SERVICE SECTION FOR TMX-8810

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DESCRIPTION

The Service Section contains the information necessary for aligning and troubleshooting the TMX-8810 mobile radio. In addition, information is provided for disassembling the radio and replacing chip 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 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.

PREVENTATIVE 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 for loose plugs, nuts, screws and other parts to make sure that nothing is working loose.

ANTENNA

The antenna, antenna base and all contacts could 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.

DISASSEMBLY PROCEDURE

TO REMOVE THE TOP COVER

1. Insert a small standard screwdriver under one side of the top cover and gently pry the side of the cover away from the frame releasing the locking tab (refer to Figure 1).
2. Using the screwdriver, press in on the tabs on the rear of the radio and release the two locking tabs.
3. Insert the screwdriver under the other side of the radio top cover, releasing the remaining locking tab, and remove the cover from the radio.

TO REMOVE THE BOTTOM COVER

Remove the two screws securing the bottom cover to the radio. One of the screws is used to hold the microphone strain relief (refer to Figure 1). The bottom cover can then be removed from the radio.

TO REMOVE THE RF BOARD

1. Remove the top and bottom covers from the radio (refer to the procedure above).
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 M3.5-0.6 x 8 TORX® screws (#15 drive) securing Q101 and U102 to the frame (on top side of the 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 five M3.5-0.6 x 8 TORX screws (#15 drive) from the bottom side of the board.
7. Disconnect wires attached to J704, J705.
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 AUDIO BOARD

1. Pull out the black clip protruding through the Audio Board which holds the Logic Board 5 volt regulator against the casting.
2. Remove the four M3.5-0.6 x 8 TORX screws (#15 drive) securing the Audio Board to the radio. Pry out the board using a screwdriver in the hole that was occupied by the clip.

TO REMOVE THE LOGIC BOARD

1. Remove the top cover, bottom cover, Front Cap assembly and the Audio Board from the radio. Refer to the disassembly for each in this section.
2. Remove interconnect plug P702 from he RF and Logic Boards on the bottom of the radio.
3. Remove the four M3.5-0.6 x 8 TORX screws (#15 drive) securing the Logic Board to the radio frame.
4. Carefully work the Logic Board out of the radio being careful not to damage the plug going to the Front Cap Assembly.

TO REMOVE THE INTERCONNECT BOARD

1. Remove the top cover of the radio. Refer to the procedure above.
2. Disconnect the cable at J151 on the PA Board.
3. Remove the four M3.5-0.6 TORX screws (#15 drive) securing the board to the frame. Carefully work the board out of the radio, unplugging it from the feedthrough assembly Z903.

TO REMOVE THE SYSTEM BOARD

1. Remove the bottom cover of the radio. Refer to the procedure above.
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 board to the frame.
6. Carefully work the board out of the radio, unplugging it from the feed through assembly Z903.

TO REMOVE THE FRONT CAP ASSEMBLY

1. Remove the top and bottom covers of the radio.
2. Remove the two M3.5-06 x 8 TORX screws (#15 drive) from both sides of the front cap and the TORX screw on the bottom of the front cap. Also on the bottom, remove the two screws securing the control panel to the front cap assembly.
3. Gently pull the front cap assembly away from the radio exposing the ribbon cable on the rear of the assembly.
4. Disconnect the ribbon cable from the rear of the assembly and disconnect the speaker leads from the System Board. The Front Cap Assembly can then be removed from the radio.

FRONT CAP DISASSEMBLY

The Front Cap Assembly consists of the Control Board, the Control Panel, the LCD assembly, and the internal speaker. The following procedures describe how to remove the Control Board, the Control Panel, and the LCD assembly after the front cap has been removed from the radio.

Control Board Disassembly

1. Disconnect the ribbon cables at J726 and J727.
2. Remove the two clips securing 5 volt regulator U727 and 3 watt PA U801 to the front cap casting.
3. Remove the four M3.5-06 x 8 TORX screws (#15 drive) securing the board to the front cap casting. Lift the board out of the front cap.

Control Panel Removal

1. Remove the two M3.5-06 x 8 TORX screws (#15 drive) from the rear of the front cap assembly if not already removed.
2. Gently pull the control panel away from the front cap and disconnect the ribbon cable on the rear of the panel.

LCD Removal

To remove the LCD assembly, the Control Panel must first be removed to expose the mounting screws and pull the assembly out of the casting. When replacing the screws, use only a moderate torque of 4 inch-pounds. Overtightening may prevent the power switch from operating.

COMPONENT REPLACEMENT

The procedure for removing chip components is given below. Replacement procedures for other unique components are found in the appropriate board LBI where the component is used (the 10 watt PA module replacement in the RF Board LBI).

CHIP COMPONENT REPLACEMENT

Replacement of chip capacitors should always be done with a temperature controlled soldering iron, using a controlled temperature of 70°F (371°C). However, do **NOT** touch black metal film of the resistors or the ceramic body of capacitors with the soldering iron.

SERVICE

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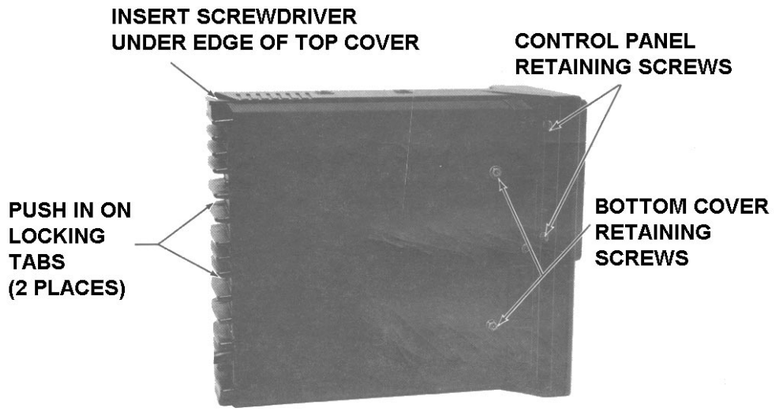


Figure 1 - Bottom View

NOTE

The metallized end terminations of the parts may be touched with the soldering iron without causing damage.

To Remove Chip Components:

1. Using two soldering irons heat each end of the chip at the same time until solder flows, and then remove and discard the chip.
2. Remove excess solder with a vacuum solder extractor.
3. Carefully remove the epoxy adhesive and excess flux to prevent damage to the printed board.

To Replace Chip Components:

1. Using as little solder as possible, "tin" one end of the component and one of the pads on the printed wiring board.
2. Place the "tinned" end of the component on the "tinned" pad on the board and simultaneously touch the component and the pad with a well "tinned" soldering iron while pressing the component down on the board.
3. Place the "tinned" soldering iron on the other end of the component and the pad simultaneously. Apply solder to the top of the end of the component until the solder starts to flow. Use as little solder as possible while getting a good joint.
4. After the component has cooled, remove all flux from the component and printed wiring board with alcohol.

CAUTION

The CMOS Integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench instrument that has a 3-prong power cord connected to an outlet with a known good earth ground. When soldering or desoldering a CMOS device, the soldering iron should also have a 3-prong power cord connected to an outlet with a known good earth ground. A battery-operated soldering iron may be used in place of the regular soldering iron.

TROUBLESHOOTING PROCEDURE

This section should help isolate a problem to a particular board or circuit. Block diagrams for power distribution and signal flow are given at the end of this manual. Refer to the appropriate LBI on the suspect board for additional troubleshooting and circuit information. The TMX-8810 is divided into 6 functionalized boards or assemblies. The outline below gives a quick list of the major functions for each board. Refer to the appropriate LBI on each for more details.

1. RF Board

   Contains:

   - 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.

2. Interconnect Board

   - Routes power from System Board to RF Board.

3. Audio Board

   Contains:

   - Analog to digital and digital to analog conversion of the RX and TX audio.
   - RX squelch - provides the CAS signal to the Logic Board.
   - Conventional analog tone filtering and processing.

4. Logic Board

   - Routes signals between the RF, Audio, and Control Boards.
   - Contains the EEPROM for the radio personality.
   - Contains the main radio microprocessor.
   - Accepts PTT from the microphone.
   - Provides DPTT to turn on the transmitter.
   - Provides synthesizer channel data to the RF Board.
   - Processes RX and TX audio using a digital signal processor.
   - Decodes tone data from the Audio Board.
   - Generates the Channel Guard tones and data.
   - Controls all audio switches on the Audio Board.
   - Accepts the CAS squelch output from the Audio Board.

5. System Board

   Contains:

   - A+ switching circuitry
   - Option connections.

6. Front Cap Assembly

   Contains:

   - Control Panel
   - LCD Assembly
   - Control Board - includes a microprocessor and 3 watt audio PA.
   - Speaker

Power On Checks

The radio provides several self diagnostic checks when power is applied and informs the user of a possible problem within the radio. These tests provide the following error messages on the display:

ERROR 1	No personality. The radio has not been programmed with customer information.
ERROR 2	Not used.
ERROR 3	Synthesizer unlocked. The synthesizer is tested to verify that it will lock in the proper amount of time at various frequencies across the band.
ERROR 4	EPROM program memory checksum error. If the microprocessor uses external memory, the EPROM has been corrupted or is malfunctioning.

TEST PREPARATION

To test the TMX-8810, a test mode must be entered to disable the normal channel scanning mode for GE-MARC operation. This test mode function is normally disabled before shipment to the customer. The radio's personality must be PC programmed to access the test mode function. This function is found on the options screen in the PC programming software.

TEST MODE COMMANDS

The test mode commands are controlled by a TMX handset. Plug the test point adapter box into the radio mic connector.

Plug the handset into the test point box. With the radio power off, push and hold the VOLUME UP and CLR/MON buttons on the radio control panel, and then turn on the radio power. After applying power, release the buttons. Test mode should appear in the radio display, followed by in the handset display.

When test mode is entered, the radio will revert to the following default conditions:

NOTE

The radio control panel buttons do not function while in test mode. Only the handset can control the radio.

- Channel Number 730:
- Volume setting at minimum.
- All audio paths muted.

$$\frac{\text{815.0125 MHz TX}}{\text{860.0125 MHz RX}}$$

Channel Frequency Select

To select another channel frequency, press the CL key followed by a 2 to 4 digit channel number (10-1528) followed by CL. A channel number can be entered with or without leading zeroes. The receive audio will be turned on after entering the channel.

Example: For channel 12, enter CL 1 2 CL.

NOTE

To determine the channel number:

$$\text{Ch. No.} = \text{Frequency} - \frac{806.0125}{0.0125} + 10$$

Channel 10 is 806.0125 MHz and channel 1528 is 824.9875 MHz. Channel spacing is 12.5 kHz. A one MHz frequency increase or decrease corresponds to a channel number increase or decrease of 80.

Test Functions

Table 1 gives a summary of the important test functions. A complete description of all tests is given below.

Enter test mode	VOLUME UP and CLR/MON (on radio)
Exit test mode	Turn radio power OFF.
Select test channel frequency	CL (channel number) CL
Ramp volume up/down	VOLUME (on handset only)
Transmitter ON Transmitter OFF	S01 E
Receive audio ON Receive audio OFF	S02 S03
Transmit audio ON Transmit audio OFF	S04 S05
Transmit busy tone	S06
PTT switch enable	S16

Table 1 - Frequently Used Test Mode Functions

The test functions are enabled by first pressing the S key followed by a two digit number. Wait until the display is updated before pushing the next button (about 1/2 second).

TRANSMITTER TEST: **S 0 1 (ON)**
E (OFF)

The carrier is ON/OFF at the specified channel frequency. This function overrides the PTT switch. Receive audio will be OFF.

RECEIVER AUDIO TEST: **S 0 4 (ON)**
S 0 3 (OFF)

The receiver audio path is On (unmuted) or OFF (muted).

TRANSMITTER AUDIO TEST **S 0 4 (ON)**
S 0 5 (OFF)

The transmitter audio path is ON (unmuted) or OFF (muted).

NOTE

The handset microphone will not function in test mode. If desired, the radio's hand mic may be plugged into the test box.

BUSY TONE TEST: **S 0 7 (ON)**
E (OFF)

The radio continuously transmits the 3051.6 Hz standard busy tone. This function overrides the alternate busy tone test.

ALTERNATE BUSY TONE TEST: **S 0 7 (ON)**
E (OFF)

The radio continuously transmits the 2918.7 Hz alternate busy tone. This function overrides the standard busy tone test.

TRANSMIT GE-MARC TONE TEST: **S 0 8** (tone 01-41)

This function transmits the selected GE-MARC tone (01 to 41). Any key causes reset to the default conditions.

CHANNEL INCREMENT: **S 0 9**

This function increments the channel number and loads the synthesizer. The receive audio is ON.

ACROSS BAND SWITCHING: **S 1 0**

This function continuously toggles the synthesizer across the band between 806.0125 and 825.9875 MHz. Any key causes reset to the default conditions.

TONE SET SELECT: **S 1 1** (tone set number 01-99)

This function selects the tone sequence from the tone set number. The tone set must be programmed in the personality PROM. This function is used along with the Call Decode and Call Encode tests.

DTMF TONE TEST: **S 1 2** (DTMF tone 0-9, *, or #)

This function transmits the selected DTMF tone. Any key causes reset to the default conditions.

Key and DTMF tone combinations are as follows:

Key	Low Tone (Hz)	High Tone (Hz)
1	697	1209
2	697	1336
3	697	1477
4	770	1209
5	770	1336
6	770	1477
7	852	1209
8	852	1336
9	852	1477
*	941	1209
0	941	1336
#	941	1477

CALL DECODE TEST: **S 1 3**

This function looks for the tone sequence selected by the tone set function (S 1 1). The three note alert tone is sounded and all handset indicators are displayed if the sequence is detected. Any key causes reset to the default conditions.

CALL ENCODE TEST: **S 1 4**

This function initiates a call using the tone sequence selected by the tone set function (S 1 1). The three note alert tone is sounded if the attempt is successful. The call is attempted at one second intervals. Any key causes reset to the default conditions.

ALERT TONE TEST: **S 1 5**

This function sounds the call initiated alert and the channels busy/error tone. Any key causes reset to the default conditions.

PTT ENABLE: **S 1 6**

This function will enable the PTT switch to turn the transmit circuit ON/OFF. The function is disabled whenever another function activates the transmitter.

RELAY SWITCH TEST: **S 1 8**

This function toggles the relay line at a 1000 Hz rate for board level testing. Any key causes reset to the default conditions.

PORT CHECK: **S 1 9**

This function is used to test the Logic Board microprocessor port pins. The pins will toggle at the rates shown below. Any key causes reset to the default conditions.

Pin	Rate
4	5 kHz
5	2500 Hz
6	1250 Hz
8	312 Hz
9	156 Hz
14	78 Hz

SOFTWARE REVISION: **S 2 0**

This test displays the microprocessor software revision. Any key causes reset to the default conditions.

DIRECT MODE TEST: **S 2 1**

This test pulls the band switch line of the VCO low. A channel can then be loaded in order to test the transmit circuit at the high end of the band (channels 3610-5310). Any key causes reset to the default conditions.

CHECKSUM TEST: **S 2 2**

This test performs a checksum test on the program memory. If the test passes, PROM OK is displayed. If the test fails, BAD PROM is displayed.

LOGIC BOARD JUMPER TEST: **S24**

This test returns the state of jumper P1 on J1 of the Logic Board. P1 is on J1-1 and 2 for radios with 45.0125 MHz offset (TMX-8825 and TMX-8810) and on J1-2 and 3 forradios with 45.3 MHz IF offset (MDX GE-MARC).

RADIO ALIGNMENT PROCEDURE

To align the radio, test mode operation should be used as described in the Test Preparation section. If the radio is PC programmed with the specified test frequencies in a conventional mode area, these may be used instead of test mode. Refer to Figures 4 and 5 for alignment controls and test points.

TRANSMITTER ALIGNMENT

FREQUENCY SET

Select any channel frequency. In test mode, the default channel is 730 at 815.0125 MHz. Key the transmitter (**S 0 1**) and measure the transmit frequency. The frequency should be within ±250 Hz of the channel frequency. If not, adjust U204 to within ±100 Hz. (Push **E** to turn off the transmitter.)

NOTE

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

MODULATION SET

l. Apply a 1 kHz, 300 mVrms signal to the MIC HI input at J725-4. Note that MIC HI has a dc voltage present. The input impedance is determined by MIC GAIN ADJUST R302 and is normally adjusted fully clockwise (maximum mic gain) at 570 ohms input impedance.

NOTE

The handset microphone will not function in test mode. If desired, the radio's hand mic may be plugged into the test box.

2. Select channel 1528 (**CL 1 5 2 8 CL**) at 824.9875 MHz. Turn on the TX audio (**S 0 4**). Turn on the busy tone which also keys the transmitter (**S 0 6**). Adjust modulation pot R226 for 4.5 +0.1, -0.2 kHz deviation.

3. Check deviation on channel 10 at 806.0125 MHz. If deviation is greater than 4.5 kHz, readjust R226.

TRANSMITTER POWER SET

NOTE

If the modulation is checked on conventional mode channels programmed with 67.0 Hz Channel Guard, the deviation should be 4.25 kHz.

1. While on channel 10, key the transmitter (**S 0 1**), and adjust R111 in the power control circuit for 11 watts.

2. Push **E** to unkey the transmitter.

RECEIVER ALIGNMENT

FREQUENCY SET

1. Verify that the transmitter is on frequency as described in the transmitter alignment above.

2. Inject a strong on channel signal at the antenna input J101 (default test mode channel is 730 at 860.0125 MHz).

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 5 kHz deviation.

2. Adjust L504, L506, and L507 for a peak on the voltmeter. Adjust the level of the signal 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 3 kHz deviation.

2. Monitor the VOL/SQ HI output at J705-3 with an AC voltmeter and adjust L509 for a peak on the meter.

RECEIVER AUDIO LEVEL

1. Inject a strong on channel signal at the antenna jack modulated with a 1 kHz tone at 3 kHz deviation.

2. Set volume on handset at maximum. Monitor RX AUDIO J703-6 on the Audio Board with an AC voltmeter. Adjust R513 on the RF Board for a reading of 1.5 ±0.1 Vrms.

SQUELCH ADJUST

1. Exit the test mode by turning the radio power off/on. The squelch cannot be adjusted in test mode.

2. Select any programmed conventional channel. Apply a signal modulated with a 1 kHz tone at 3 kHz deviation to the antenna input jack.

3. Using an insulated tuning tool, turn SQUELCH R602 on the Audio Board fully counterclockwise.

4. While monitoring SPKR HI J725-3, adjust the signal generator for 8 dB SINAD.

5. Adjust SQUELCH fully clockwise then slowly adjust counterclockwise until squelch just opens.

6. Check adjustment by turning signal generator RF level down slowly until squelch closes. Slowly bring RF level back up. Squelch should open at 8 dB SINAD.

TRANSMITTER VERIFICATION

Place the radio into test mode operation for the following tests.

TRANSMIT FREQUENCY

Key the transmitter on any channel (**S 0 1**) and measure the transmit frequency (default test mode channel is 730 at 815.0125 MHz). The measured frequency should be within ±250 Hz. (Push **E** to unkey the transmitter.)

TRANSMIT POWER

Select channel 10 (**CL 1 0 CL**) at 806.0125 MHz. Key the transmitter (**S 0 1**). Power should be 11 watts ±0.5 dB. Current should be less than 5 amps. (Push **E** to unkey the transmitter.)

MODULATION LIMITING

1. Apply a 1 kHz tone at 300 mVrms to MIC HI input J725-4.

2. Select channel 1528 (**CL 1 5 2 8 CL**) at 824.9875 MHz. Turn on the TX audio (**S 0 4**). Turn on the busy tone which also keys the transmitter (**S 0 6**). Measure and note the deviation.

3. Select channel 10. Measure the deviation. The highest measured deviation on the two channels should be 4.5 ±0.2 kHz. (Push **E** to unkey the transmitter.)

BUSY TONE DEVIATION

1. Select channel 730 (**CL 7 3 0 CL**) at 815.0125 MHz. Turn on the busy tone which also keys the transmitter (**S 0 6**).

2. The measured deviation should be 1 kHz +0.2, -0.3 kHz.

RECEIVER VERIFICATION

SINAD

1. Apply a RF generator to the antenna jack at 851.0125 MHz modulated with a 1 kHz tone at 3 kHz deviation. Set the RF level to -116 dBm.

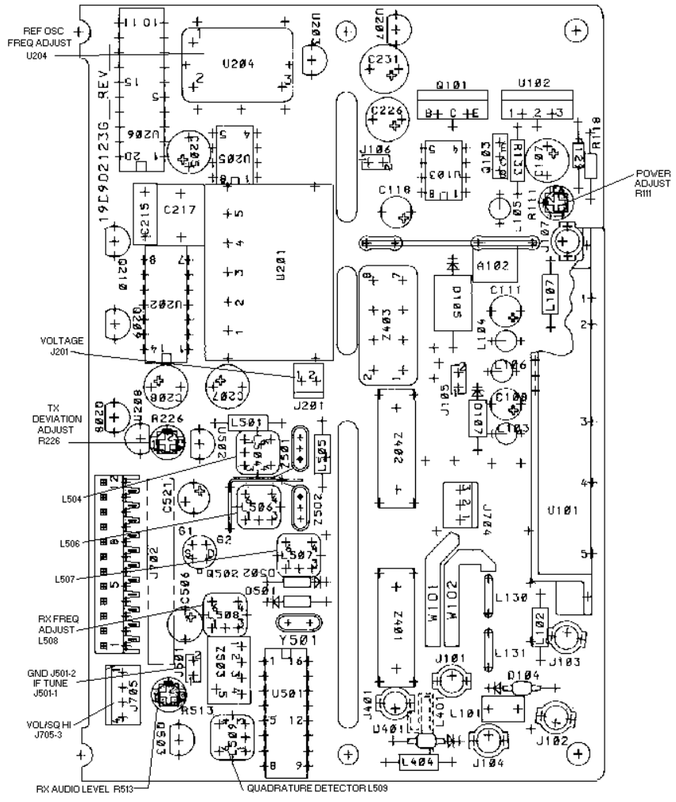
2. Check for greater than 12 dB SINAD on channel 10 (**CL 1 0 CL**) at the SPKR HI output.

3. Repeat the test for channel 730 at 860.0125 MHz and channel 1208 at 865.9875 MHz.

AUDIO OUTPUT

1. Apply a strong (-50 dBm) on channel signal modulated with a 1 kHz tone at 3 kHz deviation.

2. Monitor SPKR HI J725-3 and adjust volume for 3 watts output (3.46 Vrms into 4 ohms). Distortion should be less than 5%.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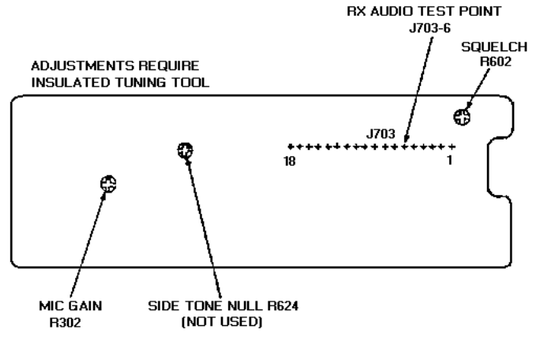
VOLTAGE J201
TX DEVIATION ADJUST R226
RX FREQ ADJUST L508
GND J501-2 IF TUNE J501-1
VOL/SQ HI J705-3
RX AUDIO LEVEL R513
QUADRATURE DETECTOR L509
POWER ADJUST R111
L504
L506
L507
19C902123G REV

AUDIO BOARD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SQUELCH R602
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J703
18
1
MIC GAIN R302
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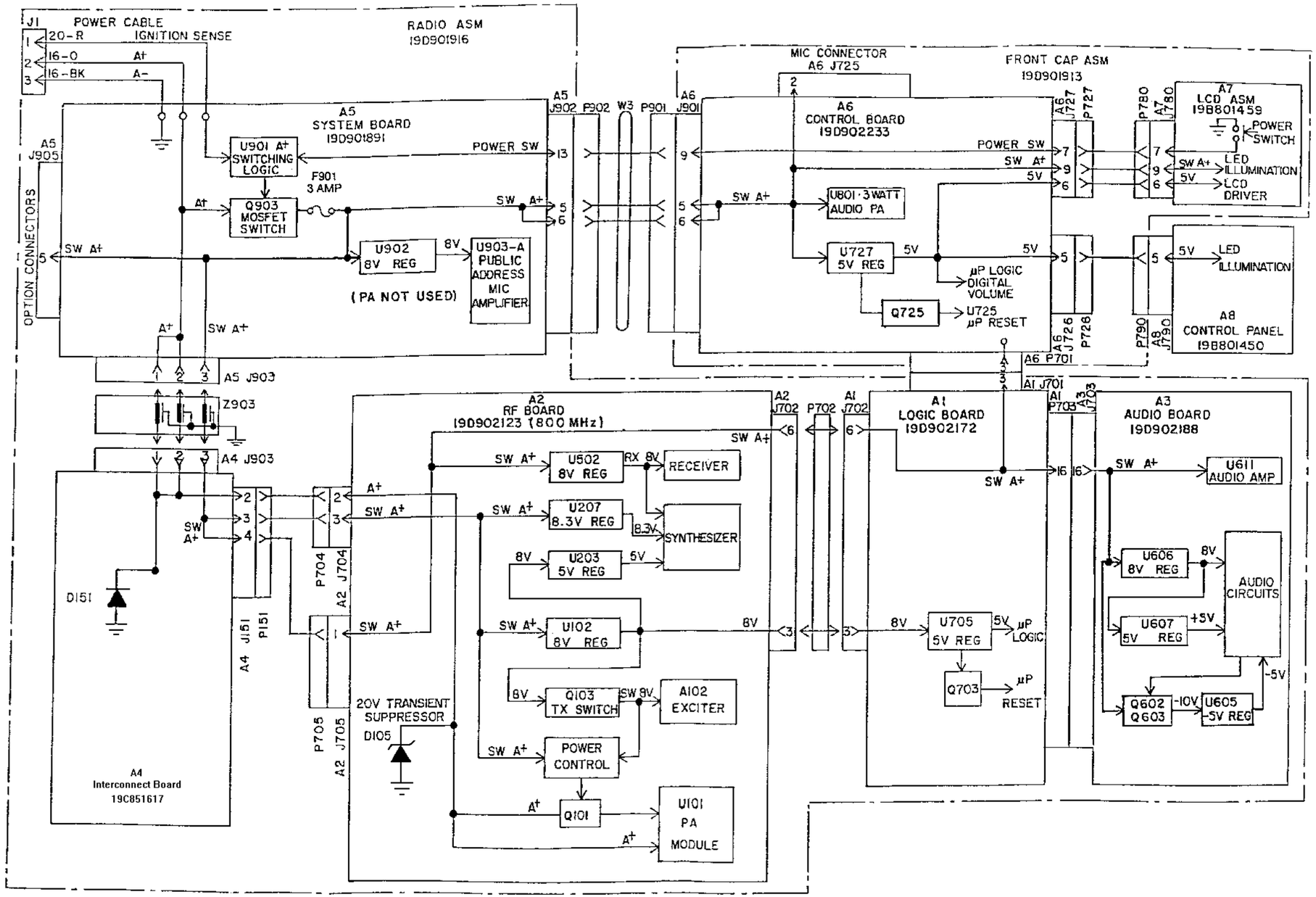

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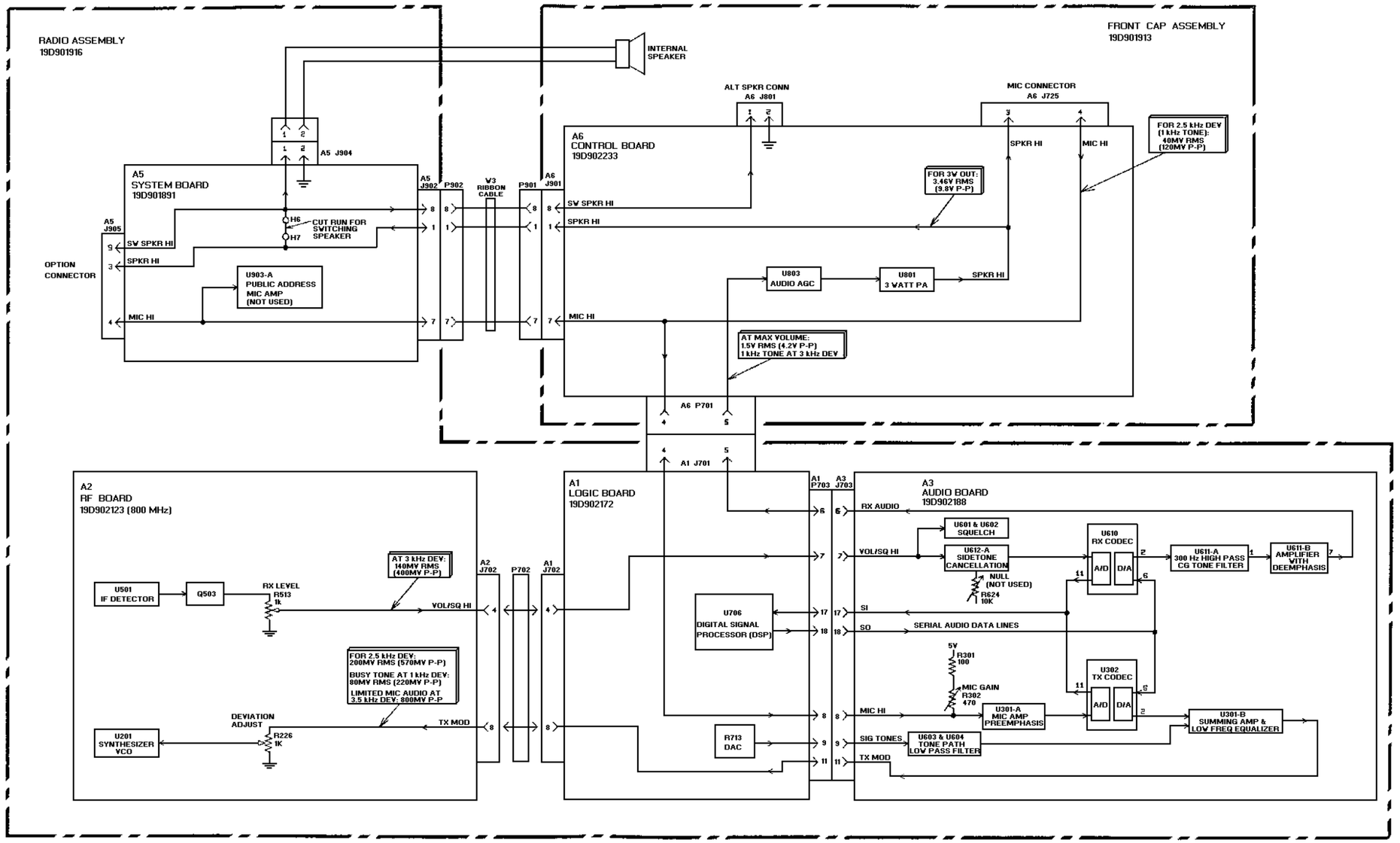
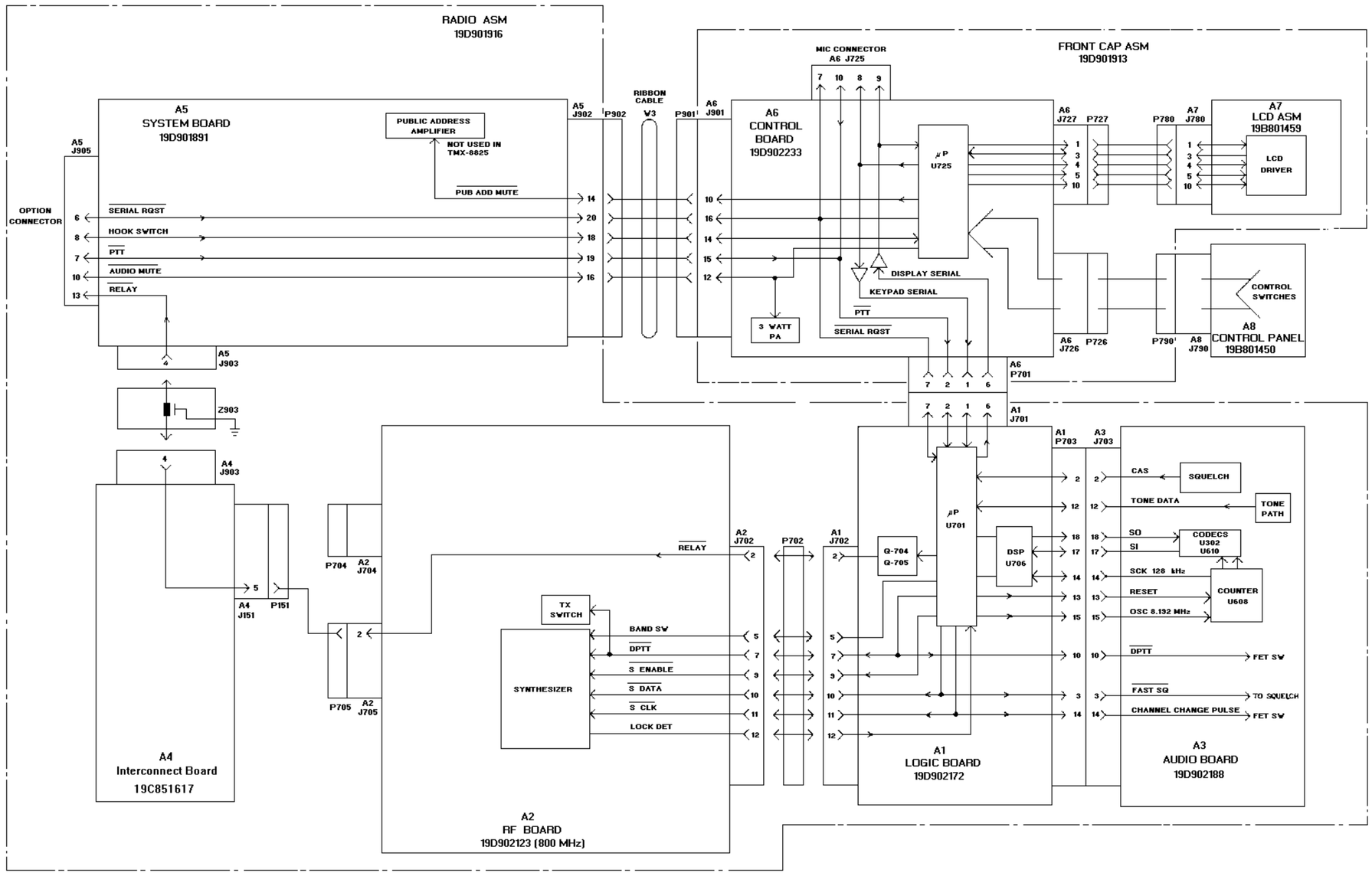


AUDIO SIGNAL FLOW



LOGIC SIGNAL FLOW

SERVICE