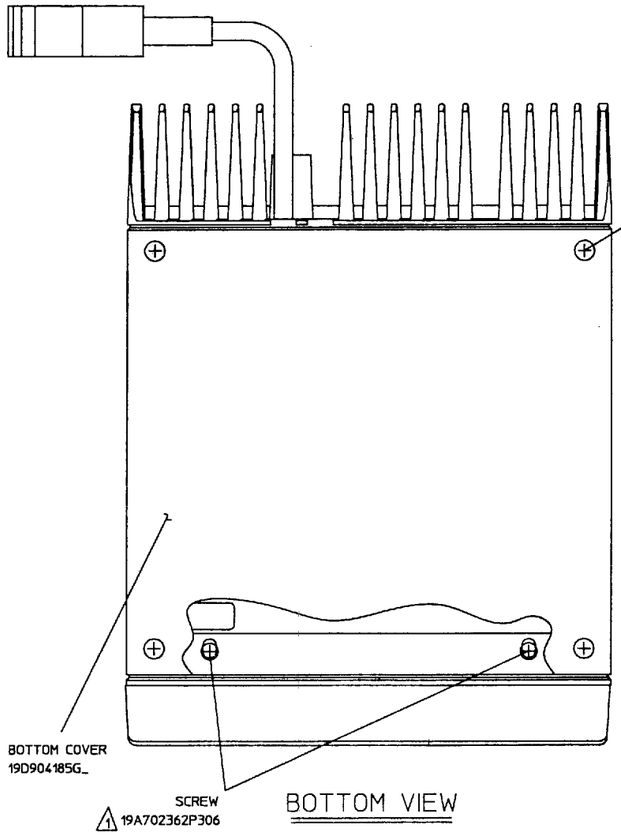
1. PART OF MDX MARRIAGE HARDWARE KIT 344A4253G1.
2. PART OF RF BD HARDWARE KIT 344A4255G7.
3. INSTALL BETWEEN PWB AND CASTING. SOLDER TO PWB.
4. APPLY SILICONE GREASE (19A701337P1) TO PA MOD,. Q101 AND U102 ON RF BD AND Q151 ON PA BD.
5. DIP ENDS OF SCREWS THAT GO INTO CASTING IN GREASE (19A115204P1) BEFORE INSTALLING INTO CASTING. TORQUE TO 15 INCH-POUNDS.
6. LUBRICATE Z903 PINS WITH GREASE (19A704532P1).
7. INSTALL U101 FLUSH TO PWB AND FASTEN WITH SUPPORT TO CASTING BEFORE SOLDERING LEADS TO PWB. TOP OF U101 SHALL NOT EXTEND MORE THAN 0.25 ABOVE ADJACENT CASTING.
8. APPLY OVER TWO HOLES ON INSIDE OF CASTING.
9. WEATHERPROOF HOLES AROUND SCREWS USING RTV162 (19A701648P2).
10. REMOVE CR1 & CR2 FROM BD BEFORE INSTALLING IN RADIO.



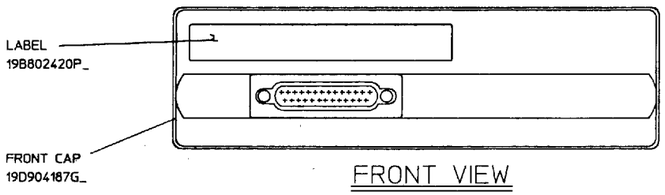
REAR VIEW



TOP VIEW



BOTTOM VIEW



FRONT VIEW

PART 1 CONTINUED

NOTES: △1 PART OF HDW KIT 344A4253G1.

Assembly Diagram
19D904542 Sh. 2