MAINTENANCE MANUAL

SERVICE SECTION FOR GE-NET TMX™ MOBILE RADIO

TABLE OF CONTENTS

DESCRIPTION

This Section contains the information necessary for aligning and troubleshooting the GE-NET TMX™ mobile radio. In addition, information is provided for disassembling the radio and replacing chip components.

INITIAL ADJUSTMENT

The mobile radio has been initially aligned at the factory, and no additional tuning should be required. After the radio has been installed as described in the Installation Manual, the following checks 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 frequency and modulation should be measured and recorded for future reference. For the complete transmitter servicing, refer to the Alignment and Test Procedure (see Table of Contents).

RECEIVER ADJUSTMENT

No initial adjustments are required for the receiver. Refer to the Table of Contents for the complete receiver Alignment and Test Procedure.

RE-INSTALLATION

The GE-NET TMX mobile 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 insure 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.

ELECTRICAL SYSTEM

Check the voltage regulator and alternator or generator periodically to keep the electrical system within safe and economical operating limits. Over-voltage 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 has become loose.

ANTENNA

The antenna, antenna base and all contacts should be kept clean and free from 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 performance should be measured periodically, and the alignment "touched up" when necessary. Refer to the Alignment/test 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 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

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 procedure 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 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 through the RF Board from the bottom side.

TO REMOVE THE AUDIO BOARD

1. Remove the top cover as in the above procedure.
2. Pull out the black clip protruding through 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.

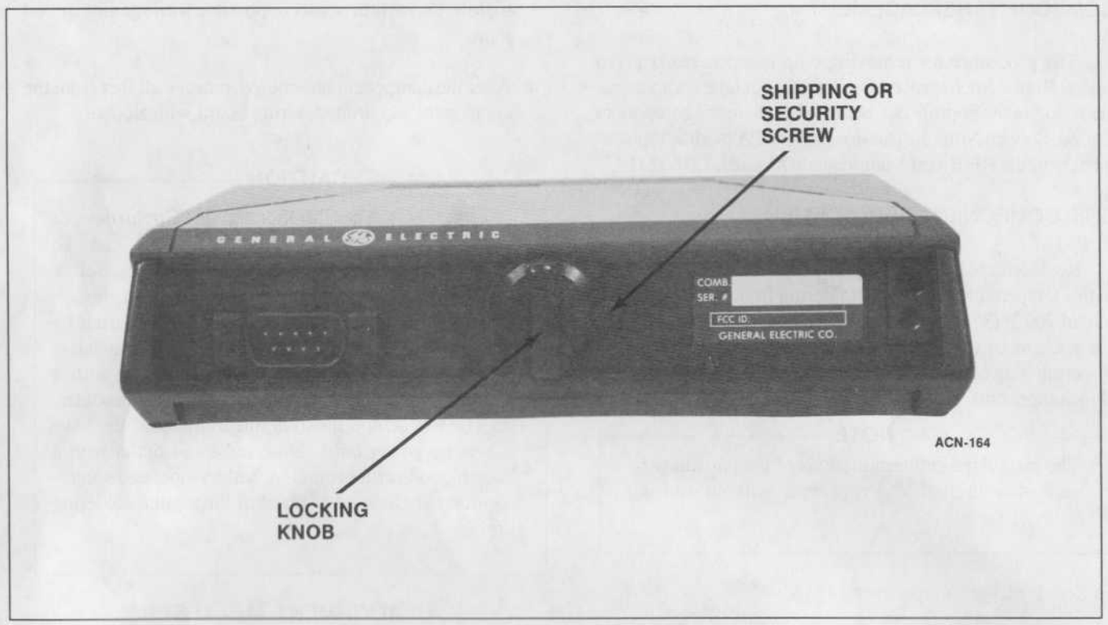


Figure 1 - Removing Bottom Cover

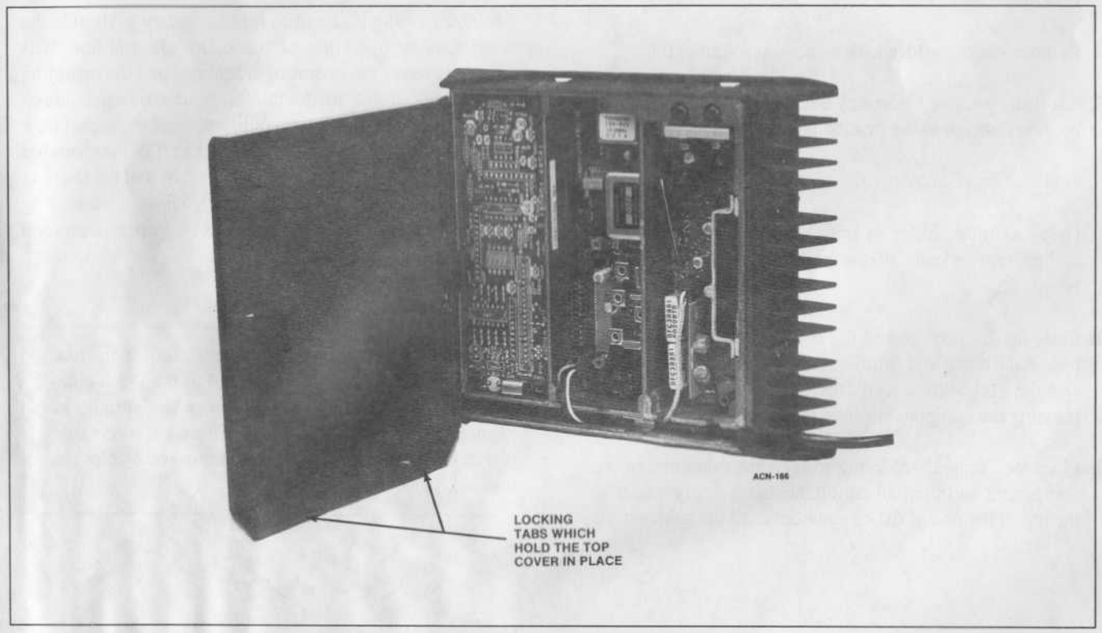


Figure 2 - Removing Top Cover

COMPONENT REPLACEMENT

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. Service Note: Instructions for the PA module replacement is in the RF Board Maintenance Manual, LBI-38114.

CHIP COMPONENT REPLACEMENT

Replacement of chip components should always be done with a temperature controlled soldering iron, with a temperature of 700°F (371°C). Do NOT touch the black metal film of the resistors or the ceramic body of the capacitors with the soldering iron. Metal tweezers may be helpful in handling the chip components.

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.

ALIGNMENT AND TEST

TEST PREPARATION

In order to align the radio, it is necessary to disable the normal trunking operation of the radio. In addition, it is necessary to select the operating frequency and the operating mode. It is desirable to do this without removing circuit boards from the radio, which would interrupt the signal flow from board to board. Using the test handset (GE Part Number 19A704950) allows the mode selections required for aligning the radio. Test point adaptor TQ2356 provides a monitoring point for the receive audio signal, and an injection point for a transmit audio signal.

NOTE

Never connect or disconnect the test handset, the test point adaptor, or the Control Head to the 9-pin connector of the radio unless the power to the radio is turned OFF. Pins of the radio connector can be inadvertently shorted when the mating connector is moved.

POWER -ON CHECKS

The GE-NET TMX mobile radio performs a self diagnositc check when power is applied and informs the user of a possible problem within the radio. If the self test passes, three quick tones will sound and the display will show "Axx Gyy", where xx and yy are the area and group number. If no alert tones are heard, and a constant tone is sounded, one of four errrors could have been detected.

To determine which error was detected, connect the test handset and power-up the radio. Refer to the following test mode description for a description of error messages.

POWER-UP SELFTEST

Various parts of the GE-NET TMX hardware are tested at power-up. The following tests are performed:

1. The EEPROM is examined to see if the unit has been programmed with personallity information.
2. The external RAM undergoes a read-write test.
3. The synthesizer is loaded with a midband channel and checked for lock. If an unlocked condition exists, then a reload is performed up to 10 times. If synthesizer lock cannot be attained in 10 tries, a failure is indicated.
4. The program PROM checksum is calculated and verified.

The results of self-test are presented as a status byte. Each bit in the byte represents the results of a particular test. If a bit is set, then that test failed. If no bits are set, then all tests passed. The individual tests are assigned bits in the seelf-test status as follows:

Bit 0 Personality programmed test
Bit 1 External RAM test
Bit 2 Synthesizer lock test
Bit 3 Program PROM checksum test
Bit 4-7 Spare, always clear

All of these tests must pass before the unit will enter normal operation; however, testmode may be entered regardless of self-test results. During execution of these tests, the radio determines the type of external device connected. Selftest results are presented according to the type of device connected.

FULL FEATURE HANDSET OPERATION

If the radio determines the full feature handset is connected and self-test detects no faults, then the display will show the AREA and GROUP selection as:

A0x G0y

where 'x' is the selected AREA (range 1 to 4) and 'y' is the selected GROUP (always 1). Pushing the '*' will cause the unit to select to the next AREA. The GROUP setting is always set to '01' since this is the normal selection for the standard TMX-9315.

If a fault is detected during self-test, then the display will show the self-test status as:

Error x

where 'x' is the lower nibble of the self-test status byte (defined in Section 2.0) displayed as ASCII'1-9, A-F'. Each fault detected sets a bit in the displayed status; therefore, multiple faults may be indicated.

CONTROL UNIT OPERATION

Successful completion of self-test is indicated by three short 1000 Hertz beeps. A fourth beep may occur if the selector switch position has changed while the radio was powered down.

A fault detected during self-test will cause a constant 500 Hertz tone to be sounded.

DEFAULT CONDITIONS

The unit, upon entering the SERVICE SHOP TESTS, will revert to default conditions to avoid undefined states.

FREQUENCY: 898.0125 MHz (TX) CHANNEL 161
937.0125 MHz (RX)

VOLUME: SET AT 1 2 (RANGE 0 - 15)
^_____(Same as used for 4 Area Controller)
ALL AUDIO PATHS WILL BE MUTED.

SPECIAL KEYS (CL, E, S, RCL, STO, *)

The handset has 8 special keys. When in the test mode, their function is as follows:

CL	=	START DELIMITER FOR CHANNEL NUMBER	'Ch=' CL	- 7FH
E	=	TURNS THE TRANSMITTER OFF	E	- 6FH
S	=	INVOKE A NEW FUNCTION	'SEL=' S	- 3DH
RCL	=	RESET TO DEFAULT CONDITONS	RCL	- 5FH
STO	=	EXIT TEST MODE	STO	- 3CH
*	=	INCREMENT TO NEXT CHANNEL	NC CHANNEL	- 3EH

FREQUENCY SELECT DISPLAY = 'ChXXXX L' (IF SYN LOCKED)
DISPLAY = 'ChXXXX u' (IF SYN UNLOCKED)

Select a frequency by entering "CL" followed by a channel number (0001 TO 9999, 0001-0480 std & 3121-3600 talkaround). Channels may be changed while the transmitter is keyed without having to re-key again. Channel numbers must be entered using leading zeros to fill the entire 4 digit field.

Example for channel 12: Enter as: 'CL 0012'

CHANNEL 0001 - 896.0125 MHz CHANNEL 0480 - 902.0000 MHz

NOTE: A 1 MHz frequency increase/decrease corresponds to a channel number increase/decrease of 80. Channel spacing - 12.5 kHz

TRANSMITTER (01) MINI DISPLAY FLAG = IN USE (WHEN KEYED)

ON (S01) (HEX 3D 30 31)
OFF (E) (HEX 6F)

Carrier on/off at the specified frequency. This function overrides the PTT switch. Transmit Mic Audio is controlled by S04 & S05. Receive audio is controlled by S02 & S03. Selecting receive audio 'on', will enable duplex operation.

RECEIVER ON (02) DISPLAY = 'Audio on'
(S02) (HEX 3D 30 32)

Receiver audio path unmuted.

RECEIVER OFF (03) DISPLAY = 'AudioOFF'
(S03) (HEX 3D 30 33)

Receiver audio path muted.

MICROPHONE ON (04) DISPLAY = 'PHonE on'
(S04) (HEX 3D 30 34)

Microphone audio path unmuted.

MICROPHONE OFF (05) DISPLAY = 'PHonEOFF'
(S05) (HEX 3D 30 35)

Microphone audio path muted.

DOTTING TONE (06) DISFLAY = '2400 CPS'
(S06) (HEX 3D 30 36)

Continuously generates 2400 Hz dotting tone from the RF modem.
This function overrides the PSUEDO RANDOM DATA function.
Note: The transmitter must be keyed (S01) prior to entering this test to actually modulate the RF carrier.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE BUT THE TRANSMITTER KEYED/UNKEYED STATUS WILL NOT CHANGE.

PSUEDO RANDOM DATA (07) DISPLAY = '4800 Prd'
(S07) (HEX 3D 30 37)

Continuously generates PSUEDO RANDOM 4800 BAUD DATA from the RF modem. This function overrides the DOTTING TONE function.
Note: The transmitter must be keyed (S01) prior to entering this test to actually modulate the RF carrier.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE BUT THE TRANSMITTER KEYED/UNKEYED STATUS WILL NOT CHANGE.

SUB-AUDIBLE TONE ENCODE (08) DISPLAY = '150 CPS'
(S08) (HEX 3D 30 38)

This function generates 150 Hz tone from the subaudible tone DAC.
Note: The transmitter must be keyed (S01) prior to entering this test to actually modulate the RF carrier.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE BUT THE TRANSMITTER KEYED/UNKEYED STATUS WILL NOT CHANGE.

CAS LINE TEST (09) DISPLAY = 'CAS on' when CAS is active or
(S09) (HEX 3D 30 39) DISPLAY = 'CAS off' when CAS is inactive.

This function reads the receiver carrier sense (CAS) line and displays its current state. It also opens the receive audio path when CAS is active (high) and mutes the receive audio path when CAS is inactive (low).

ACROSS BAND SWITCHING (10) DISPLAY = 'Ch0001 L' (Alternating)
'Ch0479 L'
(S10) (HEX 3D 31 30) 'Ch0001 L
•
•

This function continuously toggles the synthesizer between the first and last channels in the band (896.0125 MHZ and 901.9875 MHZ) at approximately 2 second intervals.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE

SUBAUDIBLE DATA DECODE (12) DISPLAY = 'Sub PASS' (IF DETECTED)
DISPLAY = 'Sub FAiL' (IF NOT DETECTED)

(S12) (HEX 3D 31 32)

This function looks for SUBAUDIBLE DATA messages from a test voice channel (on the presently selected receive frequency).
This test is intended to check the subaudible data decode sensitivity level. If no message is detected within 3 seconds, then a "not detected" response is output. RECEIVE AUDIO IS MUTED.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE

DATA DECODE (13) DISPLAY = 'Sid PASS' (IF DETECTED)
DISPLAY = 'Sid FAiL' (IF NOT DETECTED)
(S13) (HEX 3D 31 33)

This function looks for a Site ID message from a test control channel (on the presently selected receive frequency). This test is intended to check the data decode sensitivity level. If barker is not detected within 200 milliseconds, then a "not detected" response is output. RECEIVE AUDIO IS MUTED.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE

DATA ENCODE (14) DISPLAY = 'GrP CALL' (Display updates
'GrP CALL' each time request
'GrP CALL' is issued).
•
•
(S14) (HEX 3D 31 34)

This function simulates a channel request using a Group Call message with Group ID = 1 and Logical ID = 1. The radio will send asynchronous channel request message at 500 mS intervals. Synthesizer load timing, DPTT, and data transmission is exactly the same as in the normal operating mode. This test is intended to check the high speed data transmission purity.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE

ALERT TONES (15) DISPLAY = 'ALErtonE'
(S15) (HEX 3D 31 35)

This function sounds a beeping 500 Hz tone to test the alert tone audio paths.

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE

PTT ENABLE (16) DISPLAY = 'Ptt EnA' (When invoked)
DISPLAY = IN USE (When PTT active)

ENABLE (S16) (HEX 3D 31 36)
DISABLE (E) (HEX 6F)

This function will allow the transmitter to be turned on/off when the PTT switch is pushed/released. This function overrides all othefunctions that deal with keying the transmitter.

PERSONALITY PROM CHECK (17) DISPLAY = 'PrS tESt' 'PrS PASS' (IF PASSED)
DISPLAY = 'PrS tESt' 'PrS FAiL' (IF FAILED)

(S17) (HEX 3D 31 37)

This function writes FF and 00 to all locations in the personality prom and reads the prom to verify its operation. The radio must verify that it is operating normally before any writes occur to the EEPROM. This will minimize accidental erasure in the event that a bad reset or processor insanity occurs.

NOTE: THE PROM MEMORY IS SAVED IN RAM BEFORE THE TEST BEGINS AND IS RESTORED AFTER COMPLETION. REMOVING POWER DURING THE TEST WILL CORRUPT THE PERSONALITY PROM DATA.

RAM CHECK (18) DISPLAY = 'Str tESt' 'Str PASS' (IF PASSED)
DISPLAY = 'Str tESt' 'Str FAiL' (IF FAILED)
(S18) (HEX 3D 31 38)

This function tests the 2K x 8 bit external ram.

PORT PIN CHECK (19) DISPLAY = 'Port tST'
(Board level test only)
(S19) (HEX 3D 31 39)

This function is used at board level test to check the operation of the port pins. The port pins will toggle at the rate indicated following table.

uP PORT	TOGGLE RATE
P1.0	1 mS
P1.1	2 mS
P1.4	4 mS
P1.5	8 mS
P1.6	16 mS
P1.7	32 mS
P3.4	64 mS
P3.5	128 mS

NOTE: ANY KEY CAUSES THIS TEST TO TERMINATE.
DEFAULT CONDITIONS ARE RESTORED WHEN TEST IS TERMINATED.

SOFTWARE REVISION (20) DISPLAY = 1uP rXX-XX'
(S20) (HEX 3D 32 30)

This test displays the microprocessor software revision where XX-XX is the version number.

DIRECT MODE (21) DISPLAY = 'dirECt'
Activate (S21) (HEX 3D 32 31)
Deactivate (RCL) (HEX 5F)

This test pulls the band switch line of the VCO low.
A channel can then be loaded in order to test the transmitter at the high end of the band. Mic audio and receive audio are controlled test mode commands S02, S03, S04, & S05.

CHECKSUM TEST (22) DISPLAY = 'ProG tSt' 'PrG PASS' (IF PASSED)
DISPLAY = 'ProG tSt' 'PrG FAiL' (IF FAILED)
(S22) (HEX 3D 32 32)

This test performs a checksum test on the program memory.

LOGIC BOARD MODEM TEST (23) DISPLAY = 'bEr tESt' 'bEr PASS' (IF PASSED)
DISPLAY = 'bEr tESt' 'bEr FAIL' (IF FAILED)

This test requires that the logic board be placed in the factory loopback test fixture which connects the modem TX data to modem RX data. The modem is checked to insure that data can be transmitted and received correctly.

SYSTEM EVALUATION DISPLAY = 'SYSCoPE'
(S25)

This test causes the radio to exit test mode and resume operation with the handset as the user control. However, the radio will now send status information to the display when placing or receiving calls. The display will be updated as follows:

> NO SERV' - On if no valid control channel is found, other wise off if locked to control channel.

>'IN USE' - On anytime the transmitter is actually keyed, otherwise off.

'A0x G01' - Normal display when radio is idle.

'Axxx-' - Channel assignment received where 'xxx' is the FCC channel number expressed in hexidecimal.

'C' - Confirmation message received on the voice channel.

'r' - Unit has opened RX audio to receive a message.

Notes: (>) indicates display flag on the LCD display.

PORT READ/WRITE TEST DISPLAY = 'Port = xx'
(S26) (HEX 3D 32 36)

This test reads the various input port pins listed below and displays the results in hexadecimal format (xx).

BIT#	JACK#	SIGNAL NAME
0	J701-2	PTT
1	J701-7	HOOKSW
2	J701-1	SEL0
3	J701-6	SEL1
4	J702-12	LOCK DET
5	NC	
6	J703-2	CAS
7	J703-3	TONE DATA

TEST DESCRIPTIONS

SELF TEST

-verifies that the synthesizer will lock in the proper amount of time at various frequencies across the band
-verifies that the personality prom is programmed
-verifies program prom is ok
-verifies RAM is ok

BOARD TEST

Used in conjunction with a test fixture in order to verify proper operation of the computer board.
-checks 5 volt regulator and reset pulse
-checks microcomputer port pin operation (shorts to other pin, etc.)
-checks latch operation
-checks that the operation prom works correctly
-checks modem operation

PERFORMANCE TEST

Using the previously listed test functions, the performance test measures radio specifications, such as receiver sensitivity, tone deviation, transmitter power, etc.

FUNCTIONAL TEST

Using the previously listed test functions, the functional test checks the radio operation in a simulated GE 900 MHz trunking system.

-data encode
-data decode
-alert tones

GE Mobile Communications
General Electric Company
Lynchburg, Virginia 24502
Printed in U.S.A.

ALIGNMENT PROCEDURE

NOTE

All alignment and performance tests must be performed with a DC supply capable of supplying ther adio with 13.6 Vdc, and at least 7 amperes. All power cables, and all friction-fit shields must be in place. Refer to Figure 3 for the radio Alignment and Test Configuration

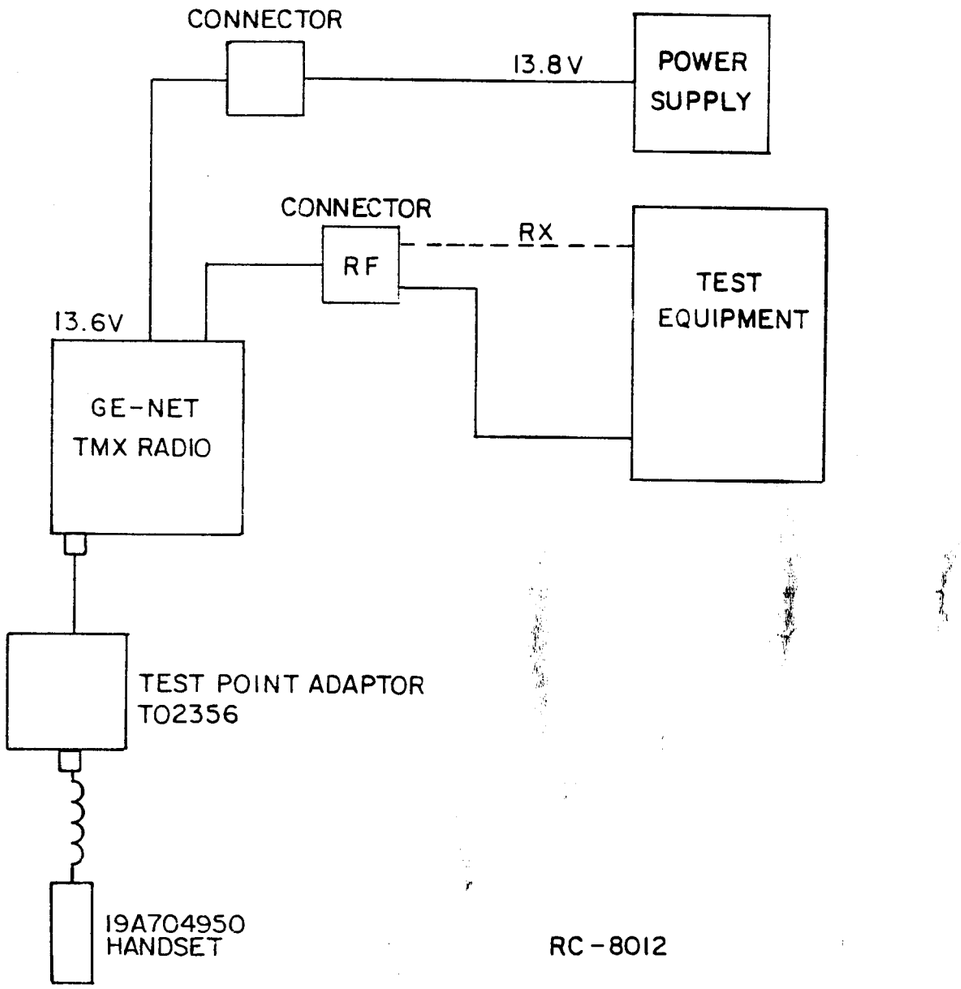


Figure 3 - Radio Alignment and Test Configuration

TRANSMITTER ALIGNMENT

SET TX POWER

Select a frequency near the band center, and key the transmitter. Adjust R113 for 15 ±0.2 watt.

SET FREQUENCY

Select a frequency near the band center (899.000 MHz) by loading the appropriate channel number from the test mode, and key the transmitter. Adjust U204 for f_c ±100 Hz. The temperature should be 25° ±5 ° C.

Service Note: Due to the necessary high frequency stability of radios operating in the 900 MHz Trunking Band, the frequency reference of the frequency counter should be accurate to within ±0.1 ppm.

SET DEVIATION

Select a channel near the band center, and key the transmitter. The modulation analyzer should have a 50 Hz highpass filter and a 3 kHz lowpass filter selected.

a. Voice Deviation - Unmute the microphone. Apply a 1 kHz, 0.4 V rms sinewave to the microphone input. Use the radio test mode command for the microcomputer to send 300 baud data. Adjust R224 to give 2.3 ±0.1 kHz deviation.

b. Data Deviation - Mute the microphone and use the test mode command to send a 2400 Hz dotting tone. Adjust R324 on the audio board for 1.7 ±0.1 kHz deviation.

RECEIVER ALIGNMENT

SET FREQUENCY

Monitor TP501 (455 kHz IF) with a frequency counter, inject a strong on-channel signal at the RF input, and adjust L508 for a counter reading of 455 kHz ±100 Hz.

IF ALIGNMENT

Select a channel near the middle of the band, and apply a -80 dBm signal modulated by 1 kHz at 2.5 kHz deviation to the antenna connector. Monitor TP501 with an AC voltmeter. Adjust L504, L506, and L507 for a peak on the voltmeter.

QUADRATURE DETECTOR

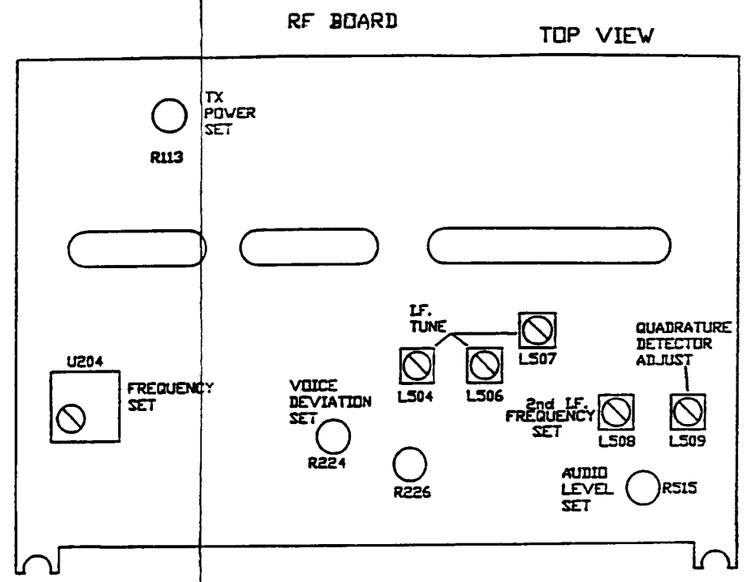
Turn R515 maximum clockwise, and monitor the audio output at J701-P5 (or at the Rx Audio port on the test point adaptor) with an AC voltmeter. Inject a strong on-channel signal at the RF input modulated with 1 kHz at 1.5 kHz deviation. Adjust L509 for a peak on the voltmeter.

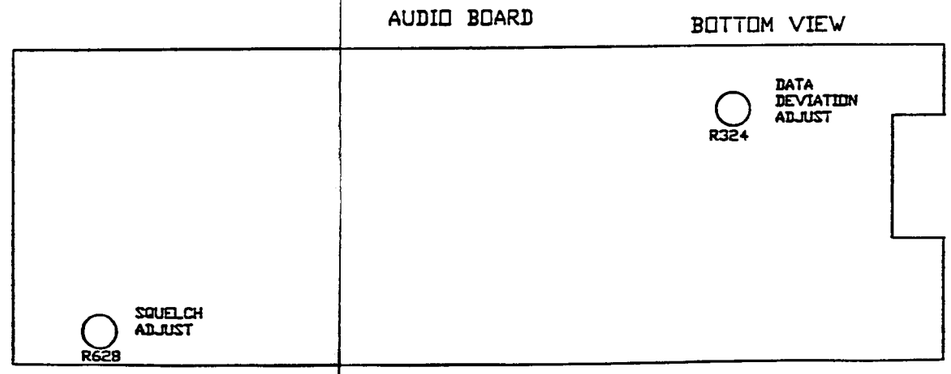
AUDIO LEVEL

Monitor the audio output with an AC voltmeter. Inject a strong on-channel signal at the RF input modulated with 1 kHz at 1.5 kHz deviation. Adjust R515 for 1.4 ± 0.1 V rms.

SQUELCH ADJUST

Select a frequency near the center of the band, and apply a signal at the RF input modulated with 1 kHz at 1.5 kHz deviation. Turn R628 on the audio board maximum clockwise. While using the test mode command to monitor the squelch line, adjust the signal generator for 8 dB SINAD. Adjust R628 fully counterclockwise. Now turn R628 clockwise until the squelch just opens.





RC-8011

ALIGNMENT PROCEDURE
Issue 1

TRANSMITTER TEST PROCEDURES

NOTE

The radio should have all shields and covers on for the verification tests.

POWER/CURRENT

Key transmitter at both band edges and measure power and current. Power should be 15 W ± 0.5 dB, and current should be less than 6.5 A.

FREQUENCY

Key transmitter and measure frequency. Frequency should be f_c ±500 Hz.

MODULATION LIMITING

Select a channel near the lower end of the frequency band, and key the transmitter. The modulation analyzer should have a 50 Hz highpass filter and a 3 kHz lowpass filter selected. Unmute the microphone. Apply a 1 kHz, 0.4 V rms sinewave to the microphone input. Use the radio test mode command for the microcomputer to send 300 baud data. Deviation should be less than 2.5 kHz, and greater than 2.0 kHz.

DISTORTION

Select a channel near the band center, and key the transmitter. The modulation analyzer should be set for 750 us deemphasis, 300 Hz highpass filter, and 3 kHz lowpass filter. Unmute the microphone. Apply a 1 kHz sinewave at a 40 millivolt level to the microphone input. Distortion should be less than 5%.

TRANSMIT HUM AND NOISE

Use the same radio set-up as abovd a 1kHz tone at 1.5 kHz deviation and read the demodulated output level. Then remove the modulation and measure the change in output level. Hum and noise should be greater than 40 dB.

RECEIVER TEST PROCEDURES

12 dB SINAD

Apply a signal modulated with 1 kHz at 1.5 kHz deviation to the RF input. Set the signal level to -116 dBm. SINAD should be greater than or equal to 12 dB at the band edges.

AUDIO DISTORTION

Apply a strong on-channel signal modulated with 1 kHz at 1.5 kHz deviation to the RF input. Measure distortion. Distortion should be less than 10%.

RECEIVE HUM AND NOISE

Apply a strong on-channel signal modulated with 1 kHz at 1.5 kHz deviation to the RF input. Remove the signal and measure the reduction in dB of the audio output level. Hum and noise should be greater than 40 dB.

CURRENT DRAIN

Apply a strong on-channel signal modulated with 1 kHz at 1.5 deviation to the RF input. Measure current drain. Current drain should be <600 mA.

TROUBLESHOOTING PROCEDURE

This section should help isolate a problem to a particular board or circuit. Radio Quickchecks and block diagrams for power distribution and signal flow are given. Refer to the appropriate Maintenance Manual for additional troubleshooting and circuit information.

The GE-NET TMX mobile radio contains three functional boards. The outline below lists the major functions for each board.

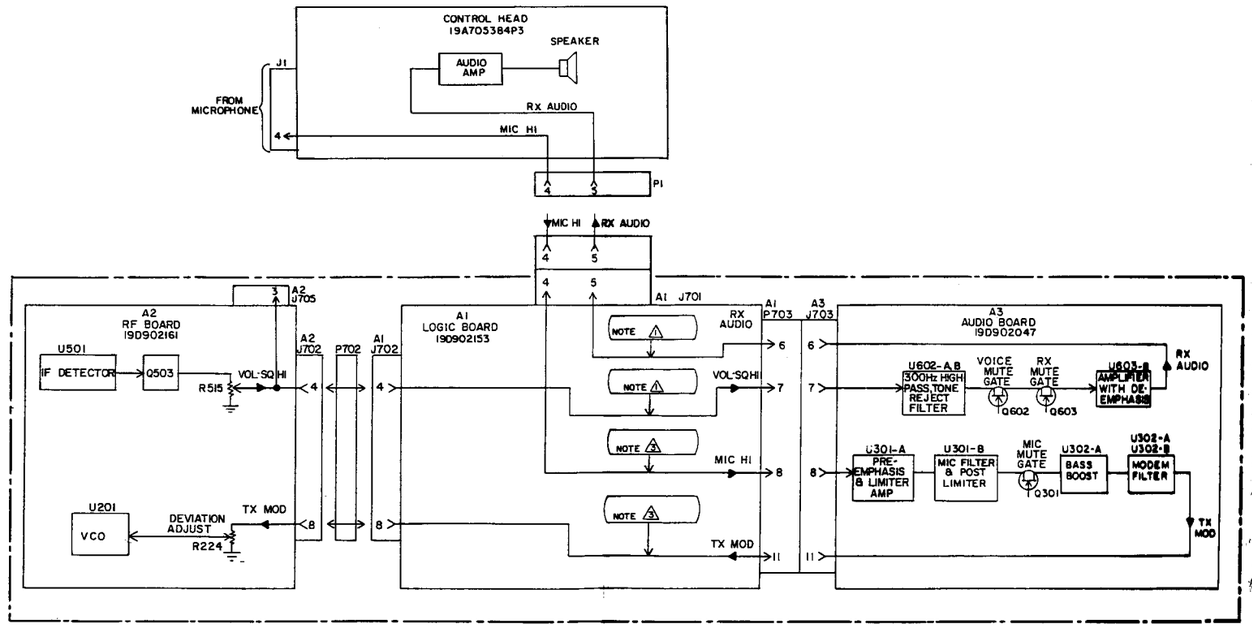
1. RF BOARD-Includes:
   - Synthesizer - generates all transmit and receive RF frequencies.
   - Receiver - provides detected audio to the Audio Board.
   - Transmitter - includes exciter and PA Module.
   - Power control circuitry for the transmitter.
   - Pin diode TX/RX switch.
   - Lowpass filter for the transmitter.
2. AUDIO BOARD-Includes:
   - RX squelch - provides the CAS signal to the Logic Board.
   - RX Audio - provides filtered and gated audio to the Control Head.
   - High and low speed data processing - provides received data to the Logic Board.
   - TX Audio - processes tones, serial data, and the Mic audio to feed the RF Board synthesizer.
3. LOGIC BOARD:
   - Routes signals between the RF and Audio 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.
   - Decodes signalling data from the Audio Board.
   - Generates the signalling data and alert tones.
   - Controls all audio switches on the Audio Board.
   - Accepts the CAS squelch output from the Audio Board.
4. CONTROL UNIT-Includes:
   - 5 Watt Audio PA.
   - Volume Control.
   - Switches for channel, power, and monitor.
   - Speaker

QUICK CHECKS

SYMPTOM:	CHECK FOR:
Low, Distorted or No RX Output	Check the receiver VOL/SQ HI output. If audio is improper, the problem is most likely on the RF Board. If synthesizer load commands are not correct (radio not on the correct channel), the problem may be on the Logic Board. If the audio is correct at VOL/SQ HI, check the Audio Board RX AUDIO output. If improper, check the Audio Board for proper unmute voltage levels from the Logic Board. Improper levels indicate a Logic Board problem. Proper levels indicate an Audio Board problem. If RX AUDIO is correct, the problem may be the speaker amplifier located in the Control Unit.
No RX Alert Tones (Radio OK Otherwise)	Check the Signalling Tone output from the Logic Board. Operate the volume control. If tones are not present, check the Logic Board. If the tones are present, the problem is most likely on the Audio Board, unless the mute levels from the Logic Board are improper.
Poor RX Sensitivity	The problem is most likely on the RF Board. Check the receiver alignment. Refer to the RF Board LBI for additional service notes.
No TX Power	Check the DPTT command to the RF Board. If present, then the problem is most likely on the RF Board. If the DPTT is not present, the problem is most likely on the Logic Board.
No TX Power and alert tone immediately heard when PTT keyed	Synthesizer on RF Board is unlocked or became momentarily unlocked. Possible power source problem or resistive A+ connections. (The voltage momentarily dropped below 10volts when the transmitter was keyed which caused the synthesizer to unlock, turning off the transmitter, and sounding the alert tone.)
Low TX Power	Check the TX frequency: If the TX frequency is off channel, check the synthesizer on the RF Board. Check the synthesizer load commands from the Logic Board. If the commands are not present, check the Logic Board. If the TX frequency is correct, refer to the RF Board Maintenance Manual and troubleshoot the transmitter.

QUICK CHECKS

SYMPTOM:	CHECK FOR:
	Check the TX MOD input to the RF Board. If present, the problem is most likely on the RF Board. If not present, determine what is missing: data, voice, or both. Missing data - Look at the MTX Data input to the Audio Board. If the data is not present, the problem is most likely onthe Logic Board. If the data is present, look for the proper unmute levels to the Audio Board from the Logic Board. If the levels are not present, the problem is most likely on the Logic Board. If the levels are present, the problem is most likely on the Audio Board. Voice Signal Missing - Again, check the mute levels from the Logic Board. Check the MIC HI input to the Audio Board. If all signals are correct, the problem is most likely on the Audio Board.
Distorted TX Audio	Check for good grounding of all boards to the casting. Check for the presence of board shield on the bottom of the radio. Check the TX MOD input to the RF Board. If distorted, a problem on the Audio Board is likely. Check the mute commands. If incorrect, a problem on the Logic Board is indicated. If only the data or alert tones are distorted, a Logic Board problem is likely.
TX Off Frequency	This is most likely a problem on the RF Board. Refer to the frequency set instructions in the transmitter alignment section. Check the synthesizer load command. If the load command is improper a Logic Board problem is likely.

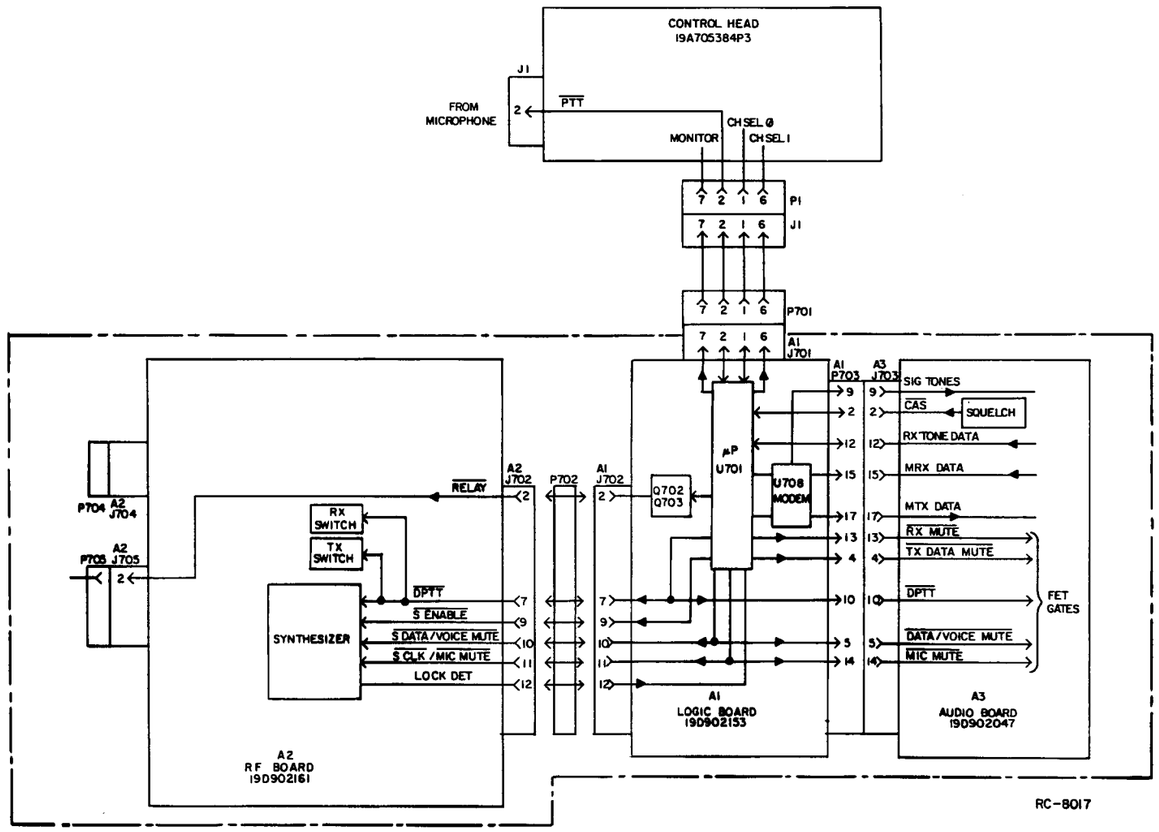


NOTES:

1. RECEIVING A 1000μV ON-FREQUENCY SIGNAL MODULATED BY 1000 Hz AT ±3kHz DEVIATION.
2. VOLUME ADJUSTED FOR 3 WATTS OUTPUT.
3. AUDIO GENERATOR APPLIED TO MIC HI AND ADJUSTED FOR 30mVrms AT 1000 Hz.
4. CUT RUN BETWEEN HOLES 6 AND 7 TO DISABLE INTERNAL SPEAKER.

RC-8016

Figure 6 - Audio Signal Flow Diagram



RC-8017

Figure 7 - Logic Signal Flow Diagram

POWER DISTRIBUTION

Refer to the Power Distribution Diagram (Figure 5) for an understanding of the distribution of A+ and regulated voltages throughout the radio.

RF Board

Power (A+ = 13.6 Volts nominal) is provided to the radio through connectors J704 (pins 2 and 3) and J705 (pin 1) on the RF board.

Pin 2 of J704 supplies A+ to the power amplifier module U101, the power control transistor Q104, and the 20V transient suppressor D105. D105 protects the radio from noise spikes and other overvoltage transients appearing on the input power cable.

Pin 3 of J704 supplies A+ to regulators U102 and U207. U102 supplies 8 Volts to the transmitter switch, the synthesizer 5 Volt regulator U203, and the Logic Board through J702 pin 3. U207 supplies 8.3 Volts to the synthesizer.

Pin 1 of J705 supplies A+ to U502, which supplies 8 Volts to the receiver.

U102 (TX 8 volt supply) and Q104 (power control output transistor) are mounted for heat sinking.

Logic Board

A single 5 volt regulator U712 is used to power 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.

A+ is routed from the RF Board to the Logic Board through pin 6 of J702. Q704 provides Filtered A+ to the Audio Board through pin 16 of J703 and to the handset through J701, pin 3. Q707 and Q708 provide surge protection by switching off Filtered A+ if high current is sensed. The circuit is reset by turning the radio off and back again.

Audio Board

An 8 volt regulator U606 provides power to all of the Audio Board circuitry. U303B provides a 5 volt reference for op amp inputs. Filtered A+ from the Logic Board provides the input voltage to the U606.

AUDIO SIGNAL FLOW

Figure 6 is an Audio Signal Flow Diagram for an understanding of the distribution of RX and TX audio signals throughout the radio. Audio levels at important points are also shown.

TRANSMITTER AUDIO

Microphone audio (MIC HI) is routed from the Mic connector on the Control Head through the Logic Board to feed the Audio Board. After processing and summing the MTX Data and signalling tones, the audio (TX MOD) is fed through the Logic Board to the RF Board. TX MOD is adjusted by Deviation Adjust R224 before feeding the modulation input to the synthesizer VCO.

RECEIVER AUDIO

Discriminator audio is buffered by Q503 on the RF Board and adjusted by R515. This audio (VOL/SQ HI) is routed to the Audio Board through the Logic Board. On the Audio Board, VOL/SQ HI feeds 3 paths. Two paths (not shown on the block diagram) are the squelch path (CAS) and the MRX Data path to process data for decoding in the Logic Board microprocessor. The third path is the RX Audio path which is filtered and routed through the Logic Board to feed the Control Head. RX AUDIO feeds the volume control and the 5 watt Audio PA in the Control Head.

LOGIC SIGNAL FLOW

Figure 7 consists of a Logic Signal Flow Diagram for an understanding of the distribution of logic signals throughout the radio. Microprocessor U701 on the Logic Board provides synthesizer data to the RF Board and control signals to the FET switches on the Audio Board. U701 also accepts squelch and data from the Audio Board and PTT, monitor, and channel switch signals from the Control Head. All logic lines should read 4 to 5 volts for a logic high and less than 0.5 volts for a logic low.

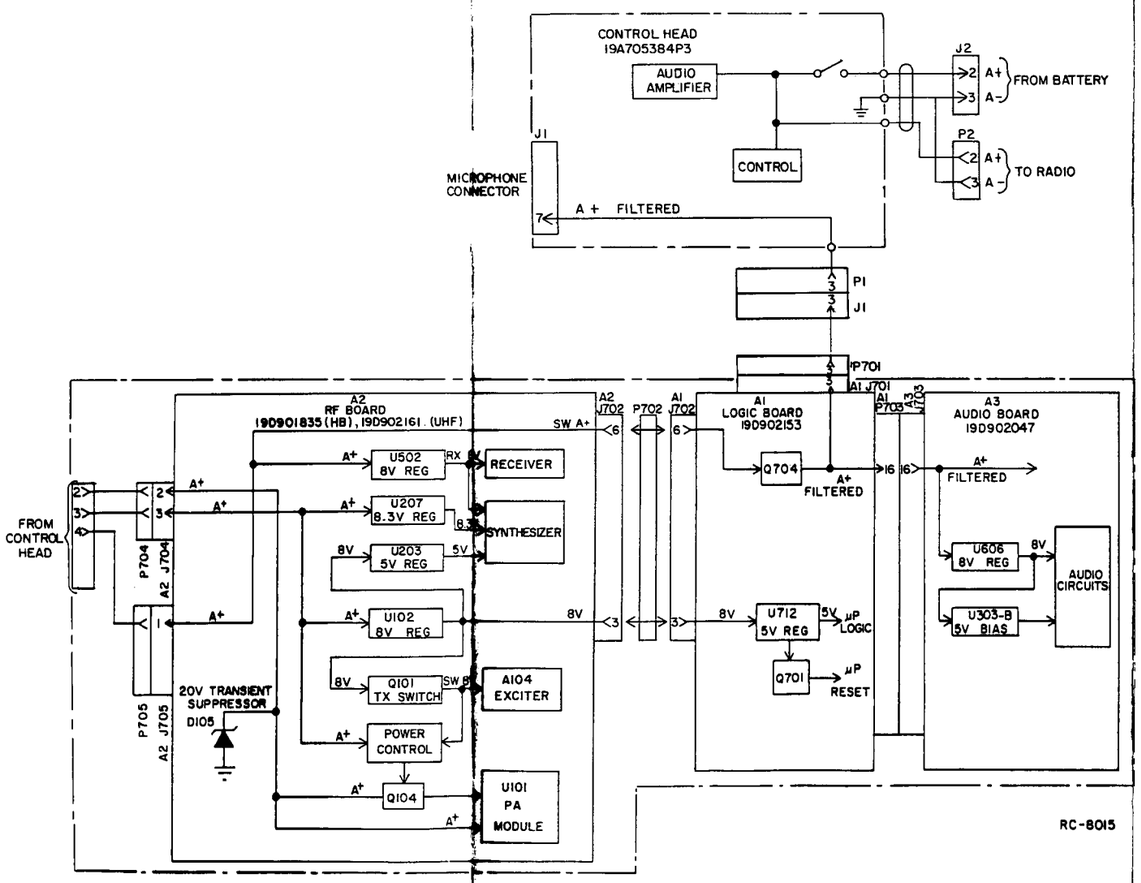


Figure 5 Power Distribution Diagram

PARTS LIST

GE-MET TMX
RADIO ASSEMBLY
19C851519G9
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
A1	19D902151G1	Logic Board. (Refer to appropriate maintenance manual for parts list).
A2	19D902132G1	RF Board. (Refer to appropriate maintenance manual for parts list).
A3	19D902047G1	Audio Board. (Refer to appropriate maintenance manual for parts list).
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P702	19B801359P5	Connector, 12 positions.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U101	19A143904P3	RF Amplifier.
U706	19A705635G3	Integrated circuit. Includes:
	19A704305P3	EPROM: CMOS 32K x 8; sim to 27C256-25.
		- - - - - - - - - - - CABLES - - - - - - - - - - -
W1	19A705301P3	RF cable assembly.
W2	19C851497P4	Power cable.
W6 and W7	19A704884P2	RF Cable.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19C851505P1	Latch.
	19D901728G1	Casting.
	19A705381P13008	Screw, thread forming.
	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8.
	19A700033P6	Lockwasher, external tooth, M3.5.
	19A701312P5	Flatwasher: M3.5.
	19C851497P2	Cable.
	19A704941P1	Dust pad.
	19C851442P1	Cover.
	19C851699G1	Support, power module.
	19A705417P1	Contact, ground.
	19A702381P525	Screw, thd. form: No. M3.5-0.6 x 25.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES