DESCRIPTION AND MAINTENANCE
MASTR® II 806-825 MHz SYNTHESIZED STATION RECEIVER

TABLE OF CONTENTS

ILLUSTRATIONS

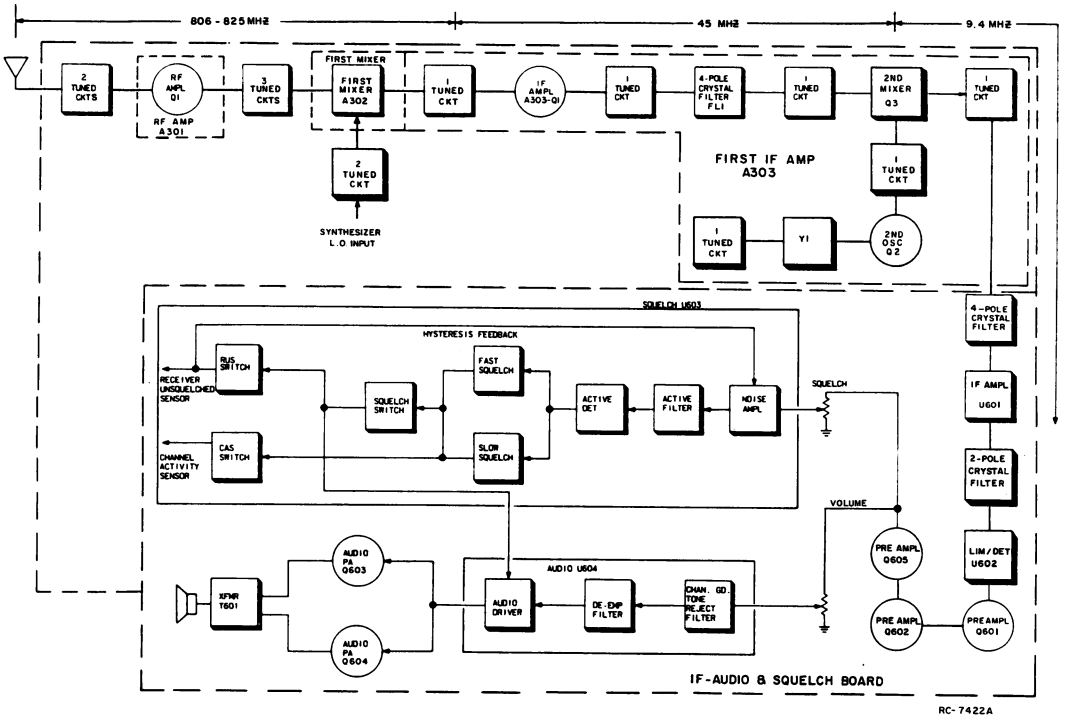


Figure 1 - Synthesized Receiver Block Diagram

DESCRIPTION

General Electric's **MASTR® II**, 806-825 MHz Synthesized station receiver is a double conversion, superheterodyne FM receiver designed for one frequency operation. This solid state receiver utilizes Integrated Circuits (IC's), monolithic crystal filters and discrete components with each of the crystal filter located between gain stages to provide 80 dB selectivity and maximum protection from de-sensitization and intermodulation.

The receiver consists of the following modules:

- RF Assembly (Includes Mixer and IF-Amplifier)
- Synthesizer/Exciter (Part of Transmit Circuit)
- Synthesizer Loader (Part of Transmit Circuit)
- IF/Audio and Squelch (IFAS)

Audio, supply voltages and control functions are connected to the system board through J1 on the Synthesizer 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 IF Detector and IF amplifier stages. Speaker high and speaker low are metered on the system board metering jack.

A Block Diagram of the 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.

MAINTENANCE

DISASSEMBLY

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

1. Turn the two latching knobs **A** counterclockwise to unlatch the Radio Housing Front door (refer to Figure 2).
2. Swing the Radio Housing Front Door down as shown.
3. Remove the top cover.

To service the receiver from the bottom or to remove any of the receiver boards:

1. Remove the wing nut **B** on the Radio Housing Front Door (refer to Figure 3).
2. Turn the two latching knobs **A** counterclockwise to unlatch the Radio Housing Front Door (refer to Figure 2).
3. Swing the Radio Housing Front Door down as shown.
4. Remove the top cover.
5. Grasp the Receiver Housing Handle at **C** and swing the Housing out to reveal the bottom side of the receiver.
6. Refer to Figure 4 for the location of Receiver Modules.

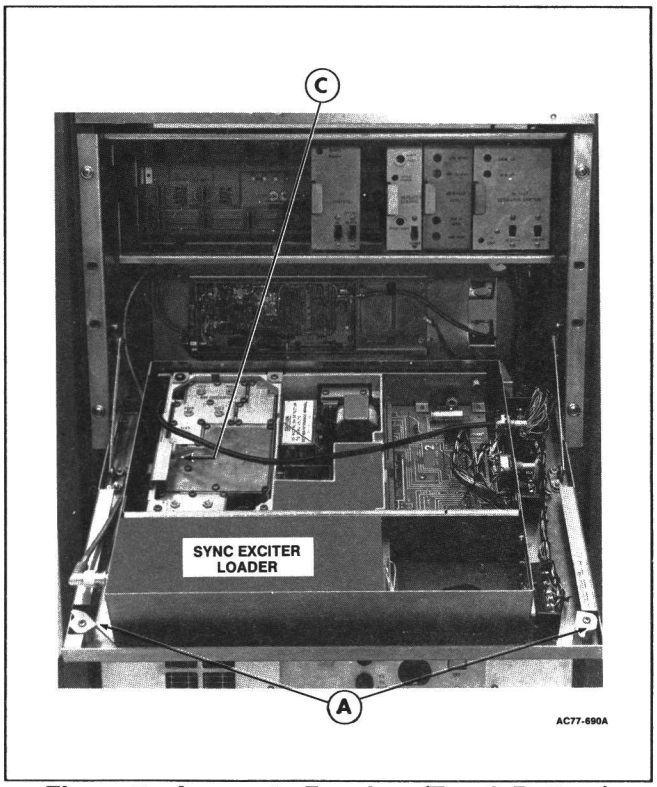


Figure 2 - Access to Receiver (Top & Bottom)

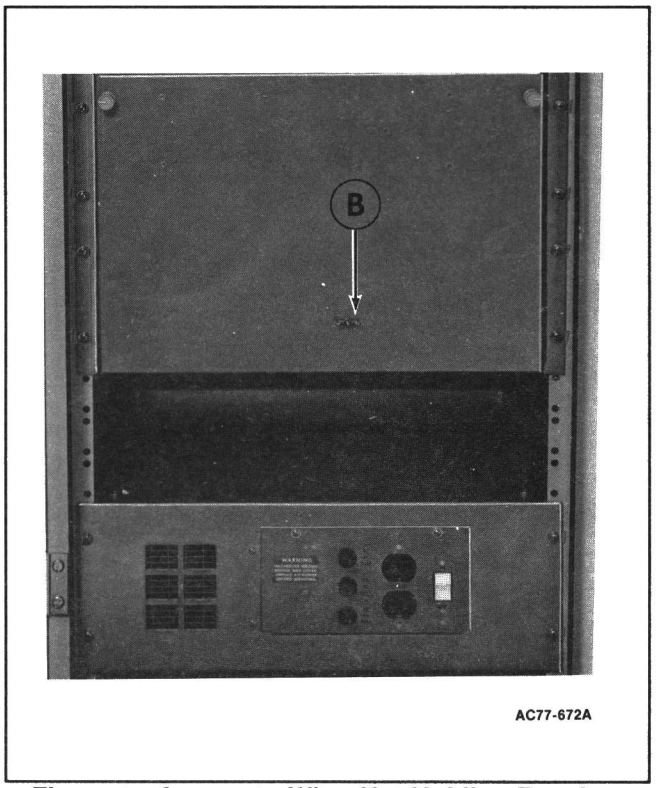


Figure 3 - Access to Wing Nut Holding Receiver Frame

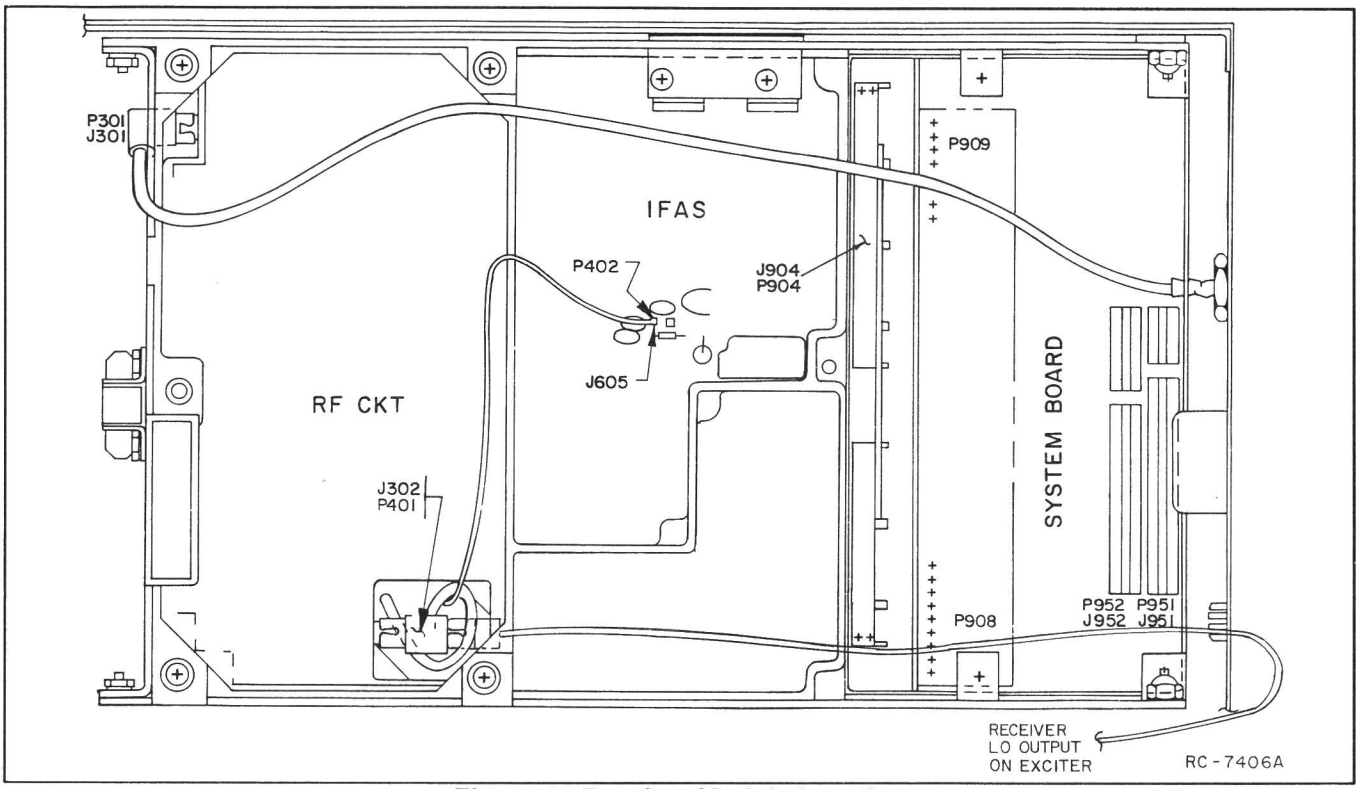


Figure 4 - Receiver Module Location

FRONT END ALIGNMENT

EQUIPMENT

1. GE Test Set Models 4EX3A11, 4EX8K12 or 20,000 Ohms-Per-Volt multimeter with a 1 volt scale.

2. An 806-825 MHz signal source.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect the **BLACK** plug from the Test Set to Receiver Centralized Metering Jack J601. Connect the **RED** plug to system board metering jack J905. Set the meter sensitivity switch to the **TEST 1** position or to the 1 volt position on Test Set Model 4EX8K12.

2. With the Test Set in Position **J**, check for regulated + 10 volts. If using a multimeter, measure between J905-3 (+) and J905-9 (-).

3. If using a multimeter, connect the negative lead to J601-9 (A-).

4. Disable Channel Guard.

PROCEDURE

Metering Position				
GE Test Set	**Multimeter - at J901-9**	**Control Tuning**	**Meter Reading**	**Procedure**
B IF AMP	Pin 1	C301 thru C305 A303-L1	Maximum	Apply an on-frequency signal to the antenna jack. Increase the generator level until about 10 dB of noise quieting occurs. Then, tune capacitors C301 through C305 and inductor L1 (**IF AMP**) for best quieting, decreasing the level of the generator as the quieting improves to maintain about 10 - 20 dB of noise quieting. Repeat these adjustments until no further noise quieting improvement can be achieved.
B IF AMP	Pin 1	C306 & C307	Maximum Quieting	Tune capacitors C306 and C307 for maximum quieting. Set tuning midway in quieting range.

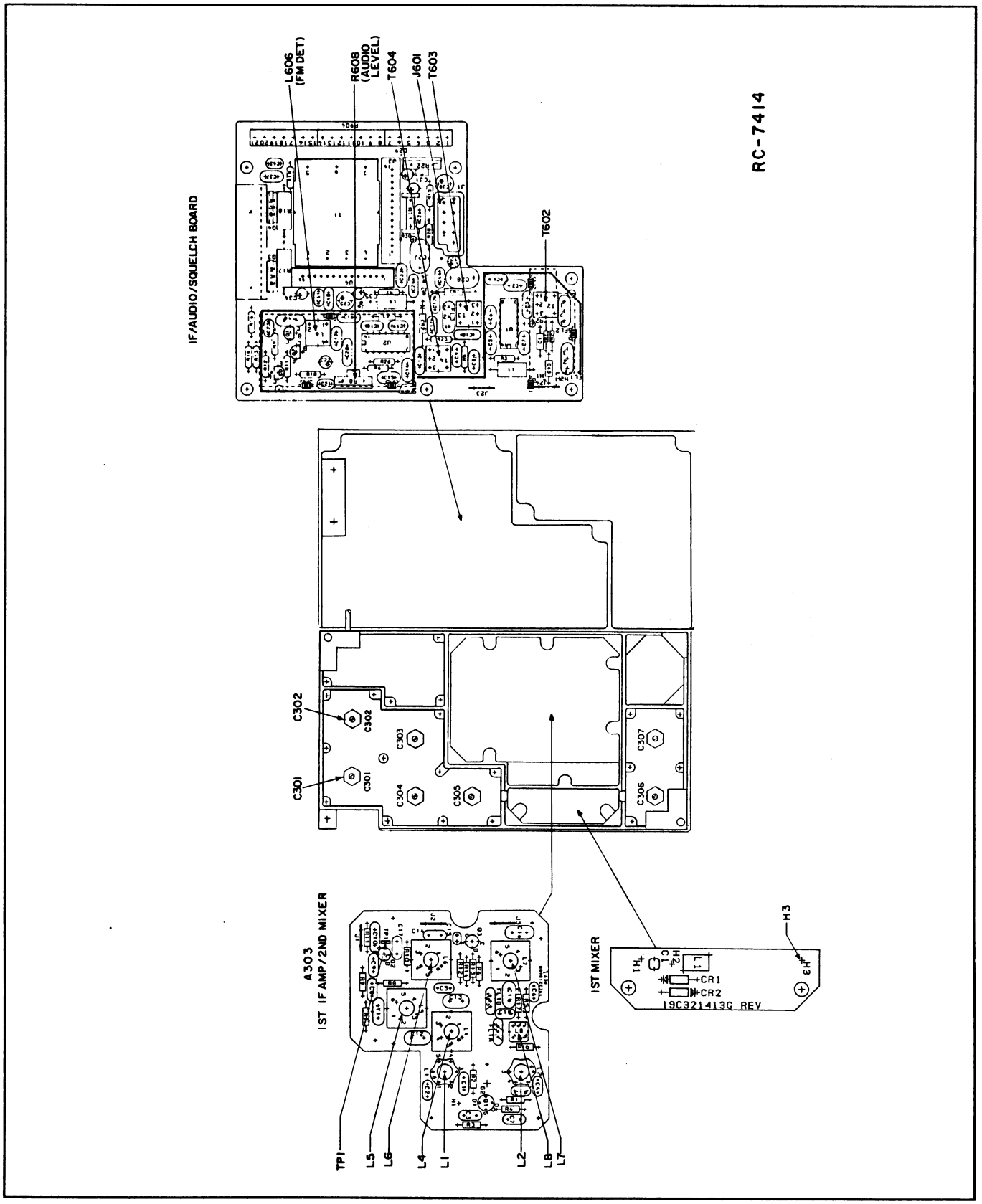


Figure 5 - Test Points and Alignment Controls

COMPLETE RECEIVER ALIGNMENT

EQUIPMENT REQUIRED:

1. GE Test Set Models 4EX3A11, 4EX8K12 or a 20,000 Ohms-Per-Volt multimeter with a 1 volt Scale.
2. An 806 - 825 MHz signal source (Cushman CE-6A or equivalent)
3. VTVM
4. Distortion Analyzer
5. Frequency Counter
6. RF Voltmeter

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect the **BLACK** plug from the Test Set to receiver meter jack J601. Connect the **RED** plug to system board metering jack J905. Set the meter sensitivity switch to Test 1 or 1 volt position on the 4EX8K12
2. With the Test Set in Position J, check for regulated + 10 volts. With the multimeter, measure form J905-3 to J905-9.
3. If using the multimeter, connect the negative lead to J601-9 (A-)
4. Disable Channel Guard

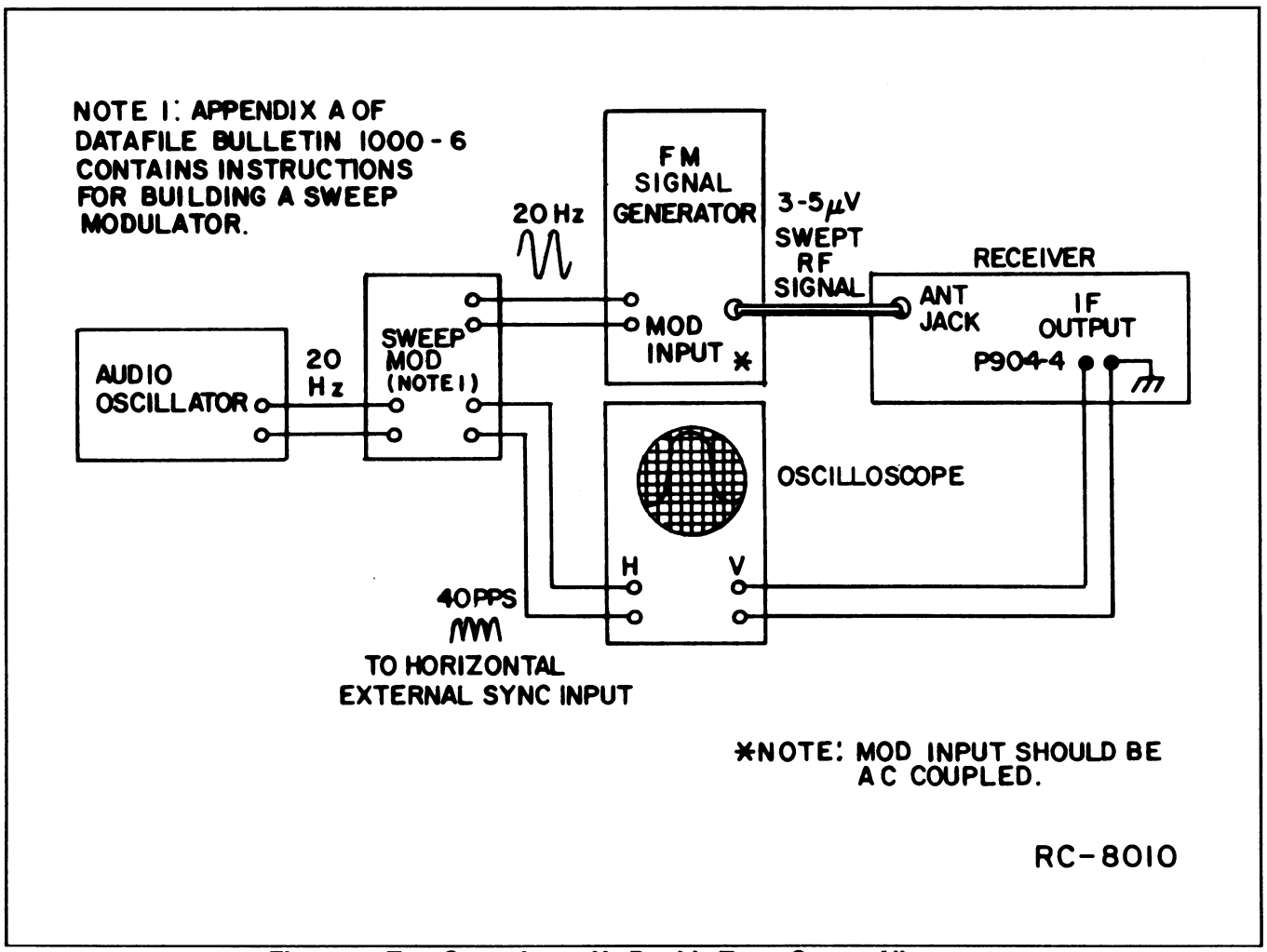


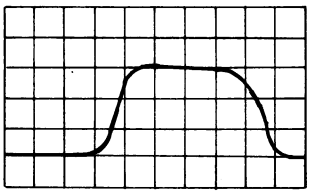
Figure 6 - Test Setup for 20 Hz Double Trace Sweep Alignment

PROCEDURE

Step	Metering Position: GE Test Set	Metering Position: Multimeter - at J901-9	Tuning Control	Meter Reading	Procedure
			FM DETECTOR		
1.	A FM Det	Pin 2	L603	0.38 V	With no signal applied, adjust L603 for a meter reading of approximately 0.38 volt.
			RF SELECTIVITY		
2.			L6	Maximum	Connect RF voltmeter to TP1. Adjust L6 for maximum meter reading
3.			L5	35.6 MHz (± 100 Hz)	Connect counter to TP1. Adjust L5 for 35.6 MHz (± 100 Hz)
4.	B IF AMP	Pin 1	C301 thru C305 A303-L1	Maximum	Apply an on-frequency signal to the antenna A303-L1 jack. Increase the generator level until about 10 dB of noise quieting occurs. Then, tune capacitors C301 through C305 and inductor L1 for best quieting, decreasing the level of the generator as the quieting improves to maintain about 10 - 20 dB of noise quieting. Repeat these adjustments until no further noise quieting improvement can be achieved.
5.			L603, R608,	Maximum 1 volt rms	Remove the Test set metering plug from J601. Apply a 100 microvolt signal with 1 kHz deviation (for standard systems or 2.4 kHz deviation for NPSPAC systems) 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-).
			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 6**.					

Continued

Continued

Step	Metering Position: GE Test Set	Metering Position: Multimeter - at J901-9	Tuning Control	Meter Reading	Procedure
MIXER & IF					
	NOTE Refer to **DATAFILE BULLETIN 1000-6 (IF Alignment of Two-Way FM Receivers)** for helpful suggestion on how to determine when IF alignment is required.				
6.	 RC-8033		L2, L4, L8, T602, T603 & T604	Waveform	Connect scope, signal generator and probe as shown in Figure 6. Set signal generator level for 3 to 5 μV and modulate with 10 kHz at 20 Hz. With probe between J601-1 and A-, tune L2, L4, L8, T602, T603 and T604 for double trace as shown on scope pattern. **NOTE**: Two traces should be coincident on the skirts. Top should be tuned for maximum width without creating a dip in the middle of the passband.
7.					Check to see that modulation acceptance bandwidth is greater than ±7 kHz.
SQUELCH ADJUSTMENT					
8.			**R953**		Set **SQUELCH ADJUST** control R953 to open with a 6 dB SINAD signal (12 dB SINAD signal when receiver is used in **GE-MARC** V applications). The control should be approximately 30° counterclockwise of critical squelch.

TEST PROCEDURES

These Test Procedures are designed to help you to service a receiver that is operating, but not properly. The problems encountered could be low power, poor sensitivity, distortion, 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 stage 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

- Distortion Analyzer similar to Heath IM-12
- Signal Generator similar to Cushman CE-6A
- 40-dB attenuation pad and 8 ohm, 15 watt resistor

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver shown in Figure 7 for all steps of the Receiver Test Procedure.
2. Turn the **SQUELCH** control fully clockwise for all steps of the Test Procedure.
3. Turn on all equipment and let it warm up for 20 minutes.

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 +3.0 kHz deviation to antenna jack J937 (±2.4 kHz deviation for systems with 12.5 kHz channel spacing)

B. Disconnect the speaker lead by unplugging P1102 from J1 on the back of the mother board of the control shelf. If a service speaker is present, put the switch in the **OFF** position.

Connect an 8 ohm, 15 watt load resistor from J905-1 to J902-2 on the System Jack. Connect the Distortion Analyzer input across the resistor as shown in Figure 7.

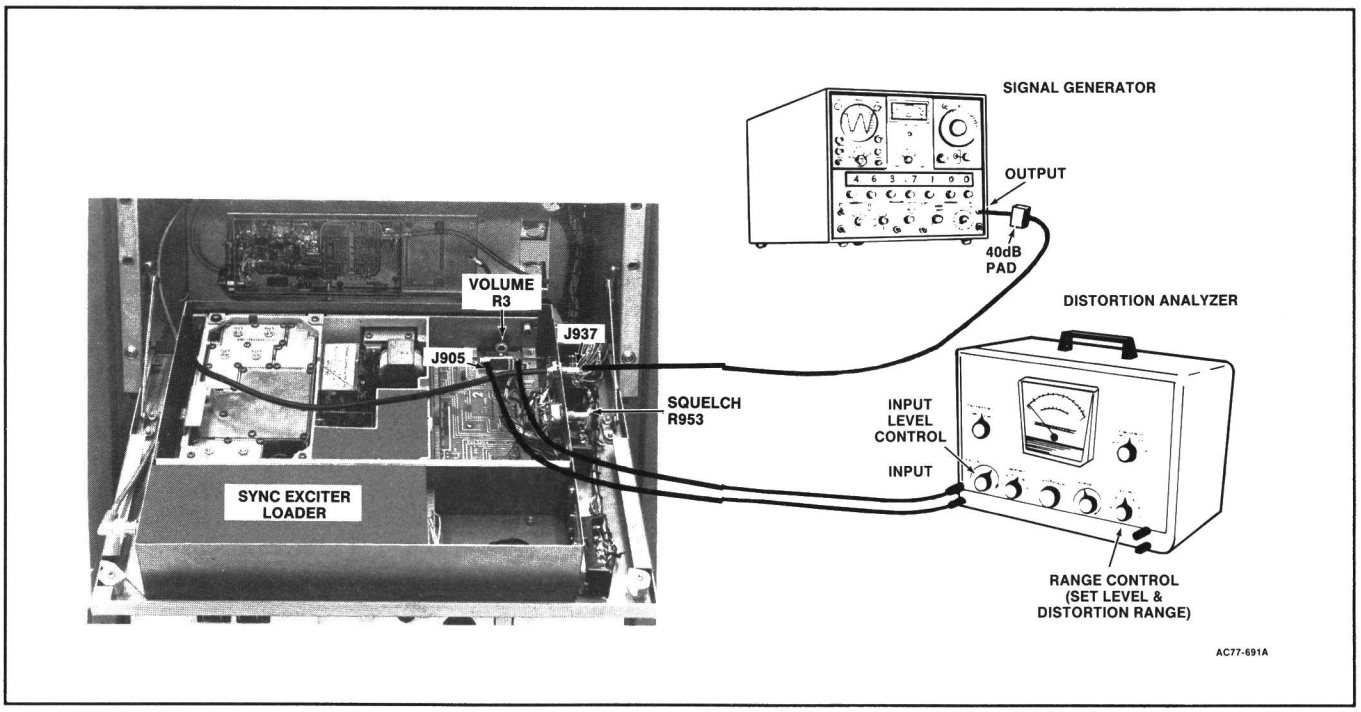


Figure 7 - Test Equipment Hook-up

With 5 Watt Speaker: Extended Local Control.

Adjust Volume Control R3 for 5 watts output (6.4 Vrms, using the Distortion Analyzer as a VTVM).

With 1 Watt Speaker:

Set the service speaker switch in the OFF position.

Adjust the **VOLUME** control for 1 watt output (2.9 Vrms using the Distortion Analyzer as a VTVM).

C. 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 specified above, make the following checks.

D. Regulator Voltage - Low voltage will cause distortion (refer to Receiver Schematic Diagram for voltages).

E. Audio Gain (refer to **Receiver Troubleshooting Procedure**).

F. FM Detector Alignment (refer to **Receiver Alignment**).

STEP 2
USABLE SENSITIVITY (12 dB SINAD)

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

A. Apply a 1000 microvolt, on frequency signal modulated by 1000 Hz with 3.0 kHz deviation to J937 (±2.4 kHz deviation for systems with 12.5 kHz channel spacing).

B. Place the **RANGE** switch of the Distortion Analyzer in the 200 to 2000 Hz distortion range position (1000 Hz filter in the circuit). Tune the filter for a minimum reading 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 position (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 better than the rated **12 dB SINAD** specification with an audio output of at least 2.5 watts (4.5 volts rms across the 8 ohm receiver load using the Distortion Analyzer as a VRVM) or 0.5 watt (1.4 Vrms)for service speaker application.

SERVICE CHECK

If the sensitivity is worse than the rated **12 dB SINAD**, check the alignment of the RF stages as directed in the Alignment Procedure and make the gain measurement as shown on the Troubleshooting Procedure. Set capacitors C306 and C307 for best **SINAD**.

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

806-825 MHz MASTR II STATION RECEIVER

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
A **(FM DET)**	Approximately 0.38 Vdc
B **(IF AMP)**	0.0
J **(Req. + 10 volts at System Metering jack)**	+ 10 Vdc

SYSTEM CHECKS

Symptom	Procedure
No Supply Voltage	• Check power connections and continuity of supply leads. Check fuse and replace if blown. Check receiver for short circuits.
No Regulated 10 volts	• Check the 117 volt supply, then check 10 volt regulator circuit (See Troubleshooting Procedure for 10 volt Regulator).
Low IF Amp Reading	• Check supply voltages and then check oscillator reading at 904-1 & 2 as shown in **STEP 2.** • Make **SIMPLIFIED VTVM GAIN CHECKS** from Mixer through IF Amplifier stages as shown in **STEP 2.**
Low Receiver Sensitivity	• Check Front End alignment (refer to **Receiver Alignment Procedure**). • Check antenna connections, cable and antenna switch. • Check both injection voltages (first and second mixers). • Check voltage readings of IF amplifiers. • 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 U603.
Low or Distorted Audio	• Check voltages on Schematic Diagram. • Make gain and waveform checks. • Check receiver alignment and **FM DET** output. • Check Q601. Q602, Q605 and other discrete components. • Replace IC U604.

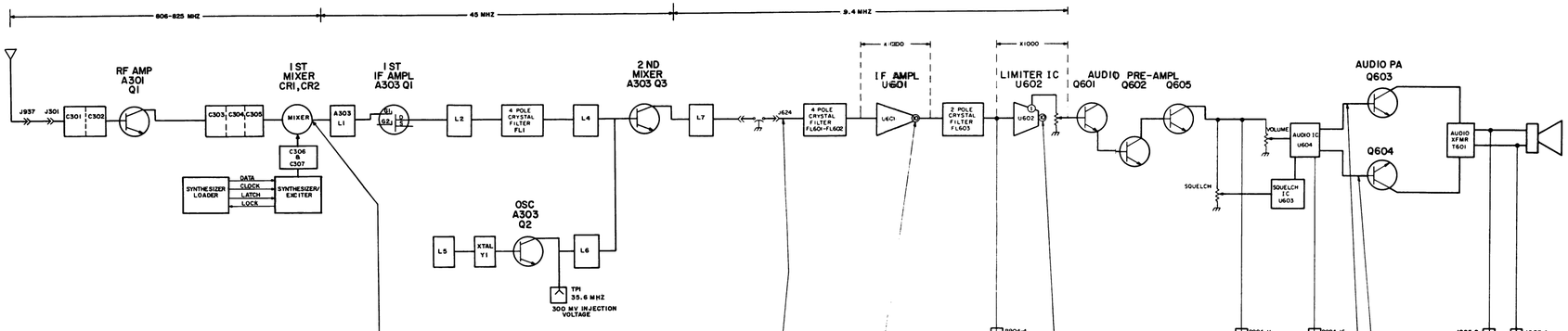
STEP 4-VOLTAGE RATIO READINGS

EQUIPMENT REQUIRED:
1. RF VOLTMETER (SIMILAR TO BOONTON MODEL 91-CA OR MILLIVAC TYPE MV-18C.
2. SIGNAL ON RECEIVER FREQUENCY (BELOW SATURATION). CORRECT FREQUENCY CAN BE DETERMINED BY FM DET READING OF 0.38 VDC. USE 1000 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.

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

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



STEP 2-SIMPLIFIED GAIN CHECKS

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

PRELIMINARY STEPS:
1. SET VOLUME R3 CONTROL FOR 6.4 VOLTS ACROSS 8-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.

SET SIGNAL GENERATOR TO CORRECT RF FREQUENCY AND APPLY TO A301-J1.	UNMODULATED	UNMODULATED	UNMODULATED	UNMODULATED	NO SIGNAL INPUT	STANDARD SIGNAL (1 MILLIVOLT AT RECEIVER FREQ MODULATED BY 1 KHz WITH 3.0 Khz DEVIATION)	STANDARD SIGNAL	STANDARD SIGNAL	STANDARD SIGNAL
PROCEDURE	SET GENERATOR OUTPUT AT 30 MV.	SET GENERATOR OUTPUT AT 1000 MICROVOLTS	INCREASE GENERATOR OUTPUT FROM ZERO UNTIL U601 SATURATES AS MEASURED WITH RF VOLTMETER	INCREASE GENERATOR OUTPUT FROM ZERO TO 40 MICROVOLTS	SHOULD BE IN SATURATION AT ALL TIMES				WITH SPEAKER DISCONNECTED, CONNECT VTVM OR SCOPE ACROSS 8-OHM LOAD CONNECTED BETWEEN J905-1 AND J905-2
READING	RF VOLTMETER READING SHOULD BE APPROX 100 MV.	RF VOLTMETER READING SHOULD BE APPROX 200 MILLIVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 20 MICROVOLTS	VTVM READING SHOULD BE APPROX 0.2 VDC	RF VOLTMETER READING SHOULD BE APPROX 0.6 V RMS	VTVM READING SHOULD BE APPROX 1.0 VAC	VTVM READING SHOULD BE APPROX 0.12 VAC	VTVM READING SHOULD BE APPROX 4.4 VAC	6.4 VAC

RC-7421A

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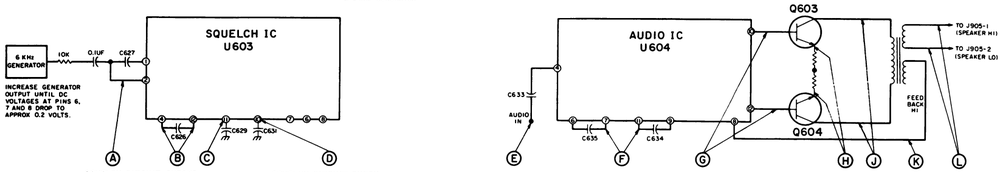
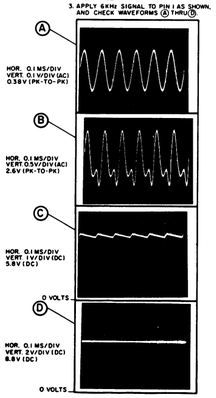
STEP 3-AUDIO & SQUELCH WAVEFORMS

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



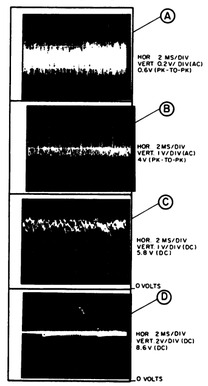
SQUELCH CIRCUIT CHECKS WITH 6 KHz SIGNAL:

PRELIMINARY STEPS
1. QUIET RECEIVER WITH A 1000 MICROVOLT, UNMODULATED SIGNAL.
2. SET SQUELCH CONTROL TO APPROX MID-RANGE.
3. APPLY 6 KHz SIGNAL TO PIN 1 AS SHOWN, AND CHECK WAVEFORMS (A) THRU (D).



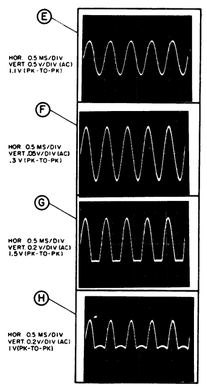
SQUELCH CIRCUIT CHECK WITH NOISE:

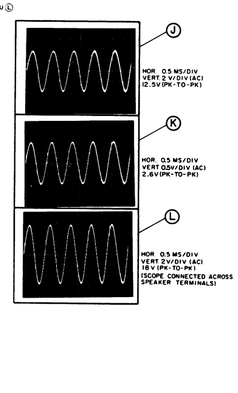
PRELIMINARY STEPS
1. NO INPUT SIGNAL APPLIED.
2. SET SQUELCH CONTROL FOR CRITICAL SQUELCH.
3. CHECK WAVEFORMS (A) THRU (D).



AUDIO CIRCUIT CHECK WITH STANDARD SIGNAL (1000 MICROVOLTS AT RECEIVER FREQ; MODULATED BY 1 KHz WITH 3.0 KHz DEVIATION)

PRELIMINARY STEPS
1. SET VOLUME CONTROL FOR 6.4 VOLTS ACROSS 8-OHM, 12 WATT LOAD.
2. SET SQUELCH CONTROL FULLY COUNTERCLOCKWISE.
3. CHECK WAVEFORMS (E) THRU (L).





(RC-3170)

INSTALLATION INSTRUCTIONS
(800 MHz Synthesized Exciter Replacement)

The Installation Hardware Kit should include the following:

Description	GE Part Number	Quantity
1.125" standoff	19B201955P12	4
1.00" standoff	19B201955P2	1
2.3125" standoff	19B201955P11	1
Jumper wire	T.B.D.	1
Star washers		10
0.5" screw		1
Synthesized Exciter Board	19D902209G1, G3 or G5	1
Synthesized Loader Board	19D902207G1	1
Loader Cable Assembly	19A705784P1	1
Rubber grommet		2
Transmit Cable Assembly	19B801454P1	1
Receive L.O. Cable Assembly	19B801529G10	1

Tools Required:

- Wire Cutters
- Cross-point screw driver
- Adjustment tool (tweaker)
- Pliers
- Narrow-blade screwdriver
- Nut driver

Procedure:

1. Turn power to the repeater station off.
2. Remove the repeater station cover plate.
3. Remove the Local Oscillator ICOM crystal.
4. Disconnect the Power Amplifier at the repeater wall (lower left front, facing unit).
5. Remove the 3-inch Exciter output cable from the exciter and the repeater door wall (left side-front of unit).
6. Remove two (2) through-hole knockouts (or metering switches from the repeater door wall (right side front of unit).
7. Remove the Molex connector from the exciter and mark the one facing the front of the repeater as Pin 1.
8. Remove the four (4) screws with washers from the exciter.
9. Remove two (2) standoffs with washers from the exciter.
10. Remove the exciter.
11. Using wire cutters, clip off the plastic housing for Pin 1 of the Molex connector (unused pin, blank). **NOTE:** the old Pin 2 has just become Pin 1 (Mark it!) of this connector.

12. Using wire cutters, clip off the plastic housing for pins 16 - 21 of the Molex connector (6 pins unused, blank).

13. Remove the wire going to Pin 8 (was Pin 9 before the old Pin 1 was clipped off) of the Molex connector from the connector.

14. Clip the wire in step 13 at the repeater bulkhead (lower right, facing the unit) and pull the wire out through the harness and discard.

15. Place the jumper wire, supplied, into Molex connector between pins 1 and 14 (new Pin 1 after clipping off old Pin 1).

16. Lower new synthesized exciter into the cavity with the connector to the right and the exciter output connector to the left.

17. Screw in the four (4) alike standoffs from the kit into the right most four (4) holes of the exciter casting. Include washers from old mounts. Finger tighten.

18. Install the 1/2 inch screw, supplied in the kit, into the lower left corner of the exciter. Leave loose.

19. Install the one long standoff, supplied in the kit, into the upper left corner of the exciter. Finger tighten.

20. Tighten all six (6) exciter mounts. **DO NOT** over -torque!

21 Mount the loader board on the four (4) standoffs over the exciter with the connector on the same side as the exciter connector.

22. Secure the loader board with three (3) of the old screws and washers from the old exciter mounts (leave the upper right hole open).

23. Screw the 1-inch standoff into the remaining mounting hole on the loader board.

24. Install the new exciter output cable assembly into repeater wall (lower left-front of unit).

25. Connect the exciter output cable to the exciter output.

26. Install two (2) rubber grommets, supplied in the repeater wall where the two knockouts were removed.

27. Remove the old local oscillator connector from the receiver. Tuck the old connector and cable down and out of the way.

28. Connect one end of the receive local oscillator cable, supplied, to the receive local oscillator connector on the receiver (the same connector that the old cable was removed from in step 27).

29. Snake the other end of the cable out through the grommet in the receiver/system cavity and back into the other grommet in the exciter section of the repeater.

30. Connect the new local oscillator connector to the exciter **REC LO** output.

31. Connect the loader harness from the loader board to the exciter board.

32 Re-connect the exciter Molex connector to the exciter board ensuring that Pin 1 is facing the front of the repeater unit.

33. Ensure that the new receive local oscillator cable is out of the way and not lying on top of the interior wall which contacts the cover plate (may be tucked under the edge of the loader board).

34. Re-connect the Power Amplifier to exciter output.

35. Set the correct frequency for the repeater according to the applicable maintenance manual for the loader board.

36. Turn the power on to the repeater.

37. Tune up the exciter according to the applicable maintenance manual for the exciter.

38. Re-install the cover plate.