MOBILE RADIO

MASTR
PROGRESS LINE
Personal Series

MAINTENANCE MANUAL

PERSONAL RADIO

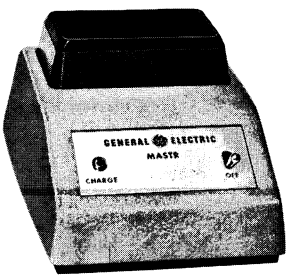
EXTERNAL MICROPHONE

406-470 MHz

TWO-WAY PERSONAL FM RADIO

LBI-4075A

DF-9022



DESK CHARGER

GENERAL ELECTRIC

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SPECIFICATIONS *

GENERAL

Frequency Range	406—470 MHz
Battery Drain (@7.5 Volts)	
Standby	13 milliamps
Receive	135 milliamps
Transmit	1.05 amperes maximum
Duty Cycle	10% transmit, 10% receive, and 80% standby
Battery Life (at rated duty cycle)	
Rechargeable	12 hours
Alkaline Batteries	24 hours
Operable Temperature Range	
Transmitter-Receiver	-30°C to +60°C (-22°F to +140°F)
Rechargeable Battery Pack	-20°C to +45°C (-4°F to +113°F)
Maximum Frequency Spacing	±0.4%

TRANSMITTER

Type Number	ET-91-A
Power Output	
Rechargeable Battery	2 watts minimum (0.4 watt minimum in the LO Power position)
Alkaline Batteries	1.6 watts minimum
Frequency Stability	
-30°C to +60°C	±.0005%
0°C to +55°C	±.0002%
Deviation Symmetry	±0.5 kHz
Spurious and Harmonic Radiation	50 dB
Audio Response	Within +1 and -3 dB of a 6-dB/octave pre-emphasis from 300 to 3000 Hz except for an additional 6-dB/octave roll-off from 2500 to 3000 Hz per EIA.
Audio Distortion	Less than 8%
Crystal Multiplication Factor	24
Output Impedance	50 ohms
Mike Input Impedance	5000 ohms

RECEIVER

Type Number	ER-57-A
Audio Output	500 Milliwatts
Channel Spacing	25 kHz
Sensitivity	
12-dB SINAD (EIA Method)	0.4 μV
20-dB Quieting Method	0.5 μV
Selectivity	
EIA Two-Signal Method	-60 dB (adjacent channel, 25-kHz channel)
20-dB Quieting Method	-80 dB at ±25 kHz
Spurious Response	-60 dB
Intermodulation (EIA)	-60 dB
Frequency Response	+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
IF Frequency	20 MHz
Input Impedance	50 ohms
Output Impedance	8 ohms

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

COMBINATION NOMENCLATURE

1st & 2nd Digits	3rd Digit	4th Digit	5th Digit	6th Digit	7th Digit	8th & 9th Digits
Product Line	RF Power Output Range	Channel Spacing	Control	Number of Freq.	Options	Frequency Range
PR Personal Series	**2** 2 Watts	**5** 25 kHz	**L** Local PTT	**A** 1-Freq.Xmit 1-Freq.Rec	**S** Standard	**77** 406—420 MHz
			R Remote PTT	**B** 2-Freq.Xmit 1-Freq.Rec	**U** Channel Guard Encoder/Decoder	**88** 450—470 MHz
			V VOX	**C** 2-Freq.Xmit 2-Freq.Rec	**R** 2-Tone Channel Guard Encoder	
				D 1-Freq.Xmit 2-Freq.Rec	**L** Type 99 Individual Call Decoder	
				E 3-Freq.Xmit 3-Freq.Rec	**B** Type 90 Encoder/Decoder	
				F 4-Freq.Xmit 4-Freq.Rec	**C** Type 90 2-Tone Encoder	
					M Type 99 Individual, Group & All-Call Decoder	

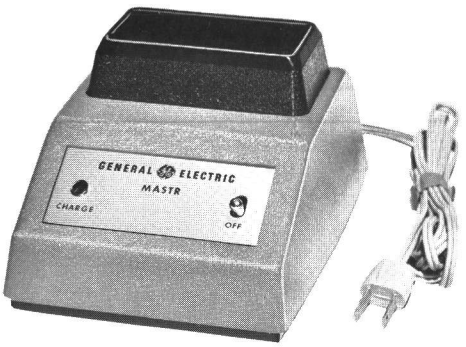
ACCESSORIES

EXTERNAL MICROPHONE

FLEXIBLE ANTENNA

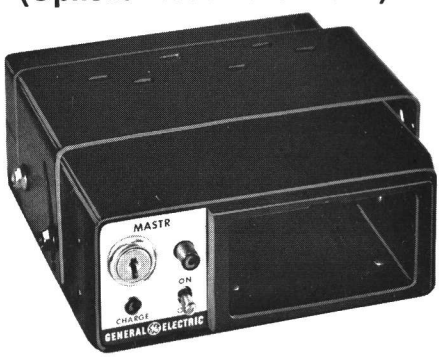
WHIP ANTENNA (Option 4321)

DESK CHARGER MODEL 4EP61A10 (Option 4345)

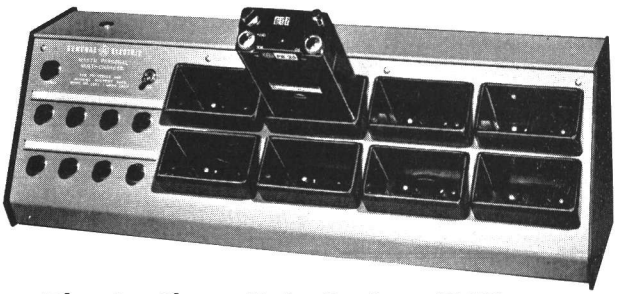


(With Antenna Jack Option 4346)

VEHICULAR CHARGER MODEL 4EP63A10 & 11 (Options 4353 thru 4357)



MULTI-CHARGER MODEL 4EP62A10 (Option 4347)



(Plug-in Slave Unit Option 4348)

FAST CHARGER MODEL 4EP64A10 (Option 4351)

ANTENNA ADAPTER CABLE

LEATHER CASE (Option 4333)

HAND STRAP (Option 4331)

SHOULDER STRAP (Option 4332)

TEST EQUIPMENT

TEST ADAPTER
MODEL 4EX12A10 (Option 4384)

Provides transmitter and receiver audio connections

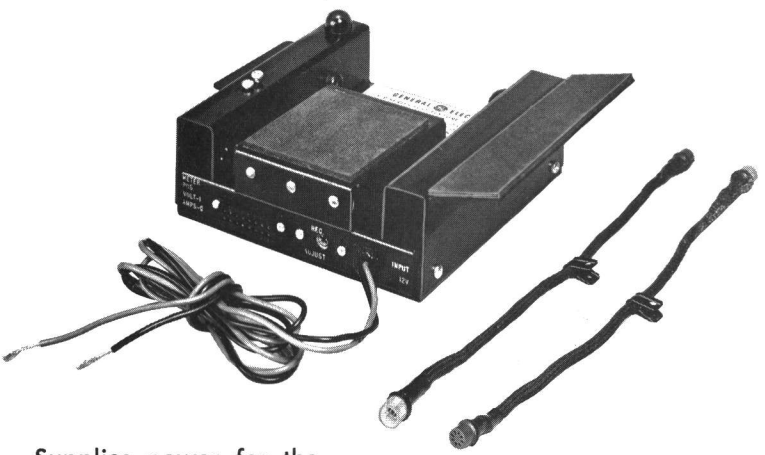
IF GENERATOR
MODEL 4EX9A10 (Option 4381)

For setting the receiver on frequency and for troubleshooting

TEST SET
MODEL 4EX3A10 (TM-11 & TM-12)

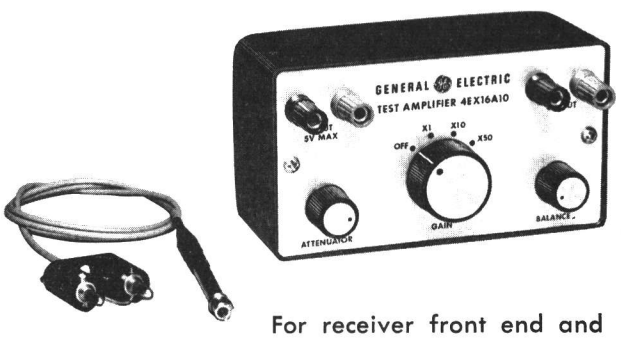
Supplies power for the radio and metering jacks for the transmitter

TEST FIXTURE
MODEL 4EX11A10 (Option 4380)



Extension cables for servicing the receiver out of the radio

TEST AMPLIFIER
MODEL 4EX16A10 &
RF PROBE 19C311370-G1 (Option 4382)



For receiver front end and IF gain measurements

VOLTAGE CALIBRATOR
MODEL 4EX10A10 (Option 4383)

For setting voltages on Personal Battery Chargers

DESCRIPTION

General Electric MASTR Personal Series radios are extremely compact, high performance two-way FM radios designed for operation in the 406—470 MHz range. The radios are fully transistorized--utilizing both discrete components and Integrated Circuit modules (IC's).

The radio is contained in a ruggedly-constructed, weatherproof Lexan® case with a cast aluminum grille. All operating controls except the PTT switch are conveniently located on the top of the radio. The accessory jack on the top of the radio is provided for external microphones, earphones and other accessories.

Power for the radio is normally supplied by a rechargeable nickel-cadmium battery pack that fits in the bottom section of the case. The battery pack can be recharged either in or out of the radio. Whenever the battery pack is not required, the radio can be operated by six standard C-size alkaline batteries.

Test Fixture Model 4EX11A10 is available for ease of servicing the Personal Series radios. The Test Fixture is designed for use with GE Test Set Models 4EX3A10 or 4EX8K11 for metering the transmitter current drain, and also provides a regulated supply voltage.

OPERATION

When using the collapsible antenna, make sure that the antenna is in the fully-extended position. If the radio is equipped with an option switch, disable the option before adjusting the radio by placing the switch in the OFF or M (Monitor) position. After adjusting the radio, place the option switch back in the ON or N (Normal) position to enable the option. Refer to LBI-4070 for complete operating instructions.

ADJUSTING THE RADIO

TO RECEIVE A MESSAGE

1. Turn the OFF-VOLUME control about half way to the right.
2. Turn the SQUELCH (SQ) control to the right as far as possible. A hissing sound will be heard from the speaker.
3. Adjust the VOLUME control until the hissing sound is easily heard but not annoyingly loud.
4. Turn the SQUELCH control slowly to the left until the hissing noise just fades out.

   In Multi-frequency units, select the proper frequency (1, 2, 3 or 4). You are now ready to receive messages from other radios in your system.

TO SEND A MESSAGE

1. Turn on the radio as directed in the "To Receive a Message" section.
2. In multi-frequency units, select the proper frequency (1, 2, 3 or 4). Then listen to make sure that no one is using the channel.
3. While holding the radio so that the antenna is vertical, press the Push-To-Talk (PTT) switch and speak directly into the local microphone (or across the face of an external microphone) in a normal tone of voice.

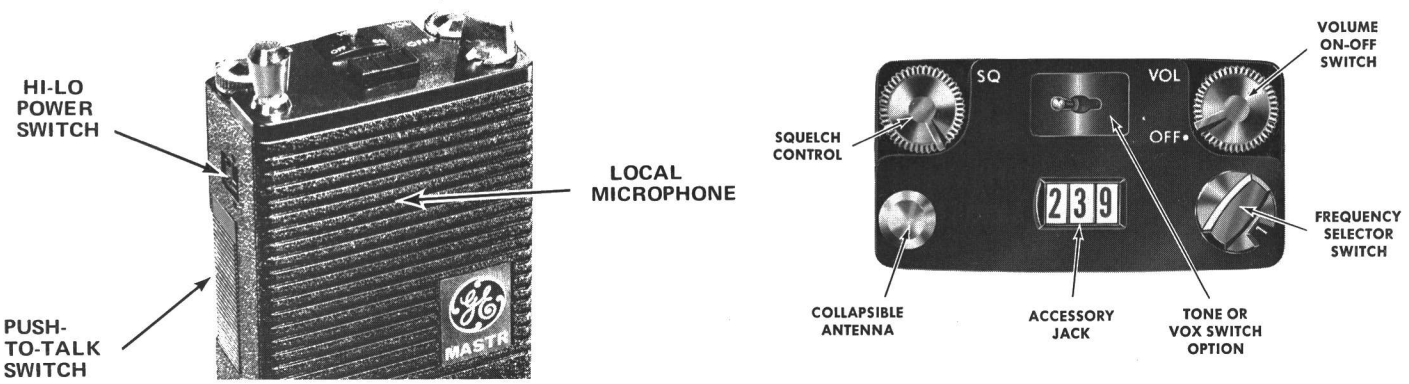


Figure 1 - Operating Controls

Release the PTT switch as soon as you stop talking. You cannot receive messages when the PTT switch is pressed.

OPERATING TIPS

The following conditions tend to reduce the effective range of Two-Way Radios, and should be avoided whenever possible.

- Operating the radio in low areas of the terrain, or while under power lines or bridges.
- Operating the radio inside of a vehicle, or in a metal or steel-framed building unless using an external antenna.
- Obstructions such as mountains or buildings between the person sending and the person receiving the messages.

In areas where the transmission or reception is poor, check to see that the antenna is fully extended. Then hold the radio so that the antenna is vertical. If this doesn't help, move a few yards or turn a corner and head in another direction. Moving to a higher elevation can help considerably.

BATTERY INFORMATION

The Personal Series two-way radio is shipped from the factory ready for immediate operation upon installation of the batteries. The radio can be operated with either of the following types of batteries:

Battery Type	GE Part Number	Equivalent
Rechargeable Battery Pack	19C317000-G1	
Alkaline Energizers (Package of 12)	19A127771-G1	Eveready E93

NOTE

Whenever the full transmitter output power is not required, or when using any type of dry battery, the life of the battery pack (or dry batteries) can be more than doubled by operating the radio with the HI/LO Power switch in the LO position.

RECHARGEABLE BATTERY PACK

The rechargeable battery pack is shipped from the factory in a fully-charged condition--ready for immediate use. If the radio has been stored for over 30 days, the battery pack should be fully recharged before using. When it is necessary to store the unit for over 30 days, it is recommended that the battery pack be kept in one of the Personal Series chargers.

BATTERY PACK FUSE

The battery pack is equipped with a thermal fuse that is designed to blow at 168°F. The fuse protects the batteries from damage due to overheating while recharging, or heating up as a result of a defective cell. Whenever the radio or battery pack is placed in any of the chargers and the charge light won't turn on, check the thermal fuse by measuring the voltage across the charging terminals. If no reading is obtained, change the fuse according to the following procedure:

1. Peel off the yellow CAUTION label and pry up the plastic fuse cover.
2. Re-check the fuse with a meter before unsoldering.
3. Solder in the new fuse being careful to heatsink the fuse lead with a pair of long nose pliers between the solder terminal and fuse (see Figure 1). Keep the fuse heatsinked until the solder cools.
4. Replace the fuse cover and attach the new caution label supplied with the fuse.

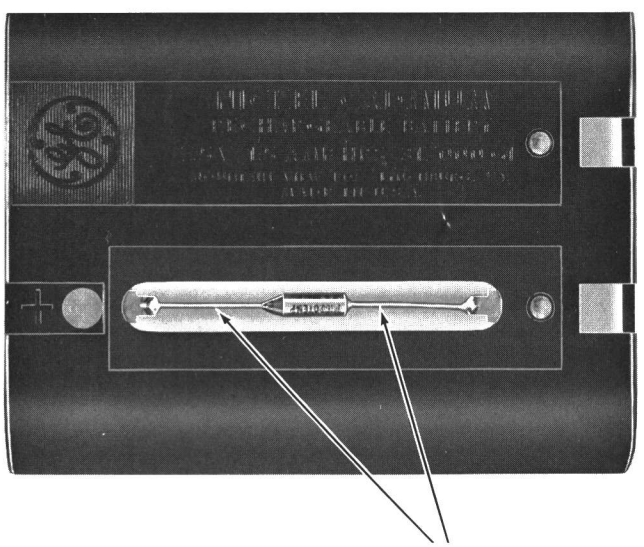


Figure 2 - Replacing Thermal Fuse

Voltage Check

The charge level of the battery pack can be checked most accurately by measuring the voltage under load. To measure the voltage:

1. Connect a voltmeter across the charging contacts on the bottom of the radio.

2. Key the transmitter and check the meter reading. A fully charged battery pack should provide a reading of 7.5 to 8 volts. A completely discharged battery pack should provide a reading of 6 to 6.5 volts.

CAUTION

Do not short circuit the charging contacts. To do so will blow the thermal fuse.

Battery Pack Replacement

To replace the battery pack:

1. Turn the radio OFF.

2. Loosen the captive screw in the back cover as shown in Figure 3 and remove the cover.

3. Place a finger in each finger slot. Next, press down firmly and pull the battery pack forward out of the radio.

4. Press the new battery pack down on the springs and push it into the radio.

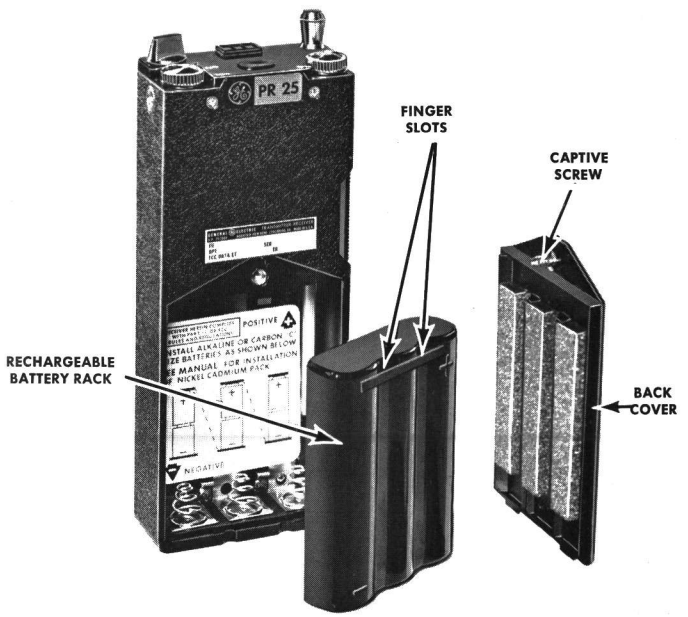


Figure 3 - Battery Pack Replacement

WARNING

Do not incinerate the rechargeable battery pack. To do so may cause a battery to explode.

ALKALINE BATTERIES

The radio may be operated by six C-Size alkaline batteries. When using these batteries, it is recommended that the radio be operated with the HI-LO Power switch in the LO position (whenever possible) to prolong battery life.

Battery Check

The charge level of the alkaline batteries can be checked most accurately by measuring the voltage under load. To measure the voltage:

1. Remove the cover on the battery compartment.

2. Connect a voltmeter from battery negative (under battery in the lower left corner) to battery plus (top of battery in upper right corner).

3. Key the transmitter and check the meter reading. Replace the batteries if the reading is 5.6 volts or less.

Battery Replacement

To replace the alkaline batteries:

1. Turn the radio OFF.

2. Loosen the captive screw in the back cover and remove the cover (see Figure 3).

3. Remove the old batteries and install all of the new batteries with the cap (+) pointing away from the springs as shown on the decal in the battery compartment.

BATTERY CHARGERS

Four different Personal Series chargers are available for recharging the battery pack. The charging times listed are the maximum times required. The charging time may be less, depending on the charge remaining in the battery pack. The different chargers are:

- Desk Charger - Charges one battery pack in or out of the radio from a 117-volt, 50/60 Hz source in 14 hours.

- Multi-Charger - Charges up to eight battery packs in or out of the radio from a 117-volt, 50/60 Hz source in 14 hours. Two additional slave charging units can be connected to the multi-charger for charging up to 24 radios or battery packs simultaneously.
- Fast Charger - Charges one radio or battery pack to 70% of capacity in 15 minutes. Fully recharges the battery pack in additional eight hours on trickle charge.
- Vehicular Charger - Charges one radio from the vehicle battery in 14 hours.

NOTE

Due to the temperature characteristics of nickel-cadmium batteries the batteries will not accept a full charge at temperature extremes. For maximum capacity, recharge the battery pack at a room temperature of from 65° to 85° Fahrenheit whenever possible.

All of the chargers are designed to prevent the battery pack from being overcharged. Whenever the CHARGE light goes out (indicating 70% of charge), a trickle charge is applied to the battery pack for the remainder of the charging time, or until the battery pack is removed. The battery pack may be safely left on trickle charge as long as desired.

Refer to the applicable battery charger Maintenance Manual for complete instructions.

DESK CHARGER

To use the Desk Charger, plug the power cable into a 117-volt AC, 50/60 Hz source. Next, place the radio into the charging insert with the speaker facing the front of the charger, or place the battery pack into the insert with the flat side towards the front of the charger. Turn the OFF-ON switch to the ON position. The red CHARGE light will glow when the battery is charging.

The radio can be used to send and receive messages while charging although it will probably take longer to recharge the battery. Simply leave the Desk Charger turned on and use the radio as you normally would.

The Desk Charger may be equipped with an optional antenna connector for connecting the unit to an external antenna. When this option is used, simply placing the radio into the charging insert automatically connects the radio to the external antenna.

MULTI-CHARGER

To use the Multi-Charger, plug the power cable into a 117-volt AC, 50/60-Hz source. Next, place the radio(s) into the charging insert(s) with the speaker facing up, or place the battery pack(s) into the insert with the flat side facing up. Then turn the OFF-ON switch to the ON position. The green CHARGE light will glow when the batteries are charging.

FAST CHARGER

To use the Fast Charger, plug the power cable into a 117-volt AC, 50/60-Hz source. Next, turn the OFF-ON switch to the ON position. Then place the radio into the charging insert with the speaker facing up, or place the battery pack into the insert with the flat side facing up. The red FAST CHARGE light will glow when the battery is charging.

The battery is charged to 70% of capacity when the FAST CHARGE light turns OFF and the amber Trickle Charge light turns ON.

The fast charge circuit will not start if the radio (or battery pack) is placed into the charging insert before the power is turned on, or if the 117-volt power source goes off while the unit is charging. If this should occur, start the charger by lifting the radio (or battery pack) off the bottom of the charging insert for a moment.

NOTE

If the fast charger will not start charging, the battery pack has either been excessively discharged or has a bad cell. Recharge the battery pack for the regular time in either the desk charger or rack charger. The battery pack should accept a full charge if it does not have a bad cell.

VEHICULAR CHARGER

To use the vehicular charger, place the radio into the charging insert with the speaker facing down. Then press in the radio against the bottom of the charging insert until the latch catches, holding the radio in the charger. Next, turn the OFF-ON switch to the ON position. The red

Charge light will glow when the battery is charging.

The radio can be used to send and receive messages while charging - although it will probably take longer to recharge the battery. An optional vehicle antenna and an external microphone are required for this application.

To remove the radio from the charger, simply press the release button on the front of the charger and slide the radio out of the insert. When it is necessary to leave the radio in the charger, use the key supplied with the charger and turn the lock all the way to the right. This blocks the release button, locking the radio in the charger.

CIRCUIT ANALYSIS

TRANSMITTER

Transmitter Type ET-91-A is a crystal-controlled, phase modulated transmitter for one- through four-frequency operation in the 406—420 MHz and 450—470 MHz bands. The transmitter utilizes both discrete components and Integrated Circuit modules (ICs) to provide a minimum RF power output of two watts in the HI power position. The transmitter consists of the following assemblies:

- Audio Board- with the Regulator and Audio-Limiter ICs, the Electronic PTT and VOX ICs and the Optional Audio Compressor IC.
- Power Amplifier Board- with the Oscillator Module, Compensator IC, discrete transistor multiplier and amplifier stages, and optional Type 99 decoder reeds.

All supply voltages for the transmitter are provided by the battery and the Regulator. The different transmitter voltages required are shown in the following chart:

Voltage	Used For:
Continuous 7.5 volts	Regulator, amplifier and multiplier circuits
Keyed 7.5 volts	Regulator 5.4-volt keying
Keyed 5.4 volts regulated	Compensator and Oscillator modules

References to symbol numbers mentioned in the following text are found on the Schematic Diagrams, Outline Diagrams and Parts Lists (see Table of Contents). The typical circuit diagrams used in the text are representative of the circuits in the IC modules. However, some of the components have been omitted for circuit simplification. A block diagram of the transmitter is shown in Figure 4.

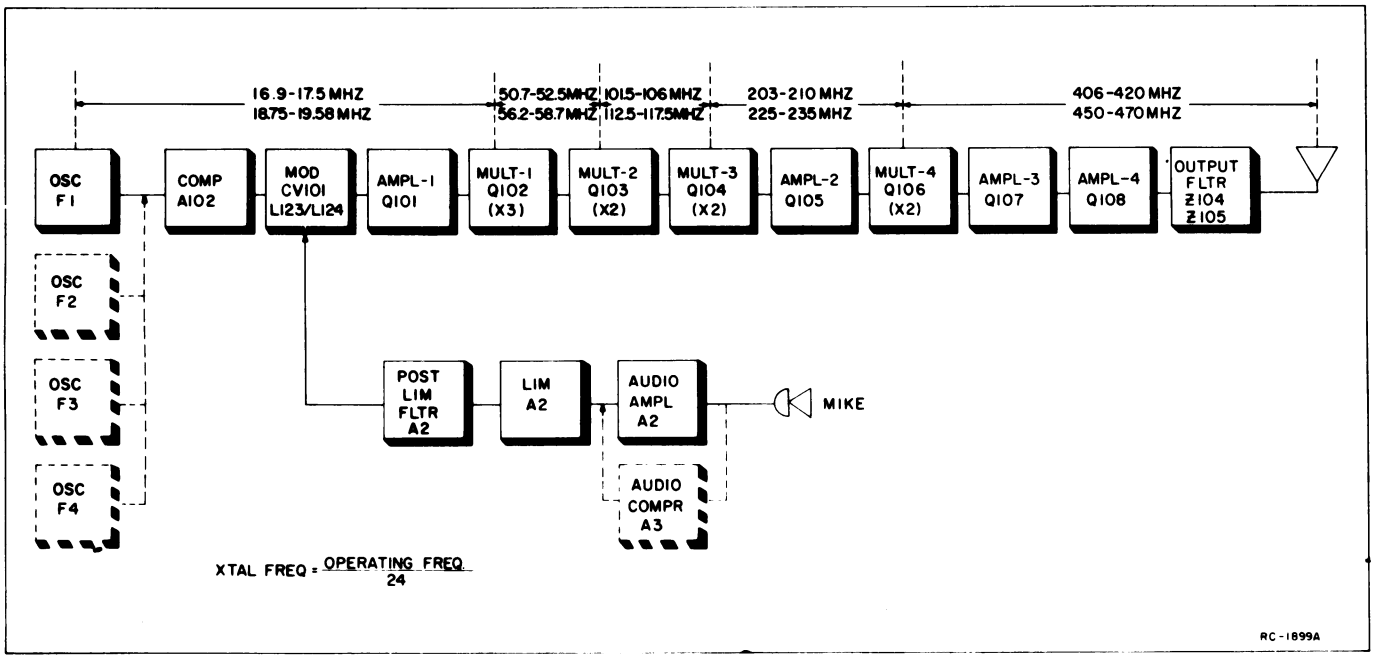


Figure 4 - Transmitter Block Diagram

Table 1 - Audio Board Applications

Audio Board	Control	Integrated Circuit Modules			
		Regulator A1 and Audio-Limiter A2	Electronic PTT A5	VOX A4	Audio Compressor A3
19C311922-G7	Local PTT	X			
19C311922-G8	Local PTT	X			X
19C311922-G9	Remote PTT	X	X		
19C311922-G10	Remote PTT	X	X		X
19C311922-G11	Remote PTT	X	X	X	
19C311922-G12	Remote PTT	X	X	X	X

AUDIO BOARD

Six different Audio Boards are available for use in the transmitter, depending on the type of control system required. The application of each Audio Board is shown in Table I.

REGULATOR A1

The Regulator module operates from the 7.5-volt from the battery, and provides a continuous, regulated 5.4 volts and a switched 5.4 volts for operating the transmitter, receiver and tone options. A typical regulator circuit is shown in Figure 5.

Turning on the radio applies the battery voltage to Pin 9 the Regulator, causing Q2 and then Q1 to conduct. When conducting, the continuous 5.4 volts at the collector of Q1 is taken from Pin 7 and applied to the receiver Compensator and Oscillator module, and to the optional transmitter Audio Compressor module.

Regulation is provided by Q2 and Q3 which operate as a differential amplifier. If the output of Q1 starts to increase, Q3 conducts harder, causing Q2 to conduct less. This causes Q1 to conduct less, keeping its output at 5.4 volts. If the output of Q1 starts to decrease, Q3 conducts less, causing Q2 to conduct harder. This causes Q1 to conduct harder, keeping the output constant.

Q4 and Q5 operate as a DC switch. Keying the transmitter applies the battery voltage to Pin 5 and to the base of Q5, turning it on. This turns on PNP transistor Q4, so that the regulated 5.4 volts at Pin 6 is applied to the transmitter Compensator

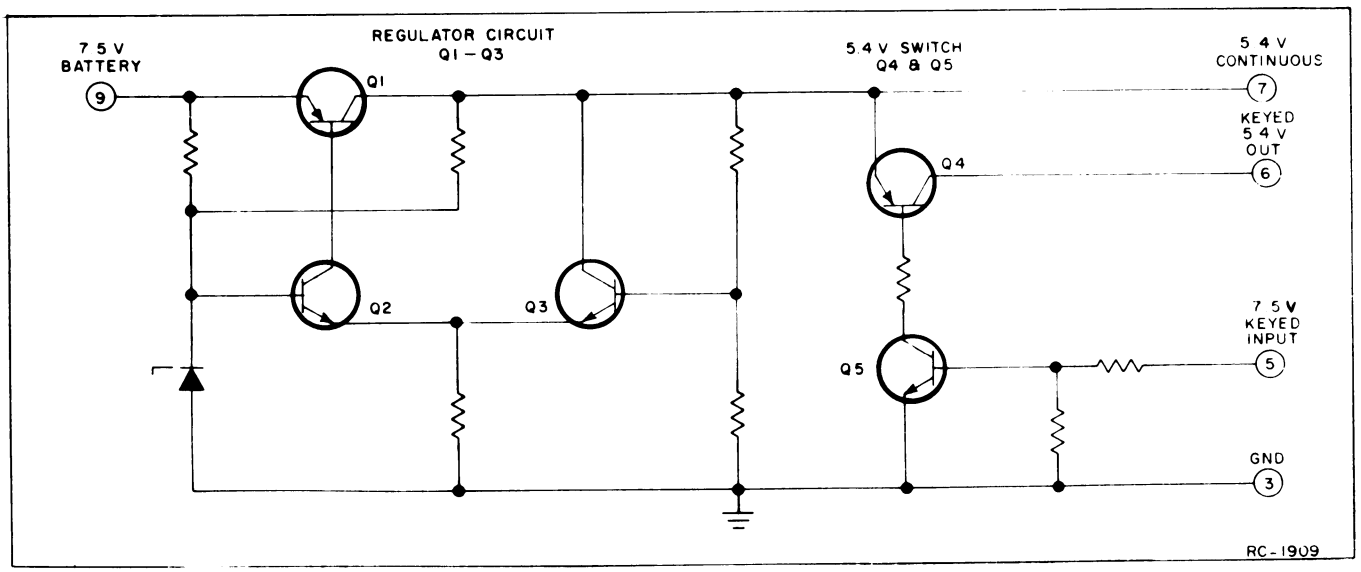


Figure 5 - Typical Regulator Circuit

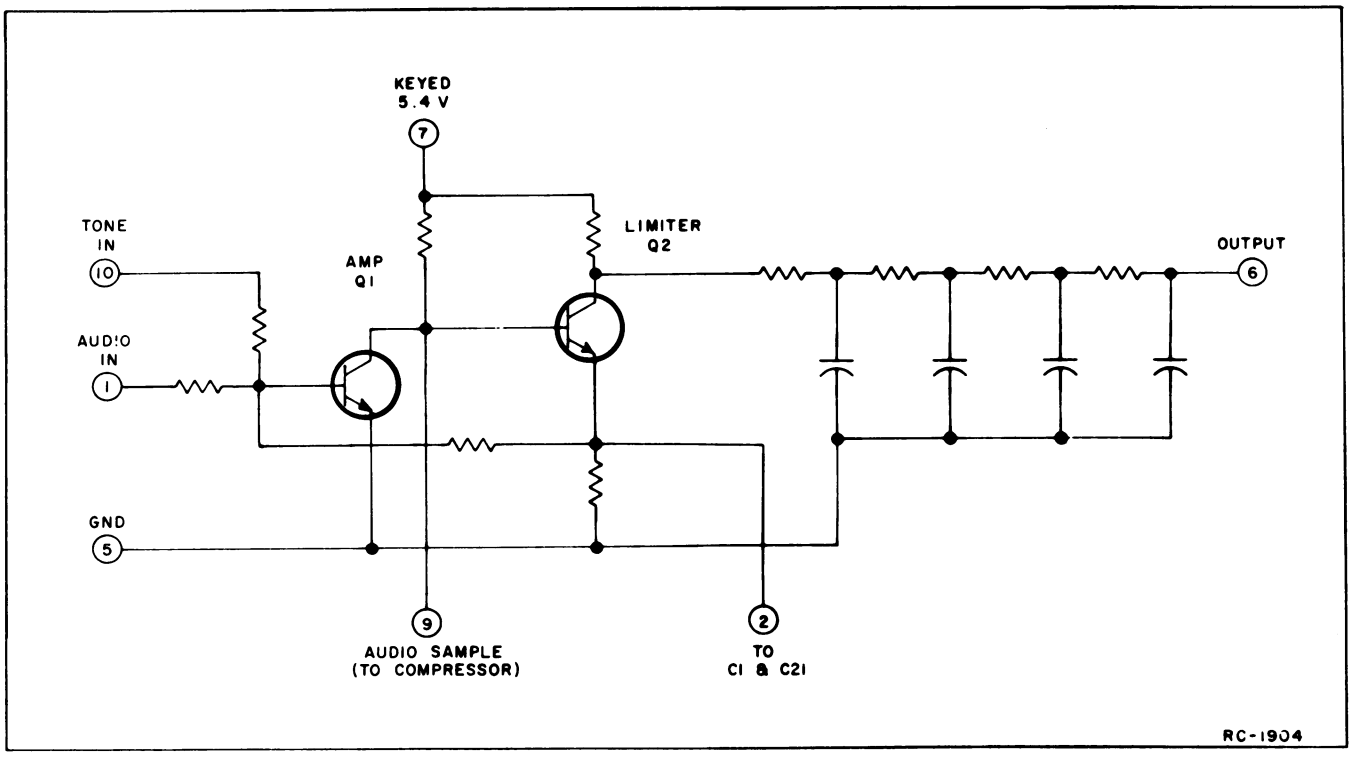


Figure 6 - Typical Audio Amplifier & Limiter Circuit

and Oscillator module, and to the optional Compressor module and multi-frequency switch S2603.

AUDIO AMPLIFIER & LIMITER A2

Audio from the microphone is coupled through C6 on the Audio Board to Pin 1 and then to the base of the audio amplifier Q1 (See Figure 6). In Type 90 encoder applications, tone is applied to the amplifier at Pin 10.

The amplifier output is applied directly to the transistorized limiter stage (Q2). Following the limiter is a combined post-limiter filter and de-emphasis network. The filter output at Pin 6 is coupled through Mod Adjust potentiometer R1 to the phase modulator on the PA board.

When the Audio Compressor option is used, audio from the microphone is coupled through the compressor and then applied to the audio amplifier stage. An audio sample from the collector of amplifier Q1 is connected from Pin 9 to the compressor circuit, keeping the audio output to the modulator constant.

ELECTRONIC PTT A5

The Electric PTT module and remote PTT switch S703 (with relay) is required for Personal Series radios equipped with an external microphone and with the VOX option. A typical diagram of the PTT module is shown in Figure 7.

Turning the radio ON applies the battery voltage to Pin 2, causing Q2 to conduct. When conducting, the 7.5 volts at the collector of Q2 supplies the Receiver Front End, Mixer, IF, Limiter, Audio Amp and Squelch modules.

Keying the transmitter grounds the base of PNP transistor Q1, causing it to conduct and turning off Q2. The supply voltage at the collector of Q1 is applied to the Regulator 5.4-volt keying circuit, turning on the transmitter Compensator and Oscillator modules. Turning on Q1 also turns on Q3, energizing the antenna switching relay.

VOX A4

Transmitters equipped with VOX require the use of an external microphone. The VOX module causes the transmitter to key each time the operator speaks. The transmitter can be keyed manually with either the local PTT switch or the PTT switch on the external microphone. A typical VOX circuit is shown in Figure 8.

The VOX circuit is controlled by a two-position VOX defect switch (S601) on the Control Unit. With the switch in the ON position, audio from the microphone is

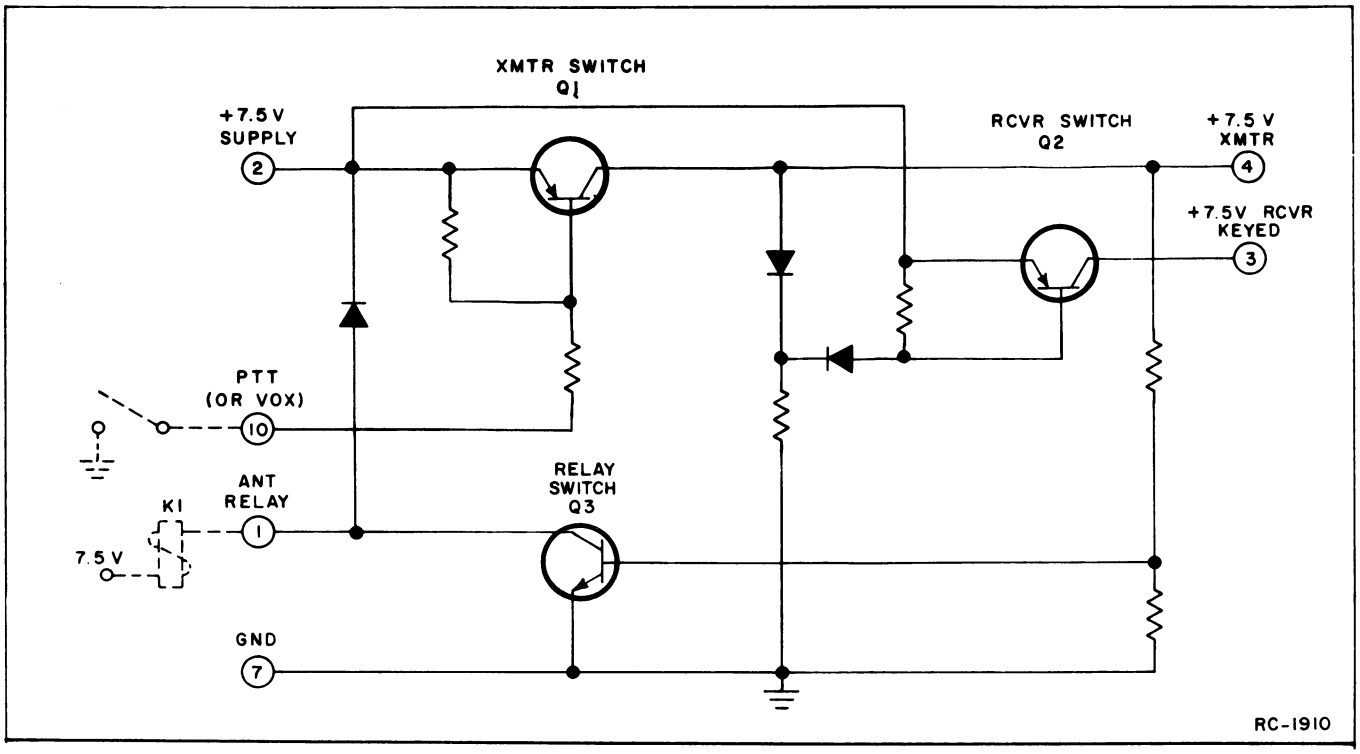


Figure 7 - Typical Electronic PTT Circuit

connected to Pin 6 and applied to the base of amplifier Q1. Following Q1 are selective amplifiers Q2 and Q3. The 400 to 600 Hz output of the selective amplifiers is rectified and the resultant positive DC voltage turns on switching transistor Q4. The collector of Q4 is connected to the base of PNP transistor Q1 in the PTT module. Turning on Q4 drops its collector to ground potential, turning on Q1 in the PTT module. This turns on the 5.4-volt switching transistor in the Regulator module which applies the 5.4 volts to the transmitter Oscillator and Compensator modules,

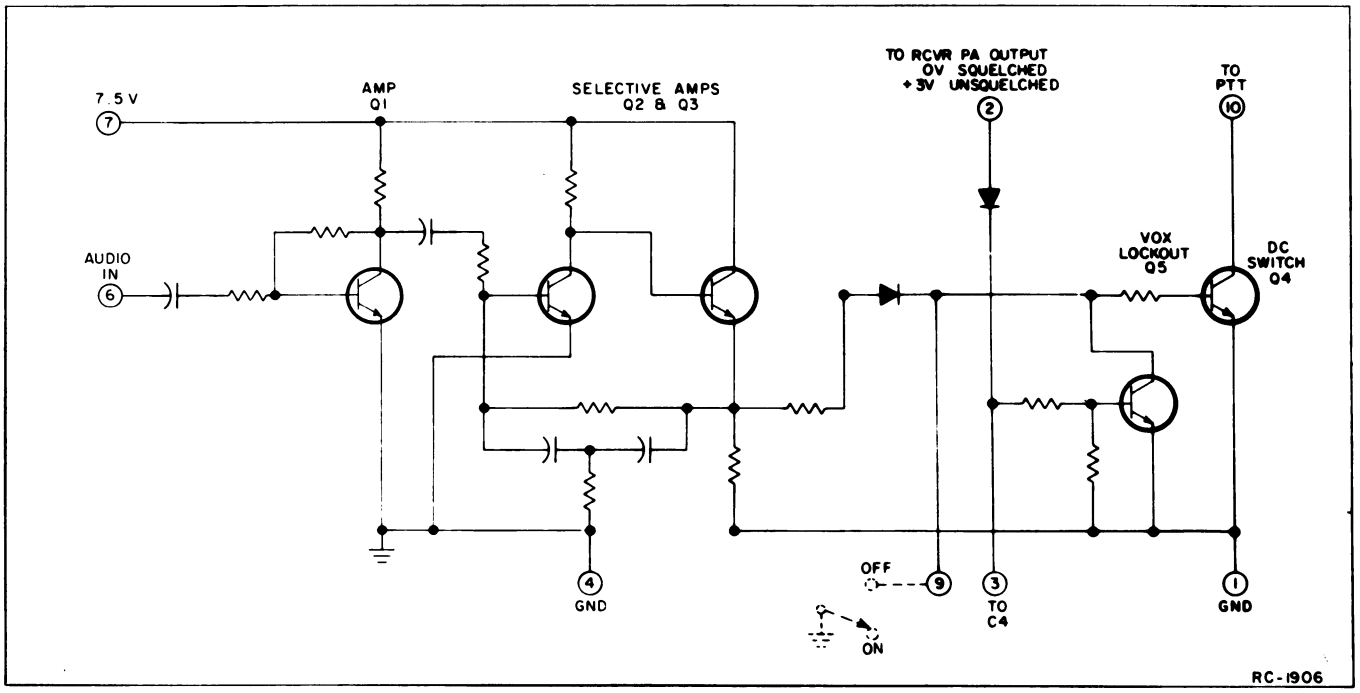


Figure 8 - Typical VOX Circuit

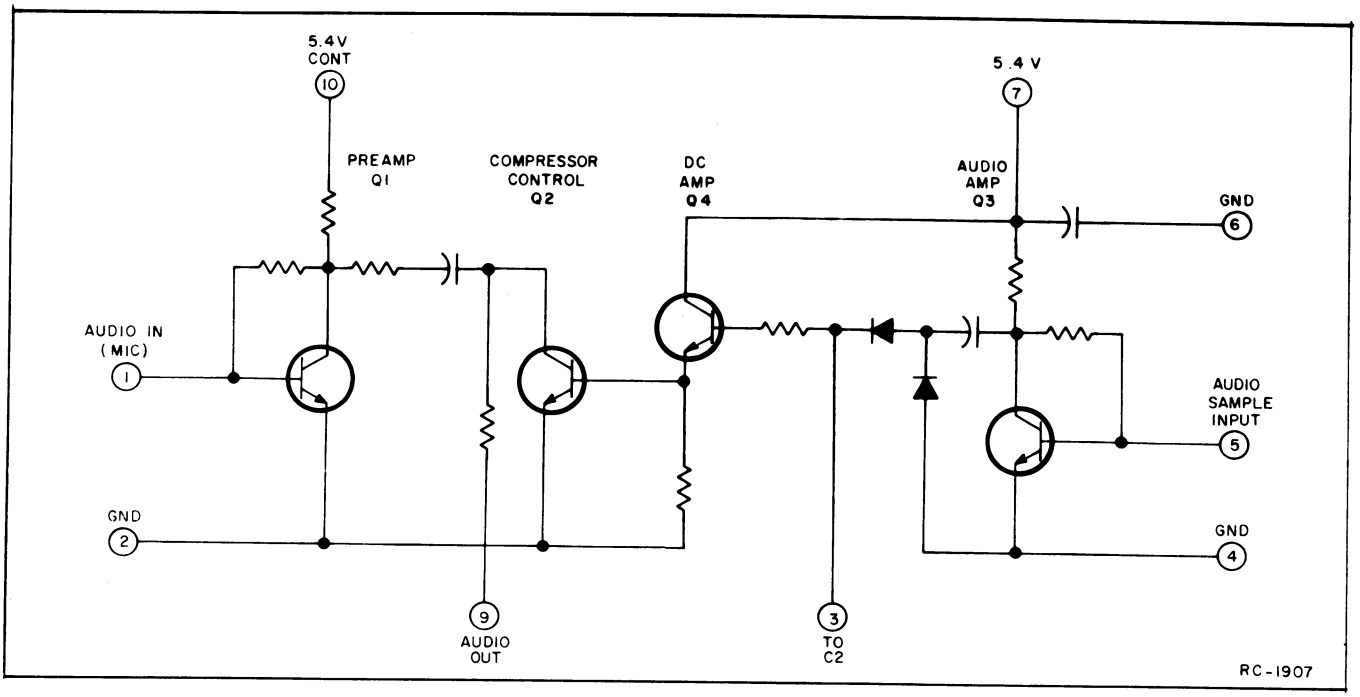


Figure 9 - Typical Audio Compressor Circuit

providing drive to the transmitter multiplier and amplifier stages.

VOX lockout stage Q5 prevents the transmitter from being keyed while the receiver is operating, giving the receiver priority of the VOX circuit. The output of the receiver PA module is connected through Pin 2 to the base of VOX lockout transistor Q5. When the receiver unsquelches, the PA output voltage rises from zero volts (Squelched) to approximately 4 volts, turning on Q5. This keeps switching transistor Q4 turned off until the receiver squelches.

Placing the VOX switch in the OFF position applies a ground to the base of Q4, keeping it turned off. The transmitter must now be keyed by the PTT switch.

AUDIO COMPRESSOR A3

The optional Audio Compressor module provides a constant audio output to the Audio Amplifier-Limiter Module over a 30 dB change in input level. The Compressor module also provides 13 dB additional gain for increased microphone sensitivity. A typical diagram of the Compressor is shown in Figure 9.

Audio from the microphone is coupled through C8 on the Audio Board to Pin 1 of the Compressor. The audio is applied to preamplifier Q1 which provides the 13 dB gain. The preamplifier output at Pin 9 is applied to the input (Pin 1) of Audio Amplifier-Limiter module A2

At the same time, an audio sample voltage from Audio module A2 is applied to Pin 5 and to audio amplifier Q3 in the Compressor module. The output of Q3 is rectified by the two diodes, and the resultant voltage applied to the base of DC amplifier Q4. The DC output of Q4 controls the operation of the compressor-control transistor Q2.

An increase in the audio sample voltage increases the DC voltage applied to Q2. This reduces the AC impedance of Q2, which decreases the audio output voltage at Pin 9. A decrease in the audio sample voltage decreases the DC voltage applied to Q2. This increases the AC impedance of Q2, and increases the audio output voltage at Pin 9.

POWER AMPLIFIER BOARD

Four Models of Power Amplifier Boards are available for use in the transmitter, depending on the frequency range and Type 99 tone option. The application of the PA Boards are shown in the following chart:

Model No.	Freq. Range	No. of Freqs.	Type 99 Decoder
4EF35A10	406-420 MHz	1 thru 4	
4EF35A11	450-470 MHz	1 thru 4	
4EF35A12	406-420 MHz	1 or 2	Yes
4EF35A13	450-470 MHz	1 or 2	Yes

OSCILLATOR MODULE

Oscillator Model 4EG27A11 consists of a crystal-controlled Colpitts oscillator and a Channel Guard tone modulator. The entire oscillator is contained in a metal can with the transmitter operating frequency

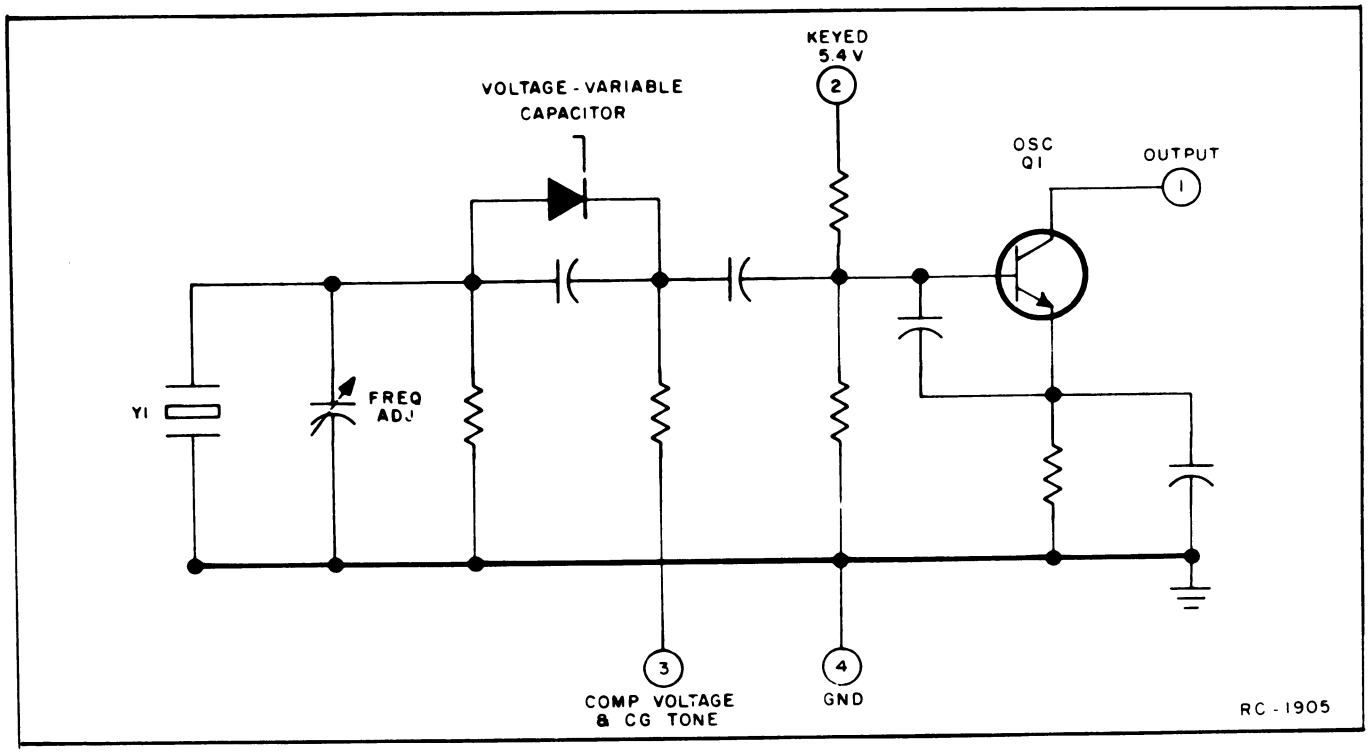


Figure 10 - Typical Oscillator Circuit

printed on the top. The crystal frequency ranges from 16.9 to 19.58 MHz, and the crystal frequency is multiplied 24 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 A102. An optional Compensator module is available with compensation for a frequency stability of ±.0005% from -30°C to +80°C. A typical oscillator circuit is shown in Figure 10.

In single-frequency transmitters, a jumper from Hole 14 to Hole 15 on the PA board connects the keyed 5.4 volt supply voltage to the oscillator module. Keying the transmitter applies the supply voltage to the oscillator, turning it on. The oscillator output is applied to Compensator A102.

In multi-frequency transmitters, up to three additional oscillator modules may be mounted on the PA board. The single-frequency supply jumper is removed, and the proper frequency is selected by connecting the keyed 5.4 volts to the selected oscillator module through frequency selector switch S2603 on the control unit.

For Channel Guard applications, tone from the Channel Guard encoder is applied to the oscillator module. The tone is applied at Pin 3 to the voltage-variable capacitor on the oscillator module where it frequency modulates the oscillator output.

CAUTION

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 A102

Compensator module A102 contains a buffer-amplifier, and the temperature compensating network for the Oscillator. A typical Compensator circuit is shown in Figure 11.

RF from the oscillator at Pin 4 is coupled through a DC-blocking capacitor to the base of buffer-amplifier Q1. This stage isolates the oscillator from the modulator. The output of Q1 connects from Pin 5 to the modulator.

In the compensation network, the keyed 5.4 volts at Pin 10 is applied to a thermistor-compensated voltage divider. The output at Pin 2 (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

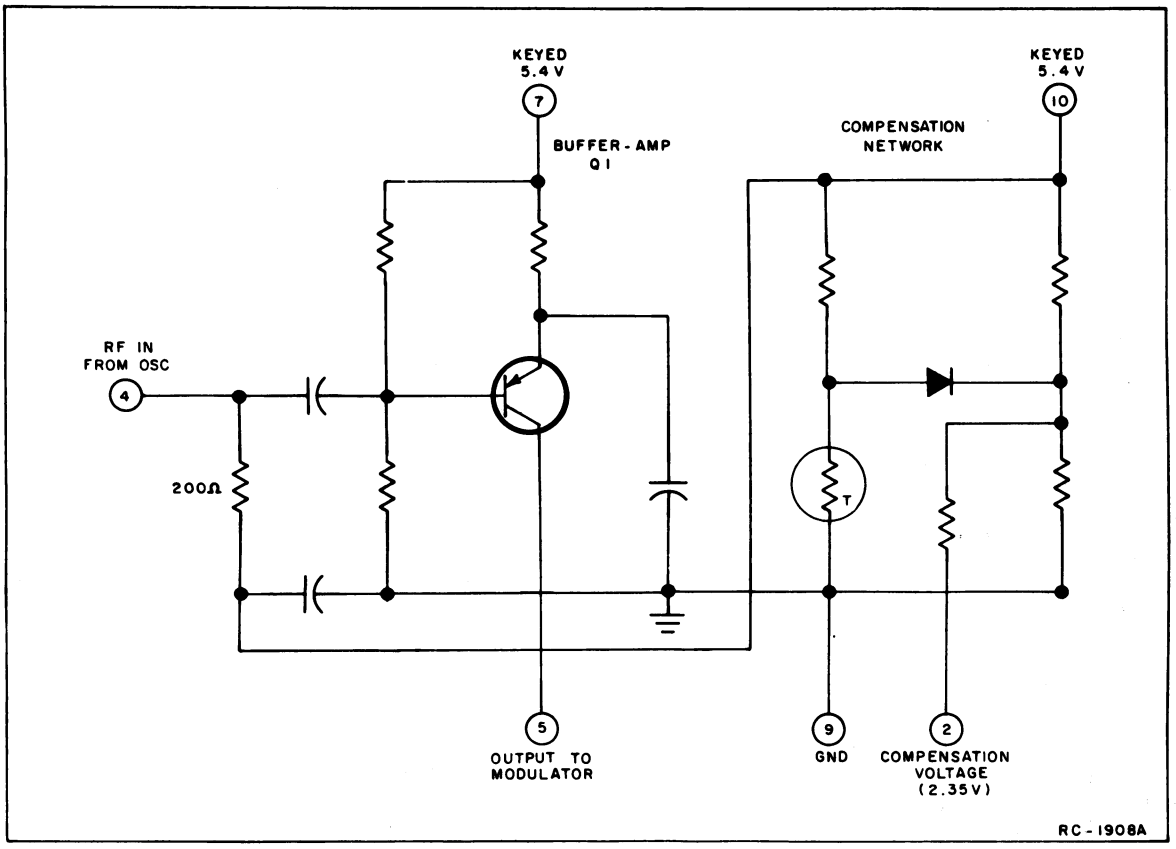


Figure 11 - Typical Compensator Circuit

maintain the proper voltage on the oscillator voltage-variable capacitor.

Service Note: An abnormally low VTVM reading (or no reading) at Pin 2 may indicate a short or leakage path in the oscillator. This can be checked by unsoldering Pin 2, 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.

PHASE MODULATOR

The phase modulator consists of varactor CV101 in series with tuneable coil L123/L124. This network appears as a series-resonant circuit to the RF output of the oscillator. Applying an audio signal to the modulator varies the vias of CV101, resulting in a phase modulated output. The output is coupled through blocking capacitor C160 to the base of the 1st amplifier.

1ST AMPLIFIER, 1ST & 2ND MULTIPLIERS

Amplifier Q101 isolates the modulator from the loading effect of the multiplier stage and provides some amplification. The amplifier output is coupled through C161 to the base of the 1st multiplier.

Following Q101 are two inductively-coupled, common-emitter multiplier stages. Q102 operates as a tripler with collector tank T101 tuned to three times the crystal frequency. This stage is metered at Test Point 1 (TP1) across metering resistor R103. The modulator and 1st amplifier stages are also metered at TP1.

The output of T102 is applied to the base of 1st doubler Q103. Collector tank T103 is tuned to six times the crystal frequency. This stage is metered at TP2 across metering resistor R105.

2ND MULTIPLIER & AMPLIFIER

Second multiplier Q104 operates as a doubler with collector tank T104 tuned to 12 times the crystal frequency. The stage is metered at TP3 across metering resistor R107. Z101 (as well as Z102 and Z103 in the 2nd amplifier and 3rd multiplier stages) consists of a ferrite core with several loops of wire. The assembly acts as a lossy choke in the base circuit of Q104 for improved stability.

The output of T105 is coupled through C123 to the base of 2nd amplifier Q105. This stage, as well as the 3rd multiplier and 3rd and 4th amplifiers are tuned by measuring the current drain of the transmitter. An ammeter with a 1.5 ampere full

scale meter is used in series with the transmitter 7.5 volt supply lead. GE Test Fixture Model 4EX11A10 and Test Set Model 4EX3A10 may be used in place of ammeter.

A constant-K, DC collector-feed network consisting of L103, L104, C128 and R110 provides improved amplifier stability. Similiar collector-feed networks are used in the remaining transistor stages.

HI-LO power switch S705 permits the transmitter to be operated at reduced power to increase battery life whenever the full power output is not required. With the switch in the HI power position, 7.5 volts from the battery is applied directly to the collector-feed network of Q105, providing the rated power output. With the switch in the LO power position, the supply voltage to the collector-feed network is dropped across resistor R111. This reduces the power output of the transmitter to 0.4 watt, greatly extending the battery life.

3RD MULTIPLIER, 3RD & 4TH AMPLIFIERS

The output of Q105 is coupled through tuneable coil L105 to the base of 3rd multiplier Q106. This stage operates as a doubler with its output tuned to 24 times the crystal frequency.

Following Q106 are two series-tuned class C power amplifier stages (Q107 and Q108). The output of Q108 is link-coupled to bandpass filter Z104/Z105 which consists of a helical resonator. The RF output is coupled through the external antenna switch (S704) to the antenna.

RECEIVER

Receiver Models 4ER57A10—15 are single conversion, superheterodyne FM receivers for operation on the 406—420 and 450—470 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 Freqs.	Tone Option
4ER57A10	406-420 MHz	1 thru 4	
4ER57A11	450-470 MHz	1 thru 4	
4ER57A12	406-420 MHz	1 thru 4	Chan.Gd.
4ER57A13	450-470 MHz	1 thru 4	Chan.Gd.
4ER57A14	406-420 MHz	1 or 2	Type 99 Decoder
4ER57A15	450-470 MHz	1 or 2	Type 99 Decoder

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. However, some of the components have been omitted for circuit simplification. A block diagram of the receiver is shown in Figure 12.

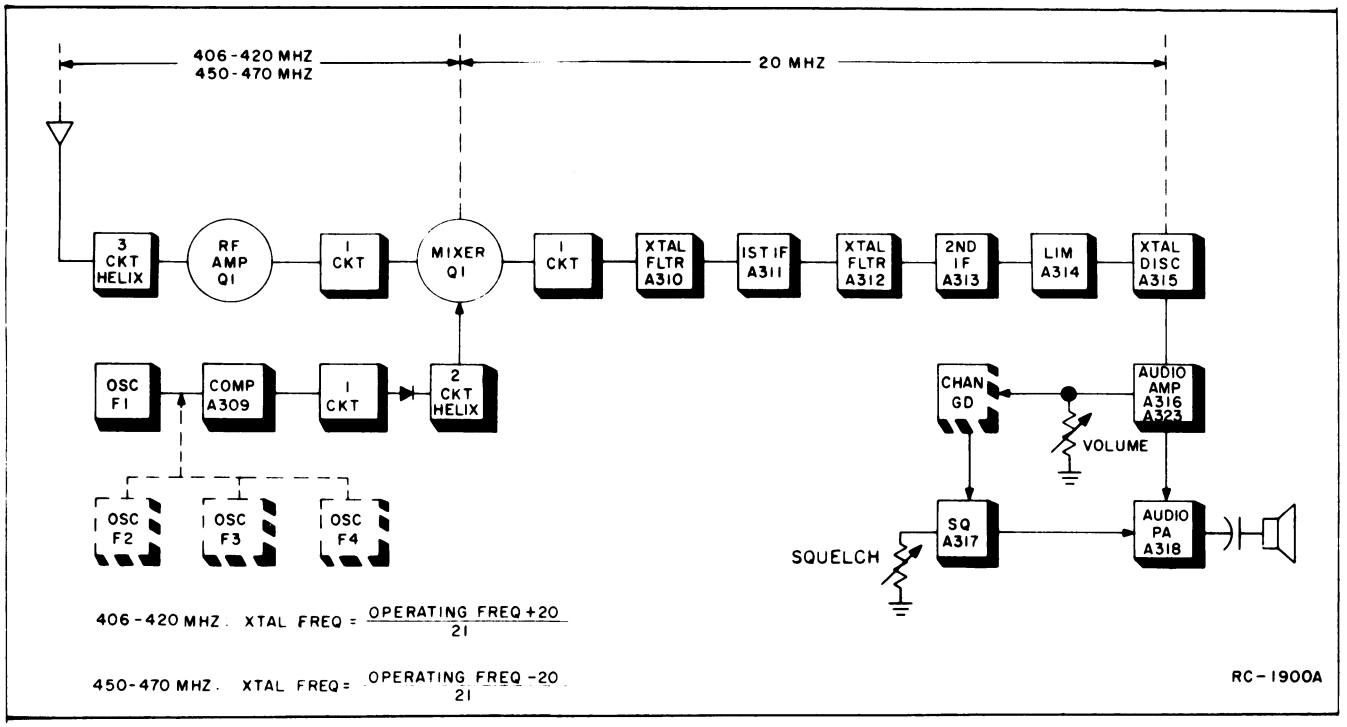


Figure 12 - Receiver Block Diagram

Supply voltage for the receiver includes a continuous 5.4 volts regulated for the Compensator module, a continuous 7.5 volts for the audio PA module, and a keyed 7.5 volts for the remaining receiver stages.

FRONT END A303/A304

The receiver Front End consists of three tuned helical resonators and an RF amplifier stage. The RF signal from the antenna is coupled through RF cable W701 to a tap on L7/L10. The tap is positioned to provide the proper impedance match to the antenna. RF energy is coupled to the third coil (L9/L12) through openings in the sides of the cans. RF is then coupled from a tap on L9/L12 through C6 to the base of RF amplifier Q1. The output of Q1 is developed across tuned circuit C7/C8-L1 and is applied to the base of the mixer (A307-Q1).

OSCILLATOR MODULE

Oscillator Model 4EG28A12 (406—420 MHz) and 4EG28A13 (450—470 MHz) consists of a crystal-controlled Colpitts oscillator similiar to the Oscillator module used in the transmitter (see Figure 10). The entire oscillator is contained in a metal can with the receiver operating frequency printed on the top. The crystal frequency ranges from 20.285 to 21.428 MHz, and the crystal frequency is multiplied 21 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 A102. An optional Compensator module is available with compensation for a frequency stability of ±.0005% from -30°C to +80°C.

In single-frequency receivers, a jumper from TB701-9 to -10 connects the oscillator module to the continuous 5.4 volt supply voltage. The oscillator output is applied to Compensator A309.

In multi-frequency receivers, up to three additional oscillator modules may be mounted on the receiver board. The single-frequency supply jumper is removed, and the proper frequency is selected by connecting the 5.4 volts to the selected oscillator module through frequency selector switch S2603 on the control unit.

CAUTION

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 A309

Compensator module A309 contains a buffer-amplifier stage, and the temperature compensation network for the oscillator similiar to the Compensator used in the transmitter (see Figure 11).

RF from the oscillator is coupled from Pin 7 through a DC blocking capacitor to the base of Q1. The output of Q1 connects to multiplier coil L1 on the Mult-Mixer 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 2, 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.

MULTIPLIER-MIXER A307

Multiplier-Mixer module A307 is DC series-connected to the Front End module. The 3.4 volts to supply the mixer stage is provided from the +7 volts applied to the Front End.

The output of the Compensator module is applied to L1 in the multiplier assembly. L1 is tuned to three times the crystal frequency and is metered at the Mult Test Point, (H6) on the receiver board. The output of L1 is applied to the anode of multiplier diode CR1. The two helical resonators following CR1 are tuned to seven times the first multiplier frequency for a total multiplication of 21 times. The output of the helical resonators is direct-coupled to the emitter of the mixer transistor. In 406 to 420 MHz receivers, a high side injection frequency is used. In 450 to 470 MHz receivers, a low side injection frequency is used.

The RF signal from the RF amplifier is applied to the base of mixer Q1 and the high or 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 (L1 & C1) to Crystal Filter A310. The collector tank also provides impedance matching to the crystal filter.

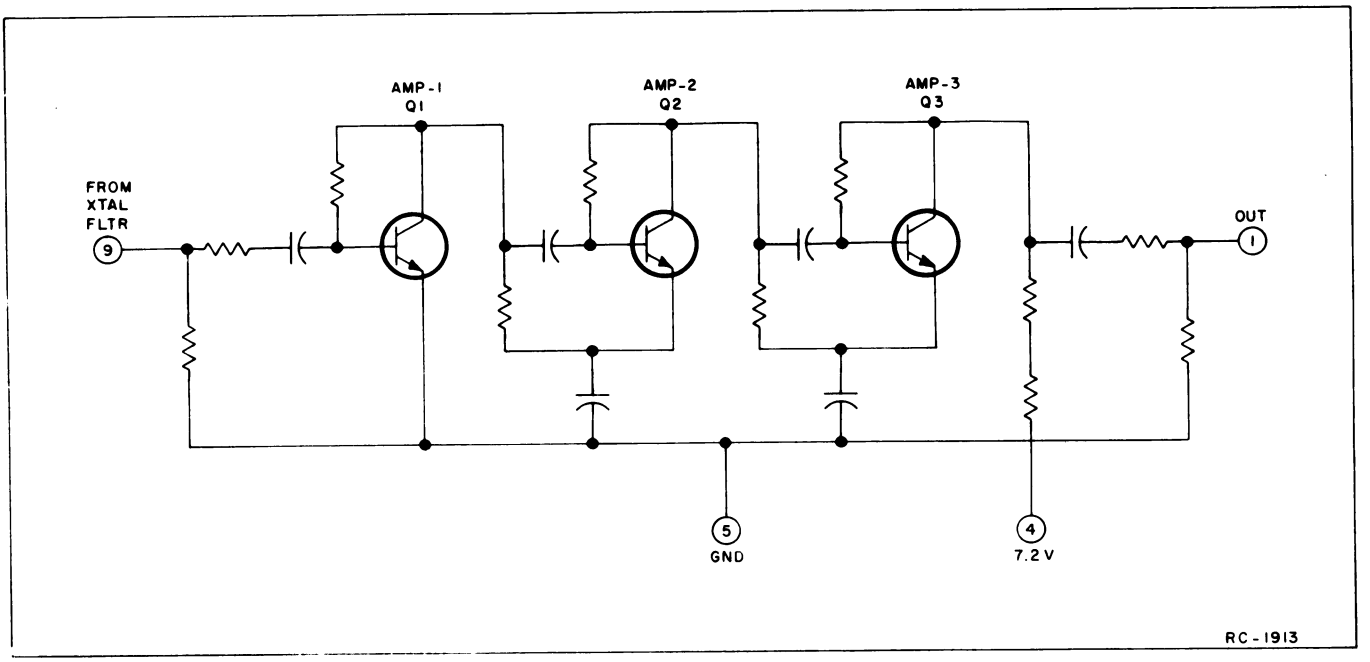


Figure 13 - Typical IF Amplifier Circuit

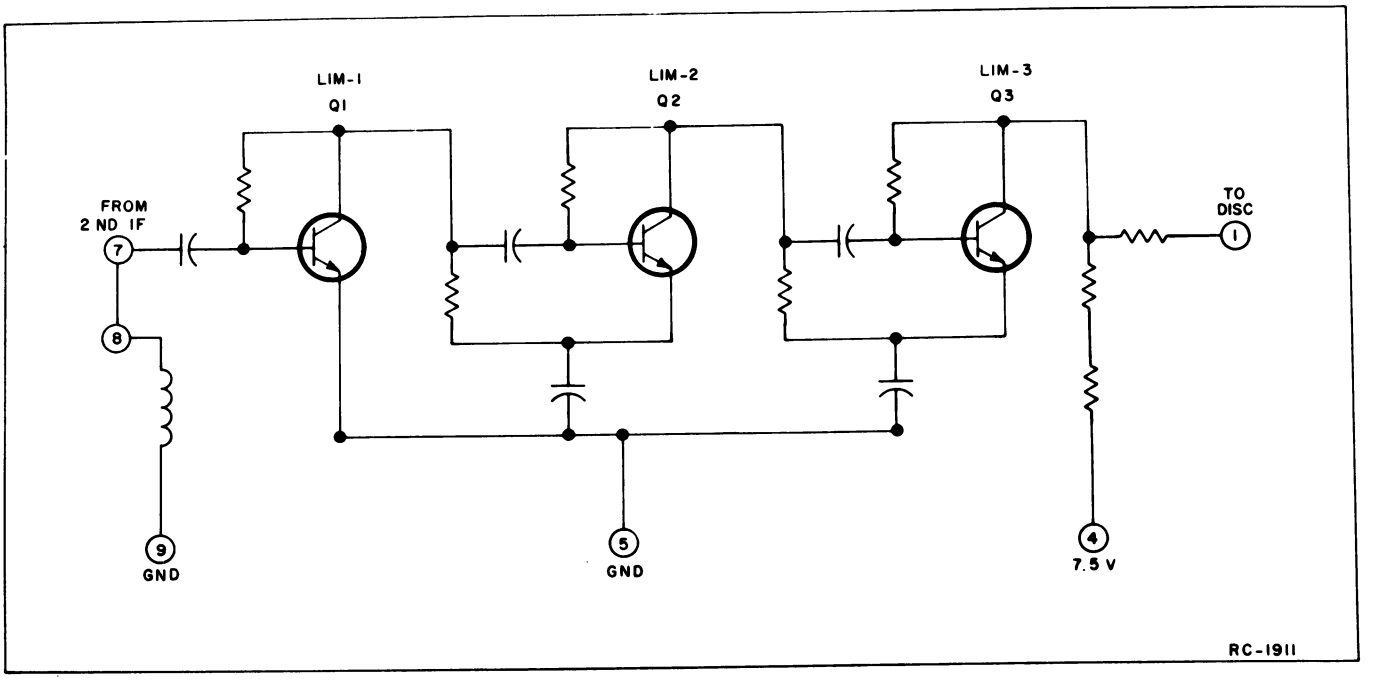


Figure 14 - Typical Limiter Circuit

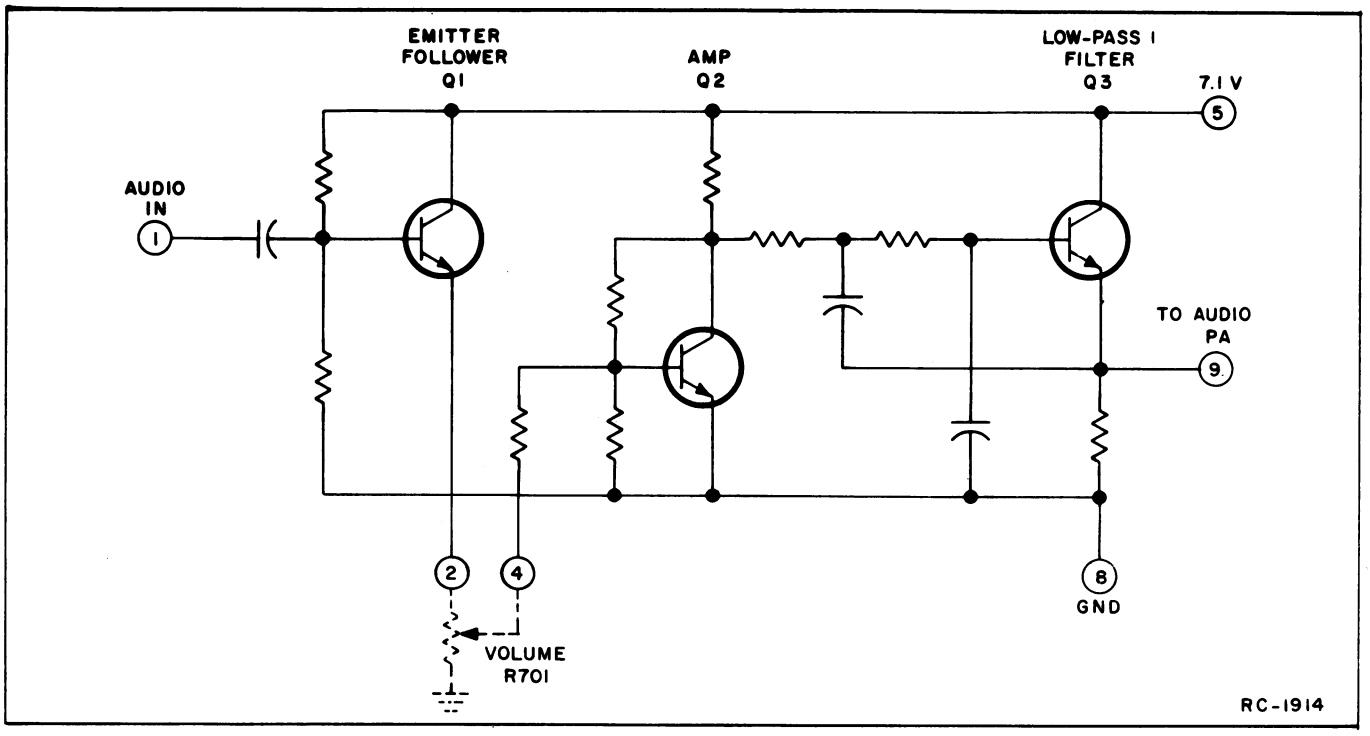


Figure 15 - Typical Audio Amplifier Circuit

CRYSTAL FILTERS A310 & A312

Filter A310 follows the Multiplier-Mixer stage, and its output is applied to the 1st IF amplifier module. Filter A312 follows the IF Amplifier module. The two Crystal Filters provide the major selectivity for the receiver. A310 provides a minimum of 40-dB stop-band attenuation, while A312 provides a minimum of 20-dB stop-band attenuation.

IF AMPS A311 & A313

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 13.

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 A314 & DISCRIMINATOR A315

Limiter A314 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 14.

The receiver uses a 20 MHz, fixed-tuned crystal discriminator (A315) to recover the audio from the IF signal. The Discriminator output is applied to the Audio Amplifier module.

AUDIO AMPLIFIER A316/A323

Audio and noise from the discriminator is applied to Audio Amplifier module A316 (A323 in Channel Guard applications). A typical audio amplifier circuit is shown in Figure 15.

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 A318

When the receiver is quieted by a signal, audio from the active filter is connected to Pin 1 of Audio PA module A318,

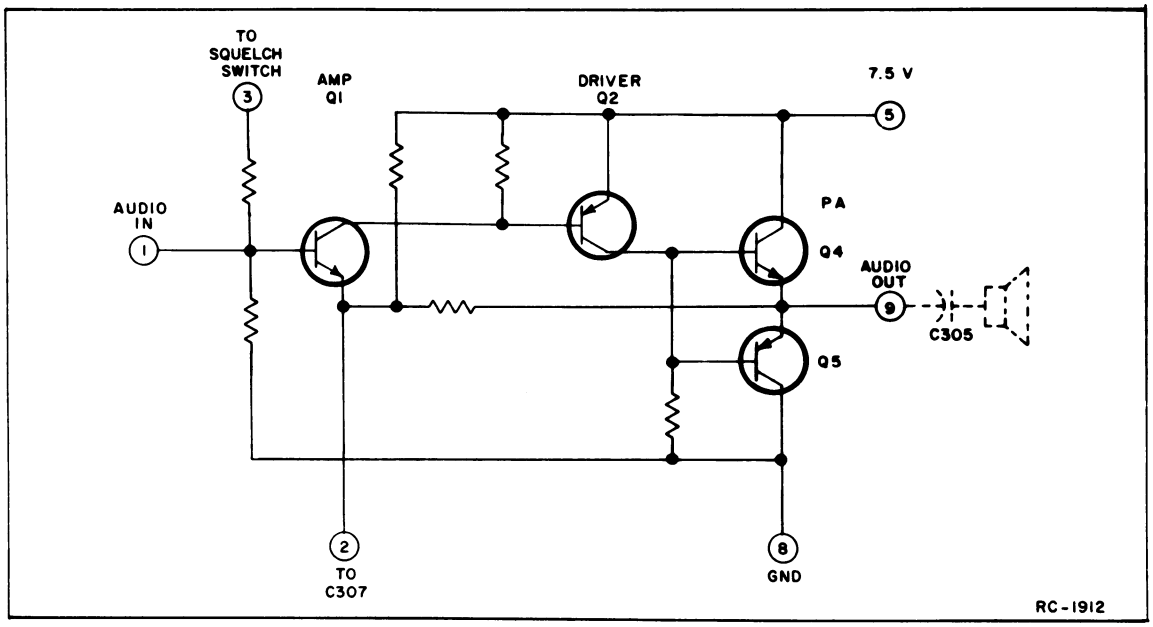


Figure 16 - Typical Audio PA Circuit

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 16.

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 C305 on the receiver board to the loudspeaker.

SQUELCH A317

Noise from Audio Amplifier A316/A323 operates the squelch circuit. A typical squelch circuit is shown in Figure 17.

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 R702. R702 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 H3 to H4. 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 H3 to H4 is removed. The emitter of squelch switch Q3 is connected to +7 volts through TB701-15 to a DC switch on the decoder board.

TONE OPTIONS

The following tone options are available for use with the Personal Series radios:

- Channel Guard Encoder/Decoder
- Channel Guard Encoder
- Type 90 Encoder/Decoder
- Type 90 Encoder
- Type 99 Selective Calling Decoder

Both the Channel Guard and Type 90 Tone Options use Selective Amplifier IC's for the frequency (tone) selective circuit. The Selective Amplifier Consists of Wien bridge circuit with an operational amplifier for controlling the encoder frequency stability and the decoder bandwidth.

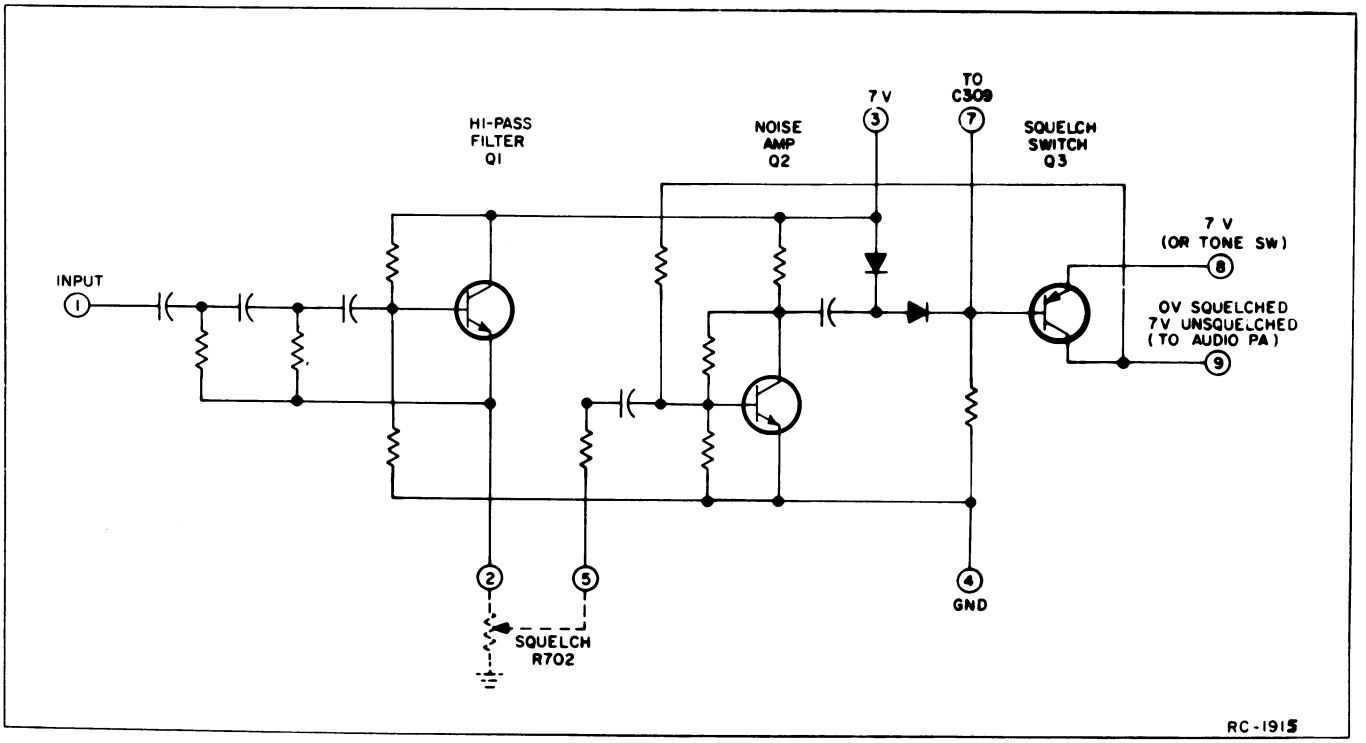


Figure 17 - Typical Squelch Circuit

Two or four reeds are used for frequency selection in the Type 99 Selective Calling decoders.

CHANNEL GUARD ENCODER/DECODER

The Encoder/Decoder assembly is a continuous-tone encoder and decoder for operation on tone frequencies in the 71.9 to 203.5 Hz range. Both the encoder and decoder operate on the same frequency. The assembly consists of three Integrated circuit modules that includes Input Filter A601, Limiter & Switch A602, and Selective Amplifier A603. Typical diagrams of the Input Filter and Limiter Switch circuits are shown in Figures 18 and 19.

The Channel Guard circuit is controlled by an ON-OFF switch on the control unit. Placing the switch in the OFF position disables the decoder circuits to permit monitoring all calls on the channel. Placing the switch in the ON position enables the Encoder/Decoder.

ENCODE

Keying the transmitter applies 7.5 volts to Pin 8 of the Input Filter module, turning on encode switch Q5. This allows tone from Selective Amplifier A603 to be coupled through Q5 and applied to the transmitter oscillator module. In multi-frequency radios, all RF channels are modulated by the Channel Guard tone.

DECODE

Releasing the PTT switch removes the 7.5 volts at Pin 8 and applies 7.5 volts to Pin 9, turning on decode switch Q4. At the same time the signal from R701-3 (Volume HI) is coupled to Pin 10 of Input Filter A601, where it is applied to a two-stage, active low-pass filter (Q1 and Q2) for attenuating frequencies over 205 Hz. When no tone is present in the signal, the random noise output of the filter will not operate the decoder circuitry.

Any tone present in the signal is limited by diodes CR1 and CR2, and the output applied through Pin 1 to the Selective Amplifier module. If the incoming tone is of the proper frequency, the output of the Selective Amplifier will be just sufficient to operate the detector circuit (Q1 thru Q3).

The positive half cycles of the Selective Amplifier output turns on Q1, which over-rides the diode and turns on Q2. Turning on Q2 causes its collector to drop to ground potential, turning on the PNP tone switch Q4. When conducting, the 7.5 volts at the collector of Q4 is applied to the squelch switching transistor on the Audio PA module. The receiver now operates on noise squelch, permitting the call to be monitored.

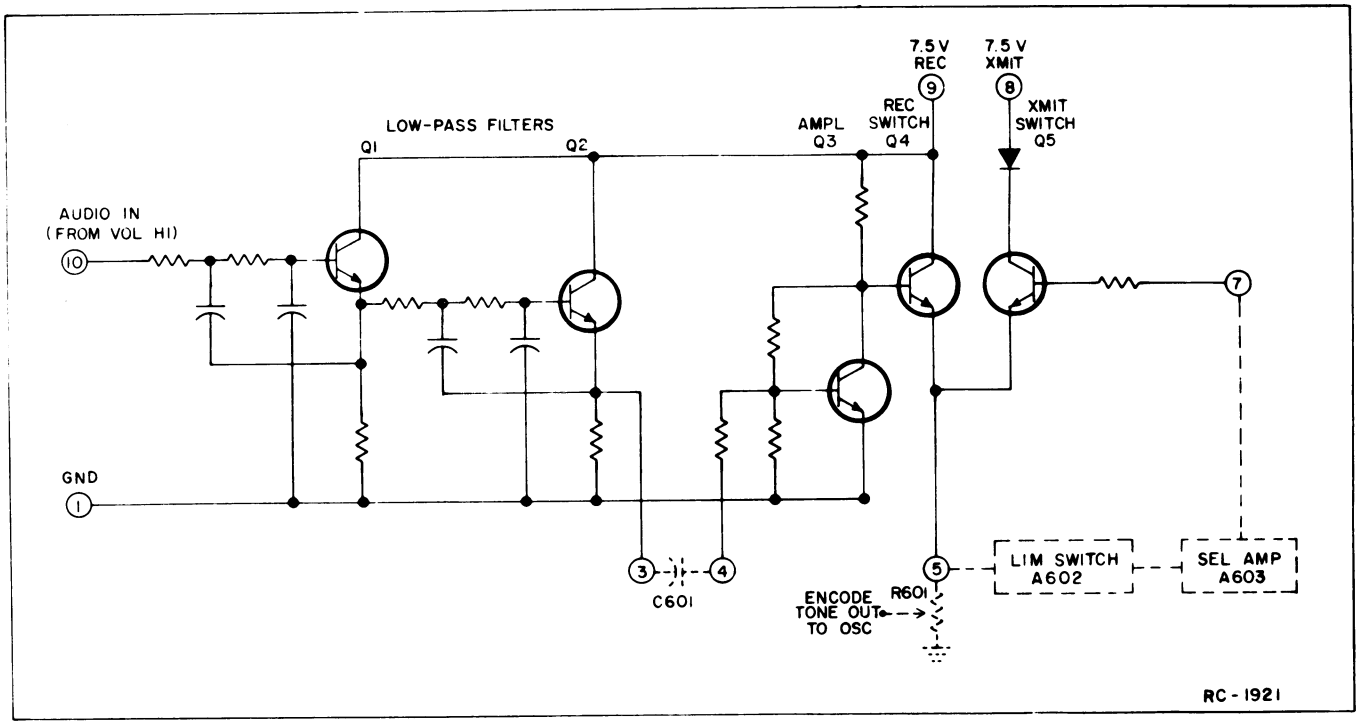


Figure 18 - Input Filter Circuit

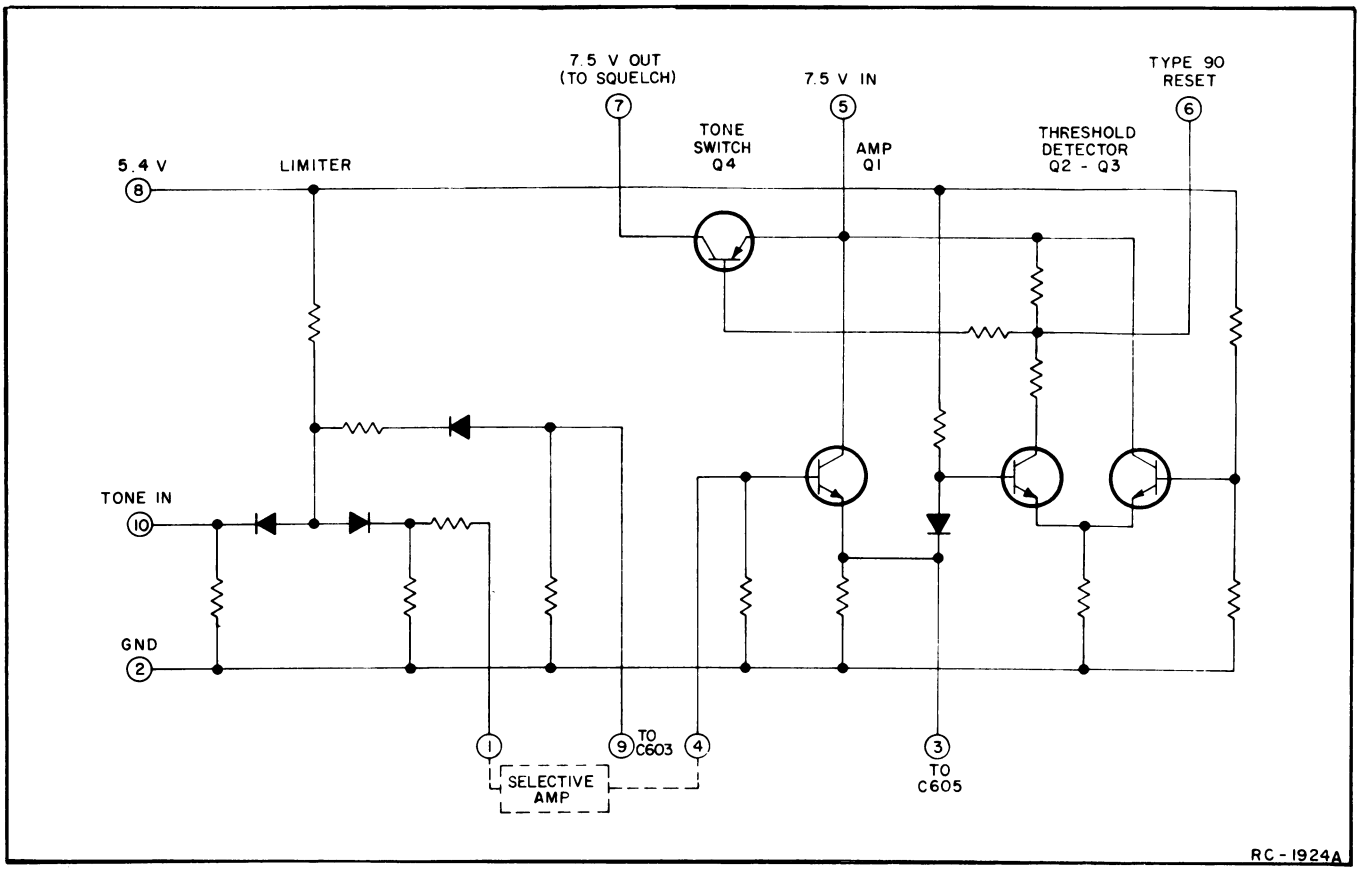


Figure 19 - Limiter-Switch Circuits

CHANNEL GUARD ENCODER

The Encoder assembly is a two-tone encoder for operation on tone frequencies in the 71.9 to 203.5 Hz range. The assembly consists of Limiter module A601 and two Selective Amplifier modules (A602 and A603). An optional single-tone encoder assembly is available that utilizes a Limiter module and only one Selective Amplifier module.

The Encoder is controlled by a three position switch on the control unit. Placing the switch in the OFF position disables the Encoder so that no tone is applied to the transmitter oscillator module.

Placing the switch in the Tone A or Tone B position applies 5.4 volts to the Limiter-Switch module and one of the Selective Amplifier modules, causing the modules to oscillate on the encode frequency. The Limiter circuit keeps the input to the Selective Amplifier constant to maintain the required frequency and level stability.

Whenever the transmitter is keyed, the encoder tone at Pin 6 of the Limiter module is applied to the transmitter oscillator module.

TYPE 90 ENCODER/DECODER

The Type 90 Encoder/Decoder is a pulsed tone encoder/decoder assembly for operating on standard Type 90 tone frequencies of 1000 to 3000 Hz. The assembly uses three Integrated Circuit modules consisting of Input Amplifier A601, Limiter-Switch A602 and Selective Amplifier A603. The Limiter Switch diagram is shown in Figure 19. A typical diagram of the Input Amplifier is shown in Figure 20.

Operation of the encoder/decoder assembly is controlled by a three position switch on the Control Unit. The switch must be in the Monitor position to transmit the encoder tone or to monitor the channel. The switch must be placed in the Reset and then in the Normal position for the decoder to operate.

MONITOR

Placing the switch in the Monitor position applies 7.5 volts to Pin 4 of the Input Amplifier module. This turns on Q4 in the burst-timer circuit, turning off Q3. Turning off Q3 removes the ground on the emitter of Q2, allowing Q2 to turn on. Tone from the Selective Amplifier module is applied to Pin 8 of the Input Amplifier, and is coupled through Q2 to Pin 2 where it is capacity coupled through C601 to amplifier Q5. The amplifier output is applied to

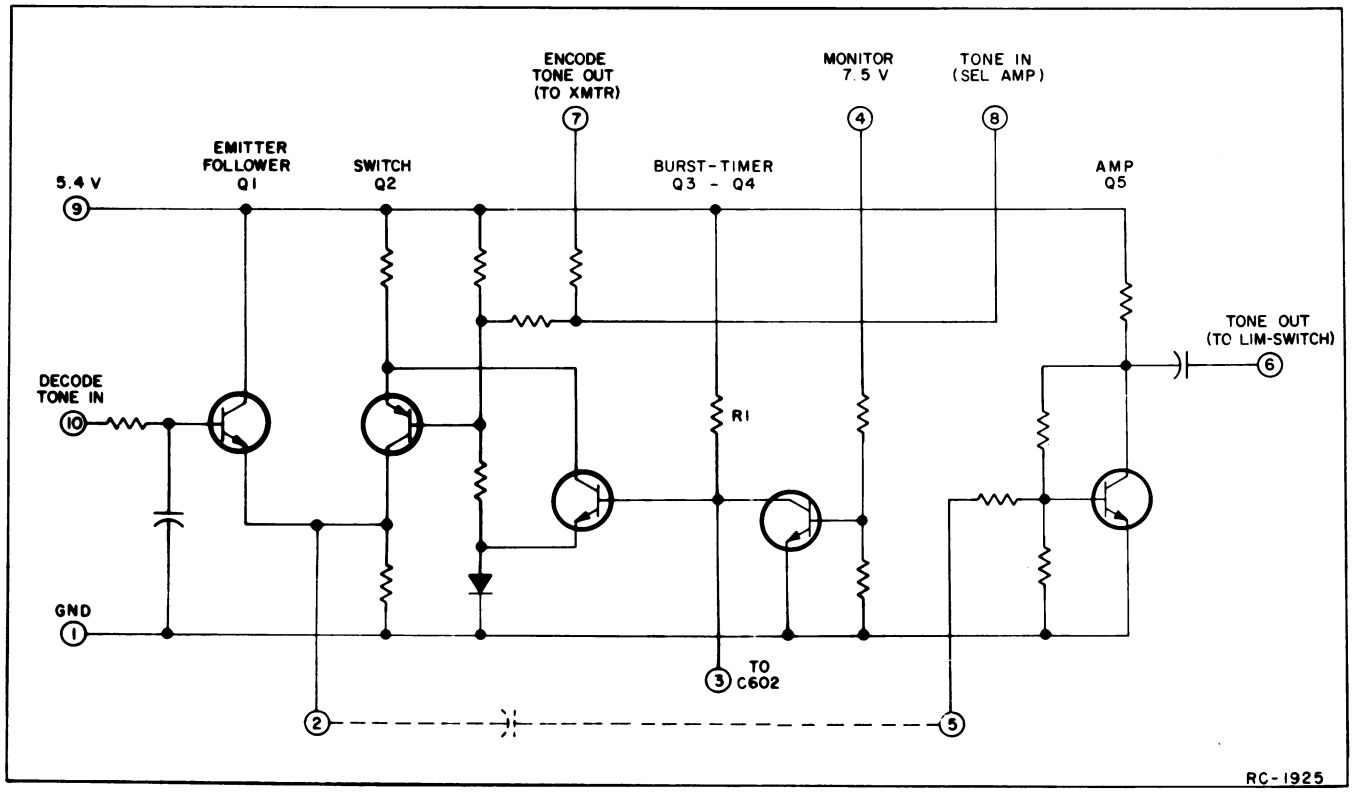


Figure 20 - Typical Input Amplifier Circuit

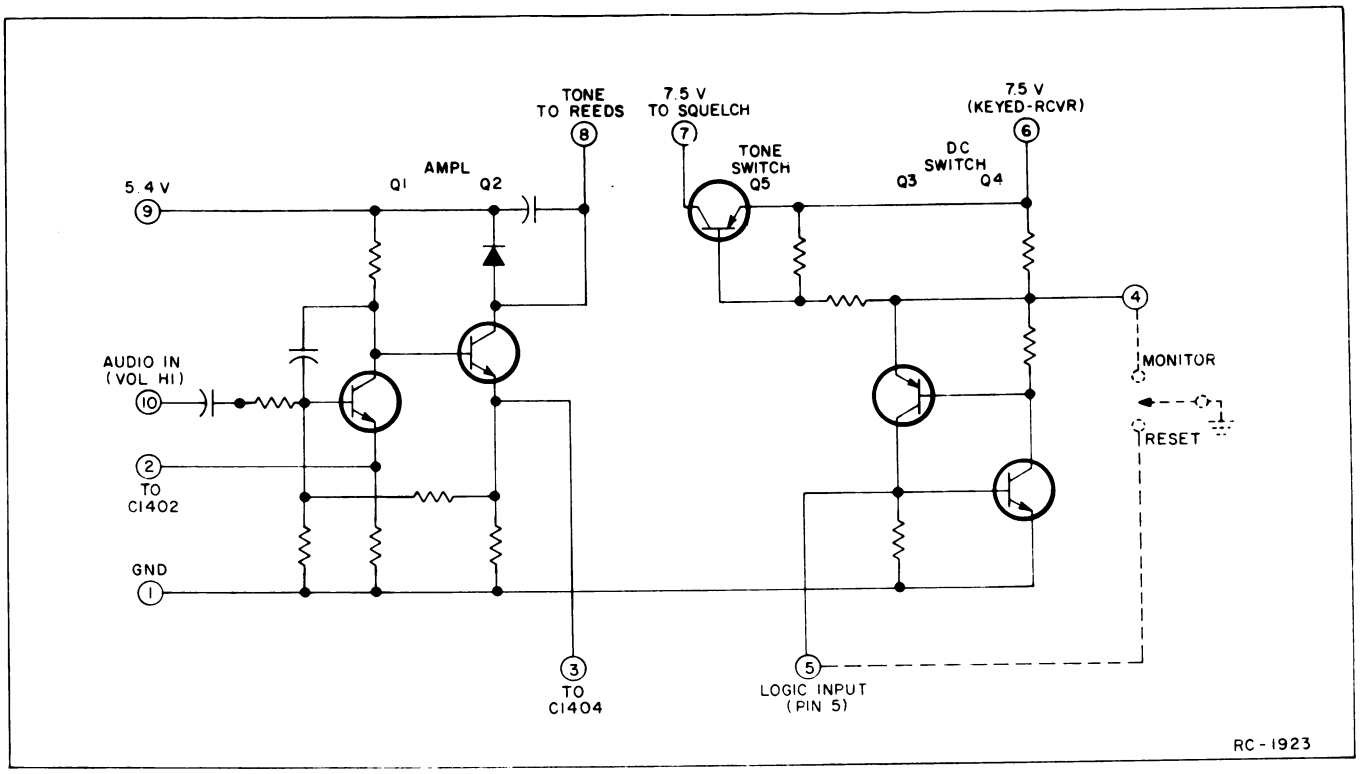


Figure 21 - Amplifier-Switch

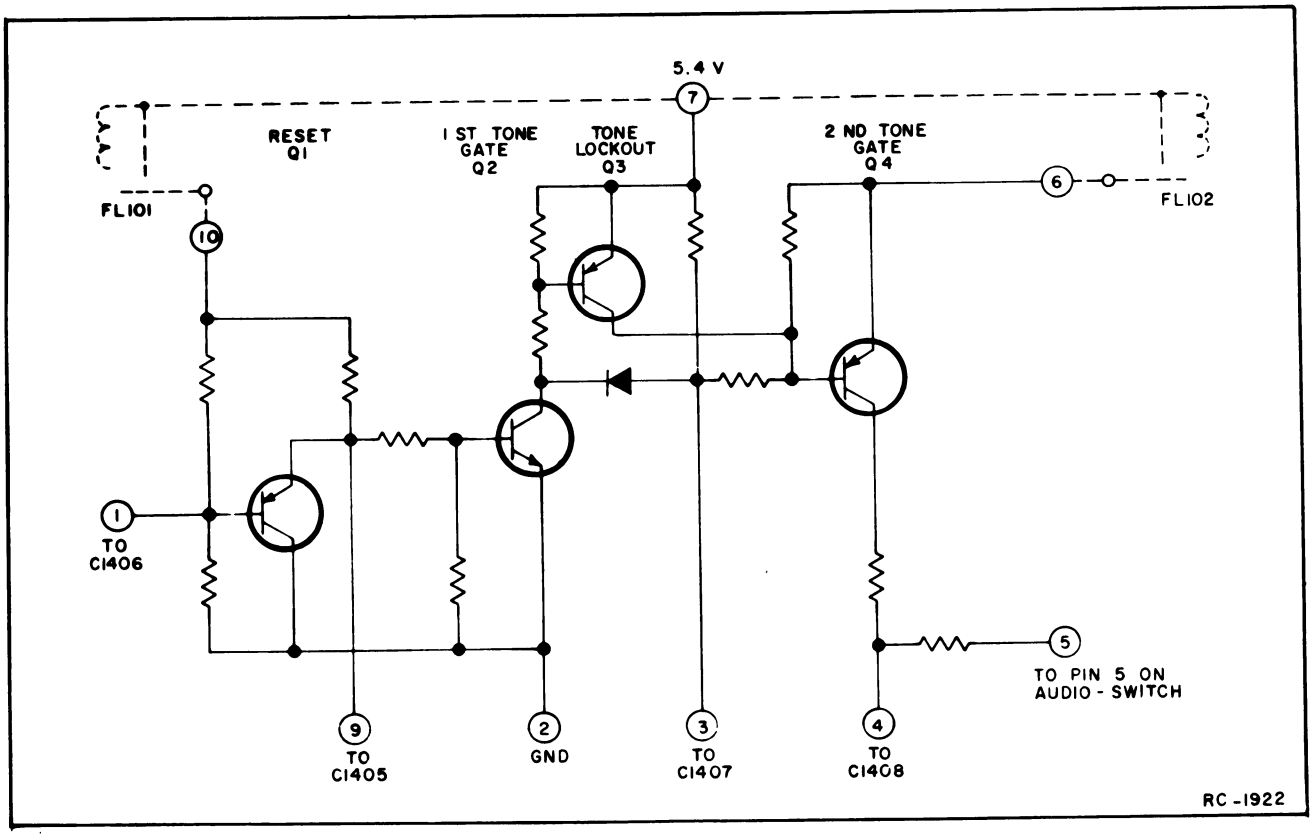


Figure 22 - Logic Module Diagrams

Pin 10 of the Limiter-Switch module where it activates the tone switch (Q4), allowing the receiver to operate on noise squelch.

ENCODE

Keying the transmitter removes the 7.5 volts at Pin 4 of the Input amplifier module, turning off Q4 in the burst-timer circuit. Capacitor C602 is kept discharged while Q4 is conducting. When Q4 turns off, Q3 also remains off until C602 charges through R1. While C602 is charging, Q2 operates and completes the feedback path for the Selective Amplifier, causing it to oscillate on the encode frequency. Tone is coupled through Encode Tone Adjust potentiometer R605 and applied to the Audio Amplifier module on the Audio Board. R605 is set for a tone output of ±3 kHz.

When C602 charges up, Q3 turns on which turns Q2 off, removing the tone to the transmitter. The burst-timer circuitry provides a pulsed tone output of approximately one second.

DECODE

When the switch is in the Normal position, the burst-timer circuit is disabled. Audio from R703-1 (Volume Hi) is applied to the base of emitter-follower Q1 on the Input Amplifier module. The output of Q1 is capacity-coupled to the base of amplifier Q5. The amplifier output is applied to the limiter circuit on the Limiter-Switch module.

Any tone present in the signal is limited by diodes CR1 and CR2, and the output applied through Pin 1 to the Selective Amplifier module. If the incoming tone is of the proper frequency, the output of the Selective Amplifier will be just sufficient to operate the detector circuit (Q1 thru Q3).

The positive half cycles of the Selective Amplifier output turns on Q1, which over-rides the diode and turns on Q2. Turning on Q2 causes its collector to drop to ground potential, turning on the PNP tone switch Q4. When conducting, the 7.5 volts at the collector of Q4 is applied to the squelch switch on the receiver Squelch module. The voltage is connected through the squelch switching transistor to the Audio PA module. The receiver now operates on noise squelch so that all calls on the channel can be monitored.

TYPE 90 ENCODER

The Type 90 Encoder Assembly is a pulsed tone encoder for operating on two tone frequencies in the 1000 to 3000 Hz range. The assembly consists of Limiter A601 and Selective Amplifiers A602 and A603. An optional single-tone encoder is available that consists of the Limiter and a single selective Amplifier module. The Limiter module contains a Tone burst timer circuit and a limiter circuit for each Selective Amplifier module. The limiter circuit keeps the input to the selective Amplifier modules constant to maintain the required frequency and level stability.

The Encoder is controlled by a three-position switch on the Control Unit. Placing the switch in the OFF position removes the 5.4-volt supply voltage and disables the Encoder. With the switch in the Tone A or Tone B position, keying the transmitter applies 5.4 volts to the Limiter module and to the selected Selective Amplifier module.

Applying power to the modules causes the Selective Amplifier to start oscillating at the desired tone frequency, and also starts the tone burst timer circuit. The burst timer provides a tone output for approximately one second. The encode tone is coupled through Encode Tone Adjust R603 to the transmitter audio module. R603 is set for ±3 kHz deviation.

TYPE 99 DECODER

The Type 99 Decoder is a sequential-tone, two or four reed decoder designed for operation with any two-tone sequential encoder. Two reeds (FL301 and FL302) are used for individual call or group call. The reeds are mounted on the receiver board board in the area normally occupied by the three- and four-frequency oscillator modules. Two additional reeds (FL101 and FL102) are required in individual call, group call and all-call applications. These reeds are mounted on thetransmitter PA board in the area normally occupied by the three- and four-frequency oscillator modules.

The Decoder assembly consists of Amplifier-Switch A1401, and Logic module A1402. The decoder may also be used with a single-tone Channel Guard Encoder. In this application, the decoder assembly also consists of Encoder Limiter A1403 and Selective Amplifier A1404. A typical diagram of the Amplifier-Switch and Logic modules is shown in Figures 21 and 22.

A three position switch on the Control Unit is used to control the decoder. Placing the switch in the Reset and then in the Normal position enables the decoder circuitry. When the first tone of a two-tone sequential call is received, it is coupled from Volume Hi (R701-3) to Pin 10 on the Amplifier-Switch module. The tone is applied to direct-coupled amplifiers Q1 and Q2, and is then connected from Pin 8 to the reeds.

TWO-REED DECODER

The reeds are selected to respond to one combination of sequential tones. When the first tone of a two-tone sequential call is received, reed FL301 responds. The contacts of FL101 close, charging C1406 from the 5.4 volt supply and turning Q1 OFF.

After Q1 turns OFF, C1405 charges from the positive supply voltage through the contacts of FL301. In approximately 500 milliseconds, the positive charge on C1405 is sufficient to turn on Q2.

When turned on, this collector potential of Q2 drops to ground. This turns on Q3 causing it to conduct and clamp the base of Q4 to positive keeping Q4 turned off. Capacitor C1407 charges in a negative direction through Q2, but Q4 is held at cutoff by the positive voltage applied to its base through Q3.

When the first tone is removed, contacts of FL301 open. This turns Q1 on, which quickly discharges C1405, turning off Q2 and Q3.

The charge on C1407 holds the base of Q4 negative for approximately one-half second. If the second tone is received during this time interval, the positive supply is connected through contacts of FL302 to the emitter of Q4 and this transistor conducts.

Turning on Q4 quickly charges up C1408, and the positive voltage at Pin 5 is applied to the base of Q4 to the Amplifier-Switch module.

The positive voltage on the base of Q4 turns it on. This turns on Q3 and the two transistors lock up. With the DC switch (Q3-Q4) locked up, tone switch Q5 conducts and applied 7.5 volts to the squelch switching transistor on the Squelch module. The receiver will now operate on noise squelch until the toggle switch is placed in the Reset position. This unlatches DC switch Q3-Q4 and turns off tone switch Q5.

Placing the switch in the Monitor position grounds the base of tone switch Q5, turning it on. This applies 7.5 volts to the receiver squelch switch.

FOUR-REED DECODER

The four-reed decoders can respond to more than one combination of sequential tones. The operation is similar to the two-reed decoders except that FL101 can operate with FL102 and FL302, while FL301 can operate with FL302 and FL102.

MAINTENANCE

SERVICING THE RADIO

A complete procedure is provided in this manual for disassembling the radio for servicing. The procedure also contains instructions for replacing the different assemblies, Integrated Circuit modules and transmitter PA transistors. Refer to the Disassembly Procedure as listed in the Table of Contents.

If the radio should begin to operate improperly (i.e., transmitted messages start getting weak and hard to understand, or the receiver won't squelch properly), the first thing to suspect is run-down batteries. If a freshly recharged battery pack or new alkaline batteries fail to restore the radio to its normal operating condition, refer to the appropriate Troubleshooting Procedure for help in isolating and correcting the problem.

TEST AND TROUBLESHOOTING PROCEDURES

Whenever difficult servicing problems occur, the Test Procedures for the transmitter and receiver can be used by the servicemen to compare the actual performance of the unit to the specifications met by the unit when shipped from the factory.

In addition, specific Troubleshooting Procedures are available for the transmitter, receiver and tone options. For best results, the Test Procedures should be used in conjunction with the Troubleshooting Procedures when servicing the radio. Refer to the Table of Contents for the applicable procedure.

CHANGING FREQUENCIES

To change the operating frequency of the transmitter and receiver, it is necessary to replace the entire oscillator module as directed in Step 8 of the Disassembly Procedure. Always give the model number of the module and the exact operating frequency required when ordering new oscillator modules.

After replacing the oscillator module, re-align the transmitter or receiver as directed in the applicable Alignment Procedure (see Table of Contents).

BELT CLIP MOUNTING

A belt clip is supplied with the radio so that the radio may be carried on the belt if desired. Mounting instructions for the belt clip are contained on page 50.

DISASSEMBLY PROCEDURE

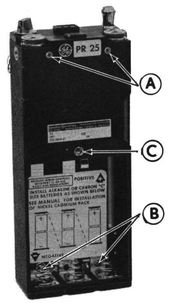
Do not attempt to remove a module from the printed wiring board until troubleshooting indicates that the module is bad. Remove or replace the assemblies or modules as directed.

Caution: Always remove the battery before removing any component board to avoid blowing the fuse.

Equipment Required

- Small Phillips-head and flat-blade screwdrivers.
- Pencil-type soldering iron (40-60 watts) with a fine tip for unsoldering module leads and component leads, and a medium tip for unsoldering module mounting tabs.
- Needlenose pliers for removing slotted nuts.

STEP 1.

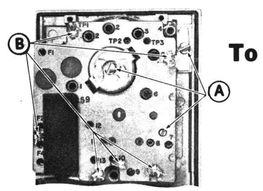


To gain access to the transmitter and receiver,

turn the radio OFF and remove the battery pack (or batteries). Loosen the two captive screws (A) and remove the two screws (B). Loosen the captive retaining screw (C). Then turn the radio on its back and carefully lift off the front cover. If the GE Test Fixture is not used, place a block under the front cover to prevent any wires from pulling loose.

NOTE: When re-assembling the unit, always attach the front cover by first screwing in the captive retaining screw (C) before replacing screws (A) and (B).

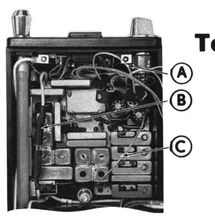
STEP 2.



To remove the transmitter board,

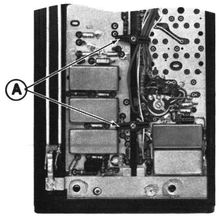
remove the three screws (A) and lift the transmitter off of the front cover. If necessary, remove the transmitter shield by unsoldering the six wire tabs (B).

STEP 3.



To remove the receiver board,

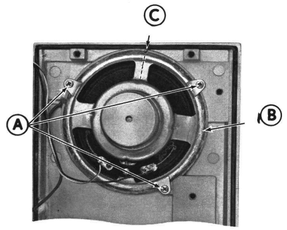
disconnect the two plugs (A) and the cable (B). Lift the receiver board out of the case by the lifting strap (C).



STEP 4.

To remove the audio or tone board,

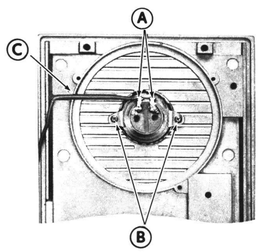
remove the two screws (A) and the two clamps. Carefully lift the board up from the top edge until it clears the clamp mounting posts.



STEP 5.

To replace the loudspeaker, or to gain

access to the microphone, remove the transmitter board according to the directions in Step 2. Remove the three screws (A) and mounting tabs. Then cut around the outside edge of the speaker to separate the weatherproof seal (B). Lift the speaker out of its mounting hole and rub off any of the sealant remaining on the speaker edges. If replacing the speaker, unsolder the two speaker leads. Replace the speaker in its mounting hole as shown, and carefully align the center of the speaker web with the small pilot mark on the rim of speaker mounting hole (C). Replace the weatherproof seal by running a bead of RTV 102 (GE Part No. 19A115153-P3) around the edge of the speaker, and into the microphone cable exit hole. Replace the three mounting tabs and screws.

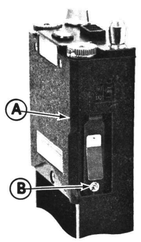


STEP 6.

To replace the microphone, remove the

loudspeaker as directed in Step 5. Unsolder the two flat wires (A) from the microphone. Remove the two screws (B) and mounting tabs and lift out the microphone.

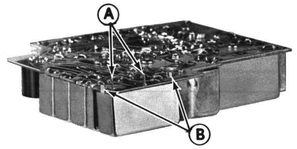
Apply a piece of tape to the microphone in the same place as on the old microphone to prevent shorting out the mike leads. Place the new microphone on the washer and weatherproof cloth in the microphone mounting hole. Solder the flat wires to the microphone and replace the two screws and mounting tabs. Make sure that the flat wires are bent down sufficiently to clear the speaker. Apply RTV 103 to the cable exit hole (C) in the rim of the speaker mounting hole. Replace the speaker as directed.



STEP 7.

To remove the PTT switch, remove the

screw (A) and lift off the PTT lever. Unscrew the slotted nut (B) on the shaft of the switch. Remove the front cover as directed and remove the C-clip below the receiver board to free the coaxial cable. Push in on the shaft of the switch and lift the switch out.



STEP 8.

To replace one of the modules unsolder

and straighten up the module wire leads (A). Remove any solder accumulation from the leads.

Unsolder and straighten up the module mounting tabs (B) and remove any solder accumulation.

If replacing the receiver front end or mixer modules, also remove the small screws holding the helical resonators.

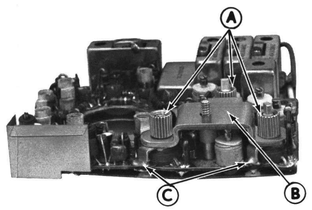
Replace the module and solder down the mounting tabs and then the wire leads. Refer to the appropriate Outline Diagram (see Table of Contents) for the wire lead placement, if required.

STEP 9.

To replace transmitter PA transistors,

(Q106 through Q108) remove the transmitter board and shield as directed in Step 1.

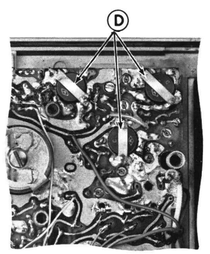
Unscrew the finned mounting nuts (A), remove the mounting bracket (B).



Unsolder the top (C) and bottom (D) ground straps, and unsolder the transistor leads. If replacing Q107, note that one emitter lead is not trimmed, but is soldered to the transmitter shield.

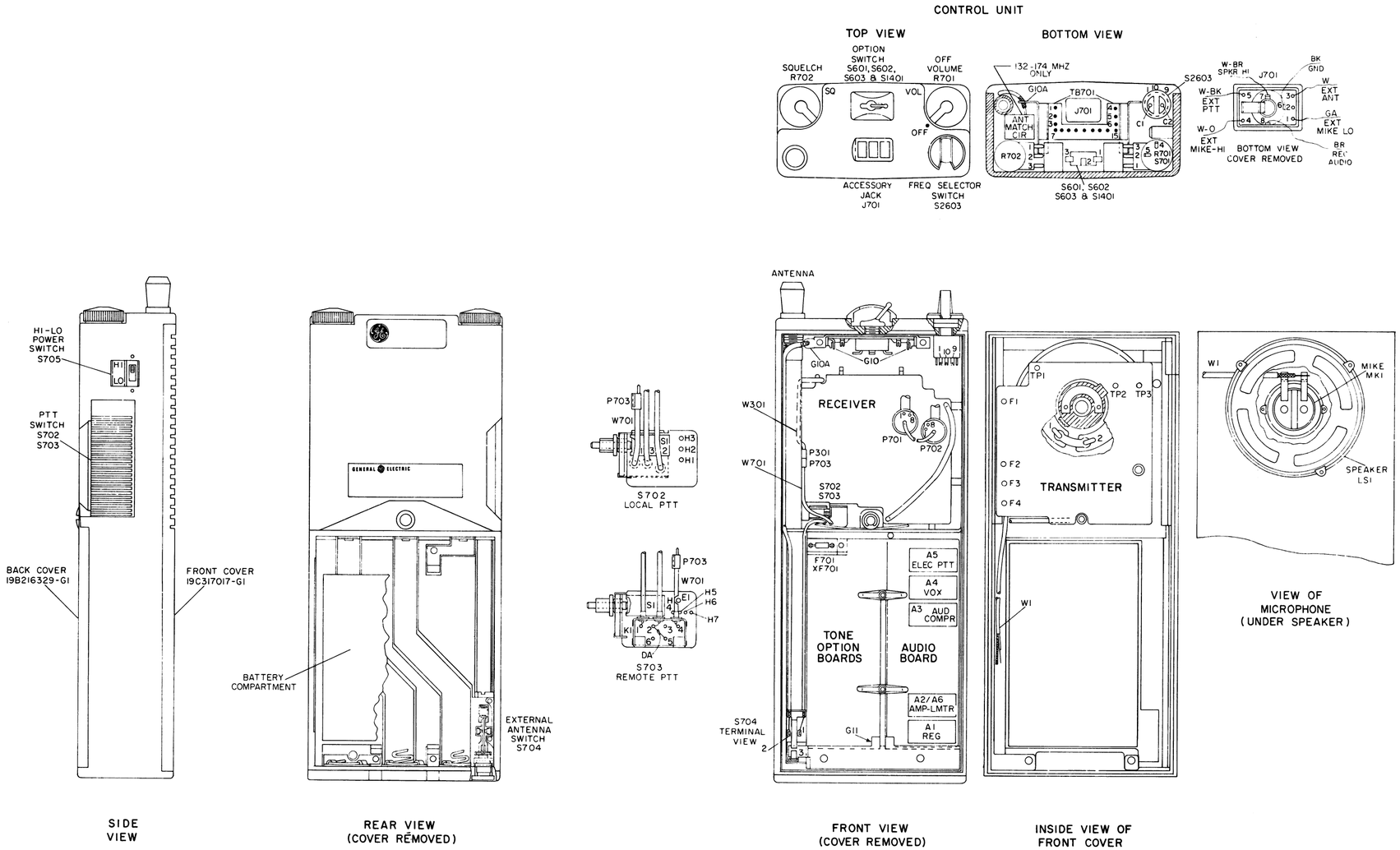
Trim the new transistor leads to the same length as the old, and cut the collector lead at a 45° angle for future identification. If replacing Q106, cut the tip of the stud off approximately 1/8-inch above the threads. (Do not cut into threads).

Replace the bottom ground strap (do not solder) and screw down the finned mounting nut finger tight, making sure that the transistor is aligned as shown in the Outline Diagram.



Solder the transistor leads and the top and bottom ground straps to the printed board. If replacing Q107, solder the long collector lead to the transmitter shield when replacing the shield.

Replace the mounting bracket. While holding the body of the transistor to prevent turning, tighten down the finned mounting nuts using light torque (approx. 5 inch-ounces). Replace the transmitter board and shield as directed in Step 1.



MODULE LAYOUT DIAGRAM

(19D413524, Rev. 2)

PERSONAL SERIES
TWO-WAY FM RADIO

MODULATION LEVEL ADJUSTMENT

The MOD ADJUST (R1) was adjusted to the proper setting before shipment and should not normally require readjustment. This setting permits approximately 75% modulation for the average voice level. The audio peaks which would cause overmodulation are clipped by the modulation limiter. The limiter, in conjunction with the de-emphasis network, instantaneously limits the slope of the audio wave to the modulator, thereby preventing overmodulation while preserving intelligibility.

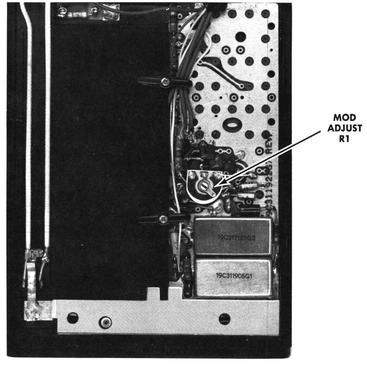
TEST EQUIPMENT

1. Audio oscillator Model 4EX6A10
2. A frequency modulation monitor
3. An output meter or a VTVM
4. GE Test Set Model 4EX3A10
5. Test Adaptor Model 4EX12A10

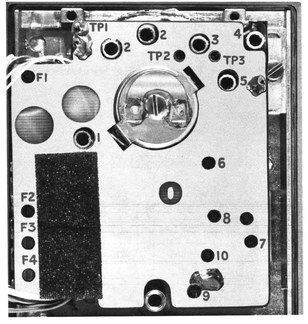
PROCEDURE

1. Connect the equipment as shown in the Test Procedure (see Table of Contents).
2. Apply a 140 millivolt signal at 1000 Hz to the Test Adaptor. If the Test Adaptor is not used, apply a 14 millivolt signal to Pin 1 (Mike Hi) and Pin 4 of Accessory Jack J701.
3. For transmitters without Channel Guard, set MOD ADJUST (R1) for a 4.5-kilohertz swing with the deviation polarity which gives the highest reading as indicated on the frequency modulation monitor. If the deviation symmetry is greater than 0.5 kHz, readjust the modulator (Tuning Control 1) for best modulation symmetry. Then re-set R1 for 4.5 kHz swing with the deviation polarity that gives the highest reading.
4. For transmitters with Channel Guard, check the Channel Guard Modulation as shown in Step 2 of the transmitter Test Procedure. With Channel Guard tone applied, set the deviation as described in Steps 2 and 3.
5. For multifrequency transmitters, set the deviation as described in Step 3 on the channel producing the largest amount of deviation.

AUDIO BOARD



TRANSMITTER PA BOARD



3-WATT INPUT ADJUSTMENT

After the transmitter has been properly aligned, the unit can be adjusted for 3-watt input as follows:

1. Remove the jumper connected between H2 and H3 on the PA board (see Outline Diagram).
2. Connect an ammeter between H2 and H3.
3. Key the transmitter and detune Tuning Control 7 (C142) for a meter reading of 400 milliamperes.
4. Remove the ammeter and re-connect the jumper between H2 and H3.

TRANSMITTER ALIGNMENT

EQUIPMENT REQUIRED

1. GE Test Set Model 4EX3A10 (or Test Kit Model 4EX8K11) connected to the metering jack of GE Test Fixture Model 4EX11A10, OR an ammeter with a two ampere scale connected in series with the transmitter B+ lead, and a 20,000 ohm-per-volt meter.
2. A 50-ohm, terminating wattmeter with a 5-watt scale connected to external antenna switch S704.
3. A frequency counter.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Open up the radio for servicing as directed in the Disassembly Procedure (see Table of Contents). Mount the radio on the Test Fixture as directed.
2. In multi-frequency transmitters, set the channel selector switch to the lowest channel frequency. Place the HI-LO Power Switch in the HI position.
3. For a large change in frequency or a badly mis-aligned transmitter, set all slugs even with the PA board. When properly aligned, the slugs will be between the PA board and the coil.
4. If using the GE Test Set and Test Fixture, switch the range to the Test 1 position and the selector switch to position "I". Check for a meter reading of 7.5 volts (read on 1-volt scale as 15-volts full scale). Then switch to position "G" for current drain readings (read as 1-1/2 ampere full scale on the 15-volt scale).
5. Test Point meter readings made with (+) meter lead to TP1 thru TP3 and with (-) lead to ground.
6. All adjustments made with the transmitter keyed.

Step	Tuning Control	Typical Meter Reading	Procedure
1.	1 (L123)	1.7 Volts (1 V Min)	Adjust Tuning Control 1 for maximum meter reading at TP1.
2.	2 (T101)	See Procedure	Adjust Tuning Control 2 nearest TP1 for a small change in meter reading (this step not required unless changing frequency).
3.	2 (T101 & T102)	0.7 Volt (0.6 V Min)	Alternately adjust the two Tuning Controls marked 2 for maximum meter reading at TP3.
4.	3 (T103)	0.7 Volt (0.5 Min)	Adjust Tuning Control 3 for maximum meter reading at TP3.
5.	4 (T104)	See Procedure	Adjust Tuning Control 4 for a change in meter reading at TP3 (not required unless changing frequency).
6.	5 & 4 (T105 & T104)	Maximum mA	Alternately adjust Tuning Control 5 and 4 for maximum transmitter current.
7.	6 (L105)	Maximum mA	Adjust Tuning Control 6 for maximum transmitter current.
8.	7 & 8 (C142 & C141	Maximum mA	Alternately adjust Tuning Controls 7 and 8 for maximum transmitter current.
9.	9 & 10 (C149 & C150)	Maximum mA	Alternately adjust Tuning Controls 9 and 10 for maximum transmitter current.
10.	13, 12 & 11 (Z104, C155 & C154)	Maximum	Alternately adjust Tuning Controls 13, 12 and 11 for maximum power. NOTE Some de-tuning of Tuning Control 13 will occur when the tuning tool is removed. Adjust 13 for maximum power output when the tool is removed.
11.	3 thru 13	Maximum Power Out	Adjust Tuning Control 3 thru 13 for maximum power output.
12.	11 & 12	1.3 amperes	Re-adjust Tuning Controls 11 and 12 for the best power output with the lowest transmitter current drain. If current drain exceeds 1.3 amperes, reduce the current to 1.3 amperes by de-tuning the Tuning Control 7. NOTE For 3-Watt input limitation, refer to the 3-Watt Input Adjustment elsewhere on this page.
			FRIQUENCY ADJUSTMENT
			With no modulation, adjust the F1 crystal trimmer for proper oscillator frequency. In multi-frequency units, adjust the F2, F3 and F4 crystal trimmers as required. Next, refer to the Modulation Adjustment. NOTE It is recommended that all frequency adjustments be made when the equipment is at a temperature of approximately 75°F. In no case should frequency adjustments be made when the equipment is outside the temperature range of 60°F to 90°F.

TEST PROCEDURES

These Test Procedures are designed to assist you in servicing a transmitter that is operating--but not properly. Problems encountered could be low power output, tone and voice deviation, defective audio sensitivity and modulator adjust control set too high. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once a defect is pin-pointed, refer to the "Service Check" and the additional corrective measures included in the Transmitter Troubleshooting Procedure. Before starting with the Transmitter Test Procedures, be sure the transmitter is tuned and aligned to the proper operating frequency.

TEST EQUIPMENT REQUIRED

for test hookup shown:

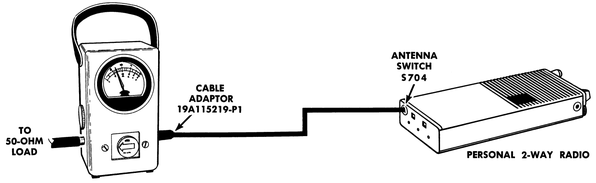
1. Wattmeter similar to:
   Bird # 43
2. VTVM similar to:
   Triplett # 850
   Heath # 1M-21
3. Audio Generator similar to:
   GE Model 4EX6A10 or
   Heath # IG-72
4. Deviation Meter (with a .75 kHz scale) similar to:
   Measurements # 140
   Lampkin # 205A
5. GE Test Adaptor Model 4EX12A10.

STEP 1

POWER MEASUREMENT

TEST PROCEDURE

A. Connect transmitter output to wattmeter as shown below. GE adaptor cable 19A115219-P1 is recommended for accurate power output readings.



B. Key transmitter and check wattmeter for minimum reading of 4.5 watts in the Hi power position and 1.5 watts in the low power position.

SERVICE CHECK

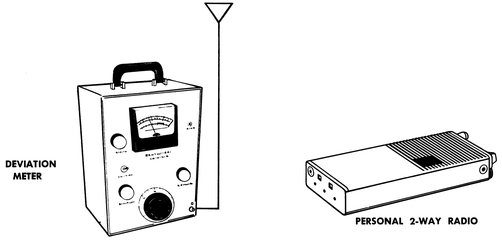
Refer to Service Hints on Transmitter Troubleshooting Procedure.

STEP 2

TONE DEVIATION WITH CHANNEL GUARD

TEST PROCEDURE

A. Set up Deviation Meter and monitor output of transmitter as shown below:



B. Key transmitter and check for 0.75-kHz deviation. If reading is low or high, refer to the Channel Guard Troubleshooting Procedure (see Table of Contents).

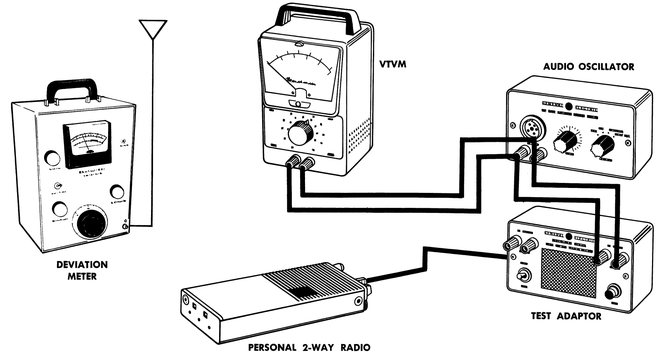
NOTES--The Tone Deviation Test Procedures should be repeated every time the Tone Frequency is changed.

STEP 3

VOICE DEVIATION AND SYMMETRY

TEST PROCEDURE

A. Connect test equipment to transmitter as shown below:



B. Set the generator output to 140 millivolts RMS and frequency to 1 kHz. If the Test Adaptor is not used, set the generator output for 14 millivolts.

C. Key the transmitter and adjust Deviation Meter to carrier frequency.

D. Deviation reading should be ±4.5 kHz. If the deviation is not 4.5 kHz, set the deviation as directed on the Transmitter Alignment Procedure (see Table of Contents).

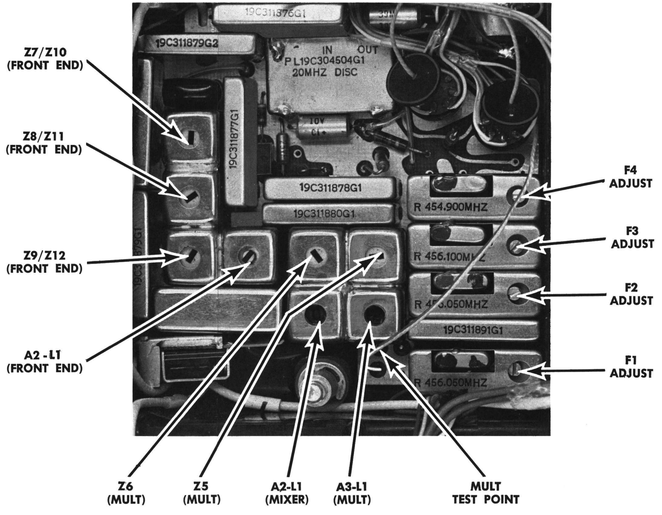
NOTES --MASTR transmitters are adjusted for 4.5 kHz deviation at the factory. The factory adjustment will prevent the transmitter from deviating more than 5.0 kHz under the worst conditions of frequency, voltage and temperature.

If the deviation reading plus (+) or minus (-) differs by more than 0.5 kHz:

E. Refer to the Modulation Adjustment on the Transmitter Alignment Procedure.

F. Check Audio Sensitivity by reducing generator output until deviation falls to 3.3 kHz. Voltage should be LESS than 14 millivolts.

RECEIVER BOARD



EQUIPMENT REQUIRED

RECEIVER ALIGNMENT

1. A 20-MHz signal source (GE IF Generator Model 4EX9A10 or equivalent) and a 406-470 MHz source.
2. GE Test Set Model 4EX3A10 or 4EX8K11 or voltmeter with equivalent sensitivity.
3. GE Test Amplifier Model 4EX16A10 and RF probe 19C311370-G1, or equivalent RF voltmeter.
4. 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 center frequency.
2. For large changes in frequency, set the slugs in Z5 thru Z9 to the bottom of the coil form for frequencies in the low end of the band. Set the slugs near the top of the coil form for frequencies near the high end of the band.
3. Connect the negative lead of the DC Test Set to the Mult Test Point (H6), and the positive lead to ground.

ALIGNMENT PROCEDURE

Step No.	Tuning Control	Procedure
1.	A3-L1 (Mult)	Adjust A3-L1 for maximum meter reading.
2.	Z5 & Z6 (Mult)	Adjust Z5 and then Z6 for a slight change in meter reading.
3.	Z7/Z10 thru Z9/Z12 & A2-L1 (Front End)	Apply an on-frequency signal to P301 and adjust Z7, Z8, Z9 and L1 for best quieting sensitivity.
4.	A2-L1 (Mixer)	Apply an on-frequency signal as above. With the RF probe on Pin 9 of IF Amp A311, tune A2-L1 for maximum meter reading.
5.	A3-L1, Z5 & Z6 (Mult)	De-tune A3-L1. Next, increase the on-frequency input signal and tune Z5 and Z6 for best quieting sensitivity. Now re-adjust A3-L1 for maximum meter reading.
	FREQUENCY ADJUSTMENT	
6.		While applying an on-frequency signal to P301, loosly couple a 20-MHz signal to the Mixer (A307). Adjust the Oscillator trimmer(s) for a zero beat frequency between the two signals. Alternate Method: Apply a strong 20 MHz signal to the Mixer (A307). Measure the output of the Discriminator with a DC-VTVM at Pin 1 of A316/A323. Note the reading. Next, remove the 20-MHz signal and apply a strong on-frequency signal to P301. Then tune the oscillator trimmer(s) for the meter reading obtained at Pin 1 of A316/A323.

TEST PROCEDURES

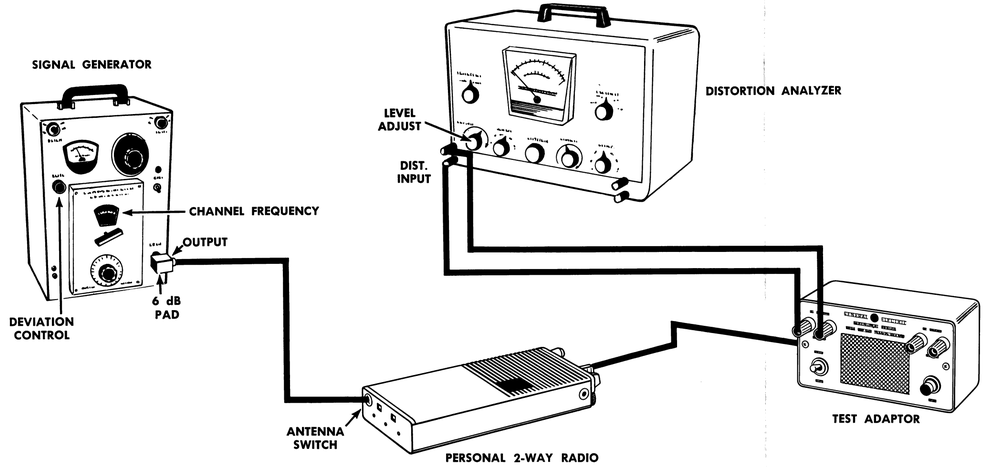
These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized. Once the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

for test hookup shown:

1. Distortion Analyzer similar to: Heath #IM-12
2. Signal Generator similar to: Measurements #M-560
3. 6-dB attenuation pad
4. Test Adaptor Model 4EX12A10

The test equipment is hooked to the receiver as shown for all Receiver Test Procedures.



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 S704.

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 5%-10% (5% is typical).

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

Measure sensitivity of the receiver modulated at the standard test modulation as follows:

A. Be sure Test Step 1 checks out properly.

B. Reduce the Signal Generator output from setting in Test Step 1A.

C. Adjust Distortion Analyzer LEVEL control for a +2 dB reading.

D. Set CONTROL from LEVEL to DISTORTION reading. Repeat Steps 2B and 2C until difference in reading is 12 dB (+2 dB to -10 dB).

E. The 12-dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is "usable" sensitivity level. Reading should be less than 0.4 microvolts with audio output at least 250 milliwatts.

SERVICE CHECK

If the sensitivity level is more than 0.4 microvolts, make the following checks:

F. Alignment of RF stages (refer to Receiver Alignment on reverse side of page).

G. Gain measurements as shown on the Receiver Troubleshooting Procedure.

STEP 3

MODULATION ACCEPTANCE BANDWIDTH (IF BANDWIDTH)

TEST PROCEDURE

A. Be sure Test Steps 1 and 2 check out properly.

B. Set Signal Generator output for twice the microvolt reading obtained in Test Step 2D.

C. Increase Signal Generator frequency deviation.

D. Adjust LEVEL Control for +2 dB.

E. Set CONTROL from LEVEL to DISTORTION reading. Repeat Steps 3C, 3D and 3E until difference between readings becomes 12 dB (from +2 dB to -10 dB).

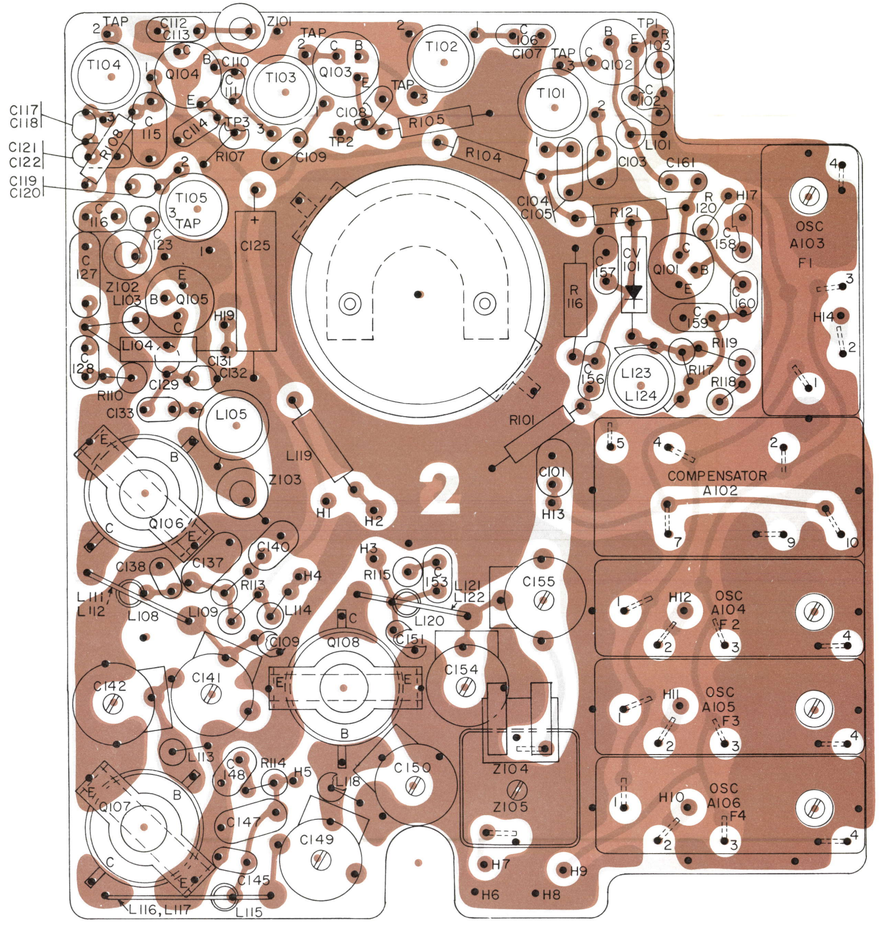
F. Deviation control reading for the 12-dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz (but less than ±9 kHz).

SERVICE CHECK

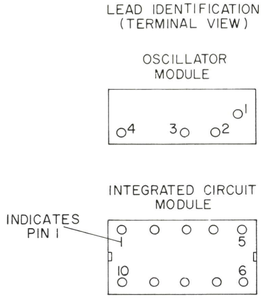
If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

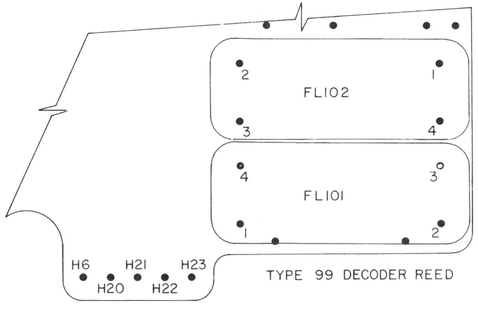
COMPONENT SIDE

(19D413538, Rev. 2)
(19D413267, Sh. 1, Rev. 2)
(19D413267, Sh. 2, Rev. 3)



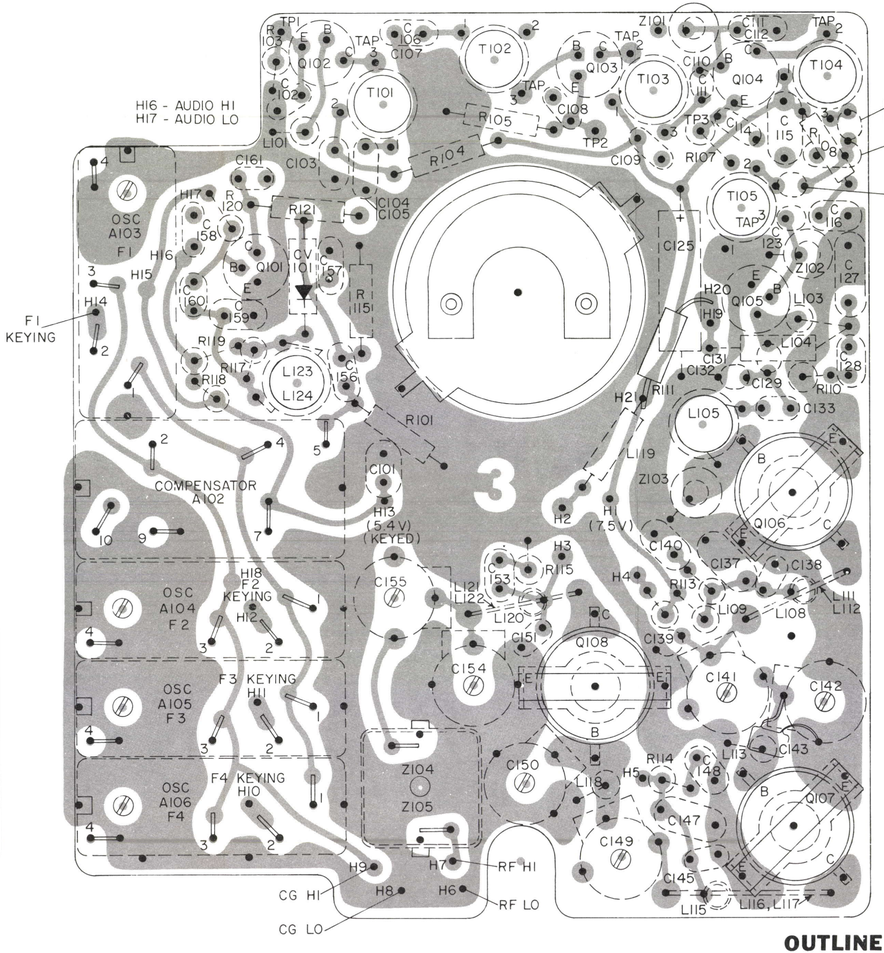
LEAD IDENTIFICATION (TERMINAL VIEW)





(19D413538, Rev. 2)
(19D413267, Sh. 2, Rev. 3)

SOLDER SIDE

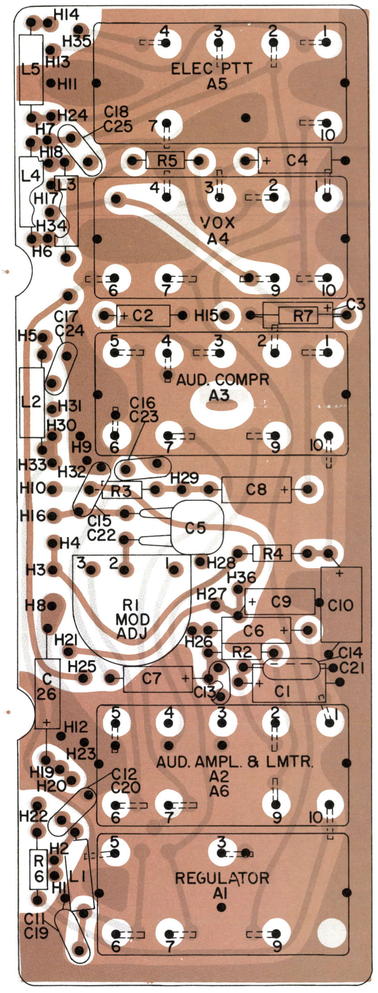


RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

OUTLINE DIAGRAM

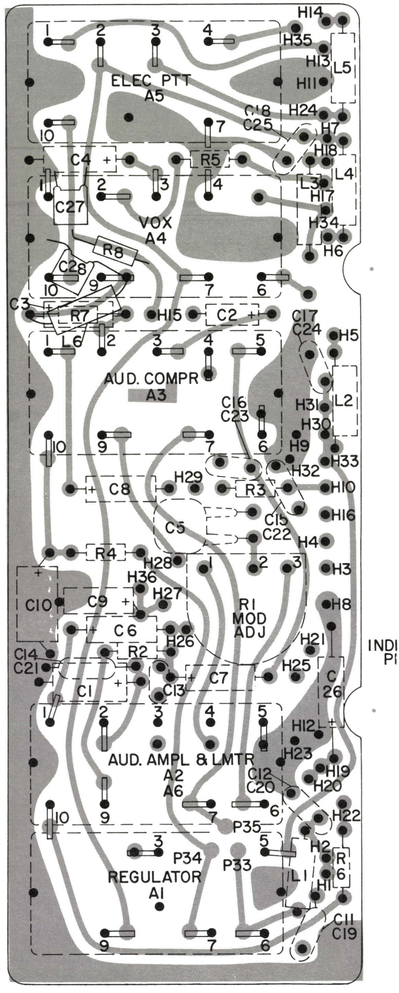
406—470 MHz PERSONAL SERIES
TRANSMITTER PA ASSEMBLY

COMPONENT SIDE

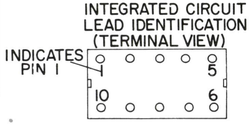


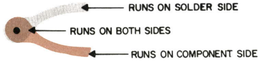
(19D413537, Rev. 2)
(19C311920, Sh. 1, Rev. 0)
(19C311930, Sh. 2, Rev. 1)

SOLDER SIDE



(19D413537, Rev. 2)
(19C311930, Sh. 2, Rev. 1)

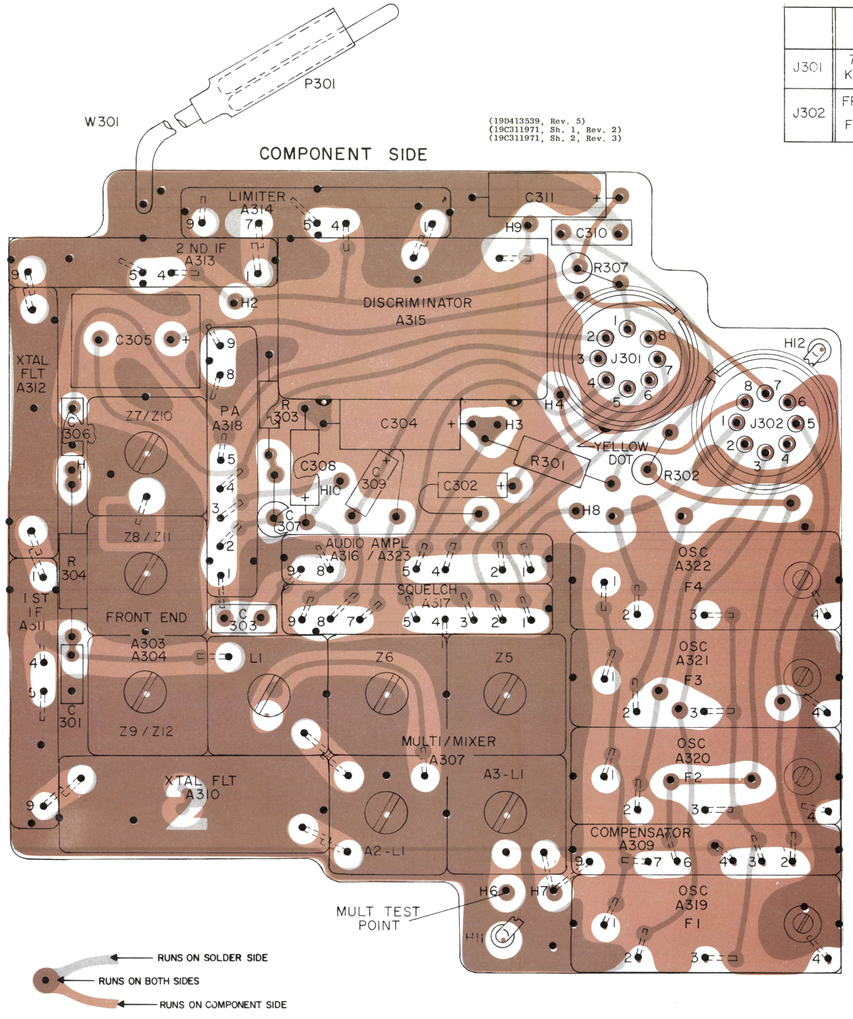


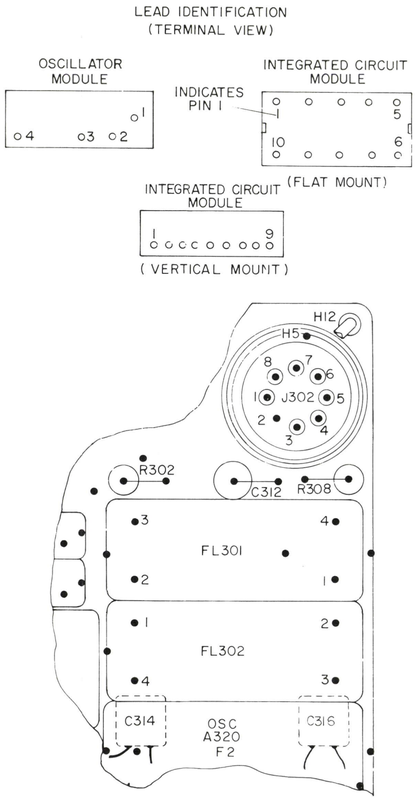


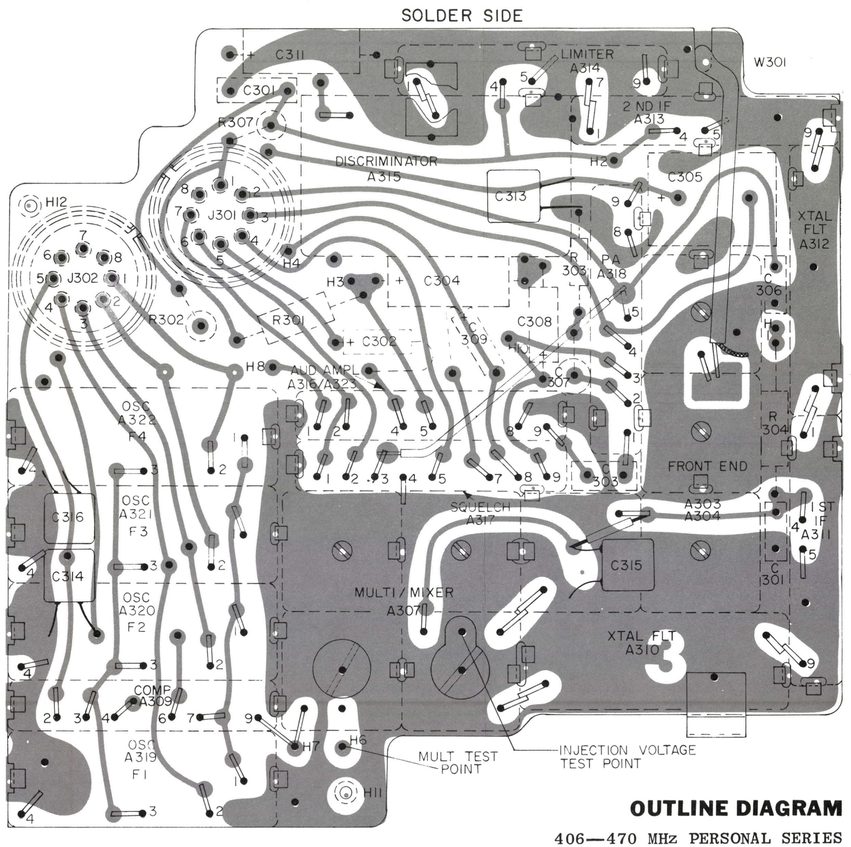
OUTLINE DIAGRAM

406—470 MHz PERSONAL SERIES
AUDIO BOARD 19C311922

	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
J301	7.5 V KEYED	7.5 V	AUDIO OUT	SQ ARM	VOL ARM	SQ HI	VOL HI	GND
J302	FREQ 4 OR FL302	FREQ 3 OR FL301	FREQ 2	FREQ 1	5.4 V	VOL & SQ LO	VOX CONT OR FL301	TONE SWITCH

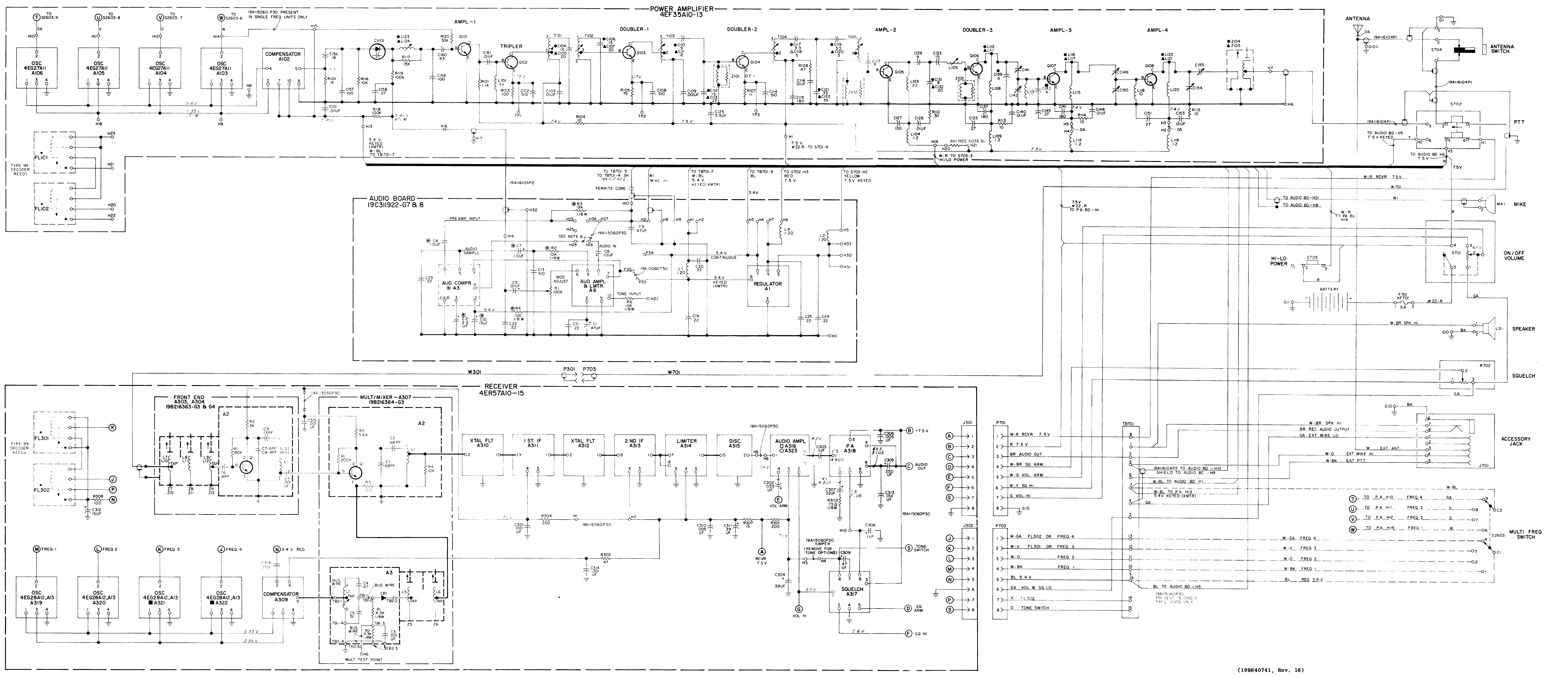






OUTLINE DIAGRAM

406—470 MHz PERSONAL SERIES
RECEIVER MODEL 4ER57A10-15



NOTES:

1. ALL WIRES ARE SFT28 EXCEPT AS NOTED.
2. COMPONENTS MARKED WITH ● ARE PRESENT IN P.A. MODELS 4EF35A11 & A13 ONLY. COMPONENTS MARKED WITH ▲ ARE PRESENT IN P.A. MODELS 4EF35A10 & A12 ONLY.
3. OSCILLATORS MARKED WITH ■ ARE PRESENT IN 4EF35A10 & A11 P.A. MODELS, 4ER57A10-A13 RECEIVER MODELS ONLY.
4. COMPONENTS MARKED BY ✱ ARE PRESENT IN POWER AMPL. MODELS 4EF35A12 & A13, RECEIVER MODELS 4ER57A14 & A15 ONLY.
5. AUDIO AMPLIFIER MARKED WITH □ PRESENT IN 4ER57A10, A11, A14 & A15 ONLY. AUDIO AMPLIFIER MARKED WITH ○ PRESENT IN 4ER57A12 & A13 ONLY.
6. FOR GROUP 8 AUDIO BD. REMOVE JUMPER BETWEEN H26 & H27 AND ADD JUMPER BETWEEN H26 & H28.
7. COMPONENTS MARKED WITH ⊛ ARE PRESENT IN GROUP 8 AUDIO BOARD ONLY.
8. CONNECTIONS SHOWN AS DASHED LINES ARE OPTIONAL AND NOT PART OF OF STANDARD WIRING.
9. VALUE OF R111 VARIES FROM 33 TO 390 OHMS. VALUE SELECTED AT TEST FOR OPTIMUM LOW POWER PERFORMANCE.

MODEL NO.	REV	FREQ. RANGE (MHZ)	NO. OF FREQ.	TONE OPTION
PA BOARD				
4EF35A10	A	406-420	1 THRU 4	
4EF35A11	A	450-470	1 THRU 4	
4EF35A12	A	406-420	1 OR 2	TYPE 99
4EF35A13	A	450-470	1 OR 2	TYPE 99
RECEIVER				
4ER57A10	B	406-420	1 THRU 4	
4ER57A11	B	450-470	1 THRU 4	
4ER57A12	B	406-420	1 THRU 4	CHAN. GD.
4ER57A13	B	450-470	1 THRU 4	CHAN. GD.
4ER57A14	B	406-420	1 OR 2	TYPE 99
4ER57A15	B	450-470	1 OR 2	TYPE 99
PL NUMBER	REV	CONTROL	AUDIO COMPR	
AUDIO BOARD				
19C311922G7		LOCAL PTT		
19C311922G8		LOCAL PTT	X	

VOLTAGE READINGS

TRANSMITTER VOLTAGE READINGS ARE DC READINGS MEASURED TO GROUND WITH A 20,000 OHM-PER-VOLT METER, EXCEPT FOR THE READING FOLLOWED BY VTVM.

RECEIVER VOLTAGE READINGS ARE DC READINGS MEASURED TO GROUND WITH A VTVM. READINGS FOLLOWED BY S ARE WITH THE RECEIVER SQUELCHED. READINGS FOLLOWED BY US ARE WITH THE RECEIVER UNSQUELCHED.

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.

ALL RESISTORS ARE 1/2 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

SCHEMATIC DIAGRAM

406—470 MHz PERSONAL SERIES
TRANSMITTER-RECEIVER
WITH LOCAL PTT

(19B640741, Rev. 16)

PARTS LIST

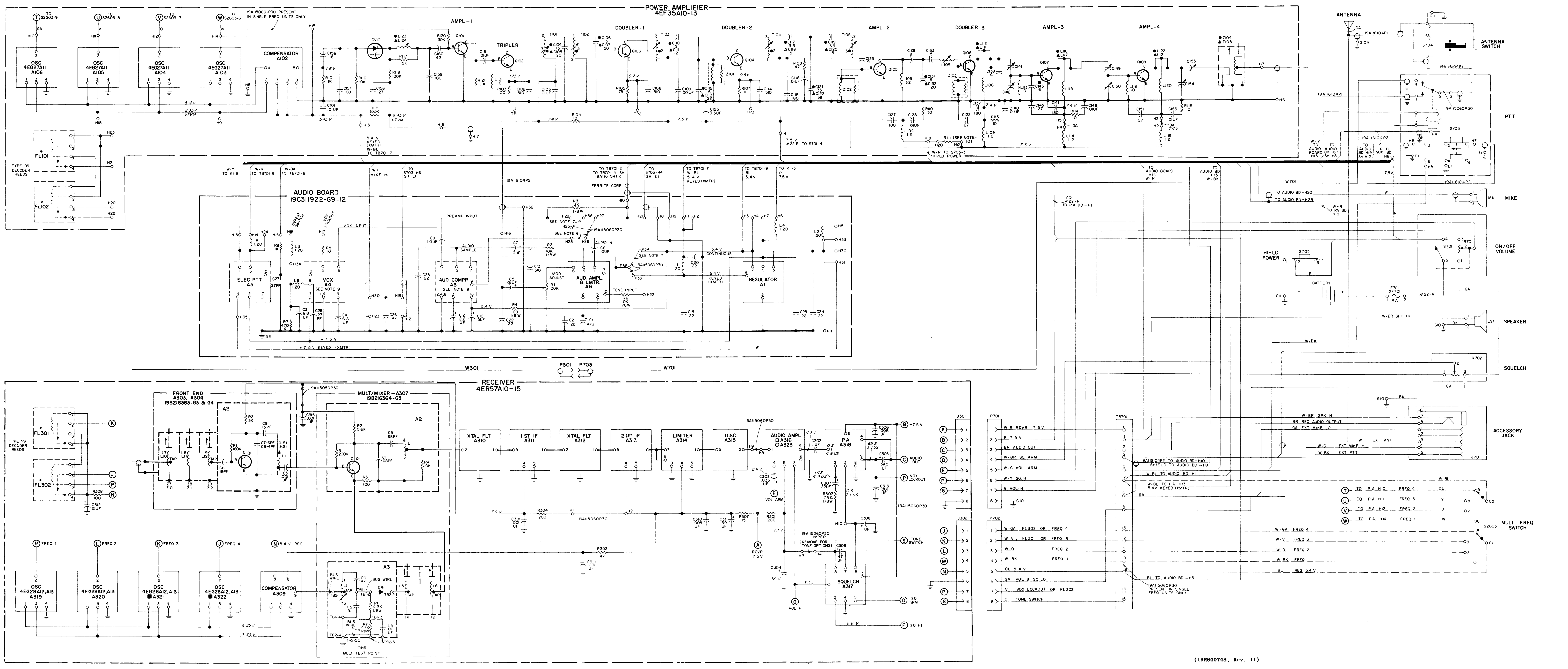
LBI-4067A

406-470 MHz TRANSMITTER-RECEIVER
PR 25

SYMBOL	GE PART NO.	DESCRIPTION
		POWER AMPLIFIER 4EF32410-13 REV A
A102	19C311891-G3	Compensator.
A103 thru A106	4EG27A11	Transmitter Oscillator.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C102	19A116114-P 13090	Ceramic: 510 pf ±5%, 100 VDCW; temp coef ±5000 PPM.
C103	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C104	19A116114-P2036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C105	19A116114-P2039	Ceramic: 20 pf ±5%, 100 VDCW; temp coef -80 PPM.
C106	19A116114-P2036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -80 PPM.
C107	19A116114-P2039	Ceramic: 20 pf ±5%, 100 VDCW; temp coef -80 PPM.
C108	19A116114-P 13090	Ceramic: 510 pf ±5%, 100 VDCW; temp coef ±5000 PPM.
C109	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
C110	19A116114-P2030	Ceramic: 9 pf ±5%, 100 VDCW; temp coef -80 PPM.
C111	19A116114-P2033	Ceramic: 12 pf ±5%, 100 VDCW; temp coef -80 PPM.
C112	19A116114-P2036	Ceramic: 15 pf ±5%, 100 VDCW; tmp coef -80 PPM.
C113	19A116114-P2041	Ceramic: 22 pf ±5%, 100 VDCW; temp coef -80 PPM.
C114	19A116114-P 13090	Ceramic: 510 pf ±5%, 100 VDCW; temp coef -5000 PPM.
C115	19C304504-P4	Ceramic disc: 180 pf ±10%, 200 VDCW.
C116	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C117	19A116114-P12	Ceramic: 3.3 pf ±5%, 100 VDCW.
C118	19A116114-P18	Ceramic: 5 pf ±5%, 100 VDCW.
C119	19A116114-P12	Ceramic: 3.3 pf ±5%, 100 VDCW.
C120	19A116114-P18	Ceramic: 5 pf ±5%, 100 VDCW.
C121	19A116114-P2047	Ceramic: 33 pf ±5%, 100 VDCW; temp coef -80 PPM.
C122	19A116114-P2050	Ceramic: 39 pf ±5%, 100 VDCW; temp coef -80 PPM.
C123	19A116114-P30	Ceramic: 9 pf ±5%, 100 VDCW.
C125	5496267-P9	Tantalum: 3.3 uf ±20%, 15 VDCW; sim to Sprague Type 150D.
C127	19A116114-P7065	Ceramic: 100 pf ±5%, 100 VDCW; temp coef -750 PPM.
C128	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C129	19A116114-P30	Ceramic: 9 pf ±5%, 100 VDCW.
C131	19A116114-P30	Ceramic: 9 pf ±5%, 100 VDCW.
C132	19A116114-P39	Ceramic: 20 pf ±5%, 100 VDCW.
C133	19A116114-P6036	Ceramic: 15 pf ±5%, 100 VDCW; temp coef -470 PPM.
C137	19C304551-P4	Ceramic disc: 180 pf ±10%, 200 VDCW.
C138	19A116114-P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C139*	19A116114-P14	Ceramic: 4 pf ±5%, 100 VDCW; temp coef 0 PPM. Earlier than REV A: Ceramic: 6 pf ±5%, 100 VDCW; temp coef 0 PPM.
C140	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C141	19A116163-P2	Variable: approx 2 to 7 pf, 50 VDCW; sim to Amperex HT10KA/27.
C142*	19A116163-P3	Variable: approx 3 to 17 pf, 50 VDCW; sim to Amperex HT10KA/218. Earlier than REV A: Variable: approx 2 to 7 pf, 50 VDCW; sim to Amperex HT10KA/27.
C143*	19A116114-P20	Ceramic: 6 pf ±5%, 100 VDCW; temp coef 0 PPM. Added by REV A.
C145	19A116114-P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C147	19C304551-P4	Ceramic disc: 180 pf ±10%, 200 VDCW.
C148	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C149	19A116163-P3	Variable: approx 2 to 7 pf, 50 VDCW; sim to Amperex HT10KA/27.
C150	19A116163-P3	Variable: approx 3 to 17 pf, 50 VDCW; sim to Amperex HT10KA/218.
C151	19A116114-P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C153	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C154 and C155	19A116163-P2	Variable: approx 2 to 7 pf, 50 VDCW; sim to Amperex HT10KA/27.
C156	19A116114-P38	Ceramic: 18 pf ±5%, 100 VDCW.
C157	19A116114-P7065	Ceramic: 100 pf ±5%, 100 VDCW; temp coef -750 PPM.
C158	19A116114-P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM.
C159	19A116114-P7065	Ceramic: 100 pf ±5%, 100 VDCW; temp coef -750 PPM.
C160	19A116114-P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM.
C161	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
CV101	5495709-P9	- - - - - - - DIODES AND RECTIFIERS - - - - - - - Varactor, silicon: 33 puf ±10%, at 4 VDC; sim Pacific Semiconductors Varicap Type V-599.
FL101 and FL102		- - - - - - - - - - FILTERS - - - - - - - - - - Reeds. Refer to Type 99 Decoder Parts List.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L101	19B209430-P130	Coil, RF: 3.90 uh ±10%, 1.00 ohms DC res max; sim to Jeffers 4436-7.
L103	19B209430-P105	Coil, RF: 0.22 uh ±10%, 0.14 ohms DC res max; sim to Jeffers 4416-5.
L104	19B209430-P114	Coil, RF: 1.20 uh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L105	19C311854-G4 19B200497-P5	Coil, Includes: Tuning slug.
L108		(Part of L111 and L112)
L109	19B209430-P114	Coil, RF: 1.20 uh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L111	19B216582-G6	Coil, Includes L108,
L112*	19B216990-G1	Coil, Earlier than REV A:
	19B216582-G1	Coil, Includes L108,
L113	19B209430-P125	Coil, RF: 10.0 uh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L114	19B209430-P114	Coil, RF: 1.20 uh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L115		(Part of L116 and L117)
L116	19B216582-G2	Coil, Includes L115,
L117	19B216582-G4	Coil, Includes L115,
L118	19B209430-P125	Coil, RF: 10.0 uh ±10%, 3.10 ohms DC res max; sim to Jeffers 4446-4.
L119	19B209430-P114	Coil, RF: 1.20 uh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L120		(Part of L121 and L122)
L121	19B216582-G5	Coil, Includes L120,
L122	19B216582-G3	Coil, Includes L120,
L123	19B216580-G3 19B200497-P5	Coil, Includes: Tuning slug.
L124	19B216580-G4 19B200497-P5	Coil, Includes: Tuning slug.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101 thru Q103	19A115330-P1	Silicon, NPN.
Q104 and Q105	19A116201-P1	Silicon, NPN.
Q106 and Q107	19A116189-P1	Silicon, NPN.
Q108	19A116259-P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R101	3R152-P103J	Composition: 1000 ohms ±5%, 1/4 w.
R103	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R104	3R152-P100K	Composition: 10 ohms ±10%, 1/4 w.
R105	3R152-P750J	Composition: 75 ohms ±5%, 1/4 w.
R107	3R152-P110J	Composition: 11 ohms ±5%, 1/4 w.
R108	3R152-P470K	Composition: 47 ohms ±10%, 1/4 w.
R110	3R152-P300J	Composition: 30 ohms ±5%, 1/4 w. NOTE: Select R111 below for 0.6 watt output in the low power position.
R111	3R152-P330J	Composition: 33 ohms ±5%, 1/4 w.
R111	3R152-P360J	Composition: 36 ohms ±5%, 1/4 w.
R111	3R152-P390J	Composition: 39 ohms ±5%, 1/4 w.
R111	3R152-P430J	Composition: 43 ohms ±5%, 1/4 w.
R111	3R152-P470J	Composition: 47 ohms ±5%, 1/4 w.
R111	3R152-P510J	Composition: 51 ohms ±5%, 1/4 w.
R111	3R152-P560J	Composition: 56 ohms ±5%, 1/4 w.
R111	3R152-P620J	Composition: 62 ohms ±5%, 1/4 w.
R111	3R152-P680J	Composition: 68 ohms ±5%, 1/4 w.
R111	3R152-P750J	Composition: 75 ohms ±5%, 1/4 w.
R111	3R152-P820J	Composition: 82 ohms ±5%, 1/4 w.
R111	3R152-P910J	Composition: 91 ohms ±5%, 1/4 w.
R111	3R152-P101J	Composition: 100 ohms ±5%, 1/4 w.
R111	3R152-P111J	Composition: 110 ohms ±5%, 1/4 w.
R111	3R152-P121J	Composition: 120 ohms ±5%, 1/4 w.
R111	3R152-P131J	Composition: 130 ohms ±5%, 1/4 w.
R111	3R152-P151J	Composition: 150 ohms ±5%, 1/4 w.
R111	3R152-P181J	Composition: 180 ohms ±5%, 1/4 w.
R111	3R152-P201J	Composition: 200 ohms ±5%, 1/4 w.
R111	3R152-P221J	Composition: 220 ohms ±5%, 1/4 w.
R111	3R152-P241J	Composition: 240 ohms ±5%, 1/4 w.
R111	3R152-P271J	Composition: 270 ohms ±5%, 1/4 w.
R111	3R152-P301J	Composition: 300 ohms ±5%, 1/4 w.
R111	3R152-P331J	Composition: 330 ohms ±5%, 1/4 w.
R111	3R152-P361J	Composition: 360 ohms ±5%, 1/4 w.
R111	3R152-P391J	Composition: 390 ohms ±5%, 1/4 w.
R113 thru R115	3R153-P100K	Composition: 10 ohms ±10%, 1/4 w.
R116	3R153-P103K	Composition: 10,000 ohms ±10%, 1/4 w.
R117	3R152-P153J	Composition: 15,000 ohms ±5%, 1/4 w.
R118 and R119	3R152-P104K	Composition: 0.10 megohm ±10%, 1/4 w.
R120	3R152-P303J	Composition: 30,000 ohms ±5%, 1/4 w.
R121	3R152-P113J	Composition: 1100 ohms ±5%, 1/4 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - - - -
T101	19B216579-G1 19B200497-P5	Coil, Includes: Tuning slug.
T102	19B216579-G2 19B200497-P5	Coil, Includes: Tuning slug.
T103	19B216579-G3 19B200497-P5	Coil, Includes: Tuning slug.
T104	19C311854-G1 19B200497-P5	Coil, Includes: Tuning slug.
T105	19C311854-G5 19B200497-P5	Coil, Includes: Tuning slug.
		- - - - - - - - - - COILS - - - - - - - - - -
Z101 thru Z103	19A127564-G1	Coil.
Z104	19C311754-G1	Helical filter.
Z105	19C311754-G2	Helical filter.
		AUDIO BOARD 19C311922-G7 thru G12 REV B
A1	19C311905-G1	Regulator.
A3	19C311907-G1	Audio Compressor.
A4	19C311898-G1	Voice Operated Transmitter (VOX)
A5	19C311908-G1	Electronic Push-To-Talk.
A6	19C317167-G2	Audio Amplifier and Limiter.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5491674-P26	Tantalum: 47 pf ±20%, 4 VDCW; sim to Sprague Type 162D.
C2	5491674-P23	Tantalum: 2.2 pf ±20%, 15 VDCW; sim to Sprague Type 162D.
C3 and C4	5491674-P33	Tantalum: 6.8 pf ±20%, 4 VDCW; sim to Sprague Type 162D.
C5	19A116192-P1	Ceramic: 0.01 pf ±20%, 50 VDCW; sim to Erie 8121-050-W5R.
C6 thru C8	5491674-P28	Tantalum: 1.0 pf ±20%, 25 VDCW; sim to Sprague Type 162D.
C9	5491674-P27	Tantalum: .47 pf ±20%, 35 VDCW; sim to Sprague Type 162D.
C10	5491674-P34	Tantalum: 15 pf ±20%, 6 VDCW; sim to Sprague Type 162D.
C13	5491500-P2	Ceramic: 2300 pf, ±5%, 75 VDCW; temp coef -5000.
C19 thru C20	5495334-P47	Ceramic disc: 22 pf ±5%, 75 VDCW, temp coef 0 PPM.
C26	5491674-P27	Tantalum: .47 pf ±20%, 35 VDCW; sim to Sprague Type 162D.
C27* and C28*	19A116114-P2044	Ceramic: 27 pf ±5%, 100 VDCW; temp coef -80 PPM. Added to G11, G12 by REV A.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1 thru L5	19B209430-P114	Coil, RF: 1.20 uh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1.
L6*	19B209430-P114	Coil, RF: 1.20 uh ±10%, 0.18 ohms DC res max; sim to Jeffers 4436-1. Added to G11, G12 by REV A.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B201999-P9	Variable, sub-miniature trimmer: 100,000 ohms ±20%, 0.1 w; sim to Centralab Series 4.
R2	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R3	3R151-P133J	Composition: 13,000 ohms ±5%, 1/8 w.
R4	3R151-P101K	Composition: 100 ohms ±10%, 1/8 w.
R5	3R151-P100K	Composition: 10 ohms ±10%, 1/8 w.
R6	3R151-P103K	Composition: 10,000 ohms ±10%, 1/8 w.
R7	3R151-P474K	Composition: 0.47 megohm ±10%, 1/8 w.
R8*	3R151-P103J	Composition: 1000 ohms ±5%, 1/8 w. Added to G11, G12 by REV A.
A303 and A304		RECEIVER 4ER37410-13 REV B
A3*		FRONT END A303 19B216393-G2 406-420 MHz A304 19B216393-G4 450-470 MHz RF AMPLIFIER 19C311871-G2 (Deleted by REV A)
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
C2	19A116149-P2	Variable: 4.5 to 15 pf, 63 VDCW; temp coef -750 PPM.
C3	19A116114-P7068	Ceramic: 120 pf ±5%, 100 VDCW; temp coef -750 PPM.
C4	19A116114-P2053	Ceramic: 47 pf ±5%, 100 VDCW; temp coef -80 PPM.
C5	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
C6	19A116114-P7068	Ceramic: 120 pf ±5%, 100 VDCW; temp coef -750 PPM.
C7	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A127480-G1	Toroidal coil.
L2	19B216393-P1	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A115991-P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	3R151-P511J	Composition: 510 ohms ±5%, 1/8 w.
R2	3R151-P113J	Composition: 11,000 ohms ±5%, 1/8 w.
R3	3R151-P91J	Composition: 9100 ohms ±5%, 1/8 w.
R4	3R151-P102J	Composition: 1000 ohms ±5%, 1/8 w.
L7	19B216439-G8 19C311750-P1	Helical resonator. (Part of Z7). Includes: Tuning slug.
L8	19B216439-G9 19C311750-P1	Helical resonator. (Part of Z8). Includes: Tuning slug.
L9	19B216439-G5 19C311750-P1	Helical resonator. (Part of Z9). Includes: Tuning slug.
L10	19B216439-G7 19C311750-P1	Helical resonator. (Part of Z10). Includes: Tuning slug.
L11	19B216439-G2 19C311750-P1	Helical resonator. (Part of Z11). Includes: Tuning slug.
L12	19B216439-G1 19C311750-P1	Helical resonator. (Part of Z12). Includes: Tuning slug.
		- - - - - - - - - - HELICAL RESONATORS - - - - - - - - - -
Z7		Consists of L7 and 19D413132-P2 can.
Z8		Consists of L8 and 19D413132-P4 can.
Z9		Consists of L9 and 19D413132-P5 can.
Z10		Consists of L10 and 19D413132-P2 can.
Z11		Consists of L11 and 19D413132-P3 can.
Z12		Consists of L12 and 19D413132-P5 can.
A5* and A6*		RF AMPLIFIER A5 19C317623-G3 A6 19C317623-G4 (Added by REV A)
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C5	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
C6	19A116114-P6038	Ceramic: 18 pf ±5%, 100 VDCW; temp coef -470 PPM.
C7	19A116114-P2020	Ceramic: 6 pf ±5%, 100 VDCW; temp coef -80 PPM.
C8	19A116114-P2014	Ceramic: 4 pf ±5%, 100 VDCW; temp coef -80 PPM.
C9	19A116114-P2035	Ceramic: 13 pf ±5%, 100 VDCW; temp coef -80 PPM.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L2	19A128005-G2 19B209430-P1	Coil, Includes: Tuning slug.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A116159-P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19A116327-P204J	Composition: 200 ohms ±5%, 1/10 w.
R2	19A116327-P563J	Composition: 56K ohms ±5%, 1/10 w.
R3	19A116327-P822J	Composition: 8200 ohms ±5%, 1/10 w.
A307		MULTIPLIER-MIXER 19D215036-G2
A3*		MIXER 19C311875-G1 (Deleted by REV A)
L5	19B216439-G4	Helical resonator. (Part of Z5). Includes tuning slug 19C311750-P1.
L6	19B216439-G3	Helical resonator. (Part of Z6). Includes tuning slug 19C311750-P1.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
C3	19A116114-P2051	Ceramic: 43 pf ±5%, 100 VDCW; temp coef -80 PPM.
C4	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
L1	19B216297-G1 19B200497-P5	Coil, Includes: Tuning slug.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A116159-P1	Silicon, NPN.
R1	3R151-P103J	Composition: 1000 ohms ±5%, 1/8 w.
R2	3R151-P113J	Composition: 11,000 ohms ±5%, 1/8 w.
R3	3R151-P363J	Composition: 36,000 ohms ±5%, 1/8 w.
R4	3R151-P162J	Composition: 1600 ohms ±5%, 1/8 w.
R5	3R151-P101J	Composition: 100 ohms ±5%, 1/8 w.
A3		MULTIPLIER 19C311873-G3
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C301	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
C302	5491674-P31	Tantalum: .033 pf ±20%, 35 VDCW; sim to Sprague Type 162D.
C303	19A116089-P1	Ceramic: 0.1 pf ±20%, 50 VDCW, temp range +85 to +85°C.
C304	5491674-P90	Tantalum: 39 pf ±20%, 10 VDCW; sim to Sprague Type 162D.
C305	19A116178-P7	Tantalum: 47 pf ±20%, 6 VDCW.
CR1*	5495323-P14	Ceramic: .005 pf +100% -20%, 75 VDCW. In REV A and earlier: Ceramic: .001 pf +100% -20%, 75 VDCW.
L1	19B216296-P1 19B200495-P5	Coil, Includes: Tuning slug.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	3R151-P433J	Composition: 4300 ohms ±5%, 1/8 w.
A5*		MIXER 19C317625-G1 (Added by REV A)
C1 and C2	19A116114-P4059	Ceramic: 68 pf ±5%, 100 VDCW; temp coef -220 PPM.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C307	5491674-P35	Tantalum: 22 pf ±20%, 4 VDCW; sim to Sprague Type 162D.
C308	5491674-P28	Tantalum: 1.0 pf ±20%, 25 VDCW; sim to Sprague Type 162D.
C309	5491674-P27	Tantalum: .47 pf ±20%, 35 VDCW; sim to Sprague Type 162D.
C310	5495323-P14	Ceramic: .005 pf +100% -20%, 75 VDCW.
C311	5491674-P30	Tantalum: 39 pf ±20%, 10 VDCW; sim to Sprague Type 162D.
C312	5491674-P37	Tantalum: 10 pf ±20%, 10 VDCW; sim to Sprague Type 162D.
C313 thru C316	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
FL301 and FL302		- - - - - - - - - - FILTERS - - - - - - - - - - Reeds. Refer to Type 99 Decoder Parts List.
		- - - - - - - - - - JACKS AND RECEPTACLES - - - - - - - - - -
J301 and J302	19A116122-P1	Feed-thru: sim to Warren Co 1-B-2094-4.
P301		- - - - - - - - - - PLUGS - - - - - - - - - - (Part of W301).
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R301	3R152-P301K	Composition: 300 ohms ±10%, 1/4 w.
R302	3R152-P470K	Composition: 47 ohms ±10%, 1/4 w.
R303	3R151-P750J	Composition: 75 ohms ±5%, 1/8 w.
R304	3R152-P201K	Composition: 200 ohms ±10%, 1/4 w.
R307	3R152-P150K	Composition: 15 ohms ±10%, 1/4 w.
R308	3R152-P101K	Composition: 100 ohms ±10%, 1/4 w.
		- - - - - - - - - - CABLES - - - - - - - - - -
W301	19B216519-G2	Cable: approx 4 inches long. (Includes P301).
		HOUSING 19E500685-G2
		- - - - - - - - - - FUSES - - - - - - - - - -
F701	19A116196-P11	Enclosed link: 5 amp at 125 v; sim to Littelfuse 275005.
		- - - - - - - - - - JACKS AND RECEPTACLES - - - - - - - - - -
J701	19B216594-G1	Connector, female: 6 contacts.
A315	19C304504-G1	Discriminator.
A316	19C311878-G1	Audio Amplifier.
A317	19C311880-G1	Squelch.
A318	19C311877-G1	PA.
A319 thru A321	4EG28A12 4EG28A13	Oscillator: (406-420 MHz). Oscillator: (450-470 MHz).
A322	19C311965-G1	Audio Amplifier (Includes Tone Filter).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C301	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
C302	5491674-P31	Tantalum: .033 pf ±20%, 35 VDCW; sim to Sprague Type 162D.
C303	19A116089-P1	Ceramic: 0.1 pf ±20%, 50 VDCW, temp range +85 to +85°C.
C304	5491674-P90	Tantalum: 39 pf ±20%, 10 VDCW; sim to Sprague Type 162D.
C305	19A116178-P7	Tantalum: 47 pf ±20%, 6 VDCW.
C306*	5495323-P14	Ceramic: .005 pf +100% -20%, 75 VDCW. In REV A and earlier: Ceramic: .001 pf +100% -20%, 75 VDCW.
L1	19B216296-P1 19B200495-P5	Coil, Includes: Tuning slug.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	3R151-P433J	Composition: 4300 ohms ±5%, 1/8 w.
A5*		MIXER 19C317625-G1 (Added by REV A)
C1 and C2	19A116114-P4059	Ceramic: 68 pf ±5%, 100 VDCW; temp coef -220 PPM.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C313 thru C316	5495323-P12	Ceramic: .001 pf +100% -20%, 75 VDCW.
FL301 and FL302		- - - - - - - - - - FILTERS - - - - - - - - - - Reeds. Refer to Type 99 Decoder Parts List.
		- - - - - - - - - - JACKS AND RECEPTACLES - - - - - - - - - -
J301 and J302	19A116122-P1	Feed-thru: sim to Warren Co 1-B-2094-4.
P301		- - - - - - - - - - PLUGS - - - - - - - - - - (Part of W301).
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R301	3R152-P301K	Composition: 300 ohms ±10%, 1/4 w.
R302	3R152-P470K	Composition: 47 ohms ±10%, 1/4 w.
R303	3R151-P750J	Composition: 75 ohms ±5%, 1/8 w.
R304	3R152-P201K	Composition: 200 ohms ±10%, 1/4 w.
R307	3R152-P150K	Composition: 15 ohms ±10%, 1/4 w.
R308	3R152-P101K	Composition: 100 ohms ±10%, 1/4 w.
		- - - - - - - - - - CABLES - - - - - - - - - -
W301	19B216519-G2	Cable: approx 4 inches long. (Includes P301).
		HOUSING 19E500685-G2
		- - - - - - - - - - FUSES - - - - - - - - - -
F701	19A116196-P11	Enclosed link: 5 amp at 125 v; sim to Littelfuse 275005.
		- - - - - - - - - - JACKS AND RECEPTACLES - - - - - - - - - -
J701	19B216594-G1	Connector, female: 6 contacts.

(Cont'd on Page 36)

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



NOTES:

1. ALL WIRES ARE SFT28 EXCEPT AS NOTED.
2. COMPONENTS MARKED WITH ● ARE PRESENT IN PA MODELS 4EF35A11 & A13 ONLY. COMPONENTS MARKED WITH ▲ ARE PRESENT IN PA MODELS 4EF35A10 & A12 ONLY.
3. OSCILLATORS MARKED WITH ■ ARE PRESENT IN 4EF35A10 & A11 PA MODELS, 4ER57A10—A13 RECEIVER MODELS ONLY.
4. COMPONENTS MARKED BY ✱ ARE PRESENT IN POWER AMPL MODELS 4EF35A12 & A13, RECEIVER MODELS 4ER57A14 & A15 ONLY.
5. AUDIO AMPLIFIER MARKED WITH □ PRESENT IN 4ER57A10, A11, A14 & A15 ONLY. AUDIO AMPLIFIER MARKED WITH ○ PRESENT IN 4ER57A12 & A13 ONLY.
6. FOR GROUP 12 AUDIO BD REMOVE JUMPER BETWEEN H26 & H27 AND ADD JUMPER BETWEEN H26 & H28.
7. FOR GROUPS 11 & 12 ADD JUMPER BETWEEN H25 & H36 AND BETWEEN PAD 35 & PAD 34. REMOVE JUMPER BETWEEN PAD 33 AND PAD 35.
8. CONNECTIONS SHOWN AS DASHED LINES ARE OPTIONAL AND NOT PART OF OF STANDARD WIRING.
9. AUDIO COMPRESSOR A3 AND ASSOCIATED PARTS ARE USED IN GROUPS 10 & 12 ONLY. VOX A4 AND ASSOCIATED PARTS ARE USED IN GROUPS 11 & 12 ONLY.
10. VALUE OF R111 VARIES FROM 33 TO 390 OHMS. VALUE SELECTED AT TEST FOR OPTIMUM LOW POWER PERFORMANCE.

MODEL NO.	REV	FREQ. RANGE (MHZ)	NO. OF FREQ.	TONE OPTION	
PA BOARD					
4EF35A10	A	406-420	1 THRU 4		
4EF35A11	A	450-470	1 THRU 4		
4EF35A12	A	406-420	1 OR 2	TYPE 99	
4EF35A13	A	450-470	1 OR 2	TYPE 99	
RECEIVER					
4ER57A10	B	406-420	1 THRU 4		
4ER57A11	B	450-470	1 THRU 4		
4ER57A12	B	406-420	1 THRU 4	CHAN. GD.	
4ER57A13	B	450-470	1 THRU 4	CHAN. GD.	
4ER57A14	B	406-420	1 OR 2	TYPE 99	
4ER57A15	B	450-470	1 OR 2	TYPE 99	
PL NUMBER	REV	CONTROL	ELECTRONIC PTT	VOX	AUDIO COMPR
AUDIO BOARD					
19C311922G9		REMOTE PTT	X		
19C311922G10		REMOTE PTT	X		X
19C311922G11	A	REMOTE PTT	X	\	
19C311922G12	A	REMOTE PTT	X	X	X

VOLTAGE READINGS

TRANSMITTER VOLTAGE READINGS ARE DC READINGS MEASURED TO GROUND WITH A 20 000 OHM-PER-VOLT METER, EXCEPT FOR THE READING FOLLOWED BY VTVM

RECEIVER VOLTAGE READINGS ARE DC READINGS MEASURED TO GROUND WITH A VTVM. READINGS FOLLOWED BY S ARE WITH THE RECEIVER SQUELCHED. READINGS FOLLOWED BY US ARE WITH THE RECEIVER UNSQUELCHED

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.

ALL RESISTORS ARE 1/2 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.

SCHEMATIC DIAGRAM

406—470 MHz PERSONAL SERIES TRANSMITTER-RECEIVER WITH REMOTE PTT

(19R640748, Rev. 11)

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - PLUGS - - - - - - - - - -
P701 and P702	19A127569-P1	Plug: 8 contacts.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R701	19A116227-P1	Variable, composition: 25,000 ohms ±20%, 1/8 w; sim to Mallory Type MLC. (VOLUME).
R702	19A116227-P2	Variable, composition: 25,000 ohms ±10%, 1/8 w; sim to Mallory Type MLC. (SQUELCH).
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S701		Part of R701. (ON-OFF).
S704		Antenna Switch. (See RC-1958, items 80-88)
S705	19B216610-G1	Slide: 0.5 amps at 100 VAC; sim to Sansei SS-12. (HI-LOW Power).
		- - - - - - - - - - TERMINAL BOARDS - - - - - - - - - -
TB701	19B216509-G1	Terminal board: 15 contacts.
		- - - - - - - - - - SOCKETS - - - - - - - - - -
XF701	19B216313-G1	Fuseholder.
		FRONT COVER ASSEMBLY 19C317017-G1
		- - - - - - - - - - LOUDSPEAKERS - - - - - - - - - -
LS1	19A116151-P1	Permanent magnet, 2-1/4 inch: 8 ohms ±10% voice coil imp, 600 Hz ±100% resonance, paper dust cap; sim to Oaktron 23A1811.
		- - - - - - - - - - MICROPHONES - - - - - - - - - -
MK1	19A116127-P1	Microphone element: 1000 ohms imp; sim to Telex Type RTX-04 EO57026.
		- - - - - - - - - - CABLES - - - - - - - - - -
W1	19A116104-P2	Cable, RF: 250 VRMS; sim to Microdot 260-3816.
		ASSOCIATED ASSEMBLIES
S601	4036949-P1	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman. (VOX).
S702	19C311865-G1	Push To Talk. (LOCAL).
S703	19C311865-G2	Push To Talk. (REMOTE).
S2601	19C317067-G1	Multi-Frequency. (2 FREQ).
S2602	19C317067-G2	Multi-Frequency. (3 FREQ).
S2603	19C317067-G3	Multi-Frequency. (4 FREQ).
		- - - - - - - - - - BATTERIES - - - - - - - - - -
	19C317000-G1	Rechargable pack: Includes thermal fuse 19A116393-P2.
		- - - - - - - - - - ANTENNAS - - - - - - - - - -
	19B216585-G1	Telescoping. (See RC-1958, items 1-4).
		MECHANICAL PARTS (RC-1958)
1	19A127295-P1	Antenna cap.
2	N70P702C13	Setscrew, No. 3-48 x 1/8.
3	19B216573-P1	Antenna rod. 3 section, 18 inches long.
4	19A127321-P1	Bushing, knurled.
5	19C311972-P1	Dummy plug. (Replaces Channel Guard, Tone, and VOX Switch).
6	19A115983-P3	Gasket. sim to Parker Seal 2-14. (Used with dummy plugs).
7	N509P606C	Pin, 1/16 x 3/8. (Used with dummy plugs).
8	19C317065-P1	Knob. (OFF-VOLUME, SQUELCH).
9	19C317123-P1	Dummy plug. (Replaces Freq select switch).
10	19A127493-P1	Support. (Used with J701).
11	19A127308-P1	Contact. (Located on MK1).
12	19A127334-P1	Clamp. (Used with LS1 and MK1).
13	19A127309-P1	Washer. (Used with MK1).
14	19A127520-P1	Gasket, weather seal.
15	19B216855-G1	Support. (Secures to LS1).
16	19D413268-P1	Printed wiring board (Without FL101, FL102).
17	19D413274-P1	Printed wiring board (With FL101, FL102).
18	4036040-P1	Pin. (Used with FL101, FL102, FL301, FL302).
19	N77P9002	Screw. No. 4-4- x 1/8.
20	19B216506-P1	Shield.
21	19B216330-P1	Insulator.
22	19B216327-P1	Spacer.
23	19A127318-P1	Diaphragm. (Used with MK1).
24	19A116125-P1002	Phillips screw. No. 0-80 x 1/8.
25	19C317814-P1	Cover. (For complete cover assembly order 19C317017-G1).
26	19A116477-P1	Screw: No. 1-64 x 5/32. (Secures A303, A304, A307).
27	19B216316-P1	Insulator. (Used with J301 and J302).
28	19D413199-P1	Printed wiring board. (Without FL301, FL302).
29	19D413198-P1	Printed wiring board. (With FL301, FL302).
30	19B216570-P1	Strap.
31	19A126140-P3	Toroidal core. (Hung in wiring- Red coax from TB701-5 to Audio Board H9, H10).
32	19A128141-P1	Cable clamp.
33	19A127646-P1	Insulator. (Used with P701 and P702- Hung in wiring).
34	19A127329-P1	Insert. (Secures Hand strap).
35	19A127319-P2	Nut. 1/4 x 28.
36	19B216520-P1	Washer, nylon.
37	N70P703C13	Set screw. No. 3-48 x 3/16. (Used with OFF-VOLUME, SQUELCH, MULTI FREQ. Knobs).
38	19C311888-P1	Knob. (MULTI-FREQ).
39	19C317050-P1	Protective Cover. (Used with J701).
40	19C311887-P1	Antenna insert.
41	19A127293-P1	Phillips screw. No. 4-40 x 1-15/32. (Secures top of front cover).
42	19A127294-P1	Screw. No. 2-56 x 15/16. (Used with PTT button).
43	19B216520-P2	Washer.
44	N910P18C13	Retaining ring.
45	19B216313-G1	Fuseholder.
46	19C311896-P1	Fastener. (Secures center of Rear Cover).
47	19B216326-P1	Contact.
48	19A127333-P1	Antenna sleeve.
49	19B216557-P1	Ground strap.
50	19A127362-P1	Strap, copper. (Used with Q106-Q108).
51	19A127727-P1	Strap. (Used with Q106-Q108).
52	19A127737-P1	Spring. (Ground PTT Assembly).
53	19B216520-P3	Washer. (Used with item 54).
54	19A127341-P1	Screw. (Secures heat sink to front cover).
55	19B216330-P3	Insulator. (Located on transmitter shield).
56	19C311759-P1	Transmitter shield.
57	19A127337-P1	Nut. (Used with Q106-Q108).
58	19B216462-P1	Heat sink. (Used with Q106-Q108).
59	N327P8008E	Rivet. (Secures 3 battery contacts).
60	19B216312-P1	Contact. (Connects to battery spring).
61	19A127310-P1	Phillips screw. No. 4-40 x 1/4. (Secures bottom of front cover).
62	19B216388-P1	Contact.
63	19A127392-P1	Spring. (Battery terminals).
64	19C311886-P1	Contact.
65	19D413216-G2	Housing.
66	19A127319-P1	Nut, knurled. No. 8-32. (Used with OFF-VOLUME, SQUELCH Knobs).
67	19A115983-P5	O ring. (Used with OFF-VOLUME, SQUELCH Knobs).
68	5490135-P3	Boot, moisture seal. (Used with Channel Guard, Tone and VOX Switch).
69	19B216569-P1	Cap. (CG OFF-ON).
70	19B216569-P2	Cap. (CG A-B-OFF).
71	19B216569-P3	Cap. (T99 M-N-R).
72	19B216569-P4	Cap. (T90 M-N-R).
73	19B216569-P5	Cap. (T90 A-OFF-B).
74	19B216569-P6	Cap. (VOX OFF-ON).
75	19B200525-P3	Rivet. (Secures item 76).
76	19B216548-P1	Spring. (Used with PTT switch).
77	19A127319-P3	Nut, No. 8-36. (Used with PTT switch S702, S703).
78	N910P18C13	Retainer ring. (Located on Rear Cover).
79	19B216330-P2	Insulator. (Located on Rear Cover).
80	19A116125-P1002	Phillips screw. No. 0-80 x 1/8. (Antenna Switch).
81	19C317057-P1	Cover. (Antenna Switch).
82	19A127382-P1	Retaining spring. (Part of antenna switch).
83	19A127339-P1	Nut. (Part of antenna switch).
84	19B216305-P1	Bushing. (Part of antenna switch).
85	19A127364-P1	Ground lug. (Part of antenna switch).
86	19C311889-P1	Printed wiring board. (Part of antenna switch).
87	19B216306-P1	Contact spring. (Part of antenna switch).
88	19A127390-P1	Spring. (Part of Antenna Switch).
89	19B216329-G1	Rear Cover Assembly. Includes items 78 and 90.
90	19A127340-P1	Lockscrew. (Part of Rear Cover).
91	19C311869-P1	Button. (PTT switch S702 and S703).
92	N40P1006Y	Screw. No. 0-80 x 3/8. (Used with S705, H1-LO).

PRODUCTION CHANGES

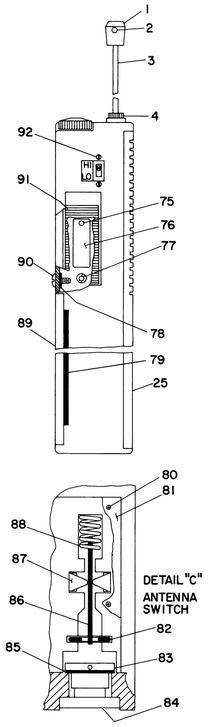
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped on the unit includes all previous revisions. Refer to the Parts List for description of parts affected by these revisions.

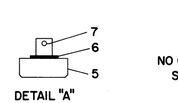
REV. A - 4EF35A10-13
To improve operation of PA board. Added C162 and L121, and deleted C101.

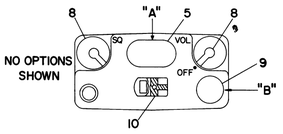
REV. A - Audio Board 19C311922-G11, G12
To improve performance of VOX keying circuit. Added RF bypassing components C57, C28, L6 and R8.

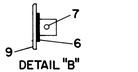
REV. A - 4ER57A10-15
To facilitate manufacturing. Redesigned Front End A303/A304, and Mult Mixer A307.

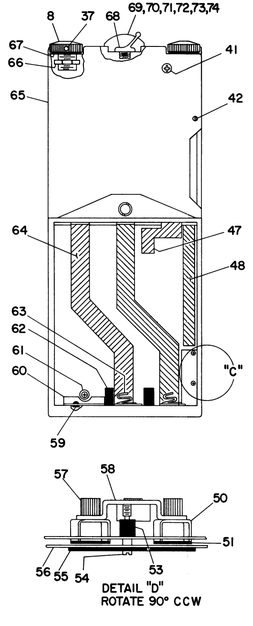
REV. B - 4ER57A10-15
To eliminate motorboating in the audio PA. Changed C306.

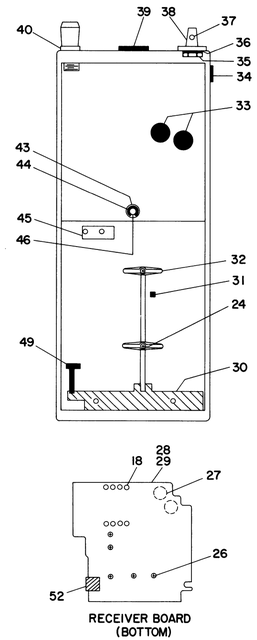


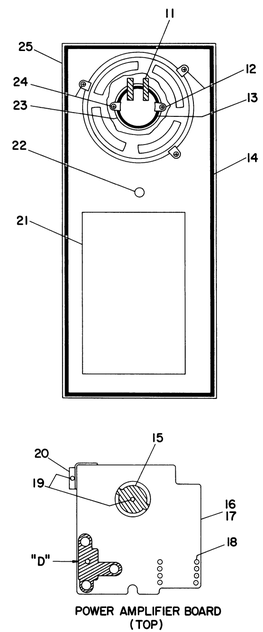












RC-1958

PARTS LIST

LBI-4072

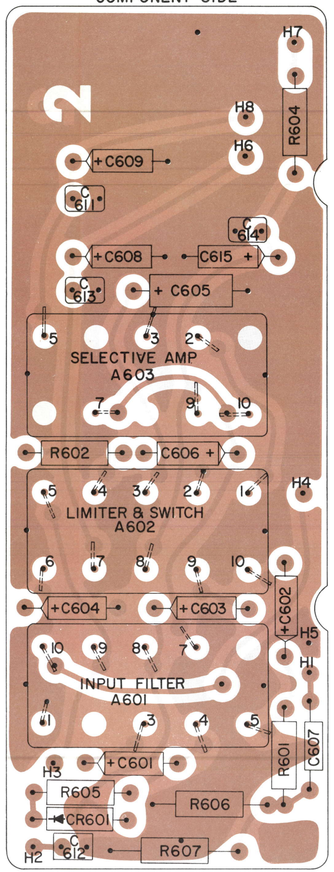
CHANNEL GUARD ENCODER/DECODER
19C317041-G1

SYMBOL	G-E PART NO.	DESCRIPTION
A601	19C317009-G1	Input Filter Assembly.
A602	19C317014-G1	Limiter and Switch Assembly.
		NOTE: When reordering A603, give GE Part Number and Specify exact frequency stamped on case of component.
A603	19D413245-G1	Selective Amplifier Assembly.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 thru C603	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C604	5491674-P28	Tantalum: 1.0 µf ±20%, 25 VDCW; sim to Sprague Type 162D.
C605	5491674-P35	Tantalum: 22 µf ±20%, 4 VDCW; sim to Sprague Type 162D.
C606	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C607	19A116207-P3	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Acrovox ELA75C104M.
C608 and C609	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C610	19C307102-P14	Tantalum: 15 µf ±20%, 10 VDCW; sim to Components Inc G156R.
C611 thru C614	19A116192-P2	Ceramic: 470 pf ±20%, 50 VDCW.
C615	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - DIODES AND RECTIFIERS - - - - - - - -
CR601	19A115250-P1	Silicon.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R152-P622J	Composition: 6200 ohms ±5%, 1/4 w.
R602	3R152-P155K	Composition: 1.5 megohms ±10%, 1/4 w.
R603	3R152-P151K	Composition: 150 ohms ±10%, 1/4 w.
R604	3R152-P101K	Composition: 100 ohms ±10%, 1/4 w.
R605	3R152-P513K	Composition: 51,000 ohms ±10%, 1/4 w.
R606	3R152-P431J	Composition: 430 ohms ±5%, 1/4 w.
R607	3R152-P152J	Composition: 1500 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S601	4036949-P1	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman TS3. (CG OFF-ON).

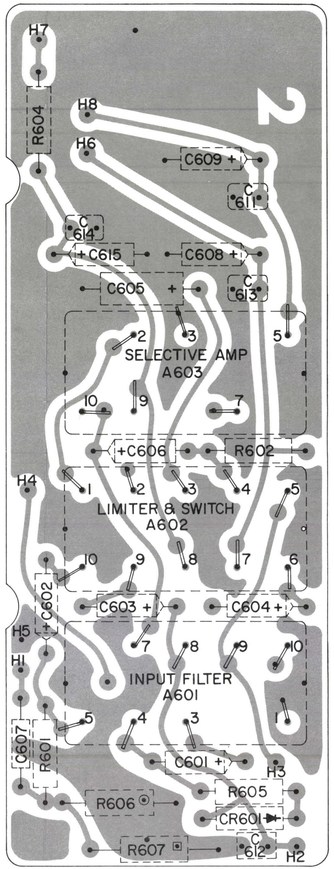
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

OUTLINE DIAGRAM

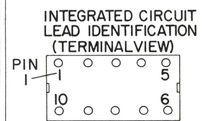
COMPONENT SIDE



SOLDER SIDE



INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)



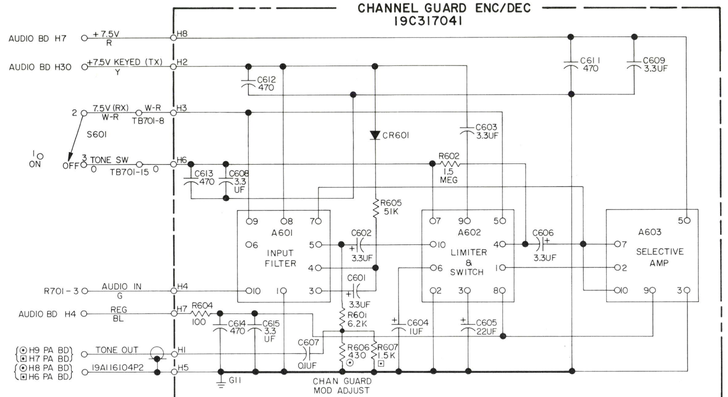
RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

(19C317372, Rev. 3)
(19C317028, Sh. 1, Rev. 1)
(19C317028, Sh. 2, Rev. 1)

(19C317372, Rev. 3)
(19C317028, Sh. 2, Rev. 1)

Denotes Solder Side

SCHEMATIC DIAGRAM



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

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.

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 (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

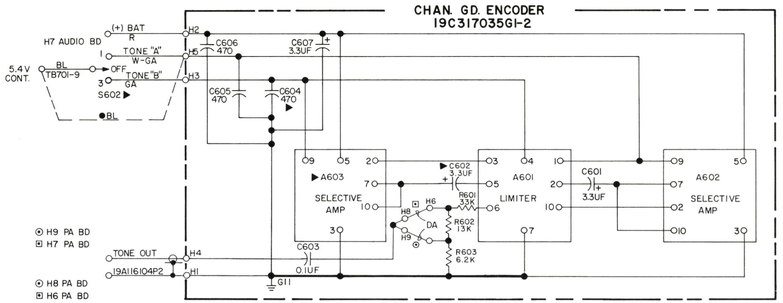
NOTES:
1. ALL WIRES ARE SFT 28 EXCEPT AS NOTED.
⊙ 4EF35A10-11 (406-470 MHZ)
⊡ 4EF34A10-11 (132-174 MHZ)

(19C317072, Rev. 4)

SCHEMATIC & OUTLINE DIAGRAM

406—470 MHz PERSONAL SERIES
CHANNEL GUARD ENCODER/DECODER

SCHEMATIC DIAGRAM



NOTE: ALL WIRES ARE SFT 28 UNLESS OTHERWISE NOTED.

- ● PRESENT IN 19C317035G1 (1 TONE)
- ▶ PRESENT IN 19C317035G2 (2 TONE)
- ⊙ 4EF35A10-11 (406-470 MHZ)
- ⊞ 4EF34A10-11 (132-174 MHZ)

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.

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 (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

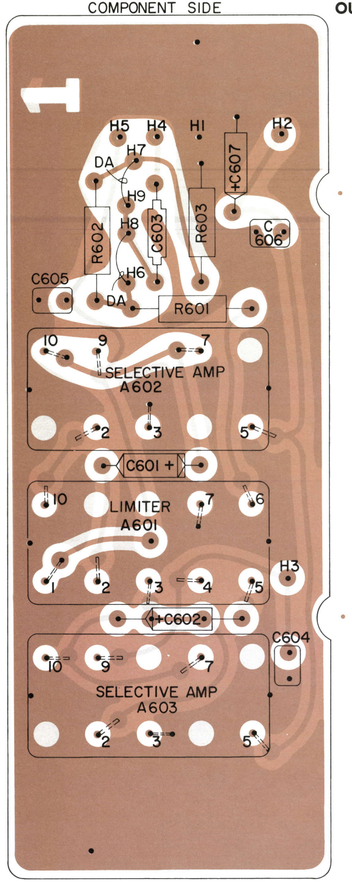
SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

(19C317071, Rev. 4)

OUTLINE DIAGRAM

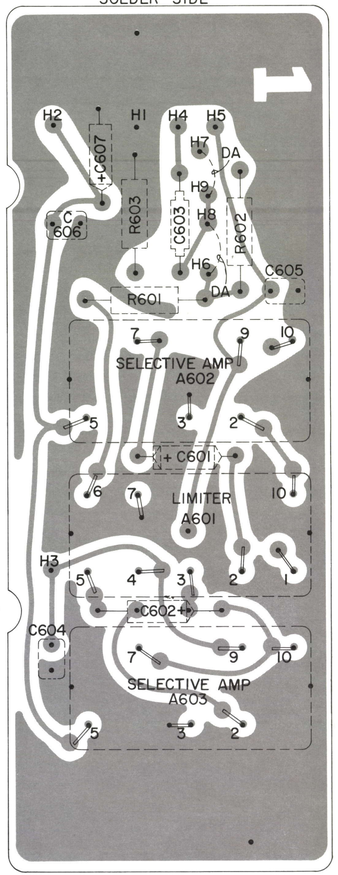
COMPONENT SIDE



(19C317374, Rev. 3)
(19C317026, Sh. 1, Rev. 2)
(19C317026, Sh. 2, Rev. 2)

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

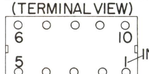
SOLDER SIDE



(19C317374, Rev. 3)
(19C317026, Sh. 2, Rev. 2)

Denotes Solder Side

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)



PARTS LIST

LBI-4073

CHANNEL GUARD ENCODER
19C317035-G1 1 TONE
19C317035-G2 2 TONE

SYMBOL	G-E PART NO.	DESCRIPTION
A601	19C317033-G1	Limiter. NOTE: When reordering give GE Part No. and specify exact frequency needed.
A602 and A603	19D413245-G1	Selective Amplifier. (71.9 Hz to 203.5 Hz freq range).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601 and C602	5491674-P36	Tantalum: 33 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C603	19A116207-P3	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA752C104W.
C604 thru C606	19A116192-P2	Ceramic: 470 pf ±20%, 50 VDCW.
C607	5491674-P36	Tantalum: 33 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R152-P333J	Composition: 33,000 ohms ±5%, 1/4 w.
R602	3R152-P113J	Composition: 11,000 ohms ±5%, 1/4 w.
R603	3R152-P622J	Composition: 6200 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S602	4036949-P8	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman TC-3. (CG A-B-OFF)

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SCHEMATIC & OUTLINE DIAGRAM

406—470 MHz PERSONAL SERIES
CHANNEL GUARD ENCODER

PARTS LIST

LBI-4071

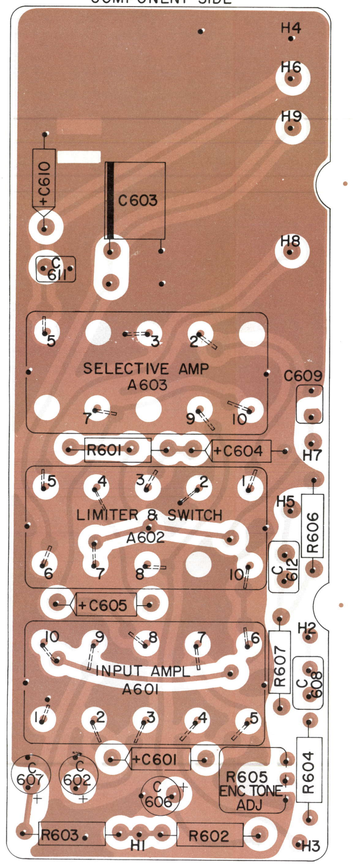
TYPE 90 ENCODER/DECODER
19C317036-G1

SYMBOL	G-E PART NO.	DESCRIPTION
A601	19C317061-G1	Input Amplifier Assembly.
A602	19C317014-G1	Limiter and Switch Assembly. NOTE: When reordering A603, give GE Part Number and Specify exact frequency stamped on case of component.
A603	19D413245-G2	Selective Amplifier Assembly. (1050-3000 Hz).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C602	19C307102-P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc G226R.
C603	19C307102-P4	Tantalum: 33 µf ±20%, 10 VDCW; sim to Components Inc S336R.
C604 and C605	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C606	19C307102-P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc G226R.
C607	19C307102-P14	Tantalum: 15 µf ±20%, 10 VDCW; sim to Components Inc G156R.
C608	19A116192-P1	Ceramic: 0.01 µf ±20%, 50 VDCW.
C609	19A116192-P2	Ceramic: 470 pf ±20%, 50 VDCW.
C610	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C611	19A116192-P2	Ceramic: 470 pf ±20%, 50 VDCW.
C612	19A116192-P1	Ceramic: 0.01 µf ±20%, 50 VDCW.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601	3R152-P153K	Composition: 15,000 ohms ±10%, 1/4 w.
R602 and R603	3R152-P271K	Composition: 270 ohms ±10%, 1/4 w.
R604	3R152-P513J	Composition: 51,000 ohms ±5%, 1/4 w.
R605	19A116093-P1	Variable, carbon film: 7500 ohms ±20%, 1/20 w; to Centralab Series 3.
R606	3R152-P623J	Composition: 62,000 ohms ±5%, 1/4 w.
R607	3R152-P104K	Composition: 0.1 megohms ±10%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S603	4036949-P9	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegeman TE-3. (T99 M-N-R).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

OUTLINE DIAGRAM

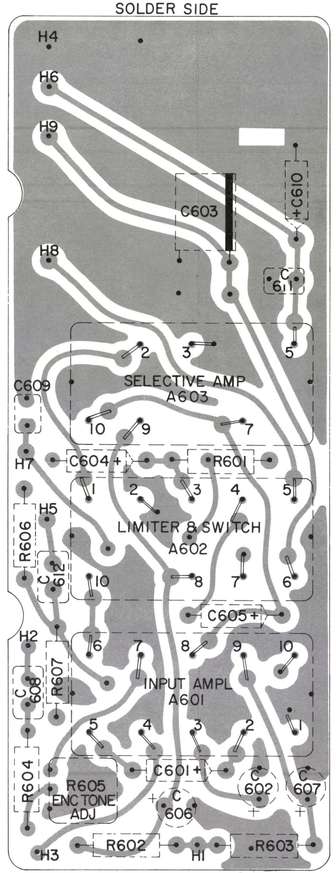
COMPONENT SIDE



(19C317371, Rev. 2)
(19C317024, Sh. 1, Rev. 1)
(19C317024, Sh. 2, Rev. 1)

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

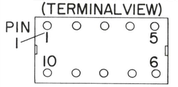
SOLDER SIDE



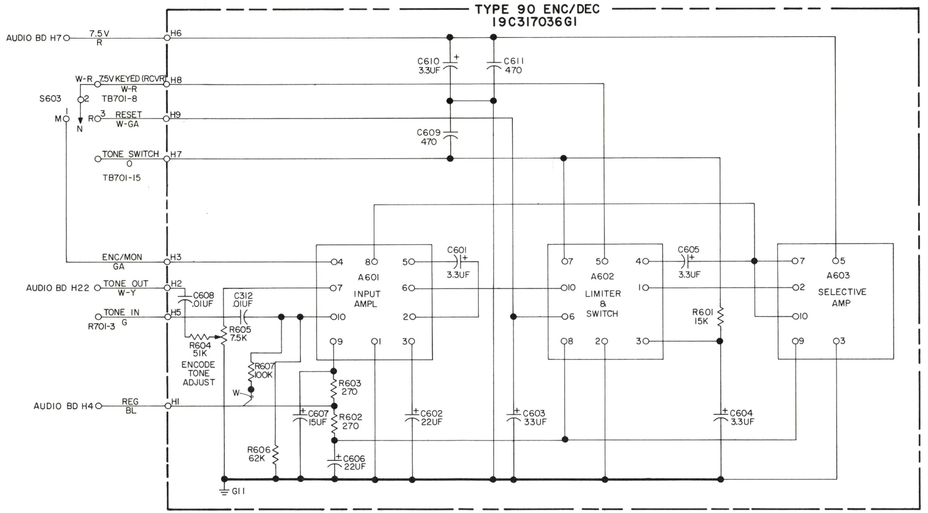
(19C317371, Rev. 2)
(19C317024, Sh. 2, Rev. 1)

Denotes Solder Side

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)



SCHEMATIC DIAGRAM



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

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.

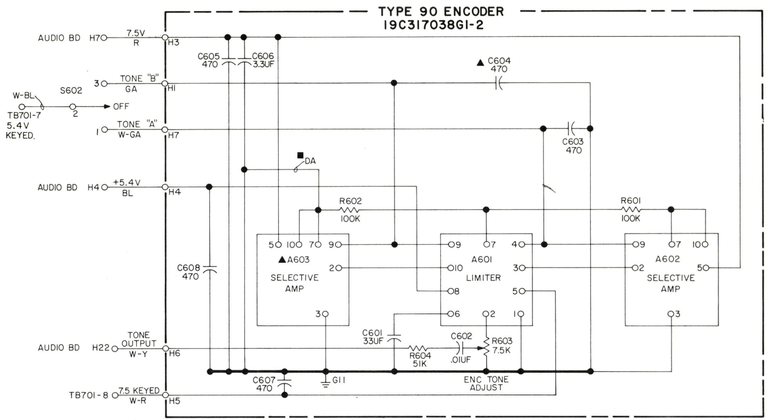
NOTES
1. ALL WIRES ARE SFT 28.

(19C317068, Rev. 2)

SCHEMATIC & OUTLINE DIAGRAM

406—470 MHz PERSONAL SERIES
TYPE 90 ENCODER/DECODER

SCHEMATIC DIAGRAM



NOTES:
1. ALL WIRES ARE SFT 28.

■ 19C317038G1 ONLY (1 TONE)
▲ 19C317038G2 ONLY (2 TONE)

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.

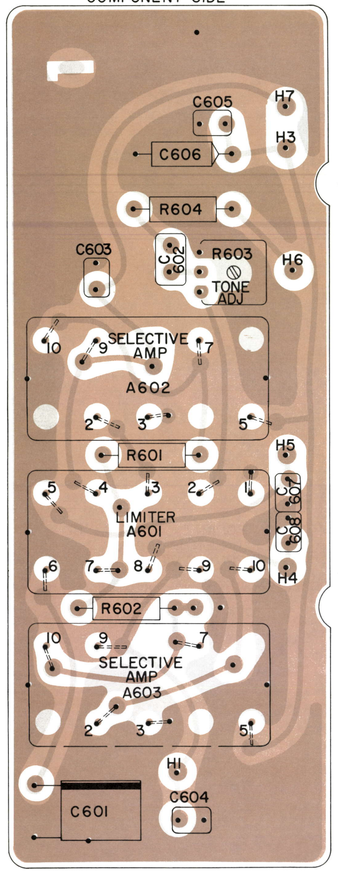
SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM DIAG APPLIES TO	
MODEL NO	REV LETTER

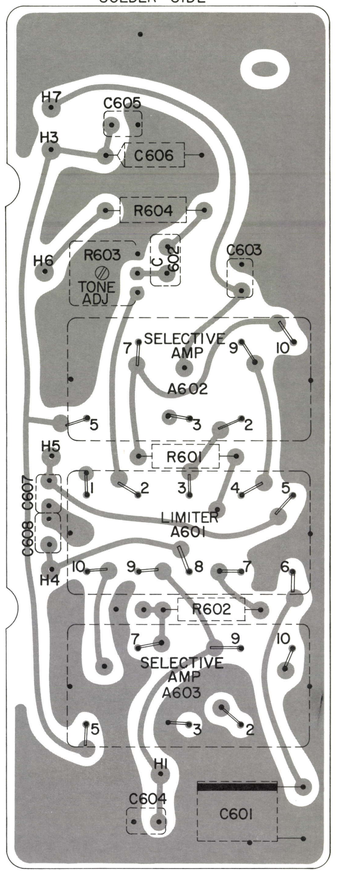
(19C317069, Rev. 3)

OUTLINE DIAGRAM

COMPONENT SIDE



SOLDER SIDE



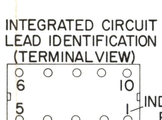
(19C317373, Rev. 2)
(19C317030, Sh. 1, Rev. 1)
(19C317030, Sh. 2, Rev. 0)

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

(19C317373, Rev. 2)
(19C317030, Sh. 2, Rev. 0)

Denotes Solder Side

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)



PARTS LIST

LBI-4069

TYPE 90 ENCODER
19C317038-G1 1 TONE
19C317038-G2 2 TONE

SYMBOL	G-E PART NO.	DESCRIPTION
A601	19C317037-G1	Limiter. NOTE: When reordering give GE Part No. and specify exact frequency needed.
A602 and A603	19D413245-G2	Selective Amplifier. (1000-2400 Hz freq range).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C601	19C307102-P4	Tantalum: 33 µf ±20%, 10 VDCW; sim to Components Inc S336R.
C602	19A116192-P1	Ceramic: 0.01 µf ±20%, 50 VDCW.
C603 thru C605	19A116192-P2	Ceramic: 470 pf ±20%, 50 VDCW.
C606	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D.
C607 and C608	19A116192-P2	Ceramic: 470 pf ±20%, 50 VDCW.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R601 and R602	3R152-P104K	Composition: 0.10 megohms ±10%, 1/4 w.
R603	19A116093-P1	Variable, carbon film: 7500 ohms ±20%, 1/20 w; sim to Centralab Series 3 Type 620-1.
R604	3R152-P513J	Composition: 51,000 ohms ±5%, 1/4 w.
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S602	4036949-P8	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware; sim to Arrow-Hart and Hegman TC-3. (TYPE 90 A-OFF-B).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SCHEMATIC & OUTLINE DIAGRAM

406—470 MHz PERSONAL SERIES
TYPE 90 ENCODER

PARTS LIST

LBI-4074

TYPE 99 DECODER AND CHANNEL GUARD ENCODER
19C317039-G1 thru G4

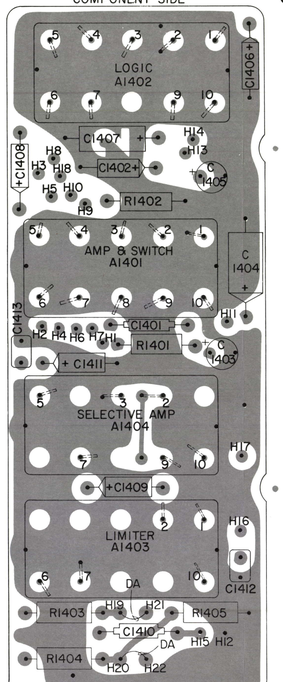
SYMBOL	G-E PART NO.	DESCRIPTION
A1401	19C311980-G1	Amplifier and Switch Assembly.
A1402	19C311981-G1	Logic Assembly.
A1403	19C317033-G1	Limiter Assembly. NOTE: When reordering A1404, give GE Part Number and Specify exact frequency stamped on case of component.
A1404	19D413245-G1	Selective Amplifier Assembly.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1401	19A116207-P3	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA752C104M,
C1402	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D,
C1403	19C307102-P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc GD226M,
C1404	5491674-P38	Tantalum: 47 µf ±20%, 4 VDCW; sim to Sprague Type 162D,
C1405	19C307103-P15	Tantalum: 22 µf ±20%, 6 VDCW; sim to Components Inc GD226M,
C1406	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D,
C1407	5491674-P37	Tantalum: 10 µf ±20%, 10 VDCW; sim to Sprague Type 162D,
C1408	5491674-P32	Tantalum: 1.0 µf ±10%, 25 VDCW; sim to Sprague Type 162D,
C1409	5491674-P36	Tantalum: 3.3 µf ±20%, 10VDCW; sim to Sprague Type 162D,
C1410	19A116207-P103	Ceramic: 0.1 µf ±20%, 25 VDCW, temp range -55 to 85°C; sim to Aerovox ELA752C104M,
C1411	5491674-P36	Tantalum: 3.3 µf ±20%, 10 VDCW; sim to Sprague Type 162D,
C1412 and C1413	19A116192-P2	Ceramic: 470 pf ±20%, 50 VDCW.
		- - - - - - - - - - DECODER REEDS - - - - - - - - - -
FL101 and FL102	19C300580-	Decoder Reed, (Check group numbers for desired frequency).
FL301 and FL302	-G1	517.5 Hz
	-G2	532.5 Hz
	-G3	547.5 Hz
	-G4	562.5 Hz
	-G5	577.5 Hz
	-G6	592.5 Hz
	-G7	607.5 Hz
	-G8	622.5 Hz
	-G9	637.5 Hz
	-G10	652.5 Hz
	-G11	667.5 Hz
	-G12	682.5 Hz
	-G13	697.5 Hz
	-G14	712.5 Hz
	-G15	727.5 Hz
	-G16	743.5 Hz
	-G17	758.5 Hz
	-G18	773.5 Hz
	-G19	787.5 Hz
	-G20	803.5 Hz
	-G21	817.5 Hz
	-G22	832.5 Hz
	-G23	847.5 Hz
	-G24	862.5 Hz
	-G25	877.5 Hz
	-G26	892.5 Hz
	-G27	907.5 Hz
	-G28	922.5 Hz
	-G29	937.5 Hz
	-G30	952.5 Hz
	-G31	967.5 Hz
	-G32	982.5 Hz
	-G33	997.5 Hz

SYMBOL	G-E PART NO	DESCRIPTION
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1401	3B152-P101J	Composition: 100 ohms ±5%, 1/4 w,
R1402	3B152-P302J	Composition: 3000 ohms ±5%, 1/4 w,
R1403	3B152-P333J	Composition: 33,000 ohms ±5%, 1/4 w,
R1404	3B152-P133J	Composition: 13,000 ohms ±5%, 1/4 w,
R1405	3B152-P622J	Composition: 6200 ohms ±5%, 1/4 w,
		- - - - - - - - - - SWITCHES - - - - - - - - - -
S1401	4036949-P9	Toggle: SPDT, 100 µa at 5 VDC, mounting hardware: sim to Arrow-Hart and Hegeman TS-3, (T99 M-8-8).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

OUTLINE DIAGRAM

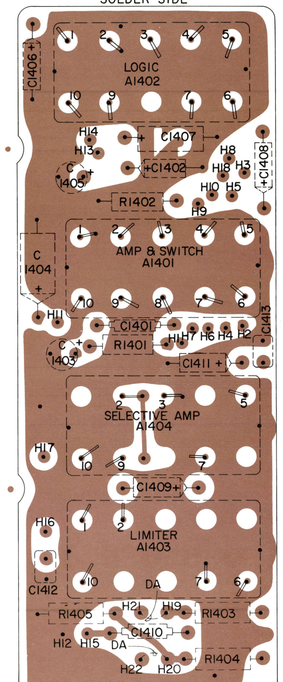
COMPONENT SIDE



(19C317370, Rev. 3)
(19C317022, Sh. 2, Rev. 2)

Denotes Solder Side

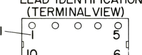
SOLDER SIDE



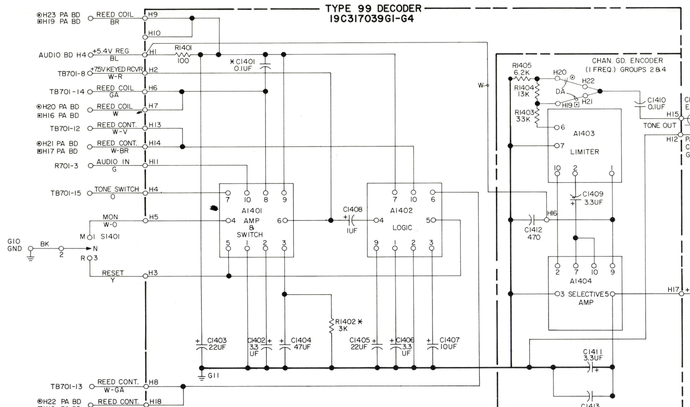
(19C317370, Rev. 3)
(19C317022, Sh. 1, Rev. 3)
(19C317022, Sh. 2, Rev. 2)

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

INTEGRATED CIRCUIT LEAD IDENTIFICATION (TERMINAL VIEW)



SCHEMATIC DIAGRAM



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.

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 (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS, INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

(19C317052, Rev. 3)

* PRESENT IN GROUPS 3 & 4 ONLY
⊗ 4EF35A12-13 (406-470 MHZ)
※ 4EF34A12-13 (132-174 MHZ)

19C317039G1- 2 REED
19C317039G2- 2 REED & CHAN GD ENC
19C317039G3- 4 REED
19C317039G4- 4 REED & CHAN GD ENC

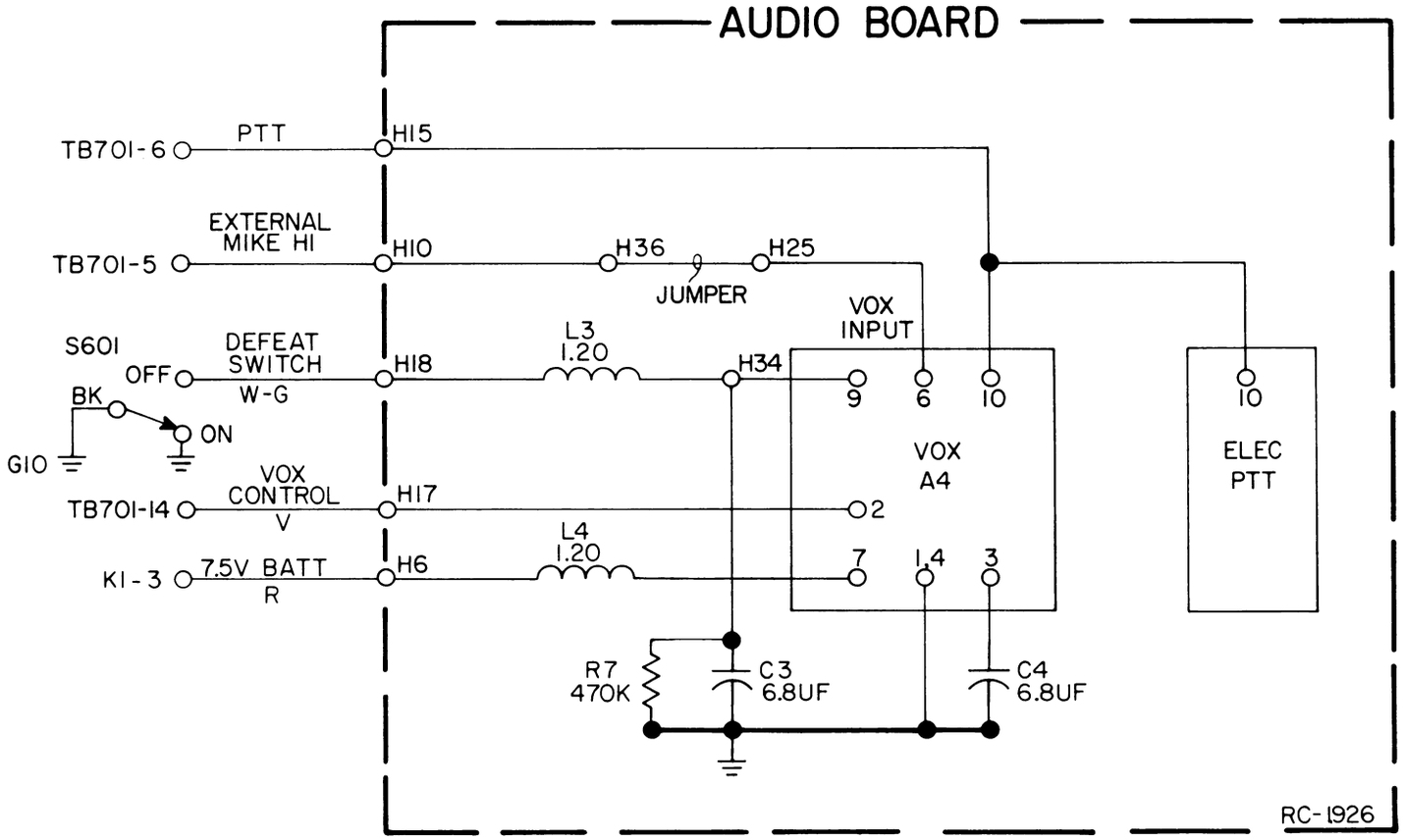
NOTES:
1. ALL WIRES ARE SFT 28 EXCEPT AS NOTED.

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

SCHEMATIC & OUTLINE DIAGRAM

406—470 MHz PERSONAL SERIES
TYPE 99 DECODER



SCHEMATIC DIAGRAM

406--470 MHz PERSONAL SERIES
VOX OPTION

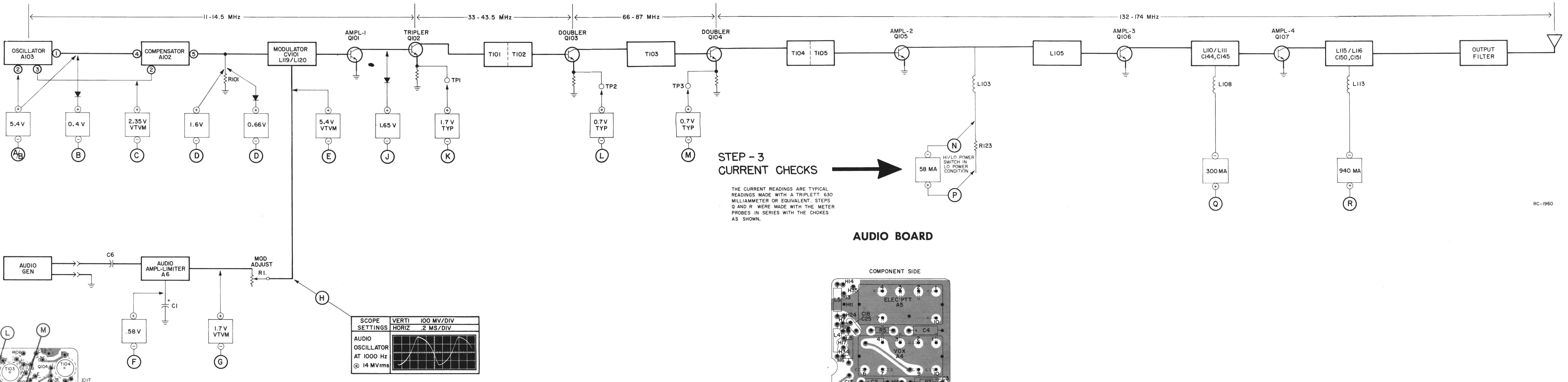
STEP-1 QUICK CHECKS

SYMPTOM	CHECK FOR:
Distorted or no audio with normal RF output	1. Voltage readings at (F), (G), and (E) (see Step 1) 2. Improper setting of Mod Adjust R1. 3. Shorted C1 or C6 on Audio Board. 4. Bad microphone.
No reading at TP1	Voltage readings at (A), (B), (D), (E) and (J) (see Step 1)
No reading at TP2, with Normal reading at TP1	1. Tuning of T101 and T102. 2. Defective Q103.
No reading at TP3, with normal reading at TP1 and TP2	1. Tuning of T103. 2. Defective Q104.
Hi-Lo power switch has no effect	1. Transmitter alignment. 2. Open wiring to S705, or a bad switch.
Radio blows fuses with the transmitter not keyed	1. Shorted wiring. 2. Shorted Q105, Q106, Q107 and Q108. Also check the tuning capacitor in the base circuit of the stage for short before replacing a transistor. NOTE: Visually check for a shorted transistor by checking for a discolored L104, L109, L114 or L119. These chokes may overheat and darken when a transistor shorts.
Low Power Output	1. Low battery voltage (refer to Battery Checks) in operation section of the manual). 2. Check the transmitter alignment.

STEP-2 TYPICAL DC READINGS

ALL READINGS MADE WITH GE TEST SET MODEL 4EX3A10 OR EQUIVALENT. READINGS SHOWN IN SERIES WITH A DIODE ARE RF READINGS TAKEN WITH RF PROBE 19C311370-G1 AND TEST SET MODEL 4EX3A10 ON 3 VOLT SCALE.

EXCEPTION: READINGS FOLLOWED BY VTVM WERE MEASURED WITH A VTVM WITH 11 MEG OHM OR GREATER METER INPUT.

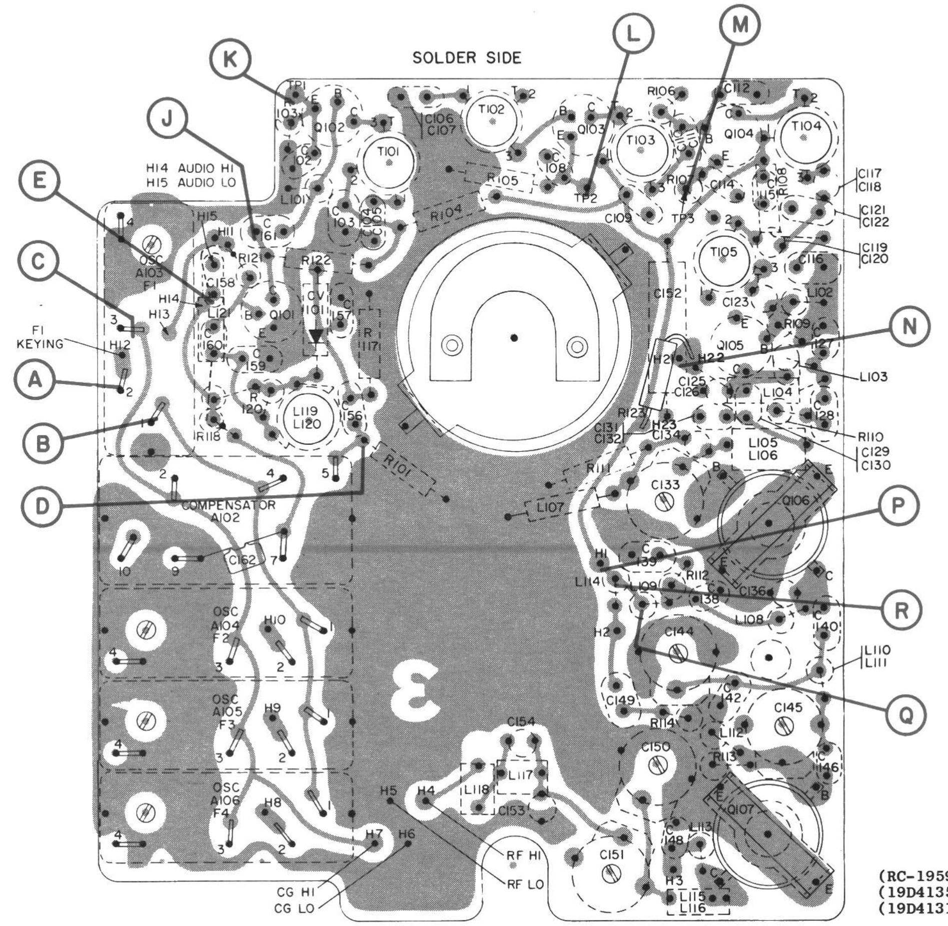


STEP-3 CURRENT CHECKS

THE CURRENT READINGS ARE TYPICAL READINGS MADE WITH A TRIPLETT 630 MILLIAMMETER OR EQUIVALENT. STEPS Q AND R WERE MADE WITH THE METER PROBES IN SERIES WITH THE CHOKES AS SHOWN.

PA BOARD

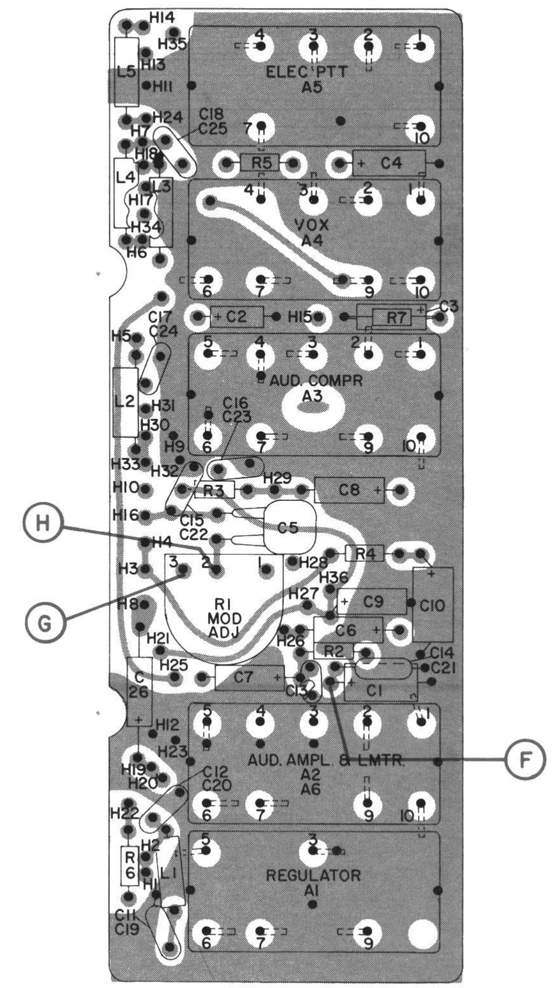
SOLDER SIDE



(RC-1959)
(19D413585, Rev. 2)
(19D413193, Sh. 2, Rev. 3)

AUDIO BOARD

COMPONENT SIDE



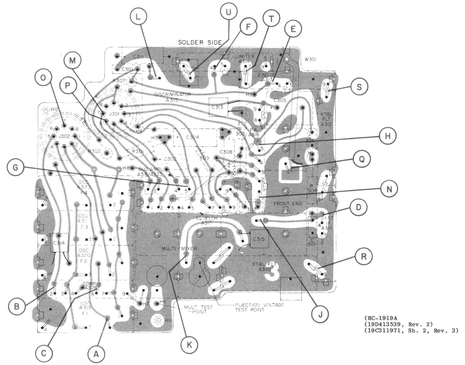
(RC-1929)
(19D413537, Rev. 1)
(19C311920, Sh. 1, Rev. 0)

TROUBLESHOOTING PROCEDURE

406—470 MHz PERSONAL SERIES
TRANSMITTER TYPE ET-91-A

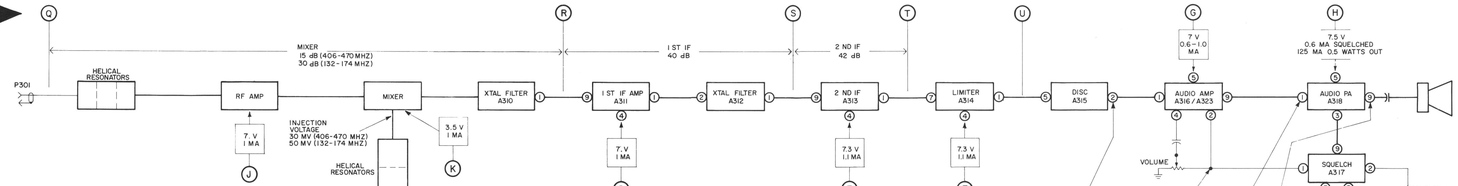
QUICK CHECKS

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 & 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).



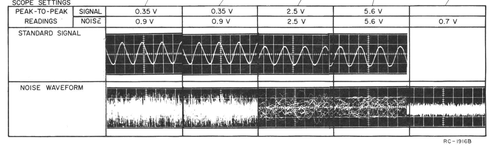
(RC-1919A
(19D413539, Rev. 2)
(19C311971, Sh. 2, Rev. 3)

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



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

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



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-560 or equivalent) connected to P301.

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.

$$\text{Example: } \frac{35 \text{ dB (dB2)}}{-15 \text{ dB (dB1)}} \\ \overline{20 \text{ dB gain}}$$

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 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

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 A318, 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

EQUIPMENT REQUIRED:

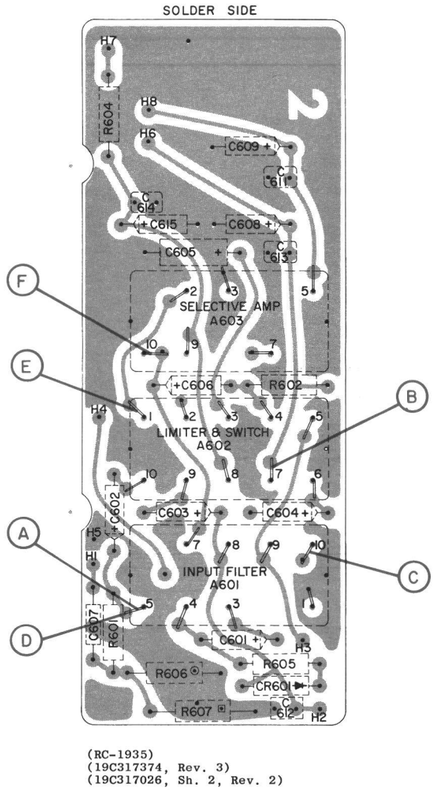
- Oscilloscope connected between the points shown and ground.
- Signal Generator (Measurements M-560 or equivalent).

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.

TROUBLESHOOTING PROCEDURE

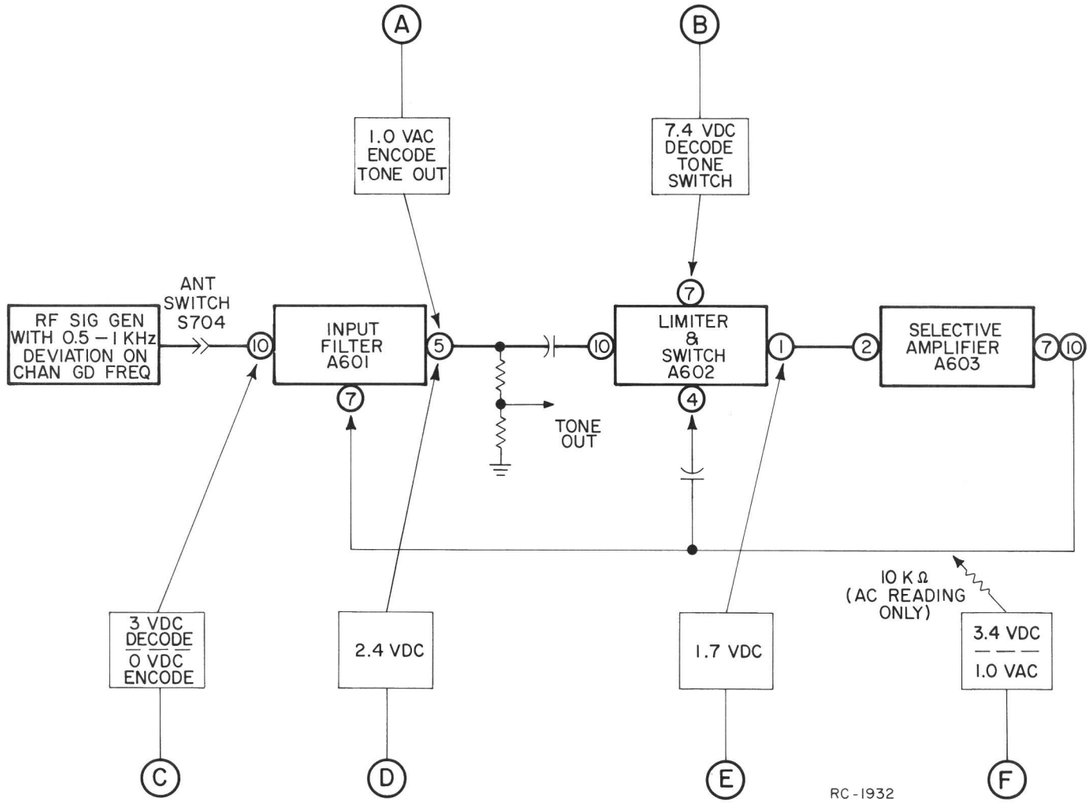
406—470 MHz PERSONAL SERIES
RECEIVER MODEL 4ER57A10-15

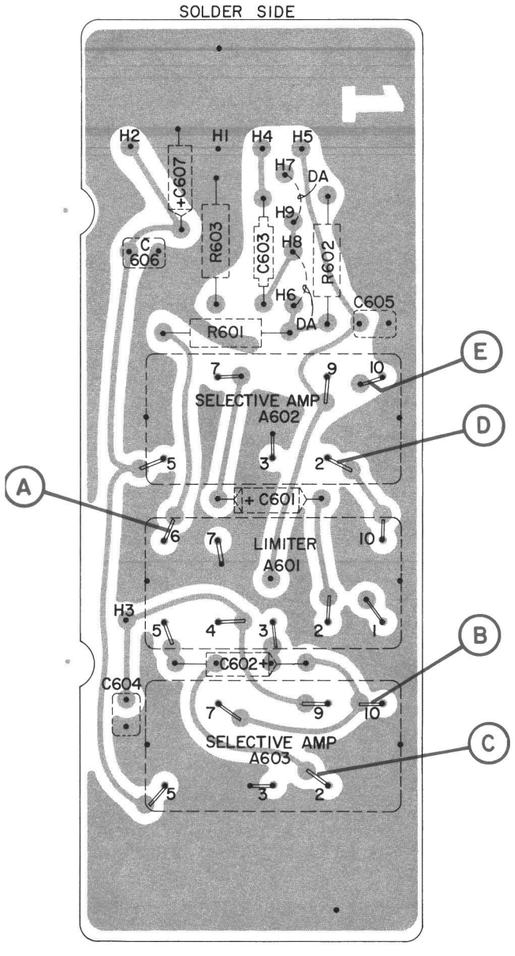


(RC-1935)
(19C317374, Rev. 3)
(19C317026, Sh. 2, Rev. 2)

TROUBLESHOOTING

SYMPTOM	PROCEDURE
Unit won't decode	1. Place the Channel Guard, switch (S601) in the OFF position and check for proper operation of the receiver. 2. If the receiver operates properly, apply the proper Channel Guard tone to the radio and check for 7.4-volts DC at Position (B). Next, remove the tone and check for zero volts at (B). 3. If readings are not correct, isolate the defective module by checking readings (C) through (F). **CAUTION** Do not ground Pins 7 or 10 on Selective Amplifier A603, or Pin 7 on Input Filter A601. To do so will destroy the Selective Amplifier module.
Unit won't encode	1. Key the transmitter and check for 1-volt RMS at Position (A). 2. If the reading is correct, check the transmitter oscillator module. 3. If the reading is not correct, isolate the defective module by checking readings (C) thru (F).





(RC-1953)
(19C317372, Rev. 3)
(19C317028, Sh. 2, Rev. 1)

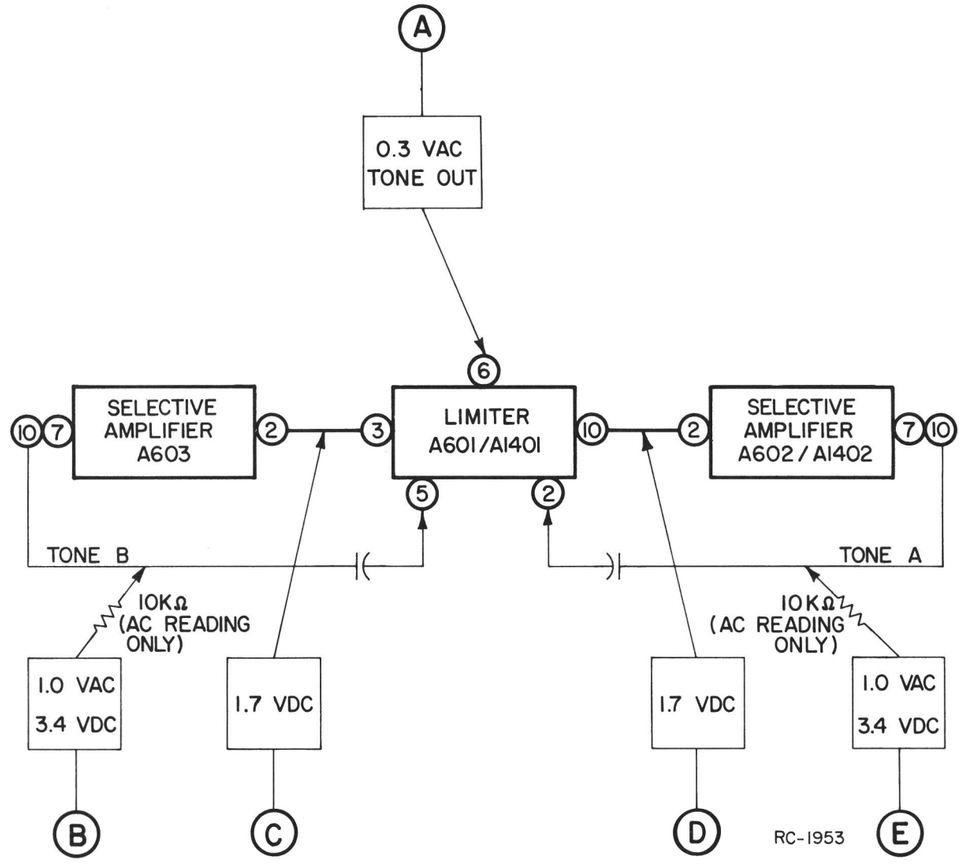
TROUBLESHOOTING

ALWAYS CONNECT THE BOARD TO GROUND (G11) WHEN REMOVED FROM THE RADIO FOR TROUBLESHOOTING.

1. Place Channel Guard switch S602 in the tone (A) or (B) position and check for 0.3 volts AC at position (A) .
2. If reading is correct, check the transmitter oscillator module.
3. If reading is not correct, check readings at (B) through (E) .

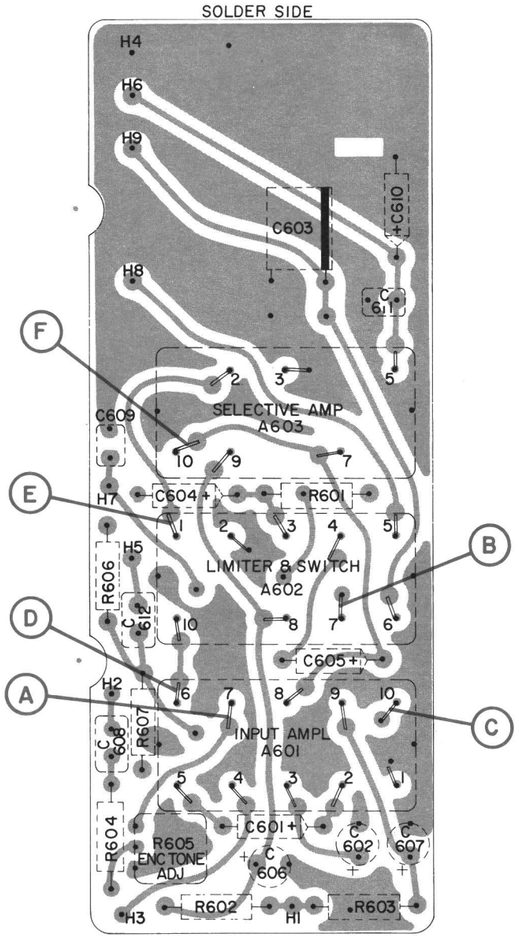
CAUTION

Do not ground pins 7 or 10 on the selective amplifier modules. To do so will destroy the selective amplifier.



TROUBLESHOOTING PROCEDURE

CHANNEL GUARD ENCODER

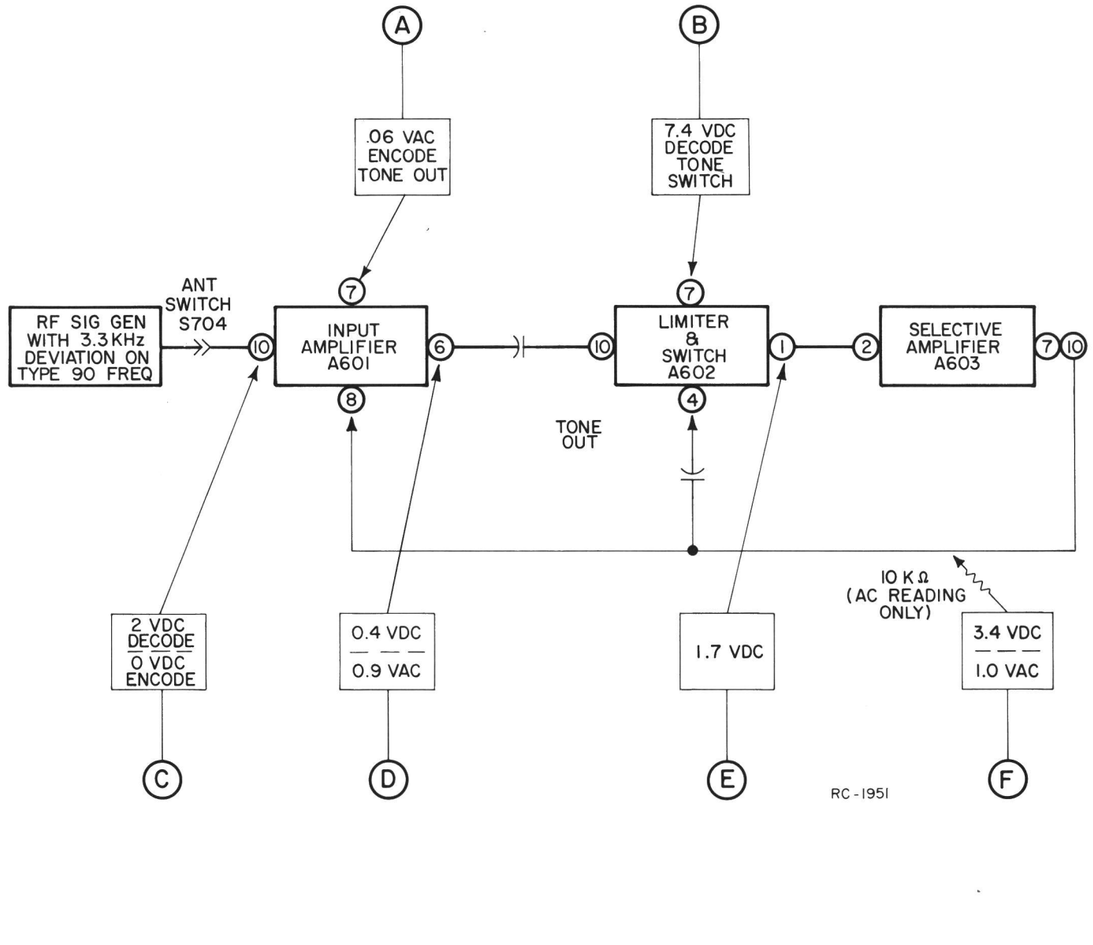


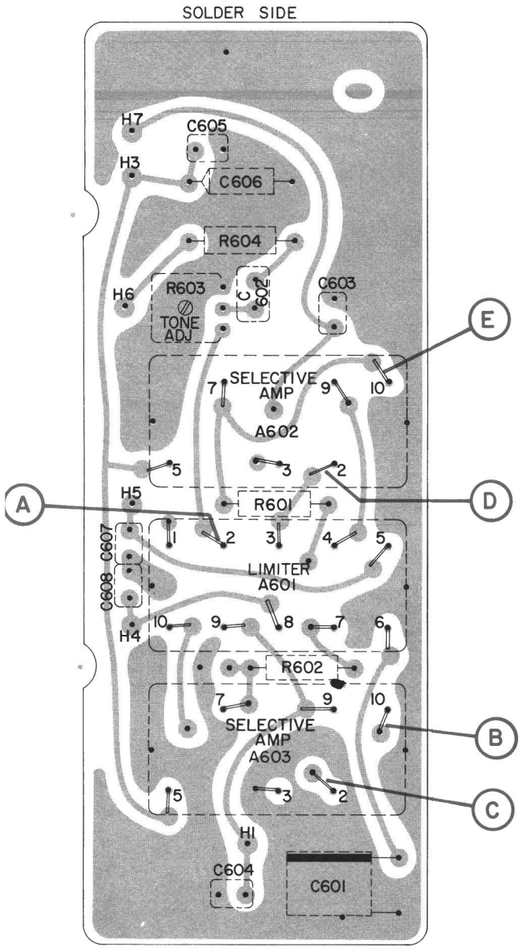
(RC-1951)
(19C317371, Rev. 2)
(19C317024, Sh. 2, Rev. 1)

TROUBLESHOOTING

Always connect the board to ground (G11) when removed from the radio for troubleshooting.

SYMPTOM	PROCEDURE
Unit won't encode	1. Place the Type 90 switch (S603) in the Monitor (encode) position, and check for .06 volts RMS at position Ⓐ. Next, key the transmitter and check for the reading at Ⓐ to drop to zero in approximately one second (pulsed tone). 2. If these readings are correct, check the transmitter audio circuit and modulation setting. 3. If the readings are not correct, isolate the defective module by checking readings Ⓒ through Ⓕ.
	- CAUTION - Do not ground Pins 7 or 10 on Selective Amplifier A603, or Pin 8 on input amplifier A601. To do so will destroy the Selective Amplifier module.
Unit won't decode	1. Place the Type 90 switch (S603) in the Reset and then in the Monitor position and check for proper operation of the receiver. 2. If the receiver operates properly, place the switch in the Reset and then the Normal position. Next, apply the proper Type 90 tone to the radio and check for 7.4 volts DC at position Ⓑ. Next, place the switch in the Reset and then the Normal position and check for zero volts at Ⓑ. 3. If the readings are not correct, isolate the defective module by checking readings Ⓒ through Ⓕ.





(RC-1952)
(19C317373, Rev. 2)
(19C317030, Sh. 2, Rev. 0)

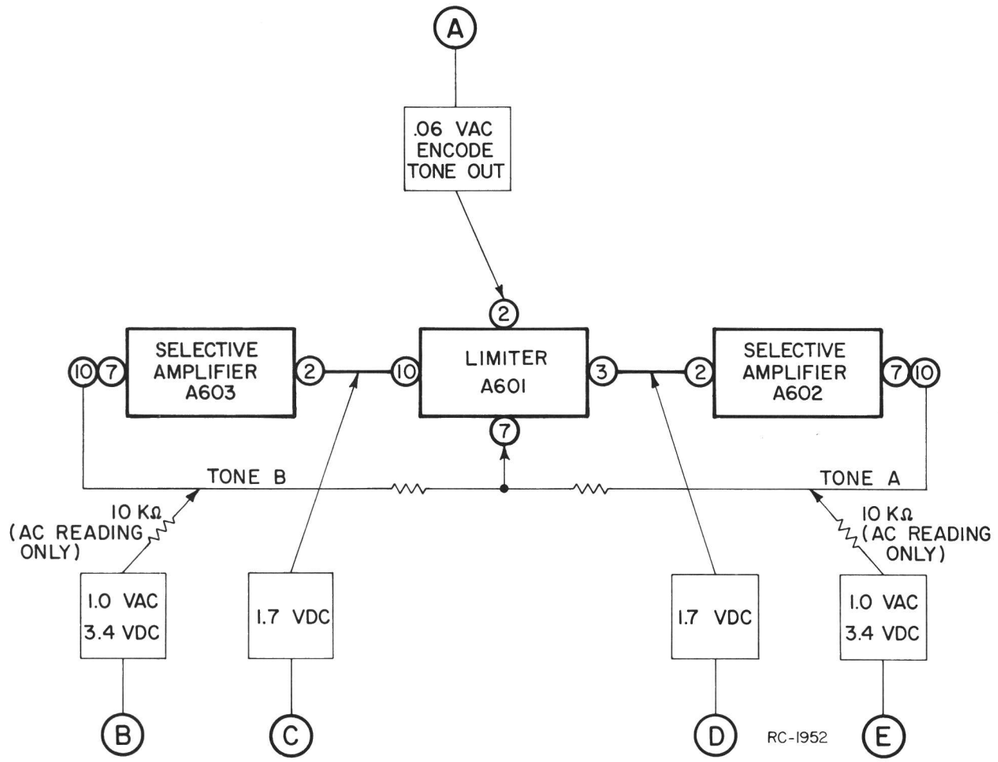
TROUBLESHOOTING

Always connect the board to ground (G11) when removed from the radio for troubleshooting.

1. Place the Type 90 switch in the Tone A or B position and check for .06 volts RMS at position Ⓐ. Next, key the transmitter and check for the reading at Ⓐ to drop to zero in approximately one second (pulsed tone).
2. If these readings are correct, then check the transmitter audio circuit and modulation setting.
3. If the readings are not correct, isolate the defective module by checking readings Ⓑ through Ⓔ.

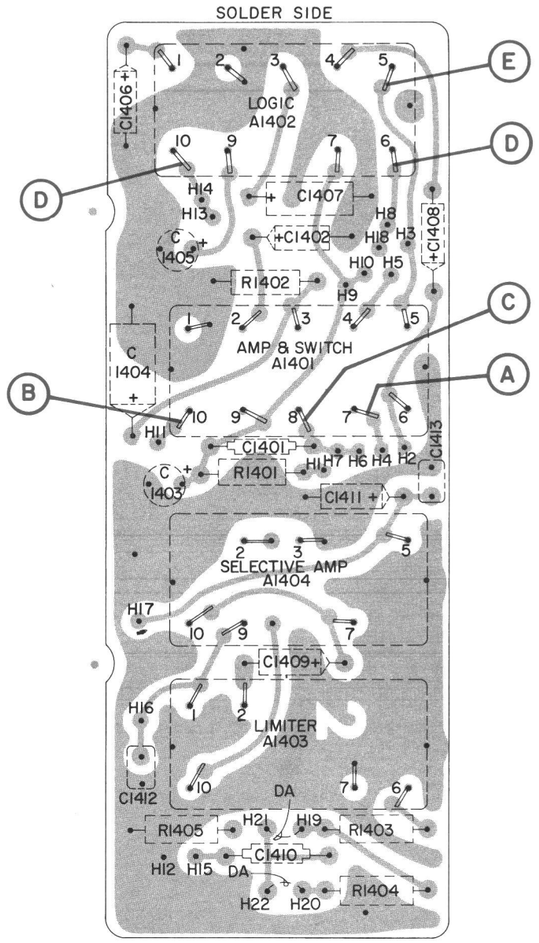
- CAUTION -

Do not ground Pins 7 or 10 of Selective Amplifiers A602 and A603, or Pin 7 of limiter A601. To do so will destroy the Selective Amplifier.



TROUBLESHOOTING PROCEDURE

TYPE 90 ENCODER



(RC-1954)
(19C317370, Rev. 3)
(19C317022, Sh. 2, Rev. 2)

TROUBLESHOOTING

ALWAYS CONNECT THE BOARD TO GROUND (G11) WHEN REMOVED FROM THE RADIO FOR TROUBLESHOOTING.

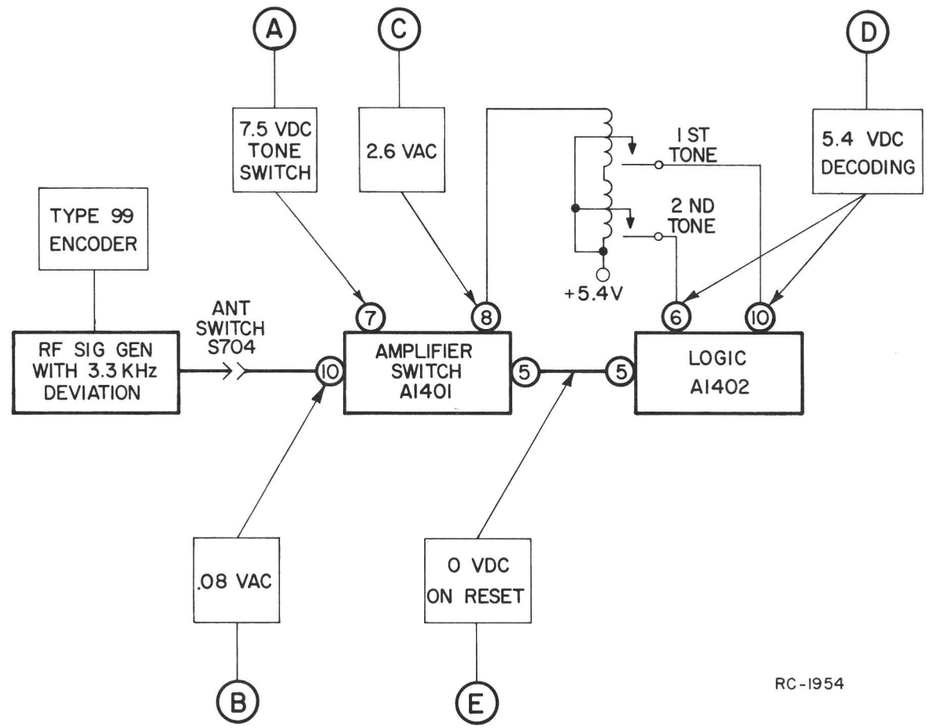
1. Place the Type 99 switch (S1401) in the Monitor position and check for proper operation of the receiver.

2. If the receiver is operating properly, place the switch in Reset and then in the Normal position. Next, apply the proper sequential tones as shown and check for 7.5 volts DC at position (A) .

3. If the reading is not correct, check the amplifier circuit by applying a continuous Type 99 tone and checking readings at (B) through (C) . If reading at (B) is not correct, check the receiver. If (B) is correct and (C) is not correct, replace amplifier switch A1401.

4. If readings are correct, check operation of reeds by applying two Type 99 tones in the proper sequence and check the readings at (D) .

5. If readings at (D) are correct, place the switch in the Reset and then in the Normal position. Check reading at (E) . Next, apply the proper tones and check for a positive meter deflection at (E) . If the meter deflection is not obtained, replace logic module A1402. If the deflection is obtained, replace A1401.

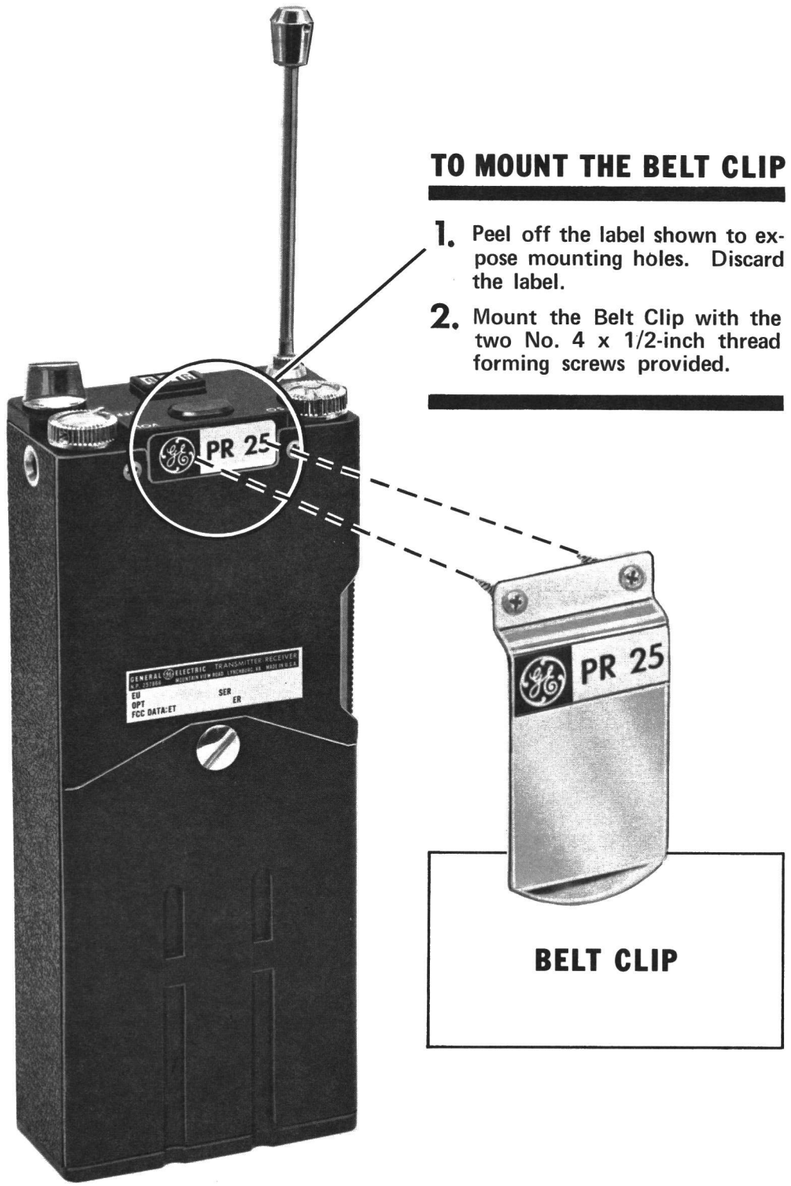


RC-1954

TROUBLESHOOTING PROCEDURE

TYPE 99 DECODER &
CHANNEL GUARD ENCODER

BELT CLIP MOUNTING INSTRUCTIONS



TO MOUNT THE BELT CLIP

1. Peel off the label shown to expose mounting holes. Discard the label.
2. Mount the Belt Clip with the two No. 4 x 1/2-inch thread forming screws provided.

BELT CLIP

ORDERING SERVICE PARTS

Each component appearing on the schematic diagram is identified by a symbol number, to simplify locating it in the parts list. Each component is listed by symbol number, followed by its description and GE Part Number.

Service Parts may be obtained from Authorized GE Communication Equipment Service Stations or through any GE Radio Communication Equipment Sales Office. When ordering a part, be sure to give:

1. GE Part Number for component
2. Description of part
3. Model number of equipment
4. Revision letter stamped on unit

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance.

Should further information be desired, or should particular problems arise which are not covered sufficiently for the purchaser's purposes, contact the nearest Radio Communication Equipment Sales Office of the General Electric Company.

MAINTENANCE MANUAL
LBI-4075

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GENERAL ELECTRIC COMPANY • LYNCHBURG, VIRGINIA 24502

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