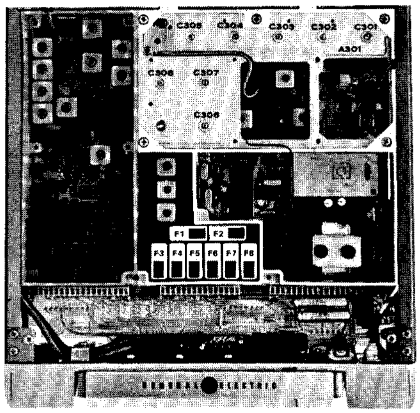
MOBILE RADIO

(This LBI has been replaced by LBI-30025)

MASTR II
MAINTENANCE MANUAL

406-420 & 450-512 MHz RECEIVER



SPECIFICATIONS *

Audio Output (to 8-ohm Speaker)	12 Watts at less than 3% distortion	
	Standard Receiver	Ultra-High Sensitivity Receiver
Sensitivity		
12-dB SINAD (EIA Method)	0.35 µV	0.20 µV
20-dB Quieting Method	0.50 µV	0.25 µV
SELECTIVITY		
EIA Two-Signal Method	-90 dB	-90 dB
20-dB Quieting Method	-100 dB	
Spurious Response	-100 dB	-90 dB
Intermodulation (EIA)	-80 dB	-75 dB
Squelch Sensitivity		
Critical Squelch	0.2 µV	0.1 µV
Maximum Squelch	Greater than 20 dB quieting (less than 1.5 µV)	
Frequency Stability		
5C-ICOM with EC-ICOM	±0.0005% (-40°C to +70°C)	
5C-ICOM or EC-ICOM	±0.0002% (0°C to +55°C)	
2C-ICOMS	±0.0002% (-40°C to +70°C)	
Modulation Acceptance	±7 kHz (narrow-band)	
Maximum Frequency Separation (Multi-Frequency Units)	Full Specifications	3dB Degradation
406 - 470 MHz	1.60 MHz	2.0 MHz
470 - 494 MHz	1.80 MHz	2.30 MHz
494 - 512 MHz	1.50 MHz	2.0 MHz
Frequency Response	Within +1 and -8 dB of a standard 6-dB per octave de-emphasis curve from 300 to 3000 Hz (1000-Hz reference)	
RF Input Impedance	50 ohms	

* These specifications are intended primarily for the use of the serviceman. Refer to the appropriate **Specification Sheet** for the complete specifications.

GENERAL ELECTRIC

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ILLUSTRATIONS

WARNING

Although the highest DC voltage in MASTR II Mobile Equipment is supplied by the vehicle battery, high currents may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits! High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. KEEP AWAY FROM THESE CIRCUITS WHEN THE TRANSMITTER IS ENERGIZED!

DESCRIPTION

MASTR II, 406 to 420 and 450 to 512 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 (Includes Mixer and IF-Amplifier)
- IF-Filter
- Oscillator/Multiplier (Osc/Mult)
- IF/Audio and Squelch (IFAS)
- Optional Ultra-High Sensitivity (UHS) Pre-Amplifier

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, discriminator and IF amplifier stages. Speaker high and low are metered on the system board metering jack.

CIRCUIT ANALYSIS

RF ASSEMBLY

PRE-AMPLIFIER

The pre-amplifier is present only in UHS receivers, and uses a bi-polar transistor to provide approximately 10 dB gain.

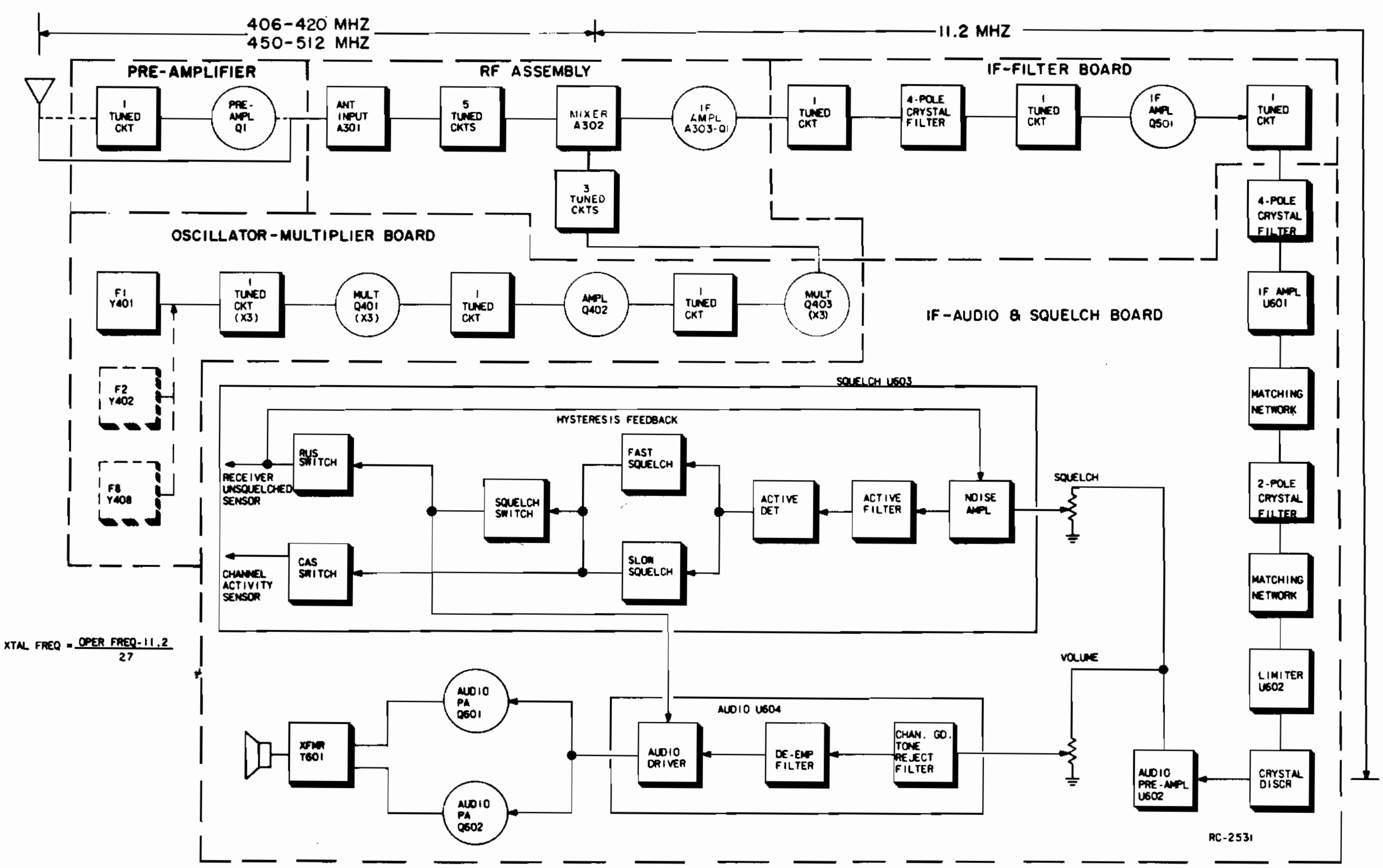

Figure 1 - Receiver Block Diagram

RF from the antenna is link-coupled through helical resonator L2301 to the base of Class A pre-amplifier Q2301. L2301 matches the 50-ohm input to the base of Q2301. The amplified output is coupled through L2302, and connected through W2301 to J1 on Antenna Input Board A301. P2301 connects to J502 on the IF-Filter Board for regulated +10-Volt supply voltage.

ANTENNA INPUT A301

An RF signal from the antenna or UHS pre-amplifier is applied to A301 which provides an AC ground between vehicle ground and receiver A-. Resistor R1 prevents a static charge from building up on the vehicle antenna. The output of A301 is coupled through five high Q helical resonators that provide the front end RF selectivity. The helicals are tuned to the incoming frequency by C301 through C305.

MIXER A302

The mixer uses 4 hot-carrier diodes which are low noise diodes with non-linear resistance characteristics.

RF from the helical resonator is coupled to the mixer circuit through T1. Injection voltage from the oscillator-selectivity stages is coupled to the mixer circuit through T2. The mixer IF output is proportional to the level of the RF input and is independant of the injection voltage. The 11.2 MHz IF output is taken from H9 in the secondary of T1 and applied to an IF amplifier stage.

IF AMPLIFIER A303

The IF amplifier uses a Field-Effect Transistor (FET) as the active device. The mixer output is applied to the Gate of the amplifier, and the output is taken from the drain and applied to the IF Filter Board. The amplifier provides approximately 15 dB of IF gain.

OSCILLATOR - MULTIPLIER

The oscillator-multiplier can be equipped with up to eight Integrated Circuit Oscillator Modules (ICOMs). The ICOM crystal frequencies range from approximately 14.5 to 18.5 megahertz, and the crystal frequency is multiplied 27 times to provide a low side injection frequency to the mixer.

ICOMS

Three different types of ICOMs are available for use in the Osc/Mult module. Each of the ICOMs contains a crystal-controlled Colpitts oscillator, and two of the ICOMs contain compensator ICs. The different ICOMs are:

- 5C-ICOM - contains an oscillator and a 5 part-per-million (±0.0005%) compensator IC. Provides compensation for EC-ICOMs.
- EC-ICOM - contains an oscillator only. Requires external compensation from a 5C-ICOM.
- 2C-ICOM - contains an oscillator and a 2 PPM (±0.0002%) compensator IC. Will not provide compensation for an EC-ICOM.

The ICOMs are enclosed in a dust-proof, RF shielded can with the type ICOM (5C-ICOM, EC-ICOM or 2C-ICOM) printed on the top of the can. Access to the oscillator trimmer is obtained by prying up the plastic tab on the top of the can. The tabs can also be used to pull the ICOMs out of the radio.

Frequency selection is accomplished by switching the ICOM keying lead (terminal 6) to A- by means of the frequency selector switch on the control unit. In single-frequency radios, a jumper from H9 to H10 in the control unit connects terminal 6 of the ICOM to A-. In the receive mode, +10 Volts is applied to the external ICOM load resistor (R401) by the RX Osc control line, keeping the selected ICOM turned on. Keying the transmitter removes the 10 Volts at R401, turning the ICOM off.

CAUTION

All ICOMs are individually compensated at the factory and cannot be repaired in the field. Any attempt to repair or change an ICOM frequency will void the warranty.

In standard 5 PPM radios using EC-ICOMs, at least one 5C-ICOM must be used. The 5C-ICOM is normally used in the receiver F1 position, but can be used in any transmit or receive position. One 5C-ICOM can provide compensation for up to 15 EC-ICOMs in the transmitter and receiver. Should the 5C-ICOM compensator fail in the open mode, the EC-ICOMs will still maintain 2 PPM frequency stability from 0°C to 55°C (+32°F to 131°F) due to the regulated compensation voltage (+5 Volts) from the 10-Volt regulator IC. If desired, up to 16 5C-ICOMs may be used in the radio.

The 2C-ICOMs are self-compensated to 2 PPM and cannot provide compensation for EC-ICOMs.

Oscillator Circuit

The quartz crystals used in ICOMs exhibit the traditional "S" curve characteristics of output frequency versus operating temperature.

At both the coldest and the hottest temperatures, the frequency increases with increasing temperature. In the middle temperature range (approximately 0°C to +55°C), frequency decreases with increasing temperature.

Since the rate of change is nearly linear over the mid-temperature range the output frequency change can be compensated by choosing a parallel compensation capacitor with a temperature coefficient approximately equal and opposite that of the crystal.

Figure 2 shows the typical performance of an uncompensated crystal as well as the typical performance of a crystal which has been matched with a properly chosen compensation capacitor.

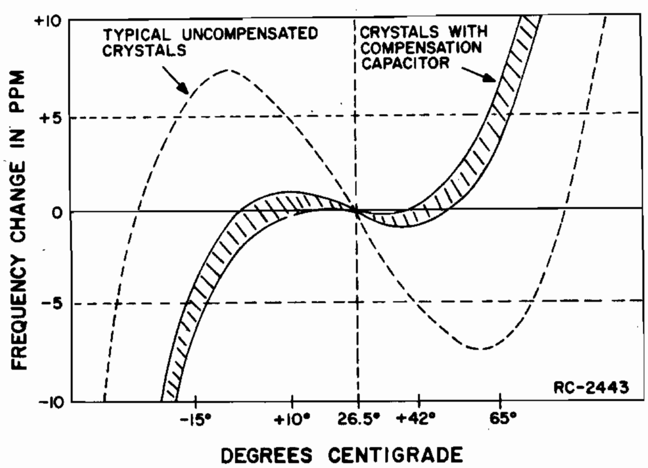

Figure 2 - Typical Crystal Characteristics

At temperatures above and below the mid-range, additional compensation must be introduced. An externally generated compensation voltage is applied to a varactor (voltage-variable capacitor) which is in parallel with the crystal.

A constant bias of 5 Volts (provided from Regulator IC U901 in parallel with the compensator) established the varactor capacity at a constant value over the entire mid-temperature range. With no additional compensation, all of the oscillators will provide 2 PPM frequency stability from 0°C to 55°C (+32°F to 131°F).

Compensator Circuits

Both the 5C-ICOMs and 2C-ICOMs are temperature compensated at both ends of the temperature range to provide instant frequency compensation. An equivalent ICOM circuit is shown in Figure 3.

The cold end compensation circuit does not operate at temperatures above 0°C. When the temperature drops below 0°C, the circuit is activated. As the temperature decreases, the equivalent resistance decreases and the compensation voltage increases.

The increase in compensation voltage decreases the capacity of the varactor in the oscillator, increasing the output frequency of the ICOM.

The hot end compensation circuit does not operate at temperatures below +55°C. When the temperature rises above +55°C, the circuit is activated. As the temperature increases, the equivalent resistance decreases and the compensation voltage decreases. The decrease in compensation voltage increases the capacity of the varactor, decreasing the output frequency of the ICOM.

Service Note: Proper ICOM operation is dependant on the closely-controlled input voltages from the 10-Volt regulator. Should all of the ICOMs shift off frequency, check the 10-Volt regulator module.

MULTIPLIER & AMPLIFIER

The output of the selected ICOM is coupled through a tuned circuit (L401 and C405) that is tuned to three times the crystal frequency. The output of the tuned circuit is applied to the base of Class C multiplier Q401. The collector tank circuit of the multiplier (L402 and C409) is tuned to nine times the crystal frequency. The multiplier stage is metered at metering jack J601-3 on the IFAS board.

Following the multiplier is a Class A Amplifier stage, Q402. Q402 is metered at J601-4 on the IFAS board through a metering network consisting of C415, C416, CR401 and R408. The amplified output of Q402 is applied to a tuned circuit (L403 and C413) that is tuned to nine times the crystal frequency. The tuned circuit provides some selectivity in the oscillator-multiplier chain.

The amplifier output is applied to the base of Class C multiplier Q403 through a matching network (T401 and C424). The output of Q403 is inductively coupled to the first of three helical resonators through L407. The helicals are tuned to 27 times the crystal frequency by C306, C307 and C308.

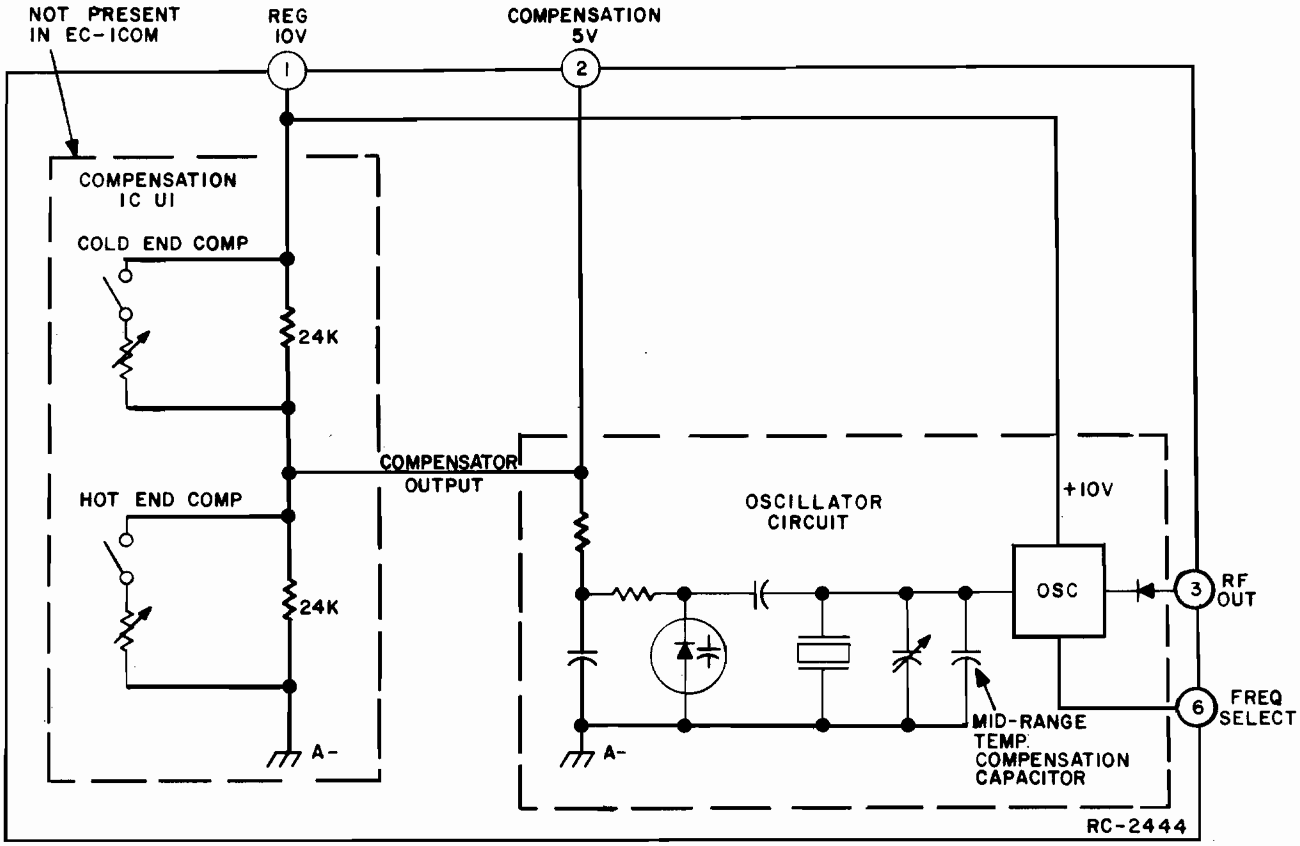

Figure 3 - Equivalent ICOM Circuit

Most of the selectivity for the oscillator-multiplier chain is provided by the three high-Q helicals. The output of the helicals is applied to the mixer circuit through T2 on the mixer board.

The multiplier output is metered at J605-7 through a metering network on the IF-Filter board. The metering network consists of L505, L506, C512, C513, C514, CR501 and R506.

IF-FILTER

CRYSTAL FILTER

The output of A303-Q1 is coupled through a tuned circuit (L501 and C501) which matches the output to the input of the four-pole monolithic crystal filter. The highly-selective crystal filter (FL501 and FL502) provides the first portion of the receiver IF selectivity. The output of the filter is coupled through impedance-matching network L505 and C511 to the IF amplifier.

Service Note: Variable capacitor C504 does not require adjustment when performing normal alignment. If the four-pole monolithic crystal filter is replaced, then adjustment of C504 is necessary for optimum IF response.

IF AMPLIFIER

IF Amplifier Q501 is a dual-gate FET. The filter output is applied to Gate 1 of the amplifier, and the output is taken from the drain. The biasing on Gate 2 and the drain load determines the gain of the stage. The amplifier provides approximately 20 dB of IF gain. The output of Q501 is coupled through a network (L504 and C509) that matches the amplifier output to the crystal filter on the IFAS board. The output of the IF-Filter board is applied to the IFAS board through feed-through capacitor C325.

Supply voltage for the RF amplifier and IF-Filter board is supplied from the IFAS board through feed-through capacitor C326.

IF-AUDIO & SQUELCH

CRYSTAL FILTERS, IF AMP & LIMITER

IF from the MIF board is applied to a second four-pole monolithic crystal filter (FL601 and FL602) for additional selectivity. The filter output is coupled through matching network L601, C602 and C603 to the IF amplifier IC(U601). The amplifier IC provides approximately 60 dB IF gain.

Following U601 are matching network L602 and C607 and two-pole crystal filter FL603 which provides the final receiver selectivity. The filter output is coupled through matching network L603, C611 and C612 to the limiter IC (U602). The limiter IC provides approximately 60 dB of IF gain. The IF amplifier output is metered at J601-1 through metering network C613, C614, L604 and CR601.

Service Note: Variable capacitors C601, C603, C607 and C612 do not require adjustment when performing normal alignment. If the 4-pole crystal filter or the 2-pole crystal filter is replaced, then adjustment of the associated capacitors will be necessary to achieve optimum IF response.

DISCRIMINATOR & AUDIO PRE-AMP

The limiter output is applied to a Foster-Seely crystal discriminator where diodes CR602 and CR603 recover the audio. L605 is adjusted for zero discriminator reading. The discriminator is metered at J601-2 through R616.

The discriminator output is coupled through potentiometer R614 which is adjusted to set the audio level to the audio pre-amp IC (U602). The pre-amp provides approximately 26 dB of audio gain.

Service Note: R614 does not normally require adjustment unless U602 or parts of the discriminator are replaced. If adjustment should be required, set R614 for one Volt RMS measured at P904-11 with a 1000 microvolt signal with 1 kHz modulation and 3 kHz deviation applied to the antenna jack.

The output of the audio pre-amp is coupled through a low-pass filter (L607 and C636) to VOLUME and SQUELCH control high. The filter removes any IF signal remaining in the audio output of the pre-amp.

AUDIO IC

The hybrid audio IC (U604) uses a custom flip-chip monolithic integrated circuit. The audio IC contains a standard EIA Channel Guard tone reject filter, a receiver de-emphases circuit, and the low level audio PA drive circuitry.

Audio from the pre-amp is coupled through the VOLUME control to pin 4 of the audio IC from P904-13 (VOL ARM). Audio at pin 4 is applied to the Channel Guard tone reject circuit, and then to the 6 dB/octave de-emphasis circuit. The filter output through C635 to the differential audio driver circuit. The output of the audio driver circuit is DC-coupled to the push-pull, Class AB audio PA transistors, Q601 and Q602. The PA output is coupled through audio transformer T601 to provide a low distortion, 12-Watt output to the 8-ohm loudspeaker. R619 and C637 in the transformer secondary protects the PA transistors against a "no-load" or open circuit. Feedback from windings T601-3 and -4 determines the gain of the audio driver amplifier.

When the receiver is squelched, pin 1 of audio IC U604 is near A-, and the entire audio circuit is turned OFF to eliminate current drain. Pin 1 is also connected to the system board through P904-7 (RX MUTE) so that the receiver audio can be disabled by the time delay circuit in the 10-Volt regulator, and by the Channel Guard option when used.

Pins 6 and 7 are connected to the system board through P904-16 (RX PA) and P904-21 (INTCM INPUT) so that the receiver audio stages can be used to provide an audio output when the radio is equipped with the Intercom option.

Pin 2 is connected to the system board through P904-6 (SQ DISABLE) so that the receiver audio stages can be independently activated and used to provide an alert tone output when the radio is equipped with the Carrier Controlled Timer option.

SQUELCH IC

The hybrid squelch IC (U603) also uses a custom flip-chip monolithic integrated circuit. The squelch IC contains the noise amplifier, active noise filter, detector, slow and fast squelch circuits as well as the receiver unsquelched sensor (RUS) switch, and carrier activity sensor (CAS) switch.

Noise Amp, Filter & Active Detector

Noise from the discriminator is coupled through the SQUELCH control to pins 1 and 2 on the squelch IC. This signal is applied to the noise amplifier and then to the active filter circuit.

The noise amp and active filter provide the gain and selectivity to distinguish between noise and audio. The filter output drives the active detector circuit to provide the squelch switching functions. Thermistor RT601 keeps the input to the active detector constant over wide variations in temperature.

Slow & Fast Squelch

With a signal below the 20 dB quieting level, the slow squelch circuit provides a conventional slow (200 millisecond) squelch operation to prevent rapid squelch opening and closing in weak signal areas.

A signal at or above the 20 dB quieting level is sensed by the signal level detector and activates the fast squelch circuit, providing a fast (10 millisecond) squelch operation.

The squelch circuits have two outputs. One output controls the squelch switch and the other output controls the CAS switch.

Squelch Switch

The squelch switch output at pin 7 is connected to pin 1 of the audio IC. When the receiver is squelched, the output pin at 7 is near A-. This keeps the receiver audio stages turned off, muting the receiver. When the receiver is quieted by an on-frequency signal (unsquelches), the voltage at pin 7 rises to approximately +10 Volts. This turns on the audio stages and sound is heard at the speaker.

With the receiver unsquelched, the output of the squelch switch turns on the RUS switch. The output of the RUS switch is connected to the noise amplifier, providing a hysteresis loop in the squelch circuit. The RUS output increases the gain of the noise amplifier, preventing squelch closing on weak signals. The RUS output at pin 8 is also connected to the system board through P904-8 for special applications.

NOTE

In Channel Guard radios, the RUS switch will operate only when an on-frequency signal with the correct Channel Guard tone is applied to the receiver.

CAS Switch

The squelch circuits also drive the CAS switch. When the receiver unsquelches, the voltage at pin 6 rises to approximately 10 Volts. This voltage is connected to the system board through P904-9, and is used to turn on an optional Channel busy light on the control Unit.

NOTE

The CAS switch will operate whenever an on-frequency signal is received, with or without a correct Channel Guard tone.

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 4).

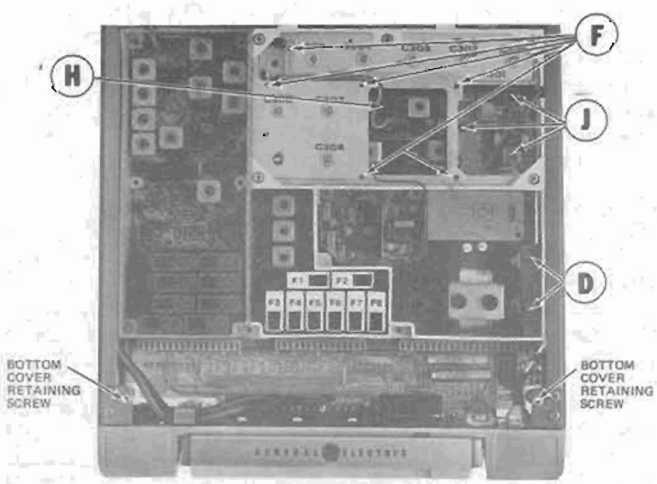

Figure 4 Disassembly Procedure (Top View)

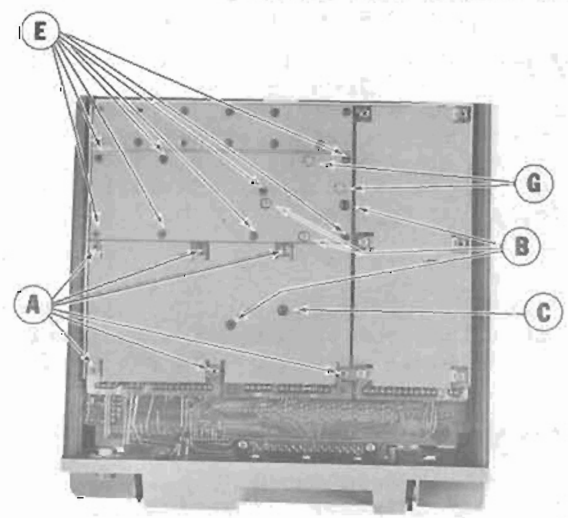

Figure 5 Disassembly Procedure (Bottom View)

3. To gain access to the bottom of the Osc/Mult and IFAS board, remove the six screws A holding the receiver bottom cover (see Figure 5).

To remove the Osc/Mult board from the radio:

1. Remove the six screws Ⓐ holding the receiver bottom cover.
2. Remove the eight screws Ⓔ holding the IF-Filter bottom cover.
3. Remove the four screws Ⓑ 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.

To remove the IFAS board from the radio:

1. Remove the six screws Ⓐ holding the bottom cover, and the one screw Ⓒ holding the board.
2. Remove the two screws Ⓓ holding the audio PA heatsink to the right side rail.
3. 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.

To remove the IF-Filter board from the radio:

1. Remove the eight screws Ⓔ holding the IF-Filter bottom cover.
2. Remove the six screws Ⓕ holding the IF-Filter top cover.
3. Remove the two screws Ⓖ and the Connector Ⓗ, and carefully push down on the top of the board to avoid damaging the feedthrough capacitors.

To remove the optional UHS pre-amplifier board:

1. Remove the eight screws Ⓔ holding the IF-Filter bottom cover, and the six screws Ⓕ holding the IF-Filter top cover.
2. Disconnect the two connectors and 10-Volt lead Ⓙ.
3. Remove the three screws on the bottom side of the board, and lift out the board.

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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 406-512 MHz signal source.

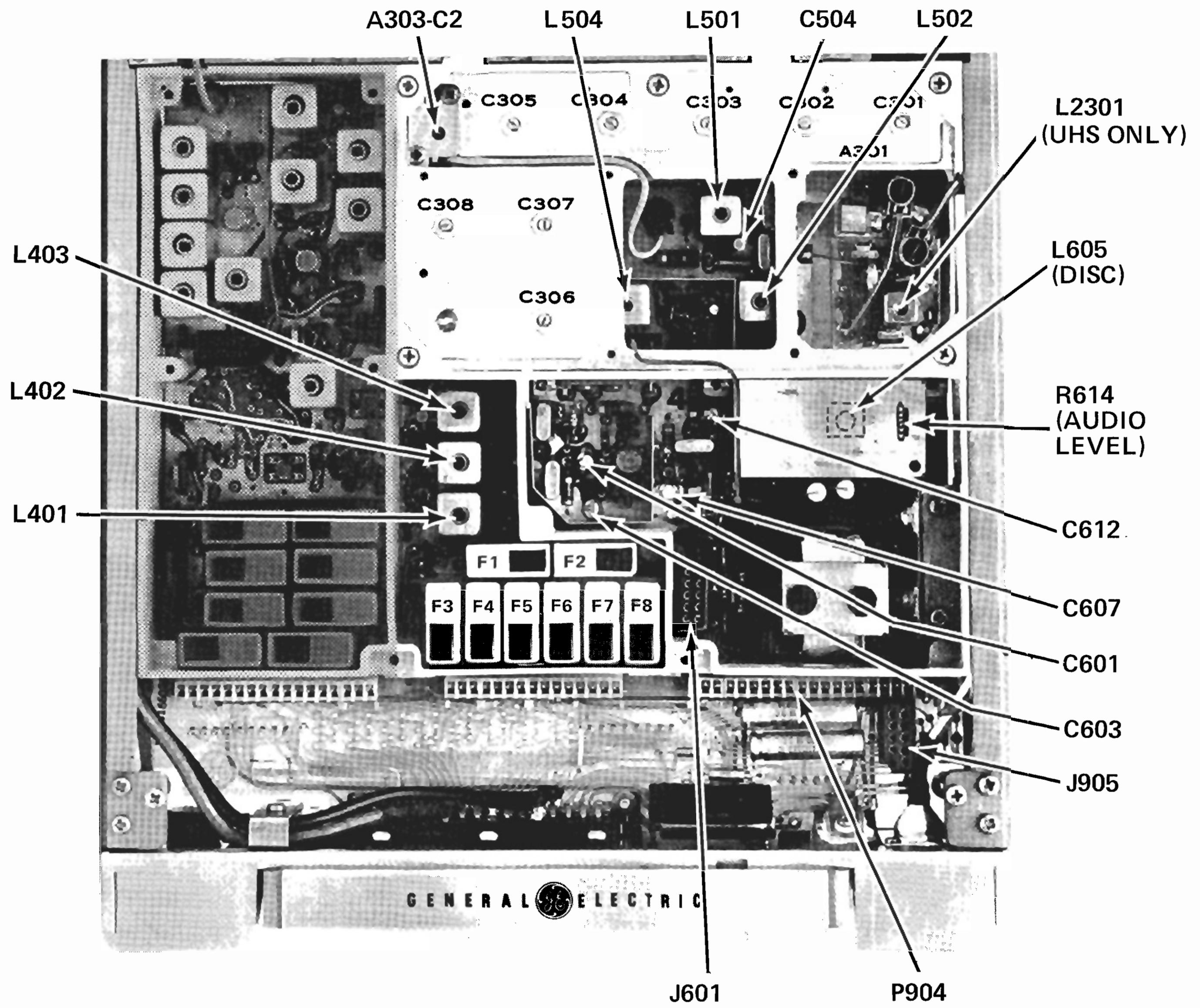
PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect black plug from Test Set to Receiver Centralized Metering Jack J601, and red plug to system board metering jack J905. Set 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 ICOM. 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 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 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 (MULTI-1)	Pin 3	L401	Maximum	Tune L401 for maximum meter reading.
2.	D (MULTI-2)	Pin 4	L402, L403, C306	See Procedure	Tune L402 and L403 for maximum meter reading. Then carefully tune C306 for a change in meter reading.
3.	F (MULTI-3)	Pin 1	C307, C306, C308	See Procedure	Tune C307 for maximum meter reading then C308 for a dip. Next, tune C306 and C307 for maximum meter reading. Then tune C308 for a dip in meter reading.
			RF SELECTIVITY		
4.	A (DISC)	Pin 2		Zero	Apply an on-frequency signal to the antenna jack. Adjust the signal generator for discriminator zero.
5.	B (IF AMP)	Pin 1	A303-C2, C301 thru C305 (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune A303-C2 and C301 through C305 for maximum meter reading. In receivers with the UHS pre-amplifier, also tune L-2301 for maximum meter reading.
6.	B (IF AMP)	Pin 1	A303-C2, C301 thru C305 (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune A303-C2, C301 through C305 (and L2301 if present) for best quieting sensitivity.



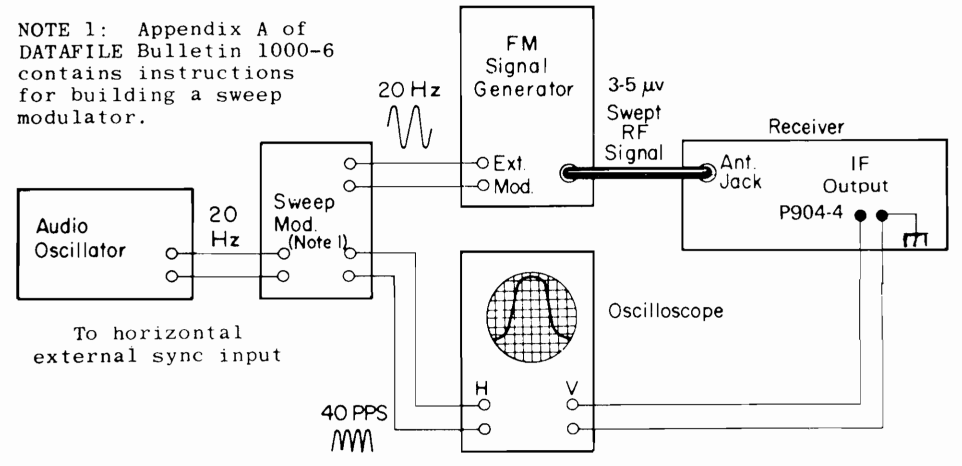


Figure 6 - Test Setup for 20-Hz Double-Trace Sweep Alignment

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 C415 and C417 on the Oscillator/Multiplier Board. The frequency measured at this point is 9 times the ICOM frequency (one-third of mixer injection 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 C415 and C417 on the Oscillator/Multiplier Board. The frequency monitored at this point is 9 times the ICOM frequency (one-third of the mixer injection 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 junction of C612 and L603 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 "beat 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 receivers input), as a function of actual temperature, by the frequency error factor (in PPM) shown in Figure 7.

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 Discriminator DC output (Meter Position A of the Test Set) is provided for routine test and measurement only. The limited resolution available (0.025 V per kHz as measured with 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 measured frequency (ICOM FREQ. X9).

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 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 7.

B. To hold setting error to ±0.35 PPM (which is considered reasonable to 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 7.

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 measured frequency of 150 MHz, adjust the oscillator for a corrected 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 measured frequency.

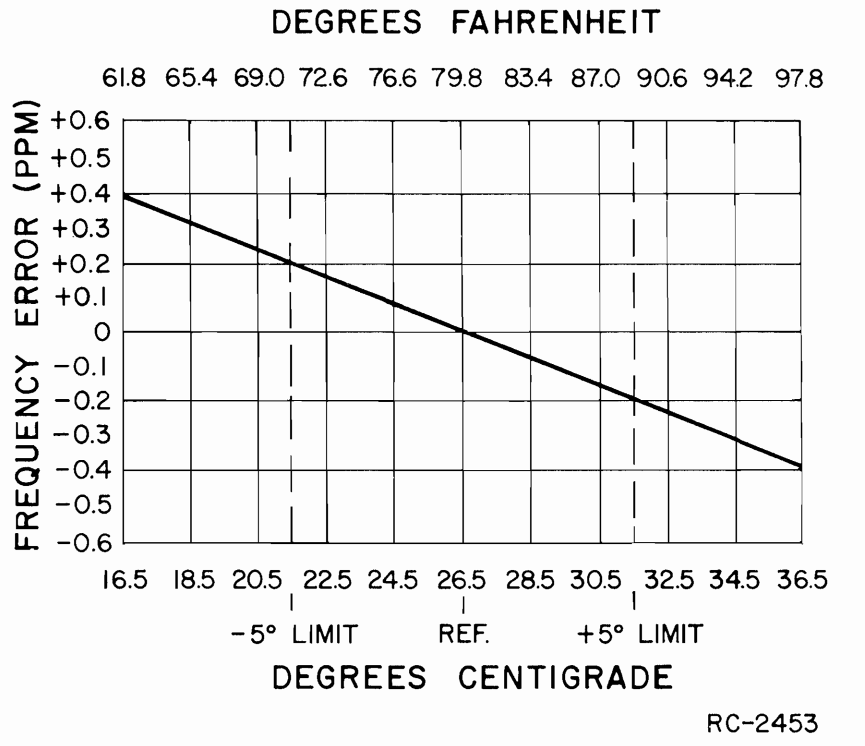


Figure 7 - Frequency Characteristics Vs. Temperature

COMPLETE RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

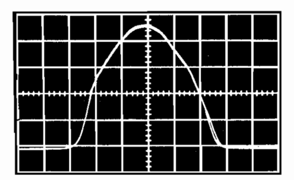
1. GE Test Models 4EX3A11, 4EX8K12 (or 20,000 ohms-per-Volt Multimeter with a 1-Volt scale.)
2. An 11.2 MHz signal source (GE Test Set Model 4EX9A10). Also a 406-512 MHz signal source (Measurements 803) with a one-inch piece of insulated wire no larger than .065 inch diameter connected to generator probe.
3. A VTVM.

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 meter sensitivity switch to the Test 1 (or 1-Volt position on the 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 ICOM. 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 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
			DISCRIMINATOR		
1.	A (DISC)	Pin 2	L605	Zero	Apply the correct IF signal between J624 and A-, and tune L605 for zero meter reading.
2.	A (DISC)	Pin 2	R614	1 Volt RMS	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. Set R614 for 1 Volt RMS measured with a VTVM at P904-11 (VOL/SQ HI) and P904-17 (A-).
3.	C (MULT-1)	Pin 3	L401	Maximum	Re-connect the Test set metering plug to J601. Tune L401 for meter reading.
4.	D (MULT-2)	Pin 4	L402, L403 and C306	See Procedure	Tune L402 and L403 for maximum meter reading. Then carefully tune C306 for a change in meter reading.
5.	F (MULT-3)	Pin 1	C306, C307 and C308	See Procedure	Tune C307 for maximum meter reading, then C308 for a dip. Next, tune C306 and C307 for maximum meter reading, then tune C308 for a dip in meter reading.
			RF SELECTIVITY		
6.	A (DISC)	Pin 2		Zero	Apply an on-frequency signal in the hole adjacent to C304. Adjust the signal generator for discriminator zero.
7.	B (IF AMP)	Pin 1	C305 and C304	Maximum	Apply an on-frequency signal in the hole adjacent to C304, keeping the signal below saturation. Then turne C305 and then C304 for maximum meter reading.
8.	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 then C303 for maximum meter reading.
9.	B (IF AMP)	Pin 1	C303 and C302	Maximum	Appy 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.
10.	B (IF AMP)	Pin 1	C302 and C301	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune C302 and C301 for maximum meter reading.
11.	B (IF AMP)	Pin 1	A303-C2, C301 thru C305 (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune A303-C2 and C301 through C305 for maximum meter reading. In receivers with the UHS preamplifier, also tune L2301 for maximum meter reading.
12.	B (IF AMP)	Pin 1	A303-C2, C301 thru C305 (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune A303-C2, C301 through C305 (and L2301 if present) for best quieting sensitivity.
			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 if required.				
13.			L501, L503, L504, C504, C601, C603, C607 and C612		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 P904-4 (or J601-1) and A-, tune L501, L503, L504, C504, C601, C603, C607 and C612 for double trace as shown on scope pattern.
14.	A	Pin 2		See Procedure	Check to see that discriminator idling voltage is within ±.05 Volt of zero with no signal applied. Check to see that modulation acceptance bandwidth is greater than ±7 kHz.

TEST PROCEDURES

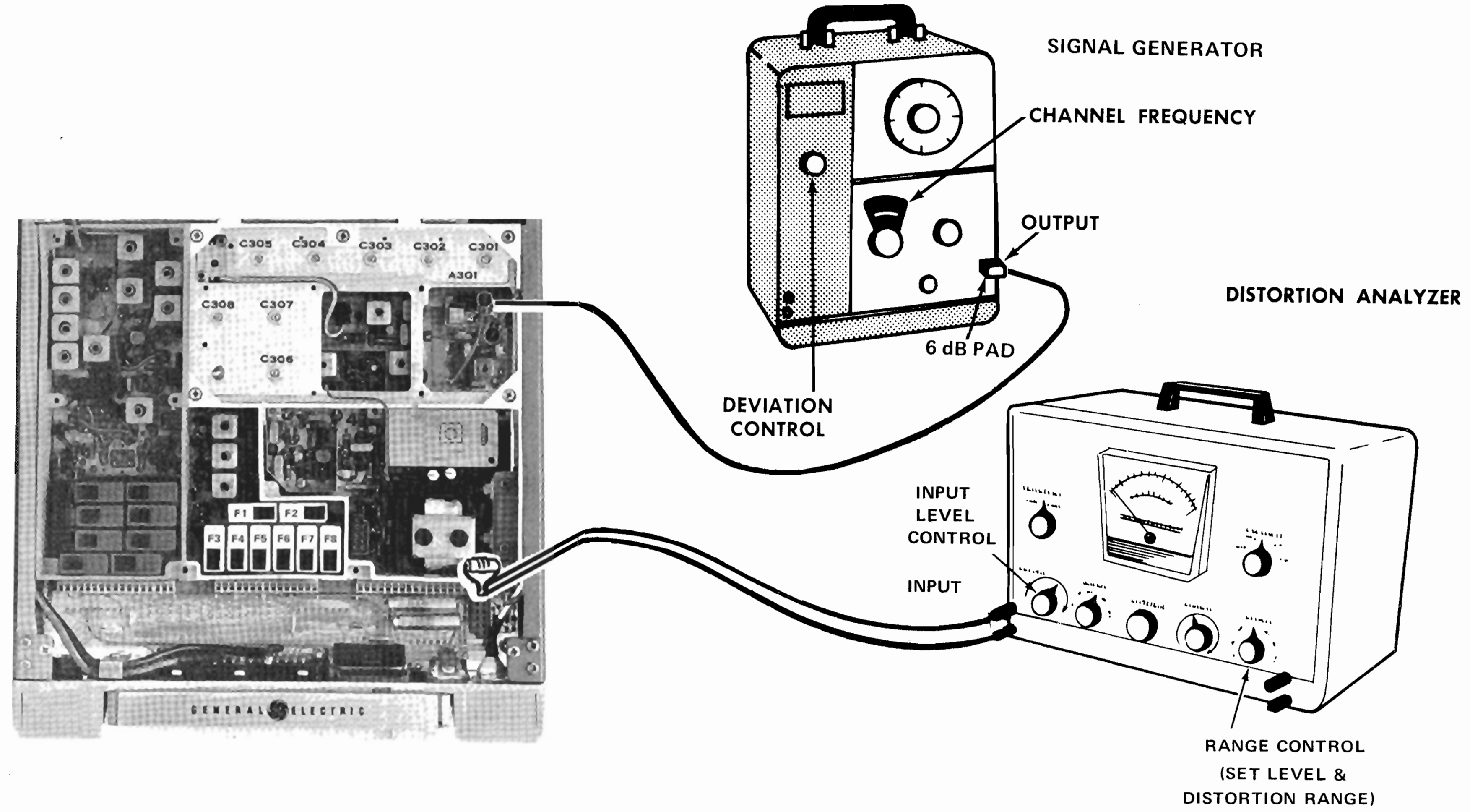
These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect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

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 output 9.8 VRMS using the Distortion Analyzer as a VTVM.

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. Discriminator 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 3.0-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 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 BANDWITH (IF BANDWITH)

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.

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-Microvolts Unmodulated
A (Disc Idling)	Less than ±.05 VDC	
B (IF Amp)		0.2 VDC
C (Mult-1)	0.2 VDC	
D (Mult-2)	0.6 VDC	
F (Mult-3)	0.3 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 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 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 chain (Q401, Q402, Q403).
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. • Replace IC circuit U603.
LOW OR DISTORTED AUDIO	• Check voltages on Schematic Diagram. • Make gain and waveform checks. • Check receiver and alignment and discriminator output. • Check Q601, Q602 and other discrete components. • Replace IC circuit U604.
DISCRIMINATOR IDLING TOO FAR OFF ZERO	• See if discriminator zero is in center of IF bandpass.

STEP 4-VOLTAGE RATIO READINGS

EQUIPMENT REQUIRED:

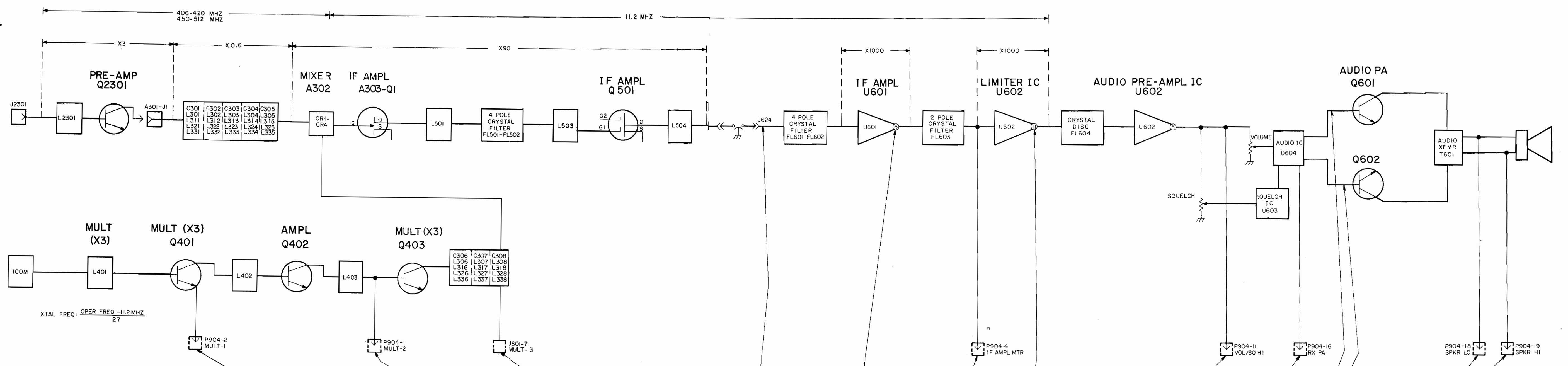
1. RF VOLTMETER (SIMILAR TO BOONTON MODEL 91-CA OR MILLIVAC TYPE MV-18 C.
2. SIGNAL ON RECEIVER FREQUENCY (BELOW SATURATION). CORRECT FREQUENCY CAN BE DETERMINED BY ZEROING THE DISCRIMINATOR. USE 1,000 HERTZ SIGNAL WITH 3.0 KHz DEVIATION.

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.



STEP 2-SIMPLIFIED GAIN CHECKS

EQUIPMENT REQUIRED:

1. VTVM - AC & DC
2. SIGNAL GENERATOR (MEASUREMENTS 803 OR EQUIVALENT).
3. RF VOLTMETER

PRELIMINARY STEPS:

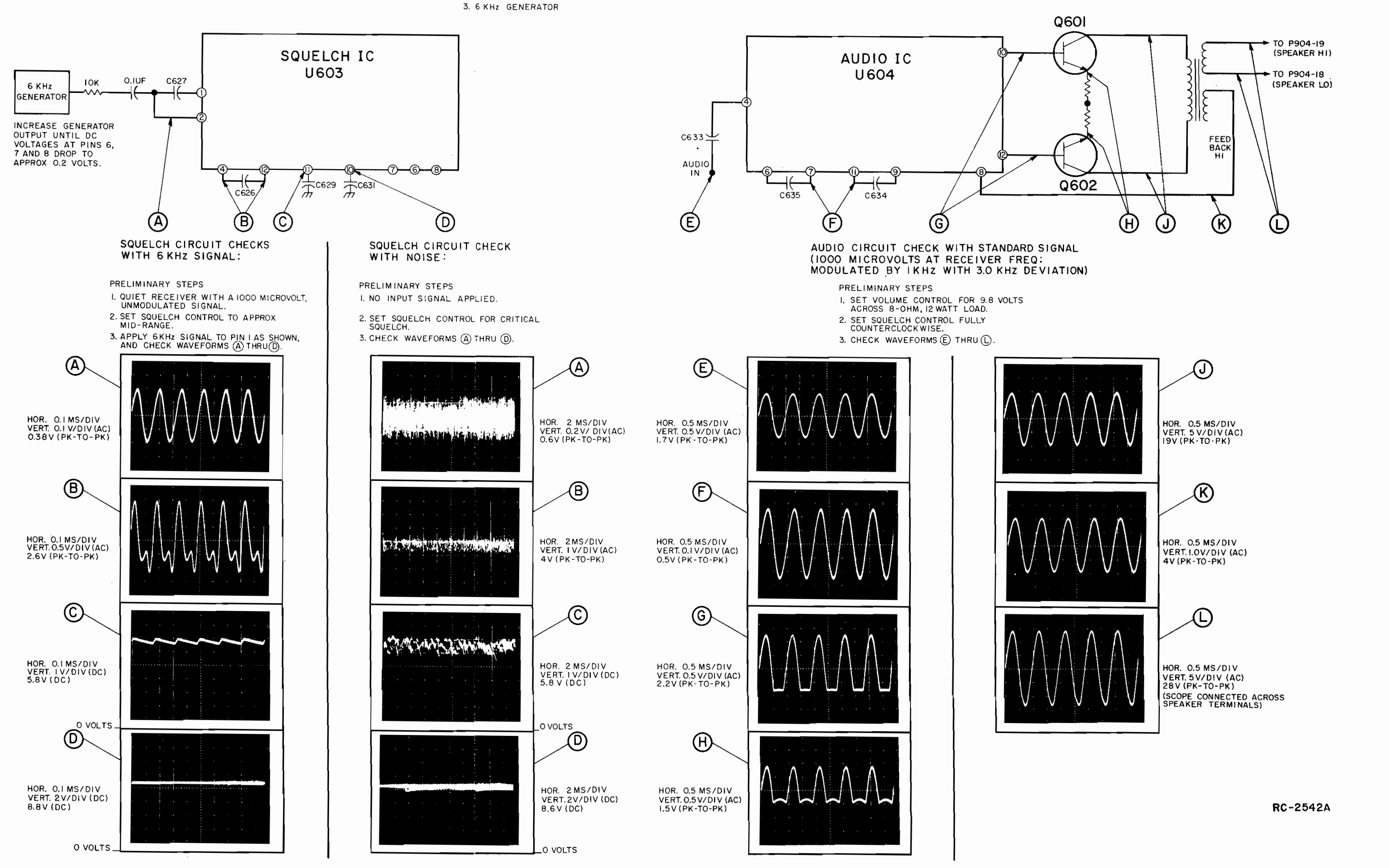
1. SET VOLUME CONTROL FOR 9.8 VOLTS ACROSS 8.0-OHM LOAD. IF THIS CANNOT BE OBTAINED, SET TO APPROX. 70% OF MAX. ROTATION.
2. SET SQUELCH CONTROL FULLY COUNTERCLOCKWISE.
3. RECEIVER SHOULD BE PROPERLY ALIGNED.
4. CONNECT METER BETWEEN A- AND POINTS INDICATED BY ARROW.

SIGNAL GENERATOR INPUT AT A301-J1 MAINTAIN SETTING AT DISCRIMINATOR ZERO				UNMODULATED	UNMODULATED	UNMODULATED	NO SIGNAL INPUT	STANDARD SIGNAL (1 MILLIVOLT AT RECEIVER FREQ MODULATED BY 1 KHz WITH 3.3 KHz DEVIATION)	STANDARD SIGNAL	STANDARD SIGNAL	STANDARD SIGNAL
PROCEDURE				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 10 MICROVOLTS	SHOULD BE IN SATURATION AT ALL TIMES				WITH SPEAKER DISCONNECTED, CONNECT VTVM OR SCOPE ACROSS 8-OHM LOAD CONNECTED BETWEEN P904-18 AND P904-19
READING	VTVM READING SHOULD BE APPROX 0.25 VDC	VTVM READING SHOULD BE APPROX 1.5 VDC	VTVM READING SHOULD BE APPROX 0.5 VDC	RF VOLTMETER READING SHOULD BE APPROX 150 MILLIVOLTS	GENERATOR OUTPUT SHOULD BE APPROX 10 MICROVOLTS	VTVM READING SHOULD BE APPROX 0.7 VDC	RF VOLTMETER READING SHOULD BE APPROX 0.6V RMS	VTVM READING SHOULD BE APPROX 1.0 VAC	VTVM READING SHOULD BE APPROX 0.18 VAC	VTVM READING SHOULD BE APPROX 6.7 VAC	9.8 VAC

STEP 3-AUDIO & SQUELCH WAVEFORMS

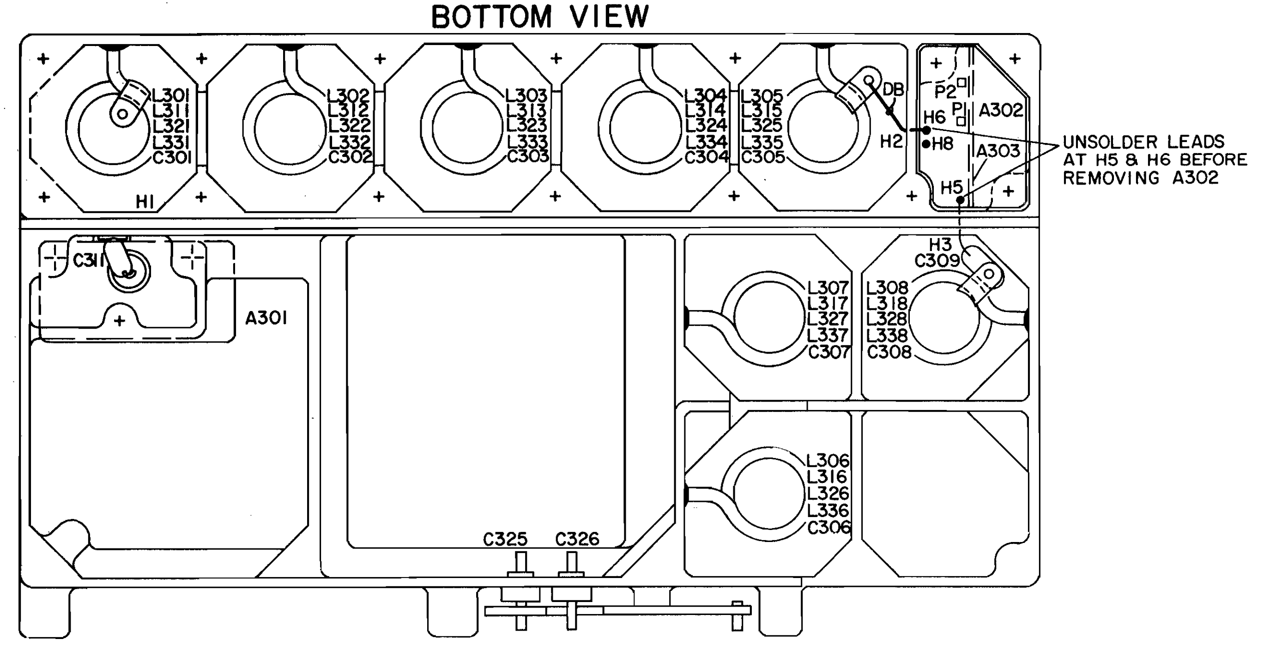
EQUIPMENT REQUIRED:

1. OSCILLOSCOPE CONNECTED BETWEEN A- AND POINTS INDICATED BY ARROW.
2. SIGNAL GENERATOR (MEASUREMENTS M803 OR EQUIVALENT.
3. 6 KHz GENERATOR

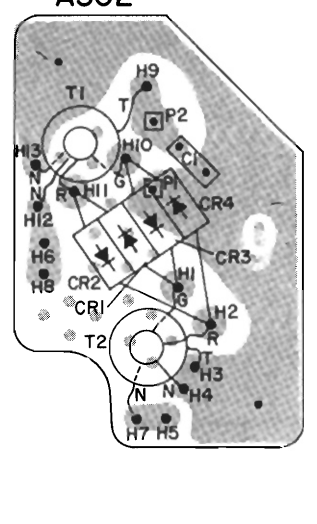


RC-2542A

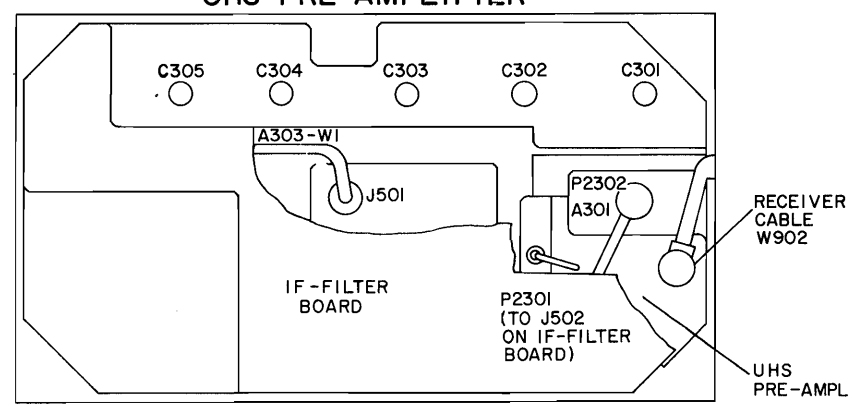
RF ASSEMBLY BOTTOM VIEW



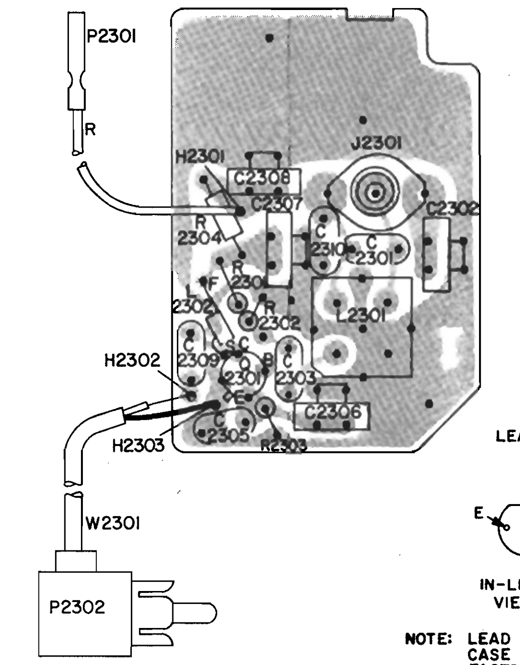
MIXER BOARD A302

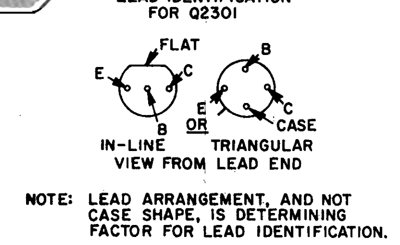


RECEIVER WITH UHS PRE-AMPLIFIER



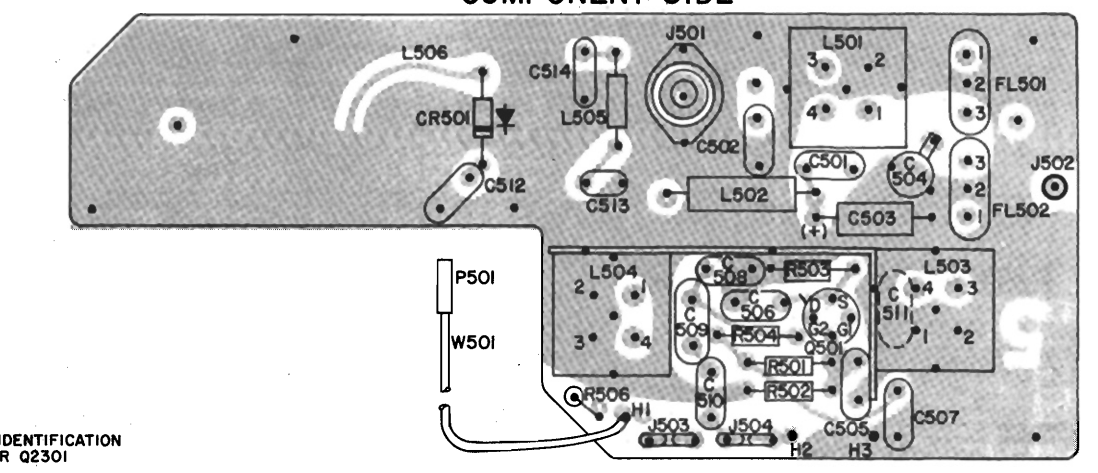
UHS PRE-AMPLIFIER





IF-FILTER BOARD

COMPONENT SIDE



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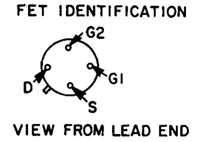
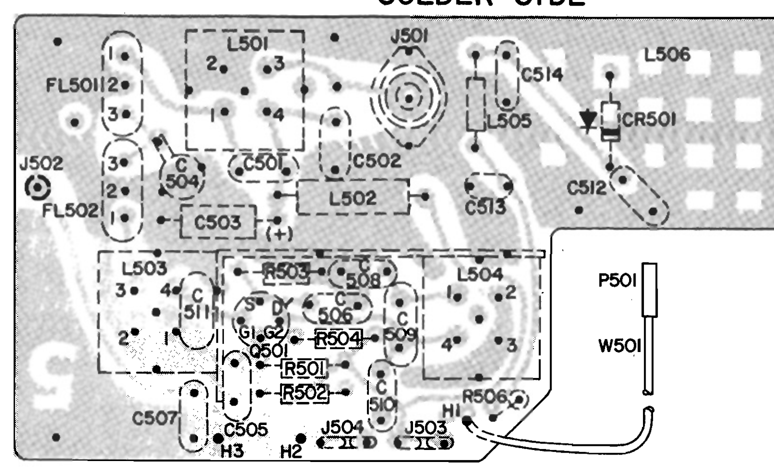
(19C320522, Sh. 3, Rev. 3)



SOLDER SIDE



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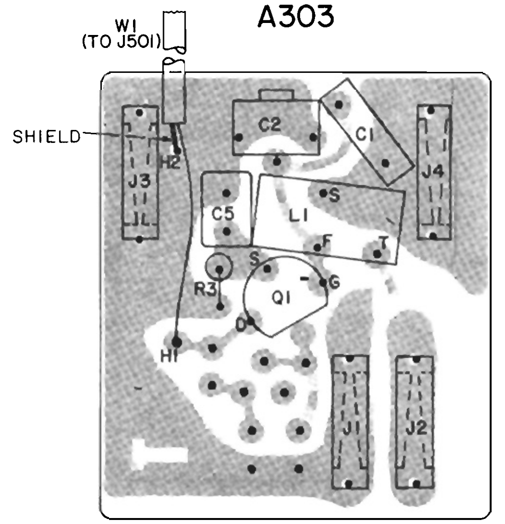
IF-AMPL BOARD A303



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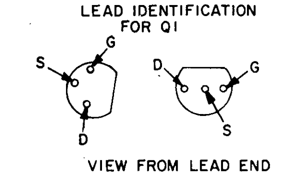
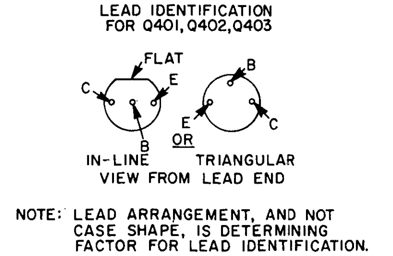
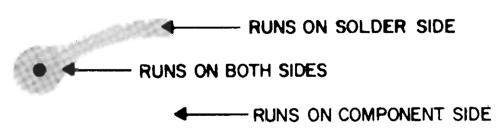
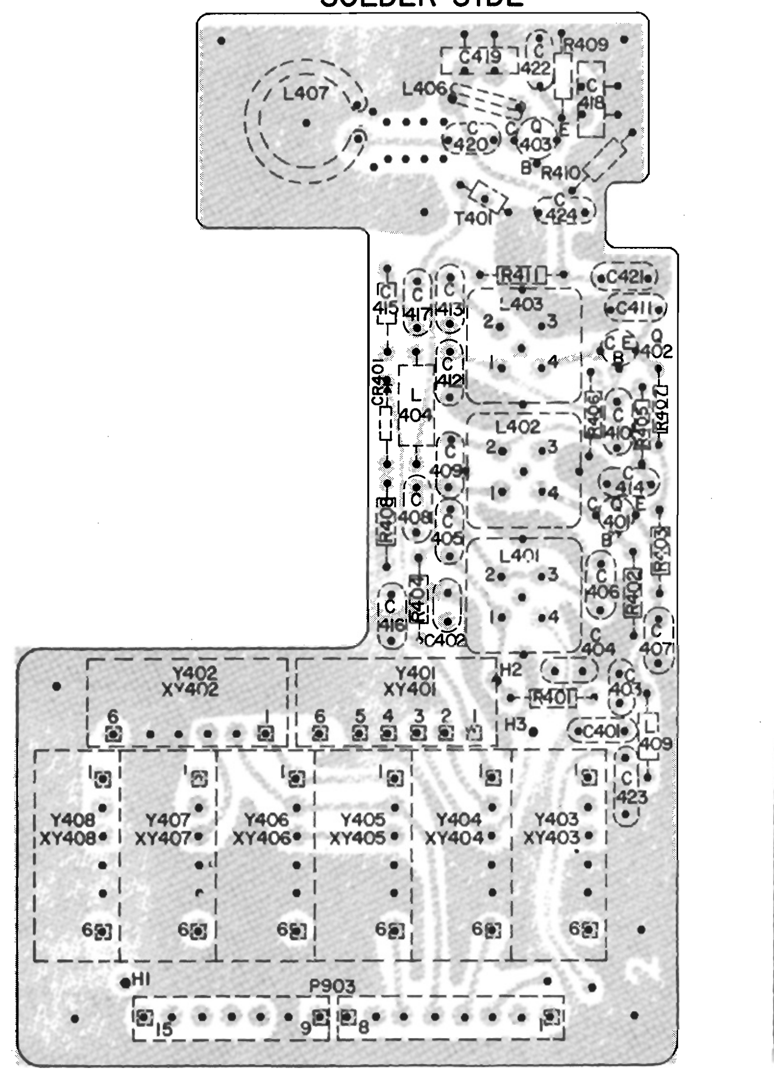




OSC/MULT BOARD

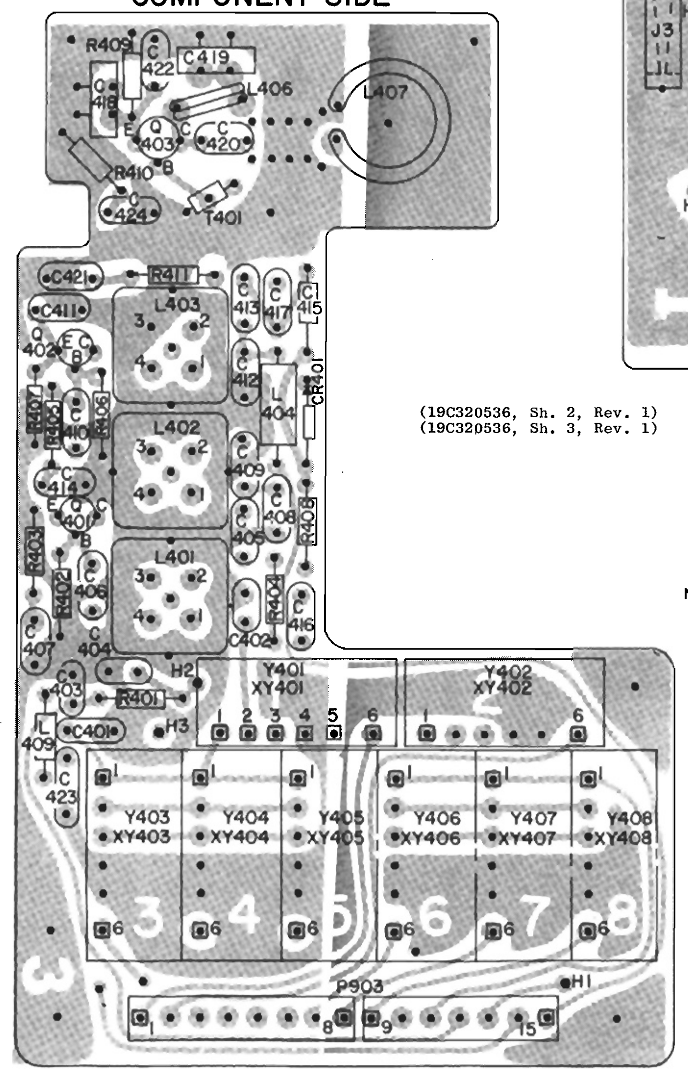


SOLDER SIDE



(19D417071, Sh. 2, Rev. 2)

COMPONENT SIDE



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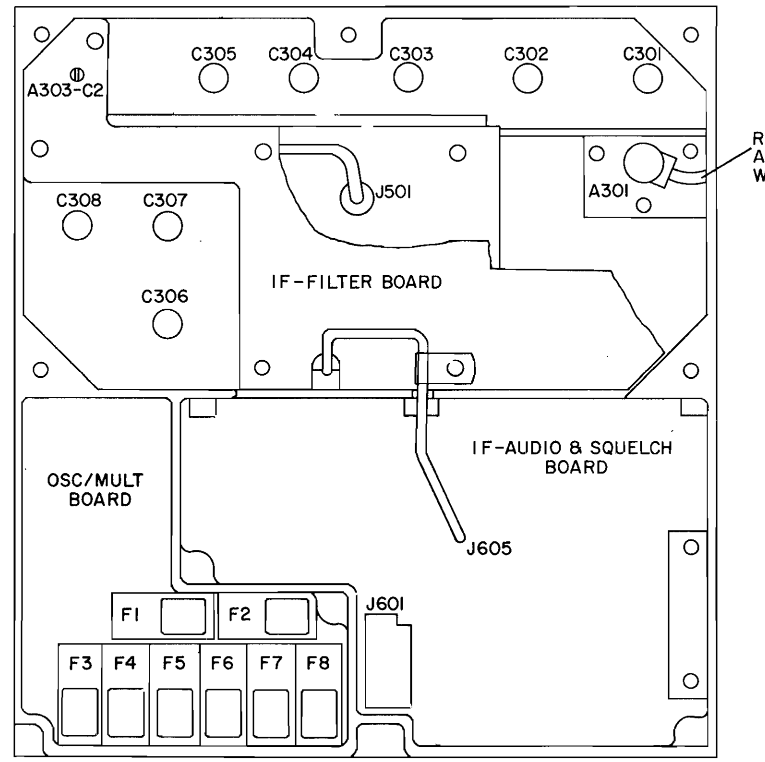
STANDARD RECEIVER



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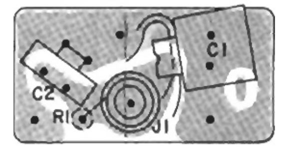
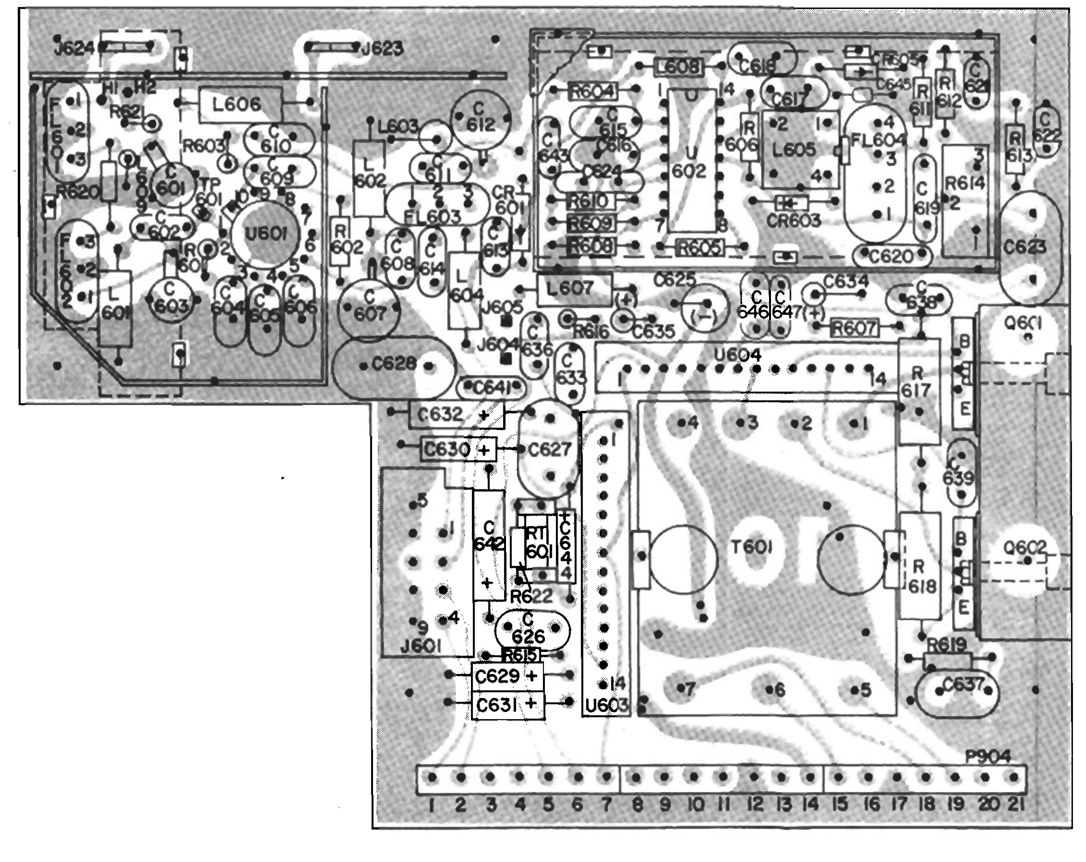
A301 ANT INPUT



IF/AUDIO & SQUELCH BOARD

COMPONENT SIDE



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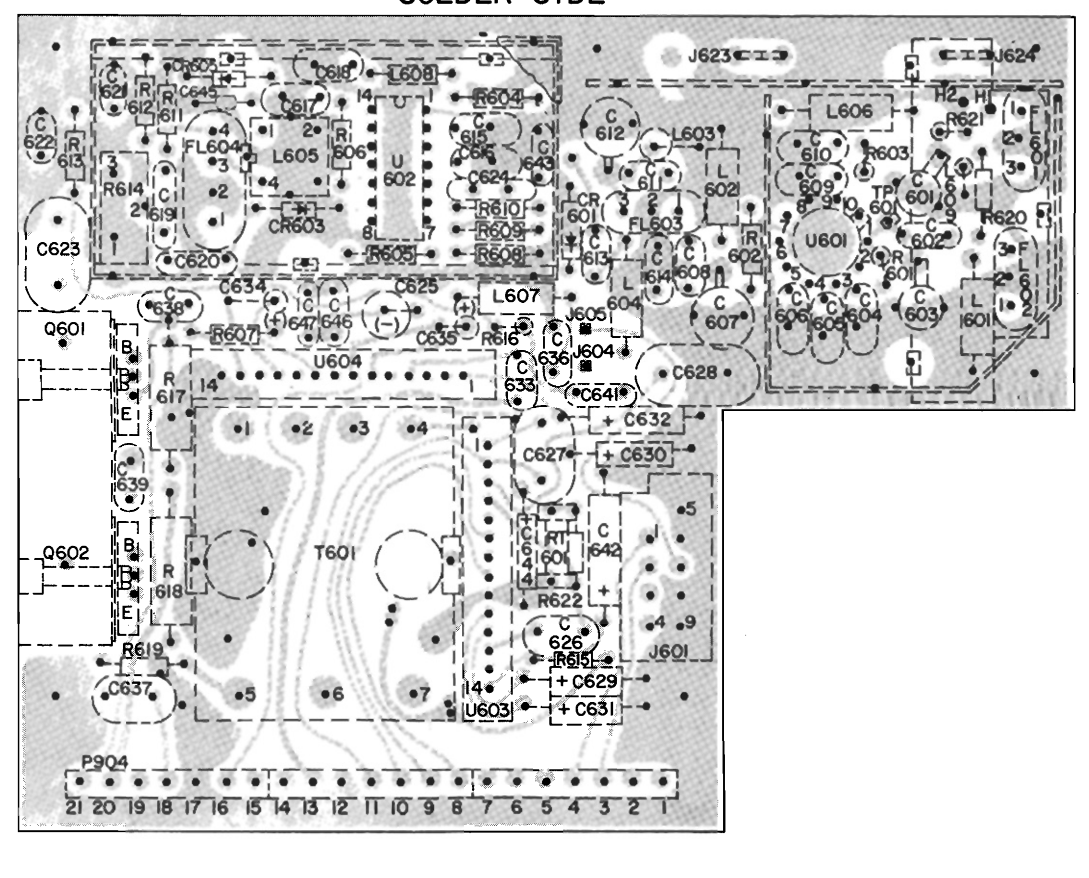
(19C320184, Sh. 2, Rev. 10)

SOLDER SIDE



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OUTLINE DIAGRAM

406—512 MHz MASTR RECEIVER

PARTS LIST

LBI-4621C

406-420, 450-512 MHz RECEIVER RF ASSEMBLY, IF-FILTER BOARD ASSEMBLY, OSCILLATOR-MULTIPLIER AND UHS PRE-AMPLIFIER

SYMBOL	GE PART NO.	DESCRIPTION
		RF ASSEMBLY 19D417075G1-G4
A301		ANTENNA INPUT BOARD 19B219942G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	7484398P3	Silver mica: 250 pf ±10%, 500 VDCW; sim to Underwood Type J1HF.
C2	19A116679P220K	Mica: 220 pf ±10%, 250 VDCW.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1	7104941P16	Connector, phono: Jack; sim to National Tel.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R152P472K	Composition: 4700 ohms ±10%, 1/4 w.
A302		**MIXER BOARD** 19C320535G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P2038	Ceramic: 18 pf ±5%, 100 VDCW; temp coef -80 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 thru CR4	19A116052P3	Silicon.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P1 and P2	19A116779P1	Contact, electrical: sim to Molex 08-54-0404.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T1	19A129716G3	Coil.
T2	19A129716G2	Coil.
A303		**IF AMPLIFIER BOARD** 19C320537G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116114P2066	Ceramic: 110 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2	19A116710P15	Variable: 6.2 to 22 pf, 50 VDCW; sim to Erie 511-002.
C3* and C4*	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R. Deleted by REV A.
C5	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J1 thru J4	19A116428P3	Contact, electrical: sim to AMP 85487-3 (Strip Form).
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19B204403G3	Coil, toroidal.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1*	19A116154P1	N Channel, field effect.
		Earlier than REV A:
	19A116818P1	N Channel, field effect.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1*	3R151P103K	Composition: 10,000 ohms ±10%, 1/8 w. Deleted by REV A.
R2*	3R151P822J	Composition: 8200 ohms ±5%, 1/8 w. Deleted by REV A.
R3*	3R151P221J	Composition: 220 ohms ±5%, 1/8 w.
		Earlier than REV A:
	3R151P470K	Composition: 47 ohms ±10%, 1/8 w.
R4*	3R151P103K	Composition: 10,000 ohms ±10%, 1/8 w. Deleted by REV A.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1	5491689P114	RF: approx 5-1/8 inches long.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C301 thru C305		Includes:
	4036765G11	Screw.
	7137968P8	Nut, stamped: thd size No. 6-32; sim to Palnut T0632005.
C306 thru C308		Includes:
	4036765G12	Screw.
	7137968P8	Nut, stamped: thd size No. 6-32; sim to Palnut T0632005.
C309	5496218P34	Ceramic disc: 3.0 pf ±0.25 pf, 500 VDCW, temp coef 0 PPM.
C311	5496218P241	Ceramic disc: 10 pf ±0.25 pf, 500 VDCW, temp coef -80 PPM.
C325	19B209488P1	Ceramic, feed-thru: 6.8 pf ±20%, 500 VDCW; sim to Allen-Bradley Style FA5D.
C326	19B209488P2	Ceramic, feed-thru: 1000 pf +100%-10%, 500 VDCW; sim to Allen-Bradley Style FA5D.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L301	19B204938G37	Coil.
L302 thru L304	19B219944P1	Coil.
L305	19B204938G33	Coil.
L306 and L307	19B219944P5	Coil.
L308	19B204938G41	Coil.
L311	19B204938G38	Coil.
L312 thru L314	19B219944P2	Coil.
L315	19B204938G34	Coil.
L316 and L317	19B219944P6	Coil.
L318	19B204938G42	Coil.
L321	19B204938G39	Coil.
L322 thru L324	19B219944P3	Coil.
L325	19B204938G35	Coil.
L326 and L327	19B219944P7	Coil.
L328	19B204938G43	Coil.
L331	19B204938G40	Coil.
L332 thru L334	19B219944P4	Coil.
L335	19B204938G36	Coil.
L336 and L337	19B219944P8	Coil.
L338	19B204938G44	Coil.
		IF-FILTER BOARD 19C320523G1
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C501	5490008P39	Silver mica: 330 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C502	19A116080P103	Polyester: 0.022 µf ±10%, 50 VDCW.
C503	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C504	19B209351P1	Variable: 1.7 to 10 pf, 200 VDCW, temp coef +500% -350 PPM; sim to Matshushita ECV-1ZW10P32.
C505 thru C508	19A116080P3	Polyester: 0.022 µf ±20%, 50 VDCW.
C509	5490008P139	Silver mica: 330 pf ±10%, 500 VDCW; sim to Electro Motive Type DM-15.
C510	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C511		(Part of L503).
C512	19A116656P20K0	Ceramic disc: 20 pf ±10%, 500 VDCW, temp coef 0 PPM.
C513	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C514	19A116655P20	Ceramic disc: 1000 pf ±10%, 1000 VDCW; sim to RMC Type JF Discap.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR501	19A116052P1	Silicon.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL501	19B219573G3	Crystal, freq: Pad A: 11,200000 KHz, Pad B: 11,196024.
FL502		(Part of FL501).
		- - - - - - - - JACKS AND RECEPTACLES - - - - -
J501	19A116832P1	Receptacle, coaxial: sim to Cinch 14H11613.
J502	4033513P1	Contact, electrical: sim to Bead Chain L93-4.
J503 and J504	19A116975P1	Receptacle, wire spring.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L501*	19C320141G34	Coil.
		Earlier than REV A:
	19C320141G28	Coil. Includes:
	5493185P9	Tuning slug.
L502	7488079P48	Choke, RF: 27.0 µh ±10%, 1.40 ohms DC res max; sim to Jeffers 4422-9.
L503	19C320141G4	Coil. Includes:
	5493185P9	Tuning slug.
L504	19C320141G29	Coil. Includes:
	5493185P9	Tuning slug.
L505	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L506		(Part of printed board 19C320522P1).
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P501		(Part of W501).
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q501	19A116818P1	N Channel, field effect.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R501	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R502	3R152P392K	Composition: 3900 ohms ±10%, 1/4 w.
R503	3R152P221K	Composition: 220 ohms ±10%, 1/4 w.
R504	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
R506	3R152P222K	Composition: 2200 ohms ±10%, 1/4 w.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W501	19A129947G1	Cable: orange, No. 22 stranded, approx 7 inches, includes (P501).
		OSCILLATOR - MULTIPLIER 19D417072G1 406-420 MHz 2 FREQ (LL) 19D417072G2 450-470 MHz 2 FREQ (L) 19D417072G3 470-494 MHz 2 FREQ (M) 19D417072G4 494-512 MHz 2 FREQ (H) 19D417072G5 406-420 MHz 8 FREQ (LL) 19D417072G6 450-470 MHz 8 FREQ (L) 19D417072G7 470-494 MHz 8 FREQ (M) 19D417072G8 494-512 MHz 8 FREQ (H)
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C401 thru C404	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C405LL	19A116656P18K1	Ceramic disc: 18 pf ±10%, 500 VDCW, temp coef -150 PPM.
C405L	19A116656P15K1	Ceramic disc: 15 pf ±10%, 500 VDCW, temp coef -150 PPM.
C405M	19A116656P12K1	Ceramic disc: 12 pf ±10%, 500 VDCW, temp coef -150 PPM.
C405H	19A116656P10K1	Ceramic disc: 10 pf ±10%, 500 VDCW, temp coef -150 PPM.
C406	19A116656P20K0	Ceramic disc: 20 pf ±10%, 500 VDCW, temp coef 0 PPM.
C407 and C408	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C409LL	19A116656P8K1	Ceramic disc: 8 pf ±10%, 500 VDCW, temp coef -150 PPM.
C409L	19A116656P6K1	Ceramic disc: 6 pf ±10%, 500 VDCW, temp coef -150 PPM.
C409M	19A116656P4K1	Ceramic disc: 4 pf ±10%, 500 VDCW, temp coef -150 PPM.
C409H	19A116656P3K1	Ceramic disc: 3 pf ±10%, 500 VDCW, temp coef -150 PPM.
C410	19A116656P3K0	Ceramic disc: 3 pf ±10%, 500 VDCW, temp coef 0 PPM.
C411 and C412	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C413LL	19A116656P8K1	Ceramic disc: 9 pf ±10%, 500 VDCW, temp coef -150 PPM.
C413L	19A116656P6K1	Ceramic disc: 6 pf ±10%, 500 VDCW, temp coef -150 PPM.
C413M	19A116656P4K1	Ceramic disc: 4 pf ±10%, 500 VDCW, temp coef -150 PPM.
C413H	19A116656P3K1	Ceramic disc: 3 pf ±10%, 500 VDCW, temp coef -150 PPM.
C414	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C415	5491601P117	Phenolic: 0.68 pf ±5%, 500 VDCW.
C416	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C417LL	19A116656P7K0	Ceramic disc: 7 pf ±10%, 500 VDCW, temp coef 0 PPM.
C417L	19A116656P3K0	Ceramic disc: 3 pf ±10%, 500 VDCW, temp coef 0 PPM.
C417M	19A116656P5K0	Ceramic disc: 5 pf ±10%, 500 VDCW, temp coef 0 PPM.
C417H	19A116656P5K0	Ceramic disc: 5 pf ±10%, 500 VDCW, temp coef 0 PPM.
C418 and C419	19A116679P220K	Mica: 220 pf ±10%, 250 VDCW.
C420	19A116656P9K0	Ceramic disc: 9 pf ±10%, 500 VDCW, temp coef 0 PPM.
C421 and C422	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C423	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C424	19A116656P3K0	Ceramic disc: 3 pf ±10%, 500 VDCW, temp coef 0 PPM.
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR401	19A115250P1	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L401	19C320141G17	Coil. Includes:
	5493185P9	Tuning slug.
L402 and L403	19C320141G8	Coil. Includes:
	5493185P9	Tuning slug.
L404	7488079P1	Choke, RF: 0.15 µh ±20%, 0.03 ohms DC res max; sim to Jeffers 4411-1M.
L406	19A129711P1	Coil.
L407	19A129710P1	Coil.
L409	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P903		Includes:
	19B219594P1	Terminal strip: 7 pins.
	19B219594P2	Terminal strip: 8 pins.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q401	19A115991P1	Silicon, NPN.
Q402 and Q403	19A116201P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R401	3R152P561K	Composition: 560 ohms ±10%, 1/4 w.
R402	3R152P392K	Composition: 3900 ohms ±10%, 1/4 w.
R403	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
R404	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
R405	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R406	3R152P392K	Composition: 3900 ohms ±10%, 1/4 w.
R407	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
R408	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R409	3R152P220K	Composition: 22 ohms ±10%, 1/4 w.
R410	3R152P471K	Composition: 470 ohms ±10%, 1/4 w.
R411	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T401	19A129920G1	Coil.
		- - - - - - - - - - - SOCKETS - - - - - - - - - -
XY401 thru XY408	19A116779P1	Contact, electrical: sim to Molex 08-54-0404. (Quantity 6 for each socket).
		- - - - - - - OSCILLATOR MODULES - - - - - - - -
		NOTE: When reordering specify ICOM Frequency. FOR STANDARD LOW SIDE INJECTION FREQUENCY.
		ICOM Freq = $\frac{\text{Operating Freq - 11.2}}{27}$
Y401 thru Y403	19A129393G12	Compensated: ±5 PPM, 406-420 MHz, 450-512 MHz.
	19A129393G8	Externally Compensated: ±5 PPM, 406-420 MHz, 450-512 MHz.
	19A129393G4	Compensated: ±2 PPM, 406-420 MHz, 450-512 MHz.
		NOTE: FOR HIGH SIDE INJECTION FREQUENCY.
		ICOM Freq = $\frac{\text{Operating Freq + 11.2}}{27}$
Y401 thru Y408	19A130283G6	Compensated: ±5 PPM, 406-420 MHz, 450-512 MHz.
	19A130283G4	Externally Compensated: ±5 PPM, 406-512 MHz.
	19A130283G2	Compensated: ±2 PPM, 406-512 MHz.
		UHS RF PRE-AMPLIFIER 19C320527G1 (LL) 19C320527G2 (L) 19C320527G3 (M) 19C320527G4 (H)
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2301	19A116656P3J8	Ceramic disc: 3 pf ±0.1 pf, 500 VDCW, temp coef -80 PPM.
C2302	19A116679P220K	Mica: 220 pf ±10%, 250 VDCW.
C2303	19A116656P18J8	Ceramic disc: 18 pf ±5%, 500 VDCW, temp coef -80 PPM.
C2305	19A116656P20K0	Ceramic disc: 20 pf ±10%, 500 VDCW, temp coef 0 PPM.
C2306	19A116679P100K	Mica: 100 pf ±10%, 250 VDCW.
C2307 and C2308	19A116679P220K	Mica: 220 pf ±10%, 250 VDCW.
C2309	19A116656P30J8	Ceramic disc: 30 pf ±5%, 500 VDCW, temp coef -80 PPM.
C2310	19A116656P20K0	Ceramic disc: 20 pf ±10%, 500 VDCW, temp coef 0 PPM.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J2301	19A116832P1	Receptacle, coaxial: sim to Cinch 14H11613.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L2301LL	19D413078G3	Helical resonator.
L2301L	19D413078G5	Helical resonator.
L2301M	19D413078G6	Helical resonator.
L2301H	19D413078G7	Helical resonator.
L2302	19A129716G1	Coil.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P2301	4029840P2	Contact, electrical: sim to Amp 42827-2.
P2302		(Part of W2301).
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q2301	19A116859P1	Silicon, NPN; sim to Type 2N5032 or 2N3570.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2301	3R152P153K	Composition: 15,000 ohms ±10%, 1/4 w.
R2302	3R152P682K	Composition: 6800 ohms ±10%, 1/4 w.
R2303	3R152P561K	Composition: 560 ohms ±10%, 1/4 w.
R2304	3R152P101K	Composition: 100 ohms ±10%, 1/4 w.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W2301	5491689P94	RF: approx 3 inches long. Includes P2302.
		- - - - - - **MISCELLANEOUS** - - - - - -
	19E501121P1	Casting, RF Circuit.
	19C320455P1	Cover, RF Circuit.
	19B219886P1	Cover. (Located over A303-C2).
	19B209209P304	Tap screw, Phillips Pozidriv©: No. 6-32 x 1/4. (Secures RF Circuit Cover).
	4036765G11	Screw. (Part of C301-C305).
	4036765G12	Screw. (Part of C306-C308).
	7137968P8	Nut, stamped: thd size No. 6-32; sim to Palnut T0632005. (Part of C301-C308).
	19B219470P2	Shield. (Used with IF Filter Board).
	19A129424G1	Can. (Used with L401-L403, L501, L503, L504).
	19A127060P2	Can. (Used with L2301).
	4035306P59	Washer, fiber. (Used with FL501, FL502).
	19A129715G1	Adapter Board. (Carries IF from IF Filter Board to IFAS Board).
		RECEIVER MODIFICATION KIT 19A129750G1 (Used with DUAL FRONT END)
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR2301	19A116925P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2301	3R152P223J	Composition: 22,000 ohms ±5%, 1/4 w.
R2302	3R152P681K	Composition: 680 ohms ±10%, 1/4 w.
		- - - - - - - - - - - CABLES - - - - - - - - - -
W2301	19B219999G2	RF: approx 10-1/2 inches long.
		DUAL FRONT END MODIFICATION KIT 19A129750G2
		- - - - - - - DIODES AND RECTIFIERS - - - - - -
CR2301	19A116925P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R2301	3R152P223J	Composition: 22,000 ohms ±5%, 1/4 w.
R2303	3R152P911J	Composition: 910 ohms ±5%, 1/4 w.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

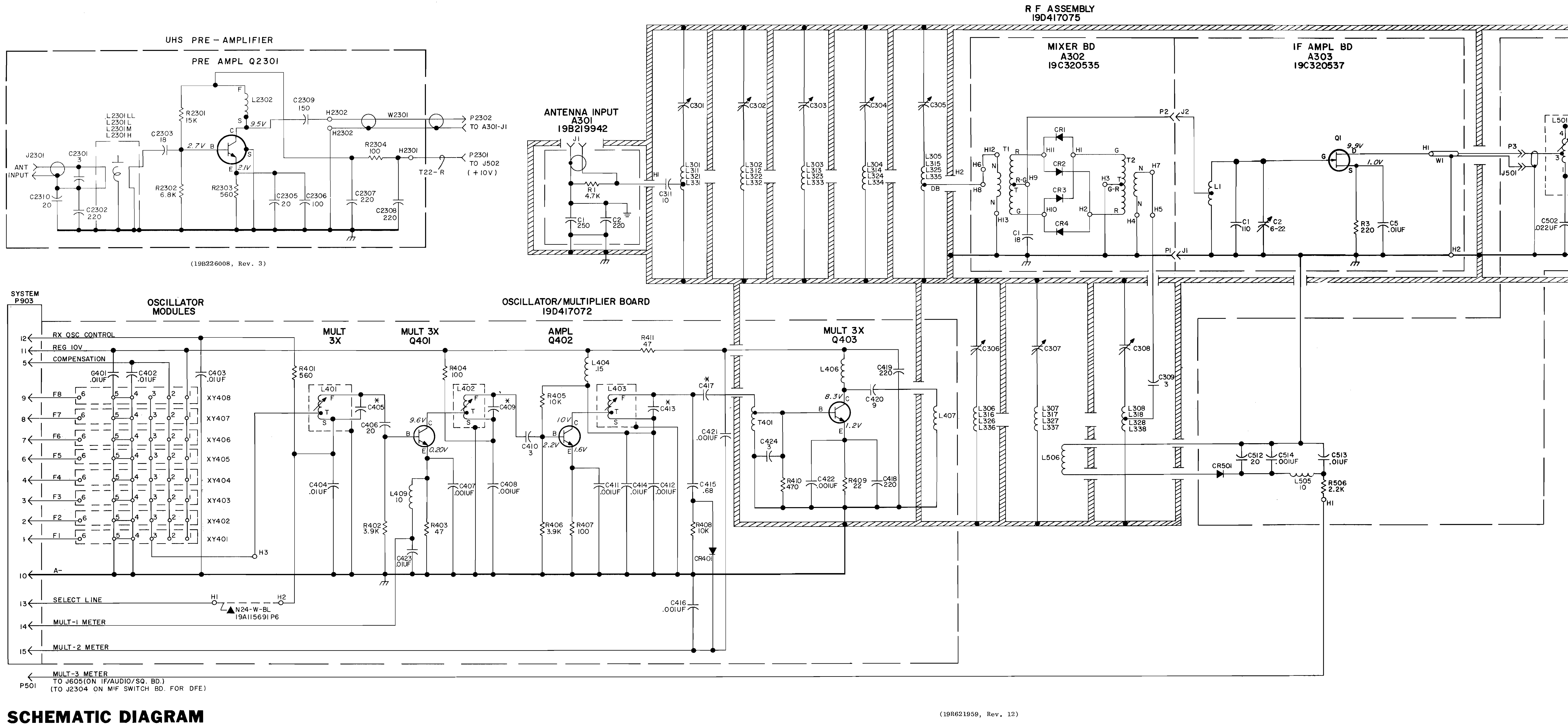
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

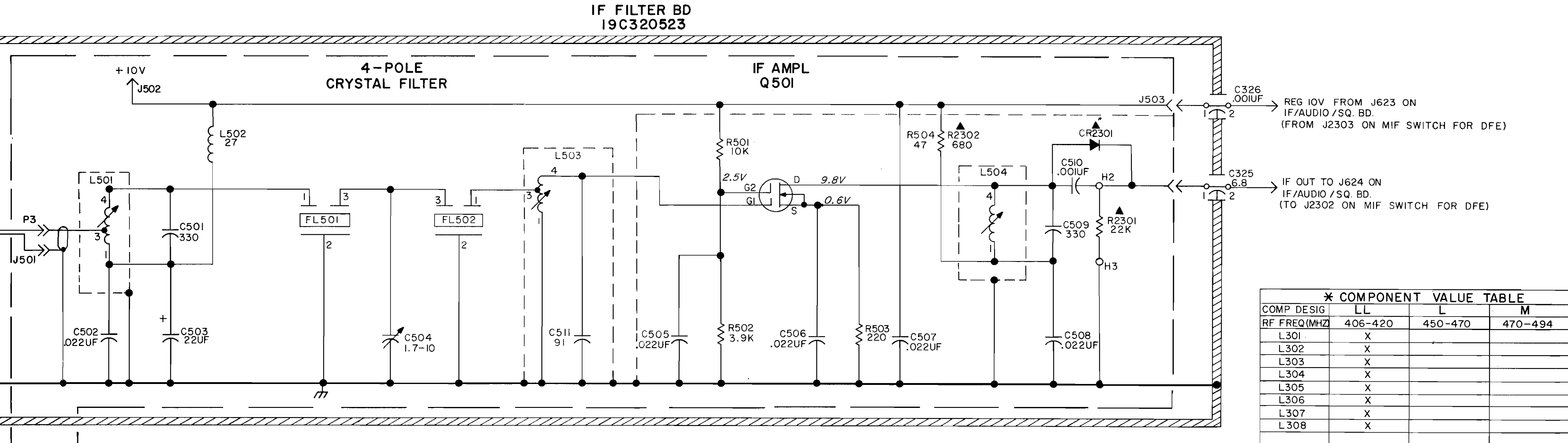
REV. A - RF Assembly (19D417075G1-G4)

To improve sensitivity of receiver. On IF amplifier board A303 (19C320537G1). Changed Q1 and R3. Deleted C3, C4, R1, R2, and R4.

REV. A - IF Filter Bd. (19C320523G1)

To improve sensitivity of receiver. Changed L501.





▲ THESE COMPONENTS ARE USED TO ADAPT A STANDARD RECEIVER TO OPERATION AS AND WITH A DUAL FRONT END. THESE COMPONENTS SHOULD BE IGNORED IN THE STANDARD RECEIVER. BOARDS IDENTIFIED BY A RED DOT HAVE BEEN MODIFIED FOR DFE OPERATION PER MOD KIT 19A129750G1 OR G2	
RECEIVER CHANNEL ON PL19C320523 (IF FILTER BD)	D. F. E. CHANNEL ON PL19C320523 (IF FILTER BD)
1. R2302 USED INSTEAD OF R504 2. CR2301 USED INSTEAD OF C510 3. R2301 ADDED BETWEEN H2 & H3.	1. R504 USED 2. CR2301 USED INSTEAD OF C510 3. R2301 ADDED BETWEEN H2 & H3.
	ON PL19D417072 (OSC/MULT BD) 1. N24-W-BL JUMPER ADDED BETWEEN H1 & H2 ON OSC/MULT BD.
THESE ITEMS ARE SUPPLIED IN MOD. KIT PL19A129750G1.	THESE ITEMS ARE SUPPLIED IN MOD. KIT PL19A129750G2.

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-10) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER.

⏚ INDICATES A-

⏚ INDICATES VEHICLE GROUND

	REV LETTER	FREQ RANGE (MHZ)	NO. OF FREQ
RF ASSEMBLY			
19D417075G1	A	406-420	
19D417075G2	A	450-470	
19D417075G3	A	470-494	
19D417075G4	A	494-512	
MIXER BD			
19C320535G1			
IF AMPL BD			
19C320537G1			
OSC/MULT BD			
19D417072G1		406-420	2
19D417072G2		450-470	2
19D417072G3		470-494	2
19D417072G4		494-512	2
19D417072G5		406-420	8
19D417072G6		450-470	8
19D417072G7		470-494	8
19D417072G8		494-512	8
IF FILTER BD			
19C320523G1	A		

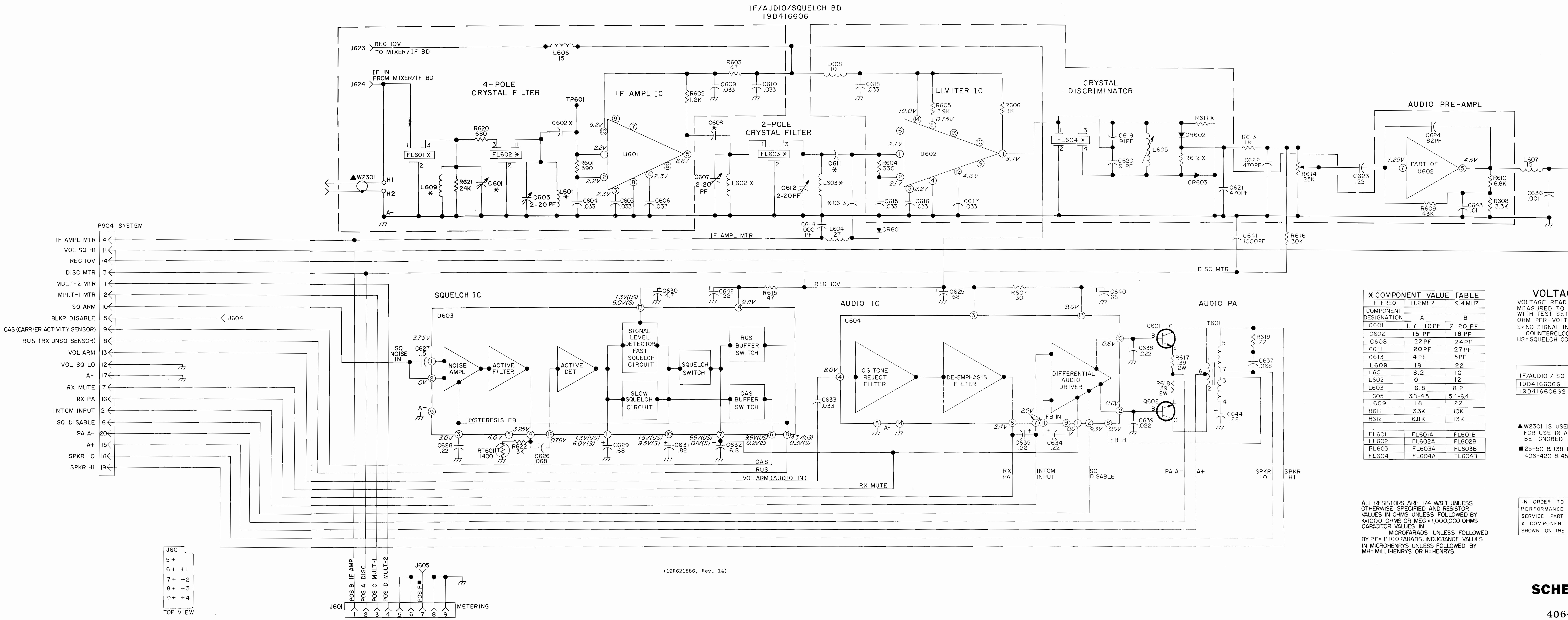
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF=MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS.

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

* COMPONENT VALUE TABLE				
COMP DESIG	LL	L	M	H
RF FREQ (MHZ)	406-420	450-470	470-494	494-512
L301	X			
L302	X			
L303	X			
L304	X			
L305	X			
L306	X			
L307	X			
L308	X			
L311		X		
L312		X		
L313		X		
L314		X		
L315		X		
L316		X		
L317		X		
L318		X		
L321			X	
L322			X	
L323			X	
L324			X	
L325			X	
L326			X	
L327			X	
L328			X	
L331				X
L332				X
L333				X
L334				X
L335				X
L336				X
L337				X
L338				X
C405	18	15	12	10
C409	8	6	4	3
C413	8	6	4	3
C417	7	3	5	5

SCHEMATIC DIAGRAM

406—512 MHz RECEIVER RF ASSEMBLY,
IF-FILTER BOARD ASSEMBLY, OSC/MULT
AND UHS PRE-AMPLIFIER



✱ COMPONENT VALUE TABLE		
IF FREQ	11.2MHZ	9.4MHZ
COMPONENT DESIGNATION	A	B
C601	1.7-10PF	2-20 PF
C602	15 PF	18 PF
C608	22PF	24PF
C611	20PF	27PF
C613	4PF	5PF
L609	18	22
L601	8.2	10
L602	10	12
L603	6.8	8.2
L605	3.8-4.5	5.4-6.4
L609	18	22
R611	3.3K	10K
R612	6.8K	13K
FL601	FL601A	FL601B
FL602	FL602A	FL602B
FL603	FL603A	FL603B
FL604	FL604A	FL604B

VOLTAGE READINGS

VOLTAGE READINGS ARE TYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P904-17) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM-PER-VOLT METER

S= NO SIGNAL IN WITH SQUELCH CONTROL FULLY COUNTERCLOCKWISE (MAXIUM SQUELCH)

US= SQUELCH CONTROL FULLY CLOCKWISE

IF/AUDIO / SQ BD	REV LETTER	IF FREQ (MHZ)
19D416606G1	B	11.2
19D416606G2	B	9.4

▲W2301 IS USED TO ADAPT A STANDARD BD FOR USE IN A DUAL FRONT END IT SHOULD BE IGNORED IN THE STANDARD BD.

■25-50 & 138-174MHZ NOISE BLANKER TEST POINT 406-420 & 450-512MHZ MULT-3 TEST POINT

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS CAPACITOR VALUES IN MICROFARADS UNLESS FOLLOWED BY PF= PICO FARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

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

SCHEMATIC DIAGRAM

406—512 MHz, IF AUDIO AND SQUELCH BOARD

PARTS LIST

LBI-4443D

IF AUDIO AND SQUELCH BOARD
19D416606G1, G2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - CAPACITORS - - - - - - - - - -
C601A*	19B209351P1	Variable: 1.7 to 10 pf, 200 VDCW; sim to Matshushita ECV-1ZW10P32.
		In REV A and earlier:
	5491601P127	Phenolic: 2.4 pf ±5%, 500 VDCW.
C601B*	19B209351P2	Variable: 2.3 to 20 pf, 200 VDCW; sim to Matshushita ECV-1ZW20P32.
		In REV A and earlier:
	5491601P128	Phenolic: 2.7 pf ±5%, 500 VDCW.
C602A*	19A116656P15J0	Ceramic, disc: 15 pf ±5%, temp coef 0 PPM.
		In REV A and earlier:
	19A116656P8J0	Ceramic, disc: 8 pf ±0.5 pf, temp coef 0 PPM.
C602B*	19A116656P18J0	Ceramic, disc: 18 pf ±5%, 500 VDCW, temp coef 0 PPM.
		In REV A and earlier:
	19A116656P13J0	Ceramic, disc: 13 pf ±5%, 500 VDCW, temp coef 0 PPM.
C603*	19B209351P2	Variable: 2.3 to 20 pf, 200 VDCW, temp coef -350 +500 PPM; sim to Matshushita ECV-1ZW20P32.
		In REV A and earlier:
	19B209351P1	Variable: 1.7 to 10 pf, 200 VDCW, temp coef -350 +500 PPM; sim to Matshushita ECV-1ZW10P32.
C604 thru C606	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C607*	19B209351P2	Variable: 2.3 to 20 pf, 200 VDCW, temp coef -250 +700 PPM; sim to Matshushita ECV-1ZW20P32.
		In REV A and earlier:
	19B209351P1	Variable: 1.7 to 10 pf, 200 VDCW, temp coef -350 +500 PPM; sim to Matshushita ECV-1ZW10P32.
C608*	19A116656P51J8	Ceramic, disc: 51 pf ±5%, 500 VDCW, temp coef -80 PPM. Deleted by REV B.
C608A*	19A116656P22J0	Ceramic, disc: 22 pf ±5%, 500 VDCW, temp coef 0 PPM. Added by REV B.
C608B*	19A116656P24J0	Ceramic, disc: 24 pf ±5%, 500 VDCW, temp coef 0 PPM. Added by REV B.
C609 and C610	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C611A*	19A116656P20J0	Ceramic, disc: 20 pf ±5%, 500 VDCW, temp coef 0 PPM.
		In REV A and earlier:
	19A116656P13J0	Ceramic, disc: 13 pf ±5%, 500 VDCW, temp coef 0 PPM.
C611B*	19A116656P27J0	Ceramic, disc: 27 pf ±5%, 500 VDCW, temp coef 0 PPM.
		In REV A and earlier:
	19A116656P15J0	Ceramic, disc: 15 pf ±5%, 500 VDCW, temp coef 0 PPM.
C612*	19B209351P2	Variable: 2.3 to 20 pf, 200 VDCW, temp coef -250 +700 PPM; sim to Matshushita ECV-1ZW20P32.
		In REV A and earlier:
	19B209351P1	Variable: 1.7 to 10 pf, 200 VDCW, temp coef -350 +500 PPM; sim to Matshushita ECV-1ZW10P32.
C613A	19A116656P4J0	Ceramic, disc: 4 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C613B	19A116656P5J0	Ceramic, disc: 5 pf ±0.5 pf, 500 VDCW, temp coef 0 PPM.
C614	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C615 thru C618	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
C619 and C620	19A116656P91J2	Ceramic, disc: 91 pf ±5%, 500 VDCW, temp coef -220 PPM.
C621 and C622	19A116655P13	Ceramic disc: 470 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C623	19A116080P109	Polyester: 0.22 µf ±10%, 50 VDCW.
C624	7489162P25	Silver mica: 82 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C625*	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
		In REV C and earlier in G1, In REV D and earlier in G2:
	5496267P111	Tantalum: 68 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C626	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C627	19A116080P108	Polyester: 0.15 µf ±10%, 50 VDCW.
C628	19A116080P109	Polyester: 0.22 µf ±10%, 50 VDCW.
C629	5496267P29	Tantalum: 0.68 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C630	5496267P5	Tantalum: 4.7 µf ±20%, 10 VDCW; sim to Sprague Type 150D.
C631	5496267P230	Tantalum: 0.82 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C632	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C633	19A116080P104	Polyester: 0.033 µf ±10%, 50 VDCW.
		Earlier than REV A:
	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C634 and C635	5496267P226	Tantalum: 0.22 µf ±10%, 35 VDCW; sim to Sprague Type 150D.
C636	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C637	19A116080P106	Polyester: 0.068 µf ±10%, 50 VDCW.
C638 and C639	19A116080P103	Polyester: 0.022 µf ±10%, 50 VDCW.
C640*	5496267P111	Tantalum: 68 µf ±20%, 15 VDCW; sim to Sprague Type 150D. Deleted in G1 by REV D, in G2 by REV E.
C641	19A116655P19	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap.
C642	5496267P10	Tantalum: 22 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C643	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C644*	5496267P226	Tantalum: 0.22 µf ±10%, 35 VDCW; sim to Sprague Type 150D. Added by REV A.
C645*	19A116114P12	Ceramic: 3.3 pf ±5%, 100 VDCW; temp coef 0 PPM. Added by REV C.
C646*	5494481P111	Ceramic disc: 1000 pf ±20%, 1000 VDCW; sim to RMC Type JF Discap. Added to G1 by REV D and G2 by REV E.
C647*	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW. Added to G1 by REV D and G2 by REV E.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR601	4038056P1	Germanium.
CR602* and CR603*	19A116052P1	Silicon.
		In REV B and earlier in G1, In REV C and earlier in G2:
	19A115775P1	Silicon.
		- - - - - - - - - - - - - FILTERS - - - - - - - - - -
FL601A	19B219573G3	Crystal freq: PAD A: 11,200000 KHz, PAD B: 11,196024 KHz.
FL601B	19B219574G3	Crystal freq: PAD A: 9400.300 KHz, PAD B: 9396.324 KHz.
FL602A		(Part of FL601A).
FL602B		(Part of FL601B).
FL603A	19B219573G1	Crystal freq: PAD A: 11,200000 KHz, PAD B: 11,200000 KHz.
FL603B	19B219574G1	Crystal freq: PAD A: 9400.300 KHz, PAD B: 9400.300 KHz.
FL604A	19B219604G1	Crystal freq: 11.200000 MHz.
FL604B	19B219604G2	Crystal freq: 9.400000 MHz.
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J601	19B219374G1	Connector. Includes:
	19C317957P1	Shell.
	19A116651P1	Contact, electrical; sim to Malco X0-2864.
J604 and J605	19A116779P1	Contact, electrical; sim to Molex 08-54-0404.
J623* and J624*	19A116975P1	Contact, electrical.
		Earlier than REV A:
	19A116428P5	Contact, electrical: sim to AMP 85486-6 (Strip Form).
		- - - - - - - - - - - INDUCTORS - - - - - - - - -
L601A*	19B209456P119	Coil, RF: 8.20 µh ±10%, 1.32 ohms DC res max; sim to Arco-Speer 15S-8R2.
		In REV A and earlier:
	19B209456P121	Coil, RF: 12 µh ±10%, 2.00 ohms DC res max; sim to Arco-Speer 15S-120K.
L601B*	19B209456P120	Coil, RF: 10 µh ±10%, 1.62 ohms DC res max; sim to Arco-Speer 15S-100K.
		In REV A and earlier:
	19B209456P122	Coil, RF: 15 µh ±10%, 0.80 ohms DC res max; sim to Arco-Speer 15S-150K.
L602A	19B209456P120	Coil, RF: 10 µh ±10%, 1.62 ohms DC res max; sim to Arco-Speer 15S-100K.
L602B*	19B209456P121	Coil, RF: 12 µh ±10%, 2.00 ohms DC res max; sim to Arco-Speer 15S-120K.
		In REV A and earlier:
	19B209456P122	Coil, RF: 15 µh ±10%, 0.80 ohms DC res max; sim to Arco-Speer 15S-150K.
L603A*	19B209456P118	Coil, RF: 6.80 µh ±10%, 1.02 ohms DC res max; sim to Arco-Speer 15S-6R8.
		In REV A and earlier:
	19B209456P120	Coil, RF: 10 µh ±10%, 1.62 ohms DC res max; sim to Arco-Speer 155-100K.
L603B*	19B209456P119	Coil, RF: 8.20 µh ±10%, 1.32 ohms DC res max; sim to Arco-Speer 15S-8R2.
		In REV A and earlier:
	19B209456P121	Coil, RF: 12 µh ±10%, 2.00 ohms DC res max; sim to Arco-Speer 15S-120K.
L604	19B209456P125	Coil, RF: 27 µh ±10%, 1.19 ohms DC res max; sim to Arco-Speer 15S-270K.
L605A	19C311181G13	Coil.
L605B	19C311181G14	Coil.
L606 and L607	7488079P18	Choke, RF: 15.0 µh ±10%, 1.20 ohms DC res max; sim to Jeffers 4421-9K.
L608	19B209420P125	Coil, RF: 10.0 µh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L609A*	19B209420P128	Coil, RF: 18.0 µh ±10%, 3.00 ohms DC res max; sim to Jeffers 1316-3. Added by REV B.
L609B*	19B209420P129	Coil, RF: 22.0 µh ±10%, 3.30 ohms DC res max; sim to Jeffers 1316-4. Added by REV B.
		- - - - - - - - - - - - PLUGS - - - - - - - - - - -
P904	19B219594P1	Contact strip: 7 pins.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - -
Q601 and Q602	19A116742P1	Silicon, NPN.
		- - - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R152P391K	Composition: 390 ohms ±10%, 1/4 w.
R602	3R152P122K	Composition: 1200 ohms ±10%, 1/4 w.
R603	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
R604	3R152P331K	Composition: 330 ohms ±10%, 1/4 w.
R605	3R152P392K	Composition: 3900 ohms ±10%, 1/4 w.
R606	3R152P102K	Composition: 1000 ohms ±10%, 1/4 w.
R607	3R152P300K	Composition: 30 ohms ±10%, 1/4 w.
R608	3R152P332K	Composition: 3300 ohms ±10%, 1/4 w.
R609	3R152P433K	Composition: 43,000 ohms ±10%, 1/4 w.
R610	3R152P682K	Composition: 6800 ohms ±10%, 1/4 w.
R611A*	3R152P562J	Composition: 5600 ohms ±5%, 1/4 w.
		In REV B and earlier in G1:
	3R152P332K	Composition: 3300 ohms ±10%, 1/4 w.
R611B	3R152P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R612A*	3R152P822J	Composition: 8200 ohms ±5%, 1/4 w.
		In REV B and earlier in G1:
	3R152P682K	Composition: 6800 ohms ±10%, 1/4 w.
R612B	3R152P133K	Composition: 13,000 ohms ±10%, 1/4 w.
R613	3R152P102K	Composition: 1000 ohms ±10%, 1/4 w.
R614	19B209358P107	Variable, carbon film: approx 75 to 25,000 ohms ±10%, 0.25 w; sim to CTS Type X-201.
R615	3R152P470K	Composition: 47 ohms ±10%, 1/4 w.
R616	3R152P303J	Composition: 30,000 ohms ±5%, 1/4 w.
R617 and R618	19B209022P5	Wirewound: 0.39 ohms ±5%, 2 w; sim to IRC Type BWH.
R619	3R152P220K	Composition: 22 ohms ±10%, 1/4 w.
R620	3R151P681J	Composition: 680 ohms ±5%, 1/8 w.
R621*	3R151P273J	Composition: 27,000 ohms ±5%, 1/8 w.
		In REV B and earlier in G1, In REV C and earlier in G2:
	3R151P153J	Composition: 15,000 ohms ±5%, 1/8 w.
R622	3R152P302J	Composition: 3000 ohms ±5%, 1/4 w.
		- - - - - - - - - - - THERMISTORS - - - - - - - - -
RT601	5490828P38	Thermistor: 1400 ohms ±5%, color code green and white; sim to Globar Type 492H.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T601	19A116747P1	Audio freq: 500 to 4000 Hz, Pri: 0.345 ohm ±15%, Sec 1: 0.36 ohms ±10%, Sec 2: 0.685 ohms ±15%.
		- - - - - - - - - - TEST POINTS - - - - - - - - - -
TP601*	N503P304C6	Cotter pin. Added by REV B.
		- - - - - - - INTEGRATED CIRCUITS - - - - - -
U601	19A116796P1	Linear, Wide Band Amplifier/Discriminator; sim to CA 3014.
U602	19A116797P1	Linear, Limiter/Audio Pre-Amp; sim to CA3042.
U603	19D416560G1	Squelch Hybrid, integrated circuit.
U604	19D416573G1	Audio Hybrid.
		MECHANICAL PARTS (SEE RC-2439)
1	19B219727G1	Shield. (Located on bottom of circuit board under U602).
2	19B219557P1	Heat sink. (For Q601 and Q602).
3	19A116023P3	Insulator, plate. (Used with Q601 and Q602).
4	19A116022P1	Bushing. (Used with Q601 and Q602).
5	4029846P1	Nut, hex, self-locking: No. 4-40. (Used with Q601 and Q602).
6	19A116417P4	Bumper, plastic. (Located at T601).
7	19C320166P1	Shield. (Located around FL601, and FL602).
8	19B219571G1	Shield. (Located on bottom of circuit board under FL601 and FL602).
9	4035306P59	Washer, fiber. (Used with FL601-FL604).
10	19A116428P4	Ground tab: sim to AMP 86031-1 (Strip Form). (Used with shields on bottom of circuit board).
11	19B219470P3	Shield. (Located by J623 and J624).
12	19B219555P1	Cover. (Located over U602 and FL604).
13	19B219554G1	Can. (Located around U602 and FL604).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

PRODUCTION CHANGES

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

IF Audio and Squelch Board (19D416606G1 and G2)

REV. A - Incorporated into initial shipment.

REV. B - To improve IF frequency response. Changed L601, L602, L603, and added L609. Changed C601, C602, C603, C607, C608, C611, and C612. Added TP601.

IF Audio and Squelch Board (19D416606G2)

REV. C - To increase audio output and reduce distortion. Added C645.

IF Audio and Squelch Board (19D416606G1)

REV. C - To improve sensitivity and squelch operation. Changed R621, R611A, R612A, CR602 and CR603. Added C645.

IF Audio and Squelch Board (19D416606G2)

REV. D - To improve sensitivity and squelch operation. Changed R621, CR602 and CR603.

REV. D - IF Audio and Squelch Board 19D416606G1
REV. E - IF Audio and Squelch Board 19D416606G2

To provide RF decoupling of the RX PA input lead. Changed C625 and deleted C640. Added C646 and C647.

REV. E - IF Audio and Squelch Board (19D416606G1)

REV. F - IF Audio and Squelch Board (19D416606G2)

To provide RF decoupling of the RX-PA input lead. Added C646, changed C625 and deleted C640.