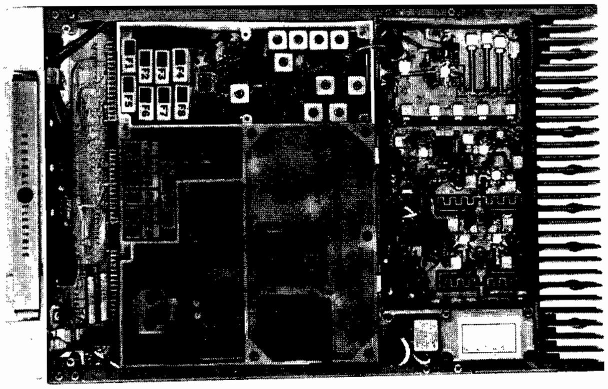
MOBILE RADIO

MASTR II MAINTENANCE MANUAL

406-420 & 450-512 MHz, 40-WATT TRANSMITTER

Maintenance Manual LBI-4622A

406-420 & 450-512 MHz EXCITER 19D416859G5-8
40-WATT PA ASSEMBLY 19C320620G5-8



SPECIFICATIONS *

Power Output	
406-420 MHz & 450-470 MHz	40 Watts (Adjustable from 12 to 40 Watts)
470-494 MHz	38 Watts (Adjustable from 12 to 38 Watts)
494-512 MHz	35 Watts (Adjustable from 12 to 35 Watts)
Crystal Multiplication Factor	36
Frequency Stability	
5C-ICOM with EC-ICOM	±0.0005% (-40°C to +70°C)
5C-ICOM or EC-ICOM	±0.0002% (0°C to +55°C)
2C-ICOMS	±0.0002% (-40°C to +70°C)
Spurious and Harmonic Emission	At least 80 dB below full rated power output.
Modulation	Adjustable from 0 to ±5 kHz swing with instantaneous modulation limiting.
Modulation Sensitivity	75 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
406-420 MHz	2.75 MHz	6.00 MHz
450-470 MHz	2.75 MHz	9.00 MHz
470-494 MHz	2.90 MHz	9.50 MHz
494-512 MHz	3.00 MHz	9.75 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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ILLUSTRATIONS

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 transmitters designed for one through eight-frequency operation in the 406 to 420 and 450 to 512 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 seven transistors and one integrated circuit 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 11.3 to 14.2 megahertz, and the crystal frequency is multiplied 36 times.

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

Centralized metering jack J103 is provided fro use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The test set meters the modulator, multiplier and amplifier stages, and the regulated 10-Volts.

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 (±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 only. 2 PPM (±0.0002%) compensator IC. Will not provide compensation for an EC-ICOM.

The ICOMs are enclosed in an 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.

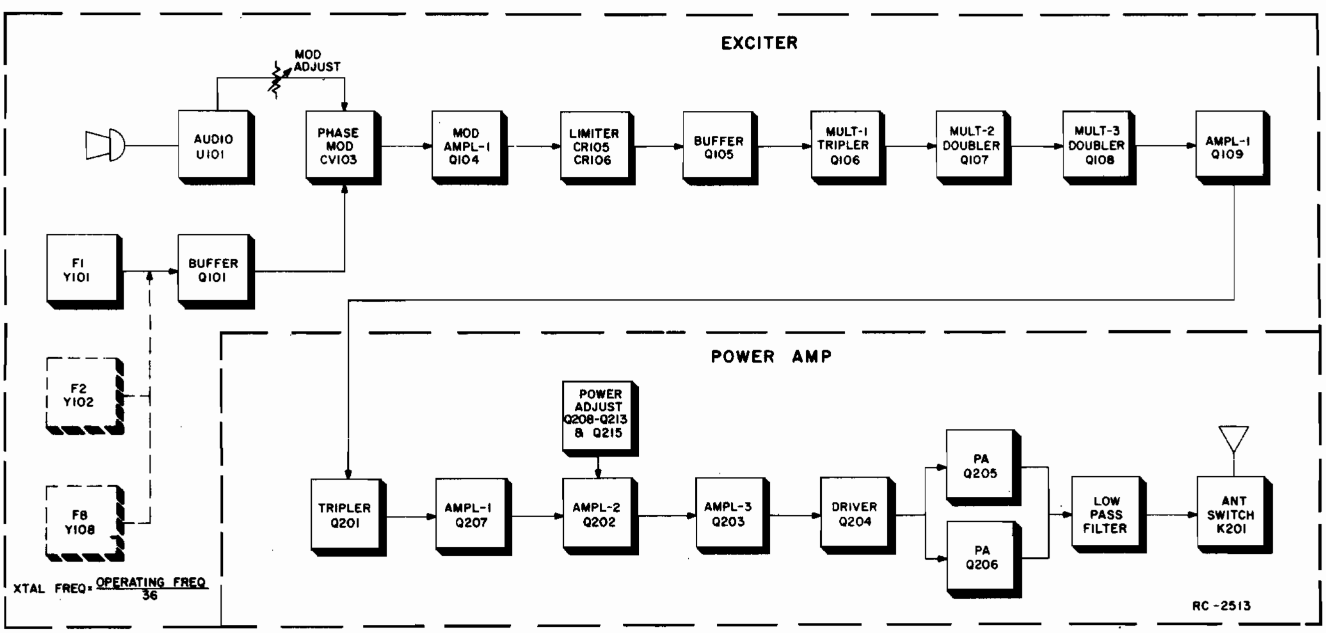

Figure 1 - Transmitter Block Diagram

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.

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 EX-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 termperature 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.

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.

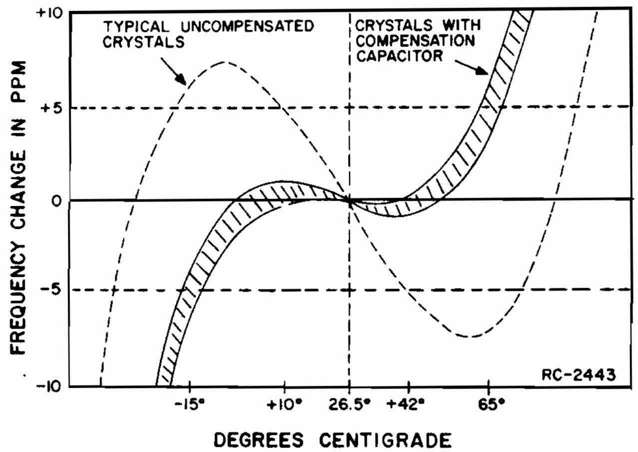

Figure 2 - Typical Crystal Characteristics

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.

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.

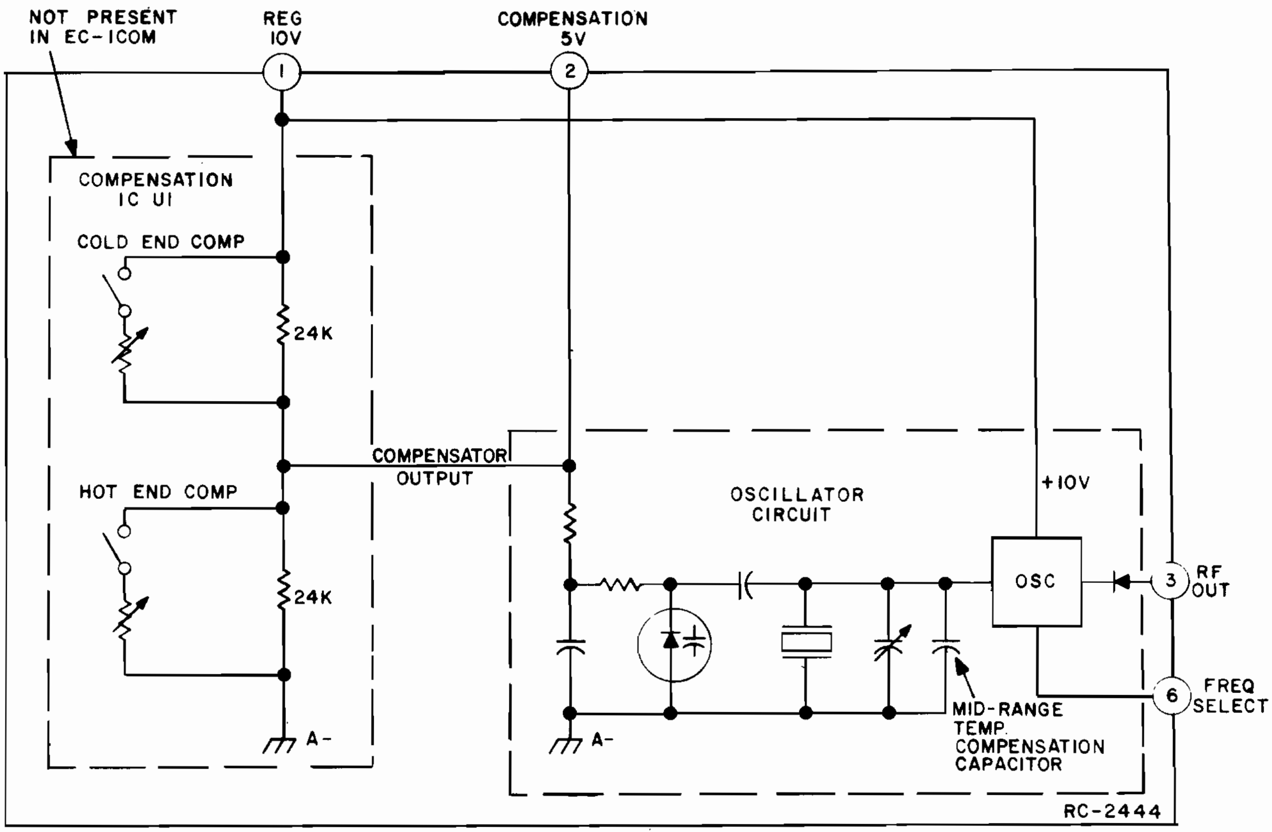

Figure 3 - Equivalent ICOM Circuit

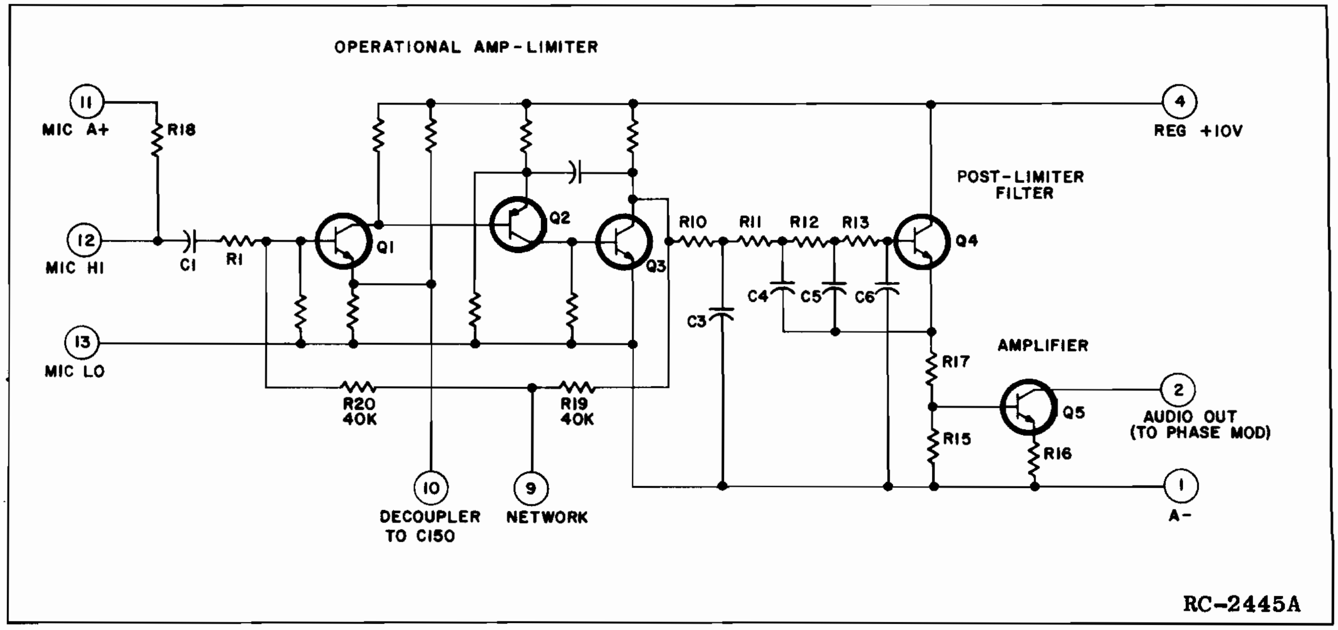

Figure 4 - Simplified Audio IC

AUDIO IC

The transmitter audio circuitry is contained in audio IC U101. 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 preamplifier 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 the resistance in the network (Pin 9).

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 R104 and resistor R125 to the phase modulator.

SERVICE NOTE: If the DC voltages to the Audio IC are correct and no audio output can be obtained, replace U101.

For radios equipped with Channel Guard, tone from the encoder is applied to the phase modulator through CHANNEL GUARD MOD ADJUST potentiometer R105, and resistor R127. Instructions for setting R105 are contained in the modulation adjustment section of the Transmitter Alignment Procedure.

BUFFER, PHASE MODULATORS & AMPLIFIERS

The output at pin 3 of the selected ICOM is coupled through buffer-amplifier Q101 to the modulator stage. The phase modulator is varactor (voltage-variable capacitor) CV103 in series with tunable coil T103. 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 C107 varies the bias of CV103, resulting in a phase modulated output. A voltage divider network (R110 and R111) provides the proper bias for varactor CV103.

The output of the modulator is coupled through blocking capacitor C150 to the base of Class A amplifier Q104. The output of the modulator is metered through C123, R128 and CR104, and is applied to the base of buffer Q105. Diodes CR105 and CR106 remove any amplitude modulation in the modulator output.

BUFFER, MULTIPLIERS & AMPLIFIER

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, Q106. The tripler stage is metered through R138. The output of Q106 is coupled through tuned circuits T104 and T105 to the base of doubler Q107. The doubler stage is metered through R141.

The output of Q107 is coupled through tuned circuits T106 and T107 to the base of second doubler Q108. Q108 is metered through R146.

The output of Q108 is coupled through three tuned circuits (T108, T109 and T110) to the base of amplifier Q109.

Q109 is a Class C amplifier, and is metered through R148. The amplifier collector circuit consists of T111, C154, C155, T112 and C157, and matches the amplifier output to the input of the power amplifier assembly.

POWER AMPLIFIER

The PA assembly uses seven RF power transistors and seven transistors in the Power Control circuitry to provide rated power output. The broadband PA has no adjustments other than Power Control potentiometer R226.

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, C299, L295 and L296 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, providing reverse voltage protection for the radio.

Centralized metering jack J205 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX8K12. The Test Set meters the Tripler drive (exciter output), Ampl-2 input, Driver and PA current.

TRIPLER & RF AMPLIFIERS

The exciter output is coupled through an RF cable to PA input jack J201. The 50-ohm RF input is coupled through a matching network (C206 and W209) to the base of the broadband tripler stage, Q201.

Part of the RF input is rectified by CR201 and is used to activate the Power Control circuit. Another portion of the rectified RF is applied to J205 for metering the tripler drive.

The output of Q201 is coupled through a 20-ohm collector matching network (C212, C213, C4219 and L203) to the input of a high-pass filter consisting of C217 through C225, and W210 through W213.

Following the high-pass filter is a low-pass filter consisting of W214 through W219, C226 through C230 (and C4214 through C4217 in the 406-420 MHz band). The two filter sections combine to act as a band-pass filter providing a minimum of 60 dB rejection below 300 megahertz and 30 dB rejection above 600 megahertz.

In 450 to 512 megahertz transmitters, the filter output is coupled through a matching network (C231, C232, C233 and W220) to the base of Class C amplifier Q207. Collector voltage to Q207 is coupled through collector stabilizing network L220, R216, L219 and C234. The output of Q207 is coupled through a matching network (W221, C236, C237 and W222) to the base of the second Class C amplifier Q202. Drive to Q202 is metered at J205 (Ampl-2 Input) through metering network C238, CR202, C239 and R205.

In 406 to 420 megahertz transmitters, Q207 and its associated circuitry is removed, and the filter output is coupled through C285 to the base of second amplifier Q202.

Collector voltage for Q202 is coupled through stabilizing network L206, R206, L205 and C240. Matching network W223, C241, C242, C243 and W224 matches the output of Q202 to the base of third amplifier Q203.

Collector voltage for Q203 is applied through stabilizing network R207, L209, and C246.

The output of Q203 is coupled through a matching network (W225, C247, C248, C249 and W226) to the base of Class C driver Q204. Collector voltage for Q204 is applied through collector stabilizing network C201, L211 and C267.

Collector current for Q204 is metered across tapped manganin resistor R214 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 Q204 is a matching network (W227 and C253) that matches the driver output to the 50-ohm impedance of power divider network W228 and R209.

The power amplifier stages consist of two identical paralleled Class C PA circuits (Q205 and Q206). One output of the power divider network is applied to the base of Q205 through matching network W229 and C268

Supply voltage for Q205 is coupled through collector stabilizing network L213, R210, L214 and C255. The output of Q205 is coupled through a matching network (W231 and C258) and added to the output of Q206 in power combiner network R212 and W233. The combined collector current for Q205 and Q206 is metered across tapped manganin resistor R213 at J205 (PA Current). 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 a low-pass filter to the antenna through antenna switch K201. Capacitors C214, C270 through C4218 provide DC ground isolation for ± ground operation.

WARNING

The stud mount 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 Q208, turning it on. Turning on Q208 turns on voltage regulator Q210, supplying a constant voltage to Power Adjust potentiometer R226.

Q212, Q213 and Q215 operate as an amplifier chain to supply voltage to the collector of Q202 (Ampl-2). The setting of R226 determines the voltage applied to the base of Q212. The higher the voltage at the base of Q212, the harder the amplifiers conduct, supplying more collector voltage to Q202. The lower the voltage at the base of Q212, the less collector voltage is supplied to Q202. Reducing the supply voltage to Q202 reduces the drive to Q203 and Q204, thereby reducing the power output of the PA. The power output can be adjusted by R226 from approximately 12 to 40 Watts.

Temperature protection is provided by Q209, Q211 and thermistor RT201 which is mounted in the PA heatsink. Under normal operating conditions, the circuit is inactive (Q209 is on and Q211 is off). When the heatsink temperature reaches approximately 100°C, the resistance of RT201 decreases. This increases the base voltage applied to Q209, turning it off. Turning off Q209 allows Q211 to turn on, decreasing the voltage at Power Adjust potentiometer R226. This reduces the base voltage to Q212 which causes Q213 and Q215 to conduct less, reducing the collector voltage to Q202 (Ampl-2). 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 second to 3 minutes.

MAINTENANCE

DISASSEMBLY

To service the transmitter from the top:

1. Pull the locking handle down, then pry up the 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) .

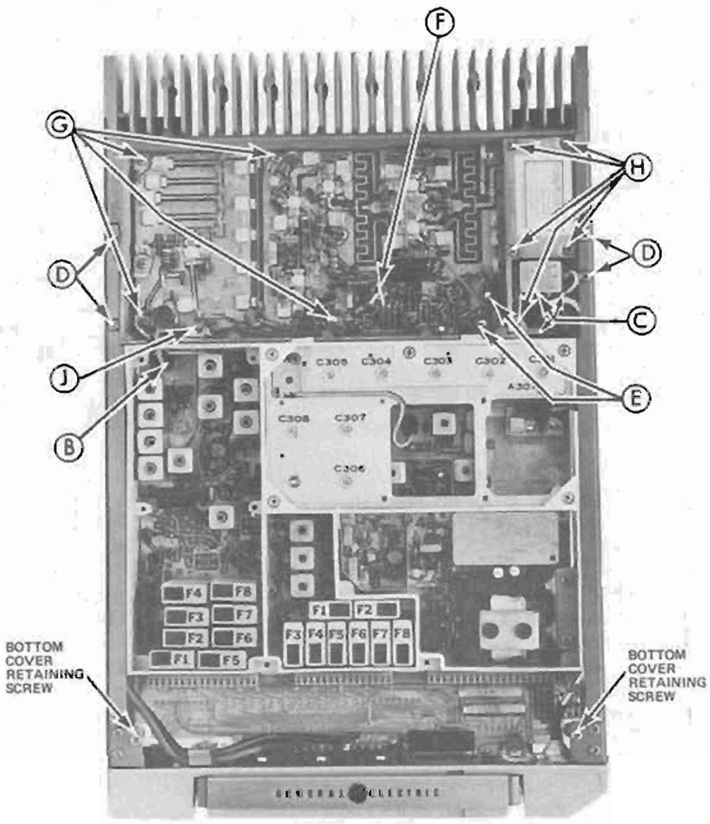

Figure 5 - Disassembly Procedure Top View

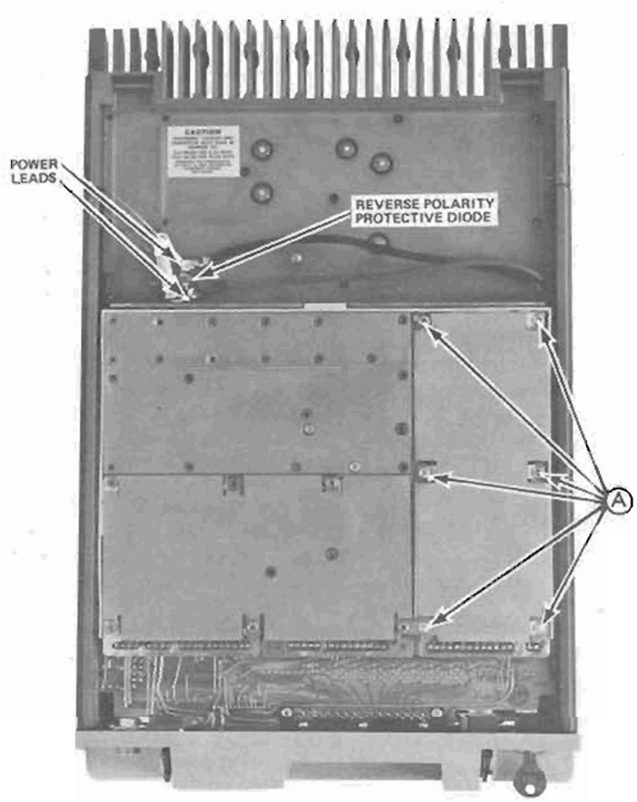

Figure 6 - Disassembly Procedure Bottom View

2. Remove the four side-rail screws Ⓓ, 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 Ⓑ.

2. Unsolder the two feedthrough coils Ⓔ and the thermistor leads Ⓕ.

3. Remove the PA transistor hold-down nuts and spring washers on the bottom of the PA assembly.

4. Remove the four PA board mounding screws Ⓖ, the five screws in the filter casting Ⓗ, and the retaining screw in Q215 Ⓙ, and lift the board out.

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. 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 because part of the matching network is included in the base and collector 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 also indicates the collector.

5. Applying 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 (8 inch-pounds). A torque wrench must be used for this adjustment since transistor damage can result if too little or too much torque is used.

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.

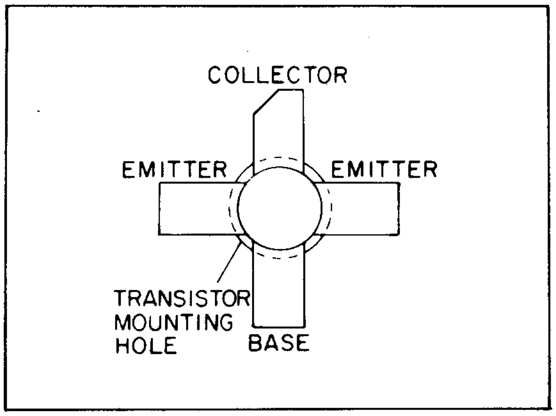

Figure 7 - Lead Identification

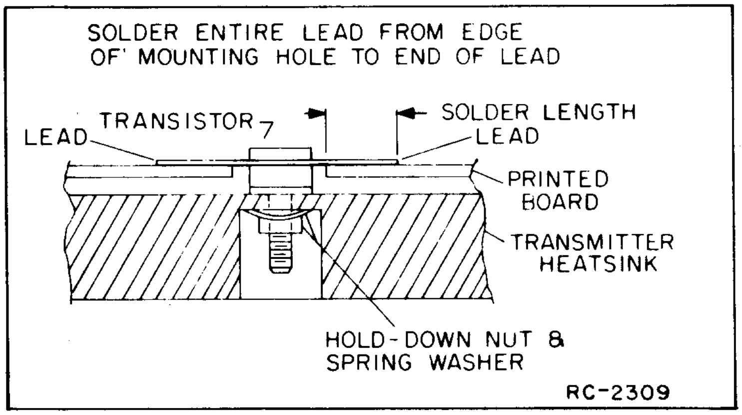

Figure 8 - Lead Forming

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MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R104) was adjusted to the proper setting before shipment 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 de-emphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing overmodulation while preserving intelligibility.

TEST EQUIPMENT

1. An audio oscillator (GE Model 4EX6A10)
2. A frequency modulation monitor
3. An output meter or a VTVM
4. GE Test Set Model 4EX3A11 or 4EX8K12

PROCEDURE

1. Connect the audio oscillator and the meter across audio input terminals J10 (Green-Hi) and J11 (Black-Lo) on GE Test Set, and connect red Test Set plug to the System red metering plug. If not using GE Test Set, connect audio oscillator and meter across P902-6 (Mike High) through a 0.5 microfarad (or larger) DC blocking capacitor, and P902-5 (Mike-Low) on the System Board.
2. Adjust the audio oscillator for 1-Volt RMS at 1000 Hz.
3. For transmitters without Channel Guard, set MOD ADJUST R104 for a 4.5-kHz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.
4. For transmitters with Channel Guard, set Channel Guard MOD ADJUST R105 for zero tone deviation. Next, with the 1-Volt signal at 1000 Hz applied, set MOD ADJUST R104 for 3.75 kHz deviation. Then remove the signal from the audio oscillator and set Channel Guard MOD ADJUST R105 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:

$$P_i = \text{PA voltage} \times \text{PA current}$$

where:

P_i is the power input in Watts,

PA voltage is measured with Test Set Model 4EX3A11 in Position G on the 15-Volt range (read as 15 Volts full scale), and with the polarity switch in the (-) position. With Test Set Model 4EX8K12, use the B+ position and the 1-Volt range (read as 15 Volts full scale), with the HIGH 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 HIGH SENSITIVITY button pressed (10 amperes full scale).

Example:

P_i = 12.6 Volts x 3.4 amperes = 43 Watts

ICOM FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency should be set with a frequency meter or counter with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained, and with the entire radio as near as possible to an ambient temperature of 26.5°C (79.8°F).

MASTR II ICOMs should be reset only when the frequency shows deviation in excess of the following limits:

A. ±0.5 PPM, when the radio is at 26.5°C (79.8°F).

B. ±2 PPM at any other temperature within the range of -5°C to +55°C (+23°F to +131°F).

C. The specification limit (±2 PPM or ±5 PPM) at any temperature within the ranges of -40°C to -5°C (-40°F to +23°F) or +55°C to +70°C (+131°F to +158°F).

If an adjustment is required, pry up the cover on the top of the ICOM to expose the trimmer, and use one of the following procedures:

If the radio is at an ambient temperature of 26.5°C (79.8°F), set the oscillator for the correct operating frequency.

If the radio is not at an ambient temperature of 26.5°C, setting errors can be minimized as follows:

A. To hold the setting error to ±0.6 PPM (which is considered reasonable for 5 PPM ICOMS):

   1. Maintain the radio at 26.5°C (±5°C) and set the oscillator to desired frequency, or-
   2. Maintain the radio at 26.5°C (±10°C) and offset the oscillator, as a function of actual temperature, by the amount shown in Figure 9.

B. To hold setting error to ±0.35 PPM (which is considered reasonable for 2 PPM ICOMs): Maintain unit at 26.5°C (±5°C) 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 18.5°C (65.4°F). At that temperature, the curve shows a correction factor of 0.3 PPM. (At 406 MHz, 1 PPM is 406 Hz. At 512 MHz, 1 PPM is 512 Hz).

With an operating frequency of 450 MHz, set the oscillator for a reading of 135 Hz 0.3 x 450 Hz) higher than the licensed operating frequency. If a negative correction actor is obtained (at temperatures above 26.5°C), set the oscillator for the indicated PM lower than the licensed operating frequency.

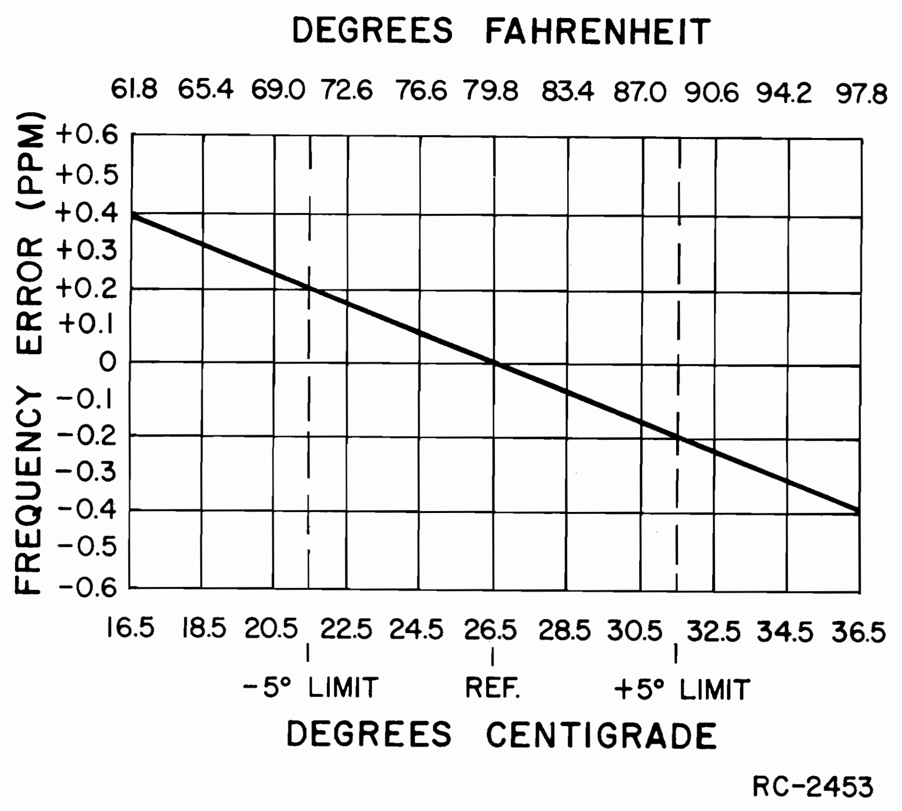
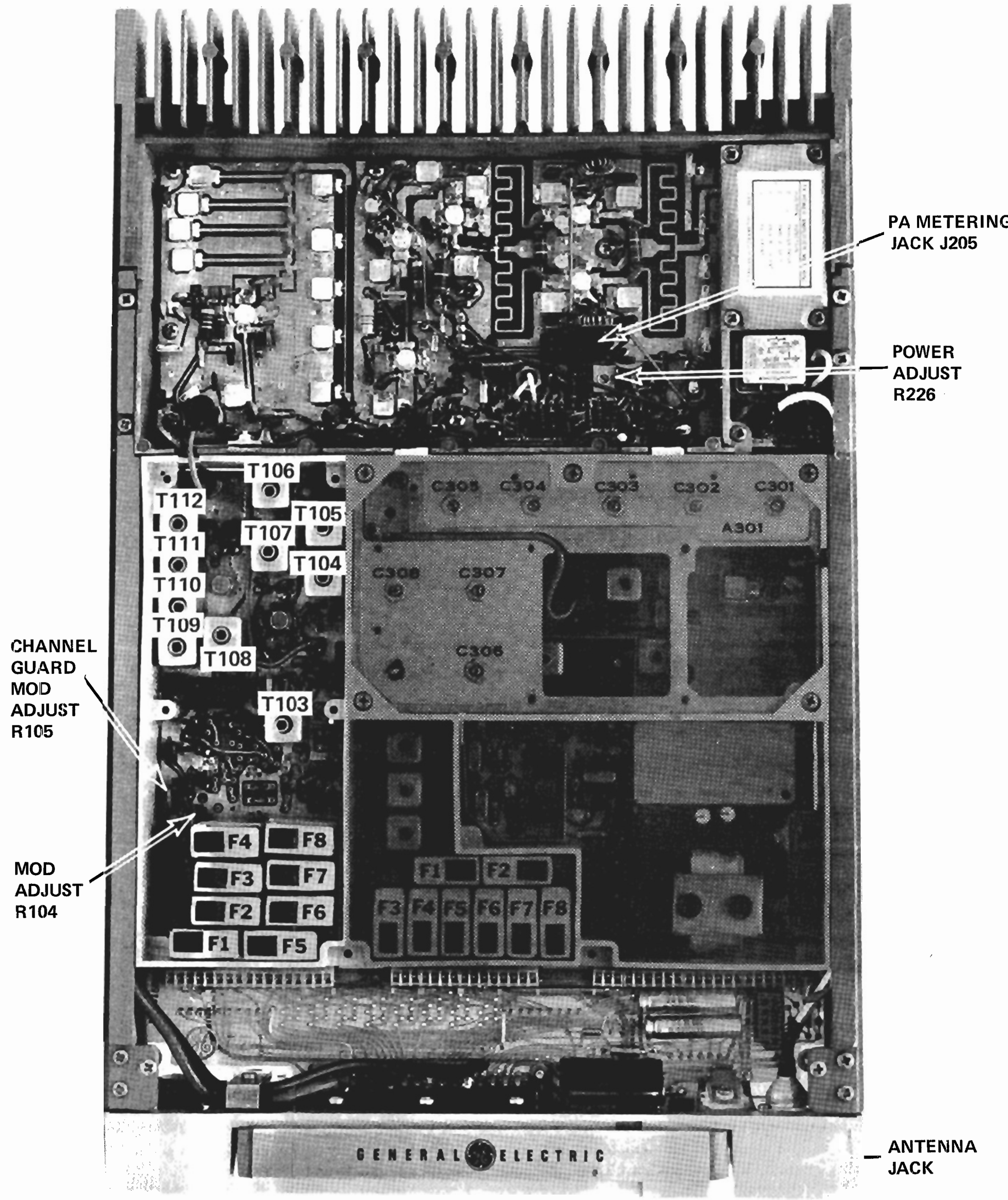


Figure 9 - Frequency Characteristics Vs. Temperature



TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED

1. GE Test Set Model 4EX3A11 or Test Kit 4EX8K12.
2. A 50-ohm wattmeter connected to antenna jack J906.
3. A frequency counter.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Place ICOMs on Exciter Board (crystal frequency = operating frequency ÷ 36).
2. For a large change in frequency or badly mis-aligned transmitter, pre-set the slugs in T104 and T105 to the bottom of the coil form. Pre-set all of the other slugs to the top of the coil form.

> NOTE
>
> The tuning frequency for multi-frequency transmitters is determined by the operating frequency and the frequency spread between transmitters. Refer to the table below for maximum frequency spread.

3. For multi-frequency transmitters with a frequency spread less than that specified in column (1) tune the transmitters to the lowest frequency. For a frequency spread exceeding the limits specified in column (1) tune the transmitters using a center frequency tune up ICOM. Except the maximum frequency spread can be extended to the limits specified in column (3) with 1 dB degradation.

   For tuning L101, L102, and L103, always tune L101, L102, and L103 on the lowest frequency.

Multi-frequency Transmitter Tuning

Transmitter Frequency Range	MAXIMUM FREQUENCY SPREAD		
	(1) Without center tuning	With center tuning	With center tuning (1 dB degradation)
406-420 MHz	2.75 MHz	5.50 MHz	6.00 MHz
450-470 MHz	2.75 MHz	5.50 MHz	9.00 MHz
470-494 MHz	2.90 MHz	5.80 MHz	9.50 MHz
494-512 MHz	3.00 MHz	6.00 MHz	9.75 MHz

4. Connect the red plug on the GE Test Set to the System Board metering jack, and the black plug to the Exciter metering jack. Set the polarity to +, and set the range to the Test 1 position (1-Volt position for 4EX8K12) for all adjustments.
   NOTE: With the Test Set connected to the PA metering jack, the voltage reading at position "F" with the HIGH SENSITIVITY button pressed may be converted to driver collector current by reading the current as 10 amperes full scale. The voltage reading at position "G" with the HIGH SENSITIVITY button pressed may be converted to PA collector current by reading the current as 10 amperes full scale.
5. All adjustments are made with the transmitter keyed. Unkey the transmitter between steps to avoid unnecessary heating.

STEP	METER POSITION	TUNING CONTROL	METER READING	PROCEDURE
1.	B (MOD-1)	T103	See Procedure	Tune T103 for the maximum meter reading on the lowest frequency. After tuning T103 for maximum, turn the slug 1/8 of a turn clockwise(increasing inductance).
2.	C (MULT-1)	T104	Minimum	Tune T104 for a dip in meter reading.
3.	D (MULT-2)	T105, T104 & T106	See Procedure	Tune T105 for maximum meter reading and re-adjust T104 for maximum meter reading. Then tune T106 for a dip in meter reading.
4.	F (MULT-3)	T107, T106, T108 & T109	See Procedure	Tune T107 for maximum meter reading and re-adjust T106 for maximum meter reading. Then tune T108 for a dip in meter reading and T109 for maximum meter reading.
5.	G (AMPL-1)	T110, T108 & T109	Maximum	Tune T110 for maximum meter reading, and then re-adjust T108 and T109 for maximum meter reading.
6.	D (AMPL-1 DRIVE on PA)	T111 & T112	Maximum	Move the black metering plug to the Power Amplifier metering jack and tune T111 and then T112 for maximum meter reading. Then alternately tune T111 and T112 for maximum meter reading.
7.	G (AMPL-1)	T108, T109 & T110	Maximum	Move the black metering plug back to the exciter metering jack and re-adjust T108, T109 and T110 for maximum meter reading.
8.	D (AMPL-1 DRIVE on PA)	T111 & T112	Maximum	Move the black metering plug back to the Power Amplifier metering jack and re-adjust T111 and T112 for maximum meter reading.
9.		R226		With the battery voltage at 13.6 Volts or the PA collector voltage at 13.0 Volts, set Power Adjust potentiometer R226 on the PA board for the desired power output (from 12 to 40 Watts). If the battery voltage is not at 13.6 Volts or the collector voltage at 13.0 Volts and full rated output is desired (40,38 or 35 Watts at 13.6 Volts), set R226 for the output power according to the battery voltage or collector voltage shown in Figures 10, 11 or 12. NOTE: The PA collector voltage is measured as described in the PA POWER INPUT section.
	ADDITIONAL STEPS FOR TRANSMITTERS USING CENTER FREQUENCY TUNE-UP ICOM			
10.	D (MULT-2)	T105	See Procedure	Move the black metering plug to the exciter metering jack and re-adjust T105 for equal drive on the highest and lowest frequency.
11.	G (AMPL-1)	T110 & T108	Maximum	Re-adjust T110 and then T108 for maximum meter reading on the lowest frequency.

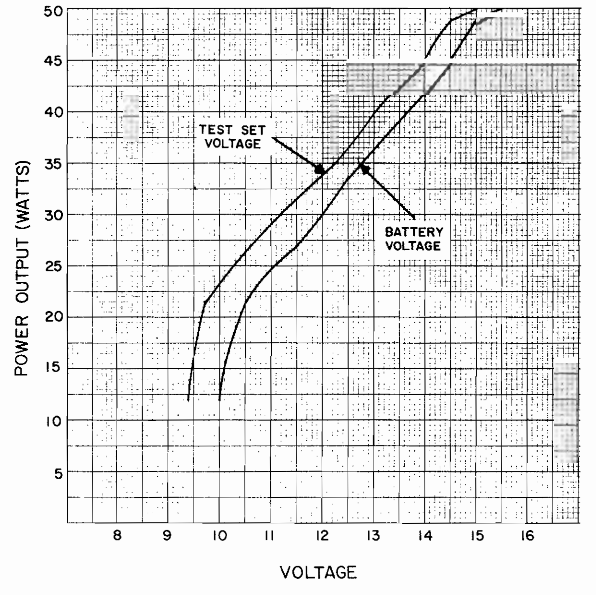


Figure 10 - 40-Watt Power Output Setting Chart

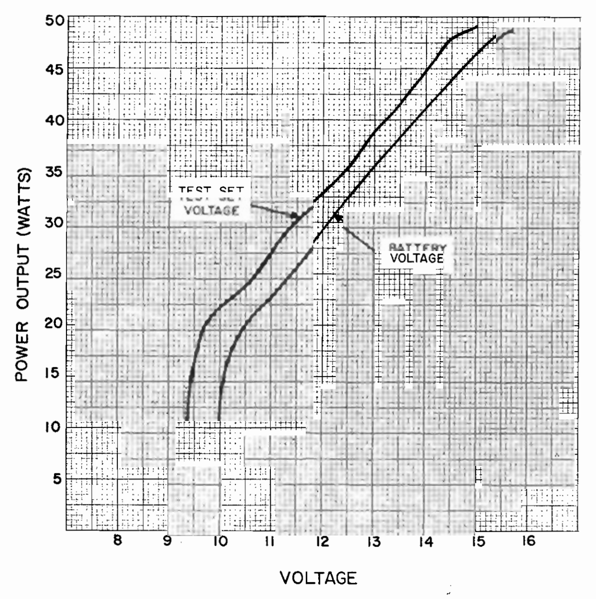


Figure 11 - 38-Watt Power Output Setting Chart

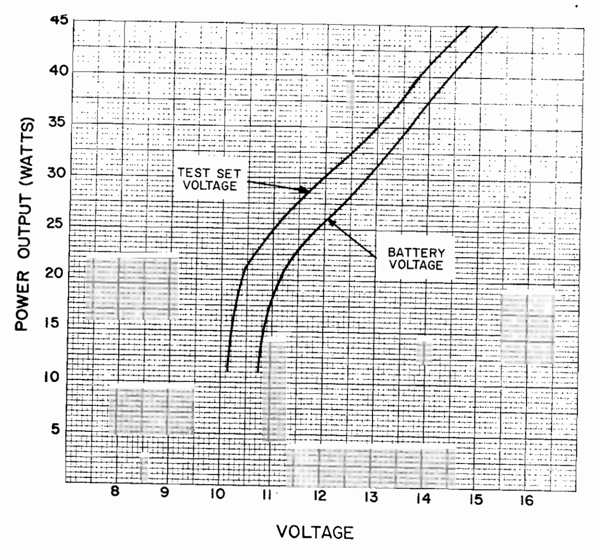


Figure 12 - 35-Watt Power Output Setting Chart

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, 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.

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: 20 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 limits 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 EIA Standard Test Voltages (13.6 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 Lapp Model 73) may be usable when operated in parallel with a 12-Volt automotive storage battery.

TEST EQUIPMENT REQUIRED

for test hookup as shown:

1. Wattmeter similar to:
   Bird # 43
   Jones # 711N
2. VTVM similar to:
   Triplett # 850
   Heath # IM-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 ohms-per-Volt voltmeter

POWER MEASUREMENT

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 (R226).

Refer to the QUICK CHECKS on the Transmitter Troubleshooting Procedure.

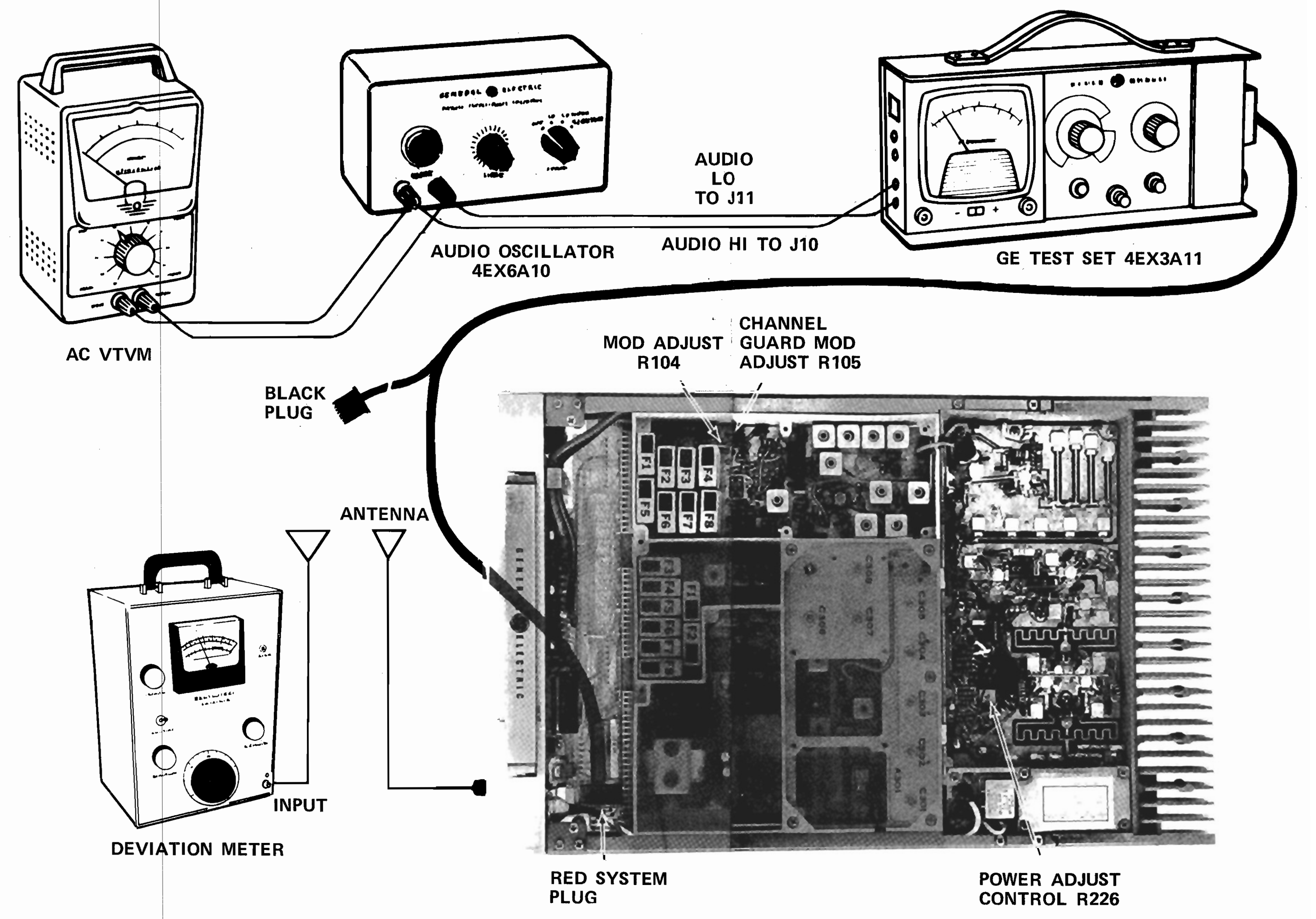
VOICE DEVIATION, SYMMETRY AND AUDIO SENSITIVITY

TEST PROCEDURE

1. Connect the test equipment to the transmitter as shown.
2. In radios with Channel Guard, set Channel Guard Mod Adjust R105 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 ±4.5 kHz in radios without Channel Guard, and ±3.75 kHz in radios with Channel Guard.
6. If necessary, adjust MOD ADJUST control R104 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.



TONE 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 R105 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 Step 1 in the Transmitter Alignment Chart).
2. The Tone Deviation Test Procedures should be repeated every time the Tone Frequency is changed.

STEP 1 - QUICK CHECKS

METER POSITION GE TEST SET	PROBABLE DEFECTIVE STAGE: HIGH METER READING	LOW METER READING	ZERO METER READING
EXCITER			
B (MOD-1)	Q102, 10-Volt Regulator	T103, CV103 C104	T103, CV103, CR104, Q104
C (MULT-1)	Q105, Q106 T104	Q105, Q106	Q105, Q106, T104
D (MULT-2)	Q107, T106	T104, T104, Q107	T104, T105, Q107, T106
F (MULT-3)	Q108, T108	T106, T107, Q108	T106, T107, Q108, T108
G (AMPL-1)	Q109, C157	T108, T109, T110, Q109	T108, T109, T110, Q109, L106
POWER AMPLIFIER			
"C" (TRIPLER DRIVE)		Low Output from Exciter	No output from Exciter CR201
"D" (AMPL-2 INPUT)	Q207	Q207	Q207, Q201
"F" (DRIVER CURRENT)	Q204	Q204, Low Output from Q201, Q207, Q202, Q203	Q203, Q202, Q207, Q201. Check Pos. C & D
"G" (PA CURRENT)	Q205, Q206	Q201, Q207, Q202, Q203, Q204, Q205, Q206	Q206, Q205, Q204, Q203, Q202, Q207, Q201, Q215

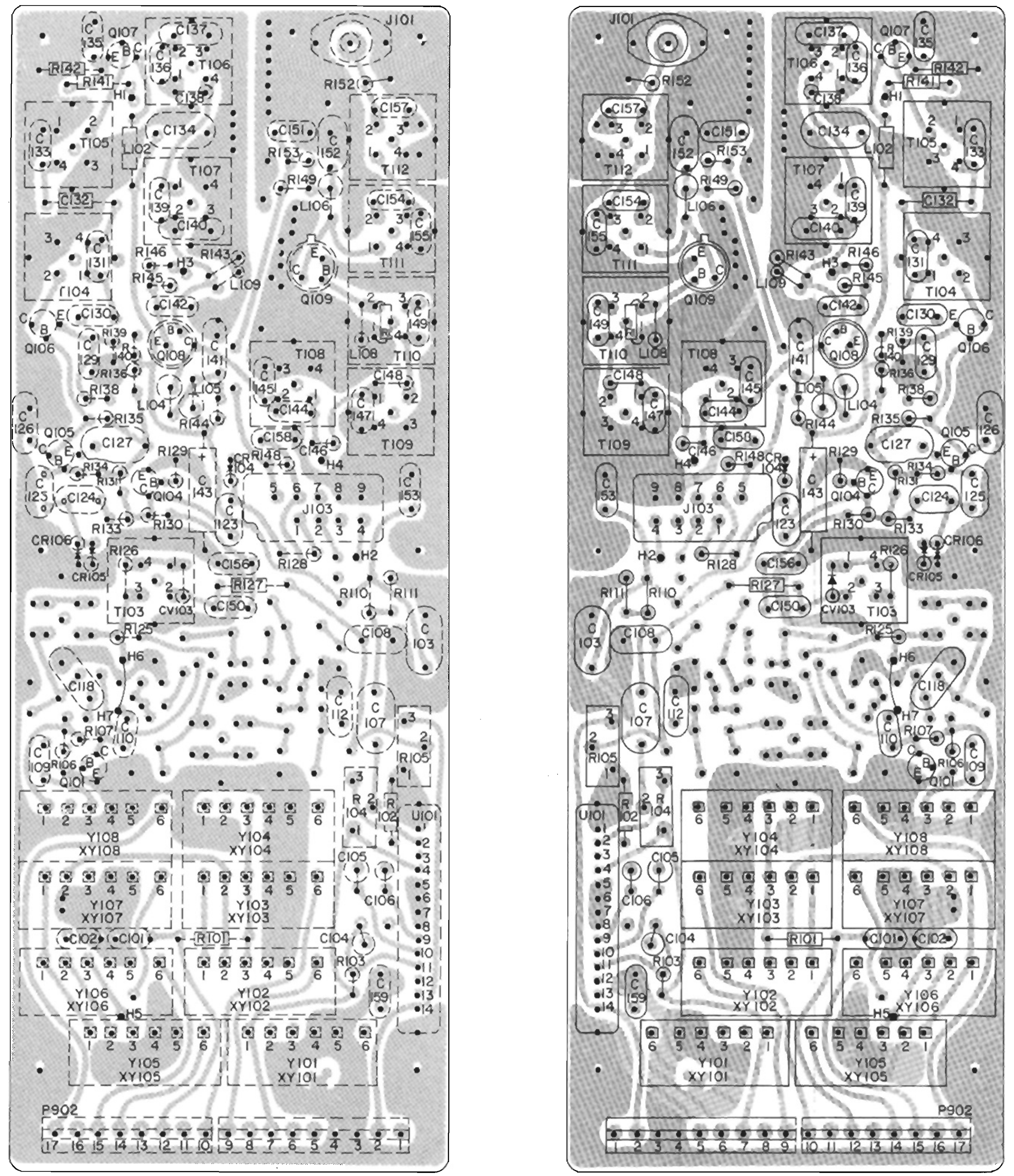
TROUBLESHOOTING PROCEDURE

406—512 MHz, 40-WATT TRANSMITTER

EXCITER BOARD

SOLDER SIDE

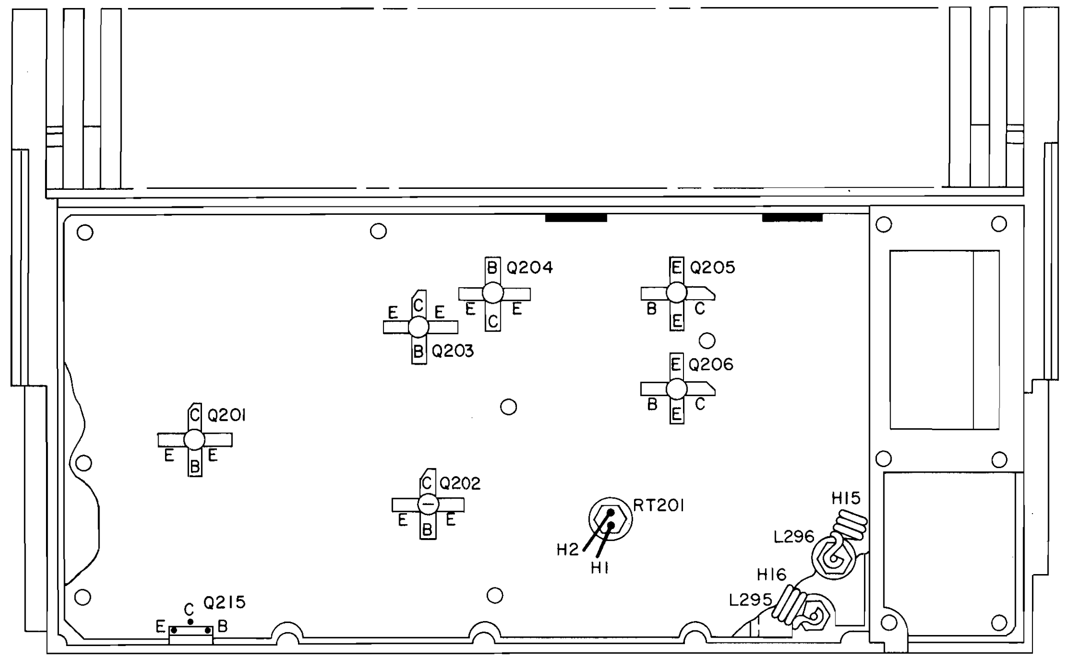
COMPONENT SIDE

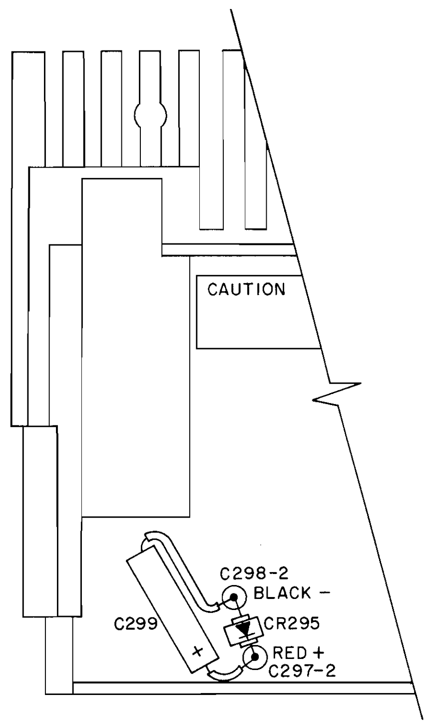


(19D416850, Sh. 2, Rev. 3)

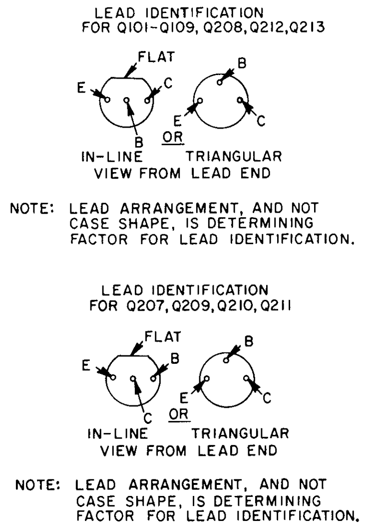
(19D416850, Sh. 2, Rev. 3)
(19D416850, Sh. 3, Rev. 3)

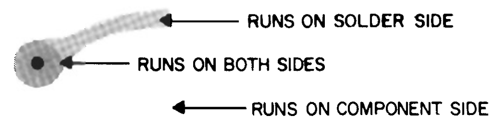
PA ASSEMBLY
TOP VIEW



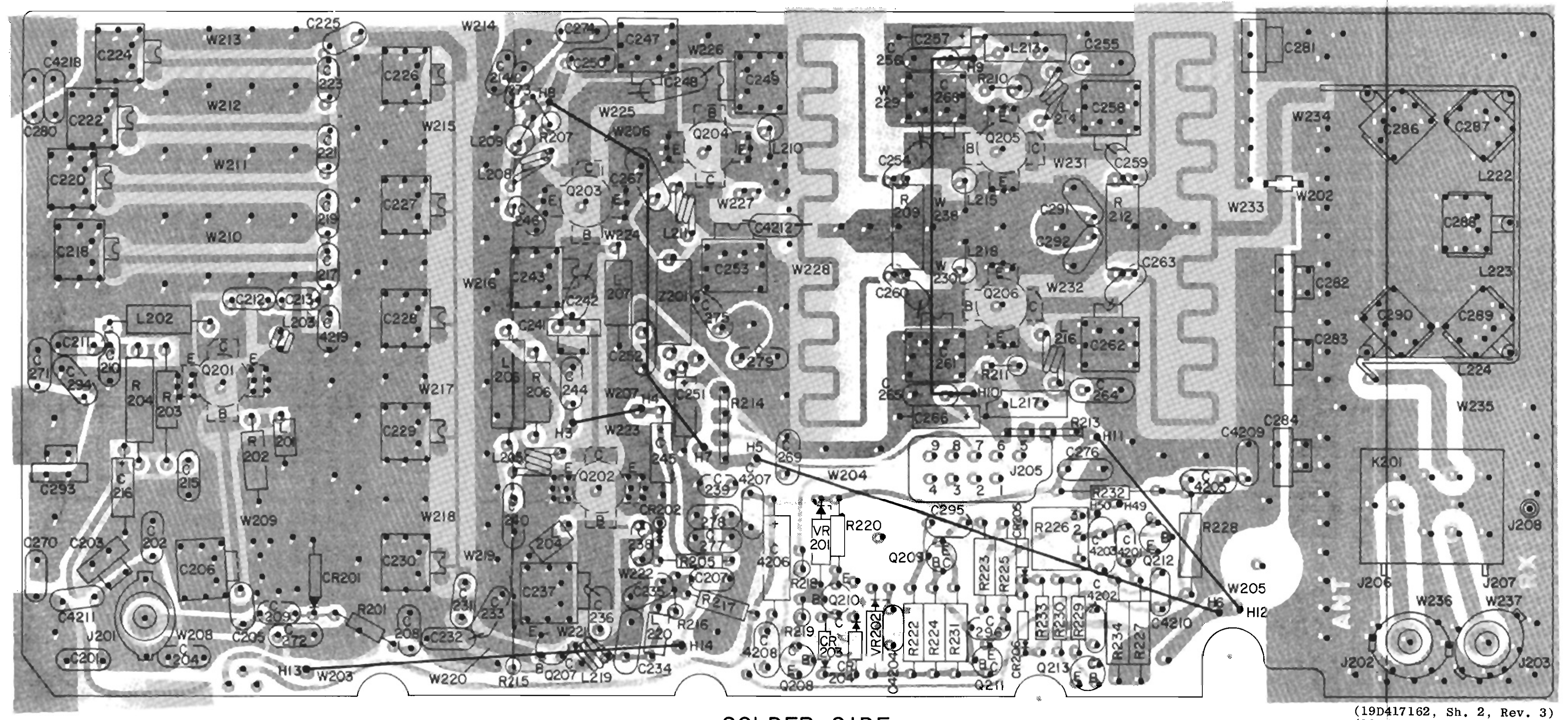


(19R622078, Rev. 3)





PA BOARD
COMPONENT SIDE



(19D417162, Sh. 2, Rev. 3)
(19D417162, Sh. 3, Rev. 5)

SOLDER SIDE

(19D417162, Sh. 2, Rev. 3)

OUTLINE DIAGRAM

406—512 MHz, 40-WATT TRANSMITTER

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A: Exciter Board 19D416859G5, G7. To improve operation. Deleted C136L. Changed C136H, C137, C144L, C145, C146, CV103. Added C137L, C145L, C146L, CV103L, L108, R152 and R153.

REV. B: To improve drive to modulator. Changed Q101 and R106.

REV. C: To increase power output and decrease transmitter noise. Changed Q109, R149 and C109. Deleted R153, C155L and C157L. Added C161L and C162L.

REV. A: Exciter Board 19D416859G6, G8. To improve drive to modulator. Changed Q101 and R106.

REV. B: To increase power output and reduce transmitter noise. Changed Q109, R149, and C109. Deleted C155H and C157H. Added C161H and C162H.

PARTS LIST

LBI-4609A

406-420 MHz, 450-512 MHz EXCITER BOARD
19D416859G5-G8

SYMBOL	GE PART NO.	DESCRIPTION
		19D416859G5 2 FREQ 406-420 MHz (L) 19D416859G6 2 FREQ 450-512 MHz (H) 19D416859G7 8 FREQ 406-420 MHz (L) 19D416859G8 8 FREQ 450-512 MHz (H)
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C101 and C102	19A116080P1	Polyester: 0.01 μf ±20%, 50 VDCW.
C103	19A116080P107	Polyester: 0.1 μf ±10%, 50 VDCW.
C104	5496267P10	Tantalum: 22 μf ±20%, 15 VDCW; sim to Sprague Type 150D.
C105	5496267P14	Tantalum: 15 μf ±20%, 20 VDCW; sim to Sprague Type 150D.
C106	5496267P9	Tantalum: 3.3 μf ±20%, 15 VDCW; sim to Sprague Type 150D.
C107	19A116080P107	Polyester: 0.1 μf ±10%, 50 VDCW.
C108	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C109 and C110	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C112	5494481P107	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C118	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C123 thru C125	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C126	7489162P27	Silver mica: 100 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C127	19A116080P107	Polyester: 10 μf ±10%, 50 VDCW.
C129 and C130	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C131L	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C131H	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C132	5491601P118	Phenolic: 0.75 pf ±5%, 500 VDCW.
C133L	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C133H	5496219P248	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -80 PPM.
C134	19A116080P107	Polyester: 0.1 μf ±10%, 50 VDCW.
C135	19A116080P105	Polyester: 0.047 μf ±10%, 50 VDCW.
C136*	5496219P246	Ceramic disc: 20 pf ±5%, 500 VDCW, temp coef -80 PPM. Added to G5 and G7 by REV A.
C136L*	5496219P348	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -150 PPM. Deleted from G5 and G7 by REV A.
C136H*	5496219P246	Ceramic disc: 20 pf ±5%, 500 VDCW, temp coef -80 PPM. Deleted from G5 and G7 by REV A.
C137*	5496219P251	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -80 PPM. Deleted from G5 and G7 by REV A.
C137L*	5496219P254	Ceramic disc: 43 pf ±5%, 500 VDCW, temp coef -80 PPM. Added to G5 and G7 by REV A.
C137H*	5496219P251	Ceramic disc: 33 pf ±5%, 500 VDCW, temp coef -80 PPM. Added to G5 and G7 by REV A.
C138	5491601P115	Phenolic: 0.56 pf ±5%, 500 VDCW.
C139L	5496219P247	Ceramic disc: 22 pf ±5%, 500 VDCW, temp coef -80 PPM.
C139H	5496219P243	Ceramic disc: 13 pf ±5%, 500 VDCW, temp coef -80 PPM.
C140	5496219P348	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef -150 PPM.
C141	5490008P127	Silver mica: 100 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C142	7489162P25	Silver mica: 82 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C143	5496267P10	Tantalum: 22 μf ±20%, 15 VDCW; sim to Sprague Type 150D.
C144L*	5496219P243	Ceramic disc: 13 pf ±15%, 500 VDCW, temp coef -80 PPM.
		In G5 and G7 earlier than REV A:
	5496219P244	Ceramic disc: 15 pf ±15%, 500 VDCW, temp coef -80 PPM.
C144H	5496219P241	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C145*	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM. Deleted in G5 and G7 by REV A.
C145L*	5496219P252	Ceramic disc: 36 pf ±5%, 500 VDCW, temp coef -80 PPM. Added to G5 and G7 by REV A.
C145H*	5496219P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM. Added to G5 and G7 by REV A.
C146*	5491601P113	Phenolic: 0.47 pf ±5%, 500 VDCW. Deleted in G5 and G7 by REV A.
C146L*	5491601P109	Phenolic: 0.33 pf ±5%, 500 VDCW. Added to G5 and G7 by REV A.
C146H*	5491601P113	Phenolic: 0.47 pf ±5%, 500 VDCW. Added to G5 and G7 by REV A.
C147L	5496219P239	Ceramic disc: 8.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C147H	5496219P236	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C148	5491601P111	Phenolic: 0.39 pf ±5%, 500 VDCW.
C149L	5496219P241	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C149H	5496219P237	Ceramic disc: 6.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C150	5496372P365	Ceramic disc: 470 pf ±10%, 500 VDCW, temp coef -4700 PPM.
C151	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C152	19A116080P107	Polyester: 0.1 μf ±10%, 50 VDCW.
C153	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C154L	5496219P238	Ceramic disc: 7.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C154H	5496219P236	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C155L	5496219P243	Ceramic disc: 13 pf ±5%, 500 VDCW, temp coef -80 PPM.
C155H	5496219P241	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C156	5494481P112	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C157L	5496219P238	Ceramic disc: 7.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C157H	5496219P236	Ceramic disc: 5.0 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C158 and C159	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR104 thru CR106	19A115250P1	Silicon.
CV103*	5495769P8	Silicon, capacitive: 33 pf ±20%, at 4 VDC. Deleted in G5 and G7 by REV A.
CV103L*	5495769P9	Silicon, capacitive: 33 pf ±20%, at 4 VDC. Added to G5 and G7 by REV A.
CV103H*	5495769P8	Silicon, capacitive: 33 pf ±20%, at 4 VDC. Added to G5 and G7 by REV A.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J101	19A116832P1	Receptacle, coaxial: sim to Cinch 14H11613.
J103	19B219374G1	Connector. Includes:
	19A116651P1	Contacts. (9).
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L102	19B209420P130	Coil, RF: 27.0 μh ±10%, 3.60 ohms DC res max; sim to Jeffers 441316-5.
L104	7488079P7	Choke, RF: 1.50 μh ±10%, 0.50 ohms DC res max; sim to Jeffers 4411-10K.
L105	7488079P18	Choke, RF: 15.0 μh ±10%, 1.20 ohms DC res max; sim to Jeffers 4421-9K.
L106	7488079P5	Choke, RF: 0.68 μh ±10%, 0.15 ohms DC res max; sim to Jeffers 4411-5K.
L108 and L109	19B209420P123	Coil, RF: 6.80 μh ±10%, 1.80 ohms DC res max; sim to Jeffers 4446-2.
		- - - - - - - - - - PLUGS - - - - - - - - - -
P902		Includes:
	19B219594P2	Contact strip: 8 pins.
	19B219594P3	Contact strip: 9 pins.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q101*	19A115330P1	Silicon, NPN.
		In G5, G7 of REV A and earlier: In G6, G8 of REV B and earlier:
	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q104 thru Q106	19A115330P1	Silicon, NPN.
Q107	19A115328P1	Silicon, NPN.
Q108 and Q109	19A115329P2	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - -
R101	3R152P561K	Composition: 560 ohms ±10%, 1/4 w.
R102	3R152P391K	Composition: 390 ohms ±10%, 1/4 w.
R103	3R152P102K	Composition: 1000 ohms ±10%, 1/4 w.
R104	19B209358P106	Variable, carbon film: approx 75 to 10,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R105	19B209358P108	Variable, carbon film: approx 100 to 50,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R106*	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
		In G5, G7 of REV A and earlier: In G6, G8 of REV B and earlier:
	3R152P393K	Composition: 39,000 ohms ±10%, 1/4 w.
R107	3R152P331K	Composition: 330 ohms ±10%, 1/4 w.
R110	3R152P104K	Composition: 0.10 megohm ±10%, 1/4 w.
R111	3R152P474K	Composition: 0.47 megohm ±10%, 1/4 w.
R125	3R152P102K	Composition: 101000 ohms ±10%, 1/4 w.
R126	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R127	3R152P223K	Composition: 22,000 ohms ±10%, 1/4 w.
R128	3R152P683K	Composition: 69,000 ohms ±10%, 1/4 w.
R129	3R152P222K	Composition: 2200 ohms ±10%, 1/4 w.
R130	3R152P562K	Composition: 5600 ohms ±10%, 1/4 w.
R131	3R152P471K	Composition: 470 ohms ±10%, 1/4 w.
R133	3R152P561K	Composition: 560 ohms ±10%, 1/4 w.
R134	3R152P223K	Composition: 22,000 ohms ±10%, 1/4 w.
R135	3R152P102K	Composition: 1000 ohms ±10%, 1/4 w.
R136	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
R138	3R152P473K	Composition: 47,000 ohms ±10%, 1/4 w.
R139	3R152P181K	Composition: 180 ohms ±10%, 1/4 w.
R140	3R152P271K	Composition: 270 ohms ±10%, 1/4 w.
R141	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R142	3R152P620J	Composition: 62 ohms ±5%, 1/4 w.
R143	3R152P331K	Composition: 330 ohms ±10%, 1/4 w.
R144	3R152P181K	Composition: 180 ohms ±10%, 1/4 w.
R145	3R152P390K	Composition: 39 ohms ±10%, 1/4 w.
R146	3R152P333K	Composition: 33,000 ohms ±10%, 1/4 w.
R148	3R77P100J	Composition: 10 ohms ±5%, 1/2 w.
R149	3R152P100K	Composition: 10 ohms ±10%, 1/4 w.
R152*	3R152P391K	Composition: 390 ohms ±10%, 1/4 w. Added to G5 and G7 by REV A.
R153*	3R152P100K	Composition: 10 ohms ±10%, 1/4 w. Added to G5 and G7 by REV A.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T103	19D416843G1	Coil. Includes:
	5493185P12	Tuning slug.
T104	19D416843G3	Coil. Includes:
	5493185P12	Tuning slug.
T105	19D416843G2	Coil. Includes:
	5493185P12	Tuning slug.
T106 and T107	19D416843G7	Coil. Includes:
	5493185P12	Tuning slug.
T108 and T109	19D416843G5	Coil. Includes:
	5493185P13	Tuning slug.
T110		COIL ASSEMBLY 19D416843G8
		- - - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P151K	Composition: 150 ohms ±10%, 1/4 w.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	5493185P13	Tuning slug.
T111	19D416843G4	Coil. Includes:
	5493185P12	Tuning slug.
T112	19D416843G6	Coil. Includes:
	5493185P12	Tuning slug.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U101	19D416542G1	Audio Transmitter.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XY101 thru XY108		Socket. Part of Mechanical Construction. Includes:
	19A116779P1	Contact, electrical: sim to Molex 08-54-0404. Quantity (6) with each.
		- - - - - - - - - - OSCILLATORS - - - - - - - - -
		NOTE: When reordering specify ICOM Frequency.
		ICOM Freq = $\frac{\text{Operating Frequency}}{36}$
Y101 thru Y108	19A129393G18	Externally compensated, ±5 PPM, 406-512 MHz.
Y101 thru Y108	19A129393G15	Externally compensated, ±2 PPM, 406-512 MHz.
		MECHANICAL PARTS
	19A129424G2	Can. (Used with T103-T112).
	4036555P1	Insulator, washer: nylon. (Used with Q108, Q109).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

COMPONENT IDENTIFICATION	L 406-420 MHZ	H 450-512 MHZ
C131	27	24
C133	27	24
C137	43	33
C139	22	13
C144	13	10
C145	36	27
C146	.33	.47
C147	8	5
C149	10	6
C154	7	5
C155	13	10
C157	7	5
R152	390	NONE
R153	10	NONE

* COMPONENT VALUES AS FOLLOWS:

▲THESE COMPONENTS NOT PRESENT ON 2ND EXCITER IN WIDE SPACE XMTR COMBINATIONS.

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MADE WITH THE TRANSMITTER KEYED, AND MEASURED WITH A 20,000 OHMS-PER-VOLT METER WITH REFERENCE TO A- AND NOT CHASSIS GROUND.

AN RF CHOKE (25-50 MICROHENRYS) IS USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

EXCITER BOARD	REV LETTER	FREQ RANGE	NO. FREQ.
19D416859G5	B	406-420	2
19D416859G6	A	450-512	2
19D416859G7	B	406-420	8
19D416859G8	A	450-512	8

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

SCHEMATIC DIAGRAM

406—512 MHz, EXCITER BOARD
19D416859G5-G8

(19R622018, Rev. 5)

* COMPONENT VALUES AS FOLLOWS

COMP IDENT	LL 406-420	L 450-470 MHZ	M 470-494 MHZ	H 494-512 MHZ
C206	105	94	85	80
C217	15	12	12	12
C218	25	22	22	22
C219	7	6	6	5
C220	14	12	12	11
C221	7	6	6	6
C222	18	16	16	15
C223	6	5	5	5
C224	105	91	91	85
C225	12	9	9	9
C226	5	10	9	9
C227	10	20	19	17
C228	10	20	19	17
C229	10	20	19	17
C230	5	10	9	9
C232	OMIT	8	7	6
C233	OMIT	8	7	6
C237	28	22	17	16
C241	13	10	9	8
C243	31	25	20	19
C247	18	15	13	11
C248	27	27	27	27
C249	39	30	28	26
C253	31	23	22	20
C254	680	24	27	27
C258	31	23	23	20
C259	680	24	680	680
C260	680	24	27	27
C261	42	30	30	27
C262	31	23	23	20
C263	680	24	680	680
C268	42	30	30	27
C286	11	10	9	9
C287	22	20	17	17
C288	22	20	17	17
C289	22	20	17	17
C290	11	10	9	9
C4212	150	680	150	680
C4218	OMIT	OMIT	27	27
C4219	OMIT	OMIT	OMIT	2
C204	1000	1000	1000	150
C275	1000	1000	1000	27
C213	3	3	3	2
C207	OMIT	27	27	27
C231	24	1000	1000	1000
C234	OMIT	18	18	18
C235	OMIT	1000	1000	1000
C236	24	1000	1000	1000
C285	18	OMIT	OMIT	OMIT
C4213	6	OMIT	OMIT	OMIT
C4214	10	OMIT	OMIT	OMIT
C4215	10	OMIT	OMIT	OMIT
C4216	10	OMIT	OMIT	OMIT
C4217	6	OMIT	OMIT	OMIT
L207	10	15	15	15
L219	OMIT	PRESENT	PRESENT	PRESENT
L220	OMIT	PRESENT	PRESENT	PRESENT
Q207	OMIT	PRESENT	PRESENT	PRESENT
R215	OMIT	51	51	51
R216	OMIT	20	20	20
R217	OMIT	47	47	47
R221	100	OMIT	OMIT	OMIT
L210	15	5.6	15	15
L215	15	5.6	15	15
L218	15	5.6	15	15

NOTES:

1. 50 OHM MICROSTRIP PART OF P.W.B.
2. W208-W233 MICROSTRIP CIRCUITY PART OF P.W.B. SEE 19C320642 FOR DIMENSIONS.
3. Q201-Q206 AND Q215 CALLED FOR ON PL19C320620.
4. ALL COMPONENTS MARKED WITH ASTERICK (*) SEE COMPONENT VALUE TABLE
5. (A- symbol) INDICATES A-
   (ground symbol) INDICATES VEHICLE GROUND

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MADE WITH TRANSMITTER KEYED, AND MEASURED WITH A 20,000 OHMS-PER-VOLT METER WITH REFERENCE TO A- AND NOT CHASSIS GROUND. AN RF CHOKE (25-50 MICROHENRYS) IS USED IN THE HOT METER LEAD TO AVOID DETUNING RF CIRCUITS.

NOTE: READINGS AT Q202 COLLECTOR AND IN THE POWER CONTROL CIRCUIT WERE TAKEN WITH THE TRANSMITTER ADJUSTED FOR 40 WATTS OUTPUT. THESE READINGS WILL VARY DEPENDING ON THE SETTING OF POWER ADJUST CONTROL R226.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

	PA ASM	REV LTR	HEATSINK ASM	REV LTR	CPNT. BD. ASM	REV LTR	FREQUENCY
STD. PKG	19C320620G5		19B219688G5		19D417166G1		406-420 MHZ
STD. PKG	19C320620G6		19B219688G5		19D417166G2		450-470 MHZ
STD. PKG	19C320620G7		19B219688G5		19D417166G3	A	470-494 MHZ
STD. PKG	19C320620G8		19B219688G5		19D417166G4		494-512 MHZ
	19C320620G17		19B219688G17		19D417166G1		406-420 MHZ
	19C320620G18		19B219688G17		19D417166G2		450-470 MHZ
	19C320620G19		19B219688G17		19D417166G3	A	470-494 MHZ
	19C320620G20		19B219688G17		19D417166G4		494-512 MHZ

SCHEMATIC DIAGRAM

406—512 MHz, 40-WATT POWER AMPLIFIER
19C320620G5-G8

Issue 2

SYMBOL	GE PART NO.	DESCRIPTION
C224H	19A116952P85	Silver mica: 85 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C225LL	19A116656P12J0	Ceramic disc: 12 pf ±5%, 500 VDCW, temp coef 0 PPM.
C225L	19A116656P9J0	Ceramic disc: 9 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C225M	19A116656P9J0	Ceramic disc: 9 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C225H	19A116656P9J0	Ceramic disc: 9 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C226LL	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C226L	19A116952P10	Silver mica: 10 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C226M	19A116952P9	Silver mica: 9 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C226H	19A116952P9	Silver mica: 9 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C227LL	19A116656P10J0	Ceramic disc: 10 pf ±0.5 pf, 250 VDCW; sim to 0 PPM.
C227L	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C227M	19A116952P19	Silver mica: 19 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C227H	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C228LL	19A116656P10J0	Ceramic disc: 10 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C228L	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C228M	19A116952P19	Silver mica: 19 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C228H	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C229LL	19A116656P10J0	Ceramic disc: 10 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C229L	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C229M	19A116952P19	Silver mica: 19 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C229H	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C230LL	19A116656P5J0	Ceramic disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C230L	19A116952P10	Silver mica: 10 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C230M	19A116952P9	Silver mica: 9 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C230H	19A116952P9	Silver mica: 9 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C231LL	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C231L	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C231M	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C231H	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C232L	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C232M	19A116656P7J0	Ceramic disc: 7 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C232H	19A116656P6J0	Ceramic disc: 6 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C233L	19A116656P8J0	Ceramic disc: 8 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C233M	19A116656P7J0	Ceramic disc: 7 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C233H	19A116656P6J0	Ceramic disc: 6 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C234	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C235	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C236LL	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C236L	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C236M	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C236H	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C237LL	19A116952P28	Silver mica: 28 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C237L	19A116952P22	Silver mica: 22 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C237M	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C237H	19A116952P16	Silver mica: 16 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C238	19A116656P3J0	Ceramic disc: 3 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C239	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C240	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C241LL	19A116679P13D	Mica: 13 pf ±.5 pf, 250 VDCW.
C241L	19A116679P10D	Mica: 10 pf ±.5 pf, 250 VDCW.
C241M	19A116679P9D	Mica: 9 pf ±.5 pf, 250 VDCW.
C241H	19A116679P8D	Mica: 8 pf ±.5 pf, 250 VDCW.
C242	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C243LL	19A116952P31	Silver mica: 31 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C243L	19A116952P25	Silver mica: 25 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C243M	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C243H	19A116952P19	Silver mica: 19 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C244	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C245	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C246	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C247LL	19A116952P18	Silver mica: 18 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C247L	19A116952P15	Silver mica: 15 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C247M	19A116952P13	Silver mica: 13 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C247H	19A116952P11	Silver mica: 11 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C248LL	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C248L	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C248M	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C248H	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C249LL	19A116952P39	Silver mica: 39 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C249L	19A116952P30	Silver mica: 30 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C249M	19A116952P28	Silver mica: 28 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C249H	19A116952P26	Silver mica: 26 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C250	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C251	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C252	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C253LL	19A116952P31	Silver mica: 31 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C253L	19A116952P23	Silver mica: 23 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C253M	19A116952P22	Silver mica: 22 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C253H	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C254LL	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C254L	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C254M	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C254H	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C255	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C256	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C257	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C258LL	19A116952P31	Silver mica: 31 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C258L	19A116952P23	Silver mica: 23 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C258M*	19A116952P23	Silver mica: 23 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
		Earlier than REV A:
	19A116952P22	Silver mica: 22 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C258H	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C259LL	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C259L	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C259M	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C259H	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C260LL	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C260L	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C260M	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C260H	5496218P249	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef -80 PPM.
C261LL	19A116952P42	Silver mica: 42 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C261L	19A116952P30	Silver mica: 30 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C261M	19A116952P30	Silver mica: 30 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C261H	19A116952P27	Silver mica: 27 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C262LL	19A116952P31	Silver mica: 31 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C262L	19A116952P23	Silver mica: 23 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C262M*	19A116952P23	Silver mica: 23 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
		Earlier than REV A:
	19A116952P22	Silver mica: 22 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C262H	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C263LL	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C263L	19A116656P24J0	Ceramic disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM.
C263M	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C263H	19A116655P18	Ceramic disc: 680 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C264	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C265	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C266	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C267	7489162P9	Silver mica: 18 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C268LL	19A116952P42	Silver mica: 42 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C268L	19A116952P30	Silver mica: 30 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C268M	19A116952P30	Silver mica: 30 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C268H	19A116952P27	Silver mica: 27 pf ±2%, 250 VDCW; sim to Underwood Type J1HF.
C269	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C270	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C271	19A116655P8	Ceramic disc: 150 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C272	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C273 and C274	19A116655P8	Ceramic disc: 150 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C275LL	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C275L	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C275M	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C275H	19A116656P27J0	Ceramic disc: 27 pf ±5%, 500 VDCW, temp coef 0 PPM.
C276 thru C280	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
C281 thru C284	19A116679P220K	Mica: 220 pf ±10%, 250 VDCW.
C285	5496218P45	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
C286LL	19A116952P11	Silver mica: 11 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C286L	19A116952P10	Silver mica: 10 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C286M	19A116952P9	Silver mica: 9 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C286H	19A116952P9	Silver mica: 9 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C287LL	19A116952P22	Silver mica: 22 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C287L	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C287M	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C287H	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C288LL	19A116952P22	Silver mica: 22 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C288L	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C288M	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C288H	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C289LL	19A116952P22	Silver mica: 22 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C289L	19A116952P20	Silver mica: 20 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C289M	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.
C289H	19A116952P17	Silver mica: 17 pf ±0.5 pf, 250 VDCW; sim to Underwood Type J1HF.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A: Power Amplifier Component Board 19D417166G3. To increase Power Output. Changed C258 and C262.