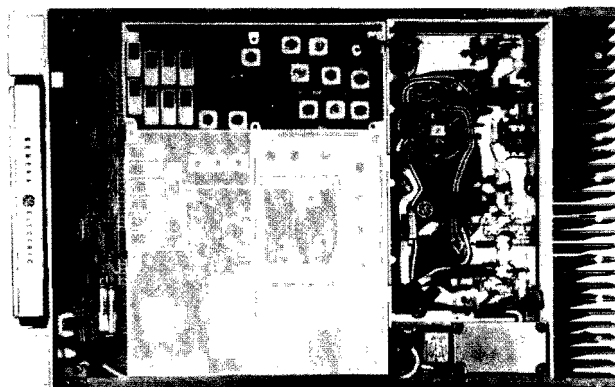


MASTR II MAINTENANCE MANUAL

25-50 MHz, 50-WATT TRANSMITTER



SPECIFICATIONS *

Frequency Range	25-50 MHz	
Power Output	50 Watts (Adjustable from 15 to 50 Watts)	
Crystal Multiplication Factor	3	
Frequency Stability	5C-ICOM with EC-ICOM $\pm 0.0005\%$ (-40°C to $+70^{\circ}\text{C}$) 5C-ICOM or EC-ICOM $\pm 0.0002\%$ (0°C to $+55^{\circ}\text{C}$) 2C-ICOMS $\pm 0.0002\%$ (-40°C to $+70^{\circ}\text{C}$)	
Spurious and Harmonic Emission	At least 85 dB below full rated power output	
Modulation	Adjustable from 0 to ± 5 kHz swing with instantaneous modulation limiting.	
Modulation Sensitivity	80 to 120 Millivolts	
Audio Frequency Characteristics	Within ± 1 dB to -3 dB of a 6-dB/octave pre-emphasis from 300 to 3000 Hz per EIA standards. Post limiter filter per FCC and EIA.	
Distortion	Less than 2% (1000 Hz) Less than 3% (300 to 3000 Hz)	
Deviation Symmetry	0.5 kHz maximum	
Maximum Frequency Spread: (2 to 8 channels)	Full Specifications	1 dB Degradation
25-30 MHz	.160 MHz	.320 MHz
30-36 MHz	.200 MHz	.400 MHz
36-42 MHz	.240 MHz	.270 MHz
42-50 MHz	.280 MHz	.540 MHz
Duty Cycle	EIA 20% Intermittent	
RF Output Impedance	50 Ohms	

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

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WARNING

Although the highest DC voltage in MASTR II Mobile Equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits! High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

DESCRIPTION

MASTR II transmitters are crystal-controlled, phase modulated and designed for one- through eight-frequency operation in the 25 to 50 megahertz band. The solid state transmitter utilizes both integrated circuits (ICs) and discrete components, and consists of the following assemblies:

- Exciter Board; with audio, modulator, amplifier and multiplier stages.
- Power Amplifier Assembly; with amplifier, driver, PA, power control, filter and antenna switch.

CIRCUIT ANALYSIS

EXCITER

The exciter uses nine transistors and two integrated circuits to drive the PA assembly. The exciter can be equipped with up to eight Integrated Circuit Oscillator Modules (ICOMs). The ICOM crystal frequency ranges from approximately 8.33 to 16.67 megahertz, and the crystal frequency is multiplied three times (divided by four

and multiplied by 12 for a multiplication factor of three).

Audio, supply voltages and control functions are connected from the system board to the exciter board through P902.

Centralized metering jack J103 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The test set meters the modulator, multiplier and amplifier stages.

ICOMS

Three different types of ICOMs are available for use in the exciter. Each of the ICOMs contains a crystal-controlled Colpitts oscillator, and two of the ICOMs contain compensator ICs. The different ICOMs are:

- 5C-ICOM - contains an oscillator and a 5 part-per-million ($\pm 0.0005\%$) compensator IC. Provides compensation for EC-ICOMs.
- EC-ICOM - contains an oscillator only. Requires external compensation from a 5C-ICOM.
- 2C-ICOM - contains an oscillator and a 2 PPM ($\pm 0.0002\%$) compensator IC. Will not provide compensation for an EC-ICOM.

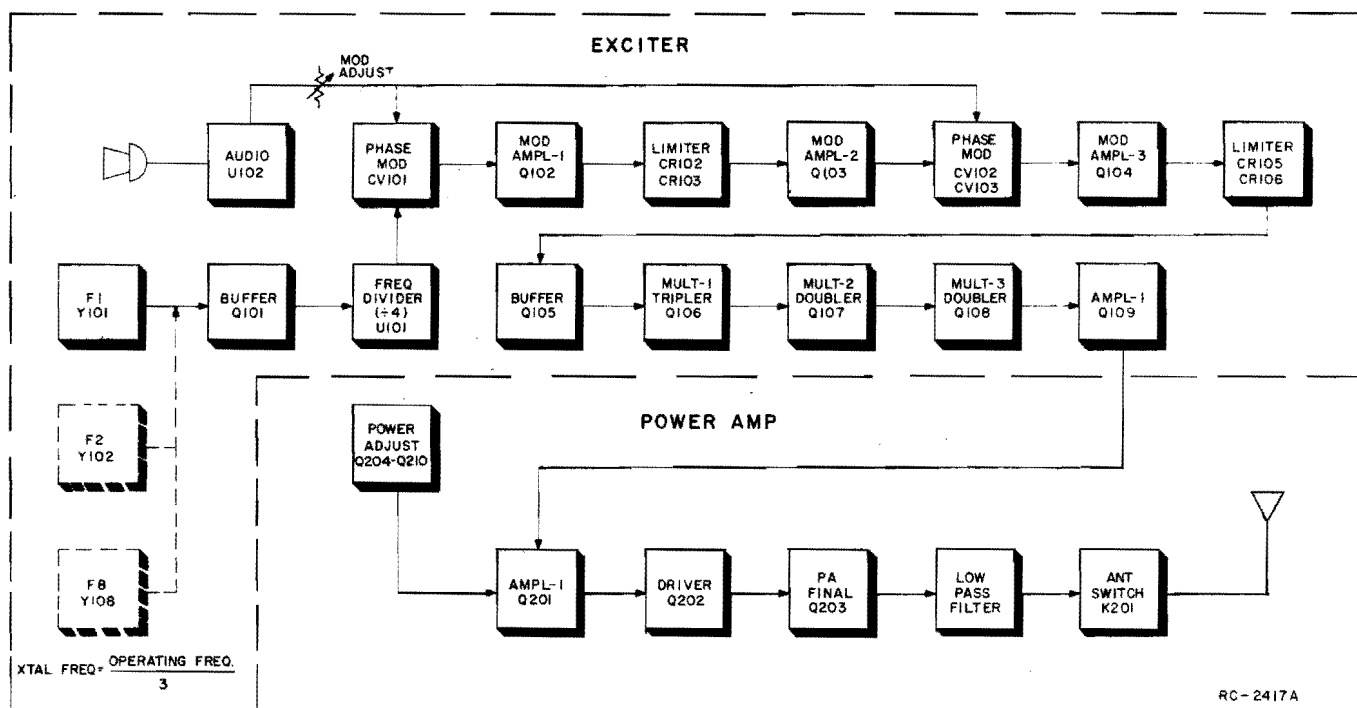


Figure 1 - Transmitter Block Diagram

The ICOMs are enclosed in a dust-proof, RF shielded can with the type ICOM (5C-ICOM, EC-ICOM, or 2C-ICOM) printed on the top of the can. Access to the oscillator trimmer is obtained by prying up the plastic tab on the top of the can. The tabs can also be used to pull the ICOMs out of the radio.

Frequency selection is accomplished by switching the ICOM keying lead (terminal 6) to A- by means of the frequency selector switch on the control unit. In single-frequency radios, a jumper from H9 to H10 in the control unit connects terminal 6 of the ICOM to A-. The oscillator is turned on by applying a keyed +10 Volts to the external oscillator load resistor. RF bypassing is provided for all unused keying leads on eight frequency radios. On two frequency radios, the six unused keying leads are shorted to ground.

CAUTION

All ICOMs are individually compensated at the factory and cannot be repaired in the field. Any attempt to repair or change an ICOM frequency will void the warranty.

In standard 5 PPM radios using EC-ICOMs, at least one 5C-ICOM must be used. The 5C-ICOM is normally used in the receiver F1 position, but can be used in any transmit or receive position. One 5C-ICOM can provide compensation for up to 15 EC-ICOMs in the transmit and receiver. Should the 5C-ICOM compensator fail in the open mode, the EC-ICOMs will still maintain 2 PPM frequency stability from 0°C to 55°C (+32°F to 131°F) due to the regulated compensation voltage (5 Volts) from the 10-Volt regulator IC. If desired, up to 16 5C-ICOMs may be used in the radio.

The 2C-ICOMs are self-compensated at 2 PPM and will not provide compensation for EC-ICOMs.

Oscillator Circuit

The quartz crystals used in ICOMs exhibit the traditional "S" curve characteristics of output frequency versus operating temperature.

At both the coldest and hottest temperatures, the frequency increases with increasing temperature. In the middle temperature range (approximately 0°C to +55°C), frequency decreases with increasing temperature.

Since the rate of change is nearly linear over the mid-temperature range, the output frequency change can be compensated by choosing a parallel compensation capacitor with a temperature coefficient approximately

equal and opposite that of the crystal.

Figure 2 shows the typical performance of an uncompensated crystal as well as the typical performance of a crystal which has been matched with a properly chosen compensation capacitor.

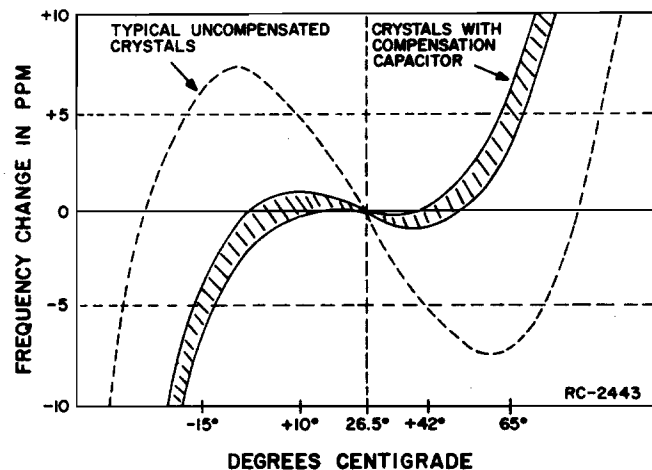


Figure 2 - Typical Crystal Characteristics

At temperatures above and below the mid-range, additional compensation must be introduced. An externally generated compensation voltage is applied to a varactor (voltage-variable capacitor) which is in parallel with the crystal.

A constant bias of 5 Volts (provided from Regulator IC U901 in parallel with the compensator) establishes the varactor capacity at a constant value over the entire mid-temperature range. With no additional compensation, all of the oscillators will provide 2 PPM frequency stability from 0°C to 55°C (32°F to 131°F).

Compensator Circuits

Both the 5C-ICOMs and 2C-ICOMs are temperature compensated at both ends of the temperature range to provide instant frequency compensation. An equivalent ICOM circuit is shown in Figure 3.

The cold end compensation circuit does not operate at temperatures above 0°C. When the temperature drops below 0°C, the circuit is activated. As the temperature decreases, the equivalent resistance decreases and the compensation voltage increases.

The increase in compensation voltage decreases the capacity of the varactor in the oscillator, increasing the output frequency of the ICOM.

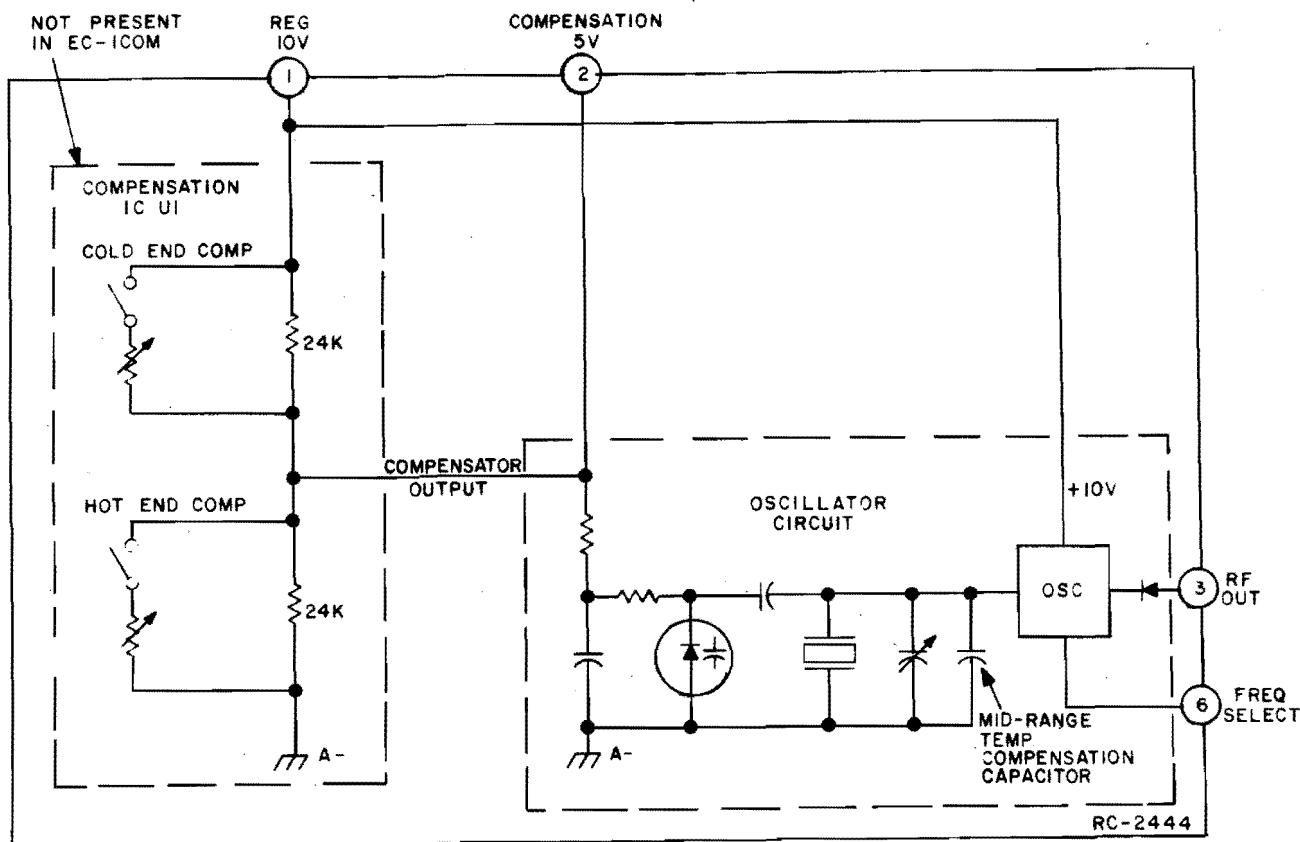


Figure 3 - Equivalent ICOM Circuit

The hot end compensation circuit does not operate at temperatures below +55°C. When the temperature rises above +55°C, the circuit is activated. As the temperature increases, the equivalent resistance decreases and the compensation voltage decreases. The decrease in compensation voltage increases the capacity of the varactor, decreasing the output frequency of the ICOM.

SERVICE NOTE: Proper ICOM operation is dependent on the closely-controlled input voltages from the 10-Volt regulator. Should all of the ICOMs shift off frequency, check the 10-Volt regulator module.

AUDIO IC

The transmitter audio circuitry is contained in audio IC U102. A simplified drawing of the audio IC is shown in Figure 4.

Audio from the microphone at pin 12 is coupled through pre-emphasis capacitor C1 to the base of Q1 in the operational amplifier-limiter circuit. Collector voltage for the transistorized microphone pre-amplifier is supplied from pin 11 through microphone collector load resistor R18 to pin 12.

The operational amplifier-limiter circuit consists of Q1, Q2 and Q3. Q3 provides limiting at high signal levels. The gain of the operational amplifier circuit is fixed by negative feedback through R19, R20 and R126.

The output of Q3 is coupled through a de-emphasis network (R10 and C3) to an active post-limiter filter consisting of C4, C5, C6, R11, R12, R13, R15, R17 and Q4.

Following the post-limiter filter is class A amplifier Q5. The output of Q5 is coupled through MOD ADJUST potentiometer R127 to the phase modulators.

SERVICE NOTE: If the DC voltages to the Audio IC are correct and no audio output can be obtained, replace U102.

For radios equipped with Channel Guard, tone from the encoder is applied to the phase modulators through CHANNEL GUARD MOD ADJUST potentiometer R128, and resistors R110, R121 and R124. Instructions for setting R128 are contained in the modulation adjustment section of the Transmitter Alignment Procedure.

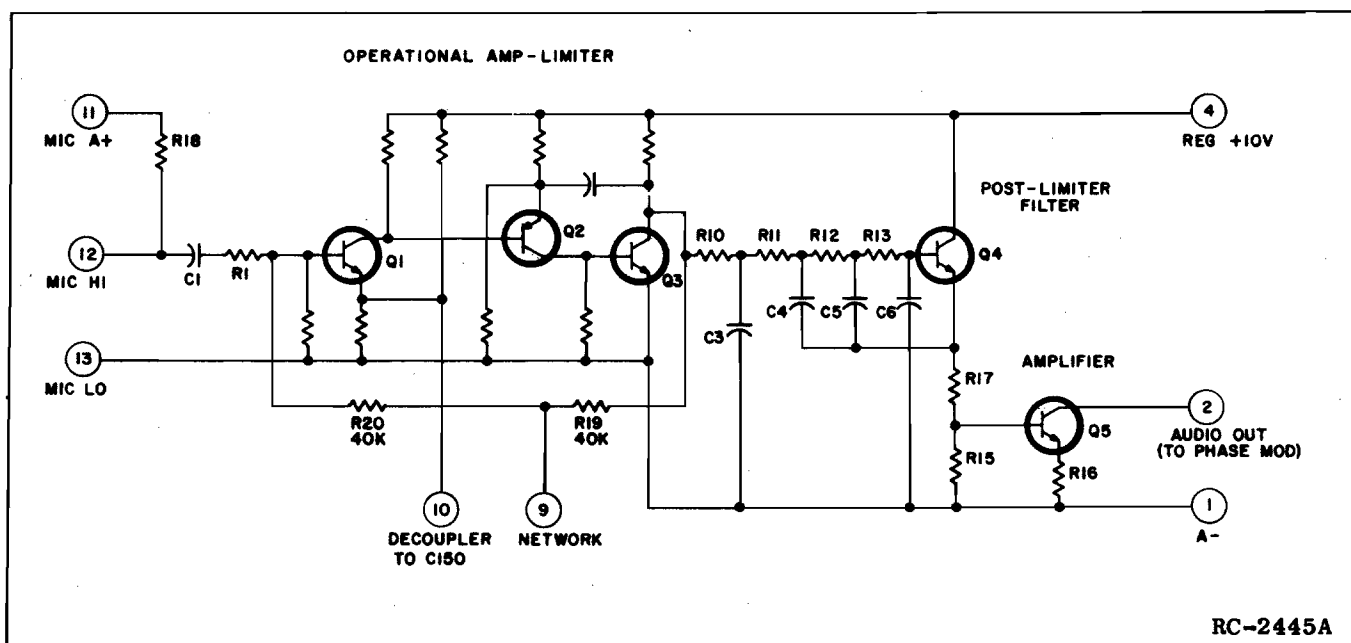


Figure 4 - Simplified Audio IC

FREQUENCY DIVIDER IC

The output at pin 3 of the selected ICOM is coupled through buffer amplifier Q101 to frequency divider U101, which divides the oscillator frequency by 4. The divider consists of two J-K flip-flops connected as a binary counter.

When the transmitter is not keyed (no ICOMs on), Q101 is saturated (turned on) with its collector voltage near zero. Keying the transmitter starts one of the ICOMs, and its output cuts Q101 on and off once each cycle. As Q101 turns off during each cycle, the drop in collector voltage causes the left flip-flop to change state. Assume the flip-flop was in the "0" state (the output at "Q" near A-). The first cycle of the oscillator output causes it to switch to the "1" stage (output at "Q" at approximately 5 Volts). The second cycle will cause the flip-flop to switch back to the "0" state. Therefore, it requires two oscillator cycles to switch the left flip-flop through one complete cycle from "0" to "1" and back to "0".

When the left flip-flop switches from "1" to "0", it causes the right flip-flop to change state. It requires two cycles of the left flip-flop to switch the right flip-flop from "0" to "1" and back to "0". Therefore, four cycles of the oscillator output are required for each cycle of output from pin 9 of U101.

If U101 was operating into a pure resistive load, its output would be a square wave. However, the modulator circuit presents a tuned load to the IC, so that harmonics are filtered out and the waveform at the junction of C102 and C103 (modulator input) is essentially a sine wave at one-fourth the oscillator frequency. The output of the frequency divider is coupled through DC blocking capacitor C102 to the first modulator stage.

PHASE MODULATORS, AMPLIFIERS AND MULTIPLIERS

The first phase modulator is varactor (voltage-variable capacitor) CV101 in series with tunable coil L101. This network appears as a series-resonant circuit to the RF output of the oscillator. An audio signal applied to the modulator circuit through blocking capacitor C115 varies the bias of CV101, resulting in a phase modulated output. A voltage divider network (R108 and R109) provides the proper bias for varactors CV101, CV102 and CV103.

The output of the first modulator is coupled through blocking capacitor C106 to the base of Class A amplifier Q102. The first modulator stage is metered through a metering network consisting of R115, R150, C107 and CR101. Diodes CR102 and CR103 remove any amplitude modulation in the modulator output.

Following Q102 is another Class A amplifier, Q103. The output of Q103 is applied to the second modulator stage. The second modulator consists of two cascaded modulator circuits consisting of CV102, L102, L103 and CV103. Following the second modulator is a Class A amplifier Q104. The output of the second modulator stage is metered through R133, R145, C117 and CR104, and is applied to the base of buffer Q105. Diodes CR105 and CR106 remove any amplitude modulation in the second modulator output.

Buffer Q105 is saturated when no RF signal is present. Applying an RF signal to Q105 provides a sawtooth waveform at its collector to drive the class C tripler, C106. The tripler stage is metered through R146. The output of Q106 is coupled through tuned circuits T101, T102 and T103 to the base of doubler Q107. T101, T102 and T103 are tuned to one-fourth of the operating frequency. The doubler stage is metered through R147.

The output of Q107 is coupled through tuned circuits T104 and T105 to the base of second doubler Q108. T104 and T105 are tuned to one-half the operating frequency. Q108 is metered through R148.

The output of Q108 is coupled through three tuned circuits (T106, T107 and T108) to the base of amplifier Q109. The circuits are tuned to the transmitter operating frequency.

Q109 is a class C amplifier with a collector feed network consisting of C139, C141, L104, L108 and R143. The stage is metered through R149. The amplifier collector circuit consists of C142, C143, C146 and L105, and matches the amplifier output to the input of the power amplifier assembly.

POWER AMPLIFIER

The PA assembly uses three RF power transistors and seven transistors in the Power Control circuitry to provide a power output of 50 Watts. The broadband PA has no adjustments other than Power Control potentiometer R216.

Supply voltage for the PA is connected through power leads from the system board to feedthrough capacitors C297 and C298 on the bottom of the PA assembly. C297, C298 and C299, L296 and L297 prevent RF from getting on the Power leads. Diode CR295 will cause the main fuse in the fuse assembly to blow if the polarity of the power leads is reversed.

Centralized metering jack J205 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The Test Set

meters the Ampl-1 drive (exciter output), Ampl-1 power control, Driver and PA current.

RF AMPLIFIERS

The exciter output is coupled through an RF cable to PA input jack J203. The RF is coupled through DC blocking capacitor C202 to the base of Class C amplifier Q201 through a matching network. The network matches the 50-ohm input to the base of Q201, and consists of C205, C206, C235, L201, L202 and L203.

Part of the RF input is rectified by CR201 and used to activate the Power Control circuit. Another portion of the rectified RF is applied to voltage dividers R223 and R224 for metering the Ampl-1 drive at J205.

Collector voltage to Q201 (Ampl-1) is controlled by the Power Control circuit, and is applied through a collector stabilizing network consisting of L224 and R225 and collector feed network L204 and C207. The collector voltage of Q201 is metered through R235 at J205.

The output of Q201 is applied to the base of Class C driver Q202 through a low-pass filter matching network (C209, C210, L205 and L206). Resistors R202, R203 and R204 lower the gain of Q202. Collector voltage to Q202 is coupled through a collector stabilizing network consisting of L225 and R233 and collector feed network L208 and C213.

Collector current for Q202 is metered across tapped manganin resistor R230 at J205 (Driver Current). The reading is taken on the one-Volt scale with the High Sensitivity button pressed, and read as 10 amperes full scale.

Following Q202 is an interstage coupling network (C214 through C221, L209 through L211, R206 and R207.) The output is applied to the base of the class C PA stage, Q203. Supply voltage is coupled through a collector stabilizing network consisting of L226 and R234 and collector feed network C222 and L212.

Collector current for Q203 is metered across tapped manganin resistor R231 at J205. The reading is taken on the one-Volt scale with the High Sensitivity button pressed, and read as 10 amperes full scale.

The PA output is coupled through an output matching network (C224, C225, C226, L213 and L214,) to an M-derived, constant K low-pass filter. C230 through C233 provides ground isolation for \pm ground operation. The filter output is applied to the antenna through antenna switch K201.

WARNING

The stud mounted RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic, or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

POWER CONTROL CIRCUIT

When the transmitter is keyed, rectified RF from CR201 is applied to the base of switch Q204, turning it on. Turning on Q204 turns on voltage regulator Q206 which supplies a constant voltage to Power Adjust potentiometer R216.

Q208, Q209 and Q210 operate as an amplifier chain to supply voltage to the collector of Q201 (Ampl-1). The setting of R216 determines the voltage applied to the base of Q208. The higher the voltage at the base of Q208, the harder the amplifiers conduct, supplying more collector voltage to Q201. The lower the voltage at the base of Q208, the less collector voltage is supplied to Q201. Reducing the supply voltage to Q201 reduces the drive to Q202 and Q203, thereby reducing the power output of the PA. The power output can be adjusted by R216 from approximately 15 to 50 Watts.

Temperature protection is provided by Q205, Q207 and thermistor RT201 which is mounted in the PA heatsink. Under normal operating conditions, the circuit is inactive (Q205 is on and Q207 is off). When the heatsink temperature reaches approximately 100°C, the resistance of RT201 decreases. This increases the base voltage applied to Q205, turning it off. Turning off Q205 allows Q207 to turn on, decreasing the voltage at Power Adjust potentiometer R216. This reduces the base voltage to Q208 which causes Q209 and Q210 to conduct less, reducing the collector voltage to Q201 (Ampl-1). This reduces the transmitter output power, keeping the heatsink at a maximum of approximately 100°C. When the heatsink temperature decreases below 100°C, the temperature control circuit turns off, allowing the normal transmitter power output.

CARRIER CONTROL TIMER

The Carrier Control Timer option shuts off the transmitter on each transmission after a one-minute timing cycle, and alerts the operator that the transmitter is off by means of an alarm tone in the speaker. The transmitter can be turned on again by releasing and rekeying the push-to-talk switch on the microphone.

The timing cycle (transmitter keyed time) is normally set at the factory for a duration of one minute. A potentiometer permits the timing cycle to be adjusted from approximately 15 seconds to 3 minutes.

MAINTENANCE**DISASSEMBLY**

To service the transmitter from the top:

1. Pull the locking handle down, then pry up the top cover at the front notch and lift off the cover.

To service the transmitter from the bottom:

1. Pull the locking handle down and pull the radio out of the mounting frame.
2. Remove the top cover, then loosen the two bottom cover retaining screws and remove the bottom cover (see Figure 5).
3. To gain access to the bottom of the exciter board, remove the six screws (A) holding the exciter board and its bottom cover to the module mounting frame, and remove the bottom cover.

To remove the exciter board from the radio:

1. Unplug the exciter/PA cable (B).
2. Remove the six screws (A) holding the exciter board and its bottom cover to the module mounting frame (see Figure 6).
3. Press straight down on the plug-in exciter from the top to avoid bending the pins when unplugging the board from the system board jack.

To remove the PA assembly:

1. Remove the PA top cover and unplug the exciter/PA cable (B), the antenna, receiver and PTT cables (C).
2. Remove the four side-rail screws (D), and unsolder the power cables from the bottom of the PA assembly if desired.

To remove the PA board:

1. Remove the PA top cover and unplug the exciter/PA cable (B).
2. Unsolder the two feedthrough coils (E) and the thermistor leads (F).
3. Remove the PA transistor hold-down nuts and spring washers on the bottom of the PA assembly.
4. Remove the four PA board mounting screws (G), the five screws in the filter casting (H), and the retaining screw in Q210 (J), and lift the board out.

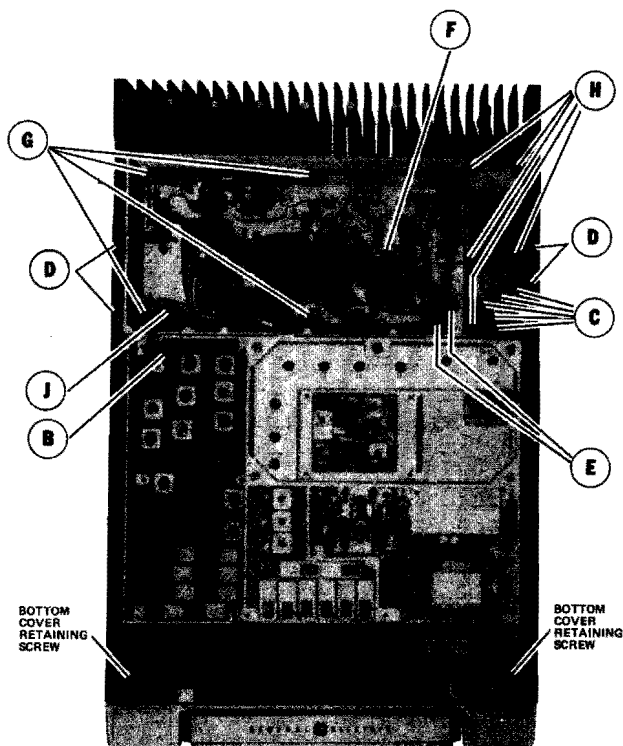


Figure 5 - Disassembly Procedure
Top View

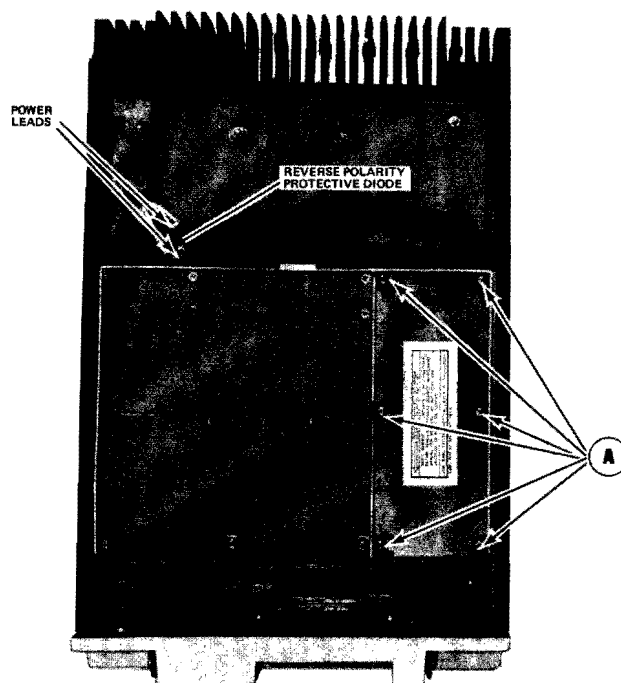


Figure 6 - Disassembly Procedure
Bottom View

PA TRANSISTOR REPLACEMENT

WARNING

The stud mounted RF Power Transistors used in the transmitter contain Beryllium Oxide, a TOXIC substance. If the ceramic or other encapsulation is opened, crushed, broken or abraded, the dust may be hazardous if inhaled. Use care in replacing transistors of this type.

To replace the PA RF transistors:

1. Unsolder one lead at a time with a 50-Watt soldering iron. Use a scribe to hold the lead away from the printed circuit board until the solder cools.
2. Turn the transmitter over.
3. Hold the body of the transistor to prevent it from turning. Remove the transistor hold-down nut and spring washer through the hole in the heatsink with an 11/32-inch nut-driver for Q201 and Q202, and a 3/8-inch nut-driver for

Q203. Lift out the transistor, and remove the old solder from the printed circuit board with a de-soldering tool such as a SOLDA PULLT®. Special care should be taken to prevent damage to the printed circuit board runs.

4. Trim the new transistor leads (if required) to the lead length of the removed transistor. Cut the collector lead at a 45° angle for future identification (see Figure 7). The letter "C" on the top of the transistor indicates the collector.
5. Apply a coating of silicon grease around the transistor mounting surface, and place the transistor in the mounting hole. Align the leads as shown in the Outline Diagram. Then hold the body of the transistor and replace the holding-down nut and spring-washer, using moderate torque (6.5 inch-pounds for Q201 and Q202, and 11 inch-pounds for Q203). A torque wrench must be used for this adjustment since transistor damage can result if too little or too much torque is used.

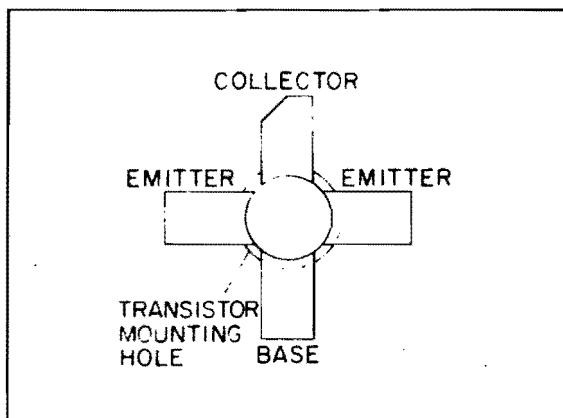


Figure 7 - Lead Identification

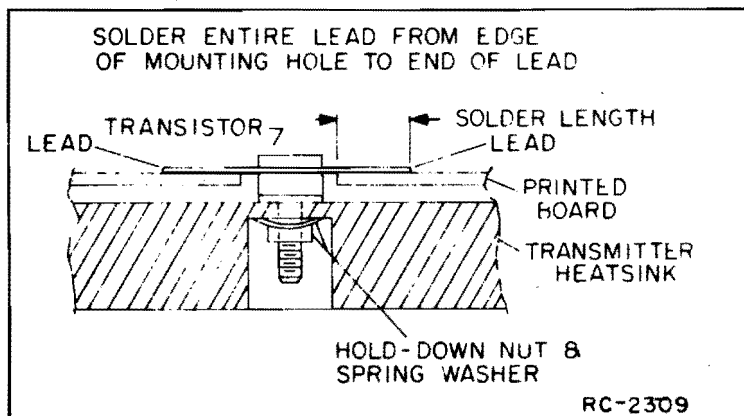


Figure 8 - Lead Forming

6. Make sure that the transistor leads are formed as shown in Figure 8 so that the leads can be soldered to the printed circuit pattern, starting from the inner edge of the mounting hole.
7. Solder the leads to the printed circuit pattern. Start at the inner edge of mounting hole and solder the remaining length of transistor lead to the board. Use care not to use excessive heat that causes the printed

wire board runs to lift up from the board. Check for shorts and solder bridges before applying power.

CAUTION

Failure to solder the transistor leads as directed may result in the generation of RF loops that could damage the transistor or may cause low power output.

The MOD ADJUST (R127) is adjusted to the proper setting before alignment and should not normally require readjustment. This setting permits approximately 75% modulation for the average voice level. The audio peaks which would cause overmodulation are clipped by the modulation limiter. The limiter, in conjunction with the deemphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing over-modulation while preserving intelligibility.

- TEST EQUIPMENT**
1. An audio oscillator (OR Model 428A410)
 2. A frequency modulation monitor
 3. An output meter or a VTVM
 4. OR Test Set Models 428A411 or 428A412

- PROCEDURE**
1. Connect the audio oscillator and the meter across audio input terminals 210 (Ground) and 211 (Channel) on OR Test Set, or across 200A-6 (Blue Ring) through a 0.5 microfarad (or larger) AC blocking capacitor, and 200B-5 (Blue-Low) on the System Board.
 2. Adjust the audio oscillator for 1-volt RMS at 1800 Hz.
 3. For transmitters without Channel Guard, set MOD ADJUST R127 for a 4.5-division deflection with the deviation polarity switch gives the highest reading as indicated on the frequency modulation monitor.
 4. For transmitters with Channel Guard, set Channel Guard MOD ADJUST R128 for zero tone deviation. Next, with the 1-volt signal at 1800 Hz applied, set MOD ADJUST R127 for a 7.75 kHz deviation. Then remove the signal from the audio oscillator and set Channel Guard MOD ADJUST R128 for 0.75 kHz tone deviation.
 5. For multi-frequency transmitters, set the deviation as described in Steps 3 or 4 on the channel producing the largest amount of deviation.

PA POWER INPUT

For FCC purposes, the PA power input can be determined by measuring the PA supply voltage and PA current, and using the following formula:

$$P_1 = P_1 \text{ voltage} \times P_1 \text{ current}$$

where:

P_1 is the power input in Watts.

P_1 voltage is measured with Test Set Model 428A411 in Position G on the 10-volt range (read as 10 volts full scale), with the polarity switch in the (+) position. With Test Set Model 428A411, use the 50 position and the 10-volt range (read as 10 volts full scale), with the SENS SENSITIVITY button pressed and the polarity switch in the (+) position.

PA current is measured with the Test Set in Position G in the Test 1 position, and with the SENS SENSITIVITY button pressed (10 appears full scale).

Example:

$$P_1 = 12.6 \text{ Volts} \times 5.6 \text{ amperes} = 62 \text{ Watts}$$

ICOM FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should be set with a frequency meter of accuracy ± 10 Hz (average accuracy that is 5 to 10 times better than the tolerance of an oscillator), and with the entire radio as near as possible to an ambient temperature of 20.5°C (68.9°F).

When 11.0000 MHz is used, the frequency above deviation is shown of the following limits:

- A. -0.5 KHz, when the radio is at 24.5°C (76.1°F).
- B. ± 0.5 KHz at any other temperature within the range of -5°C to +55°C (-23°F to +133°F).
- C. The specification limit (± 0.5 KHz or 15 PPM) at any temperature within the range of -5°C to +55°C (-23°F to +133°F) or +100°F to +125°F (-131°F to +158°F).

If an adjustment is required, get up the case on the top of the DMM to expose the trimmer, and use one of the following procedures:

If the radio is at an ambient temperature of 20.5°C (68.9°F), set the oscillator for the correct frequency.

- A. To hold setting error to 10.0 PPM (which is considered reasonable for 0 PPM (0.0001)):
 1. Measure the radio at 20.5°C (68.9°F) and set the oscillator to the desired frequency.
 2. Measure the radio at 24.5°C (76.1°F) and offset the oscillator, as a function of actual temperature, by the amount shown in Figure 9.
 3. Hold setting error to 10.0 PPM (which is considered reasonable for 0 PPM (0.0001)) measure until at 24.5°C (76.1°F) and offset the oscillator, as a function of actual temperature, by the amount shown in Figure 9.
- B. To hold setting error to 10.0 PPM (which is considered reasonable for 0 PPM (0.0001)) measure until at 24.5°C (76.1°F) and offset the oscillator, as a function of actual temperature, by the amount shown in Figure 9.

For example: Assume the ambient temperature of the radio is 20.5°C (68.9°F). At that temperature, the curve shows a correction factor of 0.3 PPM. At 24.5°C, 1 PPM to 10 Hz. At 20 Hz, 1 PPM to 10 Hz.

With an operating frequency of 30 MHz, set the oscillator for a reading of 10 Hz (0.3 + 10 Hz) higher than the closest operating frequency. If a negative correction factor is indicated, temperature should be 24.5°C, set the oscillator for the indicated PPM lower than the closest operating frequency.

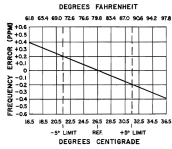
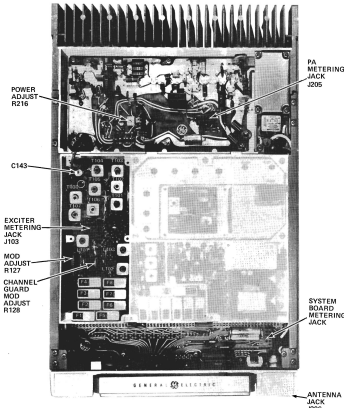


Figure 9 - Frequency Characteristic Vs. Temperature



TRANSMITTER ALIGNMENT

LBI-4896

- NECESSARY TOOLS**
1. OR Test Set Model 428A411 or Test Set Model 428A412
 2. A radio frequency monitor or a VTVM
 3. A frequency monitor
- NECESSARY CIRCUITRY AND ADJUSTMENTS**
1. When 11.0000 MHz is used, the frequency above deviation is shown of the following limits:
 2. The radio is at an ambient temperature of 20.5°C (68.9°F), set the oscillator for the correct frequency.

NOTE			
The radio is at an ambient temperature of 20.5°C (68.9°F), set the oscillator for the correct frequency.			
The radio is at an ambient temperature of 20.5°C (68.9°F), set the oscillator for the correct frequency.			
The radio is at an ambient temperature of 20.5°C (68.9°F), set the oscillator for the correct frequency.			
The radio is at an ambient temperature of 20.5°C (68.9°F), set the oscillator for the correct frequency.			

Frequency Range	NOTES			
	(1) Without auto tuning	(2) With auto tuning	(3) With auto tuning	(4) With auto tuning
10.0-10.5 MHz	10.0-10.5 MHz	10.0-10.5 MHz	10.0-10.5 MHz	10.0-10.5 MHz
10.5-11.0 MHz	10.5-11.0 MHz	10.5-11.0 MHz	10.5-11.0 MHz	10.5-11.0 MHz
11.0-11.5 MHz	11.0-11.5 MHz	11.0-11.5 MHz	11.0-11.5 MHz	11.0-11.5 MHz
11.5-12.0 MHz	11.5-12.0 MHz	11.5-12.0 MHz	11.5-12.0 MHz	11.5-12.0 MHz

STEP	METER INDICATOR	FUNCTION CONTROL	METER INDICATOR	REMARKS
1.	1.	1.	1.	1.
2.	2.	2.	2.	2.
3.	3.	3.	3.	3.
4.	4.	4.	4.	4.
5.	5.	5.	5.	5.
6.	6.	6.	6.	6.
7.	7.	7.	7.	7.
8.	8.	8.	8.	8.

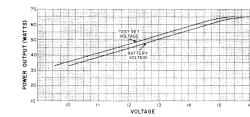


Figure 10 - Power Output Setting Chart

ALIGNMENT PROCEDURE
25-50 MHz, 50-WATT TRANSMITTER
Issue 1 9

TEST PROCEDURES

These Test Procedures are designed to assist you in servicing a transmitter that is operating—but not properly. Problems encountered could be low power output, tone and voice deviation, defective audio sensitivity, and modulator adjust control set too high. Once a defect is pin-pointed,

CAUTION

Before bench testing the MASTR II Mobile Radio, be sure of the output voltage characteristics of your bench power supply.

To protect the transmitter power output transistors from possible instant destruction, the following input voltages must not be exceeded:

Transmitter unkeyed: 30 Volts
Transmitter keyed (50 ohm resistive load): 18 Volts
Transmitter keyed (no load or non-resistive load): 15.5 Volts

These voltages are specified at the normal vehicle battery terminals of the radio and take the voltage drop of standard cables into account. The voltage limit shown for a non-optimum load is for "worst case" conditions. For antenna mismatches likely to be encountered in practice, the actual limit will approach the 18 Volt figure.

Routine transmitter tests should be performed at RIA Standard Test Voltages (12.6 VDC for loads of 6 to 16 amperes; 13.4 VDC for loads of 16 to 36 amperes). Input voltages must not exceed the limits shown, even for transient peaks of short duration.

Many commonly used bench power supplies cannot meet these requirements for load regulation and transient voltage suppression. Bench supplies which employ "brute force" regulation and filtering (such as Lego Model 72) may be usable when operated in parallel with a 12-Volt automotive storage battery.

TEST EQUIPMENT REQUIRED

for test loading as shown

- | | | |
|---|--|--|
| 1. Wattmeter similar to:
Bird # 43
Jones # 711N | 2. VTVM similar to:
Triplet # 850
Heath # 19-21 | 3. Audio Generator similar to:
GE Model 4EX6A10 |
| 4. Deviation Meter (with a .75 kHz scale) similar to:
Measurements # 720 | 5. Multimeter similar to:
GE TEST SET MODEL 4EX3A11,
MODEL 4EX8K12 or
20,000 ohm-per-Volt voltmeter | |

refer to the "Service Check" and the additional corrective measures included in the Transmitter Troubleshooting Procedure. Before starting with the Transmitter Test Procedures, be sure the transmitter is tuned and aligned to the proper operating frequency.

TEST PROCEDURE

1. Connect transmitter output from the antenna jack to the wattmeter through a 50-ohm coaxial cable. Make sure the wattmeter is terminated into a 50-ohm load.
2. Key the transmitter and check the wattmeter for the desired power output.

SERVICE CHECK

Check the setting of the Power Adjust Control (R216).
Refer to the QUICK CHECKS on the Transmitter Troubleshooting Procedure.

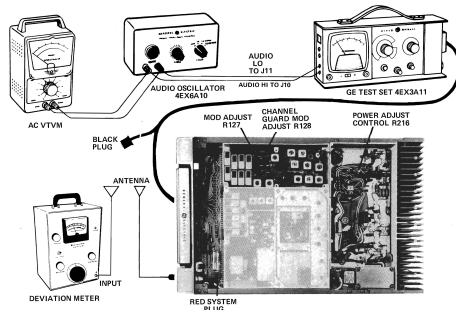
VOICE DEVIATION, SYMMETRY AND AUDIO SENSITIVITY

TEST PROCEDURE

1. Connect the test equipment to the transmitter as shown.
2. In radios with Channel Guard, set Channel Guard Mod Adjust R128 for zero tone deviation.
3. Set the Audio generator output to 1.0 VOLTS RMS and frequency to 1 kHz.
4. Key the transmitter and adjust Deviation Meter to carrier frequency.
5. Deviation reading should be 34.5 kHz in radios without Channel Guard, and 22.75 kHz in radios with Channel Guard.
6. If necessary, adjust MOD ADJUST control R127 for the proper deviation on plus (+) or minus (-) deviation, whichever is greater.

- NOTES:** -- MASTR II transmitters are adjusted for 4.5 kHz deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 5.0 kHz under the worst conditions of frequency, voltage and temperature.
7. If the deviation reading plus (+) or minus (-) differs by more than 0.5 kHz, recheck Steps 1 and 2 as shown in the Transmitter Alignment Chart.
 8. Check Audio Sensitivity by reducing generator output until deviation falls to 3.0 kHz for radios without Channel Guard, or 2.25 kHz for radios with Channel Guard. Voltage should be LESS than 120 millivolts. If not, refer to the Transmitter Troubleshooting Procedure.

POWER MEASUREMENT



VOICE DEVIATION WITH CHANNEL GUARD

TEST PROCEDURE

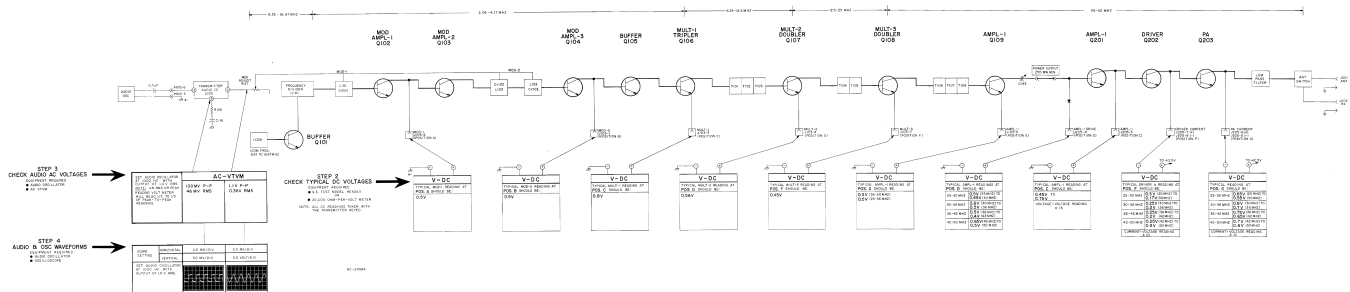
1. Set up the Deviation Meter and monitor the output of the transmitter.
2. Remove the 1000 Hz signal from the audio generator.
3. Key the transmitter and check for 0.75 kHz deviation. If the reading is low or high, adjust Channel Guard MOD ADJUST R128 for a reading of 0.75 kHz.

NOTES:

1. On units supplied with Channel Guard, the Phase Modulator Tuning should be adjusted carefully to insure proper performance. (Refer to Steps 1 and 2 in the Transmitter Alignment Chart).
2. The Tone Deviation Test Procedures should be repeated every time the Tone Frequency is changed.

STEP I - QUICK CHECKS

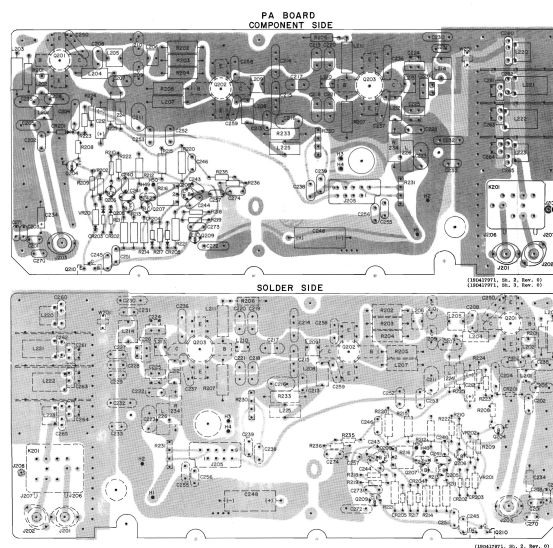
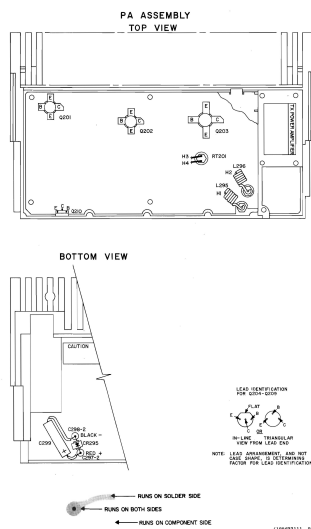
AIDS TEST RESULTS	PERSONAL DEFECTIVE STATE		FBI REMARKS
	ADVERSE REMARKS	EXCITED	
(R2-1)	0325, 30- 10-11-61	Q100, Q101, Q102, Q103, Q104, Q105, Q106, Q107, Q108, Q109, Q110, Q111, Q112, Q113, Q114, Q115, Q116, Q117, Q118, Q119, Q120, Q121, Q122, Q123, Q124, Q125, Q126, Q127, Q128, Q129, Q130, Q131, Q132, Q133, Q134, Q135, Q136, Q137, Q138, Q139, Q140, Q141, Q142, Q143, Q144, Q145, Q146, Q147, Q148, Q149, Q150, Q151, Q152, Q153, Q154, Q155, Q156, Q157, Q158, Q159, Q160, Q161, Q162, Q163, Q164, Q165, Q166, Q167, Q168, Q169, Q170, Q171, Q172, Q173, Q174, Q175, Q176, Q177, Q178, Q179, Q180, Q181, Q182, Q183, Q184, Q185, Q186, Q187, Q188, Q189, Q190, Q191, Q192, Q193, Q194, Q195, Q196, Q197, Q198, Q199, Q200, Q201, Q202, Q203, Q204, Q205, Q206, Q207, Q208, Q209, Q210, Q211, Q212, Q213, Q214, Q215, Q216, Q217, Q218, Q219, Q220, Q221, Q222, Q223, Q224, Q225, Q226, Q227, Q228, Q229, Q230, Q231, Q232, Q233, Q234, Q235, Q236, Q237, Q238, Q239, Q240, Q241, Q242, Q243, Q244, Q245, Q246, Q247, Q248, Q249, Q250, Q251, Q252, Q253, Q254, Q255, Q256, Q257, Q258, Q259, Q260, Q261, Q262, Q263, Q264, Q265, Q266, Q267, Q268, Q269, Q270, Q271, Q272, Q273, Q274, Q275, Q276, Q277, Q278, Q279, Q280, Q281, Q282, Q283, Q284, Q285, Q286, Q287, Q288, Q289, Q290, Q291, Q292, Q293, Q294, Q295, Q296, Q297, Q298, Q299, Q300, Q301, Q302, Q303, Q304, Q305, Q306, Q307, Q308, Q309, Q310, Q311, Q312, Q313, Q314, Q315, Q316, Q317, Q318, Q319, Q320, Q321, Q322, Q323, Q324, Q325, Q326, Q327, Q328, Q329, Q330, Q331, Q332, Q333, Q334, Q335, Q336, Q337, Q338, Q339, Q340, Q341, Q342, Q343, Q344, Q345, Q346, Q347, Q348, Q349, Q350, Q351, Q352, Q353, Q354, Q355, Q356, Q357, Q358, Q359, Q360, Q361, Q362, Q363, Q364, Q365, Q366, Q367, Q368, Q369, Q370, Q371, Q372, Q373, Q374, Q375, Q376, Q377, Q378, Q379, Q380, Q381, Q382, Q383, Q384, Q385, Q386, Q387, Q388, Q389, Q390, Q391, Q392, Q393, Q394, Q395, Q396, Q397, Q398, Q399, Q400, Q401, Q402, Q403, Q404, Q405, Q406, Q407, Q408, Q409, Q410, Q411, Q412, Q413, Q414, Q415, Q416, Q417, Q418, Q419, Q420, Q421, Q422, Q423, Q424, Q425, Q426, Q427, 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Q107, Q108, Q109, Q110, Q111, Q112, Q113, Q114, Q115, Q116, Q117, Q118, Q119, Q120, Q121, Q122, Q123, Q124, Q125, Q126, Q127, Q128, Q129, Q130, Q131, Q132, Q133, Q134, Q135, Q136, Q137, Q138, Q139, Q140, Q141, Q142, Q143, Q144, Q145, Q146, Q147, Q148, Q149, Q150, Q151, Q152, Q153, Q154, Q155, Q156, Q157, Q158, Q159, Q160, Q161, Q162, Q163, Q164, Q165, Q166, Q167, Q168, Q169, Q170, Q171, Q172, Q173, Q174, Q175, Q176, Q177, Q178, Q179, Q180, Q181, Q182, Q183, Q184, Q185, Q186, Q187, Q188, Q189, Q190, Q191, Q192, Q193, Q194, Q195, Q196, Q197, Q198, Q199, Q200, Q201, Q202, Q203, Q204, Q205, Q206, Q207, Q208, Q209, Q210, Q211, Q212, Q213, Q214, Q215, Q216, Q217, Q218, Q219, Q220, Q221, Q222, Q223, Q224, Q225, Q226, Q227, Q228, Q229, Q230, Q231, Q232, Q233, Q234, Q235, Q236, Q237, Q238, Q239, Q240, Q241, Q242, Q243, Q244, Q245, Q246, Q247, Q248, Q249, Q250, Q251, Q252, Q253, Q254, Q255, Q256, Q257, Q258, Q259, Q260, Q261, Q262, Q263, Q264, Q265, Q266, Q267, Q268, Q269, Q270, Q271, Q272, 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(R2-2)	0326, 30- 10-11-61	Q100, Q101, Q102, Q103, Q104, Q105, Q106, Q107, Q108, Q109, Q110, Q111, Q112, Q113, Q114, Q115, Q116, Q117, Q118, Q119, Q120, Q121, Q122, Q123, Q124, Q125, Q126, Q127, Q128, Q129, Q130, Q131, Q132, Q133, Q134, Q135, Q136, Q137, Q138, Q139, Q140, Q141, Q142, Q143, Q144, Q145, Q146, Q147, Q148, Q149, Q150, Q151, Q152, Q153, Q154, Q155, Q156, Q157, Q158, Q159, Q160, Q161, Q162, Q163, Q164, Q165, Q166, Q167, Q168, Q169, Q170, Q171, Q172, Q173, Q174, Q175, Q176, Q177, Q178, Q179, Q180, Q181, Q182, Q183, Q184, Q185, Q186, Q187, Q188, Q189, Q190, Q191, Q192, Q193, Q194, Q195, Q196, Q197, Q198, Q199, Q200, Q201, Q202, Q203, Q204, Q205, Q206, Q207, Q208, Q209, Q210, Q211, Q212, Q213, Q214, Q215, Q216, Q217, Q218, Q219, Q220, Q221, Q222, Q223, Q224, Q225, Q226, Q227, Q228, Q229, Q230, Q231, Q232, Q233, Q234, Q235, Q236, Q237, Q238, Q239, Q240, Q241, Q242, Q243, Q244, Q245, Q246, Q247, Q248, Q249, Q250, Q251, Q252, Q253, Q254, Q255, Q256, Q257, Q258, Q259, Q260, Q261, 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TROUBLESHOOTING PROCEDURE

25-50 MHz, 50-WATT TRANSMITTER

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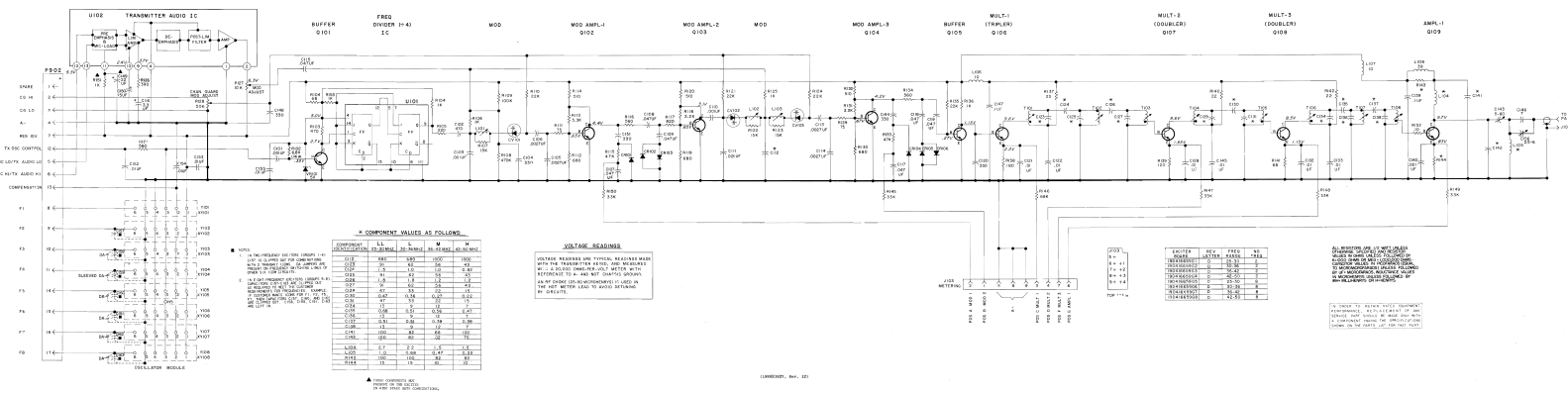


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