

**MAINTENANCE MANUAL
SERVICE SECTION
MLSU141 and MLSU241
FOR
MLS UHF TWO-WAY MOBILE RADIOS**

TABLE OF CONTENTS

	Page
DESCRIPTION	1
INITIAL ADJUSTMENT	1
MAINTENANCE	
Preventive Maintenance	2
Driver Replacement	2
PA Transistor Replacement	3
Chip Component Replacement	3
DISASSEMBLY PROCEDURE.....	4
ALIGNMENT AND TROUBLESHOOTING PROCEDURES	8
SYNTHESIZER	8
TRANSMITTER.....	14
RECEIVER.....	19

DESCRIPTION:

The service section contains the information necessary for aligning and troubleshooting the MLS two-way FM mobile radio. In addition, information is provided for removing and replacing chip components, disassembly procedures and module replacement procedures.

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 adjust, 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 MLS series mobile radios are 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.

MAINTENANCE

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 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 applicable Alignment Procedure and Troubleshooting sheet for typical voltage readings.

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

To gain access to the transmitter, receiver, and the system control/synthesizer for servicing, loosen the four screws securing the cover at the rear of the radio. Then pull the cover out from under the edge of the front panel and lift the cover off.

DRIVER REPLACEMENT

To remove Driver HC1

1. Remove the two screws securing HC1 to the printed wire board.
2. Unsolder the five (5) leads bridging HC1 to the printed board while lifting each lead as they are unsoldered.

Service Note: These leads are soft and can be bent very easily.

3. Gently lift up on the module, taking care not to damage the spacer under the module.

NOTE: The module may stick to the printed board.

To replace Driver HC1:

1. Position the module properly, aligning the screw holes and leads with the printed board. Trim leads if necessary (see Figure 1).
2. Replace the two screws securing the driver to the printed board, using a moderate torque of 5 inch-pounds.
3. Solder the five leads of driver HC1 to the printed board and ground strap.

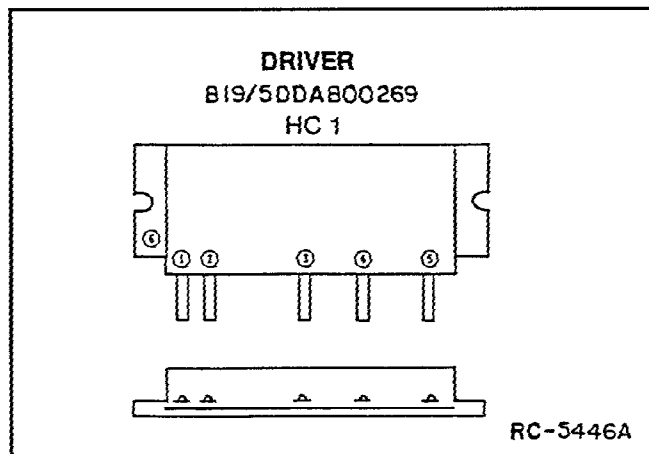


Figure 1 - Driver Lead Identification

PA TRANSISTOR REPLACEMENT

NOTE

The PA transistor contains Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the escaping dust may be hazardous if inhaled. Use care when replacing the module.

1. Remove the two retaining screws securing PA transistor TR1 to chassis assembly.
2. Unsolder and remove capacitors. Use a desoldering tool as necessary while lifting the transistor leads with a small screw driver or pick. Discard old capacitors.
3. Unsolder the emitter, base and collector leads of the transistor, and remove it from the printed board.
4. Remove all excess solder from the board, and clean the holes to allow the new transistor to be positioned properly and the capacitors to fit into proper locations. Refer to Figure 2 and trim the new transistor leads (if required) to the lead length of the removed transistor.
5. Apply silicon grease to back of the replacement transistor and place the transistor into the mounting slot.
6. Replace the transistor mounting screws using a moderate torque of 5 inch-pounds.

7. Tack solder the four base leads to the printed board, using minimum solder. Then solder the emitter and collector leads.
8. Install the capacitors into their proper mounting areas, flush to the board.
9. Solder the capacitor bodies to the printed board by first soldering the outside edge. Then, holding the iron to the outside edge, touch the solder to the inside edge of the capacitor. Be careful not to create solder bridges at the front and back edges of the capacitors.
10. Remove any flux left on board.

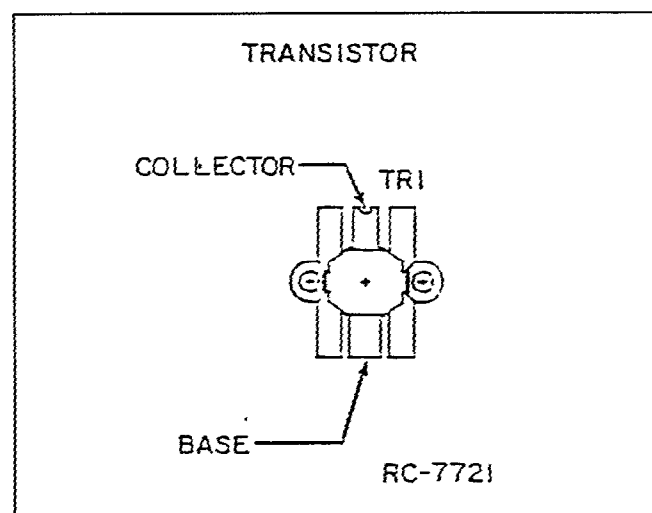


Figure 2 - PA Transistor Lead Identification

CHIP COMPONENT REPLACEMENT

Replacement of chip capacitors should always be done with a temperature controlled soldering iron, using a controlled temperature of 700°F (371°C). However, do NOT touch black metal film of the resistors or the ceramic body of capacitors with the soldering iron.

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 area with alcohol.

DISASSEMBLY PROCEDURE

Procedure:

To remove the System Control/Synthesizer Board:

1. Remove the two (2) screws (A) securing the top cover (refer to Figure 3). Remove the top cover. Then disconnect the interconnecting cables.
2. Remove the eight (8) screws (B) Securing the Synthesizer shield. Remove the shield.
3. Remove the three (3) screws (D) securing the board.
4. Remove the screws (C) securing regulator and carefully lift up and remove the board.

To Remove the Transmitter/Receiver Board:

1. Remove the screws (A) and (E) securing the top cover and the bottom cover (refer to figures 3 & 4).
2. Disconnect the interconnecting cables and then remove the seven (7) screws (G) securing the shield to the board.
3. Disconnect the interconnecting cable. Remove the four (4) screws (H) securing the antenna shield.
4. Remove the two (2) screws (F) Connecting the power supply cable to the board and turn the cable stopper mounted on the rear of the frame assembly 90 degrees. Lift up the cable stopper up and remove the power supply cable.
5. Remove the two (2) screws (I) securing power module HC1. Remove the screws (J) securing power transistor TR1.
6. Remove the two (2) screws (K) securing the board. Carefully lift up and remove the board.

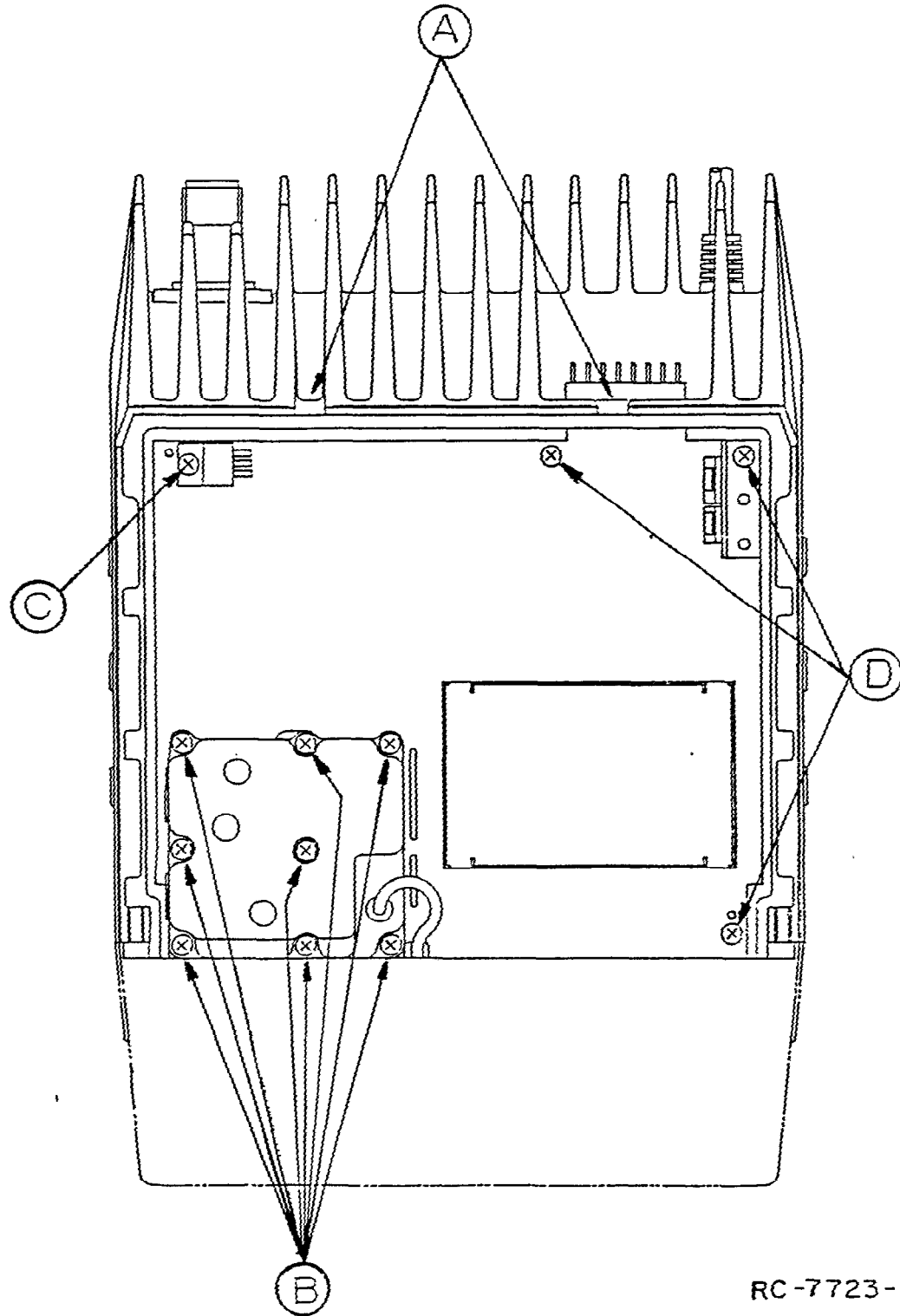
To Remove the Front Panel/Control Unit:

1. Remove the four (4) screws (N) securing the front panel to the frame assembly (refer to figure 5)
2. Carefully disconnect the speaker cable from the connector on the Control/Synthesizer board.
3. Separate the front panel from the frame assembly.
4. Carefully disconnect the ribbon cable connecting the Front Panel/Control unit to the Control/Synthesizer Board at (O).
5. Remove the two (2) screws located at (P).
6. While pushing the lock tabs at (Q) remove the Control Panel - toward front.

CAUTION

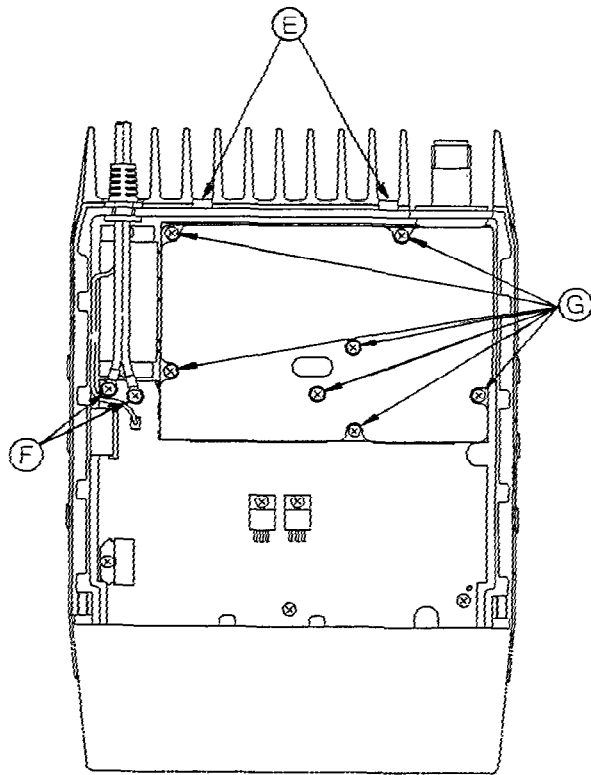


The CMOS integrated Circuit devices used in this equipment can be destroyed by static discharges. Before handling one of these devices, the serviceman should discharge himself by touching the case of a bench test instrument that has a 3-prong power cord connected to an outlet with a known good earth 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.

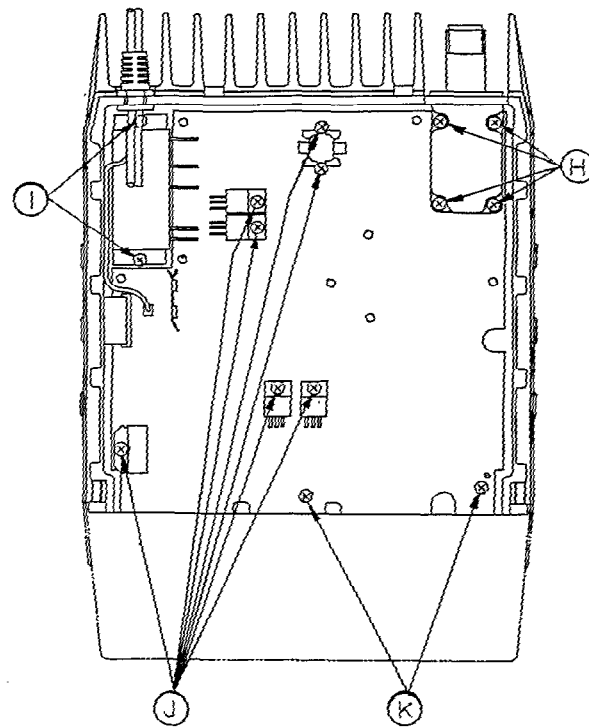


RC-7723-1

Figure 3 - Disassembly Procedure (Top View)

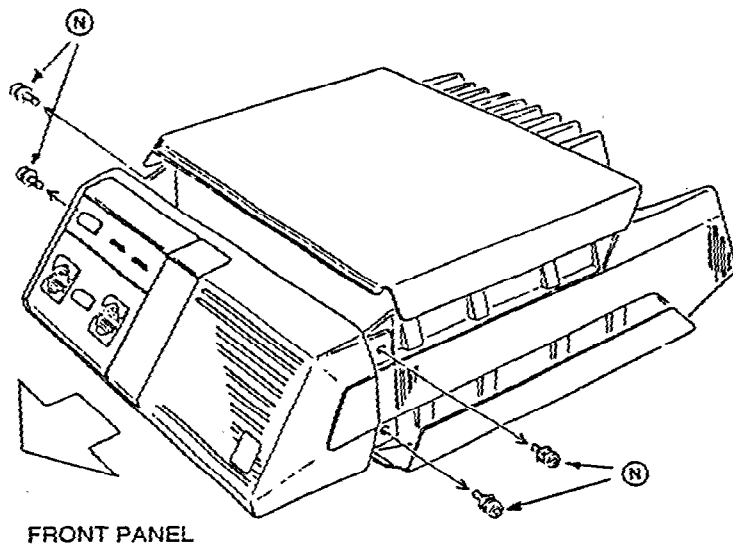


RC-7723-2

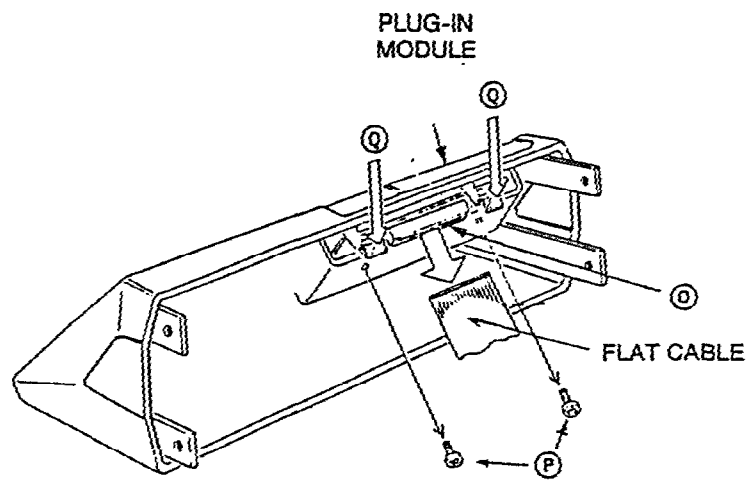


RC-7723-3

Figure 4 - Disassembly Procedure (Bottom View)



FRONT PANEL



PLUG-IN
MODULE

FLAT CABLE

RC-5428A

Figure 5 - Disassembly Procedure (Front Panel)

**ALIGNMENT AND TROUBLESHOOTING
PROCEDURES**

Radio maintenance is facilitated by using the Troubleshooting Procedures and servicing techniques unique to this radio. The Troubleshooting Procedures are designed to lead the serviceman rapidly to the defective component or circuit.

Troubleshooting procedures are provided for most major problems that might arise in the Transmitter, the Receiver, and the System Control/Synthesizer Board.

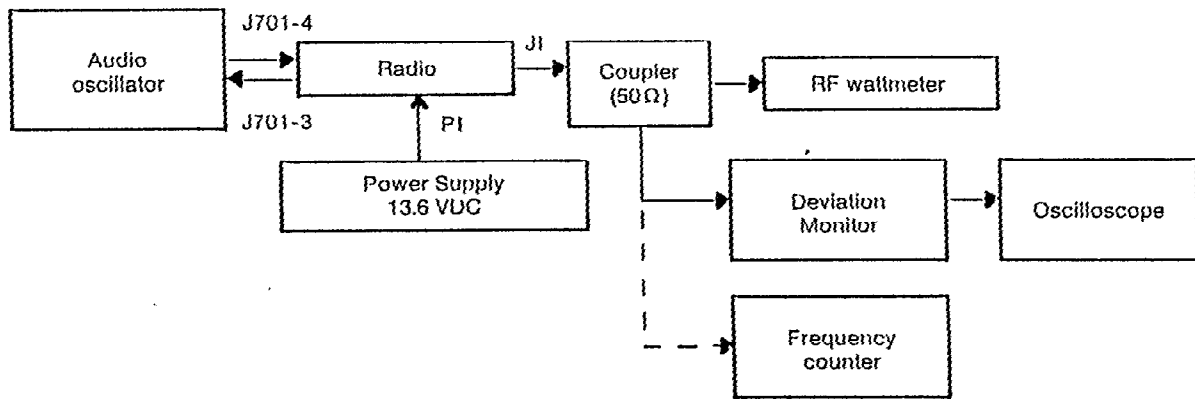
SYNTHESIZER

Alignment and Troubleshooting for Synthesizer Circuitry on System Control/Synthesizer Board CMC-553A/B.

TEST EQUIPMENT REQUIRED

1. Audio Oscillator
2. Deviation Monitor
3. Oscilloscope
4. Frequency Counter
5. RF Wattmeter (50 ohms, 100 W)
6. VTVM
7. Digital Voltmeter
8. Power Supply, 13.6 VDC regulated

Measuring system



RC-5429B

NOTE

Refer to Figure 6 for location of tuning and adjustment controls.

TX VCO & RX VCO ALIGNMENT

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
1	TP201 Control Voltage Monitor	CV202	7.0 VDC	Select highest frequency transmit channel. With 50 ohm load on the antenna connector J1, key the radio. Monitor TP201 with digital voltmeter and tune CV202 for 7.0 VDC ± 0.1 V. Unkey the radio.
2	TP201	CV201	7.0 VDC	Select highest frequency receive channel. Monitor TP201 with digital voltmeter and tune CV201 for 7.0 VDC ± 0.1 V.
3	TP201		3.5-7.5 VDC	Select lowest frequency channel. Voltage should be between 3.5 - 7.5 VDC transmit and receive for lowest and highest frequency channels.
4	J201		+1 to +7 dBm	RX/EX injection level should be between +1 and +7 dBm.

TRANSMITTER FREQUENCY ADJUSTMENT

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
1	J201 (or J1)	FREQ TRIM Control on TCXO (XU201)	Channel Operating Frequency	<p style="text-align: center;">NOTE</p> <p>This step assumes the frequency is measured when the transmitter is first keyed. If delayed, the rapidly rising ambient temperature must be taken into consideration. The Oscillator frequency should be set at 25°C ambient temperature.</p> <p>Press the PTT switch while monitoring TX/RX injection frequency at J201. Adjust FREQ TRIM Control on TCXO (XU201) for the assigned channel frequency ± 0.5 PPM.</p>

RECEIVER FREQUENCY ADJUSTMENT

No receiver frequency adjustment is required.

With proper alignment of EX injection frequency, RX injection frequency will automatically be correct.

MODULATION LEVEL ADJUSTMENT

Procedure for synthesizer Transmit Deviation

1. Select the highest frequency channel.
2. Rotate CG DEV ADJUST, RV202 fully counterclockwise.
3. Connect the audio oscillator and apply a 1 KHz tone at 850 mV rms to MIC HI, J701-4. Connect the deviation monitor to the antenna connector, J1 through a 30 dB decoupler. Key the radio. Set DEV ADJUST, RV201 for ± 3.75 KHz deviation.
4. Set RV202 fully clockwise. Remove P602 from position 1-2 and set aside. Apply a 400 Hz tone

to J602-2 and with the radio keyed, vary its amplitude until the Deviation Monitor reads 2 kHz. Note the level.

5. Change the audio oscillator frequency for a 10 Hz tone at the same level and set LOOP MOD ADJUST RV203 for a deviation of 2 kHz. Unkey the radio.
6. Disconnect the audio oscillator and replace P602 in position 1-2.
7. Select a frequency with Tone Channel Guard.
8. Key the radio and set CG DEVIATION ADJUST RV202 for a deviation reading of ± 0.75 kHz.

NOTE: If channel guard is not used on any frequency channel, CG DEV ADJUST, RV201 may be set for ± 4.5 KHz deviation instead of ± 3.75 KHZ.

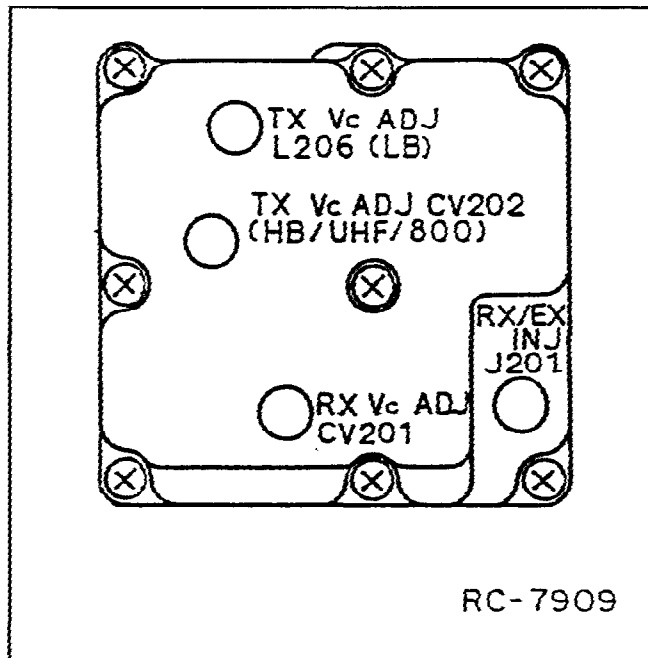


Figure 6 - Synthesizer Tuning and Adjustment Controls

AUDIO CHECK

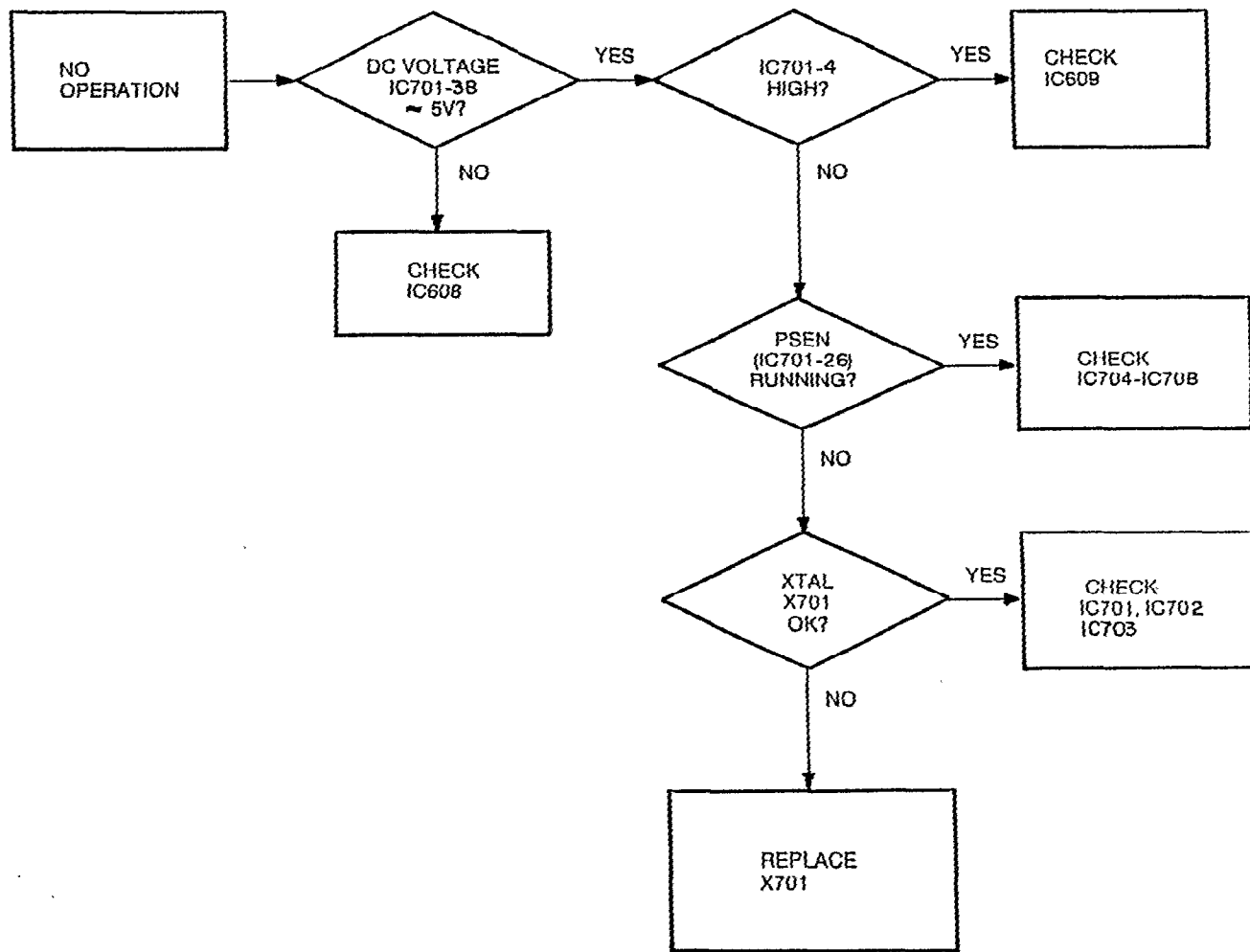
Audio Sensitivity

1. Connect audio oscillator output to MIC HI, J701-4. Adjust output for 1 KHz at 1 Vrms.
2. Reduce oscillator output until deviation monitor indication falls to ± 3.0 KHz for radios without Channel Guard or to ± 2.25 KHz for radios with Channel Guard. Oscillator output voltage should be less than 120 millivolts.

AUDIO OUTPUT LEVEL ADJUSTMENT PROCEDURE

STEP	METERING POINT	TUNING CONTROL	METER READING	PROCEDURE
1	J701-1	RV601	SEE PROCEDURE	<p>Set the signal generator to the receiver frequency with ± 3 KHz deviation and 1 KHz modulation. Set the RF signal level to 1000 microvolts. Move P551 from J551-1, 2 to J551-2, 3 on the Transmitter/Receiver Board.</p> <p>Connect RF signal generator to J1.</p> <p>Terminate J701-1, 6 with a 4-ohm, 6-watt resistor, connect the audio level meter and the distortion analyzer input across the resistor. Set the volume to the maximum point. Press DOWN button two times. Adjust RV601 for 4-watt output (4 Vrms, using the distortion analyzer as Volt Meter). Return P551 to J551-1, 2.</p>

CONTROL LOGIC TROUBLESHOOTING



RC-5432B

TRANSMITTER

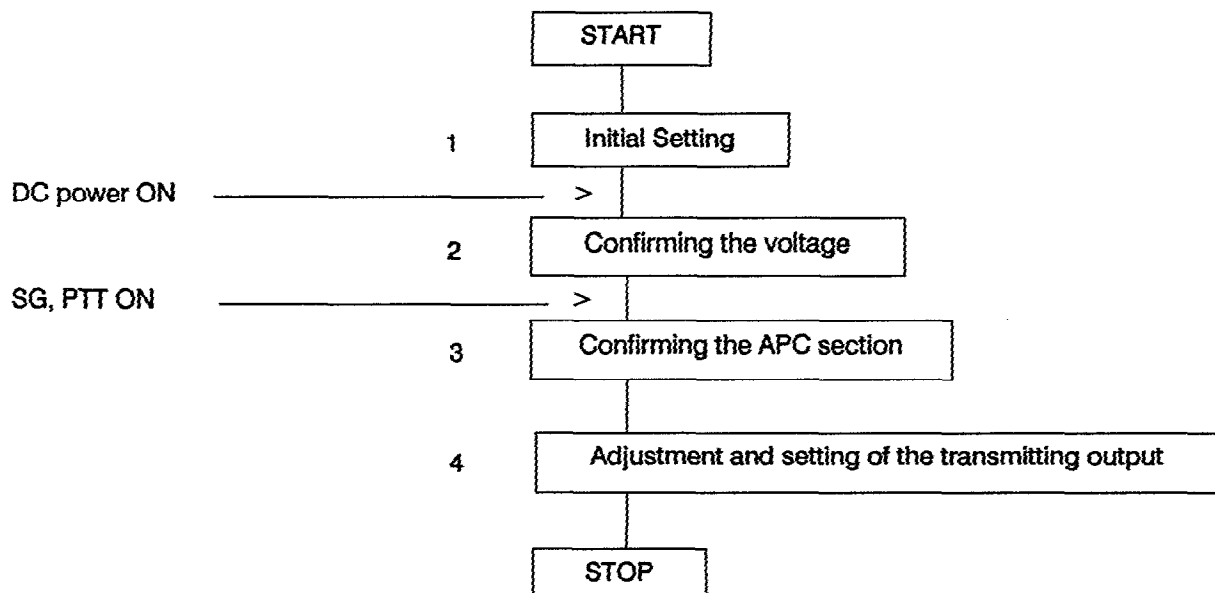
Alignment and troubleshooting for Transmitter circuitry on the Transmitter/Receiver board GMN-234A/B.

1. GENERAL DESCRIPTION OF ADJUSTMENT

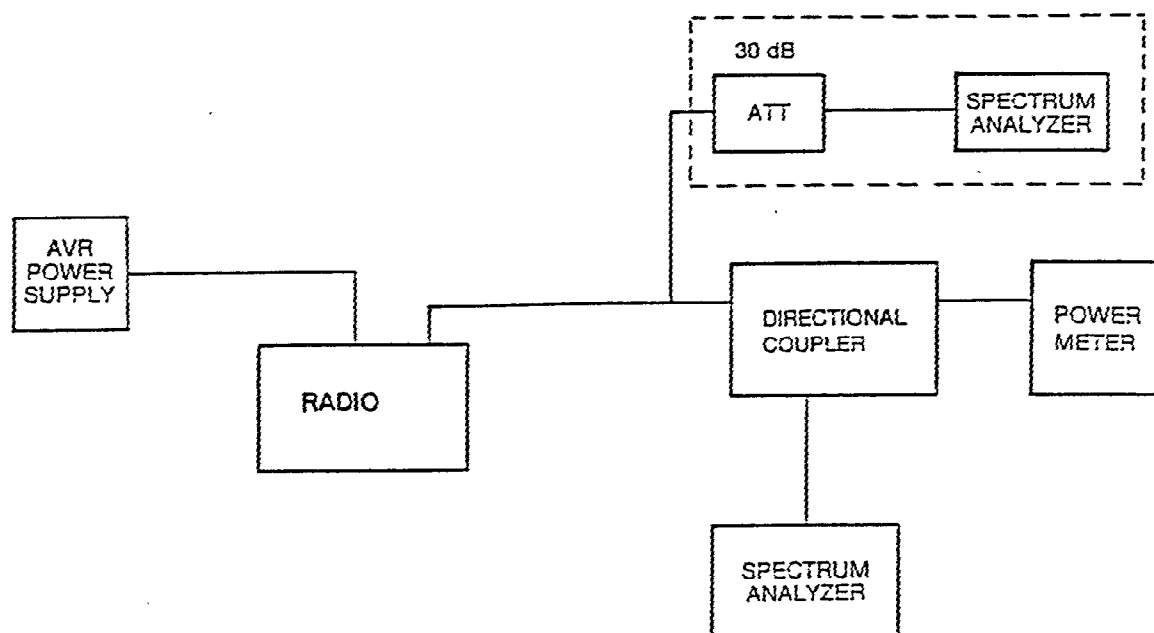
This manual is prepared for adjustments and confirmations of the Exciter/PA section and covers the following items.

2. MEASURING INSTRUMENTS

- a. AVR (DC Power Supply DC 0-20V, 20A)
- b. Power Meter (Usable at the value above 80 W)
- c. Directional Coupler
- d. Signal Generator
- e. Spectrum Analyzer
- f. Attenuator (30 dB, above 80 W)
- g. Tester



3. ADJUSTMENT SYSTEM



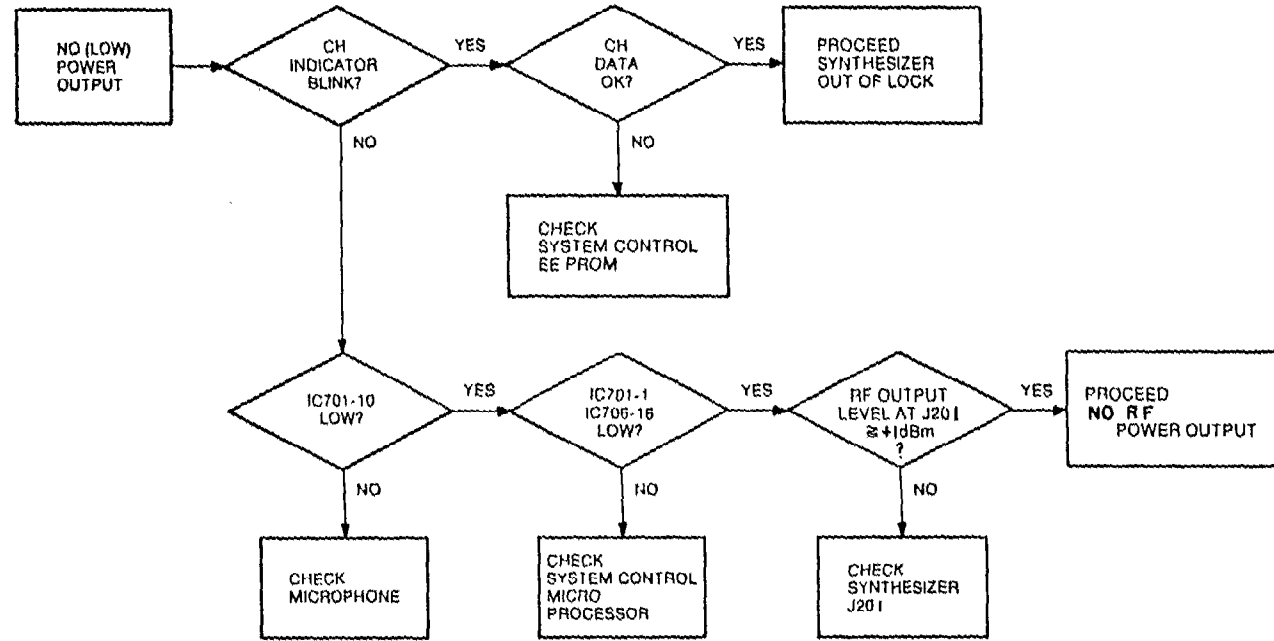
* FOR MEASURING SPURIOUS ONLY.

RC - 5434 B

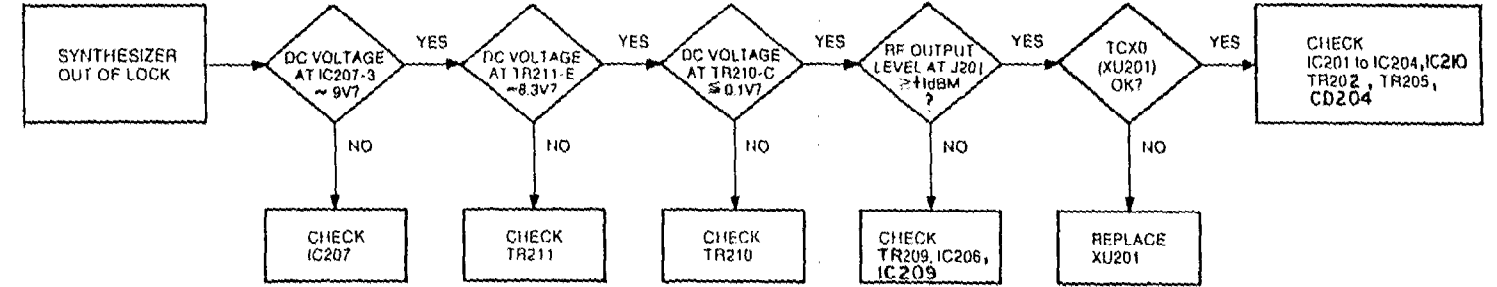
TRANSMITTER ADJUSTMENT PROCEDURE

STEP	ITEM	TEST POINT	TUNING CONTROL	PROCEDURE
1	Initial Setting			Turn the volume on APC RV1, RV2 fully counterclockwise (CCW).
2	Confirming the voltage	TP4		Disconnect RF cable P101 from connector J201. Turn on the power. Turn on the PTT (ground J701-2). Confirm voltage of TR6 collector is 9V at TP4 and that the relay K1 clicks at this time.
3	Setting APC off power		RV1 RV2	Connect RF cable P101 to J201. Turn the volume RV1 on APC fully clockwise (CW). Next turn the volume RV2 slowly CW and set an output of 48W \pm 2W at the center frequency of each band.
4	Confirming minimum power		RV1	Turn the volume RV1 on APC fully CCW and confirm minimum power of 20 W or less.
5	Confirming APC on power		RV1	Turn volume RV1 on APC slowly CW and set an output of 44W \pm 2W at the highest frequency of each band. 40W or more for other Frequencies.

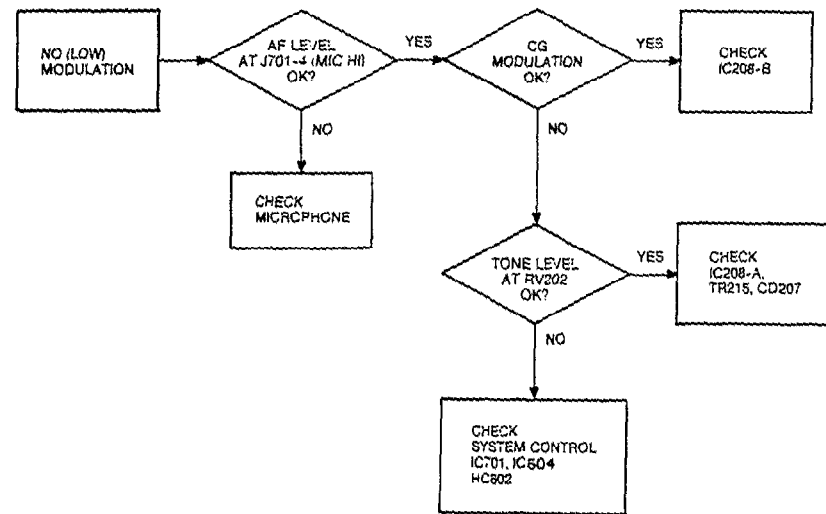
TRANSMITTER TROUBLESHOOTING



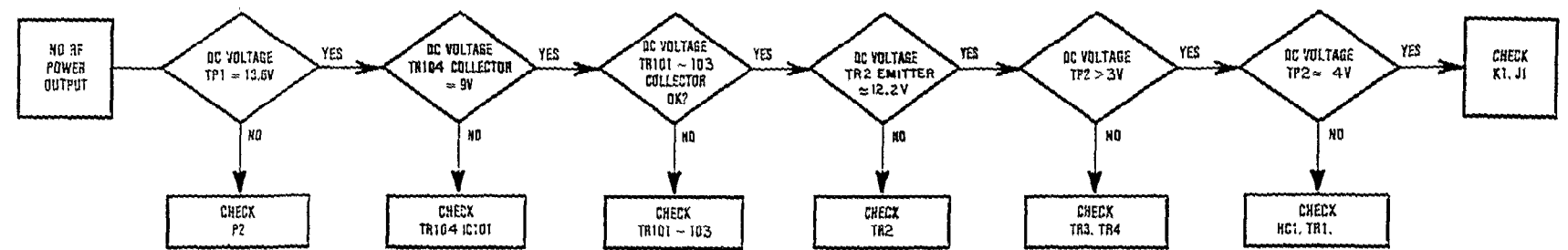
RC-7680 SHEET 1, REV. A



RC-7680 SHEET 2, REV. A



RC-5439A
SHEET 4, REV. A



RC-5562 A

RECEIVER

Alignment and Troubleshooting for Receiver Circuitry on Transmitter/Receiver Board CMN-234A/B.

RECEIVER ALIGNMENT

Equipment Required

1. RF Signal Generator (403 - 470 MHz)
2. DC Voltmeter
3. Frequency Counter (up to 500 MHz with 0.05 V sensitivity)
4. Audio Level Meter and Distortion Analyzer
5. 4 Ohm, 6 Watt Resistor

Preliminary Adjustment

1. Connect 13.8 VDC to P2
2. Set MONITOR switch to "out" position
3. Select desired channel
4. Disable Channel Guard by connecting ground to J701-7
5. Connect RF Signal Generator to antenna jack J1

NOTE

Make sure that the transmitter is properly aligned before aligning the receiver.

ALIGNMENT PROCEDURE

STEP	TEST POINT	TUNING CONTROL	METER READING	PROCEDURE
1	TP501		9.0 \pm 0.2 VDC	Connect the DC Volt-meter to TP501.
2	TP504	L511	See Procedure	Connect RF signal probe from the frequency counter to TP504. Check for a reading of 81.745 MHz \pm 200 Hz.
3	TP503	L513	See Procedure	Set the signal generator on the receive frequency with \pm 3 KHz deviation and 1 KHz modulation. Set the RF signal level to 1000 microvolts. Connect the audio level meter (use a high impedance meter) to TP503. Adjust the L513 until audio output level becomes maximum.
4	J701-1 -6		See Procedure	Move P551 from J551-1 & 2 to J551-2 & 3 in receiver unit. Terminate J701-1 & -6 with a 4 ohm, 6 watt resistor. Connect the Audio Level Meter and distortion Analyzer input across the resistor. Adjust the volume control for 4 W output (4.0 Vrms) using Audio Level Meter.
5	J701-1 -6	L501 L503	See Procedure	Set the output signal level of RF signal generator so as to obtain 12 dB SINAD at audio output. Adjust coils L501 and L503 obtain maximum 12 dB SINAD sensitivity. Return P551 to J551-1, 2.

FIXED SQUELCH ADJUSTMENT

1. Disable Channel Guard, if present, (ground J701-7). Set Squelch control RV531 full CCW.
2. Connect a signal generator to antenna jack J1 and adjust for nominal 8 dB SINAD signal.
3. Adjust squelch control RV531 to maximum squelch. Receiver must be muted.
4. Adjust squelch control RV531 slowly until receiver unmutes.
5. Check that the squelch opens at an input signal level corresponding to 8 dB SINAD (± 1 dB).
6. Remove ground from J701-7 or re-enable Channel Guard.

RECEIVER TEST PROCEDURES**TEST PROCEDURES**

These Test Procedures are designed to help you to service a receiver that is operating, but not properly. The problems encountered could be low power, poor sensitivity, distortion, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedures. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency and the transmitter is operating properly.

TEST EQUIPMENT REQUIRED

1. Distortion Analyzer
2. Signal Generator
3. 6-dB Attenuation Pad, and 4.0-ohm, 6-Watt Resistor

TEST PROCEDURE**STEP 1: AUDIO OUTPUT AND DISTORTION**

Measure Audio Power Output as follows:

- A. Apply a 1000 microvolt, on-frequency test signal modulated by 1000 Hz with 3.0 KHz deviation to antenna jack J1.

B. With 4 Watt Speaker

Disconnect speaker plug if present.

Connect a 4.0-ohm, 6-watt load resistor across the external speaker loads

- C. Adjust the VOLUME control for rated power output of 4 watts (4.0 Vrms across the 4-ohm load) using the Distortion Analyzer as a voltmeter.
- D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 5%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 4 watts, make the following checks: Battery and regulator voltage, low voltage will cause distortion.

Audio Gain (refer to Receiver Troubleshooting Procedure).

FM Detector Alignment (refer to Receiver Alignment).

Step 2: USABLE SENSITIVITY (12 dB SINAD)

If step 1 checks out properly, measure the receiver sensitivity as follows:

- A. Apply a 1000 microvolt, on-frequency signal modulated by 1000 Hz with 3 KHz deviation to J1.
- B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000 Hz distortion range position (1000 Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.).
- C. Place the RANGE switch to SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).
- D. Set signal generator output to 0.3 V. Switch the RANGE control from SET LEVEL to the distortion range. Readjust Distortion Analyzer SET LEVEL as required until a 12 dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

- E. The 12 dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio input of at least 2 Watts (2.83 Vrms across the 4-ohm receiver load using the meter).
- F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.
- B. Set the Range control on the Distortion Analyzer in the SET LEVEL position (1000 Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.
- C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12 dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the IF stage as directed in the Alignment Procedure.

STEP 3: MODULATION ACCEPTANCE (BANDWIDTH OR IF BANDWIDTH)

If Steps 1 and 2 check out properly, measure the bandwidth as follows:

- A. Set the Signal Generator output for twice the microvolt reading obtained in the 12 dB SINAD measurement.

- D. The deviation control reading for the 12 dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ± 6.7 KHz.

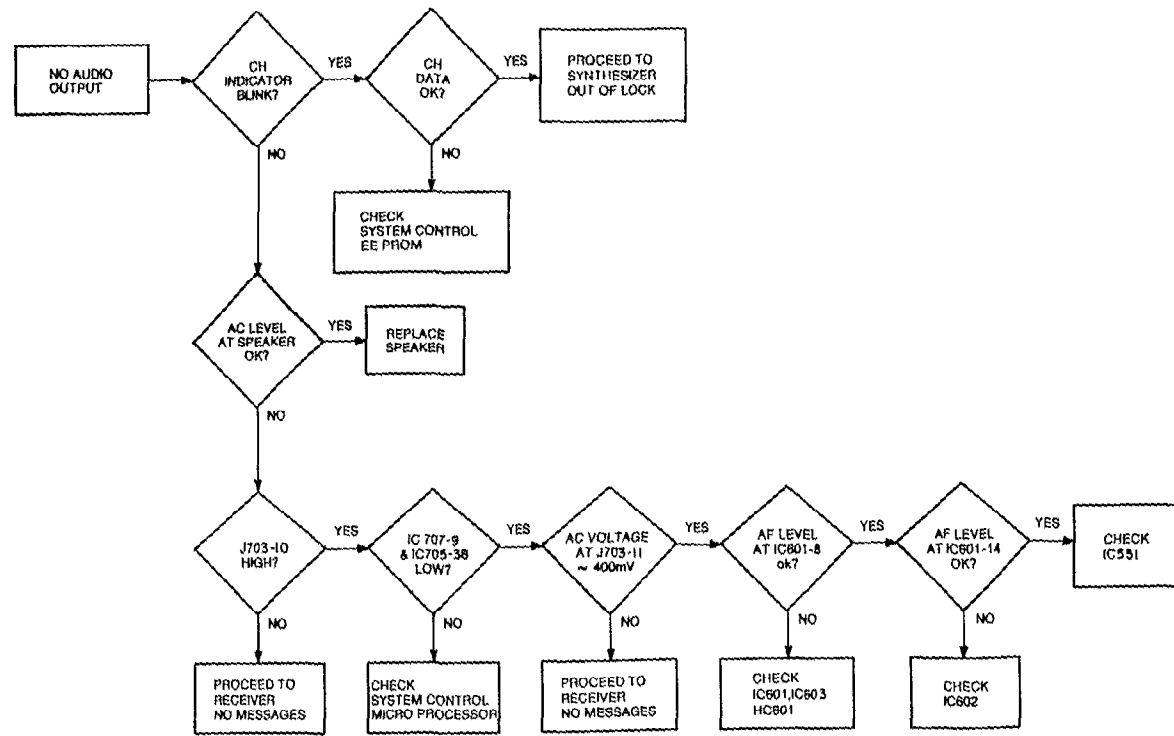
SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, refer to the Receiver Troubleshooting Procedure.

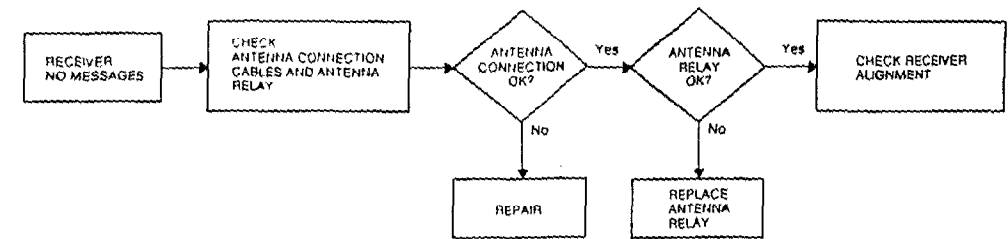


Ericsson GE Mobile Communications Inc.
Mountain View Road • Lynchburg, Virginia 24502

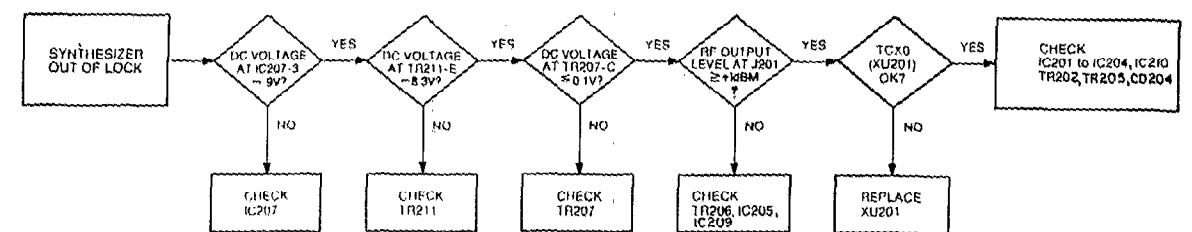
RECEIVER TROUBLESHOOTING



RC-5435B



RC-5436B



RC-7679