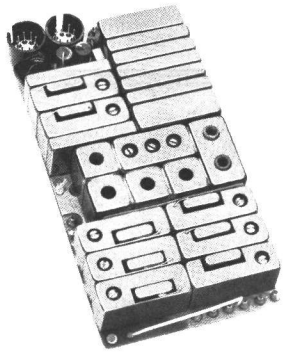
MOBILE RADIO

MASTR® Personal Series
PROGRESS LINE

PE MODELS
150.8–174 MHz, RECEIVER TYPE ER-59-D



ER-59-D

SPECIFICATIONS *

Type Number	ER-59-D
Audio Output (EIA)	500 milliwatts at less than 5% distortion
Channel Spacing	30 kHz
Sensitivity	
12-dB SINAD (EIA Method)	0.35 µV
20-dB Quieting Method	0.50 µV
Selectivity	
EIA Two-Signal	-85 dB at ±30 kHz
20-dB Quieting Method	-110 dB at ±30 kHz
Spurious Response	-80 dB
Intermodulation (EIA)	-75 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	0.25 µV
Maximum Squelch	Greater than 20-dB Quieting

Maximum Frequency Spread (MHz)	Full Performance	1 dB Degradation in Sensitivity
	0.60 MHz	1.20 MHz

*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 4ER59D11 and 13 are single conversion, superheterodyne FM receivers for one through eight frequency operation on the 150.8-174 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
4ER59D11	150.8-174 MHz	3 to 8	
4ER59D13	150.8-174 MHz	3 to 8	Channel Guard

References to symbol numbers mentioned in the following text 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 4EG28A11 (150.8-174 MHz) 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 14.53 to 17.11 MHz and the crystal frequency is multiplied 9 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 jumper is removed, and the proper

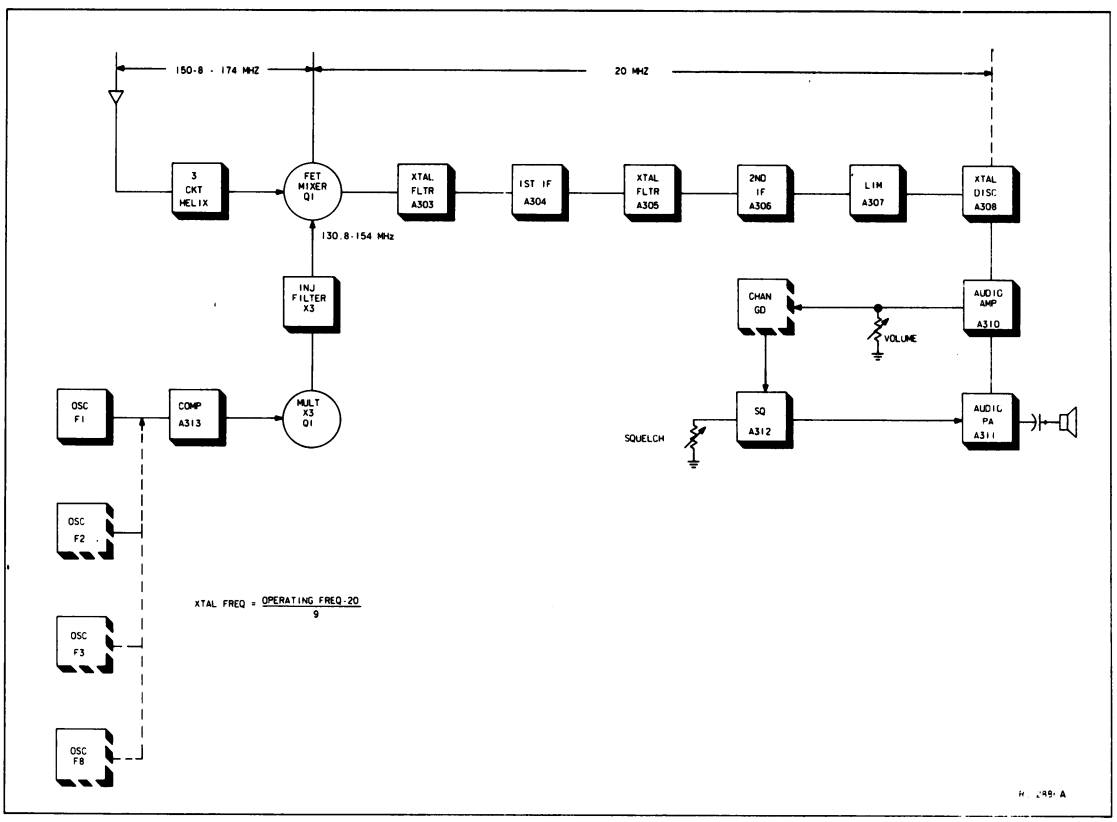


Figure 1 - Receiver Block Diagram

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 (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 A338 (19C317295G10)

Receiver Front End Assembly 19C317295G10 consists of RF helical resonators Z28, Z29 and Z30, and Mixer, Multiplier and injection filter circuit A16. A16 consists of Mixer-Multiplier circuit A1 and Injection Filter A1 and A3.

The crystal frequency from the receiver compensator module is applied to resonator circuit L1, C1 and C2 in Multiplier Circuit A1. Resonator circuit L1, C1 and C2 is tuned to three times the 14.53 to 17.11 MHz crystal frequency and is connected in the base circuit of multiplier

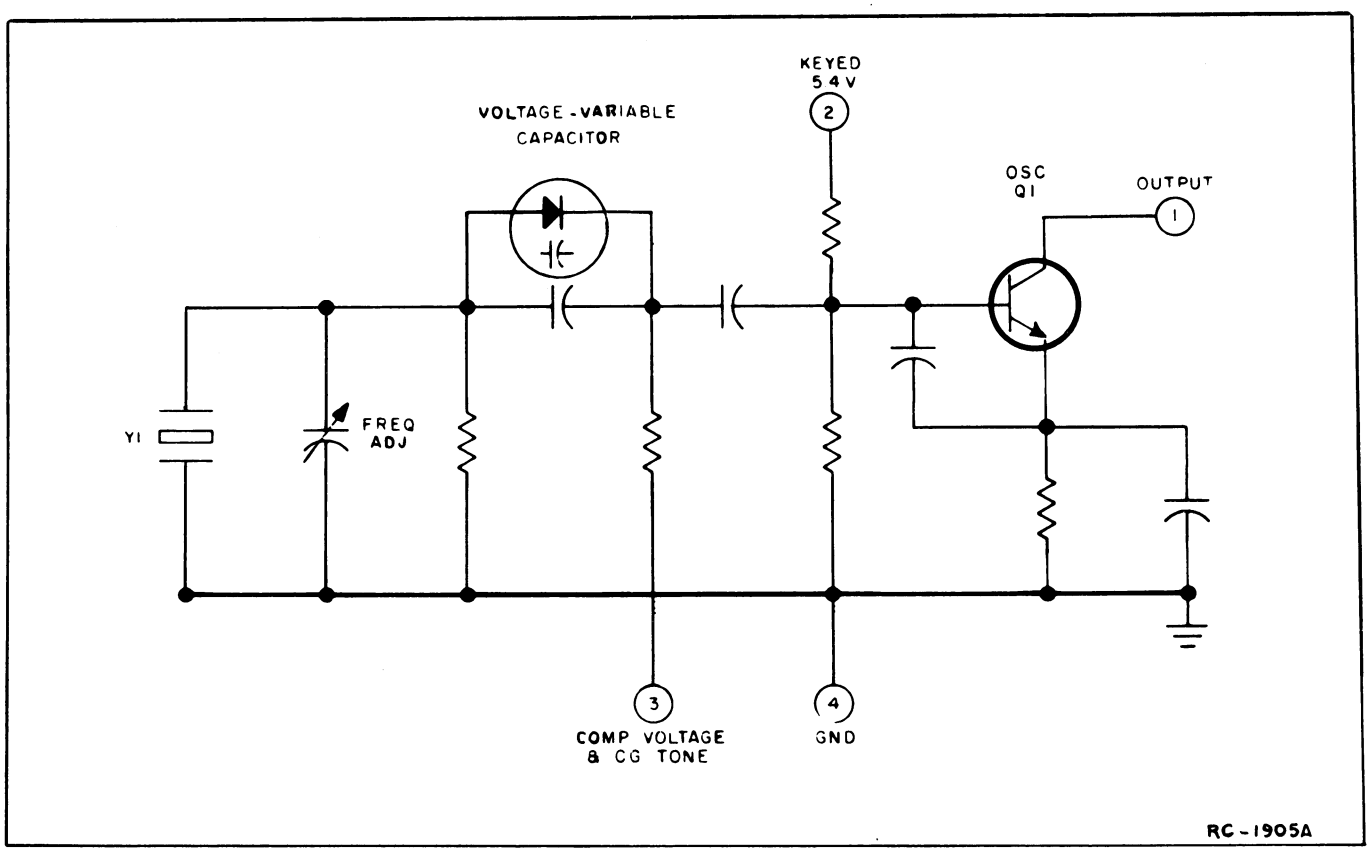


Figure 2 - Typical Oscillator Circuit

transistor Q1. The collector of Q1 is connected to the input of injection filter A1-A3. Injection filter A1-A3 is tuned to nine times the crystal frequency for an injection frequency of 130.8 to 154 MHz. The output of A1-A3 is connected to the source of Field Effect Transistor (FET) Q2 in mixer circuit A1.

RF from the antenna is connected to the tap on helical L27. The tap is positioned to provide proper impedance matching to the antenna. RF energy is coupled to helical coil L7 through openings in the sides of the cans. RF is coupled from a tap on L8 through capacitor C10 to L5 in mixer circuit A1. L5 is connected in the gate circuit of FET Q2. The result of the RF signal on the gate of FET Q2 and the injection frequency on the source is a 20 MHz IF on the drain. The 20 MHz IF is coupled through C12 to the input of the receiver crystal filters and coupling networks.

FRONT END A335

Receiver Front End Assembly 19C317295G8 consists of RF helical resonators Z26, Z7 and Z27, Mixer circuit A12/A15, multiplier circuit A13 and injection filter circuit A14. The crystal frequency from the receiver compensator module is applied to resonator circuit L1, C1 and C2 in Multiplier module A13. Resonator circuit L1, C1 and C2 is tuned to three times the 14.53 to 17.11 MHz crystal frequency and is connected in the base of multiplier transistor Q1. The collector of Q1 is connected to the input of injection filter A14. Injection filter A14 is tuned to nine times the crystal frequency for an injection frequency of 130.8 to 154 MHz. The output of A14 is connected to the source of Field Effect Transistor (FET) Q1 in mixer module A12/A15.

RF from the antenna is connected to a tap on helical L26. The tap is positioned to provide proper impedance matching to the antenna. RF energy is coupled to helical coil L8 through openings in the sides of the cans. RF is coupled from a tap on L8 through capacitor C8 to L1 in mixer module A12/A15. L1 is connected in the gate circuit of FET Q1. The result of the RF signal on the gate of FET Q1 and the injection frequency on the source is a 20 MHz IF on the drain. The 20 MHz IF is coupled through matching network C4 and C5 to the input of the receiver crystal filters and coupling networks. Refer to Table of Contents for Service Sheets.

CRYSTAL FILTERS A303 & A305

Filter A303 follows the receiver front end 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. A305 provides a minimum of 85-dB stop-band attenuation.

IF AMPL A304 & A306

An IF Amplifier module follows each of the crystal filters, and contain the

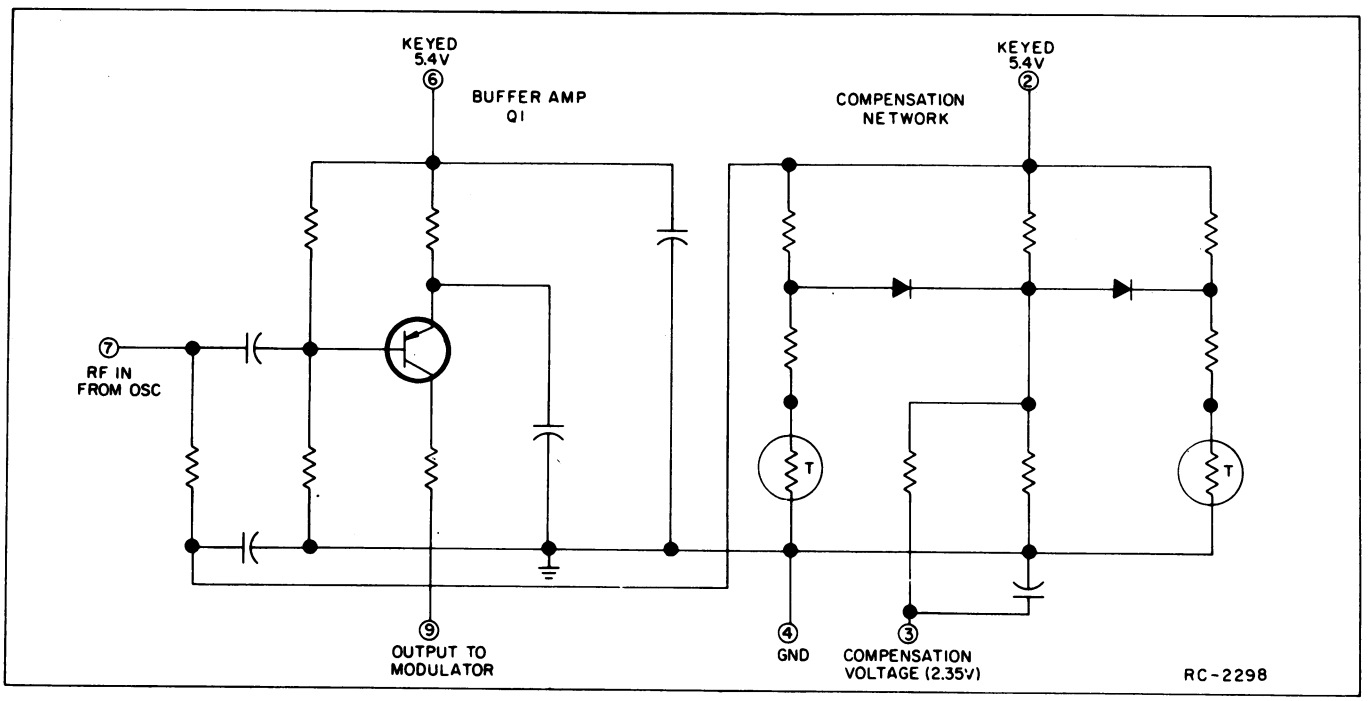


Figure 3 - Typical Compensator Circuit

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.

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.

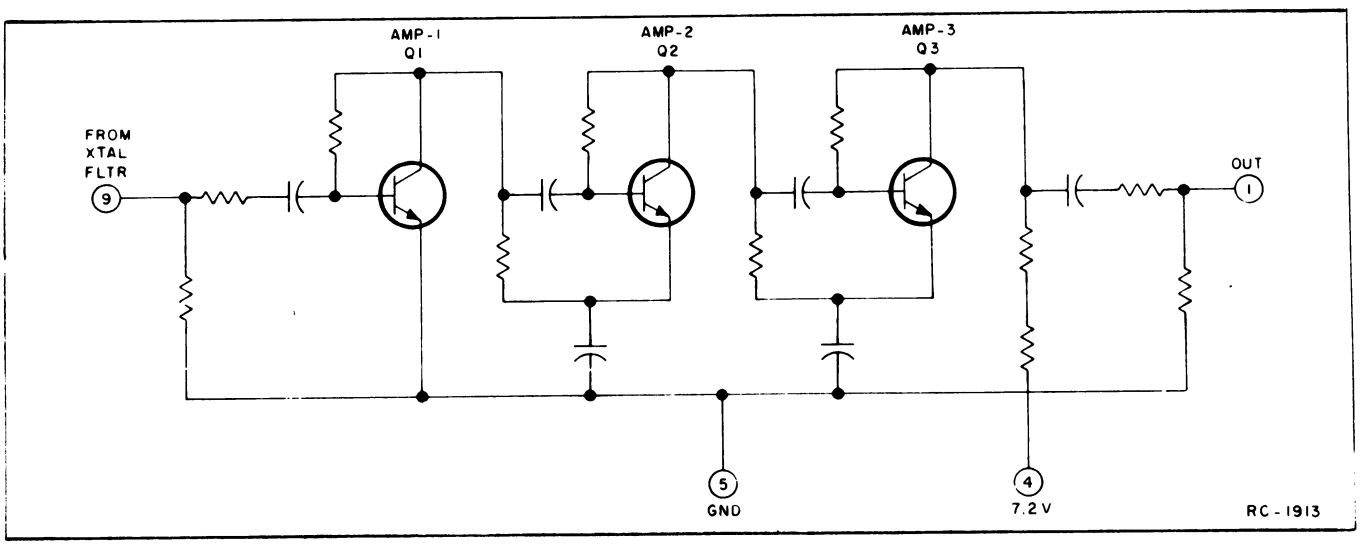


Figure 4 - Typical IF Amplifier Circuit

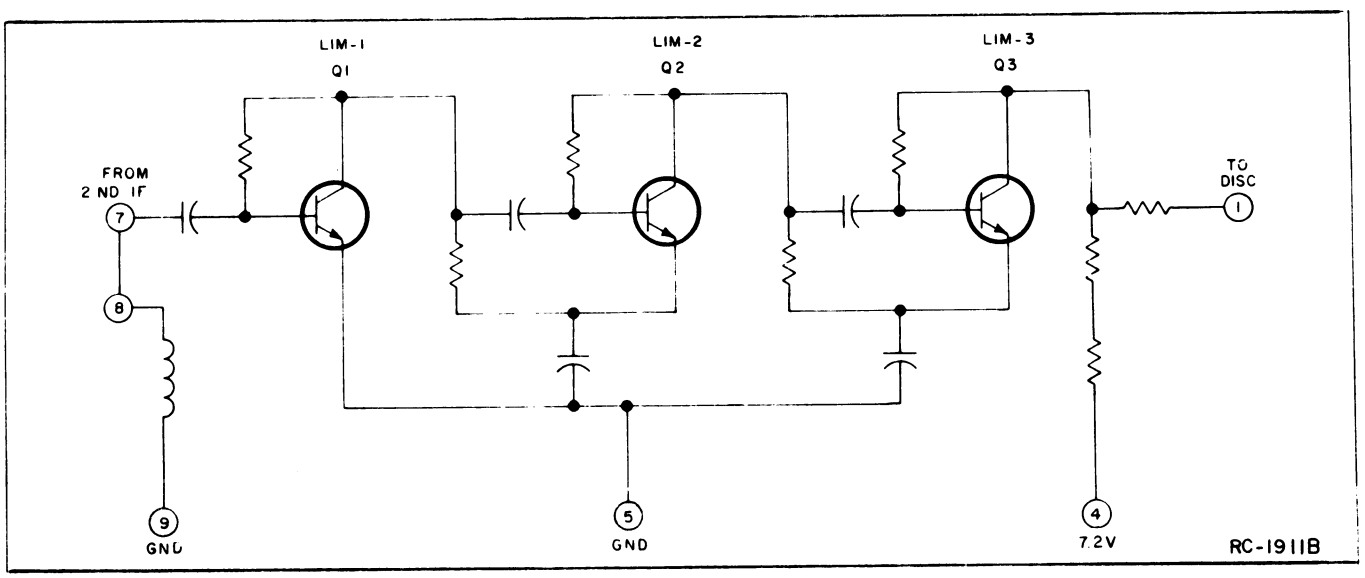


Figure 5 - Typical Limiter Circuit

AUDIO AMPLIFIER A310

Audio and noise from the discriminator is applied to Audio Amplifier Module A310. 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 state (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 the 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.

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.

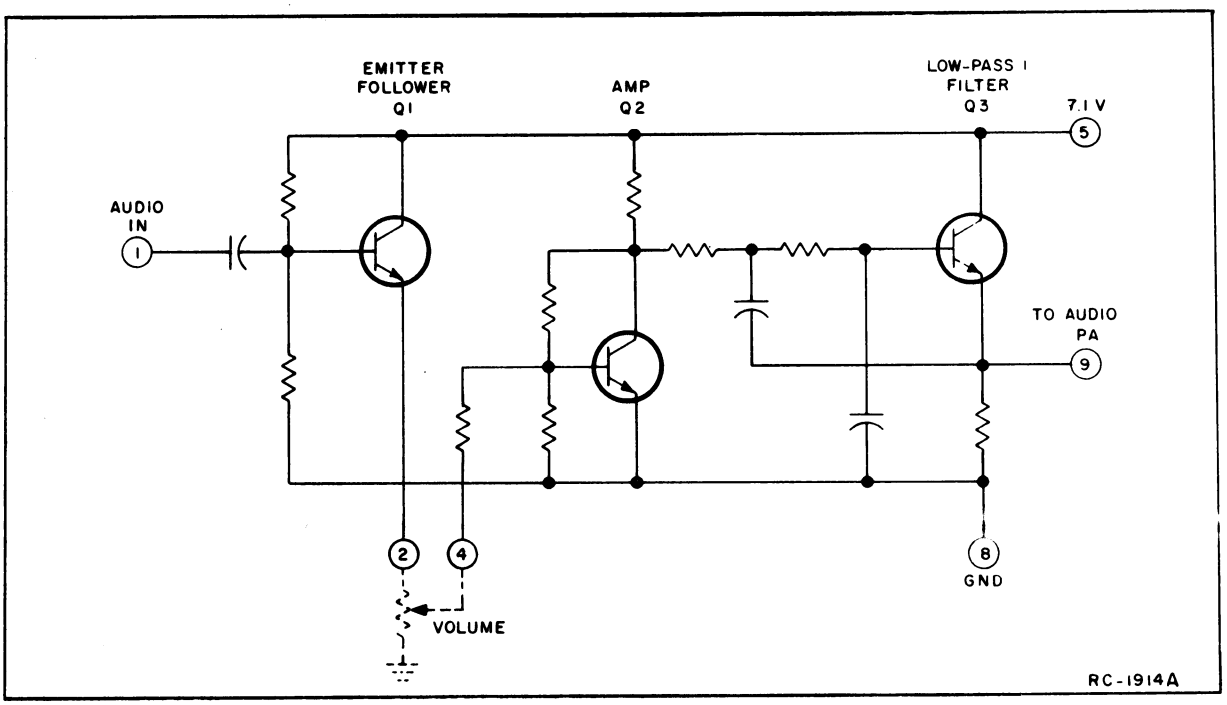


Figure 6 - Typical Audio Amplifier

MOBILE DETECTOR APPLICATIONS

PE receiver types ER59D are used as Mobile Detector boards used in Vehicular Repeater applications. Detector boards 19D417493G4, & G5 are similar to PE receiver boards except that PA module A311, C302, C305, C345 and R301 are not used. Also, R306 (3R151P103J) is added.

The Mobile Detector monitors the mobile radio transmit frequencies to determine if a second vehicular repeater is repeating portable-to-base station transmissions. If a portable-to-base transmission is in progress, the mobile detector prevents the Vehicular Repeater from becoming the priority unit.

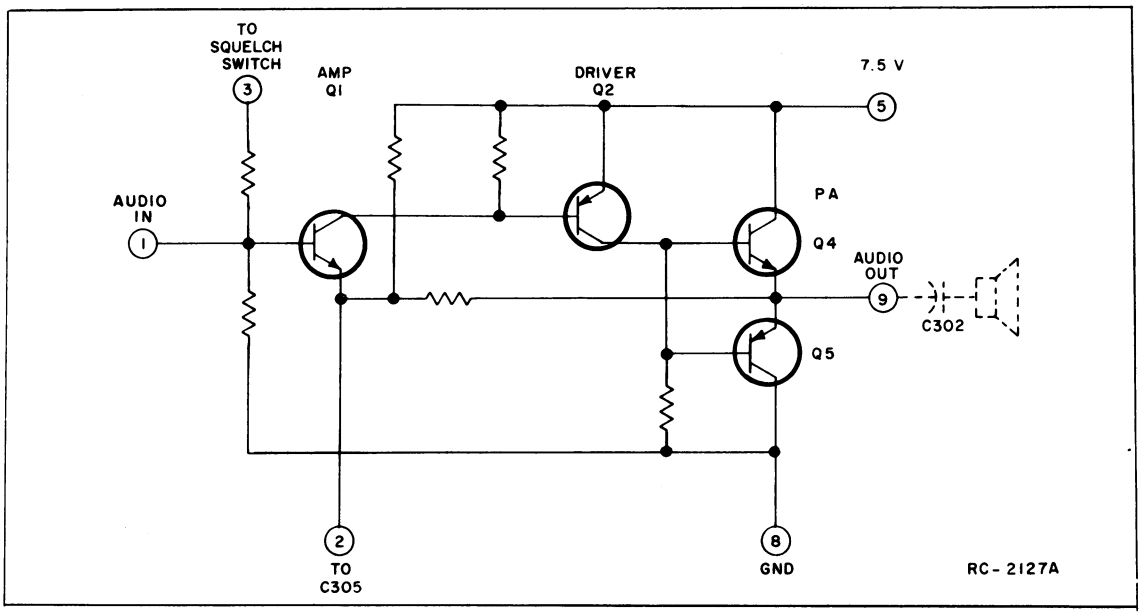


Figure 7 - Typical Audio PA Circuit

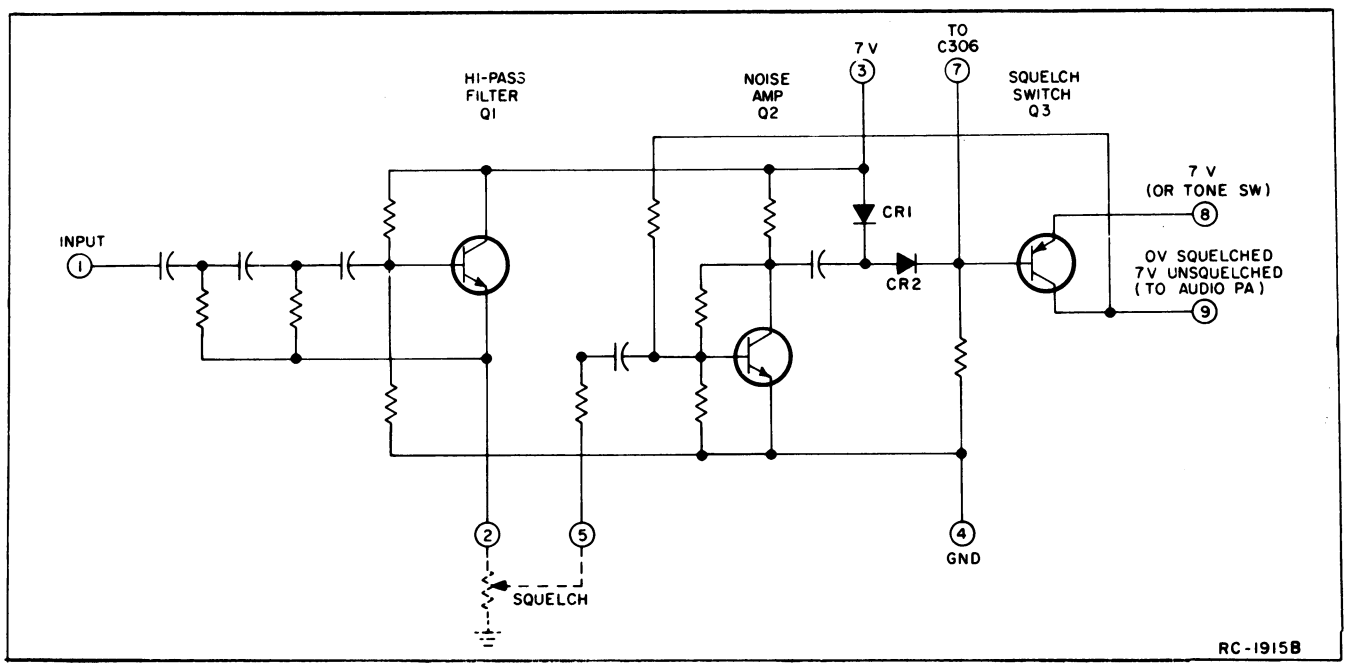


Figure 8 - Typical Squelch Circuit

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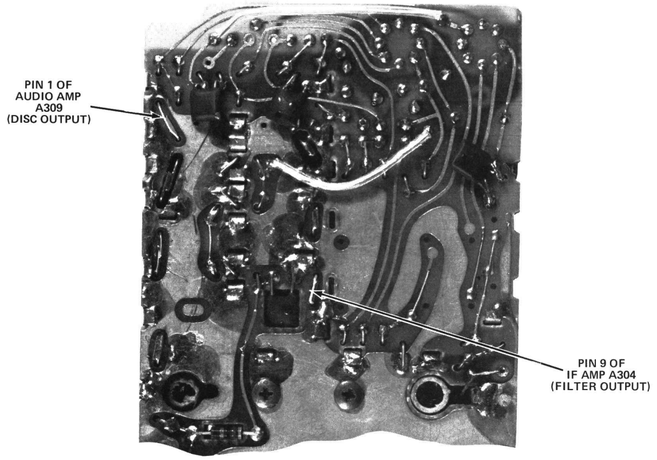
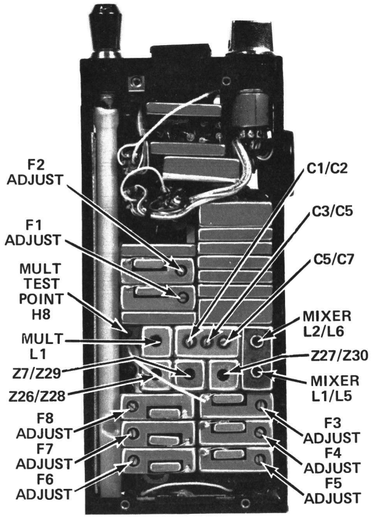




RECEIVER ALIGNMENT

EQUIPMENT

1. A 150.8-174 MHz source connected to antenna switch J702 by receiver test cable 19C317633G1.
2. GE Test Amplifier Model 4EX16A10 and RF probe 19C311370G1, or equivalent RF voltmeter.
3. Tektronix Oscilloscope Model No. 515A or equivalent.

PRELIMINARY ADJUSTMENTS

1. Set tuning slug in multiplier coil L1 at the top of the can for frequencies at the low end of the range, middle of the can for frequencies in the middle of the range and at the bottom of the can for frequencies at the high end of the range.
2. Set helical resonators Z26/Z28, Z7/Z29 and Z27/Z30 at the top of the can for frequencies at the high end of the range and at the bottom of the can for frequencies at the low end of the range.
3. Connect the 150.8-174 MHz source to the antenna jack with 50 millivolts output.

RECEIVER ALIGNMENT

Step No.	Tuning Control	Procedure
1.	Z26, Z7 & Z27 Z26/Z28, Z7/Z29, & Z27/Z30	With an on frequency signal applied to the antenna jack, tune helicals Z26/Z28, Z7/Z29 and Z27/Z30 for maximum quieting sensitivity.
2.	Mixer L1/L5	Tune L1/L5 for maximum quieting sensitivity.
3.	Filter C1/C2, C3/C5 & C5/C7	Tune C1/C2, C3/C5 & C5/C7 for maximum quieting sensitivity.
4.	Mult. L1	Tune L1 for maximum quieting sensitivity.
5.	Mixer L2/L6	Modulate the 20 kHz signal generator with the sawtooth output of the oscilloscope. Set the sweep rate for 2 ms/cm. Connect the output of the detector probe to the vertical input of the scope. Set the vertical sensitivity of the scope for highest sensitivity. With the probe connected to pin 9 of A304 increase the input of the generator until the IF band pass is displayed on the scope. Adjust L2/L6 for maximum flatness. NOTE: The mixer will tune with the slug in two positions. The correct position is the one closest to the board.
		FREQUENCY ADJUSTMENT
6.	F1 Adjust F2 Adjust	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 the two signals. Alternate Method: 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.

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.

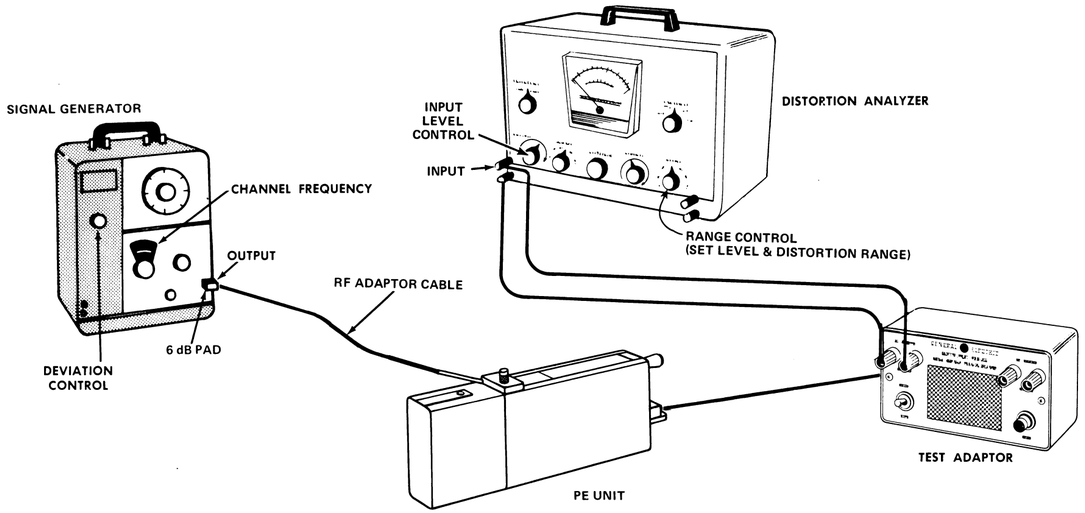
Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

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 ± 3.0 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 3.0-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.

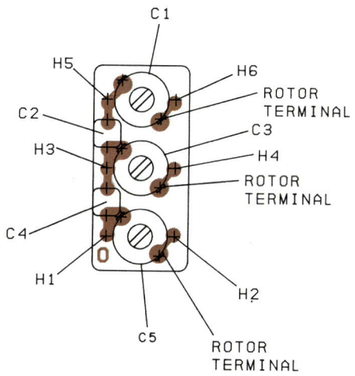
B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000-Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

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.



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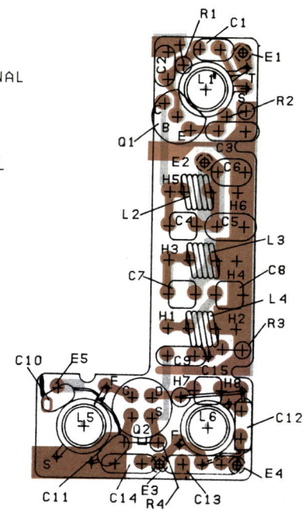

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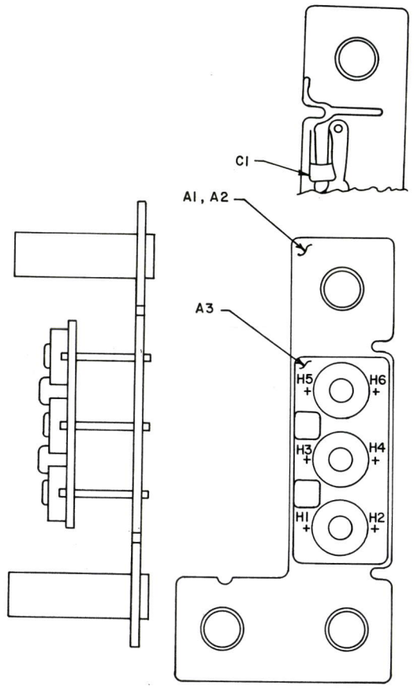

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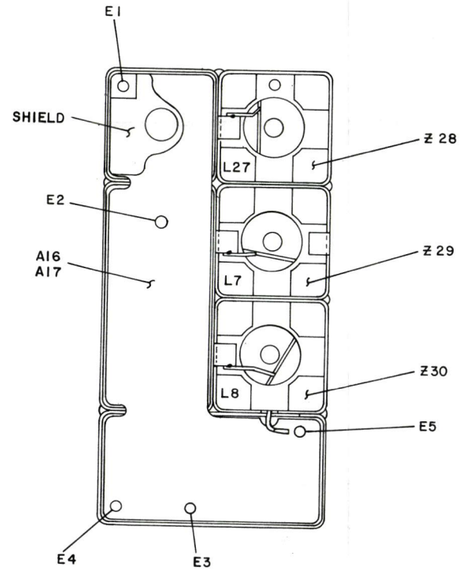

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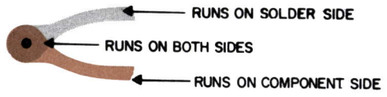
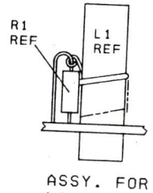
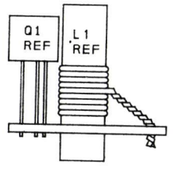
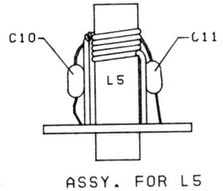




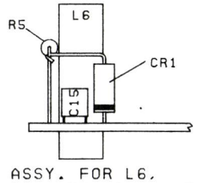
ASSY. FOR
L1 AND R1



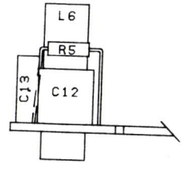
ASSY. FOR
L1 AND Q1



ASSY. FOR L5
C10 AND C11

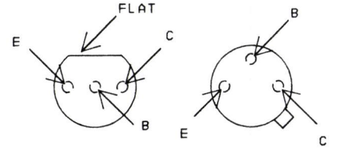


ASSY. FOR L6,
R5, CR1, AND C15



ASSY. FOR L6, R5,
C12 AND C13

LEAD IDENTIFICATION
FOR Q1



OR
IN-LINE TRIANGULAR
VIEW FROM LEAD END

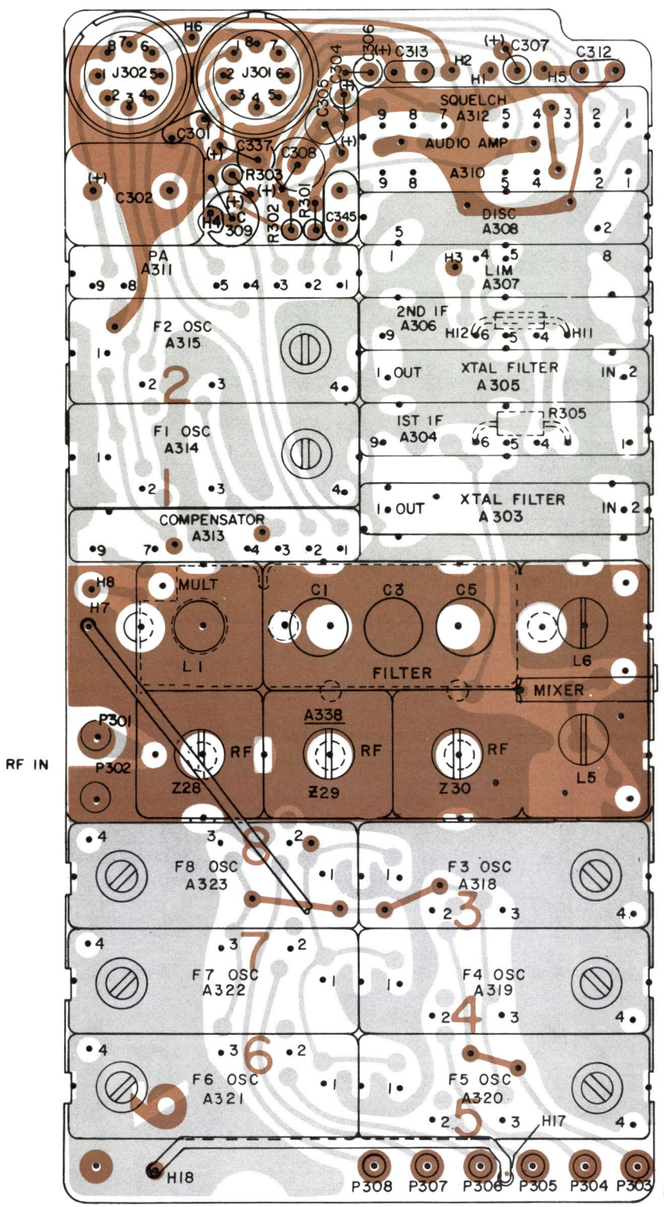
NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

OUTLINE DIAGRAM

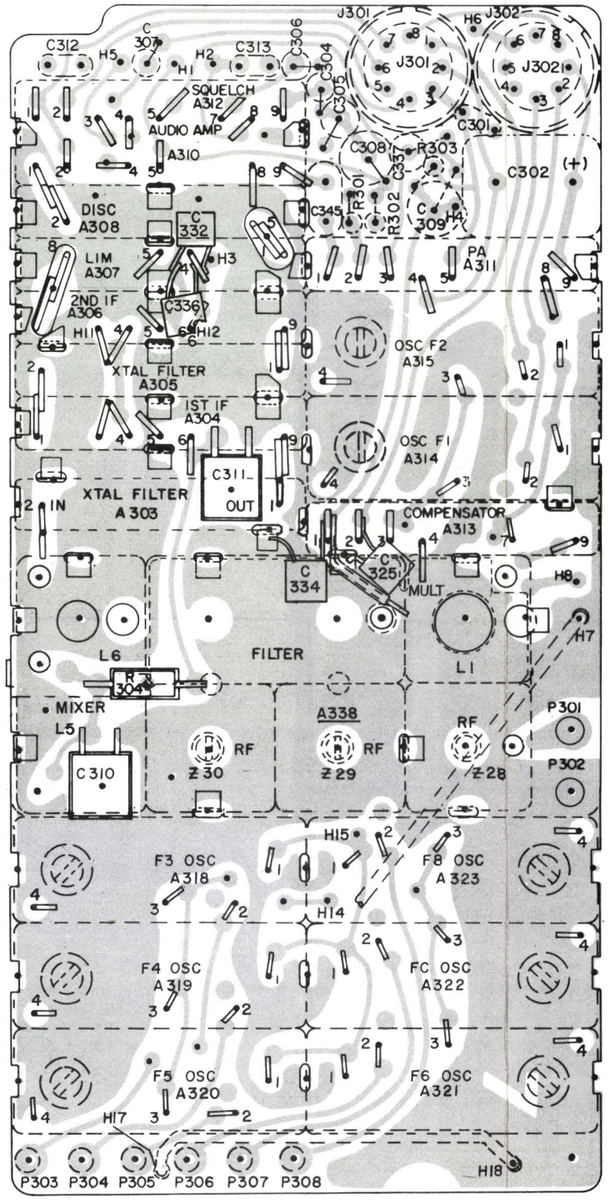
150.8—174 MHz RECEIVER
FRONT END (A338)

	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



SOLDER SIDE



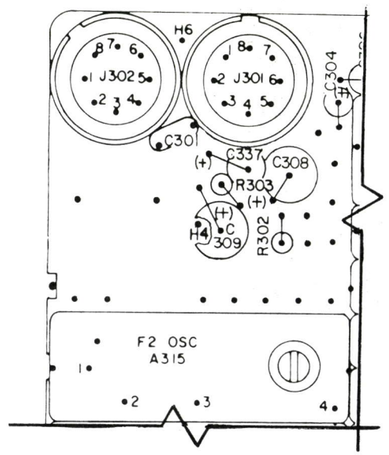
OUTLINE DIAGRAM

(19D416896, Sh. 2, Rev. 7)
(19D416896, Sh. 3, Rev. 6)

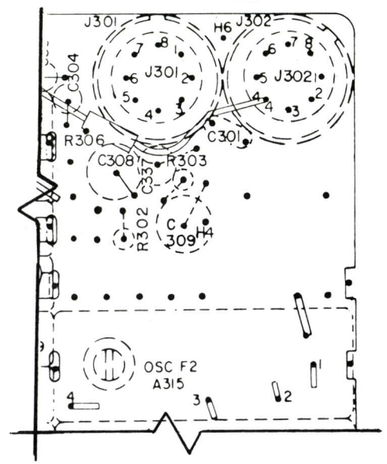
(19D416896, Sh. 2, Rev. 7)

MOBILE DETECTOR APPLICATIONS

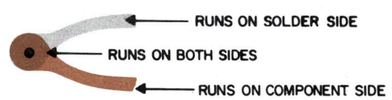
COMPONENT SIDE



SOLDER SIDE



(19D430370, Rev. 1)

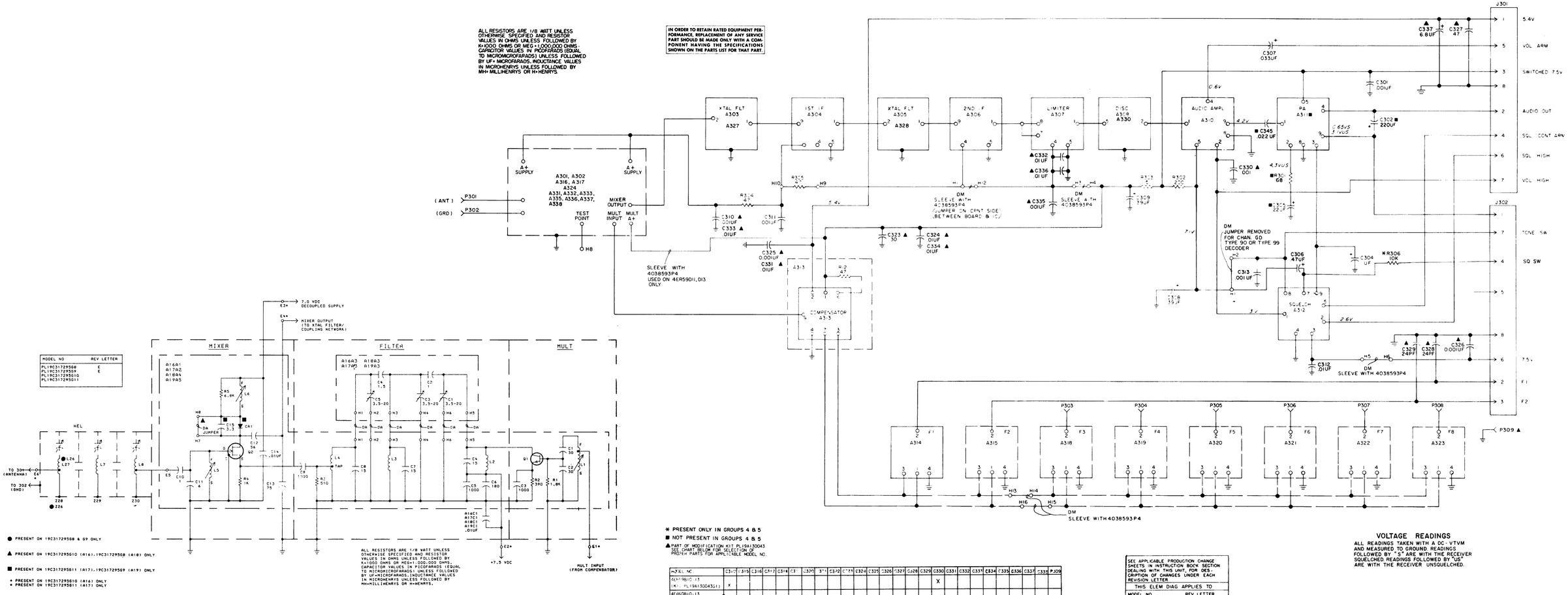


150.8—174 MHz RECEIVER
MODELS 4ER59D11 & 13

(19D429258, Rev. 0)

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.



● PRESENT ON 19C317295G8 & G9 ONLY

▲ PRESENT ON 19C317295G10 (A16),19C317295G8 (A18) ONLY

■ PRESENT ON 19C317295G11 (A17),19C317295G9 (A19) ONLY

* PRESENT ON 19C317295G10 (A16) ONLY
+ PRESENT ON 19C317295G11 (A17) ONLY

(19D424705, Rev. 3)

✱ 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.	C301	C315	C316	C317	C318	C321	C322	C323	C324	C325	C326	C327	C328	C329	C330	C331	C332	C333	C334	C335	C336	C337	C338	PJ09
4ER59B10-13 (KIT PL19A130043G1)	X														X									
4ER59B10-13 (KIT PL19A130043G2)	X								▲		▲	X	X	X	X	X				X				X
4ER59B11-13, -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					

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	G
PL19D417493G2	F
PL19D417493G3	F
PL19A130043G1	A
PL19A130043G2	A
PL19A130043G3	A
PL19A130043G4	A
PL19A130043G5	A
PL19A130043G6	A
PL19D417493G4	G
PL19D417493G5	F

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.

(19R622036, Rev. 17)

SCHEMATIC DIAGRAM

150.8—174 MHz RECEIVER FRONT END (A338)
MODELS 4ER59D11 & 13

SCHEMATIC DIAGRAM

150.8—174 MHz RECEIVER
MODELS 4ER59D11 & 13

PARTS LIST

LBI30036C

150.8-174 MHz RECEIVER
MODEL 4ER59D11 STANDARD
MODEL 4ER59D13 CHANNEL GUARD

SYMBOL	GE PART NO.	DESCRIPTION
A338		FRONT END 19C317295G10 (Replaces 19C317295G8)
A16		MULTIPLIER/MIXER 19C327738G1
A1		MIXER BOARD 19D424746G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1 and C2	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM.
C3	5495323P12	Ceramic: 0.001 µf +100% -20%, 75 VDCW.
C4	19A116114P3036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -150 PPM.
C5	5495323P12	Ceramic: 0.001 µf +100% -20%, 75 VDCW.
C6	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C7 and C8	19A116114P3036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -150 PPM.
C9	5495323P12	Ceramic: 0.001 µf +100% -20%, 75 VDCW.
C10	19A116114P1	Ceramic: 1 pf ±5%, 100 VDCW; temp coef 0 PPM.
C11	19A116114P2020	Ceramic: 6 pf ±5%, 100 VDCW; temp coef -80 PPM.
C12	19A116114P3056	Ceramic: 56 pf ±5%, 100 VDCW; temp coef -150 PPM.
C13	19A116114P2060	Ceramic: 75 pf ±5%, 100 VDCW; temp coef -80 PPM.
C14	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1	19A116925P1	Silicon.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B226718G1	Coil. Includes:
	19B209436P1	Tuning slug.
L2 and L3	19A130474P1	Coil.
L4	19A130473P1	Coil.
L5	19B226750G1	Coil.
L6	19C320379G11	Coil. Includes:
	19B209436P1	Tuning slug.
		- - - - - - - - - TRANSISTORS - - - - - - - -
Q1	19A115910P1	Silicon, NPN; sim to Type 2N3904.
Q2	19A116960P1	N Type, field effect; sim to Type 2N4416.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151P182J	Composition: 1.8K ohms ±5%, 1/8 w.
R2	3R151P391K	Composition: 390 ohms ±10%, 1/8 w.
R3	3R151P511J	Composition: 510 ohms ±5%, 1/8 w.
R4	3R151P102J	Composition: 1K ohms ±5%, 1/8 w.
R5	3R151P682J	Composition: 6.8K ohms ±5%, 1/8 w.

SYMBOL	GE PART NO.	DESCRIPTION
A3		FILTER BOARD 19C327735G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A134162P3	Variable, ceramic: approx 3.5 to 20 pf; sim to Erie Style 513-001.
C2	19A116114P1	Ceramic: 1 pf ±10%, 100 VDCW; temp coef 0 PPM.
C3	19A134162P3	Variable, ceramic: approx 3.5 to 20 pf; sim to Erie Style 513-001.
C4	19A116114P4	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef 0 PPM.
C5	19A134162P3	Variable, ceramic: approx 3.5 to 20 pf; sim to Erie Style 513-001.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDC*; sim to Erie 8121 SPECIAL.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L7	19B216441G3	Helical resonator. (Part of Z29). Includes:
	19C311727P1	Tuning slug.
L8	19B216441G12	Helical resonator. (Part of Z30). Includes:
	19C311727P1	Tuning slug.
L27	19B216441G17	Helical resonator. (Part of Z28). Includes:
	19C311727P1	Tuning slug.
		- - - - - - - HELICAL RESONATORS - - - - - - -
Z28		Consists of L27 and 19C327717G1 can.
Z29		Consists of L7 and 19C327717G1 can.
Z30		Consists of L8 and 19C327717G1 can.
		RECEIVER BOARD 19D417493G1
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	19C311995G4	Audio Amplifier. (Includes Tone Filter).
A311*	19C311877G4	PA.
		In REV E & earlier:
	19C311877G2	PA.
A312	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 E.
C304	5491674P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C305	5491674P35	Tantalum: 22 µf ±20%, 4 VDC*; sim to Sprague Type 162D.

SYMBOL	GE PART NO.	DESCRIPTION
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.
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 G.
		- - - - - - - 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 C & earlier:
	3R151P101J	Composition: 100 ohms ±5%, 1/8 w.
R302	3R151P201J	Composition: 200 ohms ±5%, 1/8 w.
R303	3R151P150J	Composition: 15 ohms ±5%, 1/8 w.
R304 and R305	3R151P470J	Composition: 47 ohms ±5%, 1/8 w.
		RECEIVER KIT 19A130043G5
		- - - - - - - - - CAPACITORS - - - - - - - - -
C310	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C325	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW.
C330*	5495323P12	Ceramic: .001 µf +100% -20%, 75 VDCW. Added by REV A.
C332	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C334	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C336	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C337	5491674P39	Tantalum: 6.8 µf ±20%, 15 VDCW; sim to Sprague Type 162D.
C338*	19A116192P1	Ceramic: 0.01 µf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL. Deleted by REV B.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B216316P1	Insulator. (Used with J301 & J302).
		ASSOCIATED PARTS
		- - - - - - - - - OSCILLATORS - - - - - - - - -
A314 and A315,		NOTE: When reordering, give GE Part Number and specify exact frequency needed.
A318 thru A323	4EG28A11	Oscillator Module. 150.8-174 MHz. Fx = $\frac{Fo - 20}{9}$
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R306	3R151P103J	Composition: 10K ohms ±5%, 1/8 w. (Used in vehicular repeater applications).

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 Board 19D417493G1
To improve audio sensitivity.
Changed R301.

REV. B - To improve critical squelch operation.
Changed C312.

REV. C - To improve producibility.
Changed A303.

REV. D - To improve audio sensitivity.
Deleted C314 and changed R301.

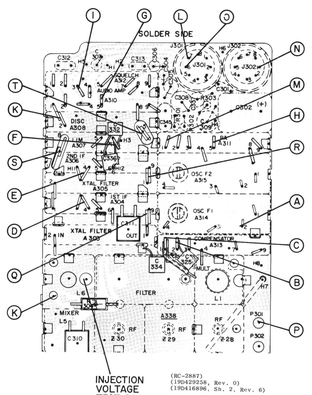
REV. E - To improve frequency response.
Added C345 to be used with CG receivers.

REV. A - Receiver Kit 19A130043G5
To improve IF filtering.
Added C330.

REV. B - To standardize assemblies.
Deleted C338 and added five washers.

REV. F - Receiver Board 19D417493G1
To improve audio quality.
Changed A311.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



QUICK CHECKS

SYMPTOM	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 and 3).
Poor Sensitivity	1. Measure the injection voltage for a minimum level of 750 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 P THRU T)

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

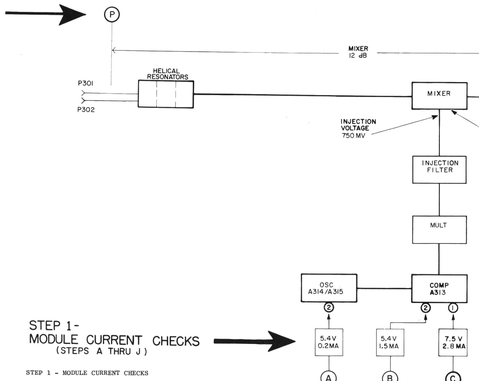
PROCEDURE FOR 2ND IF:

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 no noise so that 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 J)

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 millianmeter 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 K THRU O)

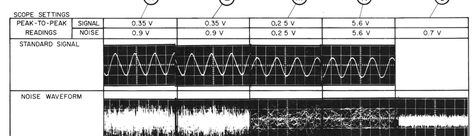
STEP 2 - AUDIO & SQUELCH WAVEFORMS

EQUIPMENT REQUIRED:

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

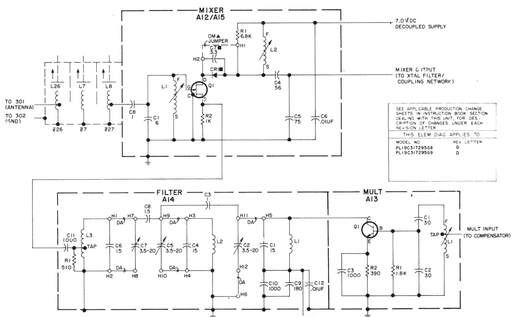
PRELIMINARY STEPS:

1. Apply a standard signal to P301. A standard signal is 1000 microvolts on the receiver frequency modulated by one kHz with 3.0 kHz deviation.
2. Set the Volume control for 0.5-watt output.



TROUBLESHOOTING PROCEDURE

150.8—174 MHz RECEIVER
MODELS 4ER59D11 & 13

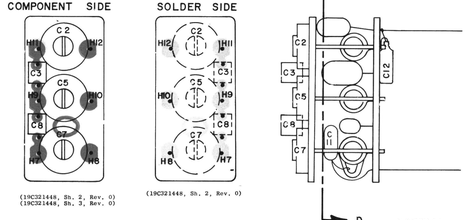


ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED. RESISTANCE VALUES IN OHMS, UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN MICROFARADS (EQUAL TO) UNLESS FOLLOWED BY PF=MICROFARADS OR UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH=MILLIHENRYS OR H=HENRYS

(19C321461, Rev. 7)

SERVICE SHEET FOR
RECEIVER FRONT END

19C317295 G8 (A335)



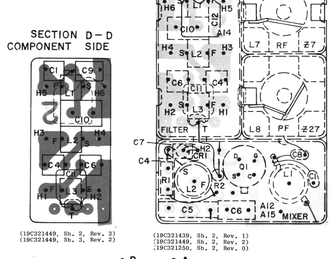
(19C321448, Sh. 2, Rev. 0)
(19C321448, Sh. 3, Rev. 0)

(19C321448, Sh. 2, Rev. 0)

TRANSISTOR LEAD IDENTIFICATION
FOR Q1 – A13 FOR Q1 – A12/A15

VIEW FROM CASE END

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION. TAB INDICATES EMITTER LEAD.



(19C321439, Sh. 2, Rev. 1)
(19C321439, Sh. 3, Rev. 1)

(19C321449, Sh. 2, Rev. 2)
(19C321449, Sh. 3, Rev. 2)

(19C321439, Sh. 2, Rev. 1)
(19C321449, Sh. 2, Rev. 2)
19C321250, Sh. 2, Rev. 0)

(19C321250, Sh. 2, Rev. 0)
(19C321250, Sh. 3, Rev. 0)

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

(19D423645, Rev. 2)

PARTS LIST

LBI-30608

FRONT END A335
19C317295G8
(Replaced by 19C317295G10)

SYMBOL	GE PART NO.	DESCRIPTION
A12		MIXER 19C321473G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1*	19A116114P2020	Ceramic: 6 pf ±5%, 100 VDCW; temp coef -80 PPM. In REV B and earlier:
	19A116114P2142	Ceramic: 24 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2*	5495323P12	Ceramic: 0.001 µf +100% -0%, 75 VDCW. Deleted by REV B.
C3*	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM. Deleted by REV D.
C4	19A116114P3056	Ceramic: 56 pf ±5%, 100 VDCW; temp coef -150 PPM.
C5	19A116114P2060	Ceramic: 75 pf ±5%, 100 VDCW; temp coef -80 PPM.
C6	19A116192P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL.
C8	19A116114P1	Ceramic: 1 pf ±10%, 100 VDCW; temp coef 0 PPM.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1	19D226750G1	Coil. Includes:
	19D209436P1	Tuning slug.
L2	19C320379G11	Coil. Includes:
	19D209436P1	Tuning slug.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A116960P1	N Type, field effect; sim to Type 2N5411.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3R151P683J	Composition: 68K ohms ±5%, 1/8 w.
R2	3R151P103J	Composition: 1K ohms ±5%, 1/8 w.
A13		MULTIPLIER BOARD 19C321440G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1*	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM. In REV B and earlier:
	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C2*	19A116114P2045	Ceramic: 30 pf ±5%, 100 VDCW; temp coef -80 PPM. In REV A and B:
	19A116114P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM. Earlier than REV A:
	19A116114P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C3*	19A116192P13	Ceramic: 1000 pf ±10%, 50 VDCW; sim to Erie 8121-A050-W58-102K. Earlier than REV A:
	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1	19D226718G1	Coil.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A115910P1	Silicon, NPN; sim to Type 2N3904.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - RESISTORS - - - - - - - - -
R1*	3R151P182J	Composition: 1.8K ohms ±5%, 1/8 w. Earlier than REV A:
	3R151P103J	Composition: 10K ohms ±5%, 1/8 w.
R2	3R151P391K	Composition: 390 ohms ±10%, 1/8 w.
A14		FILTER BOARD 19C321453G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116114P3036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -150 PPM.
C2	19A134916P3	Variable, ceramic: approx 3.5 to 20 pf; sim to Erie Style 513-001.
C3	19A116114P1	Ceramic: 1 pf ±10%, 100 VDCW; temp coef 0 PPM.
C4	19A116114P3036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C5	19A134916P9	Variable, ceramic: approx 3.5 to 20 pf; sim to Erie Style 513-001.
C6	19A116114P3036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -150 PPM.
C7	19A134916P9	Variable, ceramic: approx 3.5 to 20 pf; sim to Erie Style 513-001.
C8	19A116114P4	Ceramic: 1.5 pf ±5%, 100 VDCW; temp coef 0 PPM.
C9	19A116114P10073	Ceramic: 180 pf ±10%, 100 VDCW; temp coef -3300 PPM.
C10	5495323P12	Ceramic: 0.001 µf +100% -20%, 75 VDCW.
C11*	5495323P12	Ceramic: 0.001 µf +100% -20%, 75 VDCW. Added by REV B.
C12*	19A116192P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121 SPECIAL. Added by REV D.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1 and L2	19A130474P1	Coil.
L3	19A130473P1	Coil.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1*	3R151P511J	Composition: 510 ohms ±5%, 1/8 w. Added by REV C.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L7	19B216441G3	Helical resonator. (Part of Z7). Includes:
	19C311727P1	Tuning slug.
L8	19B216441G12	Helical resonator. (Part of Z27). Includes:
	19C311727P1	Tuning slug.
L26	19B216441G16	Helical resonator. (Part of Z26). Includes:
	19C311727P1	Tuning slug.
		- - - - - - - - - HELICAL RESONATORS - - - - - - - - -
Z7		Consists of L7 and 19D413133G3 can.
Z26		Consists of L26 and 19D413133G36 can.
Z27		Consists of L8 and 19D413133G37 can.

PRODUCTION CHANGES

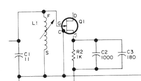
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for descriptions of parts affected by these revisions.

REV. A – Receiver Front End 19C317295G8

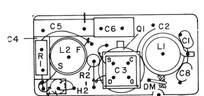
To improve sensitivity.
Changed C1 on A12/A15.
Changed C2 and C3 on A14.
Changed R1 on A13.

REV. B – To improve tuning.
Deleted C2, C3 and changed R1 on A12/A15 as shown.

Schematic Diagram was:



Outline Diagram was:



REV. C – To improve tuning.
Changed C4 on A13.
Added R1 to A14.
Changed design of L1 on A12/A15.