(Non-NB version is LBI-30109)

DESCRIPTION AND MAINTENANCE

MASTR® II 138—174 MHz RECEIVER (WITH NOISE BLANKER)

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ILLUSTRATIONS

DESCRIPTION

MASTR II, 138 to 174 megahertz receivers are single conversion, superheterdyne FM receivers designed for one- through eight-frequency operation. The solid state receiver utilizes integrated circuits (ICs), monolithic crystal filters and discrete components with each of the crystal filters located between gain stages to provide 100 dB selectivity and maximum protection from de-sensitization and intermodulation.

The receiver consists of the following modules:

- RF Assembly
- Mixer/IF/Noise Blanker (MIF/NB)
- Oscillator/Multiplier (Osc/Mult)
- IF/AUDIO and Squelch (IFAS)

Audio, supply voltages and control functions are connected to the system board through P903 on the Osc/Mult board, and P904 on the IFAS board. The regulated +10 Volts is used for all receiver stages except the audio PA stage which operates from the A+ system supply.

Centralized metering jack J601 on the IFAS board is provided for use with GE test Set 4EX3A11 or Test Kit 4EX8K12. The test set meters the oscillator, multiplier, noise blanker, IF Detector and IF amplifier stages. Speaker high and low are metered on the system board metering jack.

A block diagram of the complete receiver is shown in Figure 1.

Refer to the appropriate Maintenance Manual for complete details on each receiver module listed in the Table of Contents.

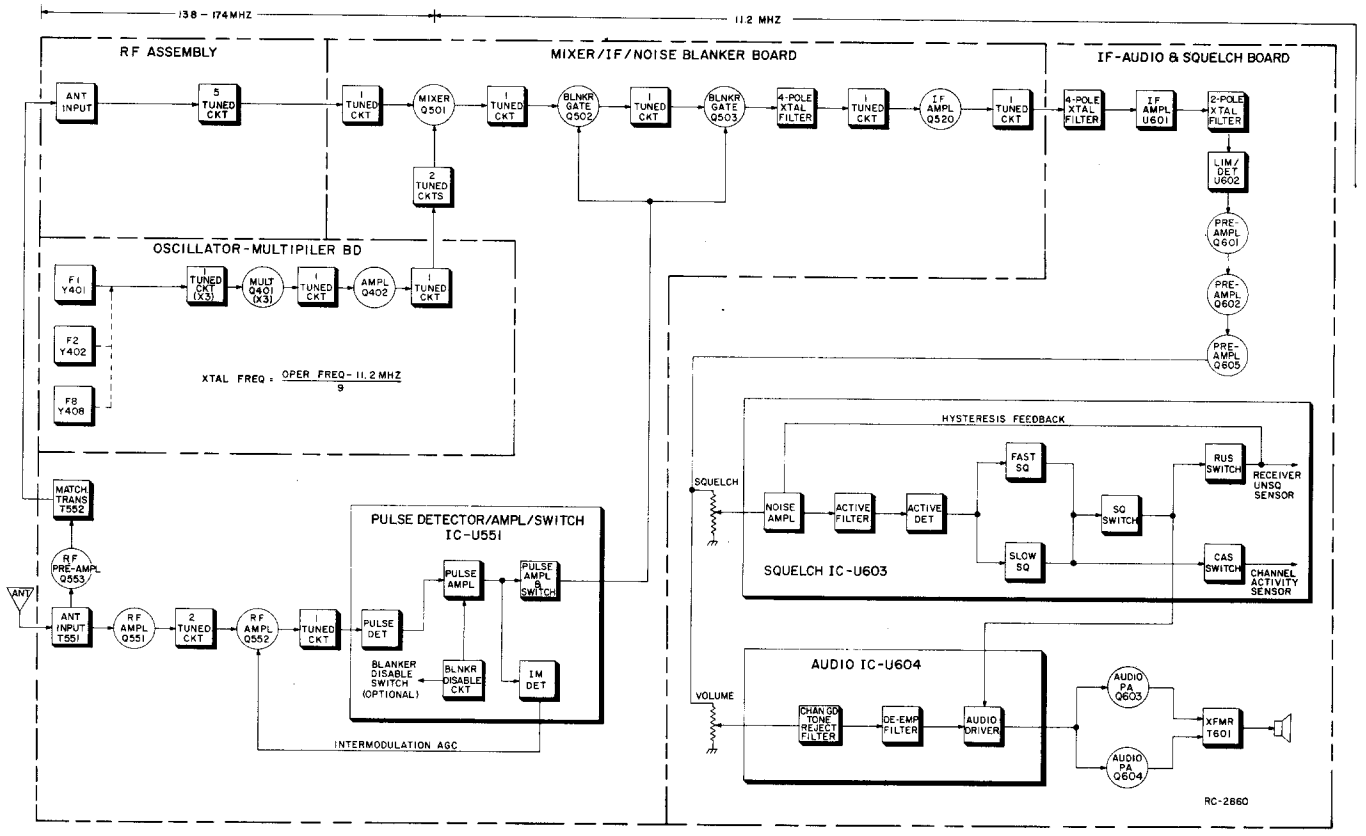

Figure 1 - Receiver Block Diagram

MAINTENANCE

DISASSEMBLY

To service the Receiver from the top (see Mechanical Parts Breakdown):

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

To service the Receiver 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 2).

To remove the MIF/NB board from the radio:

1. Remove Connectors (H), (J), (K), and (L).
2. Remove the seven screws (E) holding the MIF bottom cover (see Figure 3).
3. Remove the four screws (F) holding the MIF top cover.
4. Remove the four screws (G) and carefully push down on the top of the board to avoid damaging the feedthrough capacitors.

NOTE

Refer to Figure 4 for receiver module location.

To remove the Osc/Mult board from the radio:

1. Remove the six screws (A) holding the receiver bottom cover.
2. Remove the seven screws (E) holding the MIF/NB bottom cover.
3. Remove the four screws (B) holding the board.
4. Press straight down on the plug-in Osc/Mult board from the top to avoid bending the pins when unplugging the board from the system board jack.

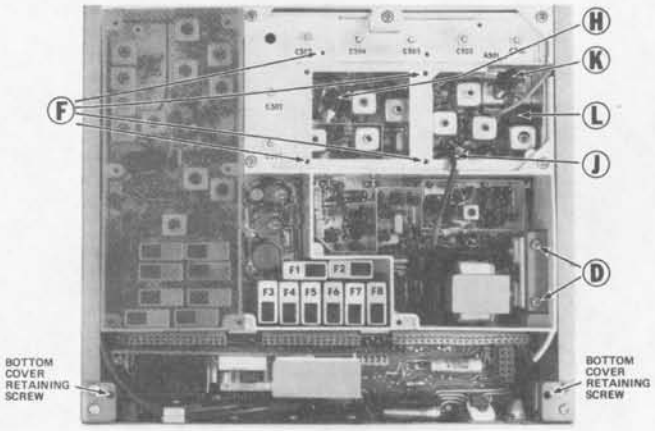

Figure 2 - Disassembly Procedure (Top View)

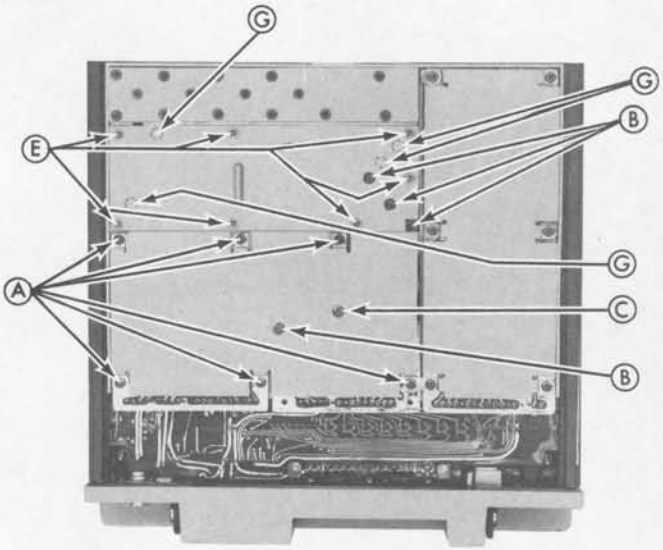

Figure 3 - Disassembly Procedure (Bottom View)

To remove the IFAS board from the radio:

1. Remove Connector (J) from J552 on MIF/NB board.
2. Remove the six screws (A) holding the bottom cover, and the one screw (C) holding the board.
3. Remove the two screws (D) holding the audio PA heatsink to the right side rail.
4. Press straight down on the plug-in IFAS board from the top to avoid bending the pins when unplugging the board from the system board jack.

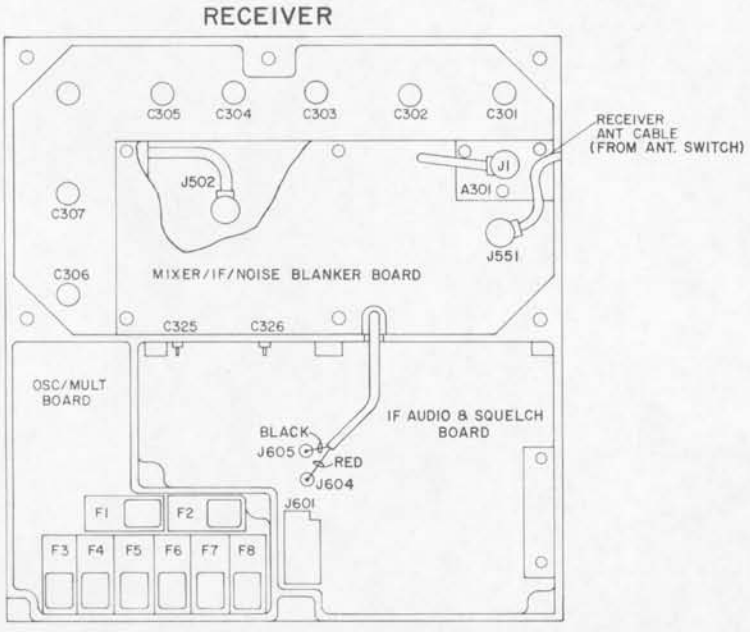

Figure 4 - Receiver Module Location

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FRONT END ALIGNMENT

EQUIPMENT

1. GE Test Set Models 4EX3A11, 4EX8K12, or 20,000 ohms-per-Volt multimeter with a 1-Volt scale.
2. A 138-174 MHz signal source.

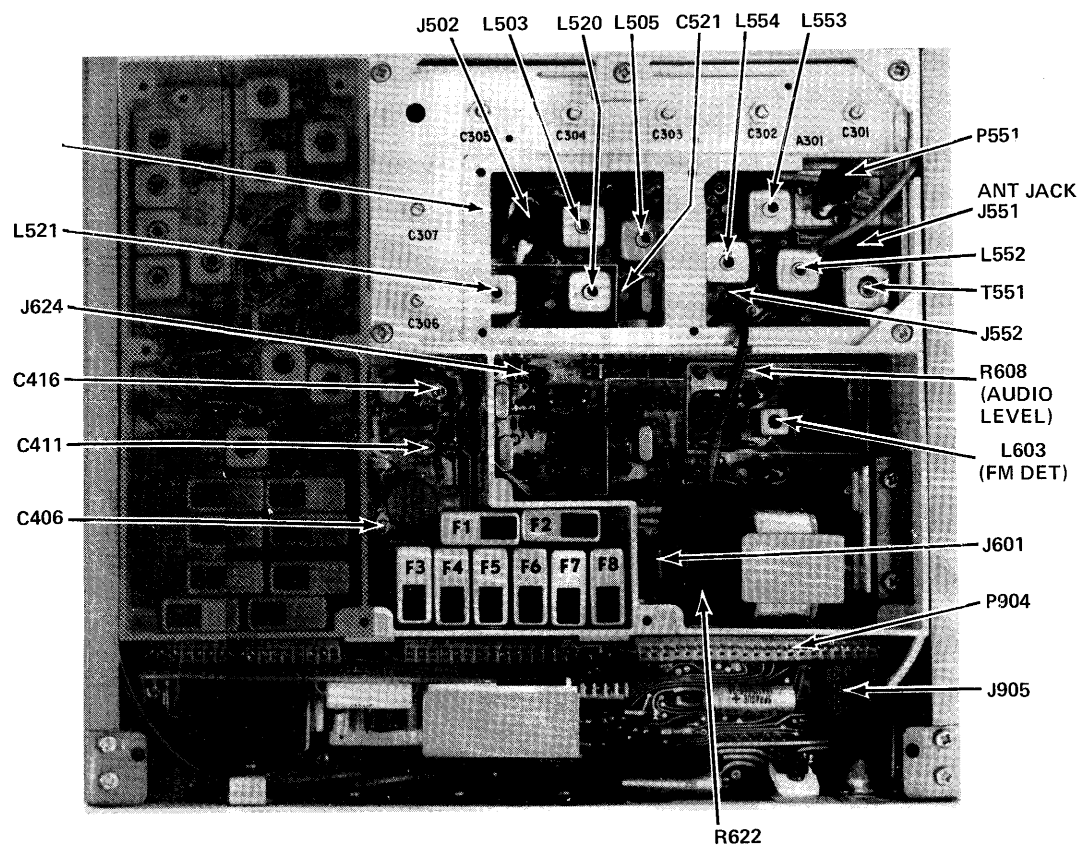
PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect black plug from Test Set to Receiver Centralized Metering Jack J601, and red plug to system board metering jack J905. Set range selector switch to the TEST 1 position (or 1-Volt position on 4EX8K12).
2. For multi-frequency receivers with a frequency spacing up to 0.450 MHz for frequency range of 138-155 MHz, or 0.500 MHz for frequency range of 150.8-174 MHz, align the receiver on the channel nearest center frequency.

   For multi-frequency receivers with a frequency spacing exceeding the above but no greater than .900 MHz for frequency range of 138-155 MHz, or 1.00 MHz for frequency range of 150.8-174 MHz, align the receiver using a center frequency tune-up ICOM. These limits can be extended to 1.60 MHz, and 1.80 MHz respectively, with 3 dB degradation in standard receiver specifications.
3. With Test Set in Position J, check for regulated +10 Volts. If using multimeter, measure between J905-3 (+) and J905-9 (-).
4. If using multimeter, connect the negative lead to J901-9 (A-).
5. Disable Channel Guard.

ALIGNMENT PROCEDURE

STEP	METERING POSITION GE Test Set	METERING POSITION Multimeter - at J601-9	TUNING CONTROL	METER READING	PROCEDURE
			OSCILLATOR/MULTIPLIER		
1.	C (MULT-1)	Pin 3	C406	Maximum	Tune C406 for maximum meter reading.
2.			C411, C416, C306, C307	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306 and C307 fully counterclockwise (minimum capacity).
3.	D (MULT-2)	Pin 4	C411, C416, C406	See Procedure	Tune C411 and C416 for maximum meter reading. Next, retune C406, C411 and C416 for maximum meter reading, then, carefully dip C306 and tune C307 for maximum meter reading. Do NOT re-adjust C306 and C307.
			RF SELECTIVITY		
4.	B (IF AMP)	Pin 1	C502, C301 thru C305 and top slug of T551 (L555)	Maximum	Apply an on-frequency signal to A301-J1, keeping the signal below saturation. Then tune C502 and C301 through C305 and T551 (top slug-L555) for maximum meter reading.
5.	B (IF AMP)	Pin 1	C502, C301 thru C307 and top slug of T551	Maximum	Apply an on-frequency signal to the antenna jack (J551) and slightly tune C301 through C305 and T551 (top slug-L555) and C502 for best quieting sensitivity. C306 and C307 also may be tuned slightly (not to exceed 1/4 turn).



NOTE 1: Appendix A of DATAFILE Bulletin 1000-6 contains instructions for building a sweep modulator.

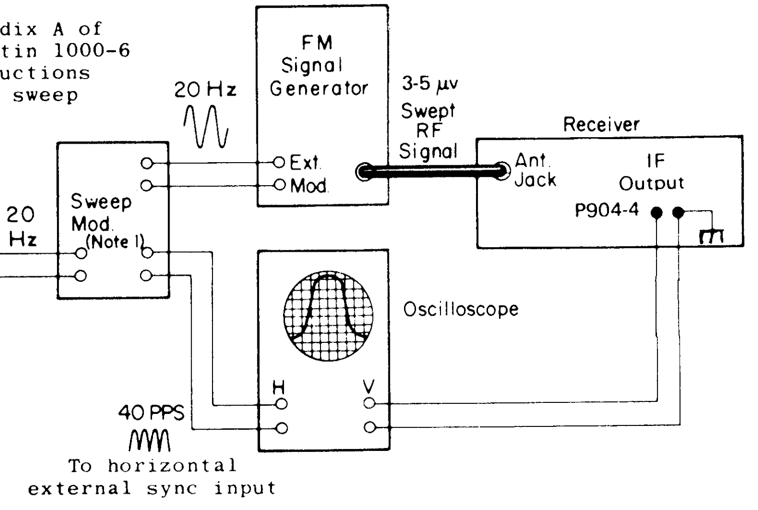


Figure 5 - Test Setup for 20-Hz Double-Trace Sweep Alignment

ICOM FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency measurement requires equipment with an absolute accuracy which is 5 to 10 times better than the tolerance to be maintained. When performing frequency measurement, the entire radio should be as near as possible to an ambient temperature of 26.5°C (79.8°F).

MASTR II ICOMs should be reset only when the measured frequency error exceeds 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 -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 -40°C to -5°C (-40°F to +23°F) or +55°C to +70°C (+131°F to +158°F).

If frequency adjustment is required, lift up the cover on the top of the ICOM to expose the adjustment trimmer. Depending upon the type of frequency measuring equipment that is available, any of the following procedures may be used:

A. DIRECT MEASUREMENT IN THE INJECTION CHAIN

1. WITH A FREQUENCY COUNTER. "Count" the frequency at the junction of C416 and L403 on the Oscillator/Multiplier Board. The frequency measured at this point is 9 times the ICOM frequency. NOTE: The output from the ICOM itself is not sufficiently sinusoidal for reliable operation with most frequency counters.
2. WITH A COMMUNICATION MONITOR (for example Cushman Model CE-3). "Monitor" frequency at the junction of C416 and L403 on the Oscillator/Multiplier Board. The frequency monitored at this point is 9 times the ICOM frequency. NOTE: This frequency will not always fall within an available measuring range of all monitors at all receiver operating frequencies.

B. STANDARD "ON FREQUENCY" SIGNAL AT THE RECEIVER INPUT (Generated from a COMMUNICATION MONITOR, for example: Cushman Model CE-3).

1. WITH A FREQUENCY COUNTER. "Count" the developed IF frequency at the top of Z602-R2 on the IFAS board. The deviation from the nominal IF frequency (11.2 MHz) in Hz is compared to the receiver operating frequency (also in Hz) to calculate error in PPM.
2. WITH AN 11.2 MHz IF FREQUENCY STANDARD (for example: General Electric Model 4EX9A10). Loosely couple the IF frequency standard to the IF signal path to create a heterodyne with the developed IF frequency. The resultant "best frequency" can be monitored by either of the following methods:

—NOTE—

To Set ICOM frequency using "beat frequency" method, the temperature should be at 26.5°C (79.8°F). If the temperature is not 26.5°C, then offset the "ON FREQUENCY" signal (at the receiver input), as a function of actual temperature, by the frequency IRROR FACTOR (in PPM) shown in Figure 6.

a. Audible "beat frequency" from the receiver speaker (this requires careful frequency adjustment of the frequency standard).

b. Observe "beat frequency" at P904-4 with an Oscilloscope.

c. With GE TEST SET (Meter Position B) connected to J601 on the IFAS Board, visually observe the "beat frequency" indicated by meter movement.

The frequency of the "beat" is the frequency error, related to the IF frequency. This deviation, in Hz, is compared to the receiver operating frequency, also in Hz, to calculate the error in PPM.

—NOTE—

The FM DETECTOR output (Meter Position A of the Test Set) has a dc voltage of +0.35 to 0.5 volt with an ON-FREQUENCY signal on under NO-SIGNAL conditions, and is provided for routine test and measurement only. The resolution of this reading is approximately .025 V per kHz as read on a GE Test Set in meter position A, or 0.1 V per kHz as measured with a VTVM at P904-3 or J601-2 on the IFAS board) is inadequate for oscillator frequency setting.

If the radio is at an ambient temperature of 26.5°C (79.8°F), set the oscillator for the correct mixer frequency (ICOM FREQ. X 9).

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 required mixer injection frequency, or
2. Maintain the radio at 26.5°C (±10°C) and offset the oscillator, as a function of actual temperature by the frequency error factor shown in Figure 6.

B. To hold setting error to ±0.35 PPM (which is considered reasonable for 2 PPM ICOMS): Maintain the unit at 26.5°C (±5°C) and offset the oscillator, as a function of actual temperature, by the frequency error factor shown in Figure 6.

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 138 MHz, 1 PPM is 138 Hz. At 174 MHz, 1 PPM is 174 Hz).

With a mixer injection frequency of 150 MHz, adjust the oscillator for a corrected mixer injection frequency 45 Hz (0.3 X 150 Hz) higher. If a negative correction factor is obtained (at temperatures above 26.5°C), set the oscillator for the indicated PPM lower than the calculated mixer injection frequency.

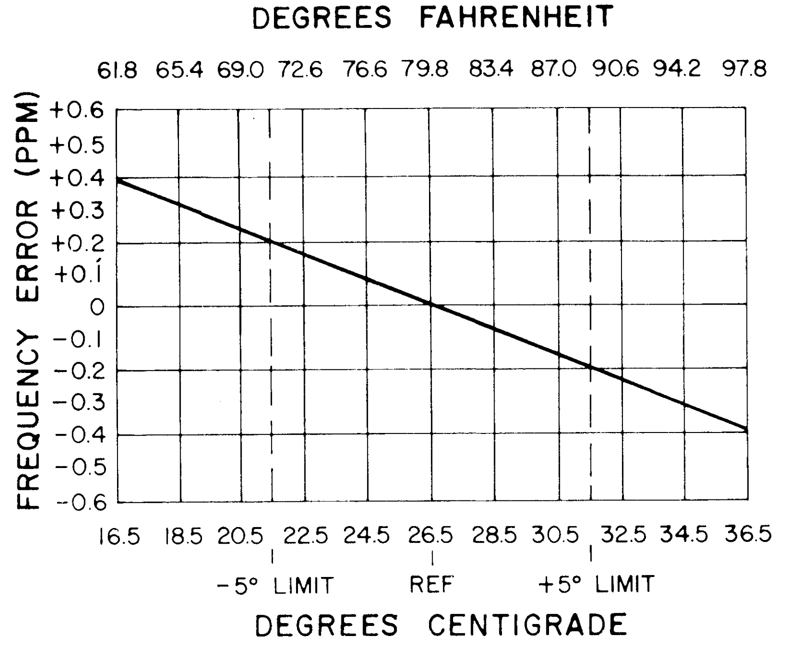


Figure 6 - Frequency Characteristics Vs. Temperature

COMPLETE RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. GE Test Models 4EX3A11, 4EX8K12 (or 20,000 ohms-per-volt multimeter with a 1-Volt scale.
2. An 11.2 MHz signal source (GE Test Set Model 4EX9A10). Also a 138-174 MHz signal source with a one-ince piece of insulated wire no larger than .065 inch diameter connected to generator probe.
3. Voltmeter/Multimeter.
4. Distortion Analyzer.

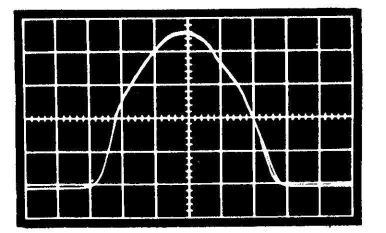
PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect the black plug from the Test Set to receiver metering jack J601, and the red plug to system board metering jack J905. Set the range selector switch to the Test 1 (or 1-Volt position on the 4EX8K12).
2. For multi-frequency receivers with a frequency spacing up to 0.450 MHz for frequency range of 138-155 MHz, or 0.500 MHz for frequency range of 150.8-174 MHz, align the receiver on the channel nearest center frequency.

   For multi-frequency receivers with a frequency spacing exceeding the above but no greater than .900 MHz for frequency range of 138-155 MHz, or 1.00 MHz fof frequency range of 150.8-174 MHz, align the receiver using a center frequency tune-up ICOM. These limits can be extended to 1.60 MHz, and 1.80 MHz respectively, with 3 dB degradation in standard receiver specifications.
3. With the Test Set in Position J, check for regulated +10 Volts. With multimeter, measure from J905-3 to J905-9.
4. If using multimeter, connect the negative lead to J601-9 (A-).
5. Disable the Channel Guard.

ALIGNMENT PROCEDURE

STEP	METERING POSITION GE Test Set	METERING POSITION Multimeter - at J601-9	TUNING CONTROL	METER READING	PROCEDURE
			FM DETECTOR		
1.	A (FM DET)	Pin 2	L603	0.38 Volt	With no signal applied, adjust L603 for a meter reading of approximately 0.38 Volt.
			OSCILLATOR/MULTIPLIER		
2.	C (MULT-1)	Pin 3	C406	Maximum	Re-connect the Test Set metering plug to J601. Tune C406 for maximum meter reading.
3.			C411, C416, C306, C307	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306 and C307 fully counterclockwise (minimum capacity).
4.	D (MULT-2)	Pin 4	C411, C416, C406	See Procedure	Tune C411 and C416 for maximum meter reading. Next, retune C406, C411 and C416 for maximum meter reading, then, carefully dip C306 and tune C307 for maximum meter reading. Do NOT readjust C306 and C307.
			RF SELECTIVITY		
5.	B (IF AMP)	Pin 1	C502	Maximum	Apply an on-frequency signal in the hole adjacent to C305 and tune C502 for maximum meter reading.
6.	B (IF AMP)	Pin 1	C305	Maximum	Apply an on-frequency signal in the hole adjacent to C304, keeping the signal below saturation. Then tune C305 for maximum meter reading.
7.	B (IF AMP)	Pin 1	C304	Maximum	Apply an on-frequency signal in the hole adjacent to C303, keeping the signal below saturation. Then tune C304 for maximum meter reading.
8.	B (IF AMP)	Pin 1	C303	Maximum	Apply an on-frequency signal in the hole adjacent to C302, keeping the signal below saturation. Then tune C303 for maximum meter reading.
9.	B (IF AMP)	Pin 1	C302 and C301	Maximum	Apply an on-frequency signal to A301-J1, keeping the signal below saturation. Then tune C302 and C301 for maximum meter reading.
10.	B (IF AMP)	Pin 1	C502, C301 thru C307 and T551 (top slug-L555)	Maximum	Apply an on-frequency signal to the antenna jack (J551), keeping the signal below saturation. Then tune C502 and C301 through C305 and T551 (top slug-L555) for maximum meter reading.
11.	B (IF AMP)	Pin 1	C502, C301 thru C305 and T551 (top slug-L555)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune C301 through C305 and T551 (top slug-L555) and C502 for best quieting sensitivity. C306 and C307 also may be tuned slightly (not to exceed 1/4 turn).
12.			R608	See Procedure.	Remove the Test Set metering plug from J601. Apply a 1000 microvolt signal with 1 kHz modulation and 3.0 kHz deviation to the antenna jack. Tune L603 for maximum voltage at 1.0 kHz and adjust R608 for 1 Volt RMS measured with a VTVM at P904-11 (VOL/SQ HI) and P904-17 (A-).

STEP	METERING POSITION GE Test Set	METERING POSITION Multimeter - at J601-9	TUNING CONTROL	METER READING	PROCEDURE
			MIXER & IF		
					The mixer and IF circuits have been aligned at the factory and will normally require no further adjustment. If adjustment is necessary, use the procedure outlined in Step 13. —NOTE— Refer to DATAFILE BULLETIN 1000-6 (IF Alignment of Two-Way Radio FM Receivers) for helpful suggestions on how to determine when IF Alignment is required.
13.			L503, L505, L520, L521 and C521		Connect scope, signal generator, and probe as shown in Figure 5. Set signal generator level for 3 to 5 μV and modulate with 20 Hz at 10 kHz deviation. With probe between P904-4 (or J601-1) and A- tune L503, L505, L520, L521 and C521, for double trace as shown on scope pattern.
14.				See Procedure	Check to see that modulation acceptance bandwidth is greater than ±6.5 kHz.
15.	F (BLANKER)	J601-Pin 7	L554, L553 L552 & L551	Maximum	Set generator output to maximum. Connect generator to Receive antenna jack J551 and adjust generator frequency in accordance with the following table: Recover RF Range (MHz) / Tuneable Range of Noise Blanker (MHz) / Align Noise Blanker to: 138-155 / 128-148 / Receiver freq.-10 MHz 150.8-174 / 128-148 / 130 MHz Tune L554, L553, L552 and L551 (Bottom slug of T551) in the order given, reducing the generator output as necessary to keep the noise blanker metering point out of saturation. —NOTE— In some instances the noise blanker circuit may be tuned to a specific frequency in order to minimize interference. The noise blanker must never be tuned closer than 8 MHz to the operating frequency of the receiver.
16.	F (BLANKER)	J601-Pin 7		Greater than VDC 0.07	Apply a 1000-microvolt signal on blanker frequency to antenna jack J551. The meter reading should be greater than 0.07 VDC.
			SQUELCH ADJUST		
17.			R622		Squelch adjust control R622 (if present) is pre-set at the factory. If further adjustment is required, adjust R622 on the IFAS board for best squelch operation. NOTE: Maximum squelch decreases with increasing resistance.

TEST PROCEDURES

LBI30110

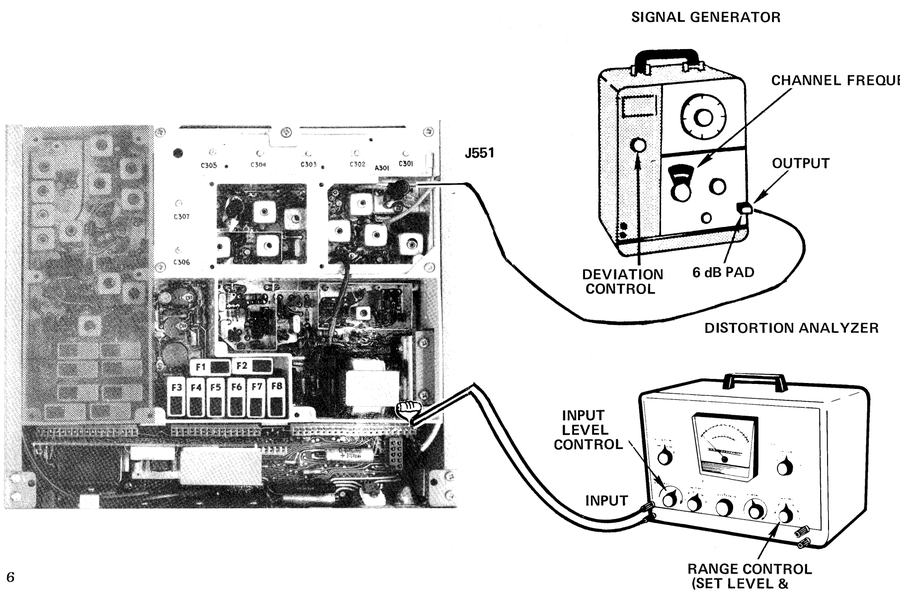
These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect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

TEST EQUIPMENT REQUIRED

- Distortion Analyzer
- Signal Generator
- 6-dB attenuation pad, and 8.0-ohm, 15-Watt resistor

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.



STEP 1
AUDIO POWER OUTPUT AND DISTORTION

TEST PROCEDURE

Measure Audio Power Output as follows:

A. Apply a 1,000-microvolt, on-frequency test signal modulated by 1,000 hertz with ±3.3 kHz deviation to antenna jack J551.

B. With 15-Watt Speaker (Mobile) 5-Watt (Station)

Disconnect speaker lead pin from Systems Plug P701-11 (on rear of Control Unit).

Connect an 8.0-ohm, 15-Watt load resistor from P904-19 to P904-18 or from P701-4 to P701-17 (SPEAKER HI) on the System Plug. Connect the Distortion Analyzer input across the resistor as shown.

OR

With Handset:

Lift the handset off of the hookswitch. Connect the Distortion Analyzer input from P904-19 to P904-18.

C. Adjust the VOLUME control for 12-Watt (Mobile) 5-Watt (Station) output 9.8 VRMS (Mobile) or 6.3 VRMS (Station) using the Distortion Analyzer as a Voltmeter.

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 3%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 3%, or maximum audio output is less than 12.0 Watts, make the following checks:

E. Battery and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. Audio Gain (Refer to Receiver Troubleshooting Procedure.)

G. FM Detector Alignment (Refer to Receiver Alignment on reverse side of page).

STEP 2
USABLE SENSITIVITY (12-dB SINAD)

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

A. Apply a 1000-microvolt, on-frequency signal modulated by 1000 Hz with 3.3-kHz deviation to Antenna Jack J551.

B. Place the RANGE switch on the Distortion Analyzer in the 200 to 2000-Hz distortion range position (1000-Hz filter in the circuit). Tune the filter for minimum reading or null on the lowest possible scale (100%, 30%, etc.)

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a mid range (30%).

D. While reducing the signal generator output, switch the RANGE control from SET LEVEL to the distortion range until a 12-dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and distortion range positions (filter out and filter in).

E. The 12-dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of at least 6.0 Watts (6.9 Volts RMS across the 8.0-ohm receiver load using the Distortion Analyzer as a VTVM).

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than rated 12 dB SINAD, check the alignment of the RF stages as directed in the Alignment Procedure, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3
MODULATION ACCEPTANCE BANDWIDTH (IF BANDWIDTH)

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

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

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000-Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12-dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

D. The deviation control reading for the 12-dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz.

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

TROUBLESHOOTING PROCEDURE

STEP 1—PERFORMANCE CHECK

Before starting the Noise Blanker troubleshooting procedure, make sure the receiver is operating properly. Align the Noise Blanker circuits as described for the ALIGNMENT PROCEDURE. Perform the following checks:

Equipment Required:

1. RF Signal Generator coupled through a 6 dB pad.
2. Pulse Generator with repetition rate and level controls (Similar to General Electric Model 4EX4A10).
3. T-Connector.
4. AC VTVM or Distortion Analyzer.
5. Oscilloscope.

Procedure:

Noise Blanker Threshold Sensitivity

1. Connect Pulse Generator and RF Signal Generator to receiver antenna jack (J551) through a T-Connector, and connect AC VTVM to receive audio output (Speaker LO, P904-18, Speaker P904-19) as shown in Figure 1.
2. Apply an unmodulated RF signal and check the 20 dB quieting sensitivity of the receiver. (Measure with Model 4EX4A10 Pulse Generator connected but turned OFF). Then adjust the RF level for an additional 10 dB on the signal generator.
3. Set the pulse generator (Model 4EX4A10) for 10 KHz continuous pulses. Slowly increase the pulse output level, degrading the receiver quieting level as measured on the AC VTVM. Prior to the sudden drop in quieting, the degradation should not exceed 20 dB quieting. The noise blanking pulse may be observed where indicated on the Troubleshooting block diagram.

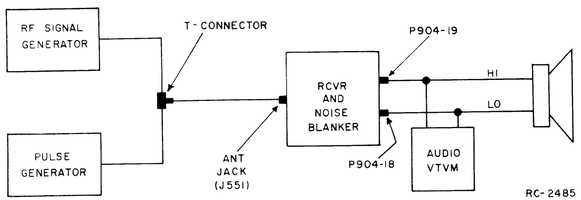


Figure 1 - Equipment Connection Diagram

IF Attenuation

1. Disable the noise blanker by connecting J604 on IFAS module or pin 5 of P904 to A-. (Use noise blanker disable switch on Control Unit if present).
2. Measure the 20 dB quieting sensitivity as in Step 2 of Threshold sensitivity measurement.
3. Adjust the RF output of the signal generator for 40 dB greater RF level than that established for 20 dB quieting sensitivity.
4. Adjust the pulse generator (Model 4EX4A10) for a repetition rate up to 30 KHz. Adjust the pulse level until the receiver is degraded to 20 dB quieting.
5. Remove the noise blanker disabling jumper from J604 (or if noise blanker disable switch is provided, place to operate position), and then adjust the signal generator RF level for 20 dB quieting. The receiver sensitivity should restore to within 5 dB of 20 dB quieting level obtained in Step 2.

STEP 2—QUICK CHECKS

Equipment Required:

1. RF Voltmeter (similar to Boonton Model 91-CA or Millivac type MV-18C).
2. RF Signal Generator.
3. AC VTVM or Distortion Analyzer.

SYMPTOMS	PROCEDURE
NO Blanking	Check voltage ratios (STEP 3)
Partial or no Blanking	a. Check IF attenuation of Noise Blanker Gates as follows: Connect signal generator to antenna jack (J551). Adjust the signal generator for on frequency signal and output level for 20 dB quieting sensitivity (Level A). Connect +10 VDC directly to the gates of Q502 and Q503. Increase the RF output level to achieve 20 dB quieting (Level B). The difference between "Level A" and "Level B" must be 60 dB or greater.
Intermodulation Interference (AGC action)	b. Check gain of Noise blanker RF circuit (IM/AGC ACTION) as follows: Connect signal generator to antenna Jack (J551). Adjust the frequency of the signal generator to the noise blanker channel frequency and adjust the RF level for 1 Millivolt (see Alignment Procedure, Step 15 for frequencies). Measure RF signal level at pin 6 of U551. This level should be 56 millivolts or greater. Apply +10 VDC through a 270 ohm resistor to the source pin of Q552 (or pin 13 of U551). (This applies approximately +3 VDC bias to Q552, simulating intermodulation AGC voltage). The RF voltage measured at pin 6 of U551 should be approximately 1.8 millivolts (Corresponds to approx. 30 dB decrease of gain in RF amplifier Q552).

STEP 3—VOLTAGE RATIO READINGS

Equipment Required:

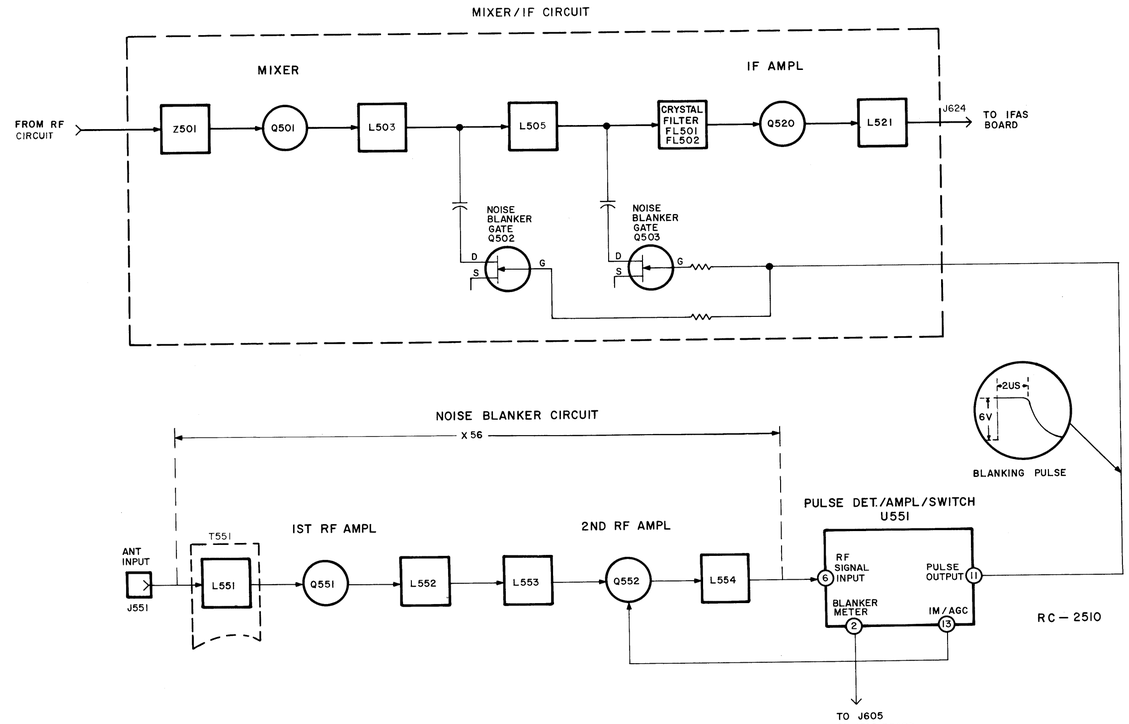
1. RF Voltmeter (Similar to Boonton Model 91-CA or Millivac Type MV-18C).
2. Signal generator.

Procedure:

1. Connect signal generator to Antenna Jack (J551). Adjust the frequency of the signal generator to the channel frequency of the noise blanker (see Alignment procedure, Step 15). Adjust the RF level for 1 Millivolt output.
2. Apply probe of RF Voltmeter to Antenna Jack (J551). Peak resonant circuit L551 (Bottom Slug of T551) and take voltage reading (E1).
3. Move probe to input of IC-V551 (pin 6). Repeak first resonant circuit L551 (Bottom Slug of T551). Then peak resonant circuit L554 and take reading (E2).
4. Convert reading by means of the following formula:

   $$\text{Voltage Ratio} = \frac{E2}{E1}$$

5. Check results with the typical voltage ratio shown on diagram.



TROUBLESHOOTING PROCEDURE

138—174 MHz MASTR II RECEIVER
NOISE BLANKER CIRCUIT

STEP 1 - QUICK CHECKS

TEST SET CHECKS

These checks are typical voltage readings measured with GE Test Set Model 4EX3A11 in the Test 1 position, or Model 4EX8K12 in the 1-Volt position.

Metering Position	Reading With No Signal In	Reading with 4 Micro-volt Unmodulated
A (FM DET)	0.38 VDC	
B (IF Amp)		0.2 VDC
C (Mult-1)	0.5 VDC	
D (Mult-2)	0.2 VDC	
J (Reg. +10 Volts at System Metering jack)	+10 VDC	

SYMPTOM CHECKS

SYMPTOM	PROCEDURE
NO SUPPLY VOLTAGE	• Check power connections and continuity of supply leads, and check fuse. If fuse is blown, check receiver for short circuits.
NO REGULATED 10-VOLTS	• Check the 12-Volt supply. Then check 10-Volt regulator circuit. (See Troubleshooting Procedure for 10-Volt Regulator).
LOW 1ST LIM READING	• Check supply voltages and then check oscillator readings at P904-1 & -2 as shown in STEP 2. • Make SIMPLIFIED VTVM GAIN CHECKS from Mixer through 1st Limiter stages as shown in STEP 2.
LOW OSCILLATOR/MULTIPLIER READINGS	• Check alignment of Oscillator/Multiplier chain. (Refer to Front End Alignment Procedure). • Check voltage readings of Oscillator/Multiplier (Q401, Q402).
LOW RECEIVER SENSITIVITY	• Check Front End Alignment. (Refer to Receiver Alignment Procedure). • Check antenna connections, cable and antenna switch. • Check Oscillator injection voltage. • Check voltage readings of Mixer and IF Amp. • Make SIMPLIFIED GAIN CHECKS (STEP 2).
IMPROPER SQUELCH OPERATION	• Check voltages on Schematic Diagram. • Make gain and waveform checks with noise. • Make gain and waveform checks with 6 kHz signal. • Check discrete components in the squelch circuit. • Replace IC circuit U603.
LOW OR DISTORTED AUDIO	• Check voltages on Schematic Diagram. • Make gain and waveform checks. • Check receiver and alignment and FM DET output. • Check Q603, Q604 and other discrete components. • Replace IC circuit U604.

STEP 4-VOLTAGE RATIO READINGS →

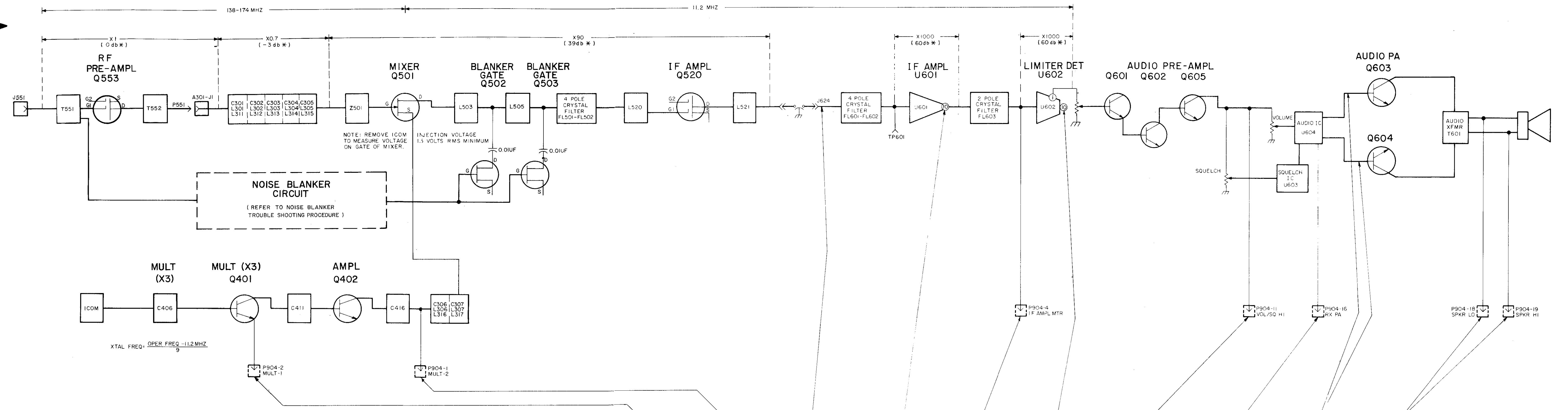
EQUIPMENT REQUIRED:
1. RF VOLTMETER (SIMILAR TO BOONTON MODEL 91-CA OR MILLIVAC TYPE MV-18C.
2. SIGNAL ON RECEIVER FREQUENCY (BELOW SATURATION). CORRECT USE 1,000 HERTZ SIGNAL WITH 3.0 KHz DEVIATION.

PROCEDURE:
1. APPLY PROBE TO INPUT OF STAGE (FOR EXAMPLE, SOURCE OF RF AMP). PEAK RESONANT CIRCUIT OF STAGE BEING MEASURED AND TAKE VOLTAGE READING (E_1).
2. MOVE PROBE TO INPUT OF FOLLOWING STAGE (MIXER). REPEAK FIRST RESONANT CIRCUIT THEN PEAK CIRCUIT BEING MEASURED AND TAKE READING (E_2).
3. CONVERT READINGS BY MEANS OF THE FOLLOWING FORMULA.

$$\text{VOLTAGE RATIO} = \frac{E_2}{E_1}$$

4. CHECK RESULTS WITH TYPICAL VOLTAGE RATIOS SHOWN ON DIAGRAM.

* DIFFERENCE BETWEEN INPUT AND OUTPUT READINGS ON db SCALE OF RF VOLTMETER. NOT ACTUAL POWER GAIN.



STEP 2-SIMPLIFIED GAIN CHECKS →

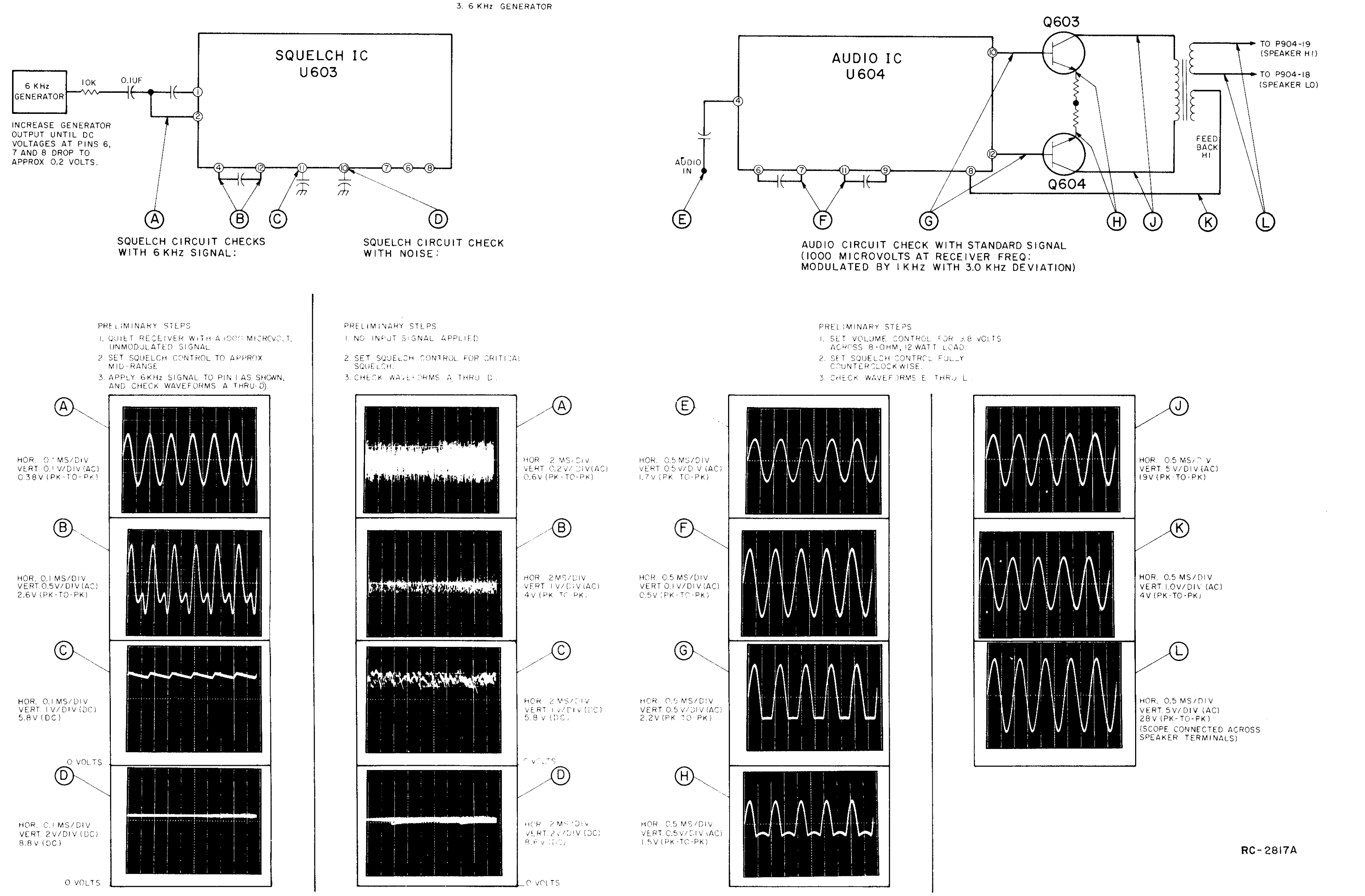
EQUIPMENT REQUIRED
1. VOLTMETER AC & DC
2. SIGNAL GENERATOR
3. RF VOLTMETER

PRELIMINARY STEPS:
1. SET VOLUME CONTROL FOR 9.8 VOLTS ACROSS 8.0-OHM LOAD. IF THIS CANNOT BE OBTAINED, SET TO APPROX. 70% OF MAX ROTATION.
2. SET SQUELCH CONTROL FULLY COUNTERCLOCKWISE.
3. RECEIVER SHOULD BE PROPERLY ALIGNED.
4. CONNECT METER BETWEEN A- AND POINTS INDICATED BY ARROW.

SIGNAL APPLIED TO J551	NONE	NONE	UNMODULATED	UNMODULATED	UNMODULATED	NO SIGNAL INPUT	MODULATED	MODULATED	MODULATED	MODULATED
PROCEDURE			SET GENERATOR OUTPUT TO 1000 MICROVOLTS AT RECEIVE FREQUENCY	RESET GENERATOR OUTPUT TO ZERO, THEN INCREASE GENERATOR OUTPUT UNTIL U601 SATURATES AS MEASURED WITH RF VOLTMETER	INCREASE GENERATOR OUTPUT FROM ZERO TO 10 MICROVOLTS	SHOULD BE IN SATURATION AT ALL TIMES	SET SIGNAL GENERATOR OUTPUT FOR 1000 MICROVOLT WITH 1KHz MODULATION AND 3KHz DEVIATION			WITH SPEAKER DISCONNECTED, CONNECT VOLTMETER OR SCOPE ACROSS 8-OHM LOAD CONNECTED BETWEEN P904-18 AND P904-19
READING	VOLTMETER READING SHOULD BE APPROX. 0.5 VDC	VOLTMETER READING SHOULD BE APPROX. 0.2 VDC	RF VOLTMETER READING SHOULD BE APPROX 200 MILLIVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 10 MICROVOLTS	VOLTMETER READING SHOULD BE APPROX 0.54 VDC	RF VOLTMETER READING SHOULD BE APPROX 0.6V RMS	VOLTMETER READING SHOULD BE APPROX 1.0 VAC	VOLTMETER READING SHOULD BE APPROX 0.18 VAC	VOLTMETER READING SHOULD BE APPROX 6.7 VAC	9.8VAC

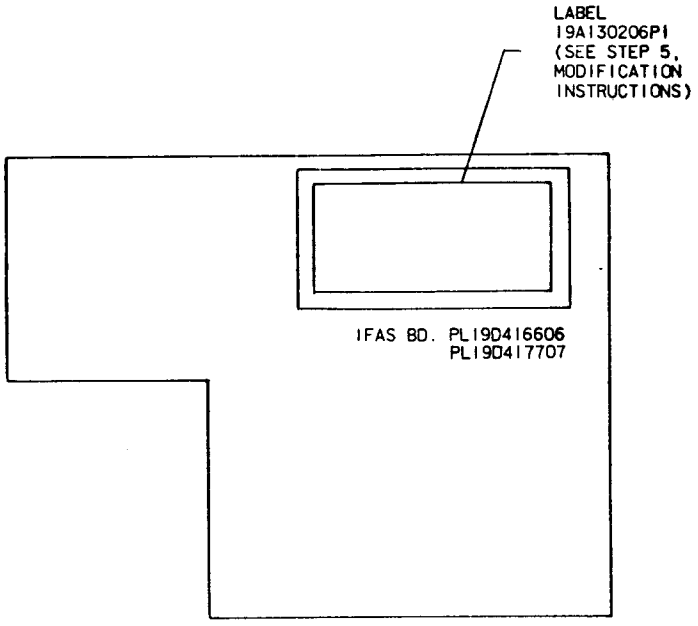
STEP 3-AUDIO & SQUELCH WAVEFORMS

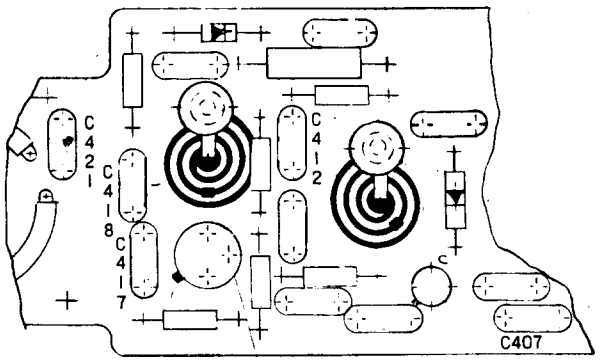
EQUIPMENT REQUIRED:
1. OSCILLOSCOPE CONNECTED BETWEEN A- AND POINTS INDICATED BY ARROW.
2. SIGNAL GENERATOR
3. 6 KHz GENERATOR



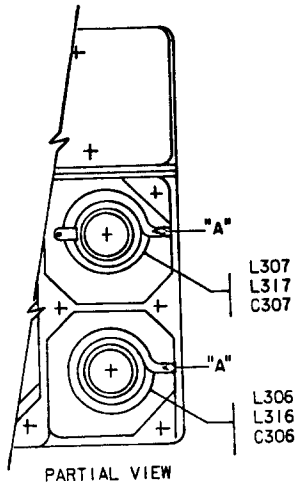
TROUBLESHOOTING PROCEDURE

138—174 MHz MASTR II RECEIVER
WITH NOISE BLANKER CIRCUIT

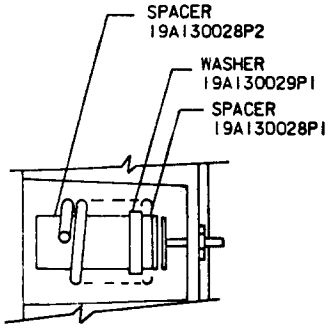




PARTIAL VIEW
OSC/MULT BD. PL19D423241



PARTIAL VIEW
R.F. CKT PL19D416693



VIEW AT "A"
(PARTIAL)
(TYP TWO PLACES)

MODIFICATION INSTRUCTIONS FOR HIGH BAND HIGH SIDE INJECTION APPLYING 19A130045G1 OR G2 KIT

1. ON OSC/MULT BD'S 19D423241G1 & G3 (LOW SPLIT) REMOVE C412 & C417, REPLACE C407 WITH C2311 (12pf, NPO), REPLACE C418 WITH C2312 (3pf, NPO), AND REPLACE C421 WITH C2313 (5pf, NPO). DISCARD C2301 THRU C2306(G1) AND C2314(G1, G2).

   ON OSC/MULT BD'S 19D423241G2 & G4 (HIGH SPLIT) REMOVE C407, C412, AND C417, REPLACE C418 WITH C2312 (3pf, NPO), AND REPLACE C421 (SPACE) WITH C2314 (4pf, NPO). DISCARD C2301 THRU C2306(G1) AND C2311, C2313(G1,G2).

   SOLDER ALL ELECTRICAL CONNECTIONS. C2301 THRU C2314 ARE PART OF MOD KIT 19A130045G1, C2311 THRU C2314 ONLY—G2.

2. MODIFY RF. CKT ASM PL19D416693 BY ADDING 19A130028P1 SPACER, 19A130029P1 WASHER, AND 19A130028P2 SPACER AS SHOWN TO L306 & L307 (LOW SPLIT) OR L316, & L317 (HIGH SPLIT). SLIDE SPACERS, & WASHER ON CERAMIC POST FROM TOP IN ORDER SHOWN. THESE ITEMS ARE PART OF MOD KIT PL19A130045G1 AND G2.

3. IN APPLICATION OF THIS KIT THE CRYSTAL OSCILLATOR FREQUENCY MUST BE CHANGED PER THE FOLLOWING FORMULA:

$$Fx = \frac{Fo + 11.2}{9}$$

4. MARK ALL OSC/MULT. BD'S (19D423241) WITH A BLUE COLOR DOT IN THE AREA OF THE PL DRAWING NO. PER 19A115740P1.

   MARK ALL RECEIVER CASTINGS WITH A BLUE COLOR DOT IN THE AREA OF THE PL DRAWING NO. PER 19A115740P1.

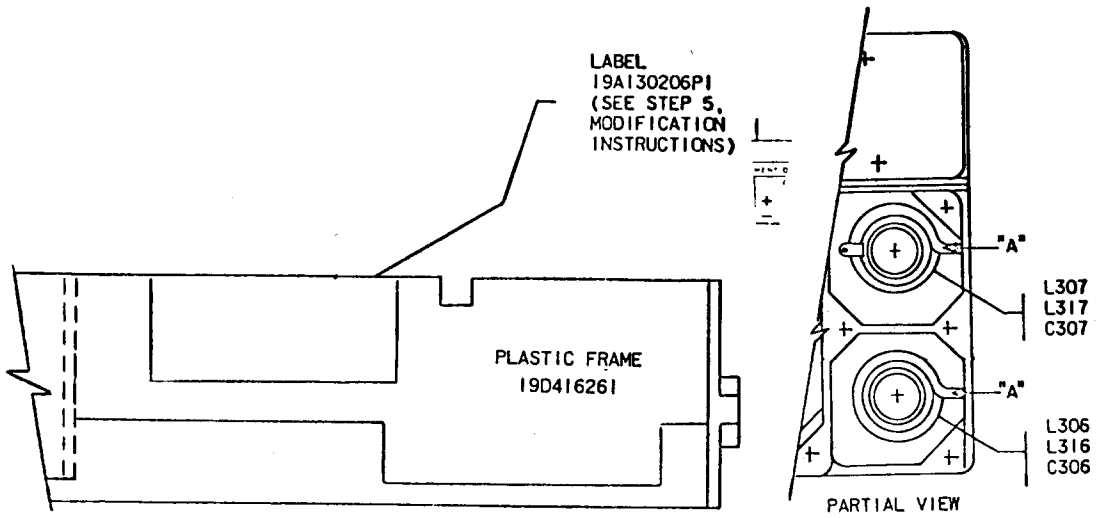
5. APPLY LABEL (19A130206P1) TO DISCRIMINATOR COVER ON IFAS BD.

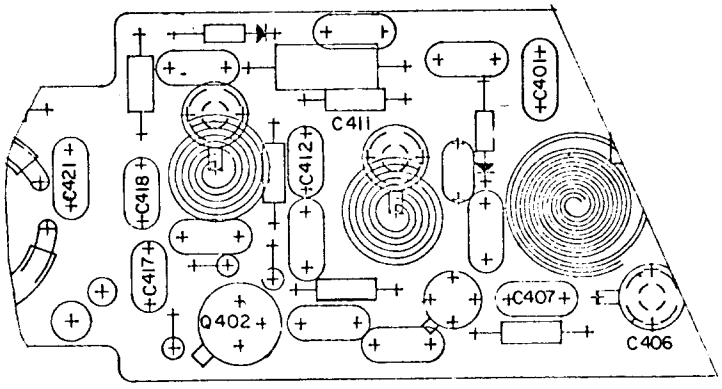
6. TEST AND ALIGN PER NORMAL PROCEDURE WITH THE FOLLOWING EXCEPTION: PRE-ADJUST C411 AND C416 TO MINIMUM CAPACITY, THEN TUNE IN SLOWLY.

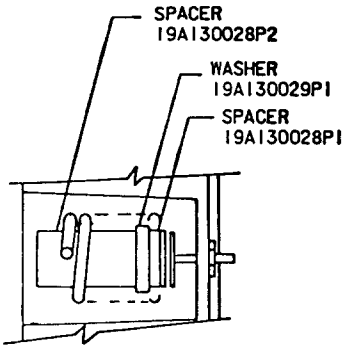
(19C320883, Sh. 2, Rev. 2)

MODIFICATION INSTRUCTIONS

HIGH SIDE INJECTION (EARLIER MODELS)







MODIFICATION INSTRUCTIONS FOR HIGH BAND HIGH SIDE INJECTION APPLYING 19A130045G1 OR G2 KIT.

1. FOR RECEIVERS OPERATING BETWEEN 138 TO 155.0MHz OSC/MULT BOARDS 19D423241G1 AND G3 (LOW SPLIT).
   A. IF RECEIVER HAS LESS THAN 8 ICOM'S, REMOVE C407, C412 AND C417. REPLACE C407 WITH C2311 (12PF NPO). REPLACE C418 WITH C2312 (3PF NPO). REPLACE C421 WITH C2313 (5PF NPO).
   B. IF THE RECEIVER HAS MORE THAN 8 ICOM'S, REMOVE C407, C412 AND C417. REPLACE C407 WITH C2318 (10PF NPO). REPLACE C418 WITH C2312 (3PF NPO). REPLACE C421 WITH C2313 (5PF NPO).

FOR RECEIVERS OPERATING BETWEEN 150.8 TO 174MHz OSC/MULT BOARDS 19D423241G2 AND G4 (HIGH SPLIT).

   A. IF THE RECEIVER HAS LESS THAN 8 ICOM'S, REMOVE C412 AND C417. REPLACE C418 WITH C2312 (3PF NPO). REPLACE C421 WITH C2314 (4PF NPO).
   B. IF THE RECEIVER HAS MORE THAN 8 ICOM'S, REMOVE C407, C412 AND C417. REPLACE C418 WITH C2312 (3PF NPO). REPLACE C421 WITH C2314 (4PF NPO).

   SOLDER ALL ELECTRICAL CONNECTIONS. DISCARD UNUSED PARTS.

2. MODIFY RF CKT ASM PL19D416693 BY ADDING 19A130028P1 SPACER, 19A130029P1 WASHER, AND 19A130028P2 SPACER AS SHOWN TO L306 & L307 (LOW SPLIT) OR L316, & L317 (HIGH SPLIT). SLIDE SPACERS, & WASHER ON CERAMIC POST FROM TOP IN ORDER SHOWN. THESE ITEMS ARE PART OF MOD KIT PL19A130045G1 & G2.
3. IN APPLICATION OF THIS KIT THE CRYSTAL OSCILLATOR FREQUENCY MUST BE CHANGED PER THE FOLLOWING FORMULA:

$$Fx = \frac{Fo + 11.2}{9}$$

4. MARK ALL OSC/MULT BDS (19D423241) WITH A BLUE COLOR DOT IN THE AREA OF THE PL DRAWING NO. PER 19A115740P1. MARK ALL RECEIVER CASTINGS WITH A BLUE COLOR DOT IN THE AREA OF THE PL DRAWING NO. PER 19A115740P1.
5. APPLY LABEL (19A130206P1) TO SIDE OF PLASTIC FRAME.
6. TEST AND ALIGN PER NORMAL PROCEDURE WITH THE FOLLOWING EXCEPTION: PRE-ADJUST C411 AND C416 TO MINIMUM CAPACITY, THEN TUNE IN SLOWLY.

(19C320883, Sh. 2, Rev. 7)

MODIFICATION INSTRUCTIONS

HIGH SIDE INJECTION (LATER MODELS)