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DESCRIPTION AND MAINTENANCE
406--512 MHz CUSTOM MVP RECEIVER

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DESCRIPTION

Custom MVP, 406-512 megahertz receivers are single conversion, superheterodyne FM receivers designed for one-through four-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 85 dB selectivity and maximum protection from desensitization and intermodulation.

The receiver consists of the following modules:

- RF Assembly
- IF Filter Board
- Oscillator-Multiplier (Osc-Mult)
- Audio and Squelch circuits (part of System-Audio & Squelch (SAS) board)
- IF Detector (IF Det)
- Optional Ultra-High Sensitivity (UHS) Pre-Amplifier

Audio, supply voltages and control functions are connected to the system board through P903 on the IF Det board, and through W401 to the Osc-Mult board. The regulated +10 Volts is used for all receiver stages escept the audio PA stage which operates from the A+ system supply.

Centralized metering jack J601 on the IF Det board is provided for use with GE Test Set 4EX3A11 or Test Kit 4EX8K12. The test set meters the oscillator-multiplier, FM Detector, 10 Volts and IF amplifier stages.

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 as listed in the Table of Contents.

MAINTENANCE

DISASSEMBLY

To gain access to the receiver for servicing, remove the wing nut at the rear of the radio and pull the radio out of the case assembly.

To remove the RF Assembly and IF-Filter board:

1. Carefully disconnect the two leads connected to loop clips J623 and J624 on the IF Detector board.
2. Unplug wire W501 from J605 on IF Detector board.
3. Unplug receiver input cable P301.
4. Remove the two countersunk flat head screws on each side of the system frame assembly and lift out RF Assembly and IF-Filter board.

To remove the Osc-Mult board:

1. Remove the crystal module.
2. Remove the two screws securing the board.
3. Carefully unplug the Osc-Mult board from the adapter board (on the receiver front end).

To remove the IF Det board:

1. Carefully disconnect the two leads connected to loop clips J623 and J624 on the IF Det board.
2. Unplug wire W501 from J605 on the IF Det board.
3. Disconnect the two plugs (P602 and J903) from the IF Det Board.
4. Remove the five screws securing the board and lift the board out.

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Ericsson GE Mobile Communications Inc.
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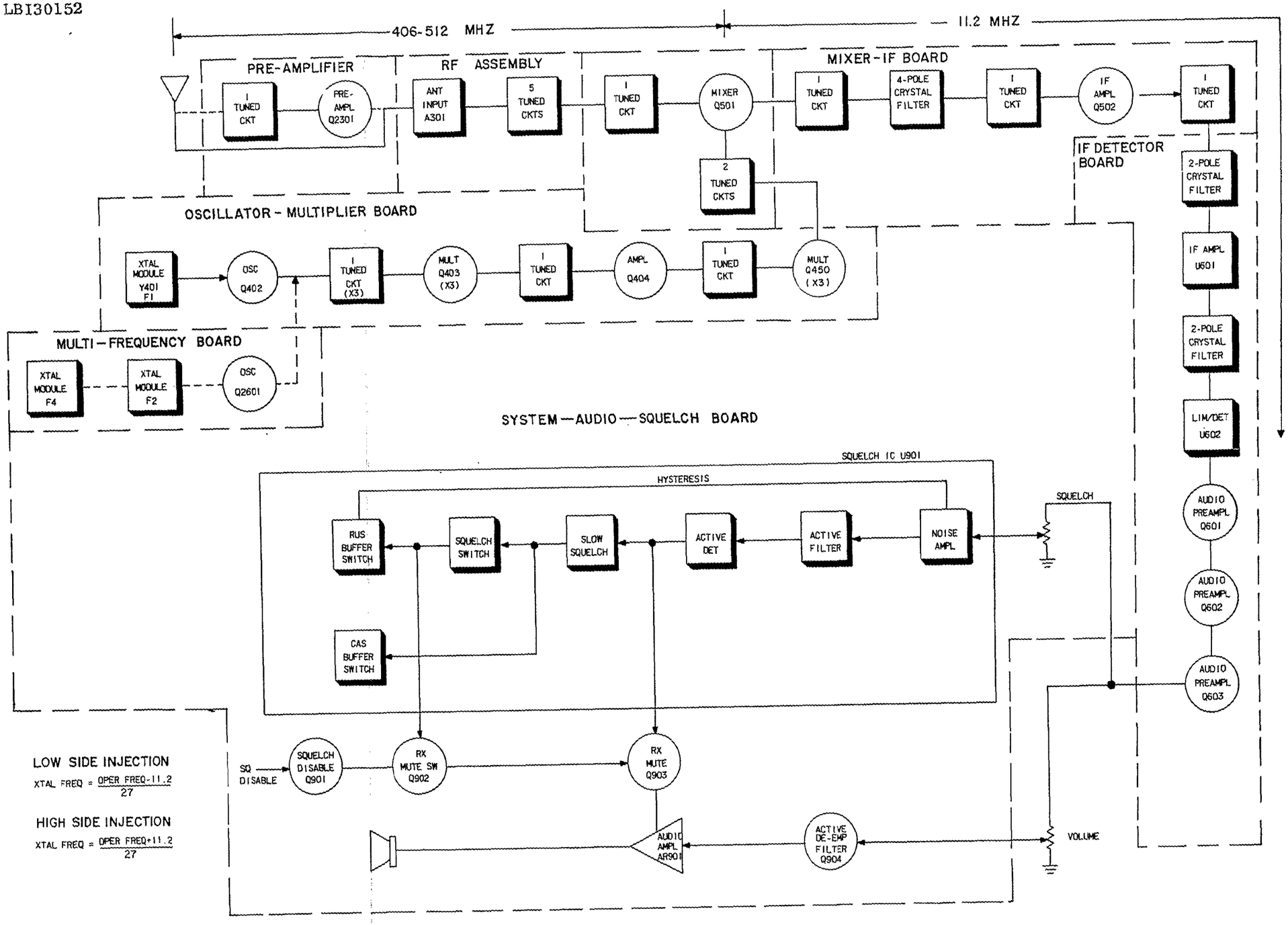


Figure 1 - Receiver Block Diagram

FRONT END ALIGNMENT

EQUIPMENT

1. GE Test Set Models 4EX3A14, 4EX8K12, or 20,000 ohms-per-Volt multimeter with a 1-Volt scale.

3. A 406-512 MHz signal source.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect black plug from Test Set to Receiver Centralized Metering Jack J601. Set meter sensitivity switch to the TEST 1 position (or 1-Volt position on 4EX8K12).

2. For multi-frequency receivers with a frequency spacing up to 0.800 MHz for frequency range of 406-470 MHz, 0.900 MHz for frequency range of 470-494 MHz or 0.750 MHz for frequency range of 494-512 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 1.60 MHz for frequency range of 406-470 MHz, 1.80 MHz for frequency range of 470-494 MHz, or 1.50 MHz for frequency range of 494-512 MHz, align the receiver using a center frequency tune-up crystal module. These limits can be extended to 2.00 MHz, 2.30 MHz and 2.00 MHz respectively, with 3 dB degradation in standard receiver specifications.

3. With Test Set in Position G, check for regulated +10 Volts. If using multimeter, measure between J601-6(+) and J601-9(-).

4. If using multimeter, connect the negative lead to J601-9 (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 and C308	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306, C307 and C308 fully counterclockwise. (Minimum capacity).
3.	D (MULT-2)	Pin 4	C411, C416, C406 and C306	See Procedure	Tune C411 and C416 for maximum meter reading. Retune C411. Next, retune C406, C411 and C416 for maximum meter reading. Then carefully tune C306 for a change in meter reading (peak or dip).
4.	F (MULT-3)	Pin 7	C306, C307 & C308	See Procedure	Carefully tune C307 and C306 for maximum meter reading. Repeak C307 and C306. Next, carefully tune C308 for minimum meter reading, and retune C306 for maximum meter reading. Do NOT readjust C307 or C308.
			RF SELECTIVITY		
5.	B	Pin 1	C301 thru C305, A303-C2, (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune C301 through C305 and A303-C2 for maximum meter reading. In receivers with the UHS preamplifier, also tune L2301 for maximum meter reading.
6.	B	Pin 1	C301 thru C305, A303-C2, (and L2301 if present) C306, C307 and C308	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune C301 through C305, A303-C2, (and L2301 if present) for best quieting sensitivity. C306, C307 and C308 may also be tuned slightly (not exceeding 1/4 turn).

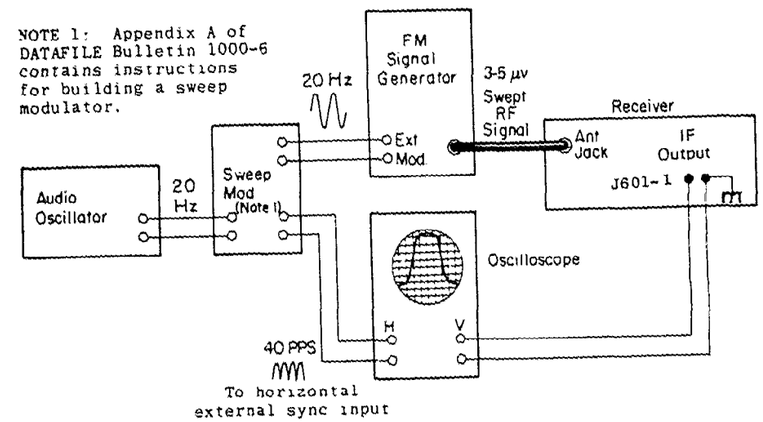
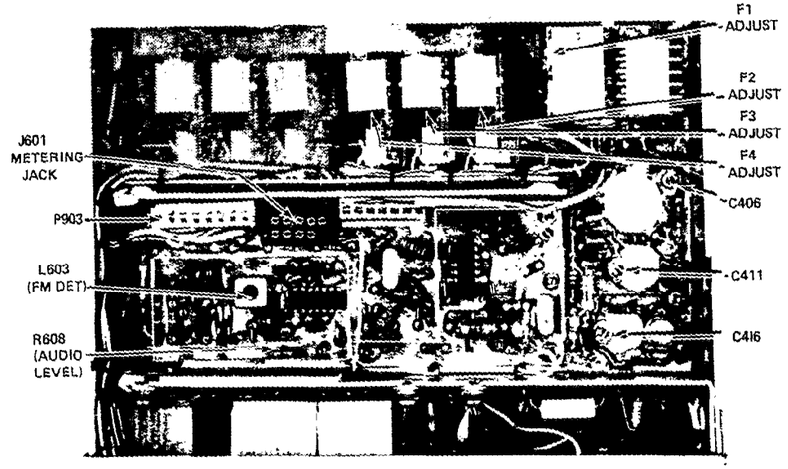
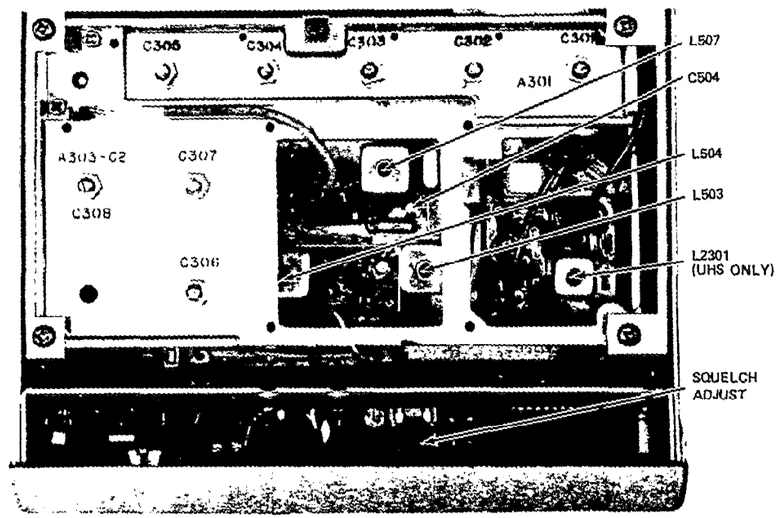


Figure 2 - Test Setup for 20-Hz Double-Trace Sweep Alignment





CRYSTAL MODULE FREQUENCY AD.

First, check the frequency to determine if any adjustment is required. (Refer to frequency ment requires equipment with an absolute accuracy that is 5 to 10 times bet r than the tolerance the entire radio should be as near as possible to an ambient temperature of 30°C (86°F).

The frequency of the crystal module should only be reset when the measured frequency error e

A. ±0.6 PPM when the ambient temperature of the radio is 30°C (86°F),

B. ±5 PPM at any other temperature within the range of -30°C to +75°C (-22°F to +167°F).

If frequency adjustment is required, refer to one of the procedures below depending on equi

A. DIRECT MEASUREMENT IN THE INJECTION CHAIN

   1. WITH A FREQUENCY COUNTER, "Count" the frequency at the junction of C416 and L403 quency measured at this point is 9 times the crystal frequency.

   2. WITH A COMMUNICATION MONITOR (for example: Cushman Model CE-3). "Monitor" freque Oscillator-Multiplier board. The frequency monitored at this point is 9 times the not always fall within an available measuring range of all monitors at all receive

B. STANDARD "ON FREQUENCY" SIGNAL AT THE RECEIVER INPUT (Generated from a COMMUNICATION MO

   1. WITH A FREQUENCY COUNTER, "Count" the developed IF frequency at the tap of Z602-2 nominal IF frequency (11.2 MHz) in Hz is compared to the receiver operating freque error.

   2. WITH AN 11.2 MHz IF FREQUENCY STANDARD (for example: General Electric Model 4EX9 to the IF signal path to create a heterodyne with the developed IF frequency. The by any of the following methods:

NOTE

To set crystal frequency using "beat frequency" method, the temperature should be 30°C, then offset the "ON FREQUENCY" signal (at the receivers input), as a functi ERROR FACTOR shown in Figure 3.

   a. Audible "beat frequency" from the receiver speaker (this requires careful fre

   b. Observe "beat frequency" at J601-1 with an oscilloscope.

   c. With GE TEST SET (Meter Position B) connected to J601 on the IF-DET Board, vis by meter movement.

The frequency of the "beat" is the frequency error related to the IF frequency. This devia freqeency, also in Hz, to calculate the frequency error.

NOTE

The FM Detector output (meter position A of the test set) has a DC voltage of .35 is provided for routine test and measurement only. The resolution of this readin GE Test Set in meter position A, or 0.1 V per kHz as measured with a VTVM at J601- oscillator frequency setting.

If the radio is at an ambient temperature of 30°C (86°F) set the oscillator for the correct

If the radio is not at an ambient temperature of 30°C setting errors can be minimized as fo

1. Maintain the radio at 30°C (±5°C) and set he oscillator to required mixer inject

2. Maintain the radio at 30°C (±5 C, -10°C) and offset the oscillator, as a function shown in Figure 3.

For example: Assume the ambient temperature of the radio is 20°C (68°F). At that tem of 675 Hz.

Adjust the oscillator for a corrected mixer injection frequency 675 Hz higher. If a temperatures above 30°C) set the oscillator for the indicated frequency lower than the calc

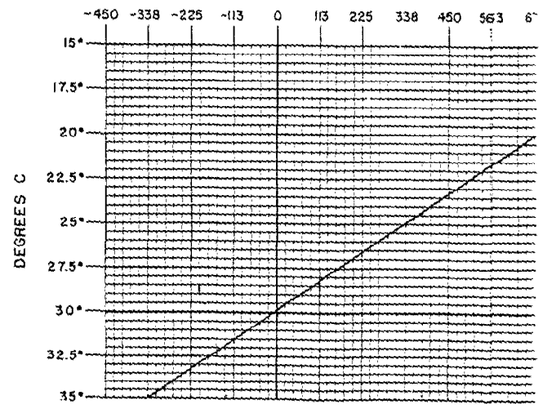
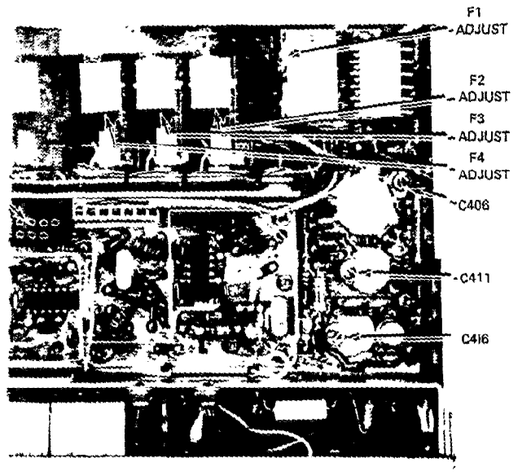


Figure 3 - Crystal Module Frequency Off

CRYSTAL MODULE FREQUENCY ADJUSTMENT



First, check the frequency to determine if any adjustment is required. (Refer to frequency offset chart, Figure 3.) The frequency measurement requires equipment with an absolute accuracy that is 5 to 10 times better than the tolerance to be maintained. When adjusting the frequency, the entire radio should be as near as possible to an ambient temperature of 30°C (86°F).

The frequency of the crystal module should only be reset when the measured frequency error exceeds the following limits:

A. ±0.6 PPM when the ambient temperature of the radio is 30°C (86°F).

B. ±5 PPM at any other temperature within the range of -30°C to +75°C (-22°F to +167°F).

If frequency adjustment is required, refer to one of the procedures below (depending on equipment available) for proper adjustment.

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 crystal frequency.

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 crystal 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 tap of Z602-R2 on the IF-DET 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 the frequency error.

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 "beat frequency" can be monitored by any of the following methods:

NOTE

To set crystal frequency using "beat frequency" method, the temperature should be at 30°C (86°F). If the temperature is not 30°C, then offset the "ON FREQUENCY" signal (at the receivers input), as a function of actual temperature, by the frequency ERROR FACTOR shown in Figure 3.

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

b. Observe "beat frequency" at J601-1 with an oscilloscope.

c. With GE TEST SET (Meter Position B) connected to J601 on the IF-DET 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, compared to the receiver operating freqeency, also in Hz, to calculate the frequency error.

NOTE

The FM Detector output (meter position A of the test set) has a DC voltage of .35 to .50 volts at the assigned frequency and is provided for routine test and measurement only. The resolution of this reading (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 J601-2 on the IF-DET board) is inadequate for oscillator frequency setting.

If the radio is at an ambient temperature of 30°C (86°F) set the oscillator for the correct mixer frequency (crystal FREQ. X 9).

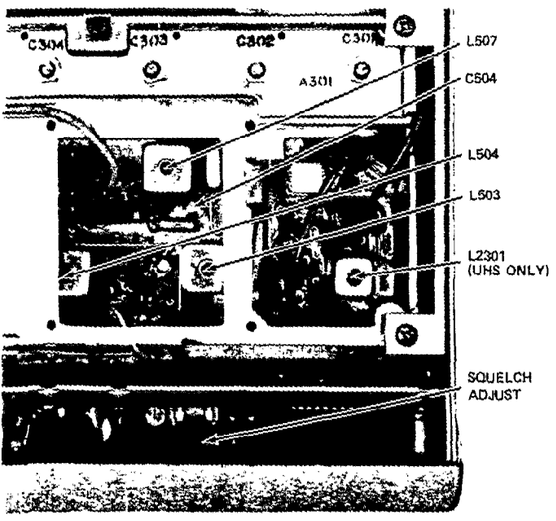
If the radio is not at an ambient temperature of 30°C setting errors can be minimized as follows:

1. Maintain the radio at 30°C (±5°C) and set the oscillator to required mixer injection frequency, or

2. Maintain the radio at 30°C (±5°C, -10°C) and offset the oscillator, as a function of actual temperature, by the frequency error shown in Figure 3.

For example: Assume the ambient temperature of the radio is 20°C (68°F). At that temperature, the curve shows a correction factor of 675 Hz.

Adjust the oscillator for a corrected mixer injection frequency 675 Hz higher. If a negative correction factor is obtained (at temperatures above 30°C) set the oscillator for the indicated frequency lower than the calculated mixer injection frequency.



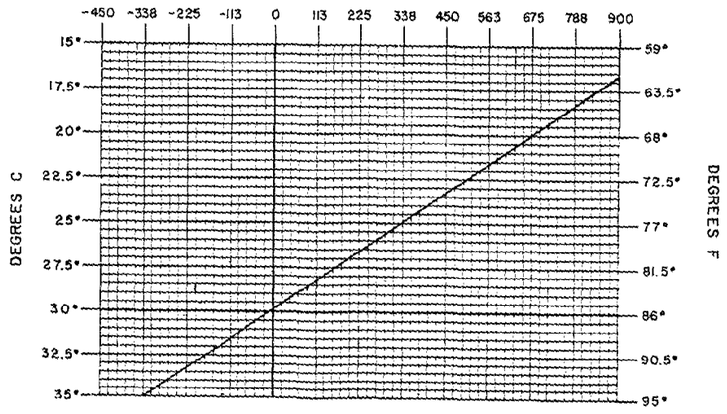


Figure 3 - Crystal Module Frequency Offset Chart

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 406-512 MHz signal source (Measurements insulated wire no larger than .065 inch diameter connected to generator probe.

3. A VTVM.

4. Distortion Analyzer

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect the black plug from the Test Set to receiver metering jack J601. Set the meter sensitivity switch on the 4EX8K12).

2. For multi-frequency receivers with a frequency spacing exceeding the above but no greater than 1.60 MHz, 1.80 MHz for frequency range of 470-494 MHz, or 1.50 MHz for frequency range of 494-512 MHz, align the tune-up crystal module. These limits can be extended to 2.00 MHz, 2.30 MHz and 2.00 MHz respectively. standard receiver specifications.

3. With the Test Set in Position G, check for regulated +10 Volts. With multimeter, measure from J601-6.

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, T604	0.38 Volt	With no signal applied, adjust L603/T604 for 0.38 Volt.
			OSCILLATOR-MULTIPLIER		
2.	C (MULT-1)	Pin 3	C406	Maximum	Tune C406 for maximum meter reading.
3.			C411, C416, C306, C307 and C308	See Procedure	Preset C411 and C416 to a position simi C307 and C308 fully counterclockwise (mi
4.	D (MULT-2)	Pin 4	C411, C416, C406 and C306	See Procedure	Tune C411 and C416 for maximum meter rea C406, C411 and C416 for maximum meter r for a change in meter reading (peak or
5.	F (MULT-3)	Pin 7	C306, C307 & C308	See Procedure	Carefully tune C307 and C306 for maximu C308. Next, carefully tune C308 for ma for maximum meter reading. Do NOT read
			RF SELECTIVITY		
6.	B (IF AMP)	Pin 1	C305, C304 and A303-C2	Maximum	Preset A303-C2 to mid position. Apply adjacent to C304, keeping the signal be C304 and then A303-C2 for maximum meter
7.	B (IF AMP)	Pin 1	C304 and C303	Maximum	Apply an on-frequency signal in the hol signal below saturation. Then tune C30
8.	B (IF AMP)	Pin 1	C303 and C302	Maximum	Apply an on-frequency signal in the hol signal below saturation. Then tune C30 reading.
9.	B (IF AMP)	Pin 1	C301 thru C305, A303-C2 (and L2301 if present)	Maximum	Apply an on-frequency signal to the ant saturation. Then tune C301 through C30 ing. In receivers with the UHS preamp meter reading.
10.	B (IF AMP)	Pin 1	C301 thru C308. A303-C2 (and L2301 if present)	Maximum	Apply an on-frequency signal to the ant through C305, A303-C2 (and L2301 if pre C306, C307 & C308 may also be tuned sl
11.			L603, R608	See Procedure	Remove the Test set metering plug from with 1 kHz modulation and 3 kHz deviat for maximum voltage at 1.0 kHz and adj a VTVM at P903-1 (VOL SQ HI) and P903-

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 406-512 MHz signal source (Measurements 803) with a one-inch piece of insulated wire no larger than .065 inch diameter connected to generator probe.
3. A VTVM.
4. Distortion Analyzer

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect the black plug from the Test Set to receiver metering jack J601. Set the meter sensitivity switch to the Test 1 (or 1-Volt position on the 4EX8K12).
2. For multi-frequency receivers with a frequency spacing exceeding the above but no greater than 1.60 MHz for frequency range of 406-470 MHz, 1.80 MHz for frequency range of 470-494 MHz, or 1.50 MHz for frequency range of 494-512 MHz, align the receiver using a center frequency tune-up crystal module. These limits can be extended to 2.00 MHz, 2.30 MHz and 2.00 MHz respectively, with 3 dB degradation in standard receiver specifications.
3. With the Test Set in Position G, check for regulated +10 Volts. With multimeter, measure from J601-6(+) and J601-9(-).
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, T604	0.38 Volt	With no signal applied, adjust L603/T604 for a meter reading of approximately 0.38 Volt.
			OSCILLATOR-MULTIPLIER		
2.	C (MULT-1)	Pin 3	C406	Maximum	Tune C406 for maximum meter reading.
3.			C411, C416, C306, C307 and C308	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306, C307 and C308 fully counterclockwise (minimum capacity).
4.	D (MULT-2)	Pin 4	C411, C416, C406 and C306	See Procedure	Tune C411 and C416 for maximum meter reading. Retune C411. Next, retune C406, C411 and C416 for maximum meter reading. Then carefully tune C306 for a change in meter reading (peak or dip).
5.	F (MULT-3)	Pin 7	C306, C307 & C308	See Procedure	Carefully tune C307 and C306 for maximum meter reading. Repeak C307 and C308. Next, carefully tune C308 for minimum meter reading, and retune C306 for maximum meter reading. Do NOT readjust C307 and C308.
			RF SELECTIVITY		
6.	B (IF AMP)	Pin 1	C305, C304 and A303-C2	Maximum	Preset A303-C2 to mid position. Apply an on-frequency signal in the hole adjacent to C304, keeping the signal below saturation. Then tune C305, C304 and then A303-C2 for maximum meter reading.
7.	B (IF AMP)	Pin 1	C304 and C303	Maximum	Apply an on-frequency signal in the hole adjacent to C303, keeping the signal below saturation. Then tune C304 and C303 for maximum meter reading.
8.	B (IF AMP)	Pin 1	C303 and C302	Maximum	Apply an on-frequency signal in the hole adjacent to C302, keeping the signal below saturation. Then tune C303 and then C302 for maximum meter reading.
9.	B (IF AMP)	Pin 1	C301 thru C305, A303-C2 (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune C301 through C305 and A303-C2 for maximum meter reading. In receivers with the UHS preamplifier, also tune L2301 for maximum meter reading.
10.	B (IF AMP)	Pin 1	C301 thru C308, A303-C2 (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune C301 through C305, A303-C2 (and L2301 if present) for best quieting sensitivity. C306, C307 & C308 may also be tuned slightly (not exceeding 1 4 turn).
11.			L603, R608	See Procedure	Remove the Test set metering plug from J601. Apply a 100 microvolt signal with 1 kHz modulation and 3 kHz deviation to the antenna jack. Tune L603/T604 for maximum voltage at 1.0 kHz and adjust R608 for 1 Volt RMS measured with a VTVM at P903-1 (VOL/SQ HI) and P903-6 (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 12.		
			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.		
12.			L507, L503, L504, C504, and T601-T603		Connect scope, signal generator and probe as shown in Figure 2. Set signal generator level for 3 to 5 uV and modulate with 10 kHz at 20 Hz. With probe between J601-1 and A-, tune L507, L503, L504 and C504 (and T601-T603*) for double trace as shown on scope pattern.
13.				See Procedure	Check to see that modulation acceptance bandwidth is greater than ±7 kHz.
			SQUELCH ADJUST		
14.			R901	∠ 30°	Set SQUELCH ADJUST control (R901) to open with a 6 dB SINAD signal. (Approximately 30° counterclockwise of critical squelch position).

* T601-T604 are present on IF Detector Board 190A52538 only.

TEST PROCEDURES

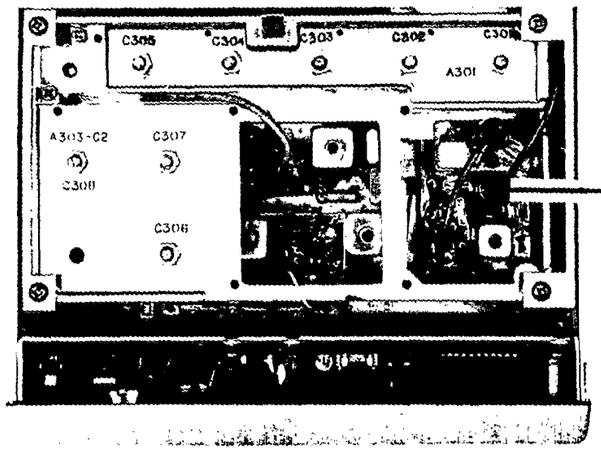
These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect 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.

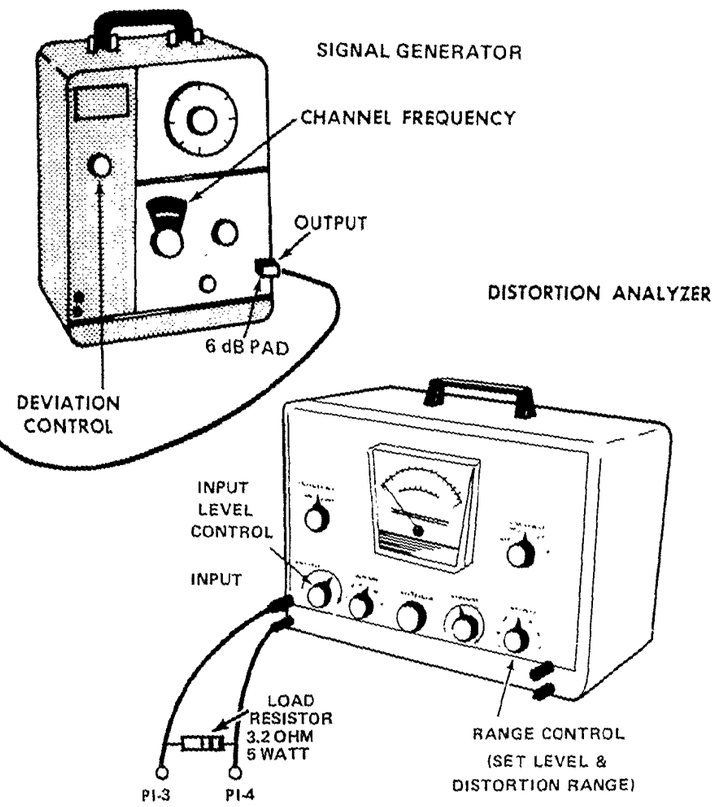
TEST EQUIPMENT REQUIRED

- Distortion Analyzer similar to:
  Heath IM-12
- Signal Generator similar to:
  Measurements 803
- 6-dB attenuation pad, and 3.2 ohm, 5-Watt resistor

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment as shown 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 of the 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 A301-J1.

B. With 5-Watt Speaker

Disconnect speaker and connect a 3.2-ohm 5-Watt load resistor from P1-3 (speaker H1) to P1-4 (A-). 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 across P1-3 and P1-4.

C. Adjust the VOLUME control for 3-Watt output using the Distortion Analyzer as a VTVM (3.1 Vrms).

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 5%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 5.0 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 adjustment (Refer to Receiver Alignment on reverse side of page).

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 A301-J1.

B. With 5-Watt Speaker

Disconnect speaker and connect a 3.2-ohm 5-Watt load resistor from P1-3 (speaker H1) to P1-4 (A-). 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 across P1-3 and P1-4.

C. Adjust the VOLUME control for 3-Watt output using the Distortion Analyzer as a VTVM (3.1 Vrms).

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 5%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

ALYZER

SERVICE CHECK

If the distortion is more than 5%, or maximum audio output is less than 5.0 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 adjustment (Refer to Receiver A[illegible]ment on reverse side of

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 A301-J1.

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 1.5 Watts (2.2 Volts) RMS across the 3.2-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. Reduce the audio output to 0.3 Watts (0.98 VRMS across the 3.2-ohm receiver load.)

C. 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.

D. 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).

E. 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.

STEP 2
.E SENSITIVITY
'-dB SINAD)

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A301-J1.

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STEP 3
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B. Reduce the audio output to 0.3 Watts (0.98 VRMS across the 3.2-ohm receiver load.)

C. 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.

D. 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).

E. 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.

STEP I - 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 Unmodulated Input	
A (FM DET)	0.35-0.50 VDC	8 Microvolts (w/o Pro-Amp)	2 Microvolts (w. Pre-Amp)
B (IF AMP)		0.1 VDC	
C (MULT-1)	0.4 VDC		
D (MULT-2)	0.4 VDC		
F (MULT-3)	0.1 VDC		
G (Reg. +10 Volts at J601	+10 VDC		

SYMPTOM CHECKS

SYMPTOM	PROCEDURE
NO SUPPLY VOLTAGE	• Check power connections and continuity of supply leads, and check fuse in power supply. 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 IF READING	• Check supply voltages and then check oscillator readings at J601 as shown in STEP 2. • Make SIMPLIFIED VTVM GAIN CHECKS from Mixer through Limiter Detector 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 chain (Q402, Q403, Q404).
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 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 on SAS board.
LOW OR DISTORTED AUDIO	• Check voltages on Schematic Diagram. • Make gain and waveform checks. • Check receiver and alignment and FM-DET output. • Check Q601, Q602, Q603 and other discrete components. • Check Q904 and AR901 on SAS board.

STEP 4-VOLTAGE RATIO READING

EQUIPMENT REQUIRED
1. RF VOLTMETER

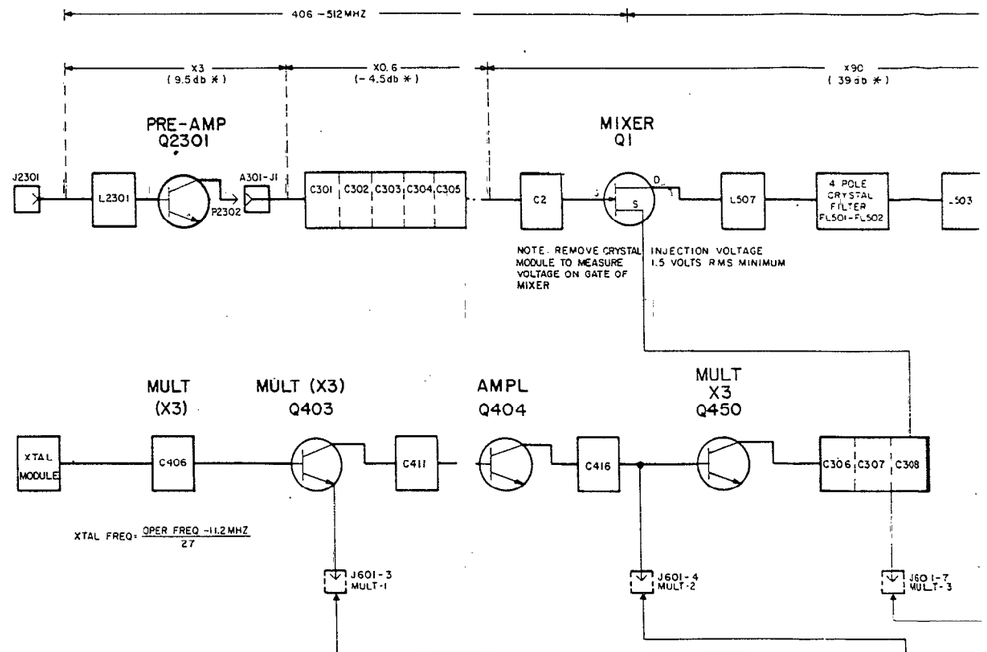
2. SIGNAL ON RECEIVER FREQUENCY (BELOW SATURATION). USE 1000 HERTZ SIGNAL WITH 3.0 KHz DEVIATION

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.

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

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

* DIFFERENCE BETWEEN INPUT AND OUTPUT READING ON db SCALE OF RF VOLTMETERS, NOT ACTUAL POWER GAIN.

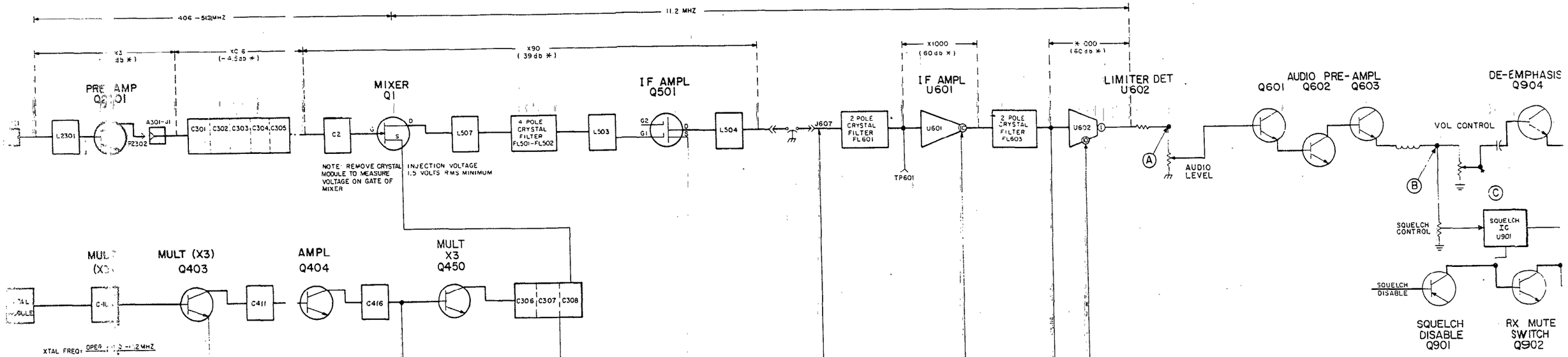


STEP 2-SIMPLIFIED GAIN CHECKS

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

PRELIMINARY STEPS
1. SET VOLUME CONTROL FOR 3.1 VOLTS ACROSS 3.2-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 A301-J1	NONE	NONE
PROCEDURE		
READING	VOLTMETER READING SHOULD BE APPROX 0.5 VDC	VOLTMETER READING SHOULD BE APPROX 0.2 VDC



SIMPLIFIED GAIN CHECKS

SIGNAL APPLIED TO A301-J1	NONE	NONE	NONE	UNMODULATED	UNMODULATED	UNMODULATED	NO SIGNAL INPUT
PROCEDURE				SET GENERATOR OUTPUT TO 1000 MICROVOLTS AT RECEIVE FREQUENCY	RESET GENERATOR OUTPUT TO ZERO, THEN INCREASE OUTPUT UNTIL U601 SATURATES AS MEASURED WITH RF VOLTMETER	SET GENERATOR OUTPUT TO 40 MICROVOLTS (10 MICROVOLTS WITH PREAMP)	SHOULD BE IN SATURATION AT ALL TIMES
READING	VOLTMETER READING SHOULD BE APPROX 0.5 VDC	VOLTMETER READING SHOULD BE APPROX 0.2 VDC	VOLTMETER READING SHOULD BE APPROX 0.5 VDC	RF VOLTMETER READING SHOULD BE APPROX 200 MILLIVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 40 MICROVOLTS (10 MICROVOLTS WITH PREAMP)	VOLTMETER READING SHOULD BE APPROX 0.54 VDC	RF VOLTMETER READING SHOULD BE APPROX 0.6V RMS

& DC
FOR

NTROL FOR TS ACROSS 3.22-OHM
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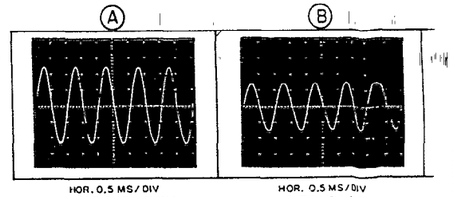
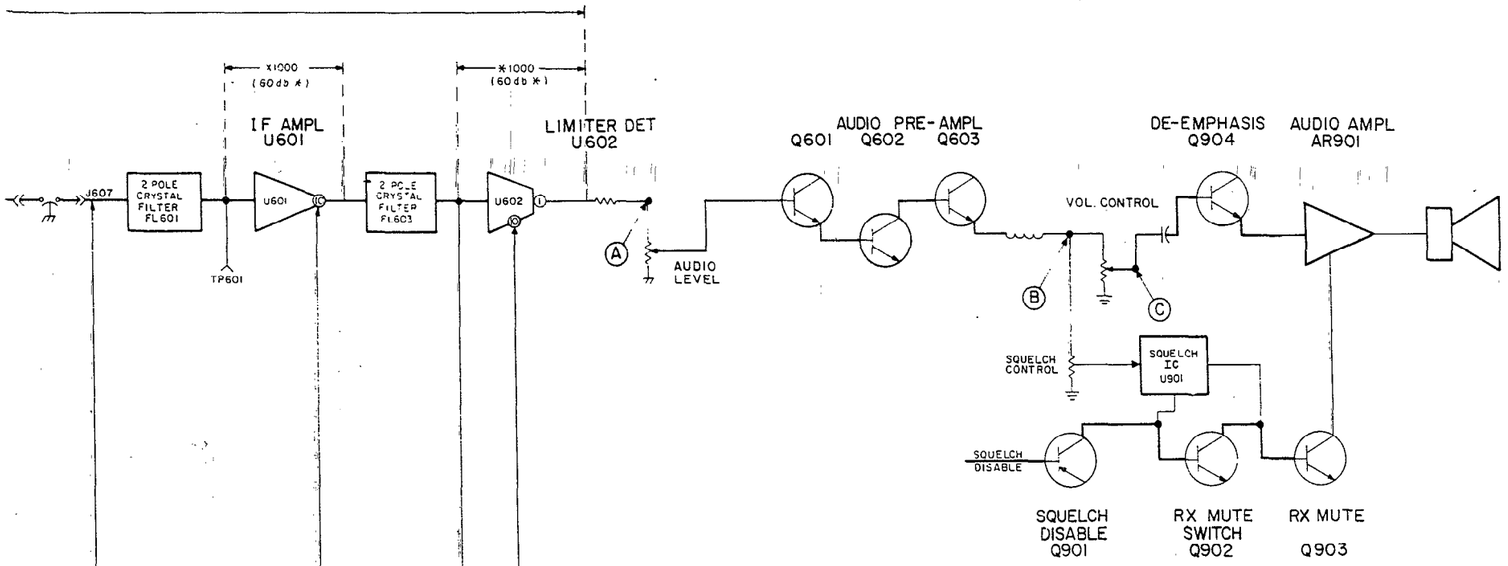
NTROL FU OUNTERCLOCKWISE
BE PRO ALIGNED
BETWEEN ND POINTS INDICATED

AUDIO WAVEFORMS

STANDARD SIGNAL
1. 1MV OF RF
2. 1KHz MOD.
3. 3KHz DEV.
4. VOLUME CONT SET FOR RATED OUTPUT (4 VRMS).



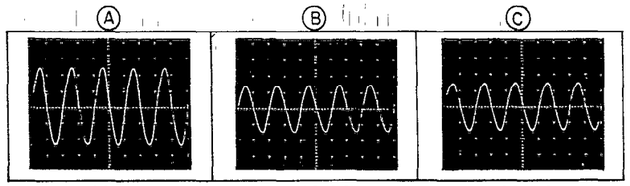


...LATED	UNMODULATED	UNMODULATED	NO SIGNAL INPUT
...R OUTPUT ...OVOLTS ...REQUENCY	RESET GENERATOR OUTPUT TO ZERO, THEN INCREASE OUTPUT UNTIL U601 SATURATES AS MEASURED WITH RF VOLTMETER	SET GENERATOR OUTPUT TO 40 MICROVOLTS (10 MICROVOLTS WITH PREAMP)	SHOULD BE IN SATURATION AT ALL TIMES
...R READING ...PPROX ...OLTS	GENERATOR OUTPUT SHOULD BE APPROX 40 MICROVOLTS (10 MICROVOLTS WITH PREAMP)	VOLTMETER READING SHOULD BE APPROX 0.54 VDC	RF VOLTMETER READING SHOULD BE APPROX 0.6V RMS

AUDIO WAVEFORMS

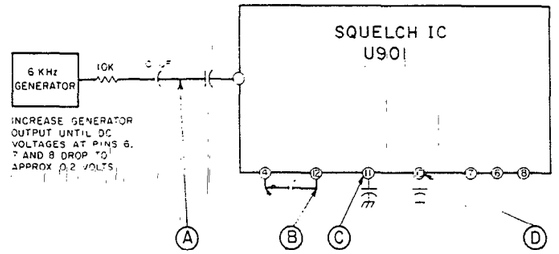
STANDARD SIGNAL

1. 1 MV OF RF
2. 1 KHz MOD.
3. 3 KHz DEV.
4. VOLUME CONT SET FOR RATED OUTPUT (4 VRMS).



STEP 3-AUDIO & SQUELCH WAVEFORMS

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



INCREASE GENERATOR OUTPUT UNTIL DC VOLTAGES AT PINS 6, 7 AND 8 DROP TO APPROX 0.2 VOLTS.

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 6KHz 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.