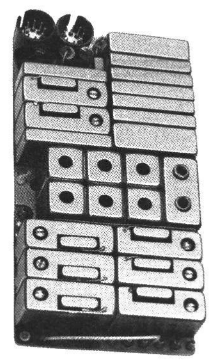
MOBILE RADIO

MASTR® Personal Series
PROGRESS LINE

PE MODELS
138-150.8 MHz, RECEIVER MODELS 4ER59B10 & 4ER59B12

Maintenance Manual LBI4664D

DATAFILE FOLDER - DF 1102



SPECIFICATIONS *

Type Number	ER-59-B
Audio Output (EIA)	500 milliwatts at less than 5% distortion
Channel Spacing	30 kHz
Sensitivity	
12-dB SINAD (EIA Method)	0.25 µV
20-dB Quieting Method	0.35 µV
Selectivity	
EIA Two-Signal	-75 dB at ±30 kHz
20-dB Quieting Method	-110 dB at ±30 kHz
Spurious Response	-70 dB
Intermodulation (EIA)	-60 dB
Audio Response	Within +2 and -10 dB of a standard 6-dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
Modulation Acceptance	±7.5 kHz
Squelch Sensitivity	
Critical Squelch	0.15 µV
Maximum Squelch	Greater than 20-dB Quieting

MAXIMUM FREQUENCY SPREAD (MHz)

FREQUENCY RANGE	FULL Performance	1 dB Degradation in Sensitivity
138-145 MHz	0.55 MHz	1.1 MHz
145-150.8 MHz	0.58 MHz	1.16 MHz

ER-59-B

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

GENERAL ELECTRIC

TABLE OF CONTENTS

ILLUSTRATIONS

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

DESCRIPTION

Receiver Models 4ER59B10 and 4ER59B12 are single conversion, superheterodyne FM receivers for one through eight frequency operation on the 138-150.8 MHz bands. The complete receiver mounts on a single printed wiring board, and utilizes both discrete components and Integrated Circuit modules.

The application of each model receiver is shown in the following chart:

Model No.	Freq. Range	Number of Freq.	Tone Option
4ER59B10	138-150.8 MHz	3 to 8	
4ER59B12	138-150.8 MHz	3 to 8	Channel Guard

References to symbol numbers mentioned in the following test are found on the Schematic Diagram, Outline Diagram and Parts List (see Table of Contents). The typical circuit diagrams used in the text are representative of the circuits used in the Integrated Circuit modules. A block diagram of the receiver is shown in Figure 1.

Supply voltage for the receiver includes a continuous regulated 5.4 Volts for the compensator module, a continuous 7.5 Volts for the squelch module, and a switched 7.5 Volts for the remaining receiver stages.

CIRCUIT ANALYSIS

OSCILLATOR MODULES

Oscillator Model 4EG28A15 consists of a crystal-controlled Colpitts oscillator similar to the Oscillator module used in the transmitter (see Figure 2). The entire oscillator is contained in a metal can with the receiver operating frequency printed on the top. The crystal frequency ranges from 14.75 to 16.87 MHz, and the crystal frequency is multiplied 8 times.

The oscillator frequency is temperature compensated to provide instant frequency compensation, with a frequency stability of ±.0002% from 0°C to +55°C and ±.0005% from -30°C to +60°C. The temperature compensation network is contained in Compensator Module A313.

In multi-frequency receivers, additional oscillator modules are mounted on the receiver board. The single-frequency supply

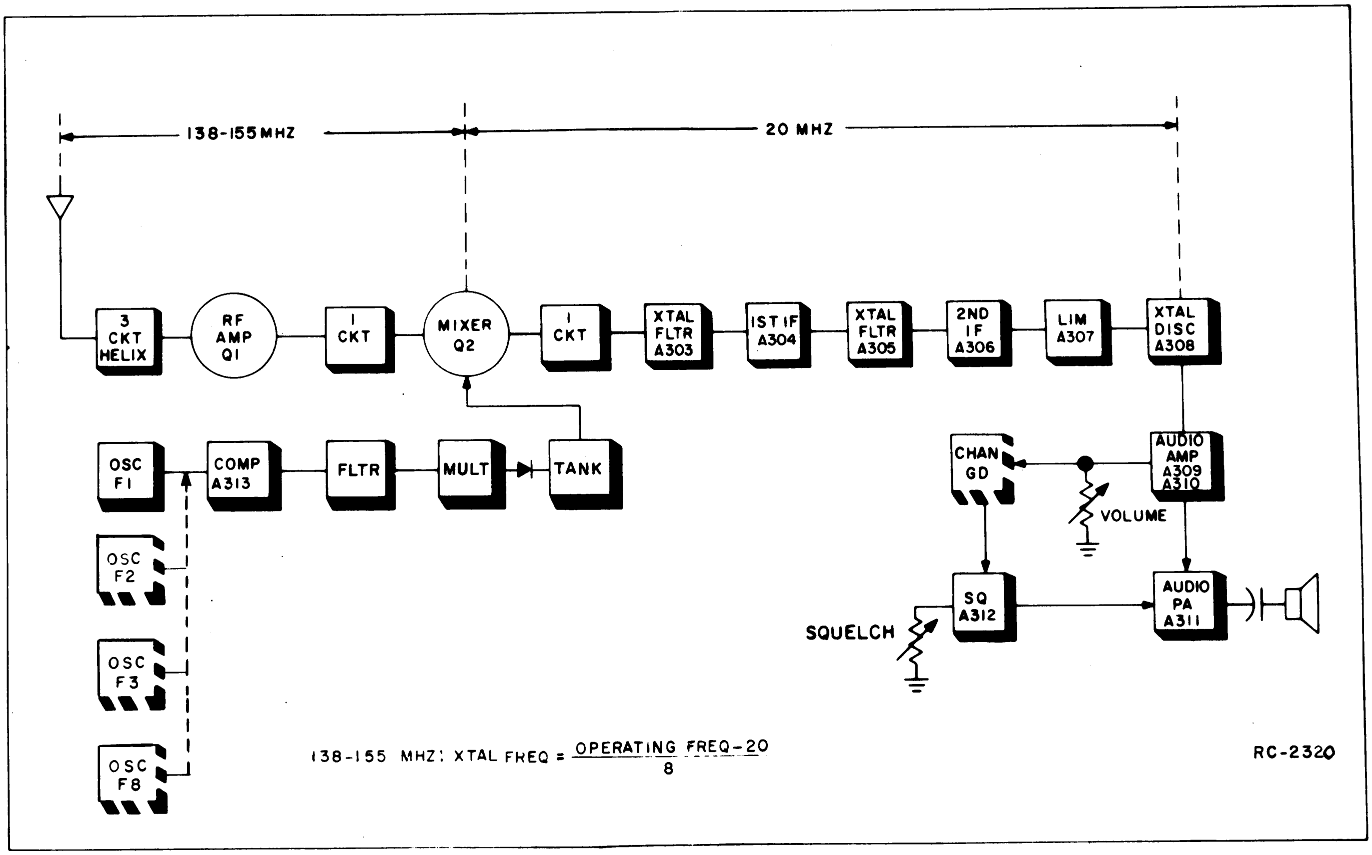


Figure 1 - Receiver Block Diagram

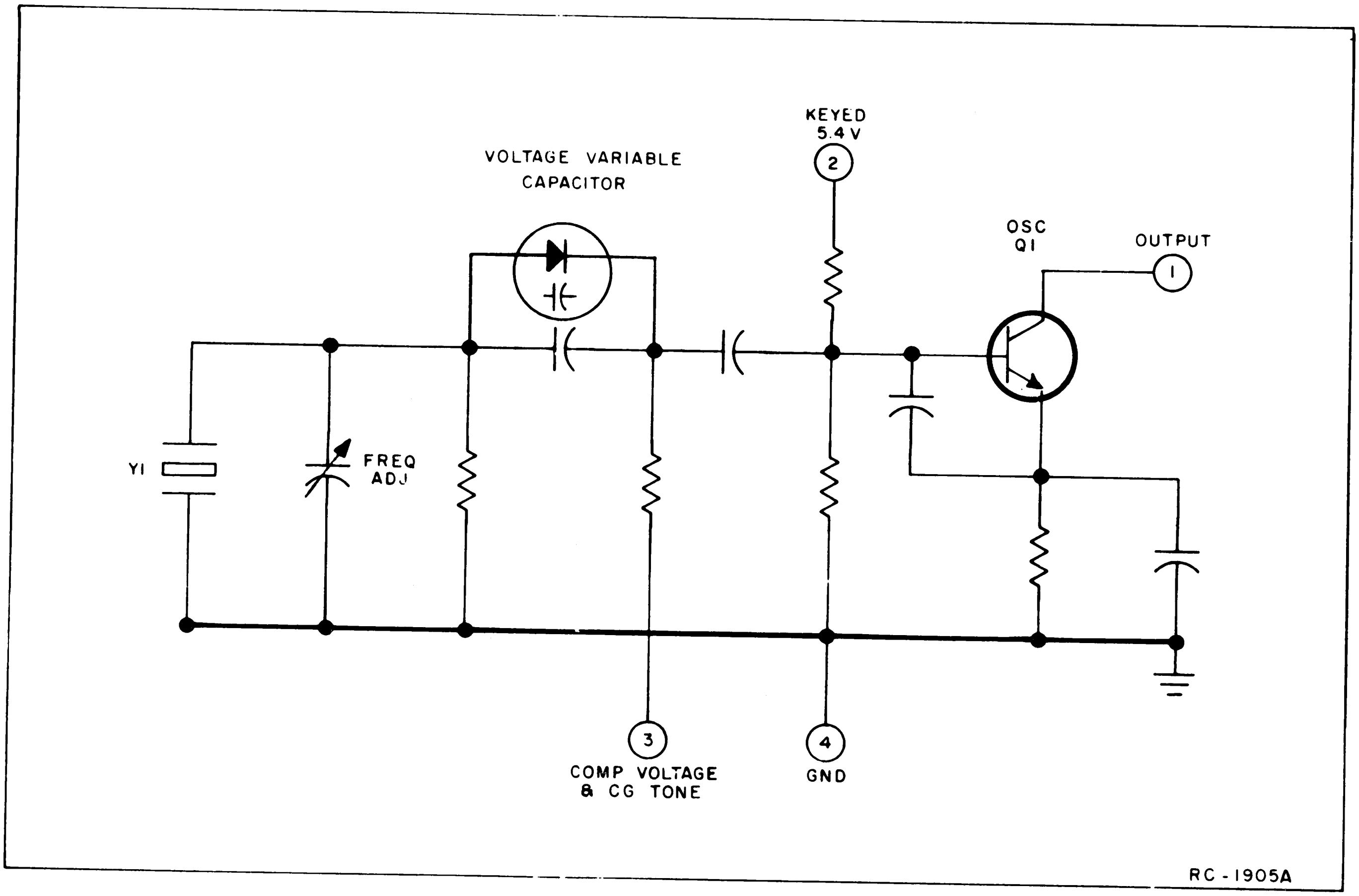


Figure 2 - Typical Oscillator Circuit

jumper is removed, and the proper frequency is selected by connecting the 5.4 Volts to the selected oscillator module through frequency selector switch S1 on the control unit.

NOTE

> All oscillator modules are individually compensated at the factory and cannot be repaired in the field. Any attempt to remove the oscillator cover will void the warranty.

COMPENSATOR A313

Compensator module A313 contains a buffer-amplifier stage, and the temperature compensation network for the oscillator similar to the Compensator used in the transmitter (see Figure 3).

RF from the oscillator is coupled through a DC blocking capacitor to the base of Q1. The output of Q1 connects to multiplier coil L1 on the Multiplier assembly.

In the compensation network, the regulated 5.4 Volts at Pin 2 is applied to a thermistor-compensated voltage divider. The output at Pin 3 (2.35 Volts measured with a VTVM) is applied to Pin 3 and to the varactor in the Oscillator module. At temperatures below -10°C, the compensated voltage increases to maintain the proper voltage on the oscillator voltage-variable capacitor.

SERVICE NOTE

> An abnormally low VTVM reading (or no reading) at Pin 3 may indicate a short or leakage path in the oscillator. This can be checked by unsoldering Pin 3, raising it off of the printed board and taking another reading. If this reading is normal, the problem is in the Oscillator module. If the reading remains low (or zero), the problem is in the Compensator.

FRONT END A301

The receiver Front End consists of three tuned helical resonators, an RF amplifier and Mixer stage as well as the Filter, Multiplier and Tank circuits. The RF signal from the antenna is coupled through RF cable W301 to a tap on L1. The tap is

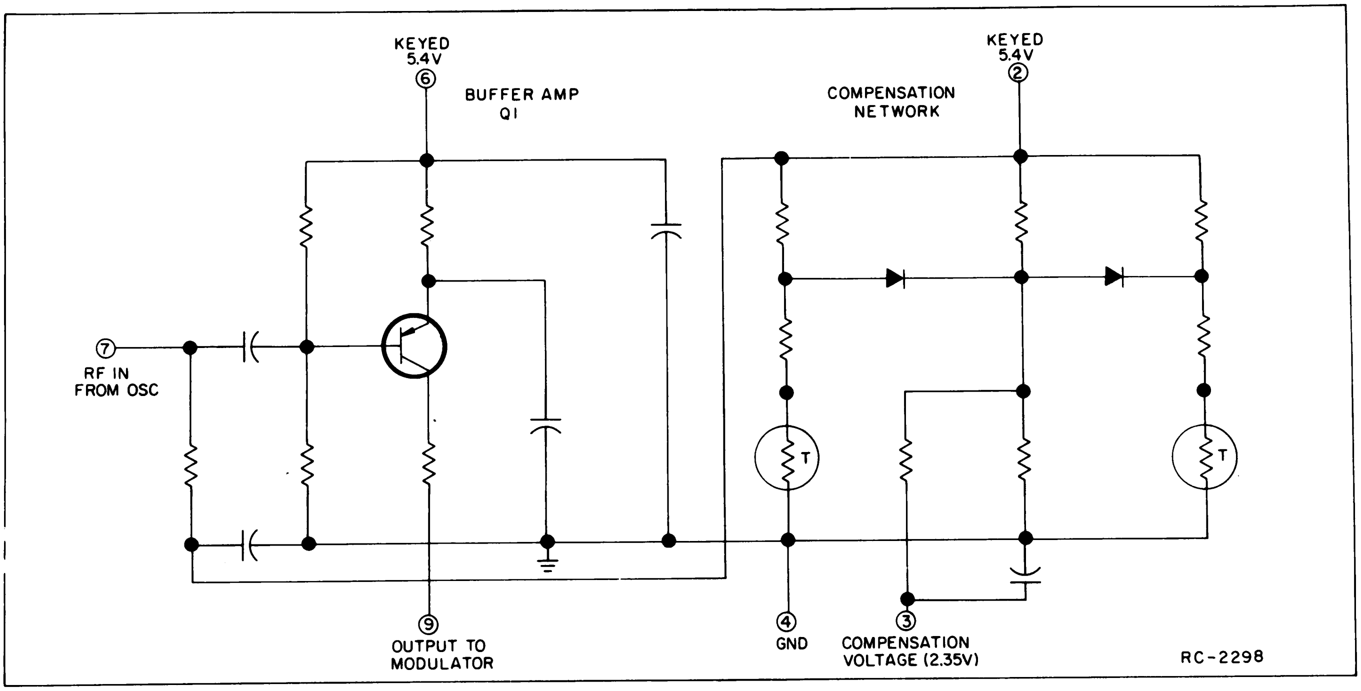


Figure 3 - Typical Compensator Circuit

positioned to provide the proper impedance match to the antenna. RF energy is coupled to the third coil (L3) through openings in the sides of the cans. RF is then coupled from a tap on L3 through C1 to the base of RF amplifier Q1. The output of Q1 is developed across tuned circuit C2/L1 and is applied to the base of the mixer.

The output of the Compensator module is applied to L1 in Filter circuit A8.

MULTIPLIER & MIXER A301

A8-L1 is tuned to four times the crystal frequency. The Filter output is applied to Multiplier A3. The multiplier coil (A3-L1) is also tuned to four times the crystal frequency and is metered at H8 (Mult Test Point). Following the multiplier is Tank circuit A9. The tank circuit coil (A9-L1) is tuned to two times the multiplier output for a total multiplication of eight times. The output of the Tank circuit is direct-coupled to the emitter of the mixer transistor.

The RF signal from the RF amplifier is applied to the base of mixer Q2 and the low side injection voltage from the multiplier assembly is applied to the emitter. The resultant 20-MHz IF frequency is coupled through the mixer collector tank (L2 & C6) to Crystal Filter A303. The collector tank also provides impedance matching to the crystal filter.

CRYSTAL FILTERS A303 & A305

Filter A303 follows the Multiplier-Mixer stage, and its output is applied to the 1st IF amplifier module. Filter A305 follows the IF Amplifier module. The two Crystal Filters provide the major selectivity for the receiver. A303 provides a minimum of 40 dB stop-band attenuation, while A305 provides a minimum of 20 dB stop-band attenuation.

IF AMPS A304 & A306

An IF Amplifier module follows each of the crystal filters, and contain the resistor-matching networks for the filters. A typical IF amplifier circuit is shown in Figure 4.

Each of the IF Amplifier modules consists of three R-C coupled amplifier stages that are DC series-connected for reduced drain. The two IF modules provide a total gain of approximately 85 dB.

LIMITER A307 & DISCRIMINATOR A308

Limiter A307 consists of three R-C coupled limiter stages that are DC series connected for reduced drain. The Limiter module also provides some gain. The output of the Limiter is applied to the discriminator. A typical Limiter circuit is shown in Figure 5.

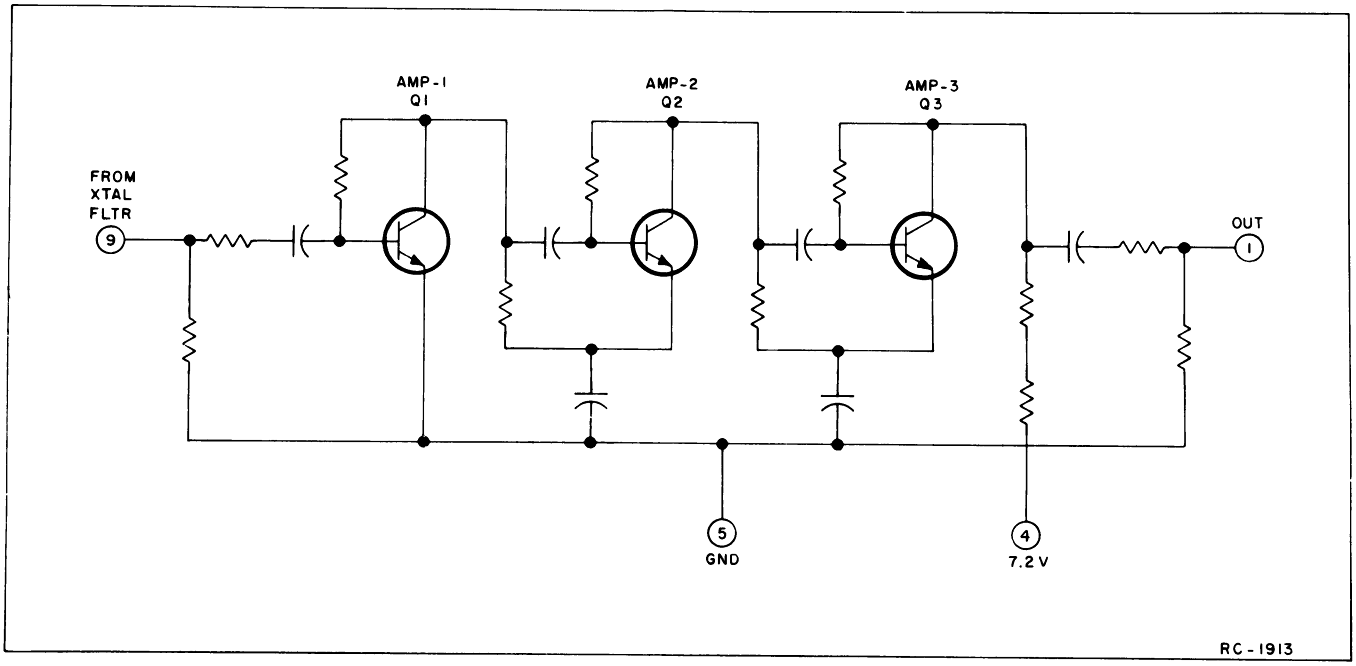


Figure 4 - Typical IF Amplifier Circuit

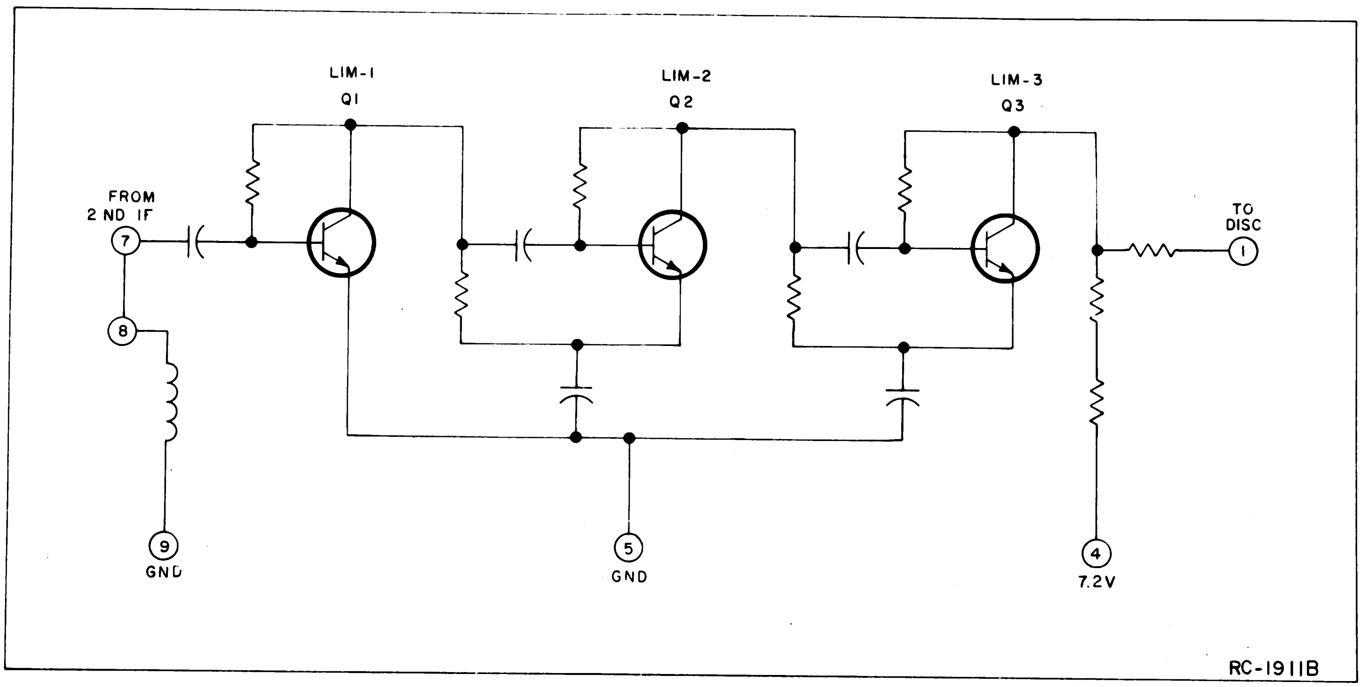


Figure 5 - Typical Limiter Circuit

The receiver uses a 20 MHz, fixed-tuned crystal discriminator (A308) to recover the audio from the IF signal. The Discriminator output is applied to the Audio Amplifier module.

AUDIO AMPLIFIER A309/A310

Audio and noise from the discriminator is applied to Audio Amplifier module A309 (A310 in Channel Guard applications). A typical audio amplifier circuit is shown in Figure 6.

Audio and noise is applied to the base of Q1. This stage operates as an emitter-follower for matching the impedance of the discriminator to the amplifier stage (Q2) and the VOLUME control. The output of Q1 connects from Pin 2 to the base of amplifier Q2 (Pin 4) through the VOLUME control. The output of Q1 is also applied to the input of the Squelch module.

Following amplifier Q2 is an active low-pass filter (Q3). Audio from the filter is connected from Pin 9 to the Audio PA module. In Audio Amplifier module A323, an active high-pass filter is added in series with the low-pass filter to provide the required tone frequency roll-off.

AUDIO PA A311

When the receiver is quieted by a signal, audio from the active filter is connected to Pin 1 of Audio PA module A311, and then to the base of amplifier Q1. Q1 feeds the audio signal to the base of Q2, which drives PA transistors Q4 and Q5. A typical audio PA circuit is shown in Figure 7.

PA transistors Q4 and Q5 operate as complementary emitter-followers, providing a 500 milliwatt output into an 8-ohm load. Audio from Pin 9 is coupled through capacitor C302 on the receiver board to the loudspeaker.

SQUELCH A312

Noise from Audio Amplifier A309/A310 operates the squelch circuit. A typical squelch circuit is shown in Figure 8.

When no carrier is present in the receiver, the noise output of active high-pass filter Q1 is coupled to the base of noise amplifier Q2 through SQUELCH control R708. R708 controls the gain of the noise amplifier.

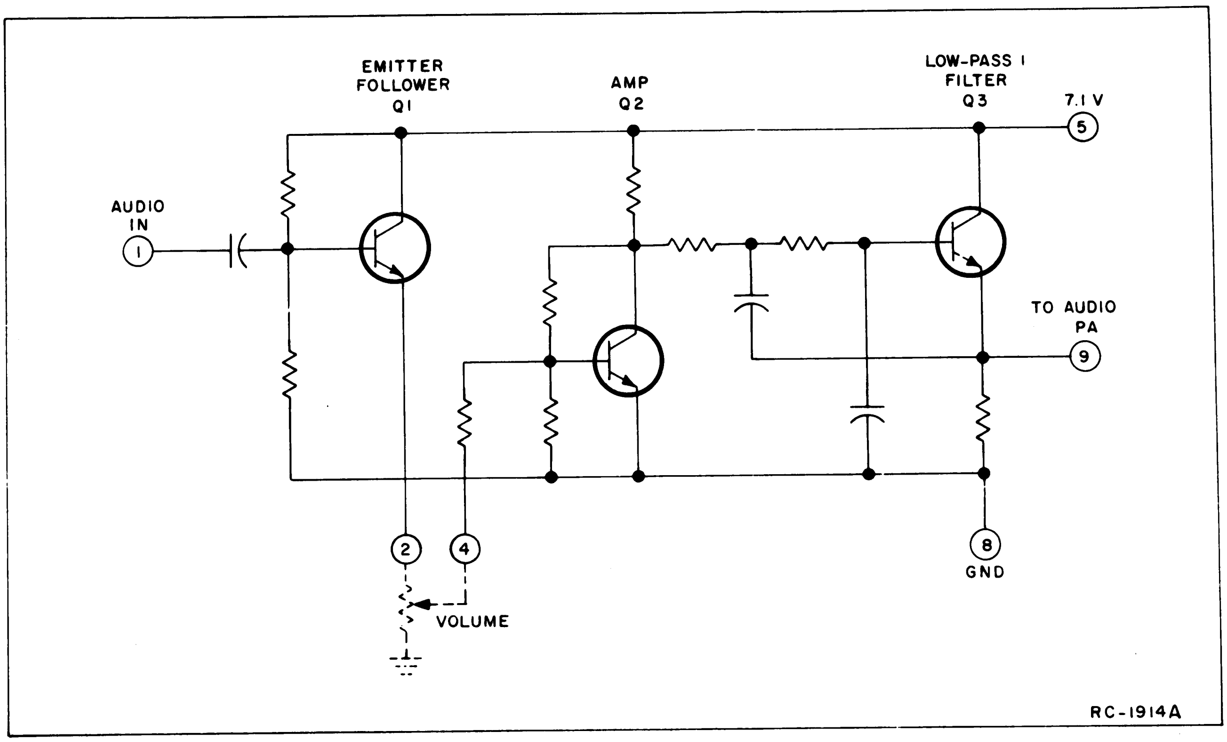


Figure 6 - Typical Audio Amplifier

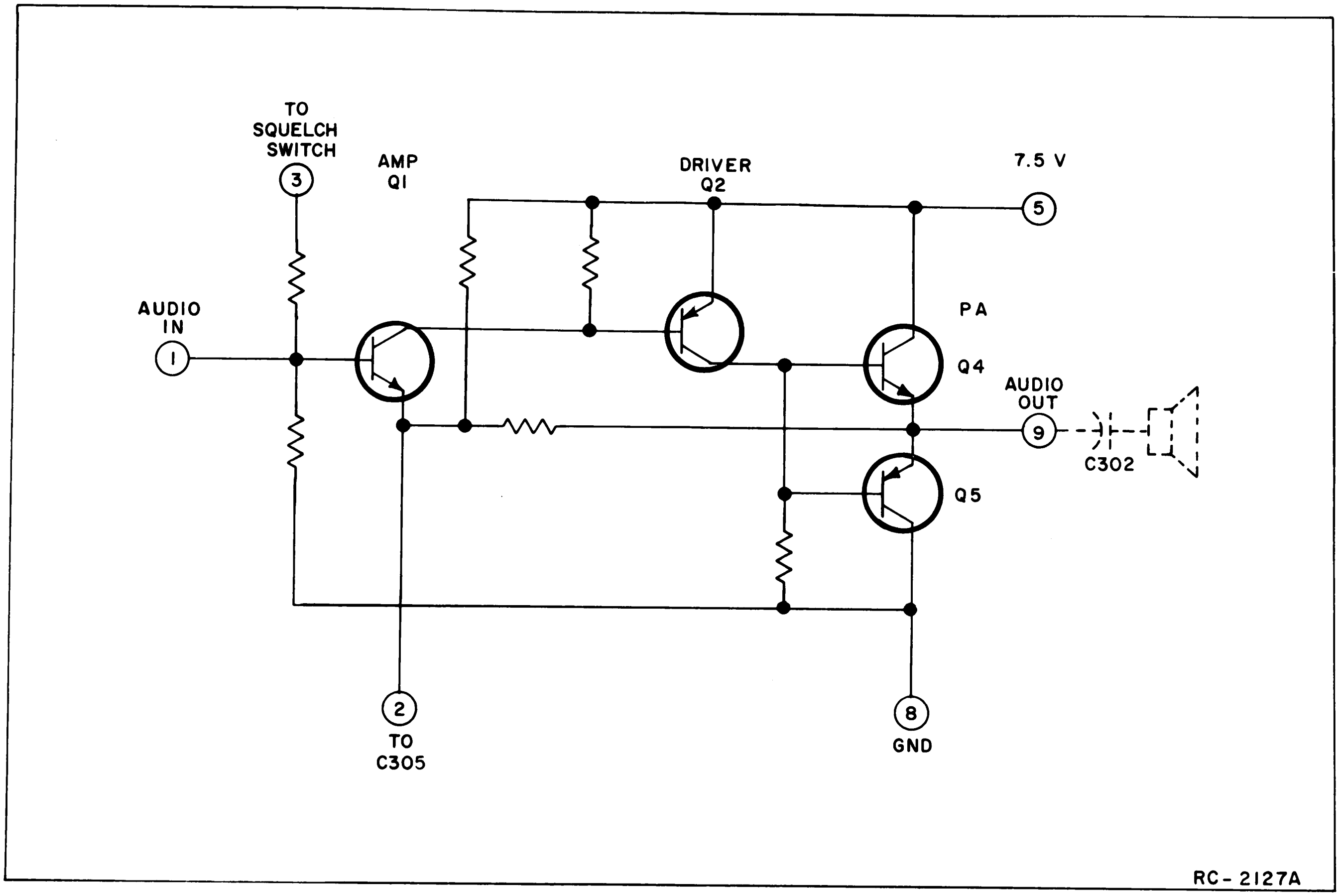


Figure 7 - Typical Audio PA Circuit

The output of noise amplifier Q2 is detected by diodes CR1 and CR2, and the resultant positive voltage turns off the PNP squelch switch Q3. In standard radios, the emitter of Q3 is connected to +7 Volts by means of a jumper from H1 to H2. When noise turns off Q3, its collector drops to ground potential. As the collector of Q3 is connected to the base of amplifier Q1 in the audio PA module, turning off Q3 also turns off Q1, keeping the audio PA turned off.

When the receiver is quieted by a signal, squelch switch Q3 turns on. This applies +7 Volts to the base of amplifier Q1 in the Audio PA module, turning the Audio PA circuit on so that sound is heard at the speaker.

In tone decoder applications, the 7-Volt jumper from H1 to H2 is removed. The emitter of squelch switch Q3 is connected to 7.5 Volts by a DC switch on the decoder board.

An RF adaptor cable is available for connecting the receiver to a signal generator. Connecting the RF adaptor cable to J702 opens a set of contacts on the antenna strip line assembly. This disconnects the antenna and connects the receiver input to J702-1. Connect to chassis ground is made at J702-4.

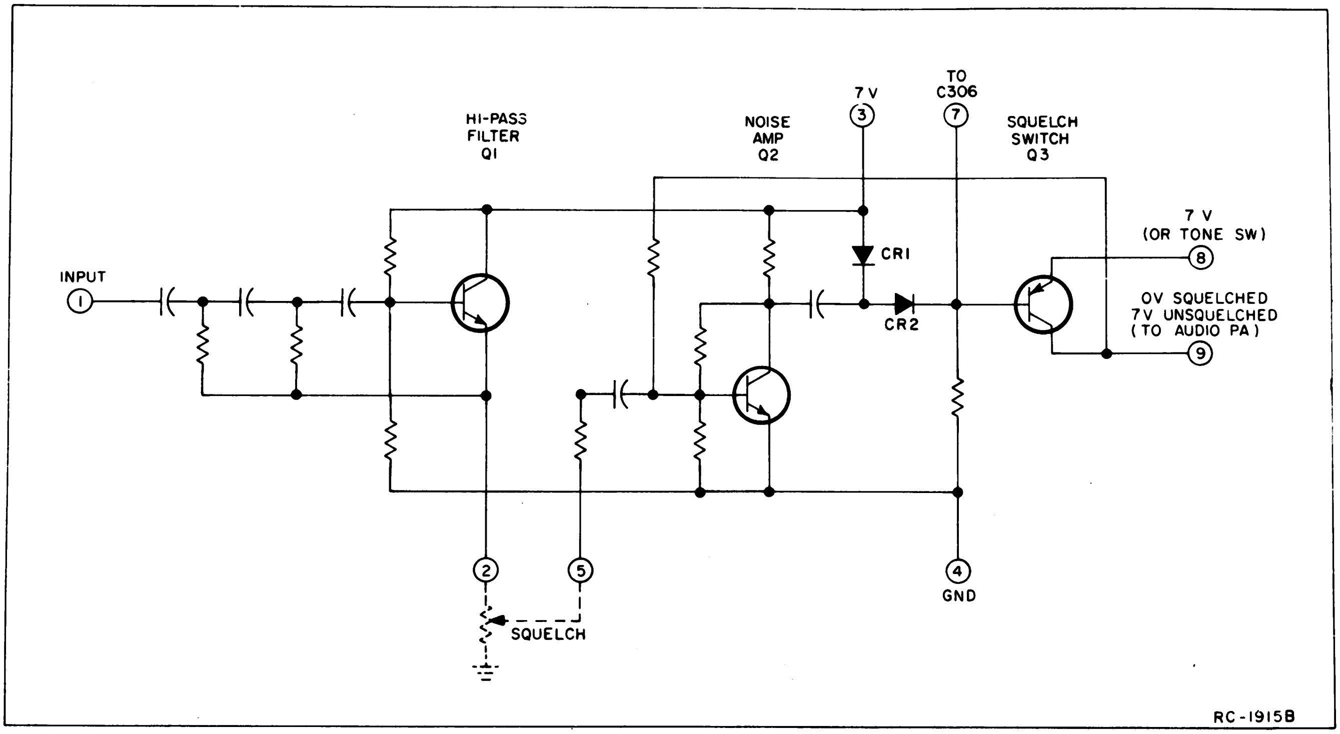


Figure 8 - Typical Squelch Circuit

GENERAL ELECTRIC COMPANY• MOBILE COMMUNICATIONS DIVISION
WORLD HEADQUARTERS• LYNCHBURG, VIRGINIA 24502 U.S.A.

GENERAL ELECTRIC*
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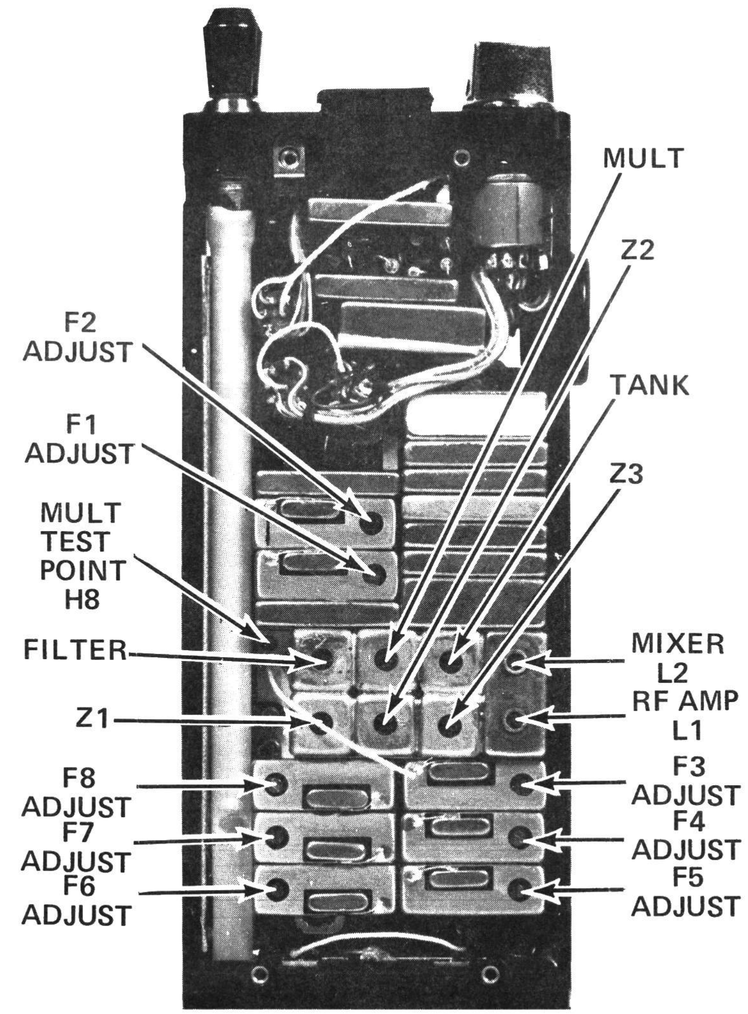
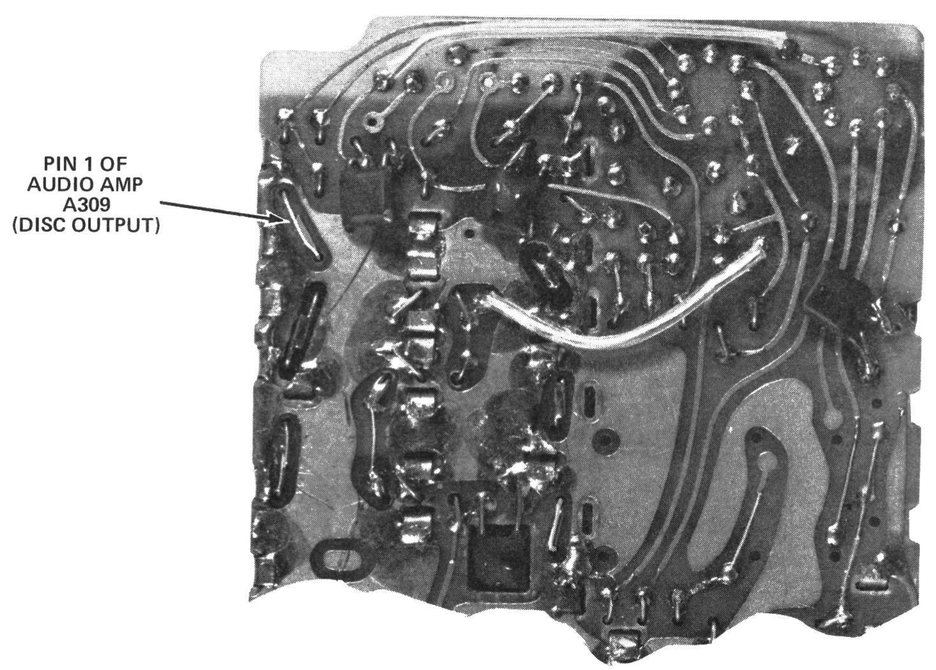
COMPONENT SIDE



SOLDER SIDE



RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. A 20-MHz signal source (GE IF Generator Model 4EX9A10 or equivalent) and a 138-155 MHz source connected to Antenna Switch J702 by Receiver Test Cable 19C317633G1.
2. GE Test Set Model 4EX3A10 or 4EX8K11 or voltmeter with equivalent sensitivity.
3. Distortion Analyzer or AC-VTVM.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. In multi-frequency receivers where the maximum frequency spacing is less than one MHz, align the receiver of the F1 channel. Where the frequency spacing is more than one MHz, align the receiver on the highest frequency.
2. For frequencies in the low end of the band, set the slugs in Z1 thru Z3, RF AMP L1, and Tank L1 to the bottom of the coil form. Set Filter, Mult, and Mixer L2 slugs to the top of the coil form.

   For frequencies near the high end of the band, set the slugs in Z1 thru Z3, Filter, Mixer L2, and Tank to the top of the coil form, set RF AMP L1 and Mult to the bottom of the coil form.
3. Connect the negative lead of the DC Test Set to the Mult Test Point (H8), and the positive lead to ground. Connect the Distortion Analyzer or AC-VTVM across the speaker leads.

ALIGNMENT PROCEDURE

Step No.	Tuning Control	Procedure
1	Mult	Apply an on-frequency signal to J702 and tune Mult for best quieting sensitivity on AC-VTVM.
2	Filter	Adjust Filter for best quieting sensitivity on AC-VTVM.
3	Mult Tank	De-tune Mult. Next, increase the on-frequency input signal and tune Tank for best quieting sensitivity on AC-VTVM.
4	Filter Mult	Adjust Filter and Mult for peak reading on meter connected to H8.
5	Z1, Z2, Z3, RF AMP L1, Mixer L2.	Adjust Z1, Z2, Z3, RF AMP L1, and Mixer L2 for best quieting sensitivity on AC-VTVM.
		FREQUENCY ADJUSTMENT
6		While applying an on-frequency signal to J702, loosely couple a 20-MHz signal to the Mixer. Adjust the Oscillator trimmer(s) for a zero beat frequency between the two signals. <u>Alternate Method</u>: Apply a strong 20 MHz signal to the Mixer. Measure the output of the Discriminator with a DC-VTVM at Pin 1 of A309/A310. Note the reading. Next, remove the 20-MHz signal and apply a strong on-frequency signal to J702. Then tune the oscillator trimmer(s) for the meter reading obtained at Pin 1 of A309/A310.

ALIGNMENT PROCEDURE

138—150.8 MHz RECEIVER
MODELS 4ER59B10 & B12

TEST PROCEDURES

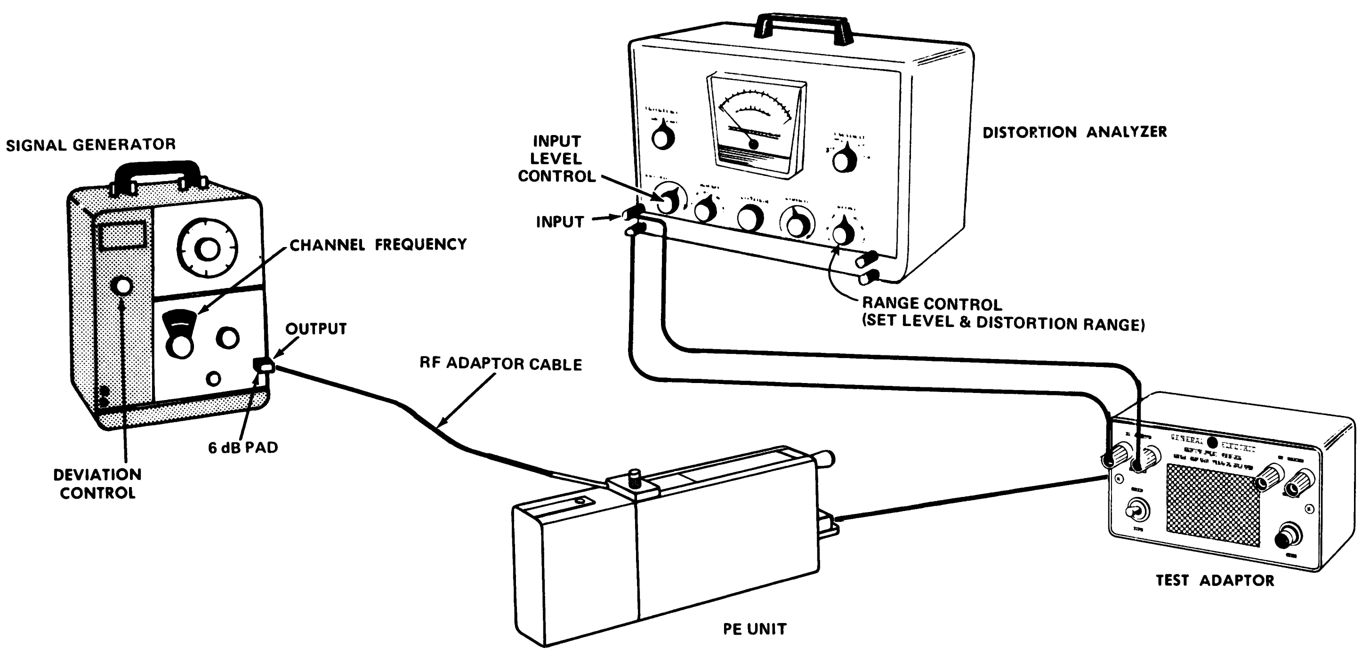
These Test Procedures are designed to help you to service a receiver that is operating --- but not properly. The problems encountered could be low power, poor sensitivity, distortion, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once 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 M-800
- 6-dB attenuation pad
- Test Adaptor Model 4EX12A10
- RF Adaptor Cable 19C317633G1

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. Connect a 1,000-microvolt test signal modulated by 1,000 hertz ±3.3 kHz deviation to the Antenna Switch J702.

B. Set the Volume Control for a 500 milliwatt output (2 volts RMS).

C. Make distortion measurements according to manufacturer's instructions. Reading should be less than 10% (5% is typical). 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 0.5 watt, make the following checks:

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

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

STEP 2

USABLE SENSITIVITY (12 dB SINAD)

TEST PROCEDURE

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

A. Apply a 1000-microvolt, on-frequency signal modulated by 1000 Hz with 3.3-kHz deviation to J702.

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 specification with an audio output of at least 250 milliwatts.

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)

TEST PROCEDURE

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).

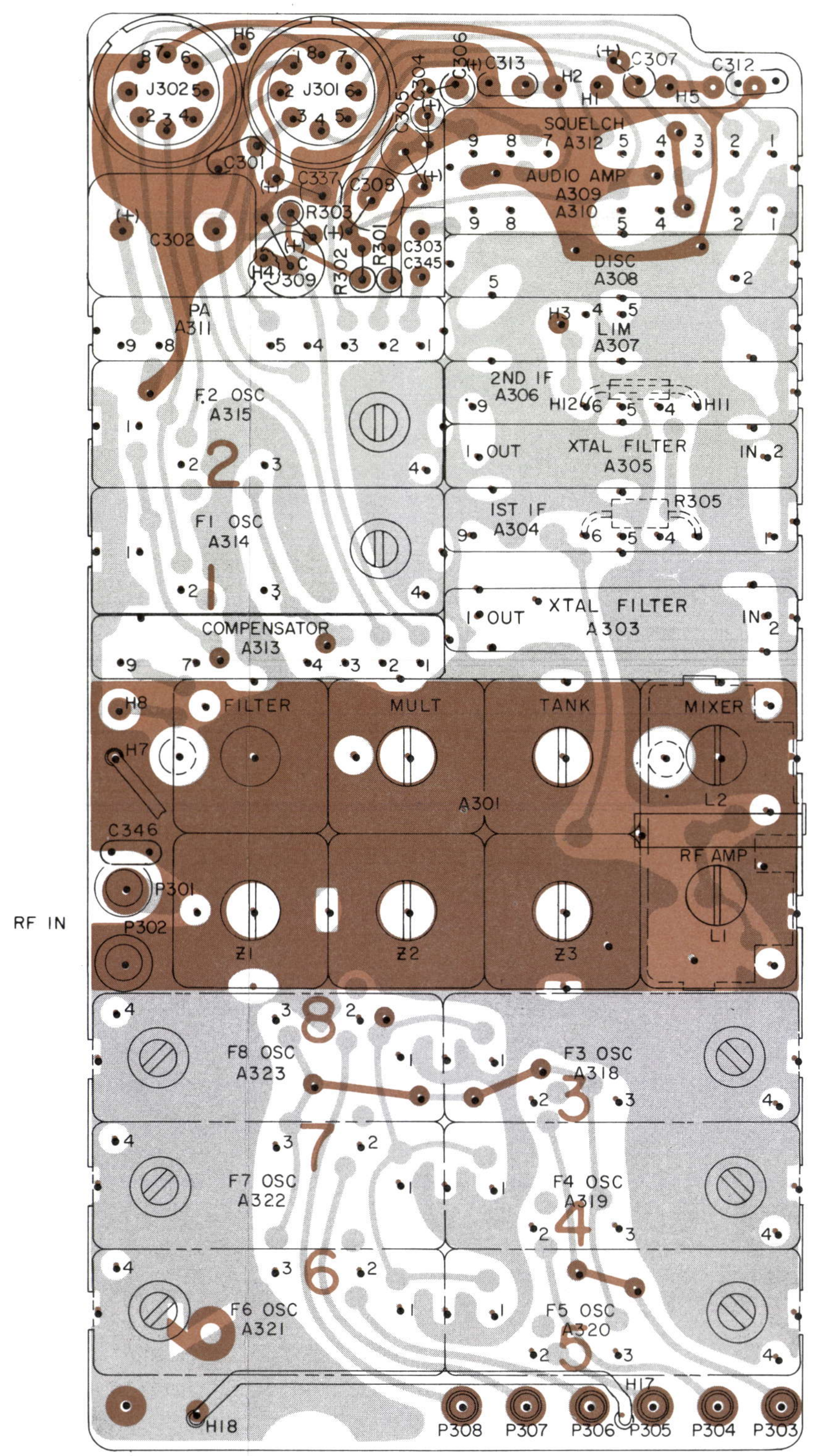
D. The deviation control reading for the 12-dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz (but less than ±9 kHz).

SERVICE CHECK

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

	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
J301	5.4V	AUDIO OUT	SWITCHED 7.5V	SQ ARM	VOL ARM	SQ HI	VOL HI	GND
J302		FREQ 1	FREQ 2			7.5V	TONE SWITCH	GND

COMPONENT SIDE



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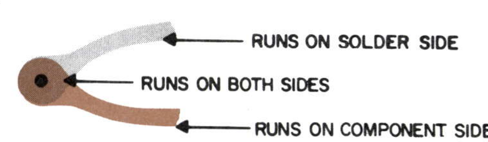
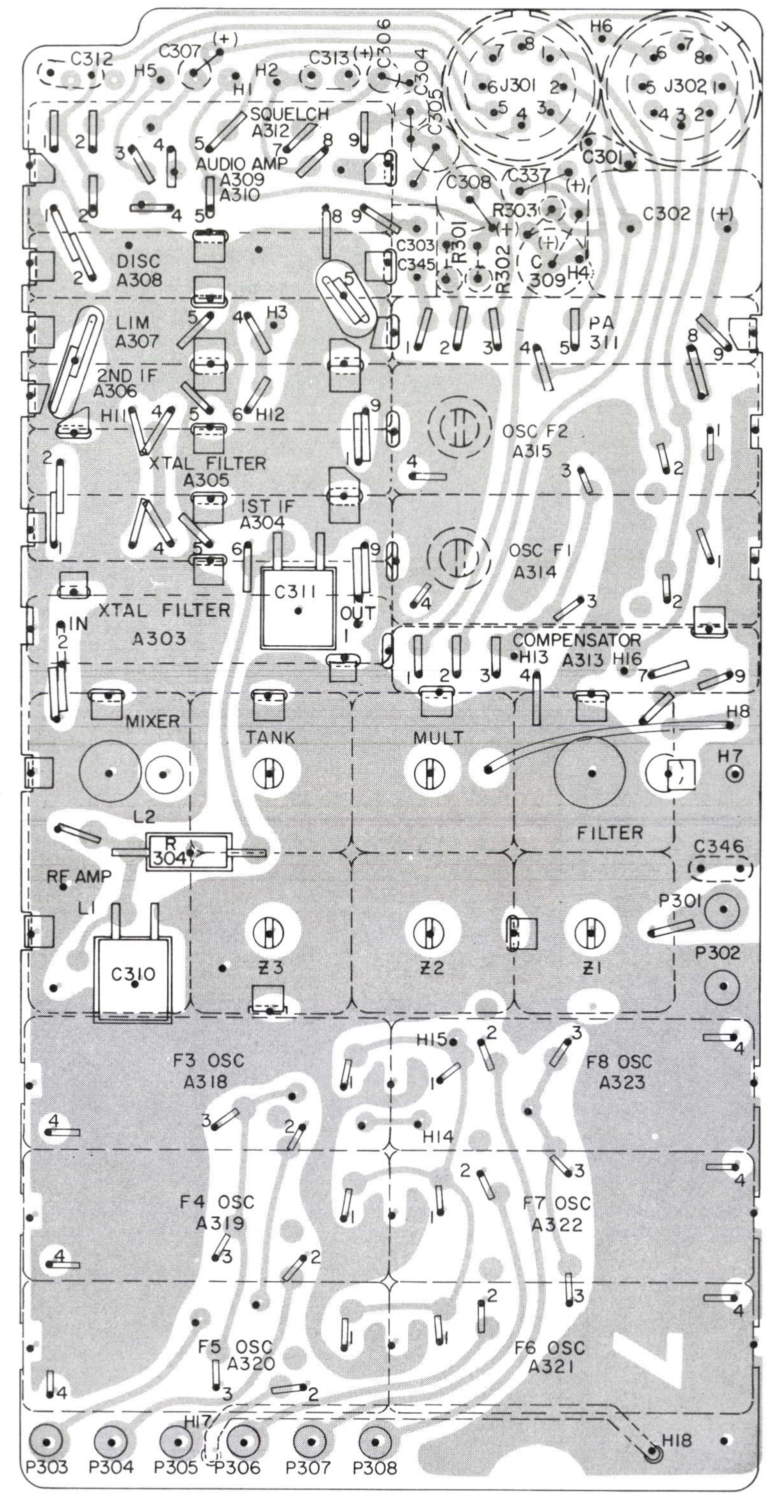
(19D416991, Rev. 6)



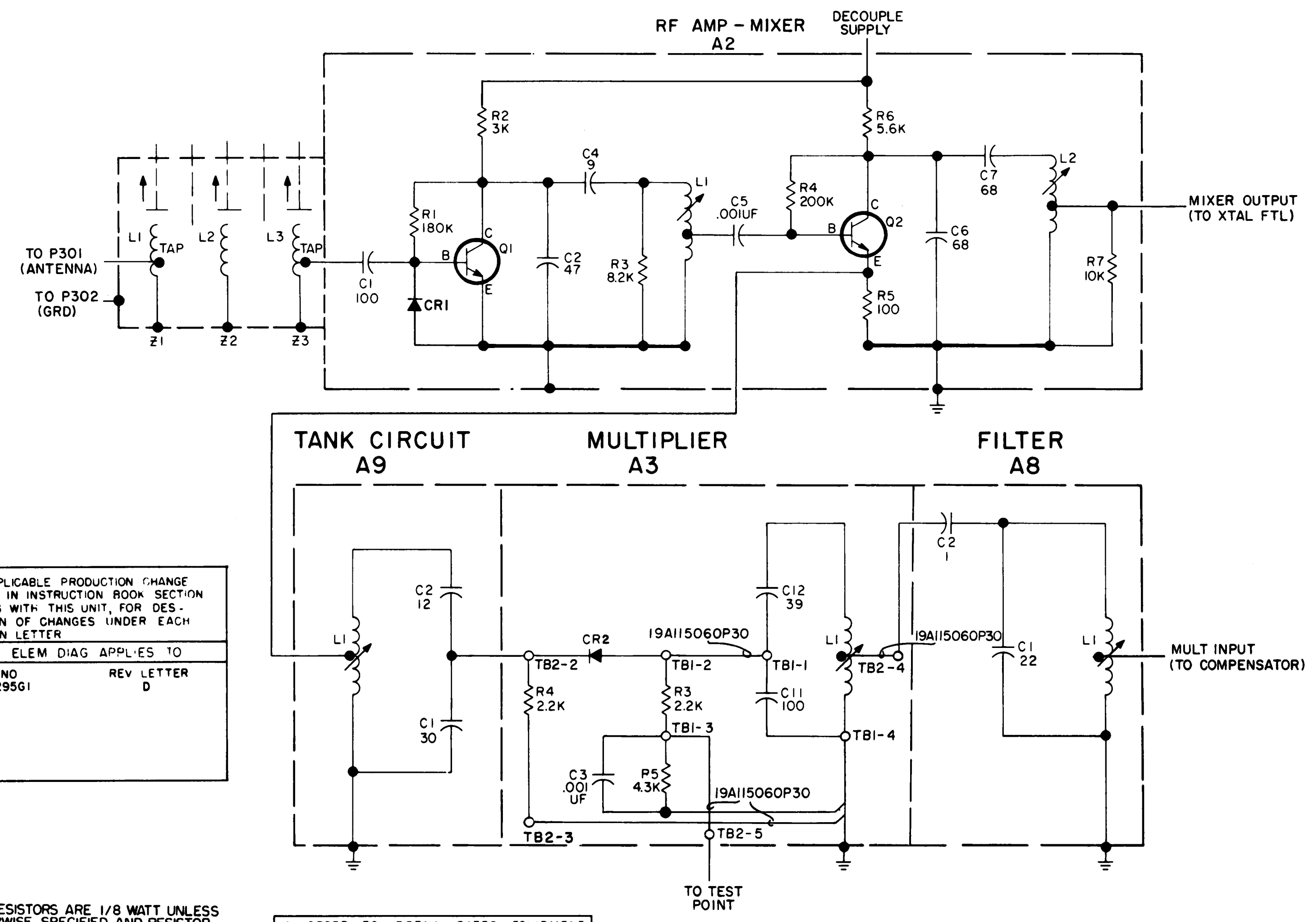
SOLDER SIDE



(19D416896, Sh. 2, Rev. 7)

OUTLINE DIAGRAM

138—150.8 MHz RECEIVER
MODELS 4ER59B10 & B12



SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER	
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
19C317295G1	D

ALL RESISTORS ARE 1/8 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.

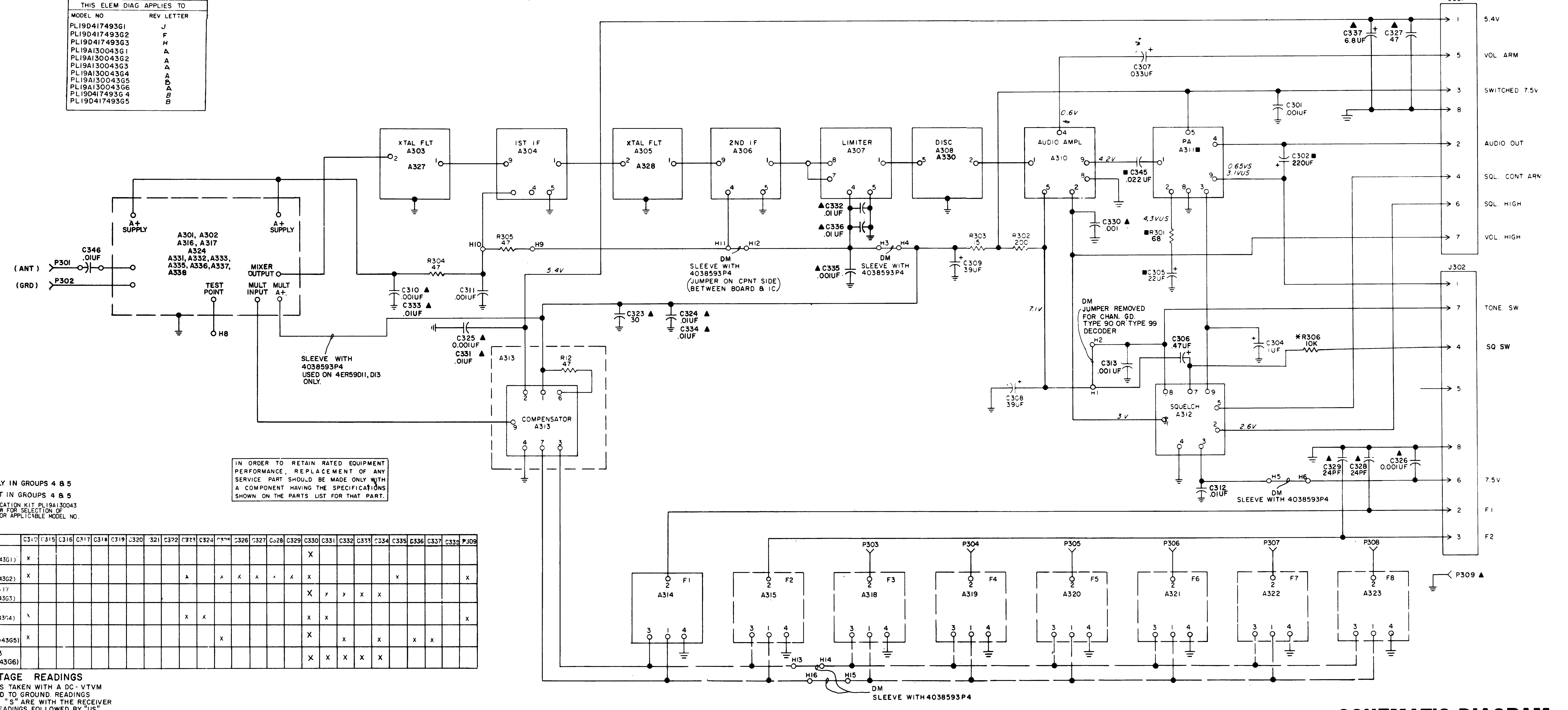
IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

(19C320884, Rev. 5)

SCHEMATIC DIAGRAM

RECEIVER FRONT END (A301)

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.	
THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D417493G1	J
PL19D417493G2	F
PL19D417493G3	H
PL19A130043G1	A
PL19A130043G2	A
PL19A130043G3	A
PL19A130043G4	A
PL19A130043G5	B
PL19A130043G6	A
PL19D417493G4	B
PL19D417493G5	B



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✱ PRESENT ONLY IN GROUPS 4 & 5

■ NOT PRESENT IN GROUPS 4 & 5

▲ PART OF MODIFICATION KIT PL19A130043 SEE CHART BELOW FOR SELECTION OF PROPER PARTS FOR APPLICABLE MODEL NO.

MODEL NO.	C310	C315	C316	C317	C318	C319	C320	C321	C322	C323	C324	C325	C326	C327	C328	C329	C330	C331	C332	C333	C334	C335	C336	C337	C339	P309
4ER59B10-13 (KIT PL19A130043G1)	X																X									
4ER60B10-13 (KIT PL19A130043G2)	X									X		X	X	X	X	X	X					X				X
4ER61B11-13, 15-17 (KIT PL19A130043G3)																	X	X	X	X	X					
4ER62B10, 11 (KIT PL19A130043G4)	X									X	X						X	X								X
4ER59D11, 13 (KIT PL19A130043G5)	X											X					X		X		X		X	X		
4ER87B10-13 (KIT PL19A130043G6)																	X	X	X	X	X					

VOLTAGE READINGS

ALL READINGS TAKEN WITH A DC-VTVM AND MEASURED TO GROUND. READINGS FOLLOWED BY "S" ARE WITH THE RECEIVER SQUELCHED. READINGS FOLLOWED BY "US" ARE WITH THE RECEIVER UNSQUELCHED.

ALL RESISTORS ARE 1/8 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.

(19R622036, Rev. 19)

SCHEMATIC DIAGRAM

138—150.8 MHz RECEIVER
MODELS 4ER59B10 & B12

PARTS LIST

LBI4387E

138-155 MHz RECEIVER
MODEL 4ER59B10
MODEL 4ER59B12

SYMBOL	GE PART NO.	DESCRIPTION
A301		FRONT END 19C317295G1
A2*		RF AMPLIFIER 19C327300G2 (Added by REV C)
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116114P11064	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -4200 PPM.
C2	19A116114P8053	Ceramic: 47 pf ±5%, 100 VDCW; temp coef -1500 PPM.
C4	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C5	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C6 and C7	19A116114P4059	Ceramic: 68 pf ±5%, 100 VDCW; temp coef -220 PPM.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1	19A116052P1	Silicon, hot carrier: Fwd. drop .350 volts max.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B216950G1	Coil.
L2	19B216948G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A116159P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P184J	Composition: 180K ohms ±5%, 1/8 w.
R2	3R151P302J	Composition: 3K ohms ±5%, 1/8 w.
R3	3R151P822J	Composition: 8.2K ohms ±5%, 1/8 w.
R4	3R151P204J	Composition: 200K ohms ±5%, 1/8 w.
R5	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R6	3R151P562J	Composition: 5.6K ohms ±5%, 1/8 w.
R7	3R151P103J	Composition: 10K ohms ±5%, 1/8 w.
A2*		RF AMPLIFIER 19C317445G2 (Deleted by REV C)
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116114P11064	Ceramic: 100 pf ±10%, 100 VDCW; temp coef -4200 PPM.
C2	19A116114P8053	Ceramic: 47 pf ±5%, 100 VDCW; temp coef -1500 PPM.
C4	19A116114P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C5	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C6 and C7	19A116114P4059	Ceramic: 68 pf ±5%, 100 VDCW; temp coef -220 PPM.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1*	19A116052P1	Silicon, fast recovery, 225 mA, 50 PIV. Added by REV B.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B216950G1	Coil.
L2	19B216948G1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A116159P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151P184J	Composition: 180K ohms ±5%, 1/8 w.
R2	3R151P302J	Composition: 3K ohms ±5%, 1/8 w.
R3	3R151P822J	Composition: 8.2K ohms ±5%, 1/8 w.
R4	3R151P204J	Composition: 200K ohms ±5%, 1/8 w.
R5	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R6	3R151P562J	Composition: 5.6K ohms ±5%, 1/8 w.
R7	3R151P103J	Composition: 10K ohms ±5%, 1/8 w.
A3		MULTIPLIER 19C311873G4
		- - - - - - - - - CAPACITORS - - - - - - - - -
C3	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C11	19A116114P2065	Ceramic: 100 pf ±5%, 100 VDCW; temp coef -80 PPM.
C12	19A116114P2050	Ceramic: 39 pf ±5%, 100 VDCW; temp coef -80 PPM.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1*	19A116081P1	Silicon. Deleted by REV D.
CR2*	19A116809P1	Silicon. Added by REV D.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B216296P1	Coil.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R3 and R4	3R151P222J	Composition: 2.2K ohms ±5%, 1/8 w.
R5	3R151P432J	Composition: 4.3K ohms ±5%, 1/8 w.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B200497P5	Tuning slug.
A8		FILTER BOARD 19C320246G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116114P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2	19A116114P1	Ceramic: 1 pf ±10%, 100 VDCW; temp coef 0 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B216296P1	Coil.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B200497P5	Tuning slug.
A9		TANK BOARD 19C320245G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2	19A116114P2033	Ceramic: 12 pf ±5%, 100 VDCW; temp coef -80 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19A129340P1	Coil.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19B200497P5	Tuning slug.
		- - - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B216441G13	Helical resonator. (Part of Z1). Includes:
	19C311727P1	Tuning slug.
L2	19B216441G14	Helical resonator. (Part of Z2). Includes:
	19C311727P1	Tuning slug.
L3	19B216441G15	Helical resonator. (Part of Z3). Includes:
	19C311727P1	Tuning slug.
		- - - - - - - HELICAL RESONATORS - - - - - -
Z1		Consists of L1 and 19D413132P16 can.
Z2		Consists of L2 and 19D413132P3 can.
Z3		Consists of L3 and 19D413132P17 can.
		RECEIVER BOARD 19D417493G1 19D417493G4 VEHICLE REPEATER
A303*	19C304824G1	Crystal Filter.
		In REV B & earlier:
	19C304516G3	Crystal Filter.
A304	19C311879G3	1st IF Amplifier.
A305	19C304824G1	Crystal Filter.
A306	19C311879G4	2nd IF Amplifier.
A307	19C311876G4	Limiter.
A308	19C304504G3	Discriminator.
A309*	19C311878G2	Audio Amplifier. Deleted by REV G.
A310*	19C330341G1	Audio Amplifier. (Includes Tone Filter).
		In REV G:
	19C311995G4	Audio Amplifier. (Includes Tone Filter).
		In REV F & earlier:
	19C311995G2	Audio Amplifier. (Includes Tone Filter).
A311*	19C311877G4	PA.
		In REV E & earlier:
	19C311877G2	PA.
A312*	19C330342G1	Squelch.
		In REV G & earlier:
	19C311880G4	Squelch.
A313	19C320061G1	Compensator.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C301	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C302	19A116178P7	Tantalum: 220 µf ±20%, 6 VDCW.
C303*	19A116089P1	Ceramic: 0.1 µf ±20%, 50 VDCW, temp range -55 to +85°C. Deleted by REV G.
C304	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C305	5491674P35	Tantalum: 22 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C306	5491674P27	Tantalum: .47 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C307	5491674P31	Tantalum: .033 µf ±20%, 35 VDCW; sim to Sprague Type 162D.
C308 and C309	5491674P30	Tantalum: 39 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C311	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C312*	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
		In REV A & earlier:
	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C313	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C314*	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW. Deleted by REV D.
C345*	19A116192P6	Ceramic: 0.022 µf ±20%, 50 VDCW; sim to Erie 8131-M050-W5R-223M. Added by REV E.
C346*	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL. Added by REV J.
		- - - - - - - JACKS AND RECEPTACLES - - - - - -
J301 and J302	19A116122P1	Feed-thru: sim to Warren Co 1-B-2994-4.
		- - - - - - - - - - - PLUGS - - - - - - - - - -
P301 thru P308	19A115834P4	Contact, electrical: sim to AMP 2-332070-9.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R301*	3R151P680J	Composition: 68 ohms ±5%, 1/8 w.
		In REV A-C:
	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
		Earlier than REV A:
	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
R302	3R151P201J	Composition: 200 ohms ±5%, 1/8 w.
R303*	3R151P150J	Composition: 15 ohms ±5%, 1/8 w. Deleted by REV K.
R304 and R305	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
R307*	19A134564P1	Metal film: 15 ohms ±5%, 1/4 w. Added by REV K.
		- - - - - - - - - MISCELLANEOUS - - - - - - - -
	19A127110P1	Screw, phillips: No. 1-64 x 5/32. (Secures A301).
	NP258043	Nameplate. (FCC).
	19C311491P6	Can, vertical. (Used with A310 & A312).
	19B216316P1	Insulator. (Used with J301, J302).
		RECEIVER KIT 19A130043G3
		- - - - - - - - - CAPACITORS - - - - - - - - -
C330*	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW. Added by REV A.
C331 thru C334	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
		ASSOCIATED ASSEMBLIES
		- - - - - - - - - OSCILLATORS - - - - - - - -
		NOTE: When reordering, give GE Part Number and specify exact frequency needed.
A314 and A315	4EG28A15	Oscillator Module. 138-155 MHz. $Fx = \frac{Fo - 20}{8}$
A318 thru A323	4EG28A15	Oscillator Module. 138-155 MHz. $Fx = \frac{Fo - 20}{8}$

*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 - Receiver Models 4ER59B10 & 12
To improve Squelch action.
Changed A312 and A305.

REV. A - Receiver Board 19D417493G1
To improve audio sensitivity.
Changed R301.

REV. A - Receiver Front End 19C317295G1
To improve spurious response.
Deleted R2 and R6. Added R9, R10 and Shield.

REV. B - Receiver Board 19D417493G1
To improve Squelch operation.
Changed C312.

REV. C - To improve producibility.
Changed A303.

REV. D - To improve audio stability.
Deleted C314 and Changed R301.

REV. E - To improve audio frequency response.
Added C345.

REV. F - To improve audio.
Changed A313.

REV. B - Receiver Front End 19C317295G1
To add protection to RF and Mixer transistors. Added CR1.

REV. C - To ease assembly, troubleshooting and repair.
Changed A2.

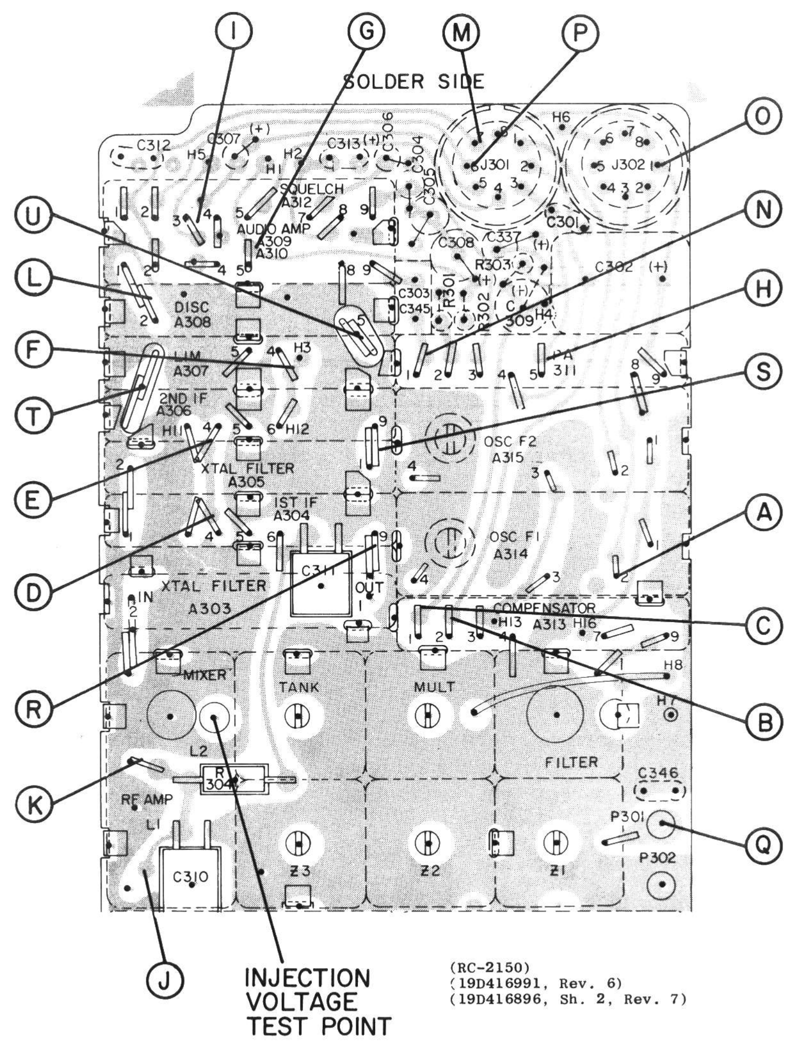
REV. G - Receiver Board 19D417493G1
To delete non-Channel Guard receiver boards.
Added A310 and C345.
Deleted drawing callouts ■A309 and circle (●) in front of A312.
Deleted drawing callouts C303, .1 µf and circle (●) in front of C345.
Deleted NOTE: ●Used with Channel Guard receivers.

REV. A - Receiver Kit 19A130043G3
To improve IF filtering. Added C330.

REV. H - Receiver Board 19D417493G1
This revision is "VOID".

REV. J - To provide DC isolation of relay receive contacts from antenna circuit.
Added C346.

REV. D - Receiver Front End 19C317295G1
To replace single source diode with a multi-source diode.
Deleted CR1.
Added CR2 and R8.



(RC-2150)
(19D416991, Rev. 6)
(19D416896, Sh. 2, Rev. 7)

QUICK CHECKS

SYMPTON	PROCEDURE
No Audio	1. Check audio waveform at the top of the Volume Control (see Step 2). 2. If audio is present, check voltage readings of Audio and Squelch modules (see Schematic Diagram). 3. If audio is not present, check gain and current readings of Front End and IF modules (see Steps 1 & 3).
Poor Sensitivity	1. Measure the injection voltage for a minimum level of 30 millivolts. If the reading is low, check the output of the Oscillator and Compensator modules with an RF voltmeter. 2. Measure the gain of the Mixer stage (see Step 3). If low, measure the gain of the RF amplifier and IF modules.
Improper Squelch Operation	1. Check the noise waveform at the input to the Squelch module and at Squelch Control high (see Step 2). 2. Measure the DC voltages for the Squelch module (squelched and unsquelched).

STEP 3 - RF GAIN CHECKS
(STEPS Q THRU U)

STEP 3 - RF GAIN CHECKS

EQUIPMENT REQUIRED:

1. RF probe and Test Amplifier Model 4EX16A10 connected to GE Test Set Model 4EX3A10, or an RF voltmeter.
2. A signal generator (M-800 or equivalent) connected to P301 (High) and P302 (Low).

PROCEDURE FOR MIXER & 1ST IF:

1. Switch the Test Set to the Test 1 position and the Test Amplifier to the X50 position.
2. Connect the RF probe across the input of the stage to be measured as shown on the diagram. Increase the signal generator output to obtain a reference reading on Test Set 4EX3A10. Note the Test Set reading and the dB reading on the generator (dB1).
3. Connect the RF probe to the output of the stage to be measured as shown on the diagram. Decrease the generator output until the Test Set reference reading in Step 2 is obtained. Note the dB reading on the generator (dB2).
4. Subtract the dB1 reading from the dB2 reading and check the results with the typical gains shown on the diagram.

```
            35 dB (dB2)
Example:   -15 dB (dB1)
            20 dB gain
```

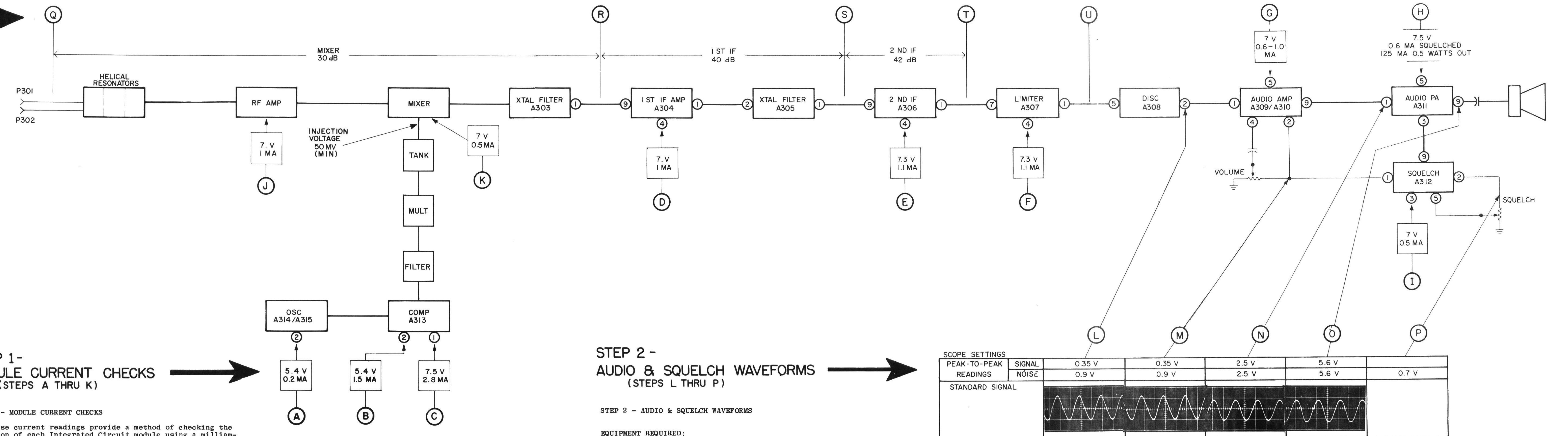
PROCEDURE FOR 2ND IF:

1. With no signal in, connect the RF probe to the output of the 2nd IF module. Increase the signal generator output until the Test Set reading increases by approximately 0.2 volt. Note Test Set and signal generator reading (dB2).
2. Connect the probe to the input of the 2nd IF module. Increase the signal generator until the Test Set reference reading is obtained, and note the dB reading (dB1).
3. Now subtract dB2 from dB1 to obtain the gain of the 2nd IF amplifier module.

LIMITER CHECK

The Limiter module limits on noise so tha the gain of the circuit cannot be measured. The following procedure provides a check to determine if the module is limiting.

1. Switch the Test Amplifier to the X1 position and the Test Set to the Test 1 position. Then connect the RF probe to the output of the Limiter module and check for a reading of approximately 0.4 volt.
2. Increase the signal generator output. There should be no appreciable increase in the limiter output meter reading.



STEP 1 - MODULE CURRENT CHECKS
(STEPS A THRU K)

STEP 1 - MODULE CURRENT CHECKS

These current readings provide a method of checking the operation of each Integrated Circuit module using a milliammeter (Triplett 630 or equivalent).

1. Unsolder the + lead as shown in the Diagram of the module to be checked.
2. Connect the milliammeter in series with the + lead, and check for the indicated current drain and supply voltage. No current drain indicates that the module should be replaced.

CAUTION

When checking the current of Audio PA module A311, do not short Pin 4 to ground or to + (Pin 5). To do so will destroy the Audio PA module.

STEP 2 - AUDIO & SQUELCH WAVEFORMS
(STEPS L THRU P)

STEP 2 - AUDIO & SQUELCH WAVEFORMS

EQUIPMENT REQUIRED:

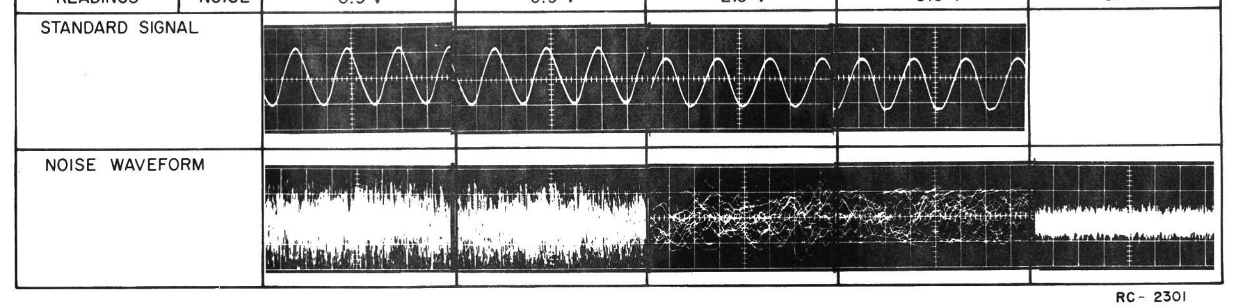
- Oscilloscope connected between the points shown and ground.
- Signal Generator (Measurements M-800 or equivalent).

PRELIMINARY STEPS:

1. Apply a standard signal to P301. A standard signal is 1000 microvolts on the receiver frequency modulated by one kHz with 3.3-kHz deviation.
2. Set the Volume control for 0.5-watt output.

SCOPE SETTINGS

		L	M	N	O	P
PEAK-TO-PEAK READINGS	SIGNAL	0.35 V	0.35 V	2.5 V	5.6 V	
	NOISE	0.9 V	0.9 V	2.5 V	5.6 V	0.7 V



RC- 2301

TROUBLESHOOTING PROCEDURE

138—150.8 MHz RECEIVER
MODELS 4ER59B10 & B12