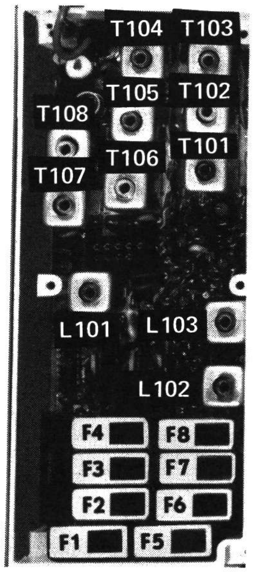
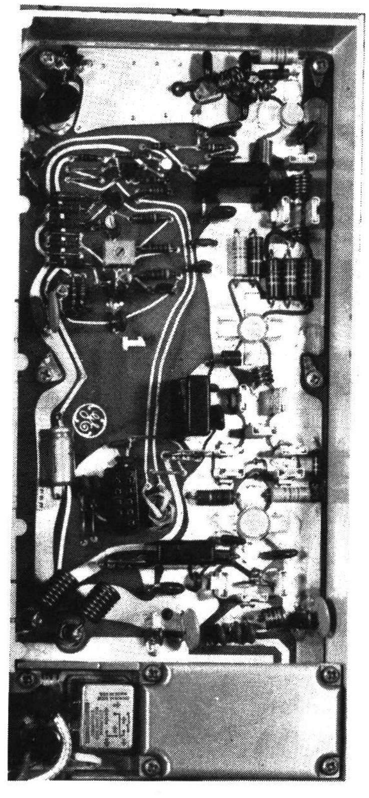
LBI-4732D

GE Mobile Communications





MASTR® II

25-50 MHz, 50-WATT STATION TRANSMITTER

Maintenance Manual

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ILLUSTRATIONS

WARNING

Although the highest DC voltage in the MASTR II station transmitter is the 12 VDC supply voltage, 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!

SPECIFICATIONS*

FCC Filing Designation	KT-56-A, C Extended local control; Intermittent Duty KT-57-A, C Extended local/DC & Tone Remote DC Remote/Tone Remote; Intermittent Duty KT-58-A, C All controls; Continuous Duty
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	±0.0005% (-30°C to +60°C)
EC-ICOM or 5C-ICOM	±0.0002% (0°C to +55°C)
2C-ICOM	±0.0002% (-30°C to +60°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.
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 4 channels)

	Full Specifications	1 dB Degradation
25-30 MHz	0.16 MHz	0.32 MHz
30-36 MHz	0.20 MHz	0.40 MHz
36-42 MHz	0.24 MHz	0.47 MHz
42-50 MHz	0.28 MHz	0.54 MHz

Duty Cycle	EIA 20% Intermittent (KT-56-A, C & KT-57-A, C) Continuous (KT-58-A, C)
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.

DESCRIPTION

Transmitter Types KT-56-A, C, KT-57-A, C & KT-58-A, C are crystal-controlled, phase modulated transmitters designed for one- through four-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 four 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 of three).

Audio, supply voltages and control functions are connected through P902.

Centralized metering jack J103 is provided for use with GE Test Set Model 4EX3A11 or Test Kit 4EX3K12. 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 (±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 (±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

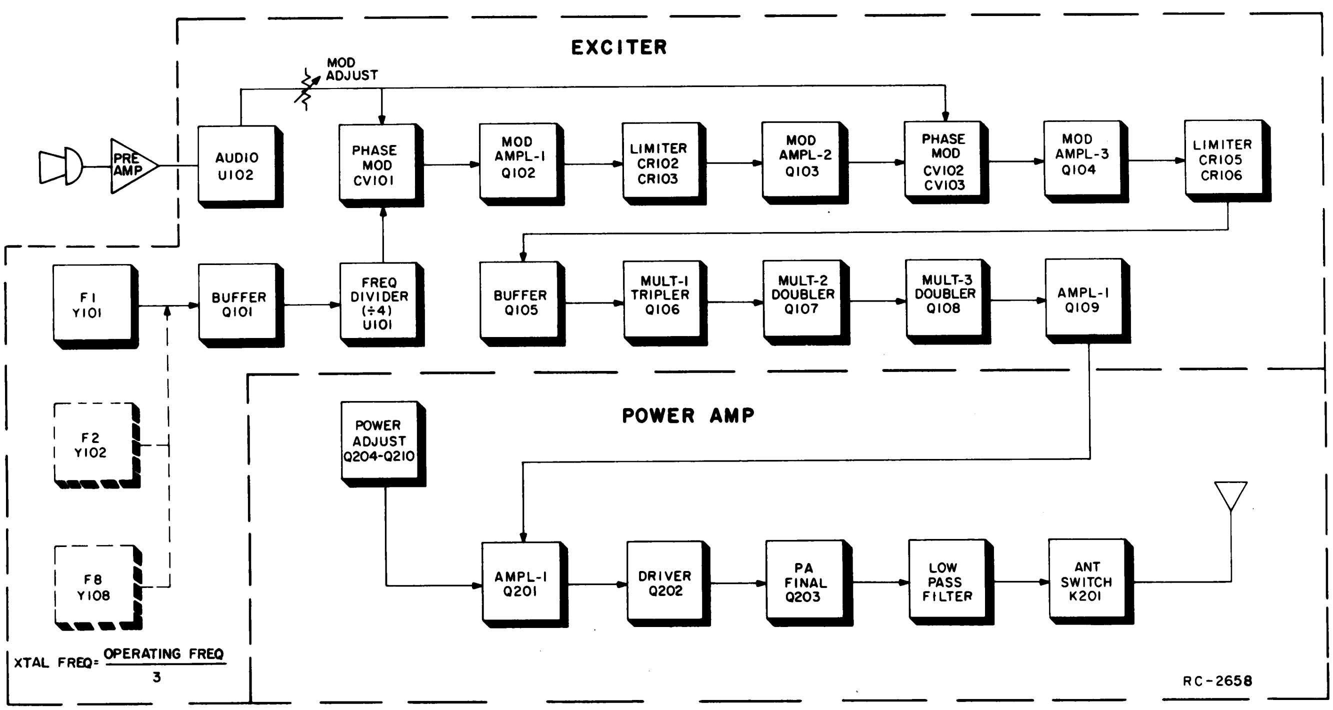


Figure 1 - Transmitter Block Diagram

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 (termianl 6) 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 transmitter types KT-56-A, C 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 8 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. In transmitter types KT-57-A, C and KT-58-A, C at least one 5C ICOM is required for the transmitter and at least one 5C-ICOM is required for the receiver. If desired, up to 8 5C-ICOMs may be used in the station.

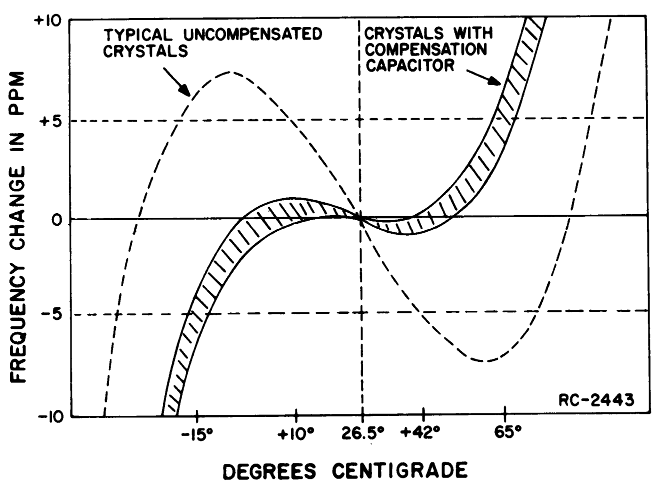


Figure 2 - Typical Crystal Characteristics

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.

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.

In transmitter types KT-56-A, C 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

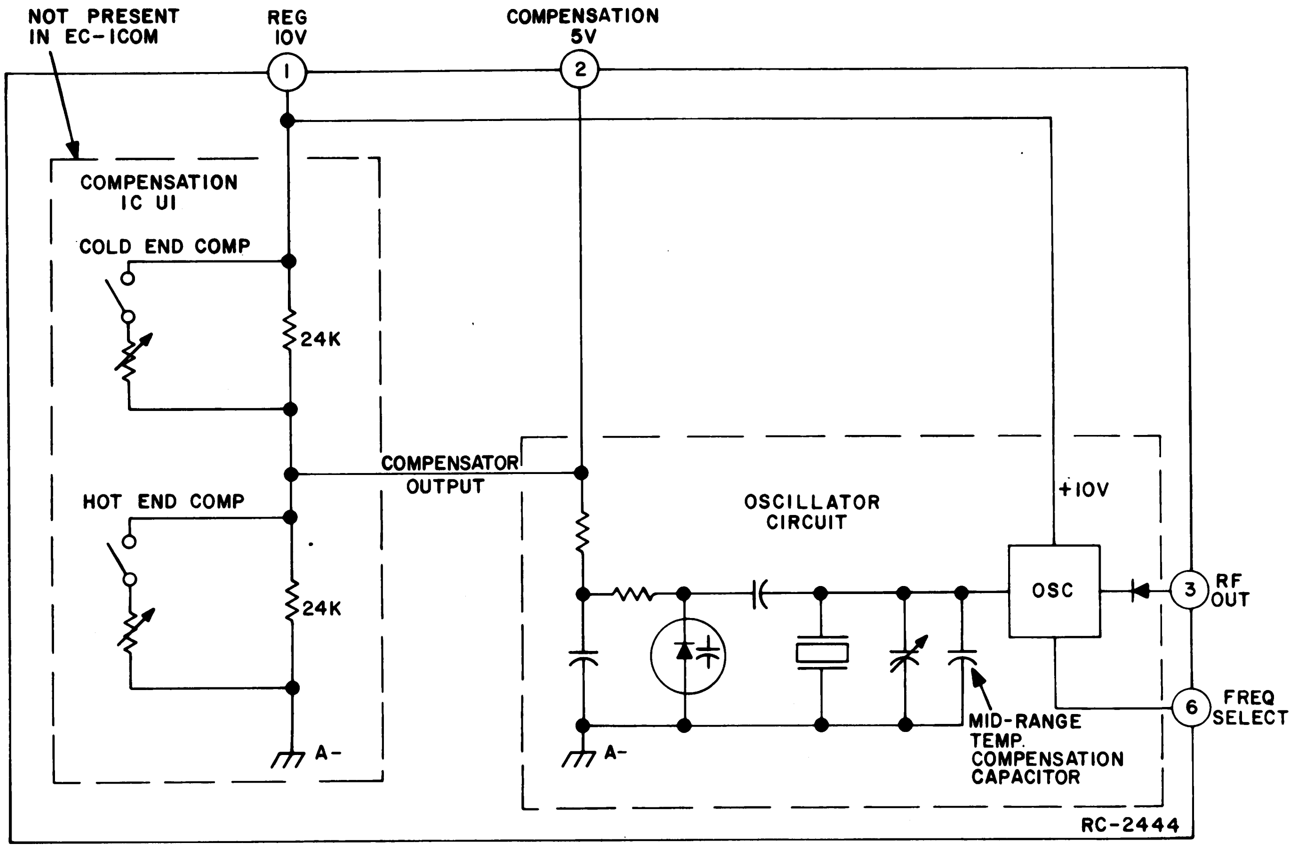


Figure 3 - Equivalent ICOM Circuit

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 or check output of 5C-ICOM.

AUDIO PREAMPLIFIER

The transmitter Audio Preamplifier is not part of the transmitter and is covered in the station Maintenance Manual.

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 Station Preamplifier at pin 12 is coupled through capacitor C1 to the base of Q1 in the operational amplifier-limiter circuit.

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 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 and station gain Control R14 on the Audio Preamplifier are contained in the modulation adjustment section of the Transmitter Alignment Procedure.

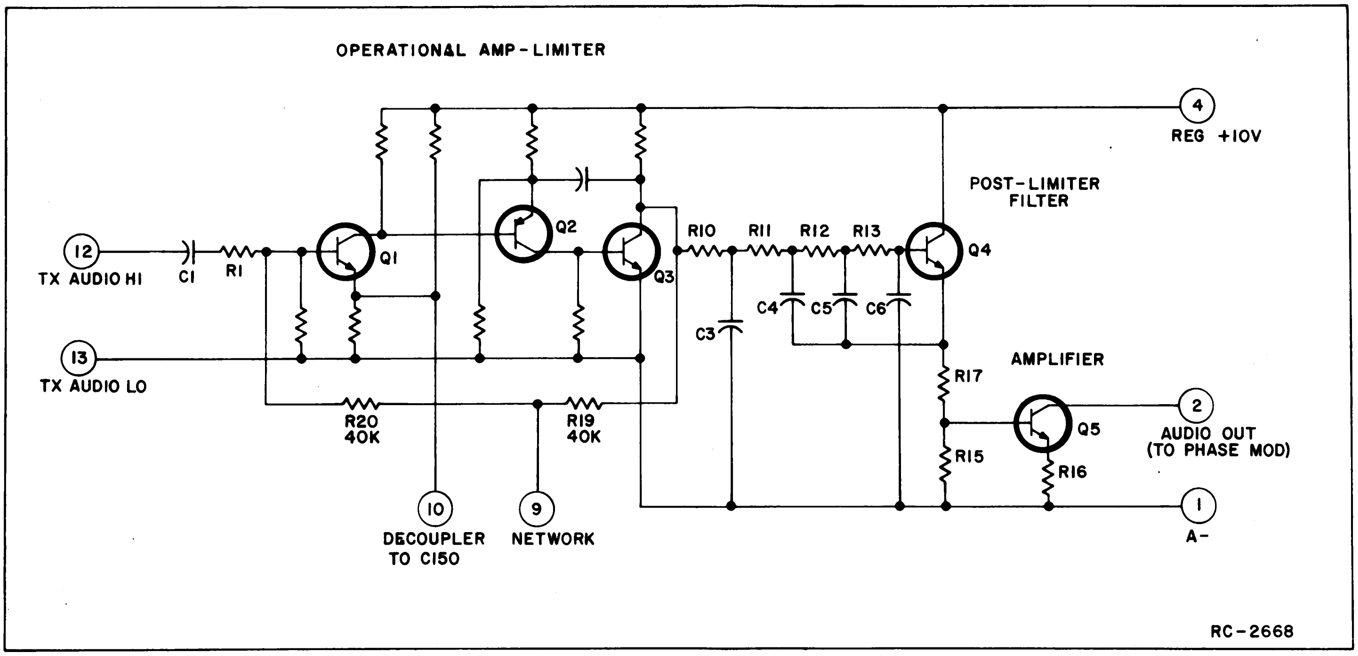


Figure 4 - Simplified Audio IC

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" 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, AMPLIFIER & 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 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, Q106. The tripler stage is metered through R146. The output of Q106 is coupled through tuned circuits T101, T102 and T103 to the base of dobuler 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 buttom 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. 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.

MAINTENANCE

DISASSEMBLY

For a more complete mechanical parts breakdown refer to the station manual. To service the transmitter exciter from the front:

1. Turn the two latching knobs (A) counterclockwise to unlatch the Radio Panel Front Door. Refer to Figure 5.

2. Swing the Radio Panel Front Door down as shown.

3. Remove covers.

To service the transmitter Power Amplifier from the rear:

1. Remove the top two screws (B) on the Intermittent or Continuous Duty Power Amplifier. Refer to Figure 6.

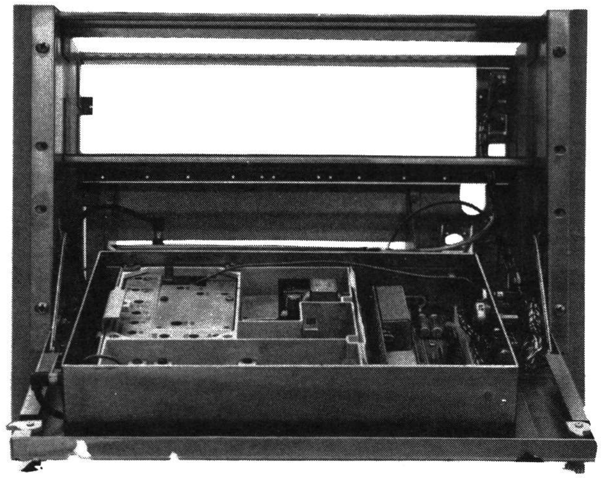


Figure 5 - Access To Exciter - Front View

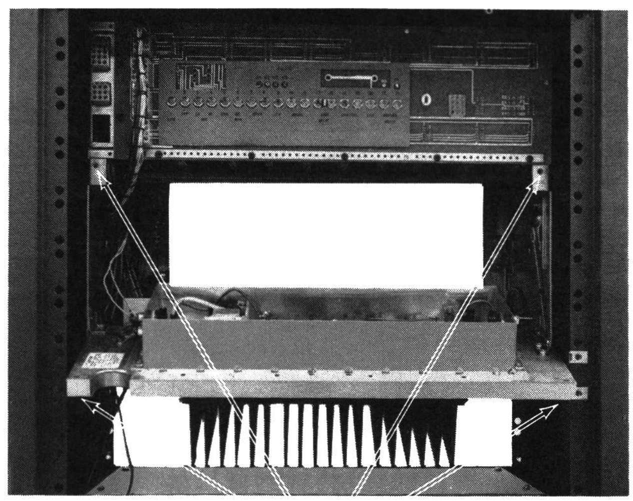


Figure 6 - Access To Power Amplifier - Rear View

2. Swing the Power Amplifier down as shown. Remove the top cover of the Power Amplifier.

NOTE

If the heatsink blower option is present, this blower must be removed before the Power Amplifier can be lowered.

To remove the PA board: Refer to Figure 7.

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. For Continuous Duty stations only, remove all heatsink sections from the heat dissapator plate.
4. Remove the PA transistor hold-down nuts and spring washer on the bottom of the PA assembly.
5. 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.

PA TRANSISTOR REPLACEMENT

When replacing a power transistor where more than one are in parallel, make sure all the paralleled transistors are from the same manufacturer for proper operation.

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.

NOTE

If the transmitter has a continuous Duty Power Amplifier a section of Heat Sink may have to be removed to get to the transistor hold-down nuts. Apply a light coat of silicon grease when replacing the removed section of Heat Sink.

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 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.

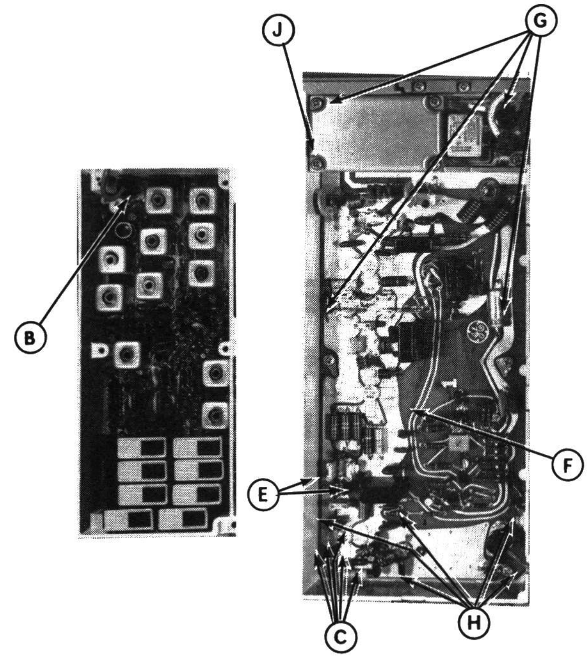


Figure 7 - PA Board Removal

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.

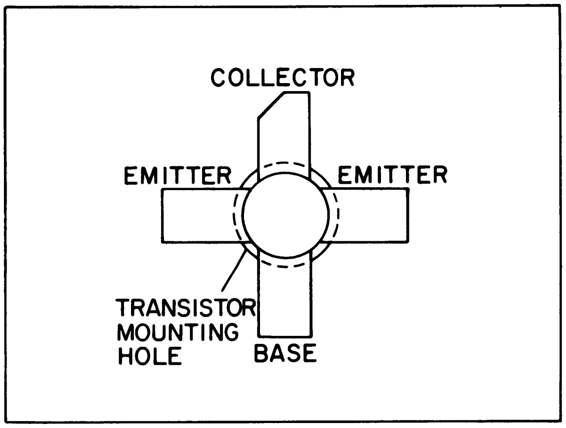


Figure 8 - Lead Identification

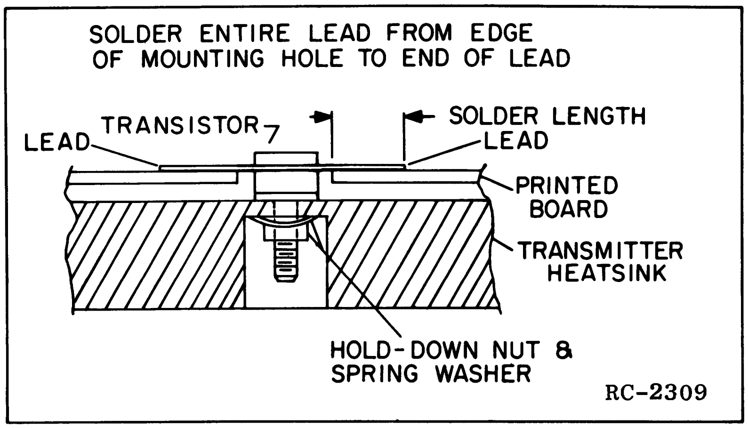


Figure 9 - Lead Forming

GE Mobile Communications

General Electric Company
Lynchburg, Virginia 24502

Printed in U.S.A.

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R127) 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 aduio 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. Set the station gain control R14 to its fully clockwise position.
2. Connect the audio oscillator and the meter through a 0.5 μF (or larger) DC blocking capacitor, across audio input terminals J10 (Green-Hi) and J11 (Black-Lo) on GE Test Set, and connect the Red Test set plug to the system Red metering plug.
3. Set the audio generator frequency to 1 kHz.
   A. In all station combinations except Local Control Intermittent Duty combinations, set the audio generator output to 30 millivolts RMS.
   B. In Local Control Intermittent Duty station combinations, set the audio generator output to 1.0 volt RMS.
4. For transmitters without Channel Guard, set MOD ADJUST R127 for a 4.5 kHz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor.
5. For transmitters with Channel Guard set Channel Guard MOD ADJUST R105 for zero tone deviation. Next, with the 30 millivolts 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 R128 for 0.75 kHz tone deviation.
6. For multi-frequency transmitters, set the deviation as described in Steps 4 or 5 on the channel producing the largest amount of deviation.
7. Remove the audio oscillator and key the mike. While talking in a normal voice at a distance of four to six inches from the station microphone, adjust station gain control R14 for a deviation of 3 kHz as measured on the deviation monitor.

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 5.0 amperes = 63 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 deviations 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 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 25 MHz, 1 PPM is 25 Hz. At 50 MHz, 1 PPM is 50 Hz).

With an operating frequency of 50 MHz, set the oscillator for a reading of 15 Hz (0.3 x 50 Hz) higher than the licensed operating frequency. If a negative correction factor is obtained (at temperatures above 26.5°C), set the oscillator for the indicated PPM lower than the licensed operating frequency.

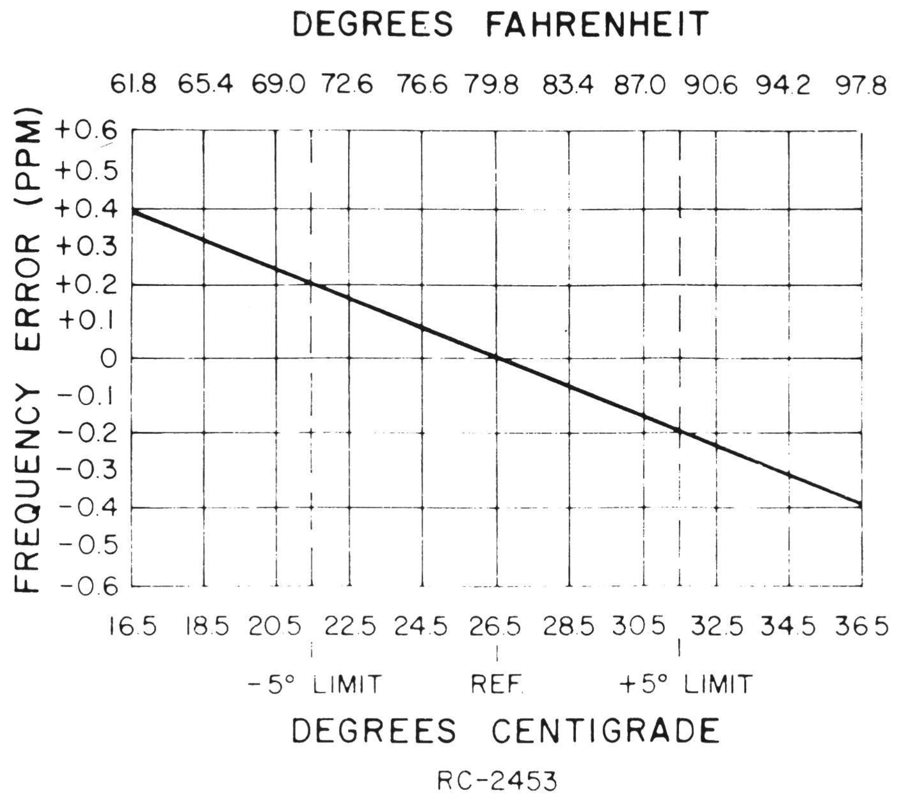
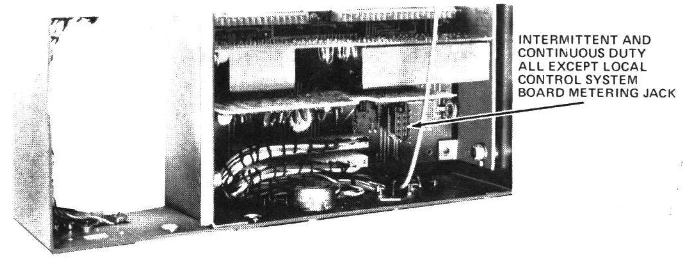
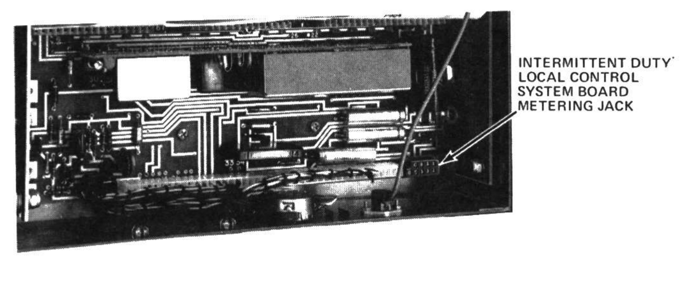
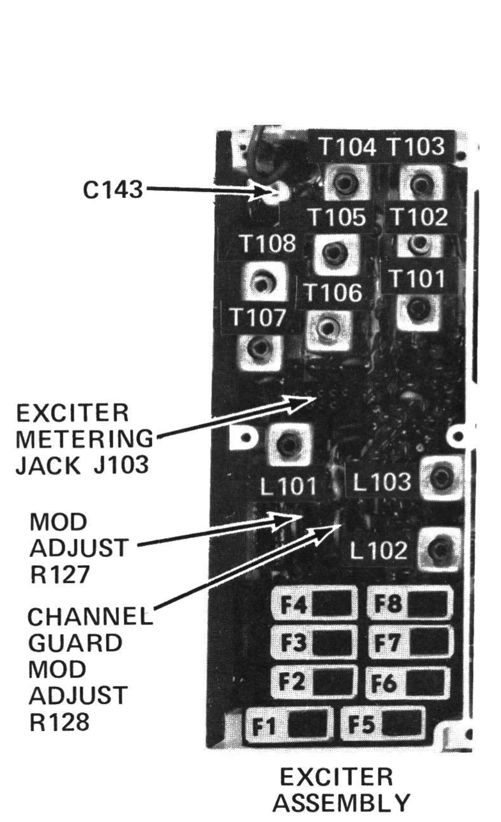
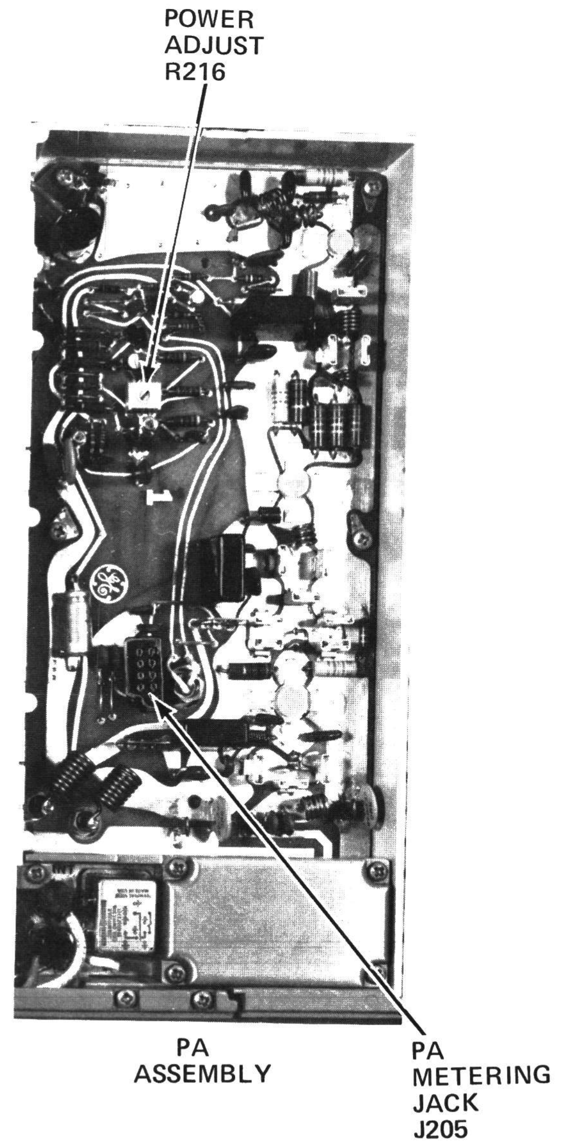


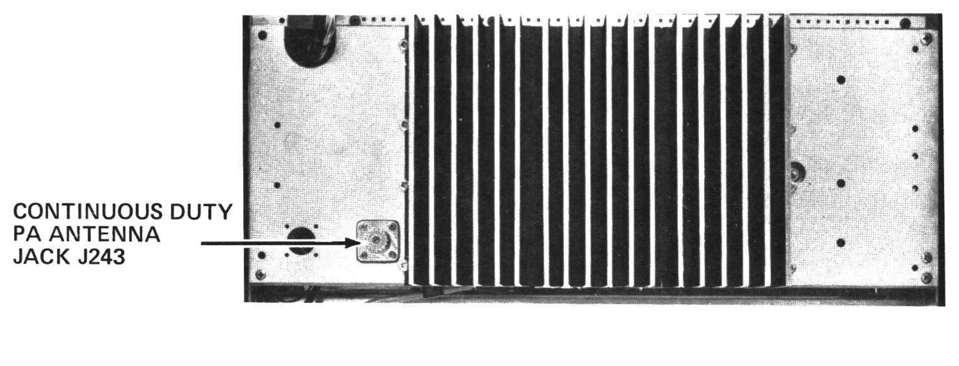
Figure 9 - Frequency Characteristics Vs. Temperature

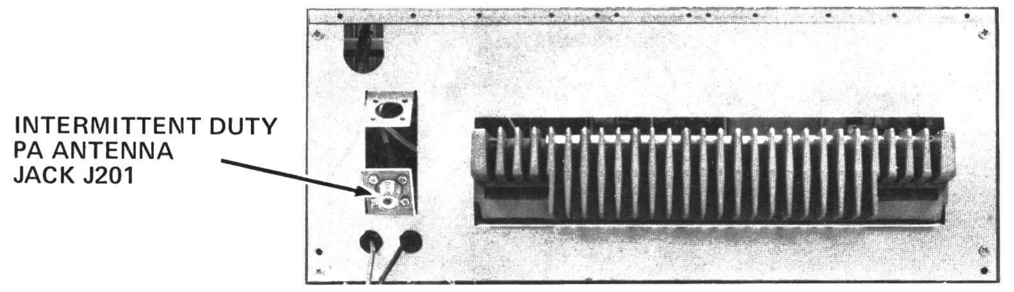












TRANSMITTER ALIGNMENT

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 ÷ 3).
2. For a large change in frequency or a badly mis-aligned transmitter, pre-set the slugs to T101 through T108, and L101, L102 and L103 to the bottom of the coil form.

NOTE

The tuning frequency for multi-frequency transmitters is determined by the operating frequency and the frequency spread between frequencies. 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 frequency spread exceeding the limits specified in column (1), tune the transmitter 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, L103, always tune L101, L102, 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)
25-30 MHz	.080 MHz	.160 MHz	.320 MHz
30-36 MHz	.100 MHz	.200 MHz	.400 MHz
36-42 MHz	.120 MHz	.240 MHz	.470 MHz
42-50 MHz	.140 MHz	.280 MHz	.540 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.	A MOD-1	L101	Maximum	Tune L101 for maximum meter reading.
2.	B	L102 & L103	Maximum	Tune L102 and then L103 for the maximum meter reading.
3.	C MULT-1	T101 & T102	See Procedure	Tune T101 for a dip in meter reading, and then tune T102 for maximum meter reading.
4.	D MULT-2	T103, T102, T101 & T104	See Procedure	Tune T103 for maximum meter reading and re-adjust T102 and T101 for maximum meter reading. Then tune T104 for a dip in meter reading.
5.	F MULT-3	T105, T104, T106 & T107	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 and T107 for maximum meter reading.
6.	G AMPL-1	T108, T107 & T106	Maximum	Tune T108 for maximum meter reading, and then re-adjust T107 and T106 for maximum meter reading.
7.	D AMPL-1 DRIVE (on PA)	C143, C156	Maximum	Move the black metering plug to the Power Amplifier metering jack and tune C143 and C156 for maximum meter reading.
8.		R216		Set Power Adjust potentiometer R216 on the PA board for the desired power output (from 15 to 50 Watts).

ALIGNMENT PROCEDURE

25—50 MHz, 50-WATT STATION TRANSMITTER
INTERMITTENT & CONTINUOUS DUTY

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.

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 (R216).

Refer to the QUICK CHECKS on the Transmitter Troubleshooting Procedure.

VOICE DEVIATION AND SYMMETRY

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 frequency to 1 kHz.

   A. In all station combinations except Local Control Intermittent Duty combinations, set the audio generator output to 30 millivolts RMS.

   B. In Local Control Intermittent Duty station combinations, set the audio generator output to 1.0 volt RMS.

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 R127 for the proper deviation on plus (+) or minus (-) deviation, whichever is greater.

NOTES: MASTR II station 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.

TONE DEVIATION WITH CHANNEL GUARD

TEST PROCEDURE

1. Set up the Deviation Meter and monitor the output of the transmitter.

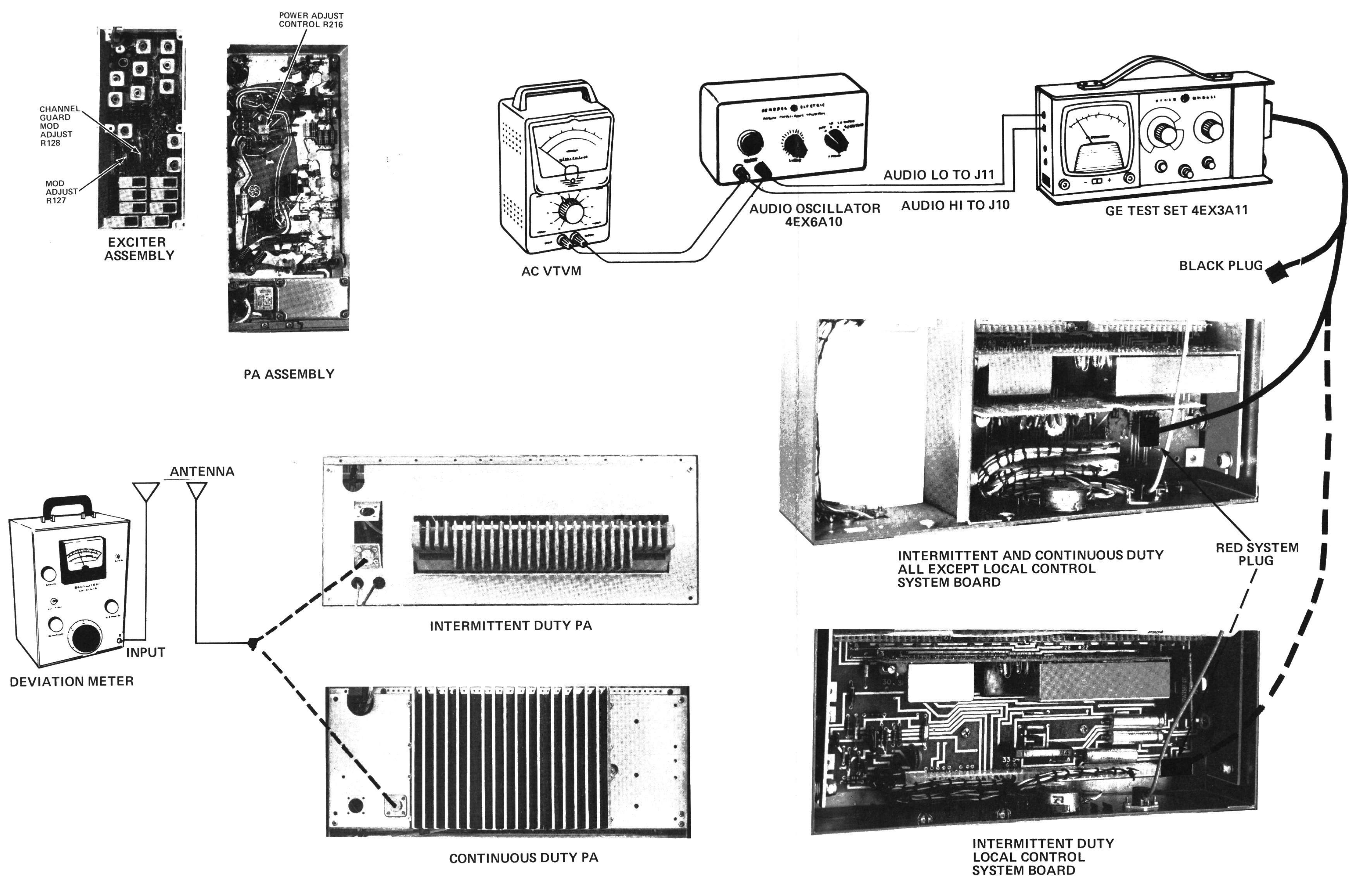
2. Remove the 1000 Hz signal from the audio generator.

3. Key the transmitter and check for 0.75 kHz deviation. If the reading is low or high, adjust Channel Guard MOD ADJUST 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 Step 1 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

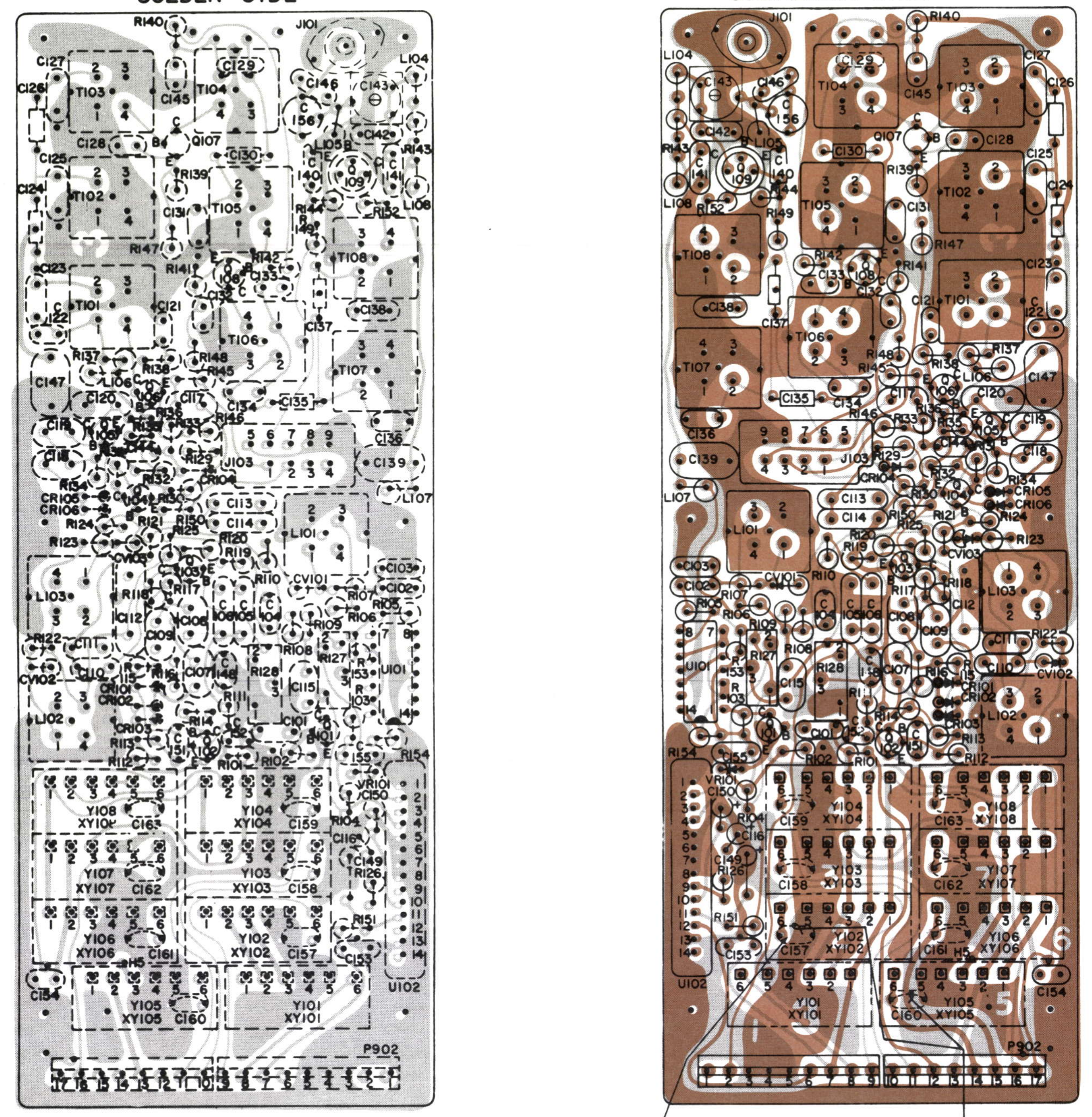
METER POSITION GE TEST SET	PROBABLE DEFECTIVE STAGE		
	HIGH METER READING	LOW METER READING	ZERO METER READING
EXCITER			
A (MOD-1)	Q102, 10-Volt regulator	Q102, CV101, L101, 10-Volt regulator	ICOM, Q101, U101, L101, Q102, CR101, 10-Volt regulator or Channel Selector switch ground.
B (MOD-2)	Q104, 10-Volt regulator	Q103, L102, L103, CV102, CV103, Q104	Q103, L102, CV102, L103, CV103, CR104, Q104
C (MULT-1)	Q105, Q106 T101	Q105, Q106	Q105, Q106, T101
D (MULT-2)	Q107, T104	T101, T102, T103, Q107	T101, T102, T103, Q107, T104
F (MULT-3)	Q108, T106	T104, T105, Q108	T104, T105, Q108, T106
G (AMPL-1)	Q109, C146, R144	T106, T107, T108, Q109, L108	T106, T107, T108, Q109, L104, L107
POWER AMPLIFIER			
"D" (AMPL-1 DRIVE)		Low Output from Exciter	No output from Exciter, CR201
"C" (AMPL-1 POWER CONTROL VOLTAGE)	Q210	Q210	No Exciter output, Q210, Q204, CR201
"F" (DRIVER CURRENT)	Q202	Q202, Low Output from Q201	Q202, Q201, Check Pos. D & C
"G" (PA CURRENT)	Q203	Q201, Q202, Q203	Q203, Q202, Q201, Q210

TROUBLESHOOTING PROCEDURE

25—50 MHz, 50-WATT STATION TRANSMITTER
INTERMITTENT & CONTINUOUS DUTY

EXCITER BOARD

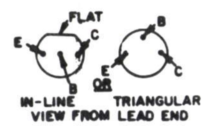
SOLDER SIDE COMPONENT SIDE



(19D423167, Sh. 2, Rev. 3)

(19D423167, Sh. 2, Rev. 3)
(19D423167, Sh. 3, Rev. 3)

LEAD IDENTIFICATION FOR Q101-Q109



VIEW FROM LEAD END

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

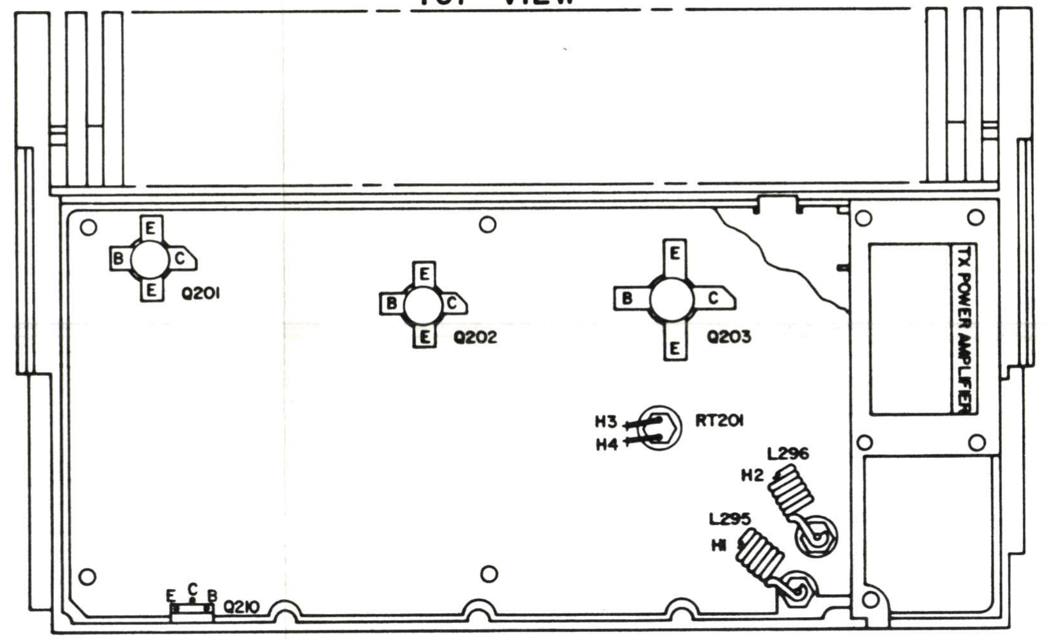
IN EIGHT-FREQUENCY EXCITERS (GROUPS 5-8), CAPACITORS C157-C163 ARE CLIPPED OUT AS REQUIRED TO MEET THE CUSTOMER REQUIREMENTS FOR FREQUENCIES. EXAMPLE; IF CUSTOMER WANTS ICOMS FOR F1, F2, F5, F7, THEN CAPACITORS C157, C160, AND C162 ARE CLIPPED OUT. C158, C159, C161, C163 ARE LEFT IN.

IN TWO-FREQUENCY EXCITERS (GROUPS 1-4) C157 IS CLIPPED OUT FOR COMBINATIONS WITH 2 TRANSMIT ICOMS. DA JUMPERS ARE PRESENT ON FREQUENCY SWITCHING LINES OF OTHER SIX ICOM CIRCUITS AS SHOWN.

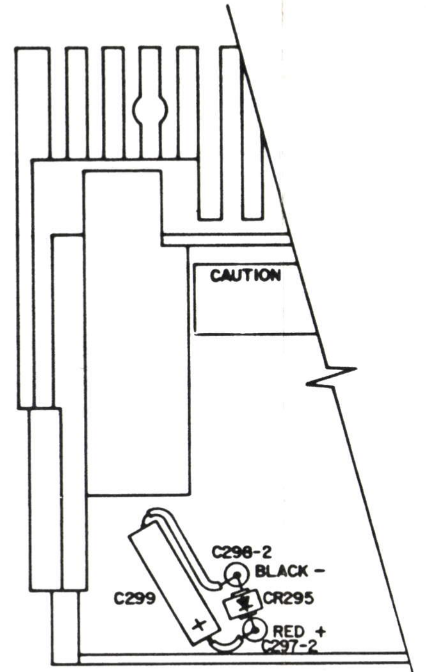
(19D423234, Rev. 3)

PA ASSEMBLY

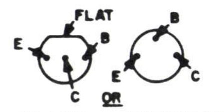
TOP VIEW



BOTTOM VIEW

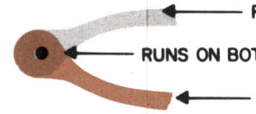


LEAD IDENTIFICATION FOR Q204-Q209



VIEW FROM LEAD END

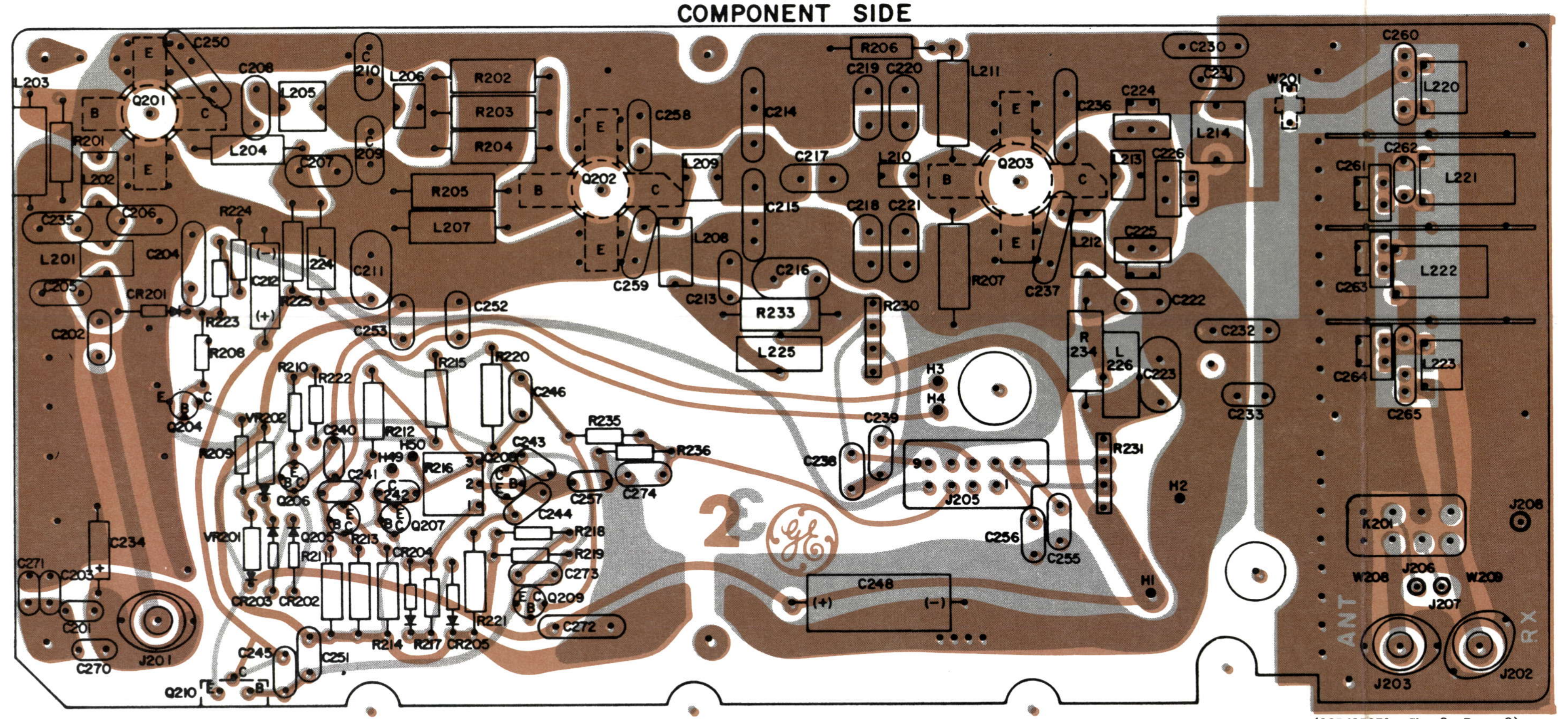
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION



(19R622111, Rev. 6)

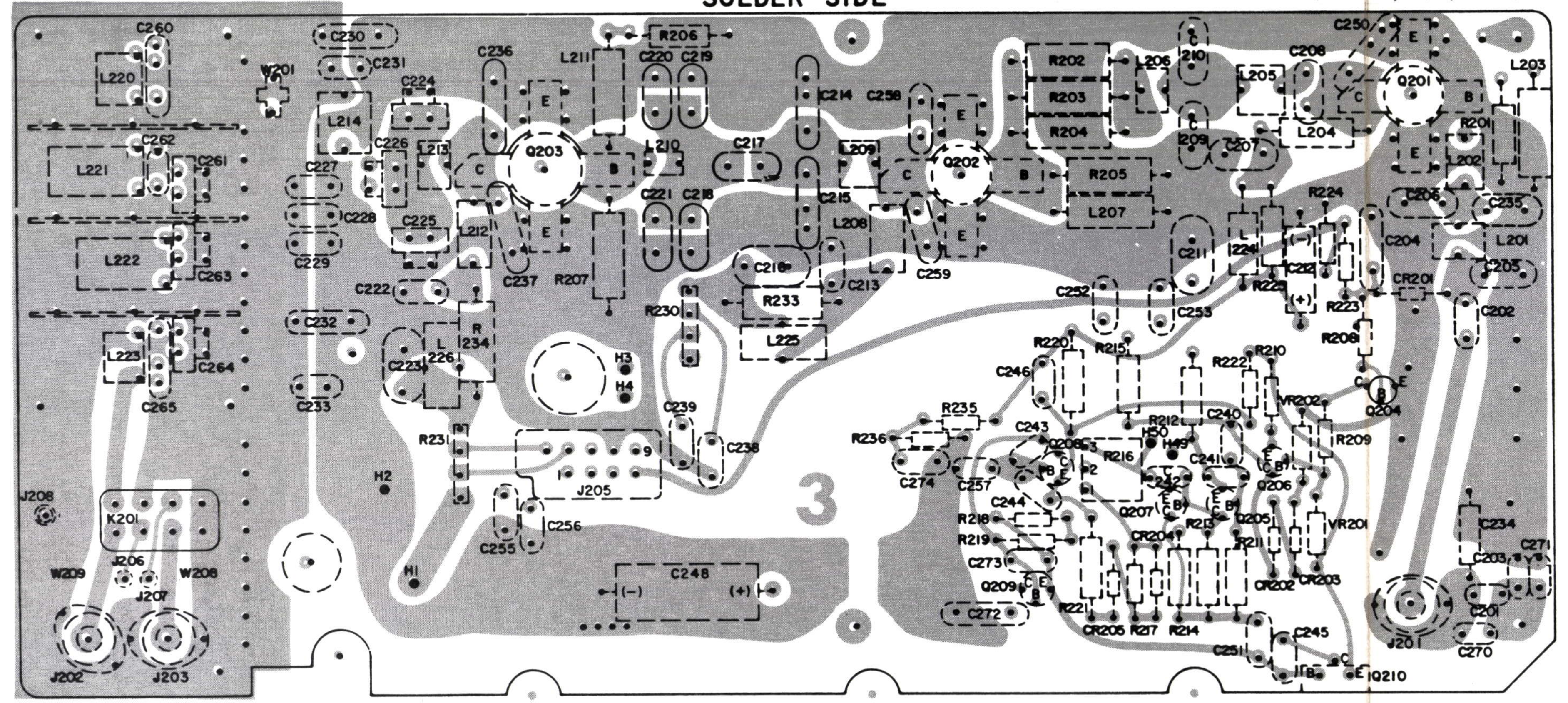
PA BOARD

COMPONENT SIDE



(19D417971, Sh. 2, Rev. 3)
(19D417971, Sh. 3, Rev. 2)

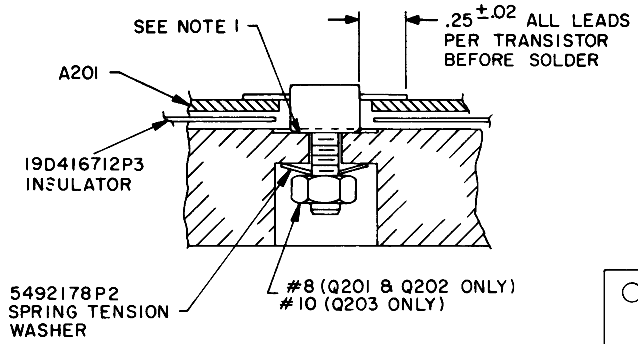
SOLDER SIDE



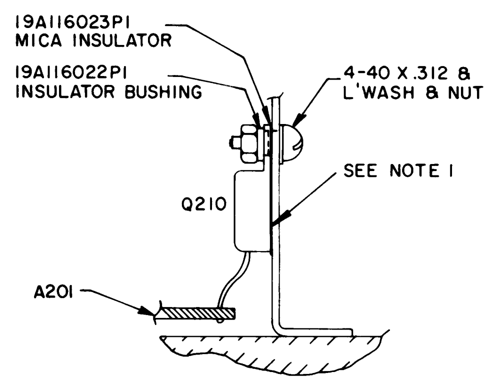
(19D417971, Sh. 2, Rev. 3)

OUTLINE DIAGRAM

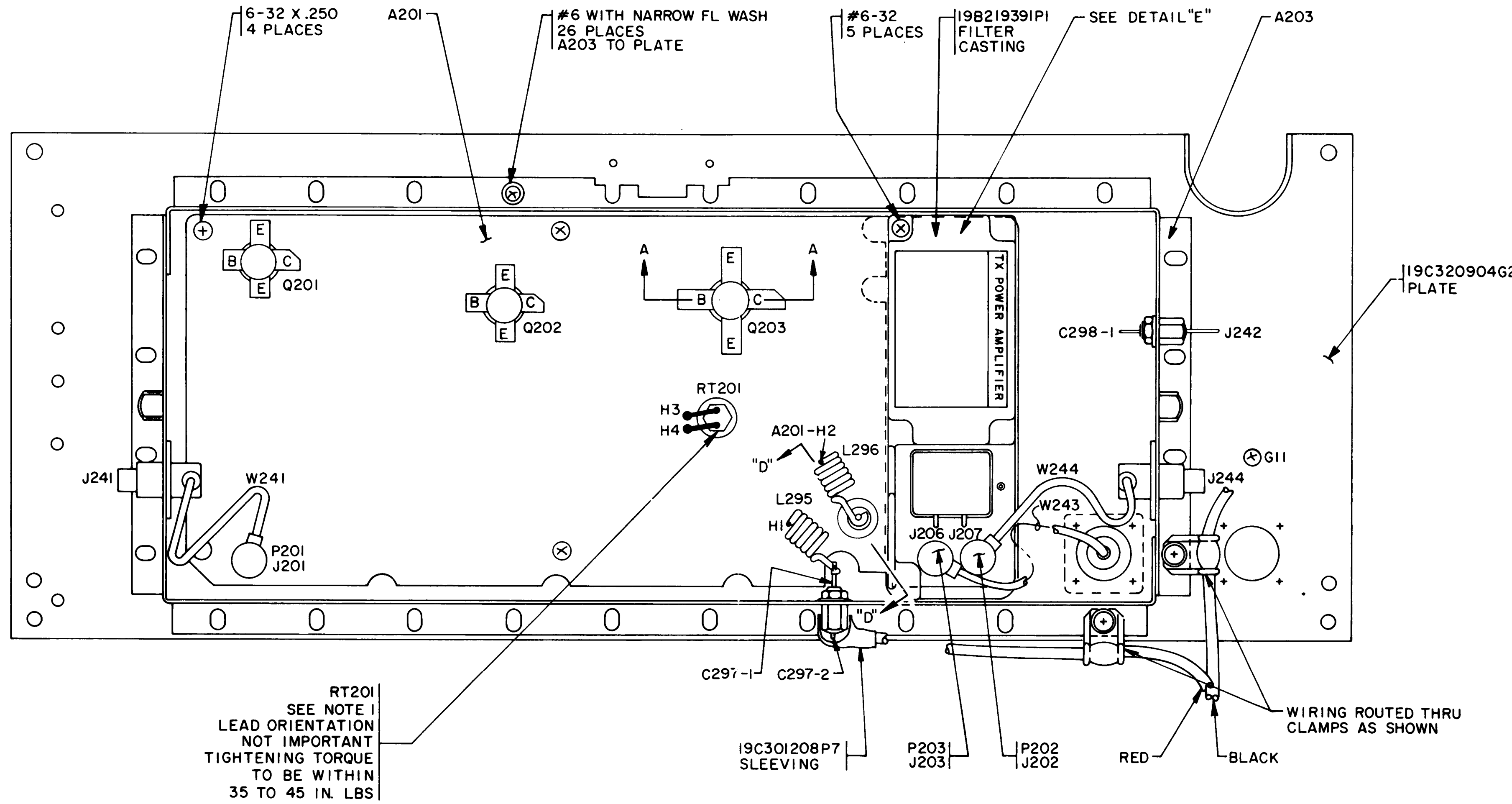
25—50 MHz, 50-WATT STATION TRANSMITTER

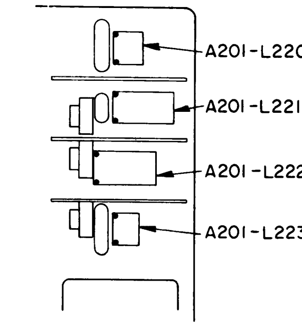


SECTION A-A
TYP MTG FOR Q201 THRU Q203

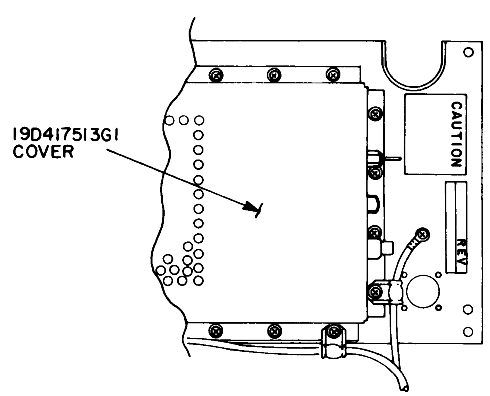


SECTION B-B

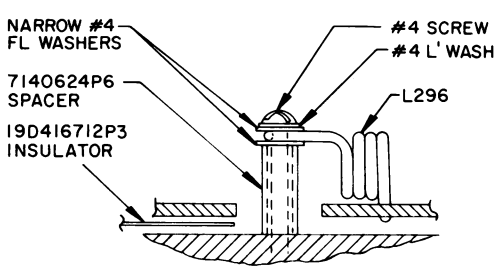




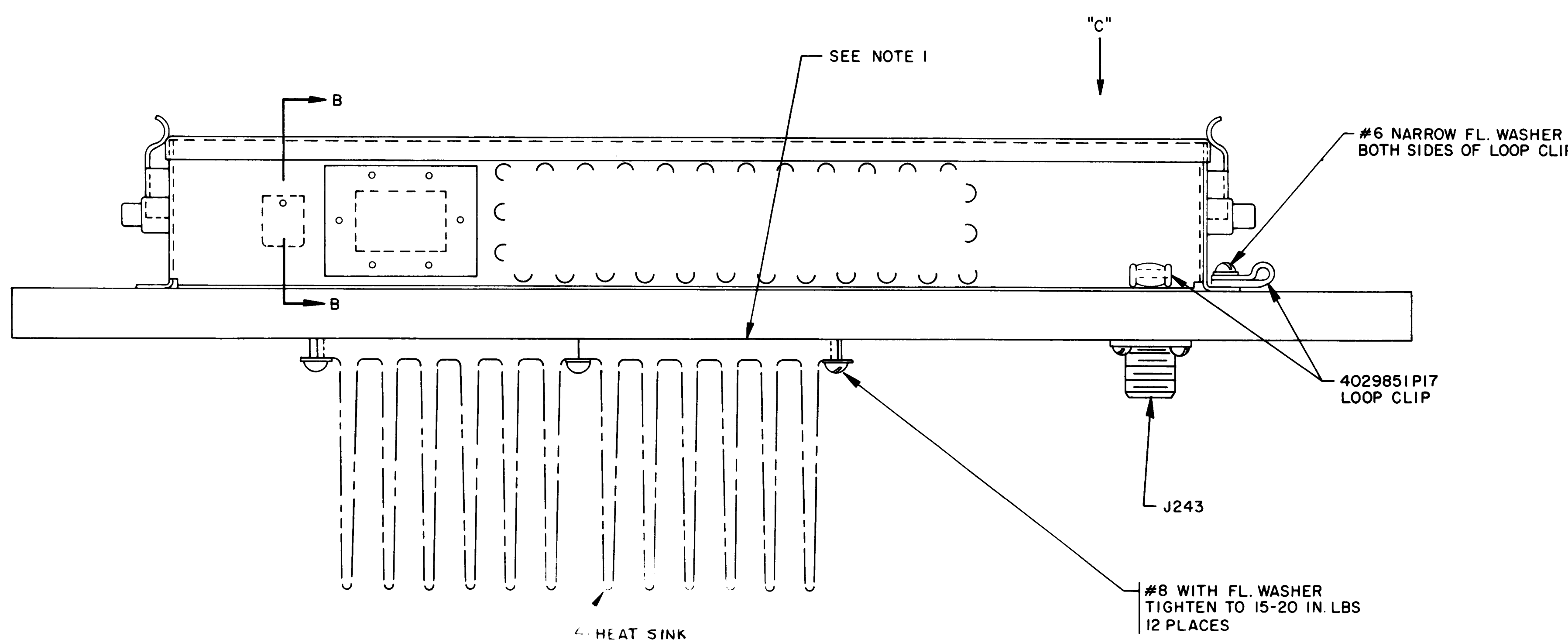
DETAIL "E"
(VIEW OF A201 WITH COVER REMOVED)



VIEW AT "C"



SECTION D-D



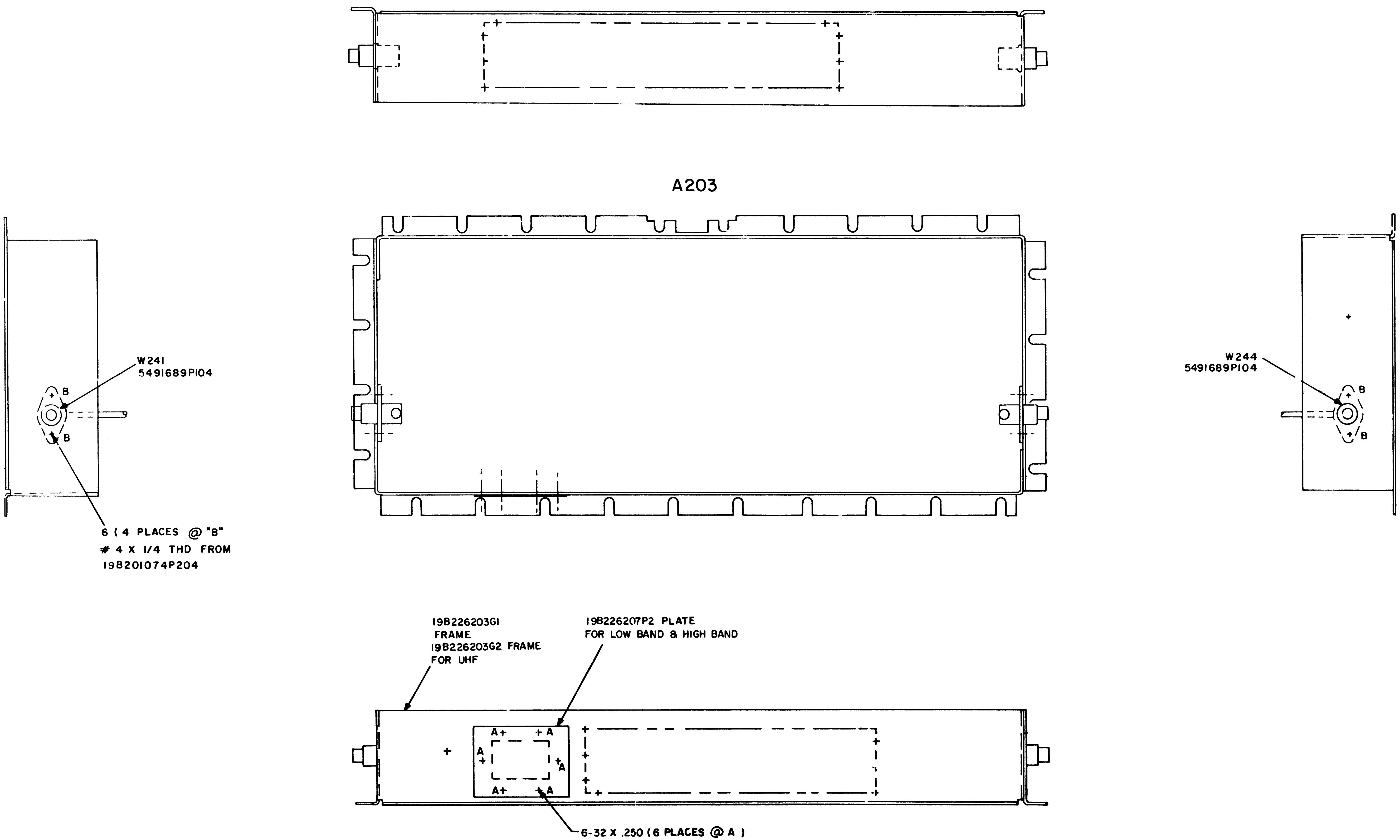
NOTES:

1. APPLY SILICONE GREASE TO BOTH SIDES OF MICA INSULATOR TO MOUNTING SURFACE OF Q201 THRU Q203 & RT201 AND UNPAINTED FLAT SURFACE OF HEAT SINKS.
NO GREASE ALLOWED ON THE THREADED PORTION OF THE MTG STUD.

(19D423085, Rev. 0)

OUTLINE DIAGRAM

25—50 MHz, 50-WATT STATION TRANSMITTER CONTINUOUS DUTY



(19D423098, Rev. 1)

OUTLINE DIAGRAM

FRAME ASSEMBLY FOR INTERMITTENT
AND CONTINUOUS DUTY TRANSMITTERS

PARTS LIST

LBI4440Q

25-50 MHZ EXCITER
19D416659G1-G8

SYMBOL	GE PART NO.	DESCRIPTION
		19D416659G1 2 FREQ 25-30 MHz (LL) 19D416659G2 2 FREQ 30-36 MHz (L) 19D416659G3 2 FREQ 36-42 MHz (M) 19D416659G4 2 FREQ 42-50 MHz (H) 19D416659G5 8 FREQ 25-30 MHz (LL) 19D416659G6 8 FREQ 30-36 MHz (L) 19D416659G7 8 FREQ 36-42 MHz (M) 19D416659G8 8 FREQ 42-50 MHz (H)
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A116655P19	Ceramic disc: 1000 pF + or - 20%, 1000 VDCW; sim to RMC Type JF Discap.
C102	19A116655P13	Ceramic disc: 470 pF + or -20%, 1000 VDCW; sim to RMC Type JF Discap.
C103	19A116655P19	Ceramic disc: 1000 pF + or - 20%, 1000 VDCW; sim to RMC Type JF Discap.
C104	5494481P105	Ceramic disc: 330 pF + or - 20%, 1000 VDCW; sim to Type JF Discap.
C105 and C106	19A116655P21	Ceramic disc: 2700 pF + or -20%, 1000 VDCW; sim to RMC Type JR Discap.
C107 thru C109	19A700005P11	Polyester: 0.047 uF + or -10%, 50 VDCW.
C110 and C111	19A116655P19	Ceramic disc: 1000 pF + or - 20%, 1000 VDCW; sim to RMC Type JF Discap.
C112LL	4029003P104	Silver mica: 680 pF + or - 10%, 500 VDCW, sim. to Electro Motive Type DM-20.
C112L	4029003P104	Silver mica: 680 pF + or - 10%, 500 VDCW, sim. to Electro Motive Type DM-20.
C112M	5493367P1000J	Mica: 1000 pF + or - 5%, sim. to Electro Motive Type DM-20.
C112H	5493367P1000J	Mica: 1000 pF + or - 5%, sim. to Electro Motive Type DM-20.
C113 and C114	19A116655P21	Ceramic disc: 2700 pF + or -20%, 1000 VDCW; sim to RMC Type JR Discap.
C115	19A700005P11	Polyester: 0.047 uF + or -10%, 50 VDCW.
C116	5496267P9	Tantalum: 3.3 uF + or - 20%, 15 VDCW; sim to Sprague Type 150D.
C117 thru C119	19A700005P11	Polyester: 0.047 uF + or -10%, 50 VDCW.
C120	5490008P139	Silver mica: 330 pF + or -10%, 500 VDCW; sim to Electro Motive Type DM-15.
C121 and C122	19A700005P7	Polyester: 0.01 uF + or -10%, 50 VDCW.
C123LL	5496219P262	Ceramic disc: 91 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C123L	5496219P258	Ceramic disc: 62 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C123M	5496219P257	Ceramic disc: 56 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C123H	5496219P254	Ceramic disc: 43 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C124LL	19A700013P15	Phenolic: 1.50 pF + or - 5%, 500 VDCW.
C124L	19A700013P13	Phenolic: 1.00 pF + or - 5%, 500 VDCW.
C124M	19A700013P13	Phenolic: 1.00 pF + or - 5%, 500 VDCW.
C124H	19A700013P12	Phenolic: 0.82 pF + or - 5%, 500 VDCW.
C125LL	5496219P262	Ceramic disc: 91 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C125L	5496219P258	Ceramic disc: 62 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C125M	5496219P257	Ceramic disc: 56 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C125H	5496219P254	Ceramic disc: 43 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C126LL	5491601P124	Phenolic: 1.8 pF + or - 5%, 500 VDCW.
C126L	5491601P124	Phenolic: 1.8 pF + or - 5%, 500 VDCW.
C126M	19A700013P14	Phenolic: 1.20 pF + or - 5%, 500 VDCW.
C126H	19A700013P14	Phenolic: 1.20 pF + or - 5%, 500 VDCW.
C127LL	5496219P262	Ceramic disc: 91 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C127L	5496219P258	Ceramic disc: 62 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C127M	5496219P257	Ceramic disc: 56 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C127H	5496219P254	Ceramic disc: 43 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C128	19A700005P7	Polyester: 0.01 uF + or -10%, 50 VDCW.
C130LL	19A700013P9	Phenolic: 0.47 pF + or - 5%, 500 VDCW.
C130L	5491601P110	Phenolic: 0.36 pF + or - 5%, 500 VDCW.
C130M	19A700013P7	Phenolic: 0.33 pF + or - 5%, 500 VDCW.
C130H	19A700013P6	Phenolic: 0.27 pF + or - 5%, 500 VDCW.
C131LL	5496219P255	Ceramic disc: 47 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C131L	5496219P251	Ceramic disc: 33 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C131M	5496219P247	Ceramic disc: 22 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C131H	5496219P244	Ceramic disc: 15 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C132 and C133	19A700005P7	Polyester: 0.01 uF + or -10%, 50 VDCW.
C134LL	5496219P243	Ceramic disc: 13 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C134L	5496219P240	Ceramic disc: 9.0 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C134M	5496219P242	Ceramic disc: 12 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C134H	5496219P238	Ceramic disc: 7.0 pF + or -0.25 pF, 500 VDCW, temp coef -80 PPM.
C135LL	19A700013P11	Phenolic: 0.68 pF + or - 5%, 500 VDCW.
C135L	5491601P114	Phenolic: 0.51 pF + or - 5%, 500 VDCW.
C135M	19A700013P10	Phenolic: 0.56 pF + or - 5%, 500 VDCW.
C135H	19A700013P9	Phenolic: 0.47 pF + or - 5%, 500 VDCW.
C136LL	5496219P243	Ceramic disc: 13 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C136L	5496219P240	Ceramic disc: 9.0 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C136M	5496219P242	Ceramic disc: 12 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C136H	5496219P238	Ceramic disc: 7.0 pF + or -0.25 pF, 500 VDCW, temp coef -80 PPM.
C137LL	5491601P114	Phenolic: 0.51 pF + or - 5%, 500 VDCW.
C137L	5491601P114	Phenolic: 0.51 pF + or - 5%, 500 VDCW.
C137M	19A700013P8	Phenolic: 0.39 pF + or - 5%, 500 VDCW.
C137H	19A700013P8	Phenolic: 0.39 pF + or - 5%, 500 VDCW.
C138LL	5496219P243	Ceramic disc: 13 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C138L	5496219P240	Ceramic disc: 9.0 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C138M	5496219P242	Ceramic disc: 12 pF + or - 5%, 500 VDCW, temp. coef -80 PPM.
C138H	5496219P238	Ceramic disc: 7.0 pF + or -0.25 pF, 500 VDCW, temp coef -80 PPM.
C139	19A116080P107	Polyester: 0.1 uF + or -10%, 50 VDCW.
C140	19A116655P19	Ceramic disc: 1000 pF + or - 20%, 1000 VDCW; sim to RMC Type JF Discap.
C141LL	5490008P127	Silver mica: 100 pF + or - 10%, 500 VDCW, sim. to Electro Motive Type DM-15.
C141L	5490008P125	Silver mica: 82 pF + or -10%, 500 VDCW; sim to Electro Motive Type DM-15.
C141M	5490008P127	Silver mica: 100 pF + or - 10%, 500 VDCW, sim. to Electro Motive Type DM-15.
C141H	5490008P127	Silver mica: 100 pF + or - 10%, 500 VDCW, sim. to Electro Motive Type DM-15.
C142LL	5490008P27	Silver mica: 100 pF + or - 5%, 500 VDCW, sim. to Electro Motive Type DM-15.
C142L	5490008P25	Silver mica: 82 pF + or - 5%, 500 VDCW, sim. to Electro Motive Type DM-15.
C142M	5490008P25	Silver mica: 82 pF + or - 5%, 500 VDCW, sim. to Electro Motive Type DM-15.
C142H	5490008P24	Silver mica: 75 pF + or - 5%, 500 VDCW, sim. to Electro Motive Type DM-15.
C143	19A116163P5	Variable: approx. 5-60 pF, 250 VDCW; sim. to Mepco Electra 2222-809-08003.
C144	5494481P105	Ceramic disc: 330 pF + or - 20%, 1000 VDCW; sim to Type JF Discap.
C145	19A700005P7	Polyester: 0.01 uF + or -10%, 50 VDCW.
C146	5496219P238	Ceramic disc: 7.0 pF + or -0.25 pF, 500 VDCW, temp coef -80 PPM.
C147	19A116080P107	Polyester: 0.1 uF + or -10%, 50 VDCW.
C148	5494481P105	Ceramic disc: 330 pF + or - 20%, 1000 VDCW; sim to Type JF Discap.
C149	5496267P10	Tantalum: 22 uF + or - 20%, 15 VDCW; sim to Sprague Type 150D.
C150	5496267P14	Tantalum: 15 uF + or - 20%, 20 VDCW; sim to Sprague Type 150D.
C151	5494481P105	Ceramic disc: 330 pF + or - 20%, 1000 VDCW; sim to Type JF Discap.
C152 thru C155	19A700005P7	Polyester: 0.01 uF + or -10%, 50 VDCW.
C156	19A116867P1	Variable: 2.5-6pF, 160 VDCW; sim. to 7S-TRIKO-02.
C157 thru C163	19A700005P7	Polyester: 0.01 uF + or -10%, 50 VDCW.
		- - - - - - - - - - - RECTIFIERS - - - - - - - - -
CR101 thru CR106	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - - - - THINGS - - - - - - - - - -
CV101 thru CV103	5495769P12	Diode, silicon.
		- - - - - - - - - - - - JACKS - - - - - - - - - - -
J101	19A700049P2	Connector, receptacle; 500 VDCW maximum; sim to NTTF-1058.
J103	19B219374G1	Connector: 9 contacts.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - -
L101LL	19D416635G9	Coil.
L101L	19D416635G17	Coil.
L101M	19D416635G1	Coil.
L101H	19D416635G18	Coil.
L102LL	19D416635G9	Coil.
L102L	19D416635G17	Coil.
L102M	19D416635G1	Coil.
L102H	19D416635G18	Coil.
L103LL	19D416635G9	Coil.
L103L	19D416635G17	Coil.
L103M	19D416635G1	Coil.
L103H	19D416635G18	Coil.
L104LL	19A700000P16	Coil, RF: 2.7 uH + or -10%; sim to Jeffers 4411-13K.
L104L	19A700000P15	Coil, RF: 2.2 uH + or -10%; sim to Jeffers 4411-12K.
L104M	19A700000P14	Coil, RF: 1.5 uH + or -10%; sim to Jeffers 4411-10K.
L104H	19A700000P14	Coil, RF: 1.5 uH + or -10%; sim to Jeffers 4411-10K.
L105LL	19A700000P12	Coil, RF: 1.0 uH + or -10%; sim to Jeffers 4411-8K.
L105L	19A700000P10	Coil, RF: 680 nH + or -10%; sim to Jeffers 4411-6K.
L105M	19A700000P8	Coil, RF: 470 nH + or -12%; sim to Jeffers 4411-4K.
L105H	19A700000P6	Coil, RF: 330 nH + or -20%; sim to Jeffers 411-3.
L106 and L107	19A700000P23	Coil, RF: 10 uH + or -10%; sim to Jeffers 4421-7K.
L108	7488079P50	Coil, RF: 39 uH 10%, 2.0 ohms DC res. max; sim. to Jeffers 4422-11.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P902		Includes:
	19B219594P2	Contact, electrical: 8 pins.
	19B219594P3	Contact, electrical: 9 pins.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101 thru Q106	19A702084P1	Silicon, NPN; sim to MPS 2369.
Q107 and Q108	19A115328P1	Silicon, NPN.
Q109	19A116868P1	Silicon, NPN; sim to Type 2N4427.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R101	19A700113P57	Composition: 560 ohms + or - 5%, 1/2 w.
R102	19A700106P83	Composition: 6.8K ohms + or - 5%, 1/4 w.
R103	19A700113P55	Composition: 470 ohms + or - 5%, 1/2 w.
R104	19A700113P35	Composition: 68 ohms + or - 5%, 1/2 w.
R105	19A700113P47	Composition: 220 ohms + or - 5%, 1/2 w.
R106	19A700113P63	Composition: 1K ohms + or - 5%, 1/2 w.
R107LL	3R77P203J	Composition: 20K ohms + or -5%, 1/2 w.
R107L	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R107M	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R107H	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R108	3R77P474J	Composition: 470K ohms + or -5%, 1/2 w.
R109	19A700113P111	Composition: 100K ohms + or - 5%, 1/2 w.
R110	19A700113P95	Composition: 22K ohms + or - 5%, 1/2 w.
R111	19A700113P36	Composition: 75 ohms + or - 5%, 1/2 w.
R112	19A700113P59	Composition: 680 ohms + or - 5%, 1/2 w.
R113	19A700113P75	Composition: 3.3K ohms + or - 5%, 1/2 w.
R114	3R77P511J	Composition: 510 ohms + or -5%, 1/2 w.
R115	19A700113P103	Composition: 47K ohms + or - 5%, 1/2 w.
R116	19A700113P57	Composition: 560 ohms + or - 5%, 1/2 w.
R117	19A700113P61	Composition: 820 ohms + or - 5%, 1/2 w.
R118	19A700113P71	Composition: 2.2K ohms + or - 5%, 1/2 w.
R119	19A700113P59	Composition: 680 ohms + or - 5%, 1/2 w.
R120	3R77P511J	Composition: 510 ohms + or -5%, 1/2 w.
R121	19A700113P95	Composition: 22K ohms + or - 5%, 1/2 w.
R122LL	3R77P203J	Composition: 20K ohms + or -5%, 1/2 w.
R122L	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R122M	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R122H	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R123LL	3R77P203J	Composition: 20K ohms + or -5%, 1/2 w.
R123L	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R123M	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R123H	19A700113P91	Composition: 15K ohms + or - 5%, 1/2 w.
R124	19A700113P95	Composition: 22K ohms + or - 5%, 1/2 w.
R125	19A700113P63	Composition: 1K ohms + or - 5%, 1/2 w.
R126	3R77P431J	Composition: 430 ohms + or -5%, 1/2 w.
R127	19B209358P106	Variable, carbon film: approx 300 to 10K ohms + or -10%, 1/4 w; sim to CTS Type X-201.
R128	19B209358P108	Variable, carbon film: approx 2K to 50K ohms + or -10%, 1/4 w; sim to CTS Type X-201.
R129	19A700113P36	Composition: 75 ohms + or - 5%, 1/2 w.
R130	19A700113P59	Composition: 680 ohms + or - 5%, 1/2 w.
R131	19A700113P75	Composition: 3.3K ohms + or - 5%, 1/2 w.
R132	3R77P511J	Composition: 510 ohms + or -5%, 1/2 w.
R133	19A700113P103	Composition: 47K ohms + or - 5%, 1/2 w.
R134	19A700113P57	Composition: 560 ohms + or - 5%, 1/2 w.
R135	19A700113P95	Composition: 22K ohms + or - 5%, 1/2 w.
R136	19A700113P63	Composition: 1K ohms + or - 5%, 1/2 w.
R137	19A700113P27	Composition: 33 ohms + or - 5%, 1/2 w.
R138	19A700113P45	Composition: 180 ohms + or - 5%, 1/2 w.
R139	19A700113P41	Composition: 120 ohms + or - 5%, 1/2 w.
R140	19A700113P23	Composition: 22 ohms + or - 5%, 1/2 w.
R141	19A700113P35	Composition: 68 ohms + or - 5%, 1/2 w.
R142	19A700113P23	Composition: 22 ohms + or - 5%, 1/2 w.
R143LL	19A700113P39	Composition: 100 ohms + or - 5%, 1/2 w.
R143L	19A700113P39	Composition: 100 ohms + or - 5%, 1/2 w.
R143M	19A700113P37	Composition: 82 ohms + or - 5%, 1/2 w.
R143H	19A700113P37	Composition: 82 ohms + or - 5%, 1/2 w.
R144LL	19A700113P19	Composition: 15 ohms + or - 5%, 1/2 w.
R144L	19A700113P19	Composition: 15 ohms + or - 5%, 1/2 w.
R144M	19A700113P21	Composition: 18 ohms + or - 5%, 1/2 w.
R144H	19A700113P15	Composition: 10 ohms + or - 5%, 1/2 w.
R145	19A700113P99	Composition: 33K ohms + or - 5%, 1/2 w.
R146	19A700113P107	Composition: 68K ohms + or - 5%, 1/2 w.
R147 thru R150	19A700113P99	Composition: 33K ohms + or - 5%, 1/2 w.
R151	19A700113P63	Composition: 1K ohms + or - 5%, 1/2 w.
R152	19A700113P15	Composition: 10 ohms + or - 5%, 1/2 w.
R153 and R154	19A700113P63	Composition: 1K ohms + or - 5%, 1/2 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - -
T101LL	19D416635G10	Coil.
T101L	19D416635G10	Coil.
T101M	19D416635G2	Coil.
T101H	19D416635G2	Coil.
T102LL	19D416635G11	Coil.
T102L	19D416635G11	Coil.
T102M	19D416635G3	Coil.
T102H	19D416635G3	Coil.
T103LL	19D416635G12	Coil.
T103L	19D416635G12	Coil.
T103M	19D416635G4	Coil.
T103H	19D416635G4	Coil.
T104LL	19D416635G19	Coil.
T104L	19D416635G20	Coil.
T104M	19D416635G21	Coil.
T104H	19D416635G22	Coil.
T105LL	19D416635G13	Coil.
T105L	19D416635G13	Coil.
T105M	19D416635G5	Coil.
T105H	19D416635G5	Coil.
T106LL	19D416635G14	Coil.
T106L	19D416635G14	Coil.
T106M	19D416635G6	Coil.
T106H	19D416635G6	Coil.
T107LL	19D416635G15	Coil.
T107L	19D416635G15	Coil.
T107M	19D416635G7	Coil.
T107H	19D416635G7	Coil.
T108LL	19D416635G16	Coil.
T108L	19D416635G16	Coil.
T108M	19D416635G8	Coil.
T108H	19D416635G8	Coil.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U101	19A700037P334	Digital, TTL: DUAL J-K MASTER-SLAVE FLIP FLOP.
U102	19A702868G2	Audio Amplifier.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - - - -
VR101	4036887P56	Zener: 500 mW, 5.0 v. nominal.
		- - - - - - - - - - - - SOCKETS - - - - - - - - - -
XY101 thru XY108	19A701785P1	Contact, electrical; sim to Molex 08-50-0404.
		- - - - - - - - - - - - CRYSTALS - - - - - - - - - -
		NOTE: When reordering, specify ICOM frequency. ICOM Freq = $\frac{\text{(Operating Freq)}}{3}$
Y101 thru Y108	19A129393G13	Compensated: 2 PPM, 25-50 MHz.
Y101 thru Y108	19A129393G16	Externally Compensated: 5 PPM, 25-50 MHz.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A701544P10	Can. (Used with T101-T108 & L101-L103).
	19A701332P4	Insulator, washer: nylon. (Used with Q109).
	19A701887P1	Heat sink. (Used with Q109).
	19A701900P2	Compression clip. (Used with Q109).

*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 - D - Exciter Board 19D416659G1-8
Incorporated in initial shipment

REV. E - To increase audio sensitivity. Changed R126.

REV. F - To eliminate possible shorting of shield to wire runs on printed wire board. Changed T104LL, T104L, T104M and T104H. Deleted shield (19B219619P1), C129LL, C129L, C129M and C129H.

Exciter Board 19D416659G4 & 8

REV. G - To improve multi-frequency spread performance in cold temperatures.

Exciter Board 19D416659G3 & G7

REV. G - To improve performance over two-frequency spread. Changed C130M and C130H to 5491601P109. Was 5491601P107. Phenolic: 0.27 pF ±5% 500 VDCW.

REV. H - To attenuate 3/2 spurious by changing PA input circuit to a high pass type. C141M was 5490008P123, 68 pF ±10% 500 VDCW. R143M was 3R77P820K, 82 ohms ±10%, 1/2 w.

Exciter Board 19D416659G1, 2, 5, 6

REV. G - To increase power output; changed Q109 from 19A115329P2 to 19A116868P1 NPN transistor.

Exciter Board 19D416659G4, 8

REV. H - Same as above.

Exciter Board 19D416659G3, G7

REV. J - Same as above.

Exciter Board 19D416659G1, G5

REV. H - To improve Channel Guard at low end of 25-30 MHz split, changed following resistors: R107LL, R107L, R107M, R107H. Added R119, R120, R121, R122LL, R122L, R122M, R122H, R123LL, R123L, R123M, R123H. Deleted R122, R123.

Exciter Board 19D416659G1, G5

REV. J - To meet symmetry specifications: R107LL, R122LL, R123LL were C3R77P303J, 30,000 ohms.

Exciter Board 19D416659G3, G7

REV. K - To improve stability of 36-42 MHz split: changed C141, R143, R144, L104, L108.

■ NOTES:

1. IN TWO-FREQUENCY EXCITERS (GROUPS 1-4) C157 IS CLIPPED OUT FOR COMBINATIONS WITH 2 TRANSMIT ICOMS. DA JUMPERS ARE PRESENT ON FREQUENCY SWITCHING LINES OF OTHER SIX ICOM CIRCUITS.

2. IN EIGHT-FREQUENCY EXCITERS (GROUPS 5-8), CAPACITORS C157-C163 ARE CLIPPED OUT AS REQUIRED TO MEET THE CUSTOMER REQUIREMENTS FOR FREQUENCIES. EXAMPLE; IF CUSTOMER WANTS ICOMS FOR F1, F2, F5, F7, THEN CAPACITORS C157, C160, AND C162 ARE CLIPPED OUT. C158, C159, C161, C163 ARE LEFT IN.

*** COMPONENT VALUES AS FOLLOWS:**

COMPONENT IDENTIFICATION	LL 25-30 MHZ	L 30-36 MHZ	M 36-42 MHZ	H 42-50 MHZ
C112	680	680	1000	1000
C123	91	62	56	43
C124	1.5	1.0	1.0	0.82
C125	91	62	56	43
C126	1.8	1.8	1.2	1.2
C127	91	62	56	43
C129	47	33	22	15
C130	0.47	0.36	0.33	0.27
C131	47	33	22	15
C134	13	9	12	7
C135	0.68	0.51	0.56	0.47
C136	13	9	12	7
C137	0.51	0.51	0.39	0.39
C138	13	9	12	7
C141	100	82	100	100
C142	100	82	82	75
L104	2.7	2.2	1.5	1.5
L105	1.0	0.68	0.47	0.33
R143	100	100	82	82
R144	15	15	18	10
R107	20K	15K	15K	15K
R122	20K	15K	15K	15K
R123	20K	15K	15K	15K

▲ 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
19D416659G1	K	25-30	2
19D416659G2	H	30-36	2
19D416659G3	L	36-42	2
19D416659G4	J	42-50	2
19D416659G5	K	25-30	8
19D416659G6	H	30-36	8
19D416659G7	L	36-42	8
19D416659G8	J	42-50	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.

(19R621827, Rev. 22)

SCHEMATIC DIAGRAM

25—50 MHz, EXCITER BOARD 19D416659G1-G8

✱ COMPONENT VALUES AS FOLLOWS:

COMP. IDENT.	LL 25-30 MHZ	L 30-36 MHZ	M 36-42 MHZ	H 42-50 MHZ
C205	120	120	120	220
C207	390	330	270	220
C208	330	270	270	220
C209	390	270	270	270
C210	330	220	220	180
C213	1000	1000	680	680
C214	56	56	47	39
C215	56	56	47	39
C217	330	330	220	180
C218	390	330	270	270
C219	390	330	270	270
C220	330	270	270	180
C221	330	270	270	180
C222	1000	1000	680	680
C224	500	500	430	360
C225	500	500	430	360
C226	200	240	220	180
C235	270	270	220	180
C236	220	150	100	150
C237	220	150	100	100
C250	100	100	150	150
C258	100			
C259	100			
C260	91	68	56	51
C261	110	91	68	56
C262	15	13	12	10
C263	140	110	91	82
C264	120	100	82	75
C265	91	68	56	51
R201	10	10	20	20
R202	5.6	5.6	2.7	1.2
R203	5.6	5.6	2.7	1.2
R204	5.6	5.6	2.7	1.2
R207				
C280				6.8U
C281				6.8U

NOTE: CHANGES TO THIS DIAG. MAY AFFECT 19R622108.

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. NOTE: READINGS AT Q201 COLLECTOR AND IN THE POWER CONTROL CIRCUIT WERE TAKEN WITH THE TRANSMITTER ADJUSTED FOR 50 WATTS OUTPUT. THESE READINGS WILL VARY DEPENDING ON THE SETTING OF POWER ADJUST CONTROL R216.

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.

NOTES:

1. CALLED FOR ON PL19C321295.
2. 50Ω MICRO STRIP, PART OF PWB.
3. (A- symbol) - INDICATES A-
   (ground symbol) - INDICATES VEHICLE GROUND

	PA ASSEMBLY	REV LTR	HEAT SINK ASM	REV LTR	CPNT. BD. ASM	REV LTR	FREQ. RANGE
STANDARD PACKAGE	19C321295G1	A	19B219688G1		19D417968G1	D	25-30 MHZ
	19C321295G2	A			19D417968G2	C	30-36 MHZ
	19C321295G3	A			19D417968G3	E	36-42 MHZ
	19C321295G4	B			19D417968G4	F	42-50 MHZ
	19C321295G9	A	19B219688G13		19D417968G1	D	25-30 MHZ
	19C321295G10	A			19D417968G2	C	30-36 MHZ
	19C321295G11	A			19D417968G3	F	36-42 MHZ
	19C321295G12	B			19D417968G4	F	42-50 MHZ

SCHEMATIC DIAGRAM

25—50 MHz, 50-WATT STATION
POWER AMPLIFIER 19C321295G1-G4

(19R622106, Rev. 16)

PARTS LIST

LBI4897B

25-50 MHz, 50 WATT
POWER AMPLIFIER
19C321295G1 - G4
19C321295G9 - G12

SYMBOL	GE PART NO.	DESCRIPTION
		19C321295G1, G9 25-30 MHz (LL) 19C321295G2, G10 30-36 MHz (L) 19C321295G3, G11 36-42 MHz (M) 19C321295G4, G11 42-50 MHz (H) - REV B
		- - - - - - - - - - CAPACITORS - - - - - - - -
C280 and C281	19A134202P15	Tantalum: 6.8 uF ±20%, 35 VDCW.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L295 and L296	19A129356P1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q201	19A116965P1	Silicon, NPN.
Q202	19A116839P2	Silicon, NPN.
Q203	19A116839P3	Silicon, NPN.
Q210	19A116375P1	Silicon, PNP.
		- - - - - - - - - - THERMISTORS - - - - - - - - -
RT201	19A129379G1	Thermistor: 40K ohms ±20%, color code white; sim to Carborundum Type M0806J-5.
		POWER AMPLIFIER BOARD 19D417968G1 25-30 MHz 19D417968G2 30-36 MHz 19D417968G3 36-42 MHz 19D417968G4 42-50 MHZ - REV F
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C201	19A116080P101	Polyester: 0.01 uF ±10%, 50 VDCW.
C202	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C203	19A116080P101	Polyester: 0.01 uF ±10%, 50 VDCW.
C204	19A116655P23	Ceramic disc: 3900 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C205LL	19A700105P36	Mica: 120 pF ±5%, 500 VDCW.
C205L	19A700105P36	Mica: 120 pF ±5%, 500 VDCW.
C205M	19A700105P36	Mica: 120 pF ±5%, 500 VDCW.
C205H	19A700105P44	Mica: 220 pF ±5%, 500 VDCW.
C206	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C207LL	7489162P41	Silver mica: 390 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C207L	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C207M	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C207H	19A700105P44	Mica: 220 pF ±5%, 500 VDCW.
C208LL	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C208L and C208M	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C208H	19A700105P44	Mica: 220 pF ±5%, 500 VDCW.
C209LL	7489162P41	Silver mica: 390 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C209L	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C209M	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C209H	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C210LL	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C210L and C210M	19A700105P44	Mica: 220 pF ±5%, 500 VDCW.
C210H	19A700105P41	Mica: 180 pF ±5%, 500 VDCW.
C211	19A116080P107	Polyester: 0.1 uF ±10%, 50 VDCW.
C212	5496267P18	Tantalum: 6.8 uF ±20%, 35 VDCW; sim to Sprague Type 150D.
C213LL and C213L	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C213M and C213H	19A116655P17	Ceramic disc: 680 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C214LL and C214L	19A116656P56J0	Ceramic disc: 56 pF ±5%, 500 VDCW; temp coef 0 PPM.
C214M	19A116656P47J0	Ceramic disc: 47 pF ±5%, 500 VDCW; temp coef 0 PPM.
C214H	19A116656P39J0	Ceramic disc: 39 pF ±5%, 500 VDCW, temp coef 0 PPM.
C215LL and C215L	19A116656P56J0	Ceramic disc: 56 pF ±5%, 500 VDCW; temp coef 0 PPM.
C215M	19A116656P47J0	Ceramic disc: 47 pF ±5%, 500 VDCW; temp coef 0 PPM.
C215H	19A116656P39J0	Ceramic disc: 39 pF ±5%, 500 VDCW, temp coef 0 PPM.
C216	19A116080P107	Polyester: 0.1 uF ±10%, 50 VDCW.
C217LL and C217L	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C217M	19A700105P44	Mica: 220 pF ±5%, 500 VDCW.
C217H	19A700105P41	Mica: 180 pF ±5%, 500 VDCW.
C218LL	7489162P41	Silver mica: 390 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C218L	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C218M and C218H	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C219LL	7489162P41	Silver mica: 390 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C219L	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C219M and C219H	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C220LL	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C220L and C220M	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C220H	19A700105P41	Mica: 180 pF ±5%, 500 VDCW.
C221LL	7489162P39	Silver mica: 330 pF ±5%, 500 VDCW; sim to Sprague Type 118.
C221L and C221M	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C221H	19A700105P41	Mica: 180 pF ±5%, 500 VDCW.
C222LL and C222L	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C222M and C222H	19A116655P17	Ceramic disc: 680 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C223	19A116080P107	Polyester: 0.1 uF ±10%, 50 VDCW.
C224LL and C224L	19A116679P500J	Silver Mica: 500 pF ±5%, 250 VDCW.
C224M	19A700015P44	Metallized teflon: 430 pF ±5%, 250 VDCW.
C224H	19A700015P42	Metallized teflon: 360 pF ±5%, 250 VDCW.
C225LL and C225L	19A116679P500J	Silver Mica: 500 pF ±5%, 250 VDCW.
C225M	19A700015P44	Metallized teflon: 430 pF ±5%, 250 VDCW.
C225H	19A700015P42	Metallized teflon: 360 pF ±5%, 250 VDCW.
C226LL	19A700015P36	Teflon/Mica: 200 pF ±5%, 250 VDCW.
C226L	19A700015P38	Teflon/Mica: 240 pF ±5%, 250 VDCW.
C226M	19A700015P37	Teflon/Mica: 220 pF ±5%, 250 VDCW.
C226H	19A700015P35	Teflon/Mica: 180 pF ±5%, 250 VDCW.
C230	19A116655P23	Ceramic disc: 3900 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C231	19A116080P103	Polyester: 0.022 uF ±10%, 50 VDCW.
C232	19A116655P23	Ceramic disc: 3900 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C233	19A116080P103	Polyester: 0.022 uF ±10%, 50 VDCW.
C234	5496267P13	Tantalum: 2.2 uF ±20%, 20 VDCW; sim to Sprague Type 150D.
C235LL and C235L	19A700105P46	Mica: 270 pF ±5%, 500 VDCW.
C235M	19A700105P44	Mica: 220 pF ±5%, 500 VDCW.
C235H	19A700105P41	Mica: 180 pF ±5%, 500 VDCW.
C236LL	19A116656P220J4	Ceramic disc: 220 pF ±5%, 500 VDCW; temp coef -470 PPM.
C236L	19A116656P150J1	Ceramic disc: 150 pF ±5%, 500 VDCW, temp coef -150 PPM.
C236M	19A116656P100J1	Ceramic disc: 100 pF ±5%, 500 VDCW, temp coef -150 PPM.
C236H	19A116656P150J1	Ceramic disc: 150 pF ±5%, 500 VDCW, temp coef -150 PPM.
C237LL	19A116656P220J4	Ceramic disc: 220 pF ±5%, 500 VDCW; temp coef -470 PPM.
C237L	19A116656P150J1	Ceramic disc: 150 pF ±5%, 500 VDCW, temp coef -150 PPM.
C237M and C237H	19A116656P100J1	Ceramic disc: 100 pF ±5%, 500 VDCW, temp coef -150 PPM.
C238 and C239	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C240	19A116080P101	Polyester: 0.01 uF ±10%, 50 VDCW.
C241 and C242	19A116655P17	Ceramic disc: 680 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C243	19A116080P101	Polyester: 0.01 uF ±10%, 50 VDCW.
C244 thru C246	19A116080P103	Polyester: 0.022 uF ±10%, 50 VDCW.
C248	19A115680P4	Electrolytic: 50 uF +150% -10%, 25 VDCW; sim to Mallory Type TTX.
C250	19A116656P100J1	Ceramic disc: 100 pF ±5%, 500 VDCW, temp coef -150 PPM.
C250M and C250H	19A116656P150J1	Ceramic disc: 150 pF ±5%, 500 VDCW, temp coef -150 PPM.
C251 thru C253	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C255 thru C257	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C258LL	19A116656P100K4	Ceramic disc: 100 pF ±10%, 500 VDCW, temp coef -470 PPM.
C259LL	19A116656P100K4	Ceramic disc: 100 pF ±10%, 500 VDCW, temp coef -470 PPM.
C260LL*	19A116656P91J2	Ceramic disc: 91 pF ±5%, 500 VDCW; temp coef -220 PPM.
		In 19D417968G1 of REV A and earlier:
	19A116656P82J1	Ceramic disc: 82 pF ±5%, 500 VDCW, temp coef -150 PPM.
C260L	19A116656P68J1	Ceramic disc: 68 pF ±5%, 500 VDCW, temp coef -150 PPM.
C260M	19A116656P56J1	Ceramic disc: 56 pF ±5%, 500 VDCW; temp coef -150 PPM.
C260H	19A116656P51J1	Ceramic disc: 51 pF ±5%, 500 VDCW; temp coef -150 PPM.
C261LL	19A700015P30	Silver mica: 110 pF ±5%, 250 VDCW.
C261L	19A700015P28	Teflon/Mica: 91 pF ±5%, 250 VDCW.
C261M	19A700015P25	Silver mica: 68 pF ±5%, 250 VDCW.
C261H	19A700015P23	Teflon/Mica: 56 pF ±5%, 250 VDCW.
C262LL	19A116656P15J1	Ceramic disc: 15 pF ±5%, 500 VDCW, temp coef -150 PPM.
C262L	19A116656P13J1	Ceramic disc: 13 pF ±5%, 500 VDCW, temp coef -150 PPM.
C262M	19A116656P12J1	Ceramic disc: 12 pF ±5%, 500 VDCW; temp coef -150 PPM.
C262H	19A116656P10J1	Ceramic disc: 10 pF ±5%, 500 VDCW; temp coef -150 PPM.
C263LL	19A116679P140J	Silver Mica: 140 pF ±5%, 250 VDCW.
C263L	19A700015P30	Silver mica: 110 pF ±5%, 250 VDCW.
C263M	19A700015P28	Teflon/Mica: 91 pF ±5%, 250 VDCW.
C263H	19A700015P27	Silver mica: 82 pF ±5%, 250 VDCW.
C264LL	19A700015P31	Teflon/Mica: 120 pF ±5%, 250 VDCW.
C264L	19A700015P29	Teflon/Mica: 100 pF ±5%, 250 VDCW.
C264M	19A700015P27	Silver mica: 82 pF ±5%, 250 VDCW.
C264H	19A700015P26	Teflon/Mica: 75 pF ±5%, 250 VDCW.
C265LL*	19A116656P91J2	Ceramic disc: 91 pF ±5%, 500 VDCW; temp coef -220 PPM.
		In 19D417968G1 of REV A and earlier:
	19A116656P82J1	Ceramic disc: 82 pF ±5%, 500 VDCW, temp coef -150 PPM.
C265L	19A116656P68J1	Ceramic disc: 68 pF ±5%, 500 VDCW, temp coef -150 PPM.
C265M	19A116656P56J1	Ceramic disc: 56 pF ±5%, 500 VDCW; temp coef -150 PPM.
C265H	19A116656P51J1	Ceramic disc: 51 pF ±5%, 500 VDCW; temp coef -150 PPM.
C270 and C271	19A116080P101	Polyester: 0.01 uF ±10%, 50 VDCW.
C272	19A116655P23	Ceramic disc: 3900 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C273	19A116080P103	Polyester: 0.022 uF ±10%, 50 VDCW.
C274	19A116655P19	Ceramic disc: 1000 pF ±20%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR201*	19A116052P2	Silicon, fast recovery; sim to Hewlett Packard 5082-2811.
		Earlier than REV A:
	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR202 thru CR205	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J201 thru J203	19A700049P2	Connector, receptacle; 500 VDCW maximum; sim to NTTF-1058.
J205	19B219374G1	Connector, Includes:
	19C317957P1	Shell.
	19A116651P1	Contact, electrical.
J206 and J207	19A134263P2	Contact, electrical: sim to Selectro 229-1071.
J208	4033513P4	Contact, electrical: sim to Bead Chain L93-3.
		- - - - - - - - - - - - RELAYS - - - - - - - - - - - -
K201	19A700061P1	Hermetic sealed: 180 to 341 ohms coil res, 8-16.3 VDC; sim to GE 3SAV1760A2, CP Clare HFW-1201558, or Potter-Brumfield HCM6160.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L201LL	19A129347P2	Coil.
L201L	19A129347P1	Coil.
L201M	19A129347P3	Coil.
L201H	19A129347P5	Coil.
L202LL	19A129352P9	Coil.
L202L	19A129354P4	Coil.
L202M	19A129352P8	Coil.
L202H	19A129352P7	Coil.
L203	19A700000P122	Coil, RF: 8.2 uH ±10%; sim to Jeffers 4422-3K.
L204	19A700000P6	Coil, RF: 330 nH ±20%; sim to Jeffers 411-3.
L205LL and L205L	19A129351P3	Coil.
L205M	19A129351P2	Coil.
L205H	19A129351P2	Coil.
L206LL	19A129352P1	Coil.
L206L	19A129352P1	Coil.
L206M	19A129352P3	Coil.
L206H	19A129348P2	Coil.
L207	19A700000P122	Coil, RF: 8.2 uH ±10%; sim to Jeffers 4422-3K.
L208LL and L208L	19A129349P1	Coil.
L208M and L208H	19A129349P2	Coil.
L209LL	19A129355P1	Coil.
L209L and L209M	19A129352P4	Coil.
L209H	19A129352P2	Coil.
L210LL	19A129358P1	Coil.
L210L	19A129359P1	Coil.
L210M	19A129357P1	Coil.
L210H	19A129357P2	Coil.
L211	19A700000P122	Coil, RF: 8.2 uH ±10%; sim to Jeffers 4422-3K.
L212LL and L212L	19A129349P1	Coil.
L212M and L212H	19A129349P2	Coil.
L213LL	19A129351P1	Coil.
L213L	19A129358P2	Coil.
L213M	19A129355P3	Coil.
L213H	19A129351P4	Coil.
L214LL	19A129353P3	Coil.
L214L	19A129355P5	Coil.
L214M	19A129355P4	Coil.
L214H	19A129352P10	Coil.
L220LL	19A129360P9	Coil.
L220L	19A129360P6	Coil.
L220M	19A129360P4	Coil.
L220H	19A129360P1	Coil.
L221LL	19A129360P10	Coil.
L221L	19A129360P7	Coil.
L221M	19A129360P3	Coil.
L221H	19A129360P2	Coil.
L222LL	19A129360P11	Coil.
L222L	19A129360P8	Coil.
L222M	19A129360P5	Coil.
L222H	19A129360P3	Coil.
L223LL	19A129360P9	Coil.
L223L	19A129360P6	Coil.
L223M	19A129360P4	Coil.
L223H	19A129360P1	Coil.
L224	19A700000P17	Coil, RF: 3.3 uH ±10%; sim to Jeffers 4421-1K.
L225 and L226	19A129346G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q204	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q205 thru Q207	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q208	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q209	19A129187P1	Silicon, PNP.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R201LL and R201L	19A700113P15	Composition: 10 ohms ±5%, 1/2 w.
R201M and R201H	3R77P200J	Composition: 20 ohms ±5%, 1/2 w.
R202LL and R202L	19A700112P9	Composition: 5.6 ohms ±5%, 1 w.
R202M	19A700112P1	Composition: 2.7 ohms ±5%, 1 w.
R202H	7147161P22	Composition: 1.2 ohms ±5%, 1/2 w.
R203LL and R203L	19A700112P9	Composition: 5.6 ohms ±5%, 1 w.
R203M	19A700112P1	Composition: 2.7 ohms ±5%, 1 w.
R203H	7147161P22	Composition: 1.2 ohms ±5%, 1/2 w.
R204LL and R204L	19A700112P9	Composition: 5.6 ohms ±5%, 1 w.
R204M	19A700112P1	Composition: 2.7 ohms ±5%, 1 w.
R204H	7147161P22	Composition: 1.2 ohms ±5%, 1/2 w.
R205	3R78P200J	Composition: 20 ohms ±5%, 500 VDCW, 1 w.
R206	19A700113P1	Composition: 2.7 ohms ±5%, 1/2 w.
R207	19A700112P15	Composition: 10 ohms ±5%, 1 w.
R208	19A700106P91	Composition: 15K ohms ±5%, 1/4 w.
R209	19A700106P83	Composition: 6.8K ohms ±5%, 1/4 w.
R210	19A700106P39	Composition: 100 ohms ±5%, 1/4 w.
R211	19A116278P233	Metal film: 2150 ohms ±2%, 1/2 w.
R212	19A116278P217	Metal film: 1470 ohms ±2%, 1/2 w.
R213	19A116278P261	Metal film: 4220 ohms ±2%, 1/2 w.
R214	19A116278P269	Metal film: 5110 ohms ±2%, 1/2 w.
R215	19A116278P261	Metal film: 4220 ohms ±2%, 1/2 w.
R216	19A116559P102	Variable cermet: 5000 ohms ±20%, 1/2 w; sim to CTS Series 360.
R217	19A700106P59	Composition: 680 ohms ±5%, 1/4 w.
R218	19A700106P57	Composition: 560 ohms ±5%, 1/4 w.
R219	19A700106P69	Composition: 1.8K ohms ±5%, 1/4 w.
R220	19A700113P55	Composition: 470 ohms ±5%, 1/2 w.
R221	19A700113P41	Composition: 120 ohms ±5%, 1/2 w.
R222	19A700106P83	Composition: 6.8K ohms ±5%, 1/4 w.
R223	19A700106P77	Composition: 3.9K ohms ±5%, 1/4 w.
R224	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
R225	19A700113P15	Composition: 10 ohms ±5%, 1/2 w.
R230 and R231	19C850605P2	Shunt resistor.
R233 and R234	19A700112P15	Composition: 10 ohms ±5%, 1 w.
R235	19A700106P75	Composition: 3.3K ohms ±5%, 1/4 w.
R236	3R152P241J	Composition: 240 ohms ±5%, 1/4 w.
		- - - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR201	4036887P1	Zener: 500 mW, 2.3 v. nominal.
VR202	4036887P5	Zener: 500 mW, 5.4 v. nominal.
		- - - - - - - - - - - - CABLES - - - - - - - - - - -
W201	19A129571P1	Wire Strap.
		HEAT SINK ASSEMBLY 19B219688G1 M MODEL & INTERMITTANT DUTY STATION 19B219688G13 E MODEL
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C297 and C298	19A116708P1	Ceramic: 0.01 uF -0 +100%, 500 VDCW, rated 20 amps; sim to Erie 327050X5W0103P.
C299	19A115680P10	Electrolytic: 200 uF +150-10%, 18 VDCW; sim to Mallory Type TTX.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR295	19A116783P1	Rectifier, silicon: 100 VDC blocking, 6 amp; sim to MR751.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19D416275P2	Filter casting.
	19D416712P1	Insulator. (Located under printed wiring board).
	5492178P2	Washer, spring tension: sim to Wallace Barnes 375-20.
	19A702782P5	Nut, hex, brass: No. 8-32. (Used with Q201 and Q202).
	N207P16C6	Hex nut: No. 10-32. (Used with Q203).
	19A700068P1	Insulator, bushing. (Used with Q210).
	19A116023P1	Insulator, plate. (Used with Q210).
	19A129361P1	Shield. (Located between L221-L222 and L222-L223).
	19A129361P2	Shield. (Located between L220-L221).

*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 - PA Board 19D417968G1-4
To improve operation in cold temperature environments with wide frequency spacing. Changed CR201.

REV. B - PA Board 19D417968G1
To improve stopband attenuation in the 25-30 MHz range. Changed C260 and C265.

PA Board 19D417968G2-G4
REV. B - To attenuate 3/2 conducted spurious by changing PA input; swapped positions of L201 and C205.

PA Board 19D417968G3-G4
REV. C - To stabilize Q203 by reducing base resistance; R207 changed from 3R78200J to 3R78100J.

PA Board 19D417968G3
REV. D - To increase power output at low end of 36 to 42 MHz split. Changed C217M from 7489162P37 (270 pF) to 7489162P35 (220 pF) and C250M from 19A116656P100J1 (100 PF) to 19A116656P150J1 (150 pF).

PA Board 19D417968G4
REV. D - To increase power output and stability at low end of band. Changed C205 from 7489162P29 (120 pF) to 7489162P35 (220 uF). Changed C217H from 7489162P35 (220 pF) to 7489162P33 (180 pF). Changed C236H and C237H from 19A116656P56J0 (56 pF) to 19A116656P68J0 (68 pF).

PA Assembly 19C321295G2 & G10
REV. A - To increase power output; deleted Q201 (19A116839P1). Added Q201L.

PA Assembly 19C321295G1-G4, G9-G12
REV. A - To increase power output. Changed Q201 from 19A116839P1 to 19A116965P1.

PA Assembly 19C321295G4, G12
REV. B - To improve operation of power control on 42-50 MHz, 50-Watt PA. Added C280 and C281.