SERVICE SECTION FOR MTD SERIES DATA ONLY 900 MHz, 10 WATT

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DESCRIPTION

This Service Section contains the information necessary for aligning and troubleshooting the MTD 900 MHz, 10 watt, Data Only mobile radio. In addition, information is provided for disassembling the radio and replacing surface-mounted 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 should be measured and recorded for future reference. For the complete transmitter alignment, refer to the Alignment Procedure (see Table of Contents).

RECEIVER ADJUSTMENT

No initial adjustments to the receiver are required. Refer to the Table of Contents for the complete receiver alignment.

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 impedance. A high impedance may cause excessive voltage drops and alternator noise problems.

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ELECTRICAL SYSTEM

Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operation 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 will often cause excessive noise or faulty operation.

MECHANICAL INSPECTION

Since mobile units are subject to constant shock and vibration, check 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 will result.

ALIGNMENT

The transmitter and receiver meter readings should be checked periodically, and the alignment "touched-up" when necessary. Refer to the Alignment Procedure in this Service manual.

FREQUENCY CHECK

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

STATIC HANDLING PRECAUTIONS

This radio contains Metal Oxide Semiconductor (MOS) devices which 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.

CAUTION

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

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 anti-static wrist strap where possible. Where ground straps can not 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 that the soldering iron is grounded using a 3-prong cord connected to an outlet with a known good earth ground.
- Use only metallized or ESD-protective vacuum-type de-soldering tools.

DISASSEMBLY PROCEDURE

TO REMOVE THE BOTTOM COVER

1. Remove the #15 TORX security screw that secures the locking knob in place (see Figure 1).
2. Rotate the latch and remove the radio bottom cover.

TO REMOVE THE TOP COVER

1. After removing the bottom cover, rotate the latch, pry a side loose, and remove the top cover (see Figure 2).

TO REMOVE THE RF BOARD

1. Remove the top and bottom covers from the radio (refer to the procedures above).
2. Pry off the friction-fit covers covering the bottom of the RF board.
3. Gently pry the 12-pin interconnect plug from the Logic and RF boards using a small standard screwdriver.
4. Remove the two #15 TORX screws securing the heat sink for Q104 and U102 to the frame (on top side of the board).
5. Remove the two #15 TORX screws securing PA module U101 to the frame.
6. Remove the five #15 TORX screws from the bottom side of the board.
7. Unplug the connectors attached to J704 and J705, and disconnect the RF cable from J101.
8. Gently push the RF board out of the radio casting, and remove the five spring clips protruding from the bottom side of the RF board.

TO REMOVE THE AUDIO BOARD

1. Remove the top cover as in the above procedure.
2. Pull out the black clip protruding from the Audio board which holds the Logic board 5 volt regulator against the casting.
3. Remove the four #15 TORX screws securing the Audio board to the radio. Pry out the board by inserting a screwdriver in the hole that was occupied by the clip.

TO REMOVE THE LOGIC BOARD

1. Remove the top cover, bottom cover, and the Audio board from the radio. Refer to the disassembly for each in this section.
2. Remove the 12-pin interconnect plug from the RF and Logic boards on the bottom of the radio.
3. Remove the four #15 TORX screws securing the Logic board to the radio frame.
4. Carefully work the Logic board out of the radio.

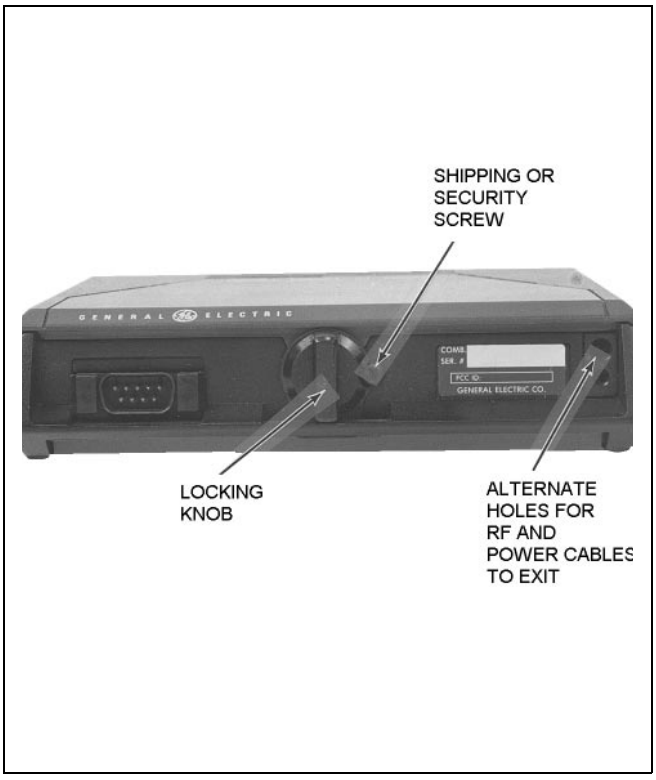

Figure 1 - Removing Bottom Cover

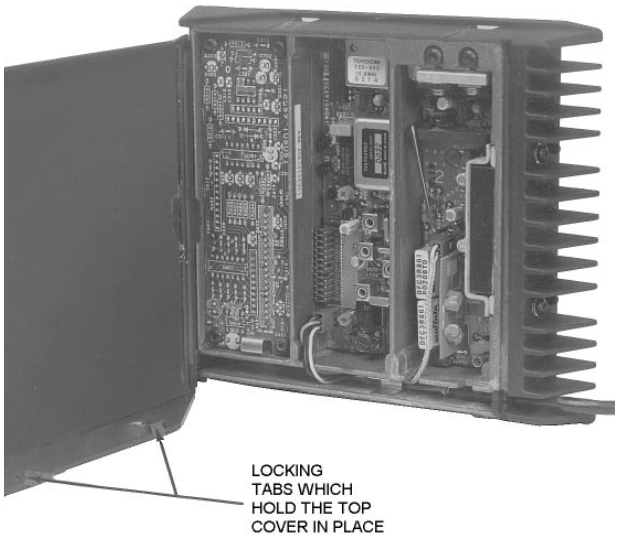

Figure 2 - Removing Top Cover

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 the static handling precautions during any service procedure.

Surface-Mounted Component Removal

1. Grip the component with tweezers or small needlenose 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. Excessive force may cause the PWB pads to separate from the board if all solder is not completely liquefied.

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 on the printed wire board.

Surface-Mounted Component Replacement

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 connection 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 another Ericsson GE approved flux remover.

SURFACE-MOUNTED INTEGRATED

CAUTION

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

CIRCUIT REPLACEMENT

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 any 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. The IC's can easily be removed and installed using the hot-air 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.

TEST PROCEDURE

TRANSMITTER VERIFICATION

Place the radio in test mode operation for the following tests:

Transmitter Frequency

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

Transmit Power

1. Select a channel. Key the transmitter. Power should be 10 watts ±0.5 dB. Current should be less than 6 amps.

High-Speed Data Check

1. Check high-speed dotting data TX out to be 1.7 kHz ±0.1 kHz.

RECEIVER VERIFICATION

SINAD

1. Apply an on-channel RF signal to the antenna jack. Modulate the signal with a 1 kHz tone at 1.5 kHz deviation. Set the RF level to -116 dBm.

2. Check for greater than 12 dB SINAD on-channel at SPKR HI output, J725-3.

3. Repeat the test for the band ends and the middle.

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 3.

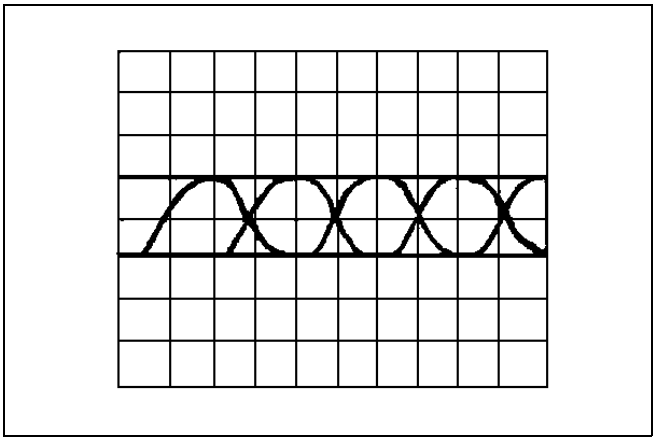

Figure 3 - High-Speed Data Eye Pattern

ALIGNMENT PROCEDURE

To align the radio, test mode operation should be used as described in the Test Procedure section.

TRANSMITTER ALIGNMENT

Frequency Set

1. 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.

Transmitter Power Set

1. While on a non-talkaround channel, key the transmitter and adjust R113 in the power control circuit for 10 watts ±0.2 watts.

High-Speed Data Modulation Set

1. Turn on the 4800 baud dotting data. Adjust Data Modulation pot R324 (on Audio board) for 1.7 kHz ±0.1 kHz.

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 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 1.5 kHz deviation.

2. Adjust L504, L506, and L507 for a peak indication on the voltmeter. Adjust the level of the generator to keep the signal at J501 out of limiting.

3. Repeak the coils.

Quadrature Detector Adjustment

1. Inject a strong on-channel signal at the antenna jack, modulated with a 1 kHz tone at 1.5 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.

TROUBLESHOOTING PROCEDURE

This section should help isolate a problem to a particular board or circuit. Refer to the appropriate LBI on the suspect board for additional troubleshooting and circuit information. The MTD 900 MHz, 10 Watt, Data Only mobile radio is divided into 3 boards or assemblies. The outline below gives a quick list of major functions for each board. Refer to the appropriate LBI on each for more details.

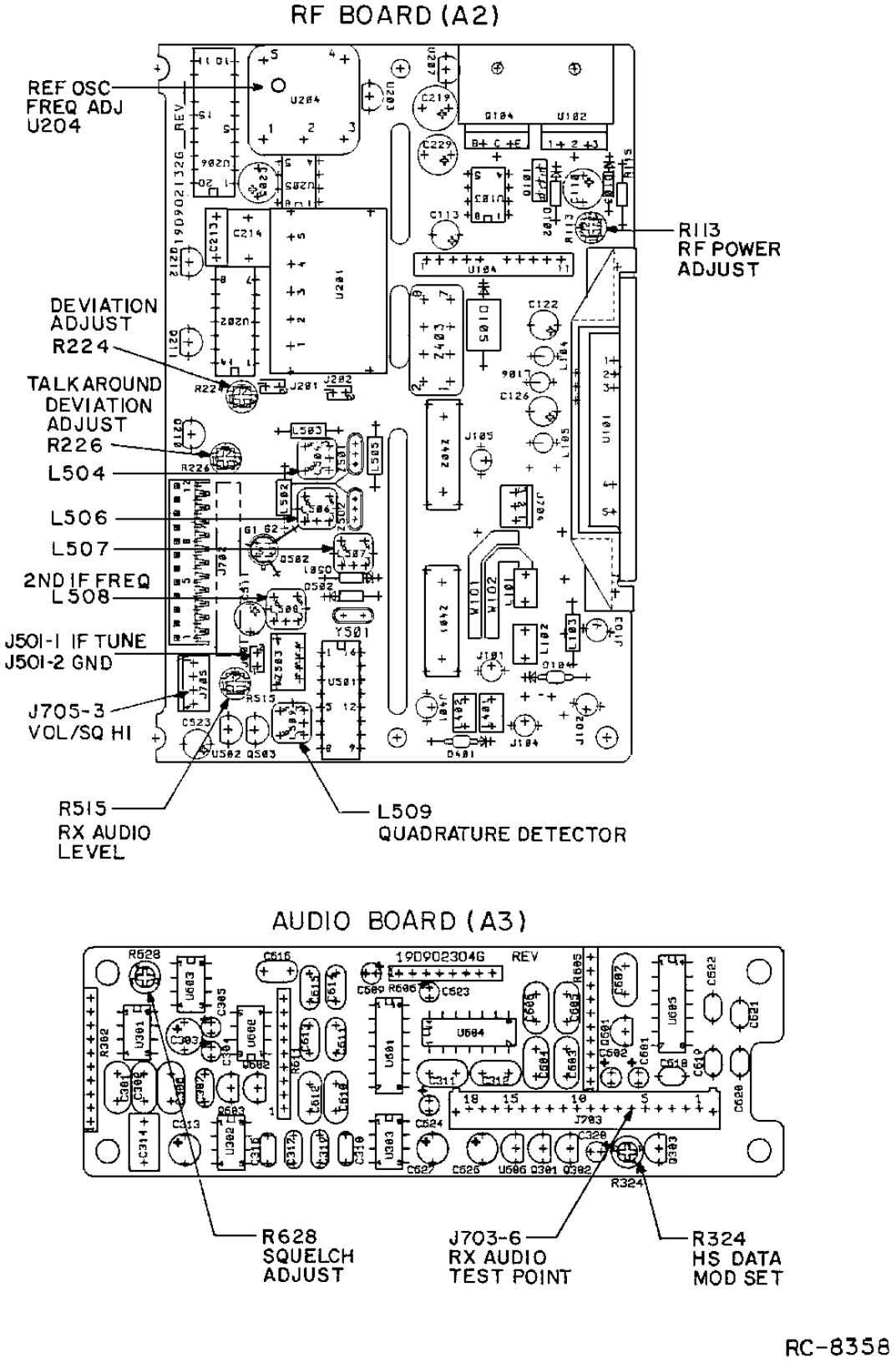

Figure 4 - Test Point and Adjustment Locations

A. RF Board (A2) contains:

1. Synthesizer - generates all transmit and receive frequencies.
2. Receiver - provides detected audio to the Audio board.
3. Transmitter - includes exciter and 10 watt PA module.
4. Power control circuitry for the transmitter.
5. Pin diode TX/RX RF switch.
6. Low-pass filter for the transmitter.

B. Audio Board (A3) contains:

1. Analog filtering of the RX and TX audio (voice, low-speed data, high-speed data, and signalling tones).
2. RX squelch - provides the CAS signal to the Logic board.
3. Conventional analog tone filtering and processing.

C. Logic Board (A1):

1. Routes signals between the RF, Audio, and Control boards.
2. Contains the EEPROM for the radio personality.
3. Contains the main radio microprocessor.
4. Accepts PTT from the microphone.
5. Provides DPTT to turn on the transmitter.
6. Provides synthesizer channel data to the RF board.
7. Controls RX and TX audio.
8. Generates and detects the Channel Guard tones and data.
9. Accepts the CAS squelch output from the Audio board.
10. Generates and detects high-speed and low-speed data.

POWER DISTRIBUTION

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

The receiver uses the 8 volt regulator U502. The synthesizer uses a separate 8.3 volt regulator (U207) and a 5 volt regulator U203. The transmitter uses another 8 volt regulator (U102). The output of U102 is switched to the exciter and the power control circuit. (U102 also powers the Logic board.) U102 (TX 8 volt supply) and Q101 (power control output transistor) are mounted for heat sinking.

Logic Board

A single 5 volt regulator U705 is used to power the Logic board. The input voltage is derived from the 8 volt TX regulator U102 on the RF board. The power-on reset circuitry for the Logic board microprocessor is part of regulator U705. This reset signal prevents scrambled operation due to low voltage transients during automobile starting.

Audio Board

An 8 volt regulator U606 provides power to all of the Audio board circuitry. SW A+ FILTERED from the Logic board provides the input voltage to the 5 volt regulator U303.

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